

Research Article

A study on diversity and distribution of *Ficus* L. (Dicotyledonae: Moraceae) species at Forest Research Institute (FRI), Dehradun (Uttarakhand), India

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Abstract

Ficus L., commonly known as Fig, is a member of the family Moraceae (mulberry family) comprises 37 genera and approximately 1,100 species distributed in diverse ecosystems, especially in tropical and temperate regions of the world. The *Ficus* genus stands out as a keystone resource provider in many tropical forests, which is probably because of continuous non-seasonal fruiting in many species. It is one of the largest genera in the angiosperms about 750 species. The present study was carried out in the Forest Research Institute (FRI) campus, Dehradun (Uttarakhand), India. The phytodiversity of *Ficus* L. and their socio-economic values worked out during the investigation, religious-spiritual attachment, food of wild animals, ethnomedicinal and timber significance. There were 16 species of *Ficus* L. recorded from New Forest, FRI, Dehradun based on the morphological observations of taxonomically significant characteristics. The species found in FRI New Forest Dehradun were, *Ficus benjamina*, *F. religiosa*, *F. racemosa*, *F. rumphii*, *F. retusa*, *F. krishnae*, *F. elastica*, *F. virens*, *F. semicordata*, *F. auriculata*, *F. hispida*, *F. pumila*, *F. palmata*, *F. drupacea*, *F. benghalensis*, *F. pomifera*. Out of the notified 16 species of *Ficus*, 11 species were trees, 3 shrubs and 2 climbers in nature. The maximum leaf size (30×27cm²) was reported in *F. auriculata*, followed by *F. semicordata* (28×10cm²), *F. benghalensis* (25×11cm²). However, minimum leaf size was noticed in *F. benjamina* (4×2cm²) and *F. retusa* (4×3cm²). Among, 15 species, axillary fig (fruit) arrangement was observed, while one species (*F. racemosa*) has stem position of fruits. The current finding is itself a pioneer study to present a glimpse of such immense species diversity of single genera from sub-valley areas and will be a milestone for future studies in conservation and management of these wild varieties.

Keywords: *Ficus* L., Key-stone, Fig, Axillary fig, Dicotyledonae, Moraceae, Diversity

INTRODUCTION

Plants are known as producers and important for reduction of pollution level. These are also a foremost source

of energy by trapping solar radiations to convert in to chemical energy in their photosynthesis activity. Linnaeus (1753) proposed the genus *Ficus* for the first time. The Latin word *Ficus* is derived from the Indian

'Fag' from which come the Italian, Portuguese and the Spanish 'Figs', the French 'Figsee' and the German 'Feigen' and the Dutch 'Rijig' (Masilamoney, 1984). Hooker (1888) gave an account of 112 species for the Indian sub-continent including Pakistan and Bangladesh). King (1887) described nearly 220 species with excellent plates in his book "Magnum opus on Indo-Malayan figs". Fischer (1928) gave a brief account on 30 species of *Ficus* for the erstwhile Madras Presidency. Available literature traces the importance of *Ficus* even from 256 B.C. It is said to be the tree under which Buddha achieved enlightenment 2500 years ago (Gadgi, 1996). Since the peepal considered as an incarnation of Vishnu or Buddha and have spiritual attachment with this tree. Tree worship on Saturday of every week constructing stone plate form around the tree, and tree marriage of peepal to bargad (*F. benghalensis*) is a special culture demonstrating our love with trees. The family Moraceae (mulberry family) comprises 37 genera and approximately 1,100 species distributed in diverse ecosystem especially in tropical and temperate regions of the world are eaten by insects, birds and animals throughout the year (Chaudhary *et al.*, 2012).

It is one of the largest genera in the angiosperms, about 755 species worldwide (Chaudhary *et al.*, 2012; Sharma *et al.*, 2016). The genus is distributed throughout the world primarily in subtropical and tropical regions (Berg and Corner, 2005). Around 511 of these are occurring in Indo-Australasian region (Asia, Malaysia, Pacific Island and Australia) and approximately 132 species in Neotropical region (Central and South America) (Berg, 2003; Berg and Corner, 2005; Kumar *et al.*, 2018). In India, the Banyan tree (*F. benghalensis*) is being cultivated as an avenue tree along roadsides for generations. The different species of *Ficus* are known for their pharmacological and ethnomedicinal properties and used in modern medicine and pharmaceutical applications (Adebayo *et al.*, 2009; Abdulla *et al.*, 2010; Sharma *et al.*, 2016). *F. racemosa* applied profoundly for the treatment of wound healing and skin cancer (Lalla, 2005; Singh *et al.*, 2019). The fruit extracts of *F. benjamina*, *F. benghalensis* and *F. religiosa* have significant antimicrobial and antibacterial activities (Mousa *et al.*, 1994; Sharma *et al.*, 2016; Singh *et al.*, 2020a,b,c). The aqueous extract of fruit and bark (*F. religiosa*) possess potent anthelmintic effect includes parasitic round worm *Ascaridia galli*, etc. (Tiwari *et al.*, 2014; Upadhyay, 2016a,b,c; Tiwari and Talreja, 2020). The ethnomedicinal significance of trees, shrubs and climbers was also evaluated and reported yesteryears investigation by different schools (Aggarwal *et al.*, 2020; Devi *et al.*, 2020; Sharma *et al.*, 2020; Singh *et al.*, 2019; Singh *et al.*, 2020c,d,e).

The first systematic account of the Indian *Ficus* L. is available in King (1887, 1888) and recorded 113 species and 47 infra-specific taxa from whole British India. Only 75 species and 16 infra-specific taxa were reported from

the present political boundary of India. However, till date no separate account of the Indian species of *Ficus* except some scattered works (Rani 1985; Shree Kumar, 1998; Priyadarsana, 1999; Kumar *et al.*, 2011; Chaudhary *et al.*, 2012). Therefore, the present study was designed to carry out phytodiversity and distribution of *Ficus* L. in the Forest Research Institute (FRI) campus, Dehradun (Uttarakhand), India on the basis of significant morphotaxometric assessment including tree habits, leaves shape, leaves size, fruiting positions etc. The socioeconomic and ethnomedicinal values of the recorded 16 species were documented as well during this investigation.

MATERIALS AND METHODS

Site of investigation

Present study on the phytodiversity and distribution of *Ficus* L. (Dicotyledonae: Moraceae) based on the scientific survey done at Forest Research Institute (FRI), Dehradun (Uttarakhand), India (Fig. 1). The vegetation is deciduous and evergreen spread over more than 1100 acre noncultivated sub-valley circumference of campus and presently known as New Forest.

Geolocation and area of site

It is situated between N30°20'31.56" Latitude and Longitude E77°59'50.28" having expansion stretch up to 4.45km². The climate is marked by hot summer, well distributed rainfall [7.7mm–686.4mm (360± 109.6mm)] during South-West Monsoons and cold winter with small amount of winter rain.

Survey and study of phytodiversity

The overall campus thoroughly surveyed viz. Beeson Road, Canning Road, Chaturvedi Road, Circular Road, Parker Road, Takle Road, Hospital Road, Howard Road, Tierman Road, Lace Road, Teak Road, Trevor Road, Troup Road, Shalich Road, Rao Road, Hart Road, Mason Road, and Wilmot Road after onsite in situ morphological examination followed by validation of the taxonomic position through comparative analysis using available keys and herbarium to the plant taxonomy housed in Systematic Botany Discipline, FRI, Dehradun. The wild as well as cultivated plant species of the family have been considered for study as the vegetation of this campus is mostly planted. Under each species, the complete citation, synonyms, short description, phenology, common name and English name and economic importance of every species have been provided (Table 1).

RESULTS

The findings of the present study done in New Forest campus of Dehradun indicated the campus abundant of

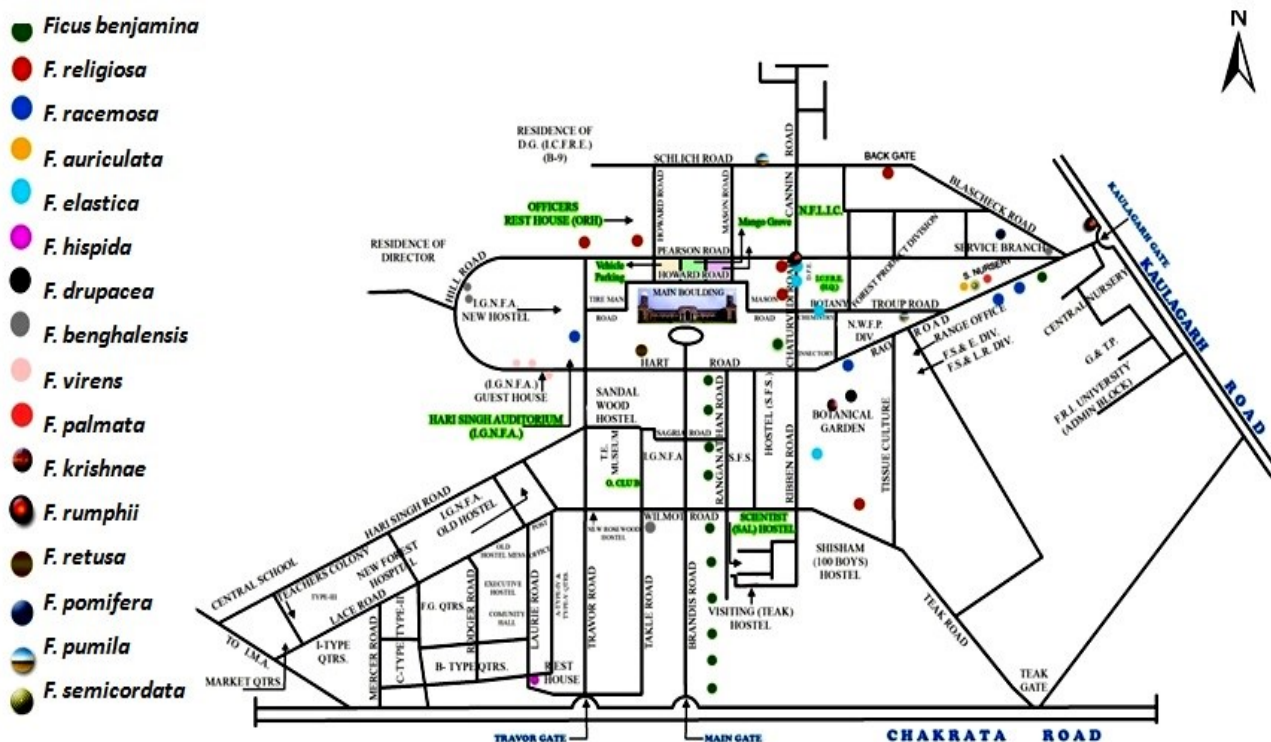


Fig. 1. Map showing site of investigation and distribution of *Ficus* L. phytodiversity in Forest Research Institute (FRI), Dehradun (Uttarakhand).



Fig. 2. Phytodiversity of *Ficus* sp.: (1) *F. racemosa*, (2) *F. pumila*, (3) *F. auriculata*, (4) *F. religiosa*, (5) *F. krishnae*, (6) *F. benghalensis*, (7) *F. virens*, (8) *F. elastica*.

Ficus species wild and planted. Out of 16 species, it was found that *Ficus racemosa*, *F. auriculata*, *F. pomifera*, *F. rumphii*, *F. palmata* var. *vigrata*, *F. benghalensis*, *F. hispida*, *F. virens* and *F. religiosa* mostly growing as a wild population. On contrary *F. drupacea*, *F. pumila*, *F. benjamina*, *F. elastica*, *F. krishnae*, *F. retusa* and *F. semicordata* are planted as avenue plan-

tation (Figs. 2,3; Table 1). Out of studied species, one species was found as straggler shrubs (*F. pumila*) and the remaining species were small tree to big free standing trees. During investigation, several figs were good examples of parasitism as strangler (*F. benghalensis*, *F. religiosa*, *F. virens*, *F. racemosa*, *F. benjamina*, *F. rumphii*).

Table 1. Morphological features, fruiting position and common name of different *Ficus* species recorded from FRI campus, Dehradun, Uttarakhand, India.

S.N.	Botanical Name	Common Name	Location	Taxonomic Feature	Leaf Size (cm)	Leaf Shape	Leaf Margin	Leaf Apex	Fig Position	Fig Size (mm)	Bark Colour
1	<i>F. racemosa</i>	Gular	Botanical Garden, Hart road, Rao road, Hill road, IMA road	Tree	10-14 x 5-4.5	Ovate	Entire	Acuminate	Stem	2-2.5	Grayish Brown
2	<i>F. pumila</i>	Creeping fig	Botanical Garden, Near bungalow no. 9, In front of Officers Rest House	Climber	5-12 x 2.5-4	Ovate	Entire	Obtuse, Acute, Acuminate	Axillary	0.5-1	Gray
3	<i>F. auriculata</i>	Fagoora, Timla	Silviculture Nursery (Rao road)	Shrub	15-30 x 15-27	Round Ovate	Regularly or slowly dentate	Acuminate	Axillary	0.3-0.6	Grayish brown, rough
4	<i>F. religiosa</i>	Pipal	In front of DFE, Botanical Garden, Deemed University, IMA road, Hill road, Pearson road, Rao road,	Tree	10-18 x 8-10	Ovate	Entire	Acute	Axillary	1.5-2	Grey
5	<i>F. krishnae</i>	Makhan katori	Botanical Garden	Tree	25-27 x 7-11	Elliptic, Cup	Entire	Acute	Axillary	1-2.5	Pale Grey
6	<i>F. benghalensis</i>	Bargad	Trevor road, Hill road, Pearson road	Tree, hemi-epiphyte	18-20 x 8-15	Ovate	Entire	Mucronate	Axillary	1-2.5	Grayish White
7	<i>F. virens</i>	Pakhad	Botanical Garden, IGFA stadium gate, Blashcheck road	Tree	10-20 x 4-7	Elliptic	Entire	Acuminate	Axillary	0.7-1.2	Grey
8	<i>F. elastica</i>	Rubber plant	Systematic Botany Discipline, Botanical Garden, Rosewood hostel	Tree	8-30 x 7-10	Elliptic	Entire	Acute	Axillary	0.5-1	Pale Gray
9	<i>F. drupacea</i>	Paras peepal	Botanical Garden	Tree	15-18 x 5-9	Elliptic	Entire	Acute	Axillary	1.5-2	Grayish-White
10	<i>F. hispida</i>	Gobla, Kithgular	Near silviculture nursery, Rao road,	Shrub	10-25 x 5-10	Elliptic	Entire	Acuminate	Axillary	1.2-3	Dark grey
11	<i>F. semicordata</i>	Khinwa	Silviculture Nursery	Tree	18-28 x 9-10	Elliptic	Entire	Acuminate	Axillary	1-1.5	Dark Brown
12	<i>F. palmata</i>	Abjiri, Bedu Plikhan	Silviculture Nursery, Botanical Garden wild in different place	Shrub	16-22 x 4-7	Flat	Entire	Murcunate	Axillary	0.8-1	Pale brown
13	<i>F. rumphii</i>	Kamarup	Botanical Garden, DFE gate, Hart road, Chaturvedi road	Tree	6-13 x 6-11	Ovate	Entire	Acuminate	Axillary	1-1.5	Gray
14	<i>F. retusa</i>	Kamarup	FRI main building ground, Hart road	Tree	4-8 x 3-4	Elliptic	Entire	Obtuse	Axillary	6-8	Dark Grey
15	<i>F. benjamina</i>	Pukar	FRI main building gate, Bound-ary SFS College, Rao road, Hart road, IMA road,	Tree, hemi-epiphyte	4-12 x 2-6	Elliptic	Entire	Acuminate	axillary	0.8-2	Grey to greyish white, smooth
16	<i>F. pomifera</i>	Giant Indian Fig, Raj dimri	Near Kaulagarh gate	Tree	5-14 x 2-7	Elliptic	Entire	Acute	Axillary	0.5-1.5	Brownish grey



Fig. 3. Phytodiversity of *Ficus* sp.: *F. drupacea* (9), *F. hispida* (10), *F. semicordata* (11), *F. palmata* (12), *F. rumphii* (13), *F. retusa* (14), *F. benamina* (15), *F. pomifera* (16).

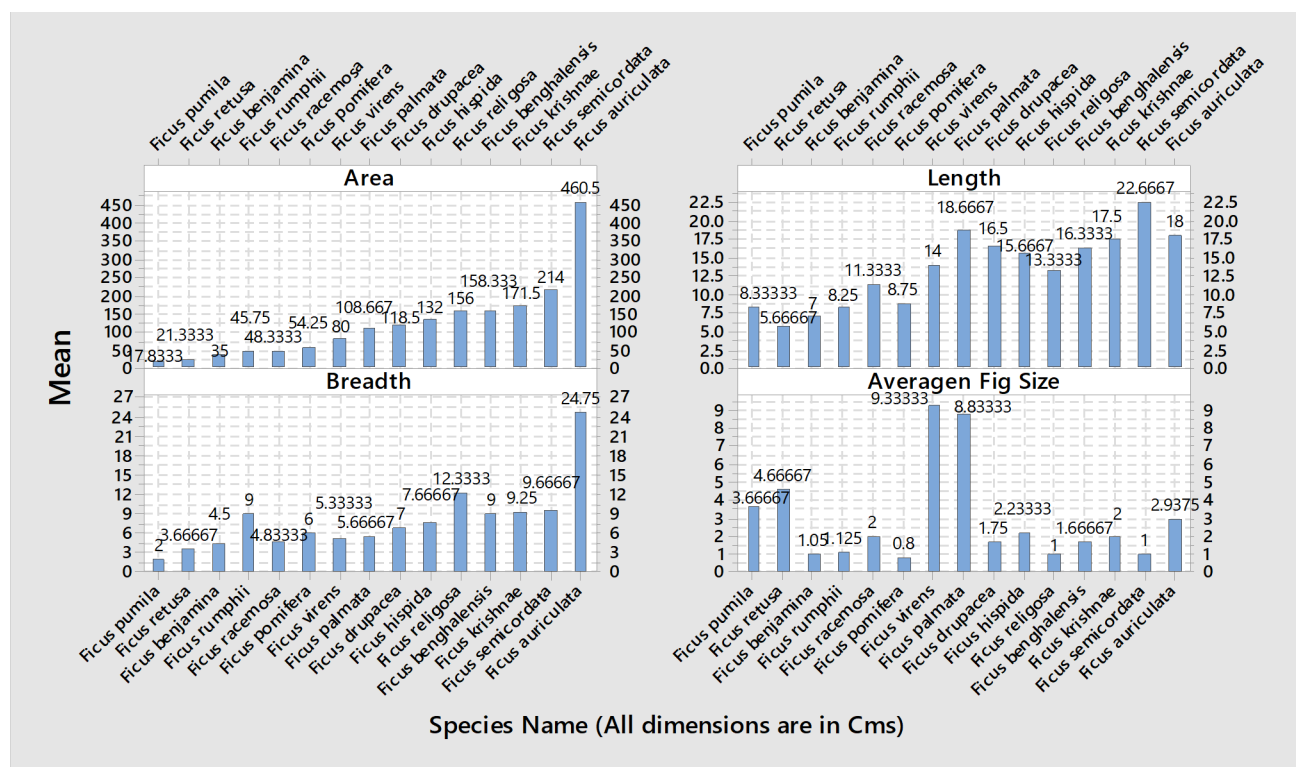


Fig. 4. Leaf area, length, breath and fig size of the different *Ficus* species.

The *Ficus* exhibited and characterized by alternate stipulated leaves (with 'pearl glands' or without 'pearl glands') with distinct stipule and milky latex in all parenchymatous tissues. Cystoliths were very commonly present (especially in the epidermis, variable in size and shape). The 'flowers' of Moraceae are often pseudanthia (reduced inflorescences). The functionally fertile male and female flowers have axillary

inflorescences; mostly with the small flowers packed into spikes, in heads or hollow receptacles, on disks etc. with or without involucre bracts and pseudanthial, or nonpseudanthial. Flowers small (reduced); regular; cyclic with monoecious, or dioecious lineages. Fruit fleshy, or non-fleshy; indehiscent; a drupe, or achene like; enclosed in the fleshy receptacle (often, and the inflorescence axis often constituting a common

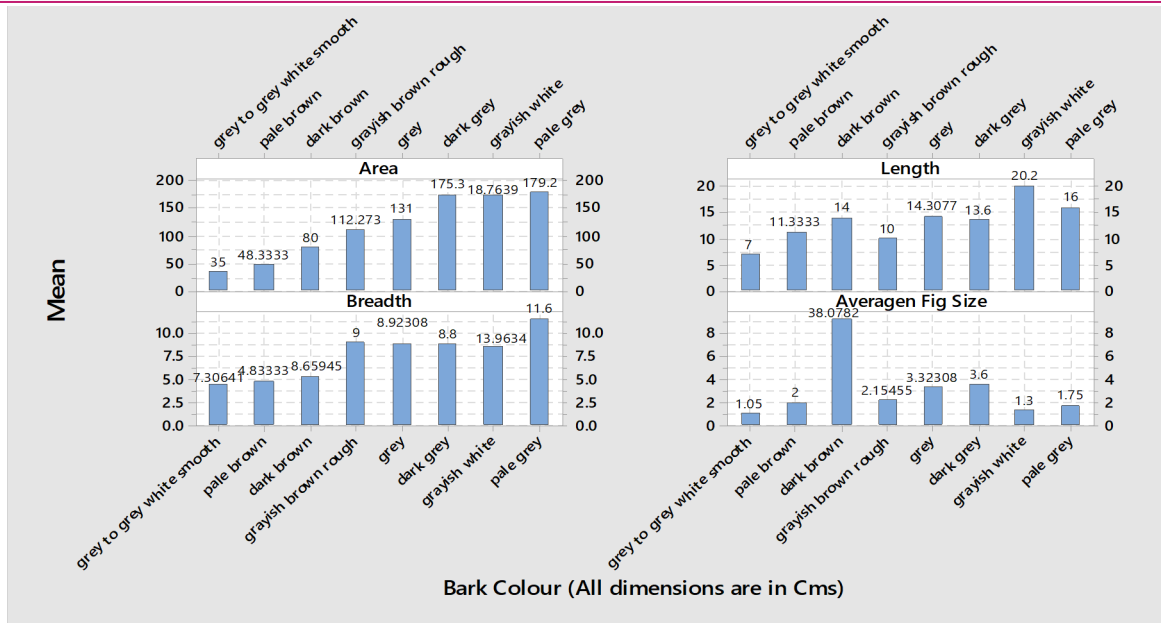


Fig. 5. Leaf area, length, breath and fig size on the basis of the leaf colours of different *Ficus* species.

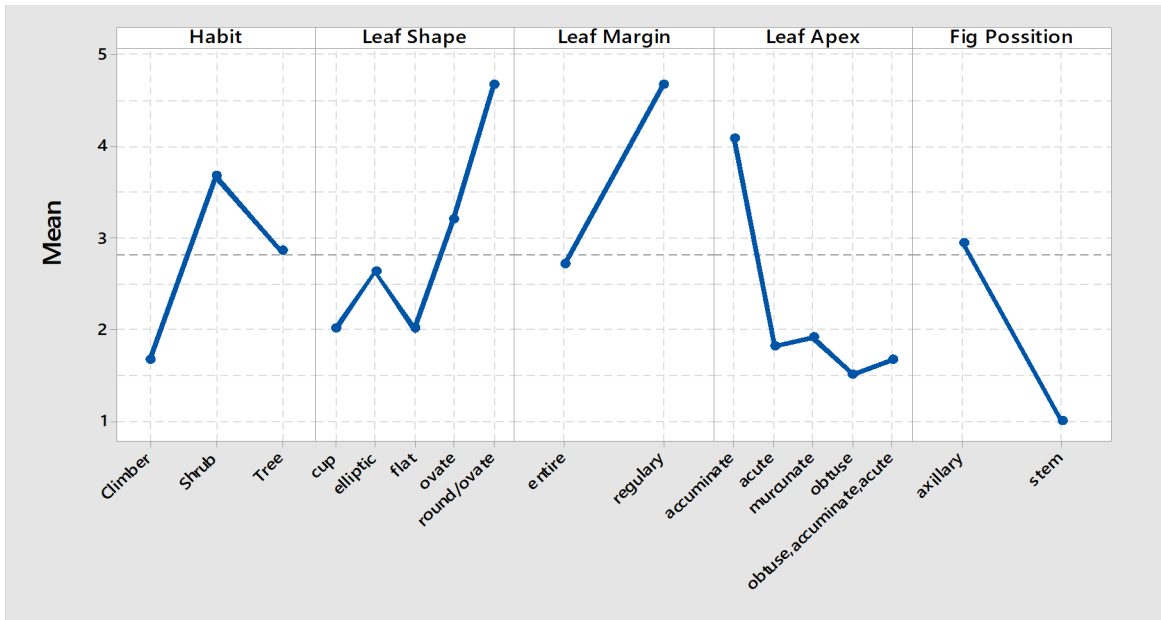


Fig. 6. Fig size according to the habit, leaf shape, margin, apex and fig position in different *Ficus* species.

fleshy receptacle), or without fleshy investment external to the original ovary. The drups with one stone and gynoecia of adjoining flowers combined to form a multiple fruits (frequently), or not forming a multiple fruits. The maximum leaf size ($30 \times 27 \text{cm}^2$) was reported in *F. auriculata*, followed by *F. semicordata* ($28 \times 10 \text{cm}^2$), *F. benghalensis* ($25 \times 11 \text{cm}^2$). However, the minimum leaf size was recorded in *F. benjamina* ($4 \times 2 \text{cm}^2$), and *F. retusa* ($4 \times 3 \text{cm}^2$) (Figs. 4,5). Out of 16 species of *Ficus*, 11 species were trees, 3 shrubs and 2 species climbers in nature (Table 1). Out of 16 species, 15 species having axillary fig (Fruit) arrangement and one species with stem position (*F. racemosa*).

DISCUSSION

A large number of works have been carried out either at regional or global levels for the systematics and distribution of *Fiscus* L., but the literature on confined locality scares (Corner, 1975, 1981; Kochummen, 1998; Chang and Wu, 1998; Berg, 2001, 2003, 2004, Dixon, 2003; Wu et al., 2003; Berg and Corner, 2005; Berg et al., 2006; Tzeng et al., 2009). The yesteryears studies bringing substantial changes in identification, circumscription, nomenclature, distributional pattern and socio-economic significance of the of the selected species which corroborated to the current findings at FRI campus (King 1887, 1888; Tzeng et al., 2009; Chaudhary et

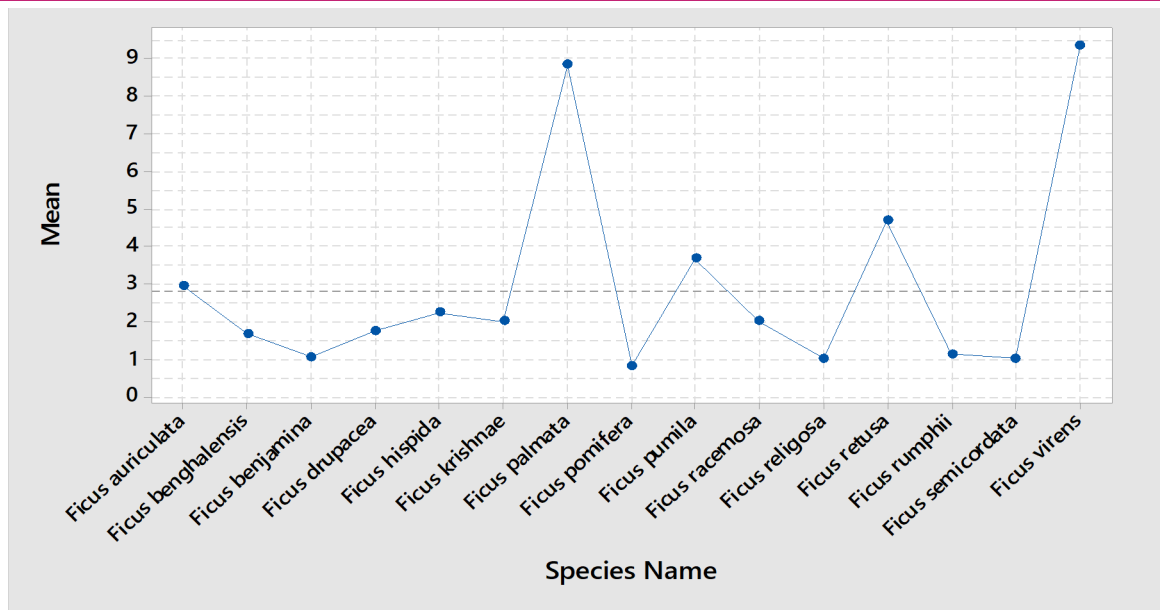


Fig. 7. Fig size of different *Ficus* species of the study area.

al., 2012; Doharey et al., 2021; Singh et al., 2021a,b). *Ficus* (Moraceae) is arguably one of the most important plant genera in the campus of FRI., Dehradun. The findings reflected 10 wild native species of *Ficus* L. viz., *F. racemosa*, *F. virens*, *F. benghalensis*, *F. auriculata*, *F. pomifera*, *F. semicordata*, *F. palmata* subsp. *virgata*, *F. hispida*, *F. religiosa*, *F. rumphii* and 6 planted exotic species including *F. krishnae*, *F. benjamina*, *F. retusa*, *F. pumila*, *F. drupacea* and *F. elastica* (Molbo et al., 2003; Machado et al., 2005; Kislev et al., 2006; Kumar et al., 2012; Moustafa, 2020; Mustafa et al., 2020). The plantation of *Ficus* L. was adequate to dot every road on the FRI campus with at least one species. Plant habits ranged from shrubby pioneers 1 to 2 meters (*F. hispida*), through small (*F. palmata* subsp. *virgata*), to emergent trees (*F. religiosa*, *F. benjamina*, *F. benghalensis*, etc.), climbers (*F. hederacea* and *F. pumila*) and hemiepiphytes (*F. religiosa*, *F. virens*, *F. benjamina*, *F. racemosa* and *F. benghalensis*). Members of this genus were difficult to distinguish by their flowers but can be differentiated by habit, leaf shape, and their figs (Whistler, 2000). In the present study, the authors found that the largest fig size was 6-8 mm (*F. retusa*). However, smallest size 0.3-0.6 mm (*F. auriculata*) was documented (Fig. 6-7). The leaf shape of *F. krishnae* was cup shaped, which shows the unique feature of the *Ficus* species and also known as makhankatori.

Conclusion

Ficus L. is a keystone species in the ecosystem because its fruit is beneficial for birds, insects and animals. Fruits are nutritious, energetic, healthy and having socio-economic and ethno-medicinal values as well.

There are 16 *Ficus* species recorded from New Forest FRI campus Dehradun. Among them, 10 were native wild species; however, 6 planted non-native species were documented during the present investigation. The current finding is a pioneer study to present a glimpse of such immense species of single genera from the sub-valley area. There are 11 species recorded as trees, 3 shrubs and 2 climbers inhabit. Most of the observed species had axillary fruit arrangement, while one species *F. racemosa* with stem position. These plants are promising candidates in ethno-pharmaceutical biology to develop and formulate new drugs to future clinical uses. Therefore, more pre-clinical and clinical studies for establishing better quality control methods must be conducted to elucidate the unexplored potential of these plants.

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Conflict of interest

The authors declare that they have no conflict of interest.

REFERENCES

1. Abdulla, M.A., Ahmed, K.A.A., Luhood, F.M.A. & Muhanid, M. (2010). Role of *Ficus deltoidea* extract in the en-

- hancement of wound healing in experimental rats. *Bio-medical Research*, 21 (3), 241-245.
2. Adebayo, E.A., Ishola, O.R., Taiwo, O.S., Majolagbe, O.N. & Adekeye, B.T. (2009). Evaluations of the methanol extract of *Ficus exasperate* stem bark, leaf and root for phytochemical analysis and antimicrobial activities. *African Journal of Plant Science*, 3(12), 283-287.
 3. Aggarwal, D., Upadhyay, S.K., Singh, R., Sehrawat, N., Yadav, M., Singh, M. & Kumar, V. (2020). Tissue culture propagation of *Bacopa monnieri* (L.) Pennell: An important medicinal plant. *Advances in Bioresearch*, 11(5), 97-103. <https://doi.org/10.15515/abr.0976-4585.11.5.97103>.
 4. Berg, C.C. & Corner, E.J.H. (2005). Moraceae – *Ficus* Flora Malesiana Series 1 (Seed Plants). *National Herbarium of the Netherlands*, 17(2), 1-730.
 5. Berg, C.C. (2001). Flora neotropica monograph 83: Moreae, Artocarpeae, Dorstenia (Moraceae) with introductions to the family and *Ficus* and with additions and corrections to flora neotropica monograph 7. The New York Botanical Garden, Bronx, NY. pp. 1-346
 6. Berg, C.C. (2003). Flora Malesiana precursor for the treatment of Moraceae 1: The main subdivision of *Ficus*: The subgenera. *Blumea*, 48, 167-178. <https://doi.org/10.3767/000651903X686132>.
 7. Berg, C.C. (2004). Flora Malesiana precursor for the treatment of Moraceae 6: *Ficus* sub-genus Sycomorus. *Blumea*, 49, 155-200. <https://doi.org/10.3767/000651904X486278>.
 8. Berg, C.C., Corner, E.J.H. & Jarrett, F.M. (2006). Moraceae (Genera other than *Ficus*). *Flora Malesiana Series 1 (Seed Plants) National Herbarium of the Netherlands*, 17 (1), 1-152.
 9. Chang, S.S. & Wu, C.Y. (1998). Moraceae. In: *Flora Reipublicae Popularis Sinicae* (eds., Chang, S.S. & Wu, C.Y.), 23, 1-219.
 10. Chaudhary, L.B., Sudhakar, J.V., Kumar, A., Bajapai, O., Tiwari, R. & Murthy, G.V.S. (2012). Synopsis of the genus *Ficus* L. (Moraceae) in India. *Taiwania*. 57(2), 193-216. [https://doi.org/10.6165/tai.2012.57\(2\).193](https://doi.org/10.6165/tai.2012.57(2).193).
 11. Corner, E.J.H. (1975). New taxa of *Ficus* (Moraceae). *Blumea*, 22, 299-309.
 12. Corner, E.J.H. (1981). Moraceae. In: *A revised handbook to The Flora of Ceylon* (ed., Dassanayake, M.D.), Oxford and IBH, New Delhi, India. 3, 230-279.
 13. Devi, A., Dahiya, V.S., Upadhyay, S.K. & Singh, R. (2020). Antimicrobial activity and phytochemical constituents present in *Syziium cumini* (L) seed, leaves and bark extract. *Plant Archives*, 20(2), 7787-7790.
 14. Dixon, D. J. (2003). A taxonomic revision of the Australian *Ficus* species in the section Malvanthera (*Ficus* subg. *Urostigma*: Moraceae). *Telopea* 10, 125-153.
 15. Doharey, V., Kumar, M., Upadhyay, S.K., Singh, R. & Kumari, B. (2021). Pharmacognostical, physicochemical and pharmaceutical paradigm of ash gourd, *Benincasa hispida* (Thunb.) fruit. *Plant Archives*, 21(1), 249-252. <https://doi.org/10.51470/PLANTARCHIVES.2021.v21.S1.041>.
 16. Gadgi, M. (1996). Documenting diversity: An experiment. *Current Science*, 70, 36.
 17. King, G. (1887). The species of *Ficus* of the Indo-Malayan and Chinese countries. *Annals of Royal Botanical Garden, Calcutta*, 1, 1-185.
 18. King, G. (1888). *Ficus* L. In: The Flora of British India (ed. Hooker, J.D.). L. Reeve & Company, London. 5, 494-537.
 19. Kislev, M.E., Hartmann, A. & Bar-Yosef, O. (2006). Response to comment on early domesticated fig in the Jordan valley. *Science*, 314 (5806), 1683b. <https://doi.org/10.1126/science.1133748>.
 20. Kochummen, K.M. (1998). New species and varieties of Moraceae from Malaysia. *Garden Bulletin of Singapore*, 50, 197-219.
 21. Kumar, A., Bajpai, O., Mishra, A.K., Sahu, N., Behera, S.K. & Chaudhary, L.B. (2011). Assessment of diversity in the genus *Ficus* L.(Moraceae) of Katerniaghat wildlife sanctuary, Uttar Pradesh, India. *American Journal of Plant Sciences*, 2(01), 78.
 22. Kumar, S., Dimple, A., Tomer, V., Gat, Y. & Kumar, V. (2018). *Ficus religiosa*: A wholesome medicinal tree. *Journal of Pharmacognosy and Phytochemistry*, 7(4), 32-37.
 23. Lalla, J.K. (2005). Herbal medicines revisited. *The Pharma Review*, 12, 101-105.
 24. Linnaeus, C. (1753). *Species Plantarum* volume 1 & volume 2. L. Salvi, Stockholm.
 25. Machado, C.A., Robbins, N., Gilbert, M.T.P. & Herre, E.A. (2005). Critical review of host specificity and its coevolutionary implications in the fig/fig-wasp mutualism. *Proceedings of the National Academy of Sciences*, 102(1), 6558-6565. <https://doi.org/10.1073/pnas.0501840102>.
 26. Molbo, D., Machado, C.A., Sevenster, J.G., Keller, L. & Herre, E.A. (2003). Cryptic species of fig-pollinating wasps: Implications for the evolution of the fig-wasp mutualism, sex allocation, and precision of adaptation. *Proceedings of the National Academy of Sciences*, 100(10), 5867-5872. <https://doi.org/10.1073/pnas.0930903100>.
 27. Mousa, O., Vuorela, P., Kiviranta, J., Wahab, S.A., Hiltunen, R. & Vuorela, H. (1994). Bioactivity of certain Egyptian *Ficus* species. *Journal of Ethnopharmacology*, 41, 71-76. [https://doi.org/10.1016/0378-8741\(94\)90060-4](https://doi.org/10.1016/0378-8741(94)90060-4).
 28. Moustafa, A.A (2020). A threatened introduced species (*Ficus benghalensis* L.) in Ismailia, Egypt. *Intech Open*, <https://doi.org/10.5772/intechopen.8>.
 29. Mustafa, I., Rohmah, N.I., Jono, S., Jatmiko, Y.D. & Siswanto, D. (2020). The potency of endophytic bacteria isolated from *Ficus septica* as phytoremediation promoting agent of Cr (VI) contaminated soil. *Biodiversitas. Journal of Biological Diversity*, 21(5), <https://doi.org/10.13057/biodiv/d210519>.
 30. Priyadarsana (1999). *Ficus superb* Miq. and *F. fergusonii* (King) Worthington (Moraceae): Two new reports from India. *Journal of Bombay Natural History Society*, 96, 492-493.
 31. Rani, N. (1985). *Ficus lbipila* (Miq.) King (Moraceae)- A new record for India. *Journal of Bombay Natural History Society*, 82, 235-237
 32. Sharma, A.K., Sharma, V., Sharma, V., Sharma, J.K. & Singh, R. (2020). Multifaceted potential of *Eichhornia crassipes* (Water Hyacinth) laden with numerous value aided and therapeutic properties. *Plant Archives*, 20(Spl. 2), 2059-2065.
 33. Sharma, D., Dang, C.B.S. & Kaur, M.A. (2016). Review on pharmacological activities and therapeutic potentials of *Ficus religiosa* (Pipal). *Indian Journal of Applied Research*, 6(1), 623-626.

34. Shree Kumar, P.V. (1998). Six new records of *Ficus* L. (Moraceae) from Andaman-Nicobar Islands, India. *Journal of Economic Taxonomy of Botany*, 22, 199-203.
35. Singh, R., Upadhyay, S.K., Rani, A., Kumar, P., Kumar, A. & Sharma, P. (2019). Ethanobotanical study of Subhartipuram, Meerut, Uttar Pradesh, India. I. Diversity and pharmacological significance of trees. *International Journal of Pharmaceutical Research*, 11(4), 782-794. <https://doi.org/10.31838/ijpr/2019.11.04.078>.
36. Singh, C., Chauhan, N., Rani, A. & Singh, R. (2020a). Restoration of world heritage site Nanda Devi Biosphere Reserve, Uttarakhand. *Journal of Agriculture and Forest Meteorology Research*, 3(5), 405-408.
37. Singh, C., Chauhan, N., Upadhyay, S.K. & Singh, R. (2020b). Phytochemistry and ethnopharmacological study of *Adiantum capillus-veneris* L. (Maidenhair fern). *Plant Archives*, 20(2), 3391-3398.
38. Singh, R., Upadhyay, S.K., Rani, A., Kumar, P. & A. Kumar (2020c). Ethanobotanical study of Subhartipuram, Meerut, Uttar Pradesh, India. II. Diversity and pharmacological significance of shrubs and climbers. *International Journal of Pharmaceutical Research*, 12(2): 383-393. <https://doi.org/10.31838/ijpr/2020.12.02.0050>.
39. Singh, R., Upadhyay, S.K., Rani, A., Kumar, P., Sharma, P., Sharma, I., Singh, C., Chauhan, N. & Kumar, M. (2020d). Ethnobotanical study of weed flora at district Ambala, Haryana, India: Comprehensive medicinal and pharmacological aspects of plant resources. *International Journal of Pharmaceutical Research*, 12(Spl.1), 1941-1956. <https://doi.org/10.31838/ijpr/2020.SP1.223>.
40. Singh, R., Upadhyay, S. K., Tuli, H.S., Singh, M., Kumar, V., Yadav, M., Aggarwal, D. & Kumar, S. (2020e). Ethnobotany and herbal medicine: Some local plants with anti-cancer activity. *Bulletin of Pure and Applied Sciences (Botany)*, 39B(1), 57-64. <https://doi.org/10.5958/2320-3196.2020.00009.9>.
41. Singh, C., Chauhan, N., Upadhyay, S.K., Singh, R. & Rani, A. (2021a). The Himalayan natural resources: Challenges and conservation for sustainable development. *Journal of Pharmacognosy and Phytochemistry*, 10(1), 1643-1648.
42. Singh, R., Upadhyay, S.K., Singh, B.J., Verma, R., Sharma, I., Sharma, P., Rani, A. & Singh, C. (2021b). Allelopathic effect of eucalyptus (*Eucalyptus camaldulensis* Dehnh) on the growth of *Aloe vera*. *Plant Cell Biotechnology and Molecular Biology*, 22(21&22), 94-100.
43. Tiwari, R., Sudhakar, V.J., Srivastava, A.K., Chaudhary, B.L., Murthy, G.V.S. & Durgapal, A. (2014). Taxonomy, distribution and diversity of *Ficus palamata* Forssk. Subsp. *virgate* (Roxb) Browicz (Moraceae) in India. *Journal of Threatened Taxa*, 6(9), 6172-6185.
44. Tiwari, S. & Talreja, S. (2020). Do you think disease and disorder are same?—Here is the comparative review to brush up your knowledge. *Journal of Pharmacy and Scientific Research*, 12(4), 462-468.
45. Tzeng, H.Y., Ou, C.H., Lu, F.Y. & Wang, C.C. (2009). Pollen morphology of *Ficus* L. (Moraceae) in Taiwan. *Forest Research Quarterly*, 31, 33-46.
46. Upadhyay, S.K. (2016a). Anthelmintic and food supplementary conscientiousness of apitoxin in poultry model. *Research Journal of Recent Sciences*, 5(10), 09-14.
47. Upadhyay, S.K. (2016b). Activity patterns of cell free supernatant of antagonistic microbial strains in rodents host-parasite systems. *International Journal of Science and Research*, 5(4), 332-336.
48. Upadhyay, S.K. (2016c). Allelopathic activities of specific microbial metabolites in the inland prawn fisheries off eastern Uttar Pradesh, India. *International Journal of Scientific Research*, 5(2), 415- 416. <https://doi.org/10.15373/22778179>.
49. Whistler, W.A. (2000). Tropical ornamentals: A guide. Portland, OR, USA: Timber Press. 542p.
50. Wu, Z., Zhou, Z.K. & Gilber, M.G. (2003). Moraceae. In: *Flora of China* (eds. Wu. Z., Raven, P.H. & Hong, D.Y.). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis. US. 5, 21-73.