Recent Research in Science and Technology 2013, 5(2): 41-45
ISSN: 2076-5061
Available Online: http://recent-science.com/

# Influence of various dominant trees on phytosociology of under storey herbaceous vegetation

**Beena Sharma* and Kavita Sharma****

*Scientific Officer CGCOST, Raipur, India.
** Arts & Commerce Girls College, Raipur, India.

**Abstract**
The Western foot hill gaps of Central Aravallis are stabilized with indigenous and exotic tree species. In the present investigation three different sites were selected, i.e. Pushkar Valley sand dunes (dominated by Acacia tortilis), Leela Sewri sand dunes (dominated by A.senegal) and Pachkund sandy plains (dominated by Eucalyptus camaldulensis). Herbaceous flora under the various tree plantations was listed separately to determine the influence of the tree species on phytosociological parameters of herbaceous vegetation. Studies on the influence of individual tree species on the structure of herbaceous vegetation show that species responses vary under different plantations. It is clear from the data that many species which show high value of frequency may not be dominants with respect to IVI (Importance Value Index). Grasses are common for all the sites of study. However, some species respond differentially and to some extent dominance of a species under a particular tree plantation may affect the soil properties and floor dynamics.

**Keywords:** Herbaceous flora, dominant trees, phytosociology, IVI (Importance Value Index)

## INTRODUCTION

Tree plantation at sandy sites influence the herbaceous species which have been naturally acclimatised as initial colonisers during stabilization. Boettcher and Kalisz (1990) have indicated that single tree influence on soil properties is detectable even in mixed stands. Isolated trees can also influence the growth and productivity of the understory herbaceous layer (Paul and Steve, 1996) and are thought to serve as nuclei for subsequent vegetation development in tropical, subtropical and temperate ecosystems (Tupas and Sajise, 1977). Trees modify the spatial pattern of plant species in herbaceous layers and the chemical condition of the soil generating special heterogeneity on different scales (Bertilde and Pablo, 2003). Impact of different tree species canopy on diversity and productivity of under storey vegetation in Indian desert was also studied by Frost and Macdogald 1989; Singh et al 2003 and Singh et al 2008. Besides other effects such as shading, light penetration through tree species on ground flora litter pattern and its chemical nature are the important factors which decide the structure of ground vegetation and floor dynamics at specific site (Jake and Michael, 2009). Some factors like size of tree relative to that of the largest tree encountered in the area and the distance from the point on the forest floor to the stem centre of tree also affects understory vegetation (Liu H.V. and Halvorsen R., 2012). The objective of this study was to determine the influence of following tree species on phytosociological parameters of herbaceous vegetation:

*Corresponding Author

Beena Sharma
Scientific Officer CGCOST, Raipur, India.

Email: drbeena_raipur@yahoo.co.in

1. Acacia senegal
2. A. tortilis
3. Eucalyptus camaldulensis

### Site of study

The area of present study is located at a distance of 10 Km N-W to Ajmer, a centrally situated city of Rajasthan lies between 26° 29' and 26° 29' N latitude and 74° 37' and 74° 42'E longitude. The area is represented by Aravalli hillocks, and dunes, sandy plains agriculture fields and fresh water bodies. The region may be regarded as 'ecotone' between NW drier and SE humid climate. The sand dunes selected for present investigation i.e. Puskar Valley Base, Leela Sewri and Pachkund are situated in 48 Sq.km areas in the North West foot hills of Nagaphar, a prominent mountain belt of central Aravallis.

## METHODS OF STUDY

Four full height trees of each species were marked in their respective localities. Under each tree a circle of 3 m was plotted taking the main trunk as centre. The circle under each tree species was divided in to 1x1 m square to count the total no. of individuals of each herbaceous species in each circle. Phytosociological parameters were calculated by taking circles under four trees of each species. Phytosociological analysis of various plant species was studied in terms of frequency, density, cover and IVI as per the method described by Misra (1968).

### Vegetation structure under A. senegal trees

Data on phytosociological characteristics are shown in Table 1.0. A perusal of frequency values indicates that under A.senegal

trees, Justicia simplex shows highest frequency (100%) and it is growing under all trees marked for this study. Portulaca olerecea and Comelina bengalensis were present only under three circles and had 75% frequency value. Species such as Borreria articulate, Indigofera linaei, I. cordifolia, Leucas urticaefolia and Corchorus trilocularis fall in the middle frequency value i.e. 50%. Herbaceous species under only one tree circle are Tribulus terrestris, Phyllanthus amerus, Comelina albescence, Tephrocea perpurea, Peristrophe bicalyculata, Indigofera tinctoria, I. asteragalina, Ocimum americanum, Pedalium murex and Achyranthus aspera.

On the basis of cover values, Comelina bengalensis is a dominant herbaceous plant species under A,.senegal trees. Its cover was calculated to be highest (18.65%). Contribution by C. bengalensis to the vegetation under A. senegal seems to be much higher and it is also supported by relative values of frequency, density, dominance and IVI values which are much higher than other species. Cover values of other plant species such as Borreria articulate, Chorchorus trilocularis, Portulaca oleracea, Leucas aspera and Justicea simplex show that they are also responsive under the plantation of A.senegal.

Among the grasses Dicanthium annulatum and Sporobolous coromandelianus are the dominants with 100% frequency, though the former had much higher values of cover (63-48%) and IVI (15.66%) as compared to other grasses.

Table 1. Phytosociological characteristics of dominant herbaceous species under Acacia senegal trees at Leela sewri sand dunes (Area size – four circles of 3m radius from the tree trunk base as the centre, value assumed for 1x1 m2 area)

| Plant species | Frequency | Density | Abundance | Cover | Relative | | | IVI |
|---|---|---|---|---|---|---|---|---|
| | | | | | Frequency | Density | Dominance | |
| Achyranthus aspera | 25 | 06.00 | 01.00 | 03.64 | 0.55 | 0.042 | 0.04 | 01.43 |
| Borreria articulateo | 50 | 35.00 | 70.00 | 06.86 | 1.10 | 1.470 | 1.58 | 04.15 |
| Commelina albisence | 25 | 00.25 | 01.00 | 00.08 | 2.20 | 0.010 | 0.68 | 00.84 |
| Commelina benghalensis | 75 | 16.50 | 33.00 | 18.65 | 2.20 | 0.010 | 0.68 | 02.89 |
| Corchorus trilocularis | 50 | 10.00 | 20.00 | 06.35 | 1.10 | 0.421 | 1.46 | 02.98 |
| Indigofer asteragalina | 25 | 00.25 | 01.00 | 00.30 | 0.55 | 0.010 | 0.06 | 00.62 |
| I. cordifolia | 50 | 06.00 | 12.00 | 00.31 | 1.10 | 0.253 | 0.07 | 02.66 |
| I.linnaei | 50 | 04.25 | 04.00 | 00.30 | 1.10 | 0.179 | 0.06 | 01.33 |
| I.tinctoria | 25 | 01.00 | 04.00 | 00.07 | 0.55 | 0.042 | 0.01 | 00.60 |
| Justicia simplex | 100 | 32.75 | 32.75 | 04.11 | 1.10 | 0.295 | 0.01 | 02.22 |
| Leucas urticaefolia | 50 | 07.00 | 14.00 | 05.49 | 1.10 | | 1.27 | 02.66 |
| Ocimum americanum | 25 | 03.75 | 15.00 | 02.94 | 0.55 | 0.042 | 0.68 | - |
| Pedalium murex | 25 | 01.00 | 04.00 | 00.38 | 0.55 | 0.042 | 0.08 | 00.67 |
| Peristrophe bicalyculata | 25 | 01.00 | 04.00 | 00.63 | 0.55 | 0.695 | 0.14 | 00.73 |
| Phylanthus amarus | 25 | 01.25 | 05.00 | 00.62 | 1.65 | 2.077 | 0.14 | 02.48 |
| Portulaca oleracea | 75 | 45.00 | 65.66 | 05.65 | 1.65 | 0.031 | 1.30 | 05.02 |
| Tephrosia purpurea | 25 | 00.75 | 01.50 | 01,15 | 0.55 | 0.084 | 0.26 | 00.84 |
| Tribulus terrestris | 25 | 02.00 | 08.00 | 00.49 | 0.55 | 0.463 | 00.11 | 00.74 |
| **Grasses** | | | | | | | | |
| Cenchrus ciliaris | 75 | 11.00 | 014.68 | 01.00 | 1.65 | 1.220 | 00.23 | 02.340 |
| Cyperus rotundus | 50 | 029.00 | 038.60 | 00.16 | 1.10 | 0.021 | 00.03 | 02.350 |
| C. setigerus | 25 | 000.50 | 001.00 | 00.19 | 0.55 | 6.570 | 00.04 | 00.610 |
| C. tricens | 25 | 002.00 | 008.00 | 00.18 | 2.20 | 6.570 | 00.04 | 08.810 |
| Dicanthium annulatum | 100 | 000.50 | 156.00 | 63.48 | 0.55 | 0.042 | 14.69 | 15.660 |
| Perotis indica | 50 | 002.00 | 004.00 | 00.25 | 1.10 | 0.084 | 00.05 | 01.230 |
| Sporobolus coromandelians | 75 | 059.00 | 078.66 | 01.85 | 1.65 | 2.480 | 00.42 | 04.550 |
| S. minitiflorus | 100 | 127.00 | 127.00 | 03.98 | 0.55 | 0.084 | 00.90 | 01.534 |

**Vegetation structure under Acacia tortilis trees**

Data on phytosociological parameters such as frequency, relative abundance, cover, relative frequency, relative density, relative dominance and IVI of individual herbaceous plant species growing under A. tortilis plantation are shown in Table 2. It was interesting to note that under A. tortilis plantation; most frequent species are Boerhavia diffusa and Ocimum americanum each with 100% frequency value. It is followed by Corchorus trilocularis and Vernonia cinerea each with 75% frequency value. Species such as Commelina benghalensis showed only 50% frequency value which was reported to be most dominant species under A. senegal trees. Many species such as Sida ovata, Portulaca oleracea, Tephrocea perpurea, Peristrophe bicalyculata, Mukia madraspatna, I. cordifolia, Evolvulus ulsinoides and Phylanthus amarus were found to be most frequent and show only 25% frequency.

Cover value of Brreria stricta was calculated to be the highest (i.e. 6.01) followed by Ocimum americanum (2.95) and Portulaca oleracea (2.82), Indigofera linifolia showed least cover (0.05). On the basis of IVI values Boerhavia diffusa is the most dominant herbaceous plant species followed by B. stricta. The values of IVI for these two dominants are 5.01 and 4.73 respectively.

Among the grasses, Sporobolus coromandelianus and Dicanthium annulatum are dominant species with 100% frequency, while Cyperus rotundus was present only in one circle of A.tortilis trees, therefore with least frequency (25%). In the present study it was reported that most of the grasses are distributed throughout sandy localities of plantations and substrate differences.

Table 2. Phytosociological characteristics of dominant herbaceous species under Acacia tortilis trees at Pushkar Valley Base sand dunes (Area size – four circles of 3m radius from the tree trunk base as the centre, value assumed for 1x1 m2 area)

| Plant species | Frequency | Density | Abundance | Cover | Relative | | | IVI |
|---|---|---|---|---|---|---|---|---|
| | | | | | Frequency | Density | Dominance | |
| Boerhavia diffusa | 100 | 68.00 | 68.0 | 1.30 | 2.10 | 2.22 | 0.69 | 05.10 |
| Borreria stricta | 50 | 14.00 | 18.6 | 6.01 | 1.05 | 0.45 | 3.23 | 04.73 |
| Commelina benghalensis | 50 | 05.00 | 10.0 | 1.92 | 1.05 | 0.16 | 1.03 | 02.24 |
| Corchorus trilocularis | 75 | 03.00 | 04.0 | 1.90 | 1.57 | 0.09 | 1.02 | 02.68 |
| Evolvulus trilocularis | 25 | 01.00 | 04.0 | 0.15 | 0.52 | 0.03 | 0.08 | 00.81 |
| Indigofera cordifolia | 25 | 01.25 | 05.0 | 0.06 | 0.52 | 0.04 | 0.03 | 00.59 |
| I.linifolia | 25 | 01.00 | 04.0 | 0.05 | 0.52 | 0.03 | 0.02 | 00.57 |
| Mukia madraspatna | 25 | 01.00 | 04.0 | 0.28 | 0.52 | 0.03 | 0.15 | 00.70 |
| Ocimum americanum | 100 | 03.00 | 06.0 | 0.95 | 2.10 | 0.09 | 1.58 | 03.77 |
| Peristrophe bicalyculata | 25 | 01.00 | 04.0 | 0.63 | 0.52 | 0.03 | 0.33 | 00.88 |
| Pedalium murex | 25 | 01.50 | 06.0 | 0.57 | 0.52 | 0.04 | 0.30 | 00.59 |
| Phylanthus amarus | 25 | 01.00 | 04.0 | 0.50 | 0.52 | 0.03 | 0.26 | 00.81 |
| Portulaca oleracea | 25 | 10.00 | 10.0 | 2.82 | 0.52 | 0.32 | 1.51 | 02.35 |
| Setaria verticillata | 25 | 04.00 | 16.0 | 1.28 | 1.05 | 0.13 | 0.15 | 00.70 |
| Sida ovate | 50 | 01.25 | 05.0 | 0.20 | 0.52 | 0.04 | 0.10 | 00.66 |
| Tephrosia purpurea | 25 | 01.00 | 04.0 | 0.78 | 0.52 | 0.03 | 0.41 | 00.96 |
| Vernonia cineria | 75 | 06.25 | 25.0 | 1.22 | 1.57 | 0.20 | 0.65 | 02.42 |
| **Grasses** | | | | | | | | |
| Cyperus rotundus | 25 | 005 | 010 | 00.45 | 0.52 | 0.16 | 0.24 | 00.92 |
| Dicanthium annulatum | 100 | 176 | 176 | 12.43 | 2.10 | 5.77 | 6.68 | 14.55 |
| Sporobolus coromandelianus | 100 | 227 | 227 | 01.78 | 2.10 | 7.43 | 0.95 | 10.48 |

**Vegetation structure under Eucalyptus camaldulensis trees**

Data on phytosociological attributes of different herbaceous plant species recorded under E. camaldulensis are presented in Table 3. Frequency of species such as Borreria articulate and Justicia simplex was observed to be comparatively higher (75%) than other species of the site. Species such as Portulaca oleracea, Phylanthus amerus, Indigofera linifolia, Ocimum americanum, Leucas urticaefolia, Pedalium murex, Euphorbia hirta and Tephrocia purpurea show 50% frequency, while less frequent herbaceous species of ground vegetation under E. camaldulensis plantation are Commelina bengalensis, Indigofera linifolia, I. cordifolia, Evolvulus ulsinoides, Sonchous oleraceus, Bidens biternata, Indigofera tinctoria, Corchours trilocularis and Achyranthus aspera each with only 25% frequency.

Cover values of various plant species suggest that Portulaca oleracea (10.92) is the most dominant followed by Justicia simplex (8.38), Indigofera linnaei (3.95), Borreria articulata (3.82). IVI of these herbaceous species growing under E. camaldulensis plantation also higher i.e. 10.29 for P. oleracea, 7.93 for Justicia simplex and 4.97 for Indigofera linifolia.

At this site of E .camaldulensis, comparatively more grasses were recorded than other two sites of study. Frequency of Sporobolus coromandelianus, S. minitiflorus, Cyperus rotundus, Dicanthium annulatum is much higher (75%) than grasses like Cyperus tricens, C. arenarius and Cynodon dactylon each with 25% frequency. On the basis of cover and IVI, Sporobolus minitiflorus (5.02 cover, 11.01 IVI) and Dicanthium annulatum (7.55 cover, 9.59 IVI) are the dominant grasses.

Table 3. Phytosociological characteristics of dominant herbaceous species under Eucalyptus camaldulensis trees at Pachkund sand dunes (Area size – four circles of 3m radius from the tree trunk base as the centre, value assumed for 1x1 m2 area)

| Plant species | Frequency | Density | Abundance | Cover | Relative | | | IVI |
|---|---|---|---|---|---|---|---|---|
| | | | | | Frequency | Density | Dominance | |
| Achyranthus aspera | 25 | 05.00 | 020.0 | 03.03 | 0.035 | 0.060 | 1.59 | 01.88 |
| Bidens biternata | 25 | 00.25 | 001.0 | 00.09 | 0.017 | 0.013 | 0.04 | 00.07 |
| Borreria articulata | 75 | 19.50 | 026.0 | 03.82 | 0.053 | 1.010 | 2.01 | 03.07 |
| Commelina benghalensis | 25 | 01.50 | 006.0 | 00.75 | 0.017 | 0.078 | 0.39 | 00.48 |
| Corchorus trilocularis | 25 | 01.00 | 004.0 | 00.63 | 0.035 | 0.052 | 0.33 | 00.41 |
| Euphorbia hirta | 50 | 02.00 | 002.0 | 00.41 | 0.017 | 0.104 | 0.07 | 00.19 |
| Indigofer asteragalina | 25 | 02.00 | 008.0 | 00.30 | 0.017 | 0.104 | 0.15 | 00.27 |
| I. cordifolia | 25 | 03.00 | 012.0 | 00.21 | 0.035 | 0.156 | 0.11 | 00.30 |
| I. linifolia | 50 | 56.00 | 112.0 | 03.95 | 0.017 | 2.910 | 2.07 | 04.99 |
| I.linnaei | 25 | 01.75 | 007.0 | 00.09 | 0.017 | 0.091 | 0.04 | 00.14 |
| I.tinctoria | 25 | 00.25 | 001.0 | 00.01 | 0.017 | 0.013 | 0.05 | 00.08 |
| Justicia simplex | 75 | 66.75 | 089.0 | 08.38 | 0.058 | 0.470 | 4.41 | 07.93 |
| Leucas urticaefolia | 50 | 02.25 | 004.5 | 00.44 | 0.035 | 0.117 | 0.23 | 00.38 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Ocimum americanum | 50 | 02.00 | 004.0 | 01.96 | 0.017 | 0.104 | 1.03 | 01.15 |
| Pedalium murex | 50 | 01.25 | 002.5 | 00.48 | 0.035 | 0.065 | 0.25 | 00.35 |
| Phyllanthus amerus | 50 | 01.50 | 003.0 | 01.50 | 0.078 | 0.078 | 0.78 | 00.89 |
| Portulaca oleracea | 50 | 87.00 | I74.0 | 10.92 | 0.035 | 4.520 | 5.74 | 10.29 |
| Sonchous oleracea | 25 | 00.25 | 001.0 | 00.03 | 0.017 | 0.013 | 0.01 | 00.04 |
| Tephrosia purpurea | 50 | 01.75 | 003.5 | 01.37 | 0.035 | 0.091 | 0.72 | 00.48 |
| **Grasses** | | | | | | | | |
| Cynodon dactylon | 25 | 007.00 | 014.0 | 0.21 | 0.035 | 0.364 | 0.11 | 00.50 |
| C. arenarius | 25 | 001.00 | 002.0 | 0.03 | 0.017 | 0.052 | 0.01 | 00.07 |
| C. rotundus | 75 | 014.00 | 018.6 | 1.27 | 0.017 | 0.728 | 0.66 | 01.40 |
| Cyperus tricens | 25 | 020.00 | 080.0 | 1.81 | 0.017 | 0.040 | 0.95 | 02.00 |
| Dicanthium annulatum | 75 | 107.00 | 142.0 | 7.55 | 0.053 | 5.570 | 3.97 | 09.59 |
| Perotis indica | 50 | 006.75 | 013.5 | 0.21 | 0.035 | 0.351 | 0.11 | 00.49 |
| Sporobolus coromandelians | 75 | 031.00 | 041.3 | 0.97 | 0.053 | 1.610 | 0.51 | 02.17 |
| S. minitiflorus | 75 | 160.00 | 213.3 | 5.02 | 0.053 | 8.320 | 2.64 | 11.01 |

The site of E. camaldulensis plantation is different with that of A.tortilis and A. senegal with respect to very high organic matter found under E. camaldulensis plantation because of high amount of litter fall. It was also observed that the floor area of individual tree cannot be separated due dense canopy and intermixing of litter on the ground.

## RESULT AND DISCUSSION

Studies on the influence of individual tree species on the structure of herbaceous vegetation show that species responses vary under different plantations. On the basis of IVI the order of dominant herbaceous species under various tree crowns may be given as follows:

**Under *A. senegal* trees:**

| | |
|---|---|
| Herbs | Commelina bengalensis |
| | Portulaca oleracea |
| | Borreria articulate |
| Grasses | Dicanthium annulatum |
| | Cyperus trisence |
| | Sporobolus coromandelianus |

**Under *A.tortilis* trees**

| | |
|---|---|
| Herbs | Boerhavia diffusa |
| | B. stricta |
| | Ocimum americanum |
| Grasses | Dicanthium annulatum |
| | Sporobolus coromandelianus |

**Under *E. camaldulensis* trees**

| | |
|---|---|
| Herbs | Portulaca oleracea |
| | Justicia simplex |
| | Indigofera linifolia |
| Grasses | Sporobolus minitiflorus |
| | Dicanthum annulatum |

It is clear from the data that many species which show high value of frequency may not be dominants with respect to IVI, for example, Justicia simplex with highest frequency (100%) under A. senegal trees shows low IVI i.e. 2.22. During surveys it was observed that most of the herbaceous species including grasses are common for all the sites of study and under crowns of each species under investigation. It was also observed that most of the plant species mentioned above show better growth under tree plantations. This is because of more water due to shading effect of trees. The differences in floristic content of herbaceous vegetation under various tree species are due to quality and quantity of organic matter which seems to a limiting factor in sand dune habitat. Jenny (1941) reported that high temperature and low rainfall combine to render the dunes poor in organic matter. However, a reverse trend was noticed in case of Ajmer sand dunes because of inputs of organic matter through leaf fall. It may be concluded that under the similar climatic conditions of sand dunes, it is only the external inputs (litter addition) which causes differences in the ground vegetation.

## REFERENCES


[1] Bertilde E. Rossi and Pablo E. Villagra, 2003. Effects of Prosopis flexuosa on soil properties and the spatial pattern of under storey species in Arid Argentina. *Journal of Vegetation Science*.Vol-14(4), pp. 543-550

[2] Boettcher, S.E. and Kalisz, P.J. 1990. Single tree influence on soil properties in the mountains of Eastern Kentucky. *Ecology,* 71(4): 1365-1372.

[3] Frost, W.E. & N.K. Mcdogald. 1989. Tree canopy effects on herbaceous production of annual rangeland during drought. *Journal of Range Management* 42: 281-283.

[4] Jake F. Weltzin and Michael B. Coughenour, 2009. Savanna tree influence on understory vegetation and soil nutrients in North West Kenya. *Journal of Vegetation Science,* 1:325-334.

[5] Jenny, H.1941, Factors of soil formation. Mcgraw-Hill Book Co. New York.

[6] Liu H.V. and Halvorsen R., 2012. Single tree influence on understory vegetation in five Chinese subtropical forests. *Journal of Biogeosciences & Forestry,* Vol. (5) pp. 179-187.

[7] Misra, R. (1968). Ecology workbook, 244 Oxford and IBH Publishing Company Calcutta.

[8] Paul W. Barner and Steve Archer, 1996. Influence of an

overstory tree (Prosopis glandulosa) on associated shrubs in savannas parkland: implications for patch dynamics. *Oecologia*, 105:493-500.

[9] Singh G., T.R. Rathod, S.Mutha, S. Upadhyay and N. Bala, 2008. Impact of different tree species canopy on diversity and productivity of Indian desert. *Tropical Ecology* 49 (1): 13-23.

[10] Singh, G., N. Bala, T. R. Rathod & S. Chouhan. 2003. Effect of adult neighbours on regeneration and performance of surface vegetation in shifting dune of Indian desert for the control of *sand drift. Environmental Conservation* 30: 353-363.