ANGIOSPERM SPECIES DIVERSITY AND ECOLOGICAL ASSESSMENT OF HASTINAPUR WILDLIFE SANCTUARY, UTTAR PRADESH (INDIA)

ABSTRACT

THESIS

SUBMITTED FOR THE AWARD OF THE DEGREE OF

Doctor of Philosophy

IN

BOTANY

BY

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DEPARTMENT OF BOTANY
ALIGARH MUSLIM UNIVERSITY
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ABSTRACT

This thesis embodies the results of extensive floristic survey of Hastinapur Wildlife Sanctuary (HWLS), conducted during 2003 – 2007, located in western part of Uttar Pradesh state of India. The thesis runs in to nine (09) chapters. A brief summary of each chapter is given in following paragraphs.

1. INTROUCTION:

The chapter begins with definition of Protected Areas (PAs). Evolution of categories of PAs as recognized by IUCN is reviewed. Current IUCN categories of PAs, their characteristics and objectives and role and the number of PAs in India are also given. The link between the science of floristics and conservation ecology is also discussed. It has been shown, on the basis of literature review, that there is large gap in our knowledge of the floristics of PAs of India. Finally, the objectives of present study have been defined as follows:

(a) Inventorization of the flowering plants of Hastinapur Wildlife Sanctuary to prepare a detailed Flora which will be useful in future studies of habitat ecology, (b) Documentation of change in flora, if any, over last half century by comparing the results with those of Murty and Singh (1961b) and (c) Preliminary study of changes in physical features of the sanctuary over last decade using remote sensing data.

2. STUDY AREA:

The sanctuary runs through five districts (Muzaffarnagar, Bijnor, Meerut, Ghaziabad and Jyotiba Phule Nagar) and is situated between 28^0 46' and 29^0 35'N latitude and 77^0 30' and 78^0 30' E longitude. The total geographic area of the sanctuary is 2073.0 km^2 which is 12.95 % of the total geographic area of above mentioned districts. The study area belongs to category IV of IUCN Protected Area Management Categories. The climate of the study area is humid – subtropical type. There are three distinct seasons i.e. winter, summer and rains in the study area. The soil is of alluvial type developed on the Indo-Gangetic alluvium. Forest cover in the constituent districts is very low ranging from 1% to 9%. Previous botanical studies conducted in the study area are also summarized.

3. PLAN OF WORK:

This chapter provides a brief description of procedures adopted for plant collection and herbarium preparation and resources used for plant identification and updating nomenclature. The flora was analyzed to estimate the number of species belonging to four plant habit categories (herbs, shrubs, climbers and trees) and nine habitat types (aquatic, roadside, agricultural fields, kholas, swamps, river banks, moist sand, dry sand and dry grasslands). Lastly, the inventory of plant species prepared during present work was compared with an earlier one prepared by Murty and Singh (1961) to find out any change in species composition.

4. KEY TO FAMILIES:

A dichotomous key was constructed, largely based on macroscopic field characters to facilitate the identification of families included in this thesis.

5. ENUMERATION:

This chapter forms the bulk of thesis, and begins with an artificial, dichotomous key to families. A family, represented by more than one genus, starts with a key to genera. Treatment of a genus represented by more than one species begins with a key to species. Currently accepted name for each species as adopted in standard works in Indian Floras, World Checklists available at websites of Kew and IPNI (International Plant Name Index) etc. is provided. Wherever necessary, basionym and synonym(s) are provided. This is followed by brief description, phenology and habitat information. Families are arranged according to the system of Bentham & Hooker (1862 – 1883) since this system is easy to work with and prevalent in Indian Herbaria and Floras. Within a family genera and species are arranged in alphabetic order for easy reference and do not reflect any phylogenetic relationship.

6. DISCUSSION:

This chapter is divided into four sections and provides a detailed analysis of the flora.

A. Floristic Analysis:

Present work enumerates 752 species, belonging to 123 families and 455 genera. Dicots account for 98 families, 347 genera and 549 species. Remaining 25 families, 108 genera and 203 species belong to monocots.

Poaceae are the largest family in terms of number of genera (61) and species (110). Seven families (Poaceae, Asteraceae, Fabaceae, Acanthaceae, Scrophulariaceae, Malvaceae and Cyperaceae) are represented by 10 or more genera. Together, these families account for 179 genera. Among dicots Asteraceae are the largest family represented by 42 genera. Five families (Asteraceae, Fabaceae, Acanthaceae, Scrophulariaceae and Malvaceae) are represented by ten or more species. Together, these families account for 108 genera. Seventeen families (Poaceae, Fabaceae, Asteraceae, Cyperaceae, Malvaceae, Euphorbiaceae, Convolvulaceae, Scrophulariaceae, Caesalpiniaceae, Amaranthaceae, Acanthaceae, Mimosaceae, Lamiaceae, Cucurbitaceae, Solanaceae, Verbenaceae and Moraceae). Together, these families account for 482 species. Among dicots fifteen families (Fabaceae, Asteraceae, Malvaceae, Euphorbiaceae, Convolvulaceae, Scrophulariaceae, Caeaslpiniaceae, Amaranthaceae, Acanthaceae, Minosaceae, Lamiacaeae, Cucurbitaceae, Solanaceae, Verbenaceae and Moraceae) are represented by ten or more species. Together, these families account for 327 species.

Taking into consideration total number of species in a genus, *Cyperus* is the largest genus, represented by 14 species, in the study area, followed by *Ipomoea* and *Eragrostis* (12 species each), and *Cassia* (10 species). Four genera (*Indigofera*, *Acacia*, *Phyllanthus* and *Fimbristylis*) are represented by 7 species each, six genera (*Sida*, *Crotalaria*, *Lindernia*, *Polygonum*, *Euphorbia* and *Ficus*) by 6 species each, 7 genera (*Corchorus*, *Conyza*, *Amaranthus*, *Schoenoplectus*, *Brachiaria*, *Digitaria* and *Setaria*) by 5 species each, 10 genera (*Hibiscus*, *Alysicarpus*, *Ludwigia*, *Alternanthera*, *Commelina*, *Eleocharis*, *Kyllinga*, *Mariscus*, *Cenchrus* and *Panicum*) by 4 species each, 34 genera by 3 species each, 73 genera by 2 species each and remaining 317 genera by 1 species each. In fact, 31 genera contribute one fourth of total species.

In dicots, *Ipomoea* is the largest genus represented by 12 species, followed by *Cassia* (10 species); *Indigofera*, *Acacia* and *Phyllanthus* (7 species each); *Sida*, *Crotalaria*, *Lindernia*, *Polygonum*, *Euphorbia* and *Ficus* (6 species each); *Corchorus*, *Conyza* and

Amaranthus (5 species each); *Hibiscus*, *Alysicarpus*, *Ludwigia* and *Alternanthera* (4 species each). Twenty eight genera are represented by 3 species each, 54 genera by 2 species each and remaining 247 genera by 1 species each. Only 14 genera contribute more than one fourth of total dicot species.

Out of 108 monocot genera, *Cyperus* is the largest genus with 14 species, followed by *Eragrostis* with 12 species. *Fimbristylis* is represented by 7 species and *Schoenoplectus*, *Brachiaria*, *Digitaria* and *Setaria* are represented by 5 species each. These seven genera account for 49% of total monocot genera. Six genera are represented by 4 species each, 6 genera by 3 species, 19 genera by 2 species and 70 genera by 1 species each.

B. Floristic Ratios:

(i) Monocot – dicot ratio:

This ratio was calculated as 1:3.92 for families, 1: 3.21 for genera and 1: 2.7 for species. The ratio was compared with ratios for Bijnor, Dehara Dun, Delhi, Rajasthan and the World. Calculation of Dicot - monocot ratio for total and aquatic flora separately showed that aquatic flora is usually rich in monocots and in total flora the representation of monocots is relatively poor. Several other studies were shown to follow the same trend.

(ii) Genus – Species Ratio:

This ratio was calculated as 1:1.65 for total flora, 1:1.58 for dicot flora and 1.1.88 for monocot flora. These ratios were compared with study areas mentioned in preceding paragraph. It was shown that this ratio (a) increases with increase in number of species and (b) is highest for monocot flora, followed by total flora and dicot flora (Monocots > total flora > dicots).

These properties of floristic ratios as described in B(i) and B(ii) have, probably, been highlighted for the first time.

(C) Neophytes:

Following species are new records for North India or Uttar Pradesh: ***Hypericum japonicum*** Thunb. ex Murr.; ***Abelmoschus tuberculatus*** Pal & Singh; ***Hibiscus micranthus*** L. f. var. ***rigidus*** (L. f.) Cuf; ***Eleiotis monophylla*** (Burm. f.) DC; ***Lotus***

corniculatus L.; ***Oenothera laciniata*** Hill; ***Sparganium erectum*** L.; ***Brachiaria kurzii*** (Hook. f.) A. Camus; ***Digitaria griffithii*** (Hook. f.) Henr.; ***Leersia hexandra*** Sw.

(D) Analysis of flora according to plant habit:

Herbaceous species account for 78.46% of total species. Dicot herbs or herbaceous species constitute 53.19% of total species. In dicots 73.04% species show herbaceous habit. In monocots 93.59% species show herbaceous habit.

Shrubs account for 12.77% of total species. Dicot shrubs account for 11.44% of total species and 15.66% of total dicot species. In monocots only 10 species (1.33% of total species and 4.9% of total monocot species) show shrub-like habit.

Eighty one species (10.77% of total species) show climbing habit. Seventy eight species of dicots (10.37% of total species and 14.2% of total dicot species) and only 3 species of monocots (0.4% of total species and 1.5% of total monocots) are climbers.

A total of 95 species (12.63% of total species) show arborescent habit. The contribution of dicots to tree flora is 98.9% (94 tree species) while monocots contribute only one species, (*Phoenix sylvestris*) to tree flora.

Only 5 species (0.66% of total number of species) in the study area exhibit parasitic habit. All of them are dicotyledonous (0.91% of total dicotyledonous species).

(E) Analysis of flora according to habitat:

Nine habitat types may be recognized in the study area. Their floristic composition is summarized below.

(i) **Aquatic Habitat:** A total of 73 species (9.71% of total species), 37 dicots (4.92% of total species and 6.74% of total dicot species) and 36 monocots (4.79% of total species and 17.73% of total monocot species), grow in aquatic habitats.

(ii) **Roadsides:** A total of 368 species (48.94 of total species), 323 dicots (43% of total species and 58.83% of total dicots) and 45 monocots (5.98% of total species and 22.17% of total monocots) were found growing on roadsides.

(iii) **Agricultural fields:** Agricultural fields provide abode for 281 species (37.37 of total species), 208 dicots (27.7% of total species and 37.89% of dicot species). Monocots contribute 73 species (9.71 of total species and 35.96% of total monocot species).

(iv) **Kholas:** A total of 252 species (33.51% of total species), 216 dicots (28.72 of total species and 39.34% of dicot species) and 36 monocot species (4.79% of total species and 17.73% of monocot species) are found in Kholas.

(v) **River banks:** A total of 321 species (42.69% of total species) are found on river banks. Dicots are represented by 239 species (31.78% of total species and 43.53% of total dicot species). Monocots account for 82 species (10.9% of total species and 40.39% of monocot species).

(vi) **Moist sand:** A total of 222 species (29.52% of total species) are found on moist sand. Dicots account for 171 species (22.74% of total species and 31.15% of total dicots) and monocots for 51 species (6.78% of total species and 25.12% of total monocot species).

(vii) **Dry sand:** A total of 163 species (21.68% of total species) were colleted from this habitat type. Dicots accounted for 135 species (17.95% of total flora and 24.59% of total dicots) and monocots for 28 species (3.72% of total and 13.79% of total monocots).

(viii) **Tall wet grasslands or Swamps:** A total of 382 species (50.8% of total species) are found in this habitat. Dicots contribute 251 species (33.38% of total species and 45.72% of dicot species) and monocots 131 species (17.42% of total and 64.53% of monocot species).

(ix) **Dry grasslands:** One hundred and fifty eight species (21.01% of total species) are found in this habitat type. Dicots contribute 131 species (17.29% of total and 23.68% of dicots) and monocots contribute 27 species (3.59% of total species and 13.3% of monocot species).

7. HABITAT CHARACTERISTICS AND FLORISTIC CHANGES IN HASTINAPUR WILDLIFE SANCTUARY

Hastinapur Wildlife Sanctuary represents one of the highly threatened biome of the country. Continuous anthropogenic pressure on the sanctuary has rendered once continuous natural vegetation tracts fragmented. Considering this, present status of natural vegetation patches was assessed and mapped using remotely sensed data. Changes brought about at the landscape level were assessed with a temporal resolution of eight years. The results revealed that natural vegetation cover is disappearing at an alarming

level and it ranged between 21 and 59 percent among various habitat types during the period of eight years. In addition to this, plant species density, diversity, richness and evenness were calculated in different habitat types as baseline information for future reference.

Floristic changes in the study area since 1961:

The inventory of flowering plant species prepared during this survey was compared with that of Murty and Singh (1961b) and following changes at different taxonomic levels were observed. .

Murty and Singh recorded a total of 102 families from the study area. In present study 123 families were recorded.

Total number of genera, recorded by Murty and Singh (1961b) was 405. This figure included large number of cultivated species which were neither included in keys nor considered for this analysis. Therefore, the number of indigenous or naturalized genera reported by Murty and Singh and considered in this analysis is 360.The total number of genera recorded in this work is 423. Ninety five genera were not reported by Murty and Singh (1961b) and 32 genera reported in earlier work could not be collected during present work.

One hundred and ninety five (195) species collected during present work were not reported by Murty and Singh (1961b). During present work 72 species of those reported by Murty and Singh (1961b) could not be collected.

8. SUMMARY:

This chapter provides a brief overview of the thesis.

9. REFERENCES :

This chapter lists the references cited in the body of thesis. Only those references marked with an asterisk (*) have been actually seen. Remaining references are those which have appeared in author citation of accepted names and synonyms.

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Certificate

This is to certify that the thesis entitled **"Angiosperm Species Diversity and Ecological Assessment of Hastinapur Wildlife Sanctuary, Uttar Pradesh (India)"** being submitted to Aligarh Muslim University, Aligarh for the award of the degree of **Doctor of Philosophy**, embodies original and bonafide work carried out by **Ms. Sweta Agarwal** under my supervision. No part of this thesis has been submitted for any other Degree or Diploma.

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(Afifullah Khan)
Co-supervisor

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Sweta

(Sweta Agarwal)

CONTENTS

LIST OF TABLES

LIST OF FIGURES

IMPORTANT ABBREVIATIONS USED IN THE THESIS

APG 2	Angiosperm phylogeny group
Bengal. Pl.	Bengal Plants.
Bot. Bihar Orissa	Botany of Bihar and Orissa.
Bull. Bot. Surv. India	Bulletin of the Botanical Survey of India.
Comp. Ind.	Compositae Indicae.
Dicot Pl. Uttar Pradesh	Dicotyledonous Plants of Uttar Pradesh.
Fasc. Fl. Ind.	Fascicles of Flora of India.
FBI	Flora of British India
Fl. Afgh.	Flora of Afghanistan
Fl. Ceylon	Flora of Ceylon (now Sri Lanka).
Fl. Ind.	Flora of India
Fl. Delhi	Flora of Delhi.
Fl. Dudhwa Nat. Park	Flora of Dudhwa National Park
Fl. Madras	Flora of Madras
Fl. Rajasthan	Flora of Rajasthan.
Fl. West Pak.	Flora of West Pakistan.
FUGP	Flora of the Upper Gangetic Plain and of the adjacent Siwalik and sub-Himalayan tracts.
GBCIP	The Grasses of Burma, Ceylon, India and Pakistan.
HFDD	Herbaceous Flora of Dehra Dun.
HWLS	Hastinapur wildlife sanctuary
Hort. Beng.	Hortus Benghalensis.
Ill. Bot. Himal.	Illustrations of the Botany and other branches of the Natural History of the Himalayan Mountains and of the Flora of Cashmere.
IPNI	International Plant Name Index.
Journ. Ind. Bot. Soc.	Journal of Indian Botanical Society.
Name Changes Flow. Pl. Ind.	Name changes in flowering plants of India.
Orchid Fl. N. W. Himalayas	The Orchid flora of North West Himalayas.

Scroph. Ind	Scrophularianeae Indicae.
WCSPF	World checklist of selected plant families (available on website of Kew Garden).

CHAPTER - 1

INTRODUCTION

The work embodied in this thesis deals with the flora of a protected area (PA), the Hastinapur Wldlife Sanctuary, Uttar Pradesh (India). The Introduction will, therefore, begin with the definition of a protected area and will, then, proceed to discuss the categories of protected areas, their objectives and roles, protected areas in the world and India, definition and role of floristics in planning and monitoring of PAs, few examples of floristic studies in PAs in the world, status of floristic studies in PAs in India, gaps in knowledge of floristics of PAs in India and finally the rationale and objectives of present study.

1.1 DEFINITION OF A PROTECTED AREA

Convention on Biological Diversity defines a protected area as follows (http://www.cbd.int/protected/intro.shtml):

"a geographically defined area which is designated or regulated and managed to achieve specific conservation objectives"

IUCN (International Union for Conservation of Nature) defines a protected area as (http://www.iucn.org/about/union/commissions/wcpa/wcpa_overview/wcpa_ppa/):

"**areas of land and / or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means.**".

These two definitions of PAs differ in words, but the ultimate objective set by them is same------ conservation of biodiversity.

Dudley (2008) defines a protected area as "**A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values**".

1.2 CATEGORIES OF PROTECTED AREAS

International Conference for the Protection of Fauna and Flora (1933) recognized four categories of protected areas-- *national park*; *strict nature reserve*; *fauna and flora reserve*; and *reserve with prohibition for hunting and collecting* (Dudley, 2008). The Western Hemisphere Convention on Nature Protection and Wildlife Preservation also recognizes four categories—*national park*; *national*

reserve; *nature monument*; and *strict wilderness reserve* (Holdgate 1999). IUCN's Commission on National Parks and Protected Areas (CNPPA), now the World Commission on Protected Areas (WCPA) decided to develop a categories system for protected areas. A Working Group Report (IUCN, 1978) proposed following ten categories:

Group A: Categories for which CNPPA will take special responsibility.

I: Scientific reserve, **II:** National park, **III:** Natural monument/national landmark, **IV:** Nature conservation reserve and, **V:** Protected landscape.

Group B: Other categories of importance to IUCN, but not exclusively in the scope of CNPPA.

VI: Resource reserve, **VII:** Anthropological reserve and, **VIII:** Multiple-use management area.

Group C: Categories that are part of international programmes.

IX: Biosphere reserve and, **X:** World Heritage site (natural).

This system suffered from following demerits (a) It did not contain a definition of a protected area, (b) several terms were used to describe the entire suite of ten categories, (c) a single protected area could be in more than one category, and (d) and the system lacked a marine dimension.

In 1984 CNPPA established a task force to update these categories. A report submitted in 1990 advised to build a new system around the 1978 categories I – V, whilst abandoning categories VI – X (Eidsvik, 1990). The IUCN General Assembly Meeting held in Buenos Aires (January, 1994) approved the new system. The six categories recognized are as follows:

Areas managed mainly for:

I: Strict protection [Ia) Strict nature reserve and Ib) Wilderness area], **II:** Ecosystem conservation and protection (i.e., National park), **III:** Conservation of natural features (i.e., Natural monument), **IV:** Conservation through active management (i.e., Habitat/species management area), **V:** Landscape/seascape conservation and recreation (i.e., Protected landscape/seascape), and **VI:** Sustainable use of natural resources (i.e., Managed resource protected area)

Another revision of categories published in 2008 recognized and defined six categories as follows (Dudley, 2008):

Category Ia: Strict nature reserve: strictly protected areas set aside to protect biodiversity and also possibly geological/geomorphological features, where human

visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring.

Category Ib: Wilderness area: usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.

Category II: National park: large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities.

Category III: Natural monument or feature: areas set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value.

Category IV: Habitat/species management area: areas aimed to protect particular species or habitats and management reflects this priority. Many category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.

Category V: Protected landscape/ seascape: a protected area where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.

Category VI: Protected area with sustainable use of natural resources: areas to conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.

1. 3 OBJECTIVES AND ROLE OF PROTECTED AREAS:

"Cornerstones of biodiversity conservation and critical to the achievement of the 2010 biodiversity target and the Millennium Development Goals" (Convention on Biological Diversity, http://www.cbd.int/protected/)

This short but eloquent statement speaks volumes of the importance of Protected Areas (PAs) in achieving the goal of biodiversity conservation.

Gadgil and Meher-Homji (1986), while emphasizing the role of protected areas in conservation of biodiversity, stated:

> **"While we may save a few hundred or at most a few thousand, of these species in botanical and zoological gardens and in deep freezers, it is clearly impossible to conserve the entire gamut of this tremendous variety through such artificial means. This can only be approached through the conservation of their natural habitats where they live as members of a community knit together in a web of life"**

Dudley (2008) has outlined the objectives of each category of PAs as follows. First objective in each category, printed in bold face, is the primary objective, while remaining objectives are 'other objectives':

CATEGORY IA:

(a) To conserve regionally, nationally or globally outstanding ecosystems, species (occurrences or aggregations) and/ or geodiversity features: these attributes will have been formed mostly or entirely by non-human forces and will be degraded or destroyed when subjected to all but very light human impact. (b) to preserve ecosystems, species and geodiversity features in a state as undisturbed by recent human activity as possible (c) to secure examples of the natural environment for scientific studies, environmental monitoring and education, including baseline areas from which all avoidable access is excluded; (d) to minimize disturbance through careful planning and implementation of research and other approved activities; (e) to conserve cultural and spiritual values associated with nature.

CATEGORY IB:

(a) To protect the long-term ecological integrity of natural areas that are undisturbed by significant human activity, free of modern infrastructure and where natural forces and processes predominate, so that current and future generations have the opportunity to experience such areas. (b) to provide for public access at levels and of a type which will maintain the wilderness qualities of the area for present and future generations; (c) to enable indigenous communities to

maintain their traditional wilderness-based lifestyle and customs, living at low density and using the available resources in ways compatible with the conservation objectives; (d) to protect the relevant cultural and spiritual values and non-material benefits to indigenous or non-indigenous populations, such as solitude, respect for sacred sites, respect for ancestors etc.; (e) to allow for low-impact minimally invasive educational and scientific research activities, when such activities cannot be conducted outside the wilderness area.

CATEGORY II:

(a) To protect natural biodiversity along with its underlying ecological structure and supporting environmental processes, and to promote education and recreation. (b) to manage the area in order to perpetuate, in as natural a state as possible, representative examples of physiographic regions, biotic communities, genetic resources and unimpaired natural processes; (c) to maintain viable and ecologically functional populations and assemblages of native species at densities sufficient to conserve ecosystem integrity and resilience in the long term; (d) to contribute in particular to conservation of wide-ranging species, regional ecological processes and migration routes;

(e) to manage visitor use for inspirational, educational, cultural and recreational purposes at a level which will not cause significant biological or ecological degradation to the natural resources; (f) to take into account the needs of indigenous people and local communities, including subsistence resource use, in so far as these will not adversely affect the primary management objective; (g) to contribute to local economies through tourism.

CATEGORY III:

(a) To protect specific outstanding natural features and their associated biodiversity and habitats. (b) to provide biodiversity protection in landscapes or seascapes that have otherwise undergone major changes; (c) to protect specific natural sites with spiritual and/or cultural values where these also have biodiversity values; (d) to conserve traditional spiritual and cultural values of the site.

CATEGORY IV:

(a) To maintain, conserve and restore species and habitats. (b) to protect vegetation patterns or other biological features through traditional management approaches; (c) to protect fragments of habitats as components of landscape or seascape-scale conservation strategies; (d) to develop public education and

appreciation of the species and/or habitats concerned; (e) to provide a means by which the urban residents may obtain regular contact with nature.

CATEGORY V:

(a) To protect and sustain important landscapes/seascapes and the associated nature conservation and other values created by interactions with humans through traditional management practices. (b) to maintain a balanced interaction of nature and culture through the protection of landscape and/or seascape and associated traditional management approaches, societies, cultures and spiritual values; (c) to contribute to broad-scale conservation by maintaining species associated with cultural landscapes and/or by providing conservation opportunities in heavily used landscapes; (d) to provide opportunities for enjoyment, well-being and socio-economic activity through recreation and tourism; (e) to provide natural products and environmental services; (f) to provide a framework to underpin active involvement by the community in the management of valued landscapes or seascapes and the natural and cultural heritage that they contain; (g) to encourage the conservation of agro biodiversity and aquatic biodiversity; (h) to act as models of sustainability so that lessons can be learnt for wider application.

CATEGORY VI:

(a) To protect natural ecosystems and use natural resources sustainably, when conservation and sustainable use can be mutually beneficial. (b) to promote sustainable use of natural resources, considering ecological, economic and social dimensions; (c) to promote social and economic benefits to local communities where relevant; (d) to facilitate inter-generational security for local communities' livelihoods – therefore ensuring that such livelihoods are sustainable; (e) to integrate other cultural approaches, belief systems and world-views within a range of social and economic approaches to nature conservation; (f) to contribute to developing and/or maintaining a more balanced relationship between humans and the rest of nature; (g) to contribute to sustainable development at national, regional and local level (in the last case mainly to local communities and/or indigenous peoples depending on the protected natural resources); (h) To facilitate scientific research and environmental monitoring, mainly related to the conservation and sustainable use of natural resources; (i) to collaborate in the delivery of benefits to people, mostly local

communities, living in or near to the designated protected area; (j) to facilitate recreation and appropriate small-scale tourism.

1. 4 PROTECTED AREAS IN WORLD AND INDIA:

A network of protected areas has been established all over the world. 2003 United Nations List of Protected Areas contains 102,102 PAs across the globe. Their total area is equivalent to 12.65% of Earth's land surface (Chape et al., 2003). In India there are a total of 597 PAs (National Parks 95, Wildlife Sanctuaries 500 and Conservation Reserves 2). The total area of these P As is 155,979.05 km^2, 4.74% of nation's geographic area (http://www.wii.gov.in/eianew/eia/database/palist.htm accessed May 25, 2009). In Uttar Pradesh state, there are 24 PAs with a total area of 5712.47 km^2, 1.94% of total geographical area of the state (Table-1).

1. 5 DEFINITION OF FLORISTICS AND ITS ROLE IN PROTECTED AREA PLANNING AND MONITORING:

Floristic studies are taxonomic studies of a flora, or of a major segment of a flora of a given area (Lawrence, 1951). Stace (1989) defines floristics as the study of floras, including the preparation of Floras.

Mere notification of an area as a PA is not an end in itself. It is just a means, a beginning. A protected area must be thoroughly planned before inception and continuously monitored, thereafter, to assess the degree of achievement of its stated objectives. Both planning and monitoring require in depth knowledge of existing socio-economic and ecological conditions. Inventorization of animal and plant species is a fundamental ecological parameter as it helps to determine the changes in species composition before and after the beginning of conservation efforts. This is a point of convergence of floristics and conservation ecology, since only an extensive floristic work can draw up an exhaustive list of plant species. All other parameters of ecological diversity need correct species identification.

In a workshop on 'Himalayan Biodiversity 2000: Options for Development', organized by Conservation of Biological Diversity Core Group of the G. B. Pant Institute of Himalayan Environment and Development, the state of existing information on wild plant biodiversity across the Himalaya was evaluated. The need for intensive inventorization of nonvascular plants, wetlands and protected areas was

emphasized (Dhar et al., 2001). This recommendation was, though, made for Himalayan region but it is equally relevant for other regions as well. Dhar (2002) reviewed various aspects of plant endemism in the Himalaya and discussed the conservation implications of high plant species endemism. He argued that dominance of endemics at high altitude Himalaya suggested high conservation value of the zone and these facts need to be recognized while developing new protected areas or extending the boundaries of existing ones. An extensive floristic survey is the only way to identify areas with high occurrence of endemic species.

1. 6 SOME EXAMPLES OF FLORISTIC STUDIES IN PAs AROUND THE WORLD

As stated earlier, inventorization is the converging point of conservation ecology and plant taxonomy. Large number of publications has appeared on inventorization of protected areas. Veillon (1993) in a study conducted in New Caledonia concluded that existing protected areas were confined mainly in south of main island, covering only 9% of the total area. He recommended to (a) increase the surface protected for the formations involved; (b) create protection zones urgently in mangrove, evergreen forests on schists and on limestone (Loyalty Islands) and sclerophyll forests; and (c) list species showing disjunct distributions and institute measures to protect their sites. Gussev et al. (1998) explored newly established Strandzha National Park (SE Bulgaria) and documented several new records for Bulgarian region of Mt. Strandzha. Felfili et al. (2000) documented the changes in floristic composition of a cerrado (savanna woodland with 10 to 60% tree cover) at Fazenda Â gua Limpa in Cerrado Biosphere Reserve, Brasília. There was little change in species composition over the period. Changes in density and basal area of the whole community were in the range of 5% over the 9 year period. Bridgewater et al. (2002) studied the vegetation of Rio Bravo Conservation and Management area, Belize. They recorded 258 species of spermatophyta (255), pteridophyta (2) and lycopsida (1). In a study "Vegetation and floristics of Mount Canobolas State Recreation Area, Orange, New South Wales" (Hunter, 2002), 309 vscular plants belonging to 93 genera and 69 families were recorded. Seven plant communities were recognized. In another study Hunter (2005) studied the vegetation of Warra National Park and *Wattlebridge*, New South Wales. He recorded 549 taxa belonging to 290 genera and 94 families. He also described 11 communities of which 4 were considered as threatened and 11 taxa were considered

of conservation significance. Bianco et al. (2003) studied the extent of ruderalization caused by change in management practice in Parco del Pineto (Rome). They concluded that "change in management of the Parco del Pineto from a pasture to a protected area for recreation and tourism has resulted in significant floristic changes. The abolition of grazing, which at first glance might be considered a good conservation measure, has coincided with an increase in nitrogen indicator values". Ion et al. (2004), in a study of conservation of terrestrial vertebrates from protected areas and natural reserves of Moladavia listed a number of plant species. But this study is not a complete floristic account of the study area. Boubli (2005) conducted a study of floristics, primary productivity and primate diversity in Pico da Neblima National Park in the Northwestern most part of Brazilian Amazonia. He encountered 229 tree species belonging to 45 families. Khanum and Gilani (2005) studied the status of seedlings in Ayubia National Park, Pakistan. They concluded that the species used as fuel wood like *Quercus dilatata*, *Quercus incana*, *Abies pindrow*, *Taxus wallichiana*, *Aesculusindica* and *Picea smithiana* were in serious threats of extinction based on the number of seedlings and saplings. Ootham and Boodram (2006) studied the vegetation of this island. A total of 112 species were recorded. 101 species were native belonging to 95 genera and 62 families. Malekmohammadi et al. (2007) surveyed the flora of Ghasemloo (Shohada) Valley forest reserve and adjacent areas (Iran). They recorded 204 species belonging to 165 genera and 50 families.Djaha et al., (2008) studied the floristic composition of Azagny National Park, Côte d' Ivoire. A total of 519 plant species belonging to 351 genera and 100 families were recorded, of which 57 were endemic to upper Guinea and 24 were endangered and threatened. Jafari and Akhani (2008) studied the flora of Jahan Nama National Park, Golestan province, Iran and recorded 607 vascular plant species belonging to 329 genera and 85 families. Gorttapeh et al. (2008) studied the flora of Marakan Protected Region (West Azerbaidgan Province), Iran. They recorded 282 species belonging to 167 genera and 47 families. Siebert and Eckhardt (2008) studied the floristics of Nkhuhlu exclosures of Kruger National Park in South Africa. Highest species richness was found in *Jasminum fluminense–Spirostachys africana* Riverine Forest with a total of 262 plant species, and in the *Enneapogon scoparius–Combretum apiculatum* Dry Mixed Savanna with a total of 260 plant species. One of the stated objectives of this study was to "provide baseline data to assess future changes in vegetation and floristic patterns due to small-scale environmental factors..." Gonzalvo et al. (2008) studied

the vegetation of a proposed Plant Micro Reserve (PMR) at Plá de Colom, Bétera (Province of Valencia). They recorded 199 vascular plant taxa. Four taxa ((*Biscutella* gr. *calduchii*, *Sideritis juryi*, *Teucrium edetanum* and *Urginea undulata* subsp. *caeculi*) were endemics restricted to the Valencian territory. Two were narrow; nearly exclusively, endemics (*Helianthemum origanifolium* subsp. *glabratum* and *Thymus vulgaris* subsp. *aestivus*) and seven were eastern Iberian endemics of wider distribution. Little Tobago Island, also known as 'Bird of Paradise Island' (113 hectares in area) is one of the most important sea-bird sanctuaries (http://www.discover-tt.com/tobago/littletobago.html). Perveen et al. (2008) inventorized the flora of Dureji Game Reserve (Pakistan) and collected 79 plant species belonging to 66 genera and 32 families. Three species (*Cometes surattensis* Burm. *Desmostachya bipinnata* (L.) Stapf., and *Solanum surattense* Burm. f.) were rare in the study area.

1. 7 STATUS OF FLORISTIC STUDIES OF PAs IN INDIA

India has a large network of protected areas across the country, but the number of PAs in which extensive and systematic floristic studies have been under taken is not very large. Venu (1998) has reviewed the floristic diversity inventory and methodology in India. Notable publications on protected areas of India are: **Uttarakhand Biosphere Reserve – Valley of Flowers** (Rau 1961, 1964; Wadhwa et al., 1987); **Rann of Kutch** (Jain, 1968; Jain and Despande, 1960; Jain and Kanodia, 1960; Sabnis and Rao, 1983); **Thar Desert Biosphere Reserve** (Unpublished Report of Arid Zone Circle, Botanical Survey of India, 1983, as cited by Venu, 1998; Pandey, 1981; Pandey et al., 1982; Shetty and Pandey, 1977; Singh and Shetty, 1977, 1983); **Namdapha Biosphere Reserve** (Joseph, 1982); **Nandadevi Biosphere Reserve** (Hajra, 1983; Hajra and Balodi, 1995); **Gulf of Mannar** (Rao et al., 1963; Daniel, 1996); **Nilgiri Biosphere Reserve** (Joseph, 1987; Sharma et al., 1977); **Great Nicobar** (Technical Report of Ethnobiology Project, 1991, as cited by Venu, 1998; Thothathri et al., 1976; Balakrishnan and Nair, 1979, 1980; Bhargava, 1981); **Nokrek Biosphere Reserve** (Ghosh et al., 1978); **Manas Biosphere Reserve** (Hajra and Jain, 1995); **Kanha National Park** (Maheshwari, 1963); **Sunderbans** (Chandra, 1977); **North Andamans** (Balakrishnan, 1989; Ellis, 1989); **Flora of Pachmarhi and Bori Reserves** (Mukherjee, 1984); **Flora of Corbett National Park** (Pant, 1986); **Flora of Palghat District including Silent Valley National Park** (Vajravelu, 1990); **Floristic**

Account of Taroba National Park (Malhotra and Moorthy, 1992); **Contribution to the Flora of Namdapha, Arunachal Pradesh** (Chauhan et al., 1996); **Flora of Dudhwa National Park** (Singh, 1997); **Plant Diversity in Tiger Reserves of India** (Hajra et al., 1998); **State Flora of Andaman and Nicobar Islands vol. I** (Hajra et al., 1999); **Flora of Great Nicobar Islands** (Sinha, 1999); **Flora of Great Himalayan National Park** (Singh and Rawat, 2000); **Economics of Protected Areas and its Effect on Biodiversity** (Kushwaha and Kumar, 2001); **Flora of the Gulf of Mannar** (Daniel and Umamaheshwari, 2001); **Biodiversity and Vegetation of Pachmarhi Hills** (Singh and Kaul, 2002); **Flora of Rajaji National Park** (Singh and Prakash, 2002); **Study of Pabitira Wildlife Sanctuary** (Bora and Kumar, 2003); **Flora of Sanjay Gandhi National Park, Borivali, Mumbai (Bombay)** (Pradhan et al., 2005); **Pteridophyte Flora of Nilgiris** (Manickam and Irudayaraj, 2003); **Flora of Hazaribagh District vol.1 & 2** (Paria and Chattopadhyay, 2000, 2005); **Biodiversity of Ranthambore Tiger Reserve, Rajasthan** (Singh & Shrivstava, 2007), and **Flora of Indravati Tiger Reserves** (Kumar, in press).

Apart from these exclusively floristic works on Indian PAs, a number of publications have appeared which combine the disciplines of plant taxonomy and ecology. Ara (1960 & 1966) and Rao (1997) presented an overview of plant diversity in India. This paper is a must read for a student of biodiversity. Husain and Garg (2004) studied the secondary succession in the buffer zone of Corbett National Park after relocation of two villages in 1990 – 1993. They noted that By 1999–2002 several plant species, namely *Abelmoschus crinitus* Wall., *Acacia pennata* (L.) Willd., *Ailanthus excelsa* Roxb., *Albizia lebbeck* (L.) Benth., *Alternanthera sessilis* (L.) DC., *Cyperus nutans*Vahl., *C. rotundus* L., *Galium aparine* L., *Heliotropium strigosum* Willd., *Indigofera glandulosa* Willd., *Ipomoea nil* (L.) Roth., *Limonia acidissima* L., *Melochia corchorifolia* L., *Mucuna capitata*Wt. & Arn., *M. nigricans* (Lour.) Steud., *Perotis hordeiformis* Nees ex Hook. & Arn., *Saccharum spontaneum* L. and *Thevetia peruviana* (Pers.) Merr., had already emerged in these buffer zones. It was therefore clear that secondary succession was fast progressing and was on way to acquire a climax. Khan et al., (1997) assessed the effectiveness of the current protected area network in conserving the biodiversity of Meghalaya state. They found that 17 % of the plant species endemic to Meghalaya occur at altitudes above 1500 m, none of the forests at these altitudes were protected and concluded that present network of PAs in Meghalaya did not effectively conserve the state's unique biodiversity. Dhar et al.

(1997) in a study of structural diversity and representativeness of forest vegetation at Askot wildlife sanctuary, Kumaon showed (i) expansion of riverine and *Pinus roxburghii* forests (ii) compositional changes in *Quercus leucotrichophora* and *Q. lanuginosa* forests, largely owing to preferred extraction demand of inhabitants; and (iii) infrequent regeneration and declining population of *Q. semecarpifolia* and *Abies pindrow* forests. A high percentage of non-natives was found in all forest types. Srivastava and Choudhary (2006) studied the floristic diversity of Itanagar Wildlife Sanctuary vis a vis the prevalent biotic pressures in the sanctuary. It was shown that species like *Dipteris wallichii, Aquillaria agallocha, Angiopteris crassipes (A. evecta sensu auct. multi.), Cyathea spinulosa* etc. are facing threat due to habitat loss. Rao and Chowlu (2006) recorded 49 species of orchids belonging to 25 genera from Kamlang Wildlife sanctuary (Arunachal Pradesh). Reddy and Ugle (2008) analyzed phytosociologcal characters and diversity pattern of tropical forests of R. V. Nagar range of Visakhapatnam district, apart of proposed Chintapally biosphere reserve. Phytosociological characteristics revealed that *Pterocarpus marsupium, Schleichera oleosa, Mangifera indica, Syzygium cumini, Bauhinia vahlii, Mallotus philippensis* and *Grewia tiliifolia* were the most frequent species when overall forest types were considered. Mishra et al., (2005) studied species diversity at four sites in Bhitarkanila sanctuary in mangrove ecosystem of Orissa. Twenty tree species were recorded from Dangmal forest block, 24 from Bhitakanika forest block, 16 from Thakurdia forest block and 17 from Kakranasi forest block (mean number of tree species per 10 X 10 m quadrat at each site 5.16, 5.56, 4.03 and 4.06 respectively). Reddy et al. (2007) monitored changes, over a period of of 30 years, in mangroves of same sanctuary using satellite data and GIS. They recorded a loss of 1534 ha mangrove area and an increase of 2436 ha agriculture area. Reddy et al. (2008) studied the quantitative structure and composition of Mudumalai wildlife sanctuary in Western Ghats. A total of 498 species were collected (156 trees, 90 shrubs, 214 herbs and 61 climbers, the total of this break up comes to 521). Earlier, tree flora of the sanctuary was worked out by Suresh et al (1996). Banerjee (1993) inventorized the plant resources of Jaldapara Rhino sanctuary (West Bengal). Ghosh and Das (2007) investigated and inventorized Rhino-fodder species in the same sanctuary. Rhinos were found to feed on 57 plant species belonging to 15 families. Fifteen species were most preferred, 38 preferred and four species were stress-time fodder. Reddy and Prasad (2008) inventorized the tree flora of Saddle Peak National Park, Andaman. A total of 188

taxa belonging to 135 genera and 50 families were recorded. Fifteen species were endemic. Other works on Andaman and Nicobar Islands include Lakshminarasimhan and Rao (1996), Reddy and Dutt (2003), Reddy et al (2004), Vasudevarao (1986), and Balakrishnan et al. (1984). Parthasarthy et al (2008) made an extensive study of Tropical Dry Evergreen Forests (TDEF) along the Coromandel Coast of peninsular India. The study area included Point Calimere Wildlife Sanctuary. A total of 149 woody plant species (102 trees and 47 lianas) were recorded.

1. 8 GAPS IN KNOWLEDGE OF FLORISTICS OF PAs IN INDIA:

It is evident from the foregoing account that full-fledged, PA specific floristic works are available for 30 PAs only. This is mere 5.02% of the number of protected areas (597) in India. Moreover, most of the studies were conducted in Andamans, Himalayan region, Sunderbans, Orissa and southern India. The protected areas in plains of north India have received little attention of plant taxonomists, although there are 24 protected areas in Uttar Pradesh alone. Extensive floristic explorations are needed to fill this gap. Botanical Survey of India has drawn up a list of Protected Areas of India, categorizing them according to the state of exploration and inventorization. Hastinapur Wildlife Sanctuary falls in 'Underexplored (< 40%)' category (Table- 2). In fact our knowledge of 'the species and the ecosystem upon which the concept of PAs is based are still not properly known or understood' (Dey, 1995). Article 8 (d) of Convention on Biological Diversity, to which India is a Party, urges upon each Contracting Party to 'Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings' (http://www.cbd.int/convention/articles.shtml?a=cbd-08). This goal can not be achieved without a thorough knowledge of the ecosystems and their constituent species, animals as well as plants.

1 . 9 RATIONALE OF PRESENT STUDY

The facts, discussed above, lead us to following conclusions (a) The floristic work on Protected Areas is highly skewed in favor of biodiversity rich areas (b) The PAs in plains of north India have received but little attention of plant taxonomists (c) As a Party to CBD India is obliged to develop a sound knowledge of PAs and (d) A baseline database is essential to facilitate the monitoring of conservation efforts. A study, results of which form the subject matter of this thesis, was, therefore,

undertaken with following objectives (a) Inventorization of the flowering plants of Hastinapur Wildlife Sanctuary to prepare a detailed Flora which will be useful in future studies of habitat ecology, (b) Documentation of change in flora, if any, over last half century by comparing the results with those of Murty and Singh (1961b) and (c) Preliminary study of changes in physical features of the sanctuary over last decade using remote sensing data.

In a very interesting and novel study Fuller et al. (2007) assessed the 'cost of postponing biodiversity (mammals) conservation' in Mexico. They showed that "**endemic mammals in Mexico could have been protected considerably more economically if a conservation plan had been implemented in 1970 than is possible today due to extensive conversion of primary habitats. Analysis of the distributions of 86 endemic mammal species in 1970, 1976, 1993, and 2000 indicates that the distributions of 90% of the species shrank during this 30-year period. At each time step, optimal conservation area networks were selected to represent all species. 90% more land must be protected after 2000 to protect adequate mammal habitat than would have been required in 1970**". This study may appear out of context here since it is not related to plants. But it should be an eye opener to those who prefer to put conservation issues on the back burner.

Table -1: Protected Areas of Uttar Pradesh

S. No.	Name of National Park/Wildlife Sanctuary	Year of Establishment	Area (Km^2)	District/Location
1.	Dudhwa NP	1977	490.00	Lakhimpur-Kheri
2.	Bakhira WLS	1990	28.94	Sant Kabir Nagar (Basti)
3.	Chandraprabha WLS	1957	78.00	Chandauli
4.	**Hastinapur WLS**	**1986**	**2,073.00**	**Muzzafarnagar,Meerut, Ghaziabad, Bijnor & Jyotibaphuley Nagar**
5.	Kaimur WLS	1982	500.73	Mirzapur, Sonbhadra
6.	Katerniaghat WLS	1976	400.69	Bahraich
7.	Kishanpur WLS	1972	227.00	Lakhimpur-Kheri, Shahjahanpur
8.	Lakh Bahosi WLS	1988	80.24	Farrukhabad
9.	Mahavir Swami WLS	1977	5.41	Lalitpur
10.	National Chambal WLS	1979	635.00	Agra, Etawah
11.	Nawabganj WLS	1984	2.25	Unnao/ Lucknow
12.	Okhala WLS	1990	4.00	Ghaziabad
13.	Parvati Aranga WLS	1990	10.84	Gonda
14.	Patna WLS	1990	1.09	Etah
15.	Ranipur WLS	1977	230.31	Banda,Chitrakoot
16.	Saman WLS	1990	5.25	Mainpuri
17.	Samaspur WLS	1987	7.99	Rae Bareli
18.	Sandi WLS	1990	3.09	Hardoi
19.	Sohagibarwa WLS	1987	428.20	Maharajganj
20.	Sohelwa WLS	1988	452.47	Shravasti,Balrampur
21.	Sur Sarovar WLS	1991	4.03	Agra
22.	Surha Tal WLS	1991	34.32	Ballia
23.	Turtle WLS	1989	7.00	Varanasi
24.	Vijai Sagar WLS	1990	2.62	Mahoba
	Total		5712.47	

Table- 2: State of exploration and inventorization in Protected Areas of Uttar Pradesh (including present Uttarakhand)

S. No.	Well Explored (> 70%)	Under Explored (<40%)
1.	Corbett National Park	Gangotri National Park
2.	Dudhwa National Park	Askot Musk Deer Wildlife Sanctuary
3.	Govind Pashu Vihar National	Bakhira Wildlife Sanctuary
4.	Nanda Devi National Park	Chandraprabha Wildlife Sanctuary
5.	Rajaji National Park	**Hastinapur Wildlife Sanctuary**
6.	Valley of Flowers National Park	Kaimur Wildlife Sanctuary
7.		Katerniaghat Wildlife Sanctuary
8.		Kedarnath Wildlife Sanctuary
9.		Kishanpur Wildlife Sanctuary
10.		Lake Bahosi Wildlife Sanctuary
11.		Mahavir Swami Wildlife Sanctuary
12.		Mussoorie Wildlife Sanctuary
13.		National Chambal Wildlife Sanctuary
14.		Nawabganj Wildlife Sanctuary
15.		Okhla Wildlife Sanctuary
16.		Parvati Aranga Wildlife Sanctuary
17.		Patna Wildlife Sanctuary
18.		Ranipur Wildlife Sanctuary
19.		Saman Wildlife Sanctuary
21.		Sandi Wildlife Sanctuary
22.		Sohagibarwa Wildlife Sanctuary
23.		Sohelwa Wildlife Sanctuary
24.		Sonanadi Wildlife Sanctuary
25.		Sur Sarovar Wildlife Sanctuary
26.		Surha Tal Wildlife Sanctuary
27.		Turtle Wildlife Sanctuary
28.		Vijai Sagar Wildlife Sanctuary

Note: In actual data there is a third category "fairly explored (40-70%)" in which no PA falls.
Source: **http://www.envfor.nic.in/bsi/**

CHAPTER - 2

STUDY AREA

2.1 GEOGRAPHICAL POSITION:

Hastinapur Wildlife Sanctuary (28 ^{0} 46' and 29 ^{0} 35'N latitude and 77 ^{0} 30' and 78 ^{0} 30' E longitude), is located in western part of Uttar Pradesh state of India. This is the largest sanctuary of the state. The total geographical area of the sanctuary is 2073.00 km^2 and it traverses five districts (Muzaffarnagar, Bijnor, Meerut, Ghaziabad and Jyotiba Phule Nagar) on either side of the river Ganga (Table-1). The geographical area of the sanctuary is 12.95% of the total land area of these districts. The sanctuary is located in Indo-Gangetic Plain phytogeographic zone. It belongs to Category IV (Habitat/species management area) of IUCN Protected Area Management Categories (World Database on Protected Areas -- http://www.wdpa.org/siteSheet.aspx?sitecode=12257).

2.2 CLIMATE:

In general the climate of Uttar Pradesh is humid subtropical type, characterized by hot summers, temperature during the coldest months falling as low as 0°C, little precipitation during the winter, high wind speed and summer rainfall with powerful thunderstorms associated with southwest summer monsoon. Occasional tropical cyclones also occur.

There are three distinct seasons in the study area, summer, rainy and winter. Summer season is characterized by high temperature, low humidity and scorching sun. This season starts from the month of March and continues up to June. In the month of May the temperature may go up to 44 ^{O}C with a mean summer temperature 32.0 – 34.0 ^{O}C. Hot and dusty westerly winds of considerable velocity, locally called as 'loo' blow in the noon. The amount of precipitation received during summers, at an average 44.0 mm in May and 21.0 mm in April, comes next to the rainy season. Rainy season begins in the middle of June and continues up to September. High temperatures during summers form a low pressure zone in plains causing the oceanic winds, saturated with water vapors, blow from the Bay of Bengal in southeast direction. These winds are locally known as 'Monsoon'. At an average 261.0 mm rainfall is received during these months. Winter season starts in the month of October and

continues up to February. This season is characterized by low temperature, low humidity, a brief spell of rains, occasional frost in night and fog in morning. The day temperature remains around 6.0 ^{O}C in the months of January and February and night temperature may be as low as 0 ^{O}C.

2.3 GEOLOGY

The geological account of the study area has been taken from Kumar (2005). Indo-Gangetic plain, the largest alluvial plain in the world, occupies an area of 7, 00,000 km^2, of which about 2, 23,000 km^2 (32%) lies in Uttar Pradesh. This vast plain is located to the south of the Sub-Himalaya and extends up to the Aravalli in the west, Satpura and Vindhayan ranges in the south. Early workers differed on the geological nature of this basin. E. Suess considered it a foredeep while Burnard (1915) considered it as a rift basin. It has now been described as peripheral foreland basin formed as a result of continent-continent collision between Asian and Indian plates. This plain forms a featureless undulatory surface with an average gradient of about 24.0 cm km^{-1} towards southeast. It lies between Himalayas in the north and peninsular upland in the south. On the basis of surface and subsurface exploration carried out during the last four decades four litho-successions ranging in age from Late Archaean to Proterozoic (Supersequences I, IIb, III and IV), and four from Upper Palaeocene to Quaternary (Supersequence XII, XIII, XIV and XV) have been recognized. Of these, the last three sequences are exposed while knowledge of other sequences is based on borehole data supplemented by geophysical surveys.

In Uttar Pradesh Indo-Gangetic plain is limited by the Yamuna River in the west and continues eastwards through Bihar to West Bengal. Singh (1971) divided the Ganga plain into three parts viz. (i) Upper Gangetic Plain delimited by 300.0 m contour to the north separating it from the Sub-Himalayas, and 100.0 m contour in the east while the Yamuna river demarcates its southern boundary with the Bundelkhand (Banda) plain, (ii) Middle Ganga Plain covering plains of eastern Uttar Pradesh, Bihar, and lying between the Ganga and Sub-Himalaya, and (iii) Lower Ganga Plain covering part of Bihar (Purnea district) and West Bengal and Bangladesh.

Morphostratigraphically, there are two units or surfaces viz. an older upland or interfluve area free from floods – the *Bangar*, and a younger, flood prone, lowland – the *Khadar* . Most of the area lies in *Khadar* area. There is development of badland topography on either side of the palaeobanks of river Ganga. These badlands are

locally known as *Kholas.* There is a prominent zone of *Kholas* along the right bank of Ganga at Hastinapur extending north and south over a distance of 15.0 km. This area is highly dissected due to intense gully erosion aided by weathering (Das Gupta and Sarkar, 1975).

The development of four levels of relict palaeo-bluffs is seen along the left bank of Ganga River downstream and upstream of Bijnor (Figure- 1). The resultant prominent terraces are labeled as the Daranagar (T1), Mandawar (T2) and the Chandok-Roorkee (T3) terraces. Major part of the study area lies in T1 and T2 terraces (Singh, 1971). These terraces are considered as evidences for the different stages in the evolution of drainage system related to the post-glacial climate fluctuations (cold to warm-humid) in the beginning of present day climate, and also to the westward shift of the course of Ganga River (Fig.-1).

2.4 TOPOGRAPHY

The area includes a high level land, the '*Khola*' and a low lying land of '*Khadar*', the old bed of river Ganga which has now shifted eastward. Most of *Khadar* is under cultivation. The *Khola* is stretching parallel to Ganga. Murty and Singh recorded that *Khola* was a belt of over 36.4 km, but now *Khola* is a greatly dissected belt as it has been leveled and converted to agricultural farms at several places. In the *Khola* there are many small hillocks rising 60-90 m from the base, and broad valley like depressions which go down 15-20 m from the normal level. At the junction of *Khola* and *Khadar* there lies a discontinuous belt of highly marshy land with profuse growth of *Typha*, *Arundo* and *Phragmites*.

Several temporary ravines flow across the *Khadar* during rainy season. Water descends through them into *Khadar* and ultimately meets the river Ganga. Besides, there is a more or less permanent ravine, the Boodhi-Ganga about 0.4 km from the *Khola*. It is an old branch of Ganga which flows parallel to it for some distance and eventually merges into it. In rainy season, the Boodhi-Ganga floods the neighboring low lying area of *Khadar*, but in other seasons the movement of water in this ravine is very insignificant. There are several ponds and ditches in *Khadar* with rich growth of aquatic plants.

Construction of a barrage across Ganga in early 1980s has significantly changed the landscape of the area. The *Khadar* which was largely inaccessible earlier became easily accessible due to construction of roads, and new human settlements came into

being besides the expansion of old ones. During the days of insurgency in early 1980s, immigrants from Punjab were settled in the area who converted large tracts of *Khadar* into agricultural farms. Very recently a large portion of *Khola* was leveled near Deval to build a Gurudwara.

2.5 SOIL:

Generally speaking, the soil in the study area is of alluvial type developed on the Indo-Gangetic alluvium. Cane Development Department of Uttar Pradesh divided the state into three ranges for working convenience (a) Western – consisting of districts of Dehra Dun, Saharanpur, Muzaffarnagar, Meerut, Bijnor, Moradabad, Nainital, Bareilly, Pilibhit and Shahjahanpur. Hastinapur Wildlife Sanctuary is situated in this range, (b) Central Range – consisting of the districts Kheri, Sitapur, Hardoi, Lucknow, Barabanki, Jaunpur, Azamgarh, and Kanpur; and (c) Eastern Range – districts of Gorakhpur, Basti, and Gonda.

In districts of Saharanpur, Muzaffarnagar and Meerut the soils are generally deep and very fertile. They possess a sandy-loam texture, with single grained structure and are reddish-brown to yellowish in color. The water table varies from 2.5 m to 4.6 m below the surface. The soils are deficient in phosphate and pH varies from 6.4 to 7.6. In Bijnor, Bareilly, Pilibhit and Moradabad districts soils are generally heavy loam in texture, single grained in structure and light-yellow in color. The water table varies from 4.6 m to 6.0 m below the surface. The soils are generally slightly alkaline (Chaudhary, 1963).

2. 6 FOREST COVER:

All districts which contribute to Hastinapur Wildlife Sanctuary possess insignificant forest cover, ranging from 9% (Bijnor) to 1% (Muzaffarnagar). Most of the forest area in these districts is moderately dense or open. The area of Bijnor which harbors very dense forest is well outside the sanctuary (Table – 3).

2. 7 PREVIOUS FLORISTIC STUDIES IN AND AROUND THE STUDY AREA

India had a strong tradition of botanical research in ancient times. But the credit of introducing India to modern botany, including floristics, goes to Portuguese. It was the arrival of Vas da Gama at Calicut on May 20, 1498 that paved the way for

European intrusion in India. With the traders and military also came the naturalists, amateur as well as professionals who started plant collection, description, naming, herbarium preparation and flora writing on modern lines. It must be pointed out here that while there are strong evidences of botanical explorations in ancient India there is no evidence of any herbarium in that period. Therefore, Europeans must be credited with introducing the concept of herbarium in India.

Garcia de Orta (1490-1570; according to some sources he was born in 1499 and died in 1568), a physician and pharmacist, came to Goa in 1534 and established a medical practice there. During his stay in Goa he extensively interacted with local Hakims, Ayurvedic Physicians, spice traders and herbalists etc. The knowledge so gathered led to the compilation of famous "*Colóquios dos simples e drogas he cousas medicinais da Índia*" ("Conversations on the simples, drugs and medicinal substances of India"), which was published at Goa in 1563. This book deals with about 57 commonly used medicinal plants. The plants were arranged in alphabetic order starting with '*aloe*' and ending with '*zedoary*' and '*zerumbet*'.

In 1661 most of the Portuguese stations fell to Dutch and in 1667 Hendrik Adriaan van Rheede tot Draakenstein (1636-1691) was appointed the Governor of Cochin (Nair et al., 1996). He was an extensive traveler with a penchant for Indian plant wealth. Based on his collection he compiled the "Hortus Malabaricus, continens Regni Malabarici apud Indos celeberrimi omnis generis Plantas rariores" (1678-1693). This work is commonly abbreviated as Hortus Malabaricus. This monumental work runs into 12 volumes and contains descriptions and illustrations of 742 plants (Mohan Ram , 2005).

Floristic explorations in north India began at a much later date. John Forbes Royle (1799-1858) was probably the first plant explorer of northern India. He succeeded George Govan as second Superintendent of Saharanpur Botanic Garden in 1823. He devoted himself to studying botany and geology, and made large collections among the Himalaya Mountains. He also investigated the medical properties of the plants of Hindustan and the history of their uses among the native races. The results of these investigations appeared in an essay *On the Antiquity of Hindu Medicine* (1837). After his retirement, he published 'Illustrations of the Botany and other branches of the Natural History of the Himalayan Mountains and of the Flora of Cashmere' (1833-1840). According to Maheshwari (1963) Royle "spent a good deal of time" in Delhi and "in front of 55 species in his book, there are comments like 'in the neighborhood

of Delhi', 'as far as Delhi' and 'between Saharanpur and Delhi" etc. It must be pointed out that one must pass through Muzaffarnagar and Meerut en route to Delhi from Saharanpur. It, therefore, appears some of the plants collected by Royle might have been collected in the area now included in Hastinapur Wildlife Sanctuary. J. L. Stewart is also said to have made some collections in Bijnor and surrounding areas.

J. F. Duthie's "Flora of Upper Gangetic Plains and adjacent Siwalik Hills (1903-1929)" is a monumental work on plants of a large area extending from foothills of Himalayas to plains of Bihar. Many plants in this work were ascribed to Meerut, Bijnor and Muzaffarnagar etc. After publication of this flora, there was a lull in botanical activities in the country as a whole. Botanical Survey of India was reorganized in 1954 and botanical exploration was resumed in all parts of country with a great enthusiasm. Steps were taken also to involve the Universities in monumental task of floristic exploration of the country. In the study area, Meerut University (now renamed as Chaudhary Charan Singh University, Meerut) played a prominent role under the stewardship of eminent taxonomist Professor Y. S. Murty and his associates especially Professor V. Sing. This duo brought out a number of publications on floristics of an area smaller than selected for present study (Murty & Singh, 1959, 1960, 1961a, 1961b; Murty & Nautiyal, 1976; Singh, 1973). Khan (1987, 2000, 2002 & 2003); Khan et al. (1984, 1985, 1986 & 2005) from Aligarh Muslim University worked out the flora of Bijnor tehsil. Later, Department of Botany and Department of Wildlife Sciences of the same University launched a joint program of floristic exploration of Hastinapur Wildlife Sanctuary (Khan & Khan, 2000; Khan et al., 2005). Few publications are available on flora of Muzaffarnagar (Singh, 1972; Tayal & Bhasin, 1972 and Khan & Khan, 2000). There is no literature available on floristic account of Ghaziabad and Jyotiba Phule Nagar districts.

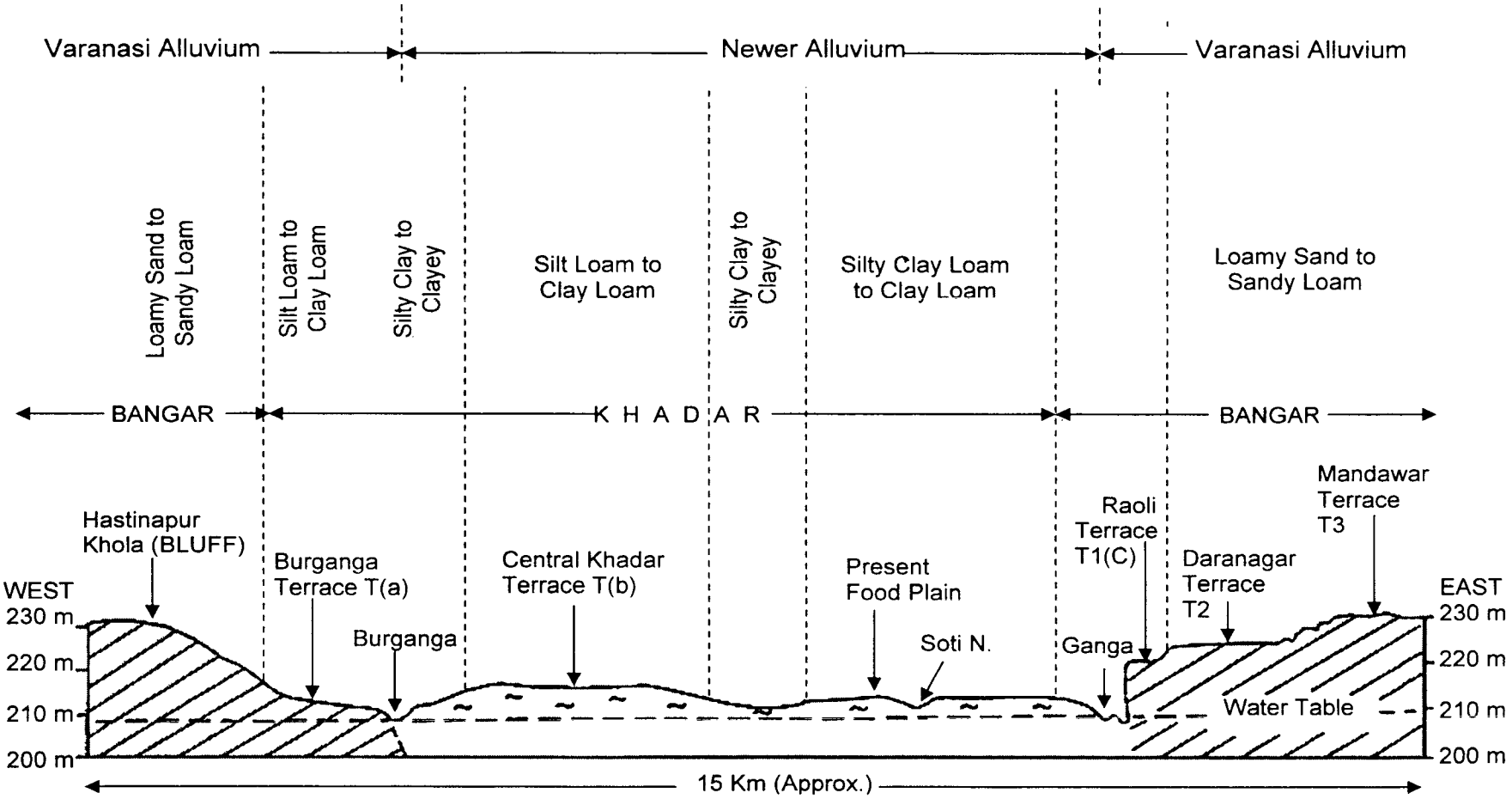

Fig.1. Schematic section across the Ganga River showing the Bangar Surface (upland), the Khadar Surface (flood plain defined by the palaeobanks) and Khola (bluff). Modified after Singh, 1971

Table- 3: State of Forests in Districts constituting the Hastinapur Wildlife Sanctuary (Area in Km^2)

S. No.		Bijnor	Meerut	Muzaffar Nagar	Ghaziabad	Jyotiba Phule Nagar
1.	Geographic Area	4561	2590	4008	3321	2249
2.	Very Dense Forest	42	0	0	0	0
3.	Moderately Dense Forest	252	30	13	4	20
4.	Open Forest	129	32	27	43	62
5.	Total	423	62	40	47	82
6.	Percent of Geographic area)	9.27	2.39	1.00	1.39	3.65
7.	Scrub	3.0	0	0	0	0

SOURCE: http://www.fsi.nic.in/sfr2005/Chapter%208/Uttar%20Pradesh.pdf

CHAPTER - 3

PLAN OF WORK

3. 1 FIELD WORK AND HERBARIUM PREPARATION

Nine habitat types may be recognized in the study area (i) Aquatic Habitat, (ii) Roadsides, (iii) Agricultural fields, (iv) Kholas, (v) River banks, (vi) Moist sand, (vii) Dry sand, (viii) Tall wet grasslands or Swamps, and (ix) Dry grasslands, therefore an extensive survey of all habitat types was undertaken in all seasons, at fortnightly interval in first year and at monthly interval in second and third years. Field and herbarium techniques as described by Lawrence (1951), Davis and Heywood (1963), and Stace (1989) were followed. Three to five specimens of each taxon were collected and pressed after noting down important field characters in a field book. Dried specimens were treated with 2% alcoholic mercuric chloride and mounted on herbarium sheet of standard size with Fevicol using glass plate method. All herbarium specimens are deposited in the Herbarium of Department of Wildlife Sciences, Aligarh Muslim University, Aligarh.

3. 2 IDENTIFICATION OF PLANT SPECIMENS

Identification was done with the help of The Flora of British India (Hooker, 1872-1897, 7 volumes); Flora of Upper Gangetic Plains (Duthie, 1903-1929, Reprinted edition, 1960, 2 vols.); Flora of Delhi (Maheshwari, 1963); Herbaceous Flora of Dehradun (Babu, 1977); Flora of Rajasthan (Shetty & Singh, 1987- 1993, 3 volumes); Flora of Dudhwa National Park (Singh, 1997); several volumes of Flora of India published by the Botanical Survey of India; The Grasses of Burma, Ceylon, India and Pakistan (Bor, 1960), Grasses of India (Moulik, 1997). Later, the identified specimens were matched with the authentic herbarium specimens deposited at the Herbarium of Botanical Survey of India (Northern Circle), Dehradun.

3. 3 NOMENCLATURE:

Nomenclature adopted in recent works on flowering plants of India e. g. Flora of India (vol. I: Ranunculaceae – Barclayaceae, 1993; II: Papaveraceae – Caryophyllaceae, 1993; III: Portulacaceae – Erythroxylaceae, 1993; IV: Malpighiaceae –

Dichapetalaceae, 1997; XII & XIII: Asteraceae, 1995); Flora of Rajasthan (vol. I, 1987, vol. II, 1991, vol. III, 1993) and web resources like International Plant Name Index (IPNI) [http://www.ipni.org/]; World Checklist of Selected Plant Families (http://apps.kew.org/wcsp/prepareChecklist.do;jsessionid=53FBC686C6CC117E62AD81D5F4E1B122?checklist=selected_families%40%40154030620091751429) and GrassBase-The Online World Grass Flora (http://www.kew.org/data/grasses-syn.html) has been followed in this thesis. .

3. 4 COMPILATION OF FLORA:

The main outcome of this work is first detailed flora of Hastinapur Wildlife sanctuary. This section of thesis begins with an artificial, dichotomous key to families. Thereafter, each family is treated individually starting with a key to genera, if required, followed by key to species for the genera represented by more than one species. The families are arranged according to the system of Bentham and Hooker. The orthography of taxonomic categories is same as given by Willis (1966). In accordance with the Articles 16.1 & 18.1 of Vienna Code (2006) names of the categories of family and above have been treated as plural (http://ibot.sav.sk/icbn/main.htm). Changes in circumscription of certain families as adopted by Hutchinson (1959) have been followed. Frequent references to changes in family concept or family position of a genus or transfer of species from one genus to another are given according to APG-2 (http://www.mobot.org/MOBOT/research/APWeb/), Vascular Plant Families and Genera Database, Kew (http://data.kew.org/vpfg1992/vascplnt.html), World Checklist of Selected Plant Families (http://apps.kew.org/wcsp/prepareChecklist.do;jsessionid=53FBC686C6CC117E62AD81D5F4E1B122?checklist=selected_families%40%40154030620091751429) and GrassBase-The Online World Grass Flora (http://www.kew.org/data/grasses-syn.html). In each family genera and species are arranged in alphabetic order. For each species current accepted name is given in bold face followed by basionym and synonym(s) in italics. This is followed by a short description. Local names have been given wherever available. Lastly, information on place of occurrence of and flowering and fruiting times are given for all species.

In order to make the Flora as complete as possible, those species which were reported by Murty & Singh (1961b), but not collected during present study were also

incorporated and a clear statement to this effect appended at the end of treatment of such species. Large number of cultivated species included in earlier work were not included in keys and detailed description. These species have been listed in Appendix-I.

3. 5 FLORISTIC ANALYSIS:

In order to get a clear picture of floristic composition of the flora, a detailed floristic analysis was carried out as follows:

3.5.1 Contribution of taxonomic categories as % of total species: obtained by dividing the number of species in a taxonomic category by total number of species and multiplying by 100.

$$\frac{\text{Number of species in a taxonomic category}}{\text{Total number of species}} \times 100$$

3. 5. 2 Contribution of dicot taxonomic categories as % of total dicot species: obtained by dividing the number of species in a taxonomic category by total number of dicot species and multiplying by 100.

$$\frac{\text{Number of species in a dicot taxonomic category}}{\text{Total number of dicot species}} \times 100$$

3. 5. 3 Floristic ratios:

3. 5. 3. 1 Dicot – monocot ratio: obtained by dividing the number of dicot families, genera or species by the number of monocot families, genera or species.

3. 5. 3. 2 Genus – species ratio: Obtained by dividing the number of total, dicot or monocot species by total, dicot or monocot genera.

3. 5. 4 Analysis of flora according to plant habit: All species were classified in to herbs, shrubs, climbers, trees and parasites. Species in each habit category were further classified according to taxonomic categories and following calculations were made:

3. 5. 4. 1 Species in each habit category as % of total species: Obtained by dividing the number of species in a habit category by total number of species and multiplying by 100.

$$\frac{\text{Number of species in a habit category}}{\text{Total number of species}} \times 100$$

3. 5. 4. 2 Dicot species in each habit category as % of total dicot species: Obtained by dividing the number of dicot species in each habit category by the number of total dicot species and multiplying by 100.

$$\frac{\text{Number of dicot species in a habit category}}{\text{Total number of dicot species}} \times 100$$

3. 5. 4. 3 Contribution of taxonomic categories to flora of a habit category as % of total species or total dicot species: Obtained by dividing the number of species in a habit category belonging to a taxonomic category by the number of total species or total dicot species and multiplying by 100.

$$\frac{\text{Number of species in a habit categoury belonging to a taxonomic category}}{\text{Total number of species or total dicot species}} \times 100$$

3. 5. 4. 4 Contribution of taxonomic categories as % of total species in a habit category: Obtained by dividing the number of species in a habit category belonging to a taxonomic category by the number of total species in that habit category and multiplying by 100.

$$\frac{\text{Number of species in a habit categoury belonging to a taxonomic category}}{\text{Total number of species in that habit categoury}} \times 100$$

3. 5. 5 Analysis of flora according to habitat: All species were classified according to their occurrence in nine habitat types (Aquatic habit, Roadsides, Agricultural fields, Kholas, River banks, Moist sand, Dry sand, Swamps, Dry grasslands) and following calculations were made.

3. 5. 5. 1 Total species in a habitat category as % of total species: Obtained by dividing the number of species in a habitat category and multiplying by 100.

$$\frac{\text{Number of species in a habit category}}{\text{Total number of species}} \times 100$$

3. 5. 5. 2 Total dicot species in a habitat category as % of total dicot species: Obtained by dividing the number of dicot species in a habitat category by the number of total dicot species and multiplying by 100.

$$\frac{\text{Number of dicot species in a habitat category}}{\text{Total number of dicot species}} \times 100$$

3. 5. 5. 3 Total monocot species in a habitat category as % of total species: Obtained by dividing the number of monocot species in a habitat category by the number of total species and multiplying by 100.

$$\frac{\text{Number of monocot species in a habitat category}}{\text{Total number of species}} \times 100$$

3. 5. 5. 4 Total monocot species in a habitat category as % of total monocot species: Obtained by dividing the number of monocot species in a habitat category by the number of total monocot species and multiplying by 100.

$$\frac{\text{Number of monocot species in a habitat category}}{\text{Total number of monocot species}} \times 100$$

3. 5. 5. 5 Contribution of taxonomic categories as % of total species in a habitat category: Obtained by dividing the number of species in a habitat category belonging to a taxonomic category by the number of total species in that habitat category and multiplying by 100.

$$\frac{\text{Number of species in a habitat categoury belonging to a taxonomic category}}{\text{Total number of species in that habitat category}} \times 100$$

All figures in these sections are based on number of species and percent contributions are shown in tables.

3. 6 Floristic change:

The inventory of flowering plants prepared during present work was compared with that of Murty & Singh (1961b) to find the number of (a) species reported in earlier work but not collected during present work, (b) species collected during present work but not reported earlier, and (c) species common between the two studies.

CHAPTER - 4

ARTIFICIAL KEY TO FAMILIES:

1. Leaves usually reticulate veined; flowers
   4- or 5- merous; cotyledons usually two.....2
1. Leaves usually parallel veined; flowers
   3- merous; cotyledon usually 1.....106
2. Perianth 2- seriate, differentiated into
   calyx and corolla.....3
2. Perianth 1-seriate, usually sepaloid,,
   sometimes absent.....89
3. Corolla polypetalous or slightly connate at
   the base; stamens not epipetalous.....4
3. Corolla gamopetalous; stamens mostly epipetalous..... 58
4. Sepals usually free or rarely connate at the base; ovary superior.....5
4. Sepals united at least in their lower halves; ovary
   superior or inferior.....44
5. Sepals free, distinct, not adnate to the ovary; stamens
   usually indefinite.....6
5. Sepals free or sometimes united, distinct or adnate to ovary; stamens
   usually definite, inserted upon the inside or outside of a ring or
   cushion like or broken into glands hypogynous disk 29
6. Gynoecium consisting of 2- many free carpels; if solitary then perianth
   not differentiated into calyx and corolla.....7
6. Carpels 1- many, united or rarely apocarpous, if free then the
   leaves usually stipulate..... 12
7. Aquatic plants.....8
7. Terrestrial plants.....10
8. Flowers unisexual, minute; rootless submerged plants; leaves deeply
   divided with filiform minutely toothed segments; carpel single..... 98. ***Ceratophyllaceae***
8. Flowers bisexual, large; rooted perennials with subterranean rhizome;
   leaves undivided; carpels more than 1.....9
9. Carpels 5- 35, sunk in the receptacle and adnate to it forming
   a many celled ovary; leaves floating on water surface.....4. ***Nymphaeaceae***
9. Carpels many, free, sunk in the apex of an obconic, fleshy receptacle;
   leaves raised above the water surface.....5. ***Nelumbonaceae***
10.Trees or shrubs with distichous, exstipulate leaves..... 2. ***Annonaceae***
10. Herbs or herbaceous climbers..... 11
11. Flowers unisexual; sepals in male flowers 2-4 seriate; fruit
    drupaceous; leaves simple entire; dioecious twiners..... 3. ***Menispermaceae***

11. Flowers bisexual; sepals 1-seriate; fruit a cluster of achenes;
leaves usuaully divided; erect herbs.....1. ***Ranunculaceae***
12. Ovary unilocular.....13
12. Ovary 2- many locular.....23
13. Placentation parietal.....14
13. Placentation free central or free basal.....21
14. Stamens numerous.....15
14. Stamens definite.....16
15. Armed or unarmed trees, without latex; fruits indehiscent or
loculicidal capsule.....12. ***Flacourtiaceae***
15. Armed latex bearing herbs; fruit a porocidal capsule.....6. ***Papaveracea***e
16. Flowers zygomorphic.....17
16. Flowers actinomorphic.....19
17. Stamens tetradynamous.....8. ***Brassicaceae***
17. Stamens not tetradynamou.....18
18. Outer one or two petals saccate at the base;
stamens 6, in two bundles; sap watery; seed single.....7. ***Fumariaceae***
18. Sepals and petals 5 each; lowermost petal spurred; anthers with
a membranous appendage; 2 anterior stamens appendiculate
on the back.....11. ***Violaceae***
19. Stamens tetradynamous.....8. ***Brassicaceae***
19. Stamens not tetradynamous.....20
20. Leaves simple; androgynophore well developed; fruit a berry;
armed shrubs or climbers.....10. ***Capparaceae***
20. Leves digitate; androgynophore absent or very short; fruit a
capsule; unarmed, glandular herbs.....9. ***Cleomaceae***
21. Leaves reduced to scales; shrubs.....16. ***Tamaricaceae***
21. Leaves well developed; herbs.....22
22. Sepals 2, connate at the base or free; leaves alternate or
opposite, often with stipular hairs; stamens as many as petals and
opposite to them or numerous, rarely fewer; capsule
circumcissile.....15. ***Portulacaceae***
22. Sepals 4-5, free or connate; leaves opposite, exstipulate or
with scarious stipules; stamens usually as many as
or twice as many as petals; capsule dehiscing by valves or teeth .....14. ***Caryophyllaceae***
23. Sepals unequal, inner ones usually larger, petaloid; ovary 2- celled;
petals usully 3, very unequal; seeds arillate or carunculate.....13. ***Polygalalceae***
23. Sepals and petals nearly equal and 5 each; seeds without aril
or caruncle.....24
24. Sepals imbricate; leaves opposite or verticillate.....25

24. Sepals valvate; leaves alternate, rarely opposite..... 26
25. Stipules present; stamens as many as or twice as many as
petals, alternate to them, free; flowers pink..... 17. ***Elatinaceae***
25. Stipules absent; stamens 5-30, in 2-5 fascicles or free,
antipetalous; flowers yellow..... 18. ***Hypericaceae***
26. Stamens monadelphous or polyadelphous..... 27
26. Stamens distinct; anthers dithecous..... 22. ***Tiliaceae***
27. Anthers monothecous; staminodes none..... 28
27. Anthers dithecous; staminodes often present..... 21. ***Sterculiaceae***
28. Stamens monadelphous; leaves simple; pollen rough..... 19. ***Malvaceae***
28. Stamens polyadelphous; leaves digitate; pollen smooth..... 20. ***Bombacaceae***
29. Placentation parietal; fruit a trigonous, elongated capsule..... 37. ***Moringaceae***
29. Placentation axile; fruit not as above..... 30
30. Styles 5, distinct..... 31
30. Styles more or less combined or solitary..... 32
31. Leaves simple..... 23. ***Linaceae***
31. Leaves compound..... 32
32. Leaves digitate; fruit a capsule; herbs..... 26. ***Oxalidaceae***
32. Leaves imparipinnate; fruit fleshy, indehiscent,
acutely 5- angled; trees..... 25. ***Averrhoaceae***
33. Leaves gland punctate..... 29. ***Rutaceae***
33. Leaves not gland punctate..... 34
34. Stamens monadelphous..... 31. ***Meliaceae***
34. Stamens not monadelphous..... 35
35. Herbs or herbaceous climbers..... 36
35. Trees or shrubs..... 40
36. Tendril climbers..... 37
36. Erect or straggling herbs, without tendrils..... 38
37. Stamens antipetalous; flowers actinomorphic,
reddish-brown; fruit a berry, 2-seeded..... 34. ***Vitaceae***
37. Stamens not antipetalou; flowers zygomorphic, white;
fruit an inflated capsule; seeds 3, with a heart shaped white aril..... 35. ***Sapindaceae***
38. Leaves pinnately compound; flowers actinomorphic
fruits spinous..... 24. ***Zygophyllaceae***
38. Leaves simple; flowers zygomorphic fruit unarmed..... 39
39. Leaves rounded, entire; ovary 3- carpellary; fruit 3- seeded,
indehiscent; strggling or prostrate herbs..... 27. ***Tropaeolaceae***
39. Leaves lanceolate, serrate; ovary 5- carpellary; fruit many
seeded, dehiscing explosively; erect herbs..... 28. ***Balsaminaceae***
40. Flowers unisexual or polygamous..... 41

40. Flowers bisexual or polygamous.....42
41. Fruit a drupe; stamen single.....36. ***Anacrdiaceae***
41. Fruit capsular or indehiscent; stamens 5- 10..... 35. ***Sapindaceae***
42. Leaves pinnate; leaflets dentate; fruit a samara..... 30. ***Simaroubaceae***
42. Leaves simple.....43
43. Stamens alternating with the petals, unarmed climbers.....32. ***Celastraceae***
43. Stamens antipetalous; spinous shrubs, trees or climbers.....33. ***Rhamnaceae***
44. Carpel single; fruit a pod or legume.....45
44. Carpels more than one; fruit otherwise.....47
45. Flowers actinomorphic; petals valvate;
stamens definite or numerous.....40. ***Mimosaceae***
45. Flowers zygomorphic; petals imbricate; stamens definite.....46
46. Corolla papilionaceous; odd petal outermost;
stamens diadelphous or rarely monadelphous.....38. ***Fabaceae***
46. Corolla not papilionaceous; odd petal innermost
in bud; stamens free.....39. ***Caeslapiniaceae***
47. Stamens usually indefinite.....48
47. Stamens definite, not more than ten.....52
48. Leaves reduced; plants succulent with jointed
phylloclades, armed.....49. ***Cactaceae***
48. Leaves well developed; plants not as above.....49
49. Gynoecium apocarpous; leaves stipulate.....41. ***Rosaceae***
49. Gynoecium syncarpous; leaves exstipulate.....50
50. Calyx free from the ovary.....51
50. Calyx more or less adnate to ovary; leaves opposite,
gland punctate, with intramarginal vein.....43. ***Myrtaceae***
51. Petals crumpled in bud; ovary 2-6 loculed.....44. ***Lythraceae***
51. Petals none; ovary 1-2 loculed; leaves opposite.....50. ***Aizoaceae***
52. Trees with suboppossite or alternate leaves; fruit
a drupe, leathery.....42. ***Combretaceae***
52. Herbs or herbaceous climbers.....53
53. Ripe carpels apocarpous (*Gisekia*) or syncarpous and then
plant body densely stellate hairy ((*Glinus*) or leaves whorled
(*Mollugo*) .....51. ***Molluginaceae***
53. Ripe carpels syncarpous.....54
54. Plants aquatic; petiole inflated; fruit with two spines.....46. ***Trapaceae***
54. Plants terrestrial or marshy, if aquatic, then fruit not spiny.....55
55. Tendrils present.....56
55. Tendrils absent.....57
56. Flowers bisexual; gynophore present.....48. ***Passifloraceae***

56. Flowers unisexual; gynophore absent.....47. ***Cucurbitaceae***

57. Flowers in simple or compound umbels; ovary 2- celled,
with a single ovule in each cell; aromatic plants.....52. ***Apiaceae***

57. Flowers solitary-axillary; ovary more than 2- celled,
ovules many; non- aromaric plants..... 45. ***Onagraceae***

58. Ovary inferior.....59

58. Ovary superior.....62

59. Inflorescence a capitulum; anthers syngenesious;
calyx reduced to pappus.....54. ***Asteraceae***

59. Inflorescence otherwise; anthers free; calyx well
developed.....60

60. Leaves opposite or whorled with inter- or
intrapetiolar stipules..... 53. ***Rubiaceae***

60. Leaves alternate, exstipulate..... 61

61. Amphibious herbs; flowers in compact, cylindrical spikes.....56. ***Sphenocleaceae***

61. Terrestrial herbs; flowers solitary or in panicled clusters.....55. ***Campanulaceae***

62. Leaves absent; twining stem- parasites.....71. ***Cuscutaceae***

62. Leaves present; plants non-parasitic.....63

63. Aquatic, insectivorous plants; leaves dissected into
capillary, bladder bearing segments.....74. ***Lentibulariaceae***

63. Terrestrial, non-insectivorous plants; leaves without bladders.....64

64. Leaves generally alternate.....65

64. Leaves generally opposite.....74

65. Flowers unisexual; stamens inserted on the receptacle; trees.....60. ***Ebenaceae***

65. Flowers bisexual; stamens inserted on the corolla.....66

66. Ovules numerous in each locule.....67

66. Ovules definite in each locule.....69

67. Placentation parietal.....68

67. Placentation axile; placenta swollen; calyx accrescent.....72. ***Solanaceae***

68. Floating herbs; petiole sheathing; corolla with a
longitudinal crest on inner side.....66. ***Menyanthaceae***

68. Rooted herbs; petiole not sheathing; corolla without
a longitudinal crest on inner side.....67. ***Hydrophyllaceae***

69. Flowers tetramerous; sepals and petals scarious; flowers
in dense spikes; leaves crowded towards the base;
seeds mucilaginous.....82. ***Plantaginaceae***

69. Flowers tetra- or pentamerous; sepals and petals not scarious.....70

70. Calyx covered with sticky glands; styles 5;
placentation free central.....57. ***Plumbaginaceae***

70. Calyx not as above; styles not 5; placentation otherwise.....71

71. Habit chiefly climbing or twining.....70. ***Convolvulaceae***
71. Habit erect or prostrate.....72
72. Herbs and under-shrubs.....73
72. Trees.....74
73. Prostrate herbs or under-shrubs with latex; style terminal; fruit capsular; hairs if present, not hispid.....70. ***Convolvulaceae***
73. Prostrate or erect herbs; style gynobasic; fruits of 4- seeded nutlets; hairs hispid.....68. ***Boraginaceae***
74. Milky latex present; corolla 4-9 lobed; fruit a berry.....59. ***Sapotaceae***
74. Milky latex absent; corolla 5- lobed; fruit a drupe of 4 nutlets.....69. ***Ehretiaceae***
75. Flowers actinomorphic; ovary of two carpels, occasionally 1 or 3.....76
75. Flowers zygomorphic; ovary of 2-4 carpels..... 81
76. Milky latx present; fruit a pair of follicles..... 77
76. Milky latex absent; fruit otherwise..... 79
77. Pollen distinct, not in pollinia; styles 2, united from the base forming a common style with a stigma; gynostegium absent.....62. ***Apocynaceae***
77. Pollen in pollinia ; styles 2, distinct in lower region, united in stigmatic region and bearing a single stigma; anthers united with the stigma forming a gynostegium.....78
78. Pollen masses granular; pollen carrier spathulate.....64. ***Periplocaceae***
78. Pollen masses waxy; pollen carrier slender.....63. ***Asclepiadaceae***
79. Stamens 2; anther lobes placed back to back; shrubs or woody climbers..... 61. ***Oleaceae***
79. Stamens 4 – 5; herbs..... 80
80. Stamens alternating with the petals; placentation parietal..... 65. ***Gentianaceae***
80. Stamens opposite to petals; placentation free central.....58. ***Primulaceae***
81. Trees; fruit an elongated capsule; seeds winged.....76. ***Bignoniaceae***
81. Herbs; fruits not elongated; seeds not winged.....82
82. Leaves scaly; root parasites..... 75. ***Orobanchaceae***
82. Leaves well developed; non parasitic or semiparasitic plants..... 83
83. Fruits spiny 84
83. Fruits not as above.....85
84. Placentation axile; spines straight.....77. ***Pedaliaceae***
84. Placentation parietal; spines hooked..... 78. ***Martyniaceae***
85. Flowers with extra-floral glands at the base of pedicels..... 77. ***Pedaliaceae***
85. Flowers without extra-floral glands at the base of pedicels..... 86
86. Style gynobasic; usually aromatic herbs..... 81. ***Lamiaceae***
86. Style terminal; usually non aromatic herbs..... 87
87. Bracts conspicuous; stem with swollen nodes..... 79. ***Acanthaceae***
87. Bracts minute or absent; stem without swollen nodes.....88

88. Ovules 1 or 2 in each cell; placenta not swollen.....80. ***Verbenaceae***
88. Ovules numerous; placenta swollen.....73. ***Scrophulariaceae***
89. Flowers all bisexual..... 90
89. Flowers unisexual or polygamous..... 97
90. Ovary superior.....91
90. Ovary inferior.....96
91. Leaves with ochreate stipules.....87. ***Polygonaceae***
91. Leaves without stipules..... 92
92. Trees; leaves divided, silvery beneath; flowers in secund,
showy racemes; seeds winged.....89. ***Proteaceae***
92. Herbs or shrubs..... 93
93. Perianth bract-like..... 94
93. Perianth not bract-like..... 95
94. Flowers bracteate, the bracts and perianth mostly scarious.....84. ***Amaranthaceae***
94. Flowers bractless, or if bracteate, the bracts not scarious;
perianth green.....85. ***Chenopodiaceae***
95. Herbs or shrubs, sometimes straggling; flowers in heads, cymes
or umbels; perianth tubular; bracts often petaloid, showy; stamens
circinately involute in bud; fruit enclosed by an anthocarpium or
surrounded by a non-accrescent basal portion of the perianth.....83. ***Nyctaginaceae***
95. Succulent twiners; flowers in spikes, racemes or panicles;
tepals petaloid, connate in the lower part; bracts and bracteoles
petaloid; not as above, dehiscing by pores.....86. ***Basellaceae***
96. Ovary 4-6 celled; non parasitic plants; perianth large,
dark-purple, zygomorphic; perianth S-shaped, mouth trumpet
shaped.....88. ***Aristolochiaceae***
96. Ovary 1-celled; partial stem parasites; perianth orange-red,
slightly curved, moth no trumpet shaped.....90. ***Loranthaceae***
97. Inflorescence a cyathium.....91. ***Euphorbiaceae***
97. Inflorescence otherwise.....98
98. Inflorescence a hypanthodium..... 93. ***Moraceae***
98. Inflorescence otherwise..... 99
99. Male and female flowers in catkins or spikes.....100
99. Flowers not in catkins or spikes.....103
100. Branches jointed, grooved; leaves reduced to teeth around each node;
fruits 1-seeded, crowded into a dry, woody cone; trees.....96. ***Casuarinaceae***
100. Branches neither jointed nor grooved; leaves well developed;
fruits not crowded into a cone.....101
101. Sap milky.....93. ***Moraceae***
101. Sap watery.....102

102. Herbs; seeds black, polished, not comose.....95. ***Urticaceae***

102. Trees; seeds comose.....97. ***Salicaceae***

103. Aquatic plants; leaves finely dissected..... 98. ***Ceratophyllaceae***

103. Terrestrial plants; leaves not as above..... 104

104. Ovary trilocular, with 1 or 2 ovules in each locule.....91. ***Euphorbiaceae***

104. Ovary unilocular..... 105

105. Aromatic herbs; leaves palmately divided; fruit an achene..... .94. ***Cannabinaceae***

105. Non aromatic trees; leaves simple; fruit a samara.....92. ***Ulmaceae***

106. Ovary inferior.....107

106. Ovary superior.....114

107. Aquatic plants.....99. ***Hydrocharitaceae***

107. Terrestrial plants.....108

108. Flowers zygomorphic; perianth distinguished into an outer calyx and an inner corolla; stamens 1 or rarely 5 or 6..... 109

109. Flowers actinomorphic or rarely zygomorphic; perianth 2- seriate; segments more or less alike; usually petaloid; stamens 6 or 3.....112

109. Placentation parietal; ovary unilocualr; one of the petals, lip or labellum, usually different from others, spurred; anther 1; androecium and gynoecium confluent in a column; ovary twisted.....100. ***Orchidaceae***

109. Placentation axile; ovary 3-celled; stamens 1- 6, distinct, free; petals equal; ovary not twisted; staminodes usually petaloid, conspicuous.....110

110. Inner perianth zygomorphic; stamens 5 or 6; staminodes absent, if present, then not petaloid, not conspicuous; large, rhizomatous herbs with pseudo-stems; inflorescence with large red spathes.....101. ***Musaceae***

110. Inner perianth actinomorphic; stamen 1; staminodes showy.....111

111. Anthers 2-celled; style tightly held between anther cells.....102. ***Zingiberaceae***

111. Anthers 1-celled; style quite free from the anther cells; stamen flat.....103. ***Cannaceae***

112. Dioecious twiners with warty bulbils; leaves cordate, multicostate; fruits winged.....106. ***Dioscoreaceae***

112. Flowers bisexual; plants erect; leaves mostly basal; stamens 6; flowers actinomorphic.....113

113. Inflorescence scapose, umbellate, subtended by an involucre of one or more spathaceous bracts; often flower solitary with a spathaceous bract .....104. ***Amaryllidaceae***

113. Inflorescence branched; perianth segments united up to the middle or more; leaves fleshy, spinous on margins.....105. ***Agavaceae***

114. Perianth absent or represented by scales (lodicules) or bristles; flowers (florets) sessile, highly reduced, in the axils of glumes or between 2 glumes (lemma and palea), arranged in spikelets..... 115

114. Perianth present, if absent, then flowers not enclosed
or subtended by glumes..... 116

115. Stem usually cylindrical with solid nodes and
hollow internodes; leaves 2-ranked; sheaths open in front;
ligule usually present; flowers enclosed by 2 glumes
(lemma and palea); styles usually 2, rarely 3 or 1..... 123. ***Poaceae***

115. Stems usually triangular, mostly solid; leaves 3- ranked
or absent; sheaths closed in front; ligules usually absent;
flowers enclosed by single glume; style 1, usually 2 or 3-fid..... 122. ***Cyperaceae***

116. Carpels free or connate at the base; mostly aquatic plants..... 117

116. Carpels united; ovary with more than one stigma..... 123

117. Flowers bracteate; carpels many..... 116. ***Alismataceae***

117. Flowers ebracteate; carpels 1-4, if 1, then with 1 stigma..... 118

118. Flowers in racemes or spikes..... 119

118. Flowers axillary, solitary or in cymes; submerged water plants..... 122

119. Flowers bisexual, in spikes..... 120

119. Flowers unisexual; anther appendages wanting; erect, tall
marshy herbs with 2-ranked leaves; male flowers above, female
below..... 121

120. Sepals 1-3; stamens 6 or more..... 117. ***Apomogetonaceae***

120. Sepals 4; stamens 4, anthers sessile..... 118. ***Potamogetonaceae***

121. Flowers in cylindrical spikes; perianth of slender hairs..... 112. ***Typhaceae***

121. Flowers in heads; perianth of green scales..... 113. ***Sparganiaceae***

122. Stems fragile; leaves dentate; male flowers with 1 stamen;
female flowers with 1 carpel..... 120. ***Najadaceae***

122. Stems tough; leaves not dentate; male flowers with 1-3 stamens;
female flowers with 1-9 free carpels..... 119. ***Zannichelliaceae***

123. Perianth distinguished into an outer calyx and an inner petaloid
corolla; segments free to the base if hyaline..... 124

123. Perianth – segments alike, conspicuous. petlaoid or
sepaloid in 2 or 1 series..... 126

124. Flowers in heads, surrounded by involucral bracts,
unisexual; perianth hyaline..... 119. ***Eriocaulaceae***

124. Flowers not in heads, unisexual or bisexual; invoucral
bracts absent; perianth otherwise..... 125

125. Trees; stem covered with dry, woody leaf bases; leaves plicate;
flowers small in large panicles, subtended by large
spathaceous bracts..... 109. ***Arecaceae***

125. Herbs; stems not as above, jointed; leaves not plicate; sheath
completely enclosing the stem; inflorescence solitary or cymose;

flowers large; fruit capsular.....107. ***Commelinaceae***

126. Perianth sepaloid or dry and glumaceous, very small and
inconspicuous, rarely absent.....127

126. Perianth petaloid.....129

127. Flowers bisexual; perianth without spathaceous but glumaceous
leaf-like bracts; grass-like plants.....108. ***Juncaceae***

127. Flowers unisexual; inflorescence with a spathaceous bract;
plants not grass like.....128

128. Free floating, small, aquatic herbs; plant body thallus like..... .113. ***Lemnaceae***

128. Terrestrial herbs; leaves basal, long petioled;
inflorescence a spadix.....112. ***Araceae***

129. Aquatic or occasionally swampy herbs; petiole inflated;
inflorescence subtended by a sptahe like leaf sheath;
flowers zygomorphic..... 106. ***Pontederiaceae***

129. Terestrial plants; petiole not inflated; inflorescence without
spathe like leaf sheath; flowers actinomorphic.....105. ***Liliaceae***

CHAPTER - 5

FLORA OF HASTINAPUR WILDLIFE SANCTUARY

1. RANUNCULACEAE

RANUNCULUS L.

Key to species:

1. Flowers white..... 3. ***R. trichophyllus***
1. Flowers yellow..... 2
2. Plant body glabrous..... 2. ***R. sceleratus***
2. Plant body hairy..... 1.***R. cantoniensis***

1. Ranunculus cantoniensis DC. Prodr. 1: 43. 1824; Fl. India 1:117.1993. *R. pensylvanicus* sensu Hook. f. FBI. 1: 19. 1872, *non* L. f. 1781.

Annual, erect, hairy herbs. Radical leaves 3-foliate. Flowers light yellow, solitary. Achenes in globose or oblong heads, compressed, shortly beaked, receptacle pilose. **Flowering and fruiting:** March - December. Occurs on moist sandy soil on the banks of Ganga and other moist localities. Unlike *R. sceleratus*, this species is not found in aquatic habitats. Sweta 787.

2. Ranunculus sceleratus L. Sp. Pl. 551.1753; FBI. 1: 19. 1872; FUGP. 1: 21. Repr.ed.1960; Fl. India 1:128.1993.

Erect glabrous, succulent annual herb, 30-50 cm high. Stem branched, fistular, ribbed. Radical leaves long petioled, cuneate, obovate; cauline leaves short petioled, linear. Flowers sulphur yellow in terminal cymes. Calyx reflexed. Achenes many, oblong, obliquely obovate. **Flowering & Fruiting:** March-June. **Local Name**: *Jaldhania.* Occurs throughout in the wet and the marshy places. Sweta 418.

3. Ranunculus trichophyllus Chaix in Vill. Hist. Pl. Dauph. 1: 335. 1786; Fl. India 1:130.1993. *R. aquatilis* L. var. *trichophyllus* Hook. f. & Thoms. FBI. 1: 16. 1872.

A white-flowered, aquatic herb. Included on authority of Murty & Singh (1961b). **Note:** According to Rau (1993) this species is a denizen of high altitudes occuring between 3500-4500 m, therefore, its occurrence at Hastinapur Wildlife sanctuary is doubtful.

2. ANNONACEAE

KEY TO GENERA:

1. Large straight trees; leaves with undulated margins;
   flowers in large drooping panicles; fruiting carpels stalked.....2. ***Polyalthia***

2. Small trees or shrubs; leaves with entire margins;
flowers on short branchlets; fruiting carpels not stalked..... 1. ***Annona***

1. ANNONA L.

Annona squamosa L. Sp. Pl. 537. 1753; FBI. 1: 78. 1872; FUGP. 1: 25. Repr. ed. 1960; Fl. India 1: 207.1993.

Evergreen shrubs or small trees. Leaves up to 10.0 cm long, oblong-lanceolate or elliptic. Flowers solitary, yellowish-green. Fruits globosely, pulp white. Seeds black, polished. **Flowering and fruiting:** Commonly planted in orchards and kitchen gardens for the sake of delicious fruits. Sweta 957.

2. POLYALTHIA Blume

Polyalthia longifolia (Son.) Thaw. Enum. Pl. Zeal. 398. 1864; FBI. 1: 62. 1872; FUGP. 1: 25. Repr. ed. 1960; Fl. India 1: 274. 1993. *Ovarian longifolia* Son. Voy. Ind. Or. 2: 223. t. 131. 1782.

A tall straight, evergreen tree with long pendulous branches. Leaves lanceolate, margins undulate. Flowers in pendulous panicles. Fruiting carpels stalked, purple on ripening. **Flowering and fruiting:** April- June. Commonly planted as an avenue tree. Sweta 958.

3. MENISPERMACEAE

KEY TO GENERA:

1. Large climbers with aerial roots; stems with numerous
lenticels; leaves cordate; flowers appearing before the leaves..... 3. ***Tinospora***
1. Slender climbers, aerial roots absent;
stems without or with few lenticels; flowers appearing with the leaves.... 2
2. Leaves peltate; filaments united; carpel solitary..... 1. ***Cissampelos***
2. Leaves not peltate; filaments free; carpels 3..... 2. ***Cocculus***

1. CISSAMPELOS L.

Cissampelos pareira L. Sp.Pl. 1031. 1753.

var. **hirsuta** (Buch.–Ham. ex DC.) Forman in Kew Bull. 22: 356. 1968; Fl. India 1:317.1993. *C. hirsuta* Buch.-Ham. ex DC. Syst. Nat. 1: 535. 1817. *C. pareira auct.* non L. 1753; *sensu* Hook. f. & Thoms. in FBI. 1: 103. 1872; FUGP. 1: 31.Repr.ed.1960.

Slender, twining, dioecious herbs. Leaves peltate, alternate, orbicular or reniform, cordate or truncate at base, apiculate, hairy. Flowers greenish-yellow; male flowers in axillary cymes; female flowers in pendulous racemes. Male bracts linear. Female bracts ovate-cordate to

reniform. Drupe subglobose, red when ripe. **Flowering and fruiting:** June-November. Common among the hedges. Sweta 300.

2. COCCULUS DC. *nom. cons.*

Cocculus hirsutus (L.) Diels in Engl. Pflanzenr. 46: 236. 1910; Fl. India 1: 318.1993. *Menispermum hirsutum* L. Sp. Pl. 341. 1753. *Cocculus villosus* DC. Syst. Nat. 1: 525. 1817; FBI. 1: 101. 1872; FUGP. 1: 29. Repr.ed.1960.

Scandent, dioecious shrubby-herbs. Leaves alternate upto 5.0 cm long, ovate-oblong, cordate-lanceolate or subdeltoid. Flowers small, yellowish-green. Male flowers in axillary, cymose panicles; female flowers in axillary clusters. Drupes smooth, reddish-purple. Seeds transeversely rugose, black. **Flowering and fruiting:** August- June. Common throughout the Sanctuary, growing among the hedges or trailing on the ground in *Kholas*. Plants growing in relatively dry environment of the *Kholas* are stunted, more woody at the base and bear smaller leaves. Sweta 786.

3. TINOSPORA Miers

Tinospora cordifolia (Willd.) Hook. f & Thomson Fl. Ind. 184. 1855 & in FBI. 1: 97. 1872; FUGP.1: 27. Repr. ed. 1960; Fl. India 1: 347.1993. *Menispermum cordifolium* Willd. Sp. Pl. 4: 826. 1806.

Large, deciduous, glabrous climbers, aerial roots long, hanging. Leaves petiolate upto 15.0 cm long, broadly ovate, cordate, acute or apiculate, nerves prominent. Flowers in axillary racemes appear before the emergence of new leaves, yellow; male ones fascicled; female ones solitary. Stamens 6. Female flowers with 6 staminodes. Drupe globose, red. **Flowering and fruiting:** March- June. Common in the area, climbing on large trees and among the hedges. Sweta 959.

4. NYMPHAEACEAE

NYMPHAEA L. *nom. cons.*

Key to species:

1. Stamens with apical, sterile appendages..... 1. ***N. nouchali***
1. Stamens without apical, sterile appendages..... 2. ***N. pubescens***

1. Nymphaea nouchali Burm.f. Fl. Ind. 120.1768; Fl. India 1: 430. 1993. *N. stellata* Willd. Sp. Pl. 1153. 1799; Wight, Ic. 1: t. 178. 1839; FBI. 1: 114. 1872; FUGP. 1: 34. Repr.ed.1960.

Aquatic herbs. Leaves deeply cordate, sharply toothed, suborbicular, floating on water surface. Flowers white with cream or yellow center, solitary. Sepals ribbed, petals oblong,

white. Anther appendages white. Stigmatic appendages none. Fruit globose; seeds broadly ellipsoidal. **Flowering & fruiting**: August-October. Common in ponds, ditches and near banks of Ganga during the rainy season. Sweta 535.

2. Nymphaea pubescens Willd. Sp. Pl. 2: 1154. 1798; Fl. India 1: 431. 1993. *N. lotus auct.* non L. (1753); FBI. 1: 114. 1872, *uterque* p. p. *N. lotus* var. *pubescens* (Willd.) Hook f. & Thomson in FBI. 1: 114. 1872; FUGP. 1: 34. Repr.ed.1960.

Aquatic herbs with ovate-elliptic or orbicular leaves, dentate, glabrous above and pubescent beneath. Flowers white with yellowish tinge, up to 12.0 cm across. Sepals ovate lanceolate, subacute or obtuse, 5-9 veined outside, white inside. Petals 10-25. Stamens yellow, numerous. Stigamtic appendages up to 1.0 cm long, yellow. **Flowering and fruiting:** August-December. Found in ponds and ditches. Sweta 338.

5. NELUMBONACEAE

NELUMBO Adans.

Nelumbo nucifera Gaertn. Fruct. Sem. Pl. 1:73. t. 19. f. 2. 1788; Fl. India 1: 441. 1993. *Nelumbium speciosum* Willd. Sp. Pl. 2: 1258. 1799; FBI. 1:116.1872; FUGP. 1: 35. Repr. ed. 1960.

Large handsome, aquatic herbs with milky juice and horizontal creeping root stock. Leaves 20-80 cm, usually raised above the water surface, shallowly notched, glabrous, glaucous, dark green above, pale beneath. Flowers rose-pink, fragrant. Anthers orange. Receptacle spongy, yellow during anthesis, turns green later and finally become dark green. Seeds ovoid, glabrous, black. **Flowerig & Fruiting**: June-October. **Local Name:** *Kamal*. Found in ponds and swampy areas. Sweta 961.

6. PAPAVERACEAE

ARGEMONE L.

Key to species:

1. Flowers light yellow; style 1-3 mm long..... 2. ***A. ochroleuca***
1. Flowers sulphur yellow, style minute or none..... 1. ***A. mexicana***

1. Argemone mexicana L. Sp. Pl. 508. 1753.; FBI. 1: 117. 1872; FUGP. 1: 37. Repr. ed. 1960, *pro parte*; Fl. India 2: 2.1993.

forma **mexicana**

Prickly, erect, robust herbs with yellow sap. Leaves 7-15 cm long, sessile, amplexicaul, spiny on margins and veins, bluish green especially on veins, sinuate -pinnatifid. Flowers yellow, solitary terminal, subtended by leafy bracts at the base. Stigmas red. Capsule erect, spinous.

Seeds numerous, black. **Flowering and fruiting:** February-October. Common in shady areas. Local Name: *Kateli, Satyanasi*. Sweta 670.

2. Argemone ochroleuca Sweet, Brit. Fl. Gard. 3: t. 242.1829; Fl. India 2: 5.1993.

Erect prickly robust annual herbs. Leaves sessile, spiny, sinuate- pinnatified, glaucous.Flowers cream or light-yellow, solitary, terminal sessile. Stigmas narrow, spreading widely. Capsule covered with spines.**Flowering and fruiting:**Throught out the year.Found commonly in fallow land and on road sides. Sweta 8.

According APG-2 this genus belongs to tribe Papavereae of subfamily Papaveroideae.

7. FUMARIACEAE

FUMARIA L.

Fumaria indica (Haussk.) Pugsley in Journ. L. Soc. 44: 313.1919; Fl. India 2: 84. 1993. 1999. *Fumaria vaillantii* Loisel.var. *indica* Haussk.in Flora 56: 443.1873. *Fumaria parviflora* Lamk. subsp. *vaillantii* (Loisel.) Hook. f. & Thoms. in FBI. 1: 128. 1872, *p. p.*; FUGP.1: 37.Repr. ed. 1960.

Much branched, diffuse annual herbs. Leaves finely dissected, segments linear -lanceolate, flat. Flowers pinkish to purplish. Sepals 2. Petals 4. Stamens in two phallanges. Fruit globular indehiscent, 1-seeded. **Flowering and fruiting:** November-February. Occurs commonly in cultivated fields. Sweta 587.

Note: According APG-2 this genus belongs to tribe Fumarieae, subfamily Fumarioideae and family Papaveraceae.

8. BRASSICACEAE

KEY TO GENERA:

1. Pods wider than long..... 2
1. Pods longer than wide..... 3
2. Prostrate herbs; leaves pinnately dissected;
   pods didymous, indehiscent.....4. ***Coronopus***
2. Erect herbs; leaves not dissected;
   pods triangular or orbicular..... 2. ***Capsella***
3. Leaves 2-3 pinnatisect.....5. ***Descurainia***
3. Leaves not as above..... 4
4. Flowers white.....5
4. Flowers yellow..... 7
5. Plants aquatic; rooting at the lower nodes..... 6. ***Nasturtium***
5. Plants terrestrial.....6

6. Leaves simple; cotyledons incumbent..... 1. ***Arabidopsis***

6. Leaves pinnate; cotyledons accumbent..... 3. ***Cardamine***

7. Seeds biseriate or sub-biseriate in fruit..... 7. ***Rorippa***

7. Seeds 1-seriate in fruit..... 8. ***Sisymbrium***

1. ARABIDOPSIS Heynh.

Arabidopsis thaliana (L.) Heynh. in Holl & Heynh. Fl. Sachs. 1: 538. 1842; Fl. India 2: 231. 1993. *Arabis thaliana* L. Sp. Pl. 665. 1753. *Sisymbrium thalianum* (L.) J. Gay & Monn. Ann. Sci. Nat. Paris Ser. 1. 7: 399. 1826; FBI. 1: 148. 1872; FUGP. 1: 41. Repr. ed. 1960.

Erect, slender, annual herbs. Basal leaves in a rosette, obovate or oblanceolate-spathulate, entire or finely dentate. Flowers white, pedicels 1.0-1.5 cm long. Petals longer than the sepals. Stamens 4. Pods linear upto 2.0 cm long; glabrous, shortly beaked. Seeds reddish-brown. **Flowering and fruiting:** January- June. Common in agricultural fields and in moist and shady places in *Kholas*. Sweta 746.

Note: According APG-2 this genus is synonymous with *Arabis* L.

2. CAPSELLA Medik. *nom. cons.*

Capsella bursa-pastoris (L.) Medik. Pflanzengatt. 1: 85. 1792; FBI. 1: 159. 1872; FUGP. 1: 46. Repr. ed 1960; Fl. India 2: 189. 1993. *Thalaspi bursa-pastoris* L. Sp. Pl. 647. 1753.

Erect, annual herbs; hairs simple or branched. Radical leaves upto 8.0 cm long, oblong or oblanceolate, toothed; cauline leaves hastate. Racemes upto 20.0 cm long. Flowers white. Pods glabrous, deltoid, notched at the apex. **Flowering and fruiting:** December-May. Occasionally found in grassy localities and agricultural fields. Sweta 962.

3. CARDAMINE L.

Cardamine impatiens L. Sp. Pl. 655. 1753; FBI. 1: 138. 1872; FUGP. 1: 40. Repr. ed. 1960; Fl. India 2: 114. 1993.

Annual herbs. Leaves crowded at base, pinnate, auricled, sparsely hairy or fringed with bristles. Inflorescence erect, racemose or somewhat sub-corymbose. Flowers white. Style very short, stigma globose. Fruit erect, linear, flat, valves with distinct midrib. Seeds many oval or ellipsoid, reddish-brown. **Flowering and fruiting:** January- April. Often found in nurseries. Sweta 960.

4. CORONOPUS L. *nom. cons.*

Coronopus didymus (L.) J. E. Smith Fl. Brit. 2: 691. 1800; Fl. India 2: 192. 1993. *Lepidium didymus* L. Syst. 2: 433. 1754. *Senebiera pinnatifida* DC. Mem. Soc. Hist. Nat. Paris 144. t. 9. 1799; FUGP. 1: 46. Repr. ed. 1960.

Small, prostrate, slightly hispidly hairy herbs. Leaves pinnately dissected, lobes spreading. Flowers pale-green, minute, in racemes. Stamens 2. Pods 1 x 2 mm, separating into 2, indehiscent transversely reticulate lobes. Seeds 2, reniform, brownish. **Flowering and fruiting:** December-April. Commonly found in moist and shady places and also as weed in crop fields. Sweta 584.

5. DESCURAINIA Webb. & Benth. *nom. cons.*

Descurainia sophia (L.) Webb. ex Prantl. in Engl. & Prantl. Pfalnzenf. 3. 2: 192. 1891; Fl. India 2: 236. 1993. *Sisymbrium sophia* L. Sp. Pl. 659. 1753; Khan et al., Journ. Sci. Res. 7(1): 41. 1985.

Erect, sparsely pubescent herbs. Leaves 2-3 pinnatisect, lobes narrowly linear. Flowers light yellow, in racemes. Fruits spreading or erect, subtorulose, valves 1-veined. Seeds reddish brown. **Flowering and fruiting:** Rainy season. Occurs in moist sandy soil. This taxon was reported by Khan et al. (1985) from Bijnor, therefore, its occcurence in the study area can not be ruled out.

6. NASTURTIUM R. Br. *nom. cons*

Nasturtium officinale R. Br. in W. Ait. Hort. Kew. ed. 2. 4: 111. 1812; FBI. 1: 133. 1872; FUGP. 1: 39. Repr. ed. 1960; Fl. India 2: 125. 1993. *Rorippa nasturtiu -aquaticum* (L.) Hayek in Sched. Fl. Stir. Exs. 22. 1905; Hochr. Candollea 2: 368. 1925. *Sisymbrium nasturtium-aquaticum* L. Sp. Pl. 657. 1753.

Aquatic or semi-aqauatic, annual herbs. Stems creeping, rooting profusely at the lower nodes. Leaves imparipinnate, leaflets 5-9, ovate-orbicular. Flowers white. Petals nearly twice the length of sepals. Pods patent, slightly curved upward, upto 2.0 cm long including beak. Seeds 2-seriate, ovoid rounded, rugose. **Flowering and fruiting:** December-June. Commonly found on margins of ponds and ditches and banks of the river Ganga. Sweta 644.

Note: According to APG-2 the accepted for this genus is *Rorippa* Scopoli.

7. RORIPPA Scop.

Rorippa montana (Hook. f. & Thomson) Small Fl. SE United States ed. 2: 1336. 1913; Fl. India 2: 131.1993. *Nasturtium montanum* Hook. f. & Thomson in J. Proc. Linn. Soc. Bot. 5: 139. 1861.

Erect, glabrous or slightly hairy herbs. Basal leaves petiolate, obovate-oblong, sinuate-pinnatifid; lower leaves very variable. Racemes 8-15 flowered. Fruits slender, cylindric, not beaked.Included on authority of Murty & Singh (1961b).

8. SISYMBRIUM L.

Sisymbrium irio L. Sp. Pl. 659. 1753; FBI. 1: 150. 1872; FUGP. 1: 42. Repr. ed. 1960; Fl. India 2: 243. 1993.

Erect, annual herbs, usually glabrous. Radical leaves petiolate, pinnatipartite, cauline ones runcinate or pinnatifid. Flowers yellow in corymbose racemes. Pods upto 6.0 cm long, slender ascending, glabrous. Seeds oblong, light-brown. **Flowering and fruiting:** December- April. Occasionally found on rodsides near villages. Sweta 963.

9. CLEOMACEAE

CLEOME L.

Key to species:

1. Flowers white or pinkish, androgynophore well developed.....1. ***C. gynandra***
1. Flowers yellow, androgynophore not well developed.....2. ***C. viscosa***

1. Cleome gynandra L. Sp. Pl. 671. 1753; Fl. India 2: 309.1993. *C. pentaphylla* L. Sp. Pl. ed. 2. 938. 1763, *nom. illegit.* based on *C. gynandra* L. *Gynandropsis pentaphylla* (L.) DC. Prodr. 1: 238. 1824; FBI. 1: 171. 1872; FUGP 1: 49. Repr. ed. 1960.

var. **gynandra**

Erect, gland-hairy, pungent smelling, annual herbs. Leaves 3- 5 foliolate, elliptic-obovate or elliptic-lanceolate, subentire. Flowers pinkish-white in long terminal racemes. Stamnes 6 with long filaments. Capsule linear-cylindric, gland pubescent, striated, many seeded. Seeds black-brown, with concentric ribs and irregular cross-ribs. **Flowering and fruiting:** September-December. Found in wastelands and cultivated fields. Sweta 964.

2. Cleome viscosa L. Sp. Pl. 672. 1753; FBI. 1: 170. 1872; FUGP 1: 48. Repr. ed. 1960; Fl. India 2: 317.1993.

Erect glandular-hairy annual herbs with foetid smell. Leaves 3-5 foliolate; elliptic- oblong or obovate. Flowers in lax, leafy racemes. Petals yellow, unequal. Capsule upto 10 cm long, glandular hairy, glands black. Seeds many, reniform, with faint concentric ribs and strong cross-ribs, dark-brown to black. **Flowering and fruiting:** August- December. Common in sandy soil, often forms dense patches. Sweta 969.

10. CAPPARACEAE

KEY TO GENERA:

1. Plants with hooked spines.....1. ***Capparis***
1. Plants without hooked spines.....2
2. Leaves simple; sepals fused.....3. ***Maerua***
2. Leaves palmate; sepals free.....2. ***Crataeva***

1. CAPPARIS L.

Key to species:

1. Leafless shrubs or small trees; flowers red, zygomorphic.....1. ***C. decidua***
1. Leafy shrubs or climbers; flowers actino- or subzygomorphic.....2
2. Younger parts ferruginous; flowers pink; climbers..... 3. ***C. zeylanica***
2. Younger parts, not ferruginous; flowers pure cream in colour; erect or subscandant shrubs .....2. ***C. sepiaria***

1. Capparis decidua (Forssk.) Edgew. in Journ. Linn. Soc. Bot. 6: 184. 1862; Fl. India 2: 265.1993. *Sodala decidua* Forssk., Fl. Aegypt.-Arab. 81. 1775. *C. aphylla* Roth, Nov. Pl. Sp. Ind. Or. 238. 1821; Hook. f. & Thoms. in Hook. f. FBI. 1: 174. 1872; FUGP. 1: 51. Repr. ed. 1960.

Extensively branched shrubs or small trees; branches glabrous. Leaves early deciduous. Flowers deep red, zygomorphic in corymbose racemes or in fascicles. Berries ovoid, many seeded, red when ripe. **Flowering and fruiting:** April-June. Occasionally occurs in dry sandy habitats. Sweta 975.

2. Capparis sepiaria L. Syst. Nat. ed. 10. 2: 1071. 1759; FBI. 1: 177. 1872, incl. vars.; FUGP. 1: 52. Repr. ed. 1960; Fl. India 2: 289.1993.

Sub-scandent or erect shrubs with zigzag branches. Leaves ovate, elliptic, oblong or oblong-lanceolate, sub-acute to retuse. Flowers white or cream in umbellate, terminal inflorescence. Petals unequal. Berries 1-seeded, black when ripe. **Flowering and fruiting:** May-July. Common in *Kholas.* Sweta 904.

3. Capparis zeylanica L. Sp.Pl. ed. 2. 720. 1762; FBI. 1: 174. 1872; Fl. India 2: 298.1993. *C. horrida* L. f. Suppl. 264. 1781; FBI. 1: 174. 1872; FUGP 1: 52. Repr. ed. 1960.

This taxon can be readily distinguished from other species of *Capparis* by its climbing habit, ferruginous younger parts and flower buds and flowers suffused with pink. **Flowering and fruiting:** March-June. Commonly found climbing on trees in *Kholas* and on roadsides. Sweta 731.

2. CRATEVA L.

Crateva magna (Lour.) DC. Prodr. 1: 243. 1824; Fl. India 2: 324. 1993. *Capparis magna* Lour. Fl. Cochinch. 1: 331. 1790. *Crateva nurvala* Buch.-Ham. in Trans. Linn. Soc. 15: 121. 1827. *C. religiosa* var. *nurvala* (Buch.- Ham.) Hook. f. & Thoms. FBI. 1: 172. 1872; *C. religiosa* auct. non Forster f. 1786.

Shrubs or medium sized trees. Leaves palmately trifoliate. Flowers creamy, polygamous, in terminal corymbs. Gynophore 4.0 –6.0 cm long. Stamens many, filaments long. **Flowering and fruiting:** April- October. Included on authority of Murty and Singh (1961b).

3. MAERUA Forssk.

Maerua oblongifolia (Forssk.) A. Rich. Tent. Fl. Abyss. i. 32. t. 5. 1847; Fl. India 2: 331. 1993. *Capparis oblongifolia* Forssk. Fl. Aegypt.- Arab. 99. 1775. *Niebuhria arenaria* DC. Prodr. 1: 24. 1824. *Maerua arenaria* (DC.) Hook. f & Thoms. FBI. 1: 171. 1872 (incl. vars. *glabra* and *scabra*); FUGP. 1: 50. Repr. ed. 1960.

Scandent shrubs. Leaves simple, ovate, elliptic-oblong or lanceolate. Corymbs axillary, dense. Flowers greenish-yellow or white. Stamens up to 25. Gynophore up to 2.5 cm long. Berries moniliform or cylindric. **Flowering and fruiting:** Nearly round the year. Included on authority of Murty and Singh (1961b).

11. VIOLACEAE

HYBANTHUS Jacq.

Hybanthus enneaspermus (L.) Muell. Fragm. Phyt. Aust. 10: 81. 1876; Fl. India 2: 343. 1993. *Viola enneasperma* L. Sp. Pl. 937. 1753. *Ionidium heterophyllum* Vent. Jard. Malm. t. 27. 1803; FUGP. 1: 54. Repr. ed. 1960. *I. suffruticosum* (L.) Roem. & Schult. Syst. Veg. 5: 394. 1819; Wight Ic. 1: t. 308. 1840; FBI. 1: 185. 1872.

Erect or diffuse, suffruticose herbs. Leaves linear or lanceolate, subsessile, serrate. Stipules gland tipped. Flowers solitary, red or pink, zygomorphic, one petal clawed. Capsule ovoid or subglobose. Seeds numerous, striated, pale-yellow. **Flowering and fruiting:** July-November. Occasionally found in moist grassy localities. Sweta 994.

12. FLACOURTIACEAE

KEY TO GENERA:

1. Armed shrubs or small trees; flowers unisexual..... 2. ***Flacourtia***
1. Unarmed trees; flowers bisexual..... 1. ***Casearia***

1. CASEARIA Jacq.

Key to species:

1. Mature leaves hairy, at least along midrib and veins beneath..... 2. ***C. tomentosa***
1. Mature leaves glabrous..... 1. ***C. graveolens***

1. Casearia graveolens Dalz. in Hook. J. Bot. 4: 107. 1852; FBI. 2: 592. 1879; FUGP. 1: 330. Repr. ed. 1960; Fl. India 2: 394. 1993.

Medium sized, deciduous trees. Leaves up to 20 x 12 cm, elliptic to elliptic-oblong, shallowly crenate, coraiceous, glabrous. Flowers greenish, foetid smelling, in dense axillary clusters. Filaments glabrous, staminodes shorter than the stamens, hairy. Stigma capitate. Capsule ellipsoid, up to 2.0 cm long, orange-yellow when ripe. **Flowering and fruiting:** March-August. Occasionally found in *Kholas.* Sweta 975.

2. Casearia tomentosa Roxb. Fl. Ind. 2: 421. 1832; FBI. 2: 593. 1879; FUGP. 1: 330. Repr. ed. 1960; Fl. India 2: 397. 1993. *C. elliptica* Willd., Sp. Pl. 628. 1799, *nom. superfl.* (based on *A. lanceolata* Lamk.); Fl. Raj. 1: 93. 1987.

Small trees up to 6.0 m tall; branches tomentose or pubescent. Leaves ovate-lanceolate, coarsely serrate or subentire, up to 15.0 cm long, mature ones sub-coriaceous, softly tomentose. Flowers small, greenish in axillary condensed fascicles. Stigma discoid. Capsules up to 2.5 cm long, ellipsoid. **Flowering and fruiting:** March- September. Found in *Kholas.* Sweta 970.

2. FLACOURTIA L' Herit.

Flacourtia indica (Burm. f.) Merr. Interpr. Rumph. Herb. Amb. 377. 1917; Fl. India 2: 402. 1993. *Gmelina indica* Burm. f. Fl. Ind. 132, t. 39, f. 5. 1768. *Flacourtia sepiaria* Roxb. Pl. Corom. 1: 48. t. 68. 1796; FBI. 1: 194. 1872; FUGP. 1: 57. Repr. ed. 1960. *F. ramontchii* L' Herit. Strip. Nov. 3: 59. t. 30. & 30B. 1786; FBI. 1: 193. 1872, *pro maj. parte* excl. var. *latifolia;* FUGP. 1: 57. Repr. ed. 1960.

Shrubs or small dioecious trees, branches thorny. Leaves obovate, ovate, oblong or suborbicular, cuneate, obtuse or emarginate, coarsely dentate. Flowers yellowish-green, in short, few flowered, axillary or terminal racemes. Stamens numerous, anthers versatile. Ovary globular, with 3-6 radiating, thick styles. Berries sub-globose, 5-10 mm across, purple or red, seeds trigonous, pale-yellow to brown. **Flowering and fruiting:** March-August. **Local name:** *Kango.* Common in *Kholas.* Sweta726.

Note: In APG-2 both *Casearia* and *Flacourtia* have been transferred to the Family Salicaceae.

13. POLYGALACEAE

POLYGALA L.

Key to species:

1. Flowers yellow.....2. ***P. erioptera***

1. Flowers pink.....1. ***P. arvensis***

1. Polygala arvensis Willd. Sp. Pl. ed. 3. 2: 876. 1803; Fl. India 2: 460. 1993. *P. chinensis auct. pl.* non L. 1753; FBI. 1: 204. 1872 *p. p.*

Erect or decumbent-ascending annual herbs. Leaves subsessile, oblanceolate to lanceolate. Racemes 1-10 flowered. Outer sepals ovate, sharply acuminate; wings falcate. Petals obovate 4.0 mm long; keel with a bearded crest. Capsule broadly oblong-orbicular, notched at the apex, narrowly winged, ciliate. Seeds black, patently hairy, 4.0 mm long. **Flowering and fruiting:** July-November. Found in grassy localities in *Kholas.* Sweta 978.

2. Polygala erioptera DC. Prodr. 1: 326. 1824; FBI. 1: 203. 1872; FUGP. 1: 60. Repr. ed. 1960; Fl. India 2: 467. 1993.

Erect or decumbent, annual herbs. Leaves obovate, obcordate or narrowly linear. Flowers in racemes, shortly pedicelled. Petals 3-lobed, middle lobe keeled. Fruit ovate, notched at the apex, pubescent; seeds densely hairy, strophiole with 3 membranous appendage. **Flowering and fruiting:** August-December. Common in *Kholas.* Sweta 1126.

14. CARYOPHYLLACEAE

KEY TO GENERA:

1. Leaves linear..... 2
1. Leaves broad..... 3
2. Inflorescence silvery-white; sepals scarious..... 2. ***Polycarpaea***
2. Inflorescence not silvery-white; sepals herbaceous..... 5. ***Spergula***
3. Stipules present, scarious..... 3. ***Polycarpon***
3. Stipules none..... 4
4. Calyx polysepalous; flowers white..... 5
4. Calyx gamosepalous; flowers pink..... 6
5. Petals deeply bi-lobed..... 6. ***Stellaria***
5. Petals entire..... 1. ***Arenaria***
6. Calyx 5-nerved; petals without basal scales..... 7. ***Vaccaria***
6. Calyx usually 10-nerved and petals with 2 basal scales..... 4. ***Silene***

1. ARENARIA L.

Arenaria serpyllifolia L. Sp. Pl. 423. 1753; FBI. 1: 239. 1874; FUGP. 1: 63. Repr. ed. 1960; Fl. India 2: 515. 1993.

Sub erect, glandular, hairy, annual, tufted herbs. Leaves ovate or ovate- elliptic, sessile. Flowers solitary, axillary and in terminal cymes, white. Styles 3-4. Capsule 6-valved. Seeds reniform, tubercled, brown to black. **Flowering and fruiting:** January-June. Found in moist places especially on sandy soil. Sweta 973.

2. POLYCARPAEA Lamk. *nom.cons.*

Polycarpaea corymbosa (L.) Lamk. Tabl. Encycl. 2: 129.1797; FBI. 1: 245.1874; FUGP. 1: 65. Repr. ed. 1960; Fl. India 2: 549. 1993. *Achyranthes corymbosa* L. Sp. Pl. 205. 1753.

var. **corymbosa**

Erect much branched herbs with purplish white branches. Leaves linear, whorled, stipulate. Flowers white or pinkish, silvery-white when mature. Sepals chaffy, silvery. Stamens 5, style 1. Capsule 3-valved, seeds minute, pale-brown. **Flowering and fruiting:**August-November. Mostly found on sandy soil, especially in *Kholas*. Sweta 347.

3. POLYCARPON L.

Polycarpon prostratum (Forssk.) Aschers. & Schweinf. in Oesterr. Bot. Zeitschr. 39: 128. 1889; Fl. India 2: 553. 1993. *Alsine prostrata* Forssk. Fl. Aegypt. - Arab. 207. 1775, *non* Del. 1813. *Polycarpon loeflingiae* (Wight & Arn.) Benth. & Hook. f. Gen. Pl. 1: 153. 1862; FBI. 1: 245. 1874; FUGP. 1: 65.Repr. ed. 1960.

Prostrate, dichotomously branched glabrous herbs. Leaves ovate-lanceolate, opposite, seemingly whorled, shortly petioled. Flowers small, in dense dichotomous cymes. Sepals keeled, Petals white, notched. Stamens 3. Capsule ovoid. **Flowering and fruiting :** June-October.Found in moist habitats. Sweta 77, 888.

4. SILENE L.

Silene conoidea L. Sp. Pl. 418. 1753; FBI. 1: 218. 1874; FUGP. 1: 62. Repr. ed. 1960; Fl. India 2: 564. 1993. .

Erect, dichotomously branched herbs. Leaves opposite, sessile; radical ones spathulate or linear-lanceolate, acute. Flowers few, rosy pink, in corymbose or paniculate cymes. Calyx tubular, teeth linear- lanceolate. Capsule narrowed at the apex, 6-toothed, shinng, ovoid, enclosed in inflated calyx. Seeds reniform, 5-ribbed, greyish-brown, shining. **Flowering and fruiting :** February-April. **Local Name:** *Chota-takla*. Common in cultivated fields. Sweta 681.

5. SPERGULA L.

Spergula fallax (Lowe) Krause in Sturm, Deutschl. Fl. ed. 2. 5: 21. 1901; Fl. India 2: 578. 1993. *Spergularia fallax* Lowe in Hook. f. Kew Journ. Bot. 8: 289. 1856. *Spergula pentandra sensu* Edgew. & Hook. f. in FBI. 1: 243. 1874, *pro parte,* non L. 1753; FUGP. 1: 63. Repr. ed. 1960.

Erect, glabrous, annual herbs. Leaves pseudo-whorled, linear, flat, grooved, obtuse, stipules ovate, acute. Flowers in lax terminal cymes, white. Sepals scarious margined. Capsule 3-valved. Seeds granulate, black with hyaline wings. **Flowering and Flruiting:** January-June.

Found in moist habitats, sometimes forming pure populations. Specimens growing in drier habitats are glaucous, smaller and bear few flowers. Sweta 980.

6. STELLARIA L.

Stellaria media (L.) Vill. Hist. Pl. Dauph. 3: 615. 1789; FBI. 1: 230. 1874; FUGP. 1: 62. Repr. ed. 1960; Fl. India 2: 585. 1993. *Alsine media* L. Sp. Pl. 272. 1753.

Annual, glabrous, decumbent herb, rooting at the lower nodes. Lower leaves long petiolated, ovate-cordate, entire, acute or acuminate; upper ones sesslie, ovate-elliptic. Flowers white in axillary and terminal cymes. Petals 5, white, bilobed nearly to the base. Capsule ovoid, 3-valved. Seeds reddish brown with acute conical tubercles. **Flowering and fruiting :** December-April. Common in cultivated fields, waste lands and near marshy places. Sweta 568.

7. VACCARIA Wolf.

Vaccaria pyramidata Medik. Philos. Bot. 1: 96. 1789; Fl. India 2: 593. 1993. *Saponaria vaccaria* L. Sp. Pl. 409. 1753; FBI. 1: 217. 1874; FUGP. 1: 62. Repr. ed. 1960.

Erect glabrous herbs. Leaves opposite, connate base, 3- nerved, acute, 2.5 – 7.0 cm long. Flowers in terminal dichotomous cymes. Calyx tubular, 5-keeled. Petals obovate, notched at apex. Capsule ovoid- globose, included within calyx. Seeds slightly angled, brown-black. **Flowerig and Fruiting:** January to May. Often found in cultivated fields. Sweta 982.

15. PORTULACACEAE

PORTULACA L.

Key to species:

1. Flowers 4- merous..... 3. ***P. quadrifida***
1. Flowers 5- merous..... 2
2. Flowers pink; nodes with hairy appendages..... 2. ***P. pilosa***
2. Flowers yellow; nodes without hairy appendages..... 1. ***P. oleracea***

1. Portulaca oleracea L. Sp. Pl. 445. 1753; FBI. 1: 246. 1874; FUGP. 1: 66. Repr. ed. 1960; Fl. India 3: 4. 1993.

Prostrate or ascending herbs. Leaves alternate, sessile, obovate. Flowers yellow. Capsule obovoid to ovoid. Seeds many, black, reniform. **Flowering and fruiting:** March- December. Common along water channels and other moist places. This taxon shows great morphological variations, probably in response to soil moisture. Plants growing in drier situation have smaller leaves crowded towards the ends of branches, and smaller flowers. Sweta 972.

2. Portulaca pilosa L. Sp. Pl. 445. 1753; Fl. India 3: 6. 1993. *Portulaca tuberosa* Roxb. Fl. Ind. 2: 464. 1832; FBI. 1: 247. 1874. *Portulaca suffruticosa* Wall. ex Wt. & Arn. Prodr. 356. 1834; FBI. 1: 249. 1874.

subsp. **pilosa**

Herbs with fusiform deep roots. Leaves about elliptic-linear, acute. Flowers terminal, pink or red, surrounded by tufted hairs. Style branches upto six. Capsule ovoid or conical. Seeds blackish, minutely tubercled. **Flowering and fruiting:** June-January. Common on sandy soil on river beds or among the grasses in *Kholas.* In some specimens lower part of the stem is completely devoid of leaves while the hairs persist. Sweta 318, 414.

3. Portulaca quadrifida L. Mant. 1: 73. 1767; FBI. 1: 247. 1874; FUGP. 1: 66. Repr. ed. 1960; Fl. India 3: 6. 1993 .

Prostrate, slender annual herbs. Leaves upto ovate, lanceolate, sessile, nodal appendages short. Flowers solitary, terminal, yellow. Capsule tetragonous, acute, red. Seeds reniform, black, concentrically muricae. **Flowering and fruiting:** May- November. Occasionally found in moist habitats. Sweta 977.

16. TAMARICACEAE

TAMARIX L.

Key to species:

1. Flowers unisexual..... 1. ***T. dioica***
1. Flowers bisexual..... 2. ***T. indica***

1. Tamarix dioica Roxb. ex Roth, Nov. Pl. Sp. Ind. Or. 185. t. 22. 1821; FBI. 1: 249. 1874; FUGP. 1: 68. Repr. ed. 1960; Fl. India 3: 24. 1993. *Tamarix longepedunculata* Blatt. & Hallb. in Blatt. *et al.* J. Ind. Bot. 1: 86. 1919.

Medium sized shrubs upto 2.0 m high. Leaves minute, closely appressed, triangular- ovate, ovate-lanceolate, acuminate. Flowers pink, unisexual. Stamens 5. Styles 3. Capsule pyramidal, 3-valved. **Flowering and fruiting:** July-October. Common in open sandy tracts near the bank of Ganga. Sweta 971.

2. Tamarix indica Willd. in Ges. Naturf. Freunde Berlin Neue Schr. 4: 214. 1803; Fl. India 3: 25. 1993. *T. gallica* var. *indica* (Willd.) Ehrenb. in Linnaea 2: 268. 1827; FBI. 1: 248. 1874. *T. gallica* auct. plur. non L. 1753; Wt. & Arn. Prodr. Fl. Pen. Ind. Or. 40. 1834; FUGP. 1: 67. Repr. ed. 1960. *T. troupii* Hole in Indian For. 45: 248. 1919.

This species can be readily distinguished from *T. dioica* by bisexual flowers and relatively short coma of seeds. Included on authority of Murty and Singh (1961b).

17. ELATINACEAE

BERGIA L.

Bergia ammannioides Roxb. [Hort. Beng. 34. 1814, *nom. nud.*] ex Roth, Nov. Pl. Sp. 219. 1821; FBI. 1: 251. 1874; FUGP. 1: 69. Repr. ed. 1960; Fl. India 3: 33. 1993.

Erect or ascending, annual herbs with reddish stem. Leaves opposite, oblanceolate or elliptic, serrate or subentire. Flowers small in dense axillary cymes, pink. Sepals and petals 5 each. Stamens 5. Capsule 5- loculed. **Flowering and fruiting:** October- May. Common in or near swampy ares. Sweta 984.

18. HYPERICACEAE

HYPERICUM L.

Hypericum japonicum Thunb. ex Murr. Syst. Veg. ed. 14: 702, July 1784; FBI. 1: 256. 1874; Fl. Ind. 3: 69. 1993; Khan et.al. J. Econ.Taxon. Bot. 30 (3): 697-698. 2006.

Branched or unbranched, succulent herbs. Stems 4-angled. Leaves sessile, opposite; pellucid punctate on both faces, margin revolute. Flowers yellow, short pedicelled, 1-2 in leaf axils. Sepals pellucid punctate. Stamens ca 30, not in fascicles. Ovary 1-locular with 3 parietal placentae. Fruit capsular, enclosed within persistent calyx, valves thinly ciliate on margins. Seeds longitudinally ribbed, shortly apiculate. **Flowering and fruiting:** Summer season, collected on June 13, 2005. Found on moist and sandy river bed. Sweta 870.

19. MALVACEAE

KEY TO GENERA:

1. Fruit a capsule..... 2
1. Fruit schizocarpic; mericarps usually separating..... 5
2. Trees; epicalyx segments obovate-spathulate..... 5. ***Kydia***
2. Herbs or low shrubs; epicalyx segments not as above..... 3
3. Calyx 2 to 3 – lobed, spathaceous, caducous..... 1. ***Abelmoschus***
3. Calyx 5- toothed or lobed, not spathaceous, persistent..... 4
4. Calyx winged..... 3. ***Fioria***
4. Calyx not winged..... 4. ***Hibiscus***
5. Epicalyx present..... 6
5. Epicalyx absent..... 9
6. Epicalyx segments 3..... 7

6. Epicalyx segments 5..... 8
7. Leaves orbicular, palminerved, long petioled; flowers pinkish or white..... 6. ***Malva***
7. Leaves ovate-lanceolate, penninerved; flowers yellow..... 7. ***Malvastrum***
8. Each sepal with a stout protuberance at the base; calyx exceeding the fruit; mericarps smooth..... 8. ***Pavonia***
8. Sepals without a protuberance at the base; calyx shorter than the fruit; mericars glochidiate..... 10. ***Urena***
9. Mericarps 2 or more seeded..... 2. ***Abutilon***
9. Mericarps 1- seeded..... 9. ***Sida***

1. ABELMOSCHUS Medic.

Key to species:

1. Tall herbs, bracteoles ovate, base of each petal completely brown forming a seemingly continuous ring at the base of corolla, hairs on fruit not tubercle based..... 1. ***A. manihot***
1. Dwarf herbs, bracteoles linear, scarlet spot at the base of each petal flanked by yellow bands forming a discontinuous ring at the base of corolla, hairs on the fruits tubercle based..... 2. ***A. tuberculatus***

1. Abelmoschus manihot (L.) Medik. Malv. 46. 1787, ampl. Hochr. in Candollea 2: 87. 1924; Fl. India 3: 304. 1993. *Hibiscus manihot* L. Sp. Pl. 696. 1753.

Herbs or undershrubs with hispid stem. Leaves usually 3 – 9 lobed or parted. Flowers solitary axillary or in terminal racemes. Epicalyx segments 4-6 ovate-oblong, acute. Corolla yellow or light-yellow with a purple centre. Capsule ovoid-oblong, 5-angled, Seeds dark-brown, stellate hairy. **Flowering and fruiting:** Rainy season. Often found in agricultural fields, may be an escape from cultivation. Sweta 979.

2. Abelmoschus tuberculatus Pal et al. in Bot. Gaz. 113. 458. 1952; Fl. India 3: 308. 1993.

Herbs or undershrubs; stem strigose with simple hairs, glaberscent at length. Leaves 3-5 lobed. Epicalyx segments linear. Corolla yellow or whitish-yellow with deep purple centre. Capsule studded with bristle bearing tubercles. **Flowering and fruiting:** Rainny season. Occasionally occurs near agricultural fields. Sweta 989.

This species was described by Pal et al. (1952) on the basis of material collected from Ajmer (Rajasthan), Indore (Madhya Pradesh) and Saharanpur (Uttar Pradesh). Curiously, this species was not reported either in Flora of Rajasthan or any latest work on flora of Uttar Pradesh. This

is, therefore, first collection of this species in plains after 1952. The digital photographs of this species on the disk accompnying this thesis may well be first color photographs.

2. ABUTILON Mill.

Key to species:

1. Mericarps 8-10, beaked; leaves glabrescent;
   fruits cylindric, less than 1.0 cm long..... 3. ***A. ramosum***
1. Mericarps more than 10, with a small mucro.....2
2. Flowers orange-yellow with a dark centre..... 1. ***A. hirtum***
2. Flowers yellow or pale-yellow, without a dark centre..... 2. ***A. indicum***

1. Abutilon hirtum (Lamk.) Sweet, Hort. Brit. ed. 1. 53. 1826; Wight & Arn. Prodr. 56. 1834; Fl. India 3: 264. 1993. *Sida hirta* Lamk. Encycl. 1: 7. 1783. *S. graveolens* Roxb. [Hort. Beng. 50. 1814, *nom. nud.*] ex Hornem. Hort. Hafn. Suppl. 77. 1819; Roxb. Fl. Ind. 3: 179. 1832. *Abutilon graveolens* (Roxb. ex Hornem.) Wight & Arn. ex Wight Cat. 13. 1833 and Wight & Arn. Prodr. 56. 1834; FBI. 1: 327. 1874 (incl. var. *hirtum*); FUGP. 1: 78. Repr. ed. 1960.

Annual under shrubs up to 2.0 m tall. Leaves broadly ovate-orbicular, crenate, dentate. Flowers orange-yellow with a dark center. Schizocarp truncate, mericarps 20- 30, shortly acuminate, 2-3 seeded. Seeds brownish-black, reniform, hairs longer at the hilum. **Flowering and fruiting:** January- May. Included on authority of Murty and Singh (1961b).

2. Abutilon indicum (L.) Sweet, Hort. Brit. ed. 1.54. 1826; FBI. 1:326.1874; FUGP. 1: 78. Repr. ed. 1960; Fl. India 3: 266. 1993. *Sida indica* L. Cent. Pl. 2: 26.1756.

Erect, branched, hairy shrubs. Leaves ovate cordate, coarsely toothed, petiole long. Flowers solitary, axillary, yellow with orange tinge. Sepals 5, keeled, acute. Fruit strongly ribbed, mericarps 15-20, black after drying. Seeds black, reniform, punctuate with minute warts. **Flowering and fruiting**: September-November. Abundantly found on the road sides and waste lands. **Local name:** *Kanghi*. Sweta 96.

3. Abutilon ramosum (Cav.) Guillemin & Perrottet in Guillemin *et al.* Fl. Seneg. Tent. 1: 68. 1830; FBI. 1: 328. 1874; FUGP. 1: 79. Repr. ed. 1960; Fl. India 3: 271. 1993. *Sida ramosa* Cav. Diss. 1: 28. t. 6. f. 1. 1785.

Perennial under shrubs up to 2.0 m tall. Leaves ovate cordate, densely stellate pubescent abaxially. Flowers solitary-axillary, yellow. Schizocarp cylindric, up to 1.0 cm long, mericarps 8-10, viscid-pubescent, each with 2 long villous awns, 2-3 seeded. Seeds reniform, brownish black, minutely stellate pubescent. **Flowering and fruiting:** August- December. Included on authority of Murty and Singh (1961b).

3. FIORIA Mattei

Fioria vitifolia (L.) Mattei in Bot. Ort. Bot. Palermo n. s. 2: 71. 1916; Fl. India 3: 310. 1993. *Hibiscus vitifolius* L. Sp. Pl. 696. 1753; FBI. 1: 338. 1874; FUGP. 1: 85. Repr. ed. 1960.

Herbs or under-shrubs, 60 cm-150 cm high. Leaves broadly ovate to orbicular, subcordate to rounded at base, crenate-serrate or dentate, acute. Flowers axillary, solitary, strongly nodding, epicalyx linear. Calyx campanulate, 5-lobed. Corolla yellow with dark purple centre. Capsule shortly beaked, 5-winged, wings bristly. Seeds reniform, glabrous, brownish-black. **Flowering and fruiting.** April-December. Often found in waste lands especially near *Kholas*. Sweta 974.

4. HIBISCUS L. *nom. cons.*

Key to species:

1. Calyx becoming fleshy and deep red after anthesis..... 4. ***H. sabdariffa***
1. Calyx not as above..... 2
2. Seeds cottony; corolla reflexed..... 3. ***H. micranthus***
2. Seeds not cottony; corolla spreading..... 3
3. Glandular hairy herbs; epicalyx minute or absent.....2. ***H. lobatus***
3. Prickly herbs; epicalyx well developed..... 1. ***H. cannabinus***

1. Hibiscus cannabinus L. Syst. Nat. ed. 10. 2: 1149. 1759; FBI. 1: 339. 1874; FUGP. 1: 85. Repr. ed. 1960; Fl. Ind. 3: 324. 1993.

Prickly herbs. Leaves palmately 3-5 lobed, lobes linear-lanceolate, serrate. Flowers solitary, yellow with a crimson center. Bracteoles 8- 10, basally adnate to calyx. Calyx white tomentose externally and with a large nectary at the base. **Flowering and fruiting:** September-December. Often cultivated in the area for the sake of fibres obtained from the stem. Sweta 985.

2. Hibiscus lobatus (Murr.) O. Kuntze, Rev. Gen. Pl. 3: 2. 19. 1898; Fl. India 3: 336. 1993. *Solandra lobata* Murr. Comm. Soc. Reg. Sci. Goetting. 6: 20. t. 1. 1785. *Hibiscus solandra* L' Herit. Strip. Nov. 1: 103. t. 49. 1788; FBI. 1: 336. 1874; FUGP. 1: 84. Repr. ed. 1960.

Erect, gland-pubescent, annual herbs. Leaves broadly ovate-orbicular, cordate at base; lower ones larger, palmatifid; upper ones smaller, entire, serrate. Flower in racemes, white. Calyx segments lanceolate, divided halfway down, soft pubescent. Petals obovate, entire. Capsule oblong, beaked, pilose at the top. Seeds black, glabrous. **Flowering and fruiting:** August – November. Found in *Kholas*. Sweta 268.

3. Hibiscus micranthus L. f. Suppl. Pl. 308. 1781; FBI. 1: 335. 1874; FUGP. 1: 84. Repr. ed. 1960; Fl. India 3: 330. 1993.

var. **rigidus** (L. f.) Cuf. in Ann. Natur. Mus. W. 56: 49. 1948; Fl. Ind. 3: 331. 1993; Fl. Pakistan (http://www.efloras.org/florataxon.aspx?flora_id=5&taxon_id=250071307 visited 21.04. 2007 at 2. 22 p. m. IST). *H. rigidus* L. f. Suppl. Pl. 310. 1781; *H. suborbiculatus* Wall. (Cat. no. 1906. 1828, *nom. nud.*) ex T. K. Paul & Nayar in Fasc. Fl. Ind. 19. 138. 1988.

Undershrubs up to 1.5 m tall; branches slender, terete. Leaves up to 1.0 cm long, ovate to oblong, obtuse, serrate, stellate hairy. Flowers solitary, axillary, pedicels short. Calyx lobes about 5.0 mm long. Corolla small, pinkish-white, petals oblong-obtuse, often reflexed. Capsule globose, 5-valved. Seeds reniform, black, hirsute with long white silky hairs. **Flowering and fruiting:** June-December. Frequently found in sandy habitats near *Kholas*. Sweta 354.

Note: According to Paul (Fl. Ind. *l. c.*) the distribution of this taxon is in southern peninsula. Therefore this is first record of its occurrence in north India.

4. Hibiscus sabdariffa L. Sp. Pl. 695. 1753; FBI. 1: 340. 1874; Fl. India 3: 391. 1993.

This species can be readily distinguished from other species of *Hibiscus* by fleshy, red and acid sepals. Often cultivated for the sake of stem fiber and edible sepals. Sweta 269.

5. KYDIA Roxb.

Kydia calycina Roxb. [Hort. Beng. 50. 1814, *nom. nud.*] Pl. Corom. 3: 11. t. 215. 1819 & Fl. Ind. 3: 188. 1832; FBI. 1: 348. 1874; FUGP. 1: 92. Repr. ed. 1960; Fl. India 3: 344. 1993. *K. fraterna* Roxb. Pl. Corom. 3: 12. t. 216. 1819. *K. roxburghiana* Wight, Icon. Pl. Ind. Orient. 3: t. 881. 1844.

Trees up to 10.0 m tall. Leaves sub-orbicular or ovate-rounded, 5-9 nerved at the base. Flowers polygamous, in axillary or terminal panicles, white or pink. Epicalyx segments 4-6, connate, oblong-spathulate or obovate. Ovary globose, woolly. **Flowering and fruiting:** October- January. This species occurs in forests of Najibabad, however, no specimen was observed in the study area. Included on authority of Murty and Singh (1961b).

6. MALVA L.

Key to species:

1. Sepals very sparsely stellate pubescent; mericarps obscurely reticulate; columella conical..... 2. ***M. verticillata***
2. Sepals densely stellate hairy; mericarps conpicuously reticulate ; columella flat or concave..... 1. ***M. parviflora***

1. Malva parviflora L. Demostr. Pl. Hort. Ups. 18. 1753 *et* Amoen. Acad. 3: 146. 1756; FBI. 1: 321. 1874; FUGP. 1: 74. Repr. ed. 1960; Fl. India 3: 361. 1993.

Prostrate or ascending, annual herbs. Leaves orbicular, 2.0-6.0 cm across, cordate, 3-5 lobed, crenate-serrate, repand. Stipulesovate-lanceolate, ciliate. Flowers in axillary clusters, white or pinkish-white. Schizocarps discoid 5.0 7.0 mm across, mericarps 8-10. Seeds black or brown, glabrous. **Flowering and fruiting:** January-June. Common in moist places, often forms dense patches on garbage heaps near villages. Sweta 991.

2. Malva verticillata L. Sp. Pl. 689. 1753; FBI. 1: 320. 1874; FUGP. 1: 74. Repr. ed. 1960; Fl. India 3: 363. 1993. *M. neilgherrensis* Wight, Icn. Pl. Ind. Orient. t. 950. 1845.

Annual, stellate hairy or glabrescent annual herbs. Leaves orbicular, 5-lobed, cordate or sub truncate, coarsely crenate-dentate. Flowers axillary, pinkish. Calyx accrescent. Petals lobed apically. Mericarps 10-12, rugose, reniform. **Flowering and fruiting:** January-June. Included on authority of Murty and Singh (1961b).

7. MALVASTRUM Gray *nom. cons.*

Malvastrum coromandelianum (L.) Garcke in Bonplandia 5: 295.1857; Fl. India 3: 277.1993. *Malva coromandeliana* L. Sp. Pl. 687.1753. *M. tricuspidatum* (R.Br). A. Gray, Pl. Wright 1:16.1852; FBI. 1:321.1874; FUGP. 1: 75. Repr. ed. 1960

Erect, appressedly hairy herbs. Leaves ovate, serrate. Flowers yellow, solitary, axillary, bracteoles 3, hairy. Corolla yellow, notched apically. Carpels reniform with 3 projecting points. **Flowering and fruiting :**Almost throughout the year. Commonly found in dry sandy and grassy places and on margins of cultivated fields. Sweta 181.

8. PAVONIA Cav/*nom. cons.*

Pavonia repanda (Roxb. ex Smith) Spreng. Syst. Veg. 3: 98. 1826; Fl. India 3: 377. 1993. *Urena repanda* Roxb. [Hort. Beng. 51. 1814, *nom. nud.*] ex Smith in Rees, Cyclop. 37 no. 6. 1819; FBI. 1: 330. 1874; FUGP. 1: 80. Repr. ed. 1960. *U. palmata* Roxb. Fl. Ind. 3: 182. 1832.

Perennial, erect or ascending, under-shrubs. Leaves ovate to ovate-rounded, upper ones lanceolate, cordate, repand, serrate, midrib with a nectary beneath. Flowers axillary, solitary

or in terminal clusters; epicalyx cup-shaped, firmer than the calyx, segments 5, strongly nerved. Petals pink with dark base, oblong-ovoid. Mericarps oblong-ovoid, unarmed, glabrous. Seeds oblong-ovoid, glabrous, brownish-black. **Flowering and fruiting:** June-November. Found on sandy soil near the banks of river Ganga.Sweta 107.

9. SIDA L.

Key to species :

1. Stems with 1-2 short spines at the base of petiole;
   mericarps with two divergent apical awns..... 6. ***S. spinosa***
1. Stems without spines; mericarps with or without
   apical awns..... 2
2. Mericarps 5; prostrate or trailing herbs covered with
   glandular hairs..... 2. ***S. cordata***
2. Mericarps 6- 12..... 3
3. Mericarps 8- 12, dehiscent.....4
3. Mericarps 6- 8, indehiscent.....5
4. Awns 2, retrorsely hairy; exceeding the calyx.....3. ***S. cordifolia***
4. Awn single or none, if present then not retrorsely hairy
   and shorter than the calyx.....5. ***S. rhombifolia***
5. Leaves oblong- ovate, downy on both surfaces; flowers
   creamy white..... 4. ***S. ovata***
5. Leaves lanceolate, glabrous; flowers yellow..... 1. ***S. acuta***

1. Sida acuta Burm.f. Fl. India 147.1768; emend. K. Schum. Fl. Brasil. 12, 3:326.1891; FUGP.1: 76. Repr.ed.1960; Fl. India 3: 281. 1993. *S. carpinifolia* non L.f. 1785; sensu Mast. In Hook.f.Fl. Brit. India 1:323.1874.

Erect, much branched, undershrubs. Leaves lanceolate oblong, serrate, glabrous, acute. Flowers solitary, axillary, pale-yellow. Calyx lobes ovate-triangular, ciliate, acute. Mericarps 6-10, 2-awned. Seeds smooth, dark brown triangular. **Flowering and fruiting:** June-December. Frequently found in the wastelands and on roadsides. Sweta 33,129.

2. Sida cordata (Burm.f.) Borssuno in Blumea 14:182.1966; Fl. India 3: 283.1993. *Melochia cordata* Burm.f. Fl. India 143.1768. *S. veronicifolia* Lamk. Encycl. 1: 5.1783; FUGP.1: 75.Repr. ed. 1960. *S. humilis* Cav. Diss. 5. t. 134. f. 2.1788; FBI.1: 322.1874, incl. var. *veronicifolia*.

Straggling, gland hairy herbs. Leaves ovate- cordate, crenate, acute to acuminate. Flowers solitary , axillary, orange -yellow. Carpels 5, mericarps awned, thin walled. Seeds triangular,

with blackish dots, dark-brown. **Flowering and fruiting:** Almost through out the year. Commonly found in wastelands, among hedges and bushes. Sweta 313.

3. Sida cordifolia L.Sp. Pl. 684.1753; FBI.1:324.1874; FUGP. 1: 77. Repr. ed. 1960; Fl. India 3: 285.1993.

Erect hairy herbs, branched from the base. Leaves ovate, crenate-dentate, cordate, tomentose. Flowers solitary, axillary, yellowish. Fruit pyriform, hairy, mericarps reticulately veined, 2 awned. Seeds triangular, brown. **Flowering and fruiting:** August-December. Commonly found throughout the area during the monsoon and post monsoon period, along the field borders, roadsides and also in wastelands and *Kholas*. Sweta 123, 304.

4. Sida ovata Forssk. Fl. Aegypt.-Arab. 124.1775; Fl. India 3: 288.1993. *S. grewioides* Guill. & Perr. In Guill. et al. Fl. Seneg. Tent. 1:71.1830; FBI. 1: 323.1874; FUGP.1: 77. Repr.ed.1960.

Erect undershrubs, branches grey tomentose with stellate hairs. Leaves oblong-ovate, obtuse, crenate-dentate. Flowers solitary, axillary, light yellow. Mericarp glabrous, shortly 2-awned. Seeds smooth, dark-brown. **Flowering and fruiting** : October- January. Commonly found in agricultural fields and wastelands. Sweta 52.

5. Sida rhombifolia L. sp. Pl. 684.1753; emend. Mast. in Hook.f. Fl. Brit. India 1:323.1874; FUGP.1: 76. Repr.ed.1960; Fl. India 3: 289.1993.

Erect, much branched, stellate hairy herbs, branches purple. Leaves obovate-rhomboid, dentate, acute-acuminate. Flowers solitary, axillary, yellow. Sepals ovate-triangular, acute. Corolla glabrous, truncate. Fruit enclosed within the calyx; mericarps 8-12, awnless. **Flowering and fruiting:** September-October. Common in wastelands and cultivated fields. Sweta 262.

6. Sida spinosa L. Sp. Pl. 683. 1753; FBI. 1: 323. 1874; FUGP. 1: 76. Repr. ed. 1960; Fl. India 3: 292.1993.

This species can be readily recognized by shortly spinous stem nodes and divergent awns of mericarps. Sweta 976.

10. URENA L.

Urena lobata L. Sp. Pl. 692.1753; FBI.1: 329. 1874; FUGP.1: 80. Repr. ed. 1960; Fl. India 3: 380. 1993.

Large shrubs with stout, slightly scabrid stem. Leaves broadly ovate, margins serrate, red. Flowers rose-pink, in axillary clusters; sepal 5, connate. Mericarps 5, covered with brown,

hooked spines. Seeds dark brown, reniform with a conspicuous scar. **Flowering & fruiting :** June-January. Abundantly found in sandy soil near the Ganga. Sweta190.

Note: According to APG-2 the taxa treated here as belonging to the family Malvaceae, belong to the group Malvoideae Burnett of Malvaceae.

20. BOMBACACEAE

BOMBAX L.

Bombax ceiba L. Sp. Pl. 511. 1753, *pro parte;* Robyns in Taxon 10: 68, 160. 1961; Fl. India 3: 398. 1993. *Salmalia malabarica* (DC.) Schott. & Endl. Melet. Bot. 35. 1832. *Bombax malabaricum* DC. Prodr. 1: 479. 1824; FBI. 1: 349. 1874; FUGP. 1: 92. Repr. ed. 1960.

Tall, deciduous trees with buttressed trunk; bark corky, spiny. Leaves crowded at the end of branches, digitately 5-7 foliate, leaflets ovate-lanceolate or elliptic-lanceolate, glabrous. Flowers crowded at the end of leafless branches, crimson or orange-yellow, shining. Sepals united, succulent, shining within. Petals recurved apically. Stamens many. Capsule woody, apiculate, 5-valved. Seeds many, cottony. **Flowering and fruiting:** April-June. Flowers appear when the tree is completely leafless. Common in grasslands. Sweta 986.

Ceiba pentandra (L.) Gaertn. is occasionally planted as ornamental.

Note: According to APG-2 the genus *Bombax* belongs to the group Bombacoideae Burnett of the family Malvaceae.

21. STERCULIACEAE

KEY TO GENERA:

1. Shrubs with zygomorphic flowers and spirally
   twisted ripe carpels.....1. ***Helicteres***
1. Under shrubs or herbs; flowers actinomorphic;
   carpels not twisted.....2
2. Herbs with deep red flowers; stamens 15 with 5
   petaloid staminodes..... 3. ***Pentapetes***
2. Flowers not deep red; staminodes absent..... 3
3. Flowers yellow; petals clawed; style single;
   capsule 2- valved.....4. ***Waltheria***
3. Flowers whitish- pink; petals not clawed; styles 5;
   capsule 5- valved.....2. ***Melochia***

1. HELICTERES L.

Helicteres isora L. Sp. Pl. 963.1753; FBI.1: 365.1874; FUGP. 1: 96. Repr. ed. 1960; Fl. India 3: 426. 1993.

Medium sized to large shrubs. Leaves 2-15 x 1-11cm, ovate, oblong, crenate-serrate, hairy, rough. Flowers solitary, axillary, orange-red. Corolla 2 lipped, glandular, clawed. Capsule woody, twisted, hairy, beaked. Seeds angled, black, wrinkled. **Flowering and fruiting:**July-November.Common in *Kholas*. Sweta 32.

Note: According to APG-2 the genus *Helicteres* belongs to the group Helicteroideae Meisner of Malvaceae.

2. MELOCHIA L.

Melochia corchorifolia L. Sp. Pl. 675.1753; FBI. 1: 374.1874; FUGP. 1: 100. Repr. ed. 1960; Fl. India 3: 441. 1993.

Much branched, erect, annual herbs. Leaves ovate-oblong, serrate-incised, glabrous. Flowers white or pinkish, in terminal capitate heads, mixed with lanceolate- subulate involucral bracts. Corolla nearly twice the length of calyx, ciliated. Petals white. Stamens 5. Capsule globular brown, hairy; seeds angular, smoothed, brown. **Flowering and fruiting:** July -October. Abundantly found near river banks and in swampy areas . Sweta 114

Note: Acording to APG-2 the genus *Malochia* belongs to group Byttnerioideae Burnett of Malvaceae.

3. PENTAPETES L.

Pentapetes phoenicea L. Sp. Pl. 698.1753; FBI.1: 371. 1874; FUGP.1: 99. Repr. ed. 1960; Fl. India 3: 443. 1993.

Erect annual, hairy herbs or under shurbs. Leaves 2.0-7.0 cm long, petiolate, linear-lanceolate, serrate. Flowers axillary, solitary, scarle-red. Stamens 15 in 5 groups, alternating with 5 petaloid staminodes. Capsule, globose, hairy. **Flowering and fruiting:** Rainy season. Ooccasionally found in moist areas, especially sugar cane fields; probably an escape from cultivation. Sweta 359.

Note: According to APG-2 the genus *Pentapetes* belongs to group Malvoideae Burnett of Malvaceae.

4. WALTHERIA L.

Waltheria indica L. Sp. Pl. 673.1753; FBI. 1: 374. 1874; FUGP 1: 101. Repr. ed. 1960; Fl. India 3: 473. 1993. *W. americana* L. Sp. Pl. 673. 1753.

Erect, white, tomentose, woody herbs or under shrubs. Leaves broad oblong, lanceolate, crenate-serrate. Flowers yellow in axillary clusters. Capusle 5-lobed, campanulate. **Flowering and fruiting:**August- November. Common in wastelands and open areas especially near the *Kholas*. Sweta 292.

22. TILIACEAE

KEY TO GENERA:

1. Fruits spiny or bristly..... 3. ***Triumfetta***
1. Fruit neither spiny nor bristly..... 2
2. Petals glandular at the base; fruit indehiscent..... 2. ***Grewia***
2. Petals eglandular; fruit dehiscent..... 1. ***Corchorus***

1. CORCHORUS L.

Key to species:

1. Capsule elongated; beaked..... 2
1. Capsule glosbose; beak none..... 2. ***C. capsularis***
2. Beak divided into 3 bifid arms..... 3
2. Beak entire, straight..... 4
3. Capsule 6-angled; three angles winged; stmens more than 15..... 1. ***C. aestuans***
3. Capsule cylindric, without angles or wings; stamens 10..... 4. ***C. tridens***
4. Capsule 5-valved, 10-ribbed..... 3. ***C. olitorius***
4. Capsule 3-4 valved, cylindric, 3-4 angled, not ribbed..... 5. ***C. trilocularis***

1. Corchorus aestuans L. Syst. Nat. ed.10. 2: 1079. 1759; Fl. India 3: 485. 1993. *C. acutangulus auct.* non Forssk. 1775; FBI. 1: 398. 1874; FUGP. 1: 114. Repr. ed. 1960.

Ascending, erect or suberect herbs. Leaves ovate-lenceolate hairy, serrate. Flowers yellowish, peduncles 2-3 flowered; sepals 5, free; margin reddish brown; petals, longer than sepals. Capsule 3-valved, cylindric, beaked. **Flowering &Fruiting:** August-October. It is most common species of *Corchorus* found in this area. Common in cultivated fields and in waste places on moist soil. Sweta120.

2. Corchorus capsularis L. Sp. Pl. 529. 1753; FBI. 1: 397. 1874; FUGP 1: 113. Repr. ed. 1960; Fl. India 3: 485. 1993.

Erect or suberect annual herbs. Leaves 6-10 cm long, ovate-lenceolate, the two lowest teeth produced into awns. Flowers yellow, solitary; sepals 5, mucronate; petals 5. Stamens 8- 10. Fruit globular with ridges and groves, ridges irregularly cut. Seed dark brown-black. **Flowering & Fruiting:** August- October. Common in marshy or wet habitats, mainly in paddy fields. Sweta 117.

3. Corchorus olitorius L. Sp. Pl. 529. 1753; FBI. 1: 397. 1874; FUGP. 1: 113. Repr. ed. 1960; Fl. India 3: 487. 1993.

Erect herbs with woody base. Leaves ovate -lanceolate, serrate. Flowers in axillary cymes, yellow. Petals 5, free, oblong, yellow. Stamens many. Fruit capsular 3-7 cm long, 5 angled, cylindric, beak blunt. **Flowering and fruiting:** September-October.Commonly found in sandy soil. Sweta 256.

4. Corchorus tridens L. Mant. Alt. 566. 1771; FBI. 1: 398. 1874; FUGP. 1: 114. Repr. ed. 1960; Fl. India 3: 488. 1993. *C. trilocularis auct.* non L. 1767; Burm. f. Fl. Ind. 125. t. 37. f. 2. 1768.

Erect or ascending annual herbs. Leaves ovate-lanceolate, serrate; basal serratures produced into filiform awns. Flowers yellow, in 2-4 flowered leaf opposed cymes. Capsule up to 4.0 cm long, cylindric, curved; beak trifurcated; valves without partitions. **Flowering and fruiting:** August- December. Included on authority of Murty and Singh (1961b).

5. Corchorus trilocularis L. Mant. Pl. 77. 1767; FBI. 1: 397. 1874; FUGP. 1: 113. Repr. ed. 1960; Fl. India 3: 488. 1993. *C. serratifolius* DC. Prodr. 1: 504. 1824.

Annual, erect or suberect, pubescent herbs. Leaves broadly oblong-elliptic, serrate, lowest serratures prlonged into awns. Flowers yellow, in 1-3 flowered leaf-opposed cymes. Stamens 15-20. Capsule upto 8.0 cm long, 3-4 angled, scabrous-tuberculate, valves with transverse partitions. Seeds 3-gonous, black. **Flowering and fruiting:** July- December. Incuded on authority of Murty and Singh (1961b).

2. GREWIA L.

Key to species:

1. Trees; peduncles shorter than the petiole; leaves tomentose, regularly crenate; main nerves arching ..... 1. ***G. asiatica***
1. Shrubs or undershrubs; peduncles much exceeding petioles..... 2
2. Leaves broad, not cordate; a dwarfed undershrub producing annual, herbaceous, flowering stems..... 3. ***G. sapida***
2. Leaves ovate-lanceolate, 3-nervd at the base, tomentose beneath and scabrous above; flowers all bisexual.....2. ***G. hirsuta***

1. Grewia asiatica L. Mant. Pl. 122. 1767; FBI. 1: 386. 1874. excl. var. *vestita*; FUGP. 1: 107. Repr. ed. 1960; Fl. Ind. 3: 494. 1993. *G. subinaequalis* DC. Prodr. 1: 511. 1824. *G. hainesiana* Hole in Ind. For. 43: 126. 1917.

Small trees or large shrubs. Leaves up to 18 x 5 cm; broadly ovate or suborbicular, obliquely cordate or rounded at the base, crenate, scabrous above, tomentose beneath. Flowers in axillary umbellate cymes; peduncles up to 3.0 cm long; buds ribbed, tomentose. Petals yellow, oblong-obovate or linear-oblong, obtuse; glands obovoid. Ovary ovoid, villous; stigma 4-lobed. Drupe 6-12 mm across, subglobose, obscurely lobed, red or purple, pilose, sweet or acid. **Flowering and fruiting:** January-August. **Local name:** *Falsa.* **Occurrence:** Usully cultivated for its fruits. Sweta 998.

2. Grewia hirsuta Vahl, Symb. Bot. 1: 34. 1790; FBI. 1: 391. 1874; FUGP. 1: 110. Repr. ed. 1960; Fl. Ind. 3: 501. 1993. *G. roxburghii* G. Don, Gen. Hist. 1: 548. 1831. excl. syn. *G. tomentosa* auct. non A. L. Juss. 1804.

Smal shrubs. Leaves up to 12.0 cm long, ovate- lanceolate or ovate-elliptic, acute, serrate, pubescent above, tomentose beneath, 3-4 nerved. Flowers polygamous in axillary, umbellate cymes, peduncles 1-3 together; buds globose. Petals white, about 3.0 mm long, oblong, rounded, glands half the length of petals. Ovary globose, densely villous; stigma 5-lobed, lobes fringed. Drupe about 1.0 cm across, subglobose, obscurely 4-lobed, fleshy, densely hirsute, wrinkled, sweet. Flowering and fruiting: April-November. **Local name:** *Gursakri.* **Occurrence:** Found in *Kholas.* Sweta 987.

3. Grewia sapida Roxb. ex DC. Prodr. 1: 512. 1824; FBI. 1: 387. 1874; FUGP. 1: 109. Repr. ed. 1960; Fl. India 3: 508. 1993. *G. pumila* Buch.-Ham. ex D. Don, Prodr. 227. 1825.

Small shrubs. Leaves up to 10.0 cm long, ovate or broadly elliptic, subacute or rounded at the base and apex, coarsely double serrate, scabrid above, tomentose beneath, 5-7 nerved. Flower in axillary cymes, yellow; buds obovoid or oblong-obovoid, tomentose. Sepals 7-12 mm long, oblong or oblanceolate. Stamens many, filaments 5-6 mm long, glabrous. Ovary elliptic-oblong, hirsute. Drupe about 6-7 mm across, subglobose or broadly obovoid, obscurely 2-lobed, hirsute. **Flowering and fruiting:** March- September. **Occurrence:** Occasionally found in *Kholas* among grasses. Sweta 784.

3. TRIUMFETTA L.

Triumfetta rhomboidea Jacq. Enum. Syst. Pl. 22. 1760; FBI.1: 395.1874; FUGP.1: 111. Repr. ed. 1960; Fl. India 3: 520. 1993. *T. bartramia* L. Syst. ed.10 . 1044.1759.

Erect, hirsute, large herbs Leaves broad, ovate. Flowers yellow, clustered at the nodes. Fruit globular, with hooked spines. **Flowering and fruiting:** August-October. Commonly found on the road sides, in cultivated field and waste lands. Sweta121.

Note: According to APG-2 these three genera belong to group Grewioideae Hochreutiner of Malvaceae.

23. LINACEAE

LINUM L.

Linum usitatissimum L. Sp. Pl. 277. 1753; FBI. 1: 410. 1874; FUGP. 1: 115. Repr. ed. 1960; Fl. India 3: 580. 1993.

Erect, glabrous annul herbs. Leaves alternate, sessile, linear-lanceolate, acute, entire. Flowers long pedicelled, light blue with dark blue dichotomous veins. Capsule globose, with a stylar beak and supported by persistent calyx. Seeds compressed, brown. **Flowering and fruiting:** January- April. Commonly cultivated as winter season oil crop; sometimes found as an escape. Sweta 701.

Linum grandiflorum Desf. is sometimes cultivated as an ornamental

24. ZYGOPHYLLACEAE

KEY TO GENERA:

1. Leaves pinnate; stipules not spinous, flowers yellow, fruit a schizocarp..... 2. ***Tribulus***
1. Leaves 1-3 foliate; stipules spinous, flowers pinkish-purple, fruit a capsule..... 1. ***Fagonia***

1. FAGONIA Tourn. ex L.

Fagonia indica Burm. f. Fl. Ind. 102. t. 34. f. 1. 1768; Fasc. Fl. India (Fasc. 20) 180. 1990. *F. cretica* auct. non L. 1753; FUGP. 1: 120. Repr. ed. 1960. *F. arabica* auct. non L. 1753; FBI. 1: 425. 1874.

Annual or perennial, profusely branched herbs. Leaves unifoliate or lower sometimes trifoliate, leaflets narrowly ovate-lanceolate. Stipular spines suberect. Flowers 10-12 mm across. Capsules softly hairy. **Flowering and fruiting:** October-March. Included on authority of Murty and Singh (1961b).

2. TRIBULUS Tourn. ex L.

Tribulus terrestris L. Sp. Pl. 387. 1753; FBI. 1: 423. 1874; FUGP. 1: 119. Repr. ed. 1960; Fasc. Fl. India (Fasc. 20) 191. 1990 .

Prostrate annual, hairy herbs. Leaves pinnate, leaflets 5-8 pairs, stipules falcate. Flowers yellow, solitary-axillary; sepals ovate-lanceolate, acute, hairy, margins narrowly scarious and thinly ciliate. Stamens 10. Ovary covered with appressed, bulbous based hairs. Fruit upto 15.0 mm across, each mericarp with 4 spines, dorsally tubercled. **Flowering and fruiting:** June-December. Common in sandy habitats. Sweta 35.

This plant shows considerable variations as regards the leaf size, flower size, fruit size and hairiness of fruits. Specimens no.524 is very close to *T. rajasthanensis.* A specimen was sent

to Dr. V. Singh, Arid Zone Circle, Botanical Survey of India, Jodhpur for identification. He commented that the speciemen appeared to be an ecological variant of *T. terrestris*. Recently in a study of Taxonomic Status of Some of the *Tribulus* Species in the Indian Subcontinent Verghese et al. (1996) have reduced *T. rajasthanensis* as a variety of *T. terrestris*. In fact it seems to be intermediate between these two species.

Note: According to APG-2 this genus belongs to group Tribuloideae (Reichenbach) D. H. Porter of Zygphyllaceae.

25. AVERRHOACEAE

AVERRHOA L.

Averrhoa carambola L. Sp. Pl. 428. 1753; FBI. 1: 439. 1874; FUGP. 1: 124. Repr. ed. 1960; Dicot. Pl. Uttar Pradesh 62. 1999.

Small trees with drooping branches. Leaves alternate, imparipinnate, estipulate. Flowers pink-red in axillary cymes. Fruit oblong, acutely 5-winged, acid. **Flowering and fruiting:** Rainy and cold season. Often cultivated in orchards for the sake of acid, edible fruits. The fruits, locally known as *'Kamrakh'*, are sold in market and eaten either raw or pickled. Sweta ????

Note: According to APG-2 this genus belongs to family Oxalidaceae.

26. OXALIDACEAE

OXALIS L.

Key to species :

1. Underground, bulbous root-stock present; flowers purplish..... 2. ***O. dehradunensis***

1. Underground, bulbous root-stock absent; flowers yellow..... 1. ***O. corniculata***

1. Oxalis corniculata L. Sp. Pl. 435. 1753 ;Wight, Ic.1: t. 18.1838; FBI. 1:436. 1874; FUGP.1: 122.Repr. ed. 1960; Dicot. Pl. Uttar Pradesh 62. 1999.

Pubscent, hairy, perennial herbs. Leaves digitately trifoliate, leaflets obcordate. Flowers yellow, subumbellate. Capsule oblong, angular, hairy, erect. Seeds transversly ribbed, brown. **Flowering and fruiting:** Almost throughout the year. Commonly found in moist to dry sandy places, cultivated fields, wastelands and in *Kholas*. Some populations growing in *Kholas* have somewhat woody stems and larger flowers suffused with red. Sweta 640.

2. **Oxalis dehradunensis** Raizada in Suppl. Duthie, Fl. Gangetic Plain 37. 176; Fl. Rajasthan 1: 171. 1987. *O. richardiana* Babu, HFDD. 104. 1977. *O. latifolia auct. Pl.* non H. B. K.

Perennial, acaulescent herbs. Root-stock. bulbous, light pink Leaves digitaely 3-foliate, petiole long, hairy; leaflets cuneate, apex deeply notched. Flowers 2- many in subumbellate

corymbs, pedicels upto 4.0 cm long. Upper two-third part of petals purplish with purplish streaks, lower one-third part greenish-yellow with green streaks. Stamens 10, longer filaments densely hairy. **Fruiting and Fruiting:** Nearly round the year. Occasionally found in moist, humus rich soil in shady places. Sweta 740.

27. TROPAEOLACEAE

TROPAEOLUM L.

Tropaeolum majus L. Sp. Pl. 345. 1753; Man. Cult. Pl. ed. 2. 662. 1949; Dicot. Pl. Uttar Pradesh 61. 1999.

Trailing or climbing, annual, glabrous herbs. Leaves orbicular, peltate, long petioled. Flower solitary-axillary, long pedicelled, orange or yellow, variously blotched, zygomorphic. Sepals 5, posterior one produced into a spur. Petals 5, distinctly clawed, 2 posterior smaller, 3 anterior larger. Ovary 3-lobed, 3- celled, style shortly 3-branched. Fruit 3-lobed capsule, 3-seeded. **Flowering and fruiting:** January-April. Cultivated in gardens and parks, sometimes found as an escape. Sweta 987.

28. BALSAMINACEAE

IMPATIENS L.

Impatiens balsamina L. Sp. Pl. 938. 1753; FBI. 1: 453. 1874; FUGP. 1: 124. Repr. ed. 1960; Dicot. Pl. Uttar Pradesh 63. 1999.

Erect annual herbs, stem reddish. Leaves oblanceolate, acute, serrate. Flower solitary or in clusters of 2-3, axillary, zygomorphic, white, purple or pink. Posterior sepal petaloid and spurred. Stamens 5, nearly sessile, anthers connivent. Ovary 5-celled, hairy. Capsule splitting elastically. Seeds many, dark brown-black. **Flowering and fruiting:** August- October. Cultivated as rainy season ornamental, often found as escape. Sweta 988.

29. RUTACEAE

KEY TO GENERA:

1. Plants without spines.....3. ***Murraya***
1. Plants with axillary spines.....2
2. Leaves imparipinnate; stamens 10-12..... 2. ***Feronia***
2. Leaves 3-foliate; stamens many..... 1. ***Aegle***

1. AEGLE Correa *nom. cons.*

Aegle marmelos (L.) Correa in Trans. Linn. Soc. 5: 223. 1800; Wight, Ic. 1: t. 16. 1838; FBI. 1: 516. 1875; FUGP. 1: 134. Repr. ed. 1960; Fl. Rajasthan 1: 173. 1987. *Crataeva marmelos* L. Sp. Pl. 444. 1753.

Thorny, deciduous trees with greyish-white bark. Leaflets 3, ovate-lanceolate, lateral leaflets sessile, terminal one stalked. Flowers greenish-white, sweet-scented, in axillary panicles. Fruits glosbose, rind rough, ripe pulp orange. Seeds glabrous, pale-brown. **Flowering and fruiting:** March- July. Mostly cultivated in the area, a few apparently self-planted specimens growing wild could be observed. However, in nearby forests of Najibabad the species is found growing wild. Sweta 990.

2. FERONIA Correa

Feronia limonia (L.) Swingle in Journ. Washington Acad. Sci. 4: 328. 1914; Fl. Rajasthan 1: 173. 1987. *Schinus limonia* L. Sp. Pl. 389. 1753. *Feronia elephantum* Correa in Trans. Linn. Soc. 5: 225. 1800; Wight, Ic. 1: t. 15. 1838; FBI. 1: 516. 1875; FUGP. 1: 134. Repr. ed. 1960. Medium sized trees, bark dark grey, spines straight. Leaves alternate, 5-7 foliate; leaflets cuneate or obovate. Flowers small, numerous, in lateral and terminal pubescent panicles, pale-green with reddish tinge. Anthers dark-red. Fruit globose, hard, woody, grey. **Flowering and fruiting:** March- September. Occasionally found near villages, probably planted. Sweta 993.

3. MURRAYA J. G. Koenig ex L. *nom. cons.*

Key to species:

1. Leaflets 5-7; flowers in few flowered inflorescence, petals reflexed.....2. ***M. paniculata***
2. Leaflets 9- 25; flowers in large terminal inflorescence, petals spreading..... 1. ***M. koenigii***

1. Murraya koenigii (L.) Spreng. Syst. Veg. 2: 315. 1825; FBI. 1: 503. 1875; FUGP. 1: 129. Repr. ed. 1960; Fl. Rajasthan 1: 174. 1987. *Bergera koenigii* L. Mant. Pl. 1: 565. 1767.

Large, deciduous shrubs or small trees with dark-brown bark. Leaves alternate, imparipinnate, leaflets 9-25, obliquely-ovate or oblanceolate, slightly pubescent. Flowers in large, terminal, corymbose cymes, creamy-white, fragrant. Petals narrowly oblong, spreading. Fruits purplish. **Flowering and fruiting:** April - June. Occasionally occurs near villages. Sweta 930.

2. Murraya paniculata (L.) Jack. in Mal. Misc. 1. 5: 31. 1820; Dicot. Pl. Uttar Pradesh 67. 1999. *Chalcas paniculata* L. Mant. 68. 1767. *Murraya exotica* L. Mant. 563. 1771; FBI. 1: 502. 1875. FUGP. 1: 128. Repr. ed. 1960.

Differs from preceding species in having 5-7 leaflets which are shining on upper surface, pure white flowers in few flowered cymes, petals broader and distinctly reflexed and the red berries. **Flowering and fruiting:** Summer to cold season. This plant bears several flushes of

flowers in summer and rainy season. Often planted in houses and orchards for the sake of fragrant flowers. Sweta 1000.

30. SIMAROUBACEAE

AILANTHUS Desf. *nom. cons.*

Ailanthus excelsa Roxb. Pl. Cor. 1: 24. t. 23. 1795; FBI. 1: 518. 1875; FUGP. 1: 136. Repr. ed. 1960; Fl. Rajasthan 1: 176. 1987; Dicot. Pl. Uttar Pradesh 68. 1999.

Tall, deciduous, foetid smelling trees. Trunk with prominent leaf scars, bark whitish-grey. Leaves crowded at the end of branches, upto 90.0. cm long, glandular hairy; leaflets 7- 29, upto 15.0 cm long, ovate lanceolate, coarsely toothed. Flowers yellowish in large hairy panicles. Samaras upto 5.0 cm long, spindle shaped, glabrous, 1-seeded. **Flowering and fruiting:** March- June. Often found in *Kholas*. Sweta 1301.

31. MELIACEAE

KEY TO GENERA:

1. Leaflets entire; stamens free; fruit dehiscent..... 3. ***Toona***
1. Leaflets toothed; stamens united; fruit indehiscent..... 2
2. Leaves 1- pinnate; staminal tube creamy white..... 1. ***Azadirachta***
2. Leaves 1-3-pinnate; staminal tube purple.....2. ***Melia***

1. AZADIRACHTA A. Juss.

Azadirachta indica A. Juss. in Mem. Mus. Hist. Nat. Paris 19: 221. t. 13. f. 5. 1830; Dicot. Pl. Uttar Pradesh 69. 1999. *Melia azadirachta* L. Sp. Pl. 385. 1753; FBI. 1: 544. 1875; FUGP. 1: 141. Repr. ed. 1960.

Tall, deciduous trees; bark fissured. Leaves 1-pinnate, leaflets 7-15, falcate, coarsely dentate. Flowers in pendulous panicles, creamy-white, slightly sweet-scented. Staminal tube creamy-white. Drupes ovoid-oblong, yellow, juicy, single seeded, immature drupes possess white latex. **Flowering and fruiting:** February- June. Commonly planted in the area. Sweta 995.

2. MELIA L.

Melia azedarach L. Sp. Pl. 384. 1753; FBI. 1: 544. 1875; FUGP. 1: 141. Repr. ed. 1960; Dicot. Pl. Uttar Pradesh 69. 1999.

Medium sized, deciduous trees. Leaves 1-3 pinnate, leaflets 5-11, ovate-lanceolate, acuminate, glabrous. Flowers in axillary, drooping panicles. Staminal tube purple. Drupes 5-seeded, ellipsoid-oblong, dry and yellow when ripe. **Flowering and fruiting:** February- May. Fruits remain on the tree almost throughout the year. Common near villages. Sweta 1302.

3. TOONA Roem.

Toona ciliata Roem. Fam. Nat. Syn. Mongr. 1: 139. 1846; Dicot. Pl. Uttar Pradesh 70. 1999. *Cedrela toona* Roxb. ex Rottl. & Willd. in Ges. Naturf. Fr. Neue Schr. 2: 198. 1803; FBI. 1: 568. 1875; FUGP. 1: 143. Repr. ed. 1960.

Large, deciduous trees. Bark dark-brown. Leaves 1-pinate; leaflets 5-11, ovate-oblong or lanceolate, acuminate, entire, glabrous. Flowers white in terminal panicles. Sepals and petals ciliate. Stamens 5, inserted on lobes of orange, fleshy disk. Stigma peltate, 5-lobed. Seeds winged at both ends. **Flowering and fruiting:** Marh- June. Planted on roadsides. Sweta 1303.

32. CELASTRACEAE

CELASTRUS L.

Celastrus paniculata Willd. Sp. Pl. 1: 1125. 1797; FBI. 1: 617. 1875; FUGP. 1: 148. Repr. ed. 1960; Dicot Pl Uttar Pradesh 72. 1999.

Medium sized, deciduous climbers with lanticellate bark. Leaves upto 10. 0 cm long, ovate or elliptic, crenulate. Racemes axillary and terminal, upto 20.0 cm long. Flowers greenish-yellow, 4-5 merous. Stamens inserted on the margin of the disk. Fruit orange-yellow, 3-celled, each cell 1-2 seeded. Seeds ribbed, brown, enclosed within red aril. **Flowering and fruiting:** April- November. Occasionally found in *Kholas* climbing on shrubs and trees. Sweta 820.

33. RHAMNACEAE

ZIZIPHUS Mill.

Key to species:

1. Straggling or climbing shrubs.....3. ***Z. oenoplia***
1. Erect shrubs or trees.....2
2. Erect trees; branches drooping; leaves densely tomentose beneath, fruits more than 1.5 cm in diametere.....1. ***Z. mauritiana***
2. Diffuse, much branched shrubs; fruits less than 1.25 cm in diameter.....2. ***Z. nummularia***

1. Ziziphus mauritiana Lamk. Encycl. 3: 319. 1789; Fasc. Fl. Ind. (Fascl. 20) 99. 1990. *Rhamnus jujuba* L. Sp. Pl. 194. 1753. *Ziziphus jujuba* (L.) Gaertn. Fruct. 1: 203. 1788 *non* Mill 1768; Roxb. Fl. Ind. 2: 357. 1824 et Fl. Ind. 1: 608. 1832. FBI. 1: 632. 1875; FUGP. 1: 152. Repr. ed. 1960.

Large shrubs or trees; bark dark-grey or black. Spines solitary or in pairs, straight or recurved. Leaves alternate, basally 3-nerved, ovate-oblong or suborbicular, entire or serrulate. Flowers in axillary fascicles, greenish-white, 4-5 mm across; calyx campanulate; petals spathulate, clawed, lamina hooded. Disc distinctly 10-grooved, fleshy. Drupe oblong or ovoid. Seeds 2-celled, with hard, thick, bony shell. **Flowering and fruiting:** April – February. **Local name:** *Ber.* Extensively cultivated for the sweet, edible fruits. Sweta 212.

2. Ziziphus nummularia (Burm. f.) Wight & Arn. Prodr. 162. 1834; FBI. 1: 633. 1875; Fasc. Fl. Ind. (Fascl. 20) 102. 1990. *Rhamnus nummularia* Burm. f. Fl. Ind. 61. 1768. *Ziziphus rotundifolia* Lamk. Encycl. 3: 319. 1789; FUGP. 1: 153. Repr. ed. 1960.

Straggling shrubs, 2.0 -3.0 m. tall. Leaves ovate-orbicular, serrate, basally 3-nerved, velvety above. Cymes axillary, dense, 10- 25 flowered. Petals 1.0- 1.5 mm long, obovate-spathulate, margin convolute. Drupe 0.5- 0.6 mm across, globose, woody, glabrous, dark-red to black, shining when ripe. Seeds 2 or 1, compressed, black. **Flowering and fruiting:** April-December. **Local name:** *Jharberi.* Common in waste places. Sweta 1304.

3. Ziziphus oenoplia (L.) Mill. Gard. Dict. ed 8: 3. 1768; FB1. 1: 634. 1875; FUGP. 1: 154. Repr. ed. 1960; Fasc. Fl. Ind. (Fascl. 20) 103. 1990. *Rhamnus oenoplia* L. Sp. Pl. 194. 1753.

Straggling or climbing shrubs, branches strigose. Stipular spines, solitary, short, straight or hooked, brown. Leaves obliquely ovate-lanceolate. Flowers in axillary cymes. Fruits 0.6-0.8 mm across, globose or ovate, black, shining, 1-2 celled. **Flowering and fruiting:** March-December. **Local name:** *Makoe, Makoh.* Found in waste places. Sweta 95.

34. VITACEAE

KEY TO GENERA:

1. Leaves trifoliate; petals 4..... 2. ***Cayratia***

1. Leaves simple; petals 5..... 1. ***Ampelocissus***

1. AMPELOCISSUS Planch. *nom. cons.*

Ampelocissus latifolius (Roxb.) Planch. in Journ. Vigne. Am. 374. 1884 *et* in DC. Monogr. Phan. 5: 370. 1887; Dicot. Pl. Uttar Pradesh 77. 1999. *Vitis latifolia* Roxb. Fl. Ind. 2: 474. 1824. FBI. 1: 652. 1875; FUGP. 1: 160. Repr. ed. 1960.

Extensive climbers with, hollow branches. Leaves long-petioled, orbicular, cordate, 3-5 angled, lobes dentate, basal nerves 5. Flowers small reddish-brown, in small, thyrsoid, compact cymes. Berries globose, black, 2-seeded. Seeds ellipsoid, margins crenate. **Flowering and fruiting:** April- October. Often found climbing on shrubs near swampy areas. Sweta 79.

2. CAYRATIA A.L. Juss. *nom. cons.*

Cayratia trifolia (L.) Domin. in Biblioth. Bot. 89. 371. 1927; Dicot. Pl. Uttar Pradesh 77. 1999. *Vitis trifolia* L. Sp. Pl. 203. 1753; FUGP. 1: 163. Repr. ed. 1960. *Cissus carnosa* Lamk. Encycl. 1: 31. 1789. *Vitis carnosa* (Lamk.) Wight & Arn. Prodr. 127. 1834; FBI. 1: 654. 1875. *Cayratia carnosa* (Lamk.) Gagnep. in Not. Syst. 1: 347. 1911.

Slender, herbaceous, climbers. Leaflets 3, ovate-elliptic or obovate, upto 7.0 cm long, somewhat fleshy, crenate. Flowers in axillary cymes, greenish white. Fruit obovoid-globose, 3-4 seeded. Seeds trigonous, rugose. **Flowering and fruiting:** July-December. Frequently found in the sanctuary climbing on trees or shrubs. Sweta 999.

Cissus qudarangularis L. (*Harjore*) is often cultivated in the area as an ornamental and is used in traditional medicine for treatment of fractured bones.

Vitis vinifera L. (*Angoor*) is cultivate for the sake of edible fruits.

Note: According to APG-2 all these genera belong to group Viticoideae Eaton of Vitaceae.

35. SAPINDACEAE

KEY TO GENERA:

1. Trees; petals none; fruit not balloon like..... 2. ***Schleichera***

1. Climbers; petals white; fruit balloon like..... 1. ***Cardiospermum***

1. CARDIOSPERMUM L.

Cardiospermum halicacabum L. Sp. Pl. 366. 1753; Wight, Ic. 2(2): 8. t. 508. 1841; FBI. 1: 670. 1875; FUGP. 1: 166. Repr. ed. 1960; Fl. Rajasthan 1: 191. 1987.

Slender, thinly hairy climbers. Tendrils axillary, 3-fid, stiff. Leaves upto 7.0 cm long deltoid or ovate. Leaflets deeply cut, acuminate, glabrous and thin. Flowers minute, white, zygomorphic. Fruits balloon like, winged. Seeds 3, globose, smooth, black with a heart shaped white aril. **Flowering and fruiting:** July- December. Often found among hedges. Sweta 1305.

2. SCHLEICHERA Willd. *nom. cons.*

Schleichera oleosa (Lour.) Oken. Alleg. Naturg. 3(2): 1341. 1841; Fl. Rajasthan 1: 192. 1987. *Pistacia oleosa* Lour. Fl. Cochinch. 615. 1790. *Schleichera trijuga* Willd. Sp. Pl. 4: 1096. 1805; FBI. 1: 681. 1875; FUGP. 1: 167. Repr. ed. 1960.

Medium sized to tall trees; bark grey, smooth. Leaves imparipinnate, upto 15.0 cm long; leaflets 2-4 pairs, oblong or elliptic-oblong, entire. Flowers yellowish-green in axillary racemes, often several together. Petals none. Fruit pointed, ovoid, dark-brown, glabrous. Seeds smooth, glabrous. **Flowering and fruiting:** March-June. Often found on roadsides as avenue tree. Young crimson foliage makes this species conspicuous in early summer season. Sweta 1306.

36. ANACARDIACEAE

MANGIFERA L.

Mangifera indica L. Sp. Pl. 200. 1753; FBI. 2: 13. 1876; FUGP. 1: 176. Repr. ed. 1960; Dicot. Pl. Uttar Pradesh 83. 1999.

Small to tall trees depending on the variety. Bark blackish-graey, fissured. Leaves oblong-lanceolate, entire or margin undulate, acute, glabrous, shining on upper surface. Flowers in large terminal panicles, yellowish-green, male and bisexual on the same panicle. Fertile stamen 1. Drupe subovoid or obliquely pyriform. Pulp fragrant, orange to whitish. **Flowering and fruiting:** February- July. Extensively planted in the area for the sake of delicious fruits. Sweta 1312.

37. MORINGACEAE

MORINGA Adans.

Moringa oleifera Lamk. Encycl. Meth. Bot. 1: 398. 1785; Dicot. Pl. Uttar Pradesh 84. 1999. *M. pterygosperma* Gaertn. Fruct. Sem. Pl. 2: 314. 1791; FBI. 2: 45. 1876; FUGP. 1: 179. Repr. ed. 1960.

Medium sized, soft wooded trees. Leaves 3-pinnate, upto 60.0 cm long, leaflets 5-9 pairs, obovate or elliptic-ovate, entire. Flowers in large panicles; sepals reddish externally near the base; petals creamy white. Antheriferous filaments hairy at the base. Capsule upto 45.0 cm long , trigonous, ribbed, beaked, dark-brown when ripe, seeds winged. **Flowering and fruiting:** February- June. Often planted near villages or in kitchen gardens for edible fruits. Sweta 1314.

38. FABACEAE

KEY TO GENERA:

1. Stamnes 1-adelphous..... 2
1. Stamnes 2-adelphous..... 9
2. Pods jointed, echinate; leaflets 2..... .....31. ***Zornia***
2. Pods not jointed.....3
3. Trees.....4
3. Erect, prostrate or twining herbs or shrubs..... 5
4. Flowers cream-yellow; calyx not brown hairy;

pods oblong or linear, thin.....9 ***Dalbergia***

4. Flowers pinkish; calyx brown hairy; pods
obliquely oblong, stout.....21. ***Pongamia***

5. Erect, or prostrate herbs; flowers yellow, in racemes;
pods turgid.....8. ***Crotalaria***

5. Herbaceous or woody twiners; flowers not yellow..... 6

6. Stamens 9; seeds pink-red with a black spot.....1. ***Abrus***

6. Stamens 10; seeds not as above..... 7

7. Anthers unifrom; leflets 5-7; style bearded below
the stigma..... 7. ***Clitoria***

7. Anthers dimorphic..... 8

8. Style bearded; pods continuous within..... 8. ***Crotalaria***

8. Style not bearded; pods septate between the seeds..... 25. ***Teramnus***

9. Stamens in two bundles of 5 each; leaves odd-pinnate;
ripe pods much longer than the calyx..... 10

9. Stamnes in two bundles of 9+1..... 11

10. Herbs or shrubs;leaflets numerous pods jointed;
standard with a central red spot.....2. ***Aeschynomene***

10. Trees; leaflets 3-5; pods not jointed; standard
without a red spot..... 9. ***Dalbergia***

11. Leaf rachis or leaflets modified into tendrils..... 12

11. Leaf rachis or leaflets not modified into tendrils,
i.e. tendrils absent..... 13

12. Staminal tube truncate at the mouth.....15. ***Lathyrus***

12. Staminal tube oblique at the mouth.....29. ***Vicia***

13. Pods jointed; herbs or shrubs..... 14

13. Pods not jointed; habit various.....17

14. Plants spiny; leaves exstipellate..... 3. ***Alhagi***

14. Plants not spiny; leaves stipellate..... 15

15. Joints of pods folded on one another..... 28. ***Uraria***

15. Joints of pods not folded 16

16. Joints of pods turgid, if compressed then corolla not
or hardly exserted..... .....4. ***Alysicarpus***

16. Joints of pods compressed; corolla always exserted.....10. ***Desmodium***

17. Trees; leaflets 3, stipellate.....18

17. Herbs, shrubs or twiners.....19

18. Armed trees; sepals green; petals very unequal in size.....12. ***Erythrina***

18. Unarmed trees; sepals with black tomentum; petals
nearly equal in size.....6. ***Butea***

19. Climbing or twining herbs or shrubs..... 20

19. Erect or prostrate herbs, under shrubs or shrubs.....26

20. Leaves gland dotted beneath.....21

20. Leaves not gland dotted beneath.....22

21. Pods 3 to many seeded; densely hairy..... 5. ***Atylosia***

21. Pods 1-2 seeded; thinly hairy or glabrous.....22. ***Rhynchosia***

22. Style bearded below the stigma..... 23

22. Style not bearded below the stigma; keel much exceeding the standard; anthers dimorphic; pods clothed with brittle, irritant bristles.....20. ***Mucuna***

23. Petals almost equal in size..... 24

23. Petals very unequal in size, blue; standard with a white spot in the centre.....7. ***Clitoria***

24. Stigma terminal; pods compressed..... 25

24. Stigma oblique; pods turgid.....30. ***Vigna***

25. Style long and slender, or slightly widened above..... 17. ***Macrotyloma***

25. Style thick, conspicuously laterally flattened, and blade like throughout its length..... 14. ***Lablab***

26. Anthers apiculate.....13. ***Indigofera***

26. Anthers muticous or obtuse..... 27

27. Leaves or leaflets entire..... 28

27. Leaves or leaflets toothed..... 32

28. Leaflets 5; lower leaflets stipule like, arising from the base of petiole; flowers subtended by a reduced 3-foliate leaf at the end of long peduncle; filaments dilated at the apex ..... 16. ***Lotus***

28. Leaflets 1- many; lower leaflets and filaments not as above; flowers not subtended by trifoliate reduced leaf.....29

29. Leaflet 1, nearly orbicular, sometimes with 2 very small lateral leaflets..... 11. ***Eleiotis***

29. Leaflets 3- many; pods 3- many seeded.....30

30. Flowers in racemes or in peduncled to sessile heads; inflorescence axillary.....31

30. Flowers axillary or in leaf opposed and / or terminal raemes..... 24. ***Tephrosia***

31. Pods transeversely septate between the seeds; erect large herbs or trees..... 23. ***Sesbania***

31. Pods aseptate or not transeversely sepatate between the seeds; flowers in pedunculate, axillary racemes; pods 4- 7 seeded; climbing or prostrate herbs..... 5. ***Atylosia***

32. Stipules adnate to the petioles.....33

32. Stipules free lateral..... 34

33. Leaves digitately 3- foliate; flowers in axillary,
condensed, head-like racemes.....26. ***Trifolium***

33. Leaves pinnately 3-foliate; flowers in long,
axillary racemes..... 19. ***Melilotus***

34. Pods spirally twisted, echinate or globose and
smooth and 1- seeded.....18. ***Medicago***

34. Pods linear , straight or slightly upcurved,
more than 2- seeded..... 27. ***Trigonella***

1. ABRUS Adans.

Abrus precatorius L. Syst. Nat. ed. 12. 472. 1767; FBI. 2: 175. 1876; FUGP. 1: 241. Repr. ed. 1960; Fl. Rajasthan 1: 201. 1987.

Deciduous, medium sized woody climbers. Leaves paripinnate; leaflets 12-20 pairs, elliptic-oblong. Flowers in short, axillary or terminal racemes, pinkish. Pods oblong, beaked, usually many seeded, truncate. Seeds subglobose, bright red with a black spot around the hilum. **Flowering and fruiting :** August-January. **Local Name.** *Ratti, Ghumchi.* Commonly found along roadsides and in the sandy soil. Sweta 309, 576.

2. AESCHYNOMENE L.

Aeschynomene indica L. Sp. Pl. 713. 1753; FBI. 2: 151. 1876; FUGP. 1: 249. Repr. ed. 1960; Fl. Rajasthan 1: 202.1987.

Erect, aquatic or amphibious, annual herbs. Stem fistular, warty. Leaves 2-10 cm long, leaflets numerous, small, lanceolate or oblong, glabrous, obtuse. Flowers 1-4, short peduncled. Calyx about 0.5 cm long, lower lip shortly 3-toothed, upper lip 2-dentate, punctate. Corolla cream, often streaked with purple, wings shorter than keels, seeds black. Pods 2.5-5 X 0.4-0.5 cm, slightly curved, 6-10 jointed. **Flowering and fruiting.** August-November. **Local name.** *Chhuimui.* Common along canal banks, in rice fields and or margins of ditches. Sweta 996.

3. ALHAGI Gagnebin

Alhagi maurorum Medic. in Vorles, Churpf. Phys. Oek. Ges. 2: 397. 1787; FBI. 2: 145. 1876; Fl. Rajasthan 2: 202. 1987. *A. camelorum* Fisch. ex. DC. Prodr. 2: 352. 1825; FUGP. 1: 257. Repr. ed. 1960.

Erect, deep-rooted, spinous bushy undershrubs. Leaves simple, obovate-oblong, entire. Flowers 1-6 on axillary spines, shortly stalked, reddish or pinkish. Corolla reddish. Pods 2-4.5

x 0.1-0.2 cm, linear-cylindric, irregularly constricted between the seeds, smooth. **Flowering and fruiting.** March-July. Included on authority of Murty and Singh (1961b).

4. ALYSICARPUS Desv. *nom. cons.*

Key to species:

1. Pods moniliform.....2
1. Pods not moniliform.....3
2. Calyx shorter than, or as long as the first joint of the pod..... 2. ***A. monilifer***
2. Calyx much longer than , or equaling the pod..... 3. ***A. rugosus***
3. Leaflet broadly elliptic-oblong or linear-lanceolate; pods turgid, not indented..... 4. ***A. vaginalis***
3. Leaflets suborbicular; pods compressed; shallowly indented on both sutures..... 1. ***A. hamosus***

1. Alysicarpus hamosus Edgew. in Journ. Asiat. Soc. Beng. 21: 171.1853; FBI.2:157.1876; FUGP. 1: 255.Repr. ed. 1960; Fl. Rajasthan 1: 204.1987. *Hedysarum procumbens* Roxb. Fl. Ind. 3: 345. 1832, non Mill. 1768. *Alysicarpus procumbens* (Roxb.) Schindl. in Fedde Repert. 21: 11. 1925. *nom. illegit.*

Prostrate, ascending, hirsute, annual herbs. Leaves 1-3 X 1.5-2.5 cm, obtuse, mucronate, base rounded. Flowers purplish, in lax 4-8 flowered racemes. Three lower calyx teeth linear-lanceolate, acute, ciliate. Pods falcate-oblong, 4-7 jointed, hooked along the sutures. Seeds oval, smooth, brown. **Flowering and fruiting.** August-November. Found in moist habitats near ditches. Sweta 324.

2. Alysicarpus monilifer (L.) DC. Prodr. 2: 353. 1825; FBI. 2: 157. 1876; FUGP.1: 254. Repr. ed. 1960; Fl. Rajasthan 1: 206. 1987. *Hedysarum moniliferum* L. Mant. 1: 102.1767.

Prostrate, perennial herbs. Leaves simple, oblong, obtuse, cordate, glabrous. Flowers shortly stalked, 4-10 in axillary or terminal peduncled racemes, pink. Calyx persistent, teeth lanceolate acute, striate.Pods 2-6 jointed, joints globose, hairs hooked. **Flowering and fruiting.** August-November.**Local name.** *Chatta ki ghas.* Common along the roadside and in waste places forming dense patches. Sweta 1307.

3. Alysicarpus rugosus (Willd.) DC. Prodr. 2: 353.1825; FBI. 2: 159. 1876; FUGP. 1: 256. Repr. ed. 1960; Fl. Rajasthan 1: 207. 1987. *Hedysarum rugosum* Willd. Sp. Pl. 3: 1172. 1802.

Erect, descending-decumbent herbs. Leaves oblong, cordate, obtuse, apiculate. Flowers sessile in dense, spike like racemes, purplish-blue. Bracts large, ovate-acuminate. Calyx teeth lanceolate, ciliate, glabrous. Pods shortly stalked, apiculate, 2-5 jointed, transversely ribbed. **Flowering and fruiting.** September-November. Common in grassy places, agricultural fields and on roadsides. Sweta 1318.

4. Alysicarpus vaginalis (L.) DC. Prodr. 2: 353.1825; FBI. 2: 158. 1876, excl. var. *heterophyllus*; FUGP. 1: 255. Repr. ed. 1960; Fl. Rajasthan 1: 208. 1987. *Hedysarum vaginalis* L. Sp. Pl. 746. 1753. *H. nummularifolium* L. Sp. Pl. 746.1753, *pro parte* non DC. 1825. *Alysicarpus vaginalis* L. var. *nummularifolius* (L.) Baker in Hook. f FBI 2: 158. 1876; FUGP. 1: 255. Repr. ed. 1960.

Erect or prostrate annual to perennial herbs. Leaves broad or oblong, oblong-lanceolate, cordate; stipules ovate, acute, parallel veined. Flowers in lax axillary racemes. Calyx teeth linear, setaceous. Corolla small, standard red, with 2 basal yellow stripes, wings dark red. Pods terete, 6-8 jointed, joints reticulately veined, 1-seeded, hairs hooked. **Flowering and fruiting.** September-November. Common in waste places and on riverbeds. Sweta 155, 199, 526.

5. ATYLOSIA Wight & Arn.

Key to species:

1. Leaflets subdigitate, much longer than the broad..... 2. ***A. scarabaeoides***
1. Leaflets not subdigitate; the terminal leaflet with an elongated stalk..... 1. ***A. platycarpa***

1. Atylosia platycarpa Benth. in Miq. Pl. Jungh. 243. 1852; FBI. 2: 216. 1876; FUGP. 1: 196. Repr. ed. 1960; Fl. Rajasthan 1: 210. 1987.

Trailing or twining, hairy herbs. Leaflets 1-2.5 x 0.5-2.0 cm, elliptic-oblong, mucronate, grey-tomentose, membranous, acuminate. Flowers 1-2, in axillary racemes shorter than the leaves, yellow. Bracts ovate, acuminate. Calyx hirsute, lobes ovate-lanceolate, densely pilose, acuminate.Corolla slightly exserted. Pods 2 x 0.5 cm, clothed with deciduous grey hairs, straight, flat; seeds oblong, black. **Flowering and fruiting.** August-November. Found in grassy fields and dried bed of Ganga. Included on authority of Murty and Singh (1961b). .

2. Atylosia scarabaeoides (L.) Benth. ex Baker in FBI. 2: 215. 1876; FUGP. 1: 196. Repr. ed. 1960; Fl. Rajasthan 1: 210. 1987. *Dolichos scarabaeoides* L. Sp. Pl. 726. 1753. *Atylosia scarabaeoides* Benth. in Miq. Pl. Jungh. 242. 1852, *nom.nud.*

Slender, trailing annual or perennial herbs with densely grey-downy stems.Leaves subdigitately 3 foliate; leaflets 1-3 x 0.5-2.0 cm, elliptic-obovate, rounded, mucronate, grey tomentose. Stipules minute, caducous. Flowers in axillary, 2-6 flowered corymbose racemes. Calyx densely grey-silky, teeth linear. Corolla yellow, slightly exserted, keel abruptly incurved at the tip. Pods 2x 6 cm, oblong, straight, 4-6 seeded. **Flowering and fruiting.** August-November. Common in waste lands, Kholas and on roadsides. Sweta 370.

6. BUTEA Roxb. ex Willd. *nom.cons.*

Butea monosperma (Lamk.) Taub. in Engl. & Prantl, Nat. Pflanzenfam. 3 (3): 366. 1894; Fl. Rajasthan 1: 211.1987. *Erythrina monosperma* Lamk. Encycl. 1: 391. 1785. *Butea frondosa* Koenig ex Roxb. in Asiat. Res. 3: 369. 1792; FBI.2: 194. 1876; FUGP. 1: 221. Repr. ed. 1960.

Small or moderate size trees. Leaflets 3, coriaceous, rhomboid or broadly obovate, glabrous above, silky-tomentose beneath, cuneate. Flowers bright orange-red, 5-8 cm long in terminal and lateral racemes. Calyx brown-velvety outside, grey silky within. Corolla silvery tomentose, bright orange-red, keel much curved, acute. Pods 12-15 x 2-6 cm, flat, silky tomentose, pendulous, 1-seeded. **Flowering and fruiting.** March-June. **Local name.** *Dhak, Palas, Tesu.* Commonly found in *Kholas*. Also cultivated in gardens for its beautiful flowers. Sweta 1311.

7. CLITORIA L.

Clitoria ternatea L. Sp. Pl. 753. 1753; FBI. 2: 208. 1876; FUGP. 1: 212. Repr. ed. 1960; Fl. Rajasthan 1: 213. 1987.

Climbers with terete, downy, stems. Leaflets 5-9, ovate-oblong, obtuse, 2-4 x 1.0-2.5 cm. Flowers axillary, solitary or paired, blue or rarely white. Bracteoles large, obtuse, suborbicular. Calyx teeth lanceolate. Corolla bright blue with a white centre. Pods 6-12 cm long, linear, flat. Seeds 6-10, oblong, glabrous, black.**Flowering and fruiting.** August-March. Found in hedges as an escape. Also cultivated as an ornamental climber. Sweta 1317.

8. CROTALARIA L.

Key to specie:

1. Leaves 3- foliate.....2

1. Leaves simple.....3

2. Pods 2- seeded, sessile.....4. ***C. medicaginea***

2 Pods many seeded, stalked..... 6. ***C. orixensis***

3. Stem alate by the decurrent stipules.....1. ***C. bialata***

3. Stem exalate; stipules not decurrent..... 4

4. Pods glabrous.....5
4. Pods densely hairy..... 3. ***C. juncea***
5. Pod as long as or hardly exceeding the calyx..... 2. ***C. calycina***
5. Pod much exceeding the calyx..... 5. ***C. mysorensis***

1. Crotalaria bialata Schrank Pl. Rar. Hort. Monac. t. 13. 1819; Fl. Java 1: 579. 1963; Dicot. Pl. Uttar Pradesh 93. 1999. *C. alata* Buch.- Ham. ex D. Don, Prodr. 241. 1825; Roxb. (Hort. Beng. 98. 1814, *nom. nud.*) Fl. Ind. ed. Carey 3: 274. 1832; FBI. 2: 69. 1876; FUGP. 1: 186. Repr. ed. 1960.

Erect, annual, shrubby herbs. Leaves short-petioled, elliptic to obovate, obtuse or retuse, mucronate, appressed hairy, up to 10.0 x 5.0 cm. Racemes few flowered, bracteoles inserted on the calyx. Calyx appressed hairy, up to 1.5 cm. Corolla hardly exserted, pale-yellow. Pod up to 5.0 cm long, 30-40 seeded. **Flowering and fruiting:** September- June. Included on authority of Murty and Singh (1961b).

2. Crotalaria calycina Schrank, Pl. Rar. Hort. Monac. t. 12. 1819; FBI. 2: 188.1876; FUGP. 1: 188. Repr. ed. 1960; Dicot. Pl. Uttar Pradesh 93. 1999.

Erect annual herbs. Leaves 3-10 x 1-2 cm, lanceolate-oblong, subobtuse, mucronate. Flowers 2-4, in short, lax racemes. Bracts lanceolate. Bracteoles inserted on the calyx. Calyx densely covered with long brown hairs, segments lanceolate-oblong. Corolla shorter than the calyx. Pods sessile, enclosed witin the calyx, 20-40 seeded. Seeds greyish white. **Flowering and fruiting.** August-December. Found in waste places and on roadsides. Sweta 1315.

3. Crotalaria juncea L. Sp. Pl. 714.1753; FBI. 2: 79.1876; FUGP. 1: 190. Repr. ed. 1960; Dicot. Pl. Uttar Pradesh 93. 1999.

Tall, erect stiff annual herbs. Leaves 4-15 x 0.5-4 cm, shortly petioled, lanceolate-oblong, mucronate, shining, reddish-brown silky hairy. Stipules minute, subulate. Flowers 3-10, in lateral and terminal lax racems. Bracts minute, linear. Calyx reddish-velvety, deeply toothed, acuminate. Corolla bright-yellow, exserted, glabrous. Pods 2-3.5 cm long, clothed with short spreading persistent greyish hairs, 6-15 seeded. **Flowering and fruiting:** September-February. Found on road sides and in waste places. Also cultivated. Sweta 362.

4. Crotalaria medicaginea Lamk. Encycl. Meth. Bot. 2: 201.1786; FBI. 2: 81.1876; FUGP. 1: 190. Repr. ed. 1960; Fl. Rajasthan 1: 218.1987. *C. neglecta* Wight & Arn. Prodr. 192.1834; *C. luxurians* Benth. in Hook. Lond. Journ. Bot. 2: 578.1843. *C. medicaginea* Lamk. var. *neglecta* (Wight & Arn.) Baker & var. *luxurians* (Benth.) Baker in FBI 2: 81.1876.

Small, erect, annual herbs. Leaves 3 foliate, oblong, obtuse, apiculate, subsessile. Stipules filiform, minute. Flowers 2-few, in dense terminal racemes. Bracts minute, linear. Bracteoles minute. Calyx clothed with appressed silky hairs, teeth linear, Corolla yellow, often streaked with red. Pods obliquely, subglobose, 2-seeded, beaked with a persistent stylar-base. Seeds greyish-brown. **Flowering and fruiting:** July-November. **Local Name**. *Gulabi.* Common in grassy area of riverbeds, roadsides, field borders. Sweta 138.

5. Crotalaria mysorensis Roth, Nov. Pl. Sp. 338. 1821; FBI.2: 70. 1876; FUGP. 1: 188. Repr. ed. 1960; Fl. Rajasthan 1: 219.1987. *C. ferruginea sensu* Duthie, FUGP. 1: 203.Repr. ed. 1960, non Grah. ex Benth. 1834.

Erect annual herbs. Leaves subsessile 2-10 x 0.5-2 cm, linear-oblong, obtuse, mucronate. Stipules foliaceous, linear or lanceolate. Flowers 3-8 in lax racemes. Bracts lanceolate, leafy. Bracteoles inserted just below the calyx, lanceolate. Calyx segments lanceolate, densely ferruginous hairy. Corolla as long as the calyx. Pods subsessile, 3-3.5 cm long, oblong, 50-60 seeded. **Flowering and fruiting.** August-December.Found in grassy areas of river beds and neglected corners of fields. Sweta 1336.

6. Crotalaria orixensis Willd. in Ges. Naturf. Fr. Berlin New Schr. 4: 217.1803; FBI. 2: 83. 1876; FUGP. 1: 191.Repr. ed. 1960; Fl. Rajasthan 1: 219.1987.

Diffuse, annual or perennial herbs. Leaflets 1.5-4 x 0.2-1.5 cm, elliptic or obovate-oblong, obtuse, gland-dotted beneath. Stipules foliaceous, lanceolate, persistent. Racemes terminal or lateral, 3-10 flowered. Bracts leafy, cordate, acuminate, reflexed. Calyx teeth linear. Pods 1.2-2 cm long, long stalked, oblong, glabrous. Seeds 8-10, reniform, brown, smooth. **Flowering and fruiting.** August-November. Rare in wet habitats. Sweta 21.

9. DALBERGIA L. f. *nom. cons.*

Key to species:

1. Leaflets rounded or emarginate at the apex..... 1. ***D. latifolia***
1. Leaflets abruptly acuminate.....2. ***D. sissoo***

1. Dalbergia latifolia Roxb. Pl. Cor. 2: 7. t. 113. 1799; FBI. 2: 231. 1876; FUGP. 1: 242. Repr. ed. 1960; Fl. Rajasthan 1: 223. 1987.

Large deciduous trees. Leaves imparipinnate, leaflets 5-9, broadly elliptic, 2-5 x 1.5-4.0 cm, elliptic obovate, obtuse, cuneate. Flowers in lax, axillary panicles, white. Corolla twice the calyx. Pods oblong-lanceolate, 4-8 x 1.2-2.0 cm, flat, 1-4 seeded. Seeds reniform, black. **Flowering and fruiting.** *Safed sisum.* Included on authority of Murty and Singh (1961b).

2. Dalbergia sissoo Roxb. Fl. Ind. 3: 223. 1832; FBI. 2: 231.1876; FUGP. 1: 243. Repr. ed. 1960; Fl. Rajasthan 1: 224. 1987.

Large deciduous trees with grey bark. Leaflets 3-5, alternate, 3-6 x 2-5.5 cm, obliquely ovate, acumiante, suborbicular, glabrous. Flowers subsessile, in axillary panicles, yellowish. Corolla yellowish-white, twice the calyx, standard with long claw. Pods 4-6 x 1 cm, strap shaped, flat, obtuse, mucronate, glabrous, 2-3 seeded. **Flowering and fruiting.** March-August. **Local name.** *Sisum or Shisham.* Commonly found along the roadsides and on boundaries of fields and gardens.Also occurs in *Kholas*. Sweta 1324.

10. DESMODIUM Desv. *nom. cons.*

Key to species:

1. Leaves trifoliate; flowers1-3 in axillary clusters;
   small prostrate herbs..... 2. ***D. triflorum***
1. Leaves simple; flowers in long, axillary and terminal
   racemes; erect herbs or undershrubs..... 1. ***D. gangeticum***

1. Desmodium gangeticum (L.) DC. Prodr. 2: 327. 1825. 1840; FBI. 2: 168. 1876; FUGP.1: 264. Repr. ed. 1960; Fl. Rajasthan 1: 226. 1987. *Hedysarum gangeticum* L. Sp. Pl. 746. 1753. *H. maculatum* L. Sp. Pl. 746.1753. *Desmodium gangeticum* (L.) DC. Var. *maculatum* (L.) Baker FBI. 2: 168. 1876; FUGP. 1: 264. Repr. ed. 1960.

Slender erect herbs or undershrubs. Leaflets ovate, oblong, acute, rounded, 3-18 x 2-10 cm, ovate or elliptic, repand, hairy beneath. Flowers in axillary and terminal racemes, white or pink. Bracts triangular, minute, setaceous. Pods linear, flat, 4-8 jointed, clothed with hooked hairs. Seeds smooth, brown. **Flowering and fruiting.** March-December. **Local name.** *Salpalni.* Common in grassy localities, fallow land and on roadsides. Sweta 725.

2. Desmodium triflorum (L.) DC. Prodr. 2: 334. 1825, excl. syn. *D. biflorum*; FBI. 2: 173. 1876; FUGP. 1: 263. Repr. ed. 1960; Fl. Rajasthan 1: 228. 1987. *Hedysarum triflorum* L. Sp. Pl. 749.1753..

Small, creeping or prostrate, perennial herbs. Leaflets 0.5-1 x 0.35-0.8 cm, obovate, truncate or emarginate, membranous. Stipules ovate-lanceolate, persistent, acuminate. Flowers 1-3, axillary. Calyx with long white hairs, teeth long, setaceous. Corolla pink. Bracts ovate, acute. Pods 2-5 jointed, linear, flat, often falcate, indented on both the sutures, joints1-seeded, pubescent. **Flowering and fruiting.** September-November. Common in grassy localities, wastelands and on roadsides. Sweta 192, 295.

11. ELEIOTIS DC.

Eleiotis monophylla (Burm. f.) DC. Mem. Legum. 2: 350. 1825; Fl. Rajasthan 1: 230. 1987. *Glycine monophylla* Burm. f. Fl. Ind. 161. t. 50. f. 2. 1768. *Hedysarum sororium* L. Mant. 2: 270. 1771. *Eleiotis sororia* (L.) DC. Mem. Legum. 2: 350. 1825; FBI. 2: 153. 1876; FUGP. 1: 251. Repr. ed. 1960.

Prostrate or straggling, glabrous, annual herbs with wiry stems. Leaves up to 4.0 x 4.5 cm, ovate-orbicular or subreniform. Stipules and stipels scarious. Flowers in axillary 5- 10 flowered racemes, pale to creamy-yellow. Calyx-tube truncate. Standard emarginate. Fruits up to 0.5 cm long, boat-shaped, compressed, brown. Seeds subreniform, dark-brown, polished. **Flowering and fruiting:** August-December. Occasionally found in *Kholas.* Sweta. 1322.

Note: According to Hooker (1876) and Duthie (1960) this species occurs in Bundelkhand in southern part of Uttar Pradesh state, close to Madhya Pradesh. Earlier works on floristics of western Uttar Pradesh, Delhi or Punjab have not documented its occurrence. Therefore, its occurrence in the study area is interesting.

12. ERYTHRINA L.

Erythrina suberosa Roxb. Fl. Ind. 3: 253. 1832; FBI. 2: 189. 1876; FUGP. 1: 219.Repr. ed. 1960; Fl. Rajasthan 1: 231. 1987.

Medium-sized deciduous trees. Leaves pinnately trifoliolate; leaflets 10-15 x 10-15 cm, broader than long, rhomboid, entire, acute. Stipules linear-lanceolate. Stipels rounded, glanduliform. Flowers in capitate racemes, gathered at the end of branches, scarlet. Calyx campanulate. Standard oblong, narrowed into a short claw, keels connate. Pods terete, tapering ends, straight, 2-5 seeded, black. **Flowering and fruiting.** April-June. Planted as an ornamental. Sweta 1310.

13. INDIGOFERA L.

Key to species:

1. Leaves simple.....2
1. Leaves compound.....3
2. Leaves linear lanceolate; pods globose, 1-seeded.....5. ***I. linifolia***
2. Leaves ovate-cordate; pods oblong, 1-2 seeded.....1. ***I. cordifolia***
3. Flowers in axillary short peduncled heads; leaves 5-9 foliolate.....6. ***I. linnaei***
3. Flowers in axillary racemes; pods more or less turgid.....4
4. Flowers upto 6 per inflorescence; usually prostrate herbs.....5
4. Flowers more than 12 in each raceme.....6
5. Leaflets 5.....2. ***I. glabra***
5. Leaflets 7-9.....4. ***I. karnatakana***
6. Pods densely tomentose.....3. ***I. hirusta***

6. Pods nearly glabrous..... 7. ***I. tinctoria***

1. Indigofera cordifolia Heyne ex Roth, Nov. Pl. Sp. 357. 1821; FBI. 2: 93. 1876; FUGP. 1: 230. Repr. ed. 1960; Fl. Rajasthan 1: 239. 1987

Prostrate or diffuse, annual herbs. Leaves 0.5-1.5 x 0.5-1.0 cm, subsessile, simple, ovate, cordate, mucronate, hairy at back. Stipules minute, setaceous. Flowers 4-8, in dense nearly sessile heads. Calyx with a short tube. Corolla bright red. Pods oblong, terete, beaked, acute, 2-seeded, seeds ovate, truncated, white. **Flowering and fruiting.** August-December. Included on authority of Murty and Singh(1961).

2. Indigofera glabra L. Sp. Pl. 751. 1753; FUGP. 1: 231. Repr. ed. 1960; Fl. Rajasthan 1: 240. 1987. *I. pentaphylla* Murr. Syst. Veg. ed. 564. 1774; FBI. 2: 95. 1876.

Densely caespitose, annual herbs. Leaves shortly petioled; leaflets 5, opposite, 4-2 x 0.2-1.0 cm, obovate, oblanceolate, membranous, hairy. Stipules lanceolate, acute, hairy persistent. Flowers in axillary, 2-4 flowered racemed, red. Pods 1-2 cm, straight, turgid, glabrous, 8-12 seeded. Seeds cylindrical, truncate. **Flowering and fruiting.** August-October. Found in dry sandy soil. Sweta 351.

3. Indigofera hirsuta L. Sp. Pl. 751. 1753; FBI. 2: 98. 1876; FUGP. 1: 234. Repr. ed. 1960; Fl. Rajasthan 1: 241. 1987. *I. astragalina* DC. Prodr. 2: 228. 1825.

Erect, annual or biennial herbs. Leaflets 5-7, 2-6 x 1.5-4.0 cm, short petioled, ovate-elliptic, hairy, ovate, membranous, greyish-green above, smooth below. Flowers in dense spikes. Calyx teeth long, setaceous, densely pubescent. Corolla exserted, reddish. Pods straight, 4-angled, 6-8 seeded, densely hairy. **Flowering and fruiting.** August-November. Common along roadsides. Sweta 160.

4. Indigofera karnatakana Snajappa in Taxon 32 (1): 120. 1983; Name Changes Flow. Pl. Ind. 295. 1987. *Indigofera tenuifolia* Rottl. ex. Wight & Arn. Prodr. 200. 1834; FBI. 2: 95. 1876; Fl. Rajasthan 1: 244. 1987.

Annual, appressedly hairy herb. Leaflets 7- 9, linear-obovate, appressed hairy. Stipule setaceous. Flowers red, minute in 3 - 6 flowered racemes. Calyx teeth setaceous, persistant in fruit. Pods linear, angular, 10-12 seeded. Seeds truncate, brownish, minute. **Flowering and fruiting:** August-October. Occurs in wastelands and open areas. Sweta 170.

5. Indigofera linifolia (L. f.) Retz. Obs. 4: 29.1786; FBI. 2: 92. 1876; FUGP. 1: 229. Repr. ed. 1960; Fl. Rajasthan 1: 242. 1987. *Hedysarum linifolium* L. f. Suppl. 331. 1781.

Suberect or prostrate, suffruticose, perennial herbs. Leaves 0.5-3 x 0.2-0.5 cm, subsessile, linear-lanceolate, appressed hairy, mucronate. Flowers bright red, sessile, in axillary racemes. Bracts ovate-lanceolate. Corolla red, 2-3 times the calyx. Pods ovoid-globose, apiculate, silky hairy, single seeded. Seeds shining, globose. **Flowering and fruiting :** July-December. Common on sandy river beds and in agricultural fields. Sweta 271.

6. Indigofera linnaei Ali in Bot. Notis. 111: 549. 1958; Fl. Rajasthan 1: 242. 1987. *I. enneaphylla auct. plur.* non L. 1771; FBI. 2: 94. 1876; FUGP. 1: 230. Repr. ed. 1960.

Prostrate, hairy annual-perennial herbs. Leaflets 5-9, obovate, nearly sessile, alternate, oblanceolate-oblong, obtuse, mucronate, hairy. Flowers in axillary, short, capitate, globose racemes, red. Pods oblong, cylindrical, hairy, 2-seeded. **Flowering and fruiting:** August-December. Commonly grows in wastelands and on roadsides. Sweta 47.

7. Indigofera tinctoria L. Sp. Pl. 751. 1753; FBI. 2: 99. 1876; FUGP. 1: 235. Repr. ed. 1960. Fl. Rajasthan 1: 244. 1987.

Grey pubescent herbs. Leaflets 7-13, obovate or oblanceolate, apiculate, silvery pubescent beneath. Stipels minute, setaceous. Flowers small, in 15 or more flowered racemes. Calyx silvery pubescent. Corolla exserted, standard greenish yellow, wings pink. Pods 3.5 cm long, slightly curved, deflexed, glabrous when mature, 8-12 seeded, septate between the seeds. Seeds oblong, truncate. **Flowering and fruiting.** August-November. **Local name.** *Neel.* Common in wastelands and on roadsides. Sweta 1326.

14. LABLAB Adans.

Lablab purpureus (L.) Sweet Hort. Brit. ed. 1: 481. 1827; Verdc., in Kew Bull. 24: 410. 1970; Dicot. Pl. Uttar Pradesh 103. 1999. *Dolichos purpureus* L. Sp. Pl. ed. 2: 1021. 1763. *Dolichos lablab* L. Sp. Pl. 725. 1753; FBI. 2: 209. 1876; FUGP. 1: 210. Repr. ed. 1960.

Extensive, twining, annual or perennial herbs. Leaflets 3, broadly ovate, acute, entire, cuneate, pale-green. Stipels small, subulate, smooth. Bracts caducous. Bracteoles oblong, spathulate. Calyx teeth short, deltoid. Corolla white or pink. Pods very variable in shape and size, tipped with the hooked persistent base of the style, glabrous, 3-5 seeded. **Flowering and fruiting.** November-June. **Local name.** *Sem.* It is usually grown along the borders of tall crops, and the castor (*Ricinus communis*) plants often form its support. Sweta 1333.

15. LATHYRUS L.

Key to species:

1. Leaflets none; flowers yellow.....1. ***L. aphaca***

1. Leaflets present; flowers red or bluish..... 2

2. Pods winged on the back..... 2. ***L. sativus***

2. Pods not winged ..... 3. ***L. sphaericus***

1. Lathyrus aphaca L. Sp. Pl. 729. 1753; FBI. 2: 179. 1876; FUGP. 1: 240. Repr. ed. 1960; Fl. Rajasthan 1: 246. 1987.

Trailing annual herbs. Stipules paired, appressed to stem, leaf-like, hastate or truncate, entire, acute. Flowers yellow, axillary, solitary. Calyx divided halfway down, lobes equal, lanceolate. Corolla yellow, twice the calyx. Pods oblong-linear, glabrous, 4-6 seeded. Seed smooth, black. **Flowering and fruiting :** November-April. **Local Name.** *Jangli mattar.* Commonly found in cultivated fields, on roadsides and on wet clayey soil. Sweta 715.

2. Lathyrus sativus L. Sp. Pl. 730. 1753; FBI. 2: 179. 1876; FUGP. 1: 240. Repr. ed. 1960; Fl. Rajasthan 1: 246. 1987.

Climbing, annual herbs. Leaves ending in 3 fid tendrils; leaflets 2, linear-lanceolate, oblong, entire. Stipules broad, semi sagittate. Flowers solitary-axillary. Corolla reddish-purple, rarely white, emarginate. Pods 3-4 cm long, flat, conspicuously winged on either side of the dorsal suture. Seeds 4-5, compressed, brown or yellowish-red. **Flowering and fruiting.** January-March. **Local name.** *Hiran Khuri*) Often grows on margins of agricultural fields and on roadsides. Sweta 1309.

3. Lathyrus sphaericus Retz. Obs. Bot. 3: 39. 1784; FBI. 2: 180. 1876; FUGP. 1: 240. Repr. ed. 1960; Ali, Biologia 11:1-10. 1965; Dicot. Pl. Uttar Pradesh 104. 1999.

Decumbent, ascending, annual herbs. Leaflets 2, 3-15 x 0.2-0.5 cm, linear, oblong, acute; stipules linear, semi-sagittate. Flowers axillary, solitary. Calyx teeth linear. Corolla reddish, twice the calyx. Pods linear, glabrous, wingless, many seeded. Seeds globular smooth. **Flowering and fruiting.** February-May. Found in agricultural fields, grassy and sandy places. This species is commonly found at Bijnor and used as vegetable and added to *Chane ka saag* (leaves of *Cicer arietinum* L.) to improve flavour and taste. Its occurrence in the study area can not be ruled out.

16. LOTUS L.

Lotus corniculatus L. Sp. Pl. 775. 1753; FBI. 2: 91. 1879; Dicot. Pl. Uttar Pradesh 105. 1999.

Erect or prostrate, perennial herbs. Leaves 5-foliate, the lowest pair of leaflets, arising from the base of the petiole and looks like stipules. Flowers reddish-yellow, subtended by a reduced trifoliate leaf. Standard obovate clawed, exceeding the wings, incurved shortly beaked keel, 2-3 times longer than the calyx. Pods brownish, cylindrical, straight, 1-3 cm

long. **Flowering and fruiting:** January-April. Occasionally found in moist to wet localities. **Note:** According to available literature, this taxon was never reported from Upper Gangetic Plain except for a single report from Delhi (Rangaswamy and Chakrabarty, 1966). Sweta 763.

17. MACROTYLOMA (Wight & Arn.) Verdc.

Macrotyloma uniflorum (Lam.) Verdc., in Kew Bull. 24: 322. 1970. *Dolichos uniflorus* Lamk. Encycl. 2: 299.1786. *D. biflorus sensu* Murr. Syst. Nat. ed. 13. 548. 1774, *pro parte* (quoad syn. Pluk. *tantum*; non L. 1753). *D. biflorus auct.* Pl. (non. L. 1753); FBI. 2: 210. 1876; FUGP. 1: 211. Repr. ed. 1960.

Trailing annual herbs. Leaflets 3, 2-5 x 1-3 cm, ovate-elliptic, cuneate, acute, softly appressed- pubescent. Flowers 1-3, axillary. Bracts 3, lanceolate. Calyx downy, teeth lanceolate. Corolla yellow, keel obtuse. Pods falcate-recurved, compressed, downy, tipped with a persistent style. Seeds 5-6, compressed, reniform, reddish-brown. **Flowering and fruiting:** September-December. **Local name.** *Kuthi.* Mostly cultivated, also found as an escape in waste places and on roadsides. Sweta 311.

18. MEDICAGO L.

Key to species:

1. Flowers blue or violet, not yellow..... 3. ***M. sativa***
1. Flowers yellow.....2
2. Pods, yellowish, spiral with armed edges..... 2. ***M. polymorpha***
2. Pods blackish, globose, unarmed..... 1. ***M. lupulina***

1. Medicago lupulina L. Sp. Pl. 779.1753; FBI. 2: 90.1876; FUGP. 1: 194. Repr. ed. 1960; Fl. Rajasthan 1: 248. 1987.

Trailing, hairy, biennial herbs. Leaves trifoliate, leaflets obovate, cuneate, apex notched, entire or dentate. Flowers very minute, yellow, in dense capitate, peduncled racemes. Pods many in clusters, minute, linear, sickle shaped, indehiscent, 1-seeded, glabrous, black at maturity. **Flowering and fruiting :** Winter season. Occurs in grasslands as weed and on the bed of canals when they dry up in the winter. Sweta 714, 766.

2. Medicago polymorpha L. Sp. Pl. 779. 1753; Fl. Rajasthan 1: 248. 1987 . *M. denticulata* Willd. Sp. Pl. 3: 1414. 1802; FBI. 2: 90. 1879; FUGP. 1: 194. Repr. ed. 1960;.

Prostrate, or decumbent-ascending, annual herbs. Leaves trifoliate, leaflets 0.5-3 x 0.5-2.0 cm, obovate, cuneate, emarginate, apex mucronate, dentate. Flowers yellow, in 2-6 flowered racemes. Pods coiled 2-3 times, with 2 marginal rows of spines on outer suture, 2 or 3 seeded.

Flowering and fruiting : January-April. Very common weed in cultivated field in winter season. Sweta 771.

3. Medicago sativa L. Sp. Pl. 2: 778. 1753; FBI. 2: 90. 1879.

Murty and Singh (1961b) reported this species from Hastinapur. This is a cultivated species grown for forage.

19. MELILOTUS Mill.

Key to species:

1. Flowers yellow; plants slender.....2. ***M. indica***
1. Flowers white; plants robust..... 1. ***M. alba***

1. Melilotus alba Medik. ex Desr. in Lamk. Encycl. 4: 63.1797; FBI. 2: 89.1876; FUGP. 1: 192.Repr. ed. 1960; Fl. Rajasthan 1: 249. 1987.

Erect, glabrous, annual herbs. Leaves trifoliate; leaflets elliptic-oblong, serrate, terminal one slightly longer. Flowers white in elongated racemes. Calyx shorter than the petals, jointed. Standard retuse, longer than the wings. Pods oblong-ovoid, glabrous, 1-seeded. **Flowering and fruiting :** Winter season. Common in wastelands and cultivated field, prefers moist habitats. Sweta 395, 634.

2. Melilotus indica (L.) All. Fl. Pedem. 1: 308.1785; FUGP. 1: 191.Repr. ed. 1960; Fl. Rajasthan 1: 249.1987. *Trifolium indicum* L. Sp. Pl. 765.1753. *Melilotus parviflorus* Desf. Fl. Atlant. 2: 192.1799; FBI. 2: 89.1876.

Erect or ascending annual or biennial herbs. Leaflets 1.5-3.0 x 0.5-1.5 cm, obovate oblanceolate, dentate, glabrous. Stipules linear, acuminate. Flowers many in lax axillary racemes. Corolla yellow, minute, standard exceeding the wings and keel. Pods 0.3-0.4 cm long, ovoid or oblong, 1-2 seeded, glabrous, reticulately veined, supported by red, persistent calyx. **Flowering and fruiting.** January-April. **Local name.** *Morila.* Common weed of cultivated fields. Sweta 1323.

20. MUCUNA Adans. *nom. cons.*

Mucuna pruriens (L.) DC. Prodr. 2: 405.1825; FBI. 2: 187. 1876; FUGP. 1: 218. Repr. ed. 1960; Fl. Rajasthan 1: 250. 1987. *Dolichos pruriens* L. In Stickman, Diss. Herb. Amb. 23. 1754.

Large, herbaceous climbers. Leaflets 3, ovate-rhombid, membranous, green, lustrous with grey-silky hairs beneath, mucronate. Flowers in axillary racemes, dark-purple. Calyx appressed, brown-hairy, with a few pungent bristles, lower tooth lanceolate. Corolla purplish, standard much shorter than the keel. Wings incurved. Pods sigmoid, covered with reddish-brown, shining, stinging hairs, 5-6 seeded, hooked at the tip. Seeds large, ovoid, blotched. **Flowering and fruiting :** September-March. **Local Name.** *Kaunch.* Found on banks of Ganga or on roadsides and *Kholas* climbing on trees or spreading on stony embankments. Sweta 148.

21. PONGAMIA Vent. *nom. cons.*

Pongamia pinnata (L.) Pierre, For. Fl. Cochinch. 5: t. 385.1899; Fl. Rajasthan 1: 251.1987. *Cytisus pinnatus* L. Sp. Pl. 741.1753. *Pongamia glabra* Vent. Jard. Malm. 1: 28. t. 28.1803; FBI. 2: 240.1876; FUGP. 1: 246.Repr. ed. 1960.

Moderate sized, glabrous, almost evergreen trees. Leaves imparipinnate, pale-green; leaflets usually 5-7, 4-10 x 3-5 cm, oblong or ovate, acuminate, entire, sub-coriaceous. Flowers in axillary racemes, pinkish-white. Calyx densely covered with ferruginous hair. Corolla white, tinged with pink. Pods 3-6 x 1.5-03.0 cm, obliquely oblong, woody, glabrous, brownish green, 2-seeded. Seeds white with brownish lines. **Flowering and fruiting.** Marchy-June. **Local name.** *Karanj.* Often planted along roadsides. Sweta 1349.

22. RHYNCHOSIA Lour. *nom. cons.*

Key to species:

1. Plants trailing; flowers in capitate racemes; pods orbicular; seeds strophiolate..... 1. ***R. capitata***
1. Plants twining; flowers in lax racemes; pods elliptic-lanceolate..... 2
2. Leaflets small, nearly glabrous..... 2. ***R. minima***
2. Leaflets large, softly pubescent; stipules lanceolate, subpersistent..... 3. ***R. rothii***

1. Rhynchosia capitata (Heyne ex Roth) DC. Prodr. 2: 386.1825; FUGP. 1: 204. Repr. ed. 1960; Fl. Rajasthan 1: 254.1987. *Glycine capitata* Heyne ex Roth, Nov. Pl. Sp. 346. 1821. *Rhynchosia aurea sensu* Baker in FBI. 2: 221.1876, *pro parte*, non DC. 1825.

Trailing or climbing, annual, hairy herbs. Leaves petiolate, 3 foliate, terminal leaflets rhomboidal, ovate-elliptic, gland-dotted beneath, cuneate. Flowers in axillary capitate racemes, yellow. Pods nearly orbicular, shortly beaked, reddish-brown with green spots and

white, long hairs, often burried in the sand, 2-seeded. **Flowering and fruiting:** April-November. Occasionally found on damp, sandy soil. Sweta 145.

2. Rhynchosia minima (L.) DC. Prodr. 2: 385.1825; FBI. 2: 223.1876 (including var. *laxiflora* (Camb.) Baker; FUGP. 1: 204. Repr. ed. 1960; Fl. Rajasthan 1: 225.1987. *Dolichos minimus* L. Sp. Pl. 726.1753.

Twinning annual herbs, nearly or quite glabrescent. Leaves 3-foliate, leaflets 2.0-5.0 x 1.5-3.0 cm, rhomboid-ovate, obtuse or acute, yellow-dotted. Flowers in 6-10 flowered, axillary racemes. Corolla yellow, standard hairy on back, purplish-streaked. Pods oblong-falcate, turgid, beaked, usually 2-seeded. Seeds compressed, black. **Flowering and fruiting.** August-November. Common among hedges in wastelands and on road sides. Sweta 1332.

3. Rhynchosia rothii Roxb. ex Aitch. Cat. Pl. Punjab Sindh 50. 1869; Fl. Rajasthan 1: 256. 1987. *Rhynchosia sericea* Spanoghe in Linnaea 15: 195. 1841, *non* Gill. ex Hook. & Arn. 1833 ; FBI. 2: 225. 1876; FUGP. 1: 205.Repr. ed. 1960.

Twinning herbs. Leaflets large, softly pubescent, pale green, conspicuously gland dotted on the lower surface, rounded base. Flowers purple, in racemes. Calyx densely grey. Corolla exserted. Standard dark purple inside, silky on back. Pods finely pubescent, turgid, 2-seeded, recurved, tipped with long persistent base of the style. **Flowering and fruiting.** Rainy season. Murty and Singh (1961b) reported it from the study area.

23. SESBANIA Adans. *emend.* Scop. *nom. cons.*

Key to species:

1. Herbs or undershrubs; branches and leaf-rachis prickly.....1. ***S. bispinosa***
1. Trees or shrubs; branches and leaf-rachis not prickly..... 2. ***S. sesban***

1. Sesbania bispinosa (Jacq.) Wight in U.S. Dept. Agr. Bur. Pl. Ind. Bull. 137: 15. 1909; Fl. Rajasthan 1: 257.1987. *Aeschynomene bispinosa* Jacq. Ic. Pl. Rar. 3: 13. t. 564. 1792. *Coronilla aculeata* Willd. Sp. Pl. 3: 1147.1802, *nom.illegit. Sesbania aculeata* (Willd.) Poir in Lamk. Encycl. 7: 128.1806, *nom.illegit.*; FBI. 2: 114. 1876; FUGP. 1: 224.Repr. ed. 1960.

Erect, large, annual herbs. Leaves pinnate; leaflets 10-45 pairs, shortly petioled, oblong-lanceolate, unequal, apex obtuse, thinly hairy, distinctly mucronate. Stipules caducous. Leaves retain their green colour in herbarium specimens. Flowers yellowish, small, 1-6, in short racemes. Pods 20-30 cm long, many seeded, tomentose, beaked, glabrous. **Flowering and fruiting :** August-October. Common in rice fields and swampy areas. Sweta 112.

2. Sesbania sesban (L.) Merrill in Philip. Journ. Sci. Bot. 7: 235.1912; Fl. Rajasthan 1: 257.1987. *Aeschynomene sesban* L. Sp. Pl. 714.1753. *Sesbania aegyptiaca* Poir, in Lamk. Encycl. 7:128.1806; FBI. 2: 114.1876; FUGP. 1: 223. Repr. ed. 1960, includ. vars. *S. aegyptiaca* Poir. var. *bicolor* Wight & Arn. Prodr. 1: 214.1834.

Glabrous, soft wooded shrubs or small trees. Leaflets many, 0.5-2.5 x 0.2-0.5 cm, linear-oblong, obtuse or acute, membranous, pale-green, apiculate, glabrous. Flowers in dropping, axillary racemes, yellow. Calyx with short deltoid teeth. Corolla pale-yellow, often dotted with purple. Pods 15-30 cm long, linear, straight, beaked, glabrous, flexible, twisted, 20-40 seeded. **Flowering and fruiting.** Almost throughout the year. **Local name.** *Rawasan, Jainti.* Usually planted near villages. Sweta 1342.

24. TEPHROSIA Pers. *nom. cons.*

Key to species:

1. Leaves simple.....3. ***T. strigosa***
1. Leaves imparipinnate.....2
2. Racemes 1-3 flowered.....1. ***T. pumila***
2. Racemes more than 3 flowered; pods straight or slightly curved at the end; leaflets 11-21; calyx teeth as long as tube..... 2. ***T. purpurea***

1. Tephrosia pumila (Lamk.) Pers. Syn. Pl. 2: 330.1807; FUGP. 1: 226.Repr. ed. 1960; Fl. Rajasthan 1: 264. 1987. *Galega pumila* Lamk. Encycl. 2: 599.1786. *Tephrosia purpurea* (L.) Pers. var. *pumila* (Lamk.) Baker. in FBI. 2: 113.1876.

Small, perennial, deep-rooted herbs. Leaflets 6-12, oblanceolate, glabrous or hairy, cuneate, apex retuse. Flowers reddish-purple. Pods straight, brown, 4-6 seeded. Seed yellowish green with black spots. **Flowering and fruiting :** August-October. Commonly found in sandy habitats. Sweta 168.

2. Tephrosia purpurea (L.) Pers. Syn. Pl. 2: 329.1807; FBI. 2: 112.1876; FUGP. 1: 225. Repr. ed. 1960; Fl. Rajasthan 1: 264. 1987. *Cracca purpurea* L. Sp. Pl. 752.1753.

Erect, perennial herbs, woody at base. Leaves imparipinnate leaflets, 6-7 pairs, oblong-obovate, hairy beneath, glabrous above. Flowers in axillary or terminal racemes, dark-purple. Calyx densely silky, teeth linear. Corolla red, thinly silky. Pods linear, brown, slightly curved near apex, hairy, 4-6 seeded. Seeds yellowish-green with dark or blackish strips. **Flowering and fruiting :** May-December. Commonly found in wastelands and on sandy soils. Sweta 15,171.

3. Tephrosia strigosa (Dalz.) Sant. & Mahesh. in Journ. Bombay Nat. Hist. Soc. 54 (3): 805. 1957; Fl. Rajasthan 1: 265. 1987. *Macronyx strigosa* Dalz. in Hook. Kew Journ. Bot. 2: 35. 1850. *Tephrosia tenuis* Wall. ex Dalz. & Gibs. Bombay Fl. 61. 1861; FBI. 2: 111. 1876; FUGP. 1: 225. Repr. ed. 1960.

Appressed hairy, annual herbs. Leaves up to 10 x 0.8 cm, simple, linear-lanceolate, thinly silky beneath. Flowers 1-2 in the axils of leaves, bluish-yellow. Pedicel filiform. Calyx teeth shorter than the tube. Standard pubescent on the back. Style short, glabrous, filiform. Pods up to 4.0 cm long, linear, flat, appressed hairy, 6-10 seeded. **Flowering and fruiting:** August-November. Included on authority of Murty and Singh (1961b).

25. TERAMNUS R. Br.

Teramnus labialis (L. f.) Spreng. Syst. Veg. 3: 235. 1826; FBI. 2: 184. 1876; FUGP. 1: 214. Repr. ed. 1960. Fl. Rajasthan 1: 267. 1987. *Glycine labialis* L. f. Suppl. 325. 1781.

Prostrate or twining herbs, thinly hairy. Leaves 3-foliate, leaflets up to 5.0 x 2.0 cm, rhomboid-oblong or ovate-lanceolate, appressed hairy beaneath. Flowers solitary or in few-flowered, axillary racemes, reddish. Pods up to 5.0 cm long, linear, slightly curved at the apex, 8-12 seeded. Seeds oblong, glabrous, brown-black. **Flowering and fruiting:** August-November. Common in grassy habitats, especially in plantations. Sweta 1356.

26. TRIFOLIUM L.

Key to species:

1. Inflated part of the calyx pyriform, with distinctly exserted, divergent upper teeth..... 1. ***T. resupinatum***
1. Inflated part of the calyx globose with inwardly or slightly exserted, recurved upper teeth..... 2. ***T. tomentosum***

1. Trifolium resupinatum L. Sp. Pl. 771. 1753; FBI. 2: 86. 1876; Fl. Rajasthan 1: 267. 1987.

Decumbent-ascending, annual, glabrous herbs. Leaves trifoliate, leaflets 1.5-2.5 x 1.2-1.5 cm, obovate-lanceolate, serrate-dentate, apex rounded, emarginate,. Flowers pinkish, in axillary capitate heads. Calyx appressed hairy on back, teeth subulate, fruiting calyx pyriform, densely hairy, reticulate. Pods 2-seeded. **Flowering and fruiting :** January–April. **Local Name:** *Barseen.* Found as weed in cultivated fields. Sweta 709.

2. Trifolium tomentosum L. Sp. Pl. 771.1753; Hossain, Notes Roy. Bot. Gard. Edinb. 23: 453.1961; HFDD. 166.1977.

Prostrate, glabrous, annual herbs. Leaves long petioled, leaflets oblong, rounded, emarginate, serrulate-dentate. Flowers pinkish, in axillary heads. Pods ovoid-ellipsoidal, 2 seeded.

Fruiting calyx globose densely hairy. **Flowering and fruiting :** October-March. Common in waste places and fallow fields etc. Sweta 1360.

27. TRIGONELLA L.

Key to species:

1. Racemes exceeding the leaves; pods upcurved.....1. ***T. corniculata***
1. Racemes shorter than or equaling the leaves; pods slightly curved.....2. ***T. monantha*** subsp. ***incisa***

1. Trigonella corniculata (L.) L. Syst. Nat. ed. 10.1180.1759; FBI. 2: 88.1876; FUGP. 1: 193. Repr. ed. 1960; Fl. Rajasthan 1: 268.1987. *Trifolium corniculata* L. Sp. Pl. 7.1753.

Erect or suberect, glabrous annual herbs. Leaflets 1-1.2 x 0.5-1.0 cm, obovate, rounded emarginate, serrate-dentate; stipules lanceolate. Flowers, yellow, closely racemed on axillary, solitary peduncles. Calyx teeth shorter than the tube, glabrous or thinly hairy. Pods 3-4 cm long, glabrous, transversely veined, 4-8 seeded. **Flowering and fruiting.** January-March. Found in cultivated fields during winter season. Sweta 1368.

2. Trigonella monantha C. A. Meyer, Verz. Pfl. Casp. Meer. 137. 1831. subsp. **incisa** (Benth.) Ali, Fl. West Pak. 100: 294. 1977; Fl Raj. 1: 269. 1987. *T. incisa* Benth. in Royle, Illust. Bot. Himal. Mount. 197. 1835. *Trigonella polycerata auct.* non L. 1753; FBI. 2: 87.1876; FUGP. 1: 193. Repr. ed 1960.

Prostrate or decumbent ascending, annual herbs. Leaflets obovate, 0.4-0.5 x 0.3-0.5 cm, cuneate, emarginate, sharply incise-dentate. Stipules semi-sagittate. Flowers 1-6, sessile, clustered on axillary peduncles. Calyx teeth setaceous, shorter than the sub-cylindrical tube. Corolla slightly exserted, yellow. Pods 0.3-0.4 cm long, 10-20 seeded, transversely wrinkled, falcate, appressedly hairy. **Flowering and fruiting.** March-May. Murty and Singh (1961b) reported it from the study area.

28. URARIA Desv.

Uraria picta (Jacq.) Desv. ex. DC. Prodr. 2: 324.1825; FBI. 2:155.1876; FUGP. 1: 252. Repr. ed. 1960; Fl. Rajasthan 1: 270.1987. *Hedysarum pictum* Jacq. Coll. Bot. 2:262.1789 & Ic. t.567.1792-94.

Erect, perennial undershrubs. Leaves imparipinnate, leaflets, linear-lanceolate, 3-9 pairs, rigidly coriaceous, acute, pubescent beneath; stipules lanceolate, acuminate. Racemes in dense cylindrical heads. Corolla exserted purple. Pods glabrous, whitish, 3-6 jointed. **Flowering and fruiting.** September-November. Murty and Singh (1961b) reported it from the study area.

29. VICIA L.

Key to spcies:

1. Erect herbs; wings with black or dark-brown spots..... 1. ***V. faba***
1. Prostrate or climbing herbs; corolla without black spots.....2
2. Flowers lilac or white; 1-5 together..... 2.***V. hirsuta***
2. Flowers reddish-pink; solitary or paired..... 3. ***V. sativa***

1. Vicia faba L. Sp. Pl. 737.1753; FUGP. 1: 239. Repr. ed. 1960; Fl. Rajasthan 1: 278. 1987. Erect, annual herbs. Leaflets elliptic-oblong, obtuse, glabrous; stipules triangular subovate. Flowers white subsessile, 2-7 in racemes. Standard obtuse, purplish streaked. Wings usually with a large, blackish-brown blotch at base. Pods 10-25 cm long, linear, cylindric, glabrous. **Flowering and fruiting.** Winter season. **Local name.** *Bakla.* Cultivated, often found as an escape. Immature pods are used as vegetable. Sweta 1347.

2. Vicia hirsuta (L.) S. F. Gray, Nat. Arr. Brit. Pl. 2: 614. 1821; FBI. 2:177. 1876; FUGP. 1: 238. Repr. ed. 1960; Fl. Rajasthan 1: 270. 1987. *Erum hirsutum* L. Sp. Pl. 738. 1753.
Twinning, glabrous or hairy, slender, annual herbs. Leaves paripinnate, leaflets 4-8 pairs,0.1-3.0 x 0.1-0.35 cm, linear-oblong, mucronate, glabrous; stipules semi-sagittate, toothed. Flowers very small, white or bluish in 1-4 flowered racemes. Calyx appressedly hairy. Corolla slightly exserted. Pods elliptic-oblong, 2-seeded, constricted between the seeds when mature. **Flowering and fruiting :** Winter season. **Local Name:** *Bakla, Kala Matar.* Abundant in cultivated fields and among hedges. Sweta 702.

3. Vicia sativa L. Sp. Pl. 736.1753; FBI. 2: 178. 1876; FUGP. 1: 238. Repr. ed. 1960; Fl. Rajasthan 1: 271. 1987.
Annual, tendril climbers. Leaflets 4-8 pairs, shortly petiolate, elliptic-lanceolate, mucronate, glabrous or hairy; stipules lanceolate, toothed, cuspidate. Flowers axillary. Corolla reddish, turning to bluish-violet after anthesis. Pods hairy or glabrescent, 8-10 seeded. **Flowering and fruiting :** Winter season. Common in cultivated fields. Sweta 1362.

30. VIGNA Savi.

Vigna aconitifolia (Jacq.) Marechal in Bull. Jard. Bot. Nat. Belge 39: 160. 1969; Fl. Rajasthan 1: 273. 1987. *Phaseolus aconitifolius* Jacq. Observ. Bot. 3: 2. t. 52.1766; FBI. 2: 202.1876; FUGP. 1: 207.Repr. ed. 1960.
Erect or decumbent, ascending, annual herbs. Leaves 3-foliate, leaflets palmatipartite; stipules small, narrowly lanceolate. Flowers minute, yellow in dense racemes, peduncles hairy.

Bracteoles linear. Pods 3-5 cm long, 3-8 seeded. Seeds oblong, smooth, brown. **Flowering and fruiting.** October-December. Found on roadsides and in cultivated fields. Sweta 1339.

31. ZORNIA J. F. Gmel.

Zornia gibbosa Span in Linnaea 15: 192.1841; Fl. Rajasthan 1: 275.1987. *Z. diphylla auct plur.* non Pers. 1807; FBI. 2: 147. 1876; FUGP. 1: 247.Repr. ed. 1960.

Annual, prostrate herbs. Leaves bifoliate, stalked, leaflets 2, 1-3 x 0.5-1.0 cm, lanceolate, acute, black dotted at lower surface; stipules semi-sagittate. Flowers yellow, in between 2 large, acute, acuminate, ovate-lanceolate, ciliate bracts. Calyx segments lanceolate, ciliate. Standard yellow, purpled veined. Pods 1-6 jointed, exserted, covered with tough hairs. **Flowering and fruiting :** August-October. Found frequently in damp, shady localities. Sweta 315.

According to APG-2 all genera listed above blong to group Faboideae Rudd of Fabaceae.

39. CAESALPINIACEAE

KEY TO GENERA:

1. Leaves simple; calyx spathaceous or splitting into two halves..... 1. ***Bauhinia***
1. Leaves pinnate.....2
2. Leaves 1- pinnate..... 3
2. Leaves 2-pinnate.....5
3. Leaf rachis ending in spine, rachilla flat, leaflets small; pods moniliform..... 5. ***Parkinsonia***
3. Leaf rachis and rachilla not as above..... 4
4. Petals 3; fertile stamens 3, monadelphous; large trees with acid leaves.....6. ***Tamarindus***
4. Petals 5; fertile stamens 5 -10, free; herbs, shrubs or trees; leaves not acid..... 3. ***Cassia***
5. Straggling shrubs; pods armed..... 2. ***Caesalpinia***
5. Erect shrubs or trees; pods not armed..... 6
6. Sepals valvate; stamens shorter than petals..... 4. ***Delonix***
6. Sepals imbricate; stamens longer than petals..... 2. ***Caesalpinia***

1. BAUHINIA L.

Key to species:

1. Fertile stamens 10.....2. ***B. racemosa***

1. Fertile stamens 3-5..... 2
2. Calyx spathaceous.....3. ***B. variegata***
2. Calyx divided into 2 halves..... 1. ***B. purpurea***

1. Bauhinia purpurea L. Sp. Pl. 375. 1753; FBI. 2: 284. 1878; FUGP. 1: 300. Repr. ed. 1960; Dicot Pl. Uttar Pradesh 117. 1999..

Small or medium sized trees. Leaves longer than broad, 9-11 nerved; lobed nearly halfwy down. Flowers rose-coloured. Calyx usually splitting into two halves. **Flowering and fruiting:** September – December. Often planted on roadsides by Forest Department. Sweta 1392.

2. Bauhinia racemosa Lam. Encycl. 1: 390. 1785; FBI. 2: 276. 1878; FUGP. 1: 298. Repr. ed. 1960; Fl. Rajasthan 1: 279. 1987.

Small trees with drooping branches and dark bark. Leaves broader than long, divided nearly halfway down, lobes rounded, tomentose beneath. Flowers in terminal or leaf opposed racemes, white. Pods 15-25 x 1.0-2.5 cm, blunt apically, somewhat falcate, glabrous. **Flowering and fruiting:** May-November. Murty and Singh (1961b) reported it from the study area.

3. Bauhinia variegata L. Sp. Pl. 375. 1753; FBI. 2: 284. 1878; FUGP. 1: 300. Repr. ed. 1960; Dicot Pl. Uttar Pradesh 118. 1999..

Differs from preceding species in lip often marked with purple or red; spatahceous calyx and narrower pods. **Flowering and fruiting:** February – October. Often cultivated on roadsides and in gardens etc. Sweta 1385.

2. CAESALPINIA L.

Key to species:

1. Scandent shrubs; flowers yellow; pods broader
   than long, covered with spines.....1. ***C. bonduc***
1. Erect shrubs; flowers red-yellow; pods longer
   than broad, glabrous.....2. ***C. pulcherrima***

1. Caeslapinia bonduc (L.) Roxb. Fl. Ind. 2: 362. 1836; FBI. 2: 255. 1878; Fl. Rajasthan 1: 279. 1987. *Guilandinia bonduc* L. Sp. Pl. 381. 1753. *G. bonducella* L. Sp. Pl. ed. 2. 545. 1762. *Caesalpinia bonducella* (L.) Fleming in As. Res. 11: 159. 1810; FBI.2: 254. 1878; FUGP. 1: 302. Repr. ed. 1960.

Scandent, armed shrubs. Prickles straight. Leaves upto 20.0 cm long; pinnae 6-8 pairs; leaflets 6-10 pairs, elliptic-oblong, pubescent beneath. Flowers in terminal and axillary racemes, yellow. Pods ovoid oblong, somewhat flattened, covered with long spines, 1-2 seeded. Seeds oblong, smooth, lead coloured. **Flowering and fruiting:** July–December. Often found near villages and in *Kholas.* Sweta 563.

2. Caesalpinia pulcherrima (L.) Sw. Observ. Bot. 166. 1791; Dicot Pl. Uttar Pradesh 118. 1999. *Poinciana pulcherrima* L. Sp. Pl. 380. 1753.

A medium sized shrub. Branches prickly and lenticellate. Pinnae 8-16. Leaflets numerous, oblique-oblong. Flowers long pedicelled, in erect terminal racemes. Pods thin, broad, brown when ripe. **Flowering and fruiting:** April- December. Often planted in gardens and parks etc. Sweta 1348.

3. CASSIA L.

Key to species:

1. Trees or shrubs.....2
1. Herbs.....6
2. Inflorescence erect; pods winged.....2. ***C. alata***
2. Inflorescence and pods not as above.....3
3. Bracts conspicuous, persistent; leaflets 8-20 pairs;
   racemes from scars of fallen leaves.....6. ***C. renigera***
3. Bracts small, caducous.....4
4. Fertile stamens 6-7.....7. ***C. siamea***
4. Fertile stamens 10.....5
5. Stamens nearly all equal in length; pods
   flat, dehiscent.....9. ***C. surattensis***
5. Stamens unequal; pods cylindric, very long, indehiscent.....3. ***C. fistula***
6. Foliar glands on the petiole always present, may
   or may not be present between the leaflets.....7
6. Foliar glands always present between the leaflets;
   usually no gland on the petiole.....9
7. Glands stalked, peltate; prostrate small herbs; stamnes 5.....5. ***C. pumilla***
7. Glands sessile; stamens usually more than 5.....8
8. Leaflets 3-5 pairs.....4. ***C. occidentalis***
8. Leaflets 8-12 pairs.....8. ***C. sophera***
9. Leaflets 2 pairs; plants with viscous hairs.....1. ***C. absus***
9. Leaflets more than 2 pairs; plants with simple hairs.....10. ***C. tora***

1. Cassia absus L. Sp. Pl. 376. 1753; FBI. 2: 265. 1878; FUGP. 1: 271. Repr. ed. 1960; Fl. Rajasthan 1: 282. 1987.

Erect, viscid herbs. Leaflets 4, membranous, 3.0-5.0 cm long, oblong, obtusely, thinly hairy beneath. Racems few flowered, erect. Stamens equal, fertile. Pods flat, covered with bristly hairs. Seeds dark-brown polished. **Flowering and fruiting:** July-December. Occasionally found in *Khloas*. Sweta 172.

2. Cassia alata L. Sp. Pl. 378. 1753; Dicot Pl. Uttar Pradesh 119. 1999.

Erect undershrubs or shrubs. Leaflets 5- 15 pairs; lowest pair close to the base of petiole, higher leaflets oblong or oblong-obovate. Racemes upto 80.0 cm long (inclusive stalk). Petals connivent, bright yellow. Fertile stamens 10. Pods patent, black when mature, broadly winged. Seeds numerous. **Flowering and fruiting:** Often planted in the area. Sweta 1330.

3. Cassia fistula L. Sp. Pl. 377. 1753; FBI. 2: 261. 1878; FUGP 1: 268. Repr. ed. 1960; Fl. Rajasthan 1: 283. 1987. *C. rhombifolia* Roxb. Fl. Ind. 3: 334. 1832; Wight, Ic. 1: t. 269. 1840.

Medium to large sized deciduous trees, bark whitish grey. Leaflets 4-8 pairs, ovate or elliptic-ovate, glabrous above thinly hairy beneath. Flowers in long, pendulous racemes, sulphur-yellow or lemon yellow. Calyx much shorter than the petals. Pods long, cylindric, indehiscent, blackish-brown when mature. Seeds embedded in brown pulp, ovate or ellipsoidal. **Flowering and fruiting:** February – July. Extensively planted as an avenue tree. Sweta 1321.

4. Cassia occcidentalis L. Sp. Pl. 377. 1753; FBI. 2: 262. 1878; FUGP. 1: 269. Repr. ed. 1960; Fl. Rajasthan 1: 285. 1987.

Subglabrous undershrubs. Leaflets 3-6 pairs, upto 10.0 cm long, lanceolate or ovate-lanceolate. Flowers in axillary corymbs, arranged in terminal panicles, yellow. Pods slightly curved, linear oblong, transversely septate. Seeds smooth, greenish-brown. **Flowering and fruiting:** June- December. Common on roadsides and wastelands. Sweta

5. Cassia pumila Lamk. Encycl. 1: 651. 1785; FBI. 2: 266. 1878; FUGP. 1: 271. Repr. ed. 1960; Fl. Rajasthan 1: 285. 1987.

Erect or ascending, thinly hairy, annual, herbs. Leaflets 20-30 pairs, close-set. Flowers shortly pedicelled, solitary-axillary. Stamens 5. Pods upto 4.0 cm long, straight, linear, pale to dark-brown. Seeds 5-10, brown. **Flowering and fruiting:** August- December. Common in grassy localities. Sweta 169. Among the spescies of *Cassia*, this species possesses smallest leaflets. This plant remains concealed among the grasses.

6. Cassia renigera Wallich ex Benth. in Trans. Linn. Soc. London 27: 518. 1871; Dicot Pl. Uttar Pradesh 120. 1999.

Medium sized trees. Flowers red, in short racemes on older branches. Sepals red. Stamens 10. Pods smooth, brown. **Flowering and fruiting:** April- December. Occasionally planted on roadsides and gardens. Sweta 1511.

7. Cassia siamea Lamk. Encycl. 1: 648. 1785; FBI. 2: 264. 1878; Dicot. Pl. Uttar Pradesh 120. 1999.

Medium sized to large trees, bark blakish-brown. Leaflets upto 14 pairs, ovate-oblong or ellipsoid-oblong. Flowers yellow, in large terminal, corymbose racemes. Fertile stamens 6-7, usually 3 posterior ones small. Pods, nearly straight, beaked, flat, sutures thickened. Seeds flat, glabrous, dark-brown. **Flowering and fruiting:** Nearly round the year. Commonly planted on roadsides. Sweta 1319.

8. Cassia sophera L. Sp. Pl. 379. 1753; FBI. 2: 262. 1878; FUGP. 1: 269. Repr. ed. 1960; Fl. Rajasthan 286. 1987.

Erect, glabrous or subglabrous under shrubs. Leaflets 8-10 pairs, upto 6.0 cm long, lanceolate, acute. Flowers in axillary and terminal, umbellate racemes, yellow. Pods turgid, linear, septate. Seeds ovoid, dark-brown. **Flowering and fruiting:** April-December. Often found in waste places and near villages. This taxon is less frequent than *C. occidentalis.* Sweta 1350.

9. Cassia surattensis Burm. f. Fl. Ind. 97. 1768; Dicot. Pl. Uttar Pradesh 120. 1999.

Small trees. Leaflets 4-6 pairs, light-green, oval-oblong, obtuse or rounded, thinly hairy. Racemes short, stalk hairy. Flowers bright yellow. Pods often curved, flat, 15-30 seeded. **Flowering and fruiting:** April- June, followed by a second, generally less profuse ,flush in September. Sweta 1357.

10. Cassia tora L. Sp. Pl. 376. 1753; FBI. 2: 263. 1878, *pro parte;* Fl. Rajasthan 1: 286. 1987.

Low, thinly hairy herbs. Leaflets sessile, upto 5.0 cm long, obovate. Flowers axillary, paired, yellow. Pods narrowly-linear, reticulate, beaked, sepals persistent. **Flowering and fruiting:** July- October. Frequently found on roadsides and in waste places. Sweta 203.

4. DELONIX Rafin.

Delonix regia (Bojer ex Hook.) Rafin. Fl. Tell. 2: 92. 1837; Dicot Pl. Uttar Pradesh 121. 1999. *Poinciana regia* Bojer ex Hook. in Bot. Mag. 56: 5. t. 2884. 1829.

A large, handsome, deciduous tree with hemispheric crown and dense foliage. Leaves 2-pinnate. Leaflets numerous. Flowers red or orange-red; odd petal often blotched with dark-red and white. Filaments red. Pods woody, upto 50.0 cm long, septate between seeds. Seeds oblong. **Flowering and fruiting:** Nearly round the year. Sweta 1361.

5. PARKINSONIA L.

Parkinsonia aculeata L. Sp. Pl. 375. 1753; FBI. 2: 260. 1878; FUGP. 1: 280. Repr. ed. 1960; Fl. Rajasthan 1: 288. 1987.

Large, glabrous, armed shrubs. Leaves 2-pinnate, rachis flat about 0.5 cm wide; leaflets very small 20-30 pairs, ovate-oblong. Flowers in axillary racemes, yellow. Petals crumpled, posterior petal blotched with red. Pods linear, constricted between seeds, light brown when ripe. Seeds oblong, smooth, mottled. **Flowering and fruiting:** May- July. Often planted in wastelands and on roadsides. Sweta 1401.

6. TAMARINDUS L.

Tamarindus indica L. Sp. Pl. 34. 1753; Fl. Rajasthan 1: 289. 1987 .

Large trees with rough bark and dense crown. Leaflets 10-20 pairs, acid, oblong. Flowers yellow, blotched with red. Young pods green, falcate; mature pods reddish-brown, fibrous, pulpy inside, pulp usually acid. Seeds dark-brown, polished. **Flowering and fruiting:** July-December. **Local name:** *Imli, Katari* (fruits). Commonly planted as avenue tree. Sweta 1422.

Note: According to APG-2 all genera listed above belong to group Caesalpinioideae Candolle of Fabaceae.

Saraca asoca (Roxb.) de Wilde is cultivated as an ornamental and medicinal plant.

40. MIMOSACEAE

KEY TO GENERA:

1. Stamens definite, as many as or twice as many as petals..... 2
1. Stamens indefinite, more than 10.....4
2. Flowers in heads.....3
2. Flowers in elongated spikes or spike like racemes.....6. ***Prosopis***
3. Plants and fruits prickly; fruits curved, with segmented valves and indehiscent sutures.....4. ***Mimosa***
3. Unarmed; fruits straight, dehiscing at the sutures; shrubs or trees; heads creamy-white; anthers not gland tipped..... 3. ***Leucaena***
4. Plants armed with spines or prickles..... 5

4. Plants unarmed.....2. ***Albizia***

5. Pinnae 1-pair; stamens monadelphous; pods coiled..... 5. ***Pithecellobium***

5. Pinnae more than one pair; stamens free; pods flat, straight..... 1. ***Acacia***

1. ACACIA Mill.

Key to species:

1. Flowers in globose heads.....2

1. Flowers in cylindrical spikes.....6

2. Trees or shrubs.....3

2. Climbers.....5

3. Pods moniliform.....6. ***A. nilotica***

3. Pods not moniliform..... 4

4. Heads axillary, fascicled.....3. ***A. farnesiana***

4. Heads in terminal panicles..... 5. ***A. leucophloea***

5. Stipules cordate-ovate; pinnae3- 6 pairs; flowers pinkish in bud..... 7. ***A. sinuata***

5. Stipules linear, caducous; pinnae 7- 14 pairs; flowers creamy-white..... 4. ***A. gageana***

6. Unarmed; leaves absent; phyllodea falcate; flowers yellow; pods coiled..... 2. ***A. auriculiformis***

6. Armed; leves present; phyllodea absent; flowers pale-yellow; pods straight.....1. ***A. catechu***

1. Acacia catechu (L. f.) Willd. Sp. Pl. 4: 1079. 1806; FBI. 2: 295. 1878; FUGP. 1: 291. Repr. ed. 1960; Fl. Rajasthan 1: 294. 1987. *Mimosa catechu* L. f. Suppl. Pl. 439. 1782.

A medium sized tree, spines hooked, paired; bark dark-brown. Petiole up to 10.0 cm long often prickly; pinnae 15-20 pairs; leaflets numerous, linear. Flowers in 5- 7 cm long cylindric spikes, white, fragrant. Fruit 5.0 6.0 cm long, flat, dark-brown, shining.**Flowering and fruiting:** August-November.**Local name:** *Khair.* Found in *Kholas*. Sweta 1435.

2. Acacia auriculiformis A. Cunn. ex Benth. in Hook. Lond. J. Bot. 1: 377. 1842; Dicot. Pl. Uttar Pradesh 122. 1999.

A medium sized to tall tree, branches drooping. Petiole flattened into a falcate, parallel veined, coriaceous, glabrous phyllode. Flowers bright yellow, in axillary spikes, 5-merous.

Pod spirally twisted, brown, 5-10 seeded. **Flowering and fruiting:** August-December. Often planted on roadsides and in *Kholas.* Sweta 1334.

3. Acacia farnesiana (L.) Willd. Sp. Pl. 4: 1083. 1806; FBI. 2: 292. 1878; FUGP. 1: 288. Repr. ed. 1960; Fl. Rajasthan 1: 295. 1987. *Mimosa farnesiana* L. Sp. Pl. 521. 1753.
A small tree with straight stipular spines. Leaves 2-pinnate, pinnae 2-8 pairs, leaflets 10-20 pairs, small. Flowers yellow in globular heads arranged in axillary fascicles, fragrant. Pods 4-6 x 1.5 cm, thick, dark-brown, cylindric, tip hooked. Seeds in 2 rows. **Flowering and fruiting:** November-June. Frequently occurs around *Kholas.*Sweta 1337.

4. Acacia gageana Craib in Bull. Misc. Inform. 1915: 409. 1915; Dicot. Pl. Uttar Pradesh 122. 1999.
A large, prickly, scrambling shrub, stems fluted, angled. Leaf-rachis 15.0 cm long; gland near rachis base, similar glands often present between upper 1-3 pairs of pinnae; pinnae 6-14 pairs, 5-10 cm long; leaflets 15-30 pairs. Flowers pale or cream white in pedunculate heads, 0.3-1.3 cm across, arranged in large terminal panicles. Pod 12-15 cm long, strap-shaped, brown. **Flowering and fruiting:** August- April.Included on authority of Murty & Singh (1961b).

5. Acacia leucophloea (Roxb.) Willd. Sp. Pl. 4: 1083. 1806; FBI. 2: 924. 1878; FUGP. 1: 290. Repr. ed. 1960; Fl. Rajasthan 1: 297. 1987. *Mimosa leucophloea* Roxb. Pl. Cor. 2: 27. t. 150. 1800.
A medium sized, grey-tomentose, thorny tree, spines straight, white. Leaf rachis downy, pinnae 6-12 pairs, 2.5- 4.0 cm long, gland cup-shaped; leaflets 15-30 pairs, crowded, linear, rigidly coriaceous. Heads about 1.0 cm in diam., in large terminal panicles, bracts 2. Corolla very small, pale-yellow or white. Pod up to 15.0 cm long, narrowly ligulate, curved, 8-12 seeded. **Flowering and fruiting:** September- October. Included on authority of Murty & Singh (1961b).

6. Acacia nilotica (L.) Willd. ex Del. Fl. Aegypt. Ill. 31. 1813. subsp. **indica** (Benth.) Brenan in Kew Bull. 12: 84. 1957; Fl. Rajasthan 1: 299. 1987. *A. arabica* (Lamk.) Willd. var. *indica* Benth. in Hook. Lond. Journ. Bot. 1: 500. 1842. *A. arabica* auct. non. (Lamk.) Willd. 1808; FBI. 2: 293. 1878; FUGP. 1: 288. Repr. ed. 1960. *Mimosa nilotica* L. Sp. Pl. 521. 1753.
Small to large trees, bark dark-grey, spines stipular. Pinnae 4-6 pairs; leaflets 10-20 pairs about 0.5 cm long, membranous, thinly hairy. Flowers yellow, fragrant, 1.0-1.5 cm across, often arranged in panicle. Calyx minute, campanulate. Corolla twice the calyx. Pod up to 15.0 cm long, sutures indented. Seeds elliptic-ovate, compressed, 8-12 in a row. **Flowering and**

fruiting: August-February. Frequently found near the villages. **Local name:** *Babul, Keekar.* Sweta 1445.

7. Acacia sinuata (Lour.) Merr. in Trans. Amer. Phil. Soc. 24(2): 186. 1835; Fl. Rajasthan 1: 300. 1987. *Mimosa sinuata* Lour. Fl. Cochinch. 653. 1790. *M. concinna* Willd. Sp. Pl. 4: 1039. 1806. *Acacia concinna* (Willd.) DC. Prodr. 2: 464. 1825; FBI. 2: 296. 1878; FUGP. 1: 292. Repr. ed. 1960.

Large, prickly climbing shrubs, prickles curved. Leaf rachis up to 15.0 cm long, with a large gland near the base; pinnae 3-6 pairs; leaflets 6-20 pairs, linear, obtuse, very unequal at the base. Heads globose, 1.0 1.5 cm across, arranged in large panicles. Calyx tubular, crimson. Corolla little exserted, white, veined with red. Pods up to 10.0 cm long, straight thick and succulent, sutures broad, 6-10 seeded. **Flowering and fruiting:** April-December. Included on authority of Murty and Singh (1961b).

2. ALBIZIA Durazz.

Key to species:

1. Flowers in umbels, stalked; pods straw colored..... 1. ***A. lebbeck***

1. Flowers in panicles, sessile; pods reddish or brown..... 2. ***A. odoratissima***

1. Albizia lebbeck (L.) Benth. in Hook. Lond. J. Bot. 3: 87. 1844; FBI 2: 298. 1878; FUGP 1: 295. Repr. ed. 1960; Fl. Rajasthan 1: 301. 1987. *Mimosa lebbeck* L. Sp. Pl. 516. 1753.

Large to medium sized, deciduous, spreading trees. Bark dark-brown, rough. Leaves 2-pinnate, pinnae2-5 pairs; leaflets 5-10 pairs, obliquely oblong. Flowers pale-yellow shortly stalked, in 20-30 flowered heads arranged in axillary clusters or terminal racemes, very fragrant, especially at night. Stamens numerous, filaments 4-7 times as long as corolla. Pods strap shaped, flat, straw -coloured, 15-20 x 4.0 cm long. Seeds compressed, elliptic-ovate, dark-brown.**Flowering and fruiting:** March-January. **Local name:** *Siris.* Frequent in the area. Sweta 599, 907.

2. Albizia odoratissima (L. f.) Benth. in Hook. Lond. J. Bot. 3: 88. 1844; FUGP. 1: 296. Repr. ed. 1960; Fl. Rajasthan 1: 302. 1987. *Mimosa odoratissima* L. f. Suppl. Pl. 437. 1781.

This species can be readily distinguished from the preceding one by sessile flowers and narrower and reddish-brown pod. **Flowering:** April-May. Included on authority of Murty and Singh (1961b).

3. LEUCAENA Benth.

Leucaena latisiliqua (L.) Gillis in Taxon 23: 190. 1974; Fl. Rajasthan !: 303. 1987. *Mimosa latisiliqua* L. Sp. Pl. 519. 1753. *Leucaena glauca* (L.) Benth. in Hook. Lond. Journ. Bot. 4: 416. 1842; FBI. 2: 290. 1878; FUGP. 1: 286. Repr. ed. 1960. *Mimosa glauca* L. Sp. Pl. ed. 2. 2: 1504. 1763, non L. 1753.

Soft wooded, small trees or shrubs. Leaves large, 2-pinnate; pinnae 6-7 pairs, a prominent gland present between lowest pair of pinnae; leaflets 14-17 pairs, linear, acute. Main rachis as well as secondary rachii end in a bristle. Peduncles solitary or paired, axillary, flowers arranged in globose heads. Petals 5, greenish-white. Stamens twice the length of corolla, anthers versatile. Pod strap-shaped, flat, shining dark-brown, in umbellate clusters, shortly beaked, many seeded. **Flowering and fruiting:** September-March. Often planted in the study area. Sweta 1458.

4. MIMOSA L.

Key to species:

1. Prostrate or difuse herbs; pinnae 1-2 pairs; stamens 4.....2. ***M. pudica***

1. Erect or straggling shrubs; pinnae 6- 10 pairs; stamens 8.....1. ***M. himalayana***

1. Mimosa himalayana Gamble in Kew Bull. 1920: 4. 1920; Fl. Rajasthan 1: 304. 1987. *M. rubicaulis sensu* Baker in FBI. 2: 291. 1878, *pro parte,* non Lamk. 1783; FUGP. 1: 286. Repr. ed. 1960.

An erect, prickly shrub.Leaves 2-pinnate, rachis ending in a bristle; pinnae 5-12 pairs; leaflets up to 20 pairs, oblong, unequal sided, obtuse, mucronate. Flowers 4-merous, pink, turning to white. Stamens 8-10. Fruits up to 12.0 x 1.25 cm; slightly curved, smooth, joints 4-10, each 1-joint seeded. **Flowering and fruiting** August- January. Often found on banks of Ganga. Sweta 183.

2. Mimosa pudica L. Sp. Pl. 518. 1753; FBI. 2: 291. 1878; FUGP. 1: 286. Repr. ed. 1960; Fl. Rajasthan 1: 305. 1987.

Spreading, prickly herbs. Pinnae 2 pairs, digitate, sensitive to touch; pinnule 10-20 pairs. Flowers purplish-pink in globular heads. Pods flat 3-5 jointed, spinous. **Flowering and fruiting:** August-December. Often found in moist and shady ditches on roadsides. Sweta 326, 429.

5. PITHECELLOBIUM Mart. *nom. cons.*

Pithecellobium dulce (Roxb.) Benth. in Hook. Lond. Jour. Bot. 3: 199. 1844; FBI. 2: 302. 1878; FUGP. 1: 297. Repr. ed. 1960; Fl. Rajasthan 1: 306. 1987. *Mimosa dulcis* Roxb. Pl. Cor. 1: 67. t. 99. 1798.

Thorny trees, up to 10.0 m high, bark greyish-white.Leaves 2-pinnate; leaflets 2, oblique-rhomboid or elliptic-oblong, coriaceous, glaberescent. Heads in terminal and axillary panicles, 0.5-1.0 cm across, white. Pods spirally twisted, torulose, red-brown, pulp sweet. Seeds broadly ovate, polished, black, covered with red or dirty green aril. **Flowering and fruiting:** March- October. **Local name:** *Jangal-jalebi.* Found on roadsides. Ripe pods are eaten. Sweta 1495.

6. PROSOPIS L.

Prosopis juliflora (Swartz) DC. Prodr. 2: 447. 1825; FUGP. 1: 285. Repr. ed. 1960; Fl. Rajasthan 1: 307. 1987. *Mimosa juliflora* Swartz, Prodr. 85. 1788.

Small trees or large shrubs, up to 5.0 m high, with solitary axillary spines. Leaves 2-pinnate, pinnael-2 pairs, leaflets 15-25 pairs, up to 15 x 4.0 mm, obliquely oblong, obtuse or mucronate. Flowers greenish-yellow, in cylindrical pendulous spikes. Stamens 10. Fruit up to 20.0 cm long, pendulous, sub-falcate, yellow, pulp sweet. Seeds ovoid to ellipsoid, glossy, brown. **Flowering and fruiting:** Almost round the year. Common in *Kholas.* Sweta 1476.

Note: According to APG-2 all genera listed above belong to group Mimosoideae Candolle of Fabaceae.

41. ROSACEAE

POTENTILLA L.

Key to species:

1. Leaves pinnately compound; flowers solitary axillary..... 2. ***P. supina***
1. Leaves digitately compound; flowers in cymes,
   combined into a leafy panicle..... 1. ***P. sundaica***

1. Potentilla sundaica (Bl.) O. Kuntze, Rev. Gen. Pl. 1: 219. 1891; Dicot. Pl. Uttar Pradesh 132. 1999. *Fragaria sundaica* Bl. Bijdr. 1106. 1826-1827. *Potentilla kleiniana* Wt. Ill. t. 85. 1831; Wt. & Arn. Prodr. 300. 1834; FBI. 2: 359. 1878.

Small, decumbent, appressed hairy, annual herbs. Lower leaves 5-foliate, petiolate; upper ones 3-foliate, sessile; leaflets oblong-obovae, dentate, obtuse. Flowers small, yellow, in axillary cymes. Bracteoles lanceolate, hairy, notched or 2-fid up to 0.5 cm long. Petals yellow, obcordate, up to 0.5 cm long. Style sub-terminal. Achene subreniform, rugose, reddish-brown. **Flowering and fruiting:** February-June. Occasionally found on moist ground near the bank of river Ganga. Sweta 887.

2. Potentilla supina L. Sp. Pl. 497. 1753; FBI. 2: 359. 1878; FUGP. 1: 301. Repr. ed. 1960; Fl. Rajasthan 1: 309. 1987.

Annual herbs with dichotomous branches. Radical leaves hairy, petiole up to 9.0 cm long, upper ones short-petioled; leaflets 5-9 in lower leaves and 3-5 in upper leaves, obovate, opposite or alternate. Flowers solitary axillary, yellow. Bracteoles ovate-oblong, entire, hairy. Styles ventral. Achenes numerous, ovoid, smooth. **Flowering and fruiting:** February-June. Common in moist and grassy localities and on semi-dried beds of ponds and ditches. Sweta 616, 654.

42. COMBRETACEAE

KEY TO GENERA:

1. Climbers with white, pink flowers..... 2. ***Quisqualis***
1. Trees or herbs with yellowish flowers..... 2
2. Herbs with xylotubers..... 1. ***Combretum***
2. Trees..... 3. ***Terminalia***

1. COMBRETUM Loefling *nom. cons.*

Combretum nanum Buch.-Ham. ex D. Don, Prodr. Fl. Nep. 219. 1825. FBI. 2: 457. 1878; FUGP. 1: 311. Repr. ed. 1960; Fl. Dudhwa Nat. Park 195. 1997.

Low undershrubs, nearly glabrous. Branches 15.0 – 50.0 cm long. Leaves upto 8.0 cm long, ovat-lanceolate, glabrous, shining, punctate on both surfaces. Racemes 1 to few, subterminal about 5.0 cm long. Flowers 4- merous, cream-white in colour. Calyx tube hairy at the base within, funnel-shaped. Petals narrowly obovate, longer than the calyx. Fruit about 4.0 cm long, wings 4, papery. **Flowering and fruiting:** July-September. Occasionally found in *Kholas* among grasses. Sweta 1325.

2. QUISQUALIS L.

Quisqualis indica L. Sp. Pl. 556. 1753; Bailey, Man. Cult. Pl. 724. 1949; Fl. Delhi. 157. 1963.

A large, deciduous, climbing shrub. Bark thin, light brown. Leaves elliptic or ovate-oblong, upto 10.0 cm long, entire, acute. Flowers white and pink, in drooping terminal spikes fragrant, especially at night. Calyx tube long, teeth reflexed. Ovary angled. Fruits not seen. **Flowering:** April-October. Widely cultivated in the area as an ornamental, occasionally found as an escape. Sweta 1331. .

3. TERMINALIA L. *nom. cons.*

Key to species:

1. Leaves long petioled; obovate-cuneate, crowded at the end of branches; fruits without wings, velvety..... 2. ***T. bellerica***
1. Leaves shortly petioled; elliptic-oblong, distributed throught the length of brances; fruits winged, fibrous..... 1. ***T. arjuna***

1. Terminalia arjuna (Roxb. ex DC.) Wight & Arn. Prodr. 314. 1834; FBI. 2: 447. 1878; Fl. Rajasthan 1: 316. 1987. *Pentaptera arjuna* Roxb. ex DC. Prodr. 3: 14. 1828, *cum descript. P. glabra* Roxb. Fl. Ind. 2: 440. 1832, *cum descript. Terminalia glabra* (Roxb.) Wight & Arn. Prodr. 314. 1834; FUGP. 1: 309. Repr. ed. 1960.

Tall trees. Bark greenish-white, exfolating in flat, thin pieces. Leaves upto 20.0 cm long, elliptic-oblong, margins subentire, base 1-2 glandular. Flowers in terminal panicles, whitish-yellow. Fruits obovoid-oblong, glabrous, dark-brown, with four fibrous wings. **Flowering and fruiting:** March-November. Often planted on roadsides and in wasteland. Sweta s. n .

2. Terminalia bellirica (Gaertn.) Roxb. Pl. Cor. 2: 54. t. 198. 1805, '*bellerica*' ; FBI. 2: 445. 1878; FUGP. 1: 308. Repr. ed. 1960, ' *belerica*' . *Myrobalanus bellirica* Gaertn. Fruct. Sem. Pl. 2: 90. t. 97. f. a-d. 1790.

Deciduous, tall trees. Bark dark-grey to nearly black, longitudinally fissured. Leaves long petioled, upto 20.0 cm long, crowded at the ends of branches, broadly obovate, cuneate. Spikes upto 15.0 cm long, axillary or from the axils of fallen leaves. Flowers foetid smelling, male flowers usually towards the upper part of the spike. Calyx teeth woolly inside. Petals none. Stamens much exserted. Fruit globose or ovoid, grey-tomentose. **Flowering and fruiting:** March-August. Planted on road sides. Sweta 1524.

43. MYRTACEAE

KEY TO GENERA:

1. Fowers red, in pendulous spikes; leaves stiff, narrowly lanceolate..... 1. ***Callistemon***
1. Flowers neither red nor in pendulous spikes.....2
2. Fruit a cup shaped capsule..... 2. ***Eucalyptus***
2. Fruit succulent, not cup shaped.....3
3. Flowers on 1 or few flowered axillary peduncles; fruit with numerous seeds.....3. ***Psidium***
3. Flowers in large paniculate cymes; fruit 1- seeded..... 4. ***Syzygium***

1. CALLISTEMON R. Br.

Callistemon lanceolatus DC. Prodr. 3: 223. 1828; Fl. Delhi 158. 1963.

Large evergreen trees or shrubs. Bark fissured, dark-brown. Branches drooping. Leaves alternate, linear-lanceolate. Flowers crimson, in terminal, pendulous spikes. Petals small, red. Stamens numerous, long-exserted, red. **Flowering and fruiting:** October- March. Planted in gardens and parks for its showy flowers. Sweta 1343.

Note: According to WCSPF the authority and citation of this combination is as follows:

Callistemon lanceolatus (Sm.) Sweet, Hort. Brit.: 155. 1826.

2. EUCALYTUS L' Herit

Following species of *Eucalyptus* are planted in the area.

1. ***E. globulus*** Labill.
2. ***E. citridora*** Hook.
3. ***E. camaldulensis*** Dehnh.

3. PSIDIUM L.

Psidium guajava L. Sp. Pl. 470. 1753; Fl. Rajasthan 1: 320. 1987.

Large shrubs or small trees. Stem knotty, bark smooth, light-brown. Leaves shortly petioled, entire. Flowers white, one or few in leaf axils. Berries yellowish when ripe, crowned with persistent calyx, pulp white or pink. **Flowering and fruiting:** There are two flushes of flowering and fruiting one in rainy season and the second in winter season. Rainy season fruits are often infested with larvae of fruit fly. Extensively planted in orchards. Sweta 1338.

4. SYZYGIUM Gaertn. *nom. cons.*

Syzygium cumini (L.) Skeels, U.S. D. A. Bur. Pl. Industr. Bull. 248: 25. 1912; Fl. Rajasthan 1: 318. 1987. *Myrtus cumini* L. Sp. Pl. 471. 1753. *Eugenia jambolana* Lamk. Encycl. 3: 198. 1789; FBI. 2: 499. 1879; FUGP. 1: 314. Repr. ed. 1960.

Large trees with light-brown and shallowly fissured bark. Leaves ovate-lanceolate, chartaceous, obtuse-acuminate, upper surface shining. Flowers in panicled cymes, nearly sessile; pale or greenish-white. Corolla calyptrate. Stamens numerous. Berries globose or oblong, purple. **Flowering and fruiting:** March-August. Commonly planted on road sides and in orchards for the sake of edible fruits. Sweta 1320.

WCSPF citation for the family:

Govaerts R, Sobral M, Ashton P, Barrie F, Holst B, Landrum L, Leucas E, Matsumoto K, Mazine F, Proenca C, Soares-Silva L, Wilson P & Nic Lughdha E (2009) World Checklist of Myrtaceae. The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ accessed 18 May 2009; 1016 IST.

44. LYTHRACEAE

KEY TO GENERA:

1. Herbs..... 2
2. Shrubs or trees..... 3
2. Flowers with petals, in terminal paniculate inflorescence..... 4. ***Rotala***
2. Flowers without petals, in axillary cymes..... 1. ***Ammannia***
3. Stamens 8..... 3. ***Lawsonia***
3. Stamens numerous..... 2. ***Lagerstroemia***

1. AMMANNIA L.

Key to species:

1. Petals present..... 1. ***A. auriculata***
1. Petals absent..... 2. ***A. baccifera***

1. Ammannia auriculata Willd. Enum. Pl. Hort. Berol. 1: 7. t. 7. 1803; Fl. Rajasthan 1: 321. 1987. *A. senegalensis auct.* non Lamk. 1791; FBI. 2: 570. 1879; FUGP. 1: 322. Repr. ed. 1960.

Erect, much branched, annual herbs. Stems 4-angled and narrowly winged in upper part. Leaves upto 8.0 cm long, linear-lanceoalte, auriculate. Flowers in few flowered, axillary cymes, purplish or dark-pink. Capsules globose, exceeding the calyx tube, red when ripe. **Flowering and fruiting:** September-November. Rare, occasionally found in moist localities. Sweta 1327.

2. Ammannia baccifera L. Sp. Pl. 120. 1753; FBI. 2: 569. 1879; FUGP. 1: 321. Repr. ed. 1960.; Fl. Rajasthan 1: 321. 1987. *Ammannia salicifolia* Hiern, Fl. Trop. Afr. [Oliver et al.] 2: 478. 1871

Erect or ascending, glabrous herbs. Leaves oblong or narrwoly elliptic, base narrowed, rounded or subcordate, acute or obtuse, entire. Flowers in condensed axillary cymes, reddish. Stamens 4. Capsule depressed-glosbose, reddish, exceeding the calyx. **Flowering and fruiting:** Nearly round the year. Abundant in the area in moist or marshy places. Sweta 157, 329.

2. LAGERSTROEMIA L.

Key to species:

1. Trees; calyx strongly ribbed; claw of petals much shorter than the limb..... 2. ***L. speciosa***

1. Shrubs; calyx not ribbed; claw of petals
equaling or longer than the limb..... 1. ***L. indica***

1. Lagerstroemia indica L. Syst. 1076. 1759; Fl. Delhi. 162. 1963.

Erect, glabrous, deciduous shrubs. Leaves shortly petioled, elliptic or oblong, acute or rounded. Flowers white, pink or purplish, in large panicles. Calyx smooth, 5-angled, glabrous. Petals with long claw, margin crisp. Stamens numerous, outer stamnes longer and curved inward. Capsule woody. **Flowering and fruiting:** March-July. Often planted as an ornamental. Sweta 1344.

2. Lagerstroemia speciosa (L.) Pers. Syn. 2: 72. 1806; Fl. Delhi 162. 1963. *Munchausia speciosa* L. in Muench. Hausv. 1: 357. t. 2. 1770. *Lagerstroemia flos-reginae* Retz. Obs. 5: 25. 1788.

Small to medium-sized trees. Leaves upto 25.0 cm long, elliptic or ovate-lanceolate, acute. Flowers in large terminal panicles. Calyx strongly ribbed, hairy. Petals shortly clawed, margin usually not crisp. Stamens all equal. Capsule globose. **Flowering and fruiting:** June-November. Often planted on roadsides. Sweta 1395.

3. LAWSONIA L.

Lawsonia inermis L. Sp. Pl. 349. 1753; Fl. Delhi 162. 1963. *Lawsonia alba* Lamk. Encycl. 3: 106. 1789; FBI. 2: 573. 1879; FUGP. 1: 323. Repr. ed. 1960. .

Large shrubs or small trees. Bark thin, greyish-brown. Leaves upto 2.0 cm long, nearly seesile, lanceolate, glabrous. Flowers in large terminal panicles, white, yellowish at length. Stamens exceeding the sepals and petals. **Flowering and fruiting:** May- August. Cultivated as hedge plant. Leaves are extensively used to dye skin and hair. Sweta s. n.

4. ROTALA L.

Key to species :

1. Bracteoles with a distinct midrib and longer
than the calyx..... 1. ***R. densiflora***
1. Bracteoles without distinct midrib and shorter
than the calyx..... 2
2. Capsule opening by 2 valves..... 2. ***R. indica***
2. Capsule opening by 4 valves..... 3. ***R. rotundifolia***

1. Rotala densiflora (Roth ex Roem. & Schult.) Koehne, Bot. Jahrb. 1: 164. 1880; Fl. Rajasthan 1: 324. 1987. *Ammannia densiflora* Roth ex Roem. & Schult. Syst. Veg. 3: 304.

1818. *A. pentandra* Roxb. Fl. Ind. 1: 448. 1820; FBI. 2: 568. 1879; FUGP. 1: 321. Repr. ed. 1960

Amphibious, annual herbs with 4-angled stems, glabrous. Leaves elliptic-oblong, sessile, faintly nerved. Flowers solitary, axillary, not in distinct spikes. Calyx teeth 5, acuminate; accessory teeth 5. Petals 5, obovate. Capsule globose, depressed. Seeds black, hemispheric. **Flowering and fruiting:** September- November. Included on authority of Murty & Singh (1961b).

2. Rotala indica (Willd.) Koehne, Bot. Jahrb. 1: 172. 1880; Fl. Rajasthan 1: 324. 1987. *Peplis indica* Willd. Sp. Pl. 2 (1): 244. 1799. *Ammannia peploides* Sprengel, Syst. Veg. 1: 444. 1824, *nom. illeg.*; FBI. 2: 566. 1879; FUGP. 1: 320. Repr. ed. 1960.

Small, glabrous, ascending herbs rooting at lower nodes. Leaves upto 2.0 cm long, ovate or oblong, sessile, entire, acute or rounded. Flowers solitary axillary, forming terminal panicles, bright-pink. Capsule two valved, ellipsoid, glabrous. Seeds pale-brown or reddish-brown. **Flowering and fruiting:** June- December. Frequently found on the margins of swamps among the grasses. Sweta 669.

3. Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne, Bot. Jahrb. 1: 175. 1880; Fl. Rajasthan 1: 325. 1987. *Ammannia rotundifolia* Buch.-Ham. ex Roxb. Fl. Ind. 1: 446. 1820; FBI. 2: 566. 1879; FUGP. 1: 320. Repr. ed. 1960.

Extensively branched, amphibious perennial herbs forming large patches. Leaves about 2.0 cm long, obovate to orbicular, subsessile or sessile. Flowers closely packed in terminal, simple or panicled spikes. Calyx tube campanulate, teeth 4, triangular. Petals 4, rose-coloured. Capsule 4-valved. Seeds light-brown, ellipsoid. **Flowering and fruiting:** December-April. Murty & Singh (1961b) reported it from Hastinapur.

45. ONAGRACEAE

KEY TO GENERA:

1. Seeds comose.....1. ***Epilobium***
1. Seeds not comose.....2
2. Calyx tube distinctly produced beyond the ovary;
   capsule sterile towards the base.....3. ***Oenothera***
2. Calyx tube not produced beyond the ovary;
   capsule fertile throughout..... 2. ***Ludwigia***

1. EPILOBIUM L.

Epilobium hirsutum L. Sp. Pl. 347. 1753; DC. Prodr. 3: 42. 1828; FBI. 2: 583. 1879; Fl. Rajasthan 1: 327. 1987.

Branched, hairy herbs up to 1.5 m high. Cauline leaves opposite, sessile, semi-aplexicaul, lanceolate, coarsely dentate, pubescent on both surfaces. Flowers solitary axillary. Petals 4, rose-purple, retuse. Ovary inferior, 4-celled. Stigmas 4, distinct, white. Capsule 5-10 cm long, hairy, 4-angled. Seeds elipsoid or obovoid, 2.5 -3 times as long as broad, coma fulvous. **Flowering and fruiting:** September-December. Occasionally found in semidried swamps and on moist bed of the river Ganga. Sweta 1478.

2. LUDWIGIA L.

Key to species:

1. Plants floating with spongy floats..... 1. ***L. adscendens***
1. Plants without spongy floats.....2
2. Stamens as many as petals.....3
2. Stamens twice as many as sepals..... 2. ***L. octovalvis***
3. Seeds in many rows in each locule of the capsule..... 3. ***L. perennis***
3. Seeds in a single row in each locule of the capsule..... 4. ***L. prostrata***

1. Ludwigia adscendens (L.) Hara in Journ. Jap. Bot. 28: 290. 1953; Fl. Rajasthan 1: 328. 1987. *Jussiaea adscendens* L. Mant. 1: 69. 1767. *J. repens* L. Sp. Pl. 388. 1753; FBI. 2: 587. 1879; FUGP. 1: 326. Repr. ed. 1960, *non Ludwigia repens* Forster 1771.

Free-floating, dark-green or brownish-green herbs. Leaves glabrous, subsessile, rounded, cuneate at the base; stipules minute. Flowers light-yellow or cream. Capsule woody, cylindric, glabrous. **Flowering and fruiting:** June- December. Common in ponds and ditches. This species can be readily recognized by white spongy floats. Sweta 341.

2. Ludwigia octovalvis (Jacq.) Raven subsp. **sessiliflora** (Micheli) Raven in Kew Bull. 15: 476. 1962; Fl. Rajasthan 1: 328. 1987. *Oenothera octovalvis* Jacq. Enum. Syst. Pl. 19. 1760. *J. suffruticosa* L. Sp. Pl. 388. 1753; FBI. 2: 587. 1879; FUGP. 1: 327. Repr. ed. 1960, non *Ludwigia suffruticosa* Walt. Fl. Carolin 90. 1788.

Erect, suffruticose, hairy herbs. Leaves ovate to subovate-lanceolate, shortly petioled, up to 10.0 x 3.0 cm. Flowers solitary, axillary, yellow, subsessile. Sepals 4, connate, lobes enlarging in fruit. Petals 4, orbicular, pale-yellow. Stamens 8. Capsule hairy cylindirc, crowned with persistent calyx. Seeds globose. **Flowering and fruiting:** October- February. Found in agricultural fields. Sweta 538.

3. Ludwigia perennis L. Sp. Pl. 119. 1753; Fl. Rajasthan 1: 329. 1987. *L. parviflora* Roxb. Fl. Ind. 1: 440. 1820; FBI. 2: 588. 1879; FUGP. 1: 327. Repr. ed 1960.

A glabrous, annual herb. Leaves linear-lanceolate or elliptic-lanceolate, entire. Flowers solitary, axillary, small, yellow. Sepals 4, connate; calyx-lobes ovate. Petals 4, equaling the sepals. Fruit obtusely 4-angled, linear-oblong, crowned by persistent calyx-lobes. **Flowering and fruiting:** August- November. Found in moist and shady places.Sweta 638.

4. Ludwigia prostrata Roxb. Fl. Ind. 1: 441. 1820; FBI. 2: 588. 1879; FUGP 1: 327. Repr. ed. 1960; Fl. Rajasthan 1: 329. 1987.

Prostrate or decumbent herbs. Stem reddish tinged. Leaves alternate, elliptic-ovate to lanceolate, acute, glabrous. Flowers 1-4, sessile. Calyx lobes ovate-lanceoalte. Petals yellow. Stamens 4. Style short. Capsule somewhat 4-angled up to 2.5 cm long. Seeds 1-seriate. **Flowering and fruiting:** September- November. Found in marshy habitats. Sweta 1478.

3. OENOTHERA L.

Key to species:

1. Leaves obovate lyrate; flowers yellow.....1. ***O. laciniata***
1. Leaves distantly dentate; flowers pink.....2. ***O. rosea***

1. Oenothera laciniata Hill. Syst. Veg. 12: 64. 1767; Small in Bull. Torrey Bot. Club 23(5): 167-194. 1896. *O. sinuata* L. Mant. 2: 228. 1771; Khan, Journ. Sci. Res. 6(2): 99-100. 1984. *O. repanda* Medic. Act. Acad. Theod. Palat. 3: 198. pl. 8. 1775.

Erect or ascending herbs, stem somewhat woody at base, red tinged. Basal and cauline both obovate-lyrate, sinuate, apex and margins slightly ciliate, veins puberulous, younger parts dense hairy. Flowers, yellow, soliatary axillary, sessile. Calyx tube nearly 2.0 cm produced beyond the ovary, densely hairy, lobes strongly reflexed.. Stigma 4-lobed, yellow. Capsule clavate, with 4 apical teeth, pubescent, 4-angled. **Flowering and fruiting:** March-June. Frequently occurs in fallow lands and on dry sandy bed of Ganga. Sweta 1482.

Note: This species was first reported from India by Khan (1987) on the basis of a single specimen collected from Bijnor. In HWLS the species is frequent in areas close to Ganga.

2. Oenothera rosea L'Hér. ex Ait. Hort. Kew. ed. 1. 2: 3. 1789; Dicot. Pl. Uttar Pradesh 155. 1999. *Xylopleurum roseum* (W. Ait.) Raimann, Pflanzenfam. 111. 7: 214. 1893; Backer & Bakh. f. Fl. Java 1: 263. 1963.

Prostrate, erect or ascending annual herbs. Stem red-tinged, hairy. Leaves alternate, ovate-lanceolate, serrate-dentate, acute. Flowers solitary, axillary. Calyx tube 1.0 cm long above the ovary, pubescent, 4-partite, lobes lanceolate. Corolla rosy-pink with a greenish yellow base,

petals obovate-rounded. Capsule clavate, 4-angled, appressed hairy. **Flowering and fruiting:** Major part of the year. Occasionally found on moist banks of Ganga. Sweta 706.

46. TRAPACEAE

TRAPA L.

Trapa natans var. **bispinosa** (Roxb.) Makino in Bot. Mag. (Tokyo) 11: (283). 1897; Fl. Rajasthan 1: 330. 1987. *T. bispinosa* Roxb. Pl. Cor. t. 3: 29. 234. 1815 & Fl. Ind. 1: 449. 1820; FBI. 2: 590. 1879, *pro parte;* FUGP. 1: 329. Repr. ed. 1960

Floating, annual, herbs. Floating leaves in rosette, rhomboid, crenate-toothed on upper margins; glabrous above, tomentose beneath; petiole inflated. Submerged leaves divided into fine linear segments. Flowers white, solitary, axillary, pedunculate. Drupes obscurely 4-angled, red or green when immature, black when ripe, glabrous, spines 2, lateral, single seeded. **Flowering and fruiting:** August- January. Extensively cultivated in ponds for edible fruits. Sweta 789.

Note: In Indian floras the citation of *T. natans* var. *bispinos* is given as follows:

Trapa natans var. **bispinosa** (Roxb.) Makino in Linuma, Somoku-Dzusetsu ed. 3. 1: 137. 1907.

I am thankful to Ms. Katherine Challis, IPNI Editor, Herbarium, Library, Art and Archives, Royal Botanic Gardens, Kew for pointing out a much earlier publication for this combination.

According to APG-2 the genus Trapa belongs to family Lythraceae.

47. CUCURBITACEAE

KEY TO GENERA:

1. Fruits operculate.....2
1. Fruits not operculate.....3
2. Fruit not fibrous; splitting in to nearly two equal halves..... 1. *Actinostemma*
2. Fruits fibrous; operculum small, apical..... 6. *Luffa*
3. Petals with fimbriate margins..... 9. *Trichosanthes*
3. Petals not fimbriate on margins..... 4
4. Anther cells sigmoid, flexuous or conduplicate..... 5
4. Anther cells straight or curved, but never conduplicate.....8
5. Male flowers with large, sessile, orbicular-reniform, cucullate or suborbicular-cordate bracts; petals with 2-3 scales at the base..... 8. *Momordica*
5. Male flowers without bracts; petals without scales..... 6
6. Corolla rotate or if campanulate then 5-partite up to the base..... 7

6. Corolla campanulate, divided less than halfway down; tendrils simple; flowers white; anthers coherent at the base only or completely free..... 4. ***Coccinia***

7. Tendrils simple; connective produced above the anther cells into an appendage; seeds ovate..... 5. ***Cucumis***

7. Tendrils 2-3 fid; connective not produced above the anther cells; seeds oblong ....3. ***Citrulus***

8. Tendrils 2-fid; fruits with six, white, longitudinal strips..... 2. ***Bryonopsis***

8. Tendrils simple; style short, surrounded by an annular disc; fruit uniformly bright red..... 7. ***Melothria***

1. ACTINOSTEMMA Griff.

Actinostemma tenerum Griff. Pl. Cantor. 24. t. 3. 1837; FBI. 2: 633. 1879 (*excl. syn.)*; FUGP. 1: 351. Repr. ed. 1960; Fasc. Fl. Ind. 11. (Cucurbitaceae) 7. f. 1-17. 1982.

An extensive climber with slender branches. Leaves narrowly ovate, sagittately-trilobed, minutely denticulate. Male flowers in long racemes, small, yellowish-white. Female flowers solitary. Fruits operculate, dehiscing transversely almost in equal halves, covered with soft spines. Seeds reddish-brown. **Flowering and fruiting:** April-December. Abudant in marshy areas. Sweta 208, 532.

2. BRYONOPSIS Arnott.

Bryonopsis laciniosa (L.) Naud. Ann. Sci. Nat. 4. 12. 141. 1859; FUGP. 1: 381. 1903; Fasc. Fl. Ind. 11. (Cucurbitaceae) 18. f. 1-10. 1982 Fl. Rajasthan 1: 1987. *Bryonia laciniosa* L. Sp. Pl. 1013. 1753; FBI. 2: 622. 1879.

Subglabrous, annual herbs. Leaves deeply palmately 5-lobed, margins distantly denticulate. Male flowers greenish-yellow. Calyx lobes spreading, about 4.0 mm long. Fruit 10.0-15.0 mm in diameter, spherical, 6-8 striped, mature fruit red with white stripes. **Flowering and fruiting:** July-October. Common in the area, found climbing on hedges and trees. All earlier authors have mentioned the fruit as six striped. However, some populations of this taxon in this area bear eight striped fruits. It may be a distinct taxon. Sweta 127.

According to APG-2 the accepted name for this genus is *Kedrostis* Medik.

3. CITRULUS Schrad. *nom. cons.*

Citrulus colocynthis Schrad. in Linnaea 12: 414. 1838; FBI. 2: 620. 1879; FUGP. 1: 344. Repr. ed. 1960; Fl. Ind. Fasc. 11 (Cucurbitaceae) 20. f. 1-7. 1982; Fl. Rajasthan 1: 333. 1987. *Cucumis colocynthis* L. Sp. Pl. 1011. 1753.

Prostrate herbs with long, trailing, angular, slightly scabrid stems. Leaves deeply 3-5 lobed, each lobe sinuate, thinly villous, nerves densely hairy abaxially. Tendrils simple or bifid. Male flowers greensih-yellow, on 4.0 -5.0 mm long hairy peduncle; calyx tube broadly campanulate, hairy; corolla lobes ovate, acute, mucronate. Fruits globose, slightly depressed, ripe fruit red, with 6-8 longitudinal, white stripes, pulp spongy and bitter. Seeds ovate-oblong, not margined about 6.0 mm long. **Flowering and fruiting:** May-October. Occasionally found in sandy localities. Sweta 1523.

4. COCCINIA Wight & Arn.

Coccinia grandis (L.) J. O. Voigt, Hort. Suburb. Calc. 59. 1845; Fl. Ind. Fasc. 11 (Cucurbitaceae) 24. f. 1-9. 1982; Fl. Rajasthan 1: 335. 1987. *Bryonia grandis* L. Mant. Pl. 1: 126. 1767. *Coccinia indica* Wight & Arn. Prodr. 347. 1834; FUGP. 1: 345. Repr. ed. 1960. *Cephalandra indica* (Wt. & Arn.) Naud. in Ann. Sci. Nat. ser. 5. 5: 16. 1859; FBI. 2: 621. 1879, *excl. syn.*

Perennial, dioecious climbers. Rootstock woody. Leaves variable, angular to palmately lobed, margins minutely denticulate. Flowers white, corolla puberulous, basal portion of corolla glabrous within. Styles 3, yellow papillose. Fruit fusiform-ellipsoidal, streaked with white when immature, bright-scarlet and fleshy when mature. Seeds oblong, compressed, yellowish. **Flowering and fruiting:** Nearly round the year. Common in the area, climbing on shrubs and small trees. Sweta 1525.

5. CUCUMIS L.

Cucumis melo L. Sp. Pl. 1011. 1753.

Var. **agrestis** Naud. Ann. Sci. Nat. Paris Ser. 4. 11: 73. 1859 & 12: 110. 1859; Cogn, & Harms, Pfreich. 88: 120. 1924; Fl. Ind. Fasc. 11 (Cucurbitaceae) 36. 1982. *Cucumis pubescens* Willd. Sp. Pl. 4: 614. 1805.

Slender, hispid annual herbs. Leaves reniform-suborbicular, deeply cordate, sinuately 3-lobed, denticulate, hispid. Male flowers in fascicles. Calyx hispid, lobes subulate. Corolla pubescent, yellow, lobes apiculate. Female flowers pedicelled, yellow. Fruit ovoid-ellipsoid, hairy, glabrescent at maturity. **Flowering and fruiting:** March- July. Occasionally found in moist and grassy places. Sweta 849.

6. LUFFA Mill.

Key to species:

1. Flowers yellow; stamens 5; fruit tuberculate..... 2. ***L. graveolens***

1. Flowers white; stamens 3; fruit densely covered

with spines..... 1. ***L. echinata***

1. Luffa echinata Roxb. Fl. Ind. 3: 716. 1832; FBI. 2: 615. 1879; FUGP. 1: 337. Repr. ed. 1960; Fasc. Fl. Ind. 11 (Cucurbitaceae) 71. 1982; Fl. Rajasthan 1: 343. 1987.

Climbers with smooth stems and 2-fid tendrils. Leaves reniform-orbicular, 5-lobed, scabrid, acute, minutely denticulate. Male racemes longer than the leaves. Flowers white. Fruits ovoid, ecostate, densely covered with stiff bristles, bristles not woolly except the ciliate apex, yellowish. Seeds ovate, black. **Flowering and fruiting:** August-November. Occasionally found in sugarcane fields. The specimens from this area are referable to var. *echinata*.Sweta 1328.

2. Luffa graveolens Roxb. Fl. Ind. 3: 716. 1832; FBI. 2: 614. 1879 Fl. Ind. Fasc. 11 (Cucurbitaceae) 71. 1982; Fl. Dudhwa Nat. Park 208. 1997.

Medium sized climbers with 3-5 fid tendrils. Leaves reniform, orbicular, angled, denticulate, scabrous adaxially. Flowers yellow, unisexual. Fruits dark-brown, ovoid-oblong, ecostae, up to 5.0 cm long, tuberculate. Seeds whitish or ashy, ovate-oblong, smooth. **Flowering and fruiting:** August-October. Occurs near villages on the margins of agricultural fields. Sweta 637.

7. MELOTHRIA L.

Key to species:

1. Male flowers subumbellate; fruits finely reticulate..... 2. ***M. perpusilla***
1. Male flowers fascicled; fruits not reticulate, finely hairy.....1. ***M. maderaspatana***

1. Melothria maderaspatana (L.) Cogn in DC. Monog. Phan. 3: 623. 1881; FUGP. 1: 347. Repr. ed. 1960; Fl. Ind. Fasc. 11 (Cucurbitaceae) 83. 1982; Fl. Rajasthan 1: 345. 1987. *Cucumis maderaspatana* L. Sp. Pl. 1012. 1753; *Mukia scabrella* Arn. in Hook. J. Bot. 3: 276. 1841; FBI. 2: 623. 1879, *excl. syn. Bryonia scabrella* L. f. Suppl. Sp. Pl. 424. 1781.

Scabrous climbers. Leaves ovate or subdeltoid, 3-5 lobed, acute, denticulate, scabrid. Flowers yellow. Fruits bright-red, finely hairy, usually in clusters of three. Seeds grey, ovoid-oblong. **Flowering and fruiting:** July- December. Commnoly found climbing on shrubs. Sweta 573.

2. Melothria perpusilla (Blume) Cogn. in DC. Monog. Phan. 3: 607. 1881; FUGP. 1: 347. Repr. ed. 1960; Fasc. Fl. Ind. 11 (Cucurbitaceae) 85. 1982; Fl. Rajasthan 1: 345. 1987.

Cucurbita perpusilla Blume, Cat. Hort. Buitenz. 105. 1823. *Zehneria hookeriana* Arn. in Hook. J. Bot. 3: 275. 1841; FBI. 2: 624. 1879.

Glabrous climbers. Leaves ovate-cordate, entire, angled or 3-5 lobed, acute or mucronate, denticulate. Flowers yellowish. Fruits globose. Seeds ovate-oblong, smooth. **Flowering and fruiting:** July- December. Included on the authority of Murty and Singh (1961b).

8. MOMORDICA L.

Momordica dioica Roxb. ex Willd. Sp. Pl. 4: 605. 1805; FBI. 2: 617. 1879; FUGP.1: 339. Repr. ed. 1960; Fasc. Fl. Ind. 11 (Cucurbitaceae) 94. 1982; Fl. Rajasthan 1: 347. 1987.

Perennial climbers, root tuberous. Leaves upto 10.0 cm long, membranous, ovate, mucronate, 3-5 lobed; lobes denticulate, dotted on lower surface. Flowers yellow. Bracts about 2.0 cm long, sessile, cucullate, orbicular-reniform. Fruit ellipsoid or ovoid, beaked, densely echinate with soft spines. Seeds pyrifrm, attenuated at the base, rounded at the apex. **Flowering and fruiting:** August-November. Occasionally found climbing on shrubs. Sweta 39.

9. TRICHOSANTHES L.

Trichosanthes cucumerina L. Sp. Pl. 1008. 1753; FBI. 2: 609. 1879; FUGP. 1: 333. Repr. ed. 1960; Fasc. Fl. Ind. 11 (Cucurbitaceae) 112. 1982; Fl. Rajasthan 1: 349. 1987.

Scabrid, annual, climbing herbs. Leaves broadly ovate or orbicular-reniform, denticulate, deeply 5-7 lobed, upto 10.0 cm long. Tendrils 2-3 fid. Flowers white. Fruits about 5.0 cm long, beaked, base attenuate, orange when ripe. Seeds ovate-oblong, compressed, truncate. **Flowering and fruiting:** August-November. Common among the hedges. Sweta 113, 936.

48. PASSIFLORACEAE

PASSIFLORA L.

Passiflora caerulea L. Sp. Pl. 959. 1753; Man. Cult. Pl. 691. 1949; Dicot. Pl. Uttar Pradesh 156. 1999.

Medium-sized woody climbers with dense foliage. Leaves palmatisect into 3-5 lobes, minutely serrate, petiole with 2-4 glands. Flowers solitary, axillary, fragrant. Sepals 5, white. Petals 5, bluish, rays of corona 2-4 seriate, purple at base, white in middle and blue at tips. Stamens 5, inserted on a gynophore. Ovary 1-celled, 3-carpellary, raised on a gynophore. Styles 3. Fruit not seen. **Flowering:** May-October. Often planted in parks, Inspection Houses and private gardens. Sweta s. n.

49. CACTACEAE

OPUNTIA Mill.

Opuntia elatior Mill. Gard. Dict. ed. 8. n. 4. 1768; Dicot. Pl. Uttar Pradesh 162. 1999. *O. dillenii* auct. pl. [non. (Ker-Gawl.) Haw. 1819]; FUGP. 1: 352. Repr. ed. 1960.

A medium-sized shrub, upper part of stem modified into flat, obovate, fleshy, olive-green phylloclades. Areoles scattered, minutely tufted hairy, spines 1-8 per areole, terete, acicular, yellowish-brown. Flowers yellow, sessile, tepals many seriate, outer ones with red middle region. Stamens numerous. Ovary glochidiate. Styles lobes 6. Fruit a pyriform berry, red when ripe. **Flowering and fruiting:** April-July.**Local name:** *Nag-phani.* Often found in dry, sandy habitats and waste places. Also used to fence the orchards. Sweta 1340.

Cereus sp. is grown on fencing of orchards etc.

50. AIZOACEAE

KEY TO GENERA:

1. Style 1..... 1. ***Trianthema***

1. Styles 2..... 2. ***Zaleya***

1. TRIANTHEMA L.

Key to species:

1. Stamnes 10 or more..... 1. ***T. portulacastrum***

1. Stamens 5..... .....2. ***T. triquetra***

1. Trianthema poltulacastrum L. Sp. Pl. 223. 1753; Fl. Rajasthan 1: 355. 1987. *T. monogyna* L. Mant. 69. 1767; FBI. 2: 660. 1879; FUGP. 1: 353. Repr. ed. 1960

Prostrate or procumbent, succulent herbs, often forming dense patches. Leaves obovate to rounded, obtuse or retuse at the apex, margin often pink. Flowers solitary-axillary, pink or white. Stamens ten or more. Fruit half sunken in the leaf axil, slightly mitriform-oblique, circumcissile. Seeds 5-10, lenticular, reniform, black. **Flowering and fruiting:** Octber-February. Often found on humus rich soil near villages. Sweta 76.

2. **Trianthema triquetra** Roxb. ex Willd. in Ges. Nat. Fr. Neue Schr. 4: 181. 1803; Fl. Rajasthan 1: 355. 1987. *T. crystellina auct. plur.* non Vahl 1790; FBI. 2: 660. 1879; FUGP. 1: 354. Repr. ed. 1960.

Prostrate, succulent, annual herbs. Leaves linear or lanceolate, dilated at the base. Capsule enclosed by perianth tube. Seeds orbicular, brownish-black. **Flowering and fruiting:** October- March. Included on authority of Murty and Singh (1961b).

2. ZALEYA Burm. f.

Zaleya decandra (L.) Burm. f. Fl. Ind. 110. t. 31. f. 3. 1768; Fl. Rajasthan 1: 355. 1987. *Trianthema decandra* L. Mant. 1: 70. 1767; FBI. 2: 661. 1879.

Prostrate, spreading herbs. Leaves elliptic-oblong or slightly obovate.Flowers in axillary clusters, pink. **Flowering and fruiting:** July-December. Included on authority of Murty and Singh (1961b).

51. MOLLUGINACEAE

KEY TO GENERA:

1. Carpels united..... 2
1. Carpels free..... 1. ***Gisekia***
2. Flowers in axillary clusters; seeds appendaged..... 2. ***Glinus***
2. Flowers in terminal, paniculate cymes; seeds not appendaged..... 3. ***Mollugo***

1. GISEKIA L.

Gisekia pharnaceoides L. Mant. Alt. 2: 562. 1771; FBI. 2: 664. 1879; FUGP. 1: 356. Repr. ed. 1960; Fl. Rajasthan 1: 357. 1987.

Prostrate, deep-rooted, glabrous herbs. Leaves linear-oblong, sub-opposite, subsessile, slightly fleshy. Flowers in axillary or terminal, umbellate-cymes, pinkish-green. Sepals 5, free or slightly connate at base, margins scarious. Stamens 5, filments dilated at the base. Carpels 5, free, style short. Fruit consisting of 5, free, densely papillose, indehiscent, cocci surrouded by persistent sepals. Seeds sub-reniform, compressed, black. **Flowering and fruiting:** June-November. Often found in moist sandy soil. Sweta 1341.

Note: According to Vascular Plant Families and Genera Database at Kew website this genus belongs to family Gisekiaceae.

2. GLINUS L.

Glinus lotoides L. Sp. Pl. 463. 1753; Fl. Rajasthan 1: 358. 1987. *Mollugo hirta* Thunb. Prodr. Pl. Cap. 24. 1794; FBI. 2: 662. 1879; FUGP. 1: 354. Repr. ed. 1960.

Profusely branched, densely stellate-hairy, prostrate herbs. Leaves ovate-obovte, up to 2.0 x 0.5 cm, densely stellate-hairy. Flowers 3-5 in axillary clusters, subsessile. Sepals 5, densely stellate-hairy. Petals 0. Stamens 5, filaments short initially, elongating later. Ovary glabrous, thin-walled, 5-celled. Styles 5. Capsule 5-valved, included in persistent calyx. Seeds many, reniform, tubercled, shining, dark-brown, with a long filiform appendage. **Flowering and fruiting:** March-September. Often found on bottom of dried ditches. Sweta 1345.

3. MOLLUGO L.

Mollugo pentaphylla L. Sp. Pl. 89. 1753; FUGP. 1: 355. Repr. ed. 1960; Fl. Rajasthan 1: 360. 1987. *M. stricta* L. Sp. Pl. ed. 2. 131. 1762; FBI. 2: 663. 1879.

Much branched, suberect, glabrous herbs, stem reddish. Leaves linear to linear-lanceolate, acute, glabrous, up to 2.5 x 0.5 cm. Flowers greenish-white, in terminal paniculate cymes, small. Perianth lobes ovate-oblong, scarious margined. Stamens 3-5. Styles 3. Capsule obtusely 3-gonous, many seeded. Seeds granulate, renifrom, dark-brown.**Flowering and fruiting:** March-December. Found in sugar cane fields and wastelands. Sweta 1351.

52. APIACEAE

KEY TO GENERA:

1. Root conical, orange to purple..... 4. ***Daucus***
1. Root not as above.....2
2. Leaves simple.....3
2. Leaves compound; 4
3. Mericarps 7-9 ribbed; leaves not lobed.....2. ***Centella***
3. Mericarps 3- ribbed; leaves deeply lobed..... 5. ***Hydrocotyle***
4. Mericarps with winged margins; leaves tripinnate..... 1. ***Anethum***
4. Mericarps not with winged margins.....5
5. Peripheral flowers of the umbel zygomorphic, light purple in colour..... 3. ***Coriandrum***
5. All flowers of the umbel actinomorphic, white or pinkish in colour..... 6
6. Stem creeping below; leaves 1-2 pinnate, glabrous..... 6. ***Oenanthe***
6. Stem not creeping below; leaves 2-3 pinnate, pubescent or hairy..... 7. ***Seseli***

1. ANETHUM L.

Anethum graveolens L. Sp. Pl. 263. 1753; Fl. Rajasthan 1: 361. 1987. *Peucedanum graveolens* (L.) Benth. & Hook. f. Gen. Pl. 1: 913. 1867; FBI. 2: 709. 1879; FUGP. 1: 363. Repr. ed. 1960.

Tall, erect, annual, glabrous herbs. Leaves 2-3 pinnate, linear, upper sessile, lower petiolate. Flower in decompound, terminal umbels, yellow. Fruits up to 0.5 cm long, dorsally compressed. **Flowering and fruiting:**December-March. Cultivated, often found as an escape.Sweta s.n.

2. CENTELLA L.

Centella asiatica (L.) Urban in Mart. Fl. Bras. 11: 287. t. 78. f. 1. 1897; Fl. Rajasthan 1: 362. 1987. *Hydrocotyle asiatica* L. Sp. Pl. 234. 1753; FBI. 2: 669. 1879; FUGP. 1: 358. Repr. ed. 1960.

Perennial, stoloniferous, creeping herbs. Leaves long petioled, up to 5.0 cm in diam., in a rossette, reniform, deeply cordate, crenate-dentate, glabrous. Flowers in axillary umbels consisting of 2-5 flowers, bracts small, pink to red in colour. Calyx teeth absent. Petals ovate-rounded 0.1-0.15 cm long. Fruits shallowly 2-lobed, 0.4-0.5 cm long, reticulately wrinkled. **Flowering and fruiting:** April-December. Found in moist and shady places, especially in plantations of *Terminalia arjuna.* Sweta 925.

3. CORIANDRUM L.

Coriandrum sativum L. Sp. Pl. 256. 1753; FBI. 2: 717. 1879; FUGP. 1: 364. Repr. ed. 1960; Fl. Rajasthan 1: 365. 1987.

Erect, glabrous, annual herbs. Juvenile leaves palmatilobed-partite; leaves in floral region decompound with fine linear segments. Flowers in axillary or terminal umbels, light-purple or white. Outer flowers of the umbel zygomorphic. Calyx teeth radiate, triangular-lanceolate, up to 0.1 cm long. Fruit subglobose, greenish-yellow or light-yellow, up to 0.2 cm long, primary ribs undulate. **Flowering and fruiting:** February-April. Widely cultivated in the area. Leaves are used to garnish curries and seeds are used as condiment. Also found as an escape near villages. Sweta 1346.

4. DAUCUS L.

Daucus carota L. Sp. Pl. 242. 1753; Fl. Rajasthan 1: 366. 1987; Dicot. Pl. Uttar Pradesh 166. 1999.

Hairy, annual herbs with orange to reddish-purple cinical roots. Leaves 2-3 pinnate to decompound, radical. Never seen in flowering. Widely cultivated as winter season vegetable crop. Sweta 1402.

5. HYDROCOTYLE L.

Hydrocotyle sibthorpioides Lamk. Encycl. 3: 153. 1789; Dicot. Pl. Uttar Pradesh 166. 1999. *H. rotundifolia* DC. Prodr. 4: 64. 1830; FBI. 2: 668. 1879; FUGP. 1: 358. Repr. ed. 1960.

Slightly fleshy, creeping or ascending, glabrous or hairy, perennial herbs. Leaves rounded, 3-5 palmatilobed, segments crenate-serrate. Stipules ovate-rounded, entire or dentate. Umbels solitary, peduncles up to 0.5 cm long. Involucres ovate-acute. Calyx teeth none. Petals red, lanceolate, acute. Fruit glabrous or hairy, often red-punctate, compressed, 5-gonal. **Flowering and fruiting:** March-November. Occasionally found in moist localities. Sweta 1426.

According to APG-2 this genus belongs to group Hydrocotyloideae Link of the family Araliaceae.

6. OENANTHE L.

Oenanthe javanica (Blume) DC. Prodr. 4: 138. 1830; Fl. Rajasthan 1: 362. 1987. *Sium javanicum* Blume, Bijdr. Fl. Ned. Ind. 15: 881. 1826. *Oenanthe stolonifera* (Roxb.) Wall. ex DC. Prodr. 4: 138. 1830; FBI. 2: 696. 1879; FUGP. 1: 362. Repr. ed. 1960. *Phelandrium stoloniferum* Roxb. Fl. Ind. 2: 93. 1832.

Stoloniferous, glabrous herbs with fistular stem. Leaves 1-pinnate; leaflets 3-5, serrate, acute, petiole long. Flowers in terminal or leaf-opposed compound umbels, white. Fruits up to 0.3 cm long, ribs swollen. **Flowering and fruiting:** January-June.Abundant in swampy areas. Sweta 45, 906.

7. SESELI L.

Seseli diffusum (Roxb. ex Sm.) Sant. & Wagh in Bull. Bot. Surv. India 5: 108. 1963; Fl. Rajasthan 1: 364. 1987. *Ligusticum diffusum* Roxb. ex Sm. in Rees, Cycl. 21: 11. 1812. *Seseli indicum* Wt. & Arn. Prodr. 371. 1834; FBI. 2: 693. 1879; FUGP. 1: 362. Repr. ed. 1960.

Densely hairy, ascending or diffuse annual herbs. Leaves 2-pinnate, segments ovate-oblong or linear-lanceolate. Flowers in compound umbels, whitish-pink. Petals 5, deeply notched. Fruits prominently ridged, subglobose, vittae distinct. **Flowering and fruiting:** April-June. Frequently found on margins of ditches and other moist localities. Sweta 1440.

53. RUBIACEAE

KEY TO GENERA

1.Herbs..... 2

1. Shrubs or trees; flowers in dense globose heads..... 5

2. Each cell of the ovary 1- ovuled..... 3

2. Each cell of the ovary 2- many ovuled..... 4

3. Leaves opposite; flowers sessile..... 1. ***Borreria***

3. Leaves whorled; flowers pedicellate..... 4. ***Galium***

4. Flowers 5- merous; throat hairy; fruits densely hairy..... 3. ***Dentella***

4. Flowers 4-merous; throat glabrous; fruit glabrous..... 6. ***Oldenlandia***

5. Ovules many in each cell, a shrub..... 2. ***Cephalanthus***

5. Ovules solitary in each cell..... 5. ***Morinda***

1. BORRERIA G. F. W. Mey., *nom. cons.*

Key to species:

1. Corolla tube with a ring of hairs within at the base..... 1. ***B. articularis***

1. Corolla tube without a ring of hairs within at the base..... ..... 2. ***B. pusilla***

1. Borreria articularis (L. f.) F.N. Will. in Bull. Herb. Boiss. ser. 2. 5: 956.1905; Fl. Rajasthan1: 369.1987. *S. articularis* L. f. Suppl. 119. 1782. *Spermacoce hispida* L. Sp. Pl. 102. 1753; FBI. 3: 200.1881; FUGP. 1: 395. Repr. ed. 1960. *Borreria hispida* (L.) K. Schum. in Engl. & Prantl, Pflanzenfam. 4 (4): 144.1891, *non* Spruce ex K. Schum. 1888.

Prostrate or procumbent herbs, stem hispidly hairy, 4 angled. Leaves subsessile, obovate, oblong or elliptical, acute, margins thickened, ciliated. Flowers whitish-pink or pale-blue, in whorls of 4-6. Calyx hispid, linear-lancoelate. Corolla salver shaped, petals oblong, acute. Mericarps hispid. Seeds brown cylindrical, grandulate. **Flowering & Fruiting:** August-October. Found frequently in sandy areas, roadsides and *Kholas.* Sweta 159.

Note: According to WCSPF the accepted name for this taxon is **Spermacoce articularis** L.f., Suppl. Pl.: 119 (1782).

2. Borreria pusilla (Wall.) DC. Prodr. 4: 543. 1830; Fl. Rajasthan 1: 370. 1987. *Spermacoce pusilla* Wall. in Roxb. Fl. India 1: 379. 1820. *S. stricta* L. f. Suppl. 120. 1781; FBI. 3: 200. 1880; FUGP. 1: 394. Repr. ed. 1960. *Borreria stricta* (L. f.) K. Schum. in Engl. & Prantl, Pflanzenfam. 4 (4): 143.1891, *non* Meyer 1818.

Erect hairy herbs; stem 4 angled, hispidly hairy. Leaves opposite, sessile, linear-lanceolate, acute, entire, margin thickened. Flowers white in axillary dense clusters. Corolla campanulate, corolla tube glabrous inside. Mericarps hairy, awn-less. Seeds brown, smooth, with a ventral groove. **Flowering & Fruiting:** August-December. Found frequently in wastelands. Sweta 275.

Note: According to WCSPF the accepted name for this taxon is **Spermacoce pusilla** Wall. in W.Roxburgh, Fl. Ind. 1: 379 (1820).

2. CEPHALANTHUS L.

Cephalanthus tetrandra (Roxb.) Ridsdale & Bakh. f. in Blumea 23. 182. 1976; Dicot Pl. Uttar Pradesh 176. 1999. *Nauclea tetrandra* Roxb. Fl. Ind. 2: 125. 1824. *C. naucleoides* DC. Prodr. 539. 1830; FBI. 3: 24. 1880, excl. Syn. *C. aralioides* Zoll. & Mor. *Cephalanthus occidentalis* auct. non L. 1753; FUGP. 1: 374. Repr. ed. 1960.

Large to medium sized, evergreen shrubs. Leaves opposite, petioled, 11-20 x 4-7 cm, ovate-lanceolate, acuminate, entire, nerves prominent; stipules short, young leaves bright-red in colour. Flowers white, fragrant, sessile, in globose heads arranged in terminal branched inflorescence or axillary-solitary. Calyx limb cup-shaped, lobes short, ovate with interposed black glands. Corolla glabrous, lobes 4-5. Style long exserted, stigma yellowish, capitate. Fruits forming a globose fleshy mass which consists of numerous indehiscent, 1-seeded cocci. **Flowering & Fruiting:** March-July. **Local Name:** *Jal Kaim.* Occurs in marshy habitats in the patches of *Phragmitis karka*. Sweta 434.

3. DENTELLA J. & G. Forst.

Dentella repens (L.) J.& G. Forster, Charact. Gen. Pl. 26. t. 13. 1775; FBI. 3: 42. 1880; FUGP. 1: 378. Repr. ed. 1960; Fl. Rajasthan 1: 371. 1987. *Oldenlandia repens* L. Mant. 40. 1767.

Small weak, prostrate, dichotomously branched, annual or perennial herbs. Leaves small, opposite, sessile, spathulate, entire, glabrous. Flowers small, white, solitary, axillary and in the forks of branches. Calyx tube globose, persistent. Corolla funnel shaped, 2-3 toothed. Ovary densely hairy. Stigmas 2, filiform. Capsule small, globose, 2-celled, densely hairy, crowend with persistent calyx. Seeds minute, angled. **Flowering & Fruiting:** February-July. Forms dense patches in marshy and wet habitats. Sweta 449.

4. GALIUM L.

Galium aparine L. Sp. Pl. 108. 1753; FBI. 3: 205. 1881; Dicot Pl. Uttar Pradesh 176. 1999.

Annual, rambling herbs. Leaves sessile, in whorls of 6-8, oblong-spathulate, mucronate. Flowers white, axillary, pedicels elongated in fruits. Corolla greenish-white, lobes ovate-triangular. Fruits clothed with spreading hooked hairs, didymous. **Flowering & Fruiting:** Febuary-March. Common in shady places in *Kholas*. Sweta 712.

5. MORINDA L.

Morinda pubescens Sm. in Rees, Cyclop. 24. n. 3. 1813; Dicot. Pl. Uttar Pradesh 179. 1999. *M. tinctoria* Roxb. Hort. Beng. 15. 1814, *nom. nud.* et Fl. India 2: 197. 1824; FBI 3: 156. 1880; FUGP. 1: 392. Repr. ed. 1960.

Small trees with 4-angled, tomentose branches. Leaves opposite, elliptic, tomentose, acute; stipules bifid, 8- 15 cm long. Flowers white, 5-merous, in globose heads. Calyx truncate. Corolla tube 2.0-3.0 cm long, lobes obtuse or subacute. Fruits globose, fleshy, about 3.0 cm in diam.**Flowering and fruiting:** April-August. Included on the authority of Murty and Singh (1961b).

6. OLDENLANDIA L. *emend.* Brem.

Oldenlandia corymbosa L. Sp. Pl. 119. 1753; FBI. 3: 64. 1880 *pro parte*; FUGP. 1: 380. Repr. ed. 1960; Fl. Rajasthan 1: 379. 1987.

Erect or decumbent annual herbs. Leaves sessile, linear-lanceolate, acute, glabrous, margins revolute, bristly, up to 2.5 cm long. Flowers 2-5, in axillary, long peduncled cymes, white or pinkish. Calyx-lobes 4, ovate-triangular, acute. Corolla lobes 4, acute. Stamens included. Capsule, crowned by calyx lobes. Seeds angular. **Flowering and fruiting:** Major part of the year. Common in grassy habitats. Sweta 884.

This taxon shows great deal of variation as regards the leaf size, number of flowers per inflorescence (sometimes up to 8) and length of the peduncle and pedicels.

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Anthocephalus chinensis (Lam.) A. Rich. ex Walp. is planted as an ornamental.

54. ASTERACEAE

KEY TO GENERA:

1. Involucral bracts spinescent or aristate;
   heads many flowered..... 2
1. Involucral bracts neither spinescent nor aristate..... 5
2. Heads heterogamous; glabrous or scabrous herbs;
   florets purple; spines of involucral bracts long, thinly
   feathery and spreading.....3. ***Amberboa***
2. Heads homogamous; involucral bracts not as above..... 3
3. Heads dioecious or polygamo-dioecious..... 4
3. Heads bisexual; achenes glabrous; leaves spinescent;
   florets orange-yellow; pappus absent..... 10. ***Carthamus***
4. Involucral-bracts of female heads united into an ovoid,
   2-beaked utricle clothed with hooked spines; florets
   without petals..... 41. ***Xanthium***
4. Involucral bracts of female heads free, spine tipped;
   florets with petals..... 8. ***Breea***
5. Heads homogamous, either male or female or bisexual.....6
5. Heads heterogamous; outer florets usually female, inner
   ones bisexual or male..... 20
6. All florets ligulate; plants usually laticiferous..... 7
6. Heads with tubular florets only (except *Pulicaria angustifolia*,
   where outer florets are ligulate).....12
7. Pappus of extremely short, 2- 3 seriate scales;
   florets purplish.....12. ***Cichorium***
7. Pappus of equal or unequal, multiseriate hairs..... 8
8. Achenes beaked; pappus hairs free..... 9

8. Achenes not beaked, with an attenuated top; pappus hairs
united at the base..... 11
9. Achenes angular or subterete..... 42. ***Youngia***
9. Achenes compressed..... 10
10. Leaves rosulate; corolla yellow..... 25. ***Ixeris***
10. Leaves otherwise; corolla bluish or rarely white..... 26. ***Lactuca***
11. Leaves mostly cauline; involucre campanulate; achenes
narrow at the base and truncate at the apex..... 35. ***Sonchus***
11. Leaves mostly basal; involucre cylindric; achenes
truncate at both ends..... 28. ***Launaea***
12. Heads compound; each head 1- flowered, sessile, in the
axils of dilated leaf- sheaths; pappus of 2 scales; anthers
exserted, dark purple..... 9. ***Caesulia***
12. Heads simple..... 13
13. Leaves opposite, at least in the lower region..... 14
13. Leaves alternate and/or radical..... 16
14. Anthers without an apical appendage; pappus of 3-4
thick, clavate, sticky scales..... 1. ***Adenostemma***
14. Anthers with an apical appendage; pappus
not as above..... 15
15. Plants with aromatic smell; pappus of 5 serrate,
awn-tipped scales..... 2. ***Ageratum***
15. Plants without any smell; pappus of 6 to many rigid,
1-seriate hairs..... 21. ***Eupatorium***
16. Involucral bracts 1-seriate..... 17
16. Involucral bracts 2- many seriate..... 18
17. All heads on a plant bisexual and fertile; involucre bracts
united before fruit maturation; receptacle flat, naked; florets
pink, rarely white; receptacle naked, flat; filaments free;
style 2-fid; plants glabrous or thinly hairy..... 18. ***Emilia***
17. Female and bisexual (functionally male) heads
on the same plant; bisexual heads with cylindric,
paleaceous receptacle and paleas enclosing
the florets; filaments united and style undivided;
plants usuallu scabrid..... 41. ***Xanthium***
18. Anther bases sagittate, tailed..... 19
18. Anther bases obtuse, not tailed..... 40. ***Vernonia***
19. Usually procumbent herbs with samaller cauline
leaves; heads yellow; outer florets ligulate; outer
pappus a laciniate cup..... 31. ***Pulicaria***

19. Usually erect herbs with large basal leaves; heads
pale-red; all florets tubular; outer pappus none..... 24. ***Himalaiella***
20. Heads collected into globular compound heads;
stem winged; florets purple..... 36. ***Sphaeranthus***
20. Heads simple distinct..... 21
21. Leaves opposite at least in the lower region..... 22
21. Leaves alternate and/or radical..... 29
22. Leaves 3-foliate or deeply pinnatifid; pappus
stiff, retrorsely barbed.....5. ***Bidens***
22. Leaves simple, entire or serrate-dentate; pappus neither
stiff nor retrorsely barbed..... 23
23. Palea concave, embracing the florets or achenes..... 24
23. Palea flat, not embracing the florets or achenes;
flowers yellow 28
24. Ray florets 2- many seriate..... 17. ***Eclipta***
24. Ray florets 1- seriate..... 25
25. Flowers white; receptacle flat; ligule of ray florets
exserted..... 6. ***Blainvillea***
25. Flowers yellow, ray florets fertile.....26
26. Involucral bracts definite..... 27
26. Involucral bracts several; receptcle raised,
conical; ligule of ray florets included; achenes
with a pungent taste.....37. ***Spilanthes***
27. Involucral bracts 4, eglandular, oblong; leaves sessile;
aquatic herbs..... 19. ***Enydra***
27. Involucral bracts 5, glandular, spathulate; lower leaves
petiolate; terrestrial herbs..... 33. ***Siegesbeckia***
28. Pappus of many, aristate, feathery bristle;small,
procumbent herbs with bulbous based hairs ..... 38. ***Tridax***
28. Pappus of 2 subulate awns; erect large herbs; hairs
not bulbous based..... 39. ***Verbesina***
29. Ray florets apetalous, fertile; disc florets male
or neuter; leaves all radical, 2-pinnatifid; heads borne
close to ground..... 34. ***Soliva***
29. Ray florets petaliferous; disc florets 2-sexual;
leaves not all radical; heads not borne close to ground..... 30
30. Ray florets ligulate.....31
30. Ray florets narrow, tubular, not ligulate..... 35
31. Pappus of 2 stiff awns.....32
31. Pappus of more than 2 hairs, bristles or scales..... 33

32. Flowers yellow; leaves simple serrate-dentate;
radical leaves absent; heads 1.5- 3.0 cm in diameter.....39. ***Verbesina***
32. Flowers white; leaves pinnately or bi-punnately
lobed; radical leaves present at least in young stage;
heads 4.0 – 5.0mm in diameter.....29. ***Parthenium***
33. Anther bases tailed.....34
33. Anther bases obtuse, not tailed; ligules purplish-pink
or white, never yellow; heads in corymbose or
branched panicles, rarely terminal solitary.....20. ***Erigeron***
34. Pappus 1-seriate, hairy; achenes not ribbed.....30. ***Pentanema***
34. Pappus 2-seriate, outer of short jagged teeth, inner of
smooth hairs; achenes ribbed.....32. ***Pulicaria***
35. Anther bases tailed.....36
35. Anther bases obtuse or truncate, not tailed.....38
36. Involucral bracts herbaceous; plants with strong
aromatic smell.....7. ***Blumea***
36. Involucral bracts dry, scarious.....37
37. Herbs; heads in leafless clusters or leafy spikes;
style arms of bisexual flowers truncate.....22. ***Gnaphalium***
37. Undershrubs; heads in leafless corymbs; style arms of
bisexual flowers filiform.....31. ***Pluchea***
38. Pappus wanting.....39
38. Pappus present.....42
39. Heads axillary, solitary.....11. ***Centipeda***
39. Heads in spiciform racemes or panicles.....40
40. Achenes with a thickened border.....16. ***Dicrocephala***
40. Achenes without a thickened border.....41
41. Flowers rose-purple; herbs with faint sweet smell.....15. ***Cyathocline***
41. Flowers white or yellow; strongly scented herbs.....4. ***Artemisia***
42. Pappus 1, wedge shaped, scaly.....14. ***Cotula***
42. Pappus more than 1, 1-seriate; styles 2-fid.....43
43. Heads solitary, terminal or leaf opposed.....23. ***Grangea***
43. Heads in clusters or various inflorescence.....44
44. Stem winged due to decurrent leaf bases.....27. ***Laggera***
44. Stem not winged; achenes compressed, not ribbed.....13. ***Conyza***

1. ADENOSTEMMA J. & G. Forster

Adenostemma lavenia (L.) Kuntze, Rev. Gen. Pl. 1: 304. 1891; Fl. Ind. 12: 346. 1995. *Verbensina lavenia* L. Sp. Pl. 902. 753. *Adenostemma viscosum* Forst. Char. Gen. 90. t. 45. 1776; FBI. 3: 242. 1881, *incl. var. elata*; FUGP. 1: 405. Repr. ed. 1960.

Erect annual herbs. Heads arranged in corymbs. Achenes brown, oblong, smooth. Pappus hairs 4-5, spathulate.**Flowering and fruiting time:** September-January. Common in damp and marshy places. Sweta 601.

2. AGERATUM L.

Key to species:

1. Heads up to 80 flowered; phyllaries acute, subglabrous;
corolla up to 2.0 mm long..... 1. ***A. conyzoides***
1. Heads 80 to 100 flowered; phyllaries setaceous, hirsute;
corolla up to 8.0 mm long..... 2. ***A. houstonianum***

1. Ageratum conyzoides L. Sp. Pl. 839. 1753; FBI.3: 243.1881; FUGP. 1: 405. Repr. ed. 1960; Fl. India 12: 348. 1995.

Erect, annual, hairy herbs. Heads in terminal corymbs, blue or white, 50-80 flowered. Pappus-scales 5, serrate, awned, often barbed. **Flowering and fruiting :** Almost throughout the year. Abundant on roadside, in waste places and agricultural fields, especially in sugar cane and wheat fields etc. Sweta 1325.

2. Ageratum houstonianum Mill. Gard. Dict. ed. 8. no. 2. 1768; Fl. India 12: 349. 1995.

Erect annual herbs. Head 80-100 flowered, in terminal or axillary dense corymbs. Corolla violet, funnel shaped. Pappus scales 5, serrate, awn-tipped. **Flowering and fruiting:** Throughout the year. Common in waste land, agricultural fields and on banks of Ganga. Sweta 615.

3. AMBERBOA (Pers.) Less.

Amberboa ramosa (Roxb.) Jafri in Scientist 3: 29.1958; Fl. India 12: 153. 1995. *Carduus ramosus* Roxb. Fl. India 3: 407. 1832. *Oligochaeta ramosa* (Roxb.) Wagenitz in Verroffent. Geobot. Inst. 37: 323.1962; Fl. Rajasthan1: 425.1987. *Volutarella divaricata* (DC) Benth. in Hook. f. Gen. Pl. 2: 476.1873, *pro parte*; FBI. 3: 383. 1881; FUGP. 1: 442. Repr. ed. 1960. *Mcirolonchus divaricatus* DC. Prodr. 6: 562. 1838.

Ascending, annual herbs. Heads light pink, ovoid-oblong, spiny. Involucral bracts ovate, with a long spinescent awn, Receptacle bristly. Ray florets tubular, pale-purple. Achenes angled, pitted with grooves. Pappus unequal, brown, hairy. **Flowering and fruiting:** Winter and summer season. **Local Name.** *Badavard.* Occasionally found on river banks, and in sandy habitats. Sweta 1352.

4. ARTEMISIA L.

Key to species:

1. Stem whitish appressed hairy, leaves densely white lanate beneath..... 3. ***A. nilagirica***
1. Stem and leaves glabrous.....2
2. Lower leaves entire to serrate-lobed..... 2. ***A. japonica***
2. Lower leaves pinnatipartite to 2-pinnate..... 1. ***A. capillaris***

1. Artemisia capillaris Thunb. Fl. Jap. 309. 1784; Fl. Ind. 12: 16. 1995. *Artemisia scoparia* Waldst. & Kit. Descr. Pl. Rar. Hung.1: 66. t. 65.1802; FBI. 3: 323. 1881; FUGP.1: 435. Repr. ed. 1960; Fl. India 12: 16. 1995.

Erect, annual, slightly woody herbs. Cauline leaves pinnatisect, hairy at lower side. Heads minute, short peduncled, greenish-yellow. Ray florets fertile, corolla filiform. Disc florets sterile, tubular. Achenes very minute, brown, glabrous. **Flowering and fruiting time:** June-February. Frequently occurs in the damp areas and along the river banks and road sides. Sweta 118.

2. Artemisia japonica Thunb. Fl. Jap. 310. 1784; Fl. Ind. 12: 28. 1995. *A. parviflora* Roxb. ex D. Don Prodr. Fl. Nepal. 181. 1825; FBI. 3: 322. 1881.

Perennial, erect or ascending glabrous herbs. Stems paniculately branched, grooved. Cauline leaves linear, entire or flabellately lobulate; uppermost leaves linear. Heads pedicelled , secund, in spreading panicled racemes. Outer florets female, fertile. Disc florets hermaphrodite, sterile. **Flowering and fruiting:** September- November. Included on authority of Murty and Singh (1961b).

3. Artemisia nilagirica (Clarke) Pamp. in Nuouv. Giorn. Bot. Ital. n.s.33. 452.1926; Fl. India 12: 36. 1995. *A. vulgaris* L. var. *nilagirica* Clarke, Comp. Ind. 162.1876. *A. vulgaris auct. plur.* non L. 1753; FBI. 3: 325.1881; FUGP. 1: 435. Repr. ed. 1960.

Tall, stoloniferous, aromatic, perennial herbs. Leaves sessile, pinnatipartite, lobed or laciniate, lanceolate-oblong. Heads sessile in spiciform racemes combined into panicles, white, ovoid or subglobose. **Flowering and fruiting.** October-February. Found on banks of Ganga among vegetation. Sweta 1358.

5. BIDENS L.

Bidens pilosa L. Sp. Pl. 832. 1753; FBI. 3: 309 (*quoad* var. *pilosa;* excl. vars. *bipinnata* Hook. f. & *decomposita* Hook. f.). 1881; Fl. India 12: 372. 1995.

Erect, annual herbs, with 4-angled stem. Leaves imparipinnately compound, opposite; upper leaves simple. Heads radiate, in corymbs, yellow. Ray florets few, sterile. Disc florets many,

dark-yellow. Achenes black, 5.0-10.0 mm long, narrowed at top. Pappus 2-4, retrorsely barbed. **Flowering and fruiting:** March-November. **Local Name:** *Chirchitta; Sui ka ped.* Abundant in the area. Sweta 260, 617.

6. BLAINVILLEA Cass.

Blainvillea acmella (L.) Philipson in Blumea 6: 350.1950; Fl. India 12: 377.1995. *Verbesina acmella* L. Sp. Pl. 901.1753. *Blainvillea rhomboidea* Cass. in Dict. Sci. Nat. 29: 493.1823; FUGP.1. 428. Repr. ed. 1960. *B. latifolia* (L. f.) DC. ex Wight, Contrib. Bot. India 71. 1834; FBI. 3: 305.1881.

Erect, annual, hispidly hairy herbs. Leaves simple, opposite, ovate-lanceolate, serrate or dentate. Heads white, terminal or axillary. Outer bracts broadly ovate, leaf like, hairy; inner bracts folded gradually becoming scale like. Ray florets ligulate. Disc florets white or yellow, tubular. Achenes 3-quetrous, hairy, greenish-black, transversely rugose. Pappus connate. **Flowering and fruiting:** Rainy season. Frequently occurs in *Kholas*. Sweta 352.

7. BLUMEA DC. *nom. cons.*

Key to species:

1. Heads purple or lilac..... 3. ***B. mollis***
1. Heads yellow.....2
2. Receptacle hairy around the pits..... 2. ***B. laciniata***
2. Receptacle glabrous..... 1. ***B. lacera***

1. Blumea lacera (Burm.f.) DC. in Wight, Contrib. Bot. Ind. 14.1834; FBI. 3: 263.1881; FUGP. 1: 414. Repr. ed. 1960; Fl. India 13: 128. 1995. *Conyza lacera* Burm.f. Fl. Ind. 180. t. 59. f.. 1. 1768.

Erect, aroamtic, viscid, annual or biennial herbs. Heads peduncled, in short axillary cymes or collected into terminal spiciform panicles, yellow. Involucral bracts villous, glandular hairy. Achenes hairy, slightly 4-gonous, not ribbed. Pappus white. **Flowering and fruiting.** January-May. Found commonly in moist and shady habitats. Sweta 1364.

2. Blumea laciniata (Roxb.) DC. Prodr. 5: 436. 1836; FBI. 3: 264. 1881; FUGP. 1: 415. Repr. ed. 1960; Fl. India 13: 128. 1995. *Conyza laciniata* Roxb. Fl. India 3: 428. 1832.

Erect, annual, hairy herbs. Lower leaves lyrate-pinnatifid, toothed, hairy. Heads yellow, combined into a large leafy panicle. Achenes brown, ribbed, sparsely hairy. Pappus hairs white. **Flowering and fruiting:** Almost through out the year; especially in February-June. Common in wastelands, open fields; particularly in wet and shady places. Sweta 844.

3. Blumea mollis (D.Don) Merr. Philipp. J. Sci. (Bot.) 5: 395. 1910; Fl. India 13: 135. 1995. *Erigeron molle* D. Don, Prodr. Fl. Nepal. 172. 1825. *B. wightiana* DC. in Wight, Contrib. Bot. Ind. 14.1834; FBI. 3: 261. 1881; FUGP. 1: 413. Repr. ed. 1960.

Erect annual-biennial herbs. Leaves ovate-oblong, dentate, densely coverd with white, soft hairs. Heads pink, in long spiciform panicles. Achenes brown, oblong, subangular, shining, and hairy. **Flowering and fruiting.** Feruary-July. Found frequently in sandy habitats. Sweta 894.

8. BREEA Less.

Breea arvensis (L.) Less., Syn. Gen. Comp. 9. 1832; Fl. India 12 : 155. 1995. *Serratula arvensis* L. Sp. Pl. 820. 1753. *Cirsium arvense* (L.) Scop. Fl. Carn. ed. 2. 2: 126. 1772; Fl. Rajasthan 1: 405. 1987. *Cnicus arvensis* (L.) Roth, Catalecta B 1: 115. 1797; FUGP 3: 362. 1881; FUGP. 1: 438. Repr. ed. 1960.

Erect, prickly herbs. Leaves sessile, oblong-linear, wooly abaxially, sinuate or pinnatifid, margins spiny. Heads purplish, dioecious. Male globose; female much longer, campanulate. Achenes smooth, shining, truncate. Pappus hairy, brownish-white. **Flowering and fruiting:** January-May. **Local Name.** *Kateli.* Found in agricultural fields and near water channels. Sweta 686.

9. CAESULIA Roxb.

Caesulia axillaris Roxb. Pl. Cor. 1: 64. t. 93. 1798; FBI. 3: 291.1881; FUGP.1: 462. 1905; Fl. India 13: 2.1995.

Prostrate, or suberect, annual, slightly fleshy herbs. Leaves sessile, lanceolate, serrate, acute, glabrous. Heads globose, axillary, sessile, pale-blue. Involucral bracts 2, membranous. Anther tube dark-purple, Pappus scales 2. **Flowering and fruiting:** Rainy and winter season. Frequently found in paddy fields, shallow ditches and also near river banks. Sweta 238.

10. CARTHAMUS L.

Carthamus oxyacantha M. Bieb. Fl. Taur. Cauc. 2: 283.1808; FBI. 3: 386.1881; Fl. India 12: 162. 1995.

Thistle like, annual herbs. Leaves spinulosely toothed. Heads orange-yellow. Outer involucral bracts foliaceous, spine-tipped. Achenes obovate, slightly 4-angled, smooth, truncate. Pappus absent. **Flowering and fruiting.** January-May. Included on authority of Murty and Singh (1961b).

11. CENTIPEDA Lour.

Centipeda minima (L.) A. Br. & Aschers. Ind. Sem. Hort. Berol. App. 6.1867; Fl. India 12: 48. 1995. *Artemisia minima* L. Sp. Pl. 849.1753. *Centipeda orbicularis* Lour. Fl. Cochinch. 2: 493.1790; FBI. 3: 317.1881; FUGP. 1: 406. Repr. ed. 1960.

Prostrate or decumbent-ascending, densely leafy annual herbs. Leaves subsessile, spathulate-oblong, entire to pinnatifid, glabrous. Heads sessile, yellowish, axillary, solitary. Ray florets 2-toothed. Disc florets yellow. Achenes oblong, 4-angular, minute. Pappus none. **Flowering and fruiting.** January-March. Common in grassy, sandy localities, ricefields and on semidried river beds. Sweta 889.

12. CICHORIUM L.

Cichorium intybus L. Pl. 813. 1753; FBI. 3: 391. 1881; Fl. Ind. 12: 248. 1995.

Annual or perennial herbs, roots fleshy. Lower leaves oblong or oblong-lanceolate, pinnatifid. Upper leaves cordate-amplexicaul at base. Heads, bright blue, solitary or clustered, terminal or axillary. Florets all ligulate. Achenes pale, subcompressed, angled, smooth, many ribbed; pappus pale very short. **Flowering and fruiting:** February-September.**Local name:** *Kasni.* Often found as weed in fields of *Trifolium alexandrinum* L. (*Barseem*). Sweta 1369.

13. CONYZA Less. *nom. cons.*

Key to species:

1. Pappus hairs white, dirty white or yellow.....2
1. Pappus hairs usually red.....3
2. Pappus hairs yellow..... 2. ***C. bonariensis***
2. Pappus hairs pale rosy or purplish..... 3. ***C. canadensis***
3. Plants not viscid, heads 0.2-0.3 cm across..... 5. ***C. stricta***
3. Plants viscid, heads 0.4-1.5 cm across.....4
4. Leaves pinnatilobed..... 1. ***C. aegyptiaca***
4. Leaves serrate-dentate, coarsely toothed or often entire, oblong-spathulate..... 4. ***C. japonica***

1. Conyza aegyptiaca (L.) W. Ait. Hort. Kew. ed. 1. 3: 183. 1789; FBI.3: 258. 1881; FUGP.1: 409. Repr. ed. 1960; Fl. India 12: 103. 1995. *Erigeron aegyptiaca* L. Mant. Pl. 1: 112.1767.

Erect, annual or biennial, hirsute herbs. Basal leaves shortly petioled, obovate; upper ones sessile Heads in terminal, compact corymbs, yellow or white. Ray florets filiform, female. Disc florets tubular. Achenes oblong, compressed, with a thickened margin, thinly hairy. Pappus hairy. **Flowering and fruiting.** June-October. Rare, found in wastelands and in dry sandy soils. Sweta 1374.

2. Conyza bonariensis (L.) Cronq. in Bull. Torrey Bot. Club. 70: 632. 1943; Fl. India 12: 104. 1995. *Erigeron bonariensis* L. Sp. Pl. 863. 1753; Fl. Rajasthan 1: 411. 1987.

Erect, annual, hirsute herbs. Leaves linear-lanceolate. Heads in pyramidal, leafy panicles, Corolla of ray florets purplish tipped and that of disc florets pale-yellow. Achenes subglabrous. Pappus yellowish. **Flowering and fruiting:** May-December. Frequently found in wastelands. Sweta 1441.

3. Conyza canadensis (L.) Cronq. in Bull. Torrey Bot. Club. 79. 632. 1943; Fl. India 12: 105. 1995. *Erigeron canadensis* L. Sp. Pl. 863. 1753; FBI. 3: 254. 1881; FUGP. 1: 408. Repr. ed. 1960; Fl. Rajasthan 1: 412. 1987.

Annual herbs. Leaves linear or linear-lanceolate. Heads in elongated, branched panicles. Ligules pale-rosy or purplish-pale. Achenes flat, nearly glabrous. Pappus hairs dirty-white. **Flowering and fruiting:** May- September. Often found in waste places and agricultural fields. Sweta 1447.

4. Conyza japonica (Thunb.) Less. ex DC. Prodr. 5: 382.1836; FBI. 3: 258.1881; FUGP. 1: 409. Repr. ed. 1960; Fl. India 12: 105. 1995.

Erect, white-villous or woolly herb. Leaves sessile, pubescent, oblong-spatulate. Heads in dense terminal corymbs. Corolla yellow or greenish yellow. Achenes nearly glabrous. Pappus hairy, reddish-brown. **Flowering and fruiting.** Winter season. Commonly found on the roadside, river banks and on margins of ponds and ditches. Sweta 751.

5. Conyza stricta Willd. Sp. Pl. 3: 1922.1803; FBI. 3: 258.1881; FUGP. 1: 410. Repr. ed. 1960; Fl. India 12: 108.1995.

Erect, villous, annual herbs. Leaves linear-spathulate. Heads in terminal corymbose panicles, white or cream. Ray florets ligulate, creamy-white. Disc florets tubular. Achenes very small, narrowly elliptic, hairy. Pappus reddish. **Flowering and fruiting:** October-March. Frequently occurs as weed in agricultural fields. Sweta 188.

14. COTULA L.

Cotula anthemoides L. Sp. Pl. 891.1753; FBI. 3: 316.1881; FUGP. 1: 434. Repr. ed. 1960; Fl. India 12: 52. 1995.

Prostrate or decumbent ascending, aromatic, annual herbs. Leaves 1-2 pinnatisect, linear-lanceolate. Heads solitary, terminal and leaf opposed, yellow. Ray florets apetalous. Disc florets with yellow corolla. Achenes of ray florets winged and that of disk florets wingless.

Flowering and fruiting. November-May. Common in dry rice-fields and ditches. Sweta 1465.

15. CYATHOCLINE Cass.

Cyathocline purpurea (Buch.-Ham. ex. D.Don) O. Kuntze, Rev. Gen. Pl. 333. 1891; Fl. India 12: 111. 1995. *Tanacetum purpureum* Buch.-Ham. ex. D.Don, Prodr. Fl. Nepal. 181. 1825. *Cyathocline lyrata* Cass. in Ann. Sci. Nat. Ser. 1. 17: 420. 1829; FBI. 3: 246. 1881; FUGP 1: 407. Repr. ed. 1960.

Erect, strongly aromatic, annual or biennial herbs. Leaves sessile, 1-2 pinnatipartite. Heads purple, in terminal corymbs. Achene minute, smooth. Pappus absent. **Flowering and fruiting:** March-November. Found on the banks of streams and in moist situations. Sweta 859.

16. DICHROCEPHALA L' Herit ex DC.

Dichrocephala integrifolia (L.f.) O. Kuntze. Rev. Gen. Pl. 1: 333.1891; Fl. India 12: 114. 1995. *Hippia integrifolia* L. f. Suppl. Pl. 389. 1781. *Dichrocephala latifolia* (Pers.) DC. in Wight, Contrib. Bot. Ind. 11. 1834; FBI. 3: 245. 1881; FUGP. 1: 406. Repr. ed. 1960. *Cotula latifolia* Pers. Pers. Syn 2: 464. 1805.

Erect annual herbs. Leaves alternate, ovate-lanceolate to lyrate. Heads small, globose, in terminal panicles. Ray florets pink or purplish, disc florets yellow. Achene minutely puberulous. **Flowering and fruiting:** May-December. Occurs frequently in moist shady places; especially on moist banks of the river Ganga. Specimens from the study area are referable to subsp. *integrifolia*. Sweta 868.

17. ECLIPTA L. *nom. cons.*

Eclipta prostrata (L.) L., Mant. Pl. 2: 286. 1771; Fl. Ind. 381. 1995. *Verbesina prostrata* L. Sp. Pl. 902. 1753. *Eclipta alba* (L.) Hassk. Pl. Jav. Rar. 528. 1848; FBI. 3: 304. 1881; Fl. Rajasthan 1: 409. 1987. *Verbesina alba* L. Sp. Pl. 902. 1753. *Eclipta erecta* L. Mant. Pl. 2: 286. 1771; FUGP. 1: 427. Repr. ed. 1960.

Erect or prostrate herbs. Leaves, simple, opposite. Heads solitary or 2-3 together, axillary, white. Ray florets 2-3 seriate, ligulate, sterile; disc florets tubular. Achenes dark brown, sharply angled or winged on margins. Pappus a ring of thick, ciliate, partially or completely united scales. **Flowering and fruiting:** Almost throughout the year. **Local Name.** *Kala Bhangara.* Commonly occurs in grasslands, agricultural fields and wet and swampy places. Specimens collected from swampy habitats are much larger, extensively branched and prostrate. Leaves are thicker, shorter and with undulate margins. Sweta 431.

18. EMILIA Cass.

Emilia sonchifolia (L.) DC. in Wight, Contrib. Bot. India 24.1834 & Prodr. 6: 302.1838; FBI. 3: 336. 1881; FUGP.1: 436. Repr. ed. 1960; Fl. India 13: 212.1995. *Cacalia sonchifolia* L. Sp. Pl. 835.1753.

var. **sonchifolia**

Slender, weak, glaucous herbs. Leaves variable in shape, lower ones petiolate, lyrate-pinnatifid with triangular-ovate terminal lobe; upper leaves sessile, coarsely toothed. Heads solitary on long peduncles, corymbose, pink or white. Involucral bracts glabrous or puberulous connate when young but separating at maturity. Achenes brown, 5-ribbed, cylindrical. Pappus hairs soft, white. **Flowering and fruiting:** Throughout the year.**Local Name.** *Hirankhur.* Occurs frequently in moist and shady places, especially or north facing slopes of *Kholas*. Sweta 319.

19. ENYDRA Lour.

Enydra fluctuans Lour. Fl. Cochinch. 511.1790; FBI. 3: 304.1881; Fl. India 12: 383. 1995 (*Enhydra*).

Decumbent, branched, floating, aquatic herbs. Stem hollow. Leaves opposite, simple, sessile, fleshy, gland dotted. Heads greenish-yellow, sessile. Involucral bracts 4, opposite, 2-seriate. Achenes oblong, compressed. Pappus absent. **Flowering and fruiting:** January-April. **Local Name:** *Raturi.* Commonly found in marshy places, ditches and ponds. Sweta 572.

Note: As regards the orthography of this genus name, Raizada (1977) pointed out, "The correct spelling is *Enydra* Lour. (Fl. Cochinch. 511. 1790) and not *Enhydra* as spelled by Hook. f. in FBI. 3: 304.1881 or in Flora of Tropical Africa, Flora of Tropical Africa ed. 1 and other works". IPNI has also spelled this genus as *Enydra.*

20. ERIGERON L.

Erigeron sublyratus DC. in Wight. Contrib. Bot. Ind. 9. 1834; Fl, Ind. 12: 125. 1995. *Erigeron asteroides* Roxb. Fl. Ind. 2. 3: 432. 1832 non Andrz. ex Bassel, 1921; FBI. 3: 254. 1881; FUGP. 1: 408. Repr. ed. 1960; Fl. Rajasthan 1: 411. 1987.

Erect, villous, annual herbs. Basal leaves obovate, shortly petioled; cauline leaves obovate-oblong, hairy. Ray florets ligulate, pinkish or purplish, many. Disc florets yellow. Achenes minute, glabrous or puberulous, compressed. Pappus hairy, dirty-white. **Flowering and fruiting :** September-March. Frequently found in moist or swampy habitats. Sweta 788.

21. EUPATORIUM L.

Eupatorium adenophorum Spreng., Syst. 3: 420. 1826; Fl. India 12: 350. 1995. *Ageratina adenophora* (Spreng.) King and Robinson in Phytologia 20: 204. 1970.

Erect, tall, annual herbs, often woody at the base. Leaves broadly ovate-triangular. Heads white, in terminal corymbose inflorescence. Involucral bracts 3-seriate, linear-lanceolate. Achene brown, 5-angled, glabrous. Pappus hairs white. **Flowering and fruiting time.** February- June. Rare, collected only once from the bank of Madhya Ganga Canal near Simbhawli Sugar Mills. Sweta 1379.

22. GNAPHALIUM L.

Key to species:

1. Pappus hairs connate into a ring at the base..... 2. ***G. pensyvanicum***
1. Pappus hairs free..... 2
2. Heads in leafy spikes.....3. ***G. polycaulon***
2. Heads in leafless corymbs.....1. ***G. luteo-album***

1. Gnaphalium luteo-album L. Sp. Pl. 851.1753; FBI. 3: 288. 1881; FUGP. 1: 421. Repr. ed. 1960; Fl. India 13: 87. 1995.

subsp. **affine** (D. Don) Koster in Blumea 4 (3): 484. 1941; Fl. Ind. 13: 89. 1995. *G. affine* D. Don Prodr. Fl. Nepal 173. 1825. *G. leuteo-album* L. var. *multiceps* DC. Prodr. 6: 222. 1838; FBI 3: 288. 1881; FUGP. 1: 421. Repr. ed. 1960

An erect, annual herb. Leaves sessile, oblong-spathulate, densely white woolly- tomentose beneath. Heads golden-yellow, clustered in terminal, leafless, corymbose inflorescence. Involucral bracts 2-3 seriate, shining. Achenes ellipsoidal, brown. Pappus hairs white. **Flowering and fruiting**: January-June. Common along river banks, temporary ponds, roadsides. Sweta 865, 893.

2. Gnaphalium pensylvanicum Willd. Enum. Hort. Berol. 867. 1809; Fl. India 13: 89. 1995. *G. peregrinum* Fernald in Rhodora 45: 479. t. 795. 1943. *G. purpureum* auct. non L. 1753; FBI. 3: 289. 1881; FUGP. 1: 421. Repr. ed. 1960.

Erect, cottony or woolly herbs. Leaves spathulate-lanceolate, white woolly on lower surface. Heads in axillary and terminal clusters, densely white woolly. Ray florets female, corolla narrow, filiform; disc florets few, bisexual. Achene brown, oblong, pappus hair white, coherent at base to form a ring. **Flowering and fruiting:** January-June. Found in agricultural fields, wastelands and on roadsides. Sweta 1468.

3. Gnaphalium polycaulon Pers. Syn. Pl. 2: 421. 1807; Fl. India 13: 91. 1995. *G. indicum* auct. non L. 1753; FBI. 3: 289. 1881; FUGP. 1: 421. Repr. ed. 1960. *G. strictum* Roxb. Fl. Ind. 3: 424. 1832. *G. multicaule* Roxb. Fl. Ind. ed. 2. 3: 425. 1832.

Erect or decumbent, slender herbs. Leaves sessile, narrowly linear-obovate or oblanceolate-spathulate, densely white-woolly beneath. Heads in dense, axillary and terminal leafy spikes. Ray florets female, fertile, with filiform corolla. Disc florets bisexual, 5-toothed. Achenes oblong, minute, minutely papillose. Pappus hairs white. **Flowering and fruiting:** December-June. Found in agricultural fields, wastelands and on roadsides. Sweta 658.

23. GRANGEA Adans.

Grangea maderaspatana (L.) Poir. in Lamk. Encycl. Suppl. 2: 825. 1812; FBI. 3: 247.1881; FUGP. 1: 407. Repr. ed. 1960; Fl. India 12: 127. 1995. *Artemisia maderaspatana* L. Sp. Pl. 849. 1753.

Prostrate, tufted, villous herbs. Leaves alternate, sessile, pinnatifid with 2-4 pairs of opposite lobes. Heads yellow, disciform. Involucral bracts broadly campanulte, densely pubescent. Receptacles convex, naked. Disc florets bisexual, fertile. Achenes glandular, compressed. Pappus a short tube with fimbriate mouth. **Flowering and fruiting :** December-June. Common on margins of ponds and ditches and in other moist habitats. Sweta 420.

24. HIMALAIELLA Raab-Straube

Himalaiella heteromalla (D. Don) Raab-Straube, Willdenowia, Bd. 33, H. 2. 391. 2003. *Saussurea heteromalla* (D.Don) Hand.-Mazz. Symb. Sin. 7: 1152.1936; Fl. India 12: 202. 1995. *Cnicus heteromallus* D. Don, Prodr. Fl. Nepal.: 166. 1825. *Saussurea candicans* (DC.) Clarke, Comp. Ind. 232. 1876; FBI. 3: 373. 1881; FUGP. 1: 440. Repr. ed. 1960.

Erect, cottony, annual herbs. Basal leaves in rosette, petiolate, lyrate-pinnatifid, covered with white soft hairs; upper leaves lanceolate, dentate. Heads on 3.0-15.0 cm long peduncles, pinkish-white, in corymbiform panicles. Achenes 4.0 mm long, 4-5 angled. Pappus hairs white, ca 1.3 cm. **Flowering and fruiting:** March-August. Occurs near *Kholas*. Sweta 774.

Note: Molecular taxonomic studies of the genus *Saussurea* (DNA sequences from the nuclear ribosomal ITS and from the chloroplast trnL-trnF regions of 47 species of all six subgenera and 13 sections of *Saussurea*) showed that *Saussurea* in its present circumscription was paraphyletic. The results also corresponded to differences in morphological characters of achenes and pappus, which also suggested that *Saussurea* sect. *Elatae*, *Saussurea* subg. *Jurinocera* and *Saussurea* subg. *Frolovia* were not closely related to the remainder of the genus. Consequently, *Saussurea* sect. *Elatae* was separated as the new genus *Himalaiella* (Raab-Straube, 2003).

25. IXERIS Cass.

Ixeris polycephala Cass. in Dict. Sci. Nat. 24: 50. 1822; Fl. Ind. 12: 279. 1995. *Lactuca polycephala* (Cass.) Benth. & Hook. f. Gen. Pl. 2: 526. 1873; FBI. 3: 410.1881; FUGP. 1: 447. Repr. ed. 1960.

Erect annual, flaccid, glabrous herbs. Leaves variable, auricled; basal leaves in rosette, linear-lanceolate; cauline ones sessile, with a sagittate, amplexicaul base. Heads sub-umbellate or corymbose. Ligules 3-toothed, yellow. Achenes yellowish, elliptic-lanceolate, 10-ribbed, beaked. Pappus hairs white. **Flowering and fruiting :** February-May. Frequently found in cultivated fields as weed, plantations of *Terminalia arjuna* and on roadsides. Sweta 769.

26. LACTUCA L.

Key to species:

1. Flowers blue, small herbs..... 1. ***L. dissecta***

1. Flowers yellow, tall herbs..... 2. ***L. serriola***

1. Lactuca dissecta D. Don, Prodr. Fl. Nepal. 164. 1825; FBI. 3: 405. 1881; FUGP. 1: 446. Repr. ed. 1960; Fl. India 12: 297. 1995. *L. auriculata* DC., Prodr. 7: 140. 1838.

Erect, annual herbs. Basal leaves lyrate-pinnatifid; upper leaves sessile, linear, entire. Heads in a terminal corymbose panicle, blue. Achenes oblanceolate, beaked, 3-ribbed on each face. Pappus hairy, white. **Flowering and fruiting :** February-May. Common in waste places, roadsides and agricultural fields. Sweta 736, 747.

2. Lactuca serriola Tourner in L. Cent. Pl. 2: 29. 1756; Fl. Ind. 12: 300. 1995. *Lactuca scariola* L. Sp. Pl. ed. 2. 1119. 1763; FBI 3: 404. 1881; Khan , Jour. Sci. Res. 2 & 3: 125. 1986.

Tall, annual herbs, upper part corymbosely branched, densely bristly or glabrous. Leaves runcinate-pinnatifid, finely spinoulose-toothed. Heads, yellow, in panicles with ascending, corymbose branches.. Achenes pale-brown, oblanceolate, 6-8 ribbed, smooth. Pappus silvery white, soft, simple and spreading. **Flowering and fruiting:** Summer season. Occasionally found on margins of agricultural fields and on roadsides. Sweta 1480.

27. LAGGERA Sch.-Bip. ex Koch.

Laggera aurita L. f. Suppl. 367. 1781; FBI. 3: 271. 1881; FUGP. 1: 417. Repr. ed. 1960; Fl. Ind. 13: 150. 1995.

Strongly scented erect herbs. Leaves viscid pubescent; lower leaves auricled, decurrent. Heads, pink – red, peduncled, in corymbose or diffused panicle. Ray florets, female, filiform, multiseriate. Disc florets bisexual, fertile. Achenes red, small, ribbed, thinly hairy. Pappus white. **Flowering and fruiting:** December-April. Found in waste places, road sides and old walls. Sweta 1363.

28. LAUNAEA Cass.

Key to species:

1. Heads terminal on paniculately branched flowering stem;
leaves not spinous margined.....1. ***L. aspleniifolia***
1. Heads in clusters on the nodes of racemose inflorescence;
leaves spinous margined.....2. ***L. procumbens***

1. Launaea aspleniifolia (Willd.) Hook. f. FBI. 3: 415. 1881; FUGP. 1: 449. Repr. ed. 1960; Fl. India 12: 306. 1995. *Prenanthes aspleniifolia* Willd. Sp. Pl. 3: 1540. 1803.

Biennial or perennial herbs with white latex. Leaves mostly radical. Heads erect, peduncles slender. Involucral bracts few seriate, outer shorter. Florets all ligulate, yellow. Achenes pale-brown, narrow, angled, smooth, much smaller than pappus. Pappus white or pale-white, deciduous. **Flowering and fruiting:** February-June. Sweta 877.

2. Launaea procumbens (Roxb.) Ramayya & Rajagopal in Kew Bull. 23 (3): 465. t. 1. 1969; Fl. India 12: 309.1995. *Prenanthes procumbens* Roxb. Fl. India 3: 404.1832. *Launaea nudicaulis* auct. pl. non (L.) Hook. f. *sensu stricto* FBI. 3: 416.1881; FUGP. 1: 450. Repr. ed. 1960.

Prostrate, glabrous herbs with yellow latex. Leaves sessile, in a basal rosette, oblong-lanceolate, spathulate, dentate, teeth cartilaginous. Heads yellow, cylindric, in terminal and subracemose clusters. Achenes pale yellow, ribbed. Pappus hairs soft, white, deciduous. **Flowering and fruiting.** March-September. **Local Name:** *Pathari.* Found commonly in wastelands, agricultural fields and on roadsides. Sweta 38.

29. PARTHENIUM L.

Parthenium hysterophorus L. Sp. Pl. 988. 1753; Fl. India 12: 403. 1995.

Erect herbs. Leaves alternate, pinnately or bipinnately lobed; uppermost leaves entire to 3-lobed. Heads numerous in lax panicles, heterogamous, white. Involucral bracts 10 in 2 series of 5 each, ovate. Achenes flattened, crowned by persistent remnant of corolla, appendage and style. Pappus of 2 broad, strongly reflexed awns. **Flowering and fruiting:** Almost round the year. Abundant in wastelnds, agricultural fields, plantations and on roadsides etc. Sweta 1359.

30. PENTANEMA Cass.

Key to species:

1. Hispidly hairy herbs; involucral bracts linear- lanceolate,
acute; ligule of ray florets lanceolate..... 1. ***P. indicum***
1. Softly villous herbs; involucral- bracts squarrose, with
filiform, recurved tips; ligule of ray florets linear..... 2. ***P. vestitum***

1. Pentanema indicum (L.) Ling in Acta Phytotax. Sin. 10: 179.1965; Fl. India 13: 28.1995. *Inula indica* L. Sp. Pl. ed. 2. 1236.1763; FBI. 3: 297. 1881; FUGP.1: 423. Repr. ed. 1960. *Vicoa indica* (L.) DC. in Wight, Contrib. Bot. Ind.10.1834.

Erect, annual herbs, rootstock woody. Leaves sessile, oblong-lanceolate, entire or serrate-dentate, scabrid, auriculate. Heads solitary, axillary or terminal, bright yellow. Ray florets 1-seriate, ligulate, female. Disc florets tubular, bisexual. Achenes brown, obovate, obtuse softly hairy. Pappus white. **Flowering and fruiting:** Almost throughout the year. Commonly found in wet lands and sugarcane fields and in *Kholas*. Sweta 255, 374.

2. Pentanema vestitum (Wall. ex DC.) Ling in Acta Phytotax. Sin 10: 180. 1965; Fl. India 13: 30. 1995. *Inula vestita* Wall. ex. DC. Prodr. 5: 470. 1836; FUGP. 1: 424. Repr. ed. 1960. *Vicoa vestita* (Wall. ex DC.) Benth. ex Hook. f. FBI. 3: 297. 1881.

This species can be readily distinguished from *P. indica* by the indumentum and involucral bracts. Indumnetum is rough in *P. indica* and soft in *P. vestita*. The tips of involucral bracts are erect in the former and recurved in the latter. **Flowering and fruiting :** March-June. Frequently found in wasteland and on sandy soil, especially in *Kholas*. Sweta 739.

31. PLUCHEA Cass.

Pluchea tomentosa DC. in Wight, Contrib. Bot. Ind. 16. 1834; FBI. 3: 272. 1881; FUGP. 1: 418. Repr. ed. 1960. Fl. Ind. 13: 155. 1995.

Tall shrubs. Leaves sessile, ovate to obovate, semi-amplexicaul, coarsely toothed. Heads in compound corymbs. Achenes obscurely angled, glabrous. Pappus reddish. **Flowering and fruiting:** August-December. Included on the authority of Murty & Singh (1961b).

32. PULICARIA Gaertn.

Key to species:

1. Peduncle thickened below the heads..... 2. ***P. wightiana***
1. Peduncle not thickened below the head..... 1. ***P. angustifolia***

1. Pulicaria angustifolia DC. Prodr. 5: 479. 1836; FBI. 3: 299. 1881; FUGP. 1: 425. Repr. ed. 1960; Fl. India 13: 33. 1995.

Erect annual herbs. Leaves sessile, linear-oblong or obovate, pubescent. Heads yellow. Ray florets ligulate. Achenes terete or 4-angled, with a few minute scattered hairs. Outer row of pappus forming a setulose-laciniate cup; inner row of white, barbellate hairs. **Flowering and fruiting:** October-February. Included on the authority of Murty & Singh (1961b).

2. Pulicaria wightiana (DC.) Clarke, Comp. Ind. 118. 1876; FBI. 3: 298. 1881; Fl. India 13: 40. 1995. *Poloa wightiana* DC. in Guill. Arca. Bot. 2: 515. 1833.

Erect annual herbs. Leaves oblong, serrate. Heads solitary, peduncles thickened below the heads. Ray florets ligulate, yellow. Achenes brown, oblong, 4-angled, hairy, shining. Pappus 2-seriate. **Flowering and fruiting time.** June to August.**Local Name.** *Sonela.* Occasionally found in sandy soil. Sweta 807.

33. SIEGESBECKIA L.

Siegesbeckia orientalis L. Sp. Pl. 900. 1753; FBI. 3: 304. 1881; FUGP. 1: 426. Repr. ed. 1960; Fl. India 12: 407. 1995.

Erect much branched herbs. Leaves opposite, ovate-triangular or rhomboid, glandular pubescent beneath. Heads combined into leafy panicles, yellow. Outer involucral bracts 5, spathulate, gland hairy outside, viscid inside. Achenes obpyramidal, 4-gonous, viscid. Pappus none. **Flowering and fruiting:** March- October. Included on authority of Murty & Singh (1961b). This species is frequently found in nearby forests of Najibabad. Habitat degradation at Hastinapur might be the reason of disappearance of this taxon.

34. SOLIVA Ruiz. & Pav.

Soliva anthemifolia (A. Juss.) R. Br. in Trans. Linn. Soc. 12: 102. 1817; Fl. India 12: 57. 1995. *Gymnostyles anthemifolia* A. Juss., Ann. Mus. Paris 4: 262. t. 61, f. 1. 1804.

Creeping, annual or biennial, stoloniferous herbs. Leaves 2-pinnatifid. Heads sessile, axillary, greenish yellow, close to ground. Ray florets in several rows, female, apetalous. Disc florets tubular, corolla greenish - yellow. Achenes truncate, winged, tipped with a persistent and hardened style. Pappus none. **Flowering and fruiting:** November-May. This species forms a dense mat on semidried bed of Madhya Ganga Canal near Ganga barrage. Sweta 669.

35. SONCHUS L.

Key to species:

1. Outer involucral bracts densely white tomentose;
   perennials..... 3. ***S. wightianus***
1. Outer involucral bracts without coarse gland- bristles;
   annuals..... 2
2. Achenes transversely rugose, thick, with a thickened
   margin; basal auricles of leaves acute; leaf margins not
   spinulose..... 2. ***S. oleraceus***
2. Achenes smooth, papery, with a winged margin;
   basa auricles of leaves rounded; margins spinulose

dentate..... 1. ***S. asper***

1. Sonchus asper (L.) Hill. Herb. Brit. 1: 47. t. 34. 1769; FBI. 3: 414. 1881; FUGP. 1: 448. Repr. ed. 1960; Fl. India 12: 318. 1995. *Sonchus oleraceus* var. *asper* L. Sp. Pl. 794. 1753.
Erect, annual, glabrous herbs. Basal leaves in rosette, spathulate- oblong, spinulosely dentate. Cauline leaves semi-amplexicaul, auricles rounded. Heads yellow, in sub-umbellate corymbs. Achenes compressed, 3-ribbed, faintly muricate between the ribs, brown, obovoid-oblong. Pappus hairs white. **Flowering and fruiting** :February -March. Common in wastelands, open fields; particularly in wet and shady places. Sweta 1501.

2. Sonchus oleraceus L. Sp. Pl. 794. 1753; FBI. 3: 414. 1881; FUGP. 1: 448. Repr. ed. 1960; Fl. Ind. 12: 321. 1995.
Erect annual herbs. Leaves quite variable, dentate, glabrous; basal auricles acute; lower leaves pinnatifid. Inflorescence corymbosely umbellate; heads glandular hispid. Florets all ligulate, yellow. Achenes ovoid, longitudinally 3-5 ribbed on lateral faces, transversely muricate between ribs. Pappus white. **Flowering and fruiting:** December-June. Common in grasslands, on margins of agricultural fields and moist patches in wastelands. Sweta 1498.

3. Sonchus wightianus DC. Prodr. 7: 187. 1838; Fl. Ind. 12: 321. 1995. *S. arvensis auct. non* L; FBI. 3: 414. 1881, *pro parte.*
Perennial herbs. Basal leaves in a rosette, pinnatifid; cauline leaves lanceolate with toothed auricles. Heads, yellow, white-woolly tomentose basally, peduncle glandular hairy distally. Achenes light brown, elliptic, faintly transversely rugose, smooth. Paapus pure white. **Flowering and fruiting :** March-August. Occasionally found in well drained moist areas. Sweta 1522.

36. SPHAERANTHUS L.

Sphaeranthus indicus L. Sp. Pl. 927. 1753; FBI. 3: 275. 1881, *pro parte*; FUGP. 1: 419. Repr. ed. 1960; Fl. India 13: 160. 1995.
Much-branched, prostrate or ascending, hairy herbs. Stem with narrowly dentate wings formed by decurrent leaf base. Leaves alternate, obovate-oblong, spathulate, dentate. Heads, compound, pink-purple, heterogamous, terminal, ovoid, globose. Outer florets female, inner ones bisexual. Achenes glabrous or glandular hairy. Pappus none. **Flowering and fruiting:** December-April.**Local name:** *Mundi.* Often found on drying silty bottom of ditches and ponds. Sweta 1547.

37. SPILANTHES Jacq.

Spilanthes ciliata H. B. K. Nov. Gen. et Sp. Pl. 208. 1820; Fl. Ind. 12: 409. 1995.

Diffuse, thinly hairy herbs. Leaves ovate acute, base rounded or truncate. Heads yellow, rays 8 or more; receptacle conical. Involucral bracts 2-seriate, 3-nerved with narrowly winged margins. Ray florets female; disc florets numerous, bisexual. Achenes of disc florets compressed, black, ciliate on margins. Pappus of two unequal bristles. **Flowering and fruiting:** June-October. Frequently found in wet habitats at the banks of Ganga. Sweta 882, 863.

Identification of this species is based on the key provided by Chowdhery (1995). My specimens come close to *S. ciliata* in having more than 8 ray florets and the size of head (less then 1.0 cm) brings it close to *S. uliginisa*. But the latter species is characterized by 5-6 ray florets against 8-12 in the former. Therefore, the specimens collected from the study area semm to be intermediate between these two species.

38. TRIDAX L.

Tridax procumbens L. Sp. Pl. 900.1753; FBI.3: 311.1881; FUGP.1: 433. Repr. ed. 1960; Fl. India 12: 418.1995.

Annual, hispid-hairy, procumbent herbs. Leaves ovate-lanceolate, confined to lower ¼th part of the stem, dentate, hair bulbous based. Heads solitary on long, upcurved peduncles, hirsute. Ray florets pale to yellow-white, ligulate. Disc florets tubular, purple tinged. Achenes oblong or obconical, black, silky hairy. Pappus bristles plumose, unequal. **Flowering and fruiting:** Almost throughout the year. Abundantly found on roadsides in wastelandsand agricultural fields. Sweta 30.

39. VERBESINA L.

Verbesina encelioides (Cav.) Benth. & Hook. f. Gen. Pl. 2: 380. 1873; Fl. India 12: 420.1995. *Ximenesia encelioides* Cav. Icon. 2: 60. t. 178. 1793.

Erect, woolly, attractive herb. Leaves alternate or lower ones opposite, ovate-lanceolate, coarsely serrate. Heads peduncled, solitary, golden-yellow. Involucral bracts 2-seriate, oblong-lanceolate, acute, strigose. Ray florets one seriate, yellow. Disc florets many, tubular. Achenes obovate, margined, pappus awns 2. **Flowering and fruiting:** July-October. Occasionally found in sandy soil on roadsides. Sweta 23.

40. VERNONIA Schrebr. *nom. cons.*

Vernonia cinerea (L.) Less. in Linnaea 4: 291. 1829; FBI. 3: 233.1881; FUGP.1: 404 Repr. ed. 1960; Fl. India 13: 367.1995.*Conyza cinerea* L. Sp. Pl. 862. 1753.

Short to tall, annual or perennial, thinly pubescent herbs,. Leaves obovate, entire to slightly dentate. Heads in terminal corymbose, panicles, purplish or pink. Achenes cylindric, appressedly silky, faintly ribbed. Pappus hairy white, biseriate, hairs of outer row short. **Flowering and fruiting:** Almost throughout the year. **Local Name.** *Sahadevi.* Abundant in a variety of habitats. Sweta 58, 245.

41. XANTHIUM L.

Xanthium indicum Koen. ex. Roxb. Fl. India 3: 601. 1832; Fl. India 12: 429. 1995. *X. strumarium* L. Sp. Pl. 987.1753; FBI. 3: 303.1881 (excl. syn. *X. strumarium* Boiss.); FUGP.1: 426. Repr. ed. 1960; Fl. Rajasthan 1: 443.1987;

Erect, annual scabrid herbs. Leaves long petioled, alternate, 3-5 palmately lobed, dentate. Heads in terminal and axillary racemes. Male head globose; anthers free. Female heads in axillary cymes, 2-flowered, fertile, ovoid. Fruit hard, oblong or ovoid, covered with hooked spines and with 2 apical, hooked spines. **Flowering and fruiting:** Rainy and winter season. **Local Name.** *Gokhru.* Commonly found in waste lands and on roadside. Sweta 111.

42. YOUNGIA Cass.

Youngia japonica (L.) DC. Prodr. 7: 194. 1838; Fl. Ind. 12: 329. 1995. *Prenanthes japonica* L. Mant. Pl. 107. 1767. *Crepis japonica* (L.) Benth. Fl. Hongk. 194. 1861; FBI. 3: 395. 1881; FUGP. 1: 445. Repr. ed. 1960.

Erect annual herbs with milky latex. Basal leaves obovate-oblong, lyrate-pinnatifid; terminal lobe largest; cauline ones few, subsessile, smaller. Heads yellow, numerous, 10-20 flowered, in lax, terminal, corymbose panicles. Achenes fusiform, brown, slightly curved. Pappus white. **Flowering and fruiting:** February-June. Often found in moist and shady localities. Sweta 660.

55. CAMPANULACEAE

KEY TO GENERA

1. Flowers in lax corymbose panicles; capsule dehiscing loculicidally..... 2. ***Wahlenbergia***
1. Flowers in panicled clusters; capsule dehiscing by lateral pores or by three basal valves..... 1. ***Campanula***

1. CAMPANULA L.

Campanula benthamii Wall. ex. Kitamura, Fl. Afgh. 377. 1960; Fl. Rajasthan 2: 453. 1991. *C. canescens* Wall. ex. DC. Prod. 7: 473. 1839, non Roth, 1827; FBI. 3: 439. 1881; FUGP. 1: 454. Repr. ed. 1960.

Erect, hispid, annual herbs. Basal leaves in a rosette, 1.0-2.0 x 1.0-1.5 cm, spathulate; upper leaves alternate, sessile, linear-lanceolate, dentate, hairy. Flowers in panicled clusters, purplish-white. Corolla divided less than half way down . Capsule hemispheric, 3-celled, hairy. Seeds much compressed, margined. **Flowering and fruiting:** December-April. Found frequently in moist and shady places, especially near ponds and ditches. Sweta 639, 734.

2. WAHLENBERGIA Schard. ex Roth *nom. cons.*

Wahlenbergia marginata (Thunb.) DC. Monogr. Camp. 143. 1830; Fl. Rajasthan 2: 454. 1991. *Campanula marginata* Thunb. Fl. Jap. 89. 1784. *C. gracilis* Forst. Prodr. 15. 1786. *Wahlenbergia gracilis* (Forst.) DC. Monogr. Camp. 142. 1830 & Prodr. 7: 433. 1838; FBI. 3: 429. 1881; FUGP. 1: 453. Repr. ed. 1960.

Erect or decumbent, glabrous, annual herbs. Leaves sessile, 2.0-8.0 cm long, linear-lanceolate, acute, entire to serrate-dentate. Flowers light purple, in terminal, few flowered, corymbose panicles. Calyx tube turbinate, lobes erect, linear in fruit. Corolla purplish, deeply divided. Capsule 3-valved, glabrous. Seeds smooth, ellipsoidal, brownish. **Flowering and fruiting:** November-April. Found in damp and shady places, especially near ponds and ditches. Sweta 683.

56. SPHENOCLEACEAE

SPHENOCLEA Gaertn. *nom.cons.*

Sphenoclea zeylanica Gaertn. Fruct. 1: 113. t. 24. f. 5. 1788; FBI. 3: 438. 1881; FUGP.1: 454. Repr. ed. 1960; Fl. Rajasthan 2: 455. 1991.

Erect amphibious, annual herbs, 30-90 cm high. Leaves 3-10 x 0.5-3 cm, oblong-lanceolate, alternate, entire, acute. Flowers sessile, greenish-yellow in compact, erect, cylindric, terminal spikes. Corolla white, caducous, lobes ovate-triangular. Capsule globose, depressed, enclosed within persistant calyx. Seeds minute, oblong, brown. **Flowering and fruiting :** June-November. Occasionally found in rice fields, on margins of ponds and semi-dried bed of Ganga where it forms pure populations. Sweta 850

Note: According to APG-2 this genus belongs to the family Campanulaceae.

57. PLUMBAGINACEAE

PLUMBAGO L.

Plumbago zeylanica L. Sp. Pl. 151. 1753; FBI. 3: 480. 1882; FUGP. 1: 457. Repr. ed. 1960; Fl. Rajasthan 2: 456. 1991.

Erect or straggling, perennial undershrubs. Leaves 2-8 x 1.5-5 cm, ovate-lanceolate, entire, acute, undulate-crispy. Flowers white in long axillary and terminal racemes. Calyx densely covered with stalked, sticky glands, persistent. Corolla salver shaped, lobes oblong, apiculate. Capsule oblong, enclosed within the persistent calyx, seeds oblong. **Flowering and fruiting:** September-March. **Local Name:** *Makkhi*. Frequently occurs straggling among bushes. Sweta 722.

58. PRIMULACEAE

KEY TO GENERA

1. Leaves mostly basal, petioled, dentate; flowers white, in terminal umbels..... 2. ***Primula***
1. Leaves all cauline, sessile, entire; flowers purple, axillary..... 1. ***Anagallis***

1. ANAGALLIS L.

Anagallis arvensis L. Sp. Pl. 148. 1753; FBI. 3: 506. 1882; FUGP. 1: 461. Repr. ed. 1960; Fl. Rajasthan 2: 457.1991.

Erect, prostrate or ascending, glabrous, annual herbs. Leaves 1-2 x 0.5-2 cm, opposite, sessile, ovate-lanceolate, glabrous, acute. Flowers axillary, solitary, blue. Calyx lobes lanceolate. Corolla blue, petal margins ciliate. Filaments bearded with pink-red moniliform hairs. Capsule many seeded, globular, dehiscense transverse. Seeds trigonous. **Flowering and fruiting:** December-March. Commonly found as weed in grasslands and cultivated fields. Sweta 380.

Note: According to APG-2 this genus belongs to family Myrsinaceae.

2. PRIMULA L.

Primula umbellata (Lour.) Bentv. Fl. Males. Ser. 1. 6: 191. 1962; Fl. Rajasthan 2: 459. 1991. *Drosera umbellate* Lour. Fl. Cochinch. 186. 1790. *Androsace saxifragifolia* Bunge in Mem. Acad. Sci. Petersb. 2: 127. 1835; FBI. 3: 496. 1882; FUGP. 1: 460. Repr. ed. 1960.

Gland-pubscent, annual herbs upto 7-15 cm high. Leaves radical, orbicular-reniform or spathulate, margin creanate-dentate. Flowers white with yellow center, in 2-6 flowered, umbels. Calyx deeply 5 lobed, elliptic, acute. Corolla white, tube globose. Capsule globose, whitish-green, 5-valved. Seeds minute, angular, pitted. **Flowering and fruiting:** December-March.Found frequently in damp waste places, especially in sugarcane fields. Sweta 667.

59. SAPOTACEAE

KEY TO GENERA

1. Leaves clustered at the end of branches, long petioled;
   calyx lobes 4-5; staminodes none..... 1. ***Madhuca***
1. Leaves not clustered at the end of branches, petiole short;
   calyx lobes 6-8; staminodes present..... 2
2. Flowers usually 4- merous; leaves acute or acuminate..... 3. ***Mimusops***
2. Flowers usually 3- merous; leaves rounded or emaginate
   at the apex..... 2. ***Manilkara***

1. MADHUCA Ham. ex J. F. Gmelin

Madhuca indica J. F. Gmelin Syst. Nat. 2 (1): 799. 1791; Fl. Rajasthan 2: 460. 1991. *Bassia latifolia* Roxb. Pl. Cor. 1: 20. t. 19. 1795; FBI. 3: 544. 1882; FUGP. 1: 465. Repr. ed. 1960. *Madhuca longifolia* (Koen.) Macbr. var. *latifolia* (Roxb.) Chevalier in Rev. Int. Bot. Appl. 23: 149. 1943; Dicot. Pl. Uttar Pradesh 231. 1999.

Medium sized to large, deciduous trees with milky latex. Leaves crowded at the end of branches, up to 18.0 x 10.0 cm, elliptic-obovate, obtuse or subacuminate, nerves prominent abaxially, young leaves crimson. Flowers white or cream, tomentose, long pedicelled. Calyx 4-lobed, tomentose. Corolla succulent, sweet, lobes 8-9, acute, erect. Stamens up to 30 in 2-3 series. Style exserted. Berries ovoid, fleshy, on long pedicels, beaked, hairy, 1-4 seeded. **Flowering and fruiting:** March- July. **Local name:** *Mahua.* Often planted on roadsides. Sweta 1552.

2. MANILKARA Adans. *nom. cons.*

Manilkara hexandra (Roxb.) Dub. in Ann. Inst. Bot.-Geol. Colon. Marseille ser. 3. 23: 9. f. 2. 1915; Fl. Rajasthan 2: 460. 1991. *Mimusops hexandra* Roxb. Pl. Cor. 1: 16. t. 15. 1795; FBI 3: 549. 1882; FUGP. 1: 467. Repr.ed. 1960.

Evergreen trees, up to 15.0 m high. Bark blackish grey, deeply furrowed. Leaves up to 10.0 x 5. 0 cm, elliptic-obovate or oblong, obtuse or emarginate, entire. Flowers in axillary, few flowered fascicles, white. Calyx lobes 6, ciliate, ovate, subacute, reflexed. Corolla lobes usually 18, in two series. Fertile stamens 6, staminodes 6 or occasionally 8, denticulate. Berries ovoid, reddish-yellow, 1-seeded, sweet. **Flowering and fruiting:** October-April. **Local name:** *Khirni.* Often planted near villages for edible fruits. Sweta 1428.

3. MIMUSOPS L.

Mimusops elengi L. Sp. Pl. 349. 1753; FBI. 3: 548. 1882; FUGP. 1: 467. Repr. ed. 1960; Fl. Rajasthan 2: 461. 1991.

Handsome trees with dark-green foliage. Leaves elliptic-oblong, acute or acuminate, shining above, margins slightly wavy, up to 12.0 x 6.0 cm. Flowers white, tinged with pink, sweet scented, star shaped, solitary, or in axillary fascicles. Calyx deeply 8-lobed, 2-seriate. Corolla 8-lobed. Stamens 8, staminodes ovate-lanceolate, acute. Berries elliptic-oblong, fleshy, yellow, edible. Seed usually single, oblong, black. **Flowering and fruiting:** March-June. **Local name:** *Maulsari.* Often planted for beautiful foliage and scented flowers in parks, mosques and on roadsides. Sweta 1431.

60. EBENACEAE

DIOSPYROS L.

Diospyros cordifolia Roxb. Pl. Cor. 1: 38. t. 50. 1795 & Fl. Ind. 2: 538. 1832; FUGP. 1: 471. Repr. ed. 1960; Fl. Rajasthan 2: 471. 1991; *D. montana* Clarke, FBI. 3: 555. 1882, *pro parte.*

Small trees, with crooked stem and black or dark-brown bark. Leaves alternate, up to 9.0 x 4.0 cm, thinly hairy, ovate-oblong or ovate-lanceolate, entire. Flowers creamy-white; males in 3-flowered cymes, female ones solitary. Corolla white or dirty-white, hairy outside. Stamens 16 in opposite pairs, united at the base, anthers awnless, pubescent. Calyx strongly reflexed in fruit. Fruit globose, up to 2.0 cm in diam., yellow and glabrous when ripe. **Flowering and fruiting:** April- October. **Local name:** *Bis-tendu.* Common in *Kholas.* Sweta 1436.

61. OLEACEAE

KEY TO GENERA

1. Fruit a berry; flowers uniformly white or yellow..... 1. ***Jasminum***
1. Fruit a capsule; flowers white with an orange tube..... 2. ***Nyctanthes***

1. JASMINUM L.

Jasminum arborescens Roxb. Fl. Ind. 1: 95. 1820; FBI. 3: 594. 1882 (incl. var. *latifolia* Roxb.); FUGP. 1: 475. Repr. ed. 1960; Fl. Dudhwa National Park 265. 1997.

Large scandent shrubs. Leaves 6.0-8.0 x 2.0-6.0 cm, simple, opposite, ovate-lanceolate, acute, entire. Flowers white in terminal cymes, pedicellate, fragrant. Calyx teeth linear, hairy. Corolla lobes linear-lanceolate, acute. Fruit globular, blackish at maturity, solitary. **Flowering:** April-May; **Fruiting:** June-August. **Local Name:** *Bela-Chameli.* Found in *Kholas.* Sweta 437.

2. NYCTANTHES L.

Nyctanthes arbor-tristis L. Sp. Pl. 6. 1753; FBI. 3: 603. 1882; FUGP. 1: 477. Repr. ed. 1960; Fl. Raj 2: 465. 1991.

Larger shrub or small trees. Leaves 3.5-10.0 x 2.0-5.0 cm, opposite, ovate-lanceolate, acuminate or acute, upper surface scabrous. Flowers fragrant, white, in 3-6 flowered axillary cymes. Corolla 4-8 lobed, lobes obcordate, white, salver-shaped, tube orange. Capsule 1.0-2.0 x 1.3-2.0 cm, dorsally compressed, 2-seeded, seeds orbicular, flattened. **Flowering and fruiting :** August-November. **Local name**. *Harsingar.* Cultivated in the gardens for ornamental purpose. Sweta 1456.

62. APOCYNACEAE

KEY TO GENERA

1. Erect herbs..... 2. ***Catharanthus***
1. Trees, shrubs or climbers..... 2
2. Armed shrubs; fruit fleshy..... 1. ***Carissa***
2. Unarmed; fruit follicular..... 3
3. Anthers free not adhering to the stigma..... 3. ***Holarrhena***
3. Anthers conniving in a cone and adhering to the stigma..... 4
4. Trees; throat scaly; corolla lobes overlapping to the left..... 6. ***Wrightia***
4. Climbers..... 5
5. Corolla lobes acuminate, hairy distally; anthers without a protuberance at the back..... 4. ***Ichnocarpus***
5. Corolla lobes neither acuminate nor hairy distally; anthers with a prominent protuberance at the back..... 5. ***Vallaris***

1. CARISSA L. *nom. cons.*

Key to species:

1. Spines paired; leaves usually obtuse; berry more than 1.0 cm in diameter..... 1. ***C. congesta***
1. Sines solitary; leaves usually acute; berry less than 1.0 cm in diameter..... 2. ***C. spinarum***

1. Carissa carandas L., Mant. Pl. 1: 52 (1767); FBI. 3: 630. 1882, *pro parte*; FUGP. 1: 483. Repr. ed. 1960, *pro parte*. . *Carissa congesta* Wight, Ic. 4 (2): 1. t. 1289. 1848; Fl. Rajasthan 2: 468. 1991.

Erect or scandent, evergreen shrubs. Leaves 2-5 x 1-2 cm, opposite, obovate, shortly mucronate, acute. Flowers white, in terminal corymbose cymes, faintly scented. Calyx acute,

ciliated. Corolla tube cylindric, dilated upwards, lobes lanceolate, acute, pubescent. Berries 1-2.5 x 1.5 cm, ellipsoid, smooth, 4-seeded, fleshy, purplish when ripe. **Flowering and fruiting.** January-June. **Local name.** *Karunda*. Often cultivated for edible fruits. Sweta 1488.

2. Carissa spinarum L. Mant. Pl. 2: 559. 1771; FBI. 3: 631. 1882; FUGP. 1: 483. Repr. ed. 1960; Fl. Rajasthan 2: 469. 1991.

Large, thorny, evergreen shurbs. Leaves 1.5-2.5 cm long, broadly-ovate, acute, entire. Flowers white, scented, tinged with pink, in corymbose cymes. Calyx lobes acuminate. Corolla salver shaped, tube cylindric. Berries globose or subglobose, reddish-brown when young, dark purple at maturity, 4-seeded. **Flowering:** July-December. **Fruiting:** February-April. **Local Name:** *Jangli-Karaunda*. Occassionally found in sandy soil near *Kholas* and nearby areas. Sweta 761.

2. CATHARANTHUS G. Don

Key to species:

1. Leaves lanceolate; flowers always white..... 1. ***C. pusillus***
1. Leaves oblong-obovate; flowers white or pink.....2. ***C. roseus***

1. Catharanthus pusillus (Murr.) G.Don, Gen. Hist. 4: 95.1837; Fl. Rajasthan 2: 469.1991. *Vinca pusilla* Murr. Novi Comm. Soc. Reg. Sci. Gotting. 3: 66. t. 2. f. 1. 1773; FBI. 3: 640. 1882. *Lochnera pusilla* (Murr.) K. Schum. in Engl. & Prantl, Pflan. 4 (2): 145. 1895; FUGP. 1: 485. Repr. ed. 1960.

Erect, glabrous annual herbs. Leaves 1.2-3 x 1-2.5 cm, membranous, lanceolate, acuminate. Flowers small, white, solitary or paired. Corolla tube hairy, lobes oblong-obovate, apiculate. Carpels 2. free, glabrous. Follicles 2.5-5 cm long, slender, straight, pointed, many ribbed. Seeds cylindric, black. **Flowering and fruiting.** June-August. Common weed on margins of agricultural fields. Sweta 1490.

2. Catharanthus roseus (L.) G. Don, Gen. Hist. 4: 95. 1837; Fl. Rajasthan 2: 472. 1991. *Vinca rosea* L. Syst. Nat. ed. 10. 944. 1759.

Erect perennial herbs. Leaves, oblong-obovate, obtuse, rounded, apiculate, glabrous. Flowers pink or white, in axillary cymes. Corolla 5-lobed, white with yellow centre or pink with dark red centre. Follicles 2.5-3 cm long, having longitudinal ridges, turns black at maturity. **Flowering and fruiting :** Almost throughout the year. **Local name.** *Sadabahar*. Cultivated as an ornamental plant. Sweta 1505.

3. **HOLARRHENA** R.Br.

Holarrhena pubescens (Buch.-Ham.) Wall ex G. Don, Gen. Hist. 4: 78. 1837; Fl. Rajasthan 2: 469. 1991. *Echites pubescens* Buch.-Ham. in Trans. Linn. Soc. 13: 521. 1821. *Holarrhena antidysenterica* (L.) Wall. ex A. DC. in DC. Prodr. 8: 413. 1844, *pro parte*; FBI. 3: 644. 1882; FUGP. 1: 487. Repr. ed. 1960. *Nerium antidysentericum* L. Sp. Pl. 209. 1753.

Small deciduous trees. Leaves opposite, nearly sessile, tomentose, broadly ovate. Flowers white in terminal, cymes, fragrant. Calyx lanceolate, acuminate, ciliate. Corolla white, hairy outside, oblong, throat hairy. Follicles marked with many white specks. Seeds linear, coma brownish. **Flowering and fruiting :** May-July. Occasionally planted in the area, probably, for its medicinal value. Sweta 101.

4. **ICHNOCARPUS** R.Br. *nom. cons.*

Ichnocarpus frutescens (L.) W.T.Aiton, Hortus Kew. 2: 69. 1811; FBI. 3: 669. 1882; FUGP. 1: 492. Repr. ed. 1960; Fl. Rajasthan 2: 470. 1991. *Apocynum frutescens* L. Sp. Pl. 213. 1753.

Large, evergreen climbing shrubs, younger parts rusty tomentose. Leaves 3-6 cm long, elliptic-oblong or ovate-lanceolate, acute to acuminate, entire. Flowers greenish-white, fragrant, in trichotomous cymes. Corolla twice as long as the calyx, lobes acuminate. Follicles slightly curved or straight, cylindric, rusty. Seeds linear, black. **Flowering and fruiting :** September-February. **Local Name:** *Kalidudhi.* Found climbing on small trees in *Kholas* and open areas. Sweta 581.

5. **VALLARIS** N.C. Burman

Vallaris solanacea (Roth) Kuntze, Rev. Gen. Pl. 2: 447. 1891; Fl. Rajasthan 2: 471. 1991. *Peltanthera solanacea* Roth, Nov. Pl. Sp. 132. 1821. *Vallaris heynei* Spreng. Syst. 1: 635. 1824; FBI. 3: 650. 1882; FUGP. 1: 488. Repr. ed. 1960

Large straggling shrubs with milky latex. Leaves 4-10 x 1.5-3 cm, opposite, ovate oblong, acute, gland dotted, glabrous, shining. Flowers white, in lax pubescent cymes, fragrant. Calyx lobes ovate lanceolate, acute at the apex. Corolla tube about 1.5 cm long, with spreading limb; lobes obovate. Anthers exserted, connective with a dorsal spherical gland. **Flowering and fruiting :** November-April. **Local name :** *Dudhi bel.* Occasionally occurs in *Kholas.* Sweta 1439.

Note: In IPNI the specific epithet has been spelled as **'heynii'**

6. **WRIGHTIA** R. Br.

Wrightia arborea (Dennst.) Mabb. in Taxon 26: 533. 1977; Fl. Rajasthan 2: 471. 1991. *Periploca arborea* Dennst. Schlussel Hort. Malab. 13, 23 & 25. 1818 & in Fort. Allg. Teut.

Gort.-Mag. 3: 32, 41 & 83. 1818. *Wrightia tomentosa* Roem. & Schult. Syst. Veg. 4: 414. 1819; FBI. 3: 653. 1882; FUGP. 1: 490. Repr. ed. 1960.

Medium sized, deciduous trees. Bark ash coloured. Leaves 5-15 x 2-5 cm, elliptical oblong, acuminate, acute, tomentose. Flowers creamy white, in short dense, erect, terminal, tomentose, cymes. Corolla white tinged with pink, turning pale yellow at length. Corona scale oblong, fleshy, orange. Follicles 12-20 cm long, cylindrical, laterally compressed, fused throuhout the length, rough. Seeds linear; coma white longer than seeds. **Flowering and fruiting:** May-December. Found on roadsides near Ganga Barrage, probably planted. Sweta 1421.

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63. ASCLEPIADACEAE

KEY TO GENERA:

1. Habit erect..... 2
1. Habit climbing.....3
2. Anthers with a membranous appendage; pollen masses pendulous; follicles paired.....1. ***Calotropis***
2. Anthers without a membranous appendage; pollen masses erect; follicles solitary (*L. reticulate* is a climber).....2. ***Leptadaenia***
3. Leaves narrowly lanceolate; flowers whitish with dark red or purple blotches.....3. ***Oxystelma***
3. Leaves broad; flowers not blotched..... 4
4. Fruits softly echinate all over.....4. ***Pergularia***
4. Fruits smooth..... 5. ***Telosma***

1. CALOTROPIS R. Br.

Key to species:

1. Buds hemispheric; corolla lobes purple apically within, erect.....2. ***C. procera***
1. Buds ovoid; corolla pure white, spreading.....1. ***C. gigantea***

1. Calotropis gigantea (L.) R. Br. in Ait. Hort. Kew. ed. 2. 2: 78. 1811; FBI. 4: 17. 1883; FUGP. 1: 497. Repr. ed. 1960; Fl. Rajasthan 2: 475. 1991. *Asclepias gigantea* L. Sp. Pl. 214. 1753.

Large shrubs or small trees with yellowish bark. Leaves sessile or shortly petioled, thick, up to 15.0 cm long, elliptic-oblong, acute or shortly-acuminate, cordate or sometimes amplexicaul. Flower in terminal and lateral umbellate cymes. Corolla white, lobes deltoid, spreading. Corona lobes shorter than the staminal column, thinly hairy, apex rounded with two obtuse auricles. Follicles up to 10.0 cm long, glabrous, green, recurved. Seeds broadly ovate, flat, comose. **Flowering and fruiting:** Nearly round the year. Often found in waste places. Perhaps an escape from cultivation. Sweta 917.

2. Calotropis procera (Ait.) Ait. f. subsp. **hamiltonii** (Wight) Ali in Notes Roy. Bot. Gard. Edinberg 38 (2): 287-290. f. 1. C-D. 1980; Fl. Rajasthan 2: 475. 1991. *C. hamiltonii* Wight, Contrib. Bot. Ind. 53.1834. *C. procera auct.* non (Ait.) Ait. f. 1811; FBI. 4: 18. 1883; FUGP. 1: 498. Repr. ed. 1960.

Erect, large, shrub. Leaves sessile, 4-13 x 2-7.5 cm, ovate oblong, acuminate, cordate. Flowers purplish, in axillary or terminal corymbose cymes. Corolla purplish, lobes erect, acute. Corona 5, fleshy glabrous, straight. Follicles 6.5-10 cm long, ellipsoid, recurved, turgid, smooth. Seeds broadly ovate, flat, minutely tomentose; coma silky white. **Flowering and fruiting :** March-July. **Local name:** *Madar, Akhra.* Occurs commonly in open waste places and on roadsides. Sweta 1423.

2. LEPTADENIA R. Br.

Key to species:

1. Erect almost leafless shrubs..... 1. ***L. pyrotechnica***
2. Climbing shrubs with well developed leaves..... 2. ***L. reticulata***

1. Leptadenia reticulata (Retz.) Wt. & Arn. in Wight, Contrib. 47.1834; FBI. 4: 63. 1883; FUGP. 1: 511. Repr. ed. 1960; Fl. Rajasthan 2: 481.1991. *Cynanchum reticulatum* Retz. Obs. Bot. 2: 15. 1781.

Much branched, twining shrubs with watery sap. Leaves 5-12 x 2.5-5 cm, ovate-lanceolate, acuminate, rounded at base, coriaceous. Flowers pale-yellow, in axillary umbellate cymes. Corolla tube very short, lobes thick, ovate-oblong, margins revolute, tips often reflexed. Follicles oblong-lanceolate, with a thick curved beak, smooth, whitish. Seeds ovate, flat; coma 2-4 cm long. **Flowering and fruiting :** July-December. Found in open waste places. Sweta 1353.

2. Leptadenia pyrotechnica (Forsk.) Decne. in Ann. Sci. Nat. ser. 2. 9: 269.1838; Fl. Rajasthan 2: 480. 1991. *Cynanchum pyrotechnicum* Forsk. Fl. Aegypt.-Arab. 53. 1775.

Leptadenia spartium Wt. & Arn. in Wight, Contrib. 48. 1834; FBI. 4: 64. 1883; FUGP. 1: 511. Repr. ed. 1960.

Erect much branched, glabrous, often leafless shrubs, with watery sap. Leaves sessile, linear, acuminate, linear lanceolate, caducous, thick. Flowers yellow in umbellate cymes. Corolla lobes deeply divided, valvate, tube funnel shaped, glabrous, thickened towards the apex. Follicles 5-15 x 0.5-1 cm, terete, lanceolate, tapering into the long straight beak, glabrous. Seeds ovate-lanceolate, glabrous; coma silky white. **Flowering and fruiting :** August-January. Included on authority of Murty and Singh (1961b).

3. OXYSTELMA R.Br.

Oxystelma esculentum (L. f.) R. Br. ex Schultes. Syst. Veg. 6: 89. 1820; FBI. 4: 17. 1883; FUGP. 1: 500. Repr. ed. 1960; Fl. Rajasthan 2: 483.1991. *Periploca esculenta* L. f. Suppl. 168. 1781.

Glabrous, twining, perennial herbs, with milky latex. Leaves 1-12 x 0.4 cm, thin, narrowly linear-lanceolate, acute, rounded. Flowers drooping, white with purplish veins and blotches on inner side. Corolla rotate. Outer staminal corona cupular, inner of 5 free lobes. Follicles ovoid-lanceolate, acute, membranous. Seeds very minute, ovate, flat, comose. **Flowering and fruiting:** July- November. Common in marshy habitats. Sweta 469.

4. PERGULARIA L.

Pergularia daemia (Forsk.) Chiov. in Result. Sci. Miss. Stefan. - Paoli Somal. Ital. 1: 115. 1916; Fl. Rajasthan 2: 484.1991. *Asclepias daemia* Forsk. Fl. Aegypt.-Arab. 51.1775. *Cynanchum extensum* Jacq. Misc. Aust. Bot. 2: 353.1781. *Daemia extensa* (Jacq.) R. Br. in Mem. Wern. Soc. 1: 50.1811; FBI. 4: 20. 1883; FUGP. 1: 501. Repr. ed. 1960.

Twining, hispid, perennial herbs. Leaves 2.5-10 x 2-7 cm, long petioled, ovate, acuminate, pubescent on upper surface, hispid on lower surface, cordate. Flowers pale - green, drooping in lateral corymbose cymes. Corolla lobes ovate, acute with ciliated margins. Follicles paired, 4-8 x 0.75-1.5 cm, lanceolate, covered with long soft spines, beaked. Seeds ovate, dentate at the margins, rounded. **Flowering and fruiting :** April-December. Included on authority of Murty and Singh (1961b).

5. TELOSMA Coville

Telosma cordata (Burm. f.) Merrill in Philipp. J. Sci. 19: 372. 1912; Fl. Rajasthan 2: 486. 1991. *Asclepias cordata* Burm.f. Fl. Ind. 72. t. 27. f. 2. 1768. *A. pallida* Roxb. Fl. Ind. 2: 48.1832. *Pergularia pallida* (Roxb.) Wt. & Arn. in Wight, Contrib. 42. 1834. FBI. 4: 38.1883; FUGP. 1: 508. Repr. ed. 1960.

Large, twining shrubs. Leaves 2-7 x 2-5 cm, ovate, acuminate, membranous, cordate or rounded. Flowers yellow, many, in umbellate cymes. Corolla lobes linear, glabrous. Corona scales lienar, beaked. Follicles 10-12 x 1.5-2.0 cm, margined, longitudinally ribbed, glabrous. Seeds ovate, flat, brown, smooth, comose. **Flowering and fruiting :** August-December. Found along the roadsides among hedges. Sweta 71.

Note: According to APG-2 the members of Asclepiadaceae are included in group Asclepiadoideae Burnett of family Apocynaceae.

64. PERIPLOCACEAE

CRYPTOSTEGIA R.Br.

Cryptostegia grandiflora R.Br. in Edwards, Bot. Reg. 5. t. 435. 1820; FBI. 4: 6. 1883; FUGP. 1: 514. Repr. ed. 1960; Fl. Rajasthan 2: 489. 1991.

Large, twining or straggling, glabrous shrubs with milky sap. Leaves 4-10 x 2.5-5 cm, opposite, elliptic-oblong, acute, shining on upper surface. Flowers light - purple in dichotomous cymes. Corolla funnel shaped. Corona lobes free, filiform. Follicles 7-15 x 2-4 cm, 3-angled, slightly woody, ovoid, tapering. Seeds many, minute, oblong, compressed; coma silky white. **Flowering and fruiting :**April-September. **Local name.** *Rubber ke bel.* Cultivated in gardens as an ornamental plant. Sweta 1354.

Note: According to APG-2 family Periplocaceae is group Periplocoideae Endlicher of Apocynaceae.

65. GENTIANACEAE

KEY TO GENERA

1. Flowers pink, in dichotomous cymes..... .....1. ***Centaurium***
1. Flowers not pink..... 2
2. Flowers in terminal dichotomous cymes; corolla
   irregular; fertile stamen one..... 3. ***Hoppea***
2. Flowers in sessile axillary clusters; corolla
   regular; all stamens fertile..... 2. ***Enicostema***

1. CENTAURIUM Hill

Centaurium centaurioides (Roxb.) Rolla Roa & Hemadri in Journ. Bomb. Nat. Hist. Soc. 67 (2): 357. 1970; Fl. Rajasthan 2: 494. 1991. *Chironia centaurioides* Roxb. Fl. Ind. 1: 585. 1832 '*centauroides*'. non *Erythraea centaurioides* Hort. Gotting ex Griseb. 1839. *Erythraea roxburghii* D. Don. in Lond. & Edin. Phil. Mag. & Jour. Sci. 8: 77. 1836; FBI. 4: 102. 1883; FUGP. 1: 520. Repr. ed. 1960.

Small, erect, annual herbs, branching from the base. Basal leaves in rosette, 0.5-2 x 0.1-0.5 cm, lanceolate-oblong, acute, obtuse; cauline leaves smaller, linear-oblong. Flowers in

dichotomous cymes, pink. Calyx segments linear-subulate. Corolla pink, lobes lanceolate, acute or obute, glabrous. Capsule linear, oblong. Seeds many, reticulate. **Flowering and fruiting:** December-June. Found among grasses on banks of Ganga and Madhya Ganga Canal. Sweta 848.

2. ENICOSTEMA Blume nom.cons.

Enicostema axillaris (Lamk.) Raynal in Adansonia 9: 75. 1969; Fl. Rajasthan 2: 495. 1991. *Gentiana axillaris* Poir ex Lamk. Tabl. Encycl. 1. 487.1793. *Exacum hyssopifolium* Willd. Sp. Pl. 1: 640. 1798. *Enicostema littorale auct.*, non Blume, 1826. FBI. 4: 101. 1883; FUGP. 1: 519. Repr. ed. 1960.

Erect, glabrous, perennial herbs. Leaves sessile, 1-6 x 0.5-1.5 cm, linear-lanceolate, 3-nerved, obtuse, amplexicaule. Flowers white in axillary whorled clusters. Corolla tubular, lobes acute, elliptic. Capsule 2-5 mm long, oblong, 2-valved, narrowed at the base. Seeds many, minute, brown. **Flowering and fruiting :** July-December. Included on authority of Murty and Singh (1961b).

3. HOPPEA Willd.

Hoppea dichotoma Heyne ex Willd. in Ges. Naturf. Fr. Berlin Neue Schr. 3: 435. 1801; FBI. 4: 100. 1883; FUGP. 2: 522. Repr. ed. 1960; Fl. Rajasthan 2: 497. 1991.

Small, annual, glabrous herb. Leaves 0.1-0.5 cm long, sessile, opposite, ovate, acute, glabrous. Flowers pale-yellow in terminal, dense, dichotomous cymes. Calyx 4-lobed, ribbed, ovate, with prominent green nerve along the margin . Corolla greenish, ovate-triangular, acute, recurved. Capsule ellipsoidal. Seeds numerous, dark - green. **Flowering and fruiting:** September-January. Common in marshy places and other moist or wet habitats. Sweta 571.

66. MENYANTHACEAE

NYMPHOIDES Seguir

Nymphoides hydrophylla (Lour.) Kuntze, Rev. Gen. Pl. 2: 429. 1891; Fl. Rajasthan 2: 498. 1991. *Menyanthes hydrophylla* Lour. Fl. Cochinch. 1: 129. 1790. *M. cristata* Roxb. Pl. Cor. 2: 3. t. 105. 1798. *Nymphoides cristata* (Roxb.) Kuntze, Rev. Gen. Pl. 2: 429. 1891. *Limnanthemum cristatum* (Roxb.) Griseb. Gen. Sp. Gent. 342. 1839; FBI. 4: 131. 1883; FUGP. 1: 525. Repr. ed. 1960.

Attached or floating, perennial herbs, rhizome short, branches petiole like. Leaves floating 10.0 x 8.0 cm, purplish beneath, elliptic-orbicular, base deeply cordate, lobes rounded. Flowers white with a yellow centre. Corolla with a longitudinal median crest, basal part hairy. Stigma sessile, 2-lobed. Capsule broadly ovoid-oblong. Seeds yellowish white, muricate.

Flowering and fruiting: October-May. Commonly found in stagnant water bodies. Sweta 266, 655.

67. HYDROPHYLLACEAE

HYDROLEA L. *nom.cons.*

Hydrolea zeylanica (L.) Vahl, Symb. Bot. 2: 46. 1791; FBI. 4: 133. 1883; FUGP. 1: 526. Repr. ed. 1960; Fl. Rajasthan 2: 500.1991.

Erect or decumbent, annual herbs. Leaves 2-8 x 1-1.5 cm, oblong-lanceolate, narrowed at both ends, shortly petioled. Flowers blue in short lateral racemes. Calyx lobes acute, lanceolate, pubescent, glandular, 3-nerved. Corolla blue with darker veins, lobes ovate. Stamens exserted. Anther sagittate or twisted. Capsule 3-6 mm long, ovoid-oblong enclosed in enlarged persistant calyx. Seeds many, minute, oblong. **Flowering and fruiting :** September-December. Found mainly in wet ground, rice fields etc. Included on authority of Murty and Singh (1961b).

Note: According to APG-2, the genus *Hydrolea* is included in group Hydrophylloideae Burnett of Boraginaceae.

68. BORAGINACEAE

KEY TO GENERA

1. Flowers yellow; root red in colour..... 1. ***Arnebia***
1. Flowers not yellow; root colourless..... 2
2. Style one, terminal, simple or bifid..... 3. ***Heliotropium***
2. Style gynobasic..... 3
3. Calyx lobes cordate or hastate at the base in fruit;
   corolla with deep reddish-brown spots at the base;
   fruits not glochidiate..... 4. ***Trichodesma***
3. Calyx lobes not as above; corolla with blue spots
   at the base; fruits glochidiate..... 2. ***Cynoglossum***

1. ARNEBIA Forsk.

Arnebia hispidissima (Lehm.) DC. Prodr. 10: 94. 1846; FBI. 4: 176.1883; FUGP. 1: 541. Repr. ed. 1960; Fl. Rajasthan 2: 501.1991. *Lithospermum hispidissimum* Lehm. Ic. Nov. Strip. t. 39. 1821.

Erect or decumbent, hispidly hairy herbs with a red root. Leaves 2.0-5.0 x 0.5-1.0 cm, alternate, sessile, linear-lanceolate, densely hispid. Flowers sessile, in secund spikes, yellow. Calyx lobe lanceolate, acute, hairy. Corolla hairy outside, lobes oblong, obtuse. Nutlets small, ovoid, tuberculate, acute, brownish. **Flowering and fruiting :** February-October. Commonly found in the dry sandy soil in *Kholas* and cultivated fields. Sweta 408, 673.

2. CYNOGLOSSUM L.

Cynoglossum zeylanicum (Vahl ex Hornem.) Thunb. ex Lehm. in Neue Schriften Naturf. Ges. Pl. Hort. Halle 3 (2): 20. 1817; Fl. Rajasthan 2: 503.1991. *Anchusa zeylanica* Vahl ex Hornem. Enum. Hafn. 3. 1807. *C. furcatum* Wall. ex. Roxb. Fl. Ind. 2: 6. 1824; FBI. 4: 155.1883. *C. denticulatum* A. DC.var. *zeylanicum* (Vahl ex Hornem.) Clarke in FBI. 4: 157. 1883; FUGP. 1: 540. Repr. ed. 1960.

Erect, hispid annual herbs. Leaves 2.0-5.0 x 1.0-1.5 cm ovate, lanceolate, acute, upper surfce with short stiff-hairs, lower surface strigose, denticulate. Flowers in axillary terminal forked cymes, shortly pedicelled. Calyx lobes ovate oblong, softly hairy. Corolla lobes oblong, white with blue tinge. Nutlets ovate, convex, minutely tuberculate, brown, margined with decurved hooks. **Flowering and fruiting :** August-January. Often found in wastelands and on banks of Ganga. Sweta 1365.

3. HELIOTROPIUM L.

Key to species:

1. Erect herbs with broad leaves..... 1. ***H. europaeum***
1. Prostrate or ascending hers with narrow leaves.....2
2. Flowers sessile; closely set on the inflorescence..... 2. ***H. marifolium***

2. Flowers subsessile to pedicellate; distantly set on the inflorescence; only lower flowers bracteate..... 3. ***H. strigosum***

1. Heliotropium europaeum L. var. **lasiocarpum** (Fish. & Mey.) Kazmi in Journ. Arnold Arbor. 51: 176. 1970; Fl. Rajasthan 2: 508. 1991. *H. lasiocarpum* Fish. & Mey. Index Sem. Hort. Petrop. 4: 38. 1837. *H. eichwaldii* Steud. var. *lasiocarpum* (Fish. & Mey.) Clarke FBI. 4: 150. 1883. *H. eichwaldii auct.* non. Steud. ex DC. 1845; FUGP. 1: 536. Repr. ed. 1960.

Greysish-green, erect, annual herbs. Leaves elliptic-ovate to obovate, acute. Flowers in terminal or axillary 3.0-5.0 cm long spikes. Calyx lobes acute. Corolla tube narrowed at the throat. Nutlets densely pilose, minutely verrucose. **Flowering.** August- April. Include on the authority of Murty & Singh (1961b).

2. Heliotropium marifolium Retz. Obs. Bot. 2: 8.1781; FBI. 4: 152. 1883; Fl. Rajasthan 2: 509. 1991. *H. scabrum* Retz. Obs. Bot. 2: 8.1781; FBI. 4: 152.1883; FUGP. 1: 537. Repr. ed. 1960.

Perennial, procumbent herbs. Leaves 1.5-2.0 x 0.1-0.75 cm, broadly lanceolate, appressed hairy with sharp tricomes. Flowers white in axillary and terminal spikes. Bracts leafy,

lanceolate. Calyx lobes unequal in size, lanceolate, densely hairy. Corolla tube cylindrical, throat densely hairy, lobes ovate, acute. Stigma elongate-conic. Fruits golobose, 4-lobed, bristly, spreading into 4 chestnut - brown nutlets. **Flowering and fruiting :** Throughout the year. Commonly grows on sandy soil. Sweta 54.

3. Heliotropium strigosum Willd. Sp. Pl. 1: 743. 1798; FBI. 4: 151. 1883; FUGP. 1: 537. Repr. ed. 1960; Fl. Rajasthan 2: 511. 1991.

Prostrate to decumbent herbs. Leaves1.0 cm long, linear, lanceolate, acute, hairy. Flowers white, small. Bracts leaf-like, linear. Calyx lobes ovate, acute. Corolla salver shaped. Stigma conical. Fruits ovoid, slightly lobed, nutlets 4. **Flowering and fruiting :** March-October. Commonly found in sandy soil and waste lands. Sweta 55.

4. TRICHODESMA R. Br. *nom. cons.*

Trichodesma indica (L.) R. Br. Prodr. Fl. Nov. Holl. 496. 1810; FBI. 4: 153. 1883; FUGP. 1: 538. Repr. ed. 1960 (*indicum*) , *pro parte*; Fl. Rajasthan 2: 515.1991. *Borago indica* L. Sp. Pl . 137. 1753.

var. **indica**

Erect or decumbent, annual, hispid herbs. Leaves 2.0-5.0 x 1.0-2.0 cm, opposite, shortly sessile, ovate-oblong, margins revolute, semi-amplexicaul, upper surface with stiff hairs seated on flattened circular discs, old dry leaves blackish. Flowers in leafy racemes, white turning to blue or pink. Calyx keeled, acute, hastate. Corolla limb funnel shaped, center with a brown spot at the base of each petal. Anther tips excurrent, hairy and twisted. Fruits pyramidal, smooth, polished. Nutlets oblong. **Flowering and fruiting :** August-December. Commonly grows in open waste lands and on dry sandy soil. Sweta 17, 413.

The orthography of the specific epithet, according to IPNI, is 'indicum'. According to IPNI the combination *Trichodesma indicum* R. Br. is an invalid name. The earliest available combination is *Trichodesma indicum* (L.) Sm. -- Cycl. (Rees) 36: Trichodesma no. 1. 1817.

Note: According to APG-2 the members of family Boraginaceae as treated here are included in groups Boraginoideae Arnott and Heliotropioideae Arnott of Boraginaceae.

69. EHRETIACEAE

KEY TO GENERA

1. Calyx accrescent in fruit; mesoscarp viscous;
   style 4-fid.....1. ***Cordia***
1. Calyx not accrescent in fruit; mesocarp not viscous;
   style 2-fid.....2. ***Ehretia***

1. CORDIA L.

Cordia dichotoma Forst. f. Prodr. 18.1786; Fl. Rajasthan 2: 519.1991. *C. myxa auct. plur.* non L. 1753; FUGP. 1: 528. Repr. ed. 1960, *pro parte.*

Medium sized, deciduous trees. Leaves 8.0-15.0 x 3.0-7.0 cm, alternate, elliptic-lanceolate to broadly-ovate, cuneate, coriaceous, sinuate - dentate. Flowers white, in dichotomous cymes. Calyx campanulate, 5-toothed, accrescent in fruit. Corolla lobes narrowly oblong, recurved. Drupe 1.0- 2.0 cm in diameter, ovoid, apiculate, green, shining, supported by accrescent, saucer - shaped calyx. **Flowering and fruiting :** March-July. **Local name :** *Lasora*. Occurs on roadsides and in *Kholas*. Sweta 1526.

Note: : Genus *Cordia* is included in group Cordioideae Link of Boraginaceae, according to APG-2.

2. EHRETIA P. Brown

Ehretia aspera Willd. Phytogr. 1 (4), t. 2. f. 1. 1794; Roxb. Pl. Cor. 1: 41. t. 55. 1796; FUGP. 1: 532. Repr. ed. 1960. *excl. syn. E. obtusifolia* Hochst. ex DC. *E. laevis* Roxb. var. *aspera* (Willd.) Clarke, FBI. 4: 142. 1883.

1. var. **aspera**

Small trees or large shrub. Leaves variable, 2.5-6.0 x 2.0-4.0 cm, oblong, elliptical, obovate, acuminate, slighty hairy. Flowers white in terminal corymbose cymes. Calyx lobes ovate-oblong, ciliated. Corolla oblong, obtuse. Drupe globose, depressed, smooth, black. **Flowering and fruiting :** June-August. Occurs in *Kholas* and on roadsides. Sweta 758, 931.

2. var. **obtusifolia** (Hochst. ex DC.) Parmar Fl. Rajasthan 2: 523. 1991. *Ehretia obtusifolia* Hochst. ex DC. Prodr. 9: 507. 1845; FBI. 4: 142. 1883; FUGP. 1: 532. Repr. ed. 1960, under synonymy of *E. aspera* Roxb.

Differs from var. *aspera* by its obovate-spathulate leaves with rounded apices, more lax corymbs and relatively larger flowers. Flowering and fruiting : March-May. **Local Name:** *Tambolan.* Frequently found in *Kholas*. Sweta 821.

Note: Genus *Ehretia* is included in group Ehretioideae Arnott of Boraginaceae, according to APG-2.

70. CONVOLVULACEAE

KEY TO GENERA

1. Capsule indehiscent with thin fragile walls.....3. ***Ipomoea***
1. Capsule dehiscent..... 2
2. Stems shortly winged; capsule operculate,
   almost translucent.....5. ***Operculina***
2. Stems not winged; capsule neither operculate

nor translucent; valvate or dehiscing irregularly.....3

3. Styles 2, free or slightly united at the base;
each style 2-fid; stigmas lateral; capsule 2-4 valved..... 2. ***Evolvulus***

3. Style 1, entire or slightly 2-lobed apically;
capsules 4 or more seeded; stigmas elliptic oblong
or globsoe.....4

4. Stigmas elliptic oblong; capsule 4-valved or
irregularly dehiscent ..... 1. ***Convolvulus***

4. Stigmas globose.....5

5. Pollen spinulose..... 3. **Ipomoea**

5. Pollen smooth..... 4. ***Merremia***

1. CONVOLVULUS L.

Key to species:

1. Leaves hastate at the base; corolla 3-4 times
as long as calyx; nearly glabrous climbing herbs..... 1. ***C. arvensis***

1. Leaves not hastate; corolla at the most twice as
long as calyx; hairy or pilose prostrate herbs..... 2. ***C. prostratus***

1. Convolvulus arvensis L. Sp. Pl. 153. 1753; FBI. 4: 219. 1883; FUGP. 1: 548. Repr. ed. 1960; Fl. Rajasthan 2: 528. 1991.

Glabrous, climbing, herbs with milky latex. Leaves 2-7 x 1.0-5 cm, ovate or oblong lanceolate, obtuse, hastate. Flowers in axillary cymes, peduncles 2-10 cm long. Calyx unequal, elliptic-oblong, mucronate, glabrous. Corolla funnel shaped, pink or white. Capsule 4-6 mm in diameter, globose, smooth, shining. Seeds slightly trigonous, tuberculate, reddish - brown. **Flowering and fruiting :** November-March. Common weed of cultivated fields and on roadsides. Sweta 1536.

2. Convolvulus prostratus Forsk. Fl. Aegypt-Arab. 203. 1775; Fl. Rajasthan 2: 530. 1991. *C. microphyllus* Sieb. ex Spreng. Syst. 1: 6.11. 1825; FBI. 4: 218. 1883, incl. var. *boissieri*. *C. pluricaulis* Choisy, in Mem. Soc. Phys. Hist. Nat. Genev. 6: 477. 1834; FBI. 4: 218; 1883; FUGP. 1: 547. Repr. ed. 1960.

Prostrate, hairy perennial herb. Leaves 2- 4 cm long, linear-oblanceolate, hairy. Flowers hairy sessile, solitary or in pairs, white or pink. Corolla funnel shaped. Capsule 4-valved, globose, oblong, brown. Seeds many, minute, brown. **Flowering and fruiting :** May-December. **Local name.** *Shankhpushpi*. Occurs on sandy soil or among grasses. Sweta 1554.

2. EVOLVULUS L.

Key to species:

1. Glabrous, prostrate herbs, rooting at the nodes;
   leaves oblong-orbicular; flowers white; fruiting pedicel
   curved downward..... 2. ***E. nummularius***
1. Hairy, ascending herbs; not rooting at the nodes;
   leaves lanceolate; flowers blue; fruiting pedicels straight..... 1. ***E. alsinoides***

1. Evolvulus alsinoides (L.) L. Sp. Pl. ed. 2. 392. 1762; FBI. 4: 220. 1883; FUGP.1: 546. Repr. ed. 1960; Fl. Rajasthan 2: 533. 1991. *Convolvulus alsinoides* L. Sp. Pl. 157. 1753.

Prostrate or ascending, multicauline, hairy, perennial herbs. Leaves1-4 x 0.25-1.5 cm, lanceolate- oblong, acute, densely hairy. Flowers blue, in axillary cymes. Calyx densely silky, lanceolate, acute. Corolla blue, rotate, shallowly lobed. Capsule globular, glabrous, 4-valved, 4-seeded. Seeds smooth, black. **Flowering and fruiting:** Rainy and winter season. Commonly found in sandy localities. Sweta 92. Habit, hairiness and length of pedicel varies a great deal in this taxon.

2. Evolvulus nummalarius (L.) L. Sp. Pl. ed. 2. 391. 1762; Fl. Raj 2: 534. 1991. *Convolvulus nummularius* L. Sp. Pl. 157. 1753. *Volvulopsis nummularius* (L.) Roberty in Candollea 14: 28. 1952.

Prostrate, creeping, perennial, glabrous herbs. Leaves 0.25-2.5 x 0.5-2.0 cm, ovate-elliptic, cordate. Flowers 1-2, sessile, pedicels erect first but curved after fruit setting. Corolla white, deeply lobed, oblong. Capsule globose, 1-locular, 4-seeded. Seeds subglobose, brown. **Flowering and fruiting:** March-November. Common in waste, landsand grasslands and margins of agricultural fields. Sweta 191.

3. IPOMOEA L.

Key to species:

1. Creeping aquatic or marshy herbs..... 1. ***I. aquatica***
1. Terrestrial herbs..... 2
2. Leaves pinnately divided into fine comb like segments ..... 9. ***I. quamoclit***
2. Leaves entire or palmately lobed..... 3
3. Ovary 3-celled..... 6. ***I. nil***
3. Ovary 2-celled..... 4
4. Flowers sessile or sub-sessile, in heads or clusters..... 5
4. Flowers pedicellate, arranged variously but not in heads..... 7
5. Leaves rotundate in outline, deeply plamately
   5-9 lobed..... 8. ***I. pes- tigridis***
5. Leaves ovate- cordate or oblong- hastate

or elliptic- rhomboid, entire or repand or obscurely 3- lobed.....6

6. Capsule glabrous; seeds villous..... 11. ***I. sindica***

6. Capsule pubescent; seeds glabrous..... 5. ***I. eriocarpa***

7. Leaves stipulate, deeply digitately or pedately 5-9 partite or foliolate; seeds pubescent..... 2. ***I. cairica***

7. Leaves exstipulate entire, angular or somewhat lobed but never digitately.....8

8. Flowers in pedunculate umbels.....9

8. Flowers in pedunculate cymes or panicles..... 10

9. Corolla up to 1.5 cm long.....12. ***I. triloba***

9. Corolla more than 2.5 cm long.....10. ***I. sepiaria***

10. Corolla upto 3.0 cm long; capsule crowned by calyx base..... 11

10. Corolla more than 5.0 cm long; capsule obtuse..... 3. ***I. carnea***

11. Sepals glabrous..... 7. ***I. obscura***

11. Sepals with long non bulbous- based hairs..... 4. ***I. dichroa***

1. Ipomoea aquatica Forsk. Fl. Aegypt.-Arab. 44. 1775; FBI. 4: 210. 1883; Fl. Rajasthan 2: 538.1991. *Ipomoea reptans* Poir. in Lamk. Encycl. Meth. Bot. Suppl. 3: 460. 1814, non *Convolvulus reptans* L.; FUGP. 1: 555. Repr. ed. 1960.

Creeping, annual or perennial, aquatic or marshy herbs. Leaves 3-8 x 1-4 cm, elliptic-oblong, glabrous, cordate or hastate, acute. Flowers axillary in 1-5 flowered, pedunculate cymes. Corolla funnel shaped, pinkish to purple with a dark centre. Filaments unequal hairy at the base. Capsule glabrous, ovoid. Seeds brown, minutely hairy. **Flowering and fruiting:** Rainy season. Commonly found in the ponds and on their edges. Sweta 344.

2. Ipomoea cairica (L.) Sweet, Hort. Brit. 287. 1827; Fl. Rajasthan 2: 538, 1991. *Convolvulous cairicus* L. Syst. Nat. ed. 10. 922. 1759. *Ipomoea palmata* Forsk. Fl. Aegypt.-Arab. 43. 1775; FBI. 4: 214. 1883, excl. some syns. *I. pulchella* Wight, Ic.1 (8): 8. t. 156. 1839, non Roth 1821; FUGP. 1: 558. Repr. ed. 1960.

var. **cairica**

Glabrous, perennial climbing shrubs. Leaves palmately 5-6 partite, lobes elliptic lanceolate, glabrous. Flowers campanulate, purplish, arranged in 1-3 flowered cymes. Calyx segments unequal, ovate, tuberculate. Corolla purplish, funnel shaped. Capsule 2-celled, 4-valved. Seeds small, slightly pubescent. **Flowering and fruiting :** Almost throughout the year. **Local name.** *Railway creeper*. Commonly found among hedges on roadsides. Sweta 1453.

3. Ipomoea carnea Jacq. Enum. Pl. Carib. 13, 1760; Fl. Rajasthan 2: 539. 1991.

Key to subspecies:

1. Twining shrubs; leaves acute or apiculate..... 1. ***I. carnea*** subsp. ***carnea***

1. Erect, stout shrubs; leaves acuminate..... 2. ***I. carnea*** subsp. ***fistulosa***

1. subsp. **carnea**

Large twining shrubs with milky latex. Leaves 8-30 x 6-8 cm, broadly ovate, acute, entire. Flower in axillary cymes, large, purple, funnel shape, with a dark centre. Stamens included. Capsules globular, brown. Seeds densely villous, light yellow. **Flowering and fruiting :** Throughout the year. Frequently found on roadsides, around the gardens. Sweta 218.

2. subsp. **fistulosa** (Mart. ex Choisy) Austin in Taxon 26: 237. f. 2.1977; Fl. Rajasthan 2: 539. 1991. *I. fistulosa* Mart. ex Choisy in Dc. Prodr. 9: 349.1845;

Large, erect or ascending, perennial shrubs with milky latex. Leaves ovate-lanceolate, glabrous, cordate, acuminate. Flower in axillary or terminal cymes, large, light-purple with dark centre, in dichotomous cymes. Calyx segments ovate, hairy outside. Corolla purple. Capsule ovoid. Seeds densely hairy, dark-brown. **Flowering and fruiting:** Throughout the year.Commonly found near water bodies and in swamps where it forms dense population. Sweta 63.

Note: This species was introduced in India as an ornamental (Raizada, 1976). Its presence as a successful esacape was first documented by Santapau and Patel (1945). In Hastinapur Wildife Sanctuary, this species outcompetes native flora in swamps and on banks of Ganga where even *Phragmites karkas* population dwindles to a great deal in patches occupied by this species. Rapid spread of this species is, probably, due to its alternative mode of reproduction. Cut stems root easily and develop into a new plant.

4. Ipomea dichroa (Roem. & Schult.) Choisy in DC. Prodr. 9: 364. 1845; Fl. Rajasthan 2: 541.1991. *Convolvulous dichrous* Roem. & Schult. Syst. Veg. 4: 263.1819. *C. pilosus* Roxb. Fl. Ind. 2: 55.1824, non Rottl. 1803. *Ipomoea pilosa* Sweet, Hort. Brit. ed. 2. 289. 1827, non Houtt. 1777; FBI. 4: 213. 1883; FUGP. 1: 555. Repr. ed. 1960.

Annual, twining herbs, clothed with long, brown, bulbous based hairs. Leaves 3-12 x 2-10 cm, broadly ovate, deeply 3-lobed, acuminate, hairy above, white woolly beneath, cordate. Flowers in axillary, racemose cymes. Bracts linear-lanceolate, subpersistent. Calyx lobes ovate- lanceolate, acuminate, densely hairy. Corolla funnel shaped, pink; limb tube suddenly widening at the mouth . Capsule globose, glabrous. Seeds cottony. **Flowering and fruiting.** August-December. Common in gardens among the hedges. Sweta 1450.

5. Ipomoea eriocarpa R. Br. Prodr. 484.1810; FBI. 4: 204.1883; Fl. Raj 2: 541.1991. *Convolvulus hispidus* Vahl, Symb. Bot. 3: 29. 1794. *I. hispida* (Vahl) Roem. & Schult. Syst. Veg. 4: 238. 1819, non Zucc. 1809; FUGP. 1: 554. Repr. ed. 1960.

Prostrate, creeping, annual, hispid herbs with milky juice. Leaves 2-10 x 1-5 cm, ovate oblong, hastate, entire, acute, hairy. Flower sessile, in short dense axillary clusters. Calyx hairy, lobes ovate, acuminate. Corolla campanulate, pink, lobes acute, pubescent in upper part. Capsule globular, 4 seeded, seeds glabrous. **Flowering and fruiting :** August-December. Occurs frequently on margins of agricultural fields. Sweta 258, 259, 361.

6. Ipomoea nil (L.) Roth, Cat. Bot. 1: 36.1797; Fl. Rajasthan 2: 543. 1991. *Convolvulus nil* L. Sp. Pl. ed. 2. 1: 219.1762. *I. hederacea auct. plur. non* (L.) Jacq. 1760; FBI. 4: 199. 1883; FUGP. 1: 556. Repr. ed. 1960. *I. hederacea* (L.) Jacq var. *integrifolia* Clarke FBI 4: 200. 1883.

var. **nil**

Medium sized, annual climbers with watery sap. Leaves 3-12 x 2-12 cm, ovate-cordate, 3-lobed lobe acute. Flower in axillary, peduncled cymes. Calyx segments ovate-lanceolate, tapering towards the apex. Corolla funnel shaped, limb purple with white external longitudinal bands, tube white. Capsule 1-1.5 cm in diametre, 3-celled, globose. Seeds 4-6, glabrous. **Flowering and fruiting :** August-November. Common in wasteland, and on roadsides. Sweta 184, 285.

7. Ipomoea obscura (L.) Ker-Gawl. Bot. Reg. 3: t. 239.1817; FBI. 4: 207.1883; FUGP. 1: 556. Repr. ed. 1960; Fl. Rajasthan 2: 544.1991. *Convolvulous obscurus* L. Sp. Pl. ed. 2. 200.1762. *Ipomoea obscura* (L.) Ker - Gawl. var. *gemella* Clarke FBI. 4: 207.1883.

Slender, twining annual herbs. Leaves 2-6 x 2-5 cm, broadly-ovate or reniform, entire, acuminate, cordate, thin, glabrous. Flowers white, axillary, 2-3 together, peduncled. Calyx lobes subequal, ovate, oblong, shortly apiculate. Corolla funnel shaped, white with yellow bands, base purple, lobes apiculate. Capsule ovoid or globose, 2-celled. Seeds 2-4, clothed with grey silky hairs, brown. **Flowering and fruiting :** October-April. Common in open areas, hedges of fields. Sweta 1551.

8. Ipomoea pes-tigridis L. Sp. Pl. 162.1753; FBI. 4: 204. 1883; FUGP. 1: 557. Repr. ed. 1960; Fl. Rajasthan 2: 545.1991. *I. hepaticaefolia* L. Sp. Pl. 161.1753. *I. capitellata* Choisy in Mem. Soc. Phys. Geneve 6: 446.1884 & in DC. Prodr. 9: 365.1845. *I. pes-tigridis* L. var. *hepaticaefolia* (L.) Clarke in FBI 4: 204.1883. *I. pes-tigridis* L. var. *capitellata* (Choisy) Clarke in FBI 4: 204. 1883.

Twining, hairy herbs. Leaves 4-10 cm, in diameter, deeply 5-7 palmately lobed, lobes elliptic oblong, hirsute. Flowers sessile in few flowered heads, peduncle equal to or exceeding the petiole. Bracts ovate-lanceolate forming an involucre. Two outer sepals larger. Corolla funnel shaped, pink. Capsule ovoid, glabrous, hidden in the calyx. Seeds minutely hairy, dark-brown, triangular. **Flowering and fruiting :** September-December. Commonly found as weed in fields, and among the hedges. Sweta 110, 126.

9. Ipomoea quamoclit L. Sp. Pl. 159. 1753; FBI. 4: 199. 1883; Dicot Pl. Uttar Pradesh 260. 1999. *Convolvulus pennatus* Desr. in Lamk. Encycl. 3: 567. 1791. *Quamoclit pennata* Boj. Hort. Maurit. 224. 1837; FUGP. 1: 563. Repr. ed. 1960.

Beautiful, dark-green, slender, glabrous, twining annual herbs. Leaves pinnately divided, segments linear, filiform. Flowers in 1 to few flowered cymes. Corolla bright-red, tubular, narrowly funnel shaped, lobes triangular. Seeds black, compressed, ellipsoid. **Flowering and fruiting:** Rainy and winter season. Included on the authority of Murty and Singh (1961b) who reported it from the area. This species is common in forest tracts of Bijnor district, therefore its occurrence in Hastinapur can not be ruled out. Also cultivated as an ornamental.

10. Ipomoea sepiaria Koen. ex Roxb. Fl. Ind. 2: 90.1824; FBI. 4: 209.1883; FUGP. 1: 555. Repr. ed. 1960; Fl. Rajasthan 2: 546.1991.

Twining annual or perennial herbs. Leaves 2-7.5 x 2.5- 6 cm, long, ovate, acute, cordate to sagittate, entire. Flowers in long peduncled, subumbellate cymes. Calyx lobes elliptic, glabrous with membranous margin, 2 outer shorter than 3 inner ones. Corolla funnel shaped, pinkish - white. Capsule globose, glabrous, 2-celled, ovoid, 2-4 seeded. Seeds light brown, glabrous or thinly hairy, ovoid. **Flowering and fruiting :** August-December. Occasionally found along the roadside or among the hedges in open areas. Sweta 229.

11. Ipomoea sindica Stapf in Kew Bull. 93: 346.1894; FUGP. 1: 554. Repr. ed. 1960; Fl. Rajasthan 2: 547. 1991.

Creeping, hirsute, annual herbs. Leaves 2-7 x 2-5 cm, ovate-cordate, sagittate, entire. Flowers axillary, solitary or in few flowered cymes, peduncle very short. Bracts linear, hispidly hairy. Calyx lanceolate, hispid, enlarged in fruit. Corolla pink, campunulate, with small tufts of hairs at the tip of each lobe. Capsule 4-8 mm long, globose, glabrous. Seeds black, thinly grey-velvety. **Flowering and fruiting :**August-November. Common in waste lands among grasses and hedges. Sweta 1565.

12. Ipomoea triloba L. Sp. Pl. 161.1753; Fl. Rajasthan 2: 549.1991.

Twining, annual herbs. Leaves 3-10 x 2-6 cm, broadly ovate-cordate, coarsely dentate. Flowers in pedunculate umbels. Calyx lanceolate, acute. Corolla 1-2 cm long, pinkish- red. Capsule glabrous, globose. **Flowering and fruiting :** August-December. Commonly found along the roadsides. Sweta 210.

4. MERREMIA Dennst.ex Endl. *non. cons.*

Key to species:

1. Flowers yellow.....3. ***M. hederacea***

1. Flowers white.....2

2. Flowers pure white.....1. ***M. aegyptiaca***

2. Flowers with a purple centre.....2. ***M. dissecta***

1. Merremia aegyptiaca (L.) Urban, Symb. Antill 4: 505. 1910; Fl. Rajasthan 2: 552. 1991. *Ipomoea aegyptiaca* L. Sp. Pl. 162. 1753. *Convolvulus pentaphylla* L. Sp. Pl. ed. 2. 223. 1762. *Ipomoea pentaphylla* (L.) Jacq. Collect. 2: 297. 1789; FBI. 4: 202. 1883. *Batatas pentaphylla* (L.) Wight Ic. 3 (2): 3. t. 834. 1844-45. *Merremia pentaphylla* (L.) Hall. f. in Engl. Bot. Jahrb. Syst. 16: 552. 1893; FUGP. 1: 551. Repr. ed. 1960.

Twiners covered with glandular based long hairs. Leaves digitately 5-foliate, leaflets subsessile, entire, acuminate; petiole 3- 10 cm long. Flowers in few flowered, lax, densely hairy racemose cymes. Three outer sepals fulvous hairy, 2 inner glabrous or with few scattered hairs. Corolla white. Capsule subglobose, papery, glabrous. Seeds brown, glabrous. Sweta 1451.

2. Merremia dissecta (Jacq.) Hall. f. in Engl. Bot. Jahrb. Syst. 16: 552. 1893; FUGP. 1: 551. Repr. ed. 1960; Fl. Rajasthan 2: 553. 1991. *Convolvulus dissectus* Jacq. Obs. Bot. 2: 4. t. 28. 1767. *Ipomoea sinuata* Ortega, Hort. Matr. Dec. 7: 84. 1798; FBI. 4: 214. 1883.

Twining herbs with dense brown hairy stems. Leaves palmately, 7-9 lobes, lobes sinuate to sinuate-dentate, glabrous. Flowers solitary, axillary or in cymes. Sepals up to 3.0 cm long, mucronate, glabrous. Corolla 2.5- 5.0 cm long, white with purple centre. Capsule1.0-2.0 cm in diam. depressed globose. Seeds black, glabrous. **Flowering and fruiting :**April-December. Often found climbing on shrubs. Sweta 498, 559.

3. Merremia hederacea (Burm. f.) Hall.f. in Engl. Jahrb. Syst. 18: 118.1894; Fl. Rajasthan 2: 554.1991. *Evolvulus hederaceus* Burm. f. Fl. India 77. t. 30. f. 2. 1768. *Ipomoea chryseides* Ker. Gawl. Bot. Reg. 4: t. 270. 1818; FBI. 4: 206.1883. *Merremia chryseides* (Ker-Gawl.) Hall. f. Engl. Bot. Jahrb. Syst. 16: 552.1893; FUGP. 1: 550. Repr. ed. 1960.

Annual, twining, herbs. Leaves 2-8 x 1.5-8 cm, ovate, cordate, acute, basal lobes rounded, entire or 3-lobed. Flowers in axillary cymes, short pedicellate. Calyx oblong, truncate, toothed, reflexed in fruit. Corolla funnel shaped, yellow with green longitudinal nerves at

each petal. Stamens slightly exerted. Stigma bilobed. Capsule 4-angled, glabrous, 2-celled, transversely wrinkled. Seeds trigonous, dark-brown. **Flowering and fruiting :**September-December. Frequently found climbing on shrubs. Sweta 201.

5. OPERCULINA Silva Manso

Operculina turpethum (L.) Manso, Enum. Subst. Bras. 16.1836; FUGP. 1: 552. Repr. ed. 1960; Fl. Rajasthan 2: 556.1991. *Convolvulus turpethum* L. Sp. Pl. 155. 1753. *Ipomoea turpethum* (L.) R. Br. Prodr. 485. 1810; FBI. 4: 212. 1883.

Stout, twining herbs with hairy, angled, shortly winged stem. Leaves ovate to oblong, cordate or truncate, acute, margin entire, petiole shortly winged. Flowers white, in few flowered cymes. Bracts large, oblong, pubscent. Outer sepals hairy, inner glabrous. Corolla white, having longitudinal bands. Stamens included. Stigma 2 lobed. Capsule globose, nearly transluscent, enclosed in calyx segments. Seeds 4, pitted. **Flowering and fruiting :** Rainy and winter season. Often found climbing on shrubs or creeping on ground on the roadsides. Sweta 206.

Note: Members of family Convolvulaceae, as treated here, now constitute group Convolvuloideae Burnett of family Convolvulaceae.

71. CUSCUTACEAE

CUSCUTA L.

Key to species:

1. Stems greenish yellow, thick; style 1; stigma ovoid..... 2. ***C. reflexa***
1. Stems orange- yellow, slender; styles 2; stigma capitate or globose..... 1. ***C. chinensis***

1. Cuscuta chinensis Lamk. Encycl. Meth. Bot. 2: 229. 1786; FBI. 4: 226. 1883; Fl. Rajasthan 2: 560. 1991.

Leafless, stem-parasites, stems filiform, twining, extensively branched, orange-yellow. Flowers in shortly peduncled cymes. Bracts ovate. Calyx lobes deltoid-ovate, keeled. Corolla lobes oblong-ovate, subobtuse, white, scales at the base of corolla tube fimbriate. Styles 2, slender. Capsule globose, hyaline. Seeds 4. **Flowering and fruiting:** June-December. **Local name:** *Amar-bel.* Fairly common. Parasitizes on *Artimisia scoparia, Ranunculus cantoniensis, Eclipta prostrate, Eleocharis sp.* and *Xanthium indicum* etc. Sweta 1387.

2. Cuscuta reflexa Roxb. Pl. Cor. 2: 3. t. 104. 1799; FBI. 4: 225. 1883; FUGP. 1: 543. Repr. ed. 1960; Fl. Rajasthan 2: 561. 1991.

Leafless, total stem parasites; stem much branched, twining, greenish-yellow or brown, thicker than that of preceding species. Flowers in clusters arranged in racemes. Bracts ovate-suborbicular, fleshy. Calyx lobes ovate-oblong, obtuse, verrucose. Corolla white, lobes deltoid, obtuse, reflexed. Scales at the base of corolla-tube fimbriate. Ovary ovoid, fleshy. Style single, thick and short. Capsule depressed globose, glabrous, circumcissile. Seeds 2-4, glabrous, black. **Flowering and fruiting:** Septmber-March. **Local name:** *Akash-bel, Amar-bel.* Commonly occurs climbing on *Bougainvillea* sp., *Cassia* spp., *Withania somnifera and Casuarina equisetifolia* etc. This taxon can be readily distinguished from *C. chinensis* by greenish-yellow, relatively thicker stem and its preference for woody host species. Sweta 1449.

Note: Members of family Cuscutaceae as treated here now constitute group Convolvuloideae Burnett of family Convolvulaceae.

72. SOLANACEAE

KEY TO GENERA:

1. Calyx completely covering the fruit..... 2
1. Calyx not completely covering the fruit..... 3
2. Densely hairy herbs or under shrubs with nearly tuberous roots; flowers fascicled in leaf axils; ripe fruit red or orange in colour..... 5. ***Withania***
2. Thinly hairy or glabrous herbs; flowers solitary- axillary; ripe fruits yellow.....3. ***Physalis***
3. Fruit a capsule; anthers not connivent.....4
3. Fruit a berry; anthers connivent into a cone around the style.....4. ***Solanum***
4. Flowers solitary, axillary; fruit spinous..... 1. ***Datura***
4. Flowers in cymose panicles or corymbs; capule unarmed.....2. ***Nicotiana***

1. DATURA L.

Key to species:

1. Branches tinged with purple; capsule covered with blunt tubercles..... 1. ***D. fastuosa***
1. Branches green; capsule covered with spines.....2
2. Plants clothed with erect, glandular hairs..... 2. ***D. innoxia***
2. Plants pubescent with eglandular hairs..... 3. ***D. stramonium***

1. Datura fastuosa L. Syst. Nat. ed. 10. 2: 932.1759; FBI. 4: 242. 1883; FUGP. 2: 9 Repr. ed. 1960; Fl. Rajasthan 2: 563. 1991. *D. metel* L. Sp. Pl. 179.1753, *nom. conf. D. alba* Nees

in Trans. Linn. Soc. 17: 73. 834; FUGP. 2: 9. Repr. ed. 1960. *D. fastuosa* L. var *alba* (Nees) Clarke in Hook. f. FBI. 4: 243.1883.

Erect branched herbs with a foetid smell. Branches zigzag with scattered white spots. Leaves 5-20 x 4-10 cm, long petioled, ovate, triangular, hairy, slightly dentate. Flowers axillary, solitary, white or purple. Calyx lobes triangular, acuminate, reflexed in fruit. Corolla purple - white, 5-angled, folds cuspidate. Capsule globular with blunt spines, nodding. Seeds red, flat, trigonous. **Flowering and fruiting :** Almost throughout the year. Occasionally found near the canals. Sweta 62.

2. Datura innoxia Mill. Gard. Dict. ed. 8. No. 5. 1768; Fl. Rajasthan 2: 564. 1991. *D. metel auct. non* L. 1753; FBI. 4: 243. 1883; FUGP. 2: 9. Repr. ed. 1960.

Stout short shrubs with grey tomentum. Leaves 8-15 x 5-10 cm, petioled, ovate-lanceolate, acute or acuminate, entire or repand-dentate. Flowers axillary, solitary, funnel shaped. Calyx accrescent, reflexed in the fruit, forms tube in flowers. Corolla white, tubular, limb 10 toothed. Capsule globose, covered with long spines.**Flowering and fruiting:** July-December. **Local Name.** *Dhatura*. Commonly in waste lands and along roadsides. Sweta 356.

3. Datura stramonium L. Sp. Pl. 179. 1753; FBI. 4: 242. 1883; Fl. Rajasthan 2: 565.1991.

Erect, annual-perennial herbs. Leaves 5-20 x 2-15 cm, ovate oblong or triangular, acuminate, cordate. Flowers solitary, axillary. Calyx 3-4 cm long, 5-angled. Corolla 5-10 cm long, white or purple, teeth 5, linear. Capsule erect, ovoid-oblong, spiny, greenish. Seed black. **Flowering and fruiting :**December-May. Rarely found in wastelands on roadsides and river beds. Sweta 1438.

2. NICOTIANA L.

Nicotiana plumbaginifolia Viv. Elench. Pl. Hort. Bot. 26. t. 5. 1802; FBI. 4: 246. 1883; Fl. Rajasthan 2: 568.1991.

Erect, glandular pubescent, viscid herbs. Basal leaves in rosette, obovate; cauline leaves elliptic-obovate, sessile, with a semi-amplexicaul base, margins undulate crispy. Flowers in corymbose, leafy, panicles, purplish-white. Calyx 10-ribbed, glandular, segments slightly reflexed, lobes unequal, lanceolate. Corolla tube long, white with purplish tinge. Capsule ovate, glabrous, enclosed within calyx. Seed many, minute, rugose. **Flowering and fruiting:** March-October. **Local Name.** *Jangli – tamaku*. Commonly found in moist places, wastelands and on banks of Ganga. Sweta 102.

3. PHYSALIS L.

Key to species:

1. Anthers blur or violet..... 1. ***P. angulata***
1. Anthers yellow..... 2
2. Leaves sinuate dentate; corolla upto 7.0 – 10.0 mm long;
   fruiting calyx 5- angled..... 3. ***P. minima***
2. Leaves entire or subentire; corolla upto 5.0 mm long;
   fruiting calyx not 5- angled..... 2. ***P. micrantha***

1. Physalis angulata L. Sp. Pl. 183.1753; Fl. Rajasthan 2: 569.1991. *P. longifolia* auct. non Nutt. 1837.

Erect, annual herbs. Leaves 2-8 x 2-5 cm, ovate, acute, irregularly sinuate - dentate,. Flowers creamish-yellow, solitary, terminal seemingly axillary. Calyx 5 angled,. Corolla yellow with light brown spots at base. Anthers bluish. Fruit globular berries, yellow, enclosed in inflataled 10-angled calyx. Seeds granulate. **Flowering and fruiting :** March-December. Common in wastelands, agricultural fields and on roadsides etc. Sweta 149, 240.

2. Physalis micrantha Link, Enum. Pl. Hort. Berol.1: 181. 1821; Fl. Rajasthan 2: 569. 1991. Erect or prostrate, glabrous, annual herbs. Leaves 1.5-6 x 1.5-5 cm, ovate, entire to dentate, acute, dentate, cuneate. Flowers solitary, terminal and axillary, pale-yellow. Calyx hairy, lobes triangular, acute. Filaments hairy at base, anthers yellow. Berries globose, enclosed in inflated calyx. **Flowering and fruiting:** July-December. Common in waste places and on roadsides. Sweta 611.

3. Physalis minima L. Sp. Pl. 183. 1753; FBI. 4: 238. 1883; FUGP. 2: 5. Repr. ed. 1960; Fl. Rajasthan 2: 570. 1991. *P. indica* Lamk. Encycl. Meth. Bot. 2: 102. 1786. *P. minima* L. var. *indica* (Lamk.) Clarke in FBI. 4: 238.1883; FUGP. 2: 6. Repr. ed. 1960.

Erect or decumbent, annual herbs.Leaves 2-6 x 2-3.5 cm, ovate, acute, slightly toothed or entire, cuneate. Flowers solitary, axillary on long slender deflexed pedicles, yellow. Corolla yellow. Berries globose, yellow when ripe, completely enclosed within the enlarged, 5-10 ribbed reticulately veined calyx. Seeds discoid, muricate, orange-yellow. **Flowering and fruiting:** May-January. Commonly found in waste places and in shady habitats. Sweta 1437.

4. SOLANUM L.

Key to species:

1. Berries less than 1.0 cm in diameter.....2
1. Berries more than 1.0 cm in diameter; prickly herbs
   with purple flowers.....3. ***S. virginianum***

2. Unarmed herbs with red or purple berries..... 2. ***S. nigrum***

2. Armed undershrubs; berries yellow or orange- yellow..... 1. ***S. anguivi***

1. Solanum anguivi Lamk. Encycl. Meth. Bot. 2: 23. 1786; Fl. Rajasthan 2: 572. 1991. *S. indicum auct.* non L. 1753; FBI. 4: 234. 1883; FUGP. 2: 3. Repr. ed. 1960.

Erect, very prickly, under-shrubs. Leaves 5-12 x 5-8 cm, ovate-oblong, acute, sinuate-toothed. Flowers in lateral cymose corymbs. Calyx base truncate, lobes ovate, acute, teeth triangular. Corolla blue with purple stellate hairs outside, lobes broadly triangular, obtuse. Berries globose, orange yellow when ripe. Seeds minutely dotted. **Flowering and fruiting :** March-November. Included on authority of Murty and Singh (1961b).

2. Solanum nigrum L. Sp. Pl. 186. 1753; FBI, 4: 229. 1883; FUGP. 2: 2. Repr. ed. 1960; Fl. Rajasthan 2: 573.1991.

Erect, glabrous, unarmed, annual herbs. Leaves 2-8 x 1-2.5 cm, ovate-oblong, sinuate or toothed, with cuneate base. Flowers white with light purple tinge, arranged in umbellate extra-axillary cymes. Corolla divided nearly halfway into 5 oblong, subacute lobes. Berries globose, yellowish-red, purple or black. Seeds minute, yellow, slightly pitted. **Flowering and fruiting:** Throughout the year. **Local Name.** *Makoi.* Common in waste places, agricultural fields and on road sides. Sweta 618.

3. Solanum virginianum L. Sp. Pl. 187. 1753; Fl. Rajasthan 2: 575. 1991. *Solanum surattense* Burm.f. Fl. India. 57. 1768. *S. xanthocarpum* Schrad. & Wendl. in Schrad. Sert. Hannov. 1: 8. t. 2. 1795; FBI. 4: 236. 1886; FUGP. 2: 3. Repr. ed. 1960.

Prostrate, prickly herbs with zigzag stem. Leaves 5-15 x 2-8 cm, ovate-elliptic, pinnately lobed, irregularly dentate, main lateral nerves armed with long straight yellow spines. Flowers bluish purple in extra axillary shortly peduncled cymes. Pedicels curved stellate hairy. Calyx densely hairy, prickly lobes linear-lanceolate, acute. Corolla bluish- purple, lobes lanceolate, acute, hairy. Fruit globular berries, yellow with white strips, smooth. Seeds, many smooth, light-brown. **Flowering and fruiting:** Major part of the year. **Local Name.** *Kateli.* Common in waste places and on road sides. Sweta 16, 69.

5. WITHANIA Pauq. *nom. cons.*

Withania somnifera (L.) Dunal in DC. Prodr. 13(1): 453. 1852; FBI. 4: 239. 1883; FUGP. 2: 6. Repr. ed. 1960; Fl. Rajasthan 2: 576. 1991. *Physalis somnifera* L. Sp. Pl. 182. 1753.

Erect, much-branched under-shrubs, with stellate, tomentose, greenish-white hairs. Leaves 5-15 x 2-6 cm, ovate-oblong, minutely stellate hairy, acute, decurrent. Flowers greenish-yellow, subsessile, in umbelliform, axillary cymes. Calyx 5-angled, teeth linear, acute.

Corolla greenish-yellow, lobes lanceolate, acute, stellate hairy outside. Fruit globular berries, reddish, enclosed in enlarged calyx. **Flowering and fruiting:** Throughout the year. **Local Name.** *Asgandh*. Common in waste places and on road sides. Sweta 933.

Note: APG-2 has divided family Solanaceae into eight clades. Members of Solanaceae listed here are included in clades Nicotianoideae Miers and Solanoideae Kosteletzky.

73. SCROPHULARIACEAE

KEY TO GENERA:

1. All leaves alternate; corolla rotate; stamens 4 or 5..... 11. ***Verbascum***
1. At least lower leaves opposite or whorled;
   corolla various; stamens 2 or 4..... 2
2. Corolla gibbous or saccate at the base or throat..... 3
2. Corolla rotate, slightly zygomorphic with su-bequal
   lobes or bilabiate; . neither gibbous nor saccate..... 5
3. Capsule dehiscing by apical pores; leaves linear;
   corolla white or pinkish..... 1. ***Antirrhinum***
3. Capsule loculicidal; leaves broad; corolla purplish
   or yellow.....4
4. Leaves ovate, cauline as well as basal; flowers yellow
   in the axils of leafy bracts; anther cells stipitate; calyx
   not much enlarged in fruit.....5. ***Lindenbergia***
4. Leaves spathulate, mostly basal; flowers not in the axils
   of leafy bracts, purplish- white; anther cells not stipitate;
   calyx much enlarged in fruit..... 7. ***Mazus***
5. Fertile stamens 2, with or without 2 staminodes..... 6
5. Fertile stamens 4..... 9
6. Anthers 2-celled; cells parallel..... 7
6. Anthers 1-celled, or if 2-celled the cells divergent at least
   at the base..... 8
7. Corolla with upper lobes outside in the bud; capsule valves
   placentiferous, 2-partite..... 3. ***Dopatrium***
7. Corolla with lateral or lower lobes outside in the bud;
   capsule valves not placentiferous, entire..... 12. ***Veronica***
8. Corolla subequal; lateral or lower lobes outside in
   the bud; corlla tube none.....12. ***Veronica***
8. Corolla distinctly 2- lipped; upper lobes outside in the
   bud, corolla tube well developed .....6. ***Lindernia***
9. Anthers 1-celled; calyx tubular, ribbed; corolla tube
   incurved at or above the middle; two upper lobes
   smaller than others.....10. ***Striga***

9. Anthers 2-celled..... 10

10. Corolla with lower lobes outside in the bud.....11

10. Corolla with upper lobes outside in the bud.....12

11. Corolla yellow , sometimes red tinged;
2-lipped 5-lobed.....5. ***Lindenbergia***

11. Corolla white; rotate, 4-lobed..... 8. ***Scoparia***

12. Corolla 4-lobed..... 8. ***Scoparia***

12. Corolla 5-lobed.....13

13. Lower pair of stamens inserted in the corolla throat;
upper pair inserted in the corolla tube; calyx not winged..... 6. ***Lindernia***

13. All the 4 stamens inserted within the corolla tube..... 14

14. Corolla campanulate; lobes rounded subequal.....2. ***Bacopa***

14. Corolla distinctly 2-lipped..... 15

15. Anther cells stipitate.....16

15. Anther cells not stipitate..... 7. ***Mazus***

16. Placentae either separating in fruit or if conjoined
in a column, the column not winged; seeds terete..... 9. ***Stemodia***

16. Placentae always conjoined in a column which
is winged by the remains of the septa; seeds
angular..... 4. ***Limnophila***

1. ANTIRRHINUM L.

Antirrhinum orontium L. Sp. Pl. 617. 1753; FBI. 4: 253. 1883; FUGP. 2: 16. Repr. ed. 1960; Fl. Rajasthan 2: 583. 1991.

Erect or ascending annual herbs. Leaves 1.5-5 x 0.1-0.6 cm, sessile, linear or oblong-lanceolate, acute, entire. Flowers nearly sessile solitary axillary, pale - pink. Calyx lobes spreading, hairy, equal to or exceeding the corolla. Corolla bilabiate, personate. Capsule obliquely ovoid, pubescent, about 1 cm long. Seeds compressed, concave, keeled. **Flowering and fruiting.** December-March. Common in grassy localities, *Kholas* and on roadsides. Sweta 1400.

2. BACOPA Aublet *nom. cons.*

Key to species:

1. Leaves entire, rounded or emarginate at the apex;
flowers purplish..... 1. ***B. monnieri***

1. Leaves crenate, acute; flowers yellow..... 2. ***B. procumbens***

1. Bacopa monnieri (L.) Wettst. in Engl. & Prantl. Pflan. 4 (3B): 77. 1891; Pennell in Proc. Acad. Nat. Sci. Phil. 98: 94. 1946; Fl. Rajasthan 2: 585. 1991. *Lysimachia monnieri* L. Cent.

Pl. 2: 9. 1756. *Moniera cuneifolia* Michx. Fl. Bor. Amer. 2: 22. 1803; FUGP. 2: 17. Repr. ed. 1960. *Herpestis monnieria* (L.) Kunth, Nov. Gen. Sp. Pl. 2: 366. 1818, *nom. illeg;* FBI. 4: 272. 1884.

Creeping-ascending, succulent herbs. Leaves 1-3 x 0.3-0.75 cm, opposite, sessile or shortly petioled, ovate-oblong, entire, fleshy, gland-dotted abaxially. Flowers solitary, axillary on 0.25-1 cm long pedicles. Outer calyx segments ovate, inner ones linear. Corolla light purple with darker veins, lobes rounded. Capsule about 0.5 cm long, ovoid, glabrous, acute. Seeds transversely rugose. **Flowering and fruiting:** Throughout the year. **Loacal Name.** *Jalbuti, Brahmi.* Abundantly found in swamp and marshy places. Sweta 1594.

2. Bacopa procumbens (Mill.) Greenm. Field Columb. Mus. Bot. ser. 2: 261. 1907; Fl. Rajasthan 2: 586. 1991. *Erinus procumbens* Mill. Gard. Dict. ed. 8. no. 6. 1768.

Prostrate or ascending annual herbs. Leaves opposite, sessile, 6-14 x 5-10 mm, ovate, crenate-serrate. Flowers axillary, solitary, yellow, long pedicellate. Calyx as long as the corolla. Corolla 2-lipped, throat hairy. Stigma lamellate. Capsule small about 5 mm long, cylindric, 2-valved. Seeds reticulate. **Flowering and fruiting:** July-August. Common in agricultural fields and in other moist and shady places. Sweta 858.

3. DOPATRIUM Buch. -Ham. ex Benth.

Dopatrium junceum (Roxb.) Buch.-Ham. ex Benth. Scroph. Ind. 31. 1835; FBI. 4: 274. 1884;FUGP. 2: 22. Repr. ed. 1960; Fl. Rajasthan 2: 588. 1991. *Gratiola juncea* Roxb. Pl. Cor. 2: 16. t. 129.1800.

Erect, rather fleshy, glabrous annual herbs. Leaves 0.4-0.15 x 0.25-0.5 cm, sessile, elliptic-oblong or ovate-lanceolate. Flowers in opposite distant pairs; lower ones sessile, cleistogamous, upper ones perfect, pedicellate. Calyx divided half way down, lobes oblong-lanceolate, obutuse. Corolla bilabiate, pinkish. Capsule globose, apiculate with persistent style base. Seeds minute, ellipsoid, tuberculate. **Flowering and fruiting:** September-November. Included on authority of Murty and Singh (1961b).

4. LIMNOPHILA R. Br. *nom. cons.*

Limnophila indica (L.) Druce in Rep. Bot. Exch. Club. Brit. Isles 3: 420. 1914; Fl. Rajasthan 2: 591. 1991. *Hottonia indica* L. Syst. Nat. ed. 10. 919. 1759. *Limnophila gratioloides* R. Br. Prodr. 442. 1810; FBI. 4: 271. 1884, incl. vars.; FUGP. 2: 21. Repr. ed. 1960, incl. vars. *L. racemosa* Benth. Scroph. Ind. 26. 1835; FBI. 4: 271. 1884; FUGP. 2: 21. Repr. ed. 1960.

Amphibious, perennial herbs with terpentine smell. Leaves slightly fleshy, punctate, ovate, dentate, sessile; lower leaves dissected. Flowers pedicelled, axillary, solitary. Bracteoles 2, linear. Calyx ovate lanceolate, shortly acuminate. Corolla white with red longitudinal streaks

on the lower lip. Fruit subglobose, compressed. **Flowering and fruiting:** August-December. Khan (1987) reported this taxon from Bijnor, therefore the possibility of its occurrence in Hastinapur can not be ruled out.

5. LINDENBERGIA Lehm

Lindenbergia indica (L.) Vatke, Osterr. Bot. Zeitschr. 25: 10. 1875; Fl. Rajasthan 2: 592. 1991. *Dodartia indica* L. Sp. Pl. 883. 1753. *L. urticaefolia* Lehm. in Link and Otto, Ind. Sem. Hort. Berol. 5. 1829; FBI. 4: 262. 1884; FUGP. 2: 33. Repr. ed. 1960. *L. polyantha* Royle ex Benth. Scroph. Ind 22. 1835; FBI. 4: 262. 1884; FUGP. 2: 33. Repr. ed. 1960. *L. abyssinica* Hochst. ex Benth. in DC. Prodr. 10: 377. 1846; FBI. 4: 262. 1884.

Erect or decumbent-ascending, annual, glandular hairy herbs. Leaves 2-10 x 1-6 cm, ovate-elliptic, crenate-serrate. Flowers axillary, shortly pedicelled, 1-3 together, passing into terminal leafy racemes. Calyx densely villous, lobes 5, campanulate. Corolla yellow with red spots, glandular hairy, 2-lipped, throat hairy. Capsule hairy, ovoid, laterally compressed, beaked. Seeds ellipsoid.**Flowering and fruiting:** July-March. Occasionally found in damp shady places, especially on walls and road sides. Sweta 1577.

6. LINDERNIA All.

Key to species:

1. Staminodes 2.....2
1. Staminodes none, all stamens fertile..... 3
2. Leaf serrations acute, aristate; flowers white
   with red streaks; seeds truncate, not tailed..... 3. ***L. ciliata***
2. Leaf serrations obtuse; flowers blue, violet or purple.....2. ***L. antipoda***
3. Capsule much exceeding the calyx; flowers pedicelled;
   calyx divided nearly to the base..... 1. ***L. anagallis***
3. Capsule not exceeding the calyx.....4
4. Leaves parallel- nerved..... 6. ***L. procumbens***
4. Leaves pinnately nerved.....5
5. Calyx divided half way down..... 4. ***L. crustacea***
5. Calyx divided nearly to the base..... 5. ***L. multiflora***

1. Lindernia anagallis (Burm. f.) Pennell in Journ. Arn. Arb. 24: 252. 1943; Fl. Rajasthan 2: 594. 1991. *Ruellia anagallis* Burm. f. Fl. Ind. 135. 1768. *Vandellia pedunculata* Benth. Scroph. Ind. 37. 1835; FBI. 4: 282. 1884; FUGP. 2: 24. Repr. ed. 1960. *V. angustifolia* Benth. Scroph. Ind. 37. 1835; FBI. 4: 282. 1884.

Erect or decumbent, annual herbs. Leaves 1.0-2.5 x 0.5- 3.0 cm, nearly sessile, ovate-oblong, serrate, glabrous. Flowers axillary, solitary, purplish, long pedicellate. Calyx segments

narrowly lanceolate, acuminate. Corolla pink or purple; upper lip entire; lower lip with a yellow spot, 3-lobed. Capsule linear, beaked with persistent style, acute. Seeds ellipsoidal. **Flowering and fruiting:** August-March. Common within the area in the swampy habitats and in rice fields. Sweta 441.

2. Lindernia antipoda (L.) Alston in Trim. Handb. Fl. Ceylon 6: 214. 1931; Fl. Rajasthan 2: 594. 1991. *Ruellia antipoda* L. Sp. Pl. 635.1753. *Gratiola veronicifolia* Retz. Obs. Bot. 4: 8. 1786. *G. verbenifolia* Colsm. Prodr. Desc. Grat. 9. 1793. *Bonnaya veronicifolia* (Retz.) Spreng. Syst. Veg. 1: 41. 1824; FUGP. 2: 26. Repr. ed. 1960. *B. verbenifolia* (Colsm.) Spreng. Syst. Veg. 1: 41. 1824. *Lindernia veronicifolia* (Retz.) F. Muell. Fragm. 6: 101. 1867. *L. verbenicifolia* (Colsm.) Pennell in Acad. Nat. Sci. Phil. Monogr. 5: 131. 1943. *Bonnaya veronicifolia* (Retz.) Spreng. var. *verbenicifolia* (Colsm.) Hook. f. FBI. 4: 285. 1884.

Prostrate-decumbent, annual herbs. Leaves 1.0-6.0 x 0.2-0.5 cm, subsessile, lanceolate-oblong, crenate-serrate, glabrous, obtuse. Flowers axillary, solitary or in racemes, blue or violet. Calyx linear-lanceolate, serrate in upper parts. Corolla bluish-purple, about 0.5-1.0 cm long. Stamens 2, staminodes yellow, clavate. Capsule cylindric. Seeds minute. **Flowering and fruiting:** July-December. Found frequently in rice fields and other moist moist places. Sweta 1510.

3. Lindernia ciliata (Colsm.) Pennell in Brittonia 2: 182. 1936; Fl. Rajasthan 2: 595. 1991. *Gratiola ciliata* Colsm. Prodr. Desc. Grat. 14. 1793. *Bonnaya brachiata* Link & Otto, Ic. Pl. Select. 25. t. 11.1820; FBI. 4: 284. 1884; FUGP. 2: 26. Repr. ed. 1960.

Erect or decumbent annual herbs. Leaves 1-3 x 0.5-1.5 cm, sessile, lanceolate-oblong, penni-nerved, densely serrate with bristle-tipped teeth. Flowers in terminal racemes. Calyx deeply divided, segments linear-lanceolate, ciliated, acuminate. Corolla white with red streaks and dots. Fertile stamens 2. Capsule cylindric. Seeds minute, truncate. **Flowering and fruiting:** July-December. Found frequently in moist and shady places. Sweta 1391.

4. Lindernia crustacea (L.) F. Muell. Syst. Census Austr. Pl. 97. 1882; Fl. Rajasthan 2: 596. 1991. *Capraria crustacea* L. Mant. Pl. 87. 1767. *Vandellia crustacea* (L.) Benth. Scroph. Ind. 35. 1835; FBI. 4: 279. 1884; FUGP. 2: 23. Repr. ed. 1960.

Erect or decumbent, annual herbs. Leaves 0.5-2.0 x 0.4-1.5 cm, petiolate, ovate, cordate, acute, serrate. Flowers axillary, soliatary or subracemose. Bracts linear. Calyx linear-lanceolate, 5-ribbed, 5-angled, acute. Corolla purple with a yellow spot at base. Stamens 4, anterior filaments appendiculate. Capsule ellipsoid-oblong, apiculate with persistent style. **Flowering and fruiting:** August-February. Common in grassy localities, agricultural fields and wet habitats. Sweta 1557.

5. Lindernia multiflora (Roxb.) Mukerjee in Journ. Ind. Bot. Soc. 24: 131. 1945; Fl. Rajasthan 2: 597. 1991. *Torenia multiflora* Roxb. Fl. Ind. 3: 96. 1832. *Vandellia multiflora* (Roxb.) G. Don, Gen. Hist. 4: 549. 1838; FBI. 4: 280. 1884; FUGP. 2: 24. Repr. ed. 1960.

Small, erect, glabrous, annual, somewhat succulent herbs. Leaves 1.0-3.0 x 1.0-1.5 cm, lower petiolate, upper sessile, ovate-oblong, cordate, acute, serrate. Flowers in terminal racemes, glandular hairy. Calyx divided nearly to the base, segments narrowly lanceolate, acute. Corolla white or pale-purple. Stamens 4, filaments of anterior pair appendaged at the base. Capsule ellipsoid-oblong, acute. Seeds rugose. **Flowering and fruiting:** August- February. Common in grassy localities and wet habitats. Sweta 1532.

6. Lindernia procumbens (Krock.) Philcox in Taxon 14: 30. 1965; Fl. Rajasthan 2: 599. 1991. *Anagalloides procumbens* Krock. Fl. Siles. 2: 398. t. 26. 1790. *Lindernia pyxidaria* L. Mant. Pl. 2: 252. 1771, *pro parte (quoad. spec. excl. syn.), nom. illeg. Vandellia erecta* Benth. Scroph. Ind. 36. 1835, *pro maj. parte*; FBI. 4: 281. 1884. *V. pyxidaria* (L.) Maxim. in Bull. Acad. Sci. St. Petersb. 20: 449. 1875; FUGP. 2: 24. Repr. ed. 1960.

Small, erect, glabrous, annual herbs. Leaves 0.25-1.0 x 0.5-1.5 cm, sessile, broadly- ovate, cordate, acute, serrate, 3-5 nerved. Flowers solitary, axillary. Calyx lobes lanceolate, acute. Corolla white, lower one purplish in centre. Stamens 4, fertile. Capsule ovoid–orbicular, acute. **Flowering and fruiting:** October-March. Occasionally found in wet and shady places, rice fields and on river-beds. Sweta 823.

7. MAZUS Lour.

Mazus pumilus (Burm. f.) Steenis In Nova Guinea (n.s.) 9: 31. 1958; Fl. Rajasthan 2: 599. 1991. *Lobelia pumila* Burm. f. Fl. Ind. 186. t. 60. f. 3. 1768. *Lindernia japonica* Thumb. Fl. Jap. 253. 1784. *Mazus rugosus* Lour. Fl. Cochinh. 385. 1790; FBI. 4: 259. 1884; FUGP. 2: 19. Repr. ed. 1960.

Erect, ascending, small, glabrous or slightly hairy, tufted, annual herbs. Basal leaves in a rosette, oblong-spathulate, crenate. Flowers purplish-white in terminal lax racemes. Calyx campanulate, enlarging after anthesis, lobes ovate-lanceolate. Corolla whitish-purple, glandular hairy outside. Capsule subglobose, supported by the calyx. Seeds minute, light-brown. **Flowering and fruiting :** June-March. Common in moist and shady places and along river banks. Sweta 585.

8. SCOPARIA L.

Scoparia dulcis L. Sp. Pl. 116. 1753; FBI. 4: 289. 1884; FUGP. 2: 27. Repr. ed. 1960; Fl. Rajasthan 2: 602. 1991.

Erect, suffruticose, annual herbs. Branches 4-6 angled. Leaves 1-6 x 0.5-4.5 cm, opposite or in whorls of 3, elliptic-lanceolate, crenate-serrate, subacute. Flowers many in terminal panicles. Calyx 4-lobed, lanceolate, ciliated, acute. Corolla whitish, 4-lobed, hairy on the throat, lobes oblong, obtuse. Capsule globose, glabrous, 4-valved. **Flowering and fruiting :** Almost through out the year. Foundcommonly along waste places, road sides, ponds, ditches. Two distinct forms occur in the study area, one with broader and dark-green leaves and the other with smaller, narrower and whitish green leaves. Sweta 1528.

9. STEMODIA L. *nom. cons.*

Stemodia viscos Roxb. Pl. Cor. 2: 33. t. 163. 1802. & Fl. Ind. 3: 94. 1832; FBI. 4: 265. 1884; FUGP. 2: 20. Repr. ed. 1960, Fl. Rajasthan 2: 603. 1991.

Erect, viscidly hairy, aromatic herbs. Leaves 1-3 x 0.25-1.0 cm, sessile, ovate-oblong, serrate or dentate, amplexicaul, glandular- pubescent. Flowers axillary, solitary or in few flowered racemes. Calyx segments lanceolate, acute, glandulary hairy. Corolla violet, glabrous, lower lip hairy. Filament glabrous. Anther cells shortly stalked, suborbicular. Capsule ovoid oblong, acuminate glabrous, 4-valved, enclosed in the calyx. Seeds ellipsoidal. **Flowering and fruiting :** August-October. Included on authority of Murty and Singh (1961b).

10. STRIGA Lour

Striga angustifloia (D. Don) Saldhana in Bull. Bot. Surv. India 5: 70. 1963; Fl. Rajasthan 2: 604. 1991. *Buchnera angustifloia* D. Don, Prodr. Fl. Nep. 91. 1825; *Striga euphrasioides sensu* Benth. in Hook. Comp. Bot. Mag 1: 364. 1836, excl. basionym *Buchnera euphrasioides* Vahl; Wight Ic. 3(2): 5. t. 855. 1843 – 45; FBI. 4: 299. 1884; FUGP. 2: 31. Repr. ed. 1960.

Erect, scabrid annual herbs. Leaves 1-6 x 0.2-0.5 cm, sessile, linear-lanceolate, hispid upper ones smaller, passing into bracts. Flowers white, subsessile, solitary, axillary, passing into terminal spikes. Calyx 5 lobed, each segment 3- ribbed. Corolla white, tube exceeding calyx. Capsule oblong, shorter than calyx. Seeds oblong, truncate, verrucose. **Flowering and fruiting :** August-November. Found in paddy fields and mixed with grasses in moist habitats. Sweta 368.

11. VERBASCUM L.

Key to species:

1. Densely pubescent herbs; leaves undivided; inflorescence compact; stamens 5..... 2. ***V. thaspus***

1. Thinly gland hairy herbs; leaves lyrate-pinnatifid; inflorescence lax; stamens 4..... 1. ***V. chinense***

1. Verbascum chinense (L.) Sant. Fl. Purandhar 90. 1958 & in Rec. Bot. Surv. India 16: 177. 1967; Fl. Rajasthan 2: 607. 1991. *Scrophularia chinensis* L. Mant. Pl. 2: 250. 1771. *Celsia coromandeliana* Vahl, Symb. Bot. 3: 79. 1794; FBI. 4: 251. 1883; FUGP. 2: 15. Repr. ed. 1960.

Erect, glandular-pubescent, annual herbs. Radical leaves in a rosette, petiolate, oblong-obovate, lyrate-pinnatifid. Cauline leaves sessile, obovate, crenate-dentate, acuminate, subentire. Flowers in glandulary hairy racemes. Calyx 5 lobed, ovate-lanceolate, entire or serrulate, acute. Corolla yellow with obtuse lobes. Stamens 4. Filament bearded. Capsule ovoid, tomentose, globose, 2-valved. Seeds oblong, longitudinally ribbed. **Flowering and fruiting.** January-December. Common in swampy and shady localities. Sweta 653.

2. Verbascum thapsus L. Sp. Pl. 177.1753: FBI. 4: 250.1883; FUGP. 2: 14. Repr. ed. 1960; Fl. Rajasthan 2: 608.1991.

Erect, annual herbs, densely covered with soft, greyish-yellow, stellate, tomentum. Radical leaves in a rosette, obovate-lanceolate. Cauline leaves oblong, acuminate, subentire, densely tomentose. Flowers in dense, stellate tomentose, spicate racemes. Bracts linear lanceolate. Calyx 5 lobed, ovate-lanceolate, acute. Corolla yellow, lobes oblong-rounded. Lower three filaments bearded. Capsule ovoid, tomentose, globose. **Flowering and fruiting.** January-June. Grows on sandy river beds, and other drier habitats. Less common than the former species. Sweta.564.

12. VERONICA L.

Key to species:

1. Prostrate herbs; leaves ovate, crenate; flowers
   solitary- axillary..... 1. ***V. agrestis***
1. Erect herbs; leaves oblong-lanceolate;
   flowers in racemes.....2. ***V. anagallis-aquatica***

1. Veronica agrestis L. Sp. Pl. 13. 1753; FBI. 4: 294. 1884; FUGP. 2: 28. Repr. ed. 1960; Fl. Rajasthan 2: 609. 1991.

Prostrate-decumbent, annual herbs. Leaves 0.5-1.5 x 0.5-1.75 cm, petiolate, broadly ovate, crenate-dentate, acuminate, hairy. Flowers axillary, solitary. Pedicels decurved in fruit. Calyx deeply divided, ovate-lanceolate, obtuse, ciliated. Corolla white or tinged with blue, lobes subequal. Stamens 2. Filament glabrous. Capsule didymous, lobes globose, 4-10 seeded. **Flowering and fruiting.** December-May. Common in moist and shady habitats. Sweta 737.

2. Veronica anagallis- aquatica L. Sp. Pl. 12.1753; FBI. 4: 293.1884; FUGP. 2: 28. Repr. ed. 1960; Fl. Rajasthan 2: 610.1991.

Key to varieties:

1. Robust herbs, upto 70.0 cm hight; rooting at the lower nodes..... 1. var. ***anagallis-aquatica***
1. Small herbs, upto 6.0 cm high; not rooting at the lower nodes; raceme as long as or longer than the leaves.....2. var. ***montioides***

1. var. **anagallis-aquatica**

Erect simple, succulent, glabrous, annual, aquatic or semi-aquatic herbs.Leaves 2-6 x 0.5-1 cm, sessile, oblong-lanceolate, subentire-crenate, amplexicaul. Flowers in lax, axillary racemes. Calyx lobes 4, lanceolate-oblong, unequal. Corolla white, with light-purple streaks, lobes rounded. Capsule orbicular, notched at apex, compressed, ciliated. Seeds oblong, biconvex. **Flowering and fruiting:** February-April. Common in moist and wet places. Sweta 652.

2. var. **montioides** Boiss. Fl. Orient. 4: 637. 1879; FBI. 4: 293. 1884; Fl. Rajasthan 2: 610. 1991.

Differs from typical variety in dwarf habit, absence of roots on the lower nodes and the racemes being equal to or longer than the leaves. **Flowering and fruiting:** January-May. Found in moist and wet places. Sweta 1384.

Note: According to Vascular Plant Families and Genera Database available at Kew website, all taxa listed above are included in family Scrophulariaceae. But according to APG-2 website, only *Verbascum* is included in Scrophulariaaceae. Remaining genera are placed in other families i.e. *Antirrhinum*, *Bacopa*, *Dopatrium*, *Limnophila*, *Scoparia*, *Stemodia* and *Veronica* (Plantaginaceae); *Striga* (Orobanchaceae); *Lindernia* (Linderniaceae). The position(s) of *Lindenbergia* and *Mazus* could not be ascertained.

74. LENTIBULARIACEAE

UTRICULARIA L.

Key to species:

1. Peduncle with a whorl of floats.....2. ***U. stellaris***
1. Peduncle without floats.....1. ***U. aureus***

1. Utricularia aurea Lour. Fl. Cochinch. 26. 1790; Fl. Rajasthan 2: 612.1991. *U. flexuosa* Vahl, Enum. Pl. 1: 198. 1804; FBI. 4: 329.1884, *pro parte*; FUGP. 2: 38. Repr. ed. 1960.

Aquatic, submerged, rootless herbs.Leaves dichotomously branched, in whorls of 4, submerged. Flowers yellow, in 5-7 flowered racemes. Calyx lobes 2, ovate, subequal. Corolla

yellow; upper lip suborbicular, folded in the middle; lower lip larger than theupper lip, orbicular. Capsule subglobose. Seeds prismatic, narrowly winged along the angles. **Flowering and fruiting:** December-March. Common in ponds, lakes etc in stagnant water. Sweta 911.

2. Utricularia stellaris L. f. Suppl. 86. 1781; FBI. 4: 328. 1884; FUGP. 2: 38. Repr. ed. 1960; Fl. Rajasthan 2: 614.1991. *U. inflexa* Forsk. var. *stellaris* (L.f) Taylor in Mitt. Bot. Staat. Munch. 4: 96.1961 and in Kew bull. 18: 189.1964.

Free-floating aquatic herbs. Leaves in whorls of 4, pinnately divided. Bladders obliquely ovoid. Racemes 4-6 flowered, rising above the water surface. Floats ellipsoidal, white, spongy, inserted above the middle on scape. Calyx lobes subequal, suborbicular, enlarged in fruit. Corolla yellow, 2-lipped, upper lip rounded and lower lip sub-quadrate, curved, spur a little shorter than the lower lip. Capsule globose, with reflexed calyx at the base. Seeds minute, discoid, 4-5 angled, slightly winged. **Flowering and fruiting:** August-December. Common in ponds, ditches and in shallow water near the bank of Ganga. Sweta 1383.

75. OROBANCHACEAE

OROBANCHE L.

Orobanche aegyptiaca Pers. Syn. 2: 181.1807;FUGP. 2: 37. Repr. ed. 1960; Fl. Rajasthan 2:616.1991. *O. indica* Buch.- Ham. ex Roxb. Fl. India 3: 27. 1832, non spreng. 1825; FBI. 4: 326. 1885. *O. ramosa auct.* non L. 1753; FBI 4: 326. 1885.

Root-parasites, usually branching from the base. Flowers sessile, forming a lax spike. Bracts ovate-lanceolate. Bracteoles 2. Calyx 4-toothed, campanulate, membranous, hairy. Corolla bluish in upper and whitish in lower portion. Upper lip 2-lobed; lower 3-lobed. Filaments hairy, anthers woolly. Capsule oblong, acuminate, glabrous. Seeds ovoid, reticulate, minute. **Flowering and fruiting.** January-March. Common parasite on the roots of *Solanum melongena* and *Brassica* spp. Sweta 1546.

76. BIGNONIACEAE

KEY TO GENERA:

1. Climbers.....2
1. Shrubs or trees.....3
2. Leaves serrate; aerial roots present; corlla funnel shaped..... 1. ***Campsis***
2. Leaves entire; tendrils present; corolla tubular..... 5. ***Pyrostegia***
3. Leaves 1- pinnate..... 4
3. Leaves 2-3 pinnate..... 5
4. Shrubs; leaflets toothed; flowers bright yellow,

corolla nearly glabrous; capsule linear..... 6. ***Tecoma***

4. Trees; leaflets entire; flowers yellowish-brown,
   woolly- tomentose; capsule large, ribbed,
   cylindric, curved..... 2. ***Fernandoa***

5. Leaflets crenate; flowers white; stamionodes absent..... 4. ***Millingtonia***

5. Leaflets entire; flowers blue; staminodes present..... 3. ***Jacranda***

1. CAMPSIS Lour.

Campsis grandiflora (Thunb.) K. Schum. in Engl. & Prantl, Nat. Pflanzenfam. 4 (3b): 230. 1894; Dicot. Pl. Uttar Pradesh 281. 1999. *Bignonia grandiflora* Thunb. Fl. Jap. 253. 1784.

Extensive, root climbers. Leaves odd-pinnate, leaflets ovate, ovate-oblong or lanceolate, acuminate, coarsely dentate, glabrous. Flowers in terminal, pendulous, racemose panicles. Calyx campnulate, lobes acute. Corolla bell-shaped, scarlet or orange, lobes rounded. Stamens included. Fruit not seen. **Flowering.** March-December. Commonly planted in gardens and parks etc. Sweta 1572.

2. FERNANDOA Welw. ex Seem.

Fernandoa adenophylla (Wall. ex G. Don) Steenis in Blumea 23 (1): 135. 1976; Fl. Rajasthan 2: 619. 1991. *Bignonia adenophylla* Wall. ex G. Don, Gen. Hist. 4: 221. 1838. *Heterophragma adenophyllum* (Wall. ex G. Don) Seem ex Benth. & Hook. f. Gen. Pl. 2: 1047. 1876; FBI. 4: 381. 1884; FUGP. 2: 46. Repr. ed. 1960. *Haplophragma adenophyllum* (Wall. ex G. Don) P. Dop in Bull. Soc. Bot. France 72: 890. 1926.

Medium-sized trees, up to 8.0 m high with an oblong-globular crown. Leaflets up to 7.0 x 15.0 cm, broadly-elliptic, entire, acute, rusty tomentose beneath. Flowers in large, terminal panicles. Calyx up to 2.0 cm long, rusty tomentose. Corolla-tube up to 3.5 cm long, tomentose, lobes subequal, obtuse, dirty yellow. Capsule up to 90.0 cm long, cylindric, ribbed, curved, sometimes almost coiled. Seeds winged. **Flowering and fruiting:** March-October. Planted along roads and on waste land by the Department of Forests. Sweta 1537.

3. JACARANDA Juss.

Jacaranda mimosaefolia D. Don in Bot. Reg. 8: t. 631. 1822 & Edinb. N. Phil. Journ. 9: 264. 1823; Fl. Rajasthan 2: 620. 1991. *J. ovalifolia* R. Br. in Curtis, Bot. Mag. t. 2327. 1822.

Medium sized trees up to 6.0 m high. Leaves 2-pinnate, pinnae about 20 pairs, leaflets up to 25 pairs and one terminal leaflet; lateral leaflets elliptic or oblong, terminal one linear-lanceolate. Flowers in axillary or terminal panicles, purple-blue, yellowish throat. Calyx 5-toothed. Corolla-tube curved, 2-lipped, lobes 5, nearly equal. Stamens 4 perfect, posterior one staminode. Capsule almost orbicular, at right angle to septum. Seeds winged. **Flowering and**

fruiting: March-September. Planted in parks an on roadsides. IPNI has spelled the specific epithet as '*mimosifolia*. Sweta 1520.

4. MILLINGTONIA L. f.

Millingtonia hortensis L. f. Suppl. Pl. 291. 1781; FBI. 4: 377. 1884; FUGP. 2: 46. Repr. ed. 1960; Fl. Rajasthan 2: 621. 1991.

Tall trees up to 15.0 m high, bark corky, wood soft, yellowish. Leaves 2-pinnate, leaflets elliptic-ovate, coarsely toothed, acuminate. Flowers in corymbose panicles, white. Corolla tubular, up to 7.0 cm long, 2-lipped. Stamens 4; anthers with 1 fertile cell, barren cell reduced to an appendage. Capsule up to 25.0 cm long. **Flowering and fruiting:** October-April. **Local name:** *Akash-Neem.* Planted on roadsides, also found near villages. Sweta 1444.

5. PYROSTEGIA Presl.

Pyrostegia venusta (Ker-Gawl.) Miers in Proc. Roy. Hort. Soc. 3: 188. 1863; Fl. Rajasthan 2: 624. 1991. *Bignonia venusta* Ker-Gawl. in Bot. Reg. 3: t. 249. 1818.

This taxon can be readily recognized by its 2-3 entire leaflets, 3-fid minutely clawed tendrils and narrowly tubular, orange corolla. **Flowering and fruiting:** December-May. A favorite climber for walls and arches etc. Sweta 1459.

6. TECOMA Juss.

Tecoma stans (L.) Juss. ex Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 3: 144. 1819; Dicot Pl. Uttar Pradesh 284. 1999. *Bignonia stans* L. Sp. Pl. ed. 2. 871. 1762.

Profusely branched shrubs. Leaves opposite, compound, leaflets 7-11, oblong-lanceolate, serrate-dentate, reddish when young. Flowers bright yellow, in panicles. Capsule erect. **Flowering and fruiting.:** Nearly round the year. Commonly planted in parks and hedges. Sweta 1434.

77. PEDALIACEAE

KEY TO GENERA:

1. Flowers yellow; fruit with 4 spines..... 1. ***Pedalium***
1. Flowers rosy-pink; fruits without spines..... 2. ***Sesamum***

1. PEDALIUM L.

Pedalium murex L. Syst. Nat. ed. 10. 1123. 1759; FBI. 4: 386. 1884; Fl. Rajasthan 2: 624. 1991.

Erect, or ascending, mucilaginous, foetid smelling herbs. Leaves obovte-oblong or obliquely-ovate, repand-dentate, 2 dark-violet glands at the base of petiole. Flowers yellow, solitary-

axillary, with two glands at the base of pedicel. Corolla densely glandular pubescent externally as well as in the throat, lobes suborbicular. Stamens 4, incuded, staminode 1, orange coloured. Ovary papillose, stigma 2-lamellate. Fruit a pyramido-conical, 4-spined capsule. Seeds 3-angled towards apex. **Flowering and fruiting:** August-December. **Local name:** *Gokharu.* Found in sandy soil, not very common. Sweta 158.

2. SESAMUM L.

Sesamum indicum L. Sp. Pl. 634. 1753; FBI. 4: 387. 1884; FUGP. 2: 47. Repr. ed. 1960; Fl. Rajasthan 2: 625. 1991. *S. orientale* L. Sp. Pl. 634. 1753. *S. mulayanum* Nair in Bull. Bot. Surv. India 5: 251. 1963.

Erect, annual, glandular-pubescent herbs, up to 100.0 cm tall; stem bluntly 4-angled, sulcate. Leaves up to 15.0 cm long, elliptic-lanceolate, upper ones entire, lower 3-partite or palmately 3-foliate, serrate. Flowers solitary-axillary, pink. Corolla 2-lipped, pubescent outside, rosy-pink, spotted with yellow. Capsule oblong-quadrangular, deeply 4-grooved, beaked. Seeds black , numerous, compressed, smooth or rugose. **Flowering and fruiting:** August-November. **Local name:** *Til.* Widely cultivated as rainy season crop. Seeds yield an edible oil and used in a variety of other ways. Frequently found as an escape. Sweta 296.

78. MARTYNIACEAE

MARTYNIA L.

Martynia annua L. Sp. Pl. 618.1753; Fl. Rajasthan 2: 625. 1991. *M. diandra* Glox. Obs. Bot. 14. t. 1.1785; FBI. 4: 386.1884; FUGP. 2: 48. Repr. ed. 1960.

Tall erect, densely gland-hairy herbs. Leaves 5-15 x 15-30 cm, broadly-ovate, sinuate, opposite, long petioled, sticky. Flowers pinkish-white, dropping Bracts caducous, pink, spathulate. Bracteoles lanceolate, apiculate, pink. Calyx glandular pubescent; segments unequal. Corolla bilabiate, pinkish outside, purple dots on the anterior lobe within. Staminodes 2-3, clavate. Fruits large, woody, green, with two apical hooked spines. Seeds black, hard. **Flowering and fruiting :** August-October. **Local name.** *Bichu.* Occurs frequently in waste lands and on roadsides. Sweta 1427.

79. ACANTHACEAE

KEY TO GENERA:

1. Corolla without an upper lip; bracts in 4 pairs..... 3. ***Blepharis***

1. Upper lip well developed or corolla lobes with
   5 unequal lobes.....2

2. Seeds not supported on hard retinaculae; peduncles of

spikes covered with alternate scales.....6. ***Elytraria***

2. Seeds supported on hard, upcurved retinaculae.....3

3. Corolla lobes twisted to the left in bud.....4

3. Corolla lobes imbricate in bud.....7

4. Corolla 2-lipped; axillary spines present.....9. ***Hygrophila***

4. Corolla sub equally 5-lobed.....5

5. Stamens 2.....7.***Hemiadelphis***

5. Stamens 4.....6

6. Capsule fusiform, not clavate, seed bearing throughout,
flowers in capitate spikes.....8. ***Hemigraphis***

6. Capsule clavate, with a sterile, solid, stalk-like base;
flowers 1-3 in the axils of leaves.....5. ***Dipteracanthus***

7. Corolla lobes 5, sub equal.....2. ***Barleria***

7. Corolla 2- lipped.....8

8. Ovules 3 to many in each cell i. e. capsule 6 or more-seeded;
flowers in unilateral racemes.....10. ***Indoneesiella***

8. Ovules 1 to 2 in each cell i. e. capsule 2 to 4-seeded.....9

9. Placenta separating elastically from the valves,
from the base upward.....10

9. Placenta not separating elastically from the valves.....11

10. Bracts in unilateral spikes.....13. ***Rungia***

10. Bracts clustered in leaf axial or laxly cymose.....4. ***Dicliptera***

11. Anther cells, at least the lower one, spurred at the base.....11. ***Justicia***

11. Anther cells not spurred at the base.....12

12. Anther cells apiculate.....1. ***Adhatoda***

12. Anther cells not apiculate.....12. ***Peristrophe***

1. ADHATODA Nees.

Adhatoda zeylanica Medic. Hist. and Commentat. Acad. Elect. Sci. Theod.- Palat. 6: 393. 1790; Fl. Rajasthan 2: 630. 1991. *Justicia adhatoda* L. Sp. Pl. 15. 1753; FUGP. 2: 76. Repr. ed. 1960. *Adhatoda vasica* Nees. in Wall. Pl. Asiat. Rar. 3: 103. 1832; FBI. 4: 540. 1885.

Erect, glabrous, evergreen shurbs, upto 2 m high. Leaves 3-8 x 1-2.5 cm, linear-obovate, glabrous, acuminate or acute. Flowers white or creamy, in dense axillary 4.5-12.5 cm long spikes. Bracts leafy, ciliate. Corolla 2 - lipped; upper lip curved, ovate, notched; lower lip 3-lobed with light-pink or purple streaks inside; throat villous. Fruit 4-seeded, dark brown, hard. Seeds glabrous, rugose, brown. **Flowering and fruiting:** October-April. **Local Name.** *Adusa*. Common on roadside, wastelands and near villages. Sweta 674.

2. BARLERIA L.

Key to species:

1. Axillary spines present; flowers yellow..... 3. ***B. prionitis***
1. Axillary spines absent; flowers purplish or white..... 2
2. Flowers purple-blue..... 1. ***B. cristata var. cristata***
2. Flowers white..... 2. ***B. cristata var. dichotoma***

1. Barleria cristata L. Sp. Pl. 636.1753; FBI. 4: 488. 1884; FUGP. 2: 70.Repr. ed. 1960; Fl. Rajasthan 2: 632.1991.

1. var. **cristata**

Erect, perennial, hairy herbs, 0.5-1.0 m high. Leaves 1.5-5.0 x 0.5-1.5 cm, 0.5-3.0 cm long petioled, entire, hairy. Flowers in axillary and terminal spikes, purplish blue. Bacteoles membranous, acute, margins ciliate. Calyx 4-partite; 2 outer lobes lanceolate, whitish, acuminate, margins ciliate; inner ones linear-lanceolate, ciliate. Corolla bluish-purple or white, tube funnel - shaped, pubescent. Stamens often 2, fertile. Capsule about 1.25 cm long, smooth, ovoid, 4-seeded. Seeds compressed, brown, silky hairy. **Flowering and fruiting :** September-February. Occasionally found among the hedges in wastelands. Sweta 349.

2. var. **dichotoma** (Roxb.) Prain, Bengal Pl. 812. 1903; Fl. Rajasthan 2: 633. 1991. *Barleria dichotoma* Roxb. Fl. Ind. 3: 39. 1832.

Perennial, erect under-shrubs, up to 70.0 cm high. Leaves elliptic-oblong, acuminate, puberulous, up to 10.0 x 4.0 cm. Flowers axillary, solitary or few, white. Calyx 4-partite, bristle tipped, thinly hairy. Corolla tube glandular. Capsule up to 1.5 cm long, ellipsoid, 4-seeded. Seeds compressed, orbicular. **Flowering and fruiting:** October- February. Often found in wastelands and in *Kholas*. Sweta 759.

2. Barleria prionitis L. Sp. Pl. 636. 1753; FBI. 4: 482.1884; FUGP. 2: 69. Repr. ed. 1960; Fl. Rajasthan 2: 635. 1991.

Erect, prickly undershrubs. Leaves 3.0-10.0 x 2.0-5.0 cm, petiolate, ovate, acute, entire, sparsely hairy, tipped with a spinule. Axillary spines white, 3-4. Flowers dark yellow, in terminal spikes. Bracts 2, lanceolate, spiny. Calyx outer 2 calyx segments oblong-lanceolate, spine-tipped; 2 inner ones, linear-lanceolate, mucronate. Corolla 2- lipped. Fruit 2-seeded, 1.0-1.5 cm long, with a solid beak. Seeds sub-orbicular, appressed hairy. **Flowering and fruiting:** October-April. **Local Name.** *Kala Bansa.* Found often in waste places near the villages. Specimens collected from the study area are referable to the subsp. *prionitis* var. *prionitis*. Sweta 688.

3. BLEPHARIS Juss.

Key to species:

1. Leaves hairy beneath..... 2. ***B. repens***
2. Leaves glabrous beneath..... 1. ***B. maderaspatensis***

1. Blepharis maderaspatensis (L.) Heyne ex. Roth, Nov. Pl. Sp. 320. 1821; Fl. Rajasthan 2: 637. 1991. *Acanthus maderaspatensis* L. Sp. Pl. 639. 1753. *Blepharis boerhaviaefolia* Pres. Syn. Pl. 2: 180. 1806; FBI. 4: 478. 1884; FUGP. 2: 53. Repr. ed. 1960.

Prostrate, perennial, pubescent herbs. Leaves in whorls of 4, unequal in size, sessile, ovate-lanceolate, acute, entire with few distant teeth, ciliate. Flowers sessile, axillary, white with purple streaks, often combined into a leafy spike. Bracts 8, in 4-opposite pairs, spathulate, upper margins with retrorsely hairy bristles. Calyx 4-lobed, sepals unequal, ciliate. Capsule about 6.0 mm long, 2-seeded, ellipsoidal, brown, polished. Seeds ovoid, compressed, echinate with white spines, smooth, brownish. **Flowering and fruiting.** September-April. Found frequently in dry sandy soil and on slopes of *Kholas*. Sweta 711

Note: According to IPNI database correct spelling of the specific epithet in Persoon's name is '*boerhaviifolia*.

2. Blepharis repens (Vahl) Roth, Nov. Pl. Sp. 321. 1821; Fl. Rajasthan 2: 637. 1991. *Acanthus repens* Vahl, Symb. Bot. 2: 76. 1791. *Blepharis molluginifolia* Pers. Syn. Pl. 2: 180. 1806; FBI. 4: 479. 1884; FUGP. 2: 54. Repr. ed. 1960.

Diffuse, pubescent herb. Leaves oblong or obovate, whorls of 4, sessile, entire, hispid, up to 4.0 cm long. Flowers sessile, axillary, solitary, blue or white; bracteoles 8- 10 spinous, in opposite pairs. Calyx segments linear- lanceolate, acute, membranous-margined. Fruits ellipsoid, compressed, glabrous, completely enclosed within calyx, 2- seeded. Seeds hairy. **Flowering and fruiting:** November- April. Included on authority of Murty and Singh (1961b).

4. DICLIPTERA Juss. *nom. cons.*

Dicliptera verticillata (Forsk.) C. Christens in Dansk. Bot. Ark. 4(3): 11. 1922; Fl. Raj. 2: 640. 1991. *Dianthera verticillata* Forsk. Fl. Aegypt.-Arab. 9. 1775. *Dicliptera micranthes* Nees in Wall. Pl. Asiat. Rar. 3: 112. 1832; FBI. 4: 553. 1885; FUGP. 2: 81. Repr. ed. 1960.

Decumbent or suberect, glabrous herbs. Leaves unequal, ovate, acuminate-acute, entire, glabrous. Flowers in axillary, sessile clusters, purplish-pink. Bracts 2, subequal, foliaceous, cuspidate-acuminate. Bracteoles linear-subulate, pubescent. Calyx lobes 5, pubescent. Corolla throat with dark purplish spots. Capsule ellipsoid, compressed, acute and pubescent at the top. Seeds suborbicular brown. **Flowering and fruiting:** October-April. Occasionally found moist and shady habitats. Khan (1987) reported this species from Bijnor, therefore, its occurence in the sanctuary can not be ruled out.

5. DIPTERACANTHUS Nees *emend* Bremek.

Dipteracanthus prostratus (Poir.)Nees in Wall. Pl. Asiat. Rar. 3: 81. 1832; Fl. Rajasthan 2: 642. 1991. *Ruellia prostrata* Poir. In Lam. Encycl. 6: 349. 1804; FBI. 4: 411. 1884. *Dipteracanthus dejectus* Nees *l.c.* 5: 82. 1832. *Ruellia prostrata* Poir. var. *dejecta* (Nees) Clarke FBI. 4: 412. 1884; FUGP 2: 57. Repr. ed. 1960.

Prostrate, branched herbs with woody base; nodes swollen, younger parts hairy. Leaves ovate-lanceolate, rounded or subcordate at the base, obtuse or acute at the apex. Flowers solitary, sessile, pale-purple. Bracteoles spathulate, subacute, longer than the calyx. Ovary densely hairy near the top. Capsule densely pubescent. **Flowering and fruiting:** February – May. Occasionally found among the hedges. Sweta 1566.

6. ELYTRARIA A. Mich. nom. cons.

Elytraria acaulis (L. f.) Lindau in Engl. & Prantl. Pflanz. Nacht. 1: 304. 1897; Fl. Rajasthan 2: 644. 1991. *Justicia acaulis* L. f. Suppl. Pl. 84. 1781. *E. crenata* Vahl. Enum. 1: 106. 1804; FBI. 4: 394. 1884. *Tubiflora acaulis* (L. f.) Kuntze, Rev. Gen. Pl. 1: 500. 1891; FUGP. 2: 51. Repr. ed. 1960.

Erect herbs with leaves crowded at the base. Leaves obovate to oblanceolate, obtuse or rounded, crenate, cuneate at the base. Spikes one to many, equal to or longer than the leaves. Flowers white. Bracts ovate, acuminate. Corolla 2-lipped, 5-lobed. Capsule ovoid, acute, brownish. Flowering and Fruiting: August – November. Occasionally found in sandy habitats. Sweta s. n.

7. HEMIADELPHIS Nees

Hemiadelphis polysperma (Heyne ex Roth) Nees in Wall. Pl. Asiat. Rar. 3: 75. 80. 1832; Fl. Rajasthan 2: 648. 1991. *Ruellia polysperma* Heyne ex Roth, Nov. Pl. Sp. 305. 1821. *Justicia polysperma* Roxb. Fl. Ind. 1: 49. 1832. *Hygrophila polysperma* (Roxb.) T. Anders. in Journ. Linn. Soc. 9: 456. 1867; FBI. 4: 406. 1884; FUGP. 2: 56. Repr. ed. 1960.

Erect or procumbent, annual herbs. Leaves 0.5-1.2 x 0.2-0.5 cm, sessile, short, opposite, oblong-ovate, entire, acute or subacute. Flowers 2-lipped, purplish or white, in terminal spikes. Bracts elliptic-oblong, hairy. Calyx 5-lobed, linear. Corolla 2-lipped. Stamens 2, fertile. Capsule about 0.8 cm long, linear, brown. Seeds numerous, light-brown. **Flowering and fruiting.** September-March. Sweta 283, 705.

8. HEMIGRAPHIS Nees emend. *T. Anders.*

Hemigraphis hirta (Vahl) T. Anders. in Journ. Linn. Soc. Bot. 9: 462. 1867; FBI. 4: 422. 1884; FUGP. 2: 60. Repr. ed. 1960; Fl. Rajasthan 2: 650. 1991. *Ruellia hirta* Vahl, Symb. Bot. 3: 84. t. 67. 1794.

Prostrate, softly pubescent herbs. Leaves 0.5-3.0 x 0.5-2.0 cm, ovate or oblong, crenate, acute. Flowers in terminal heads, pale-blue. Bracts elliptic, pubescent. Filaments hairy below. Capsule linear, 0.5-1.0 cm long, glabrous. Seeds 12, compressed, brownish, discoid. **Flowering and fruiting time.** April-July. Occasionally found on margins of agricultural fields and other moist habitats. Sweta 897.

9. HYGROPHILA R.Br. *emend.* Heine

Hygrophila auriculata (Schum.) Heine in Kew Bull. 16: 172. 1962; Fl. Rajasthan 2: 652.1991. *Barleria longifolia* L. Cent. Pl. 2: 22. 1756, non *H. longifolia* Nees, 1847. *B. auriculata* Schum. in Schum. & Thonn. Beskr. Guin. Pl. 285.1827. *Asteracantha longifolia* (L.) Nees in Wall. Pl. Asiat. Rar. 3: 90. 1832; FUGP. 2: 55. Repr. ed. 1960. *Hygrophila spinosa* T. Anders. in Thw. Enum. Pl. Zeyl. 225. 1860; FBI.4: 408. 1884.

Erect, hispid, perennial herbs, with straight, yellow, axillary spines. Leaves 3.0-15.0 x 0.5-2.5 cm, oblong-lanceolate, sessile, hispid. Flowers many, axillary, blue, Bracts 2-seriate, lanceolate, hispidly hairy. Calyx 4 partite, lobes unequal, lanceolate, hyaline, ciliate, upper one broader. Capsule oblong, pointed, 4-6 seeded. **Flowering and fruiting** : September-January. Common in marshy places and on margins of water bodies. Sweta 1567.

10. INDONEESIELLA Sreemadh.

Indoneesiella echioides (L.) Sreemadh. in Phytologia 16: 466. 1968; Fl. Rajasthan 2: 653.1991. *Justicia echioides* L. Sp. Pl. 16. 1753. *Andrographis echoides* (L.) Nees in Wall.Pl. Asiat. Rar. 3: 117. 1832; FBI. 4: 505. 1884; FUGP. 2: 197. Repr. ed. 1960.

Erect, annual herbs. Leaves sessile, elliptic-oblong or oblanceolate, glabrous above, lineolate beneath. Flowers pink, in subsecund racemes. Lower lip of corola mottled with red or dark purple spots. Anthers and filaments bearded, red. Capsules elliptic-oblong. **Flowering and Fruiting:** August-December. Included on authority of Murty and Singh (1961b).

11. JUSTICIA L.

Justicia quinqueangularis Koenig ex Roxb. Fl. India 1: 134.1832; FBI. 4: 536.1885; FUGP. 2: 77. Repr. ed. 1960; Fl. Rajasthan 2: 659. 1991. *Rostellaria quinqueangularis* (Koenig ex Roxb.) Nees in Wall. Pl. Asiat. Rar. 3: 101. 1832. *Rostellularia quinqueangularis* (Koenig ex Roxb.) Nees in DC. Prodr. 11: 375. 1847.

Erect glabrous herbs. Leaves 5.5 x 1.5 cm long, shortly petioled, lanceolate, glabrous, entire. Flowers pinkish in terminal spikes. Calyx 4-partite, sepals all similar, linear, margins

scarious, obtuse, glabrous. Corolla bilabiate; upper lip notched, white or colourless; lower lip broad, with radiating reddish streaks. Stamens 2. Fruit capsule, oblong. Seeds 4, compressed. **Flowering and fruiting.** August-December. Common weed throughout the area. Sweta 116.

Note: IPNI has spelled the specific epithet as '*quinquangularis*'

12. PERISTROPHE Nees

Peristrophe paniculata (Forsk.) Brummitt in Kew Bull. 38: 451. 1983; Fl. Rajasthan 2: 666. 1991. *Dianthera paniculata* Forsk. Fl. Aegypt.-Arab. 7. 1775. *Dianthera bicalyculata* Retz. in Vet. Acad. Handl. 297. t. 9. 1775. *Justicia bicalyculata* (Retz.) Vahl, Symb. Bot. 2: 13. 1791. *Peristrophe bicalyculata* (Retz.) Nees. in Wall. Pl. Asiat. Rar. 3: 113.1832; FBI. 4: 554. 1885; FUGP. 2: 79. Repr. ed. 1960.

Erect, annual shrubby herbs. Leaves ovate-lanceolate, acute, margin entire, ciliate. Flowers in axillary, dichotomous cymes, pink or light purple. Bracts 2 unequal, linear, acute. Calyx lobe linear-lanceolate, ciliate, acute. Collora bilabiate. Stamens 2. Capsule about 5.0 mm long, ellipsoidal, stalked, pubescent. Seeds brown, slightly rugose. **Flowering and fruiting.** October- February. Commonly found in waste lands, on margins of cultivated fields and roadsides. Sweta 116.

13. RUNGIA Nees.

Key to species:

1. Bracts dimorphic..... 1. ***R. pectinata***
1. Bracts uniform.....2. ***R. repens***

1. Rungia pectinata (L.) Nees in DC. Prodr. 11: 469.1847; Fl. Rajasthan 2: 670.1991. *Justicia pectinata* L. Cent. Pl. 2: 3. 1756 and Amoen. Acad. 4: 299. 1759. *Rungia parviflora* (Retz.) Nees var. *pectinata* (L.) Clarke in Hook. f. FBI. 4: 550. 1885; FUGP 2: 80. Repr. ed. 1960. *R. parviflora* (Retz.) Nees var. *muralis* Clarke in Hook. f. FBI. 4: 550.1885.

Erect, procumbent, annual herbs. Leaves 1.5-4.0 x 0.6-1.5cm, elliptic-oblong, acute, entire. Flowers in axillary or terminal one sided spikes, blue, bilabiate. Bracts scarious margined. Capsule 4 seeded .**Flowering and fruiting**: Rainy season. Found commonly in moist and shady places. Sweta 144.

2. Rungia repens (L.) Nees in Wall. Pl. Asiat. Rar. 3: 110.1832; FBI. 4: 549. 1885; FUGP. 2: 80. Repr. ed. 1960; Fl. Rajasthan 2: 670. 1991. *Justicia repens* L. Sp. Pl. 15. 1753.

Spreading, decumbent herbs. Leaves elliptic-lanceolate, acute or obtuse, glabrous, sub-entire. Flowers purplish, in erect terminal 3-10 cm long spikes. Bracts broad, elliptic, cuspidate. Bracteoles lanceolate, ciliate, acuminate. Calyx 5 lobed, lobes lanceolate, ciliate, acute.

Corolla 2 lipped, with purple spots. Capsule pubescent, brown. **Local Name** : *Kharmor*.**Flowering and fruiting:** October-December. Common in moist places near the river bank. Sweta 570.

80. VERBENACEAE

KEY TO GENERA:

1. Trees..... 2
1. Shrubs or herbs..... 4
2. Corolla regular; stamens all equal; calyx accrescent, bladder like in fuit..... 6. ***Tectona***
2. Corolla 2-lipped; stamens didymous..... 3
3. Flowers upto 3.0 cm long, brownish-yellow..... 2. ***Gmelina***
3. Flowers 1.0 -1.5 cm bong, greenish-yellow..... 5. ***Premna***
4. Leaves digitate..... 8. ***Vitex***
4. Leaves simple..... 5
5. Flowers in cone-like head; creeping herbs..... 4. ***Phyla***
5. Inflorescence otherwise..... 6
6. Bracts conspicuous in fruits..... 7
6. Bracts inconspicuous in fruits; Corolla irregular, 2-lipped; inflorescence cymose; stamens exserted..... 1. ***Clerodendrum***
7. Spikes elongate; calyx tubular, ribbed; fruit dry; herbs..... 7. ***Verbena***
7. Spikes condensed; calyx truncate, not ribbed; fruit fleshy; shrubs..... 3. ***Lantana***

1. CLERODENDRUM L.

Key to species:

1. Leaves verticillate, entire; stem fistular; calyx fleshy and brick-red in fruit..... 1. ***C. indicum***
1. Leaves opposite, dentate; stem solid; calyx not fleshy in fruit..... 2
2. Leaves broadly ovate-cordate; calyx enlarged and red in fruit; corolla with crimson throat..... 2. ***C. infortunatum***
2. Leaves oblong-ovate; calyx not much enlarged in fruit; corolla pure white..... 3. ***C. phlomidis***

1. Clerodendrum indicum (L.) Kuntze, Rev. Gen. Pl. 586.1891; Fl. Rajasthan 2: 677.1991. *Siphonauthus indica* L. Sp. Pl. 109.1753. *Clerodendrum siphonanthus* R.Br. in Ait. f. Hort. Kew. ed. 2. 4: 65.1812; FBI. 4: 595.1885; FUGP. 2: 93. Repr. ed. 1960.

Erect, perennial, under shrubs. Leaves 5-18 x 1-3 cm, sessile, lanceolate-oblong, acute, entire, acuminate. Flwoers white, in large terminal panicles. Bracts linear-lanceolate. Calyx 5-partite, lobes ovate-triangular, apiculate. Corolla long tubular. Drupes obovoid, bluish-green, supported by red persistent calyx. **Flowering and fruiting :** June-March. Common in open grassy places and on margins of agricultural fields, probably an escape from cultivation. Sweta 482, 723.

2. Clerodendrum infortunatum L., Sp. Pl.: 637. 1753; FBI. 4. 594. 1885; FUGP. 2: 93. Repr. ed. 1960. *Clerodendrum viscosum* Vent. Jard. Malm. t. 25. 1803; Dicot. Pl. Uttar Pradesh 295. 1999.

Perennial under shrubs, softly tomentose, stem angular. Leaves 15-30 x 10-15 cm, opposite, broadly ovate-cordate, crenate-dentate, hairy. Flowers pedicellate, white in large terminal, corymbose panicles. Calyx segments ovate-lanceolate, subacute. Corolla white hairy outside; segments obovate-blong, obtusely apiculate. Stamens exserted. Drupe bluish-black when ripe, sub-globose, enclosed within enlarged red calyx. **Flowering and fruiting :** March-June. **Local Name:** *Bhant*. Common in waste places and on roadsides. Sweta 482,777.

3. Clerodendrum phlomidis L. f. Suppl. 292. 1782; FBI. 4: 590. 1885; FUGP. 2: 92. Repr. ed. 1960; Fl. Rajasthan 2: 677. 1991.

Large shrubs. Leaves 1-6 x 1-5 cm, petiolate, ovate-rhomboid, crenate, acute to acuminate, margin entire or undulate. Flowers white or creamish, fragrant in dichotomous axillary, termianal panicles. Bracts leaf like, lanceolate, acute. Calyx glabrous, slightly enlarged in fruit. Corolla much exserted, 5 lobed, elliptic, obtuse. Drupe obovoid, glabrous, blakish brown. Seeds oblong, dirty white. **Flowering and fruiting :**August-March. Planted in the hedges of gardens. Sweta 750.

Note: According to WCSPF the genus *Clerodendrum* belong to the family Lamiaceae.

2. GMELINA L.

Gmelina arborea Roxb. Pl. Cor. 3: 42. t. 246.1815 & Fl. Ind. 3: 84. 1832; FBI. 4: 581.1885; FUGP. 2: 88. Repr. ed. 1960; Fl. Rajasthan 2: 679.1991.

Unarmed deciduous trees. Leaves 5-18 x 2.5-1.5 cm, broadly ovate, acuminate, entire, cordate, glabrous. Flowers in large terminal or axillary panicles, fulvous- tomentose. Calyx campanulate, densely hairy, teeth triangular, acute. Corolla 5-lobed, deeply divided, pinkish-red, densely hairy outside, 2 lipped. Drupes 3 x 2 cm, ovoid, smooth, yellowish-orange with persistent calyx, oblong. **Flowering and fruiting:** April-August. Included on authority of Murty and Singh (1961b).

Note: According to WCSPF the genus *Gmelina* belong to the family Lamiaceae.

3. LANTANA L.

Key to species:

1. Inflorescence corymbose; flowers pink and
   yellow in the same inflorescence; armed shrubs..... 1. ***L. camara***
1. Inflorescence elngated; flowers white;
   unarmed shrubs.....2. ***L. veronicifolia***

1. Lantana camara L. Sp. Pl. 627.1753; FBI. 4: 562.1885; FUGP. 2: 84. Repr. ed. 1960; Fl. Rajasthan 2: 680.1991. *L. camara* L. var. *aculeata* (L.) Moldenke in Torreya 34: 9.1934.

Erect spiny shrubs with an unpleasant smell. Leaves 2-10 x 1-6 cm, opposite, ovate-oblong, crenate-serrate, hairy on the lower surface, acuminate. Flowers orange or yellow, in axillary long peduncles. Bracts lanceolate, appressed hairy. Calyx white hairy. Corolla 4-lobed, lobe unequal. Drupe globose, deep purple, shining, 2-seeded. **Flowering and fruiting :** Almost throughout the year. Abundantly found in the study area. Sweta 53.

2. Lantana veronicifolia Hayek, Repert. Spec. Nov. Regni Veg. 2: 163. 1906. *Lantana wightiana* WalL. ex Gamble, Fl. Madras 2: 761.1087.1924; Fl. Rajasthan 2: 681.1991. *L. indica* Roxb. var. *albiflora* Wight ex Clarke in FBI. 4: 562.1885. *L. indica sensu* Duthie, FUGP. 2: 83. Repr. ed. 1960, non Roxb. 1832.

Erect, unarmed shrubs. Leaves 3-12 x 1-5 cm, opposite or in whorls of 3, ovate -lanceolate, serrate. Flowers white, slightly aromatic, in axillary peduncled spikes. Calyx truncate, densely hairy, membranous. Corolla with yellow tube, hairy outside. Drupes 0.2-0.5 cm across, globose, shining, purple when ripe. **Flowering and fruiting :** throughout the year. Found occasionally on roadsides. Sweta 1571.

4. PHYLA Lour.

Phyla nodiflora (L.) E. Greene in Pittonia 4: 46. 1899; Fl. Rajasthan 2: 681. 1991. *Verbena nodiflora* L. Sp. Pl. 20. 1753. *Lippia nodiflora* (L.) A. Rich. In Michaux, Fl. Bor.-Amer. 2: 1 5.1803; FBI. 4.563.1885; FUGP. 2: 84. Repr. ed. 1960.

Widely creeping herbs. Leaves 0.5-4 x 0.3-2 cm, subsessile, spathulate, cuneate, dentate. Flowers pinkish or white, sessile, in dense globose, peduncled, axillary heads. Calyx membranous, compressed, 2-lipped, hairy outside, closely covering the fruit. Corolla 2-lipped. Fruits about 0.1 cm across, enclosed within the persistant calyx, separating at maturity into two, 1-seeded, plano-convex, pale-brown pyrenes. **Flowering and fruiting :** May-October. Commonly found in moist places forming a mat on the ground. Some forms of this taxon bear quite long spikes and appear to be perennial in habit. Sweta 40.

5. PREMNA L.

Premna mollissima Roth, Nov. Pl. Sp.: 286 (1821); *Premna latifolia* Roxb. var. *mucronata* (Roxb.) Cl. in FBI. 4: 578. 1885. Dicot. Pl. Uttar Pradesh 297. 1999. *Premna mucronata* Roxb. Hort. Beng. 95, 1814, nom. nud. & Fl. Ind. 3:80. 1832; FUGP. 2: 89. Repr. ed. 1960.

Small or medium sized trees with hairy stem. Leaves broadly ovate, margin entire, deep green, membranous, acuminate, cuneate. Flowers white in terminal corymbs, rusty pubscent. Calyx 5-teethed, accrescent. Corolla 2 - lipped, greenish-white. Anthers black. Fruit globose, dark purple, supported by enlarged calyx. **Flowering and fruiting:** April-September. Not common, planted on the roadside. Sweta 104.

Note: According to WCSPF the genus *Premna* belong to the family Lamiaceae.

6. TECTONA L.f. *nom.cons*

Tectona grandis L.f. suppl. Pl. 151. 1782; FBI. 4: 570.1885; FUGP. 2: 87. Repr. ed. 1960; Fl. Rajasthan 2: 682.1991.

Tall, straight, deciduous trees. Leaves 10-50 x 12-32 cm, broadly elliptic, acute, cuneate, entire, grey or yellowish tomentose. Flowers white in large pyramidal panicles. Calyx broadly campanulate, 5-7 lobed, unequal lobed, bladder like. Corolla white, glabrous, lobes equal, spreading. Fruits globose, 1.0-2.0 cm across, 4 - celled, enclosed in enlarged calyx. Seed oblong, brown. **Flowering and fruiting :** September-December. **Local name**. *Teak, Sagon.* Commonly planted as a timber crop. Sweta 1573.

Note: According to WCSPF the genus *Tectona* belong to the family Lamiaceae.

7. VERBENA L.

Verbena officinalis L. Sp. Pl. 20. 1753; FBI. 4: 565. 1885; FUGP. 2: 85. Repr. ed. 1960; Fl. Rajasthan 2: 683. 1991.

Erect, pubescent, perennial herbs. Leaves 4-10 x 2-4 cm, oblong, scabrous, lyrately pinnatifid; lower petiolate, coarsely toothed; upper ones sessile, usually 3-partite. Flowers bluish in dense, slender, terminal spikes. Calyx 5-toothed, pubescent, ribbed. Corolla 5-lobed, throat hairy. Fruits dry, oblong, 1-seeded. **Flowering and fruiting :** March-November. Found on waste ground and roadsides. Sweta 1581.

8. VITEX L.

Vitex negundo L. Sp. Pl. 638.1753; FBI. 4: 583. 1885; FUGP. 2: 90. Repr. ed. 1960; Fl. Rajasthan 2: 684.1991.

Large spreading shrubs with thin, grey bark. Leaves digitately trifoliate, leaflets stalked, lanceolate, acute, glabrous, crenate serrate, white-tomentose abaxially. Flowers light purple in large, pyramidal, terminal panicles. Calyx white tomentose, teeth small, triangular. Drupe 4-celled, black on ripening, enclosed within calyx. **Flowering and fruiting :** Throughout the year. Confined to sandy habitats near *Kholas* where it grows in clumps. Sweta 80.

Note: According to WCSPF the genus *Tectona* belong to the family Lamiaceae.

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81. LAMIACEAE (Labiatae *nom. alt.*)

KEY TO GENERA:

1. Stamens erect or ascending..... 2
1. Stamens declinate..... 7
2. Corolla 4-lobed, aubequal; stamens 4, equal or subequal;
   clayx 5- toothed; stamens exserted; flowers purplish.....8. ***Pogostemon***
2. Corolla 2-lipped; stames 2, if 4, then didynamous..... 3
3. Perfect stamens 2..... 9. ***Salvia***
3. Perfect stamens 4..... 4
4. Calyx 15 nerved; upper pair of stamens longer;
   small herbs with purplish flowers..... 5. ***Nepeta***
4. Calyx 5-10 nerved; lower pair of stamens longer..... 5
5. Flowers reddish, in elongated inflorescence..... 1. ***Anisomeles***
5. Flowers orange or white, in globular heads..... 6
6. flowers orange..... 3. ***Leonotis***
6. Flowers white.....4. ***Leucas***
7. Lower lip of corolla deflexed ; corolla 5-lobed;
   lowest lobe shorter or equaling the other lobes;
   saccate, contracted at the base..... 2. ***Hyptis***
7. Lower lip of the corolla declinate, flat or nearly so..... 8
8. Corolla tube exceeding the calyx; stamens included;
   stigma entire..... 7. ***Orthosiphon***
8. Corolla tube not exceeding the calyx; stamens exserted;
   stigma 2-fid..... 6. ***Ocimum***

1. ANISOMELES R. Br.

Anisomeles indica (L.) O. Kuntze, Rev. Gen. Pl. 2: 512.1891; Fl. Rajasthan 2: 688.1991. *Nepeta indica* L. Sp. Pl. 571.1753. *Anisomeles ovata* R. Br. in Ait. Hort. Kew. ed. 2. 2: 364. 1811; FBI. 4: 672.1885; FUGP. 2: 109. Repr. ed. 1960.

Erect, densely hairy herbs. Leaves 3-15 x 2.5-10 cm, broadly ovate, crenate-dentate, acute, cuneate to rounded at base. Verticillasters many flowered, axillary, arranged in interrupted spikes. Corolla bilabiate, bluish-purple, lower lip 3-lobed. Nutlets ovoid, black when ripe, polished, with rounded ends. **Flowering and fruiting:** Throughout the year. Commonly found in wastelands and open sandy habitats . Sweta 124.

2. HYPTIS Jacq. *nom. cons.*

Hyptis suaveolens (L.) Poit. in Ann. Mus. Natl. Hist. Paris 7: 472. t. 29. f. 2.1806; FBI. 4: 630.1885; Fl. Rajasthan 2: 690.1991. *Ballota suaveolens* L. syst. Nat. ed. 10.1100.1759.

Tall, strongly aromatic, annual-perennial herbs. Leaves 2-8 x 2.5-9.5 cm, petioled, opposite, dentate, ovate, cordate. Flowers in axillary cymes, arranged racemosely. Calyx 10-ribbed, patently hairy. Corolla blue. Stamens 4, didynamous. Nutlets oblong, emarginated, glabrous. **Flowering and fruiting:** Rainy and winter season. Commonly found in the open waste lands and on roadsides. Sweta 125.

3. LEONOTIS R. Br.

Leonotis nepetifolia (L.) R. Br. in Ait. Hort. Kew. ed. 2.3: 409.1811; FBI. 4: 691.1885; FUGP. 2: 116. Repr. ed. 1960; Fl. Rajasthan 2: 692.1991. *Phlomis nepetaefolia* L. Sp. Pl. 586.1753.

Tall, erect, hairy, annual herbs. Leaves 1-15 x 0.75-6 cm, ovate-lanceolate, petioled, crenate-serrate, acute, cuneate. Flowers in glomerate, axillary whorls, orange. Bracts linear, deflexed, hairy, spine-tipped. Calyx ribbed, tube incurved, throat glabrous, teeth unequal, spine tipped. Corolla 2-lipped, densely woolly, orange. **Flowering and fruiting**: September-February. This is a characteristic species of areas close to Ganga. Sweta 270.

Note: Hooker (1885) and Duthie have spelled the specific epithet of this taxon as '***nepetaefolia***' while Shetty and Singh (1991) spelled the same as '***nepetiifolia***'. International Plant Name Index (IPNI) spells the specific epithet as '***nepetifolia***'.[http://www.ipni.org/ipni/idPlantNameSearch.do?id=1273103&back_page=%2Fipni%2FeditSimplePlantNameSearch.do%3Ffind_wholeName%3DLeonotis%2Bnepetifolia%2B%26output_format%3Dnormal]. I have followed IPNI in this regard.

4. LEUCAS R. Br.

Key to species:

1. Flowers in terminal heads only..... 2. ***L. cephalotes***
1. Flowers in terminal heads and/or axillary whorls..... 2
2. Lower half of calyx mouth exceeding the upper.....3. ***L. urticaefolia***
2. Upper half of calyx mouth exceeding the lower,
calyx mouth glabrous or minutely pubescent within.....1. ***L. aspera***

1. Leucas aspera (Willd.) Link. Enum. Pl. Hort. Berol. 2: 113.1822; FBI. 4: 690. 1885; FUGP. 2: 114. Repr. ed. 1960; Fl. Rajasthan 2: 694. 1991. *Phlomis aspera* Willd. Enum. Pl. Hort. Berol. 2. 621. 1809.

Erect, hairy, much branched herbs, hairs spreading. Leaves short petioled, linear lanceolate, obtuse, entire, hairy, tapering at the base. Flowers white, sessile, in terminal and axillary glomerate whorls. Calyx tube glabrous in lower half and hairy in upper half, mouth, wide, toothed. Corolla 2 lipped, upper lip smaller, white-woolly, lower lip spreading. Stamens 4, didynamous, anthers red. Nutlets smooth, oblong, brown. **Flowering and fruiting:** Rainy and winter season. Commonly found in wastelands, cultivated fields and on roadsides. Sweta115, 273.

2. Leucas cephalotes (Koen.ex Roth) Spreng. Syst. Veg. 2: 743. 1825; FBI. 4: 689. 1885; FUGP. 2: 114. Repr. ed. 1960; Fl. Rajasthan 2: 695.1991. *Phlomis cephalotes* Koen.ex Roth, Nov. Pl. Sp. 262.1821.

Erect, annual, hispid herbs. Stem 4-angled, hairy. Leaves ovate, lanceolate, membranous, crenate-serrate base tapering. Flowers white, sessile, in dense, globose, terminal whorls. Bracts lanceolate, acute, ciliate. Corolla woolly. Nutlets round, smooth, brown. **Flowering and fruiting**: August-March. Commonly found as weeds in cultivated field. Sweta152.

3. Leucas urticifolia (Vahl) R.Br. ex Sm. in A.Rees, Cycl. 20: 4. 1812.; FBI. 4: 680. 1885; FUGP. 2: 112. Repr. ed. 1960; Fl. Rajasthan 2: 698. 1991. *Phlomis urticaefolia* Vahl, Symb. Bot. 3: 76. 1794.

Erect, hairy, annual herbs. Leaves 3-8 x 2-3 cm, ovate, acute, serrate, rounded at base, hairy. Flowers in dense axillary globose whorls. Bracts subsessile, lanceolate, acute, ciliate with distinct veins. Calyx cylindric, villous, mouth oblique, lower lip much prolonged. Nutlets obovoid-oblong, 3-gonous, brown, obliquely truncate apex. **Flowering and fruiting :** October-February. Common in open dry or moist sandy habitats. Sweta 1586.

5. NEPETA L.

Nepeta hindostana (B.Heyne ex Roth) Haines, Bot. Bihar Orissa 4: 744. 1922; Fl. Raj 2: 700.1991. *Glechoma hindostana* B. Heyne ex Roth, Nov. Pl. Sp. 258. 1821. *N. ruderalis*

Buch. Ham.ex Benth. in Wall. Pl. As. Rar. 1: 64. 1830; FBI. 4: 661. 1885; FUGP. 2: 117. Repr. ed. 1960.

Annual, pubscent herbs. Leaves 1-7 x 0.75-4 cm, petioled, ovate, serrate-dentate, appressed-pubescent, obtuse, cordate. Flowers in dense, axillary racemes, light purple. Bracts setaceous, hairy, acute, linear. Calyx 5-toothed, tubular. Corolla 2-lipped. Stamens 4. Nutlets minute, white spotted, oblong, ellipsoidal, mucilaginous when moistened. **Flowering and fruiting:** Winter season. Abundantly found in moist, shady and damp places. Sweta 146.

6. OCIMUM L.

Key to species

1. Calyx tube with a hairy annulus within..... 2
1. Calyx tube glabrous within; pedicel equaling the calyx;
   lower lip of calyx not upcurved after anthesis; corolla
   reddish-pink..... 3. ***O. tenuiflorum***
2. Fruiting calyx 3-5 mm long;
   corolla 4.0 -6.0 mm long..... .1. ***O. americanum***
2. Fruiting calyx 5.0- 7.0 m long; corolla
   7.0- 10.0 mm long..... 2. ***O bacilicum***

1. Ocimum americanum L., Cent. Pl. I: 15. 1755. *Ocimum canum* Sims. in Curtis, Bot. Mag. 51: t. 2452. 1823; FBI. 4: 607. 1885; FUGP. 2: 98. Repr. ed. 1960; Fl. Rajasthan 2: 701. 1991.

Erect, gland-hairy, annual herbs. Leaves 0.5-4 x 0.25-2 cm, elliptic-lanceolate, cuneate, acute, gland-dotted. Venticillasters 6-flowered, combined into an interrupted, spicate inflorescence. Bracts shortly stalked, ovate, ciliate. Corolla white, upper lip broadly oblong, 4 - toothed, lower lip obtuse, oblong. Nutlets ovoid, ellipsoidal, smooth, black. **Flowering and fruiting** : Throughout the year. **Local name**. *Ram Tulsi*. Cultivated in gardens, also found in open waste places. Sweta 1593.

2. Ocimum basilicum L. Sp. Pl. 597. 1753; FBI.4: 608. 1885; FUGP. 2: 99. Repr. ed. 1960; Fl. Rajasthan 2: 701.1991.

Erect, strongly aromatic, annual herbs. Leaves 1-6 x 0.75-2.5 cm, ovate-lanceolate, acute, entire or toothed, thinly hairy. Flowers in verticillasters, arranged in simple or branched racemes, white. Bracts stalked, ovate, acute. Corolla white or pale-purple, pubescent. Stamens exserted. Nutlets 0.1-0.15 cm long, oblonge-ellipsoid, glabrous, black or dark-brown. **Flowering and fruiting :** Almost throughout the year. **Local name.** *Kali Tulsi*. Cultivated in gardens, also found as an escape. Sweta 1591.

3. Ocimum tenuiflorum L. Sp. Pl. 597.1753; Fl. Rajasthan 2: 702.1991. *O. sanctum* L. Mant. Pl. 1: 85.1767; FBI. 4: 609. 1885; FUGP.2: 98. Repr. ed. 1960.

Erect annual herbs, often woody at base and clothed with reddish-purple hairs. Leaves 1-3 x 0.50-2.5 cm, elliptic-oblong, acute, serrate, hairy, minutely gland dotted. Flowers in axillary whorls arranged in racemes, purplish. Bracts broadly ovate, acuminate, ciliate. Nutlets ellipsoidal, smooth, warty, yellow, dotted with black. **Flowering and fruiting :** throughout the year. **Local name.** *Krishna Tulsi.* Mostly cultivated in garden, sometimes also found in waste places as an escape. Sweta 1568.

7. ORTHOSIPHON Benth.

Orthosiphon pallidus Royle ex Benth., Hooker's J. Bot. Kew Gard. Misc. 3: 370.1833; FBI. 4: 613. 1885; FUGP.2: 100. Repr. ed. 1960; Fl. Rajasthan 2: 703. 1991..

Diffuse herbs or under shrubs. Leaves 1-4 x 1-2.5 cm, petioled, ovate, acute, coarsely serrate, hairy. Verticellaster 6-flowered, combined into long racemes, white. Calyx ovoid, campanulate, deflexed in fruit. Corolla 2-lipped. Nutlets subglobose, smooth, pale brown. **Flowering and fruiting :** June-December. **Local name.** *Ban tulsi.* Included on authority of Murty and Singh (1961b).

8. POGOSTEMON Desf.

Pogostemon benghalensis (Burm.f.) O.Ktze. Rev. Gen. Pl. 2: 529. 1891; Fl. Rajasthan 2: 705. 1991. *Origanum benghalense* Burm. f. Fl. Ind. 128. t. 38. f. 3. 1768. *Pogostemon plectranthoides* Desf. in Ann. Mus. Nalt. Hist. Nat. Paris 2: 156. t. 6. 1808; FBI.4: 632. 1885; FUGP.2: 105. Repr. ed. 1960.

Large, strongly aromatic undershrubs. Leaves 5-15 x 2-8 cm, broadly ovate or ovate-lanceolate, acute, doubly serrate, cuneate. Verticillasters combined into paniculate spikes. Bracts leaf-like, ovate, acute, ciliate. Bracteoles falcate-lanceolate, acuminate, often tinged with purple. Calyx teeth triangular-lanceolate, hirsute, gland, punctate. Corolla white with purple tinge, gland punctate. Nutlets minute, ellipsoidal, smooth, dark-brown, glabrous. **Flowering and fruiting :** January-May. Found on roadsides and in waste places. Sweta 1540.

Note: In Indian floras the specific epithet is spelled as '*benghalense*'.

9. SALVIA L.

Salvia plebeia R. Br. Prodr. 501. 1810; FBI. 4: 655.1885; FUGP.2: 118. Repr. ed. 1960; Fl. Rajasthan 2: 707.1991.

Erect, roughly pubescent, annual herbs. Leaves 2-8 x 1.5-5 cm, oblong, lanceolate, subacute, crenate, acute. Flowers small, in panicled, spicate racemes. Bracts linear, spathulate. Calyx 2-lipped, reflexed. Corolla 2-lipped, white or whitish-pink. Stamens 2. Staminodes 2. Nutlets

minute, ovoid, brown when ripe, smooth or rugose. **Flowering and fruiting :** January-May. Abundantly found in agricultural fields and other moist places. Sweta 566.

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82. PLANTAGINACEAE

PLANTAGO L.

Plantago amplexicaulis Cav. Icon. Descr. 2: 22. t. 125. 1793; FBI. 4: 706. 1885; FUGP.2: 123. Repr. ed. 1960; Fl. Rajasthan 2: 710. 1991. *P. bauphula* Edgew. in Hook. Journ. Bot. 2: 285. 1840.

Annual or perennial, hairy, acaulescent herbs. Leaves 5-15 x 0.5-1.5 cm, lanceolate, finely acuminate, base sheathing, distantly toothed. Scapes axillary, many, terete. Flowers in 1-4 cm long ovoid spikes. Bracts cup-like, membranous, glabrous. Corolla lobes ovate, acute.Capsule ellipsoidal, 2-celled, subobtuse. Seeds 2, oblong, boat-shaped, brownish or black. **Flowering and fruiting:** January-March. **Local Name:** *Isabgol*. Found in sandy soil and in waste places. Sweta 708.

83. NYCTAGINACEAE

KEY TO GENERA:

1. Erect herbs; flowers more than 2.0 cm long, with
   an involucre of prominent sepaloid bracts..... 3. ***Mirabilis***
1. Prostrate, suberect or scandent herbs; flowers
   less than 1.0 cm long; bracts not as above.....2
2. Flowers shortly pedicelled or sessile; stamens
   shorter than or equal to perianth tube; prostrate or
   suberect herbs..... 1. ***Boerhavia***
2. Flowers long pedicelled; stamens much linger than
   the perianth tube; scamdent herbs..... 2. ***Commicarpus***

1. BOERHAVIA L.

Boerhavia diffusa L. Sp. Pl. 3.1753; FUGP.2: 127. Repr. ed. 1960; Fl. Rajasthan 2: 713.1991. *B. repens* L. **var.** *diffusa* (L.) Hook. f. FBI. 4: 709.1885.

Prostrate, spreading herbs. Leaves 1-5 x 0.5-5 cm, ovate-lanceolate, margins undulate, apex rounded. Flowers minute, in axillary and terminal, bracteolate panicles or subcapitate umbels. Perianth pink-red. Stamens scarcely exserted. Anthocarp 0.3-0.4 cm long, clavate, fusiform,

green. **Flowering and fruiting:** Major part of the year. Occurs commonly in wastelands, open areas and on roadsides. Sweta 37.

2. COMMICARPUS Standley

Commicarpus chinensis (L.) Heimerl in Engler & Prantl, Nat. Pflanzenf. ed. 2. 16: 117. 1934; Fl. Rajasthan 2: 715. 1991. *Valeriana chinensis* L. Sp. Pl. 33.1753. *Boerhavia repanda* Willd. Sp. Pl. 1: 22. 1797; FBI. 4: 709. 1885; FUGP.2: 128. Repr. ed. 1960.

Diffuse or scandent, glabrous herb. Leaves 1-4 x 1-3.5 cm, opposite, equal, paired, cordate, broadly ovate, sinuate-repand. Inflorescence terminal or axillary, superposed umbels. Perianth funnel-shaped, pink with greenish tube. Stamens 4 or 5, much exserted. Fruit clavate, longitudinally grooved, uniformly covered with warty glands. **Flowering and fruiting :** August -December. Found among the hedges, especially in moist pklaces. Sweta 185.

3. MIRABILIS L.

Mirabilis jalapa L. Sp. Pl. 177. 1753; FUGP.2: 129. Repr. ed. 1960; Fl. Rajasthan 2: 717. 1991.

Erect, glabrous, annual herbs. Leaves 2-10 x 1-6 cm, ovate-lanceolate, acuminate, subentire, glabrous. Flowers subsessile, crowded in fascicles. Perianth red, white, yellow or variegated, glandular hairy. Stamens 5, exserted. Anther yellow. Anthocarps globose, 5-ribbed, black at maturity. **Flowering and fruiting :**Almost through out the year. Cultivated in gardens as an ornamental, also found as an escape in waste places. Sweta 1545.

84. AMARANTHACEAE

KEY TO GENERA:

1. Inflorescence spinous.....2
1. Inflorescence not spinous.....3
2. Flowers clustered at the nodes of spikes; fertile flowers surrounded by sterile flowers modified into hooked spines..... 8. ***Pupalia***
2. Flowers single at the nodes of spikes; bracts and bracteoles spinous, not hooked.....1. ***Achyranthes***
3. Leaves never all opposite..... 4
3. Leaves all opposite..... 7
4. Pseudostaminodes present..... 2. ***Aerva***
4. Pseudostaminodes absent..... 5
5. Indflorescence condensed; ovary multiovulate..... 5. ***Celosia***

5. Inflorescence elongated; ovary uniovulate..... 6

6. Flowers unisexual, green.....4. ***Amaranthus***

6. Flowers bisexual, red-pink.....6. ***Digera***

7. Flowers in sessile, axillary head-like spikes;
stigma capitate.....3. ***Alternanthera***

7. Flowers in peduncled, termial head- like spikes;
stigma bifid.....7. ***Gomphrena***

1. ACHYRANTHES L.

Key to varieties:

1. Plants sub-glabrous; leaves membranous; flowers
brihgt reddish-purple.....2. ***A. aspera*** var. ***porphyristachya***

1. Plants hairy to densely tomentose; flowers greenish.....1. ***A. aspera*** var. ***aspera***

1. Achyranthes aspera L. Sp. Pl. 204.1753; FBI. 4: 730. 1885; FUGP.2: 140. Repr. ed. 1960; Fl. Raj . 2: 718. 1991.

1. var. **aspera**

Ercert herbs with 4-angled and tomentose stem . Leaves 1.5-9.0 x 0.8-6.0 cm, broadly, obovate and rounded at apex, softly hairy . Flowers in terminal and axillary long spikes , sharply deflexed against the rachis. Bracts and bracteoles spinous. Urticles 1-3 mm long. Seeds cylindric, smooth. **Flowering and fruiting**: All most throughout the year. Commonly found along the road sides, also as weed in wastelands and agricultural fields. Sweta 143.

2. var. **porphyristachya** (Wall. ex Moq.) Hook. f. FBI. 4: 730. 1885; Fl. Rajasthan 2: 719.1991. *Achyranthes porphyristachya* Wall. ex Moq. in DC. Prodr. 13 (2) : 316. 1849. Distinguishable from var.*aspera* by its leaves which are membranous, up to 15.0 x 8.0 cm, elliptic-lanceolate or ovate-lanceolate, glabrous. Flowers bright reddish-purple. **Flowering and fruiting:** August -February. Occasionally found in moist and shady places. Sweta 142.

2. AERVA Forsk. *nom. cons.*

Key to species:

1. Flowers unisexual, dioecious; outer tepals with the
midrib creasing well below the apex..... 1. ***A. javanica***

1. Flowers bisexual or female and hermaphrodite; outer
tepals with the midrib excurrent into a distinct mucro.....2

2. Leaves alternate; spikes axillary, forming a long leafy
inflorescence; flowers bisexual..... 2. ***A. lanata***

2. Leaves alternate and opposite; spikes in axillary and

terminal racemes, not subtended by leaves; flowers
bisexual or bisexul and female both..... 3. ***A. sanguinolenta***

1. Aerva javanica (Burm.f.) Juss ex schult. in Ann. Mus. Hist. Nat. Par. 11: 13.1808 & Syst. Veg. ed. 15. 5: 565.1819; FBI. 4: 727.1885; Fl. Rajasthan 2: 721. 1991. *Iresine javanica* Burm. f. Fl. Ind. 212. t. 65. f. 2. 1768. *Aerva tomentosa* Forsk. Fl. Aeg-Arab. 122. 170. 1775; FUGP.2: 138. Repr. ed. 1960.

var. **javanica**

Hairy tomentose undershrubs. Leaves 1-3 cm long, alternate, sessile, oblong-spathulate, acute or retuse, densely tomentose. Flowers dioecious, in cylindric, dense, sessile, woolly spikes. Bracteoles ovate, acute, hyaline. Male flowers tepal elliptic oblong, woolly on the back. Female flowers tepals oblong-spathulate, apiculate. Stigmas 2. Utricles ovoid, compressed. Seeds dark-brown, round, shining, compressed. **Flowering and fruiting:** June-January. Common in open dry area, near *Kholas* and on roadsides. Sweta 1515.

2. Aerva lanata (L.) Juss. ex Schult. in Ann. Mus. Hist. Nat. Paris 11: 131.1808 *et* Syst. Veg. ed. 15. 5: 546. 1819; FBI. .4: 728. 1885; FUGP.2: 139. Repr. ed. 1960; Fl. Rajasthan 2: 722. 1991. *Achyranthes lanata* L. Sp. Pl. 204.1753.

Erect or prostrate, perennial herbs. Leaves 1.0-6.0 x 0.25-3.0 cm, alternate, elliptic-obovate, acute, cuneate, pubescent above, white woolly beneath. Flowers minute, sessile, white or creamy, in dense axillary spikes. Bracteoles ovate, apiculate. Perianth ovate-oblong, apiculate. Urticles ovoid, acute and compressed. Seeds reniform, black and shining. **Flowering and fruiting.** Throughout the year. Common in open waste places. Sweta 1417.

3. Aerva sanguinolenta (L.) Blume, Bijdr. Fl. Nederl. Ind. 11: 547. 1826; Fl. Rajasthan 2: 722.1991. *Achyranthes sanguinolenta* L. Sp. Pl. ed. 2: 294. 1762. *A. scandens* Roxb. Fl. Ind. 2: 503. 1824. *Aerva scandens* (Roxb.) Moq. in DC. Prodr. 13 (2): 302.1849; FBI. 4: 727.1885; FUGP. 2: 138. Repr. ed. 1960.

Erect perennial herbs. Leaves alternate, opposite, 1.5-5.0 x 0.8-3 cm, elliptic-ovate, acute, hairy. Flowers silvery-white, bisexual, in ovoid or cylindric axillary or terminal spikes. Bracteoles ovate, hairy. Stamens 4, connate, forming a cup around the ovary. Seeds black, reniform. **Flowering and fruiting** :July- December. Commonly found among hedges. Sweta 27, 89, 174.

3. ALTERNANTHERA Forsk.

Key to species:

1. Bracts and tepals spine tipped..... 3. ***A. pungens***
1. Bracts and tepals not spine tipped.....2
2. Hydrophytic herbs; inflorescence on long peduncles..... 2. ***A. philoxeroides***
2. Amphibious herbs; inflorescence sessile or shortly peduncled.....3
3. Inflorescence pinkish-red; stamens 3..... 4. ***A. sessilis***
3. Inflorescence white or dirty white; stamens 5.....1. ***A. paronychioides***

1. Alternanthera paronychioides St. Hill. Voy. Dist. Diamans Bres. (Ser. II) 2: 439. 1833; Fl. Rajasthan 2: 723. 1991.

Prostrate, branched, annual herbs. Leaves opposite, ovate-oblong, spathulate, acute, entire. Flowers white, sessile, in 2 or 3 axillary, globose heads. Bracts and bracteoles small, white, scarious. Tepals lanceolate, acute. Urticles winged, brown, shining. **Flowering and fruiting :** Almost throughout the year. Occurs chiefly on drying bottom of ditches and ponds. Sweta 422.

2. Alternanthera philoxeroides (Mart.) Gris. in Abh. Ges. Wiss. Goett. 24: 36. 1879; Kuntz. Rev. Gen. Pl. 2: 540. 1891; Chaudhury & Bhattacharyya in Bull. Bot. Surv. India 36(1-4): 273. 1994. *Bucholzia philoxeroides* Mart. in Nova Acta Leop.-Carol 13.1: 315. 1826.

Aquatic or marshy herbs, up to 100. cm long. Leaves up to 10.0 x 1.5 cm, oblong-lanceolate to spathulate-obovate, apex submucronate, entire or remotely denticulate. Inflorescence ovoid-globular, peduncled, white head. Flowers up to 7.0 mm long, whitish. Bract ovate, acute, 1-nerved; bracteoles ovate-lanceolate, acuminate, glabrous, 1-nerved. Tepals 5, subequal, 5-7 mm, lanceolate-oblong. Stamens 5, up to 4.0 mm long, anthers yellowish; pseudostaminodes strap-shaped, 2-3 fid. Fruit not seen. **Flowering and fruiting:** April-November. Collected only once from a swamp at Bihargarh. Sweta 1530.

Note: According to IPNI database the combination *Bucholzia philoxeroides* Mart. was published in *Beitraege zur kenntnis der Naturlichen Families der Amarantaceen* in the year 1825.

3. Alternanthera pungens Kunth in H.B.K. Nov. Gen. Sp. Pl. 2: 206.1818; Fl. Rajasthan 2: 724.1991.

Prostrate, spiny, perennial herbs. Leaves 1.0-4.0 x 0.25-0.75 cm, rhomboid or broadly ovate, opposite, entire. Flowers in sessile, whitish, axillary, cylindrical, prickly heads. Bracts lanceolate-ovate, denticulate. Tepals unequal. Urticles rounded above, about 0.2 cm long enclosed within persistent perianth. Seeds rounded, brownish. **Flowering and fruiting.** July-

December. **Local name.** *Kante-wali-Santi.* Occasionally found in waste lands and on roadsides. Sweta 1538.

4. Alternanthera sessilis (L.) R.Br. ex DC. Cat. Pl. Hort. Bot. Monsp. 4: 77.1813; FBI. 4: 731.1885; FUGP. 2: 142.Repr. ed. 1960; Fl. Rajasthan 2: 725.1991. *Gomphrena sessilis* L. Sp. Pl. 225.1753.

Prostrate, annual or perennial herbs. Leaves shortly petioled, linear-lanceolate, ovate or spathulate, slightly fleshy. Flowers sessile, reddish, in axillary, globose heads. Bracts ovate, glaborus, dentate. Bracteoles ovate scarious. Tepals elliptic lanceolate, acute. Ovary compressed. Urticles broadly obcordate, thickened on margins. Seeds discoid, shining, brown. **Flowering and fruiting.** Major part of the year. Common in moist, marshy places near ponds, ditches, paddy fields and river banks. Sweta 202.

4. AMARANTHUS L.

Key to species:

1. Axillary spines present.....2. ***A. spinosus***
1. Axillary spines absent.....2
2. Capsule circumcissile; flowers in axillary cymose clusters.....3
2. Capsule indehiscent or irregualry rupturing; flowers in axillary or terminal spikes and sometimes in axillary clusters also.....4
3. Perianth segments 2; capsule hyaline, with prominent green, longitudinal ribs.....3. ***A. tenuifolius***
3. Perianth segments 3; capsule neither hyaline nor ribbed.....4. ***A. tricolor***
4. Capsule smooth or rugose; distinctly exceeding the female perianth.....1. ***A. lividus***
4. Capsule very strongly corrugated; scarsely exceedig the female perianth.....5. ***A. viridis***

1. Amaranthus lividus L. Sp. Pl. 990. 1753; Fl. Rajasthan 2: 728. 1991. *Amaranthus blitum* L. Sp. Pl. 990. 1753, *nomen confusum;* FBI. 4: 721. 1885, *excl.* var. *sylvestris*; FUGP. 2: 136. Repr. ed. 1960. *Amaranthus oleraceus* L. Sp. Pl. ed. 2. 1403. 1763.

Erect, decumbent, annual herbs. Leaves long petioled, ovate-rhomboidal, broad, emarginate, cuneate. Flowers in axillary clusters or terminal spikes, green. Urticles ovoid, bidentate, smooth, wrinkled on drying. Seeds round, compressed, reddish-brown, shining, glabrous.

Flowering and fruiting: December-May. Common in waste places and on roadsides. Sweta 633, 926.

2. Amaranthus spinosus L. Sp. Pl. 991.1753; FBI. 4: 718.1885; FUGP. 2: 133. Repr. ed. 1960; Fl. Rajasthan 2: 729.1991.

Erect, spinous, annual herbs. Leaves 2.0-8.0 x 0.75-2.0 cm, ovate-lanceolate, alternate blunt at the apex, cuneate, entire. Flowers green in axillary clusters and long dense terminal spikes. Bracts linear, tipped with a bristle. Perianth of male flowers, ovate, acute; that of female flowers; oblong, obtuse, apiculate. Stamen. 5. Urticles ovoid, rugose, thickened above. Seeds black, shining. **Flowering and fruiting.** Major part of the year. **Local name:** *Kataili chaulai.* Common weed in agricultural fields, waste places and on roadsides. Sweta 1555.

3. Amaranthus tenuifolius Willd. Sp. Pl. ed. 4. 4: 381. 1805; FBI. 4: 722. 1885; FUGP. 2: 137. Repr. ed. 1960; Fl. Rajasthan 2: 730. 1991.

Prostrate or ascending, annual herbs. Leaves linear-oblong to linear-oblanceoalte, apex emarginate or rounded, mucronate, glabrous. Flowers green, in small axillary, cymose clusters. Bracts and bracteoles narrowly oblong-elliptic. Stamens 2. Utricle ellipsoid, delicate, hyaline. Seeds round, smooth, shining, brown. **Flowering and fruiting:** December- June. Not common, occurs on moist bed of Ganga in summer season. Sweta 832, 920.

4. Amaranthus tricolor L. Sp. Pl. 989.1753; Fl. Rajasthan 2: 730.1991. *A. mangostanus* L. Cent. Pl. 1: 32.1755; FBI. 4: 720.1885. *A. polygamus* L. Cent. Pl. 1: 32.1755, non Hook.f. FBI.. 4: 721.1885; FUGP. 2: 135. Repr. ed. 1960. *A. gangeticus* L. Syst. Nat. ed. 10. 1268. 1759; FBI. 4: 719.1885; FUGP. 2: 135. Repr. ed. 1960, including var. *tristis*.

Erect, stout, glabrous, annual herbs. Leaves long petioled, 1.0-7.0 x 1.0-4.0 cm, broadly rhomboidal, base cuneate, acute, mucronate, emarginate. Flowers in globose, axillary clsuters, green. Bracts ovate, membranous. Bracteoles deltoid-ovate. Tepals 3, lanceolate. Urticles flask-shaped or ovoid, membranous. Seeds black, shining, lenticular. **Flowering and fruiting.** September-March. Found in waste places, cultivated fields and on roadsides. Sweta 1582.

5. Amaranthus viridis L. Sp. Pl. ed. 2. 1405.1763; FBI. 4: 720.1885; FUGP. 2: 136. Repr. ed. 1960; Fl. Rajasthan 2: 731.1991.

Erect ascending glaborus, annual herbs.Leaves 2.0-8.0 x 1.5-4.0 cm, ovate-rhomboid, petioled, obtuse, subentire, glabrous. Flowers shortly stalked, in axillary or terminal panicled spikes, green. Bracts ovate, acute, membranous, keeled. Bracteoles lanceolate ovate. Tepals 3, lanceolate-oblong, mucronate, acute. Stamens 3. Urticles ovoid, compressed, strongly rugose,

acute, shortly beaked. Seeds minute, rounded, black, shining. **Flowering and fruiting.** October-March. Common weed in cultivated fields. Also found in open waste places and grasslands. Sweta s.n.

5. CELOSIA L.

Celosia argentea L. Sp. Pl. 205.1753; FBI. 4: 714.1885; FUGP. 2:131. Repr. ed. 1960; Fl. Rajasthan 2: 731.1991.

Erect, glabrous, annual herbs. Leaves 2.0-15.0 x 0.5-4.0 cm, linear-lanceolate, ovate, lower ones short-petioled, upper ones sessile, often tinged with red, entire. Flowers in dense axillary or terminal cylindrical spikes, pink or white, glistening later. Bracts and bracteoles subequal, linear-lanceolate, mucronate. Tepals 5, ovate-lanceolate, acute, mucronate, white or pink. Stamens 5. anthers purplish. Utricles 0.35 cm, ellipsoidal. Seeds 4-6, lenticular, black, shining. **Flowering and fruiting.** September-November. **Local name.** *Sufaid Murgha.* Commonly found in cultivated fields, waste places and on roadsides. Sweta 1570.

6. DIGERA Forsk.

Digera muricata (L.) Mart. Beitr. Amar. 77. n. 2.1825 *et* Nov. Act. Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 13 (1): 285. 1826; Fl. Rajasthan 2: 732.1991. *Achyranthes muricata* L. Sp. Pl. ed. 2. 295.1762. *Digera arvensis* Forsk. Fl. Aeg.-Arab. 65. 1775; FBI. 4: 717. 1885; FUGP.2: 132.Repr. ed. 1960.

Erect-ascending, annual or perennial herbs. Leaves 1.5-10.0 x 0.5-3.0 cm, ovate or elliptic, acute, apiculate or rounded. Flowers sessile in lax, axillary, peduncled spikes, deep pink. Bracts ovate, acute, persistent. Tepals ovate-oblong, acute. Utricle globose, somewhat compressed. Seeds yellowish-brown. **Flowering and fruiting:** September-December. Common in waste places on roadsides and margins of agricultural fields. Sweta 1543.

7. GOMPHRENA L.

Gomphrena celosioides Mart. Beitr. Amar. 93. 1825. et Nov. Act. Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 13 (1) 301. 1826; Fl. Rajasthan 2: 732. 1991.

Ascending or prostrate herbs. Leaves spathulate or oblong, entire. Flowers sessile, in terminal spikes, subtented by a pair of leaves, silvery-white. Perianth lobes 5 , lanceolate, densely white woolly. Urticles compressed. Seeds light-brown. **Flowering and Friuting:** March-November. Frequently found on road sides, in waste lands and grassy habitats. Sweta 11.

8. PUPALIA Juss. *nom. cons.*

Pupalia lappacea (L.) Juss. in Ann. Mus. Natl. Hist. Nat. Paris 2: 132.1803; FBI. 4: 724. 1885; FUGP 2: 141. Repr. ed. 1960; Fl. Rajasthan 2: 734. 1991. *Achyranthes lappacea* L. Sp.

Pl. 204. 1753. *A. atropurpurea* Lamk. Encyl. 1: 546. 1785. *P. atropurpurea* (Lamk.) Moq. in DC. Prodr.13 (2): 331. 1849; FBI. 4: 723. 1885.

Straggling or semiscandent, annual or perennial herbs. Leaves up to 10.0 x 5.0 cm, ovate or elliptic-lanceolate, acuminate, mucronate. Flowers in sessile clusters, arrangred in lax, pedunculate, terminal, erect or drooping spikes. Bracteoles of 2-sexual flowers cordate-ovate, mucronate; spines of modified flowers galbrous, hooked. Utricle ovoid, membranous. Seeds oblong-ellipsoid, with subtruncate ends. **Flowering and fruiting:** Through out the year. Commonly found among the hedges. Sweta 24.

85. CHENOPODIACEAE

KEY TO GENERA:

1. Fruiting perianth with transverse wing..... 2. ***Kochia***
1. Fruiting perianth not winged..... 1. ***Chenopodium***

1. CHENOPODIUM L.

Key to species:

1. Plants with strong terpentine smell; stigmas 5.....2. ***C. ambrosioides***
1. Plant without terpentine smell; stigmas 2..... 2
2. Seeds dull black..... 3. ***C. murale***
2. Seeds shining black..... 1. ***C. album***

1. Chenopodium album L. Sp. Pl. 219. 1753; FBI. 5: 3. 1886; FUGP. 2: 143. Repr. ed. 1960; Fl. Rajasthan 2: 737. 1991.

Erect, annual herbs, clothed with white powdery vesicles. Leaves 0.5-10 x 0.2-5 cm; lower ones long-petioled, ovate-rhomboid to oblong, irregularly dentate; upper ones short petioled, elliptic-ovate, acute, entire. Flowers in paniculate clusters, combined in large terminal, leafy, lax, panicles. Tepals ovate, rounded. Fruits depressed globose. Seeds orbicular, compressed, polished. **Flowering and fruiting:** October-April. **Local name:** *Bathua.* Common weed in cultivated fields and waste places. Sweta 93.

2. Chenopodium ambrosioides L. Sp. Pl. 219.1753; FBI. 5: 4.1886; Fl. Rajasthan 2: 737.1991.

Erect, annual or perennial herbs with sweetish terpentine smell. Leaves 3-15 x 1-3 cm, oblong-ovate, obtuse or acute, serrate-dentate, thinly pilose. Flowers greenish, sessile in axillary clusters combined into a large leafy panicles. Tepals 5, green, cordate, ovate-rounded, keeled. Urticles enclosed in perianth. Seeds smooth, shining with an obtuse margin.

Flowering and fruiting: Winter season. Commonly found as weed in cultivated field, moist places and along river banks. Sweta 73.

3. Chenopodium murale L. Sp. Pl. 219.1753; FBI. 5: 4.1886; FUGP. 2: 144. Repr. ed. 1960; Fl. Rajasthan 2: 738.1991

Erect, subglabrous herbs. Leaves 1-6 x 0.5-3.5 cm, alternate, oblong-ovate, dentate or irregularly lobulate or toothed, cuneate. Flowers greenish, axillary, in racemes or panicles. Tepals oblong, slightly keeled, subacute. Seeds horizontal, orbicular, compressed, keeled, rugose, dull-black. **Flowering and fruiting:** November-March. Frequently found on moist soil and in agricultural fields. Sweta 225.

2. KOCHIA Roth

Kochia indica Wight Ic. 5 (2): 5. t. 1791. 1852; FBI. 5: 11. 1886; FUGP. 2: 144. Repr. ed. 1960; Fl. Rajasthan 2: 739. 1991.

Tall, erect, annual, white-villous herbs. Leaves sessile, linear-lanceolate, acute. Flowers solitary or in pairs, axillary. Utricle thinly membranous, wings of fruiting perianth short, broadly triangular-ovate, obtuse. Seeds orbicular or ovoid, black. **Flowering and fruiting:** October-November. Included on authority of Murty and Singh (1961b).

Note: Acording to APG-2 both *Chenopodium* and *Kochia* are now included in Amaranthaceae.

86. BASELLACEAE

BASELLA L.

Basella rubra L. Sp. Pl. 272. 1753; FBI.. 5: 20. 1886; FUGP. 2: 147. Repr. ed. 1960; Fl. Rajasthan 2: 743. 1991. *B. alba* L. Sp. Pl. 272. 1753; Dicot. Pl. Uttar Pradesh 315. 1999. Glabrous, twining, succulent herbs. Leaves ovate-cordate, up to 10.0 x 4.5 cm, entire, acuminate. Flowers sessile, in lax, pedunculate spikes, red or greenish-white. Perianth 5-fid. Stamens 5, anthers versatile, globose. Fruits globose, utricle enclosed within the fleshy perianth. **Flowering and fruiting:** October- May. **Local name:** *Poi.* Common on road sides, climbing on trees and shrubs. Also cultivated for the sake of leaves which are used as vegtable. Sweta 200, 602.

87. POLYGONACEAE

KEY TO GENERA:

1. Perianth petaloid, pink or white..... 2
1. Perainth sepaloid..... 3. ***Rumex***
2. Climbers; apical portion of inflorescence modified into tendril..... 1. ***Antigonon***

2. Erect or prostrate herbs; tendrils absent..... 2. ***Polygonum***

1. ANTIGONON Endl.

Antigonon leptopus Hook. & Arn. Bot. Beechey Voy. 308. t. 69.1838; Fl. Rajasthan 2: 755. 1991; Dicot. Pl. Uttar Pradesh 316. 1999.

Large, extensive, herbaceous climbers. Leaves ovate-triangular, cordate, petiolate, entire, acute, subglabrous or thinly hairy. Flowers in axillary racemes, terminating in a branched tendril, pink or white; 3 outer prianth lobes larger. Fruits enclosed within perianth lobes, 3-angled. **Flowering and fruiting:** Winter season. Frequently cultivated as an ornamental, also found as an escape.Sweta 1529.

2. POLYGONUM L.

Key to species:

1. Prostrate or ascending herbs; flowers
   all axillary.....6. ***P. plebeium***
1. Erect or ascending herbs; flowers in terminal
   pseudo-spikes..... 2
2. Stipules echinate at the margins..... 3. ***P. glabrum***
2. Stipules ciliate at the margins.....3
3. Styles 2; nut biconvex; bracts densely
   white woolly.....5. ***P. lapathifolium*** var. ***lanatum***
3. Styles 3; nut trigonous..... 4
4. Pseudo-spikes dense; bracts closely imbricate..... 5
4. Pseudo-spikes lax; bracts remote..... 6
5. Leaf base acute, narrowed..... 1. ***P. barbatum*** sussp. ***barbatum***
5. Leaf base usually rounded or subcordate.....2. ***P barbatum*** subsp. ***gracile***
6. Perianth glandular; stem egalndular;
   ochrea long ciliate..... 4. ***P. hydropiper*** subsp. ***microcarpum***
6. Perianth eglandular; ochrea long ciliate,
   appressed hairy; aceme filiform; bracts remote,
   short ciliate; perianth white.....2. ***P. caespitosum***

1. Polygonum barbatum L. Sp. PL. 362. 1753; FBI .5: 37.1886; FUGP. 2: 154. Repr. ed. 1960; Fl. Rajasthan 2. 747. 1991. *P. stagninum* Buch.-Ham. ex. Meissn. in Wall. Pl. As. Rar. 3: 56.1832; FBI. 5: 37.1886; FUGP. 2: 154. Repr. ed. 1960.

1. subsp **barbatum**

Erect or creeping-ascending, annual-perennial herbs. Leaves 5.0-15.0 x 1.5-2.0 cm, sessile, lanceolate-oblong, acuminate, leaf base narrowed. Ochrea appressed-pubescent, strigose, cilia

longer than the tube. Flowers in pseudo-lateral spikes, white or pinkish, peduncles quite glabrous. Bracts crowded, glabrous, shortly ciliated. Perianth eglandualr, white, segments ovate-rounded. Nutlets trigonous, blackish-brown, shining, enclosed within presistent perianth. **Flowering and fruiting:** Winter season. Common in marshy habitats and at the margins of ponds and ditches. Sweta 327.

2. subsp. **gracile** Danser in Bull. Jard. Bot. Buit. ser. 3. 8: 146. f. 2. 1927; Fl. Rajasthan 2: 748. 1991. *Polygonum flaccidum* Roxb. Fl. India 2: 291. 1832, non Meissn. 1856. *P. serrulatum sensu* Hook. f. FBI. 5: 38. 1886, excl.var. *donii,* non Lagasca 1816; FUGP. 2: 155. Repr. ed. 1960.

Readily distinguishable from the former subspecies by rounded or subcordate leaf base. **Flowering and fruiting :**Winter season. Commonly found in marshy and moist places. Sweta 619, 635.

2. Polygonum caespitosum Bl. Bijdr. Fl. Ned. Ind. 532. Dec. 1825; Danser, Bull. Jard. Bot. Buit. ser. 3.8: 151, 153. 1927 (incl. subsp. *yokusaianum*); HFDD. 442. 1977. *P. posumbu* Buch.- Ham. ex D. Don, Prodr. 71. Feb. 1826; FBI. 5: 38. 1886; FUGP. 2: 156. Repr. ed. 1960.

Erect, creeping, flaccid, perennial herbs. Leaves 2.0-10.0 x 1.0-3.0 cm, elliptic-lanceolate, cuneate, acuminate, appressedly hairy on nerves. Ochreae thin, appressed. Raceme erect, filiform. Bracts minute, imbricate, very shortly ciliate. Perianth white, very small, eglandular. Nutlets brownish, smooth, polished. **Flowering and fruiting:** Winter season. Commonly found in marshy & swampy localities. Sweta 196.

3. Polygonum glabrum Willd. Sp. PL. 2: 447. 1779; FBI.5: 34. 1886; FUGP. 2: 153. Repr. ed. 1960; Fl. Rajasthan 2: 718. 1991.

Erect, glabrous, stout, annual herb. Leaves 15.0-18.0 x 1.0-3.0 cm, lanceolate, acute, entire, gland-dotted on both surfaces. Ochreae eciliate, upto 3.0 cm long. Flowers in paniculate, slender racemes. Bracts glabrous. Perianth pink or white, segments ovate-oblong, obtuse. Stamens 6, reddish. Nutlets biconvex, black or brown, polished. **Flowering and fruiting:** September-March. Commonly found on margins of ditches and ponds and wet places near banks of Ganga. Sweta 234.

4. Polygonum hydropiper L. subsp. **microcarpum** Danser var. **lenticularis** Danser in Bull. Jard. Bot. Buit. ser. 3. 8: 189. 1927; Fl. Rajasthan 2: 749. 1991. *P. hydropiper* Meissn. in DC. Prodr. 14: 109. 1856, *pro parte*, non L. 1753; FBI. 5: 39. 1886; FUGP. 2: 155. Repr. ed. 1960.

Erect, ascending, annual herbs. Leaves 3.0-10.0 x 1.0-2.0 cm, shortly stalked, oblong-lanceolate, acuminate, gland-dotted. Ochreae glabrous, shortly ciliate. Flowers in slender, filiform, flexuous racemes, pink. Bracts glabrous, gland-dotted. Perianth pink, glandular. Nutlets trigonous, granulate, opaque. **Flowering and fruiting:** September-April. Commonly found in marshy places. Sweta 1590.

5. Polygonum lapathifolium L. Sp. Pl. 360. 1753. var. **lanatum** (Roxb.) Steward, Contrib. Gray Herb. 5 (88): 46. 1930; Fl. Rajasthan 2: 749. 1991. *P. lanatum* Roxb. Fl. Ind. 2: 285. 1824. *P. lanigerum auct.* non R.Br. 1810; FBI. 5: 35. 1886; FUGP. 2: 152. Repr. ed. 1960.

Erect, robust, annual herbs. Leaves 5.0-18.0 x 1.0-5.0 cm, lanceolate, acuminate, densely white-woolly beneath. Ochereae membranous, striate. Flowers in terminal or axillary spikes. Bracts small, crowded, white-woolly. Perianth white or pink, eglandular. Nutlets brown, ovoid, biconvex, black, polished. **Flowering and fruiting:** August-November. Found mostly in marshy places. Sweta 196, 325.

6. Polygonum plebeium R. Br. Prodr. 420. 1810, "*plebejum*"; FBI. 5: 27. 1886; FUGP. 2: 149. Repr. ed. 1960; Fl. Rajasthan 2: 750. 1991.

Key to varieties:

1. Stipules longer than the leaves; leaves elliptic oblong;
   margins strongly recurved; flowers sunken among the
   stipules..... 3. ***P. plebeium*** var. ***scindica***
1. Stipules shorter than the leaves..... 2
2. Flowers sessile, almost concealed by the stipules;
   sepals broad, rounded..... 2. ***P. plebeium*** var. ***plebeium***
2. Flowers shortly pedicellate, not concealed by the bracts..... 1. ***P. plebeium*** var. ***indica***

1. var. **indica** (Heyne ex Roth) Hook.f. FBI. 5: 28. 1886; FUGP. 2: 151. Repr. ed. 1960; Fl. Rajasthan 2: 752.1991. *Polygonum indicum* Heyne ex Roth, Nov. Sp. Pl. 208. 1821; Wight, Ic. 5 (2): 7. t. 1808.1852.

Highly branched, prostrate herbs. Leaves 0.5-1.25 cm long, short, linear, flat, oblong. Ochreae very short or minute, membranous. Flowers crowded in the leaf axils, reddish. Tepals broad, 2 outer ones acute. Nutlets trigonous, brown. **Flowering and fruiting :** August - December. Occasionally found in waste land. Sweta 561.

2. var. **plebeium**

Prostrate or decumbent-ascending, much branched herbs. Leaves 1.0-3.0 x 0.25-0.5 cm, oblong - lanceolate, glabrous, obtuse or rounded. Ochreae white, papery. Flowers pink, 1-5 in axils, pedicel short. Perianth segment rounded. Nutlets trigonous, brown, polished. **Flowering and fruiting:** October-April. Commonly found in sandy areas, sometimes also on the old walls. Sweta 78.

3. var. **scindica** Hook. f. FBI. 5: 29. 1886; Bhandari, Fl. Ind. Desert 334. 1978; Fl. Rajasthan 2: 753. 1991.

Highly branched, prostrate herb. Leaves 0.1-0.3 cm long, short, linear, flat, oblong.Ochreae very short or minute, cilated. Flowers subsessile, sunken among stipules. Nutlets trigonous, brown. **Flowering and fruiting :** October-November. Occassionally found among stones on the bed of Madhya Ganga canal. Sweta 1589.

3. RUMEX L.

Key to species:

1. Leaves strongly wavy; tapering at base into
   a petiole; inner perianth lobes entire or nearly so
   at the margins in fruit..... 1. ***R. crispus***
1. Leaves rounded or cordate at the base; inner perianth
   segments dentate; teeth erect.....2. ***R. dentatus***

1. Rumex crispus L. Sp. Pl. 335. 1753; Fl. Rajasthan 2: 754. 1991.

Erect, perennial, glabrous herbs. Leaves 3.0-8.0 x 0.5-1.5 cm, alternate, crumpled, crenulate, acute, glabrous. Flowers in compound raceme, green. Nutlet smooth, triangular, brown. **Flowering and fruiting:** April-August. Rare, in moist habitats. Sweta 100.

2. Rumex dentatus L. Mant. Pl. 2: 226.1771; subsp. **klotzschianus** (Meissn.) Rech. f. Beih. Bot. Centralb. 49: 19.1932 *et* in Candollea 12: 119. 1949; Fl. Rajasthan 2: 754. 1991. *R. klotzschianus* Meiss. in DC. Prodr. 14: 57.1856. *R. dentatus sensu* Hook. f. FBI.5: 59.1890 *non* L. 1771; FUGP 2: 158. Repr. ed. 1960.

Erect, glabrous, much branched herbs. Lower leaves petioled, oblong, obtuse rounded, wavy, entire margin. Flowers in axillary whorls, deflexed. Inner segments broadly ovate, much enlarged in fruit, ovoid-oblong smooth, margins irregularly toothed. Nutlets typically trigonous, brown, beaked. **Flowering and fruiting :** March - June. Commonly found in marshy places and rice fields. Sweta 562.

88. ARISTOLOCHIACEAE

ARISTOLOCHIA L.

Aristolochia bracteolata Lamk. Encycl. Meth. Bot. 1: 258. 1783; Fl. Rajasthan 2: 756. 1991. *A. bracteata* Retz. Obs. Bot. 5: 29. 1788; FBI. 5: 75. 1886; FUGP. 2: 160. Repr. ed. 1960.

Erect to prostrate perennial herbs. Leaves petioled, up to 2.0 x 8.0 cm, broadly ovate or reniform, obtuse, cordate, glaucous beneath. Flowers dark-purple, solitary, pedicel about 2.0 cm long, bracts large, sessile, orbicular or subreniform, inserted near the base of pedicel. Perianth base subglobose. Capsule up to 2.0 cm long, oblong-ellipsoid, glabrous, 12-ribbed. Seeds triangular, flattened, cordate. **Flowering and fruiting:** July- December. Included on authority of Murty & Singh (1961b) who collected a single specimen of this taxon from the study area. According to Duthie (*l.c.*) this plant is found in Bundelkhand and Gwalior. The specimen collected by Murty & Singh might be a casual.

89. PROTEACEAE

GREVILLEA R. Br. *nom. cons.*

Grevillea robusta A. Cunn. ex R. Br. Prot. Nov. 24. 1830; Fl. Rajasthan 2: 758. 1991.

Medium sized to large straight trees. Leaves alternate, bipinnatifid, lanceolate, silvery white beneath, tough. Flowers 1-5 nate, in secund racemes. Perianth 4-lobed, upper 1/3 part recurved, orange-yellow externally, dark-red streaked inside. Stamens 4, sessile. Ovary glabrous, stipitate, 1-celled, 2-ovuled. Fruits brown, oblique, coriaceous follicle. Seeds 1-2, winged. **Flowering and fruiting:** March-August. Planted on roadsides. Sweta 1597.

90. LORANTHACEAE

DENDROPHTHOE Mart.

Dendrophthoe falcata (L.f.) Etting. in Denkschr. Akad. Wiss. Math.-Naturwise. 32: 52-53. 58. t. 13. f.14.1872; Fl. Rajasthan 2: 759.1991. *Loranthus falcatus* L. f. Suppl. 211.1781. *L. longiflorus* Desr. in Lamk. Encycl. 3: 598.1792; FBI. 5: 214.1886, incl. var. *falcata* (L. f.) Kurz & var. *amplexifolia* (DC.) Thw; FUGP. 2: 175. Repr. ed. 1960.

Large, bushy, perennial, partial stem parasites. Leaves 6-20 x 3-12 cm, opposite, ovate-lanceolate, elliptic-oblong, glabrous, thickly coriaceous. Flowers orange in secund racemes, orange -red or yellowish -red. Perianth curved, glabrous, 5 lobed, linear, reflexed. Stamens 5, epipetalous. Fruits ovoid-oblong, glabrous, red when ripe. **Flowering and fruiting.** September-November. Found as a partial parasite on *Mangifera indica* and *Ficus religiosa* etc. Sweta 1600.

91. EUPHORBIACEAE

KEY TO GENERA:

1. Dioecious trees.....6. ***Mallotus***
1. Monoecious herbs, shrubs or trees.....2
2. Inflorescence a cyathium.....4. ***Euphorbia***
2. Inflorescence otherwise.....3
3. Small herbs.....4
3. Trees or shrubs.....6
4. Leaves distichous, flowers axillary.....7. ***Phyllanthus***
4. Leaves otherwise, flowers in racemes.....5
5. Each female flower subtended by a cupular bract.....1. ***Acalypha***
5. Female flowers not subtended by cupular bracts.....3. ***Croton***
6. Leaves peltate, palmately lobed; fruits echinate.....8. ***Ricinus***
6. Leaves not as above, fruits not echinate.....7
7. Leaves 2-glandular at base; trees.....9. ***Triadica***
7. Leaves eglandular at base.....8
8. Leaves distichous.....9
8. Leaves not distichous.....10
9. Fruit small, red, seated on enlarged calyx; shrubs.....2. ***Breynia***
9. Fruits large, yellowish-green, not seated on enlarged calyx; trees.....7. ***Pyllanthus***
10. All stamens free; pistillodes large; fruit white; shrubs.....5. ***Flueggea***
10. Three stamens united, 2 free; pistillodes absent; fruit deep-purple to black; straggling shrubs.....7. ***Phyllanthus***

1. ACALYPHA L.

Key to species:

1. Bracts fimbriate; capsule glabrous.....1. ***A. ciliata***
1. Bracts shortly dentate; capsule hispid.....2. ***A. indica***

1. Acalypha ciliata Forsk. Fl. Aegypt.-Arab. 162. 1775; FBI. .5: 417.1887; FUGP.2: 209.Repr. ed. 1960; Fl. Rajasthan 2: 763.1991.

Erect, often much-branched, annual herbs. Leaves 2.0-6.0 x 1.5-4.0 cm, ovate-lanceolate, acuminate, mucronate, finely serrate, hairy on the nerves beneath. Flowers in axillary androgynous spikes; male ones sessile, near the top of spikes; female ones towards the base. Bracts large, green, exceeding capsules. Capsule glabrous, white, twisted after dehiscence, seeds globosely ovoid, smooth. **Flowering and fruiting.** August-February. Included on authority of Murty & Singh (1961b).

2. Acalypha indica L. Sp. Pl. 1003. 1753; FBI. 5: 416.1887; FUGP.2: 209.Repr. ed. 1960; Fl. Rajasthan 2: 764.1991.

Erect, annual herbs. Leaves 1.5-7.0 x 1.0-5.0 cm, long petioled, ovate or ovate-rhomboid, obtuse, crenate-serrate, cuneate. Flowers in long, axillary, lax, androgynous spikes, greenish yellow; male ones minute, ebracteate; female ones 3-5, subtended by a shortly stalked leaf-like, cup-shaped dentate, many nerved bract. Capsule hispid, small, grey-white. Seeds ovoid, smooth, pale-brown. **Flowering and fruiting.** June-December. Common weed in moist places and on roadsides. Sweta 579.

2. BREYNIA J. Forster & G. Forster *nom.cons.*

Breynia vitis-idaea (Burm. f.) Fischer in Kew Bull. 1932: 65.1932; Fl. Rajasthan 2: 766.1991. *Rhamnus vitis-idaea* Burm.f. Fl. Ind. 61. 1768. *Phyllanthus rhamnoides* Retz. Obs. Bot. 5: 30.1788; *Breynia rhamnoides* (Retz.) Muell.-Arg. in DC. Prodr. 15 (2): 440.1866; FBI. 5: 330.1887; FUGP. 2: 197.Repr. ed. 1960.

Small or large, glabrous shrubs with horizontal, bifarious branches. Leaves 2.0-3.0 cm long, membranous, elliptic-ovate, shortly stalked, dark-brown or black when dry. Flowers axillary, monoecious, very small; male flowers: calyx sub-campanulate, mouth entire or obscurely lobed; female flowers: calyx cup shaped, 6-lobed, acute. Fruits small, globose, smooth, succulent, dull-red or purple. **Flowering and fruiting.** October-December. Included on authority of Murty and Singh (1961b).

Note: According to WCSPF the genus *Breynia* belongs to family Phyllanthaceae.

3. CROTON L.

Croton bonplandianum Baill. in Adansonia 4: 339.1864; Fl. Rajasthan 2: 771.1991.

Erect, hairy, monoecious annual to perennial herbs. Leaves 2.0-5.0 x 0.25-2.0 cm, ovate-lanceolate, serrate, with 2 glands at the base. Flowers in terminal racemes; male flowers pale-white, borne at the top of inflorescence. Stamens about 15. Females ones at base. Capsule trigonous, stellately hairy. Seeds rugose, oblong, grey. **Flowering and fruiting.** May-September. **Local name.** *Kala-Bhangra.* Common weed in fallow fields, on roadsides, dry sandy banks and bed of the river Ganga. Sweta 10.

Note: According to WCSPF the specific epithet is '*bonplandianus*'.

4. EUPHORBIA L.

Key to species:

1. Cactus like, succulent shrubs; stem with three faces;
   each node with a pair of spines; leaves small deciduous..... 1. ***E. antiquorum***
1. Normal plants, neither suculent nor spinous; leaves well

developed and not deciduous.....2

2. Upper leaves opposite, lower alternate..... 3

2. All leaves opposite..... 4

3. Rootstock with proliferous shoots; seeds smooth, with a strophiole..... 5. ***E. prolifera***

3. Rootstock not proliferous; seeds rugose or tuberculate, strophiolate..... 2. ***E. dracunculoides***

4. Involucral gland with a conspicuous, petaloid limb..... 4. ***E. indica***

4. Involucral glands without a conspicuous petaloid limb..... 5

5. Ascending or erect herbs; leaves upto 4.0 cm ong.....3. ***E. hirta***

5. Prostrate, hairy herbs; leaves less than 1.0 cm long, crenulate; capsule hairy throughout; seeds furrowed..... 6. ***E. thymifolia***

1. Euphorbia antiquorum L. Sp. Pl.1: 450. 1753; FBI. 5: 255. 1887; FUGP. 2: 183. Repr. ed. 1960; Dicot Pl. Uttar Pradesh 331. 1999.

Large, dark-green, erect, succulent shrubs with milky latex. Branches 3-angled with longitudinal rows of paired stipular spines. Leaves small, nearly orbicular, caducous. Cyathia in short peduncled cymes, yellow or greenish-yellow; glands 5, large. Fruits not seen. **Flowering and fruiting:** March-April. Often planted on the margins of orchards for fencing. Also planted as ornamental in rockeries. Sweta 1432.

2. Euphorbia dracunculoides Lamk. Dict. 2: 428.1786 *et* Encycl. 2: 428.1788; FBI. 5: 262.1887; FUGP. 2: 185.Repr. ed. 1960; Fl. Rajasthan 2: 777. 1991.

Erect, glabrous, annual herbs. Leaves 0.5-6.0 x 0.2-1.0 cm, linear-lanceolate, subacute to acute, entire. Involucres subsessile, solitary, campanulate, glabrous, subtended by lanceolate floral leaves, lobes ovate, ciliolate. Filaments pubescent. Capsule smooth, 3-lobed, 3-seeded. Seeds oblong, obovoid or ellipsoidal, grooved on one side; testa whitish, rugose. **Flowering and fruiting.** August-May. **Local name.** *Ban beri.*Occasionally found in fallow land. Sweta 1598.

3. Euphorbia hirta L. Sp. Pl. 454. 1753; FUGP. 2: 187. Repr. ed. 1960; Fl. Rajasthan 2: 780.1991. *E. pilulifera auct. plur.* non L. 1753; FBI. 5: 250.1887.

Erect, ascending, annual, hairy herbs. Leaves 1.0-4.0 x 0.5-2.0 cm, opposite, shortly stalked, elliptic-oblong or oblong-lanceolate, acute, serrate, base obliquely cordate. Involucres many, crowded in axillary and terminal, shortly pedunculate cymes, glands minute, globose, with an obsolete apendage. Ovary on a long stalk, hairy. Capsule appressedly hairy, trigonous. Seeds ovoid, trigonous, transversely rugose, reddish-brown. **Flowering and fruiting.** Almost

throughout the year. **Local name.** *Dudhi.* Common in grassy localities, waste places, cultivated fields and on roadsides. Sweta 175.

4. Euphorbia indica Lamk. Encycl. 2: 423. 1786; Fl. Rajasthan 2: 780. 1991. *Euphorbia hypericifolia auct.* non. L. Sp. Pl. 454.1753; FUGP 2: 187. Repr. ed. 1960.

Erect or decumbent, annual herbs. Leaves 0.2-1.5 x 0.2-1.0 m, opposite, linear-oblong to elliptic ovate, rounded or subacute, serrate, glabrous, base oblique. Cymes axillary, densely many flowered. Involucres minute, cup shaped, entire, 5-lobed, ovate, glands green with pink or white margin. Capsule depressed-globose, style short, deeply bifid. Seeds ellipsoid, 4 angled, rugose, reddish-brown. **Flowering and fruiting.** Almost throughout the year. Common weed in cultivated fields and on wet clayey soil. Very close to *E. hirta* L. but can be readily distinguished by petaloid limb of the involucral glands which are not so in *E. hirta.* Sweta 1366.

5. Euphorbia prolifera Buch.-Ham. ex. D. Don, Prodr. Fl. Nepal. 62.1825; FBI. 5: 264.1887; FUGP.2: 186 Repr. ed. 1960; HFDD. 459.1977.

Erect, glaucescent, multicauline, perennial herbs. Leaves 2.0-4.5 x 0.3-0.8 m, alternate, sessile, coriaceous, linear-oblong or spathulate, acute, mucronate, somewhat fleshy. Involucres shortly campanulate; lobes 5, triangular, glands yellow, reniform, stalked, 2-horned. Capsule glabrous seeds 4-angled, grooved, glabrous, reddish-brown. **Flowering and fruiting.** March-June. Found on dry margins of canals. Sweta 56.

6. Euphorbia thymifolia L. Sp. Pl. 454.1753; FBI. 5: 252.1887; FUGP 2: 188. Repr. ed. 1960; Fl. Rajasthan 2: 783.1991. *E. prostrata* Graham, Cat. 179.1839, non Ait. 1789.

Small, hispid, annual herbs, pale with coppery tinge,. Leaves 0.2-1 x 0.2-0.8 cm, obovate-oblong, opposite, obliquely-oblong, crenulate. Involucres minute, axillary, solitary or 2-3 together, campanulate. Capsules erect, shortly stalked, obtusely keeled, pubescent. Seeds 4-angled, bluntly pointed, with 5-6 shallow transverse furrows. **Flowering and fruiting.** August-December. **Local name.** *Duddhi.* Found on roadsides wasteland and margins of agricultural fields. Sweta 1355.

5. FLUEGGEA Willd.

Flueggea virosa (Roxb. ex Willd.) Voigt, Hort. Suburb. Calcutt.: 152. 1845. *Securinega virosa* (Roxb. ex Willd.) Baillon in Adansonia 6: 334.1865-66, excl. descr. Fl. Rajasthan 2: 792.1991. *Phyllanthus virosus* Roxb. ex Willd. Sp. Pl. 4: 578.1805. *Flueggea microcarpa* Blume, Bijdr. Fl. Ned. Ind. 12: 580. 1826; FBI. 5: 328.1887, *pro parte*; FUGP. 2: 196.Repr. ed. 1960.

Erect, glabrous, annual or perennial shrubs . Leaves shortly petioled, 3.0-8.0 x 1.0-6.0 cm, obovate, ovate-elliptic or nearly orbicular, cuneate, entire. Stipules ovate-lanceolate, acute, scarious. Flowers very small in axillary clusters, greenish-yellow. Male flowers many on filiform pedicels. Sepals 5, ovate, subobtuse, ciliate, concave. Stamens usually 5, exserted. Female flowers 1-5. Berry globose, white when mature, fleshy. Seeds 3-6, minutely punctate. **Flowering and fruiting.** August-April. Frequently in soil especially near *Kholas.* Sweta 94, 75.

Note: According to WCSPF the genus *Flueggea* belongs to family Phyllanthaceae.

6. MALLOTUS Lour.

Key to species:

1. Ripe fruits covered with red powder; male inflorescence not pendulous..... 2. ***M. phippensis***
1. Ripe fruits whitish; male inflorescence long, pendulous..... 1. ***M. nudiflorus***

1. Mallotus nudiflorus (L.) Kulju & Welzen, Blumea 52: 124. 2007. *Trewia nudiflora* L. Sp. Pl. 1193. 1753; FBI. 5: 423. 1887; FUGP. 2: 210. Repr. ed. 1960; Fl. Dudhwa Nat. Park 371. 1997.

Medium sized deciduous tree. Leaves ovate, acuminate, bright-green above, glabrous, rounded or cordate, 3-5 nerved. Male flowers pale- green, in pendulous racemes. Sepals valvate, concave. Female flowers solitary or 2-3 together, on long peduncles. Sepals 5, caducous, styles yellow. Fruits almost woody, globose, seeds smooth, dark-brown, polished. **Flowering and fruiting.** December-April. Found near villages and on roadsides, probably planted. Sweta 814.

2. Mallotus philippensis (Lamk.) Muell. - Arg. in Linnaea 34: 196.1865; FBI. 5: 442.1887; FUGP. 2: 210. Repr. ed. 1960; Fl. Rajasthan 2: 785.1991. *Croton philippense* Lamk. Encycl. 2: 206.1786.

Small, dioecious, evergreen trees with thin, dark-grey bark. Leaves 4.0-22.0 x 2.0-15.0 cm, alternate, ovate- lanceolate, acuminate, entire or slightly toothed, strongly 3-nerved. Flowers small, dioecious. Male flowers sessile, in clusters in erect terminal spikes. Sepals 4, lanceolate, acute. Female flowers solitary, in short spikes. Sepals 3-4. Capsule 3-lobed, 3-valved, covered with bright red powder consisting of resinous substance and minute stellate hairs. Seeds subglobose, smooth, black. **Flowering and fruiting.** December-March. **Local name.** *Senduria, Kamala, Rohni.* Occasionally found in *Kholas.*Sweta 322, 391.

Note: In Indian floras *Mallotus* and *Trewia* are treated as separate genera. I have followed WCSPF in this regard.

7. PHYLLANTHUS L.

Key to species:

1. Fruits fleshy indehiscent; shrubs or trees..... 2
1. Fruits dehiscent capsule; herbs..... 3
2. Ripe fruit purplis-red, 3-4 mm across;
straggling shrubs.....5. ***P. reticulatus***
2. Ripe fruits yellowish-green, 2.0 -2.5 cm
acroos; trees.....2. ***P. emblica***
3. Capsule echinate..... 4. ***P. urinaria***
3. Capsule smooth..... 4
4. Stipules peltate..... 5
4. Stipules simple, not peltate..... 6
5. Stipules red-brown, sagittate at base; leaves
linear-oblong, rounded at base..... 5. ***P. virgatus***
5. Stipules scarious, whitish; leaves obovate,
cuneate at base..... 3. ***P. maderaspatensis***
6. Leaves closely distichous, obtuse to rounded at apex;
style minute 2-lobed; disk of female flowers irregualrly
cup-shaped, with deep 6-9 crenulate-lacerate segments.....2. ***P. fraternus***
6. Leaves not imbricating, acute; styles 2, distinct, with
reflexed and recurved arms..... 1. ***P. debilis***

1. Phyllanthus debilis Klein ex Willd. Sp. Pl. 4: 582.1805; FBI. 5: 299.1887; Fl. Rajasthan 2: 787.1991.

Erect, glabrous, annual herbs with a woody base. Leaves 0.5-1.0 x 0.2-0.5 cm, ovate elliptic, acute, subacute, dark-green above. Stipules lanceolate, acuminate. Flowers axillary. Male flowers in fascicles. Perianth segments 5-6, subequal, 2-seriate. Stamens 3. Female flowers solitary, yellowish; perianth segments 6, obovate-spathulate, styles free. Capsule oblate, 0.2-0.3 cm across, smooth; seeds brown, longitudinally ribbed, transversely striate between the ribs on the back side. **Flowering and fruiting.** September- November. Found in cultivated fields, waste places and on roadsides. Sweta 216.

2. Phyllanthus emblica L. Sp. Pl. 982.1753; FBI. 5: 289.1887; FUGP. 2: 199. Repr. ed. 1960. *Emblica officinalis* Gaertn. Fruct. Sem. Pl. 2: 122.1790; Fl. Dudhwa Nat. Park 381. 1997.

Moderate sized, deciduous trees. Leaves pinnate; leaflets small, subsessile, 1.2-2.0 x 0.3-0.5 cm, linear, obtuse. Flowers yellow, in axillary fascicles; male flowers many, shortly

pedicelled, sepals 6, oblong, obtuse, anthers 3; female flowers few, subsessile. Ovary 3-celled. Fruits fleshy, globose, pale-yellow obscurely 6-lobed, breaking into three, 2 seeded, crustaceous cocci when dry. Seeds 6, trigonous. **Flowering.** March-May; **Fruiting.** Winter season. **Local name.** *Amla, Anwla.* Cultivated in the fruit orchards. Sweta 1424.

3. Phyllanthus fraternus Webster, Contr. Grey. Herb. 176: 53.1955; Fl. Rajasthan 2: 788.1991. *P. niruri auct. pl.* non L. 1753; FBI. 5: 298. 1887; FUGP. 2: 201. Repr. ed. 1960.

Erect, glabrous, somewhat glaucous, annual herbs with spreading branches. Leaves 0.5-1.8 x 0.3-1.0 cm, oblong, distichous, often overlapping. Flowers yellowish, axillary. Male flowers 1-3 together. Bracts subulate. Perianth segments 5, ovate-rounded. Stamens 3. Female solitary. Perianth segments oblong-spathulate. Capsule depressed globose, smooth. Seeds trigonous, pale-brown, longitudinally ribbed. **Flowering and fruiting.** July-November.**Local name**. *Jaramla.*Common in gardens, field, waste places and on roadsides. Sweta 1378.

4. Phyllanthus maderaspatensis L. Sp. Pl. 982. 1753; BI. 5:292. 1887; FUGP.2: 200. Repr. ed. 1960; Fl. Rajasthan 2: 789.1991.

Erect, glabrous, annual herbs with angular branches. Leaves 1.0-3.0 x 0.5-1.0 cm, oblong-obovate, distant, alternate, mucronate, short petioled. Stipules membranous, acute. Flowers axillary; male subsessile, minute, in small clusters; female solitary, stalked. Sepals 6, obovate, green, margined with white. Stamens 3. Filament connate. Styles 3, minute, free, 2-lobed. Capsule globose, 3-lobed, glabrous, seeds trigonous, muricated on fine lines, glabrous. **Flowering and fruiting.** August-October. **Local name.** *Bazarmain.* Common weed in gardens, cultivated fields and wastelands. Sweta 1442.

5. Phyllanthus reticulatus Poir. in Lamk. Encycl. 5: 298.1804; FBI. 5: 288.1887; FUGP. 2: 199. Repr. ed. 1960. *Kirganelia reticulata* (Poir.) Baill. Etud. Gen. Euphor. 614.1874; Fl. Rajasthan 2: 785.1991.

Large, glabrous, monoecious, straggling shrubs. Leaves 3.0-4.0 x 1.0-2.0 cm, oblong-elliptic, glabrous, acute. Stipules ovate, acute, sometimes bristle pointed. Flowers axillary, pinkish-white. Male flowers fascicled, stamens 5, the 3 inner connate, 2 outer free and shorter. Female flowers solitary, ovary 5-10 celled, styles 3, minute, 3-lobed. Fruits globose berry, smooth, dark-purple, or black. Seeds irregularly trigonous, glabrous, finely reticulate. **Flowering and fruiting.** April-July. **Local name.** *Makki, Neelbari.* Often found straggling amongst bushes and in hedges. Sweta 91, 141.

6. Phyllanthus urinaria L. Sp. Pl. 982.1753; FBI. 5: 293.1887; FUGP. 2: 200. Repr. ed. 1960; Fl. Rajasthan 2: 790.1991.

Erect or decumbent, annual herbs. Leaves 1.0-2.0 x 0.3-0.7 cm, oblong-obovate, cuneate, mucronate, dark-green above, pale beneath, oblique at the base. Stipules ovate, triangular, acuminate. Flowers axillary; male pedicellate, fascicled, sepals ovate-suborbicular to elliptic-oblong, obtuse. Stamens 3. Female flowers sessile, solitary sepals 5-6, ovate-oblong, obtuse. Style arms recurved. Capsule globose, densely warty, bright red in colour. Seeds transversely ribbed, greenish brown. **Flowering and fruiting.** After the rainy season. Common weed in cultivated fields, gardens, wastelands etc. Sweta 214, 280.

7. **Phyllanthus virgatus** Forst. Fl. Insul. Austr. Prodr. 65.1786; Fl. Rajasthan 2: 790.1991. *P. simplex* Retz. Obs. Bot. 5: 29.1788; FBI. 5: 295.1887; FUGP. 2: 200. Repr. ed. 1960.

Erect or decumbent, ascending, perennial herbs. Leaves 1.0-3.0 x 0.3-0.6 mm, elliptic lanceolate to oblong, obtuse, entire, glabrous. Stipules ovate triangular, acute. Flowers pedicellate, solitary, axillary. Male flowers solitary; perianth segments 5-7, oblong. Stamens 3. Filaments free. Female flowers solitary; perianth segments 5-6, ovate oblong, obtuse. Style 2-fid. Disc cup-shaped, glandular. Capsule globose, warty, obscurely 3-lobed. Seeds minute, 3-gonous, brown. **Flowering and fruiting.** August-December. Common in grassy localities and cultivated fields. Sweta 1470.

Note: According to WCSPF the genus *Phyllanthus* belongs to family Phyllanthaceae.

8. **RICINUS** L.

Ricinus communis L. Sp. Pl. 1007. 1753; FBI. 5: 457. 1887; FUGP. 2: 212.Repr. ed. 1960; Fl. Rajasthan 2: 791.1991.

Large, erect glabrous, monoecious, annual or perennial shrubby herbs. Leaves 10-30 cm in diam., palmately 5-7 lobed, alternate, long-petioled. Flowers in pyramidal, terminal or leaf opposed panicles. Male flowers pedicellate, perianth segments 5, unequal, ovate-lanceolate, acute, glandular. Female flowers sessile, solitary, perianth spathaceous or 2-3 lobed, caducous. Capsules subglobose, covered with soft spines. Seeds oblong-ovoid, smooth, mottled, caruncled.**Flowering and fruiting.** Almost throughout the year. **Local name.** *Arandi.* Common in waste places and roadsides. Also cultivated for ornamental purpose. Two forms of this taxon are met with in the study area, one with red fruits the other with green. Sweta 1479.

9. **TRIADICA**

Triadica sebifera (L.) Small, Florida Trees: 59. 1913; World Checklist of Selected Plant Families. (2009). The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ accessed May 23, 2009 at 12.45 pm IST. *Croton sebiferum* L., Sp. Pl.: 1004. 1753.

A small, deciduous tree with a dense crown of foliage. Leaves broad rhomboid, acuminate, base deltoid. Included on authority of Murty and Singh (1961b).

WCSPF citation:

Govaerts R, Barker C, Carter S, Davies S, Esser H.-J., Gilbert M, Hoffman P, Radcliffe-Smith A, Steinman V, van Welzen P & Whitmoore T (2009) World Checklist of Euphorbiaceae. The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ accessed 15 May 2009; 08. 55 pm IST.

92. ULMACEAE

HOLOPTELEA Planch.

Holoptelea integrifolia (Roxb.) Planch. in Ann. Sci. Nat. Bot. ser. 3. 10: 269. 1848; FBI. 5: 481.1888; FUGP. 2: 217. Repr. ed. 1960; Fl. Rajasthan 2: 796. 1991. *Ulmus integrifolia* Roxb. Pl. Cor. 1: 56. t. 78. 1796-98.

Large spreading, deciduous, almost glabrous trees. Leaves broadly elliptic-ovate, acuminate, entire, subcordate, entire or distantly toothed. Flowers purplish-green. Perianth pubescent, segments 4-5 partite, connate basally. Stamens 5-7, anthers hairy. Ovary shortly-stalked, glabrous, elliptic, compressed, margined, styles 2. Samara broadly elliptic, notched at apex, flat, winged. Seeds ovate-oblong. **Flowering and fruiting:** February-May. **Local Name:** *Chilbil, Papri.* Planted along the road side. Sweta 727.

93. MORACEAE

KEY TO GENERA:

1. Flowers arranged in globose heads or inside fleshy receptacles..... 2
1. Flowers arranged in spikes or heads..... 3
2. Flowers arranged on the outside of the recepatacle..... 1. ***Artocarpus***
2. Flowers arranged on the inside of the recepatacle..... 3. ***Ficus***
3. Male flowers spicate; perianth fleshy in fruits..... 4
3. Male flowers in heads or spikes; female flowers solitary or 2-3 together; perianth not fleshy in fruits..... 5. ***Streblus***
4. Style undivided..... 2. ***Broussonetia***
4. Style 2-fid..... 4. ***Morus***

1. ARTOCARPUS J. & G. Forst. *nom. cons.*

Key to species:

1. Fruit subglobose, smooth, velvety..... 2. ***A. lakoocha***
1. Flowers cylindric, tubercled..... 1. ***A. heterophylla***

1. Artocarpus heterophyllus Lamk. Encycl. 3: 209. 1789; Fl. Rajasthan 2: 806. 1991; Fl. Dudhwa Nat. Park 388. 1997. *A. integrifolia* auct. (non L. f. 1781); FBI. 5: 541. 1888; FUGP. 2: 235. Repr. ed. 1960.

Large, evergreen trees. Leaves elliptic or obovate, up to 20.0 cm long, coriaceous, glabrous; stipules large caducous. Flowers on main trunk or older woody branches. Fruits cylindric, oblong, up to 45.0 cm long, covered with thick conical tubercles and with sticky latex. **Flowering and fruiting:** February-November. **Local name:** *Kathal.* Often planted for the sake of fruits which are used as vegetable and sold in market. Sweta 1799.

2. Artocarpus lakoocha Roxb. Fl. Ind. 3: 524. 1832; FBI. 5: 543. 1888; FUGP. 2: 234. Repr. ed. 1960; Fl. Rajasthan 2: 806. 1991; Fl. Dudhwa Nat. Park 388. 1997.

Large deciduous trees, up to 15.0 m tall. Leaves subcoriaceous, up to 20.0 cm long, oblong or elliptic, entire or serrate; dark-green, glabrous, shining. Stipules lanceolate, caducous. Flowers in axillary, globose, shortly stalked heads, sepals 2-3, truncate, stamen 1. Fruit clusters up to 6.0 cm in diam., lobulate, smooth, velvety, orange-yellow when ripe, mature fruits sweet-acid. **Flowering and fruiting:** March-October. **Local name:** *Barhal.* Often planted in gardens for the sake of edible fruits. Sweta 1486.

2. BROUSSONETIA L' Herit ex Vent.

Broussonetia papyrifera (L.) Vent. Tabl. Reg. Veg. 3: 547. 1794; FBI. 5: 490. 1888; FUGP. 2: 250. Repr. ed. 1960; Fl. Rajasthan 2: 806. 1991. *Morus papyrifera* L. Sp. Pl. 2: 986. 1753.

Small or medium sized trees with smooth, grey bark. Leaves ovate, acuminate, base oblique, crenate, scabrous, up to 20.0 x 10.0 cm. **Flowers and fruits:** Not seen. Included on authority of Murty and Singh (1961b).

3. FICUS L.

Key to species:

1. Receptacles sessile..... 2
1. Receptcles stalked..... 3
2. Leaves pubescent beneath; apex rounded..... 1. ***F. beghalensis***
2. Leaves glabrous; apex caudate- cuspidate..... 4. ***F. religiosa***
3. Stamen 1..... 4
3. Stamens 2-3..... 5
4. Receptacles in clusters on leafless branches; leaves scabrous, base unequal..... 5. ***F. semicordata***
4. Receptacles paired, axillary; leaves glabrous, base

rounded..... 6. ***F. virens var. virens***

5. Leaves scabrous, crenate-serrate; receptcles on normal branches..... 2. ***F. palmata***

5. Leaves glabrous, entire; receptacles on short leafless branches..... 3. ***F. racemosa***

1. Ficus benghalensis L. Sp. Pl. 1059.1753; FBI. 5: 499.1888; FUGP. 2: 238. Repr. ed. 1960; Fl. Rajasthan 2: 801.1991. *Urostigma benghalense* (L.) Gasp. Nov. Gen. Fic. 7.1844.

Large, evergreen trees. Branches horizontally spreading, producing a succession of stout aerial roots. Leaves 5.0-20.0 x 5.0-15.0 cm, ovate-oblong, obtuse, entire, thinly coriaceous, rounded at base; stipules coriaceous, red. Receptacles sessile, axillary, globose, silky pubescent, red. Male flowers many, sepals 4, lanceolate. Stamens 1. Gall flowers perianth as in male flowers. Fertile flowers perianth shorter than male, elongated styles. **Flowering and fruiting.** Almost throughout the year. **Local name.** *Bargad.* Appears spontaneously on tombs or old buildings and also as an epiphyte on the stem of various trees. Also planted by Hindus near villages and in the vicinity of their temples. Sweta 1398.

2. Ficus palmata Forsk. Fl. Aegypt.-Arab. 179. 1775; FBI. 5: 530. 1888; FUGP. 2: 247. Repr. ed. 1960; Fl. Dudhwa Nat. Park 393. 1997.

Medium sized to large shrubs. Bark smooth dull grey. Leaves 5.0-15.0 x 4.0-10.0 cm, orbicular-ovate, palmilobed, acute, dentate-serrate. Receptacle axillary, solitary, subglobose or pyriform, stalked, pubescent. Bracts acute, ovate, deciduous. Male flowers on hairy pedicels, sepals 4-5, lanceolate hairy. Gall flowers shortly stalked, perianth deeply 5-fid. Female flowers: ovary ovoid, smooth, style short, stigma dilated. Achenes trigonous, granular. **Flowering and fruiting.** March-July. **Local name.** *Jangli Anjir.* Commonly found on roadsides and boundaries of the fields and orchards. Sweta 1375.

3. Ficus racemosa L. Sp. Pl. 1060.1753; Fl. Rajasthan 2: 804.1991. *F. glomerata* Roxb. Pl. Cor. 2: 13. t.123.1798; FBI. 5: 535. 1888; FUGP. 2: 248. .Repr. ed. 1960.

Tall evergreen trees with few, short, aerial roots and ash-grey bark. Leaves membranous, 5.0-15.0 x 2.0-8.0 cm, ovate, oblong or elliptic-lanceolate, subacute, entire. Receptacles ovoid, subglobose, smooth or downy, reddish when ripe, on short, thick, scaly, tubercled, leafless branchlets. Male flowers sessile; sepals 3-4, membranous, inflated. Stamens 2. Gall flowers stalked; sepals irregularly toothed, gamophyllous; style lateral, elongated, stigma clavate. Fertile flowers nearly sessile; sepals gamophyllous, lanceolate teeth. Style subterminal; stigma clavate. **Flowering and fruiting.** Throughout the year. **Local name.** *Gular.* Planted in villages. Sweta 1386.

4. Ficus religiosa L. Sp. Pl. 1059.1753; FBI. 5: 513.1888; FUGP. 2: 241. Repr. ed. 1960; Fl. Rajasthan 2: 804.1991. *Urostigma religiosum* (L.) Gasp. Ric. Caprif. 82. t. 7. f.1-5.1845.

Large, deciduous, glabrous trees. Leaves 7.0-20.0 x 6.0-12.0 cm ovate, long petioled, shining, apex, long caudate-acuminate, cordate, 5-7 nerved. Receptacles paired, axillary, sessile, smooth, spherical, reddish purple when ripe. Male flowers few sessile; sepals 3, broadly ovate. Stamen 1, filament short. Gall flowers: sepals 3. Fertile flowers: speals 5, lanceolate. **Flowering and fruiting.** Throughout the year. **Local name.** *Pipal.* Commonly planted in villages and in the vicinity of Hindu temples. Also on the walls of old buildings and as epiphyte on *Phoenix sylvestris* (L.) Roxb. Sweta 1469.

5. Ficus semicordata Buch.- Ham. ex J. E. Smith in in A. Rees, Cyclop., 14: Ficus n. 71. 1810. ; Fl. Dudhwa Nat. Park 392. 1997. *F. cunia* Buch.-Ham. ex Roxb. Fl. Ind. 3: 561. 1832; FBI. 5: 523. 1888; FUGP. 2: 246. Repr. ed. 1960.

Medium sized trees. Leaves alternate, petioled, entire, acute, base semi-cordate, surface very scabrous. Receptacles shortly peduncled, paniculate on special, drooping branches, pyriform, hispid, reddish-brown and ribbed when ripe; basal bracts 3. **Flowering and fruiting:** February-September. Khan (1987) reported this taxon from a nearby place, Balawali, situated on the bank of Ganga. Therefore, the occurrence of this taxon in Hastinapur Wildlife sanctuary can not be ruled out.

6. Ficus virens Ait. Hort. Kew. 3: 451.1789. Fl. Rajasthan 2: 805.1991. *F. infectoria sensu* Roxb. Fl. Ind. 3: 551.1832; non Willd. 1806; FBI. 5: 515.1888; FUGP. 2: 243. Repr. ed. 1960.

var. **virens.**

Large, spreading, deciduous, fast growing trees. Bark smooth, greenish grey. Leaves 5.0-10.0 x 2.0-5.0 cm membranous. ovate-oblong, acuminate, entire, slightly cordate, acute, 3-nerved. Stipules broadly ovate, acute, pubescent. Receptacles in axillary pairs, globose, creamy-white. Male flowers, few sessile; sepals 4-5. Stamen 1. Gall flowers style short. Female flowers long; stigma elongated. Achenes smooth. **Flowering and fruiting.** October-June. **Local name.** *Pilkhan.* Occasionally met with near villages, probably planted. Sweta 1494.

4. MORUS L.

Morus alba L. Sp. Pl. 986.1753; FBI. 5: 492. 1888; FUGP. 2: 231.Repr. ed. 1960; Dicot. Pl. Uttar Pradesh 344. 1999.

Medium sized, deciduous trees. Leaves 5.0-15.0 cm long, ovate, acute, serrate or dentate, cordate, often lobed. Flowers in short ovoid spikes. Female flower sepals 4, two inner ones

flat, outer ones keeled. Style free. Fruiting spikes white or red, sweet. **Flowering and fruiting.** Summer season. **Local name.** *Shetut.* Commonly found on roadsides and near villages. Sweta 778.

5. STREBLUS Lour.

Streblus asper Lour. Fl. Cochinch. 2: 615.1790; FUGP. 2: 232.Repr. ed. 1960; Dicot. Pl. Uttar Pradesh 344. 1999.

Small, evergreen trees. Leaves elliptic or rhomboid, acuminate, toothed, rough. Stipules oblique, lanceolate. Flowers dioecious. Male flowers shortly stalked. Sepals hairy outside. Female flowers solitary, on slender axillary pedicels. Fruits subglobose, 1-seeded, yellow when ripe. **Flowering and fruiting.** January-July. **Local name.** *Sihora.*Common along river banks and in hedges near villages. Sweta 1483.

Murty and Singh (1961b) reported *Morus australis* Poir. and *M. macroura* Miq. from this area.

94. CANNABINACEAE

CANNABIS L.

Cannabis sativa L. Sp. Pl.1027.1753; FBI. 5: 487.1888; FUGP. 2: 220. Repr. ed. 1960; Fl.Rajasthan 2: 797.1991.

Erect, dioecious, aromatic, annual herbs. Leaves 3-6 foliate, petiolate; leaflets lanceolate, serrate. Stipules filiform. Flowers greenish-white. Male ones in short, terminal panicles, perianth lobes 5. Stamens 5, antipetalous, filmnents filiform. Female ones enclosed by prominent, gland-pubescent bracts; ovary 1-celled, style 1. Fruits about 4.0 mm long, compressed, brownish yellow. Seeds light brown. **Flowering and fruiting:** January-October. Commonly found in wastelands and along roadsides.**Local name:** *Bhang.* Sweta 1393.

95. URTICACEAE

POUZOLZIA Gaud.

Key to species:

1. Flowers in terminal bracteate spikes; stamens 5..... 1. ***P. pentandra***

1. Flowers in axillary clusters; stamens 4..... 2. ***P. zeylanica***

1. Pouzolzia pentandra (Roxb.) Benn. Pl. Jav. Rar. 64. t.14. 1838; FBI. 5: 583.1888; FUGP. 2: 227. Repr. ed. 1960; Fl. Rajasthan 2: 811.1991. *Urtica pentandra* Roxb. Fl. Ind. 3: 583.1832.

Medium sized, erect-decumbent, glabrous perennial herbs with 4-angled stem. Leaves 2.0-8.0 x 0.5-2.5 cm, sessile or shortly stalked, lower ones opposite, oblong-linear-lanceolate, acute to acuminate, strongly 3-nerved ciliate. Upper ones smaller, alternate, linear-oblong, acuminate, cordate. Flowers in axillary clusters, greenish-white; male flowers stalked. Perianth 5-partite, lancoelate-oblong, stamens 5; female flowers sessile. Fruiting perianth with 2 broad, semiorbicular wings and 1 shorter wing. Achenes ovoid, acute, enclosed in persistent calyx, polished, black.**Flowering and fruiting.** October-January. Occasionally found on the riverbank and wet and shady habitats. Sweta 41, 197.

2. Pouzolzia zeylanica (L.) Benn. Pl. Jav. Rar. 67. 1838; Fl. Rajasthan 2: 811.1991. *Parietaria zeylanica* L. Sp. Pl. 1052. 1753. *P. indica* L. Mant. Pl. 1: 128. 1767. *Pouzolzia indica* (L.) Gaud. Freyc. Voy. Bot. 503. 1826; FBI. 5: 581. 1888; FUGP. 2: 226. Repr. ed. 1960

A perennial, strigose, erect or ascending herbs. Leaves opposite, ovate, acute or acuminate, entire, base acute or rounded, lateral nerves one pair above the three basal ones. Sepals of male flowers dorsally rounded, acute; those of female flowers tubular perisitent, ribbed, bifid at apex. Achene broadly ovoid, shining. **Flowering and fruiting:** September-December. Occasionally found among tall grasses on the margins of ponds and streams. Sweta 1472.

96. CASUARINACEAE

CASUARINA L.

Casuarina equisetifolia L. Amoen. Acad. 4: 143. 1759 *'equisefolia'*; FBI. 5: 598. 1888; FUGP. 2: 250. Repr. ed. 1960; Fl. Rajasthan 2: 812. 1991. *C. muricata* Roxb. Fl. Ind. 3: 519. 1832.

Evergreen, handsome, leafless trees with drooping branches. Leaves highly reduced, minute, scaly, 6-9, whorled , basally connate. Male flowers in spikes on lateral branches. Stamen1, purplish. Female flowers in ovoid heads. Ovary 2-celled, ovules 2, style red, bifid. Fruit an apically winged samara. **Flowering and fruiting:** April-September. Often planted on roadsides and in wastelands.Sweta 1394.

97. SALICACEAE

SALIX L.

Salix tetrasperma Roxb. Pl. Cor. 1: 66. t. 97. 1798 *et* Fl. India 3: 753. 1832; FBI. 5: 626. 1888; FUGP. 2: 253. Repr. ed. 1960; Fl. Rajasthan 2: 814. 1991.

Medium sized to large, branched, deciduous trees, up to 5.0 m tall. Leaves 3.0-9.0 x 1.5-2.5 cm, ovate-lanceolate or elliptic-lanceolate, serrate, membranous, acuminate. Flowers unisexual; male ones sessile, yellowish, scented, stamens 5-10. Female inflorescence up to 10.0 cm long, flowers pedicellate. Capsule glabrous, long stalked, puberulous, dark-brown when mature. Seeds 4-6, cottony. **Flowering and fruiting:** October-March. Found frequently in swampy areas an on banks of Ganga. Sweta 729, 732.

98. CERATOPHYLLACEAE

CERATOPHYLLUM L.

Ceratophyllum demersum L. Sp. Pl. 992.1753; FBI. 5: 639. 1888; FUGP. 2: 255. Repr. ed. 1960; Fl. Rajasthan 2: 814.1991.

Submerged, rootless, rough, aquatic herbs. Leaves dichotomously forked, usually 5-10 in a whorl, minutely toothed. Flowers minute, sessile, axillary, solitary, unisexual. Male flowers: perianth segments 10-12, 2-fid, stamens 10-20. Female flowers: ovary sessile, 1-celled, style 1, stigma 1 with a lateral pouch. Achene ellipsoid, with persistent, subulate style and subtended by 2 basal spines. **Flowering & Fruiting:** September-November. Common in ponds, ditches and in stagnant water near banks of the river Ganga. Sweta 1420.

99. HYDROCHARITACEAE

KEY TO GENERA:

1. Leaves all radical, ribbon-like; female flowers long pedicelled which coil after fertilization..... 3. ***Vallisneria***
1. Leaves radical or cauline; pedicel of female flowers not as above.....2
2. Leaves radical, long petioled, ovate-cordate with prominent nerves; spathe winged.....2. ***Ottelia***
2. Leaves cauline, whorled; spathe not winged..... 1. ***Hydrilla***

1. HYDRILLA L.C.Rich

Hydrilla verticillata (L. f.) Royle, Ill. Bot. Himal. t. 376.1839; FBI. 5: 659. 1888; FUGP. 2: 262. Repr. ed. 1960; Fl. Rajasthan 2: 816.1991. *Serpicula verticillata* L. f. Suppl. 416.1781. *Vallisneria verticillata* (L. f.) Roxb. Fl. India 3: 751.1832.

Slender, leafy, submerged, fresh water herbs forming large masses. Leaves in whorls of 3-8, oblong or linear, serrate-dentate. Flowers unisexual, white or reddish, minute, solitary. Male flowers pedicellate; female flowers sessile. Perianth of 3 sepals and 3 petals. Stamens 3.

Fruits softly echinate. Seeds dark-brown. **Flowering and fruiting :** September-November. Common in ditches, ponds and tanks. Sweta 339.

2. OTTELIA Pers.

Ottelia alismoides (L.) Pers. Syn. Pl. 1: 400.1805; FBI. 5: 662.1888; FUGP. 2: 265. Repr. ed. 1960; Fl. Rajasthan 2: 818.1991. *Stratiotes alismoides* L. Sp. Pl. 535.1753.

Submerged, aquatic, large, rooted herbs. Leaves ovate-reniform, acute, undulating margins, many-nerved, base cordate or truncate, obtuse or rounded. Flowers white solitary-axillary, bisexual. Spathe tubular, 2-10 winged, margins wavy. Sepals linear, oblong green. Petals obovate, white with yellow-blotched base. Stamens 6-8. Ovary beaked; styles 5-10, stigmas fimbriate. Fruits oblong-ellipsoidal, crowned with sepals. Seeds oblong or fusiform. **Flowering and fruiting:** March-December. Common in ponds, ditches and in shallow water near margins of Ganga. Sweta 345.

3. VALLISNERIA L.

Vallisneria spiralis L. Sp. Pl. 1015.1753; FBI. 5: 660.1888; FUGP. 2: 263. Repr. ed. 1960; Fl. Rajasthan 2: 818. 1991.

Submerged, tufted, dioecious, rooted, perennial herbs. Leaves radical, linear, ribbon like, base sheathing, serrate, erect. Female flowers solitary on long flexuous or spiral, leafless scape coiled after pollination. Male flowers minute, short stalked, enclosed in a 3-lobed spathe. Petals 3, minute. Staminodes 3, bifid. Fruits up to 1.5 cm long, linear. Seeds oblong-fusiform, embedded in a gelatinous mass. **Flowering and fruiting:** August-October. Found frequently at the bottom of ponds and ditches. Plants growing in slow running water are longer and prostrate. Sweta 664.

100. ORCHIDACEAE

KEY TO GENERA:

1. Flowers distinctly pedicelled, lip spurred and
   with pink margins..... 1. ***Eulophia***
1. Flowers subsessile; lip not spurred, saccate, white.....2. ***Zeuxine***

1. EULOPHIA R. Br. *nom. cons.*

Eulophia dabia (D. Don) Hochr. Bull. N. Y. Bot. Gard. 6: 270. 1910; Som Deva & Naithani in Orchid Fl. N. W. Himalayas 385. 1986. *Bletia dabia* D. Don Prodr. Fl. Nepal 30. 1825. *Eulophia campestris* Wall. (Cat. n. 7617. 1832, *nom. nud.)* ex Lindl. Gen. Sp. Orch. 185. 1833; FBI. 6: 4. 1890; FUGP. 2: 281. Repr. ed. 1960.

Erect, terrestrial orchids. Leaves 2 arising from the pseudostem after flowering, up to 30.0 cm long, linear, acuminate. Racemes lax, subsecund, up to 15.0 cm long; scape sheathed with loose, membranous bracts. Flowers pale-pink with purple tinge. Bracts linear or lanceoalte, acuminate, usually longer than the ovary. Sepals linear-lanceoalte, acute or acuminate, 5-nerved, with a prominent midrib. Lip as long as sepals, oblong. Spur short, conical, subacute. Capsule oblong-obovate. **Flowering and fruiting.** May-August. Occasionally occurs among grasses in moist, humus rich soil. Sweta 772.

2. ZEUXINE Lindl. *nom. cons.*

Zeuxine strateumatica (L.) Schlecht. in Engl. Bot. Jahrb, 45: 394. 1911; Som Deva & Naithani in Orchid Fl. N. W. Himalayas 99. 1986; Fl. Rajasthan 2: 825. 1991. *Orchis strateumatica* L. Sp. Pl. 943. 1753. *Zeuxine sulcata* Lindl. Gen. Sp. Orch. 485. 1840; FBI. 6: 106. 1890; FUGP. 2: 298. Repr. ed. 1960.

Glabrous, fleshy, erect herbs, up to 25.0 cm high. Leaves linear, acuminate, sessile. Inflorescence a compact, erect spike. Bracts ovate-lanceoalte, acuminate, 2 auricled. Sepals subequal, odd one ovate, obtuse; lateral ones ovate-lanceolate. Petals falcate- lanceolate to oblong, obtuse, white. Lip panduriform, obtuse or shallowly notched. Ovary sessile, ovoid-tumid, ribbed. Capsule ovoid, beaked, ribbed. **Flowering and fruiting:** January-June. Common in swampy areas. Sweta 689.

Rhynchostylis retusa (L.) Bl. was seen growing in some nurseries.

WCSPF citation:

Govaerts R, Campacci M A, Holland Baptista D, Cribb P, George A, Kreuz K & Wood J (2009) World Checklist of Orchidaceae. The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ accessed 14 May 2009; 10. 42 pm IST. (Names of reviewers were not availbale).

101. MUSACEAE

MUSA L.

Musa paradisiaca L. Sp. Pl. 1043. 1753; Fl. Rajasthan 2: 829. 1991. *M. sapientum* L. Syst. Nat. ed. 10.1303.1759; FBI. 6: 262.1892; FUGP. 2: 312. Repr. ed. 1960.

Stoloniferous, tree like herbs, 1.5-3.0 m tall. Leaves 1.5-2.0 x 18.0-45.0 cm, spirally arranged, oblong, erect or ascending, entire. Flowers yellow in drooping spikes. Upper ones male, lower ones female. Bracts many flowered, deciduous, spathaceous, ovate, dark-red. Berries oblong, yellowish-green, trigonous, pulp soft, sweet, edible. **Flowering and fruiting:** Almost throughout the year. **Local name:** *Kela*. Planted in gardens and orchards for edible fruits. Sweta 1430.

102. ZINGIBERACEAE

KEY TO GENERA:

1. Inflorescence compact; low herbs..... 1
2. Inflorescence lax; filaments long; anther cells divergent
   at apex; stigma subglobose; large shrubs..... 1. ***Alpinia***
2. Lateral staminodes well developed and broad; rhizome
   orange inside.....2. ***Curcuma***
2. Lateral staminodes none or minute; rhizome not
   orange inside.....3. ***Zingiber***

1. ALPINIA Roxb.

Alpinia zerumbet (Pers.) B.L.Burtt & R.M.Sm., Notes Roy. Bot. Gard. Edinburgh 31: 204 (1972). *Costus zerumbet* Pers., Syn. Pl. 1: 3 (1805). *Catimbium speciosum* (Wendl.) Holttum Gard. Bull. 13: 152. 1950. *Zerumbet speciosum* Wendl. Sert. Hanov. 4: 3. t.19. 1798. *Alpinia nutans* Roscoe in Sm. Exot. Bot. 2: 93. t.106. 1805; FBI. 6: 256. 1892. *Alpinia speciosa* (Wendl.) K. Schum. Fl. Kaiser-Wilhelmsl. 29. 1887 & in Bot. Jahrb. 15: 418. 1893; Man. Cult. Pl. 289. 1949; Fl. Delhi 333.1963.

Erect, perennial, aromatic, herbs, root stock rhizomatous. Leaves 60.0 x10.0 cm, oblong-lanceolate, cuneate, acute, glabrous, shining. Flowers white, drooping, rosy or purplish, fragrant. Bracts large, white, pinkish at tip. Calyx cylindric, 3-toothed. Corolla lip deeply 3-lobed. Stamen 1, white. Staminodes 2. **Flowering and fruiting.** March-June. **Local name.** *Elaichi*. Planted as an ornamental. Sweta 1407.

2. CURCUMA L.

Curcuma longa L. Sp. Pl. 2. 1753; FBI. 6: 214. 1890; FUGP. 2: 309. Repr. ed. 1960; HFDD. 501. 1977.

Erect herbs. Rootstock rhizomatous, ovoid, sessile cylindric, orange inside. Leaves very large, oblong-lanceolate, tapering base. **Flowering and fruiting:** Not seen. **Local name.** *Haldi.* Cultivated for the sake of rhizomes which are extensively used in cooking and in medicines. Sweta 1491.

3. ZINGIBER Boehm., *nom.cons.*

Zingiber officinale Roscoe Trans. Linn. Soc. Lond. 8: 348. 1807; FBI. 6: 246. 1892; FUGP.2: 310. Repr. ed. 1960; HFDD. 504.1977

Erect, perennial herbs with horizontal, jointed, tuberous rhizomes. Leaves 10.0-35.0 cm long, subsessile, lancoelate, glabrous beneath, attenuate base, acuminate. Ligule glabrous. Sheath

glabrous. **Flowering and fruiting:** Not seen. **Local name.** *Adrak.* Locally cultivated in gardens for rhizomes. Sweta 1466.

Govaerts R & Lock J M (2009) World Checklist of Zingiberaceae. The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ accessed 22 May 2009; 08. 45 pm IST.

103. CANNACEAE

CANNA L.

Canna indica L. Sp. Pl. 1.1753; FBI.6: 260.1892; FUGP. 2: 311.Repr. ed. 1960; Fl. Rajasthan 2: 829.1991.

Erect, perennial herbs. Pseudo-stems leafy. Leaves 35.0-40.0 x 10.0-15.0 cm, subsessile, oblong, acuminate, elliptic-lanceolate, entire. Flowers scarlet or yellow, zygomorphic, distant in terminal panicles, erect, sessile. Bracts rounded suborbicular. Bracteoles ovate-oblong, red, lanceolate-oblong. Corolla oblong-oblanceolate, acute. Staminodes 5. Capsule 3-gonous, red, muricate, 1.5-2.0 x 2.0 cm. **Flowering and fruiting.** August-December. Widely cultivated as an ornamental herb; often occurs as escape on margins of water bodies and water channels. Sweta 1485.

104. AMARYLLIDACEAE

KEY TO GENERA:

1. Peduncle fistular in the upper part; leaves about
   0.5 cm broad..... 2. ***Zephyranthes***
1. Peduncle solid; leaves 5.0 cm or more in breadth..... 1. ***Crinum***

1. CRINUM L.

Crinum asiaticum L. Sp. Pl. 292. 1753; FBI. 6: 280. 1892; FUGP. 2: 320. Repr. ed. 1960; Fl. Rajasthan 2: 831.1991.

Stout, perennial herbs. Leaves 50.0-90.0 x 2.5-6.0 cm, erect, linear-oblong, concave, channelled, large and entire. Flowers white in terminal umbels. Bracts 2. Perianth tube straight; lobes 6, linear-lanceolate, spreading. Filaments free. Anthers linear. Fruits subglobose or ovoid. **Flowering and fruiting.** August-December. Commonly cultivated as an ornamental plant. Sweta 1527.

2. ZEPHYRANTHES Herb.

Zephyranthes grandiflora Lindl. Bot. Reg. 11. t. 902. 1825; Man. Cult. Pl. 254. 1949; HFDD. 511. 1977. *Z. rosea* auct. pl. Hort. non Lindl. 1825. *Z. carinata* Herb. Bot. Mag. t. 2594. 1825.

Scapigerous, erect, perennial herbs. Leaves in basal rosettes, linear-lanceolate. Scape fistular, one flowered. Corolla purple or pink. Capsule three lobed. **Flowering and fruiting.** Rainy season. Cultivated in gardens as an ornamental. Sweta 1509.

105. AGAVACEAE

AGAVE L.

Agave wightii Drumm. & Prain in Bengal Agricul. Bull. 8: 15. 1906; FUGP. 2: 317. Repr. ed. 1960; Fl. Rajasthan 2: 833. 1991.

Perennial, stout, erect herbs. Leaves linear-lanceolate, margins spinous, spines dark-brown, erecto-patent, apex sharply spine tipped. Flowers on tall columnar scape, in pyramidal panicles, often replaced by bulbils. Perinath-lobes 6, lanceolate, obtuse. Stamens 6. Fruits not seen. **Flowering and fruiting:** March-July. Often planted on margins of orchards. Sweta 1390.

106. DIOSCOREACEAE

DIOSCOREA L.

Dioscorea bulbifera L. Sp. Pl. 1033.1753; FUGP. 2: 324. Repr. ed. 1960; Fl. Rajasthan 2: 836. 1991. *D. sativa* Thunb. Fl. Jap. 151.1784 non L. 1753; FBI. 6: 295.1892.

Twining, dioecious, glabrous, perennial, tuberous herbs. Leaves 15-20 x 10-20 cm, alternate, broadly ovate, cordate, acuminate, 7-13 nerved at the base, often with axillary bulbils. Male flowers fragrant, white-purple. Bracts ovate, acuminate. Stamens 6. Female flowers in axillary, solitary or fascicled, pendulous spikes. Perianth lobes linear. Staminodes 6. Style conical, stigma 3, recurved. Capsule winged, oblong, reflexed, straw coloured. **Flowering and fruiting.** August-December. **Local name.** *Ratalu.* Common in waste lands among bushes, hedge. Cultivated for the sake of tubers which are used as vegetable. Sweta 1397.

107. LILIACEAE

KEY TO GENERA:

1. Climbers..... 2
1. Erect herbs with radical, fistular leaves..... 2. ***Asphodelus***
2. Leaves minute without tendrilar apex; flowers white, in racemes..... 1. ***Asparagus***
2. Leaves well developed, apices modified into tendrils; flowers solitary axillary, orange-yellow or scarlet..... 3. ***Gloriosa***

1. ASPARAGUS L.

Asparagus racemosus Willd. Sp. Pl. 2: 152. 1799; FBI. 6: 316.1892; FUGP. 2: 327. Repr. ed. 1960; Fl. Rajasthan 2: 841.1991.

Tall, much branched, scandent, spinous undershrubs. Cladodes in axillary whorls of 2-6, falcate, acuminate. Flowers white, in axillary, solitary, simple or branched racemes. Bracts triangular. Anthers minute, purplish. Style shortly 3-fid. Berries red, nearly globose, 1-3 seeded. **Flowering and fruiting.** March. **Local name.** *Satawar.* Found climbing on bushes in *Kholas*. Cultivated in gardens as an ornamental plant. Sweta 320.

Note: According to WCSPF this taxon blongs to family Asparagaceae.

2. ASPHODELUS L.

Asphodelus tenuifolius Cav. in Anal. Cienc. Nat. 3: 46. t. 27. f. 2.1801; FBI. 6: 332.1892, excl. syn. *A. fistulosus* L. 1753; FUGP. 2: 333. Repr. ed. 1960; Fl. Rajasthan 2: 841.1991.

Erect, annual herbs with a short root stock and scapose, leafless stem. Leaves in a rosette, 10.0-35.0 x 0.2-0.3 cm, acute, sheathing at base, erect, ribbed. Flowers white or pinkish, laxly racemose, scapes solid. Bracts broadly ovate, boat-shaped, brownish keeled. Perianth whitish-brown, lanceolate oblong, segments oblong, obtuse and with amedian dark brown keel. Capsule globose, 3-gonous, 3-valved. Seeds 2 in each locule, obovoid, rugose, black. **Flowering and fruiting.** May. **Local name.** *Piazi.*Common weed during winter season in agricultural fields. Sweta 1556.

Note: According to WCSPF this taxon blongs to family Xanthorrhoeaceae.

3. GLORIOSA L.

Gloriosa superba L. Sp. Pl. 305. 1753; FBI. 6: 358.1892; FUGP. 2: 330. Repr. ed. 1960; Fl. Rajasthan 3: 844.1991.

Tall, branched, climbing herbs, with leaf apices modified into tendrils. Leaves 5.0-15.0 x 2.0-5.0 cm, sessile, alternate, opposite, ovate-lanceolate, cordate. Flowers axillary, solitary, deflexed. Tepals lanceolate, yellow spotted with red, acuminate, crispy-undulate margins. Filaments golden yellow. Anthers dorsiflexed. Style 3-fid, deflexed. Capsule linear-oblong, septicidal. Seeds many, subglobose, black. **Flowering and fruiting.** August-November. **Local name.** *Lalukhri, languli.* Found in *Kholas* climbing on shrubs. Sweta 493.

Note: According to WCSPF this taxon blongs to family Colchicaceae.

Aloe vera (L.) Burm. f. (*Gheekavar*) is often cultivated as a medicinal plant. The genus Aloe belongs to Xanthorrhoeaceae.

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Govaerts R & Newton L (2009) World Checklist of Xanthorrhoeaceae. The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ accessed 14 May 2009; 09. 55 pm IST.

Govaerts R & Zona S A (2009) World Checklist of Asparagaceae . The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ accessed 14 May 2009; 09. 50 pm IST.

Govaerts R (2009) World Checklist of Colchicaceae. The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ accessed 14 May 2009; 10. 00 pm IST. (Names of reviewers were not availbale).

108. PONTEDERIACEAE

KEY TO GENERA:

1. Floating herbs; petioles swollen into floats; flowers zygomorphic; posterio tepal with a yellow blotch; filaments hairy..... 1. ***Eichhornia***

1. Rooted herbs; petioles not swollen; flowers actinomorphic; all tepals of same color; filaments glabrous..... 2. ***Monochoria***

1. EICHHORNIA Kunth *nom.cons.*

Eichhornia crassipes (Mart.) Solms in DC. Monogr. Phan. 4: 527.1883; Fl. Rajasthan 2: 847.1991. *Pontederia crassipes* Mart. Nov. Gen. Sp. 9. t .4.1823.

Floating, stoloniferous, aquatic herbs. Leaves 10.0-20.0 x 12.0-20.0 cm, radical, broadly ovate, smooth, cuneate, obtuse, spathulate. Flowers 10.0-20.0 cm long spikes, lilac-blue. Perianth lobes ovate-broadly oblong; posterior one blotched with yellow. Filaments densely gland hairy. Stigma hairy, fringed. **Flowering and fruiting.** During rainy season. **Local name.** *Jal Kumbhi.* An obnoxoius invasive species common in ponds, ditches, marshy areas forming a mat on the water surface. Sweta 334.

2. MONOCHORIA Persl.

Key to species:

1. Leaf base hastate or sagittate, lobes acuminate or acute..... 1. ***M. hastata***

1. Leaf base rounded-truncate to cordate, lobes rounded..... 2. ***M. vaginalis***

1. Monochoria hastata (L.) Solms in DC. Monogr. Phan. 4: 523.1883; Fl. Rajasthan 2: 848.1991. *Pontederia hastata* L. Sp. Pl. 288.1753. *Monochoria hastaefolia* Presl. Rel. Haenk. 1: 128. 1827 ('*hastifolia*' in IPNI); FBI. 6: 362.1892; FUGP. 2: 336. Repr. ed. 1960.

Perennial, marshy, rhizomatous, herbs. Base clothed with remains of old leaf sheaths. Leaves 7.0-25.0 x 4.0-20.0 cm, ovate-triangular, sagittate or hastate, glossy. Racemes erect, dense, short peduncled, deflexed finally. Flowers bright purplish-blue. Anthers linear-oblong, larger one blue, others yellow. Ovary ovoid. Stigma 3-lobed. Capsule ellipsoidal, oblong, enclosed within thickened and twisted midribs of perianth lobes. Seeds rounded, pale, with many fine brown ribs. **Flowering and fruiting.** September. Abundant within the area near streams and tanks. Sweta 443.

2. Monochoria vaginalis (Burm. f.) Presl. Rel. Haenk. 1: 128.1827; FBI.6: 363.1892; FUGP. 2: 336. Repr. ed. 1960; Fl. Rajasthan 2: 848.1991. *Pontederia vaginalis* Burm. f. Fl. Ind. 80.1768. *P. plantaginea* Roxb. Fl. Ind. 2: 123.1832. *Monochoria vaginalis* (Burm. f.) Presl. var. *plantaginea* (Roxb.) Solms in DC. Monogr. Phan. 4: 523.1883; FBI. 6: 363.1892; FUGP. 2: 337. Repr. ed. 1960.

Annual or perennial herbs. Leaves 5.0-12.0 x 0.5-10.0 cm, ovate-oblong to triangular or linear-lanceolate, cordate, acuminate, glabrous. Flowers blue, spotted with red. Perianth campanulate, outer tepals lanceolate-oblong; inner ones broader. Capsule glandular outside, ellipsoid, 3-gonous, seeds brown, 10 ribbed. **Flowering and fruiting.** September-November. Included on authority of Murty and Singh (1961b). Khan (1987) reported this taxon from Bijnor, therefore, its occurrence in the study area can not be ruled out.

109. COMMELINACEAE

KEY TO GENERA:

1. Filaments bearded.....2
1. Filaments glabrous; perfect stamnes 3.....1. ***Commelina***
2. Perfect stamens 2, with 3 staminodes.....4. ***Murdania***
2. Perfect stamens 6; staminodes none.....3. ***Cyanotis***

1. COMMELINA L.

Key to species:

1. Capsule usually 2-celled, sometimes 1-celled; each cell 2-seeded..... 1. ***C. attenuata***
1. Capsule 3-celled.....2

2. Capsule 3-seeded and 3-valved; seeds free in the cells..... 4. ***C. paludosa***
2. Caspsules usually 5-seeded, i.e. two anterior cells
   2-seede and the posterior cell 1-seeded or obsolete..... 3
3. Leaves elliptic-ovate; spathes sessile or subsessile,
   turbinate; seeds closely pitted.....2. ***C. benghalensis***
3. Leaves lanceolate; spathes distinctly pedunculate, cordate;
   seeds smooth, truncate at one end and sub-acute or
   rounded at the other..... 3. ***C. caroliniana***

1. Commelina attenuata Koenig ex Vahl, Enum. Pl. 2: 168. 1805; FBI. 6: 372. 1892; FUGP. 2: 340. Repr. ed. 1960; Fl. Rajasthan 2: 852. 1991.

Slender, much-branched herbs, upto 60.0 cm long tall. Leaves linear or linear-lanceolate, up to 10.0 x 0.5 cm, acute or subobtuse; sheaths ciliate. Spathes ovate-lanceolate, acute or caudate-acuminate, cordate, glabrous, up to 2.0 x 3.0 cm. Flowers small, blue. Capsule 1-2 celled, each locule 2-seeded. Seeds oblong-ellipsoid, truncate. **Flowering and fruiting:** October-December. Included on authority of Murty & Singh (1961b).

2. Commelina benghalensis L. Sp. Pl. 41.1753; FBI. 6: 370.1892; FUGP. 2: 339. Repr. ed. 1960; Fl. Rajasthan 2: 853.1991.

Prostrate herb, roots bearing white, cleistogamous flowers. Leaves ovate-oblong, sheath inflated. Aerial flowers blue, 2 posterior petals larger, clawed, anterior one smaller, concave. Stamens 6, 3 posterior ones with divergent, cruciform, yellow anthers. Capsule trigonous, shortly stalked. Seeds wrinkled, pitted. **Flowering and fruiting:**August-November. Commonly found as weeds in crop fields, wastelands. Sweta 284.

3. Commelina caroliniana Walter, Fl. Carol.: 68.1788. *Commelina hasskarlii* Clarke, Comm. & Cyrt. Beng. 13. t. 5.1874 et in DC. Monogr. Phan. 3: 157. 1888; FBI. 6: 370. 1892; FUGP. 2: 339. Repr. ed. 1960; Fl. Rajasthan 2: 855. 1991.

Much branched, glabrous, creeping or decumbent herbs. Leaves lanceolate, acute. Spathes axillary, cordate. Flowers in unequal cymes, blue. Capsule quadrate, apiculate, glabrous Seeds cylindric, dark-grey, smooth. **Flowering and fruiting:** August-November. Commonly found as weed in agricultural fields and other moist places. Sweta 249, 316.

4. Commelina paludosa Blum. Enum. Pl. Jav. 1: 2. 1827; Fl. Rajasthan 2: 856. 1991. *C. obliqua* Buch.-Ham. ex D. Don, Prodr. 45. 1825, non Vahl 1805; FBI. 6: 372. 1892; FUGP. 2: 340. Repr. ed. 1960.

Tall, scandent or scrambling, perennial herbs. Leaves subsessile, lanceolate-oblong to oblong or elliptic-lanceolate, acuminate or acute. Sheaths glabrous, mouth oblique, ciliate. Spathes 3-8 clustered, funnel-shaped, cordate, acuminate, up to 2.0 x 1.5 cm. Cymes simple or branched. Sepals unequal. Petals blue, large petals orbicular. Capsule 3-celled, 3-seeded. Seeds ovoid-oblong, smooth. **Flowering and fruiting:** August-December. Found in moist and shady localities. Sweta 1580.

2. CYANOTIS D. Don. *nom. cons.*

Key to species:

1. Leaf sheaths inflated; flowers sessile, in axillary fascicles, enclosed in inflated leaf sheaths; bracteoles small, not imbricated ..... 1. ***C. axillaris***

1. Leaf sheaths not inflated; flowers pedicellate, in terminal scorpioid cymes; bracteoles 2-seriate, imbricated..... 2. ***C. cristata***

1. Cyanotis axillaris (L.) D.Don ex Sweet, Hort. Brit.: 430 1826; FBI. 6: 388.1892; FUGP.2: 344. Repr. ed. 1960. *Amischophacelus axillaris* (L.) Rao & Kammathy in Journ. Linn. Soc. Bot. 59: 306.1966; Fl. Rajasthan 2: 849. 1991. *Commelina axillaris* L. Sp. Pl. 42.1753.

Prostrate, fleshy herbs. Leaves sessile, linear-lanceolate, acute, sheaths inflated. Flowers purple, in axillary cymes. Petals 3. Stamens 6. Capsule oblong-ellipsoid, seeds pitted, grey. **Flowering and fruiting:** August-December. Commonly found in shady or marshy places. Sweta 252, 277.

2. Cyanotis cristata (L.) D. Don, Prodr. Fl. Nepal. 46. 1825; Wight, Ic. 6: 32. t. 2082. 1853; FBI. 6: 385. 1892; FUGP. 2: 343. Repr. ed. 1960; Fl. Rajasthan 2: 857. 1991. *Commelina cristata* L. Sp. Pl. 42. 1753.

Annual, slender herbs. Leaves sessile, ovate-oblong, acute, glabrous, margins ciliate, cordate, up to 7.5 x 1.5 cm. Sheath short, hairy. Flowers in scorpioid, recurved cymes, violet-purple. Bracts foliaceous, ovate, cordate, acuminate, ciliate. Bracteoles glabrous or long-ciliate. Sepals lanceolate, acuminate. Fruits oblong, 3-gonous, truncate, nearly glabrous. Seeds striate with 2 large pits on faces, black. **Flowering and fruiting:** July- December. Included on authority of Murty & Singh (1961b).

3. MURDANNIA Royle *nom. cons.*

Murdannia nudiflora (L.) Brenan in Kew Bull. 7: 189. 1952; Fl. Rajasthan 2: 858. 1991. *Commelina nudiflora* L. Sp. Pl. 41. 1753, *pro typ. parte* (excl. *syn.* et ref. Fl. Zeyl. et

Plukenet). *Aneilema nudiflora* (L.) R. Br. Prodr. 271. 1810; FBI. 6: 378. 1892; FUGP. 2: 342. Repr. ed. 1960.

Erect or decumbent, annual herbs. Leaves sessile, linear-lanceolate to oblong; base rounded or sub-cordate, subacute. Flowers in cymose panicles, pink. Bracts ovate, obtuse. Sepals ovate-oblong, obtuse. Petals obovate-rounded. Fertile stamens 2, staminodes 3. Capsule subglobose, 6-seeded. Seeds trigonous, tuberculate, reddish to dark-brown. **Flowering and fruiting:** August-November. Common in grassy and moist localities. Sweta 316.

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110. JUNCACEAE

JUNCUS L.

Key to species:

1. Leaves septate; cymes teminal, compact..... 2. ***J. wallichianus***
1. Leaves not septate; cymes lax, scattered..... 1. ***J. bufonius***

1. Juncus bufonius L. Sp. Pl. 328. 1753; FBI. 6: 392. 1892; FUGP. 2: 346. Repr. ed. 1960; Fl. Rajasthan 2: 860. 1991.

Erect, slender, tufted, annual grass like herbs, up to 20.0 cm high. Leaves linear, acute, sheath not auricled. Flowers sessile, solitary or 2-5 in lax cymes. Bracts and bracteoles membranous, ovate-acute. Outer tepals lanceolate, acute, green, membranous margins; inner ones smalller. Stamens 6. Styles pinkish. **Flowering and fruiting:** January- June. Abundant in the area, found in moist to wet habitats. Sweta 647.

2. Juncus wallichianus J.Gay ex Laharpe, Essai Monogr. Jonc.: 51. 1825. *Juncus monticola* Steud. Syn. 2: 301. 1855; HFDD. 532. 1977. *J. prismatocarpus* auct. pl. (non R. Br. 1810); FBI. 6: 395. 1892; FUGP. 2: 346. Repr. ed. 1960.

Tufted herbs, root-stock very short. Leaves few, soft, terete or flat, septate. Flowers 5 to many in sessile, terminal heads, arranged in panicles. Tepals up to 0.4 cm long. Stamens 3. Capsule trigonous, acute. Seeds reticulate, minute. **Flowering and fruiting:** March-June. Occasionally found on moist sandy bed of Ganga. Sweta 1539.

Note: In Indian floras this species is referred to as *J. monticola* Steud., I have followed International Organization for Plant Information: Provisional Global Plant Checklist (http://bgbm3.bgbm.fuberlin.de/IOPI/GPC/PTaxonDetail.asp?NameId=318&PTRefFk=1).

(Source: J. Kirschner (compiler) 2002: Species Plantarum: Flora of the World parts 6-8 - Juncaceae. Australian Biological Resources Study: Canberra.)

111. ARECACEAE

PHOENIX L.

Phoenix sylvestris (L.) Roxb. Fl. Ind. 3: 787. 1832; FBI. 6: 425. 1892; FUGP. 2: 354. Repr. ed. 1960. Fl. Rajasthan 3: 861. 1993. *Elate sylvestris* L. Sp. Pl. 1189. 1753.

Tall, unbranched, monoecious, handsome palms. Leaflets up to 25.0 x 2.0 cm, linear-lanceoalte, cunduplicate, coriaceous, apices spinous. Spathe woody, dark-brown, scurfy, consisting of 2 boat-shaped, keeled, valves. Male flowers numerous, creamish-yellow, fragrant. Female flowers distant, roundish. Fruits oblong-ellipsoid, scattered, orange-yellow. Seeds rounded, deeply grooved. **Flowering and fruiting.** February-August. Commonly found in wastelands and on roadsides. Sweta 1502.

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112. TYPHACEAE

TYPHA L.

Typha elephantina Roxb. Fl. Ind. 3: 566. 1832; FBI. 6: 489. 1893; FUGP. 2: 359. Repr. ed. 1960. Fl. Rajasthan 3: 864. 1993.

Erect perennial, marshy herbs, upto 3.0 m tall. Leaves exceeding the flowering stem, trigonous, vertical, linear, acute. Sipkes cylindrical, 40.0-50.0 cm long, dark-brown. Female spikes reddish-brown. Male flowers mixed with clavate-tipped pistillodes. Ovary on gynophore, white hairs at base. Stigma spathulate. Fruits not seen. **Flowering & Fruiting:** October-June.**Local name:** *Patera.* Commonly found in aquatic and marshy places. This species is extensively harvested for making mats. Sweta 912.

113. SPARGANIACEAE

SPARGANIUM L.

Sparganium erectum L. Sp. Pl. 971. 1753; subsp. **stoloniferum** (Graebn.) Hara in J. Japan Bot. 51: 228. 1976; Bennet, Name Changes Flowering Pl. India 531. 1987; Khan & Khan, Acta Botanica Indica 28: 195-196. 2000. *S. ramosum* subsp. *stoloniferum* Graebn. in Pfreich. 4. 10(Ht. 2): 14. 1900. *S. stoloniferum* Ham. in Wall. Cat. no. 4990. 1832, *nom. nud. S. ramosum auct.* non. Hudson, FBI. 6: 490. 1893, *pro maj. p.*; FUGP. 2: 359. Repr. ed. 1960.

Erect herbs, rootstock creeping, upto 75.0 cm high. Leaves up to 90.0 cm long, broad, 2-ranked, linear, margins entire, triquetrous. Flowers in round heads, sessile or shortly stalked, male heads smaller, olive- brown, soon falling off, male flowers with 2-3 stamens surrounded by 3-6 linear scales; female heads larger. Drupe angled, sessile, shortly beaked.**Flowering and fruiting.** February-June. Common in shallow water on banks of the river Ganga and in marshy habitats. Sweta 1474.

Note: First reported from western Uttar Pradesh by Khan & Khan (2000). This taxon seems to have entered this area very recently and has spread all over the sanctuary. Studies to assess its impact on local flora are needed.

Note: According to APG-2 the genus *Sparganium* belongs to family Typhaceae.

114. ARACEAE

COLOCASIA Schott

Colocasia esculenta (L.) Schott in Schott & Endl. Melet. Bot. 1: 18. 1832; Fl. Rajasthan 3: 865. 1993. *Arum esculentum* L. Sp. Pl. 965. 1753. *Colocasia antiquorum* Schott, Melet. Bot. 1: 18. 1832; FBI. 6: 523. 1893; FUGP. 2: 365. Repr. ed. 1960.

Prennial herbs, with short, tuberous root-stock. Leaves purple blotched, up to 35.0 x 15.0 cm, cordate or sagittate, apiculate. Spathe up to 30.0 cm long, lanceoalte-oblong, convolute, cylindric, tube pale- yellow. Spadix shorter than the spathes. Berries several, angular, reddish-orange or orange. **Flowering and fruiting:** August-November. **Local name:** *Arvi, Ghuiyan.* Found in marshy habitats. Also cultivated for edible subterranian parts which are sold in market. Sweta 1545.

115. LEMNACEAE

KEY TO GENERA:

1. Fronds subglobose, not flat, rootless; reproductive
   pouch solitary, basal; inflorescence espathaceous, male
   and female flowers one each..... 3. ***Wolffia***
1. Fronds flat above; roots 1- many; reproductive
   pouches 2, marginal; inflorescence spathaceous;
   male and female flowers 2 and 1 respectively.....2
2. Fronds 3-18 nerved, with a dorsal and ventral scale
   and two to many roots; stipe ventrally attached; anthers
   longitudinally dehiscent; utricle winged..... 2. ***Spirodella***
2. Fronds 1- 3 nerved, without scales and with a
   solitary root; marginally attached; anthers transeversely
   dehiscent; utricles smooth, not winged..... 1. ***Lemna***

1. LEMNA L.

Key to species:

1. Fronds tailed; root cap acute..... 2
1. Fronds sessile, not tailed; root cap obtuse..... 1. ***L. minor***
2. Plants submerged; fronds symmetric, crenate-serrate near the apex; root sheath indistinct..... 3. ***L. trisulcata***
2. Plants floating; fronds aymmetric, entire; root sheath winged at the base..... 2. ***L. perpusilla***

1. Lemna minor L. Sp. Pl. 970. 1753; FBI. 6: 556. 1893; Fl. Rajasthan 3: 870. 1993.

Minute, floating, annual herbs. Fronds up to 3.0 mm long, sessile, symmetrical obovoid or oblong. Flowers in marginal clefts of fronds, spathe 2- lipped. Stamens 2. Style long; ovule solitary. **Flowering and fruiting:** July-October. Found in ponds, pools and ditches. Sweta 1579.

2. Lemna perpusilla Torrey in Fl. New York 2: 245.1843; Fl. Rajasthan 3: 871.1993. *L. paucicostata* Hagelm. Lemnac. 139. t. 8. 1868; FBI. 6: 556. 1893; FUGP. 2: 368. Repr. ed. 1960;

Floating, minute, annual, aquatic herbs. Fronds obovate, flat, glabrous, entire. Spathe membranous with two male and one female flower. Male flower with one stamens. Female flowers- ovary one, one-ovuled. **Flowering and fruiting:** July-September. Common in ponds, canals and lakes etc. Sweta 643.

3. Lemna trisulca L. Sp. Pl. 970. 1753; FBI. 6: 557. 1893; FUGP. 2: 368. Repr. ed. 1960; Fl. Rajasthan 3: 871. 1993.

Small, submerged, annual, aquatic herbs. Fronds 4.0 -8.0 mm long, flat, oblanceolate, tip serrate. Flowers 1-3, naked or in spathe, perianth none. Stamens 1-2, anthers 1 or 2 celled. Ovary 1-celled, style very short, ovule solitary. Seeds horizontal, testa rough, grooved. **Flowering:** March-April. Included on authority of Murty and Singh (1961b).

According to WCSPF specific epithet is '***trisulca***'.

2. SPIRODELA Schleid.

Spirodela polyrhiza (L.) Schleid. in Linnaea 13: 392. 1839; FUGP. 2: 368. Repr. ed. 1960; Fl. Rajasthan 3: 871. 1993. *Lemna polyrhiza* L. Sp. Pl. 970. 1753; FBI 6: 557. 1893.

Minute, floating herbs. Fronds up to 8.0 x 7.0 mm, flat, orbicular or broadly ovate-oblong, opaque, dark-green above, purplish beneath. Spathes with 2 male and 1 female flower.

Stamen 1. Ovary 2-ovuled. Fruit 1-seeded. Seeds smooth or faintly reticulate. **Flowering and fruiting:** February-April. Found in ponds and ditches. Sweta 642.

Note: According to WCSPF the orthography of the specific epithet is '***polyrrhiza***'

3. WOLFFIA Horkel ex Schleid. *nom. cons.*

Key to species:

1. Fronds subglobose on lower side..... 1. ***W. arrhiza***

1. Fronds conical or subcylindric on lower side..... 2. ***W. micropscopica***

1. Wolffia arrhiza (L.) Horkel ex Wimmer, Fl. Schles. ed. 3. 140. 1857; FBI. 6: 557. 1893, *pro parte;* FUGP. 2: 369. Repr. ed. 1960; Fl. Rajasthan 3: 872. 1993. *Lemna arrhiza* L. Mant. Alt. 2: 294. 1771.

Smallest, simplest plants resembling small dots or grains floating on still water. Fronds up to 1.0 x 1.5 mm, orbicular or ellipsoid, upper surface slightly convex.. **Flowering and fruiting:** Not seen. Common in ponds and ditches. Sweta 1562.

2. Wolffia microscopica (Griff. ex Voigt) Kurz in Journ. Linn. Soc. Bot. 9: 265. 1867; FBI. 6: 558. 1893; FUGP. 2: 369. Repr. ed. 1960; Fl. Rajasthan 3: 872. 1993. *Grantia microscopica* Griff. ex Voigt, Hort. Suburb. Calc. 692. 1845.

Floating, aquatic herbs. Fronds flat, ovate or obovate, glabrous, entire. Male and female flowers solitary, inserted in groove on upper surface of frond. **Flowering and fruiting:** July-October. Included on authority of Murty and Singh (1961b).

Note: In WCSPF all duckweeds are placed in family Araceae.

WCSPF citation:

Govaerts R, Bogner J, Boos J, Boyce P, Cosgriff B, Craot T, Convcalves E, Grayum M, Hay A, Hetterscheid W, Ittenbach S, Landolt E, Mayo S, Murata J, Nguyen V D, Sakuragui C M, Singh Y, Thompson S & Zhu G (2009) World Checklist of Araceae. The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ accessed 19 May 2009; 01. 50 pm IST.

116. ALISMATACEAE

SAGITTARIA L.

Key to species:

1. Leaves erect, raised above the water surface;
   sagittate, acute..... 2. ***S. sagittifolia***

1. Leaves floating on water surface, ovate-cordate

with rounded basal lobes, obtuse..... 1. ***S. guayanensis***

1. Sagittaria guayanensis HBK, Nov. Gen. Sp. 1: 250. 1816.

subsp. **lappula** (D. Don) Bogin in Mem. New York Bot. Gard. 9: 192. f. 5. 1955; Fl. Rajasthan 3: 874. 1993. *S. lappula* D. Don Prodr. Fl. Nep. 22. 1825. *S. guayanensis* auct. pl. non Kunth 1816; FBI. 6: 561. 1893; FUGP. 2: 372. Repr. ed. 1960.

Laticiferous, aquatic, floating herbs, often thinly hairy. Leaves floating, up to 6.0 x 3.5 cm, ovate, deeply cordate, obtuse. Flowers white, in irregular whorls, lower whorl bisexual, upper staminate; pedicel very short, stout. Achenes numerous, flat, wing toothed. **Flowering and fruiting.** August- December. Found in paddy fields and stagnant water bodies. Less common than *S. sagittifolia.* Sweta 1576.

2. Sagittaria sagittifolia L. Sp. Pl. 993.1753; FBI. 6: 561.1893; FUGP. 2: 371. Repr. ed. 1960; Fl. Rajasthan 3: 874.1993.

Monoecious aquatic herbs. Radical leaves raised above the water surface, petiole long, triquetrous, sagittate, smooth, 5 nerved. Flowers white, unisexual, 2-3 in a whorl; female in lower part of the scape and male in upper part. Sepals 3, herbaceous, ovate, acute. Petals 3, white, broadly obovate, clawed. Stamens numerous, anther yellow, sagittate. Achenes obliquely, ovate, flat, winged. **Flowering and fruiting:** January- June. Common in marshy places, on margins of ponds and along banks of Ganga. Sweta 443, 641.

WCSPF citation:

Govaerts R (2009) World Checklist of Alismataceae. The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ accessed 19 May 2009; 11. 19 am IST. (Names of reviewers were not availbale).

117. APONOGETONACEAE

APONOGETON L. f.

Aponogeton natans (L.) Engl. & Krause in Engl. Pflanzenr. 4. 13: 11. 1906; Fl. Rajasthan 3: 875. 1993. *Saururus natans* L. Mant. Alt. 2: 227. 1771. *Aponogeton monostachyon* L. f. Suppl. Pl. 214. 1781; FBI. 6: 564. 1893; FUGP. 2: 373. Repr. ed. 1960.

Submerged, aquatic herbs. Leaves lanceoalte to linear-oblong, cuneate, opaque, nerves 2-3. Floating leaves larger, 7-nerved. Flowers in solitary, dense spike, blue. Spathe up to 15.0 mm long, caducous. Stamens 6, anthers bluish-purple. Follicles up to 3.5 x 2.0 mm, beaked. Seeds 4-8 longitudinally ribbed. **Flowering and fruiting:** August- November. Included on authority of Murty & Singh (1961b).

WCSPF citation:

Govaerts R (2009) World Checklist of Aponogetonaceae. The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ accessed 14 May 2009; 09. 44 pm IST. (Names of reviewers were not availbale).

118. POTAMOGETONACEAE

KEY TO GENERA:

1. Leaves linear, filiform; sheaths up to 2 cm long.....2. ***Stuckenia***
1. Leaves not as above; sheaths free, forming stipules.....1. ***Potamogeton***

Key to species:

1. Upper leaves floating, coraiceous; lower leaves submerged and membranous.....2. ***P. nodosus***
1. All leaves similar and submerged; margins crisped and serrulate .....1. ***P. crispus***

1. POTAMOGETON L.

1. Potamogeton crispus L. Sp. Pl. 126.1753; FBI. 6: 566.1893; FUGP. 2: 375. Repr. ed. 1960; Fl. Rajasthan 3: 876.1993.

Submerged aquatic herbs. Leaves 5.0 -10.0 x 2.5-4.0 cm, linear to elliptic-lanceolate, glabrous, margins undulate. Spikes dense 4.0 -5.0 cm long, reddish-brown.Tepals 4, clawed, suborbicular, concave. Druplets obliquely-ovoid, shortly beaked. **Flowering and fruiting:** December- May. Common throughout the study area in pond and marshy places. Sweta 6.

2. Potamogeton nodosus Poir. Lamk. Encycl. Menth. Bot. Suppl. 4: 535. 1816; Fl. Rajasthan 3: 877.1993. *P. indicus* Roxb. Fl. Ind. 1: 471. 1820, *non* Roth ex Roem. & Schult. 1818.; FBI. 6: 565.1893; FUGP. 2: 374. Repr. ed. 1960.

Floating or marshy, pale-purple herbs. Submerged leaves lanceolate, very thin, often with undulate margins; floating ones elliptic lanceolate, thicker. Flowers white, in reddish brown spikes. Fruits 3-ribbed, with a recurved beak. **Flowering and fruiting :** November-June. Common in ponds, ditches and in slow running water. Sweta 403.

2. STUCKENIA Börner

Stuckenia pectinata (L.) Börner, Fl. Deutsche Volk 713. 1912; Kaplan Z., Folia Geobot. 43: 159-234. 2008. *Potamogeton pectinatus* L. Sp. Pl. 127.1753; FBI. 6: 567.1893;FUGP. 2: 375. Repr. ed. 1960; Fl. Rajasthan 3: 877.1993.

Submerged grass-like, aquatic herbs. Leaves linear to filiform.Stipules adnate to the leaf sheath. Spikelets 1.5-2.0 cm long, white, short, projecting above the water surface. Tepals 4,

broadly obovate. Fruits oblique, shortly beaked, hardly keeled. **Flowering and fruiting:** October-April. Found frequently in ponds, ditches and slow running water of Madhya Ganga Canal. Sweta 406.

Note: According to Kaplan (2008) the genus *Stuckenia* is characterized by the presence of long leaf sheaths, characteristic leaf and peduncle anatomy and a higher ploidy level (hexaploid) than in *Potamogeton* s. str. (generally diploid or tetraploid). The genus is represented, in Asia, by seven species and three confirmed hybrids. *S. pectinata* is cosmopolitan in distribution.

WCSPF citation:

Govaerts R (2009) World Checklist of Potamogetonaceae. The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ accessed 19 May 2009; 0. 41 pm IST. (Names of reviewers were not availbale).

119. ZANNICHELLIACEAE

ZANNICHELLIA L.

Zannichellia palustris L. Sp. Pl. 969. 1753; FBI. 6: 568. 1893; FUGP. 2: 376. Repr. ed. 1960; Fl. Rajasthan 3: 878. 1993. *Z. palustris* L. subsp. *pedicellata* Wahlenb. & Rosen in Nov. Act. Soc. Sci. Upsal. 8: 254. 1821.

Fragile, submerged herbs. Leaves opposite or whorled, linear or filiform. Male flower 1, naked, stamen solitary. Female flowers 2-5, perianth cupular, hyaline. Carpels 1-9, stigma peltate. Achenes stipitate, rostrate, tuberculate. Seeds oblong, pendulous. **Flowering and fruiting:** February-July. Often found in ponds and ditches. Sweta 1561.

120. NAJADACEAE

NAJAS L.

Najas minor All. Auct. Syn. Meth. Strip. Hort. Taurin. 3. 1773 & Fl. Pedem. 2: 221. 1785; FBI. 6: 569. 1893, *pro parte;* FUGP. 2: 377. Repr. ed. 1960; Fl. Rajasthan 3: 880. 1993. *Fluvialis minor* (All.) Pers. Syn. 2: 530. 1807.

Submerged, fragile, dichotomously branched herbs. Leaves up to 2.5 cm long, with 6-12, broad-based, upcurved spinules on margins. **Flowering and fruiting:** Not seen. Occasionally found in large water bodies and in shallow water near margins of Ganga. Sweta 1446.

121. ERIOCAULACEAE

ERIOCAULON L.

Eriocaulon cinereum R. Br. Prodr. 254. 1810; Fl. Rajasthan 3: 882. 1993. *E. sieboldianum* Sieb. & Zucc. ex Steud. Syn. Pl. Glum. 2: 272. 1855; FBI. 6: 577. 1893; FUGP. 2: 378. Repr. ed. 1960.

Stemless, monoecious, glabrous, small, annual herbs. Leaves in a rosette, subulate to linear, opaque. Heads 2.5- 3.0 mm across, ovoid-globose, grey or blackish-white. Involucre bracts many, scarious, biseriate. Male flowers stipitate, outer perianth segments 3, basally connate, cupular. Female flowers with 2, free, linear, acute sepals, petals none; style long, stigmas 3, filiform. Capsule membranous. Seeds ellipsoid-ovoid, smooth, pale-brown. **Flowering and fruiting:** August- November. Often found in sugarcane fields. Sweta 1496.

122. CYPERACEAE

KEY TO GENERA:

1. Flowers unisexual; female flowers enclosed in a utricle..... 3. ***Carex***
1. Flowers bisexual; female flowers not enclosed within a utricle.....2
2. Style jointed with the ovary, style-base dilated or spongy-thickened, clearly demarcated..... 3
2. Style continuous with the ovary, without any demarcation between ovary and style, or any protuberance at the top of achene.....5
3. Hypogynous bristles present; spikelets solitary terminal..... 5. ***Eleocharis***
3. Hypogynous bristles none; spikelets not solitary terminal (except in *F. ovata*)..... 4
4. Entire style falling off from achene; achene not crowned by a bulbous style base.....6. ***Fimbristylis***
4. Style persistent on the mature achene, hence achene crowned by a bulbous style base..... 2. ***Bulbostylis***
5. Hypogynous bristles present; glumes spirally imbricated..... 6
5. Hypogynous bristles absent; glumes spirally imbricated or 2-ranked..... 7
6. Leaves absent or reduced to sheaths, or at the a most mucro; hypogynous bristles needle-like..... 10. ***Schoenoplectus***
6. Leaves with distinct lamina; hypogynous bristles 3-6, not needle-like, retrorsely scabrid, upto as long as the nut; styles 2, rarely three; nut obovate.....1. ***Bolboschoenus***
7. Glumes spiral..... 10. ***Schoenoplectus***
7. Glumes 2-ranked.....8
8. Rachilla articulated; spikelets falling entirely.....9
8. Rachilla not articulated, persistent; glumes falling apart from the rachilla.....10
9. Nut triangular with one side facing rachilla.....8. ***Mariscus***
9. Nut bilaterally flattened with one side facing the rachilla..... 7. ***Kyllinga***

10. Nut triangular or dorsiventrally flattened with one side facing rachilla..... 4. ***Cyperus***

10. Nut bilaterally flattened with one angle facing rachilla..... 9. ***Pycreus***

1. BOLBOSCHOENUS (Ascherson) Palla

Bolboschoenus maritimus (L.) Palla in Koch. Syn. Deutsch. Fl. ed. 3. 3532. 1904; Fl. Rajasthan 3: 888. 1993. *Scirpus maritimus* L. Sp. Pl. 51. 1753; FBI. 6: 658. 1893; FUGP. 2: 412. Repr. ed. 1960. *Scirpus tuberosus* Desf. Fl. Atlant. 1: 50. 1798; D.A. Simpson, J. Bruhl, P. Goetghebeur, K. Wilson), T. Egorova (2005). World Checklist of Cyperaceae. The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ accessed 16 May 2007; 11 : 30 IST.

var. **maritimus**

Erect, perennial, rhizomatous sedges. Leaves 2.0-10.0 mm broad, as long as the stem, flat, grass-like. Involucral bracts 1-3, leaflike, unequal. Inflorescence a compound umbel. Spikelets 3-8, oblong-ovoid. Glumes broadly ovate, bifid apically and strongly keeled, brown or golden-brown. Bristles 6 unequal, retrorsely scabrid. Nuts trigonous, beaked, smooth, sessile, black.**Flowering and fruiting** : October-March. Common in marshy places, on the bank of Ganga and margins of ponds and ditches. Sweta 663.

2. BULBOSTYLIS Kunth *nom. cons.*

Bulbostylis barbata (Rottb.) Clarke in FBI 6: 651.1893; FUGP. 2: 408. Repr. ed. 1960; Fl. Rajasthan 3: 889.1993. *Scirpus barbata* Rottb. Descr. Pl. Rar. Prog. 27.1772 et Ic. Rar. Nov. Pl. 52. t.17. f. 4.1773.

Slender, tufted, annual, glabrous herbs. Leaves 3.0-8.0 x 0.25-0.5 cm, filiform, linear, acute, margins thickened, sheath ciliate. Inflorescence capitate. Spikelets 3-12, sessile, yellowish-brown, polygonal. Glumes boat-shaped, rusty-brown, keeled. Stamens 1-3. Nuts trigonous, yellowish, surface with rectangular shallow pits. **Flowering and fruiting :** July-November. Commonly found on sandy soil in agricultural fields. Sweta 163.

3. CAREX L.

Key to species:

1. Spikes green, drooping; stigmas 2; utricle compressed..... 1. ***C. dimorpholepis***

1. Spikes yellowish-brown, erecto-patent; stigmas 3; utricle not compressed..... 2. ***C. fedia***

1. **Carex dimorpholepis** Steud., Syn. Pl. Glumac. 2: 214. 1855. *Carex cernua* Boott, Ill. 4. 171. t. 578. 1867, *nom. illeg.*; FBI. 6: 708. 1894; FUGP. 2: 417. Repr. ed. 1960; Fl. Dudhwa National Park 428. 1997.

Erect perennial herbs. Leaves equalling the stem, flat, linear, scabrous. Spikes 4-6, cylindric, 4-6 cm long; female spikelets at top; male at base. Bracts leaf like. Urticles stalked, obovate, conically beaked, densely glandular. **Flowering and fruiting** : February-April. Occasionally found near water streams. Sweta 762.

2. **Carex fedia** Nees in Wight Contrib. 129. 1934; Fl. Dudhwa National Park 428. 1997. *C. wallichiana* auct. (non Spreng.); FBI. 6: 747. 1894; FUGP. 2: 418. Repr. ed. 1960.

Erect, rhizomatous, marshy herb up to 75.0 cm high. Basal leaves equaling the stem, up to 0.3 cm broad; margins smooth; sheath broken into fibers. Spikelets racemose. Female spikelets 2-5 at base, male ones 3-6 at apex. Achene elliptic-elongate, trigonous, enclosed in perigynium. **Flowering and fruiting.** January-April. Found in moist places, especially on clayey soil. Sweta 753.

4. **CYPERUS** L.

Key to species:

1. Stigmas 2; nuts dorsally compressed..... 2
1. Stigmas 3; nuts trigonous or triquetrous; spikelets in lobed heads..... 4
2. Spikelets in a decompound umbel..... 1. ***C. alopecuroides***
2. Spikelets in lobed heads..... 3
3. Perennial, rhizomatous herbs; spikelets in pseudolateral heads..... 8. ***C. laevigatus***
3. Annual herbs, with fibrous roots; spikelets in terminal heads..... 9. ***C. michelianus***
4. Spikelets digitately or stellately arranged..... 5
4. Spikelets distinctly spicately or rarely sub-racemosely arranged..... 8
5. Annuals with fibrous roots; stamen 1, rarely 2; glumes obtuse or mucronate..... 6
5. Perennials with a woody root-stock; culms nodose at base, closely uniseriate; spikelets white..... 10. ***C. niveus***
6. Spikelets in dense, globsoe heads..... 4. ***C. difformis***
6. Spikelets in compound umbels..... 7
7. Glumes mucronate; nut pale-brown or dirty white; spikelets upto 1.0 cm long..... 3. ***C. amabilis***

7. Glumes obtuse, emucronate; nut white;
spikelets upto 0.5 cm long..... 14. ***C. tenuispica***
8. Rachilla of spikelets distinctly alate with
decurrent base of glumes..... 9
8. Rachilla of spikelets exalate..... 10
9. Rhizomes stoloniferous; stolons persistent, bearing hard,
black, fragrant tubers; bracts 3; glumes frequently
slightly recurved at the apex; slenderly 5-nerved;
nuts oblong..... 13. ***C. rotundus***
9. Rhizomes not stolonoferous; wings of rachilla persistent;
spikelets conspicuously flattened, laxly arranged,
exposing rachis; ripe spikelets ascending..... 6. ***C. exaltatus*** var. ***dives***
10. Annuals with tufted stems; roots fibrous only.....11
10. Perennials with woody rhizomes and
often with long stolons..... 12
11. Glumes dorsally 3 to 5 nerved, back smooth..... 7. ***C. iria***
11. Glumes dorsally 5 to 7 nerved, back spinulose-ciliate.....2. ***C. alulatus***
12. Rachilla pilose; spikelets over 1.0 cm long..... 12. ***C. procerus***
12. Rachilla glabrous..... 12 -
13. Plants without true stolons; spikelets in
cylindric spikes..... 11. ***C. nutans***
13. Plants stoloniferous; spikelets in spicate racemes;
mature spikelets acicular, patent; glumes obtuse;
nuts as long as the glumes..... 5. ***C. distans***

1. Cyperus alopecuroides Rottb., Descr. Icon. Rar. Pl.: 38. 1773; Fl. Rajasthan 3: 896.1993. *Juncellus alopecuroides* (Rottb.) Clarke, FBI. 6: 595.1893; FUGP. 2: 394.Repr. ed. 1960.

Erect, stout, perennial, marshy herbs. Leaves 4.0-6.0 x 0.5-1.5 cm, linear, acuminate. Spikes digitate, patent, cylindrical, in compound umbles. Bracts 3. Spikelets ovate-lanceolate, brown, acute. Glumes boat shaped, keeled, 5-6 nerved. Nuts broadly obovate, pale-brown, apiculate. **Flowering and fruiting :** August-November. Frequently found in the marshy places. Sweta 219, 834.

2. Cyperus alulatus Kern in Reinwardtia 1: 643. f. 1. 1952; Fl. Rajasthan 3: 897. 1993.

Erect, tufted, annual sedges. Leaves longer than the stem. Involural bracts 3 -5, unequal. Inflorescence a terminal, lax, compound umbel. Spikelets patent, compressed, ovate to oblong – linear, 5-15 flowered, golden- or yellowish-brown. Nuts obovate-ellipsoid, triquetrous with

concave, smooth sides, stipitate, apiculate, brown to dark-brown. Flowering and fruiting: August – October. Included on authority of Murty & Singh (1961b).

3. Cyperus amabilis Vahl, Enum. Pl. 2: 318. 1805; FBI. 6: 598. 1894; FUGP. 2: 383. Repr. ed. 1960; HFDD. 554. 1977.

Erect annual herbs. Leaves 0.2-0.5 cm broad, subbasal. Spikelets linear, reddish-brown. Bracts 2. Glumes ovate-oblong, mucronate. Stamens-1. Nut obovoid, pale-brown, rugose. **Flowering and fruiting :** August-December. Found in marshy places. Sweta 1418.

4. Cyperus difformis L. Cent. Pl. 2: 6. 1756; FBI. 6: 599. 1893; FUGP. 2: 382. Repr. ed. 1960; Fl. Rajasthan 3: 902. 1993.

Erect, tufted, annual herbs with purple, fibrous roots. Leaves 0.2-0.5 cm broad, smooth, linear. Inflorescence a terminal, compound umbel with a sessile head at the base of umbel, rays 3-9, very unequal. Bracts 2-3. Spikelets linear to linear-oblong, 10-25 flowered. Rachilla wingless. Glumes membranous, obtuse, emarginate, white-hyaline on margins, brown. Nuts obovoid, triquetrous, yellowish or pale-brown. **Flowering and fruiting :** June-December. Found on margins of ponds and ditches. Sweta 826.

5. Cyperus distans L. f. Suppl. Sp. Pl. 103. 1781; FBI. 6: 607. 1893; FUGP. 2: 390. Repr. ed. 1960; Fl. Rajasthan 3: 903. 1993.

Tall, perennial sedges with knotty rhizomes. Leaves shorter than or equaling the stem, about 5.0 mm wide, linear. Inflorescence an open, compound or decompound umbel. Bracts 4-6, leafy. Spikes loose, broadly ovate, bearing 10- 20 spikelets. Spikelets linear, divergent, subterete, 10-30 flowered. Rachilla winged. Glumes distant on zig-zag rachilla, elliptic to ovate-oblong, obtuse, membranous, 3-5 nerved on either sides of keel. Nut narrowly ellipsoid, trigonous, dark-brown. **Flowering and fruiting :** July-December. Found on road sides and in agricultural fields. Sweta 1464.

6. Cyperus exaltatus Retz. Obs. Bot. 5: 11.1789; FBI. 6: 617. 1893; FUGP. 2: 387. Repr. ed. 1960; Fl. Rajasthan 3: 904. 1993.

var. **dives** (Del.) Clarke in Journ. Linn. Soc. 21:187. 1884 *et* FBI. 6: 617. 1893; Fl. Rajasthan 3: 904. 1993. *Cyperus dives* Del. Fl. Aegypt. Illus. 5. t. 4. f. 3. 1813.

Tall, erect, glabrous, perennial herbs. Leaves many, leaf blades linear, acuminate. Inflorescence a terminal, compound umbel. Bracts 5-6, leafy, unequal. Spikes 0.5-1.5 cm broad, cylindrical. Spikelets linear, spreading, much compressed, 5-20 flowered. Glumes imbricate, ovate-oblong, membranous, keeled, golden-yellow, scarious at margins. Nut

elliptic to elliptic-obovate, trigonous, brown. **Flowering and fruiting :** June-December. Found frequently in marshy habitats and on margins of water bodies. Sweta 43.

7. Cyperus iria L. Sp. Pl. 45. 1753; FBI. 6: 606.1893; FUGP. 2: 385.Repr. ed. 1960; Fl. Rajasthan 3: 906. 1993.

var. **iria**

Erect, glabrous, tall herbs with fibrous roots. Leaves 0.2-0.5 cm broad, linear, acuminate, margins scabrous. Inflorescence a terminal, compound umbel. Bracts 3-5, leafy. Spikes ovate-oblong, 1.0-4.0 cm long. Spikelets erect, linear-oblong, golden-yellow, 5-28 flowered. Rachilla straight, narrowly winged. Glumes boat-shaped, acute, sharply keeled, mucronate. Nut triquetrous, dark-brown, smooth, obovate. **Flowering and fruiting :** July-November. Found in paddy fields and on margins of water bodies. Sweta 205.

8. Cyperus laevigatus L. Mant. Pl. Alt. 179. 1771; Fl. Rajasthan 3: 906. 1993. *Juncellus laevigatus* (L.) Clarke in FBI. 6: 596. 1893; FUGP. 2: 395. Repr. ed. 1960.

Erect, perennial, glabrous herbs, rhizomes horizontal, creeping. Leaves usually absent, if present, then equalling or shorter than the stem. Spikelets 1-30 in pseudolateral heads, straw-coloured, 0.2-0.5 cm broad, ovate, acute, dotted with brown spots. Glumes oblong, acute, mucronate, margins hyaline. Nuts ellipsoid, minute. **Flowering and fruiting :** August-November. Common in marshy places. Sweta 1535.

9. Cyperus michelianus subsp. **pygmaeus** (Rottb.) Asch. & Graebn., Syn. Mitteleur. Fl. 2(2): 273.1904; World Checklist of Selected Plant Families. (2009). The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ 19 May 2009. *Cyperus pygmaeus* Rottb. Descr. Ic. Rar. Nov. Pl. 20. t. 14. f. 4-5. 1773; Fl. Rajasthan 3: 911. 1993. *Juncellus pygmaeus* (Rottb.) Clarke in FBI. 6: 596. 1893; FUGP. 2: 395. Repr. ed. 1960.

Annual, densely tufted sedges with fibrous roots. Leaves 8.0-10.0 cm long, linear, acuminate, slightly longer than stem, scabrid on margins. Sheaths reddish-brown. Inflorescence solitary, terminal head , 3- or more lobed, spikelets numerous. Bracts 4-6, dilated at base. Spikelets 0.1-0.25 cm broad, ovate-lanceolate, compressed, 8-20 flowered, greenish-white. Glumes boat shaped, acuminate, keel rounded. Stamens 2. Nuts oblong, plano-convex, trigonous, pale-brown. **Flowering and fruiting :** Almost throughout the year. Common on damp and sandy soil, on the river banks and margins of ponds etc. Sweta 828.

10. Cyperus niveus Retz. Obs. Bot. 5: 12. 1789; FBI. 6: 601.1893; FUGP. 2: 383. Repr. ed. 1960; Fl. Rajasthan 3: 907.1993.

Perennial, slender herbs. Rhizomes woody and arranged in a single file. Leaves 0.2-0.35 cm broad, linear, acuminate. Inflorescence a sessile head of digitae spikes. Spikelets 3-10, white or dirty white, elliptic, compressed. Bracts 2, unequal. Glumes ovate, acute, 0.4 x 0.1 cm, keeled. Stamens 3. Nut triquterous, obovoid-elliptic, black or dark-brown. **Flowering and fruiting :** July-November. Commonly found in dry, sandy habitats, especially in *Kholas*. This is a highly variable species as regards the size of plant, number of spikes per head and colour of the inflorescence varying from pure white to brownish white. Sweta 51, 410.

11. Cyperus nutans Vahl, Enum. Pl. 2: 263. 1805; FBI. 6: 607. 1893.

var. **eleusinoides** (Kunth) Haines, Bot. Bihar Orissa 5: 898. 1924. *C. nutans* subsp. *eleusinoides* (Kunth) T.Koyama, Gard. Bull. Singapore 30: 136. 1977; Fl. Rajasthan 3: 909. 1993. *Cyperus eleusinoides* Kunth. Enum. Pl. 2: 39. 1837; FBI. 6: 608. 1893; FUGP. 2: 386. Repr. ed. 1960.

Eerect, annual herbs, rhizomes stoloniferous. Leaves equalling the stem, linear, basal. Inflorescence a large compound umbel of corymbose spikes. Primary bracts leafy, scabrid, pale-yellow. Secondary bracts linear. Spikelets pale-brown. Rachilla winged. Glumes oblong, slightly mucronate, ellipsoidal , curved, apiculate. Nuts brown, slightly curved. **Flowering and fruiting :** July-March. Common in marshy places. Sweta 402.

12. Cyperus procerus Rottb. Descr. Ic. 29. *t.* 5.1773; FBI. 6: 610. 1894; FUGP. 2: 389. Repr. ed. 1960; HFDD. 559. 1977.

Erect, perennial herbs with stoloniferous rhizomes. Leaves linear, longer than the stem. Inflorescence a compound umbel. Spikelets reddish-brown, ovate. Rachilla flattened. Glumes elliptic, boat-shaped, keeled. Stamens 3. Nut trigonous, obovoid, brownish. **Flowering and fruiting :** August December. Found in swampy habitats. Sweta 542.

13. Cyperus rotundus L. Sp. Pl. 45.1753; FBI. 6: 614.1893; FUGP. 2: 388.Repr. ed. 1960; Fl. Rajasthan 3: 911.1993.

Erect, glabrous, perennial herbs; rhizome woody, stoloniferous. Leaves 0.15-0.45 cm broad, shorter than the stem, linear. Bracts 3, leaf like, unequal, exceeding umbel. Spikelets pale-yellow or brownish, with reddish tinge, linear, acute, 10-30 flowered. Glumes ovate, subacute, keeled, margins hyaline. Stamens 3. Nuts dark-brown, obovoid, triangular. **Flowering and fruiting :** Throughout the year. **Local Name.** *Nagar motha*.Commonly found as weeds in lawns, wastelands and cultivated fields. Sweta 2, 675.

14. Cyperus tenuispica Steud. Synop. Pl. Glum. 2: 11. 1855; Fl. Rajasthan 3: 913. 1993. *Cyperus flavidus* senus Clarke in FBI. 6: 600. 1893. non Retz. 1879; FUGP. 2: 382. Repr. ed. 1960.

Erect or diffuse, tufted, annual herbs, roots fibrous, red-purplish. Leaves few, basal, 0.25-0.45 cm broad, equal to stem, linear. Inflorescence a terminal, compound umbel. Bracts 1-2 unequal, slightly longer than umbels. Spikelets 0.05-0.07 cm, linear-oblong, compressed, 8-25 flowered. Glumes ovate-oblong, reddish brown. Stamens 2. Nuts oval, slightly trigonous, white or yellow. **Flowering and fruiting :** July-December. Found mainly in marshy habitats and paddy fields. Sweta 1367.

5. ELEOCHARIS R. Br.

Key to species:

1. Annual herbs; spikelets less than 10.0 mm long;
   stigmas 2; nuts black about 0.5 mm long..... 2. ***E. atropurpurea***
1. Perennials; spikelets more than 10.0 mm long..... 2
2. Glumes membranous, keel green;
   nuts smooth..... 4. ***E. palustris***
2. Glumes sub-rigid, not keeled; nuts vertically striate.....3
3. Culms terete, hollow, transversely septate when dry..... 3. ***E. dulcis***
3. Culms triquetrous, solid, not transversely septate.....1. ***E. acutangula***

1. Eleocharis acutangula (Roxb.) Schult. in Roem. & Schult. Mant. 2: 91. 1824; Fl. Rajasthan 3: 914. 1993. *Scirpus acutangulus* Roxb. Fl. Ind. 1: 216. 1820. *S. fistulosus* Poir. in Lamk. Encycl. 6: 749. 1804, non Forsk. 1775. *Eleocharis fistulosa* (Poir.) Schult. in Roem. & Schult. Mant. 2: 89. 1824, *nom illeigit.*; FBI. 6: 626. 1893.

Perennial, tufted, stoloniferous herbs. Leaves represented by sheaths. Spikelets cylindric, up to 3.0 cm long, subacute, obtusely angular, pale-green. Glumes ovate to ovate-elliptic, rounded, unicostate, hyaline. Nuts compressed, up to 2.0 mm long, triangular, apex constricted to annular neck. Hypogynous bristles 6, rigid, retrorsely barbulate. **Flowering and fruiting.** December-June. Occasionally found in marshy habitats. Sweta 1370.

2. Eleocharis atropurpurea (Retz.) Presl, Reliq. Haenk. 1: 196. 1826; FBI. 6: 627.1893 *et* Illus. Cyper. t. 36. f. 6-9. 1909; Fl. Rajasthan 3: 915. 1993. *Scirpus atropurpureus* Retz. Obs. Bot. 5: 14. 1789. *Heleocharis atropurpurea* (Retz.) Kunth, Enum. 2: 151. 1837; FUGP. 2: 400. Repr. ed. 1960.

Annual, tufted sedges, up to 30.0 cm high. Leaves absent. Sheath membranous, reddish tinged, glabrous. Spikelets 0.2-0.50 cm broad, terminal, long, ovoid, acute, purplish-brown.

Glumes 0.3-0.75 cm, ovate-oblong, dark-brown, keel greenish. Hypogynous bristles 4-5, longer than the achene, whitish. Nuts biconvex, minute, smooth, black or dark-brown, rouded-truncate at apex. **Flowering and fruiting :** September-April. Occurs in marshy habitats or in paddy fields. Sweta 410.

Note: Author citation, according to WCSPF was as follows:

Eleocharis atropurpurea (Retz.) Kunth, Enum. Pl. 2: 151 (1837). Since the combination of Presl was published earlier, therefore, I have retained it. This error in the WCSPF was communicated to Dr. R. Govaerts. In his e-mail dated May 19, 2009, he agreed that this was valid and made necessory change in the database.

3. Eleocharis dulcis (Burm. f.) Trin. ex. Hensch. Vita Rumph. 186. 1833; Fl. Rajasthan 3: 916. 1993. *Andropogon dulce* Burm. f. Ind. 219. 1768. *Scirpus plantagineus* Retz. Obs. Bot. 5: 14. 1799. *Eleocharis plantaginea* (Retz.) Roem. & Schult. Syst. Veg. 2: 150. 1817; FBI. 6: 625. 1893; FUGP. 2: 401. Repr. ed. 1960.

Perennial, robust, densely tufted, stoloniferous herbs. Basal sheath membranous, reddish-brown. Spikelets cylindric, 1.5-3.5 cm long, brownish-green, terete, many-flowered. Glumes imbricate, elliptic-oblong, truncate, hyaline. Bristles 6-8, hispid, unequal, retrosely scabrid. Nuts obovoid, smooth, brownish-yellow, tipped by conical style base. **Flowering and fruiting :** June-December. **Local Name.** *Naryee*. Commonly found in swampy and marshy areas. Sweta 827.

4. Eleocharis palustris (L.) R. Br. Prod. Fl. Nov. Holl. 1: 224. 1810 *emend.* Roem. & Schult. Syst. Veg. 2: 151. 1817, *sp. aggr.*; FBI. 6: 628. 1893; Fl. Rajasthan 3: 917. 1993. *Scirpus palustris* L. Sp. Pl. 1: 47. 1753. *Heleocharis palustris* (L.) R. Br. Prodr. Fl. Nov. Holland.. 1: 224. 1810; FUGP. 2: 400. Repr. ed. 1960.

Erect tufted, stoloniferous sedges. Basal sheath membranous, truncate. Spikelets 0.1-0.2 cm long, cylindrical, yellowish-brown. Glumes imbricate, ovate-lanceolate, keel green. Nuts *c.* 2.0 mm long, obovoid, biconvex, pale-brown, smooth, shiny. Hypogynous bristles 3-6, retrosely scabrid. **Flowering and fruiting :** January-June. Occurs frequently in marshy places and on moist bed of Ganga. Sweta 829.

6. FIMBRISTYLIS Vahl *nom. cons.*

Key to species:

1. Stigmas 2; nut biconvex..... 2
1. Stigmas 3; nut trigonous..... 5
2. Ligule of a ciliate auricle or a fringe of pubescens..... 3
2. Ligule absent; style base glabrous..... 1. ***F. aestivalis***
3. Spikelets 2.0 -4.0 mm wide; glumes usually with 2-4

lateral nerves...4

3. Spikelets 1.2 – 1.8 mm wide; glumes usually without distinct lateral nerves.....2. ***F. bisumbellata***

4. Style-base conical; stamens usually 2..... 3. ***F. dichotoma*** ssp. ***dichotoma***

4. Style-base inconspicuous; stamen usually 1.....4. ***F. dichotoma*** ssp. ***podocarpa***

5. Glumes 2-ranked, at in the lower part of a spikelet.....5. ***F. ovata***

5. Glumes spirally imbricated.....6

6. All leaves at the culm base with blade; ligule none; rhizome very short or inconspicuous; glumes glabrous, puberulous on upper half with short glandular hairs; keel acute .....7. ***F. tenera***

6. Some leaves at culm-base reduced to bladeless sheath..... 7

7. Culms compressed; tetragonal; leaves laterally flattened; rachilla deeply pitted after the fall of glumes..... 4. ***F. miliacea***

7. Culms acutely pentagonous; leaves dorsiventrally flattened; rachilla ragged with scale like wings after the fall of glumes.....6. ***F. quinquangularis***

1. Fimbristylis aestivalis (Retz.) Vahl, Enum. Pl. 2: 288. 1805; FBI. 6: 637. 1893; Fl. Rajasthan 3: 920. 1993. *Scirpus aestivalis* Retz. Obs. Bot. 4: 12. 1786.

Densely tufted annual herbs. Leaves linear, acute. Sheath hairy, yellowish-brown. Inflorescence a terminal, dense, compound umbel. Bracts 3, unequal. Spikelets 0.1-0.15 cm broad, lanceolate-ovate, solitary, 8-30 flowered. Glumes boat-shaped, mucronate, lower ones hairy, 3-nerved, keeled, brownish. Nuts slightly biconvex, cuneate at base, yellow. **Flowering and fruiting :** August-December. Rarely, found in marshy places. Sweta 1372.

2. Fimbristylis bisumbellata (Forsk.) Bubani. Dodecanth. 30. 1850; Fl. Rajasthan 3. 921. 1993. *Scirpus bisumbellata* Forsk. Fl. Aegypt.-Arab. 15. 1775. *Fimbristylis dichotoma auct.* non Vahl, 1806; FBI. 6: 635. 1893; FUGP. 2: 403 . Repr. ed. 1960.

Densely tufted, annual herbs. Leaf blades 5.0-15.0 cm long, linear, blunt at apex, margins scabrous, incurved. Sheath 1-3 cm long, pale-green, membranous, hairy. Bracts leafy 1-3, unequal. Inflorescence a compound umbel. Spikelets ovate-oblong, yellow-brown, acute, 10-25 flowered. Glumes broadly ovate, boat shaped, apiculate, keel ridged, excurrent into a recurved mucro. Nuts broadly ovate, light-brown or yellow, smooth, minute, rounded. **Flowering and fruiting :** June-March. Common in marshy places and along river banks. Sweta 424, 704.

3. Fimbristylis dichotoma (L.) Vahl, Enum. Pl. 2: 287.1805; Fl. Rajasthan 3: 923. 1993. *Scirpus dichotomus* L. Sp. Pl. 50. 1753. *S. diphylla* Retz. Obs. Bot. 5: 15. 1789. *Fimbristylis diphylla* (Retz.) Vahl, Enum. Pl. 2: 289.1805; FBI. 6: 636.1893; FUGP. 2: 402. Repr. ed. 1960.

subsp. **dichotoma**

Tufted perennials. Leaves 0.15-0.30 cm broad, linear, glabrous. Inflorescence a compound umbel. Bracts 5, unequal. Spikelets ovate-lanceolate, sessile, brown. Glumes 0.1-0.25 cm broad, ovate, mucronate, keeled. Stamens 2. Style hairy. Nut transversely rugose, straw-coloured. **Flowering and fruiting :** July-November. Common in moist, sandy localities. Sweta 1380.

subsp. **podocarpa** (Nees & Meyen ex Nees) Koyama in Micronesica 1: 87. 1964; Fl. Rajasthan 3: 923.1993. *F. podocarpa* Nees & Meyen ex. Nees in Wight, Contrib. Bot. India 98.1834, includ. vr. α, β & γ; FBI. 6: 638.1893; FUGP. 2: 404.Repr. ed. 1960.

Erect annual or perennial herbs. Leaves 0.1-0.25 cm broad, linear, smooth. Inflorescence simple or compound corymbs. Spikelets many flowered, ovate, acute. Glumes ovoid to ovoid-ellipsoidal or orbicular, pale brown, lateral nerves 2-3. Stamen 1. Nuts flattened, thickly biconvex. **Flowering and fruiting:** Almost throughout the year. Occasionally found in the marshy places. Sweta 87.

4. Fimbristylis miliacea (L.) Vahl, Enum. Pl. 2: 287.1805; FBI. 6: 644; 1893; FUGP. 2: 406. Repr. ed. 1960; Fl. Rajasthan 3: 925.1993. *Scirpus miliaceus* L. Syst. Nat. ed. 10. 2: 868.1759.

Erect, annual herbs with short woody rhizomes. Leaves 0.1-0.25 cm broad, basal, margins thick. Inflorescence a decompound umbel. Bracts short, unequal, leafy. Spikelet solitary, brown, obtuse, 0.2-0.4 x 0.1-0.2 cm, many flowered. Glumes oblong, obtuse, boat-shaped, mucronate, pale-brown, keeled, glabrous. Stamens 2. Nuts trigonous, dirty white. **Flowering and fruiting :** July-November. Common in moist and swampy places.

5. Fimbristylis ovata (Burm. f.) Kern in Blumea 15: 126. 1967; Fl. Rajasthan 3: 925.1993. *Carex ovata* Burm.f. Fl. Ind. 194.1768. *Cyperus monostachyos* L. Mant. Pl. 2: 180.1771. *Fimbristylis monostachya* (L.) Hassk. Pl. Jav. Rar. 61. 1848; FBI. 6: 649.1893; FUGP. 2: 405.Repr. ed. 1960.

Erect perennial herbs, rhizomes short, knotty. Leaves linear, acute, shorter than stem. Sheath scarious on margins. Inflorescence a single terminal spikelet, 0.5-1.5 x 0.25-0.75 cm, narrowly ovate, acute, 10-20 flowered. Glumes triangular, ovate, acute keel, mucronate, pale-

yellow. Nuts trigonous, light-brown, rounded, yellowish. **Flowering and fruiting:** August-November. Frequently found in damp, sandy soil. Sweta 198.

6. Fimbristylis quinquangularis (Vahl) Kunth, Enum. Pl. 2: 229. 1837 (1827? IPNI); FBI. 6: 644. 1893; FUGP. 2: 406. Repr. ed. 1960; Fl. Rajasthan 3: 926. 1993. *Scirpus quinquangularis* Vahl, Enum. Pl. 2: 279. 1805. *Fimbristylis miliacea* (L.) Vahl, Enum. Pl. 2: 267. 1805, nom. rejic.

Erect, annual herbs with short woody rhizomes. Leaves 0.1-0.25 cm broad, basal, margins thick. Inflorescence a decompound umbel. Bracts short, unequal, leafy. Spikelet solitary, brown, obtuse, 0.2-0.4 x 0.1-0.2 cm, many flowered. Glumes oblong, obtuse, boat-shaped, mucronate, pale-brown, keeled, glabrous. Stamens 2. Nuts trigonous, dirty white. **Flowering and fruiting :** July-November. Common in moist and swampy places. Sweta 153, 231.

Note: In Flora of Rajasthan (Shetty and Singh, 1993) *Fimbristylis miliacea* (L.) Vahl and *Fimbristylis quinquangularis* (Vahl) Kunth are treated as different species. But according to WCSPF they are conspecific.

7. Fimbristylis tenera Roem.& Schult. Mant. Syst. 2: 57.1824; FBI. 6: 642.1893; FUGP. 2: 406. Repr. ed. 1960; Fl. Rajasthan 3: 929. 1993. *Scirpus tenellus* Roxb. Fl. Ind. 1: 227. 1820, non *F. tenella* Schult. 1824.

Tufted, tall, erect, annual herbs with very short rhizomes. Leaves 1.0-12.0 x 0.025-0.1 cm, linear, falcate. Sheath red-punctate. Corymbs simple or compound with 3-14 spikelets. Bracts 2-4, leafy. Spikelets 0.1-0.2 cm broad, ovoid , lanceolate, acute, brownish-red. Glumes broadly ovate, boat-shaped, with an acute keel, margins hyaline. Nut trignous, dirty-white, minutely verrucose. **Flowering and fruiting :** July-November. Frequently found in paddy fields. Sweta 57.

7. KYLLINGA Rottb. *nom. cons.*

Key to species:

1. Glumes winged on keels; plants stoloniferous;
   wings of glumes serrulate-scabrous..... 4. ***K. nemoralis***
1. Glumes not winged on keel.....2
2. Rhizomes long, stolonoferous; culms arrnaged in
   a single file along the rhizome; keel of glumes spinulose
   at least towards the apex..... 1. ***K. brevifolius***
2. Rhizomes short, not stolonoferous..... 3
3. Lower 2 glumes 1 or 3 nerved; nuts brownish..... 2. ***K. bulbosus***
3. First and second glumes 9-11 nerved; nuts black..... 3. ***K. odorata*** subsp. ***cylindrica***

1. Kyllinga brevifolia Rottb. Descr. Ic. Rar. Nov. Pl. 13. t. 4. f. 3. 1773; FBI. 6: 588.1893; FUGP. 2: 396. Repr. ed. 1960; Fl. Rajasthan 3: 932. 1993. *Cyperus brevifolius* (Rottb.) Hassk. Cat. Hort. Bot. Bogor. 24.1844.

Perennial, rhizomatous herbs. Leaves 0.1-0.35 cm broad, linear, scabrid on margins. Sheath short, membranous, brownish. Inflorescence terminal single, globose head. Bracts 3-4, unequal. Spikelets lanceolate, numerous, greenish-white, laterally compressed, 1-2 flowered. Glumes ovate-lanceolate, keel acute, membranous, 5-7 nerved. Stamens 2. Nuts obovate, brownish, compressed. **Flowering and fruiting :** July-December. Found in marshy habitats and on the edges of paddy fields. Sweta 1381.

2. Kyllinga bulbosa Beauv. Fl. d'Oware & Benin 1: 11. t. 8. f. 1. 1804; Koyama in Dassanayake & Fosberg, Fl. Ceylon 5: 245. 1985; Fl. Rajasthan 3: 933. 1993. *K. triceps* Rottb. Descr. Ic. Rar. Nov. Pl. 14. t. 4. f. 6. 1773, *nom. illegit*; FBI. 6: 587. 1893; FUGP. 2: 396. Repr. ed. 1960. *Schaenoides triceps* Rottb. Descr. Pl. Rar. Progr. 15. 1772, *invalid name. Cyperus triceps* (Rottb.) Endl. Cat. Hort. Acad. Vindb. 1: 94.1842 , *nom. illegit.*

Erect, densely tufted, small perennial herbs. Leaves flat, linear, 0.1-0.25 cm, acuminate. Inflorescence a terminal head of 3-5 spikes. Bracts leafy 2-4, linear, unequal. Spikelets 0.15 x 0.06 cm, lanceolate, greenish, 1- flowered. Glume ovate-oblong, acute, keeled. Stamens 2. Nut brownish, oblong apiculate, laterally compressed. **Flowering and fruiting :** July-November. Frequently found in sandy localities and on roadsides. Sweta 1549.

3. Kyllinga nemoralis (J. R. & G. Forster) Dandy ex Hutch. & Dalz. Fl. West. Trop. Africa 2: 487. 1936; Fl. Rajasthan 3: 933. 1993. *Thryocephalon nemorale* J. R. & G. Forster, Char. Gen. Pl. 130. 1776. *Kyllinga monocephala* Rottb. Descr. Ic. Rar. Nov. Pl. 13. t. 4. f. 4. 1773, *nom. illegit.;* FBI. 6: 588. 1893; FUGP. 2: 397. Repr. ed. 1960.

Tufted, erect, perennial herbs. Leaves basal, 0.1-0.45 cm broad, slightly shorter than the stem, linear. Inflorescence a terminal head bearing globose central spike and 2-3 small lateral spikes. Bracts 3, leafy. Spikelets compressed, ovate-elliptic,whitish, 1-2 flowered. Glumes usually five, the lowest two smaller and narrow, ovate, acuminate, brownish, 3-4 nerved on either sides of keel. Nut reddish-brown, apiculate, oblong or biconvex. **Flowering and fruiting :** July-December. Found rarely in marshy places. Sweta 1553.

Note: According to IPNI the citation of the basionym is as follows: *Thryocephalon nemorale* J.R.Forst. & G.Forst. Char. Gen. Pl. 65. 1775.

4. Kyllinga odorata subsp. **cylindrica** (Nees) T.Koyama, Gard. Bull. Singapore 30: 161. 1977. *Kyllinga cylindrica* Nees in R.Wight, Contr. Bot. India: 91. 1834; Bot. Bihar & Orissa 3: 950. Repr. ed. 1961.

According to Haines (1921-24) this species is more slender than *K. bulbosa* Beauv. Stem up to 30 cm , not much thickened into short rootstock. Heads cylindric up to 4.0 mm long. Keel green, scarcely excurrent, sides strongly nerved. Included on authority of Murty & Singh (1961b). This is the only report of the occurrence of this species in Upper Gangetic Plain and adjoining areas.

8. MARISCUS Vahl *nom. cons.*

Key to species:

1. Anthela compound or decompound; spikes globose.....1. ***M. compactus***
1. Anthela simple; cylindrical, subglobose or ellipsoidal..... 2
2. Spikelets more or less flattened, with an acute edge, bearing 3-many nuts; glumes folded, with conspicuous keel and recurved awn..... 3. ***M. squarrosus***
2. Spikelets terete, without conspicuous edge, bearing 1-2 nuts; glumes involute, without distinct keel and awn; base of culm hardly enlarged; basal leaf sheaths purplish-brown..... 3
3. Spikelets 4.0-5.0 mm long, patent to ascending at maturity; nuts 2, 2.0 mm long..... 4. ***M. sumatrensis***
3. Spikelets 2.0 3.0 mm long, spreading at maturity; nut single, less than 2.0 mm long..... 2. ***M. paniceus***

1. Mariscus compactus (Retz.) Bold., Zakfl. Java: 77 .1916. *Cyperus compactus* Retz. Obs. Bot. 5: 10. 1789. *M. microcephalus* Presl. Reliq. Haenk. 1: 182. 1828; FBI. 6: 624. 1893. *M. dilutus* Nees in Wight, Contrib. Bot. Ind. 90. 1834; FUGP. 2: 398. Repr. ed. 1960.

Perennial sedges with, short, often corm like rhizomes. Culms obtusely trigonous to subterete, solitary or few together. Leaves few, slightly longer than the stem. Sheaths purple-brown. Bracts 3-5 or up to 8, patent to divergent, unequal. Spikes with many, stellately arranged spikelets. Rachis very short. Spikelets jointed at the base, narrowly lanceolate to linear-subulate, pale-green and tinged with rusty-brown. Rachilla wings pale-white, hyaline. Glumes 5-7 nerved, obtuse or subacute at apex. Nuts linear-oblong, trigonous, yellow-brown. **Flowering and fruiting:** July-September. Found in moist habitats. Sweta 1120.

Note: According to WCSPF the acepted name of this species is *Cyperuscompactus*. Citation is as follows:

Cyperus compactus Retz., Observ. Bot. 5: 10 (1788).

2. Mariscus paniceus (Rottb.) Vahl, Enum. Pl. 2: 373. 1805; FBI. 6: 620.1893, includ. var. *roxburghiana*; FUGP. 2: 399. Repr. ed. 1960; Koyama in Gard. Bull. Singapore 30:

157.1977; Fl. Rajasthan 3: 938. 1993. *Schaenoides paniceus* Rottb. Descr. Pl. Rar. Progr. 15. 1772, *nom. provis. Kyllinga panicea* Rottb. Descr. Ic. Rar. Nov. Pl. 15. t. 4. f. 1.1773.

Erect, perennial, glabrous herbs. Leaves shorter than the stem, 0.25-0.50cm broad, slender-linear, acute. Sheaths reddish-brown. Bracts leaf like, 2-4, unequal. Inflorescence simple umble. Spikes 0.2-0.6 cm broad, truncate. Spikelets ovate-lanceolate, greenish, 1-flowered. Glumes 4. Lowest glume empty, second glume ovate, empty, third glume fertile, ovate, keeled, fourth glume ovate-lanceolate. Stamens 3. Anther apiculate. Nut elliptic oblong, trigonous, pale brown. **Flowering and fruiting :** July-November. Frequently found in moist sandy places. Sweta 99.

Note: According to WCSPF the acepted name of this species is *Cyperus paniceus*. Citation is as follows:

Cyperus paniceus (Rottb.) Boeckeler, Linnaea 36: 381 (1870).

3. Mariscus squarrosus (L.) Clarke in FBI. 6: 623. 1893; Koyama in Gard. Bull. Singapore 30: 153. 1977; Fl. Rajasthan 3: 939. 1993. *Cyperus squarrosus* L. Cent. Pl. 2: 6. 1756. *C. aristatus* Rottb. Descr. Pl. Rar. Progr. 22. 1772 *et* Descr. Ic. Rar. Nov. Pl. 23. t. 6. f. 1. 1773; FBI. 6: 606. 1893; FUGP. 2: 385 . Repr. ed. 1960.

Erect, annual herbs with reddish fibrous roots. Leaves linear, 0.1-0.25 cm broad, filiform, shorter than the stem. Sheaths membranous, greenish. Inflorescene a compound umbel. Bracts 2-4, unequal, longer than inflorescence. Spikes 0.5-1.25 cm broad, yellowish -green. Spikelets membranous, ovate-oblong, greenish. Glume ovate, recurved awns, keeled. Stamens 1. Nuts obovoid, triangular, pale brown, apiculate. **Flowering and fruiting:** July-November. Commonly found in sandy localities and on roadsides. Sweta 1596.

Note: According to WCSPF the accepted of this species is ***Cyperus squarrosus*** L., Cent. Pl. II: 6 (1756).

4. Mariscus sumatrensis (Retz.) J. Raynal in Adansonia 15: 110. 1975; Fl. Rajasthan 3: 939. 1993. *Kyllinga sumatrensis* Retz. Obs. Bot. 4: 13. 1786. *Scirpus cyperoides* L. Mant. Pl. 2: 181. 1771, non *Mariscus cyperoides* (Roxb.) A. Dietr. *Mariscus sieberianus* Nees ex Clarke in FBI. 6: 622. 1893 *et* Illus. Cyper. t. 23. f. 5-6. 1909. *Cyperus cyperoides* (L.) O. Ktze. Rev. Gen. Pl. 3 (2): 333. 1898.

Perennial herbs, rhizome short, woody. Leaves usually longer than the stem, 0.2-0.50 cm broad, flat, acuminate. Inflorescence a compound umbel. Bracts 6-10, unequal, leafy. Spikes cylindric-oblong, pale brown. Spikelets linear-lanceolate, 3-5 flowered. Glumes membranous, ovate-oblong, acute. Stamens 3. Style arms 3. Ovary elongated. Anthers elongated, apiculate. Nuts trigonous, straw coloured, ellipsoidal. **Flowering and fruiting** :June-November. Common in sahdy places. Sweta 1477.

Note: According to WCSPF the accepted name for this species is *Cyperus cyperoides* (L.) Kuntze, Revis. Gen. Pl. 3(2): 333 (1898) subsp. *cyperoides*.

9. PYCREUS P. Beauv.

Key to species:

1. Glumes with 3-nerved keel and nerveless
   sides; stamen usually 1..... 2. ***P. pumillus***
1. Glumes with 3-nerved keel and distinctly
   nerved sides; stamens usually 2.....2
2. Stem erect, not rooting at the lower nodes;
   glumes with straight keel. without
   depression; nuts oblong or oblong-obovate.....1. ***P. flavidus***
2. Stem decumbent and rooting at the lower nodes;
   keel of glumes arcuate and usually with a depression on either
   side; nuts oblong to almost orbicular..... 3. ***P. sanguinolentus***

1. Pycreus flavidus (Retz.) Koyama in Journ. Jap. Bot. 51: 313. 1976; Fl. Rajasthan 3: 942. 1993. *Cyperus flavidus* Retz. Obs. Bot. 5: 13.1788, non Clarke in FBI 6: 600.1893. *C. globosus* All. Fl. Pedem. Auct. 49.1789, non Forsk. 1775. *C. capillaris* Koenig ex Roxb. Fl. India 1: 198. 1820. *Pycreus globosus* (All.) Reich. Fl. Germ. Exc. 2:140.1830, *nom. illegit.* ; FUGP. 2: 392. Repr. ed. 1960. *P. capillaris* (Koenig ex Roxb.) Nees ex Clarke in FBI. 6: 591.1893.

var. **flavidus**

Erect, marshy, perennial herbs. Leaves linear, gland-punctate, longer than stem, 0.1-0.3 cm broad. Inflorescence a compound umbel. Spikelets lanceolate, umbellate, spreading, strongly flattened, densely 10-15 flowered, brownish or dirty-white. Glumes pale-brown, folded, ovate-oblong, keeled. Rachis ciliate. Stamens 2. Nuts obovate to oblong, apiculate, compressed, keeled, dark-brown. **Flowering and fruiting :** August-November. Frequently found in marshy places, and on margins of ponds, lakes and ditches. Sweta 232.

2. Pycreus pumilus (L.) Nees, Linnaea 9: 283. 1834; FUGP. 2: 393. Repr. ed. 1960; Fl. Rajasthan 3: 943. 1993. *Cyperus pumilus* L. Cent. Pl. 2: 6. 1756. *Pycreus nitens* Nees in Nova Actor. Acad. Caes. Leop.-Carol. Nat. Cur. 19. Suppl. 1: 53. 1843; FBI. 6: 591. 1893.

Small, glabrous, tufted, annual herbs. Leaves 0.1-0.25 cm broad, linear, shorter or longer than the culm. Inflorescence a compound umbel of short spikes or contracted to a head. Bracts 3-5, leafy. Spikelets linear, compressed, 10-30 flowered, light greenish, digitate. Glumes ovate, boat-shaped, acute, keeled, greenish. Nuts obovoid, compressed, blackish, minute, apiculate.

Flowering and fruiting : August-October. Commonly found in agricultural fields, and in open moist places. Sweta 330.

3. Pycreus sanguinolentus (Vahl) Nees, Linnaea 9: 283. 1834; Fl. Rajasthan 3: 944. 1993; FUGP. 2: 393. Repr. ed. 1960. *Cyperus sanguinolentus* Vahl. Enum. Pl. 2: 351. 1805.

Annual or short-lived perennial, with short rhizome. Culms tufted, trigonous. Leaves shorter than the culms. Anthels simple with 2-5 short rays or or more or less in a head-like cluster. Spikes ovoid, densely bearing 3-15 spikelets on short rachis. Bracts leafy, 3-5 unequal. Spikelets narrowly ovate or lanceolate-oblong, subacute, flattened, 10-30 flowered, brownish. Rachilla 4-gonous straight. Glumes ovate, obtuse, membranous, sides nerveless, pale-brown, keel 3-5 nerved. **Flowering and fruiting:** July – December. Found in marshy habitats. Sweta 773.

10. SCHOENOPLECTUS (Reichb.) Palla *nom. cons.*

Key to species:

1. Inflorescence congested in a head, rarely corymbose with short rays..... 2
1. Inflorescence anthellate, open, with elongated rays.....4
2. Hypogynous bristles retrorsely scabrid; culms triquetrous; styles 3..... 3. ***S. mucronatus***
2. Hypogynous bristles absent; culms usually flowering in the upper half; not or scarcely septate when dry; glumes mucronate, distinctly keeled..... 3
3. Culms often septate when dry; glumes multistriate, lax, inflated in fruit..... ....4. ***S. roylei***
3. Glumes aseptate when dry; glumes smooth, imbricating, not inflated in fruit..... 5. ***S. supinus***
4. Hypogynous bristles soft, plumose..... 2. ***S. littoralis***
4. Hypogynous harsh, retrorsely scabrid..... 1. ***S. lacustris***

1. Schoenoplectus lacustris (L.) Palla in Sitzber. Zool.-Bot. Ges. Wien 38: 49. 1888 *et* Bot. Jahrb. Syst. 10: 298. 1889; Fl. Rajasthan 3: 948. 1993. *Scirpus lacustirs* L. Sp. Pl. 48. 1753; FBI. 6: 658. 1894; FUGP. 2: 412. Repr. ed. 1960.

Perennial sedges, rhizome horizontal. Culms terete or obtusely triangular near the top. Sheath membranous, acute. Leaves mostly absent or 4, floating. Umbels reduced to small terminal head. Glumes ovate, notched tip, margins pilose. Nuts obovoid, plano-convex, smooth, dark-brown. **Flowering and fruiting :** January-April. Common in marshy places. Sweta 730.

2. Schoenoplectus litoralis (Schrad.) Palla subsp. **subulatus** (Vahl) Koyama in Dassanayake and Fosberg, Fl. Ceylon 5: 157. 1985; Fl. Rajasthan 3: 948. 1993. *Scirpus subulatus* Vahl, Enum. Pl. 2: 268. 1805. *S. littoralis sensu* Clarke in FBI. 6: 659. 1893, non Schrad. 1806.; FUGP. 2: 411. Repr. ed. 1960.

Erect, perennial herbs with stoloniferous rhizomes. Leaves absent. Sheaths membranous, brownish. Inflorescence pseudolateral, simple, umbellate corymb. Rays slightly compressed. Spikelets 0.25-0.5 cm broad, oblong-ovate, many flowered. Glumes ovate-oblong, membranous, brown, keeled. Bristle 3-4, papulose near the base, plumose upward. Nuts broadly obovate, brownish-black. **Flowering and fruiting :** October- April. Found in marshy places and on banks of Ganga and canals. Sweta 1425.

Note: In Flora of Rajasthan (Shetty and Singh, 1993) the specific epithet is spelled as **'littoralis'**.

3. Schoenoplectus mucronatus (L.) Palla in Sitzber. Zool.-Bot. Ges. Wien 38: 49.1888; Fl. Rajasthan 3: 949.1993. *Scirpus mucronatus* L. Sp. Pl. 50.1753; FBI. 6: 657.1893; FUGP. 2: 409. Repr. ed. 1960. *S. triangulatus* Roxb. Fl. India 1: 219.1820.

Erect, perennial, rhizomatous herbs. Leaves absent. Sheath membranous, lowest scale like, throat oblique. Inflorescence a hemispherical head. Bract 1. Glumes ovate, many nerved, boat-shaped, brownish, membranous, mucronate. Stamens 3. Anthers yellow. Hypogynous bristles 6, white, scabrous. Nuts transversely wrinkled, triangular, apiculate, brownish- black. **Flowering and fruiting :** July-December. Found in marshy places. Sweta 450, 718.

4. Schoenoplectus roylei (Nees) Lye in Bot. Notiser 124: 290.1971; Fl. Rajasthan 3: 950.1993. *Isolepis roylei* Nees in Wight, Contrib. 107.1834. *Scirpus quinquerfarius* Buch. - Ham. ex Bocck. in Linnaea 36:701.1870; FBI.6: 657.1893. *S. roylei* (Nees) Parker in FUGP. 2: 410. Repr. ed. 1960.

Erect, annual sedges with fibrous roots. Leaves absent. Infloresence pseudolateral heads. Spikelets 0.5-1.5 cm long, ovoid-oblong, acute, slightly compressed, shining, straw-brown. Glumes 5-ranked, many-ribbed, elliptic-lanceolate, membranous, keeled. Nuts about 1.5 cm long, trigonous, apiculate, black. **Flowering and fruiting:** October – March. Common in marshy places. Sweta 1460.

Note: Lye (2003) described a new genus *Schoenoplectiella* based mainly on *rbc*L data to seggregate all annual taxa, previously part of *Schoenoplectus* (Simpson et al., 2007). If this seggregation is followed, this species is transferred to Schoenoplectiella as follows:

Schoenoplectiella roylei (Nees) Lye, Lidia 6: 26 (2003).

5. Schoenoplectus supinus (L.) Palla subsp. **lateriflorus** (Gmelin) Koyama in Hara, Stearn & Williams, Enum. Fl. Pl. Nepal 1: 119.1978; Fl. Rajasthan 3: 950.1993. *S. supinus auct.*

plur. non L.1753; FBI. 6: 655.1893 et Illus. Cyper. t. 48. f.13-14.1909; FUGP. 2: 410. Repr. ed. 1960.

Annual or perennial, tufted sedges. Leaves absent. Sheath membranous, glabrous, pale-green. Inflorescence pseudolateral, head like or corymbose. Bracts erect, 1 or 2. Spikelets 3-4 in single lateral cluster, 4.0-8.0 x 2.0-3.0 mm, ovate-lanceolate, pale-green, many flowered. Glumes ovate, boat shaped, keeled. Stamens 3. Nuts 3-gonous, obovate, triangular, apiculate, black, transversely rugose. **Flowering and fruiting.** October-March. Common in marshy places. Sweta 1487.

Note: If transferred to *Schoenoplectiella* and elevatdd to rank of species, the name of this species is as follows:

Schoenoplectiella lateriflora (J.F.Gmel.) Lye, Lidia 6: 25 (2003).

WCSPF citation:

Govaerts R, Simpson D A, Goetghebeur P, Wilson K, Egorova T & Bruhl J (2009) World Checklist of Cyperaceae. The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ accessed 16 May 2009; 10. 40 pm IST.

123. POACEAE

KEY TO GENERA:

1. Upper glume with rows of stout, hooked spines.....57. ***Tragus***
1. Upper glume without spines..... 2
2. Spikelets 2-flowered, falling entire at maturity, usually with female upper floret and male or barren lower one, frequently dorsally compressed..... 3
2. Spikelets 1-many flowered, breaking up at maturity, if falling entire, then not 2-flowered, usually laterally compressed or terete..... 33
3. Spikelets all hermaphrodite, with male or barren or hemaphrodite spikelets mixed in the same inflorescence; if unisexual then lemmas of the fertile floret indurated.....4
3. Male and female spikelets in separate inflorescences or different parts of the same inflorescence.....32
4. Spikelets paired, with one sessile and one pedicelled ones, similar or dissimilar; glumes as long as the spikelet and enclose the florets, rigid; lemmas hyaline or membranous; upper one usually awned..... 5
4. Spikelets solitary or paired, usually similar;

glumes shorter or as long as the spikelets,
membranous; lemmas especially upper one papery
to very tough, rigid, awnless..... 20

5. Spikelets in similar pairs; female joints thin, linear
or slightly dilated at the top..... 6

5. Spikelets in dissimilar pairs, sessile one hermaphrodite,
pedicelled male or sterile or absent, if similar then joints
and pedicel thick and swollen.....10

6. Spikelets in panicles or in compound racemes..... 7

6. Spikelets in 2-few digitate racemes; lower glume more or
less flat, shallowly depressed, neither furrowed nor rounded
on the back; lower glume not markedly truncate; pedicelled
spikelets developed; florets 2; upper lemma 2-toothed.....28. ***Eulaliopsis***

7. Rachis of racemes tough or tardily breaking up..... 8

7. Rachis of racemes fragile, breaking up..... 9

8. Lemmas awned; panicles narrow, contracted; glumes very
delicate; callus hairs twice as ong as the glume or more.....33. ***Imperata***

8. Lemmas unawned.....39. ***Narenga***

9. Spikelets awned.....26. ***Erianthus***

9. Spikelets unawned..... 52. ***Saccharum***

10. Joints of rachis and pedicels swollen, 3-angled,
rounded or flattened..... 11

10. Joints of rachis and pedicels narrow, neither thickened
nor flattened, often with a longitudinal, transluscent groove..... 14

11. Upper lemma awned; sessile spikelets with male and
hermaphrodite florets.....12

11. Upper lemma unawned; sessile spikelets with hermaphrodite
florets only, or rarely with male floret below..... 13

12. Racemes 1-noded, reduced to 3 heteromorphous spkelets,
enclosed in a boat shaped spathe.....3. ***Apluda***

12. Racemes many-noded, espathate..... 35. ***Ischaemum***

13. Sessile spikelets rounded; lower glume pitted..... 29. ***Hackelochloa***

13. Sessile spikelet not rounded; lower glume not pitted;
rachis of the spike tough, not breaking up..... 30. ***Hemarthria***

14. Spikelets in racemes which are neither interrupted by
spathes nor solitary at the end of branches, usually in
whorled panicles..... 15

14 Spikelets in panicles of racemes interrupted by spathes,
if not, then the racemes solitary or digitate; upper lemma from
the tip or sinus, often reduced to hyaline base of an awn.....17

15. Spikelets dorsally compressed (lower glume flat)..... 54. ***Sorghum***

15. Spikelets laterally compressed (lower glume usually convex)..... 16

16. Lower glume tuberculate; spikelets in pairs.....60. ***Vetiveria***

16. Lower glume smooth; spikelet 3-nate at the
end of branches.....14. ***Chrysopogon***

17. Lower glume of the sessile spikelets with in-folded
margins, 2-keeled; awn glabrous..... 18

17. Lower glume of sessile spikelets without inflexed
sides, inturned and rounded, not keeled as above, if keeled then
keeled mostly at the top; racemes without and involucre of
homogamous spikelets; awns long, brown, twisted..... 31. ***Heteropogon***

18. Upper lemma of sessile spikelets awned from the entire tip,
often stipitate and passing into an awn; racemes digitate or
in short, spiciform panicles.....19

18. Upper lemma of sessile spikelets 2-cleft or lobed, awned from
the sinus; racemes 2-nate, combined into large spathate panicles;
plants aromatic.....16. ***Cymbopogon***

19. Joints and pedicels with a translucent furrow; pairs of spikelets
heterogamous .....10. ***Bothriochloa***

19. Joints and pedicels without a translucent furrow; lowest
1-3 pairs of spikelets homogamous; upper lemma of sessile
spikelets reduced to the translucent base of an awn..... 21. ***Dichanthium***

20. Spikelets with an involucre of bristles or subtended by
a solitary bristle, falling with or without bristles at maturity.....21

20. Spikelets not subtended by an involucre of bristles
or a solitary bristle, falling singly..... 23

21. Upper lemma transversely rugose; bristles persistent.....53. ***Setaria***

21. Upper lemma smooth; bristles caducous.....22

22. Involucre of free, naked or plumose bristles..... 46. ***Pennisetum***

22. Involucre of spines or rigid bristles united at the
base in to a hard cup.....12. ***Cenchrus***

23. Spikelets in open panicles, not gibbous..... 43. ***Panicum***

23. Spikelets in secund (1-sided) spikes or spicate racemes,
which are either digitate or scattered, rarely solitary..... 24

24. Lemma of the upper floret more or less crustaceous or
coriaceous, usually with inrolled margins exposing much
of the palea..... 25

24. Lemma of the upper floret thinly cartilagenous,
usually with flat, hyaline margins; spikelets awnless.....22. ***Digitaria***

25. Lower glume and lowest internode of the rachis not formong

a swollen callus at the base of the spikelet..... 26

25. Lower glume and lowest internode of the rachilla forming
a swollen callus at the base of the spikelet; upper lemma
mucronate or shortly awned..... 27. ***Eriochloa***

26. Lower glume turned away from the rachis, with back to
upper lemma facing it, i.e. spikelets abaxial.....27

26. Lower glume turned towards the rachis, with back of
upper lemma turned away from it, i.e. spikelets adaxial..... 31

27. Lower glume usually present, often very much reduced..... 28

27. Lower glume usually absent..... 45. ***Paspalum***

28. Glumes acuminate or awned ; upper lemma not mucronate..... 29

28. Glumes not awned, if acuminate then upper lemma mucronate.....30

29. Leaves linear; culms erect; leaf base not oblique..... 23. ***Echinochloa***

29. Leaves ovte-lanceolate; culms creeping below;
leaf base oblique.....41. ***Oplismenus***

30. Upper lemma acute, not mucronate..... 44. ***Paspalidium***

30. Upper lemma obtuse, mucronate or very short-awned..... 59. ***Urochloa***

31. Lower glume present.....11. ***Brachiaria***

31. Lower glume absent..... 8. ***Axonopus***

32. Male and female flowers in the same inflorescence;
male above and single female flower below; female spikelets
enclosed in a metamorphosed leaf sheath which forms a spherical
or cylindrical, ivory-bead like structure..... 15. ***Coix***

32. Male inflorescence terminal, female axillary; female spikelets
in crowded longitudinal rows on a very thick axis..... 61. ***Zea***

33. Arborescent; leaves articulated with sheaths; stamens 6;
lodicules usually 3 34

33. Otherwise; leaves not articulated with sheaths; stamens 1-3;
lodicules usually 2 or absent.....35

34. Spikelets in dense globose heads; pericarp fleshy,
free from the seeds..... 19. ***Dendrocalamus***

34. Spikelets not in globose heads; pericarp thin;
closely adhering to seeds.....9. ***Bambusa***

35. Spikelets in open or contracted, spicate panicles, less often
in racemes or spikes..... 36

35. Spikelets on opposite sides of the rachis of a solitary spike
or spicate raceme.....58. ***Triticum***

36. Spikelets with one fertile floret, with or without 1 or 2 male or
barren florets below it..... 37

36. Spikelets with 2 or more fertile florets, if one, then with

sterile floret above.....48

37. Glumes minute or suppressed; fertile lemma and palea similar in shape and texture.....38

37. Glumes well developed; fertile lemma and palea not similar.....40

38. Leaf blades ovate-oblong or ovate lanceolate, with inflated sheath; a floating grass; glumes absent; floret one; lemma awned..... 32. ***Hygroryza***

38. Leaf blade linear, acute or acuminate;without inflated sheath; aquatic or marshy grasses..... 39

39. Fertile lemma supported by 2 empty scales; tip of pedicel with 2 lips..... 42. ***Oryza***

39. Fertile lemma solitary; tip of fertile lemma without lips; spikelets imbricate..... 36. ***Leersia***

40 . Spikelets with 3 florets, lower 2 florets reduced to lemmas which are often minute or absent..... 48. ***Phalaris***

40. Spikelets with 1-2 florets..... 41

41. Spikelets with 2 florets.....42

41. Spikelets with 1 floret.....44

42. Lower floret empty, epaleate; glumes about half the length of the spikelet..... 56. ***Thysanolaena***

42. Lower floret male or empty, usually paleate; upper glume as long as the spikelet..... 43

43. Glumes unequal, lower one acute, upper one acuminate; upper lemma awned.....5. ***Arundinella***

43. Glumes equal, obtuse or mucronate; upper lemma awnless..... 34. ***Isachne***

44. Spikelets very rarely falling entire, and then with firmly membranous to coriaceous, awned or 5-nerved lemmas..... 45

44. Spikelets falling entire at maturity, either singly or in clusters..... 47. ***Perotis***

45. Lemmas hyaline or membranous at maturity, rarely indurated and then laterally compressed.....46

45. Lemmas indurated or rigid at maturity, terete or dorsally compressed..... 4. ***Aristida***

46. Lemmas 1-3 nerved, awnless; glumes and lemmas similar in texture, hyaline or thinly membranous.....55. ***Sporobolus***

46. Lemmas usually 3-5-nerved, very often awned; glumes longer and firmer than hyaline lemmas..... 47

47. Panicle cylindric, spiciform, compact.....2. ***Alopecurus***

47. Panicle spreading, lobulate..... 51. ***Polypogon***

48. Lemmas or rachilla joints long hairy which envelope lemmas..... 49

48. Lemmas and rachilla joints glabrous, if hairy, then hairs not

enveloping lemmas, or if so, then lemmas with a geniculate awn..... 50

49. Lemmas gabrous; rachilla long hairy.....49. ***Phragmites***

49. Lemmas hairy on the back; rachilla glabrous..... 6. ***Arundo***

50. Glumes as long as or longer than the lowest floret, often as long as the spikelet..... 7. ***Avena***

50. Glumes usually shorter than the lowest floret, with the upper floret distinctly exserted.....51

51. Lemmas 5-13 nerved..... 52

51. Lemmas 1-3 nerved.....53

52. Spikelets in a simple, solitary raceme, awned..... 38. ***Lolium***

52. Spikelets in panicle, awnless..... 50. ***Poa***

53. Inflorescence of digitate secund spikes.....54

53. Inflorescence of panicles.....55

54. Spikelets without imperfect flowers, awnless.....17. ***Cynodon***

54. Spikelets with 1 or more imperfect flowers, awned.....13. ***Chloris***

55. Lemmas 2-4 lobed or –toothed or – notched at the apex, if entire, then hairy on the nerves.....56

55. Lemmas usually entire at the apex, obtuse, acute or acuminate; lemmas 1-3 nerved; inflorescence a panicle or a raceme 57

56. Spikelets in panicles; perennials.....40. ***Neyraudia***

56. Spikelets in spike – like racemes.....37. ***Leptochloa***

57. Spikelets in open or contracted spicate panicle..... 25. ***Eragrostis***

57. Spikelets in digitate or racemosely arranged spikes or spicate racemes..... 58

58. Axis and branches or inflorescence ending in a spikelet..... 59

58. Axis of the spike ending in a sharp point.....18. ***Dactyloctenium***

59. Spikelets falling entire, in numerous spikes which are crowded into a long, narrow, dense or lax panicle.....20. ***Desmostachya***

59. Spikelets breaking up at maturity; spikes few to several..... 60

60. Spikes usually in pseudo-whorls or scattered; lemmas with the lateral nerves running out into minute teeth and the middle nerve into a mucro or short awn..... 1. ***Acrachne***

60. Spikes digitate or subdigitate; lemma entire; spikes persistent.....24. ***Eleusine***

1. **ACRACHNE** Wt. & Arn. ex. Chiov.

Acrachne racemosa (Heyne ex Roth) Ohwi in Bull. Tokyo Sci. Mus. no. 18: 1. 1947; GBCIP. 487. 1960; Fl. Rajasthan 3: 969. 1993; Moulik 2: 584. 1997 . *Eleusine racemosa* Heyne ex Roem. & Schult. Syst. Veg. 2: 583. 1817. *E. verticillata* Roxb. Fl. Ind. 1: 346. 1820; FBI. 7: 295.1897.

Erect or decumbent-ascending herbs. Leaves 4.0-12.0 x 0.25-1.0 cm, linear, acuminate. Ligule short, fimbriate. Spikelets scattered, pedicellate, ellipsoidal. Spikelets many flowered, brownish and shining. Glumes unequal, acuminate. Lemma 3-nerved, two lateral ones running out into minute teeth, the middle one in form of awn. Caryopsis rugose. **Flowering and fruiting:** August-November. Common in sandy loam soil. Sweta 1493.

2. ALOPECURUS L.

Alopecurus nepalensis Trin. ex Steud. Syn. Pl. Glum. 1: 148. 1854; FBI. 7: 239. 1897; GBCIP. 393. 1960; Moulik 2: 383. 1997.

Prostrate or decumbent-ascending herbs. Leaves 12.0 x 0.1-0.2 cm, linear, long, acuminate. Ligule fimbriate. Spikelets pedicellate, ellipsoidal. Glumes acute, 0.2 cm long. Lemma truncate, 0.25-0.3 cm long, unawned. Stamens 2-3, anthers yellow. **Flowering and fruiting:** December-April. common on moist, clayey soil on bed of Ganga River in winter and summer season. Sweta 317.

3. APLUDA L.

Apluda mutica L. Sp. Pl. 82.1753; GBCIP. 93.1960; Fl. Rajasthan 3: 972.1993; Moulik 2: 305. 1997. *A. varia* Hack.in DC. Monogr. Phan. 6: 196.1889, includ. subsp. *aristata* and *mutica*; FBI.7:150.1897.

Ascending or erect perennial herbs, upto 1.2 m high. Leaves 8.0-40.0 x 0.5-1.5 cm, linear-lanceolate, long, acuminate. Ligule membranous. Sheath glabrous. Inflorescence a leafy panicle of 2- many simple racemes, each enclosed in a peduncled spathe. Spikelets 3, 1 sessile, 2 pedicellate. Sessile spikelet hermaphrodite. Glumes equal, chartaceous. Upper lemma awned. Caryopsis oblong. **Flowering and fruiting.** August-February. Commonly grows among hedges, in fallow lands and in *Kholas*. Two distinct forms grow in the area, one tall and the other dwarf in relatively shady places in *Kholas.* Sweta 167, 178.

4. ARISTIDA L.

Key to species:

1. Articulation between the lemma and awn near
   the base of column; lower glume always longer than
   the upper one; base of callus pointed; column of the
   awns more than 2.5 cm long..... 2. ***A. funiculata***
1. Articulation between the lemma and awn absent..... 2
2. Glumes awned; panicles effuse.....3. ***A. hystrix***
2. Glumes not awned.....1. ***A. adscensionis***

1. Aristida adscensionis L. Sp. Pl. 82.1753; FBI. 7: 224. 1897; GBCIP. 407.1960; Fl. Rajasthan 3: 973. 1993; Moulik 2: 423. 1997. *A. depressa* Retz. Obs. Bot. 4: 22. 1786; GBCIP 409. 1960.

Erect or ascending, annual or perennial grasses. Leaves 5.0- 20.0 x 0.1-0.5 cm, convolute. Ligule hairy. Spikelets erect, green, turn to purple at maturity.Glumes unequal, linear-lanceolate, emarginate, acute. Lemma laterally compressed, tripartite awn. Caryopsis linear-oblong. **Flowering and fruiting.** July-October. Common in dry sandy habitats. Sweta 281.

2. Aristida funiculata Trin. & Rupr. in Mem. Acad. Petersb. Ser. VI. vii. 159. 1842; FBI. 7: 226. 1897; GBCIP. 410. 1960; Fl. Rajasthan 3: 974. 1993; Moulik 2: 424. 1997.

Ascending annual herbs.Leaves 14.0 x 0.1 cm, flat, hairy. Ligule menbranous, hairy. Spikelets about 2.0 cm long, green with purple tinge. Lower glume liner-lanceolate, acute, awned; upper one slightly shorter than lower one. Lemma articulated at the top; column twisted, awn branched, twisted. **Flowering and fruiting.** August-November. Included on authority of Murty and Singh (1961b).

3. **Aristida hystrix** L. f. Suppl. Pl. 113. 1781; FBI. 7: 225. 1897; GBCIP. 410. 1960; Fl. Rajasthan 3: 976. 1993; Moulik 2: 424. 1997.

Diffusely branched perennial herbs. Leaves 3.0- 7.0 x 0.25- 0.50 cm, glabrous, acute. Ligule hairy. Rachis angular. Sipkelets greenish-brown. Lower glume awned, lanceolate, acuminate; upper one glabrous, toothed. Lemmas subequal. **Flowering and fruiting.** August-November. Included on authority of Murty and Singh (1961b).

5. ARUNDINELLA Raddi

Key to species:

1. Spikelets small, not more than 2.0 mm long;
   upper lemma 1.0 mm long; leaf blade
   elliptic-acuminate, membranous to chartaceous,
   3.0 – 25.0 cm long, 5.0 25.0 mm wide;
   inflorescence a very effuse panicle 10.0 30.0 cm
   long with many spikelets; annual grasses.....2. ***A. pumila***
1. Spikelets well above 2.0 m long; leaves not as above;
   spikelets glabrous or shortly and thinly hairy on the keels
   of the glumes; panicle 10.0 45.0 cm long; pedicels shorter
   than or not much longer tan the spikelets; perennial grasses.....1. ***A. nepalensis***

1. Arundinella nepalensis Trin. Sp. Gram. t 268. 1826; GBCIP. 423. 1960; Moulik 1: 59. 1997 . *A. brasiliensis* sensu Hook.f. FBI. 7: 73. 1897, pro parte.

Erect, perennial herbs. Leaves 0.75- 1.25 cm, hirsute. Ligule membranous. Sheath glabrous. Lower glume acuminate, 3-nerved; upper one 5-nerved. Lower lemma 5-nerved, acute; upper lemma 3-nerved, awned. **Flowering and fruiting.** August-November. Included on authority of Murty and Singh (1961b).

2. Arundinella pumila (Hochst. ex A. Rich.) Steud. Syn. Pl. Gram. 114.1854; GBCIP. 423.1960; Fl. Rajasthan 3: 982.1991; Moulik 1: 59. 1997. *Acrantherum pumilum* Hochst. ex A. Rich Tent. Fl. Abyss. 2: 414. t. 100. 1851. *Arundinella tenella* Nees ex Steud. Syn. Pl. Glum.. 1: 115.1854; FBI. 7: 71.1897.

Tufted, erect, annual hairy grasses. Leaves 6.0 x 2.5 cm, linear-lanceolate, membranous, acuminate. Sheaths ciliate on margins. Panicle 5.0-25.0 cm long, branched effuse. Rachis slender, erect. Spikelets upto 2.0 mm long. Lower glume ovate-lanceolate, acute, 3 nerved; upper glume acumiante, 5-nerved. Lower lemma ovate, obtuse; upper one awned. **Flowering and fruiting.** August-December. Included on authority of Murty and Singh (1961b).

6. ARUNDO L.

Arundo donax L. Sp. Pl. 81. 1753; FBI. 7: 302. 1897; GBCIP. 413. f. 44. 1960; Fl. Rajasthan 3: 982. 1993; Moulik 2: 430. 1997.

Erect, perennial herbs. Leaves 15.0-40.0 x 2.0-4.0 cm, linear-lanceolate, glabrous, acuminate, rounded at base. Ligule a scarious rim. Panicle plumose, about 60.0 cm long. Spikelets brown or purplish, 2-flowered. Glumes subequal, 5-nerved, acuminate, scabrid at keel. Lemma 5-nerved, long hairy. Stamens 2-3. Caryopsis with linear hilum. **Flowering and fruiting.** August-January. Commonly found in moist places especially on dried up beds of Ganga. Sweta 355.

7. AVENA L.

Avena sterilis L. Sp. Pl. 80. 1753 var. **culta** Raizada in Ind. For. 80: 36.1954; Fl. Rajasthan 3: 983.1993. *A. sativa auct.* non L. 79. 1753; GBCIP. 434.1960.

Tufted, erect annual grasses. Leaves 15.0-35.0 x 1.0-2.0 cm, linear-lanceolate, acute. Ligule hairy. Panicles lax, terminal, upto 15.0-20.0 cm long. Spikelets 2.0-3.0 cm long, 2-3 flowered. Rachilla articulated. Glumes lanceolate, acute, white. Lemma bearded, awned. Caryopsis

silky. **Flowering and fruiting.** October-January. Found in cultivated fields, especially in wheat fields. Sweta 953.

8. AXONOPUS P. Beauv.

Axonopus compressus (Swartz) P. Beauv. Ess. Agrost. 12: 154. 167. 1812; Moulik 1: 72. 1997. *Milium compressum* Sw. Prodr. Veg. Ind. Occ. 24. 1788.

Perennial herbs. Leaves hairy, lanceolate; ligule ciliate; sheath compressed. Spikelets elliptical, acute, purplish. Upper glume flat, ovate, hairy; lower one absent. Caryopsis brownish yellow. Found in sandy habitats. Sweta 3.

9. BAMBUSA Schreb. *nom. cons.*

Bambusa bambos (L.) Voss in Vilmorin's Blumeng., ed. 3, i: 1189. 1895; Clayton & Harman, World Grass Species: Synonymy, Royal Botanic Garden, Kew 2002 onwards, updated Jan. 29, 2008. *Bambusa arundinacea* (Retz.) Roxb. Corom. Pl. 1: 56. f. 79. 1796; FBI. 7: 395. 1897; Fl. Rajasthan 3: 984. 1993. *Bambusa arundinacea* (Retz.) Willd. Sp. Pl. 2: 245. 1799; Moulik 1: 22. 1997. *Bambos arundinacea* Retz. Obs. Bot. 5: 24. 1789.

Tufted, stout, woody, thorny reed-bamboos, up to 15.0 m tall. Stem sheath coriaceous, golden hairy. Leaves 5.0 -15.0 cm long, triangular-lanceolate, acuminate, glandular, densely hirsute, margins ciliate; ligule narrow. Flowers not seen. **Flowering and fruiting:** Flowers after a long periods. Often found near villages. Sweta 954.

10. BOTHRIOCHLOA O.Kuntze

Bothriochloa pertusa (L.) A.Camus, Ann. Soc. L. Lyon, 1930. n.s. 76: 164.1931; GBCIP. 109. 1960; Moulik 1: 267. 1997. *Holcus pertusus* L. Mant. Alt. 301. 1771. *Andropogon pertusus* (L.) Willd. Sp. Pl. 4: 922. 1806; FBI. 7: 173.1897.

Perennial, rhizomatous grasses. Leaves linear. Sheath compressed, glabrous. Raceme subdigitate, silky, purplish. Spikelets sessile, oblong-lanceolate. Upper glume acute, with a blakish awn. **Flowering and fruiting.** September-December. Commonly found in wastelands and on river beds. Sweta 180, 365, 272.

11. BRACHIARIA (Trin.) Griseb.

Key to species:

1. Spikelets solitary..... 2
1. Spikelets paired or fascicled, distant or clustered..... 3
2. Spikelets upto 2.5 mm long, elliptic, turgid.....5. ***B. villosa***
2. Spikelets 3.0 – 4.0 mm long, ovate to lanceolate,
   not turgid..... 4. ***B. setigera***

3. Spikelets upto 2.0 mm long; lower glume truncate..... 3. ***B. reptans***

3. Spikelets more than 2.5 mm long; lower glume acute to subacute.....4

4. Distance between the spikelets upto 1.5 mm ; sheath and blades glabrous; leaf blade entire, with cordate base..... 2. ***B. ramosa***

4. Distance between the spikelets 1.0 -2.0 mm ; leaves less than 10.0 cm long; spikelets acute; pedicels shorter than the apikelets..... 1. ***B. kurzii***

1. Brachiaria kurzii (Hook. f.) A. Camus in Lecomte, Fl. Gen. de l' Indo-Chine 7: 438. 1922; GBCIP. 283. 1960; Moulik 1: 77. 1997. *Panicum kurzii* Hook. f. FBI. 7: 38. 1896.

Erect or decumbent, annual herbs. Leaves 3.0- 8.0 x 0.5-1.5 cm, lanceolate, acuminate, amplexicaul, margins cripsed. Ligule beared. Spikelets ovate, glabrous. Lower glume 5-nerved. Upper lemma elliptic-oblong, apiculate. **Flowering and fruiting.** August-November. Often found in sandy habitats in rainy and early winter season. According to Bor (1960) this taxon occurs in Bengal, Bihar and Madras. . Sweta 1373, 66.

Note: Moulik (1997) stated this species to be distributed in Uttar Pradesh, Madhya Pradesh, Bihar, West Bengal, Andhra Pradesh and Tamilnadu between 450-900m. Therefore, its occurence in Hastinapur Wildlife Sanctuary at a much lower altitude is noteworthy.

2. Brachiaria ramosa (L.) Stapf in Prain, Fl. Trop. Afr. 9: 542.1919; GBCIP. 284.1960; Moulik 1: 78. 1997. *Panicum ramosum* L. Mant. Pl. 1: 29.1767; FBI. 7: 36. 1897 *pro parte.*

Erect or prostrate, branched herbs. Leaves 3.0-12.0 x 0.5- 1.0 cm, ovate-lanceolate, acuminate, rounded at the base. Ligule a ring of hairs. Sheath thinly ciliate. Rachis scabrid, hairy. Spikelets paired, globose, alternate. Lower glume ovate, glabrous; upper pubescent. Lower lemma 5-nerved, glabrous, empty. Upper lemma transversely rugose, apiculate. Caryopsis elliptical, flattened. **Flowering and fruiting.** June-November. Common in cultivated fields and on road sides. Sweta 182, 288.

3. Brachiaria reptans (L.) C. A.Gardner & C. E. Hubbard in Hook. Icon. Pl. 34. t. 3363. p.3.1938; GBCIP. 285.1960; Fl. Rajasthan 3: 991.1993; Moulik 1: 79. 1997. *Panicum reptans* L. Syst. Nat. ed. 10. 870.1759. *P. prostratum* Lamk. Tab. Encycl. 1:171.1791; FBI. 7: 33.1897.

Tufted, erect, annual or perennial herbs. Leaves 5.0 x 2.0 cm, ovate-lanceolate, acuminate, amplexicaul, glabrous. Ligule a ciliate rim. Sheath ciliate. Panicle shortly peduncled. Spikes secund. Rachis scabrid, trigonous, hairy. Spikelets broadly elliptic, acute, glabrous. Lower glume a small, ovate, triangular scale; upper faintly 5-nerved. Upper lemma mucronate,

glabrous, shining, rugose, whitish. Lower lemma 5-nerved. Caryopsis about 1.0 mm long, oblong-elliptic, flattened. **Flowering and fruiting.** June-October. Common throughout the sanctuary in mixed habitats. Sweta 1508.

4. Brachiaria setigera (Retz.) C. E.Hubbard in Hook. Icon. Pl. 34. t. 3363. p. 2. 1938 in adnot. ; GBCIP.286. 1960; Fl. Rajasthan 3: 991.1993; Moulik 1: 80. 1997. *Panicum setigerum* Retz. Obs. Bot. 4: 15. 1786; FBI. 7: 36. 1897.

Tufted, prostrate, annual grasses. Leaves broadly lanceolate, acuminate, hairy abaxillay. Ligule hairy. Rachis long hairy. Spikelets acuminate, glabrescent. Lower glume one-third the length of spikelets; upper one broadly ovate, acuminate. Upper lemma elliptic, apiculate. **Flowering and fruiting.** August-November. Found in moist and shady places. Sweta 293.

Note: According to GrassBase-The Online World Grass Flora (Calyton & Hrman, 2002 onwards), the accepted name for this species is as follows:

Urochloa setigera (Retz.) Stapf in Prain, Fl. Trop. Afr. ix. 598 (1920).

5. Brachiaria villosa (Lamk.) A. Camus in Lecomte, Fl. Gen. del' Indo-Chine 7: 433. 1922; GBCIP. 286. 1960; Fl. Rajasthan 3: 991. 1993; Moulik 1: 80. 1997. *Panicum villosum* Lamk. Tab. Encycl. Meth. Bot. 1: 173. 1791, *in parte;* FBI. 7: 34. 1896.

Tufted, erect, annual herbs, 20.0-40.0 cm high. Leaves 2.0-4.0 x 0.5-1.2 cm, lanceolate, acuminate, glabrous. Ligule a ciliate rim. Inflorescence consisting of 3-9, secund racemes. Spikelets acute, glabrous. Upper lemma transversely rugulose. Caryopsis ellipsoidal, smooth. **Flowering and fruiting.** June-October. Common on sandy exposed soil. Sweta 632.

12. CENCHRUS L.

Key to species:

1. Bristles of the involucre retrosrsely scabrid, tenaciously prickly..... 1. ***C. biflorus***
1. Bristles of the involucre antrorsely scabrid, not prickly..... 2
2. Bristles united only at the base to form a shallow disc; base of involucre small, elliptic; inner bristles not very stout at the base; outer ones not more than 1.50 cm long; perennials..... 2. ***C. cilliaris***
2. Bristles connate above the base a 1.0 -4.0 mm long cup..... 3
3. Outer bristles numerous, slender; one of the inner bristles longer and stouter than the rest, otherwise very slender, widened into a cup at the base and tapering to a setiform tip. more than 1.5 cm long..... 3. ***C. pennisetiformis***

3. Outer bristles few or absent; none of the inner bristles longer and stouter than the rest, all similar, rigid, flattened and subulate, acute at the tip, upto 5.0 mm long; rachilla scabrid; perennials..... 4. ***C. setigerus***

1. Cenchrus biflorus Roxb. Fl. Ind. 1: 238. 1820; FBI. 7: 89. 1896; GBCIP. 287. 1960; Fl. Rajasthan 3: 993. 1993; Moulik 1: 81. 1997. *C. catharticus* Delile, Cat. Hort. Monsp. 1838: 4. 1839; FBI 7: 90. 1897.

Erect or ascending herbs, about 10.0-60.0 cm high. Leaves 1.0-18.0 x 0.25-1.0 cm, scabrid, acuminate. Ligule a ciliate rim. Spikelets 2, sessile. Lower glume hyaline, lanceolate; upper one ovate. **Flowering and fruiting.** August-December. Common on sandy exposed soil. Sweta 1531.

2. Cenchrus ciliaris L. Mant. Alt. 302. 1771; GBCIP. 287. f. 33. 1960; Fl. Rajasthan 3: 994. 1993; Moulik 1: 82. 1997. *Pennisetum cenchroides* Rich. in Pers. Syn.1: 72.1805; FBI. 7: 88. 1897. *P. ciliare* (L.) Link, Hort. Berol.1: 213.1827.

Tufted, prostrate, perennial grasses, 25.0-110.0 cm high. Leaves 4.0-23.0 x 0.25-0.5 cm, linear, flat, tapering. Panicle purplish, cylindric. Spikelets oblong-lanceolate.Upper and lower glumes lanceolate, acute, 1-nerved. **Flowering and fruiting.** August-March. Commonly found in sandy habitats. Sweta 85, 282.

3. Cenchrus pennisetiformis Steud. Syn. Pl. Glum.1: 109.1854; GBCIP.289.1960; Fl. Rajasthan 3: 994.1993; Moulik 1: 82. 1997. *Pennisetum cenchroides* (L.) Rich.var. *echinoides* FBI. 7: 88.1897.

Erect or ascending, perennial herbs, 50.0-60.0 cm high. Leaves 2.0-12.0 x 0.25-0.5 cm, linear, flat, acute, hairy. Ligule a ciliate rim. Panicle cylindric, greenish with a purple tinge. Involucre subsessile with numerous bristles. Rachis wavy. Spikelets 2-4, sessile. Glume membranous. Caryopsis brownish, obovate, truncate. **Flowering and fruiting.** August-October. Found occassionally in moist, sandy soil. Sweta 68.

4. Cenchrus setigerus Vahl, Enum. Pl. 2: 395. 1806; GBCIP. 290. 1960; Fl. Rajasthan 3: 996. 1993; Moulik 1: 84. 1997. *C. biflorus* auct. non. Roxb. 1820; FBI. 7: 89. 1897.

Erect or geniculately ascending, perennial herbs, 10.0-60.0 cm high. Leaves 4.0- 20.0 x 0.25-0.5 cm, lanceolate, acuminate. Ligule a ciliate rim. Panicle cylindric, greenish with purple tinge. Spikelets 2-3, sessile. Lower glume 1-nerved, hyaline; upper one 5- nerved. Caryopsis dorsally compressed, oblong, smooth. **Flowering and fruiting.** August-November. Found occassionally in sandy moist soil. Sweta 1585.

13. CHLORIS Sw.

Key to species:

1. Empty lemmas above the floret 2-4..... 1. ***C. barbata***

1. Empty lemma above the fertile floret solitary.....2. ***C. dolichostachya***

1. Chloris barbata Sw. Fl. Ind. Occ. 1: 200. 1797; FBI. 7: 292. 1897; GBCIP. 465. 1960; Fl. Rajasthan 3: 998. 1993; Moulik 2: 563. 1997.

Tufted, erect or geniculately ascending, perennial herbs. Leaves 8.0-35.0 x 0.25-0.5 cm, flat, linear, acuminate. Ligule membranous. Spikes 5-12, digitate, slightly purple tinged. Spikelets 3-flowered and 3-awned. Lower glume upto 1.25 mm long; upper glume about 2.0 mm long. Lower lemma ovate-elliptic, pallid, ciliate, awned; upper one much smaller, obovate, awned, glabrous. **Flowering and fruiting.** July-September. Often found in sandy soil near vilages. Common on earthen walls and roofs. Sweta 965.

2. Chloris dolichostachya Lag. Gen. Sp. Pl. 5. 1816; GBCIP. 466. 1960; Fl. Rajasthan 3: 999. 1993; Moulik 2: 563. 1997. *C. incompleta* Roth, Nov. Pl. Sp. 60. 1821; FBI. 7: 290. 1897

Tufted, erect or geniculately ascending herbs. Leaves 10.0-20.0 x 0.25-1.5 cm, flat, linear. Ligule a ring of hairs. Sheath compressed, keeled. Spikes 6-10, digitate. Rachis trigonous, scabrid. Spikelets 2-flowered, 2-awned, imbricate, lanceolate. Lower glume acuminate, keeled, glabrous; upper one 1-nerved. Lemmas 3-nerved, scabrid, with a 0.75-1.25 cm long awn. Stamens 3. Caryopsis 2-2.5 mm long, enclosed in persistent lemma and palea. **Flowering and fruiting.** August-December. Found in *Kholas*. Sweta 966.

Note: According to GrassBase-The Online World Grass Flora (Calyton & Hrman, 2002 onwards), the accepted name for this species is as follows:

Enteropogon dolichostachyus (Lagas.) Keng Clav.Gram. Prim. Sin. :197 (1957).

14. CHRYSOPOGON Trin. *nom. cons.*

Chrysopogon fulvus (Spreng.) Chiov. Fl. Somala. 1: 327. 1929; GBCIP. 116. 1960; Fl. Rajasthan 3: 1003. 1993; Moulik 1: 240. 1997. *Pollinia fulva* Spreng. Pugill. 2: 10. 1815. *Chrysopogon montanus* Trin. ex Spreng. Neue Entdeck. 2: 93. 1821. *Andropogon monticola* Roem. & Schult. Syst.Veg. Mant. 2: 665. 1827; FBI. 7: 192. 1897.

Erect or ascending, perennial herbs. Leaves 35.0 x 1.0 cm, linear-lanceolate, acuminate. Ligule a membranous rim. Panicle yellowish-purple. Sessile spikelets longer than pedicellate

one. Callus with stiff, golden-brown hairs. Glume awned, hairy. **Flowering and fruiting.** August-November. Included on authority of Murty and Singh (1961b).

15. COIX L.

Key to species:

1. Lower glume of the male spikelets hardly or narrowly winged..... 2. ***C. lacryma – jobi***
1. Lower glume of the male spikelets distinctly and broadly winged at the apex..... 1. ***C. gigantea***

1. Coix gigantea Koenig ex Roxb. Fl. Ind. 3: 570.1832; GBCIP. 264.1960; Fl. Raj. 3: 1006. 1993; Moulik 1: 174. 1997. *C. lingulata* Hack. in Ost. Bot. Z. 41: 5. 1891. *C. lacryma-jobi* L. var. *gigantea* (Koen.ex Roxb.) Stapf in FBI. 7: 100.1897.

Erect, tall, perennial herbs. Leaves 80.0 x 3.0 cm, broadly ovate- lanceolate. Inflorescensce false drooping racemes. Flowers unisexual, monoeious. Lower glume of male spikelets broadly winged at top, upper one lanceolate. Stamens 3. **Flowering and fruiting.** August-November. Grows in marshy habitats. Sweta 194, 253.

Note: According to GrassBase-The Online World Grass Flora (Calyton & Hrman, 2002 onwards), the accepted name for this species is as follows:

Chionachne gigantea (Koenig) Veldkamp in Blumea 47:559 (2002).

2. Coix lacryma-jobi L. Sp. Pl. 972. 1753; FBI. 7: 100. 1897; GBCIP. 264. 1960; Fl. Rajasthan 3: 1006. 1993; Moulik 1: 175. 1997. *C. lachryma* L. Syst. Nat. ed. 10. 1261. 1759.

Annual, marshy herbs. Leaves 6.0-35.0 x 1.5-4.0 cm, ovate- lanceolate, acuminate, glabrous, margins scabrid; ligule membranous; sheath glabrous. Raceme androgynous, solitary. Female spikelet at base, solitary, whitish. Male spikelets 3-nate, imbricate. Lower glume lanceolate-elliptic, keeled; upper glume lanceloate, acuminate. **Flowering and fruiting.** August-November. Grows in marshy habitats. Sweta 967.

16. CYMBOPOGON Spreng.

Cymbopogon jwarancusa (Jones) Schult. Syst. Veg. Mant. 2: 458. 1824; GBCIP.128.1960; Fl. Rajasthan 3: 1009. 1993; Moulik 1: 214. 1997. *Andropogon jwarancusa* Jones, Asiat. Res. 4: 109. 1795; FBI. 7: 203. 1897.

Erect, perennial, aromatic grasses. Leaves 8.0-25.0 x 0.25-0.5 cm, flat, linear, narrowed at base; ligule oblong membranous; sheath glabrous. Inflorescence a panicle, spatheate; internodes and pedicels densely ciliate. Sessile spikelets linear-lanceolate, hermaphrodite,

awned. Pedicellate spikeletes, oblong, acuminate. Fruits not seen. **Flowering and fruiting.** August-December. Found frequently in the sandy habitats and in crevices between concrete slabs near barrage. Sweta 274.

17. CYNODON L. C. Rich. *nom. cons.*

Cynodon dactylon (L.) Pers. Syn. Pl. 1: 85.1805; FBI. 7: 288.1897; GBCIP. 469. f. 52.1960; Fl. Rajasthan 3:1011.1993; Moulik 2: 566. 1997. *Panicum dactylon* L. Sp. Pl. 58.1753.

Creeping, perennial grasses. Leaves 2.0-12.0 x 0.25-0.75 cm, linear-lanceolate, acute, glabrous, margins scabrid. Ligule a minute, ciliate rim. Sheath compressed, keeled, hairy at throat. Spikes 2.0-4.0, 2.0-6.0 cm long, spikelets 0.2-0.25 x 0.75-0.1 m crowded, secund. Lower glume linear-lanceolate, acute, 1-nerved; upper one short. Lemmas bidentate, obliquely oblong, keeled. Paleas 2-keeled. Stamens 3. Caryopsis 1.0 mm long, turgid, laterally compressed. **Flowering and fruiting.** January-December. **Local name.** *Doob.* A dominant species of grasslands, on road sides and in wet habitats. Sweta 756.

18. DACTYLOCTENIUM Willd.

Key to species:

1. Stoloniferous perennials; anthers more than
   1.0 mm long..... 2. ***D. scindica***
1. Non-stoloniferous annuals; anthers less than
   0.75 mm long; spikes 2.5 -6.0 cm long; tip of the rachis
   shortly produced , upto2.0 mm long; lemmas acute,
   cuspidate or mucronate; caryopsis finely rugose.....1. ***D. aegyptium***

1. Dactyloctenium aegyptium (L.) Willd. Enum. Hort. Berol.1029.1809; GBCIP. 489. f. 54.1960; Fl. Rajasthan 3:1012.1993; Moulik 2: 585. 1997. *Cynosurus aegyptius* L. Sp. Pl. 72.1753. *Eleusine aegyptia* (L.) Desf. Fl. Atlant. 1: 85. 1798; FBI. 7: 295.1897.

Erect or decumbent, annual grasses. Leaves 5.0-18.0 x 0.25-0.5 cm, linear, acute, flat; ligule a ring of white hairs; sheath compressed, glabrous. Spikes digitate. Rachis trigonous, rigid. Glumes subequal, keeled. Anthers yellow. Caryopsis subglobose, light brown or reddish, compressed, rugose. **Flowering and fruiting.** May-November. Common on moist sandy soil; along paddy fields, road sides and on margins of water bodies. Sweta 235.

2. Dactyloctenium scindicum Boiss. Diagn. Pl. Orient. Ser. 2. 4: 131.1859; GBCIP. 489. 1960; Fl. Rajasthan 3:1013. 1993; Moulik 2: 587. 1997. *Eleusine aristata* Ehrenb. ex Boiss. Fl. Orient. 5: 557.1884; FBI. 7: 296.1897. *Eleusine scindica* (Boiss.) Duthie, Illust. Indig. Fodd. Grass. pl. 36.1886 *et* Fodd. Grass. N. India 58.1888.

Profusely branched, creeping, annual herbs. Leaves 1.0-10.0 x 0.1-0.5 cm, linear, margins hairy. Ligule membranous, hairy. Spikes 3-4, 1.0-2.0 cm long, digitately radiating, falcate, rachis produced into a short mucro. Spikelets 3-9 flowered. Glumes unequal. Upper glume, keeled awned; lower one narrowly winged at keel. Caryopsis ovoid, transversely rugose, brownish. **Flowering and fruiting.** Throught out the year. Commonly found in sandy places, forms a mat on the ground. Sweta 161.

19. DENDROCALAMUS Nees

Dendrocalamus strictus (Roxb.) Nees in Linnaea 9: 476. 1834; FBI. 7: 404. 1897; Fl. Rajasthan 3: 1014. 1993; Moulik 1: 30. 1997. *Bambusa stricta* Roxb. Pl. Cor. 1: 58. t. 80. 1798.

Densely tufted, arborescent bamboos up to 5.0 m tall. Leaves 15.0 x 2.5 cm, linear-lanceolate, rounded at the base, hairy, acuminate; ligule serrate; sheath hairy. Inflorescence a panicle of dense, globular heads. Spikelets spiny, terete, hairy. Glumes hairy, mucronate. Lemma ovate, hairy, sharply spine tipped. Paleas 2-keeled, truncate, hairy. Caryopsis globular, brownish. **Flowering and fruiting.** At the intervals of many years. **Local Name.** *Bans, Basahli.* Found in dry placesnear villages. Sweta 955.

20. DESMOSTACHYA Stapf

Desmostachya bipinnata (L.) Stapf in Dyer, Fl. Cap. 7: 632.1900; GBCIP. 491.1960; Fl. Rajasthan 3: 1015. 1993; Moulik 2: 588. 1997. *Briza bipinnata* L. Syst. Nat. ed. 10. 2: 875. 1759. *Eragrostis cynosuroides* (Retz.) P. Beauv. Ess. Agrost.162. 1812; FBI. 7: 324.1897. *Poa cynosuroides* Retz. Obs. Bot. 4: 20. 1786.

Tufted, rhizomatous, perennial tall grasses. Rhizome woody, golden yellow. Leaves 18.0-45.0 x 0.25-1.0 cm, linear-lanceolate, acuminate,. Sheath hairy. Spikes 1.0-3.0 cm long, clustered. Spikelets 15-25, sessile secund, 2-seriate, yellowish-brown.Glumes unequal; lower glume keeled, mucronate; upper ones longer than lower . Lemma scabrid at keels. **Flowering and fruiting.** June-October. Found in sandy and water-logged soils. Sweta 7.

21. DICHANTHIUM Willemet

Key to species:

1. Nodes of the culm glabrous; lower glume of
   the sessile spikelet obovate, with simple, scattered hairs
   on the dorsal surface; pedicel of pedicellate spikelet less
   than half the length of the sessile spikelets..... 2. ***D. caricosum***
1. Nodes of the culms densely bearded; lower glume
   of the sessile spikelet oblong, with bulbous based hairs

on the keels and near the apex; pedicel of the pedicellate spikelet equal to or more than half the length of the sessile spikelets..... 1. ***D. annualtum***

1. Dichanthium annulatum (Forssk.) Stapf in Prain, Fl. Trop. Africa 9: 178.1917; GBCIP.133.1960; Fl. Rajasthan 3: 1017.1993; Moulik 1: 271. 1997. *Andropogon annulatus* Forsk. Fl. Aegypt.-Arab.173.1775; FBI. 7: 196.1897.

Erect, perennial, densely tufted grasses. Leaves 4.0-22.0 x 0.25-1.0 cm, linear-lanceolate, subcordate, acuminate. Ligule about 0.1-0.2 cm long. Raceme 2-6 digitate, greenish or purplish, joints silky hairy. Glumes equal; lower glume hairy, truncate, 5-nerved, oblong, keeled; upper 3-nerved, lanceolate, one keeled, awned. Pedicellate spikelets, oblanceolate-spathulate, reduced to empty glume, awned. **Flowering and fruiting.** August- November. Occurs on roadsides, banks of rivers Ganga and in wasteland. Sweta 180.

2. Dichanthium caricosum (L.) A. Camus in Bull. Mus. Hist. Nat. Paris 27: 549. 1921; GBCIP. 134. 1960; Fl. Rajasthan 3: 1018. 1993; Moulik 1: 273. 1997. *Andropogon caricosus* L. Sp. Pl. ed. 2. 1480. 1763; FBI. 7: 196. 1897, incl. var. *mollicomus* (Kunth) Hack. *Dichanthium aristatum* (Poir.) C.E.Hubb. in Kew Bull. 1939. 654. 1939; GBCIP 134. 1960. *A. aristatus* Poir. in Lamk. Encycl. Meth. Bot. Suppl. 1: 585. 1810.

Erect, perennial, densely tufted herbs. Leaves 3.0-22.0 x 0.25-1.0 cm, linear-lanceolate, glabrescent, acuminate. Ligule about 0.1-0.2 cm long, membranous. Raceme 2-6 digitate, hairy. Sessile spikelets elliptical. Glumes equal; lower ones hairy, 5-nerved, keeled, awned; upper ones 3-nerved, lanceolate, keeled, awned. **Flowering and fruiting.** August- January. Occurs in rocky and sandy places. Sweta 1389.

22. DIGITARIA Haller *nom. cons.*

Key to species:

1. Hairs on the spikelets always verrucose; culms erect; leaves all linear; inflorescence 2-6 racemes 4.0 – 10.0 cm long; mature fruit purplish; annuals..... 5. ***D. violascens***
1. Hairs on the spikelets, if any, never verrucose.....2
2. Hairs on the spikelets clavate; tips of the pedicels with a corona of hairs exceeding the summit.....4. ***D. stricta***
2. Hairs on the spikelets not clavate.....3
3. Lower glume sometimes missing in the upper spikelets, usually present as minute triangular scale..... 2. ***D. griffithii***
3. Lower glume always present and well developed.....4
4. Racemes mostly 2, divaricate, stiff; spikelets of

each pair heteromorphous; sessile spikelets nearly
glabrous in front, the pedicellate ones coated with
long hairs often spreading at maturity..... ..... 1. ***D. bicornis***

4. Racemes more tan 3, nodding, flexible; spikelets
of each pair not heteromorphous, both spikelets of
each pair with the same type of indumentum; nerves
of the lower lemma with minute, many triangular
spines on the upper part of the nerves..... 3. ***D. sanguinalis***

1. Digitaria bicornis (Lamk.) Roem. & Schult. Syst. Veg. 2: 470. 1817; GBCIP. 299.1960; Fl. Rajasthan 3: 1024. 1993; Moulik 1: 90. 1997. *Paspalum bicorne* Lamk. Tab. Encycl. Meth. Bot. 1:176. 1791. *P. heteranthum* Hook. f. FBI. 7: 16.1897, non Link 1820, non Nees & Meyen 1843.

Decumbent, ascending, annual herbs. Leaves 2.0-8.0 x 0.25- 0.5 cm, linear, scabrid margins. Ligule 1.0-2.0 mm long, truncate, hirsute. Racemes 2-4, digitate, terminal. Rachis wavy. Spikelets elliptic-lanceolate, slightly hairy. Lower glume reduce to minute scale. Stamens 3. Caryopsis obtusely elliptical. **Flowering and fruiting.** July-October. Found frequently in moist places along the streams. Sweta 226, 227.

2. Digitaria griffithii (Hook. f.) Henr. in Blumea 1: 100. 1934; GBCIP 301. 1960; Moulik 1: 93. 1997. *Paspalum sanguinale* (L.) Lamk. var. *griffithii* Hook. f. FBI. 7: 15. 1897.

Perennial grasses.. Leaf-blades 10–12 cm long; 4.0–8.0 mm wide; flaccid, scabrous, rough on both sides; glabrous, or pilose; with tubercle-based hairs. Ligule an eciliate membrane; lacerate; truncate. Racemes 4; digitate; unilateral; 2.0 -10.0 cm long. Rhachis narrowly winged; angular; scabrous on margins. Spikelets paired, distant. Fertile spikelets pedicelled; pikelets comprising 1 basal sterile florets; 1 fertile florets; without rhachilla extension, lanceolate, dorsally compressed, acute; 2.5–3 mm long; falling entire. Lower glume absent or obscure; shorter than spikelet. Upper glume ovate; 0.75 times length of spikelet; membranous; 3 –veined, surface pubescent; hairy between veins, apex acute. Basal florets barren; without significant palea. Lemma of lower sterile floret elliptic; membranous; 5 - veined; pubescent; hairy between veins; acute. Fertile lemma elliptic, or oblong; 2.5–3 mm long; cartilaginous; 3 -veined. Lemma margins flat; covering most of palea. Lemma apex acute, or apiculate. Palea cartilaginous. Anthers 3; 1.2 mm long. Rarely found in sandy soil. Sweta 452, 463.

Note: According to Moulik (1997) this species is found in Sri Lanka and Southern India. This is, therefore, first record of its occurrence in Northern India. This species can be easily distinguished from other related species of *Digitaria* by triangular scale like lower glume.

3. Digitaria sanguinalis (L.) Scop. Fl. Carn. ed. 2. 1: 52. 1772; GBCIP. 304. 1960; Fl. Rajasthan 3: 1028. 1993; Moulik 1: 94. 1997. *Panicum sanguinale* L. Sp. Pl. 57. 1753. *Paspalum sanguinale* (L.) Lamk. Tab. Encycl. Meth. Bot. 1: 176. 1791; FBI. 7: 13. 1897.

Erect annual herbs. Leaves 4.0-18.0 x 0.25-0.75 cm, linear-lanceolate, acute, hairy. Ligule membranous. Racemes 10-12, digitate. Rachis winged. Spikelets pedicellate, elliptic-lanceolate, acute. Lower glume ovate; upper one 3-nerved, glabrescent. Lower lemma membranous, minute, triangular, pubescent. Caryopsis lanceolate, brownish. **Flowering and fruiting.** August-November. Found as a weed in cultivated fields. Sweta 1541.

4. Digitaria stricta Roth ex Roem. & Schult. Syst. Veg. 2: 474. 1817; GBCIP. 305. 1960; Fl. Rajasthan 3: 1029. 1993; Moulik 1: 97. 1997. *D. denudata* Link, Hort. Berol. 1: 222. 1827. *Paspalum royleanum* Nees ex Thw. Enum. Pl. Zeyl. 358. 1864; FBI. 7: 18. 1897. *Digitaria stricta* Roth ex Roem. & Schult. var. *denudata* (Link) Henr. Monogr. Digitaria 175. 1950.

Erect, annaual herbs. Leaves 5.0-18.0 x 0.25-0.75 cm, linear, acuminate. Ligule membranous. Sheath glabrous. Rachis triquetrous, narrowly winged, hairy. Inflorescence subdigitate, spikelets oblong, hairs verrucose. Upper glume with clavate hairs. Lower lemma 5-nerved, hairy, empty. Stamens 3. Caryopsis ellipsoidal, brownish. **Flowering and fruiting.** July-November. Frequently found in open waste lands. Sweta 1595.

5. Digitaria violascens Link, Hort. Berol. 1: 229.1827; GBCIP. 308. 1960; Moulik 1:97. 1997.

Erect, annaual herb. Leaves 25.0x 1.0 cm long, linear, margins incurved. Sheath glabrous. Raceme 3-6, digitate. Rachis wavy. Spikelets elliptic, acute, greyish white. Lower glume absent; upper glume hairy. Upper lemma purple, acute. Caryopsis oblong, black. **Flowering and fruiting.** July-November. Frequently found in paddy field and river beds of Ganga. Sweta 264.

23. ECHINOCHLOA P. Beauv. *nom. cons.*

Key to species:

1. Spikelets acuminate to awned, hispid; racemes
   2- several rowed, the longest more than 5.0 cm long
   and usually with secondary branches at the base.....2. ***E. crus-galli***
1. Spikelets acute to cuspidate, pubescent; racemes less
   than 3.0 cm long, simple.....2
2. Spikelets up to 3.0 mm long; racemes distinctly

4- rowed, openly placed, commonly half of their length
apart and half appressed to the axis, sometimes
subverticillate and spreading.....1. ***E. colona***

2. Spikelets up to 3.5 mm long; racemes crowded
with plump, pallid spikelets closely placed to form
a dense, lanceolate head.....3. ***E. frumentacea***

1. Echinochloa colona (L.) Link, Hort. Berol. 2: 209. 1833; GBCIP. 308. f. 34. 1960 ('*colonum*'); Fl. Rajasthan 3: 1033.1993; Moulik 1: 98. 1997 ('*colonum*'). *Panicum colonum* L. Syst. Nat. ed.10. 2: 870.1759; FBI. 7: 32. 1897.

Annual, prostrate or decumbent, ascending grasses. Leaves 3.0-22.0 x 0.5-0.75 cm, linear-lanceolate, flat, acute, flaccid, glabrous. Sheath glabrous, compressed. Racemes distinctly 4 rowed. Spikes sessile, simple. Spikelets crowded, ovoid. Lower glume ovate, 5-nerved; upper ones acute, 7-nerved. Caryopsis plano-convex, broadly elliptic. **Flowering and fruiting.** June-November. Commonly found along river banks and in paddy fields. Sweta 278.

2. Echinochloa crus-galli (L.) P. Beauv. Ess. Agrost. 53: 161. 1812; GBCIP. 310. 1960; Fl. Rajasthan 3: 1033. 1993; Moulik 1: 99. 1997. *Panicum crus-galli* L. Sp. Pl. 56. 1753; FBI. 7: 30. 1897, *pro parte. Echinochloa crus-galli* (L.) P.Beauv. var. *breviseta* (Doell) Neilr. Fl. Nied. Ost. 31. 1859; GBCIP 310. 1960. *E. glabrescens* Murno ex Hook. f. FBI. 7: 31. 1897; GBCIP 311. 1960.

Erect annual herbs. Leaves 5.0-25.0 x 0.5-1.0 cm, linear, acute, hairy. Ligule absent. Sheath glabrous, compressed. Racemes 2-3 together, erect. Rachis 2-nate, hairy with white bulbous based hairs. Spikelets 2-3-nate, elliptic, acuminate, awned, hispid. Lower glume ovate, rounded, 5-nerved; upper glume cuspidate, hairy, 7-nerved. Lower lemma awned. Caryopsis 1.25- 1.50 mm long, elliptic. **Flowering and fruiting.** July-November. Found commonly in paddy fields or in moist shady places. Sweta 1433.

Note: In GrassBase the specific epithet is spelled as **'crusgalli'**.

3. Echinochloa frumentacea Link, Hort. Berol.1: 204.1827; GBCIP. 311.1960; Fl. Rajasthan 3: 1034.1993; Moulik 1: 101. 1997. *Panicum frumentaceum* Roxb. Fl. Ind. 1: 307.1820, non Salisb.1796. *Panicum crus-galli* L.var. *frumentaceum* (Link) Trimen, Syst. Cat. Ceyl. Pl. 104.1885; FBI. 7: 31.1897. *Echinochloa crus-galli* (L.) P.Beauv.var. *frumentacea* (Link) W. F. Wight, Suppl.Cent. Dict. 810.1909. *E. colona* (L.) Link var. *frumentacea* (Link) Ridl. Fl. Malay Penin. 5: 223. 1925.

Tall erect, robust annual herbs. Leaves 24.0 x 2.0-3.0 cm, linear, acute, scabrid, dentate. Sheath glabrous, compressed. Ligule absent. Spikelets 3-4-nate, acute, yellowish, hairy.

Lower glume ovate, acuminate, hairy; upper ones with sacbrid nerves. Lower lemma empty; upper ones acuminate. Caryopsis plano-convex polished, light-brown or yellowish. **Flowering and fruiting.** July-November. Found commonly in paddy fields and in swampy areas. Sweta 233, 267, 426, 589.

24. ELEUSINE Gaertn.

Key to species:

1. Spikes less than 0.75 cm wide, slender, straight,
   nearly glabrous at the base; spikelets elliptic, disarticulating
   between the florets; caryopsis elliptic to oblong, obtusely
   trigonous, not exposed when ripe..... 2. ***E. indica***
1. Spikes more than 1.0 cm wide, stout, incurved,
   hairy at the base; spikelets ovate, non shattering,
   very closely over-lapping; caryopsis globose,
   exposed when ripe..... 1. ***E. coracana***

1. Eleusine coracana (L.) Gaertn. Fruct. 1: 8. t. 1. f. 11. 1788; FBI. 7: 294. 1897; GBCIP. 492. 1960; Fl. Rajasthan 3: 1035. 1993; Moulik 2: 590. 1997. *Cynosurus coracanus* L. Syst. Nat. ed. 10. 2: 875. 1759.

Erect, tall, annual herbs. Leaves 2.5-18.0 x 0.25-0.75 cm, acute, hairy. Ligule ring of hairs. Sheath compressed, membranous. Spikes 4-10 subdigitate, erect. Spikelets ovate-elliptic, 4-5 flowered, awnless. Glumes unequal, membranous. Lower glume lanceolate, 1-nerved; upper glume 2-5 nerved. Lemmas broadly ovate, obtuse, winged keel. Stamens 3. Caryopsis smooth, globose, brown or blackish. **Flowering and fruiting.** August-November. Included on authority of Murty and Singh (1960a). .

2. Eleusine indica (L.) Gaertn. Fruct.1: 8. 1788; FBI. 7: 293. 1897; GBCIP. 493.1960; Fl. Rajasthan 3: 1036.1993; Moulik 2: 590. 1997. *Cynosurus indicus* L. Sp. Pl.72.1753.

Erect tufted annual grasses. Leaves 20.0 x 1.0 cm, flat, linear, acute, hairy. Sheath keeled, glabrous, margin cilicate. Ligule hairy, membranous. Spikes 2-8, digitate. Rachis flattened. Spikelets elliptic, secund, 4-6 flowered, glabrous. Glumes unequal, acute, membranous. Lower glume lanceolate, 1-nerved; upper ones 2-5 nerved. Lemma ovate-oblong or boat shaped, mucronate, keeled. Caryopsis obtusely trigonous, reddish-brown. **Flowering and fruiting.** August-November. Commonly found on roadsides and in agricultural fields. Sweta 207.

25. ERAGROSTIS N. M. Wolf

Key to species:

1. Spikelets breaking up from apex downwards at maturity; rachis fragile.....2
1. Spikelets breakingup from below upwards at maturity; rachis tough 5
2. Lemma ciliate on margins.....3. ***E. coarctata***
2. Lemma eciliate on the margins.....3
3. Keels of the palea more or less ciliate..... 4
3. Keels of the palea scabrid or smooth, eciliate; panicles oblong or linear; branches not capillary; lemmas less than 1.0 mm long ..... 5. ***E. japonica***
4. Panicle compact and dense; lemmas ciliate on keels; stamens 2; annuals..... 2. ***E. ciliaris***
4. Panicle effuse; lemmas eciliate on the keel; culms and leaves not viscous; panicles loose, with spreading branches; axis more or less bearded at the nodes..... 10. ***E. tenella***
5. Plants glandular..... 6
5. Plants eglandular..... 7
6. Lowest branches of panicle fascicled or subwhorled, with pitted glands just above and below the lowest node and also with glandular band below culm-nodes; palea deciduous..... 9. ***E. pilosa***
6. Lowest branches of panicle not whorled; glandular bands below the culm-nodes absent; palea persistent; fresh plants without any specific odour; pedicels of spikelets with crateriform glands..... 6. ***E. minor***
7. Spikelets broadly ovate to ovate-oblong..... 12. ***E. unioloides***
7. Spikelets narrowly oblong or linear..... 8
8. Lemmas up to 1.5 mm long..... 9
8. Lemma more than 1.5 m long..... 11
9. Stamens 2; spikelets more than 10 flowered; lemmas acute to subacute, with overlapping margins.....4. ***E. gangetica***
9. Stamens 3..... 10
10. Spikelets slatey – grey to black; caryopsis about 0.75 mm long, truncate at both ends, slightly grooved dorsally.....7. ***E. nigra***
10. Spikelets grey or purple; caryopsis about 0.5 mm long, cylindrical , smooth.....1. ***E. atrovirens***
11.Annuals; pedicels over 5.0 mm long ; lemmas

broadly ovate; stamens 2..... 11. ***E. tremula***

11.Perennials; stamens 3; lemms less than 1.75 mm long; panicle contracted; spikelets less than 1.0 mm wide, crowded, packed, straight; lemmas oblong, acute, lateral nerves straight..... 8. ***E. nutans***

1. Eragrostis atrovirens (Desf.) Trin.ex Steud. Nom. Bot. ed. 2. 1: 562.1840; GBCIP. 503.1960; Fl. Rajasthan 3: 1044.1993; Moulik 2: 597. 1997. *Poa atrovirens* Desf. Fl. Atlant. 1: 73. t. 14.1798.

Erect, perennial grasses. Leaves 4.0-20.0 x 0.25-0.50 cm, linear, acute, margins incurved. Ligule minute, membranous. Sheath hairy. Panicle long, ovate. Spikelets 10-15 flowered, linear, grey or purple. Glumes unequal, ovate-lanceolate, 1-nerved. Lemma elliptic-oblong, acute, keeled. Stamens 3. Caryopsis cylindrical, smooth, brownish. **Flowering and fruiting.** Almost throughout the year. Commonly found near the water bodies and marshy places. Sweta 86, 672.

2. Eragrostis ciliaris (L.) R.Br. in Tuckey, Narr. Exp. Congo App. 478. 1818; FBI. 7: 314. 1897; GBCIP. 506. 1960; Fl. Rajasthan 3: 1045. 1993; Moulik 2: 598. 1997. *Poa ciliaris* L. Syst. Nat. ed. 10. 2: 875. 1759. *Eragrostis ciliaris* (L.) R. Br. var. *brachystachya* Boiss. Fl. Orient. 5: 582. 1884; FBI.. 7: 315. 1897; GBCIP 506. 1960.

Erect, tufted, slender, annual grasses. Leaves 2.5-8.0 x 0.1-0.25 cm, linear-lanceolate, acuminate. Sheath glabrous. Ligule ciliate. Panicles dense, cylindric, woolly. Spikelets 4-10 flowered. Rachilla fragile. Glumes subequal, ovate. Lemmas ciliated, keeled. Palea keeled, hairs bulbous based. Caryopsis ovoid, brown. **Flowering and fruiting.** June– December. Commonly found in moist places along the river banks and irrigation channels. Sweta 61.

3. Eragrostis coarctata Stapf *apud* FBI. 7: 313. 1897; GBCIP. 507. 1960; Fl. Rajasthan 3: 1046. 1993; Moulik 2: 601. 1997.

Erect or decumbent, ascending, tufted, annual grasses. Leaves 8.0 x 0.5 cm, linear-lanceolate, acuminate; ligule a hairy rim; sheath glabrous. Panicles spiciform, compact, reddish-purple. Rachis fragile. Spikelets 8-10 flowered. Glumes subequal, lanceolate, acute. Lemma ciliated margins. Palea-keeled, hairs. Caryopsis ovoid-globose, polished brown colour. **Flowering and fruiting.** July-March. Found in the open waste places. Sweta 1484.

4. Eragrostis gangetica (Roxb.) Steud. Syn. Pl. Glum. 1: 266. 1854; GBCIP. 508. 1960; Fl. Rajasthan 3: 1047. 1993; Moulik 2: 602. 1997. *Poa gangetica* Roxb. Fl. Ind. 1: 341. 1820.

Eragrostis stenophylla Hochst. ex Miq. in Verh. Konink.-Nederl. Inst. 3: 4. 39. 1851, *pro parte*; FBI. 7: 318. 1896, *pro parte.*

Tall erect, annual or perennial grasses. Leaves 5.0-12.0 x 0.25-0.5 cm, linear, flat or inrolled. Ligule a short hairy rim. Sheath glabrous. Infloresence a panicle. Spikelets 10 flowered, linear. Glumes subequal, ovate-lanceolate, acute. Lemma boat shaped, acute. Palea-scabrid. Stamens 2. Caryopsis subglobose, reddish brown. **Flowering and fruiting.** August – December. Commonly found in moist habitats along the river banks and on sandy river bed. Sweta 588.

5. Eragrostis japonica (Thunb.) Trin. in Mem. Acad. Sci. Petersb.ser. 6. 1: 405. 1830; GBCIP. 509. 1960; Fl. Rajasthan 3: 1047. 1993; Moulik 2: 603. 1997. *Poa japonica* Thunb. Fl. Jap. 51. 1784. *P. diarrhena* Schult. Syst. Veg. Mant. 2: 616. 1824. *Eragrostis diarrhena* (Schult.) Steud. Syn. Pl. Glum. 1: 266. 1854; GBCIP. 507. 1960. *Eragrostis interrupta auct. plur.* non (R. Br.) P. Beauv. 1812.; FBI. 7: 316. 1897, incl. vars. *diarrhena* (Schult.) Stapf and *koenigii* Stapf.

Erect, tufted, annual or perennial grasses. Leaves 5.0-20.0 x 0.25-1.0 cm, linear, acute, glabrous. Ligule a scarious rim. Sheath glabrous. Panicles linear, greenish-purple. Spikelets 4-8 flowered, linear. Glumes subequal, ovate, oblong, 1-nerved. Lemma ovate, obtuse, 3-nerved, about 1.0 mm long. Palea with smooth keels. Stamens 3. Caryopsis obovoid, polished, brown. **Flowering and fruiting.** August-March. Commonly found in moist places along the river banks, sandy river beds and in paddy fields. Sweta 134.

6. Eragrostis minor Host, Fl. Austr. i. 135. 1827 ; FBI. 7: 321. 1897; Fl. Rajasthan 3: 1048. 1993; Moulik 2: 604. 1997. *Poa eragrostis* L. Sp. Pl. 68. 1753. *Eragrostis poaeoides* P. Beauv. Ess. Agrost. 162. 1812; GBCIP. 512. 1960.

Erect tufted slender annual grasses. Leaves 2.5-8.0 x 0.25-0.5 cm, linear-lanceolate, acute; ligule hairy; sheath glandular. Panicles 8.0-12.0 cm long, stiff with short pedicels. Pedicels with crateriform glands. Spikelets 4-10 flowered, green with purple tinge. Glumes subequal, ovate. Lemmas obtuse, keel glandular. Palea-keeled. Stamens 3. Caryopsis dorsally flattened, brown. **Flowering and fruiting.** September-March. Commonly found in the moist places in cultivated fields. Sweta 1455.

Eragrostis minor Host, Icon. Descr. Gram. Austr. 4: 15. 1809.

7. Eragrostis nigra Nees ex Steud. Syn. Pl. Glum. 1: 267. 1854; FBI. 7: 324. 1896; GBCIP. 511.1960; Fl. Rajasthan 3: 1049. 1993; Moulik 2: 605. 1997.

Erect tufted perennial grasses. Leaves 10.0-22.0 x 0.25-0.5 cm, linear, flat, acute; sheath glandular; ligule a ciliated rim. Spikelets slaty-greyish to black. Glumes subequal, ovate.

Lemmas ovate, acute. Palea keeled, scabrid. Stamens 3, yellow. Caryopsis slightly grooved dorsally. **Flowering and fruiting.** July-November. Commonly found in the moist places and on margins of swamps. Sweta 1584.

8. Eragrostis nutans (Retz.) Nees. ex Steud. Nom. Bot. ed. 2. 563. 1840; GBCIP. 511. 1960; Fl. Rajasthan 3: 1049. 1993; Moulik 2: 605. 1997. *Poa nutans* Retz. Obs. Bot. 4: 19. 1786. *E. stenophylla auct.* non Hochst. ex Miq. 1851; FBI. 7: 318. 1896.

Erect, densely tufted perennial grasses. Leaves 5.0-13.0 x 0.25-0.5 cm, linear, convolute, acute; sheath glandular; ligule membranous. Panicles contracted, oblong. Spikelets 15-25 flowered, crowded, straight. Glumes unequal, ovate, nerved. Lemmas ovate, oblong, acute, lateral nerves straight. Palea-keeled, scabrid. Stamens 3. Caryopsis ellipsoid-globose, circular in section. **Flowering and fruiting.** July-November. Rare, weed in cultivated fields. Sweta 1448.

9. Eragrostis pilosa (L.) P. Beauv. Ess. Agrost. 71. 162. 175. 1812; FBI. 7: 323. 1897; GBCIP. 512. 1960; Fl. Rajasthan 3: 1050. 1993; Moulik 2: 606. 1997. *Poa pilosa* L. Sp. Pl. 68. 1753.

Erect, tufted annual grasses. Leaves 5.0-15.0 x 0.25-0.5 cm, linear, convolute, acuminate; sheath glandular. Ligule a ring of hairs. Spikelets 10 flowered, purplish-green, linear. Glumes unequal; lower glume lanceolate, acute, nerveless; upper glume 1-nerved. Lemmas ovate, bidentate, 3-nerved. Palea keeled, scabrid, deciduous. Stamens 3. Caryopsis ellipsoid, pale-brown, laterally compressed. **Flowering and fruiting.** July-December. Common in moist and marshy places. Sweta 1454.

10. Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult. Syst. Veg. 2: 576.1817; FBI. 7: 315. 1897; GBCIP. 513. 1960; Fl. Rajasthan 3: 1051. 1993; Moulik 2: 608. 1997. *Poa tenella* L. Sp. Pl. 69.1753.

Erect or decumbent-ascending, weak annual grasses. Leaves 4.0-12.0 x 0.25-1.0 cm, linear-lanceolate, acuminate; sheath glabrous; ligule a scarious rim. Spikelets 4-10 flowered, greenish. Rachilla scrabrous, fragile. Glumes subequal, ovate-lanceolate, 1-nerved. Lemmas ovate, oblong, 3-nerved. Palea keeled, hairy. Stamens 3. Caryopsis oblanceolate, polished, brown. **Flowering and fruiting.** June-December.Commonly found in the moist places along the river banks. **Sweta** 155, 308.

Note: J. F. Veldkamp (2002) in a revision of genus *Eragrostis* in Malesia pointed out that *Eragrostis amabilis* (L.) Nees was the correct name for *E. tenella* (L.) Roem. & Schult. Since, full paper was not available to me, therefore, I have retained *E. tenella*, the name currently in vogue. Moreover, in GrassBase E. tenella is still the accepted name for this species.

11. Eragrostis tremula (Lamk.) Hochst. ex. Steud. Syn. Pl. Glum. 1: 269. 1854; FBI. 7: 320.1897; GBCIP. 514. 1960; Fl. Rajasthan 3: 1052.1993; Moulik 2: 609. 1997. *Poa tremula* Lamk. Tab. Encycl. Meth. Bot. 1: 185. 1791.

Tufted erect annual grasses. Leaves 5.0-18.0 x 0.25-0.75 cm, linear-lanceolate, flat, acute, hairy; ligule a minute line of hairs; sheath beared at mouth. Spikelets 8 to many flowered, linear. Glumes subequal, obtuse, 1-nerved. Lemmas about 3.0 mm long, broadly-ovate. Palea with scabrid keel. Stamens 2. Caryopsis brownish yellow, globose. **Flowering and fruiting.** August-October. Common in wet habitats. Sweta 348.

12. Eragrostis unioloides (Retz.) Nees ex. Steud. Syn. Pl. Glum. 1: 264.1854; GBCIP. 515.1960; Fl. Rajasthan 3:1053.1993; Moulik 2: 609. 1997. *Poa unioloides* Retz. Obs. Bot. 5: 19.1789.

Slender, erect or ascending, tufted, annual grasses. Leaves 5.0-15.0 x 0.25-0.5 cm, linear-lanceolate, base rounded, glabrous; ligule a scarious rim; sheath smooth. Spikelets many flowered, straw-coloured, purple tinged, broadly-ovate or ovoid-oblong. Glumes ovate-lanceolate, subequal or unequal, acute, 1-nerved. Lemmas acute, elliptic, paniculate, glabrous. Palea bidentate, keeled. Stamens 3. Caryopsis obovoid, laterally compressed, pale-brown. **Flowering and fruiting.** July-November. Common in sandy soil; found in agricultural fields. Sweta 361.

26. ERIANTHUS Michx.

Erianthus ravennae (L.) P. Beauv. Ess. Agrost. 14. 1812; GBCIP. 151.1960; Moulik 1: 310. 1997. *Andropogon ravennae* L. Sp. Pl. ed. 2. 1481.1763. *Erianthus elephantinus* Hook. f. FBI. 7: 122. 1897.

Tall tufted, glabrous, perennial herbs. Leaves linear, margins scabrid; sheath glabrous; ligule a rim of hairs. Spikelets paired, ovate-lanceolate, awned, one sessile, other pedicellate. Callus bearded with creamish-white hairs. Lower glume ovate-lanceolate, 2-dentate, hairy; upper glume lanceolate, acuminate. Lower lemma empty, 1-nerved; upper lemma long, glabrous, awned. **Flowering and fruiting.** September-January. Commonly found on roadsides and dry sandy habitats. Sweta 355.

Note: According to GrassBase the accepted for this species is follows:

Saccharum ravennae (L.) Murr. Syst. ed. XIII. 88 (1774).

27. ERIOCHLOA H. B. K.

Eriochloa procera (Retz.) C.E. Hubbard in Kew Bull. 1930: 256. 1930; GBCIP. 312. 1960; Fl. Rajasthan 3: 1055. 1993; Moulik 1: 102. 1997. *Agrostis procera* Retz. Obs. Bot. 4: 19. 1786. *Eriochloa polystachya sensu* Hook. f. FBI. 7: 20. 1897, non H. B. K. 1816.

Tufted, erect annual grasses. Leaves 4.0-22.0 x 0.25-1.0 cm, flat, ovate-lanceolate, acute; sheath glabrous, membranous; ligule a scarious rim. Spikelets acute, slightly hairy. Lower glume absent; upper glume acute, awnless. Lemma mucronate. Caryopsis compressed, smooth, lenticular. **Flowering and fruiting.** September-November. Found frequently in moist and marshy places; especially in water logged areas. Sweta 136, 360, 630.

28. EULALIOPSIS Honda

Eulaliopsis binata (Retz.) C. E. Hubbard in Hook. Icon. Pl. 33. t. 3262. p. 6. 1935; GBCIP. 158. 1960; Fl. Rajasthan 3: 1056. 1993; Moulik 1: 335. 1997. *Andropogon binatus* Retz. Obs. Bot. 5: 21. 1789. *Ischaemum angustifolium* (Trin.) Hack. in DC. Monogr. Phan. 6: 241. 1889; FBI. 7: 129. 1897.

Tufted, erect, perennial grasses, rootstock thick, woody, rhizomatous. Leaves 10.0-50.0 x 0.25-0.50 cm, folded; sheath glabrous, ciliated at mouth; ligule a scarious rim. Racemes 2-4, whitish-brown, unequal, hairy. Sessile spikelets lanceolate. Lower glume lanceolate, 2-3 toothed, hairy; upper glume obtuse, hairy, keeled. Lower lemma lanceolate, oblong, 1-nerved; upper lemma hermaphrodite, bidentate, awned. Caryopsis linear-oblong, free. **Flowering and fruiting.** September-January. Included on authority of Murty and Singh (1961b).

29. HACKELOCHLOA O. Ktze.

Hackelochloa granularis (L.) O. Kuntze Rev. Gen. Pl. 2: 776. 1891; GBCIP. 159. 1960; Fl. Rajasthan 3: 1057. 1993; Moulik 1: 194. 1997. *Cenchrus granularis* L. Mant. 2: 575. 1771. *Manisuris granularis* (L.) L. f. Nov. Gram. Gen. 37. 1779; FBI. 7: 159. 1897.

Tufted, erect, hirsute, annual grasses. Leaves 4.0-15.0 x 0.5-1.0 cm, linear-lanceolate, acute, hirsute; ligule a scarious rim. Racemes spatheate, spiciform. Sessile spikelets globular. Pedicelled spikelets ovate-lanceolate, acute. Glumes subequal; lower glume rounded, pitted, tubercled; upper glume obtuse, oblong, 3-nerved. Lower lemma empty; upper lemma hermaphrodite, obtuse. Caryopsis about 1.5mm long. **Flowering and fruiting.** July-October. Included on authority of Murty & Singh (1961b). This taxon is common in forests of Najibabad.

30. HEMARTHRIA R. Br.

Hemarthria compressa (L. f.) R. Br. Prodr. 207. 1810; GBCIP. 161. 1960; Fl. Rajasthan 3: 1058. 1993; Moulik 1: 195. 1997. *Rottboellia compressa* L. f. Suppl. 114. 1781; FBI. 7: 153. 1897.

Prostrate or ascending, slender, perennial herbs. Leaves 2.0-15.0 x 0.1-0.5 cm, linear, acute, rounded or subcordate at base, glabrous; sheath ciliated at base, hairy at mouth; ligule a scarious rim. Racemes solitary, compressed. Sessile spikelets elliptic-oblong. Pedicelled spikelets acute. Glumes subequal ; lower glume bidentate, lanceolate, ciliolate, winged; upper glume acute, membranous. Lower lemma empty; upper lemma hermaphrodite. **Flowering and fruiting.** July-November. Common in moist and marshy localities. Sweta 98.

31. HETEROPOGON Pers.

Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult. Syst. Veg. 2: 836. 1817; GBCIP. 163. f. 6. 1960; Fl. Rajasthan 3: 1059. 1993; Moulik 1: 226. 1997. *Andropogon contortus* L. Sp. Pl. 1045. 1753; FBI. 7: 199. 1897.

Erect or decumbent-ascending perennial herbs. Leaves 5.0-22.0 x 0.25-0.5 cm, linear, acuminate, hairy; sheath compressed, keeled, ciliated at mouth; ligule a scarious rim. Lower sessile spikelets male or neutral, awnless; upper spikelets hermaphrodite, awn brown. Glumes subequal. Lower glume lanceolate, eglandular, hirsute, glandular, awned; upper glume linear, truncate, acuminate, glabrous. Lower lemma empty; upper lemma hermaphrodite, awn brownish, twisted, hirsute. Caryopsis oblong, terete. **Flowering and fruiting.** August-November. Common in wastelands, along road sides and in *Kholas*. Sweta 323.

32. HYGRORYZA Nees

Hygroryza aristata (Retz.) Nees ex Wight & Arn. in Edinb. New Phil. Journ.15: 380.1833; FBI. 7: 95. 1897; GBCIP. 597. 1960; Fl. Rajasthan 3:1061.1993; Moulik 1: 43. 1997. *Pharus aristatus* Retz. Obs.Bot. 5: 23.1789.

Hydrophytic herbs. Leaves 4.0 x 2.0 cm, oblong, base rounded, wavy; sheath inflated; ligule membranous. Spikelets sessile or shortly pedicellate. Lemma tapering into long scaberulous awn. **Flowering and fruiting.** October-February. Often found floating in ponds, ditches and near banks of the river Ganga etc. Sweta 131.

33. IMPERATA Cyr.

Imperata cylindrica (L.) Raeuschel. Nom. Bot.ed. 3.10.1797; Fl. Rajasthan 3:1062.1993. *I. cylindrica* (L.) P. Beauv. Ess. Agrost. 165. 1812; GBCIP. 169.1960; Moulik 1: 311. 1997. *Lagurus cylindricus* L. Syst. Nat. ed. 10. 2: 878. 1759. *Imperata arundinacea* Cirillo Pl. Rar. Neap. 2: 26. 1792; FBI. 7: 106. 1897.

Tall, erect, perennial herbs. Leaves 4.5-12.0 x 0.25-0.5 cm, linear, flat, hairy; ligule a scarious rim; sheath glabrous. Inflorescence silvery-white, dense. Spikelets linear lanceolate, acute.

Lemmas hyaline, oblong, empty, denticulate. Callus bearded with white, soft hairs exceeding spikelets. Stamens 2. **Flowering and fruiting.** Almost throughout the year. Commonly found in moist and marshy places. Sweta 93, 905.

34. ISACHNE R. Br.

Key to species:

1. Spikelets 2.0 -2.5 mm long; leaves not particularly rigid; pedicels glandular..... 2. ***I. himalaica***
1. Spikelets about 1.5 mm long; leaves stiff; pedicels eglandular..... 1. ***I. albens***

1. Isachne albens Trin. Ic. Gram. 8. t. 85. 1826; FBI. 7: 22. 1897; GBCIP. 579. 1960; Moulik 2: 542. 1997.

Perennial grasses, up to 60.0 cm high, erect, tufted, glabrous. Leaves linear-lanceolate, scabrid along margins, up to 15.0 x 0.5 cm; sheath loose, glabrous; ligule a rim of hairs. Panicles up to 20.0 cm long, solitary-terminal, spreading. Spikelets globose, 2.0 -4.0 mm long, 2-flowered. Glumes sub-equal, many nerved. Lemmas cartilagenous, obtuse, pubescent. Stamens 3. Stigma plumose. Caryopsis orbicular, glabrous. **Flowering and fruiting:** Major part of the year. Occasionally found in swampy habitats. Sweta 519.

2. Isachne himalaica Hook. f. FBI. 7: 23. 1897; GBCIP. 581. 1960; Moulik 2: 545. 1997.

Perennial herbs up to 30.0–60.0 cm long. Leaves linear; 3.0–13.0 cm long; 4.0–9.0 mm wide, surface scabrous; glabrous, margins cartilaginous; sheaths glabrous; ligule a fringe of hairs. Spikelets orbicular, dorsally compressed, 1.8–2.5 mm long. Glumes deciduous; lower glume ovate, 1.8–2.5 mm long, membranous, smooth, or scabrous, obtuse; upper glume ovate, 1.8–2.5 mm long, membranous, smooth, obtuse. Lemma of lower sterile floret ovate, 1.5 mm long. Anthers 3. Caryopsis with adherent pericarp. **Flowering and fruiting:** Septembser-October. Included on authority of Murty & Singh (1961b). According to Moulik (1997) this taxon occurs between 1000-1500 m.

35. ISCHAEMUM L.

Ischaemum rugosum Salisb. Icon. Strip. Rar. 1. t. l. 1791; FBI. 7: 127. 1897; GBCIP. 184. 1960; Fl. Rajasthan 3: 1068.1993; Moulik 1: 296. 1997.

Erect, annual herbs. Leaves 5.0- 25.0 x 0.25-1.0 cm, linear-lanceolate, acuminate, hairy. Ligule truncate. Sheaths inflated. Racemes in pairs, erect, yellowish. Sessile spikelets, rugose, whitish-purplish. Lower glumes coriaceous, ridged, 2 keeled, margins inflexed; upper glume oblong-lanceolate, keeled. Lower lemma lanceolate, acute, hyaline, ciliate; upper lemma

hermaphrodite, oblong, awned. Lower glume winged; upper glume without winged keel. **Flowering and fruiting.** September- December. Found near the moist places and on the margins of water bodies. Sweta 1467.

36. LEERSIA Soland. ex Sw. *nom. cons.*

Leersia hexandra Sw. Prodr. Veg. Ind. Occ. 21. 1788; FBI. 7: 94. 1897; GBCIP. 599. 1960; Moulik 1: 45. 1997.

Culms 50.0-60.0 cm long, weak, smooth, ascending. Leaves linear, acute, scabrid, upto 20.0 x 0.4 cm; sheath glabrous, ligule truncate, membranous. Spikelets about 3.0 mm long, laterally compressed, 1-flowered. Glumes reduced. Lemma boat-shaped, keeled, 5-nerved. Palea 3-nerved. Stamens 6. Styles 2. Caryopsis oblong. **Flowering and fruiting** October- December. Occasionally found on the margins of ponds. Sweta 372.

Note: According to distribution range, in India, of this taxon as given by Moulik (1997) this is first record of its occurrence in Uttar Pradesh.

37. LEPTOCHLOA P. Beauv.

Key to species:

1. Lemmas acuminate; anthers 0.25- 0.5 mm long.....2. ***L. panicea***
1. Lemmas acute to obtuse; anthers
   0.5- 0.75 mm long..... 1. ***L. chinensis***

1. Leptochloa chinensis (L.) Nees, Syll. Ratisb. 1: 4. 1824; GBCIP. 516. 1960; Moulik 2: 613. 1997. *Poa chinensis* L. Sp. Pl. 69. 1753.

Annual grasses, upto 100.0 cm tall; culms erect from the geniculate base. Leaves 20-40 cm long. Ligule lacerate. Panicle about 30.0 cm long, branches erect or patent. Spikelets 4-6 flowered. Lower glume lanceolate, subulate. Upper glume lanceolate. Lemmas lanceolate. Caryopsis trigonous, rugose . **Flowering and fruiting.** September- December. Found near the moist places. Sweta 103.

2. Leptochloa panicea (Retz.) Ohwi in Bot. Mag. Tokyo 55: 311. 1941; GBCIP. 517. 1960; Fl. Rajasthan 3: 1072. 1993; Moulik 2: 614. 1997. *Poa panicea* Retz. Obs. Bot. 3: 11. 1783. *Leptochloa filiformis* sensu Hook. f. FBI. 7: 298. 1897, non P. Beauv. 1812.

Erect or geniculately ascending, annual herbs. Leaves 20.0 x 0.5 cm, linear-lanceolate, acuminate, hairy; sheath compressed, hairy; ligule a scarious rim. Racemes filiform. Spikelets 2-3 flowered, green, overlapping. Lower glumes linear, acute mucronate, 1-nerved; upper glume lanceolate, acute or acuminate, oblong. Lemmas obovate, obtuse, hairy, 2-lobed. **Flowering and fruiting.** July- December. Rare, in paddy fields. Sweta 1534.

38. LOLIUM L.

Lolium temulentum L. Sp. Pl. 83. 1753; GBCIP. 546. 1960; Fl. Rajasthan 3: 1073. 1993; Moulik 2: 525. 1997.

Tufted, erect, annual grasses, 20-50 cm tall. Leaves 5.0-22.0 x 0.25-1.0 cm, linear-lanceolate, acuminate, auricled; sheath glabrous; ligule a scarious rim. Spikelets upto 10 flowered, elliptic-oblong. Lower glumes absent; upper glume lanceolate, obtuse, 5-9 nerved, equaling or exceeding the spikelet. Lemmas elliptic-oblong, turgid, awn 1.5-2.0 cm long. **Flowering and fruiting.** January-July. Found as a weed in cultivated fields especially in wheat fields. Sweta 1382.

39. NARENGA Bor

Narenga porphyrocoma (Hance ex Trim.) Bor, Ind. For. 66: 267. 1940; GBCIP. 198. 1960; Moulik 1: 317. 1997. *Eriochrysis porphyrocoma* Hance ex Trim. J. Bot. 14: 294. 1876. *Saccharum narenga* Wall. (Cat. n. 8856. 1832, *nom. nud.)* ex Hack. in DC. Monogr. Phan. 6: 120. 1889; FBI. 7: 120. 1897.

Tufted, erect, perennial grasses. Leaves 0.25-0.75 cm broad, linear-lanceolate; sheath hairy; ligule a scarious rim. Sessile spikelets golden-brown, lanceolate, rounded base. Lower glumes hairy; upper glume ciliated. Lower lemma empty, flat, ciliated. **Flowering and fruiting.** August-November. Found in open wastelands. Sweta 1542.

Note: According to GrassBase the accepted name for this species is as follows:

Saccharum narenga (Nees ex Steud.) Hack. in DC., Monogr. Phan. 6:19 (1889).

40. NEYRAUDIA Hook. f.

Neyraudia arundinacea (L.) Henr. Meded. Herb. Leid. n. 58: 8. 1929 ; GBCIP. 518. 1960; Moulik, 2: 615. 1997. *Aristida arundinacea* L. Mant. Pl. 186. 1771. *Neyraudia madagascariensis* (Kunth) Hook. f. FBI. 7: 305. 1897. *Arundo madagascariensis* Kunth, Rev. Gram. 1: 273. t. 48. 1830.

Tall, erect, glabrous, perennial herbs. Leaves linear, filiform, up to 0.5 cm broad, rolled; ligule a ring of hairs; sheath glabrous, throat hairy. Spikelets compressed, florets 5-6. Lower glume lanceolate, mucronate. 1-nerved; upper glume slightly longer. Lemmas 3-nerved, awned. Palea shortly bi-dentate, keeled. **Flowering and fruiting:** January- June. Common in *Kholas*. Sweta 299, 671, 743.

41. OPLISMENUS P. Beauv. *nom. cons.*

Key to species:

1. Rachis and pedicels with long hairs; awns pale,

barbellate.....1. ***O. burmannii***

1. Rachis and pedicels with short hairs; awns reddish, smooth, viscid..... 2. ***O. compositus***

1. Oplismenus burmannii (Retz.) P. Beauv. Ess. Agrost. 54. 169. 1812 ; FBI. 7 : 68. 1897 ; GBCIP. 317. 1960; Fl. Rajasthan 3: 1076. 1993; Moulik 1: 106. 1997. *Panicum burmannii* Retz. Obs. Bot. 3: 10. 1783.

Prostrate or decumbent-ascending, annual herbs. Leaves 3.0 x 2.0 cm, ovate-lanceolate, acute, hairy; ligule a scarious rim. Spikelets lanceolate, secund, acute, 2-3 nate, pubescent. Lower glumes ovate-lanceolate, silky hairy, 3-nerved, brown, awn barbellate; upper glume ciliate, 5-nerved. Lower lemma ovate, acute, hairs, 8-nerved; upper lemma acute. **Flowering and fruiting.** July-November. Common in shady, grassy localities. Sweta 42, 140.

2. Oplismenus compositus (L.) P. Beauv. Ess. Agrost. 54.169. 1812 ; FBI. 7: 66. 1897 ; GBCIP. 317. 1960 ; Fl. Rajasthan 3: 1077. 1993; Moulik 1: 109. 1997. *Panicum compositum* L. Sp. Pl. 57. 1753.

Annual, decumbent-ascending herbs. Leaves 10.0 x 2.0 cm, linear-lanceolate, acute, hairy; sheath hairy; ligule ciliate. Spikelets lanceolate, secund, acute, 2-3 nate, purple tinged. Lower glumes ciliate, scabrid, 5-nerved, reddish, viscid, awn smooth; upper glume ciliate or hairy, 9-nerved, awned. Lower lemma ovate, acute, empty, 8-nerved, membranous; upper lemma acute. Caryopsis dorsally compessed. **Flowering and fruiting.** August-November. Rare, in wet and shady localities. Sweta 1533.

42. ORYZA L.

Oryza rufipogon Griff. Notul. 3: 5. 1851 & Icon. Pl. As. 3: t. 144. f. 2. 1851; GBCIP. 605. 1960; Fl. Rajasthan 3: 1079. 1993; Moulik 1: 47. 1997. *Oryza nivara* Sharma & Shastri in Ind. Journ. Gen. & Pl. Breed. 25: 161. 1965.

Marshy or aquatic perennial herbs. Leaves 25.0 x 1.0 cm, linear-lanceolate, acute, hairy; sheath glabrous, compressed; ligule membranous. Spikelets deciduous. Sterile lemma 1-nerved, keeled. Fertile lemma hispid, having a conical callus, awn scabrid. Caryopsis compessed. **Flowering and fruiting:** September-December. Occasionally, found near marshy habitats. Sweta 217.

43. PANICUM L.

Key to species:

1. Upper lemma finely transversely rugose..... 2. ***P. maximum***

1. Upper lemma quite smooth and shining..... 2
2. Aquatic grasses; culms soft, spongy, green floating;
   spikelets narrowly lanceolate..... 4. ***P. paludosum***
2. Terrestrial grasses of sandy or moist habitats; culms
   not spongy; spikelets oblong, ovate- oblong to elliptic,
   mostly obtuse.....3
3. Lower glume quarter to half the length of spikelet;
   root stock villous –hairy, stout, creeping; lower florets
   neuter.....1. ***P. antidotale***
3. Lower glume one-half to three-quarter the length
   of spikelet or more; root –stock woody; leaves deeply
   cordate at the base; ligule obscure, with long soft hairs;
   spikelets obtuse..... 3. ***P. notatum***

1. Panicum antidotale Retz. Obs. Bot. 4 : 17. 1786 ; FBI. 7 : 52. 1897; GBCIP. 322. 1960; Fl. Rajasthan 3: 1081. 1993; Moulik 1: 113. 1997.

Stout, creeping, perennial herbs. Leaves 10.0-50.0 x 0.75-1.0 cm, linear-lanceolate, acute, hairy; sheath glabrous; ligule membranous. Spikelets ovoid, acute, glabrous. Lower glume broadly ovate, 5-nerved. Lower lemma hairy, 5-7 nerved; upper lemma pallid or dull. **Flowering and fruiting:** October- February. Found commonly in sandy localities. Sweta 305.

2. Panicum maximum Jacq. Icon. Pl. Rar. 1.t. 13; Coll. 1. 76. 1781 & Collect. Bot. 1: 76. 1787 ; FBI. 7: 49. 1987; GBCIP. 327. 1960; Fl. Rajasthan 3: 1082. 1993; Moulik 1: 119. 1997.

Stout, erect, perennial herbs, more than 2.0 m in height. Leaves 50.0 x 2.5 cm, linear-lanceolate, acuminate, softly hirsute; sheath glabrous, compressed, keeled, hairy; ligule membranous, hairy. Spikelets oblong, obtuse, acute, glabrous. Glumes unequal. Lower glume transparent; upper glume 4-7 nerved. Lower lemma hairy; upper lemma transversely rugose. Caryopsis about 1.0 mm long, pallid. **Flowering and fruiting:** March-November. Found along the water streams. Sweta 1396.

3. Panicum notatum Retz. Obs. Bot. 4: 18. 1786 ; GBCIP. 701. 1960; Fl. Rajasthan 3: 1084. 1993; Moulik 1: 133. 1997. *P. montanum* Roxb. Fl. Ind. 1: 315. 1820; FBI. 7: 53. 1897; GBCIP. 329. 1960.

Tall, erect, tufted, perennial herbs with woody rootstock. Leaves 12.0 x 2.0 cm, lanceolate, acuminate, deeply cordate, softly hairy; sheath compressed, hairy; ligule obscure. Spikelets elliptic-oblong, obtuse, 1-2-nate, acute, glabrous. Glumes unequal. Lower glume ovate-

lanceolate, acute, 5-nerved, sparsely hairy; upper glume acute. Lower lemma obtuse, ovoid, empty; upper lemma brown, coriaceous. **Flowering and fruiting:** August-November. Found in moist places. Sweta 224, 373.

4. Panicum paludosum Roxb. Fl. Ind. 1:310.1820; GBCIP. 329.1960; Fl. Rajasthan 3: 1084. 1993; Moulik 1: 122. 1997. *P. proliferum auct. plur.* non Lamk. 1797; FBI. 7: 50.1897.

Hydrophytic herbs. Leaves linear, flat, glabrous; sheath prominantly veined; ligule membranous, finely dissected. Spikelets ovate-lanceolate, acuminate. Lower glume cup like; upper glume ovate-lanceolate, acute. **Flowering and fruiting:** August-November. Commonly found in marshy places, along river banks and in stagnant water. Sweta 132.

44. PASPALIDIUM Stapf

Key to species:

1. Upper lemma rugulose;lower floret sterile
   without palea..... 3. ***P. punctatum***
1. Upper lemma granulose; lower florets male, paleate..... 2
2. Leaves obtuse; sheaths terete, glabrous; racemes
   usually distant by 2-4 times their own length; spikelets
   gibbously globose.....1. ***P. flavidum***
2. Leaves acuminate; sheaths compressed, keeled, ciliate;
   racemes usually less than their own length apart;spikelets
   planoconvex.....2. ***P. geminatum***

1. Paspalidium flavidum (Retz.) A. Camus in Lecomte, Fl. Gen. Indo-Chine 7 : 419. 1922 ; GBCIP. 333. 1960; Fl. Rajasthan 3: 1088. 1993; Moulik 1: 125. 1997. *Panicum flavidum* Retz. Obs. Bot. 4 : 15. 1786 ; FBI. 7: 28. 1897.

Tufted, erect or decumbent-ascending, perennial herbs. Leaves 20.0 x 1.0 cm, flat, obtuse, glabrous; sheath terete, hairy at throat; ligule a ring of hairs. Spikelets ovoid-ellipsoidal, obtuse, sessile. Lower glume suborbicular, 5-nerved; upper glume ovate, 7-nerved. Lower lemma ovate, acute, 5-nerved; upper lemma granular, acute. Caryopsis ovoid, 1.5-2.5 mm long. **Flowering and fruiting:** August-November. Commonly found in marshy places. Sweta 1550.

2. Paspalidium geminatum (Forsk.) Stapf. in Prain, Fl. Trop. Africa 9: 583. 1920; GBCIP 333. 1960; Fl. Rajasthan 3: 1088. 1993; Moulik 1: 125. 1997. *Panicum geminatum* Forsk. Fl. Aegypt.-Arab. 18. 1775. *P. paspaloides* Pers. Syn. 1: 81. 1805; FBI. 7: 30. 1897.

Creeping perennials. Leaves linear, acuminate, up to 18.0 x 1.0 cm. Spikelets about 2.0 mm long, ovate-acute. Glumes unequal. Lower lemma equal to spikelet, coriaceous, shining. **Flowering and fruiting:** September- April. Found in wet habitats. Sweta 133.

3. Paspalidium punctatum (Burm. f.) A Camus in Lecomte, Fl. Gen. Indo-Chine 7 : 419. 1922; GBCIP. 333. 1960; Fl. Rajasthan 3: 1088. 1993; Moulik 1: 126. 1997. *Panicum punctatum* Burm. f. Fl. Ind. 26. 1768; FBI. 7 : 29. 1897.

Tufted, erect, glaucous, perennial herbs. Leaves 20.0 x 1.0 cm, convolute, obtuse, scabrid margins; sheath hairy at throat; ligule a short hairy rim. Spikelets ovate-oblong, obtuse, glabrous. Lower glume membranous, 5-nerved; upper glume ovate. Lower lemma ovate, acute, sterile, without palea; upper lemma rugulose, acute. Caryopsis ovoid, compressed. **Flowering and fruiting:** August-November. Rare, in marshy places. Sweta 1399.

45. PASPALUM L.

Key to species:

1. Spikelets rotundate-elliptic, broadly obovate-elliptic to almost orbicular, obtuse; upper glume papery, glabrous..... 2. ***P. scrobiculatum***
1. Spikelets broadly elliptic to ovate –elliptic, acute; upper glume herbaceous, mostly pubescent.....2
2. Erect or geniculate grasses; racemes up to 10.0 cm long; spikelets eliptic, twice as long as broad; upper glume pubescent; lower lemma with a prominent middle nerve .....1. ***P. paspaloides***
2. Prostrate grasses, with stem rooting at the nodes; racemes less than 4.0 cm long; spikelets broadly lanceolate, three times as long as broad; upper glume glabrous; lower lemma with faint middle nerve..... 3. ***P. vaginatum***

1. Paspalum paspaloides (Michaux) Scribner in Mem. Torrey Bot. Club 5: 29.1894; Fl. Rajasthan 3: 1090.1993; Moulik 1: 133. 1997. *Digitaria paspaloides* Michaux, Fl. Bor. Amer. 1: 46.1803. *Paspalum distichum auct. pl.* non L. 1759; FBI. 7: 12. 1897; GBCIP. 338. 1960.

Marshy, creeping, annual herbs. Leaves 2.0-12.0 x 0.25-1.0 cm, linear-lanceolate, sparsely hairy; ligule short, membranous; sheath ciliate, hairy margins. Spikelets 2-3 seriate, elliptic, acute, green, secund. Upper glume pubescent, acute, 5-nerved. Lower lemma 3-nerved, glabrous; upper lemma smooth, greenish white. Caryopsis ovoid. **Flowering and fruiting:** September-March. Commonly found in marshy habitats and near water bodies. 133, 333.

Note: According to GrassBase the accepted name for this spcies is as follows:

Paspalum distichum L. Syst. Nat. ed. 10, ii. 855 (1759).

2. Paspalum scrobiculatum L. Mant. 1: 29.1767; FBI. 7: 10.1897; GBCIP. 340.1960; Fl. Rajasthan 3:1091.1993; Moulik 1: 134. 1997. *P. orbiculare* Forst. Fl. Insul. Austr. Prodr. 7. 1786; GBCIP 340. 1960. *P. commersonii* Lamk. Tab. Encycl. Meth. Bot. 1: 175. t. 43. f. 1. 1791; GBCIP 335.1960.

Erect, perennial herbs. Leaves 15.0-20.0 x 0.75-1.0 cm, linear, white margined, pubescent; sheath glabrous, keeled, compressed. Spikelets whitish, biseriate, secund, elliptic-rounded or obovate. Lower glume absent; upper glume papery, glabrous, 3-6 nerved. Lower lemma 3-5 nerved, epaleate; upper lemma brown. Stamens 3. Caryopsis light brown, smooth, subglobose. **Flowering and fruiting:** July-November. Commonly found near the ponds and ditches. Sweta 230.

3. Paspalum vaginatum Swartz, Prodr. Veg. Ind. Occ. 21. 1788; GBCIP. 341. 1960; Fl. Rajasthan 3: 1091. 1993. *P. distichum auct. pl.* non. L. 1753, *nom. Conf.*; FBI. 7 : 12.1897; Moulik 1: 131. 1997.

Prostrate, rhizomatous, perennial herbs. Leaves 12.0 x 0.50-0.75 cm, linear, acuminate; sheath bearded at mouth; ligule short, membranous. Spikelets broadly lanceolate, subsessile, flattened, glabrous. Lower glume absent; upper glume membranous, glabrous. Lower lemma epaleate; upper lemma acute. Caryopsis light-brown, smooth, elliptic. **Flowering and fruiting:** July-November. Found commonly near the ponds, ditches and water bodies. Sweta 910.

46. PENNISETUM L. C. Rich.

Pennisetum typhoides (Burm. f.) Stapf & Hubb. Kew Bull. 1933: 271. 1933; GBCIP. 350. 1960; Moulik 1: 142. 1997. *Alopecurus typhoides* Burm. f. Fl. Ind. 27. 1768.

Erect, annual herbs. Leaves 12.0 x 1.0-3.0 cm, linear-lanceolate, acuminate, hairy; sheath hairy at mouth; ligule a ring of short white hairs. Spikelets ovate-elliptic. Lower glume minute, ciliate, orbicular; upper glume absent. Lower lemma 3-nerved, ciliate, obtuse; upper lemma hermaphrodite, 5-nerved. Palea 2-3 toothed, ciliated. Caryopsis brown, smooth. **Flowering and fruiting:** August-November. **Local Name.** *Bajra.* Widely cultivated in the area, also found as an escape. Sweta 375.

47. PEROTIS W. Ait.

Perotis indica (L.) O. Kuntze. Rev. Gen. Pl. 2 : 787. 1891; GBCIP. 611. f. 72. 1960; Fl. Rajasthan 3: 1096. 1993; Moulik 2: 504. 1997. *Anthoxanthum indicum* L. Sp. Pl. 28. 1753. *Perotis latifolia* Ait. Hort. Kew. 1: 85. 1789, *pro parte* ; FBI. 7: 98. 1897, *pro parte.*

Erect-ascending herbs. Leaves 12.0 x 1.0-3.0 cm, linear-lanceolate, acuminate, hairy; sheath hairy at mouth; ligule a short scarious rim. Spikelets linear-lanceolate, 1-flowered, 2-awned, awns usually purplish. Glume equal, hairy on dorsal surface. Stamens 3. Caryopsis smooth, cylindrical. **Flowering and fruiting:** August-October. Found commonly in sandy soil, open dry waste places and *Eucalyptus* plantations. Sweta 150, 197.

48. PHALARIS L.

Phalaris minor Retz. Obs. Bot. 3: 8. 1783; FBI. 7: 221. 1897; GBCIP. 616. 1960; Fl. Rajasthan 3: 1097. 1993; Moulik 2: 471. 1997.

Erect or decumbent-ascending, annual herbs, upto 100.0 cm tall. Leaves 20.0-25.0 x 1.0-1.50 cm, linear-lanceolate, acuminate, glabrous; sheath compressed; ligule a scarious rim. Spikelets oblong, compressed. Glumes equal in size, broadly winged, keeled, apiculate. Lower lemma absent; upper lemma fertile, broadly ovate-lanceolate, 5-nerved, acute, shining. Palea lanceolate, 2-keeled, hairy. Caryopsis smooth, brown. **Flowering and fruiting:** August-October. Commonly found in agricultural fields, especially wheat fields, sandy soil and semi-dried bed of the river Ganga. The specimens collected from agricultural fields are as rule erect and taller, while those collected from the bed of Ganga are smaller and prostrate or ascending. Sweta 59, 684.

49. PHRAGMITES Trin.

Phragmites karka (Retz.) Trin. ex Steud. Nom. Bot. ed. 2. 2: 324. 1841; FBI. 7: 304.1897; GBCIP. 416. 1960; Fl. Rajasthan 3: 1098.1993; Moulik 2: 433. 1997. *Arundo karka* Retz. Obs. Bot. 4: 21.1786.

Erect, perennial herbs, culms hollow. Leaves 40.0-50.0 x 2.0-3.0 cm, linear-lanceolate, acuminate, coriaceous; sheath with a hairy throat; ligule a ciliate ridge. Spikelets hermaphrodite. Lower glume lanceolate, acute, glabrous; upper glume apiculate. Lemmas hermaphrodite, narrower upwards. Stamens 3. Caryopsis oblong, free. **Flowering and fruiting:** Winter season. Most dominant species in swamps. Sweta 367.

50. POA L.

Poa annua L. Sp. Pl. 68. 1753; FBI. 7: 345. 1897; GBCIP. 555. 1960; Fl. Rajasthan 3: 1099. 1993; Moulik 2: 529. 1997.

Erect or decumbent-ascending, flaccid, light green, annual herbs. Leaves 1.0-8.0 x 0.25-0.5 cm, linear-lanceolate, margins scabrid; sheath compressed; ligule ovate, rounded. Spikelets lanceolate oblong, obtuse, 3-5 flowered. Lower glume lanceolate, glabrous, 1-nerved; upper glume ovate-lanceolate, 3-nerved. Lemma oblong, obtuse. Palea truncate, ciliate keels.

Stamens 3. Caryopsis ellipsoidal. **Flowering and fruiting:** Almost throughout the year. Common weed in irrigated fields, along water streams. Sweta 70, 956.

51. POLYPOGON Desf.

Key to species:

1. Callus short or obsolete; awn 0.4 – 1.0 cm long..... 1. ***P. monspeliensis***
1. Callus prominent; awn 0.15 – 0.3 cm long..... 2. ***P. fugax***

1. Polypogon fugax Nees ex Steud. Syn. Pl. Glum. 1: 184. 1854; GBCIP. 403. 1960; Moulik 2: 413. 1997.

Erect or decumbent-ascending, annual herbs. Leaves 0.75-1.0 cm broad, linear-lanceolate; sheath glabrous; ligule a scarious rim. Spikelets lanceolate, greenish, hispid. Glumes equal, lanceolate, glabrous, bidentate, ciliate. Lemma oblong, obtuse, hairy, 5-toothed. Palea truncate, 2-toothed. Stamens 3. Caryopsis ellipsoidal. **Flowering and fruiting:** Almost throughout the year. Occasionally found in swampy localities. Sweta 885.

2. Polypogon monspeliensis (L.) Desf. Fl. Atlant. 1: 66. 1798; FBI. 7: 245. 1897; GBCIP. 403. 1960; Fl. Rajasthan 3: 1099. 1993; Moulik 2: 415. 1997. *Alopecurus monspeliensis* L. Sp. Pl. 61. 1753.

Prostrate or decumbent-ascending, annual herbs. Leaves 3.0-12.0 x 0.25-0.75 cm, linear-lanceolate, flat, acute; sheath glabrous; ligule 2-3 mm long. Spikelets linear-lanceolate, greenish-yellow. Glumes equal, lanceolate, notched at apex, hairy margins, awn antrorsely barbellate. Lemma oblong, hairy, 5-toothed, 5-neved, awned. Palea truncate, 2-toothed. Stamens 3. **Flowering and fruiting:** Almost throughout the year. Commonly found in moist and shady localities. This plant shows a great deal of variation as regards the size of plant, inflorescence and number of spikelets. Sweta 98, 685.

52. SACCHARUM L.

Key to species:

1. Leaves petiolate, base with a narrow wing on either
   side of the mid nerve; peduncles hairy below the panicles;
   rachis very fragile; lower glume of the sessile spikelets
   glabrous on the back..... 2. ***S. spontaneum***
1. Leaves neither petiolate nor winged at the base;
   peduncles glabrous below the panicles; rachis not so fragile;
   lower glume of sessile spikelets hairy on the back..... 1. ***S. bengalense***

1. Saccharum bengalense Retz. Obs. Bot. 5 : 16. 1789; GBCIP. 211. 1960; Fl. Rajasthan 3: 1103. 1993; Moulik 1: 319. 1997 . *S. munja* Roxb. Fl. Ind. 1 : 250. 1820. *S. arundinaceum* Hook. f. FBI. 7: 119. 1897 , non Retz. 1786.

Erect, tall, perennial herbs, stem solid. Leaves 50.0-70.0 x 1.0-2.0 cm, linear-lanceolate, glaucous, acuminate, scabrid margins; sheath silky; ligule a ciliate rim. Panicle silvery-white, woolly. Sessile spikelets linear-lanceolate. Glumes equal; upper glume acuminate, glabrous; lower glume acute, empty. Lower lemma hairy, acute, membranous, empty; upper lemma hermaphrodite, ciliated margings, acuminate. Stamens 3. Caryopsis oblong, brown. **Flowering and fruiting:** November-March. Local name: *Moonj*. Commonly found along the river banks and in moist places. 1463.

2. Saccharum spontaneum L. Mant. Alt. 2: 183.1771; FBI. 7: 118. 1897; GBCIP. 214. 1960; Fl. Rajasthan 3: 1104.1993; Moulik 1: 322. 1997.

Erect, tall, rhizomatous, glabrous, perennial herbs. Leaves 70.0-90.0 x 1.0-1.25 cm, linear, folded, acute, glaucous, margin scabrid; sheath hairy; ligule membranous, somewhat triangular. Panicle slivery white, ciliated. Sessile spikelets linear-lanceolate. Lower glume lanceolate, glabrous, sharply acute, brown; upper glume acuminate. Lower lemma empty, hyaline, ovate-lanceolate, ciliated; upper lemma awned, hermaphrodite. Stamens 3. Caryopsis oblong. **Flowering and fruiting:** Almost throughout the year. **Local Name.** *Kans.*Commonly found in swampy places and along river banks. Sweta 162.

53. SETARIA P. Beauv. *nom. cons.*

Key to species:

1. Panicle cylindrical, dense or often lobulate; leaves not plicate..... 2
1. Panicle lax, effuse, with branched primary branches; involucre bristles not more than twice as long as spikelets; leaves plicate..... 3. ***S. palmifolia***
2. Perennials..... 1. ***S. geniculata***
2. Annuals..... 3
3. Involucre- bristles retrorsely barbed..... 5. ***S. verticillata***
3. Involucre-bristles antrorsely barbed; upper lemma rugose and shorter than the upper glume.....4
4. Panicle spiciform, lobulate.....4. ***S. tomentosa***
4. Panicle cylindric, dense; spikelets about 0.3 cm long; upper lemma slightly keeled at the top..... 2. ***S. glauca***

1. Setaria geniculata (Lamk.) P. Beauv. Ess. Agrost. 51. 169. 178. 1812; GBCIP. 360. 1960; Fl. Rajasthan 3: 1110. 1993; Moulik 1: 152. 1997. *Panicum geniculatum* Lamk. Encycl. Meth. Bot. 4: 727. 1798.

Perennial, rhizomatous herbs. Leaves 2.5-7.0 x 0.25-0.5 cm. linear, acute, flat, hairy; sheath glabrous, keeled; ligule a stiff rim of short hairs. Lower glume hyaline, acute, 3-nerved; upper glume hyaline, 5-nerved. Lower lemma 7-nerved; upper lemma transversely rugose.**Flowering and fruiting:** August-October. Commonly found in agricultural fields. 243, 540.

Note: According to GrassBase the accepted name for this species is as follows:

Pennisetum polystachion (L.) Schult. Mant. ii. 146 (1824).

Basionym: Panicum polystachion L. Syst. ed. X. 870 (1759).

2. Setaria glauca (L.) P. Beauv. Ess. Agrost. 51. 169. 178. 1812 ; FBI. 7: 78. 1897; GBCIP. 360. 1960; Fl. Rajasthan 3: 1111. 1993; Moulik 1: 153. 1997. *Panicum glaucum* L. Sp. Pl. 56. 1753.

Erect or decumbent-ascending, annual herbs. Leaves 5.0-20.0 x 0.75-1.0 cm, linear, acuminate, margins scabrid; sheath compressed, smooth, keeled; ligule a ring of hairs. Spikelets ellipsoidal, solitary, smooth. Bristles reddish brown or yellow. Lower glume ovate, hyaline, rounded at base, 3-nerved; upper glume ovate, subacute, 5-nerved. Lower lemma hyaline, 5-nerved, 2-toothed; upper lemma rugose, acute, boat- shaped, keeled, 3-nerved. **Flowering and fruiting:** Almost throughout the year. Commonly found in sandy habitats. Sweta 195, 243.

Note: In GrassBase this species has been transferred to *Pennisetum* as follows:

Pennisetum glaucum (L.) R. Br. Prod. 195 (1810).

3. Setaria palmifolia (Koenig) Stapf, Journ. Linn. Soc.(Bot.) 42: 186. 1914; GBCIP. 363. 1960; Moulik 1: 156. 1997. *Panicum palmifolia* (palmifolium IPNI) Koenig, Naturforscher 23: 208. 1788. *P. plicatum* Willd. Enum. Pl. 1033. 1809 (non Lamk. 1791).

Prostrate, perennial herbs. Leaves 5.0-10.0 cm broad, linear-lanceolate, acuminate, glabrous; sheath ciliate; ligule a hairy ring. Spikelets lanceolate, acute. Lower glume ovate, rounded base, 3-5 nerved. Upper glume 7-nerved. Upper lemma rugose, apiculate; lower lemma empty, membranous, 5-nerved. Stamens 3. Caryopsis plano-convex. **Flowering and fruiting:** August-November. Included on authority of Murty & Singh (1961b).

4. Setaria intermedia Roem. & Schult. Syst. Veg. 2: 489. 1817; FBI. 7: 79. 1897; Fl. Rajasthan 3: 1112. 1993; Moulik 1: 155. 1997. *Setaria tomentosa* (Roxb.) Kunth, Rev. Gram. 1: 47. 1829; GBCIP. 365. 1960. *Panicum tomentosum* Roxb. Fl. Ind. 1: 303. 1820.

Prostrate-ascending, annual grasses. Leaves 15.0-20.0 x 0.75-1.0 cm, linear-lanceolate, acuminate, hairy; sheath ciliate, keeled; ligule ciliate. Spikelets soliatary. Bristles scabrid, slender. Lower glume ovate, membranous, apiculate, glabrous; upper glume ovate, shortly apiculate. Lower lemma empty, membranous, 5-nerved; upper lemma transversely rugose. Stamens 3. Caryopsis plano-convex, with punctiform hilum. **Flowering and fruiting:** August-November. Commonly found in open wase lands, roadsides. Sweta 1558.

5. Setaria verticillata (L.) P. Beauv. Ess. Agrost. 51. 178. 1812; FBI. 7: 80. 1897; GBCIP. 365. 1960; Fl. Rajasthan 3: 1114. 1993; Moulik 1: 159. 1997. *Panicum verticillatum* L. Sp. Pl. ed. 2. 82. 1762.

Tufted, erect or geniculately ascending, annual herbs. Leaves 25.0 x 2.0 cm, linear-lanceolate, acuminate, margins scabrid; sheath compressed, keeled, hairy; ligule ciliate. Spikelets ovate, usually 2. Bristles retrorsely barbed. Lower glume ovate, hyaline, 3-nerved, apiculate; upper glume obtuse, 5-nerved. Lower lemma empty, dorsally compressed, 5-nerved; upper lemma transversely rugose, coriaceous, apiculate. Stamens 3. **Flowering and fruiting:** July-November. Commonly found on margins of agricultural fields, roadsides and in waste places. Sweta 968.

54. SORGHUM Moench. *nom. cons.*

Sorghum halepense (L.) Pers. Syn. Pl. 1: 101. 1805; GBCIP. 222. 1960; Fl. Rajasthan 3: 1115. 1993; Moulik 1: 249. 1997. *Holcus halepensis* L. Sp. Pl. 1047.1753. *Andropogon halepensis* (L.) Brot. Fl. Lusit. 1: 89. 1804; FBI. 7: 182. 1897. *A. miliaceus* Roxb. Fl. Ind. 1: 276.1820. *Sorghum miliaceum* (Roxb.) Snowden in Journ. Linn. Soc. Bot. 55: 207. 1955; GBCIP. 223. 1960.

Erect, perennial herbs. Leaves 40.0-4.0 cm, linear-lanceolate, acuminate; ligule hairy, membranous; sheath glabrous. Spikelets acute, red. Sessile spikelets acute, elliptic. Lower glume keeled, ciliated, 2-toothed, glabrescent, 7-9 nerved; upper glume narrower, acute, hairy. Lower lemma empty, acute, 2-nerved, ciliate; upper lemma hermaphordite, ovate, ciliated, awned. Stamens 3, anthers yellow. Style yellow. **Flowering and fruiting:** September-December. Abundantly found in agricultural fields and on road sides. Sweta 186, 606.

55. SPOROBOLUS R.Br.

Key to species:

1. Lowest branches of the inflorescence not whorled;
   upper glume distinctly shorter than the lemma;
   stamens 2..... 1. ***S. diander***

1. Lowest branches of the inflorescence whorled;
upper glume equal or longer than the lemma; stamens 3..... 2. ***S. virginicus***

1. Sporobolus diander (Retz.) P. Beauv. Ess. Agrost. 26, 147, 178. 1812; FBI. 7: 247. 1897; GBCIP. 629. 1960; Fl. Rajasthan 3: 1120. 1993; Moulik 2: 478. 1997. *Agrostis diander* Retz. Obs. Bot. 5: 19. 1789.

Tufted, erect, perennial herbs. Leaves 20-0.25 cm, linear, acute, often rolled; ligule a ring of hairs; sheath glabrous. Sipkelets 1-flowered, lanceolate, acute. Lower glume ovate, nerveless 0.4 mm long; upper glume elliptic, truncate, 1-nerved. Lemmas lanceolate, ovate. Stamens 2, anthers purple. Caryopsis 0.5-0.75 mm long, compressed, truncate, reddish-brown. **Flowering and fruiting:** August-December. **Local Name.** *Chiriya-ka-dana.* Abundantly found in moist places. Sweta 59, 369.

In GrassBase the specific epithet is spelled as '***diandrus***'.

2. Sporobolus virginicus (L.) Kunth Rev. Gram. 1:67 1829; Clayton & Harman, World Grass Species: Synonymy, Royal Botanic Garden, Kew 2002 onwards, updated Jan. 29, 2008. *Agrostis virginica* L. Sp. Pl. 63 (1753). *Sporobolus tremulus* (Willd.) Kunth, Rev. Gram. 1: 67. 1829; FBI. 7: 250. 1897; GBCIP. 633. 1960; Fl. Rajasthan 3: 1124. 1993; Moulik 2: 481. 1997. *Agrostis tremula* Willd. Sp. Pl. 1: 372. 1797 (nom. superfl.).

Tufted, erect or prostrate perennial herbs. Leaves 2.0-3.0 x 0.1-0.25 cm, flat, acute, filiform; ligule hairy; sheath glabrous. Sipkelets crowded, shortly pedicellate. Lower glume ovate, lanceolate, acute, 1-nerved; upper glume elliptic, ovate, 1-nerved. Stamens 3. Caryopsis broadly oblong. **Flowering and fruiting:** August-December. Rarely found in moist places. Sweta 428, 827.

56. THYSANOLAENA Nees

Thysanolaena latifolia (Roxb. ex Hornem.) Honda in J. Fac. Sci. Univ. Tokyo 3 Bot. :312 (1980); Clayton & Harman, World Grass Species: Synonymy, Royal Botanic Garden, Kew 2002 onwards, updated Jan. 29, 2008. *Thysanolaena maxima* (Roxb.) O. Kuntze, Rev. Gen. Pl. 2: 794. 1891; GBCIP. 650. 1960; Moulik 2: 558. 1997. *Agrostis maxima* Roxb. Fl. Ind. 1: 319. 1820. *Thysanolaena agrostis* Nees in Edinb. New Phil. J. 18: 180. 1835; FBI. 7: 61. 1897.

Erect, perennial herbs. Leaves 50.0-60.0 x 5.0-10.0 cm, lanceolate, semi-amplexicaul, acuminate, glabrous; ligule a scariuos rim; sheath hairy. Sipkelets greenish or purplish, elliptic-lanceolate, 2-flowered, acuminate, hairy. Lower glume ovate, acute, nerveless; upper glume ovate. Lower lemma truncate, 2-nerved; upper lemma hermaphrodite, ovate, acute, 3-

nerved, white hairs. Stamens 2-3. **Flowering and fruiting:** December-June. Common on roadsides near the river Ganga. Sweta 48.

57. TRAGUS A. Haller *nom. cons.*

Tragus roxburghii Panigrahi in Kew Bull. 29: 495. 1974; Fl. Rajasthan 1131. 1993. *T. biflorus sensu* Schult. Syst. Veg. Mant. 2: 205. 1824 *quoad. descript.*; GBCIP 682. 1960. *T. racemosus sensu* Hook. f. FBI. 7: 97. 1896, non Scop. 1777.

Ascending or prostrate, annual grasses. Leaves linear-lanceolate, bristles tubercle- based. Ligule a ciliate rim. Inflorescence a loose spike-like panicle or a single terminal, spike-like raceme. Spikelets paired. Lower glume minute, upper 5-nerved and with rows of stout hooked spines. **Flowering and fruiting:** Rainy and winter season. Included on authority of Murty and Singh (1961b).

Note: According to GrassBase the accepted name for this species is as follows:

Tragus mongolorum Ohwi in Acta Phytotax. & Geobot., Kyoto, x. 268 (1941).

58. TRITICUM L.

Triticum aestivum L. Sp. Pl. 85. 1753; GBCIP. 679. 1960; Fl Rajasthan 3: 1140. 1993; Moulik 2: 496. 1997.

Annual, erect herbs. Leaves up to 1.0 cm broad; ligule 2.0 mm long; sheaths glabrous. Spikes up to 12.0 x 1.0 cm. Spikelets laterally compressed, 3-5 flowered, hairy. Glumes ovate, hairy, rounded at base, keeled, awn up to 1.0 cm long. Lemmas 5-nerved, an scabrid awn up to 10.0 cm long. Paleas 2-keeled, entire, obtuse or truncate, keeled. Stamens 3. Ovary hairy. **Flowering and fruiting:** February-May. Extensively cultivate in the area. Occasionally found as an escape near villages. Sweta 1559.

59. UROCHLOA P. Beauv.

Urochloa panicoides P. Beauv. Ess. Agrost. 52. t. 11. f. 1. 1812; GBCIP. 372. 1960; Fl. Rajasthan 3: 1135. 1993; Moulik 1: 167. 1997. *Panicum javanicum* Poir. in Lamk. Encycl. Math. Bot. Suppl. 4: t. 274. 1816; FBI. 7: 35. 1897. *Urochloa pubescens* Kunth, Rev. Gram. 1: 31. 1829. *U. panicoides* P. Beauv. var. *pubescens* (Kunth) Bor, GBCIP 372. 1960.

Tufted, prostrate or geniculately ascending grasses. Leaves linear-lanceolate, up to 10.0 x 2.0 cm, acute, semi-amplexicaul, crisped-undulate, ciliate; sheath striated, densely ciliated-pubescent; ligule a ciliate rim. Spikelets 4.0-5.0 mm long, ovte or elliptic-oblong, acute, glabrous or hairy. Lower glume 5-nerved; upper glume more than 7-nerved. Upper lemmas hermaphrodite, mucronate, transversely rugose or granulate. Caryopsis up to 2.5 mm long, rotundate, compressed, yellowish-brown. **Flowering and fruiting:** August- January. Common in cultivate fields and on margins of orchards. Sweta 1564.

60. VETIVERIA Lem. -Lisanc.

Vetiveria zizanioides (L.) Nash in Small, Fl. South-East U. S. 67. 1903; GBCIP. 258. 1960; Fl. Rajasthan 3: 1137. 1993; Moulik 1: 256. 1997. *Phalaris zizanioides* L. Mant. Pl. 2: 183. 1771. *Andropogon squarrosus sensu* Hook. f. FBI. 7: 186. 1897, non L. f. 1781.

Erect, prerennial herbs, with aromatic roots. Leaves 50.0-60.0 x 1.5-1.0 cm, linear, glaucous; ligule a minute, scariuos rim; sheath glabrous. Sessile sipkelets lanceolate, acute, yellowish, dark-yellow at maturity. Lower glume lanceolate, spinulose, 5-nerved; upper glume concave, spinulose. Lower lemma empty, acute, lanceolate, ciliate; upper lemma hermaphrodite, mucronate, notched at apex. **Flowering and fruiting:** August-March. **Loacal Name.** *Khas.* Common in moist to wet habitats, on banks of Ganga or margins of water bodies. Sweta 242, 342.

Note: In GrassBase this species has been transferred to *Chrysopogon* as follows:

Chrysopogon zizanioides (L.) Roberty in Bull. Inst. Franc. Afr. Noire, Ser. A. xxii. 106 (1960).

61. ZEA L.

Zea mays L. Sp. Pl. 971. 1753; HFDD 654. 1977.

Erect, annual, tall herbs. Leaves upto 10 cm broad, sheath glabrous, throat hairy. Male spikes in terminal panicle. Female spikelets seated on the spongy axis of the cylindrical axillary spike, suurounded by the bracts. **Flowering and fruiting:** Rainy season. Widely cultivated in the study area. Sweta 1419.

CHAPTER - 6

ANALYSIS OF FLORA

6. 1. FLORISTIC ANALYSIS:

This thesis enumerates 752 species of indigenous and naturalized flowering plants, collected from Hastinapur Wildlife Sanctuary, belonging to 123 families and 455 genera. Seventy eight cultivated species are also listed in Appendix–I. A detailed floristic analysis is given in following paragraphs. All analyses are based on 752 species and 455 genera.

6. 1. 1 Number and Size of Families:

Dicotyledonous and monocotyledonous species are distributed over 98 and 25 families respectively. Among dicots Polypetalae alone account for 52 families (Table-4), followed by Gamopetalae (30 families) and Monochlamydeae (16 families). In Polypetalae, Thalamiflorae account for 22 families, Disciflorae 15 families and Calyciflorae 15 families. In Gamopetalae only 2 families belong to Inferae, 6 families to Heteromerae and 22 families to Bicarpellatae. Thus, dicot families contribute 79.67% of total flora and monocot families 20.33%. Polypetalous families account for 42.28% of total flora and 53.06% of dicot flora. Gamopetalous families contribute 24.39% of total flora and 30.61% of dicot flora, while Monochlamydeae contribute 13% of total flora and 16.33% of dicot flora (Table-5).

Taking into consideration the number of genera, dicot families contribute 76.26% (347 genera) and monocot families 23.74% (108 genera) of total genera (Tables-4 & 5). Poaceae are the largest family with 61 genera (Table-6). Seven families (Poaceae, Asteraceae, Fabaceae, Scrophulariaceae, Acanthaceae, Malvaceae and Cyperaceae) are represented by 10 or more genera (Table - 6). In fact these seven families contribute 39% (179 genera) of total genera recorded.

Among dicots Asteraceae are the largest family with 42 genera, followed by Fabaceae (31 genera). Only three more families, Malvaceae, Scrophulariaceae and Acanthaceae are represented by ten or more genera. In Polypetalae, Fabaceae are the largest family, followed by Malvaceae. These two families, together, account for 26% of polypetalous genera. In Gamopetalae, Asteraceae are the largest family (42 genera) followed by Acanthaceae (13 genera) and Scrophulariaceae (12 genera) (Table-6).

These three families account for 45% of total gamopetalous genera. In Monochlamydeae, Euphorbiaceae are the largest family (9 genera), followed by Amaranthaceae and Moraceae with 8 and 5 genera respectively. These three families account for 55% of total genera of Monochlamydeae. In monocots Poaceae are the largest family with 61 genera, followed by Cyperaceae (10 genera). These two families account for 65.74% of total monocot genera. Table-7 shows the break up of total families according to number of representative genus/genera. In Appendix – III families belonging to polypetalae, gamopetalae, monochlamydeae and monocots are arranged in descending order according to number of genera.

Taking in to account the number of species in each family, the contribution of the dicot families (549 species) to total flora is 73.01% (Tables – 4 & 5) and that of monocot families is 26.99% (203 species). Poaceae are, again, the largest family contributing 110 species (15% of total species). Among dicots Fabaceae are the largest family with 62 species (8% of total species and 11% of dicot species), closely followed by Asteraceae with 59 species.

Polypetalae contribute 259 species to the flora of the study area (34.44% of total species and 47.18% of dicot species). Fabaceae are the largest family with 62 species, followed by Malvaceae with 22 species, Caesalpiniaceae 18 species, Mimosaceae 14 species, and Cucurbitaceae 11 species. These five families, together, account for 23% of total dicot species and 49% of polypetalous species. One family is represented by 9 species, 2 families by 8 species, 3 families by 7 species, 1 family by 6 species, I family by 5 species, 3 families by 4 species, 8 families by 3 species, 11 families by 2 species and 17 families by 1 species each.

Gamopetalae contribute 213 species to the flora of the study area (28.32% of total species and 38.80% of dicot flora). Asteraceae are the largest family with 59 species, followed by Scrophulariaceae and Convolvulaceae with 20 species each, Acanthaceae with 16 species, Lamiaceae with 13 species, and Verbenaceae and Solanaceae with 11 species each. One family is represented by 8 species, 2 families by 7 species, 2 families by 6 species, 2 families by 3 species, 7 families by 2 species and 9 families by 1 species each.

Monochlamydeae contribute only 77 species to the flora of the study area (10.24% of total species and 14.03% of dicot species). Euphorbiaceae are the largest family with 22 species, followed by Amaranthaceae with 17 species and Moraceae

with 11 species. Four families are represented by 9, 4, 3 and 2 species respectively. Nine families are represented by 1 species each.

Total contribution of monocot families has already been mentioned. Poaceae with 110 species are the largest family, followed by Cyperaceae with 45 species. These two families, together, account for 20.6% of total species and 76.7% of monocot species. Two families are represented by 7 and 6 species respectively, 5 families by 3 species, 4 families by 2 species and 12 families by 1 species each.

It emerges from the foregoing analysis that the flora of Hastinapur Wildlife Sanctuary is predominantly dicotyledonous. Monocot families make but little contribution to the flora.

Table-7 shows the break up of total families according to number of representative species. Table- 8 shows ten dominant families in the study area and comparison with three nearby areas, Upper Gangetic plain, India and world. Appendix – IV lists all families in descending order according to number of species.

6. 1. 2 Number and Size of Genera:

Out of 455 genera collected from the study area, 347 genera (76.26% of the total genera) are dicotyledonous and 108 (23.74% of total) genera are monocotyledonous (Table – 4 & 5). Among dicots, polypetalous families account for 159 genera (34.95% of the total and 45.82% of dicot genera), gamopetalous families for 148 genera (32.53% of total and 42.65% of dicots), and Monochlamydeae for 40 genera (8.79% of total and 11.53% of dicots) (Table – 4 & 5).

Taking into consideration total number of species in a genus, *Cyperus* is the largest genus, represented by 14 species, followed by *Ipomoea* and *Eragrostis* (12 species each), and *Cassia* (10 species). Four genera (*Indigofera*, *Acacia*, *Phyllanthus* and *Fimbristylis*) are represented by 7 species each, six genera (*Sida*, *Crotalaria*, *Lindernia*, *Polygonum*, *Euphorbia* and *Ficus*) by 6 species each, 7 genera (*Corchorus*, *Conyza*, *Amaranthus*, *Schoenoplectus*, *Brachiaria*, *Digitaria* and *Setaria*) by 5 species each, 10 genera (*Hibiscus*, *Alysicarpus*, *Ludwigia*, *Alternanthera*, *Commelina*, *Eleocharis*, *Kyllinga*, *Mariscus*, *Cenchrus* and *Panicum*) by 4 species each, 34 genera by 3 species each, 73 genera by 2 species each and remaining 317 genera by 1 species each. In fact, 31 genera contribute one fourth of total species.

In dicots, *Ipomoea* is the largest genus represented by 12 species, followed by *Cassia* (10 species); *Indigofera*, *Acacia* and *Phyllanthus* (7 species each); *Sida*, *Crotalaria*, *Lindernia*, *Polygonum*, *Euphorbia* and *Ficus* (6 species each); *Corchorus*, *Conyza* and *Amaranthus* (5 species each); *Hibiscus*, *Alysicarpus*, *Ludwigia* and *Alternanthera* (4 species each). Twenty eight genera are represented by 3 species each, 54 genera by 2 species each and remaining 247 genera by 1 species each. Only 14 genera contribute more than one fourth of total dicot species.

In Polypetalae *Cassia* is the largest genus with 10 species, followed by *Indigfera* and *Acacia* with 7 species each, *Sida* and *Crotalaria* with 6 species each and *Corchorus* with 5 species. Three genera (*Hibiscus*, *Alysicarpus* and *Ludwigia*) are represented by 4 species each, 14 genera by 3 species each, 28 genera by 2 species each, and 108 genera by 1 species each.

In Gamopetalae *Ipomoea* is the largest genus with 12 species, followed by *Lindernia* and *Conyza* with 6 and 5 species respectively; 12 genera are represented by 3 species each; 21 genera by 2 species each and 112 genera by 1 species each.

The contribution of Monochlamydeae to dicots is limited to 40 genera (8.79% of total and 11.53% of dicot genera). *Phyllanthus* is the largest genus with 7 species, followed by *Polygonum*, *Euphorbia* and *Ficus* (6 species each), and *Amaranthus* with 5 species. *Alternanthera* is represented by 4 species and *Aerva* and *Chenopodium* by 3 species each. Five genera are represented by 2 species each and 27 genera by 1 species each.

Out of 108 monocot genera, *Cyperus* is the largest genus with 14 species, followed by *Eragrostis* with 12 species. *Fimbristylis* is represented by 7 species and *Schoenoplectus*, *Brachiaria*, *Digitaria* and *Setaria* are represented by 5 species each. These seven genera account for 49% of total monocot genera. Six genera are represented by 4 species each, 6 genera by 3 species, 19 genera by 2 species and 70 genera by 1 species each.

The analysis in foregoing paragraphs clearly shows that the generic composition of the flora of study area is dominated by a few genera. Only 21 genera (with 5 or more species) account for 147 species, 19.54% of total number of species (Table – 9). On the other hand the number of genera represented by 1 species is pretty high (317), 69.7% of total number of genera. Appendix – V lists all genera according to number of representative species in descending order.

6. 1. 3 Number of Species:

As stated earlier this work yielded a total of 752 species of flowering plants, 549 dicots (73.01% of total species) and 203 monocots (26.99% of total species). In dicots, Polypetalae contribute 259 species (34.4% of total and 47.18% of dicot species), Gamopetalae 213 species (28.32% of total and 38.80% of dicot species) and Monochlamydeae 77 species (10.24% of total and 14.03% of dicot species) (Tables – 4 & 5). In monocots the distribution of species among families is still more skewed. Only one family, Poaceae, accounts for about 55% of total monocot species and two families, Cyperaceae and Poaceae, account for 76% of monocot species. Remaining 23 families contribute just 48 species.

6. 2 Floristic Ratios:

6. 2. 1 Monocot – Dicot Ratio

Monocot – dicot ratio was calculated for the study area and compared with four adjoining areas and world (Table – 10). This ratio is strongly influenced by the total number of taxa and relative numerical strength of dicots and monocots and shows the number of dicot taxa in a particular category for one monocot taxon in the same category. In Hastinapur Wildlife Sanctuary there are about four dicot families for every monocot family and three dicot genera and species for every monocot genus and species. This index reflects relatively poor representation of monocots in the study area, and same trend is evident in adjoining areas and the world as well.

Calculation of reverse ratio (number of monocot species / number of dicot species) for total and aquatic flora gave very interesting results. On the basis of total flora, this ratio was 1: 0.37 and for aquatic flora this ratio was 1: 0.97 (Table – 11). It means that while in total flora there are about three dicot species for every monocot species, in aquatic habitats there is nearly one monocot species for every dicot species. Clearly, monocots are floristically more dominant in aquatic habitats than in terrestrial habitats. In fact the floristic dominance of monocots in aquatic habitats is nearly three times of their dominance in total flora. Crow (1993) in a study of latitudinal patterns of aquatic angiosperms species diversity listed the number of aquatic species in various families in north eastern North America, southeastern US and Central America. Monoct –dicot ratios were calculated for these three regions using the data provided in above cited study (Table- 11). In all three regions the dicot

– monocot ratio ranges from 1: 2.6 to 1: 3.4. It further shows that, floristically, monocots outnumber dicots in aquatic habitats. Reverse is true for terrestrial habitats which are generally poor in monocot species. Further studies based on data from larger areas in different biomes or phytogeographic regions may corroborate or refute this assumption.

6. 2. 2 Genus – Species ratio:

This ratio may be considered as an indicator of within genus diversity i.e. the average number of species per genus. For the study area this ratio was calculated as 1:1.65 on the basis of total species, 1: 1.58 for dicots alone and 1: 1.88 for monocots. Table- 12 shows the comparison of these ratios calculated for HWLS, Bijnor, Dehra Dun, Delhi, Rajasthan and world. It may be argued that this ratio increases with the size of flora. In Hastinapur, Bijnor, and Delhi the total number of species is less than one thousand and the ratios are less than 1: 2. Total number of species recorded for Dehra Dun is 1230 and, consequently, the ratio approaches 1: 2 for total flora and dicots and exceeds 1: 2 for monocots. In Rajasthan the number of species is 1911 and the ratios exceed 1: 2 in all cases, in fact, nearly 1: 3 for monocots. The estimated genus-species ratio for the whole of India is about 1: 7 (Shetty & Singh, 1993), which also indicates an increase in this ratio with increase in number of species. According to data available on APG 2 (Angiosperm Phylogeny Group) website (Stenvens, 2001 onwards), there are estimated 13193 genera and 267142 species of flowering plants in the world and the genus species ratio is 1: 20.25 (Table – 12). It further shows that genus – species ration tends to rise with increase in the size of flora.

Another interesting trend emerged from the analysis of genus –species ratios of total flora, dicot flora and monocot flora separately. In all cases, except Bijnor, the genus species ratio is highest for monocots, followed by total flora and dicots in the same order (Monocots > total flora > dicots). The observed deviation from this apparent trend for the flora of Bijnor might be because of incomplete survey. No generalization is intended at this juncture, but further analysis of the flora of different areas is needed to show whether this is a general rule or not and whether this relationship may be used to assess the minimum adequacy of the survey work. World flora also appears to follow same trend. Family size data available at APG 2 website

were used to calculate genus- species ratio for world flora. As expected, Monocots showed highest ratio, followed by total flora and dicots (Table- 12).

6. 3 Neophytes:

Following species are new records:

1. ***Hypericum japonicum*** Thunb. ex Murr. (Hypericaceae) See note under description of the species.
2. ***Abelmoschus tuberculatus*** Pal & Singh (Malvaceae) See note under description of the species.
3. ***Hibiscus micranthus*** L. f. var. ***rigidus*** (L. f.) Cuf. See note under description of the species.
4. ***Eleiotis monophylla*** (Burm. f.) DC. See note under description of the species.
5. ***Lotus corniculatus*** L. See note under description of the species.
6. ***Oenothera laciniata*** Hill. See note under description of the species.
7. ***Sparganium erectum*** L. See note under description of the species.
8. ***Brachiaria kurzii*** (Hook. f.) A. Camus See note under description of the species.
9. ***Digitaria griffithii*** (Hook. f.) Henr. See note under description of the species.
10. ***Leersia hexandra*** Sw. See note under description of the species.

6. 4 ANALYSIS OF FLORA ACCORDING TO PLANT HABIT:

Since, one of the objectives of present work was to prepare ground for future ecological studies in the sanctuary; therefore, all species recorded from the study area were analyzed to find out the number of herbs, shrubs, trees and climbers. A fairly good picture of vegetation stratification will emerge from this analysis. It must be borne in mind that the categories of herbs, shrubs, trees and climbers are not absolute. A given species may assume the dimensions of a tree in one habitat and it may appear like a shrub in another habitat. Besides this, certain species, for example, a herbaceous climber is counted in categories, herbs as well as climber.

Taking in to account the total number of species, there are 590 herbaceous species (400 dicots and 190 monocots), 96 shrubs (86 dicots and 10 monocots), 81 climbers (78 dicots and 3 monocots) and 95 trees (94 dicots and 1 monocot) (Figure - 2 & 3). Detailed analysis of each habit category is given below.

6. 4. 1 Herbs:

Total herbs or herbaceous species account for 78.46% of total species of flowering plants in the study area (Table – 13). Dicot herbs or herbaceous species constitute 53.19% of total species. In dicots 73% species show herbaceous habit (Table - 14). On the basis of total number of species maximum contribution to herbaceous flora comes from Bicarpellatae (13.43%), closely followed by Calyciflorae (13.16%). The contributions of Thalamiflorae and Inferae to total herbaceous flora are 8.91% and 8.24% respectively, followed by Monochlamydeae (7.31 %), Disciflorae (1.33%) and Heteromerae (0.8%) (Table - 13). On the basis of the number of total dicot species, the contributions made by Thalamiflorae, Disciflorae, Calyciflorae, Inferae, Heteromerae, Bicarpellatae and Monochlamydeae are 12.2%, 1.82%, 18.21%, 11.29%, 1.09%, 18.4%, and 10.02% respectively (Table-14). Calculation of percent contribution of these taxonomic categories to the total herbaceous species (Table – 15) shows that Calyciflorae and Bicarpellatae, together, account for half of total herbs, each contributing about 25% of herbs. These are followed by Thalamiflorae (16.71%), Inferae (15.46%), Monochlamydeae (13.72%), Disciflorae (2.49%) and Heteromerae (1.5%).

Some examples of major herbaceous families of the area are: Brassicaceae, Caryophyllaceae, Malvaceae, Tiliaceae, Fabaceae, Cucurbitaceae, Rubiaceae, Asteraceae, Boraginaceae, Convolvulaceae, Solanaceae, Scrophulariaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Chenopodiaceae, Polygonaceae, Cyperaceae and Poaceae.

6. 4. 2. Shrubs:

Shrubs or shrubby species account for 12.77% of total species recorded (Table-13). Dicot shrubs account for 11.44% of total species and 15.66% of total dicot species (Table-13). On the basis of the total number of species, largest contribution of 4.12% comes from Bicarpellatae followed by 2.93% from Thalamiflorae, 2.26% from Calyciflorae and 1.33% from monocots. All other categories contribute less than 1% to shrub flora. On the basis of the number of total dicot species, the contribution of Bicarpellatae is about 5.65%, Thalamiflorae 4%, Calyciflorae 3.1% and Monochlamydeae 1.09% (Table-14). Calculation of per cent contribution of these

taxonomic categories to the total dicot shrub species shows that Thalamiflorae, Calyciflorae and Bicarpellatae account for more than 80% of shrubs, each contributing 25.58%, 19.77% and 36.05% respectively. Each remaining category contributes less than 6% (Table-15). In monocots only 10 species (1.33% of total species and 4.93% of total monocot species) show shrub-like habit.

Some examples of families which make significant contribution to shrub flora are: Capparidaceae, Rhamnaceae, Fabaceae, Caesalpiniaceae, Mimosaceae, Apocynaceae, Asclepiadaceae, Verbenaceae, and Euphorbiaceae etc.

6. 4. 3 Climbers:

Eighty-one species (10.77% of total species) show climbing habit. Seventy-eight species of dicots (10.37% of total species and 14.21% of total dicot species) and only 3 species of monocots (0.4% of total species and 1.47% of total monocots) are climbers (Tables-13 & 14). On the basis of the total number of species, highest contribution of 4.79% comes from Bicarpellatae, followed by 3.72% from Calyciflorae. Except Heteromerae, which has no climber, all remaining taxonomic categories, individually, contribute less than 1% to this habit category (Table-13). On the basis of total dicot species only, Bicarpellatae account for 6.56% climbers followed by Calyciflorae (5.1%) (Table-14). In Bicarpellatae, 46.15% species are climbers, largely due to the family Convolvulaceae and in Calyciflorae 35.9% species are climbers, largely due to families Fabaceae and Cucurbitaceae (Table-15). These two taxonomic categories, together, account for about 80% of dicot climbers.

Major families contributing to climber flora are: Menispermaceae, Vitaceae, Celastraceae, Fabaceae, Cucurbitaceae, Apocynaceae, and Convolvulaceae. In Monocots only two families Liliaceae (*Asparagus racemosus* and *Gloriosa superba*) amd Dioscoreaceae (*Dioscorea bulbifera*) include climbing species.

6. 4. 4 Trees:

A total of 95 species (12.63% of total species) show arborescent habit (Table – 13). Ninety-four species belong to dicots and only one species (*Phoenix sylvestris*) belongs to monocots. On the basis of total number of species Thalamiflorae, Disciflorae, Calyciflorae, Inferae, Heteromerae, Bicarpellatae and Monochlamydeae contribute 1.46%, 1.73%, 4.79%, 0.13%, 0.53%, 1.46%, and 2.39% respectively to

tree flora (Table-13). On the basis of total dicot species, the contribution of these categories is 2%, 2.37%, 6.56%, 0.18%, 0.73%, 2% and 3.28% respectively (Table-14). Calyciflorae alone accounts for 38.3% of tree species, followed by Monochlamydeae (19.15%), Disciflorae (13.83%), Thalamiflorae and Bicarpellatae (each 11.7%), Heteromerae (4.26%) and Inferae (1.06%) (Table – 15).

The families making significant contribution to tree flora in the study area are: Annonaceae, Flacourtiaceae, Rutaceae, Meliaceae, Fabaceae, Caesalpiniaceae, Mimosaceae, Myrtaceae, Sapotaceae, Ehretiaceae, Bignoniaceae, Euphorbiaceae, and Moraceae.

6. 4. 5 Parasites:

Only 5 species (0.66% of total number of species) exhibit parasitic habit. All of them are dicotyledonous (0.91% of total dicotyledonous species). Three species (*Cuscuta chinensis*, *C. reflexa* and *Orobanche aegyptiaca*) are total parasites, while *Dendrophthoe falcata* and *Striga angustifolia* are partial parasites. *D. falcata* occurs less frequently than other four species.

6. 5 ANALYSIS OF FLORA ACCORDING TO HABITAT:

Nine habitat types may be recognized in the study area i. e. (1) **Aquatic habitats**, including the river Ganga, its canals, ponds, and ditches etc. (2) **Roadsides**, the land on either sides of roads not covered with Tarmac. (3) **Agricultural fields** (4) **Kholas**, small hillocks of sandy-loam soil on western bank of Ganga (5) **River banks**, sandy tract along the Ganga which remains water saturated for most part of the year. Here, vegetation is dense as compared with next two habitat types (6) **Moist sand**, sandy area away from the river bank where sand is not water saturated, but moisture is higher than next habitat type (7) **Dry sand**, sandy areas away from moist sand and very low in moisture content or dry sandy bed of Ganga or its canals when water recedes in winter and early summer seasons (8) **Tall wet grasslands or Swamps**, areas which become inundated in rainy season and remain water saturated almost round the year, the soil is clayey. This is the principal habitat of the swamp dear and harbors tall grasses like *Phragmites karka* and *Arundo donax* etc. (9) **Dry grasslands**, tract of flat land between Kholas and the river Ganga, covered with short grasses and dicot herbs. The soil is loamy, not pure sand, and moisture content is low.

6. 5. 1 Aquatic habitat:

A total of 73 species (9.71% of total species), 37 dicots (4.92% of total species and 6.74% of total dicot species) and 36 monocots (4.79% of total species and 17.73% of total monocot species), grow in aquatic habitats (Table-16 & Figures-4, 5 & 6). Among dicots Bicarpellatae account for 13.7% of total aquatic species (Table-17), followed by Thalamiflorae (11%), Monochlamydeae (9.59%), Inferae (8.22%), Calyciflorae (6.85%) and Heteromerae (1.37%).

Families making significant contribution to aquatic flora are: Ranunculaceae, Nymphaeaceae, Nelumbonaceae, Onagraceae, Trapaceae, Asteraceae, Menyanthaceae, Convolvulaceae, Scrophulariaceae, Lentibulariaceae, Acanthaceae (1 species), Amaranthaceae (1species), Polygonaceae, Hydrocharitaceae, Pontederiaceae, Typhaceae, Sparganiaceae, Lemnaceae, Aponogetonaceae, Potamogetonaceae, Zannichelliaceae, Cyperaceae and Poaceae.

6. 5. 2 Roadsides:

A total of 368 species (48.94% of total species), 323 dicots (43% of total species and 58.83% of total dicots) and 45 monocots (5.98% of total species and 22.17% of total monocots) were found growing on roadsides (Table-16, Figures-4, 5 & 6). Among dicots Calyciflorae accounted for 26.9% of roadside flora (Table-17), followed by Bicarpellatae (20.4%). Among remaining categories Thalamiflorae accounts for 11.7%, Disciflorae 4.89%, Inferae (9.768%), Heteromerae (1.09%) and Monochlamydeae (13%).

Families contributing to roadside flora are: Ranunculaceae, Annonaceae, Menispermaceae, Papaveraceae, Brassicaceae, Capparidaceae, Cleomaceae, Caryophyllaceae, Malvaceae, Sterculiaceae, Tiliaceae, Zygophyllaceae, Lythraceae, Onagraceae, Cucurbitaceae, Rubiaceae, Asteraceae, Apocynaceae, Asclepiadaceae, Boraginaceae, Convolvulaceae, Solanaceae, Scrophulariaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, and Moraceae etc.

6. 5. 3 Agricultural Fields:

Agricultural fields provide abode for 281 species (37.37% of total species), 208 dicots (27.7% of total species and 37.89% of dicot species). Monocots contribute 73 species (9.71% of total species and 35.96% of total monocot species) (Table-16,

Figures-4, 5 & 6). Among dicots Bicarpellatae account for 17.4% of the flora of agricultural fields (Table-17), followed by Calyciflorae (16%), Thalamiflorae (14.2%), Inferae (12.8%), Monochlamydeae (11.4%), Disciflorae (1.42) and Heteromerae (0.71%). Among monocots, Poaceae and Cyperaceae contribute greater share to weeds of agriculture.

Important weedy families in the study area are: Ranunculaceae, Fumariaceae, Papaveraceae, Brassicaceae, Cleomaceae, Caryophyllaceae, Portulacaceae, Malvaceae, Sterculiaceae, Tiliaceae, Zygophyllaceae, Oxalidaceae, Fabaceae, Caesalpiniaceae, Mimosaceae, Rosaceae, Lythraceae, Aizoaceae, Rubiaceae, Asteraceae, Primulaceae, Apocynaceae, Boraginaceae, Convolvulaceae, Solanaceae, Scrophulariaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Chenopodiaceae, Polygonaceae, Euphorbiaceae, Commelinaceae, Cyperaceae and Poaceae.

6. 5. 4 Kholas:

A total of 252 species (33.51% of total species), 216 dicots (28.72% of total species and 39.34% of dicot species) and 36 monocot species (4.79% of total species and 17.73% of monocot species) are found in Kholas (Table-16, Figures-4, 5 & 6). Among dicots, Bicarpellatae account for 21.43% species found in Kholas, Calyciflorae (18.65%), Thalamiflorae (18.25%), Monochlamydeae (11.11%), Inferae (9.52%), Disciflorae (5.95%) and Heteromerae account for only 0.79% (Table-17). Kholas are, in fact, relics of erstwhile forest vegetation. Out of 216 dicot species occurring in Kholas, 59 species (27.3%) are trees.

A good number of plant species are found nowhere else, except in or around the *Kholas* or their population size is larger in this habitat as compared with other habitat types i. e. *Capparis sepiaria*, *C. zeylanica*, *Casearia graveolens*, *C. tomentosa*, *Flacourtia indica*, *Helicteres isora*, *Fioria vitifolia*, *Grewia hirsuta*, *G. sapida*, *Celastrus paniculata*, *Butea monosperma*, *Eleiotis monophylla*, *Acacia catechu*, *Combretum nanum*, *Galium aparine*, *Blainvillea acmella*, *Himalaiella heteromalla*, *Jasminum arborescens*, *Carissa spinarum*, *Trichodesma indica*, *Pedalium murex*, *Blepharis maderaspatensis*, *Mallotus philippensis*, *Asparagus racemosus*, *Gloriosa superba*, and *Neyraudia arundinaceae*.

6. 5. 5 River bank:

A total of 321 species (42.69% of total species) are found on riverbanks. Dicots are represented by 239 species (31.78% of total species and 43.53% of total dicot species). Monocots account for 82 species (10.9% of total species and 40.39% of monocot species) (Table-16, Figure-4, 5 & 6). Among dicots, Bicarpellatae account for 21.5% species, Calyciflorae 20.56%, Inferae 14.02%, Monochlamydeae 12.46%, Thalamiflorae 3.74%, Heteromerae 1.56% and Disciflorae 0.62% species (Table-17).

Examples of families contributing to riverbank vegetation are: Ranunculaceae, Nymphaeaceae, Brassicaceae, Caryophyllaceae, Malvaceae, Sterculiaceae, Tiliaceae, Vitaceae, Fabaceae, Caesalpiniaceae, Mimosaceae, Lythraceae, Onagraceae, Cucurbitaceae, Apiaceae, Asteraceae, Campanulaceae, Primulaceae, Apocynaceae, Asclepiadaceae, Gentianaceae, Convolvulaceae, Scrophulariaceae, Acanthaceae, Verbenaceae, Lamiaceae, Amaranthaceae, Chenopodiaceae, Polygonaceae, Euphorbiaceae, Salicaceae, Commelinaceae, Najadaceae, Potamogetonaceae, Cyperaceae and Poaceae.

6. 5. 6 Moist sand:

A total of 222 species (29.52% of total species) are found on moist sand. Dicots account for 171 species (22.74% of total species and 31.15% of total dicots) and monocots for 51 species (6.78% of total species and 25.12% of total monocot species) (Table-16, Figures-4, 5 & 6). Among dicots Thalamiflorae, Disciflorae, Calyciflorae, Inferae, Heteromerae, Bicarpellatae and Monochlamydeae contribute 9.91%, 0.45%, 11.26%, 15.77%, 1.8%. 24.77% and 13.06% species to the vegetation of this habitat type (Table-17).

Examples of families contributing to moist sand vegetation are: Ranunculaceae, Brassicaceae, Caryophyllaceae, Hypericaceae, Malvaceae, Sterculiaceae, Tiliaceae, Fabaceae, Caesalpiniaceae, Mimosaceae, Lythraceae, Onagraceae, Cucurbitaceae, Apiaceae, Asteraceae, Campanulaceae, Primulaceae, Apocynaceae, Asclepiadaceae, Gentianaceae, Convolvulaceae, Solanaceae, Scrophulariaceae, Acanthaceae, Verbenaceae, Lamiaceae, Amaranthaceae, Chenopodiaceae, Polygonaceae, Euphorbiaceae, Commelinaceae, Juncaceae, Cyperaceae and Poaceae.

Ranunculus cantoniensis, *Hypericum japonicum*, *Citrulus colocynthis*, *Oenothera rosea* and *Juncus wallichianus* were collected from this type of habitat only.

6. 5. 7 Dry sand:

A total of 163 species (21.68% of total species) were colleted from this habitat type. Dicots accounted for 135 species (17.95% of total flora and 24.59% of total dicots) and monocots for 28 species (3.72% of total species and 13.79% of total monocots) (Table-16, Figure-4, 5 & 6). Among dicots Thalamiflorae, Disciflorae, Calyciflorae, Inferae, Heteromerae, Bicarpellatae and Monochlamydeae contribute 14.72%, 2.45%, 13.5%, 12.27%, 0.61%, 25.15% and 14.11% species respectively (Table-17).

Examples of families contributing to dry sand vegetation are: Ranunculaceae, Menispermaceae, Papaveraceae, Brassicaceae, Cleomaceae, Caryophyllaceae, Malvaceae, Tiliaceae, Zygophyllaceae, Onagraceae, Cucurbitaceae, Rubiaceae, Asteraceae, Asclepiadaceae, Boraginaceae, Convolvulaceae, Solanaceae, Scrophulariaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Moraceae, Cyperaceae and Poaceae etc.

Species like *Pavonia repanda*, *Hibiscus micranthus*, *Oenothera laciniata*, and *Amberboa ramosa* are found in this type of habitat.

6. 5. 8 Tall wet grasslands or swamps:

This is the principal habitat of swamp dear, and is experiencing high degree of modification, along with Kholas, due to human activities. A total of 382 species (50.8% of total species) are found in this habitat. Dicots contribute 251 species (33.38% of total species and 45.72% of dicot species) and monocots 131 species (17.42% of total and 64.53% of monocot species) (Table-16, Figures-4, 5 & 6). Among dicots Thalamiflorae, Disciflorae, Calyciflorae, Inferae, Heteromerae, Bicarpellatae and Monochlamydeae contribute 14.72%, 2.45%, 13.5%, 12.27%, 0.61%, 25.15% and 14.11% species respectively to moist grassland flora (Table-17).

Families which contribute to flora of this habitat type are: Ranunculaceae, Nelumbonaceae, Fumariaceae, Brassicaceae, Caryophyllaceae, Malvaceae,

Sterculiaceae, Tiliaceae, Fabaceae, Rosaceae, Lythraceae, Onagraceae, Cucurbitaceae, Rubiaceae, Asteraceae, Convolvulaceae, Solanaceae, Scrophulariaceae, Acanthaceae, Commelinaceae, Typahceae, Sparganiaceae, Araceae, Cyperaceae and Poaceae etc.

Some species like *Rotala indica*, *Ludwigia octovalvis*, *Actinostemma tenerum*, *Oenanthe javanica*, *Cepahalanthus tetrandra*, *Adenostemma lavenia*, *Oxystelma esculentum*, *Monochoria* spp., *Colocasia esculenta*, *Schoenoplectus lacustris*, *Coix gigantea*, *C. lachryma-jobi*, *Leersia hexandra*, *Isachne albens*, *Oryza rufipogon* and *Phragmites karka* are mainly found in this habitat type. Moreover, majority of species of *Cyperus* and *Fimbristylis* are found in swamps. *Epilobium hirsutum* was collected from moist sand as well as swamps. The specimens collected from the latter were much taller than those collected from the former.

6. 5. 9 Dry grasslands:

One hundred and fifty eight species (21.01% of total species) are found in this habitat type. Dicots contribute 131 species (17.29% of total and 23.68% of dicots) and monocots contribute 27 species (3.59% of total species and 13.3% of monocot species) (Table-16, Figures-4, 5 & 6). Among dicots, Thalamiflorae, Disciflorae, Calyciflorae, Inferae, Heteromerae, Bicarpellatae and Monochlamydeae contribute 12.66%, 2.53%, 17.09%, 15.19%, 0.63%, 21.52%, and 13.29% species respectively (Table-17).

Some examples of families which make major contribution to flora of this habitat are: Menispermaceae, Papaveraceae, Cleomaceae, Caryophyllaceae, Portulacaceae, Malvaceae, Zygophyllaceae, Oxalidaceae, Rhamnaceae, Fabaceae, Caesalpiniaceae, Onagraceae, Cucurbitaceae, Aizoaceae, Cactaceae, Rubiaceae, Asteraceae, Plumbaginaceae, Apocynaceae, Asclepiadaceae, Boraginaceae, Convolvulaceae, Solanaceae, Scrophulariaceae, Acanthaceae, Verbenaceae, Lamiaceae, Amaranthaceae, Chenopodiaceae, Euphorbiaceae, Cyperaceae and Poaceae.

Some examples of species more likely to be found in this habitat are: *Cocculus hirsutus*, *Argemone mexicana*, *A. ochroleuca*, *Cleome viscosa*, *Polycarpaea corymbosa*, *Stellaria media*, *Abutilon indicum*, *Malvastrum coromandelianum*, *Sida acuta*, *Sida ovata*, *Sida spinosa*, *Urena lobata*, *Waltheria indica*, *Triumfetta rhomboidea*, *Tribulus terrestris*, *Oxalis corniculata*, *Ziziphus nummularia*, *Abrus*

*precatorius, Alysicarpus monilifer, Alysicarpus vaginalis, Atylosia scarabaeoides, Desmodium gangeticum, Indigofera linnaei, Tephrosia purpurea, Coccinia grandis, Mollugo pentaphylla, Borreria articularis, B. pusilla, Conyza bonariensis, Gnaphalium pensylvanicum, Launaea procumbens, Tridax procumbens, Xanthium indicum, Calotropis procera, Cynoglossum zeylanicum, Heliotropium strigosum, Convolvulus prostratus, Evolvulus alsinoides, Solanum nigrum, Solanum virginianum, Antirrhinum orontium, Verbascum thapsus, Clerodendrum infortunatum, Lantana camara, Hyptis suaveolens, Ocimum americanum, Boerhavia diffusa, Achyranthes aspera, Aerva sanguinolenta, Alternanthera pungens, Amaranthus viridis, Gomphrena celosioides, Pupalia lappacea, Croton bonplandianum, Euphorbia hirta, Bulbostylis barbata, Cyperus rotundus, Cenchrus ciliaris, Cynodon dactylon, Dichanthium annulatum, Imperata cylindrica,*and *Setaria verticillata* etc.

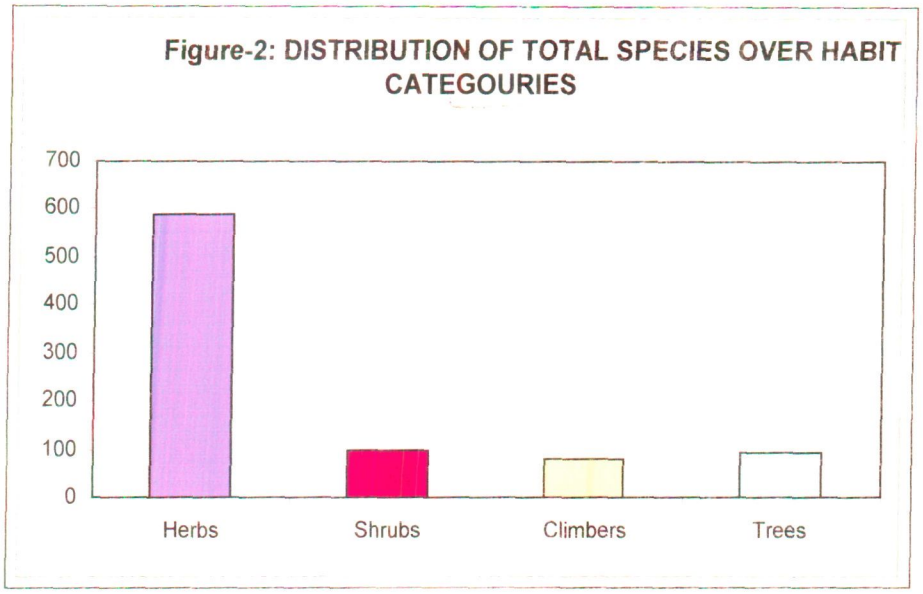


Figure-2: DISTRIBUTION OF TOTAL SPECIES OVER HABIT CATEGOURIES
700
600
500
400
300
200
100
0
Herbs
Shrubs
Climbers
Trees

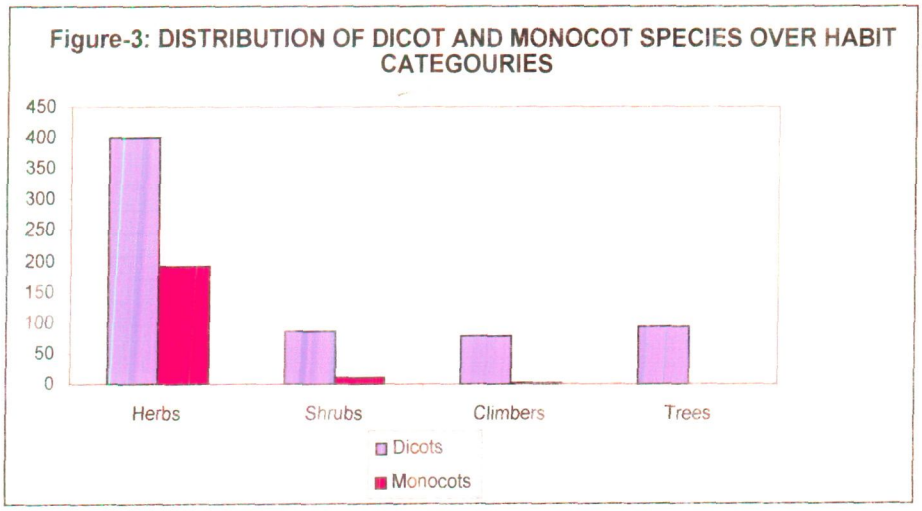
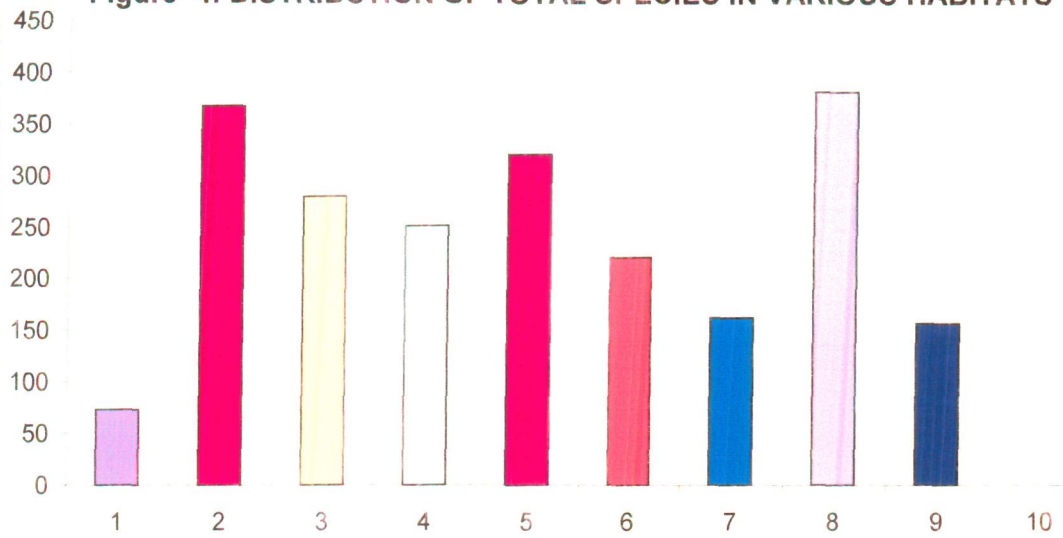


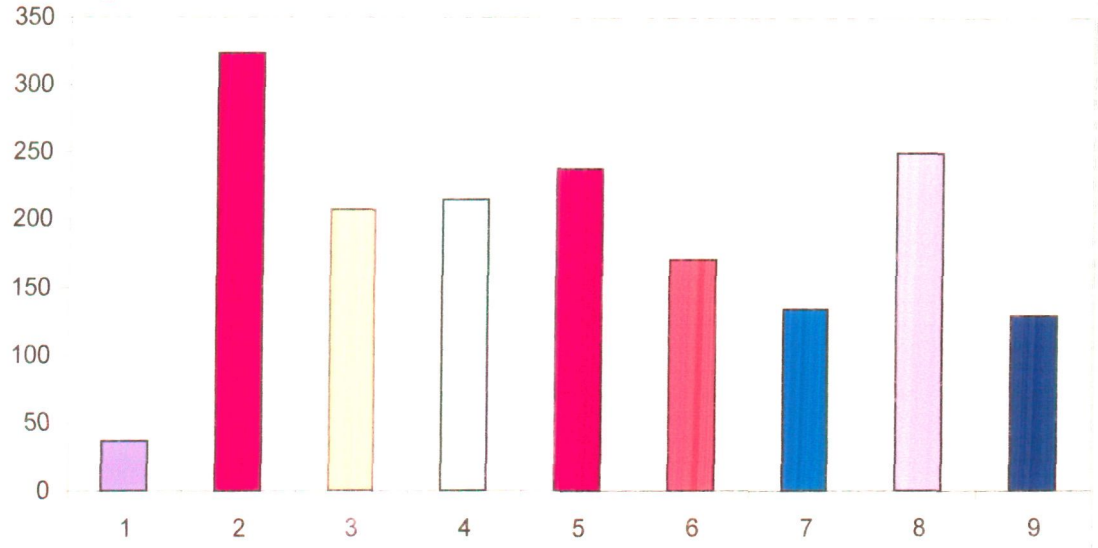
Figure-3: DISTRIBUTION OF DICOT AND MONOCOT SPECIES OVER HABIT CATEGOURIES
450
400
350
300
250
200
150
100
50
0
Herbs
Shrubs
Climbers
Trees
Dicots
Monocots

Figure- 4: DISTRIBUTION OF TOTAL SPECIES IN VARIOUS HABITATS



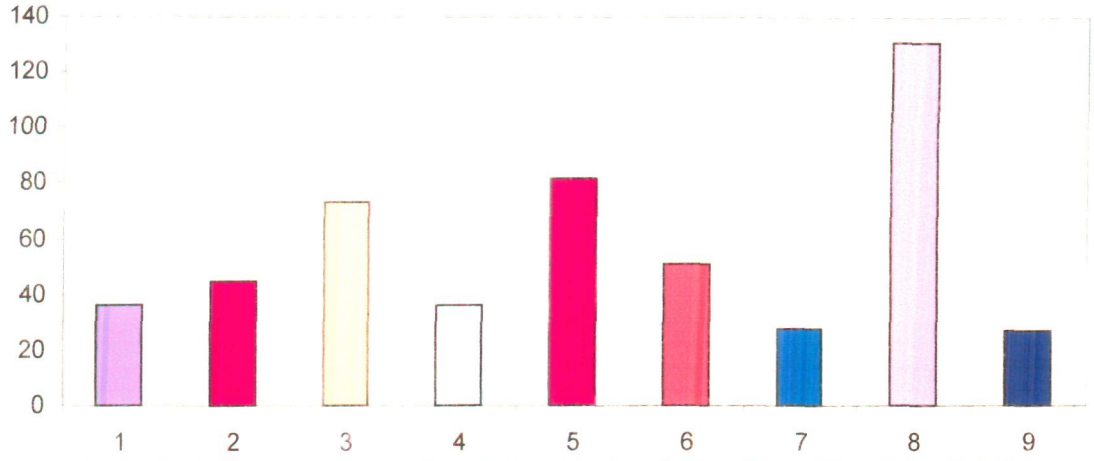
1-Aquatic; 2-Roadside; 3-Agricultural fields; 4-Kholas; 5- River Bank; 6- Moist Sand; 7-Dry Sand; 8- Swamp; 9- Dry Grassland

Figure- 5: DISTRIBUTION OF DICOT SPECIES IN VARIOUS HABITATS



1-Aquatic; 2-Roadside; 3-Agricultural fields; 4-Kholas; 5- River Bank; 6- Moist Sand; 7-Dry Sand; 8- Swamp; 9- Dry Grassland

Figure- 6: DISTRIBUTION OF MONOCOT SPECIES IN VARIOUS HABITATS



1-Aquatic; 2-Roadside; 3-Agricultural fields; 4-Kholas; 5- River Bank; 6- Moist Sand; 7-Dry Sand; 8- Swamp; 9- Dry Grassland

Table-4: Summary of floristic composition of the flora of Hastinapur Wildlife Sanctuary

S. No.	Name of taxon	Number
1.	**FAMILIES**	
	Dicot	
	Polypetalae	**52**
	Tahlamiflorae	22
	Disciflorae	15
	Calyciflorae	15
	Gamopetalae	**30**
	Inferae	2
	Heteromerae	6
	Bicarpellatae	22
	Monochlamydeae	**16**
	Dicot total	**98**
	Monocots	25
	Grand total	**123**
2.	**GENERA**	
	Dicot	
	Polypetalae	**159**
	Tahlamiflorae	55
	Disciflorae	22
	Calyciflorae	82
	Gamopetalae	**148**
	Inferae	48
	Heteromerae	10
	Bicarpellatae	90
	Monochlamydeae	**40**
	Dicot total	**347**
	Monocots	108
	Grand total	**455**
3.	**SPECIES**	
	Dicot	
	Polypetalae	**259**
	Tahlamiflorae	85
	Disciflorae	26
	Calyciflorae	148
	Gamopetalae	**213**
	Inferae	66
	Heteromerae	10
	Bicarpellatae	137
	Monochlamydeae	**77**
	Dicot total	**549**
	Monocots	203
	Grand total	**752**

Table- 5: Per cent contribution of different taxa to flora of Hastinapur Wildlife Sanctuary

S. No.	Taxa	% of total	% of dicot/monocot
1.	**FAMILIES**		-
	Dciot	79.67	
	Polypetalae	**42.28**	**53.06**
	Tahalamiflorae	17.9	22.45
	Disciflorae	12.2	15.31
	Calyciflorae	12.2	15.31
	Gamopetalae	**24.39**	**30.61**
	Inferae	1.63	2.04
	Heteromerae	4.88	6.12
	Bicarpellatae	17.89	22.45
	Monochlamydeae	**13.00**	**16.33**
	Monocots	20.33	-
2.	**GENERA**		-
	Dciot	76.26	
	Polypetalae	**34.95**	**45.82**
	Tahalamiflorae	12.09	15.85
	Disciflorae	4.84	6.34
	Calyciflorae	18.02	23.63
	Gamopetalae	**32.53**	**42.65**
	Inferae	10.55	13.83
	Heteromerae	2.20	2.88
	Bicarpellatae	19.78	25.94
	Monochlamydeae	**8.79**	**11.53**
	Monocots	23.74	-
3.	**SPECIES**		
	Dciot	73.01	
	Polypetalae	**34.44**	**47.18**
	Tahalamiflorae	11.30	15.48
	Disciflorae	3.46	4.74
	Calyciflorae	19.68	26.96
	Gamopetalae	**28.32**	**38.80**
	Inferae	8.78	12.02
	Heteromerae	1.33	1.82
	Bicarpellatae	18.22	24.95
	Monochlamydeae	**10.24**	**14.03**
	Monocots	26.99	-

Table- 6: Ten largest families of Hastinapur Wildlife Sanctuary according to number of genera and species

S. No.	Families	Number of Genera	Families	Number of species
1.	Poaceae	61	Poaceae	110
2.	Asteraceae	42	Fabaceae	62
3.	Fabaceae	31	Asteraceae	59
4.	Acanthaceae	13	Cyperaceae	45
5.	Scrophulariaceae	12	Malvaceae	22
6.	Malvaceae	10	Euphorbiaceae	22
7.	Cyperaceae	10	Convolvulaceae	20
8.	Cucurbitaceae	9	Scrophulariaceae	20
9.	Lamiaceae	9	Caesalpiniaceae	18
10.	Euphorbiaceae	9	Amaranthaceae	17

Table- 7: Break up of total families according to number of representative genera and species

S. No.	Genus/Genera per family	Number of families	Species per family	Number of families
1.	61	1	110	1
2.	42	1	62	1
3.	31	1	59	1
4.	13	1	45	1
6.	12	1	22	2
7.	10	2	20	2
8.	9	3	18	1
9.	8	3	17	1
10.	7	2	16	1
11.	6	5	14	1
12.	5	4	13	1
13.	4	4	11	4
14.	3	17	9	2
15.	2	16	8	3
16.	1	62	7	6
17.			6	4
18.			5	1
19.			4	4
20.			3	16
21.			2	23
			1	47

Table- 8: Comparison of ten dominant families in Hastinapur, some adjoining areas, Upper Gangetic Plain, India and World.

S. No.	Hastinapur [1]	Bijnor [2]	Dehra Dun [3]	Delhi [4]	Upper Gangetic Plain [5]	India [6]	World [7]
1.	Poaceae	Poaceae	Poaceae	Poaceae	Poaceae	Orchidaceae	Asteraceae
2.	Fabaceae	Fabaceae	Fabaceae	Fabaceae	Leguminosae	Leguminosae	Orchidaceae
3.	Asteraceae	Asteraceae	Asteraceae	Asteraceae	Cyperaceae	Poaceae	Fabaceae
4.	Cyperaceae	Euphorbiaceae	Orchidaceae	Cyperaceae	Asteraceae	Rubiaceae	Poaceae
5.	Malvaceae	Cyperaceae	Cyperaceae	Acanthaceae	Scrophulariaceae	Euphorbiaceae	Rubiaceae
6.	Euphorbiaceae	Solanaceae	Scrophulariaceae	Euphorbiaceae	Malvaceae	Acanthaceae	Lamiaceae
7.	Convolvulaceae	Acanthaceae	Lamiaceae	Convolvulaceae	Acanthaceae	Asteraceae	Euphorbiaceae
8.	Scrophulariaceae	Scrophulariaceae/ Malvaceae	Acanthaceae	Malvaceae	Euphorbiaceae	Cyperaceae	Melastomaceae
9.	Caesalpiniaceae	Convolvulaceae/ Brassicaceae	Rubiaceae	Amaranthaceae	Convolvulaceae	Lamiaceae	Myrtaceae
10.	Amaranthaceae	Caesalpiniaceae	Malvaceae	Scrophulariaceae	Lamiaceae	Urticaceae	Apocynaceae

[1] Present work; [2] Khan, 1987; [3] Babu, 1977; [4] Maheshwari, 1963; [5] Duthie, 1903 - 1929; [6] Hooker, 1907 & [7] Stevens (2001 onwards).

Table- 9: Break up of genera according to number of representative species.

S. No.	Number of species per genus	Number of genus/genera
1.	14	1
2.	12	2
3.	10	1
4.	7	4
5.	6	6
6.	5	7
7.	4	10
8.	3	34
9.	2	73
10.	1	317

Table- 10: Dicot – monocot Ratio in the Hastinapur Wildlife Sanctuary, adjoining areas and world.

S. No.	Taxon	Hastinapur [1]	Bijnor [2]	Dehra Dun [3]	Delhi [4]	Rajasthan [5]	World [6]
1.	Family	1 : 3.92	1 : 4.3	1 : 3.2	1 : 4.7	1 : 3.9	1: 3.98
2.	Genus	1 : 3.21	1 : 3.8	1 : 2.3	1 : 3.2	1 : 3.4	1: 3.84
3.	Species	1 : 2.7	1 : 3.9	1 : 2.6	1 : 2.7	1 : 2.7	1: 3.44

[1] Present work; [2] Khan, 1987; [3] Babu, 1977; [4] Maheshwari, 1963; [5] Shetty & Singh , 1993; [6] Stevens (2001 onwards)

Table- 11: Monocot – dicot and Dicot - monocot ratios for aquatic angiosperms in Hastinapur, north eastern North America, southeastern US and Central America.

S. No.	Region	Dicot species	Monocot species	Monocot – Dicot ratio	Dicot-Monocot ratio
1.	Hastinapur[1]	37	36	1 : 1.03	1: 0.97
2.	Northeastern North America[2]	39	106	1 : 0.37	1 : 2.71
3.	Southeastern US[2]	34	88	1 : 0.39	1 : 2.6
4.	Central America[2]	27	93	1 : 0.3	1 : 3.4

[1]Present work; [2]Crow (1993).

Table - 12: Genus – species Ratio in the Hastinapur Wildlife Sanctuary, some adjoining areas and world on the basis of total flora and dicot and monocot flora

S. No.	Flora	Hastinapur [1]	Bijnor [2]	Dehra Dun [3]	Delhi [4]	Rajasthan [5]	World [6]
1.	Total	1 : 1.65	1 : 1.4	1 : 1.97	1 : 1.63	1 : 2.4	1 : 20.25
2.	Dicot	1 : 1.58	1 : 1.45	1 : 1.89	1 : 1.54	1 : 2.3	1 : 19.8
3.	Monocot	1 : 1.88	1 : 1.41	1 : 2.16	1 : 1.83	1 : 2.9	1 : 22.05

[1] Present work; [2] Khan, 1987; [3] Babu, 1977; [4] Maheshwari, 1963; [5] Shetty & Singh , 1993; [6] Stevens (2001 onwards)

Table-13: Percent contribution of major taxonomic categories to flora of various habits*

S. No.	TAXONOMIC CATEGOURIES	HERBS	SHRUBS	CLIMBERS	TREES
1.	Thalamiflorae	8.91	2.93	0.53	1.46
2.	Disciflorae	1.33	0.66	0.66	1.73
3.	Calyciflorae	13.16	2.26	3.72	4.79
4.	Inferae	8.24	0.53	0.13	0.13
5.	Heteromerae	0.80	0.13	0.00	0.53
6.	Bicarpellatae	13.43	4.12	4.79	1.46
7.	Monochlamydeae	7.31	0.80	0.53	2.39
8	DICOT TOTAL	**53.19**	**11.44**	**10.37**	**12.50**
9.	Monocots	25.27	1.33	0.40	0.13
	TOTAL	**78.46**	**12.77**	**10.77**	**12.63**

* based on of total species

Table-14: Percent contribution of major dicot taxonomic categories to flora of various habits*

S. No.	Taxonomic categories	Herbs	Shrubs	Climbers	Trees
1.	Thalamiflorae	12.20	4.01	0.73	2.00
2.	Disciflorae	1.82	0.91	0.91	2.37
3.	Calyciflorae	18.21	3.10	5.10	6.56
4.	Inferae	11.29	0.73	0.18	0.18
5.	Heteromerae	1.09	0.18	0.00	0.73
6.	Bicarpellatae	18.40	5.65	6.56	2.00
7.	Monochlamydeae	10.02	1.09	0.73	3.28
8	DICOT TOTAL	73.04	15.66	14.21	17.12

* based on total dicots

Table- 15: Within habit percent contribution of major taxonomic categories of dicots

S. No.	Taxonomic categories	Herbs	Shrubs	Climbers	Trees
1.	**Thalamiflorae**	16.71	25.58	5.13	11.70
2.	**Disciflorae**	2.49	5.81	6.41	13.83
3.	**Calyciflorae**	24.94	19.77	35.90	38.30
4.	**Inferae**	15.46	4.65	1.28	1.06
5.	**Heteromerae**	1.50	1.16	0.00	4.26
6.	**Bicarpellatae**	25.19	36.05	46.15	11.70
7.	**Monochlamydeae**	13.72	6.98	5.13	19.15
	TOTAL	100.00	100.00	100.00	100.00

Table-16: Percent distribution of plant species in various habitat categouries

S. No.	Taxonomic categoury	Aquatic	Roadside	Agricultural fields	Kholas	River banks	Moist sand	Drysand	Swamps	Dry grasslands
1.	Dicots as per cent of total species	4.92	43.00	27.70	28.72	31.78	22.74	17.95	33.38	17.29
2.	Dicots as per cent of total dicots	6.74	58.83	37.89	39.34	43.53	31.15	24.59	45.72	23.68
3.	Monocots as per cent of total species	4.79	5.98	9.71	4.79	10.90	6.78	3.72	17.42	3.59
4.	Monocots as per cent of total monocot species	17.73	22.17	35.96	17.73	40.39	25.12	13.79	64.53	13.30
5.	Total	**9.71**	**48.94**	**37.37**	**33.51**	**42.69**	**29.52**	**21.68**	**50.80**	**21.01**

Table-17: Percent contribution of dicot taxonomic categories to flora of various habitats

S. No.	Taxonomic category	Aquatic	Roadside	Agricultural fields	Kholas	River banks	Moist sand	Drysand	Swamps	Dry grasslands
1.	Thalamiflorae	11.00	11.70	14.20	18.25	3.74	9.91	14.72	14.72	12.66
2.	Disciflorae	0.00	4.89	1.42	5.95	0.62	0.45	2.454	2.45	2.53
3.	Calyciflorae	6.85	26.90	16.00	18.65	20.56	11.26	13.50	13.50	17.09
4.	Inferae	8.22	9.78	12.80	9.52	14.02	15.77	12.27	12.27	15.19
5.	Heteromerae	1.37	1.09	0.71	0.79	1.56	1.80	0.613	0.61	0.63
6.	Bicarpellatae	13.70	20.40	17.40	21.43	21.50	24.77	25.15	25.15	21.52
7.	Monochlamydeae	9.59	13.00	11.40	11.11	12.46	13.06	14.11	14.11	13.29

CHAPTER-7

HABITAT CHARACTERISTICS AND FLORISTIC CHANGES IN HASTINAPUR WILDLIFE SANCTUARY

7. 1 INTRODUCTION

The Gangetic Plain in Uttar Pradesh covers an area of 1,79,400 sq. km and is among few first areas to be colonised by human civilization. The earliest record of establishing human habitation in the area date backs 1800 B.C. (Bridget and Allchin 1983) and since then the human population has continuously been growing in this region. Today, the Gangetic Plains are among the few densely populated areas of the country.

The ever increasing human population in the Gangetic plains has created an adverse impact on the natural resources due to their increased demand and change in landuse pattern. The worst affected natural resources are the forests and wildlife. In the historic past, the area was rich in flora and fauna both. Till few centuries ago, there were extensive tracts of natural vegetation those supported populations of rhino, elephant, buffalo, swamp deer and attended carnivora but most populations have disappeared before almost total agricultural landuse (Rodgers & Panwar, 1988). The changing landuse has completely altered the natural character of this region. According to Mani (1974) "The characteristics of the fauna today give any clue to its pattern of diversity and distribution just 5000 years ago. Biogeographically the plain is now distinguished entirely by negative characters. Either no species were differentiated on the plains or all have been eliminated by today, so there is a most striking poverty of endemic elements." In spite the large scale destruction of natural biomes in Uttar Pradesh (U.P) plains, there are few areas those still possess some natural elements but are threatened and need conservation efforts. One such biome is the Gangetic Grasslands locally known as Khadar.

Till the middle of the last century, there were extensive tracts of Khadar with rich faunal diversity all along the Ganga. However, after the independence of the country, Gangetic grasslands have received heavy influx of people and today, the entire region is cultivated by Pakistani emigrants of 1950s and a few decades back by

Punajabi emigrants of 1980s. Thus, the Gangetic Khadar is one of the highly threatened biomes of India.

During the last few decades, efforts have been made by the Government to protect example of each of the existing natural biomes by establishing a protected area network. Considering the importance of Gangetic grasslands, the Government of UP in 1987 declared an area of 2073 sq. km. as Hastinapur Wildlife Sanctuary along the banks of Ganga (Fig.- 7). However, since its inception, this Sanctuary is facing several conservation problems due to exploitation of resources and change in land use pattern (Khan & Khan 1998). Moreover, no systematic study has ever been attempted to document the changes brought about in landuse pattern. It is therefore, necessary to understand the current status of floral resources and the changes brought about in the natural vegetation by the anthropogenic factors, so that a comprehensive strategy for long-term conservation of this biome can be prepared.

In this chapter, I have made attempts to map extent of natural vegetation along with land cover/landuse pattern using remotely sensed data and depicted spatially some of the attributes of plant community such as density, diversity, richness and evenness.

7. 1. 1 Remote Sensing and GIS Technology

Above absolute temperature all the objects radiate electromagnetic energy by the virtue of their atomic and molecular oscillations. The total amount of emitted radiation increases with the body's absolute temperature and it peaks at progressively shorter wavelengths. Remote sensing works on above property and is defined as acquisition of information about the condition and/or the state of target at earth's surface by a sensor (placed on broad a satellite) that is not in physical contact with the target. The basic strategy for sensing electromagnetic radiations is that everything in nature has its own unique distribution of reflected, emitted and absorbed radiations. These spectral characteristics, if ingeniously exploited, can be used to distinguish one object from the other or to obtain information about shape, size and other physical and chemical properties. This is accomplished by measuring Electro Magnetic Radiation (EMR) emitted or reflected by the surface of the earth. The interaction between the Sun's electromagnetic radiation and the earth's surface modulates the characteristics of emerging radiation from the earth's surface. The modulation may result in the change in the brightness, polarization and the direction of radiation; it is radiation dependent as well. This modulation serves as a signal that is used for remote sensing

of target characteristics. Therefore, by measuring radiant energy (reflected or emitted) in different part of the electromagnetic spectrum, one can differentiate or distinguish features on the earth's surface. The remotely sensed data contains both spatial (size-shape characteristics) as well as the spectral information.

Various satellite sensors have been designed to capture the radiant energy reflected or emitted by the objects in the different parts of the electromagnetic radiation. Sensor is a device that gathers energy, converts it into a signal and presents it in a form suitable for obtaining information about the target under investigation. A sensor may be called as active or passive sensor depending upon the source of energy.

What we see in remote sensing is mostly shapes and size of total variations of the different kinds of vegetation and the large features like the human settlement, forests, wetlands and hills etc. constituting of different macro habitats and their continuity in space and time.

Remote Sensing in combination with ground based studies has proved to be an effective technology to study and monitor changes in natural reserves (Leopold, 1933; Mosby,1971 Giles, 1978). With the advent of satellite remote sensing technology, which has capability to record electromagnetic radiation information extraction capability from remote sensing data about environment is greatly extended (Roy, 1986). Also with the improvement in software and hardware and decrease in the cost of imagery, remote sensing is being used for more and more studies particularly at the landscape level. These studies add to the basic understanding of biology that previously could not be realized with research at the local level. Also by using geographic information system (GIS) spatial relationships can be more easily examined. Remote sensing techniques have revolutionized the process of data gathering and map making offering the possibilities of conducting resources surveys over large areas rapidly, cost effectively and accurately. Such surveys can provide various levels of information to suit the desired intensity and quality of management planning requirement (Lillesand and Keifer, 1979; Teer, 1982; Sawarkar, 1986).

GIS is a system of hardware, software and procedures designed to support the capture, management manipulation; analysis-modeling display of spatially referenced data for solving complex planning and management problems (Burroghs, 1986). GIS provides ample opportunities to integrate, analyze and generate scenarios based on human knowledge and geospatial parameters. Combination of remote sensing and GIS is making tasks of planning and decision-making much easier (Roy *et al.,* 2000).

Geographic Information system is paying an increasingly important role in plant community studies as it provides an efficient means for modeling potential distribution of the species and their associations (Davis *et. al.,* 1990; Kushwaha *et al.,* 2000). The usefulness of GIS technology is now limited by the data availability, quality and the reliability of habitat preferences model than by the technological obstacles (Storms, 1992). A geographic information system, which is designed to create, analyze and store large volumes of spatial data, is becoming popular in public and private sectors (Mead, 1982). GIS databases may provide a useful source of landuse data, which can be used to automate the application of HSI models (Donovan *et al.,* 1987).

Numerous digital layers can be used in GIS. These include digital elevation models (DEM), satellite images, digital orthophoto quads (DOQ), soil maps, land cover maps, digital raster graphics (DRG), Digital topographic maps, road maps, stream layers, etc. DEM's can be used to examine how topography may effect distribution of organisms as well as other biological processes (Hepinstall *et al.,* 1997). Satellite imagery and DOQ's can be used to develop land cover and land use maps. Satellite imagery such as Landsat- TM with their 30 x 30 m pixel allows for a broader landscape level analysis. Where as DOQ's and high resolution satellite images allow for a more local or fine scale analysis of land cover mapping. DRG's can be used as base maps for plotting locations and measuring spatial aspects.

7. 2 DATA AND SOFTWARE USED

Considering the nature of the study area that lies on both sides of the river Ganges with swamps and gently rising drier plains, it was decided to procure Landsat TM and ETM data as it is designed to maximize vegetative analysis capabilities for agricultural applications. Band 1(0.45-0.52 μm) is capable to penetrate through water and strong vegetation absorptance while the NIR band 4 (0.76-0.69μm) provides high land water contrast and strong vegetation reflectance. Band 5 near –middle infrared (1.55-1.75μm) is very sensitive to moisture. The Landsat ETM data of October 2000 path 146 and row 40 was procured to compare it with the Landsat TM data of 1992 of the same period (Fig.- 8) October is the time when most of the crops fields are being prepared for sowing of wheat and grasses are full grown and not yet dry that makes identification and classification of natural areas easier in an agriculture dominated landscape. Survey of India toposheets of 1: 50,000 scale were used for ancillary data

(Fig.- 9). The image processing was carried out using ERDAS Imagine 8.4 while ARC/Info 8.1 was used for generation of maps in GIS domain.

7. 3 METHODOLOGY

The raw satellite data was subjected to rectification in order to remove the geometric and radiometric distortions. First order correction was done by dark pixel subtraction technique (Lillesand and Kiefer, 1999). This technique assumes, that water body reflectance in the near infrared region should be near zero. However, due to atmospheric scattering the reflectance in this region is non-zero. The relative contributions of other spectral bands in the visible region with respect to near-infrared band were considered to know the magnitude of contribution of the atmospheric haze. This factor was then reduced from each band to radiometrically correct the image.

A reconnaissance survey was conducted to get acquainted with the general pattern of vegetation types and land use land cover of the area along with FCC and a GPS (Garmin 12). Ground control points were collected for reference while attempting classification of the satellite data. The satellite data was then subjected to unsupervised classification to obtain 200 classes. Later these classes were merged on the basis of tone, texture, association and the knowledge gained through GPS positions during the reconnaissance survey. Later, the classified map was taken to the field for ground checks. Wherever disagreement in assigning classes were observed, they were corrected and a final map was generated.

For change detection, 1992 data of Landsat TM was used for classification. First an unsupervised classification was carried out and using the knowledge of classified map of 2000 Landsat ETM data a supervised map was generated. The results so obtained in different land use/ land cover categories during 1992 and 2000 were simply compared.

In order to collect quantitative data on ecological attributes of vegetation, Stratified Random Sampling method following Mueller-Dombois & Ellenberg (1974) was used. Data on plant species density, diversity, richness and evenness was collected in three natural vegetation types viz., scrubland, dry grasslands and tall wet grasslands. Transects each of one km length were laid in respective habitats. Vegetation sampling was carried out along each transect at a regular interval of 100 m. At each sampling point, plant species other than grasses and sages were counted in

2 m radius circular plot. Grasses and sages were counted in a four 0.5 m × 0.5 m quadrat, and each grass clump was considered as one individual.

7. 3. 1 Data analysis

The diversity of herb/Shrubs and grasses were calculated by Shannon-Weiner Diversity Index (H') using the formula:

$H' =$ pi x log pi

where, pi is the proportion of i th species in the sample.

The species richness was calculated by the Margalef's Richness Index (RI) using the formula

$RI =$ S 1 log n

where, S is the number of species in the sample, n is the number of individuals.

The Evenness Index (EI) was calculated using Simpson Evenness Index as:

$EI =$ D D max

where D is diversity index and D max is the maximum possible value for diversity index.

7. 4 RESULTS AND DISCUSSION

7. 4. 1 Landuse/ land cover pattern in Hastinapur Wildlife Sanctuary

The result of classification indicate that the sanctuary covers an area of 1793.22 sq. km. as against the officially stated area of 2073 sq. km. indicating a difference of about 279.78 sq. km. This difference is not due to some error in calculation of the area but may be due to the unclear demarcation of the boundary by the U.P. Forest Department. The boundary map was procured from the office of the Wildlife Warden, Meerut and the same boundary was transferred on to the SOI toposheets of 1:50,000 scale. The area calculation was then carried out.

The classified map of 2000 is shown in figure 10. Nine categories of landuse/land cover were identified. Out of the total area of the sanctuary tall wet grasslands encompass an area 9.8 percent, dry grasslands 4.6 percent, forest and plantations 4.5 percent and scrub occupies an area of 12.8 percent. The share of agriculture is 32.78 percent and open fields cover an area of 16.9 percent. Sandbeds along the Ganges and few other places cover an area 13.87 percent while the area under human habitations (builtup area) 1.2 percent. Water constitutes 4.1 percent. Table- 18 summarises the area under each landuse category along with its percentage.

7. 4. 2 Change in landuse/ land cover pattern in Hastinapur Wildlife Sanctuary

The classified map of 1992 is shown in figure 11. The same nine classes of landuse land cover types were identified in the area. The tall wet grasslands covered an area of about 12 percent , dry grassland 10 percent and forest/plantations 11.23 percent. The area under scrub was about 9 percent while the crop fields constituted 25.55 percent. Open land was estimated to be 12.24 percent and sandbeds 13.41 percent. Area under human habitation (builtup area) was 0.73 percent while water covered an area of about 5 percent (Table- 19).

The comparison of landuse land cover pattern between 1992 and 2000 has revealed marked differences. Table 20 provides the details of the area under each landuse/ landcover category during 1992 and 2000 and percent change. The change in landuse pattern of Hastinapur Wildlife Sanctuary occurred between 1992 and 2000 and its causes has been discussed as following.

1. Tall Wet Grassland

The tall wet grasslands occur mostly in the swampy low-lying areas where water remain inundated for most of the year. During 19992 the extent of tall wet grasslands was 223.58 sq. Km. which reduced to 176 sq. km in 2000; a decrease of about 21.2 percent. These grasslands were located mostly at the northern boundary of the sanctuary and along the Ganga. The construction of Madhya Ganga Canal (MGC) during late 1980s has opened up area for transportation and many inaccessible areas which were not frequented earlier were now accessible. That prompted people to legally and illegally exploit these so called waste lands for the purpose of cultivation. Many such areas were converted into crop field. Local village panchayat have taken up the task of development and resultantly water from several swampy areas was drained out either to make approach roads to connect remotely located villages with that of the urban areas or for cultivation.

2. Dry Grasslands

The sanctuary has witnessed a decrease of about 54 percent in the dry grasslands over a period of eight years. During 1992 the extent of these grasslands was 182 sq. km while it merely reduced to 82 sq. km. in 2000. The dry grasslands occurred either on the river islands or in Khola. River islands keep changing between years due to the change in the river course and presents a dynamic entity. However

such a change in extent of dry grasslands is not due to the change in river flow, as old areas get washed away the new one comes up from where water has receded. In fact the change has been witnessed in grassland areas which are in khola and are not affected by the change in the river course but more so due to the cultivation.

3. Forest/ Plantation

Since Hsatinapur Wildlife Sanctuary is located along the Ganges the area does not ecologically support the occurrence of natural forest. However, part of the sanctuary is in Khola which are undulating grounds gently rising from the level of the Ganges merging into plains, supports growth of woody vegetation and forest. There was a marked decrease in the forest cover from 201 sq.km in 1992 to only 81 sq. km in 2000. However the change is not so radical. In fact the calculated forest cover does not discreminate between the plantations raised on private or panchayat land and natural forest. Much of the forest cover change can be attributed to the plantations. Mostly Eucalyptus and Polpulas species were planted at large scale in the low lying areas where water remained inundated in order to convert the land into cultivation. After the construction of MGC, once the areas were open for transportation, the plantations were removed by both the forest department as well as by the locals and hence a change of this magnitude.

4. Scrub

There was an increase in the scrub areas of about 41 percent from 163 to 230 sq. km. from 1992 to 2000. This change can be attributed to the fact that the removal of trees from Kholas have rendered area as scrub. Much of the change is noticeable only in this area. Another reason of increase in scrub areas is due the lowering of water in the Ganges. The areas from where the water has receded permanently are converted to dry grasslands and later to scrub.

5. Agriculture fields/ open land

The area has witnessed an increase in the crop fields by about 28 percent. Pattern of cropping changes with the time of the cropping season and it is difficult to assess the change only on the basis of presence of crop at a particular time. Therefore it is necessary to take into consideration the areas where crops are not sown at that particular time of the year. Such areas were classified separately as open land. If the

area under open land is added to the areas under crop the change is of about 60 percent.

6. Sandbeds

There is an increase of about three percent in the sandbeds. The sandbeds encompassed an area of about 240 sq. km. in 1992 and 248 sq. km. in 2000 whereas the reduction in the area covered by water was about 18 percent. Considering this a change of three percent in the areas covered by sand is lower than expected. This is mainly due to the fact that many recently created sandbeds have come under the cultivation.

7. Builtup areas

There has been a marked change in the builtup areas. Expansion of human habitation and development in terms of infrastructure is a buzz word. The area has also witnessed a change in terms of builtup areas. It has increased by about 67 percent over eight years. The area under human habitation was about 13 sq. km. in 1992, which increased to 22 sq. km. by 2000.

8.Water

The actual assessment of reduction in the area covered by water is difficult mainly due to the fact that shallow water areas are mostly covered by tall wet grasslands and are categorized under that particular class. The change assessed during this study mainly reflects the reduction in areas of open water bodies particularly of the Ganaga river. A decrease of 18 percent water cover is noticeable. During 1992 water covered an area of about 90 sq. km. that was reduced to about 73 sq. km in 2000.

7. 4. 3 Plant species diversity, richness and evenness in different habitats

Sampling for estimating species diversity, richness and evenness was carried out only in natural vegetation types represented in the study area. These were scrub, tall wet grasslands and dry grassland. A total of 772 sampling plots were established in three habitat types; 250 in tall wet grassland, 224 in dry grassland and 298 in scrub. Plant species diversity, richness and evenness were calculated separately for the herb, shrub, grass and sedge species.

7. 4. 4 Herb species diversity, richness and evenness in different habitats

Highest density (58 plants/m²) of herbs was recorded in tall wet grasslands while minimum (16 plants/ m²) in dry grasslands. The density of herb species in scrub was 27 plants/ m². Fig. 12 shows density of herb species in various habitat types in Hastinapur Wildlife Sanctuary. The diversity of herbs varied between different habitats. It was .859 in tall wet grassland, 1.141 was in dry grassland and .962 in scrub (Fig.- 13). Similar pattern was observed in the values of herb richness. The maximum (3.359) species richness was recorded in dry grassland and minimum (2.39) in tall wet grassland (Fig.-14). Evenness value was highest in dry grassland and lowest in tall wet grassland (Table- 21). Fig. 15 shows the evenness values in different areas of Hastinapur Wildlife Sanctuary.

7. 4. 5 Shrub species diversity, richness and evenness in different habitats

There were marked differences in the density of shrub species in three different habitats. The lowest shrub density (6 plants/ 100 m²) was recorded in the tall wet grassland and highest (53 plants/ 100 m²) was recorded in dry grassland. In scrub the density value was 10 plants/ 100 m². Figure 16 shows density of shrub species in various strata of HWLS. Shrub diversity in scrub was highest (0.566) and it was followed by tall wet grassland (0.376) and lowest diversity value was recorded in dry grassland (Fig.- 17). Shrub species richness was more or less similar in tall wet grassland and scrub and it was marginally higher in tall wet as compared to scrub (Fig.- 18). Evenness value was once again highest in tall wet grassland and lowest in dry grassland (Fig.-19). Shrub species density, diversity, richness and evenness are summarized in Table- 22.

7. 4. 6 Grass species diversity, richness and evenness in different habitats

The density of grass clumps was highest in tall wet grassland and it was 12.8 clumps per m² while the lowest density (2.4 clumps/ m²) was recorded in scrub. The density of grass clumps was 3.6 clumps/ m² in dry grassland. Figure 20 shows the density of grass clumps in different strata of HWLS. The diversity values of grasses was highest in scrub (0.645) and it was lowest in tall wet grassland (0.449). Figure 21 shows spatial distribution of grass diversity values in HWLS. Grass species richness was recorded highest in scrub (1.048) and lowest in tall wet grassland (Fig.- 22). The value for species richness was 0.774 for the dry grassland. The evenness values for

the dry grassland and scrub were marginally different and they were 0.878 and 0.829 respectively. It was lowest in tall wet grassland with a value of 0.667 (Fig. -23). Grass species density, diversity, richness and evenness values among different habitat types are presented in Table- 23

7. 5 FLORISTIC CHANGES IN THE STUDY AREA SINCE 1961

It is well known that large scale changes at the landscape level, fragmentation and or environmental perturbations can affect the fauna as well as flora of a region (Sharma & Joshi 2008). The most significant changes in distribution of plant species, however, may be caused by fragmentation and habitat loss (Khan 2004). Hastinapur Wildlife Sanctuary is one such area where large scale destruction of natural habitats occurred during last few decade. The rate of destruction ranges between 3 and 7 percent per annum as revealed by the results of this study. It is therefore, expected that change in habitat of this magnitude must have caused some changes in species composition too.

The inventory of flowering plant species prepared during this survey was compared with that of Murty and Singh (1961a) and following changes at different taxonomic levels were observed. .

7. 5. 1 Families

Murty and Singh recorded a total of 102 families from the study area. In present study 123 families were recorded. Some example of new families recorded are *Elatincaceae, Hypericaceae, Balsaminaceae, Tropaeolaceae, Celastraceae, Passifloraceae, Cactaceae, Sphenocleaceae, Periplocaceae, Plantaginaceae, Basellaceae, Proteaceae, Ulmaceae, Cannaceae and Sparganiaceae* etc. Two families, *Polygalaceae* and *Aponogetonaceae* could not be found in this study.

7. 5. 2 Genera

Total number of genera recorded by Murty and Singh (1961) was 405. This figure included large number of cultivated species, which are neither included in keys nor considered for the floristic analysis in this study. Therefore, the number of indigenous or naturalized genera reported by Murty and Singh and considered in this analysis is 360.The total number of genera recorded in this work is 423. Ninety-five genera were not reported by Murty and Singh (1961) and 32 genera reported in earlier work could not be collected during present work. Out of 95 genera added, only 41

were purely cultivated and remaining were of wild origin or established escapes. Some examples of new genera recorded are *Capsella, Sisymbrium, Polycarpon, Silene, Bergia, Hypericum, Pentapetes, Celastrus, Eleiotis, Lotus, Pongamia, Teramnus, Combretum, Epilobium, Oenothera, Bryonopsis, Oenanthe, Sessili, Cephalanthus, Dentella, Blainvillea, Cyathocline, Dichrocephala, Enydra, Eupatorium, Grangea, Ixeris, Laggera, Parthenium, Soliva, Spilanthus, Verbesina, Sphenoclea, Jasminum, Hyptis, Plantago, Basella, Mallotus, Ottelia, Eulophia, Sparganium, Leersia, Neyraudia* and *Thysanolaena* etc.

Thirty-two genera of indigenous or naturalized plants, reported by Murty and Singh (1961), could not be collected during present study. Some examples of such genera are *Maerua, Polygala, Kydia, Fagonia, Dodonaea, Alhagi, Uraria, Morinda, Enicostemma, Hydrolea, Stemodia, Dipteracanthus, Indonesiella, Ruellia, Orthosiphon, Breynia, Sapium, Arundenella, Eulaliopsis, Mnesethia* and *Tragus* etc.

7. 5. 3 Species

One hundred and ninety five (195) species collected during present work were not reported by Murty and Singh (1961). These species can be divided into three categories (a) wide spread (b) restricted and (c) occasional. Examples of widespread newly added species are *Ranunculus cantoniensis, Argemone ochroleuca, Rorippa nasturtium-aquaticum, Polycarpon prostratum, Silene conoidea, Pongamia pinnata, Teramnus labialis, Trifolium sp., Cassia tora, Bryonopsis laciniosa, Oenanthe javanica, Ageratum houstonianum, Erigeron sublyratus, Gnaphalium leuteo-album, Grangea mderaspatana, Parthenium hysterophorus, Soliva anthemifolia, Centaurium centaurioides, Cuscuta chinensis, Physalis angulata, Bacopa procumbens, Hemiadelphis polysperma, Clerodendrum viscosum, Lantana camara, Hyptis suaveolens, Leonotis nepetifolia, Alternanthera paronychioides, Basella rubra, Kirganellia reticulate, Sparganium erectum, Potamogeton nodosus, Carex fedia, Cyperus compressus, Cymbopogon jawarancusa, Echinochloa frumentacea and Setaria verticillata* etc.

Following new additions are of restricted distribution. *Casearia graveolens, Bergia ammanioides, Hibiscus sabdariffa, Pentapetes phoenicia, Celastrus paniculatus, Eleiotis monophylla, Lotus corniculatus, Caesalpinia bonduc, Potentilla sundaica, Conbretum nanum, Rotala indica, Epilobium sp., Ludwigia prostrata, Oenothera rosea, O. sinuata, O. laciniata, Citrulus colocynthis, Luffa echinata, L.*

graveolens, Opuntia elatior, Hydrocotyle sibthorpioides, Cephalnthus occidentalis, Dentella repens, Gallium aparine, Blainvillea acmella, Cyathocline purpurea, Dichrocephala integrifolia, Enydra fluctuans, Sonchus wightianus, Spilanthus paniculatus, Verbesina encelioides, Youngia japoniaca, Wahlenbergia marginata, Sphenoclea zeylanica, Primula umbellate, Jasminum arborescence, Calotropis gigantea, Operculina terpathum, Verbascum thaspus, Barleria cristata var. dichotoma, Amaranthus tenuifolius, Mallotus nudiflorus, Ottelia alismoides, Eulophia dabia, Najas minor, Axonopus compressus, Coix gigantea, Digitaria griffithii, Isachne albens, Neraudia arundinacea, Oryza rufipogon, Polypogon fugax and Thysanolaena maxima etc.

New species which are occasionally met with in the sanctuary are *Capsella bursa-pastoris, Sisymbrium irio, Capparis decidua, Hypericum japonicum, Crotalaria orixensis, Alternanthera philoxeroidess, Polygonum pleibium* var. *sindica, Rumex crispus,* and *Mallotus philippensis,* etc.

During present work 72 species of those reported by Murty and Singh (1961) could not be collected. Some examples of such species are, *Ranunculus trichophyllus* (=*Ranunculus aquatilis*), *Maerua arenaria,, Abutilon hirtum, Abutilon ramosum, Kydia calycina, Corchorus tridens, Fagonia arabica, Atylosia platycarpa, Crotalaria bialata, Dalbergia latifolia, Indigofera cordifolia, Rhynchosia rothii, Uraria picta, Acacia gageana, Melothria purpusilla, Morinda tinctoria, Carthamus oxyacantha, Seigesbeckia orientalis, Leptadenia pyrotechnica, Enicostemma axillaries, Hydrolea zeylanica, Heliotropium europeum, Acalypha ciliata ,Breynia vitis-idaea, Commelina attenuata, Cyanotis cristata, Aponogeton natans, Acrachne racemosa, Aristida funiculate and A. hystrix* etc. Appendix- II provides complete list of species included in these two categories.

7. 5. 4 Proximate causes of floristic changes

The species gain and loss recorded in present study can be attributed to three factors (a) Floristic--- omissions during survey (b) Taxonomic--- species that were earlier reported to occur in the study area but according to current standard works those species do not occur in and around the study area and (c) Ecological--- large scale ecological changes occurring in the study area.

The possibility of some species being over - sighted during survey conducted by Murty and Singh (1961) or during present one can not be ruled out. It may be,

however, argued that the populations of those species which could not be collected during present work may have dwindled to such extent as to make their collection difficult during a normal survey. However, more extensive surveys may result in collection of some missing species. As regards the species not reported earlier, the species included in widespread category in this communication, could never have been missed provided their population size was the same as today. These species either invaded this area after 1960s or at the time of survey by Murty and Singh (1961) their population size was too small to be collected during a normal survey schedule. Accessibility of the area in 1960s must be taken in to account while attempting to explain so large number of species being missed in earlier work. A massive barrage was built across the Ganga in early 1980s. A 26 km long road was constructed to connect Bijnor with Delhi-Dehra Dun highway. Construction of this road and a number of smaller link roads in the study area has rendered the entire sanctuary much more easily accessible which was not possible in 1960s.

Ranunculus trichophyllus, reported by Murty and Singh (1961) from Hastinapur, is a high altitude species (3500 – 4500 m). This species does not occur even in Dehra Dun situated at much higher altitude than Hastinapur Wildlife Sanctuary (Babu, 1977). According to latest work on Indian grasses (Moulik, 1997) *Arundinella nepalensis* occurs between 1500 – 2000 m; *Aristida funiculata* is found in Punjab, Rajasthan and Tamil Nadu; *A. hystrix* occurs in Madhya Pradesh, Tamil Nadu and Kerala; *Isachne himalaica* occurs between 1000 – 1500 m and *Setaria palmifolia* is found in West Bengal, Assam, Meghalaya, Arunachal Pradesh, Andhra Pradesh and Kerala. A few species were reported on the basis of only a few individuals as remarked by the authors themselves--- for example *Acacia leucophloea* (Roxb.) Willd. (few individuals), and *Aristolochia bracteolata* Lamk. (a single individual).

An analysis of change in landuse/ land cover of Hastinapur Wildlife Sanctuary was carried out using remote sensing data and it was revealed that between 1992 and 2000 tall wet grasslands have shrunk by 21.2% (223.58 km^2 in 1992 and 176 km^2 in 2000) and the forest area has reduced by 59.0% (201.44 km^2 in 1992 and 81.37 km^2 in 2000). At the same time this area has witnessed 28% increase in agiculture and about 68% increase in builtup area (Khan *et al.*, 2007). Such large scale changes in land use pattern must have had modified the habitat characteristics in the study area and changed the community composition.

The changes in floristic composition documented here are in line with a similar study conducted in Mothronwala swamp forest in Dehra Dun (Sharma & Joshi, 2008). These workers explored the Mothronwala swamp during 2002 – 2003 and compared their data with findings of Dakshini (1970& 1974) and found a decline in number of genera and species. It was found that since the study of Dakshini (*ibid.*) 211 species became locally extinct and 135 tolerant, opportunistic species immigrated into the study area. These floristic changes were attributed to such factors as increased human population, drainage of swamp water, farming on encroached forest lands, urbanization, and unmindful destruction of forest wealth by villagers for various wood and non-wood products.

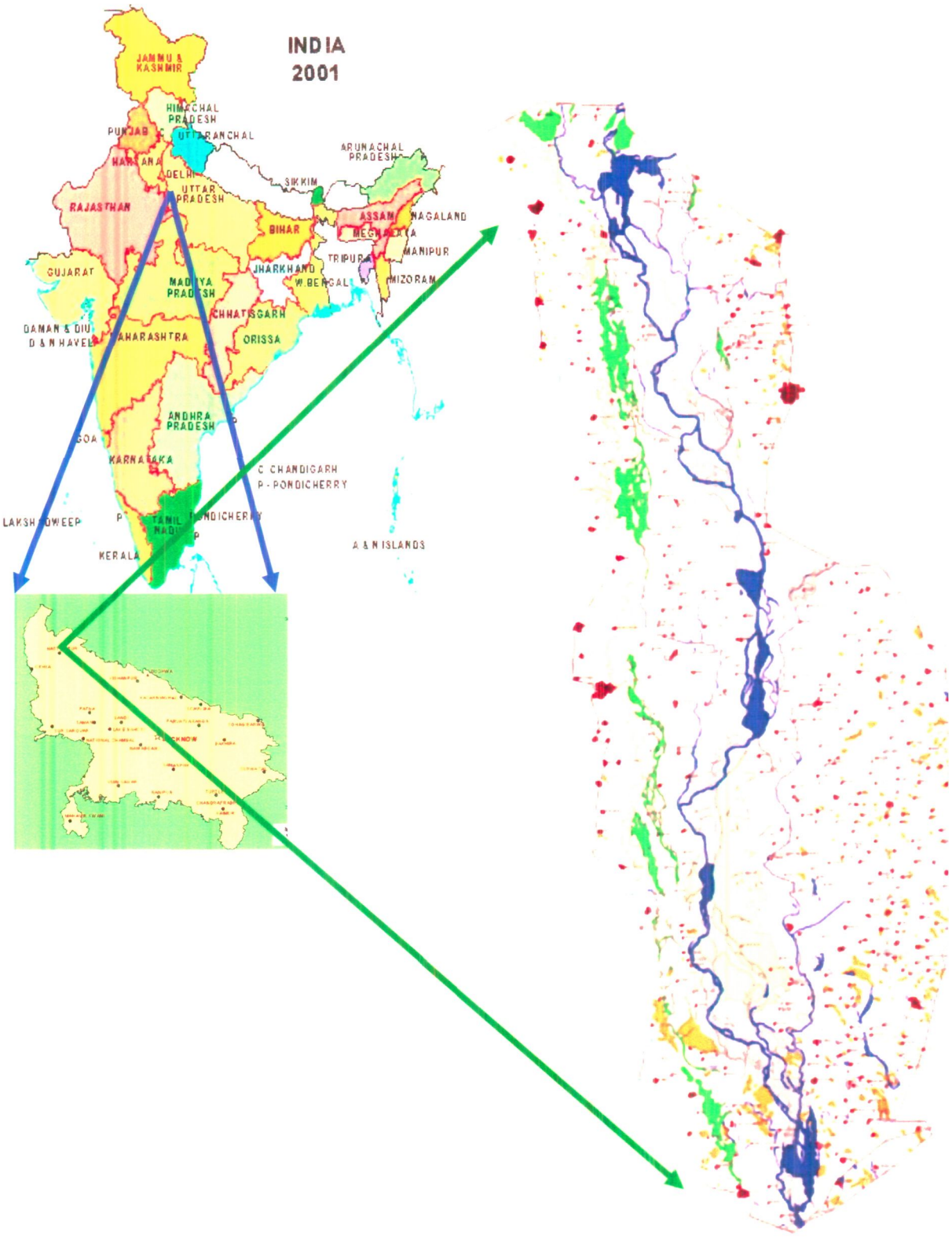


Fig.7 Location of Hastinapur Wildlife Sanctuary

22nd Oct. 2000) Path-Row –> 146-40

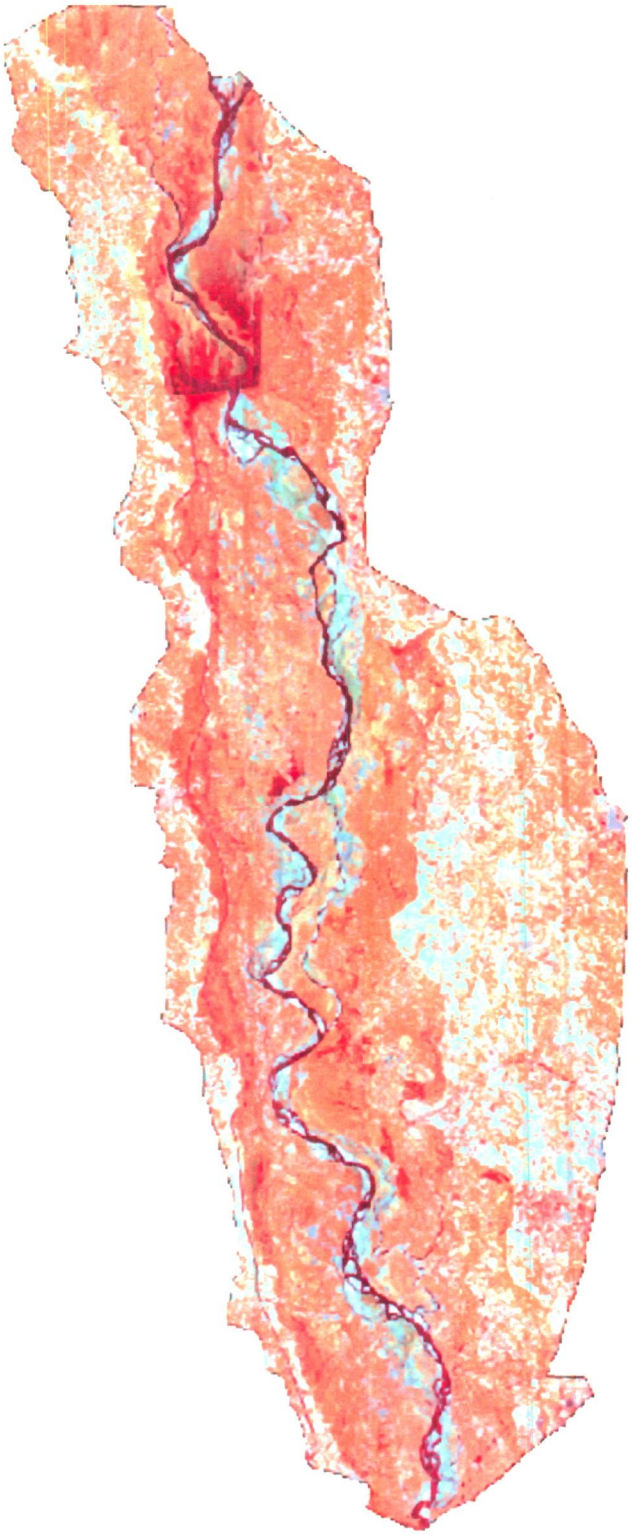


Fig. 8 Landsat Image of Hastinapur Wildlife Sanctuary

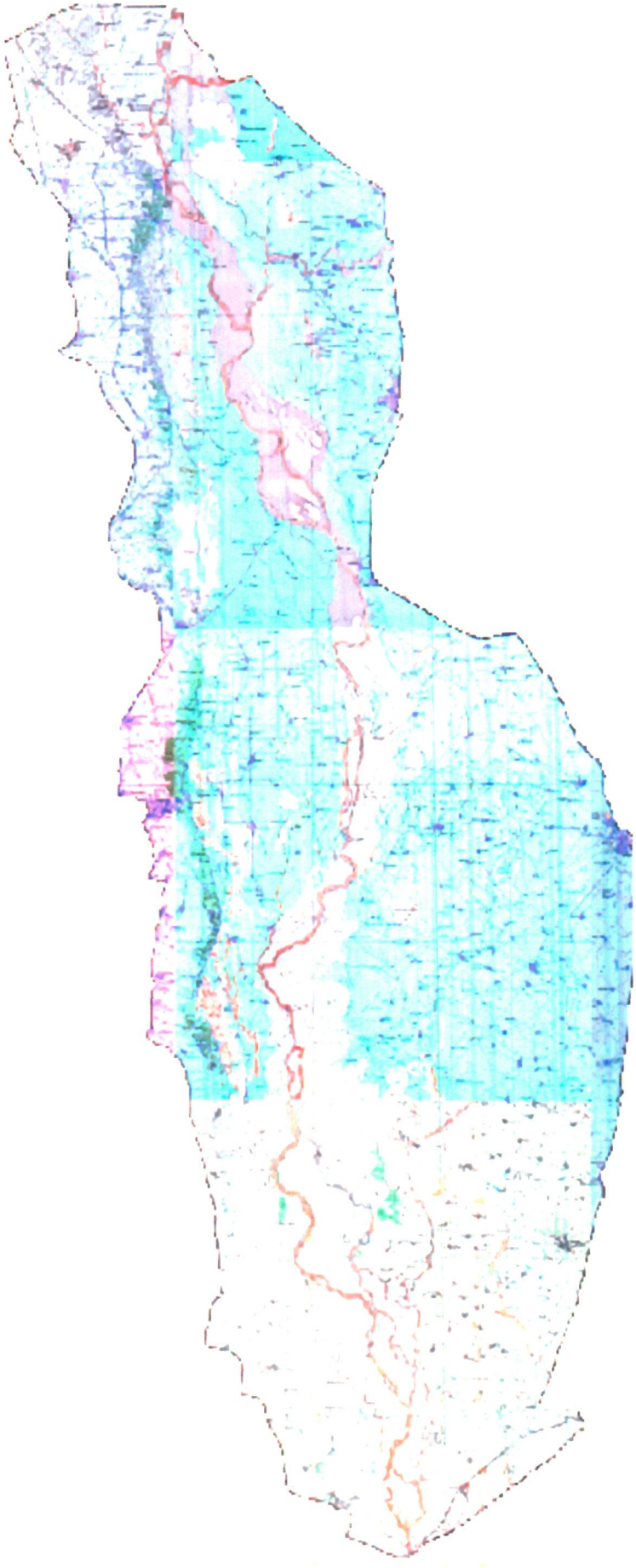


Fig. 9 Mosaic Topographic Map of Hastinapur WLS

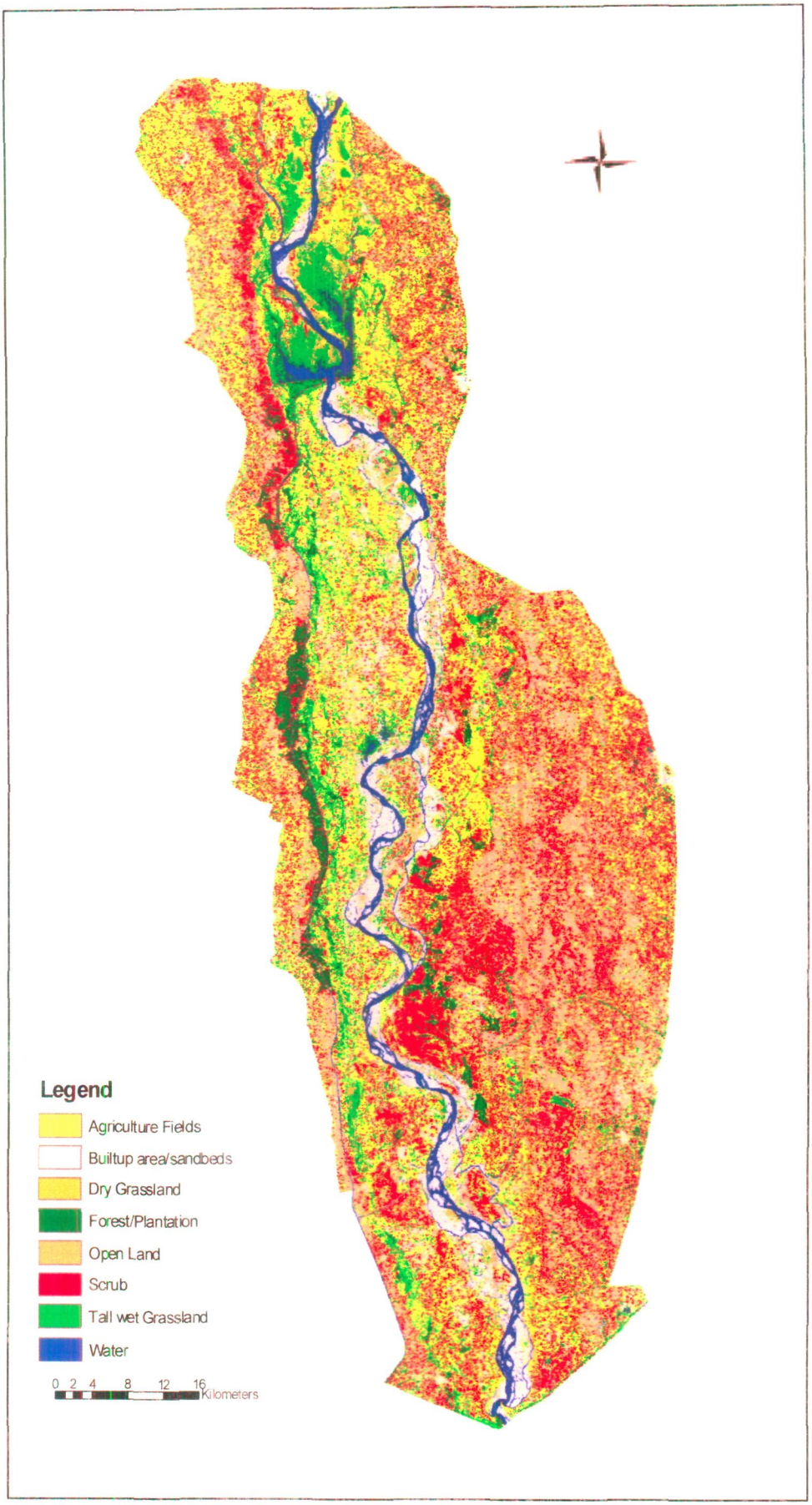


Fig. 10 Landuse / land cover map of Hastinapur WLS (2000)

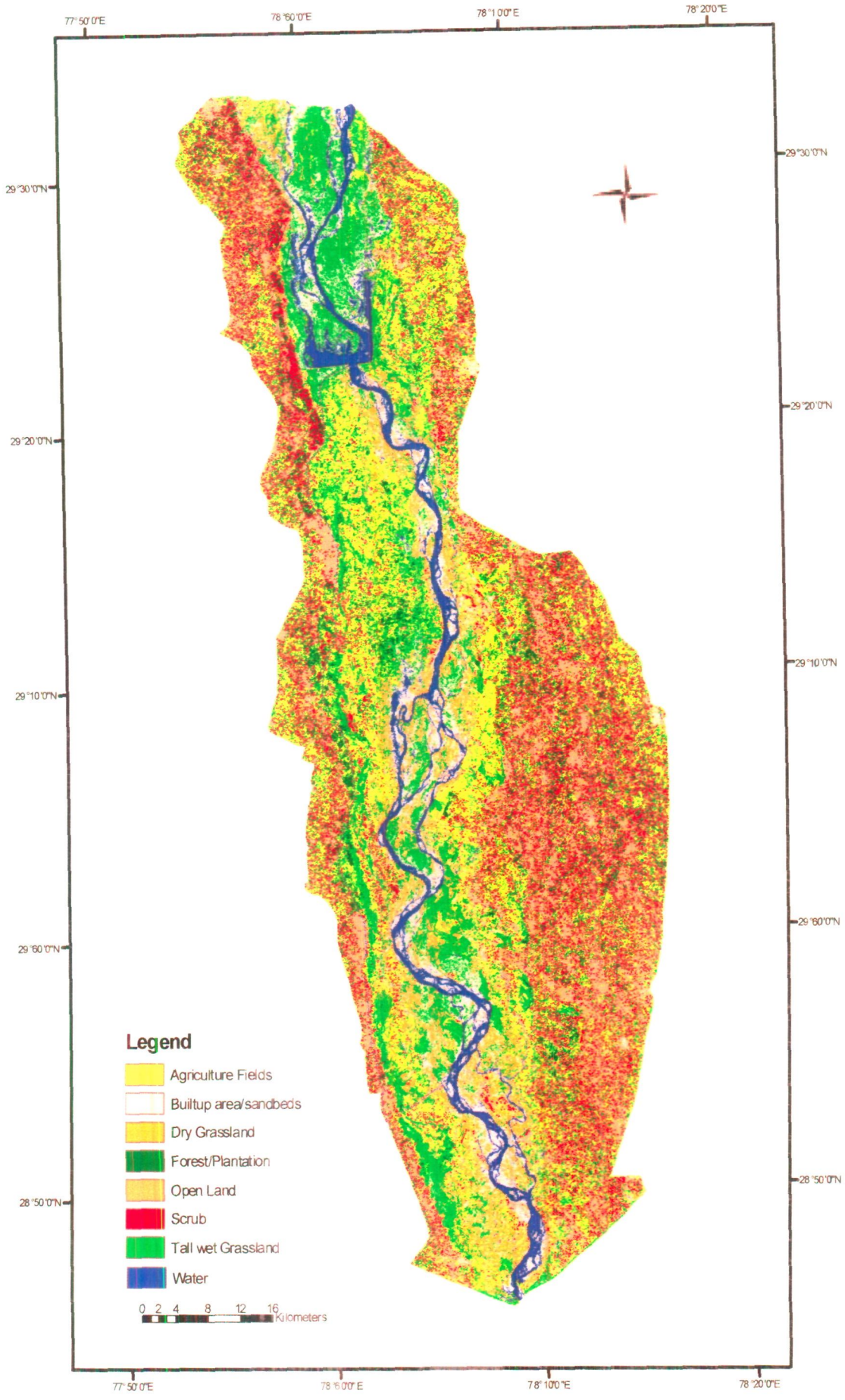


Fig. 11 Landuse /Land cover map of Hastinapur WLS (1992)

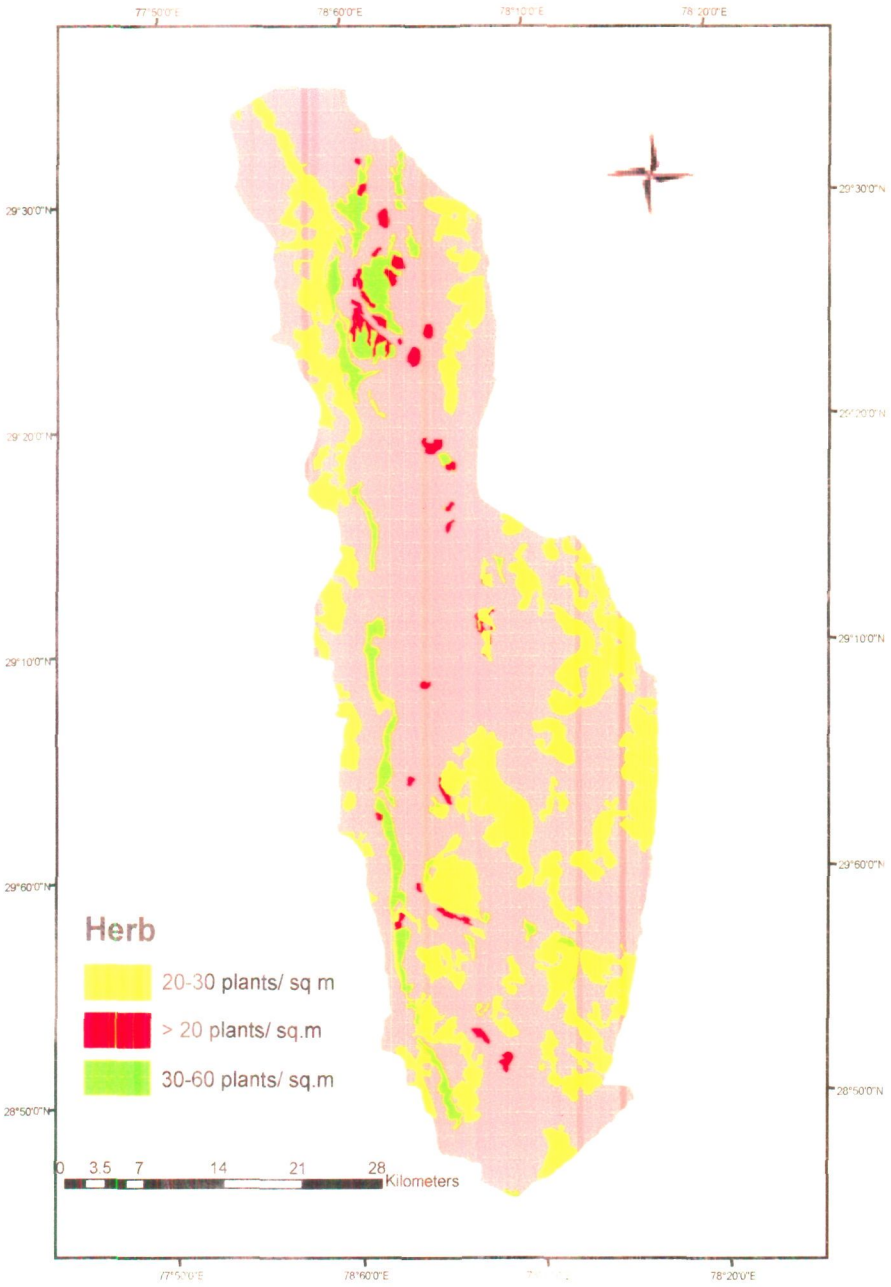


Fig. 12 Density of Herbs in Hastinapur Wildlife Sanctuary

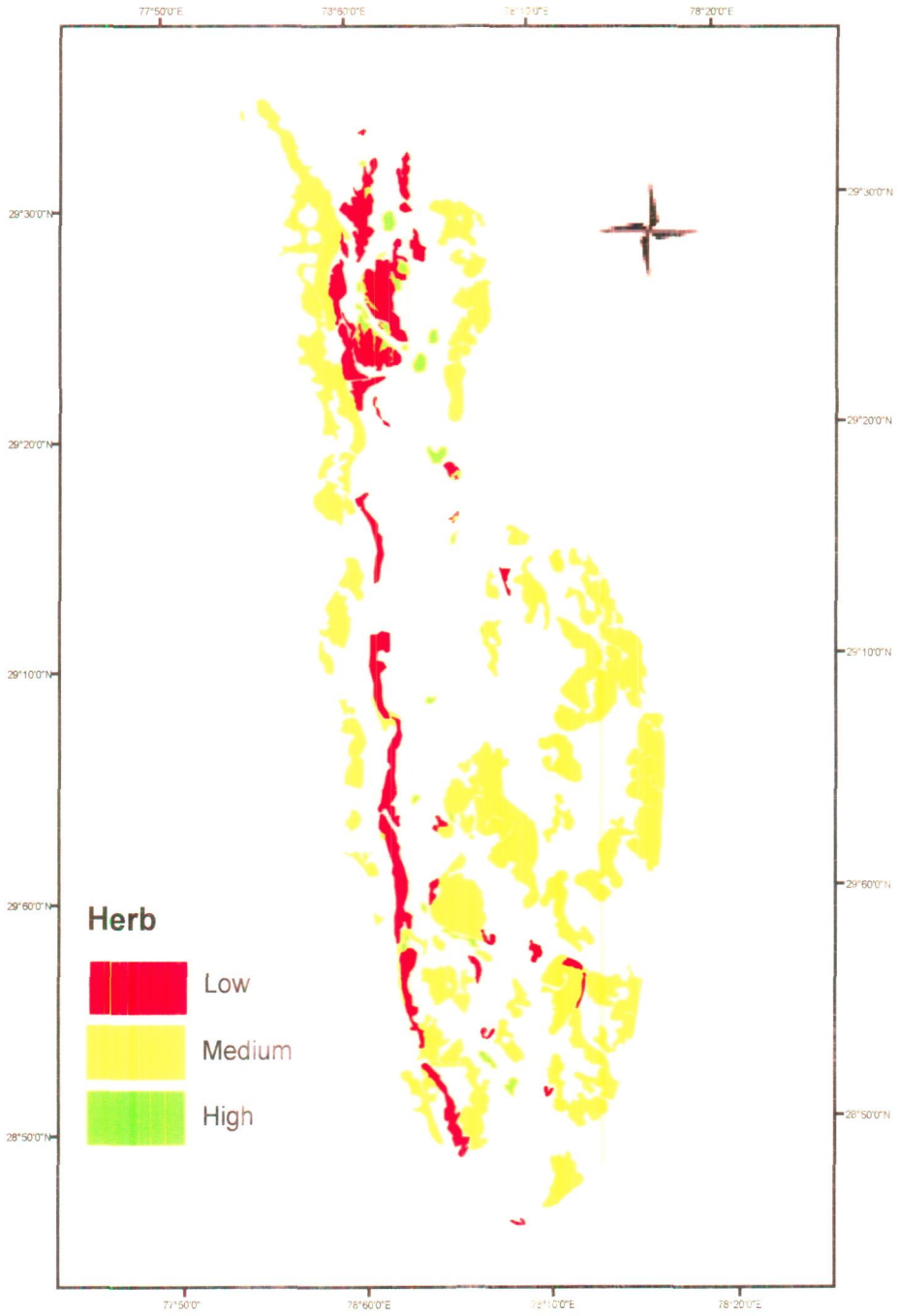


Fig.13 Diversity of Herb Species in Hastinapur Wildlife Sanctuary

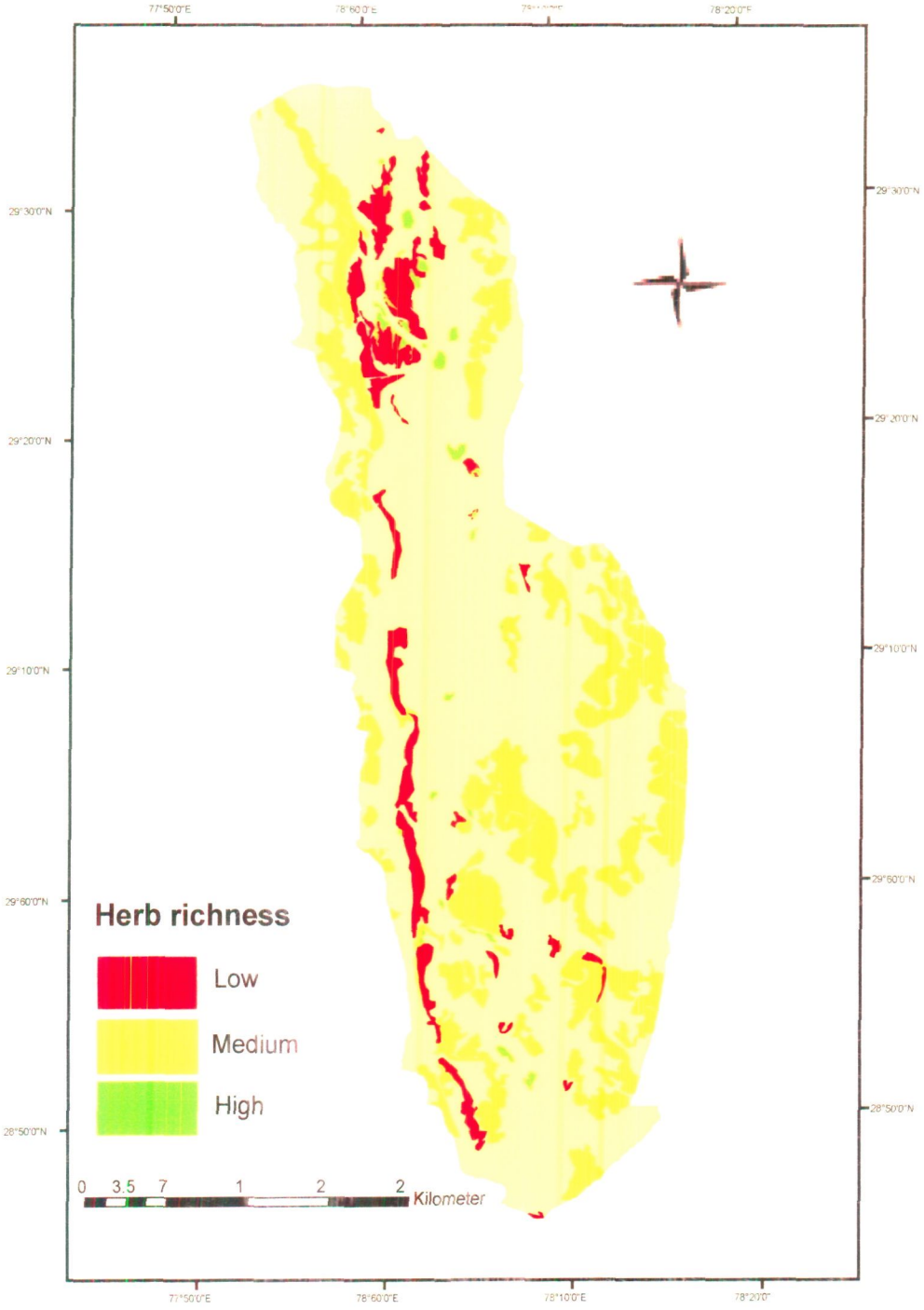


Fig. 14 Herb species richness in Hastinapur Wildlife Sanctuary

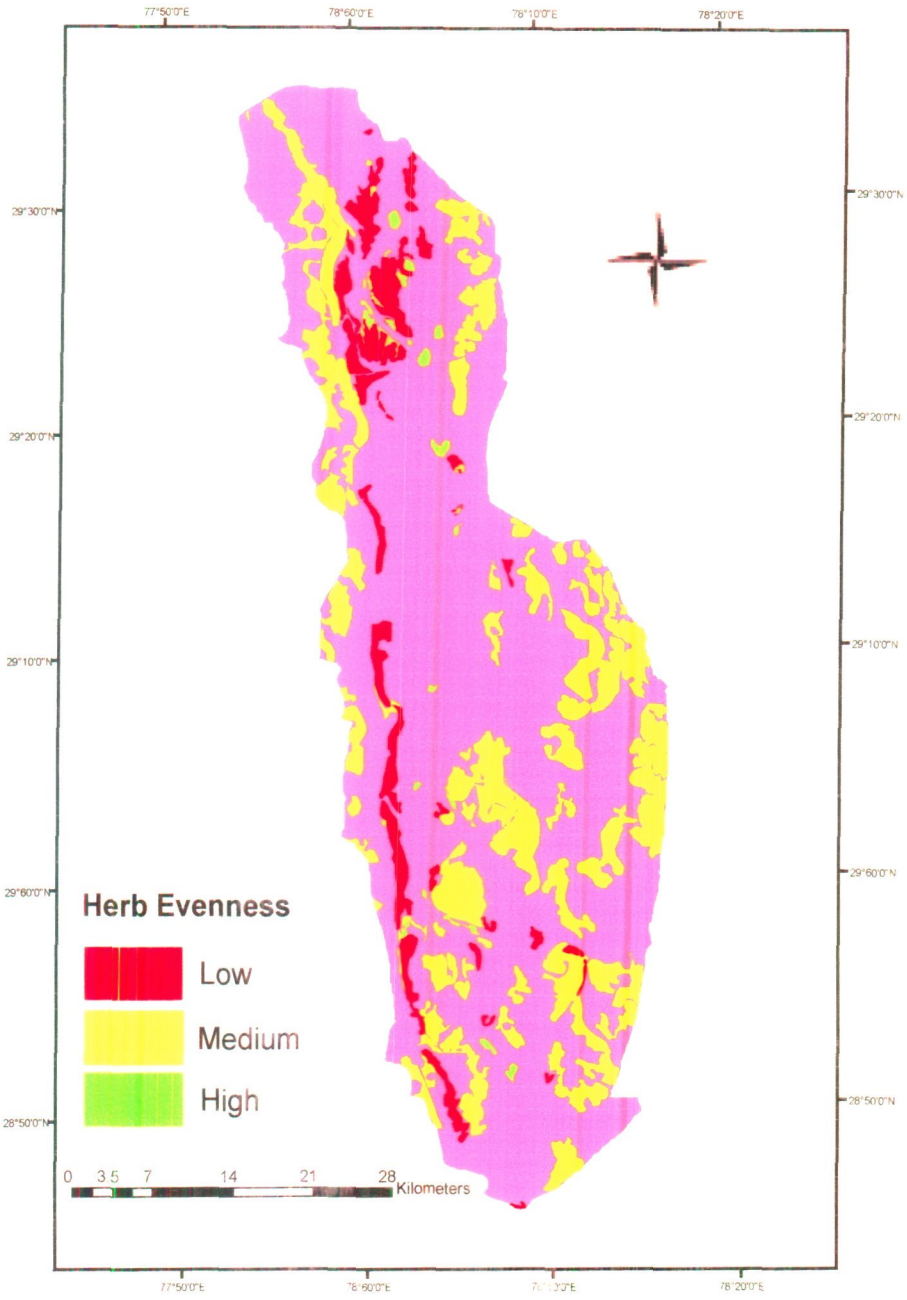


Fig. 15 Herb Evenness in Hastinapur Wildlife Sanctuary

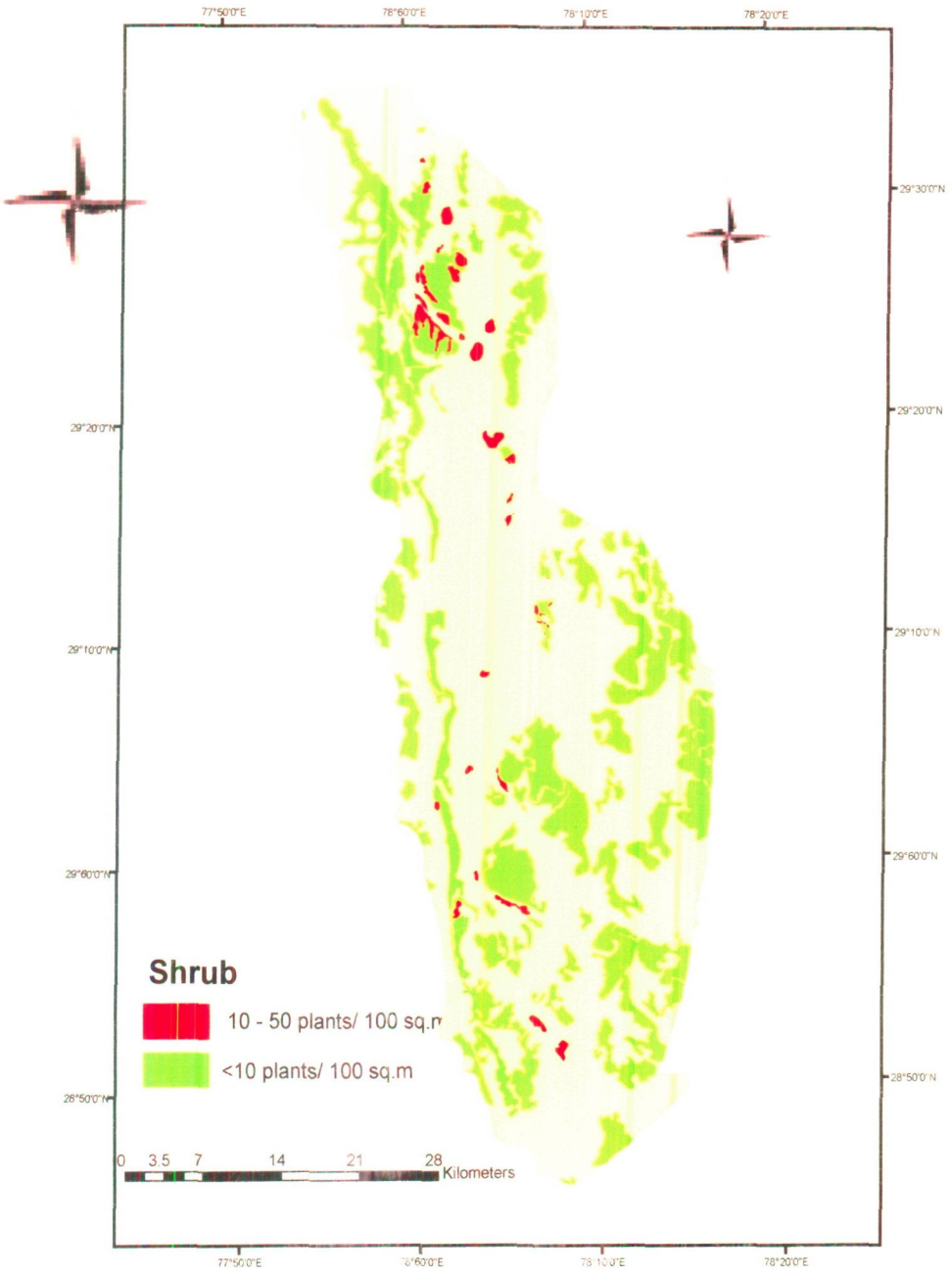


Fig. 16 Density of Shrub species in Hastinapur Wildlife Sanctuary

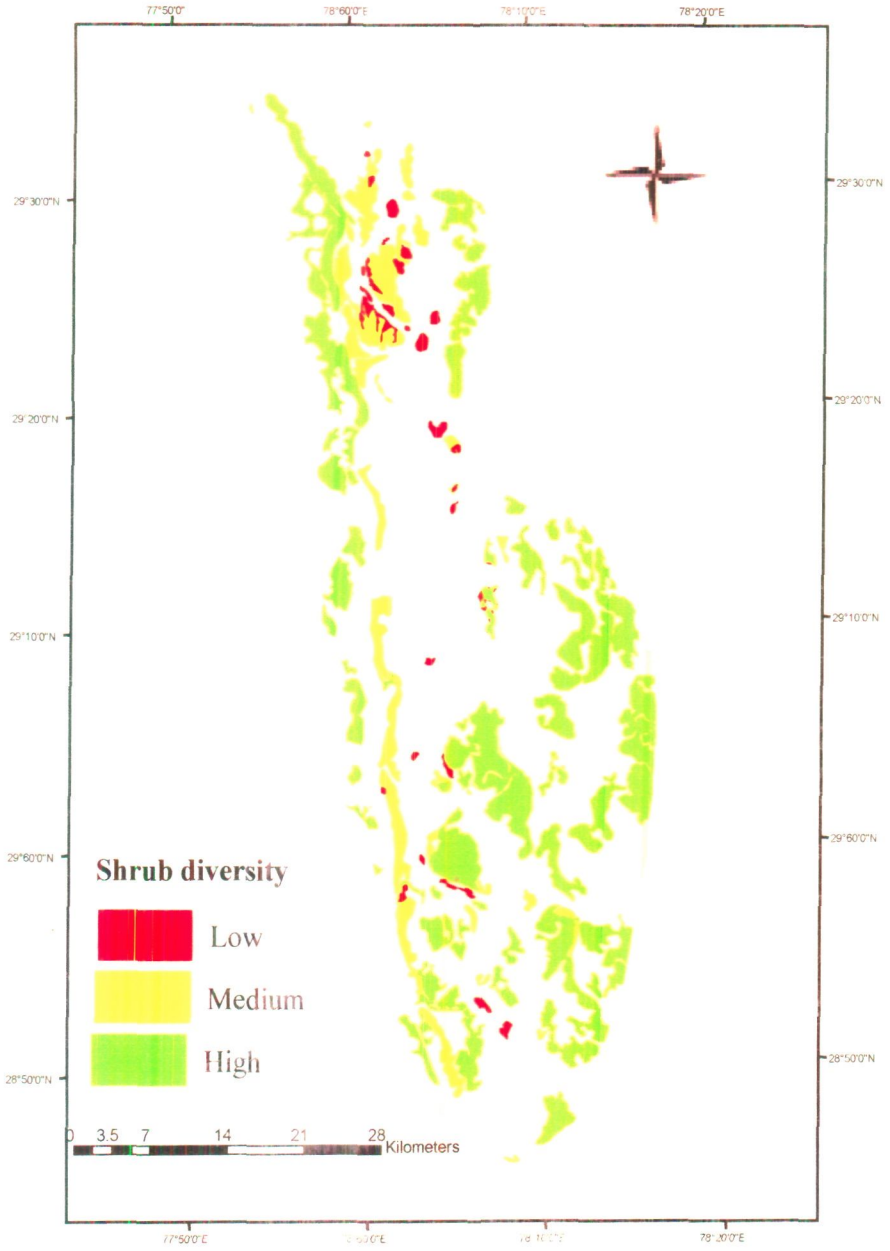


Fig.17 Shrub species diversity in Hastinapur Wildlife Sanctuary

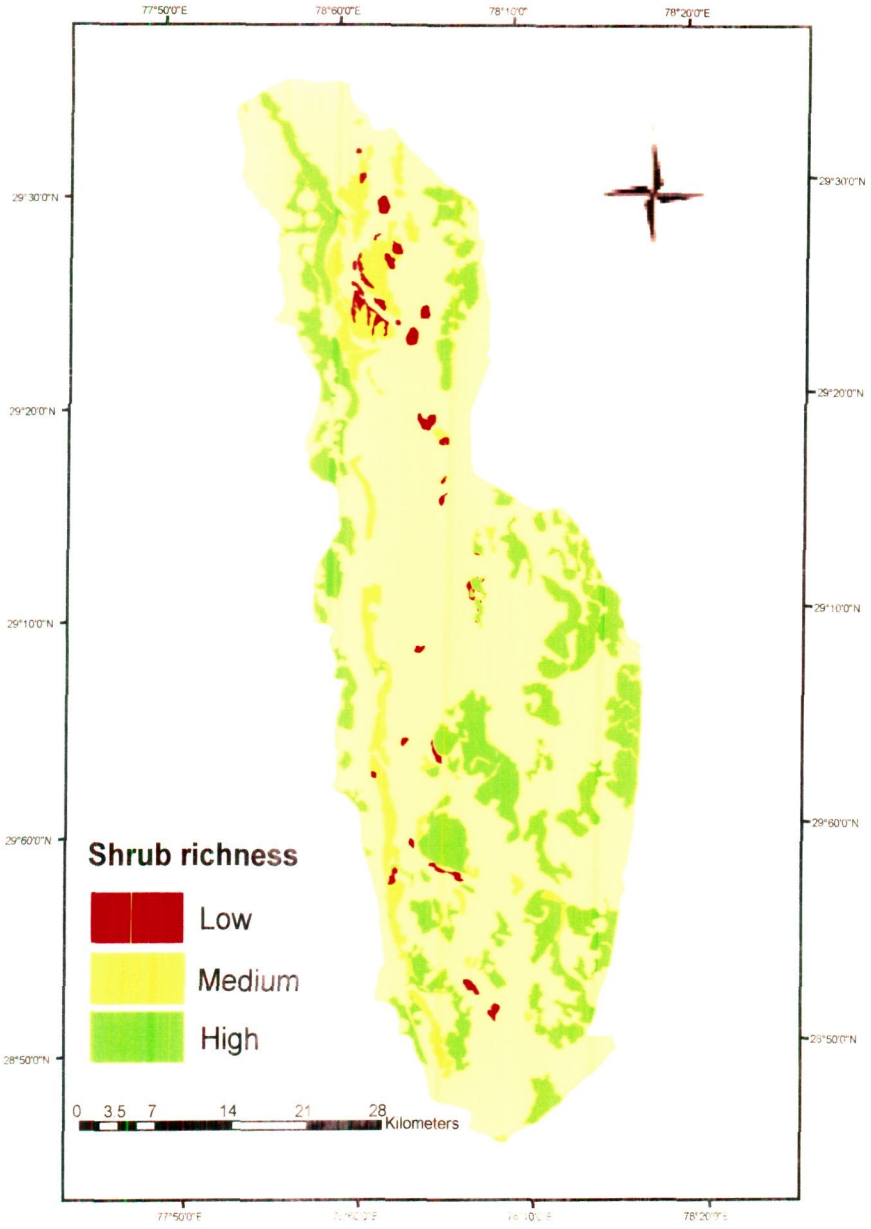


Fig. 18 Shrub species richness in Hastinapur Wildlife Sanctuary

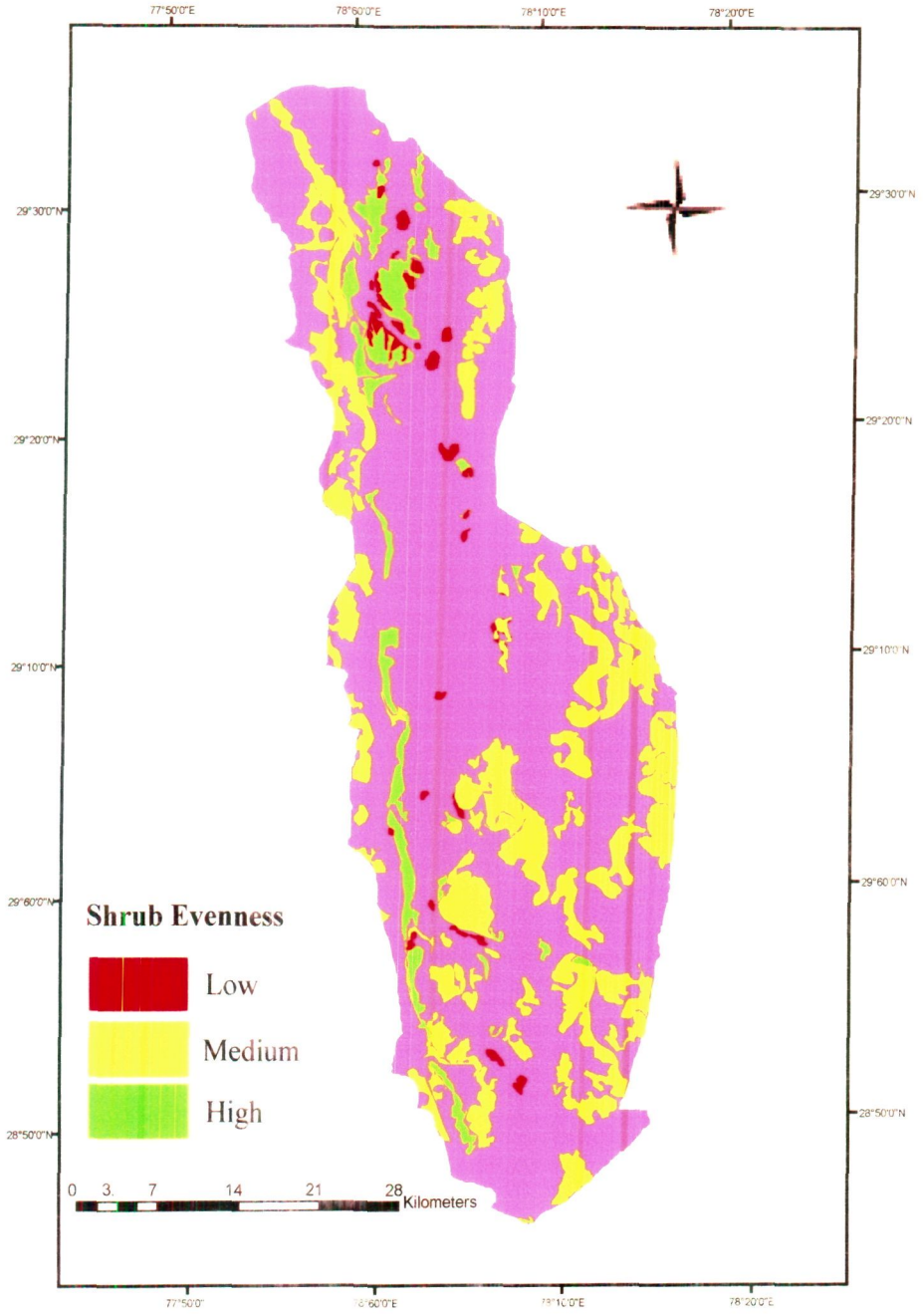


Fig. 19 Shrub species Evenness in Hastinapur Wildlife Sanctuary

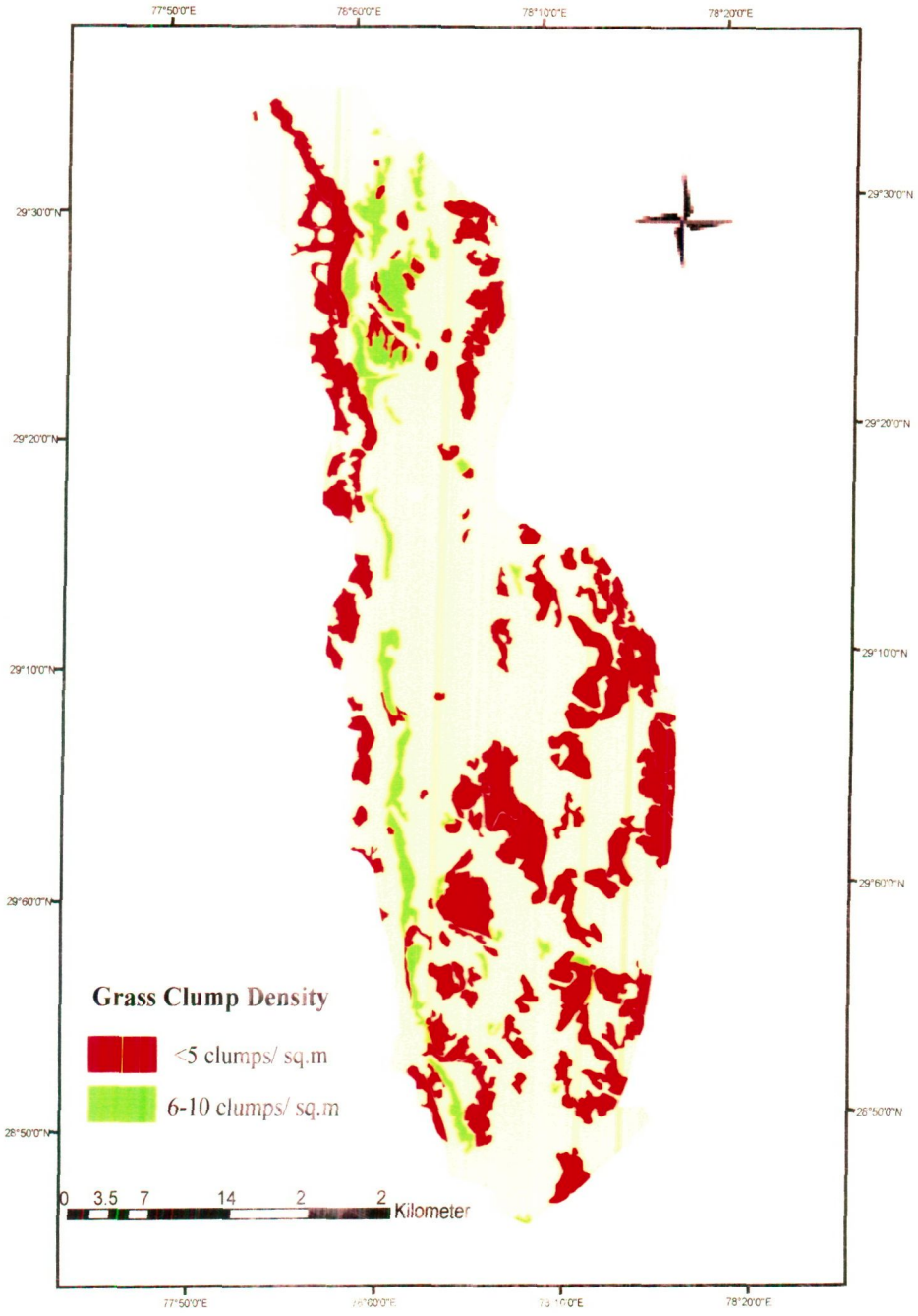


Fig. 20 Density of Grass Clumps in Hastinapur Wildlife Sanctuary

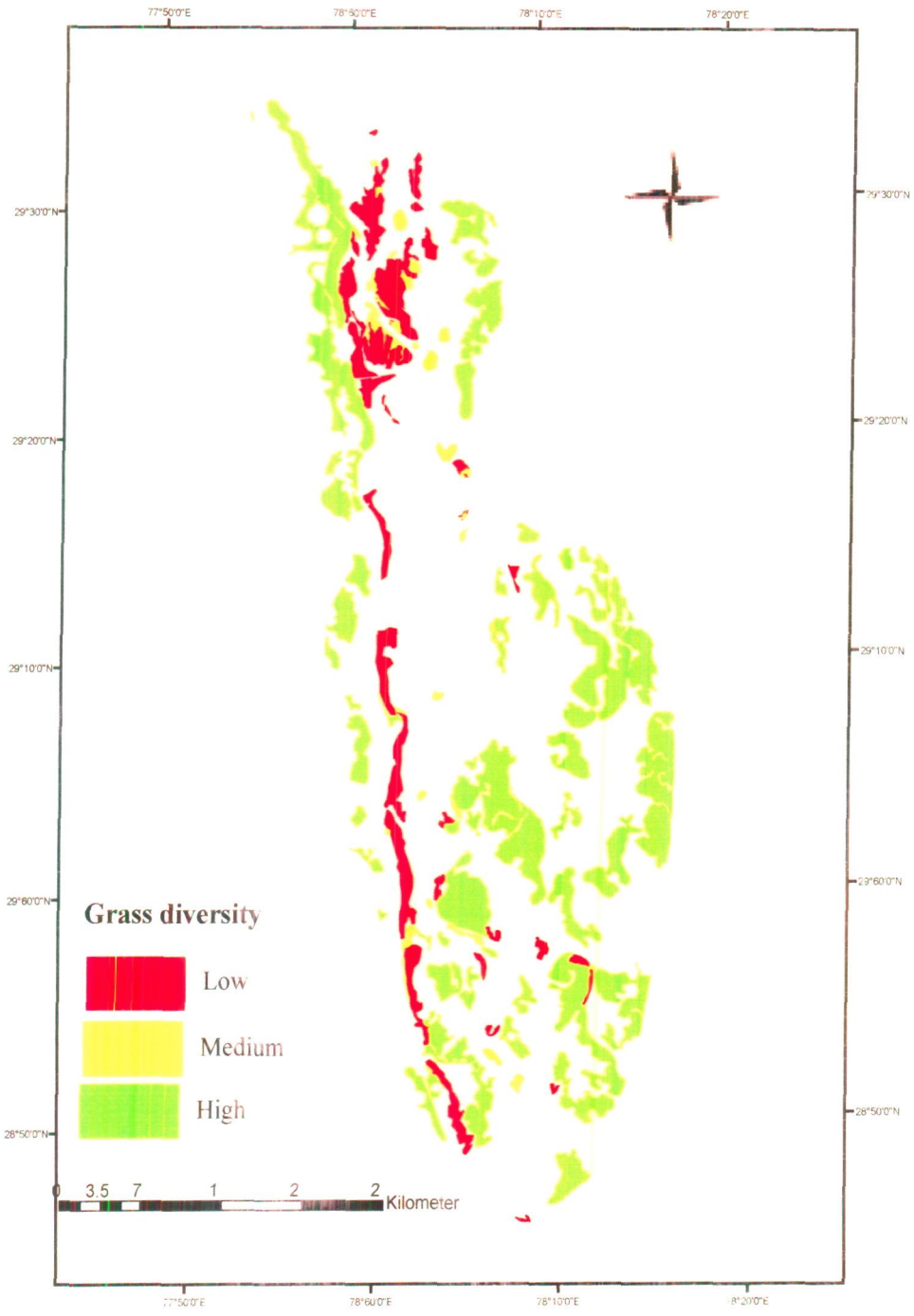


Fig. 21 Grass diversity in Hastinapur Wildlife Sanctuary

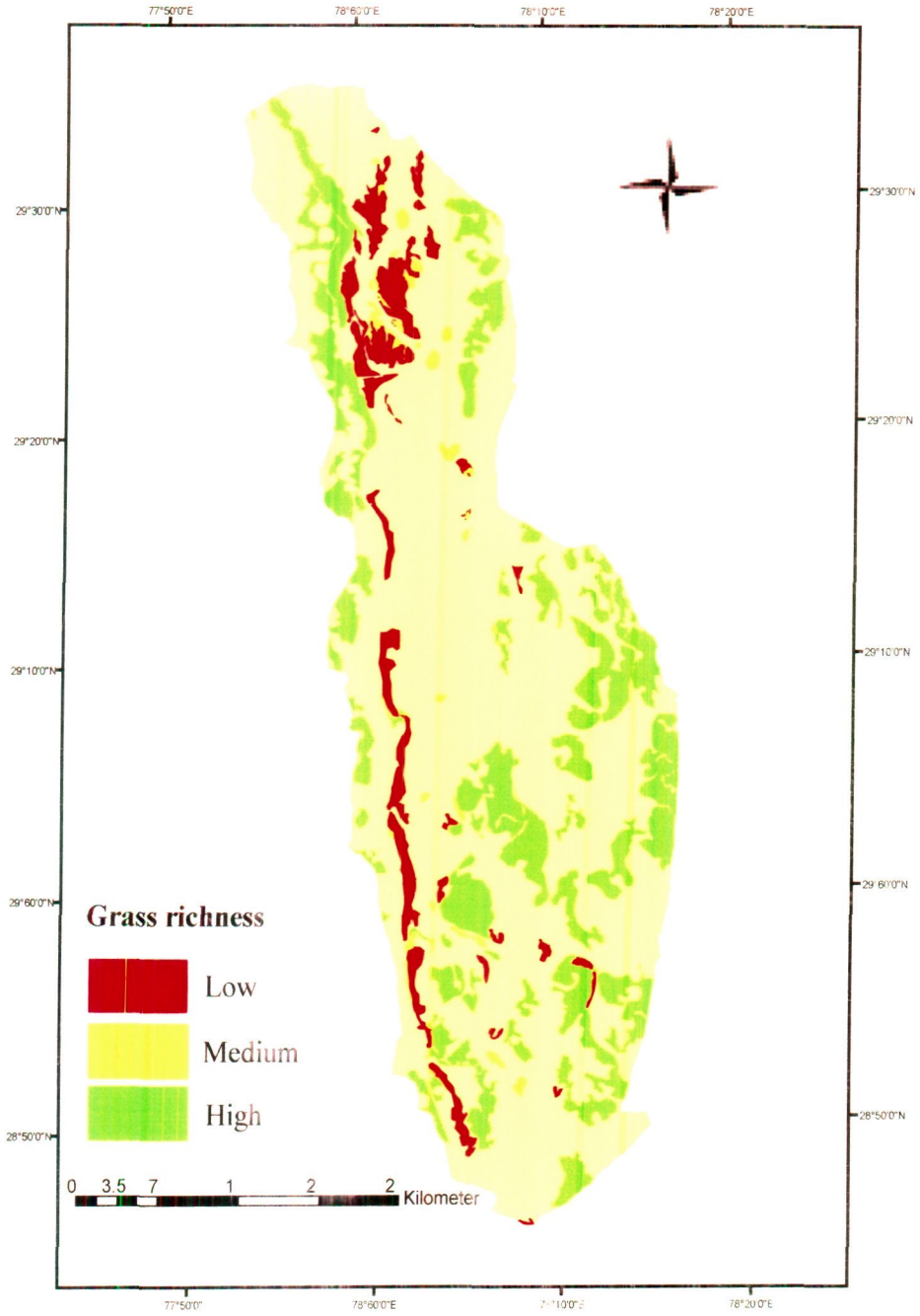


Fig. 22 Grass richness in Hastinapur Wildlife Sanctuary

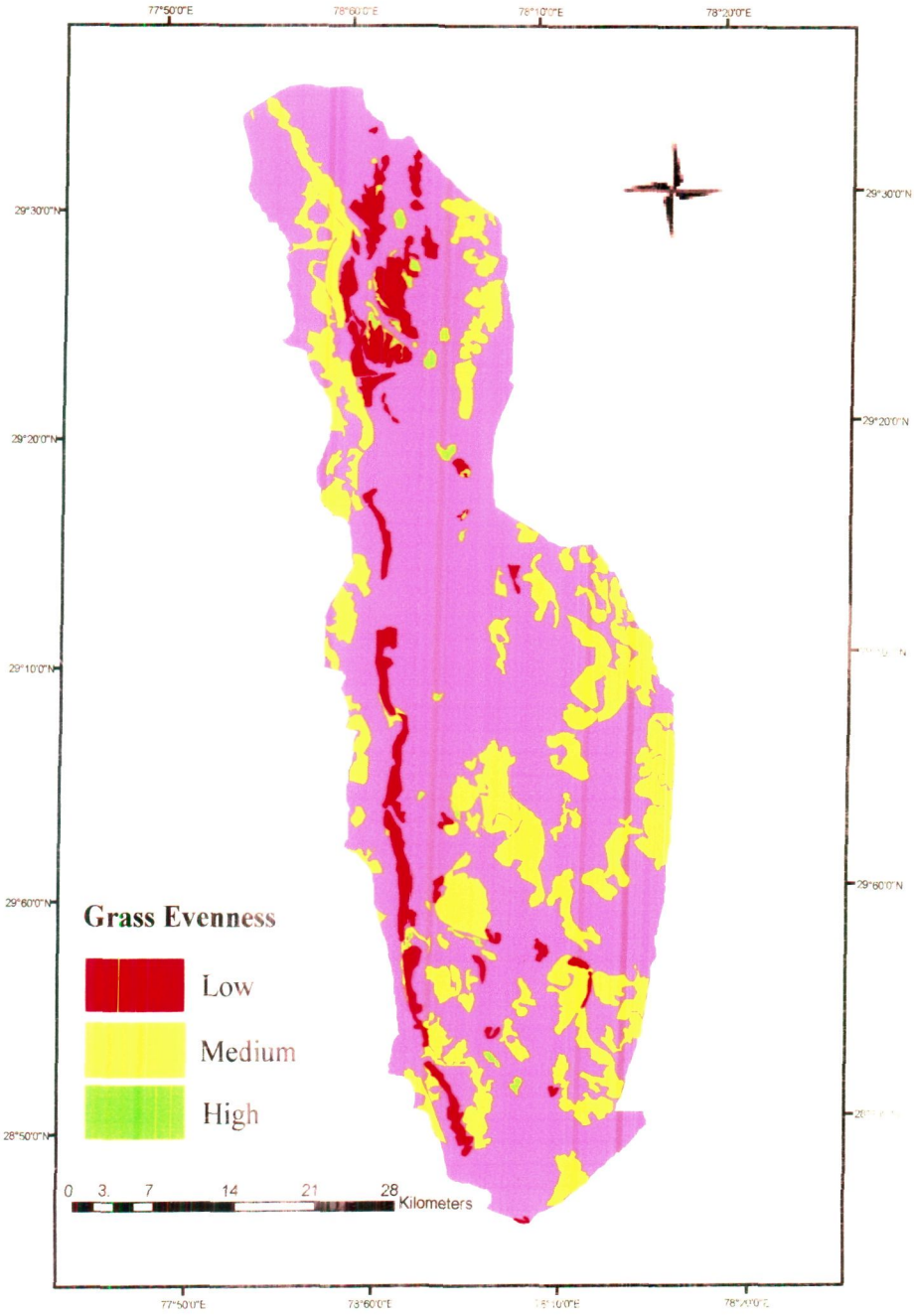


Fig. 23 Grass evenness in Hastinapur Wildlife Sanctuary

Table- 18: Area and percentage of area under different landcover categories in Hastinapur Wildlife Sanctuary during 2000

S.No.	Land cover categories	Area in Km^2	Percentage Area
1	Tall Wet Grassland	176.09	9.82
2	Dry Grassland	82.78	4.61
3	Forest/Plantation	81.37	4.53
4	Scrub	230.03	12.82
5	Agriculture Fields	587.95	32.78
6	Open Land	290.40	16.19
7	Sandbeds	148.85	13.87
8	Builtup areas	22.16	1.23
9	Water	73.54	4.10
Total Area		**1793.22**	

Table -19: Area and percentage of area under different land cover categories in Hastinapur Wildlife Sanctuary during 1992

S.No.	Land cover categories	Area in Km^2	Percentage Area
1	Tall Wet Grassland	223.58	12.46
2	Dry Grassland	182.90	10.19
3	Forest/Plantation	201.44	11.23
4	Scrub	163.02	9.09
5	Agriculture Fields	458.34	25.55
6	Open Land	219.55	12.24
7	Sandbeds	240.49	13.41
8	Builtup areas	13.20	0.73
9	Water	90.67	5.05
Total Area		**1793.22**	

Table -20: Area under different landcover categories and percentage of Change between 1992 and 2000 in the landscape of Hastinapur Wildlife Sanctuary

S.No.	Land cover categories	Area (km^2) in 1992	Area (km^2) in 2000	Change in Area	Percetage of change
1	Tall Wet Grassland	223.58	176.09	47.48	21.23
2	Dry Grassland	182.90	82.78	100.12	54.74
3	Forest/Plantation	201.44	81.37	120.06	59.60
4	Scrub	163.02	230.03	67.01	41.10
5	Agriculture Fields	458.34	587.95	129.61	28.27
6	Open Land	219.55	290.40	70.85	32.27
7	Sandbeds	240.49	148.85	91.64	38.10
8	Builtup areas	13.20	22.16	8.96	67.87
9	Water	90.67	73.54	17.12	18.88

Table- 21: Density, diversity, richness and evenness of herb species in different habitats.

Habitat Type	Species number	Density (m^2)	(H')	(R)	(E)
Tall wet Grassland	25	58. 105±42. 79	0. 859	2. 39	0. 858
Dry grassland	29	16. 594 ± 8. 20	1. 141	3. 359	0. 937
Scrub	27	30. 03 ± 20. 57	0. 962	2. 91	0. 88

H' = Shanon diversity index, R= Margalef richness index, E = Simpson's evenness index

Table- 22: Density, diversity, richness and evenness of shrub species in different habitats.

Habitat Type	Species number	Density ($100m^2$)	(H')	(R)	(E)
Tall wet Grassland	18	06.0± 0. 392	0. 376	0. 558	0. 889
Dry grassland	22	53. 19±97. 24	0. 279	0. 406	0. 086
Scrub	24	9. 95 ±7. 682	0. 504	0. 566	0. 845

H' = Shanon diversity index, R= Margalef richness index, E = Simpson's evenness index

Table- 23: Density, diversity, richness and evenness of grass species in different habitats.

Habitat Type	Species number	Density (m^2)	(H')	(R)	(E)
Tall wet Grassland	15	12. 83± 7.91	0. 449	0. 535	0. 667
Dry grassland	18	3. 675± 1. 83	0. 627	0. 774	0. 878
Scrub	24	2.44± 1.96	0. 645	1. 048	0. 829

H' = Shanon diversity index, R= Margalef richness index, E = Simpson's evenness index

CHAPTER -8

SUMMARY

Hastinapur Wildlife Sanctuary (28 ^{0} 46' and 29 ^{0} 35'N latitude and 77 ^{0} 30' and 78 ^{0} 30' E longitude, total area 2073 km^2) runs through five districts (Muzaffarnagar, Bijnor, Meerut, Ghaziabad and Jyotiba Phule Nagar) of western Uttar Pradesh, India. The sanctuary is a narrow strip of land on either sides of the river Ganga and belongs to category IV of IUCN Protected Area Management Categories as it was established for conservation of a particular species, the Swamp dear, in the year 1986. An extensive floristic exploration of the sanctuary was conducted during the period 2003-2007 with following objectives---(a) Inventorization of the flowering plants of Hastinapur Wildlife Sanctuary to prepare a detailed Flora which will be useful in future studies of habitat ecology, (b) Documentation of change in flora, if any, over last half century by comparing the results with those of Murty and Singh (1961b) and (c) Preliminary study of changes in physical features of the sanctuary over last decade using remote sensing data.

Main findings of this work are as follows:

1. There are 752 species of flowering plants belonging to 123 families and 455 genera.

2. Dicots account for 98 families, 347 genera and 549 species. Remaining 25 families, 108 genera and 203 species belong to monocots.

3. On the basis of total number of species, the contribution of dicots in 73.0% and that of monocots 26.99%.

4. Ten largest families of the study area are Poaceae (110 species), Fabaceae (62 species), Asteraceae (59 species), Cyperaceae (45 species), Malvaceae (22 species), Euphorbiaceae (22 species), Convolvulaceae (20 species), Scrophulariaceae (20 species), Caesalpiniaceae (18 species) and Amaranthacaeae (17 species). Other families contributing more than ten species are Acanthaceae (16 species), Mimosaceae (14 species), Lamiaceae (13 species), Cucurbitaceae, Solanaceae, Verbenaceae and Moraceae (11 species each). Two families are represented by 9 species each, three families by 8 species, 6 families by 7 species, 4 families by 6

species, one family by 5 species, 4 families by 4 species, 16 families by 3 species, 23 families by 2 species and 47 families by I species each.

5. Four genera are represented by ten or more species i.e. *Cyperus* (14 species), *Ipomoea* (12 species), *Eragrostis* (12 species) and *Cassia* (10 species). Four genera are represented by 7 species, 6 genera by six species, seven genera by 5 species, 10 genera by 4 species, 34 genera by 3 species, 73 genera by 2 species and 317 genera by 1 species each.

6. The flora of the sanctuary is predominantly herbaceous as 78% species recorded from the study area are herbaceous. Dicots account for 53% and monocots for 25% herbaceous species. Among dicots 73% species are herbaceous while among monocots 93.59% species are herbaceous.

7. Shrubs account for 12.77% of total species. Contribution of dicots to shrub flora is 11.44% and that of monocots 1.33%. Among dicots 15.66% species are shrubs.

8. 10.77% of total species are climbers. Dicots account for 10.37% and monocots 0.4% climbers. Among dicots 14.21% species are climbers while in monocots 1.47% species are climbers.

9. Trees account for 12.63% of total species. Dicots account for 12.50% tree species. Among dicots 17.12% species show tree habit and in monocots 0.13% species are trees.

10. Nine habitat types were recognized in the study area and distribution of species in these habitats is as follows:

(i). **Aquatic**: 9.71% of total species.

(ii). **Roadsides:** 48.94% of total species.

(iii). **Agricultural fields:** 37.37% of total species.

(iv). **Kholas:** 33.51% of total species.

(v). **River banks:** 42.69% of total species.

(vi). **Moist sand:** 29.52% of total species.

(vii). **Dry sand:** 21.68% of total species.

(viii). **Tall wet grasslands or Swamps:** 50.8% of total species.

(ix). **Dry grasslands:** 21% of total species.

11. **Monocot - dicot ratio** was calculated as 1:3.92 for families, 1: 3.21 for genera and 1: 2.7 for species.

12. **Genus – species ratio** was calculated as 1:1.65 for total flora, 1:1.58 for dicot flora and 1:1.88 for monocot flora.

13. Ten species are new records for North India or Uttar Pradesh: ***Hypericum japonicum*** Thunb. ex Murr.; ***Abelmoschus tuberculatus*** Pal & Singh; ***Hibiscus micranthus*** L. f. var. ***rigidus*** (L. f.) Cuf; ***Eleiotis monophylla*** (Burm. f.) DC; ***Lotus corniculatus*** L.; ***Oenothera laciniata*** Hill; ***Sparganium erectum*** L.; ***Brachiaria kurzii*** (Hook. f.) A. Camus; ***Digitaria griffithii*** (Hook. f.) Henr.; ***Leersia hexandra*** Sw.

14. Changes brought about at the landscape level were assessed with a temporal resolution of eight years using remote sensing data. The results revealed that natural vegetation cover is disappearing at an alarming level and it ranged between 21 and 59 percent among various habitat types during the period of eight years.

15. Comparison of present floristic composition of the study area with that reported by Murty and Singh (1961b) brought to light following floristic changes during last half century:

(i) The number of flowering plant families in this study is 123 against 102 reported in earlier study.

(ii) The number of genera recorded in present study is 423 against 405 reported earlier.

(iii) 195 species collected during present study were not reported earlier and 72 species recorded earlier were not collected during present study.

CHAPTER - 9

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APPENDIX - I

FIELD CROPS

1. **Brassica campestris** L.
2. **Brassica juncea** (L.) Czern.
3. **B. oleracea** var. **botrytis** L.
4. **B. oleracea** var. **capitata** L.
5. **B. oleracea** var. **gongylodes** L.
6. **Eruca sativa** Mill.
7. **Arachis hypogea** L. (Mungphal).
8. **Cajanus cajan** (L.) Millsp. (Arha).
9. **Cicer arietinum** L. (Chana).
10. **Cyamopsis tetragonoloba** (L.) Taub. (Gwar
11. **Lens culinaris** Medik. (Masoor).
12. **Pisum arvense** L.
13. **Pisum sativum** L. (Matar).
14. **Trifolium alexandrinum** L. (Barseem).
15. **Trigonella foenum-graecum** L.
16. **Vigna mungo** (L.) Hepper (Urd)
17. **Vigna radiata** (L.) Wilczek (Moong).
18. **Ipomoea batatas** (L.) Lamk. (Shakarkand) is cultivated in the study area. Sweet tuberous roots are eaten by wild animals like porcupine and wild boar.
19. **Nicotiana tabacum** L. (Tambaku, Tamaku).
20. **Hordeum vulgare** L. (Jau).
21. **Oryza sativa** L. (Dhaan, Moonji, Chawal).
22. **Pennisetum americanum** (L.) Leeke (Bajra).
23. **Saccharum officinarum** L. (Ganna).

FRUITS

1. **Citrus aurantifolia (Christ.) Swingle (Kaghzi nimbu)**
2. **Citrus aurantium L. (Narangi)**
3. **Citrus maxima (Burm.) Merr. (Chakotra)**
4. **Citrus medica L. (Nimbu)**
5. **Vitis vinifera** L. (Angoor) is cultivate for the sake of edible fruits.
6. **Eriobotrya japonica** (Thunb.) Lindl. (Loquat)
7. **Prunus domestica** L. subsp. **insititia** (L.) Schneid. (Aloo-bukhara).

8. **Prunus persica** (L.) Stokes (Aru)

9. **Punica granatum** (Anaar).

10. **Carica papaya** (Papeeta).

11. **Ficus carica** L. (Anjir, Injeer) is frequently cultivated for edible fruits.

ORNAMENTALS

7. **Iberis amara** L.

11. **Gossypium arboreum** L. var. **arboreum.**

10. **Alcea rosea** L. [= Althaea rosea (L.) Cav.].

12. **Hibiscus mutabilis** L.

13. **Hibiscus rosa-sinensis** L.

14. **Hibiscus schizopetalous** (Mast.) Hook. f.

15. **Ceiba pentandra** (L.) Gaertn.

20. **Cissus qudarangularis** L. (Harjore) is often cultivated in the area as an ornamental and is used in traditional medicine for treatment of fractured bones.

26. **Lthyrus odoratus** L. (Matar).

34. **Saraca asoca** (Roxb.) de Wilde

38. **Rosa sp.** (Gulab)

55. **Anthocephalus chinensis** (Lam.) A. Rich. ex Walp.

56. **Heliantus annuus** L.

57. **Jasminum auriculatum** Vahl. (Joohi).

58. **J. multiflorum** (Burm.f.) Andr. (Bela).

59. **J. officinale** L. (Motia).

60. **J. sambac** (L.) Ait. (Bela, Mogra).

61. **Nerium oleander** L. (Kaner)

62. **Plumeria acuminata** Ait. (Gul-e-Cheen)

63. **Thevetia peruviana** (Pers.) K. Schum. (Peeli Kaner)

64. **Tabernaemontana divaricata** (L.) R. Br. (Chandni)

71. **Bougainvillea glabra** Choisy and **B. spectabilis** Willd. are extensively planted on roadsides especilly near barrage and provide nesting place for many smaller birds.

73. **Rhynchostylis retusa** (L.) Bl. was seen growing in some nurseries.

74. **Aloe vera** (L.) Burm. f. (Gheekavar) is often cultivated as an ornamental and medicinal plant.

VEGETABLES

8. **Raphanus sativus** L.

9. **Abelmoschus esculentus** (L.) Moench.

41. **Benincasa hispida** (Thunb.) Cogn. (Petha).

42. **Citrulus lanatus** (Thunb.) Matsumura & Nakai var. **lanatus** (Tarbooz).

43. **C. lanatus** var. **fistulosa** (Stocks) Chakravarty (Tinda).

44. **Cucumis melo** L. var. **melo** (Kharbooza).

45. **C. melo** L. var. **momordica** Duthie & Fuller (Phoont).

46. **C. melo** L. var. utilissimus Duthie & Fuller (Kakri).

47. **Cucumis sativus** L. var. **sativus** (Kheera).

48. **Cucurbita maxima** Duch. ex Lam. (Sitaphal).

49. **Lagenaria siceraria** (Molina) Standl. (Lauki).

50. **Luffa acutangula** (L.) Roxb. var. **acutangula** (Kali tori).

51. **L. acutangula** var. **cylindrica** (L.) M. Roem. (Ghia tori).

52. **Momordica charantia** L. (Karela).

53.**Trichosanthes anguina** L. (Chachenda, Chichinda).

54. **T. dioica** Roxb. var. **dioica** (Palwal, Parwal).

66. **Capsicum annuum** L (Mirch)

67. **Lycopersicon esculentum** Mill. (Tamatar).

69. **Solanum melongena** L. var. **melongena** (Baingan).

70. **Solanum tuberosum** L. (Aaloo).

APPENDIX - II

LIST OF PLANTS NOT REPORTED BY MURTY AND SINGH (1961)

Ranunculus cantoniensis DC.

Nelumbo nucifera Gaertn.

Argemone ochroleuca Sweet

Capsella bursa-pastoris (L.) Medik.

Descurainia sophia (L.) Webb. ex Prantl.

Nasturtium officinale R. Br.

Sisymbrium irio L.

Capparis decidua (Forssk.) Edgew.

Casearia graveolens Dalz.

Polycarpon prostratum (Forssk.) Aschers. & Schweinf.

Silene conoidea L.

Vaccaria pyramidata Medik.

Bergia ammannioides Roxb.

Hypericum japonicum Thunb. ex Murr.

Abelmoschus manihot (L.) Medik.

Abelmoschus tuberculatus Pal & Singh

Hibiscus sabdariffa

Pentapetes phoenicea L.

Tropaeolum majus L.

Impatiens balsamina L.

Celastrus paniculata Willd.

Schleichera oleosa (Lour.) Oken.

Crotalaria orixensis Willd.

Eleiotis monophylla (Burm. f.) DC.

Lablab purpureus (L.) Sweet

Lotus corniculatus L.

Teramnus labialis (L. f.) Spreng.

Trifolium tomentosum L.

Cassia renigera Wallich ex Benth.

Cassia siamea Lamk.

Cassia surattensis Burm. f.

Mimosa himalayana Gamble

Potentilla sundaica (Bl.) O. Kuntze

Combretum nanum Buch. –Ham. ex D. Don

E. globulus Labill.

E. citridora Hook.

E. camaldulensis Dehnh.

Rotala indica (Willd.) Koehne

Epilobium hirsutum L.

Ludwigia prostrata Roxb.

Oenothera laciniata Hill.

Oenothera rosea L'Hér. ex Ait.

Bryonopsis laciniosa (L.) Naud.

Citrulus colocynthis Schrad.

Luffa echinata Roxb.

Luffa graveolens Roxb.

Passiflora caerulea L.

Hydrocotyle sibthorpioides Lamk.

Oenanthe javanica (Blume) DC.

Seseli diffusum (Roxb. ex Sm.) Sant. & Wagh

Cephalanthus tetrandra (Roxb.) Ridsdale & Bakh. f.

Dentella repens (L.) J.& G. Forster

Galium aparine L.

Adenostemma lavenia (L.) Kuntze

Ageratum houstonianum Mill.

Blainvillea acmella (L.) Philipson

Blumea mollis (D.Don) Merr.

Cichorium intybus L.

Conyza bonariensis (L.) Cronq.

Conyza japonica (Thunb.) Less. ex DC.

Conyza stricta Willd.

Cyathocline purpurea (Buch.-Ham. ex. D.Don) O. Kuntze

Dichrocephala integrifolia (L.f.) O. Kuntze

Enydra fluctuans Lour.

Erigeron sublyratus DC.

Eupatorium adenophorum Spreng.,

Gnaphalium luteo-album L.

Grangea maderaspatana (L.) Poir.

Ixeris polycephala Cass.

Lactuca dissecta D. Don

Lactuca serriola Tourner

Laggera aurita L. f.

Parthenium hysterophorus L.

Pulicaria wightiana (DC.) Clarke

Soliva anthemifolia (A. Juss.) R. Br.

Sonchus asper (L.) Hill.

Sonchus wightianus DC.

Spilanthes ciliata H. B. K.

Verbesina encelioides (Cav.) Benth. & Hook. f.

Youngia japonica (L.) DC.

Wahlenbergia marginata (Thunb.) DC.

Sphenoclea zeylanica Gaertn.

Primula umbellata (Lour.) Bentv.

Mimusops elengi L.

Jasminum arborescens Roxb.

Catharanthus roseus (L.) G. Don

Holarrhena pubescens (Buch. – Ham.) Wall ex G. Don

Vallaris solanacea (Roth) Kuntze

Calotropis gigantea (L.) R. Br.

Telosma cordata (Burm. f.) Merrill

Centaurium centaurioides (Roxb.) Rolla Roa & Hemadri

Hoppea dichotoma Heyne ex Willd.

Heliotropium marifolium Retz.

Evolvulus nummalarius (L.) L.

Ipomoea triloba L.

Merremia aegyptiaca (L.) Urban

Merremia dissecta (Jacq.) Hall. f.

Operculina turpethum (L.) Manso

Cuscuta chinensis Lamk.

Datura fastuosa L.

Physalis angulata L.

Physalis micrantha Link

Bacopa procumbens (Mill.) Greenm.

Limnophila indica (L.) Druce

Lindernia anagallis (Burm. f.) Pennell

Lindernia procumbens (Krock.) Philcox

Verbascum thapsus L.

Campsis grandiflora (Thunb.) K. Schum.

Fernandoa adenophylla (Wall. ex G. Don) Steenis

Millingtonia hortensis L. f.

Pyrostegia venusta (Ker-Gawl.) Miers

Dicliptera verticillata (Forsk.) C. Christens

Hemiadelphis polysperma (Heyne ex Roth) Nees

Clerodendrum infortunatum L.,

Lantana camara L.

Premna mollissima Roth

Hyptis suaveolens (L.) Poit.

Leonotis nepetifolia (L.) R. Br.

Pogostemon benghalensis (Burm.f.) O.Ktze.

Plantago amplexicaulis Cav.

Alternanthera paronychioides St. Hill.

Alternanthera philoxeroides (Mart.) Gris.

Amaranthus tenuifolius Willd.

Amaranthus viridis L.

Basella rubra L.

Antigonon leptopus Hook. & Arn.

Polygonum caespitosum Bl.

Polygonum lapathifolium L.

Rumex crispus L.

Grevillea robusta A. Cunn. ex R. Br.

Euphorbia antiquorum L.

Mallotus nudiflorus (L.) Kulju & Welzen

Mallotus philippensis (Lamk.) Muell. - Arg.

Phyllanthus debilis Klein ex Willd.

Phyllanthus reticulatus Poir.

Phyllanthus urinaria L.

Phyllanthus virgatus Forst.

Ricinus communis L.

Holoptelea integrifolia (Roxb.) Planch.

Artocarpus heterophyllus Lamk.

Artocarpus lakoocha Roxb.

Ficus semicordata Buch.- Ham. ex J. E. Smith

Pouzolzia zeylanica (L.) Benn.

Ottelia alismoides (L.) Pers.

Eulophia dabia (D. Don) Hochr.

Alpinia zerumbet (Pers.) B.L.Burtt & R.M.Sm.,

Canna indica L.

Crinum asiaticum L.

Zephyranthes grandiflora Lindl.

Commelina caroliniana Walter

Juncus wallichianus J.Gay ex Laharpe

Sparganium erectum L.

Lemna minor L.

Wolffia arrhiza (L.) Horkel ex Wimmer

Potamogeton nodosus Poir.

Stuckenia pectinata (L.) Börner

Carex fedia Nees

Cyperus nutans Vahl

Cyperus procerus Rottb.

Cyperus tenuispica Steud.

Eleocharis acutangula (Roxb.) Schult.

Eleocharis palustris (L.) R. Br.

Fimbristylis bisumbellata (Forsk.) Bubani.

Kyllinga brevifolia Rottb.

Kyllinga bulbosa Beauv.

Panicum paludosum Roxb.

Schoenoplectus litoralis (Schrad.) Palla subsp. subulatus (Vahl) Koyama

Paspalidium geminatum (Forsk.) Stapf.

Brachiaria kurzii (Hook. f.) A. Camus

Paspalum paspaloides (Michaux) Scribner

Brachiaria setigera (Retz.) C. E.Hubbard

Paspalum vaginatum Swartz

Brachiaria villosa (Lamk.) A. Camus

Polypogon fugax Nees ex Steud.

Coix gigantea Koenig ex Roxb.

Setaria geniculata (Lamk.) P. Beauv.

Cymbopogon jwarancusa (Jones) Schult.

Setaria verticillata (L.) P. Beauv.

Dactyloctenium scindicum Boiss.

Sporobolus virginicus (L.) Kunth

Digitaria bicornis (Lamk.) Roem. & Schult.

Thysanolaena latifolia (Roxb. ex Hornem.) Honda

Digitaria griffithii (Hook. f.) Henr.

Pycreus sanguinolentus

Digitaria violascens Link

Echinochloa frumentacea Link

Eragrostis atrovirens (Desf.) Trin.ex Steud.

Eragrostis gangetica (Roxb.) Steud.

Erianthus ravennae (L.) P. Beauv.

Isachne albens Trin.

Leersia hexandra Sw.

Leptochloa chinensis (L.) Nees

Neyraudia arundinacea (L.) Henr.

Oryza rufipogon Griff.

Panicum notatum Retz.

LIST OF PLANTS REPORTED BY MURTY AND SINGH (1961) BUT NOT *COLLECTED DURING PRESENT STUDY*

Ranunculus trichophyllus Chaix

Tephrosia strigosa (Dalz.) Sant. & Mahesh.

Rorippa montana (Hook. f. & Thomson) Small

Trigonella monantha C. A. Meyer

Crateva magna (Lour.) DC.

Uraria picta (Jacq.) Desv. ex. DC.

Maerua oblongifolia (Forssk.) A. Rich.

Bauhinia racemosa Lam.

Tamarix indica Willd.

Acacia gageana Craib

Abutilon hirtum (Lamk.) Sweet

Acacia leucophloea (Roxb.) Willd.

Abutilon ramosum (Cav.) Guillemin & Perrottet

Acacia sinuata (Lour.) Merr.

Kydia calycina Roxb.

Rotala densiflora (Roth ex Roem. & Schult.) Koehne

Malva verticillata L.

Melothria perpusilla (Blume) Cogn.

Corchorus tridens L.

Trianthema triquetra Roxb. ex Willd.

Corchorus trilocularis L.

Morinda pubescens Sm.

Fagonia indica Burm. f.

Artemisia japonica Thunb.

Alhagi maurorum Medic.

Carthamus oxyacantha M. Bieb.

Alysicarpus monilifer (L.) DC.

Pluchea tomentosa DC.

Atylosia platycarpa Benth.

Siegesbeckia orientalis L.

Dalbergia latifolia Roxb.

Leptadenia pyrotechnica (Forsk.) Decne.

Indigofera cordifolia Heyne ex Roth

Pergularia daemia (Forsk.) Chiov.

Rhynchosia rothii Roxb. ex Aitch.

Enicostema axillare (Lamk.) Raynal

Hydrolea zeylanica (L.) Vahl

Heliotropium europaeum L. var. lasiocarpum (Fish. & Mey.) Kazmi

Ipomoea quamoclit L.

Solanum anguivi Lamk.

Dopatrium junceum (Roxb.) Buch.-Ham. ex Benth.

Stemodia viscos Roxb.

Blepharis repens (Vahl) Roth

Gmelina arborea Roxb.

Orthosiphon pallidus Royle ex Benth.,

Kochia indica Wight

Aristolochia bracteolata Lamk.

Acalypha ciliata Forsk.

Breynia vitis-idaea (Burm. f.) Fischer

Triadica sebifera (L.) Small

Broussonetia papyrifera (L.) Vent.

Commelina attenuata Koenig ex Vahl

Cyanotis cristata (L.) D. Don

Lemna trisulca L.

Wolffia microscopica (Griff. ex Voigt) Kurz

Aponogeton natans (L.) Engl. & Krause

Aristida funiculata Trin. & Rupr.

Aristida hystrix L. f.

Arundinella nepalensis Trin.

Arundinella pumila (Hochst. ex A. Rich.) Steud.

Chrysopogon fulvus (Spreng.) Chiov.

Eleusine coracana (L.) Gaertn.

Eulaliopsis binata (Retz.) C. E. Hubbard

Hackelochloa granularis (L.) O. Kuntze

Isachne himalaica Hook. f.

Setaria palmifolia (Koenig) Stapf

Tragus roxburghii Panigrahi

Cyperus alulatus

Kylinga odorata

Zaleya decandra

Indoneesiella echioides (L.) Sreemadh.

APPENDIX – III: FAMILIES SORTED ACCORDING TO NUMBER OF GENERA

POLYPETALAE

FABACEAE	31
MALVACEAE	10
CUCURBITACEAE	9
BRASSICACEAE	8
CARYOPHYLLACEAE	7
APIACEAE	7
CAESALPINIACEAE	6
MIMOSACEAE	6
STERCULIACEAE	4
MYRTACEAE	4
LYTHRACEAE	4
MENISPERMACEAE	3
CAPPARACEAE	3
TILIACEAE	3
RUTACEAE	3
MELIACEAE	3
COMBRETACEAE	3
ONAGRACEAE	3
MOLLUGINACEAE	3
ANNONACEAE	2
FLACOURTIACEAE	2
ZYGOPHYLLACEAE	2
VITACEAE	2
SAPINDACEAE	2
AIZOACEAE	2
RANUNCULACEAE	1
NYMPHAEACEAE	1
NELUMBONACEAE	1
PAPAVERACEAE	1
FUMARIACEAE	1
CLEOMACEAE	1
VIOLACEAE	1
POLYGALACEAE	1
PORTULACACEAE	1
TAMARICACEAE	1
ELATINACEAE	1
HYPERICACEAE	1
BOMBACACEAE	1
LINACEAE	1
AVERRHOACEAE	1
OXALIDACEAE	1
TROPAEOLACEAE	1
BALSAMINACEAE	1
SIMAROUBACEAE	1
CELASTRACEAE	1
RHAMNACEAE	1
ANACARDIACEAE	1
MORINGACEAE	1
ROSACEAE	1
TRAPACEAE	1
PASSIFLORACEAE	1
CACTACEAE	1

GAMOPETALAE

ASTERACEAE	42
ACANTHACEAE	13
SCROPHULARIACEAE	12
LAMIACEAE	9
VERBENACEAE	8
RUBIACEAE	6
APOCYNACEAE	6
BIGNONIACEAE	6
ASCLEPIADACEAE	5
CONVOLVULACEAE	5
SOLANACEAE	5
BORAGINACEAE	4
SAPOTACEAE	3
GENTIANACEAE	3
CAMPANULACEAE	2
PRIMULACEAE	2
OLEACEAE	2
EHRETIACEAE	2
PEDALIACEAE	2
SPHENOCLEACEAE	1
PLUMBAGINACEAE	1

EBENACEAE	1	LENTIBULARIACEAE	1
PERIPLOCACEAE	1	OROBANCHACEAE	1
MENYANTHACEAE	1	MARTYNIACEAE	1
HYDROPHYLLACEAE	1	PLANTAGINACEAE	1
CUSCUTACEAE	1		

MONOCHLAMYDEAE

EUPHORBIACEAE	9	LORANTHACEAE	1
AMARANTHACEAE	8	ULMACEAE	1
MORACEAE	5	CANNABINACEAE	1
NYCTAGINACEAE	3	URTICACEAE	1
POLYGONACEAE	3	CASUARINACEAE	1
CHENOPODIACEAE	2	SALICACEAE	1
BASELLACEAE	1	CERATOPHYLLACEAE	1
ARISTOLOCHIACEAE	1		
PROTEACEAE	1		

MONOCOTS

POACEAE	61	AGAVACEAE	1
CYPERACEAE	10	DIOSCOREACEAE	1
HYDROCHARITACEAE	3	JUNCACEAE	1
ZINGIBERACEAE	3	ARECACEAE	1
LILIACEAE	3	TYPHACEAE	1
COMMELINACEAE	3	SPARGANIACEAE	1
LEMNACEAE	3	ARACEAE	1
ORCHIDACEAE	2	ALISMATACEAE	1
AMARYLLIDACEAE	2	APONOGETONACEAE	1
PONTEDERIACEAE	2	ZANNICHELLIACEAE	1
POTAMOGETONACEAE	2	NAJADACEAE	1
MUSACEAE	1	ERIOCAULACEAE	1
CANNACEAE	1		

APPENDIX – IV: FAMILIES SORTED ACCORDING TO NUMBER OF SPECIES.

POLYPETALAE

FABACEAE	62
MALVACEAE	22
CAESALPINIACEAE	18
MIMOSACEAE	14
CUCURBITACEAE	11
TILIACEAE	9
BRASSICACEAE	8
LYTHRACEAE	8
CARYOPHYLLACEAE	7
ONAGRACEAE	7
APIACEAE	7
MYRTACEAE	6
CAPPARACEAE	5
STERCULIACEAE	4
RUTACEAE	4
COMBRETACEAE	4
RANUNCULACEAE	3
MENISPERMACEAE	3
FLACOURTIACEAE	3
PORTULACACEAE	3
MELIACEAE	3
RHAMNACEAE	3
AIZOACEAE	3
MOLLUGINACEAE	3
ANNONACEAE	2
NYMPHAEACEAE	2
PAPAVERACEAE	2
CLEOMACEAE	2
POLYGALACEAE	2
TAMARICACEAE	2
ZYGOPHYLLACEAE	2
OXALIDACEAE	2
VITACEAE	2
SAPINDACEAE	2
ROSACEAE	2
NELUMBONACEAE	1
FUMARIACEAE	1
VIOLACEAE	1
ELATINACEAE	1
HYPERICACEAE	1
BOMBACACEAE	1
LINACEAE	1
AVERRHOACEAE	1
TROPAEOLACEAE	1
BALSAMINACEAE	1
SIMAROUBACEAE	1
CELASTRACEAE	1
ANACARDIACEAE	1
MORINGACEAE	1
TRAPACEAE	1
PASSIFLORACEAE	1
CACTACEAE	1

GAMOPETALAE

ASTERACEAE	59
CONVOLVULACEAE	20
SCROPHULARIACEAE	20
ACANTHACEAE	16
LAMIACEAE	13
SOLANACEAE	11
VERBENACEAE	11
APOCYNACEAE	8
RUBIACEAE	7
ASCLEPIADACEAE	7
BORAGINACEAE	6
BIGNONIACEAE	6
SAPOTACEAE	3
GENTIANACEAE	3
CAMPANULACEAE	2
PRIMULACEAE	2
OLEACEAE	2
EHRETIACEAE	2
CUSCUTACEAE	2
LENTIBULARIACEAE	2
PEDALIACEAE	2

SPHENOCLEACEAE	1
PLUMBAGINACEAE	1
EBENACEAE	1
PERIPLOCACEAE	1
MENYANTHACEAE	1
HYDROPHYLLACEAE	1
OROBANCHACEAE	1
MARTYNIACEAE	1
PLANTAGINACEAE	1

MONOCHLAMYDEAE

EUPHORBIACEAE	22
AMARANTHACEAE	17
MORACEAE	11
POLYGONACEAE	9
CHENOPODIACEAE	4
NYCTAGINACEAE	3
URTICACEAE	2
BASELLACEAE	1
ARISTOLOCHIACEAE	1
PROTEACEAE	1
LORANTHACEAE	1
ULMACEAE	1
CANNABINACEAE	1
CASUARINACEAE	1
SALICACEAE	1
CERATOPHYLLACEAE	1

MONOCOTS

POACEAE	110
CYPERACEAE	45
COMMELINACEAE	7
LEMNACEAE	6
HYDROCHARITACEAE	3
ZINGIBERACEAE	3
LILIACEAE	3
PONTEDERIACEAE	3
POTAMOGETONACEAE	3
ORCHIDACEAE	2
AMARYLLIDACEAE	2
JUNCACEAE	2
ALISMATACEAE	2
MUSACEAE	1
CANNACEAE	1
AGAVACEAE	1
DIOSCOREACEAE	1
ARECACEAE	1
TYPHACEAE	1
SPARGANIACEAE	1
ARACEAE	1
APONOGETONACEAE	1
ZANNICHELLIACEAE	1
NAJADACEAE	1
ERIOCAULACEAE	1

APPENDIX – V: GENERA SORTED ACCORDING TO NUMBER OF SPECIES.

POLYPETALAE

CASSIA L.	10
INDIGOFERA L.	7
ACACIA Mill.	7
SIDA L.	6
CROTALARIA L.	6
CORCHORUS L.	5
HIBISCUS L. *nom. cons.*	4
ALYSICARPUS Desv. *nom. cons.*	4
LUDWIGIA L.	4
RANUNCULUS L.	3
CAPPARIS L.	3
PORTULACA L.	3
ABUTILON Mill.	3
GREWIA L.	3
ZIZIPHUS Mill.	3
LATHYRUS L.	3
MEDICAGO L.	3
RHYNCHOSIA Lour. *nom. cons.*	3
TEPHROSIA Pers. *nom. cons.*	3
VICIA L.	3
BAUHINIA L.	3
EUCALYTUS L' Herit	3
ROTALA L.	3
NYMPHAEA L. *nom. cons.*	2
ARGEMONE L.	2
CLEOME L.	2
CASEARIA Jacq.	2
POLYGALA L.	2
TAMARIX L.	2
ABELMOSCHUS Medic.	2
MALVA L.	2
OXALIS L.	2
MURRAYA J. G. Koenig ex L. *nom. cons.*	2
ATYLOSIA Wight & Arn.	2
DALBERGIA L. f. *nom. cons.*	2
DESMODIUM Desv. *nom. cons.*	2
MELILOTUS Mill.	2
SESBANIA Adans. *emend.* Scop. *nom. cons.*	2
TRIFOLIUM L.	2
TRIGONELLA L.	2
CAESALPINIA L.	2
ALBIZIA Durazz.	2
MIMOSA L.	2
POTENTILLA L.	2
TERMINALIA L. *nom. cons.*	2
AMMANNIA L.	2
LAGERSTROEMIA L.	2
OENOTHERA L.	2
LUFFA Mill.	2
MELOTHRIA L.	2
TRIANTHEMA L.	2
ANNONA L.	1
POLYALTHIA Blume	1
CISSAMPELOS L.	1
COCCULUS DC. *nom. cons.*	1
TINOSPORA Miers	1
NELUMBO Adans.	1
FUMARIA L.	1
ARABIDOPSIS Heynh.	1
CAPSELLA Medik. *nom. cons.*	1
CARDAMINE L.	1
CORONOPUS L. *nom. cons.*	1
DESCURAINIA Webb. & Benth. *nom. cons.*	1
NASTURTIUM R. Br. *nom. cons*	1
RORIPPA Scop.	1
SISYMBRIUM L.	1
CRATEVA L.	1
MAERUA Forssk.	1
HYBANTHUS Jacq..	1
FLACOURTIA L' Herit.	1
ARENARIA L.	1
POLYCARPAEA Lamk. *nom.cons.*	1
POLYCARPON L.	1
SILENE L.	1
SPERGULA L.	1

STELLARIA L.	1
VACCARIA Wolf.	1
BERGIA L.	1
HYPERICUM L.	1
FIORIA Mattei	1
KYDIA Roxb.	1
MALVASTRUM Gray *nom. cons.*	1
PAVONIA Cav. *nom. cons.*	1
URENA L.	1
BOMBAX L.	1
HELICTERES L.	1
MELOCHIA L.	1
PENTAPETES L.	1
WALTHERIA L.	1
TRIUMFETTA L.	1
LINUM L.	1
FAGONIA Tourn. ex L.	1
TRIBULUS Tourn. ex L.	1
AVERRHOA L.	1
TROPAEOLUM L.	1
IMPATIENS L.	1
AEGLE Correa *nom. cons.*	1
FERONIA Correa	1
AILANTHUS Desf. *nom. cons.*	1
AZADIRACHTA A. Juss.	1
MELIA L.	1
TOONA Roem.	1
CELASTRUS L.	1
AMPELOCISSUS Planch. *nom. cons.*	1
CAYRATIA A.L. Juss. *nom. cons.*	1
CARDIOSPERMUM L.	1
SCHLEICHERA Willd. *nom. cons.*	1
MANGIFERA L.	1
MORINGA Adans.	1
ABRUS Adans.	1
AESCHYNOMENE L.	1
ALHAGI Gagnebin	1
BUTEA Roxb. ex Willd. *nom.cons.*	1
CLITORIA L.	1
ELEIOTIS DC.	1
ERYTHRINA L.	1
LABLAB Adans. .	1
LOTUS L.	1
MACROTYLOMA (Wight & Arn.) Verdc.	1
MUCUNA Adans. *nom. cons.*	1
PONGAMIA Vent. *nom. cons.*	1
TERAMNUS R. Br.	1
URARIA Desv.	1
VIGNA Savi.	1
ZORNIA J. F. Gmel.	1
DELONIX Rafin.	1
PARKINSONIA L.	1
TAMARINDUS L.	1
LEUCAENA Benth.	1
PITHECELLOBIUM Mart. *nom. cons.*	1
PROSOPIS L.	1
COMBRETUM Loefling *nom. cons.*	1
QUISQUALIS L.	1
CALLISTEMON R. Br.	1
PSIDIUM L.	1
SYZYGIUM Gaertn. *nom. cons.*	1
LAWSONIA L.	1
EPILOBIUM L.	1
TRAPA L.	1
ACTINOSTEMMA Griff.	1
BRYONOPSIS Arnott.	1
CITRULUS Schrad. *nom. cons.*	1
COCCINIA Wight & Arn.	1
CUCUMIS L.	1
MOMORDICA L.	1
TRICHOSANTHES L.	1
PASSIFLORA L.	1
OPUNTIA Mill.	1
ZALEYA	1
GISEKIA L.	1
GLINUS L.	1
MOLLUGO L.	1
ANETHUM L.	1
CENTELLA L.	1
CORIANDRUM L.	1
DAUCUS L.	1
HYDROCOTYLE L.	1
OENANTHE L.	1
SESELI L.	1

GAMOPETALAE

IPOMOEA L.	12
LINDERNIA All.	6
CONYZA *Less.* nom. cons.	5
ARTEMISIA L.	3
BLUMEA *DC.* nom. cons.	3
GNAPHALIUM L.	3
SONCHUS L.	3
HELIOTROPIUM L.	3
MERREMIA Dennst.ex Endl. *non. cons.*	3
DATURA L.	3
PHYSALIS L.	3
SOLANUM L.	3
CLERODENDRUM L.	3
LEUCAS R. Br.	3
OCIMUM	3
BORRERIA G. F. W. Mey. , *nom. cons.*	2
AGERATUM L.	2
LACTUCA L.	2
LAUNAEA Cass.	2
PENTANEMA Cass.	2
PULICARIA Gaertn.	2
CARISSA L. *nom. cons.*	2
CATHARANTHUS G. Don	2
CALOTROPIS R. Br.	2
LEPTADENIA R. Br.	2
CONVOLVULUS L.	2
EVOLVULUS L.	2
CUSCUTA L.	2
BACOPA Aublet *nom. cons.*	2
VERBASCUM L.	2
VERONICA L.	2
UTRICULARIA L.	2
BARLERIA L.	2
BLEPHARIS Juss.	2
RUNGIA Nees.	2
LANTANA L.	2
CEPHALANTHUS L.	1
DENTELLA J. & G. Forst.	1
GALIUM L.	1
MORINDA L.	1
OLDENLANDIA L. *emend.* Brem.	1
ADENOSTEMMA J. & G. Forster	1
AMBERBOA (Pers.) Less.	1
BIDENS L.	1
BLAINVILLEA Cass.	1
BREEA Less.	1
CAESULIA Roxb.	1
CARTHAMUS L.	1
CENTIPEDA Lour.	1
CICHORIUM L.	1
COTULA L.	1
CYATHOCLINE Cass.	1
DICHROCEPHALA L' Herit ex DC.	1
ECLIPTA L. *nom. cons.*	1
EMILIA Cass.	1
ENYDRA Lour.	1
ERIGERON L.	1
EUPATORIUM L.	1
GRANGEA Adans.	1
HIMALAIELLA Raab-Straube.	1
IXERIS Cass.	1
LAGGERA Sch. – Bip. ex Koch.	1
PARTHENIUM L.	1
PLUCHEA Cass.	1
SIEGESBECKIA L.	1
SOLIVA Ruiz. & Pav.	1
SPHAERANTHUS L.	1
SPILANTHES Jacq.	1
TRIDAX L.	1
VERBESINA L.	1
VERNONIA Schrebr. *nom. cons.*	1
XANTHIUM L.	1
YOUNGIA Cass.	1
CAMPANULA L.	1
WAHLENBERGIA Schard. ex Roth nom. cons.	1
SPHENOCLEA Gaertn. nom.cons.	1
PLUMBAGO *L.*	1
ANAGALLIS L.	1
PRIMULA L.	1
MADHUCA Ham. ex J. F. Gmelin	1
MANILKARA Adans. *nom. cons.*	1
MIMUSOPS L.	1
DIOSPYROS L.	1

JASMINUM L.	1
NYCTANTHES L.	1
HOLARRHENA R.Br.	1
ICHNOCARPUS R.Br. *nom. cons.*	1
VALLARIS N.C. Burman	1
WRIGHTIA R. Br.	1
OXYSTELMA *R.Br.*	1
PERGULARIA L.	1
TELOSMA Coville	1
CRYPTOSTEGIA R.Br.	1
CENTAURIUM Hill	1
ENICOSTEMA Blume nom.cons.	1
HOPPEA Willd.	1
NYMPHOIDES Seguir	1
HYDROLEA L. *nom.cons.*	1
ARNEBIA Forsk.	1
CYNOGLOSSUM L.	1
TRICHODESMA R. Br. *nom. cons.*	1
CORDIA L.	1
EHRETIA P. Brown	1
OPERCULINA Silva Manso	1
NICOTIANA L.	1
WITHANIA Pauq. *nom. cons.*	1
ANTIRRHINUM L.	1
DOPATRIUM Buch. -Ham. ex Benth.	1
LIMNOPHILA R. Br. *nom. cons.*	1
LINDENBERGIA Lehm	1
MAZUS Lour.	1
SCOPARIA L.	1
STEMODIA L. *nom. cons.*	1
STRIGA Lour	1
OROBANCHE L.	1
CAMPSIS Lour.	1
FERNANDOA Welw. ex Seem.	1
JACARANDA Juss.	1
MILLINGTONIA L. f.	1
PYROSTEGIA Presl.	1
TECOMA Juss.	1
PEDALIUM L.	1
SESAMUM L.	1
MARTYNIA L.	1
ADHATODA Nees.	1
DICLIPTERA Juss. *nom. cons.*	1
Elytraria	1
DIPTERACANTHUS Nees *emend* Bremek.	1
HEMIADELPHIS Nees	1
HEMIGRAPHIS Nees emend. *T. Anders.*	1
HYGROPHILA R.Br. *emend.* Heine	1
INDONEESIELLA Sreemadh.	1
JUSTICIA L.	1
PERISTROPHE Nees	1
GMELINA L.	1
PHYLA Lour.	1
PREMNA L.	1
TECTONA L.f. *nom.cons*	1
VERBENA L.	1
VITEX L.	1
ANISOMELES R. Br.	1
HYPTIS Jacq. *nom. cons.*	1
LEONOTIS R. Br.	1
NEPETA L.	1
ORTHOSIPHON Benth.	1
POGOSTEMON Desf.	1
SALVIA L.	1
PLANTAGO L.	1

MONOCHLAMYDEAE

PHYLLANTHUS L.	7
POLYGONUM L.	6
EUPHORBIA L.	6
FICUS L.	6
AMARANTHUS L.	5
ALTERNANTHERA Forsk.	4
AERVA Forsk. *nom. cons.*	3
CHENOPODIUM L.	3
RUMEX L.	2
ACALYPHA L.	2
MALLOTUS Lour.	2
ARTOCARPUS J. & G. Forst. *nom. cons.*	2
POUZOLZIA Gaud.	2

BOERHAVIA L.	1
COMMICARPUS Standley	1
MIRABILIS L.	1
ACHYRANTHES L.	1
KOCHIA Roth	1
BASELLA L.	1
ANTIGONON Endl.	1
ARISTOLOCHIA L.	1
GREVILLEA R. Br. *nom cons*	1
DENDROPHTHOE Mart.	1
BREYNIA J. Forster & G. Forster *nom.cons.*	1
CROTON L.	1
FLUEGGEA Willd.	1
RICINUS L.	1

MONOCOTS

CYPERUS L.	14
ERAGROSTIS N. M. Wolf	12
FIMBRISTYLIS Vahl *nom. cons.*	7
SCHOENOPLECTUS (Reichb.) Palla *nom. cons.*	5
BRACHIARIA (Trin.) Griseb.	5
DIGITARIA Haller *nom. cons.*	5
SETARIA P. Beauv. *nom. cons.*	5
COMMELINA L.	4
ELEOCHARIS R. Br.	4
KYLLINGA Rottb. *nom. cons.*	4
MARISCUS Vahl *nom. cons.*	4
CENCHRUS L.	4
PANICUM L.	4
LEMNA L.	3
PYCREUS P. Beauv.	3
ARISTIDA L.	3
ECHINOCHLOA P. Beauv. *nom. cons.*	3
PASPALIDIUM Stapf	3
PASPALUM L.	3
MONOCHORIA Persl.	2
CYANOTIS D. Don. *nom. cons.*	2
JUNCUS L.	2
WOLFFIA Horkel ex Schleid. *nom. cons.*	2
SAGITTARIA L.	2
POTAMOGETON L.	2
CELOSIA L.	1
DIGERA Forsk.	1
GOMPHRENA L.	1
PUPALIA Juss. *nom. cons.*	1
TRIADICA Lour.	1
HOLOPTELEA Planch.	1
BROUSSONETIA L' Herit ex Vent.	1
MORUS	1
STREBLUS	1
CANNABIS L.	1
CASUARINA L.	1
SALIX L.	1
CERATOPHYLLUM L.	1
CAREX L.	2
ARUNDINELLA Raddi	2
CHLORIS Sw.	2
COIX L.	2
DACTYLOCTENIUM Willd.	2
DICHANTHIUM Willemet	2
ELEUSINE Gaertn.	2
ISACHNE R. Br.	2
LEPTOCHLOA P. Beauv.	2
OPLISMENUS P. Beauv. *nom. cons.*	2
POLYPOGON Desf.	2
SACCHARUM L.	2
SPOROBOLUS R.Br.	2
HYDRILLA L.C.Rich	1
OTTELIA Pers.	1
VALLISNERIA L.	1
EULOPHIA R. Br. *nom. cons.*	1
ZEUXINE Lindl. *nom. cons.*	1
MUSA L.	1
ALPINIA	1
CURCUMA	1
ZINGIBER Boehm., *nom.cons.*	1
CANNA L.	1
CRINUM L.	1
ZEPHYRANTHES	1
AGAVE L.	1
DIOSCOREA L.	1
ASPARAGUS L.	1

ASPHODELUS L.	1
GLORIOSA L.	1
EICHHORNIA Kunth *nom.cons.*	1
MURDANNIA Royle *nom. cons.*	1
PHOENIX L.	1
TYPHA L.	1
SPARGANIUM L.	1
COLOCASIA Schott	1
SPIRODELA Schleid.	1
APONOGETON L. f.	1
STUCKENIA Börner	1
ZANNICHELLIA L.	1
NAJAS L.	1
ERIOCAULON L.	1
BOLBOSCHOENUS (Ascherson) Palla	1
BULBOSTYLIS Kunth *nom. cons.*	1
ACRACHNE Wt. & Arn. ex. Chiov.	1
ALOPECURUS L.	1
APLUDA L.	1
ARUNDO L.	1
AVENA L.	1
AXONOPUS P. Beauv.	1
BAMBUSA Schreb. *nom. cons.*	1
BOTHRIOCHLOA O.Kuntze	1
CHRYSOPOGON Trin. *nom. cons.*	1
CYMBOPOGON Spreng.	1
CYNODON L. C. Rich. *nom. cons.*	1
DENDROCALAMUS Nees	1
DESMOSTACHYA Stapf	1
ERIANTHUS Michx.	1
ERIOCHLOA H. B. K.	1
EULALIOPSIS Honda	1
HACKELOCHLOA O. Ktze.	1
HEMARTHRIA R. Br.	1
HETEROPOGON Pers.	1
HYGRORYZA Nees	1
IMPERATA Cyr.	1
ISCHAEMUM L.	1
LEERSIA Soland. ex Sw. *nom. cons.*	1
LOLIUM L.	1
NARENGA Bor	1
NEYRAUDIA Hook. f.	1
ORYZA L.	1
PENNISETUM L. C. Rich.	1
PEROTIS W. Ait.	1
PHALARIS L.	1
PHRAGMITES Trin.	1
POA L.	1
SORGHUM Moench. *nom. cons.*	1
THYSANOLAENA Nees	1
TRAGUS A. Haller *nom. cons.*	1
TRITICUM L.	1
UROCHLOA P. Beauv.	1
VETIVERIA Lem. –Lisanc.	1
ZEA L.	1