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PHYTOSOCIOLOGICAL STUDIES ON SOME SPECIES OF *SENNA* WITH SPECIAL REFERENCE TO IMPACT ON *PARTHENIUM HYSTEROPHOROUS* L.

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Present study deals with the analysis of different parameters of phytosociology in *Senna* Mill. dominating phytocommunity. Phytosociological observations were made for the community where herbaceous species of *Senna* (*S. tora* (L.) Roxb, *S. obtusifolia* (L.) Irwin & Barneby, *S. occidentalis* (L.) Roxb. and *S. alata* (L.) Roxb.), were growing abundantly. The frequency, density, abundance, dominance, Importance Value Index (IVI) were determined. It was analyzed from the quantitative study that the greater area of vegetation is occupied by *Cynodon dactylon* (L.) Pers. followed by *S. occidentalis* and *S. tora. S. tora* and *S. occidentalis* impose synergistic biochemical and elemental allelopathic impact on the population of obnoxious weed *Parthenium hysterophorous* L. Thus these *Senna* speceis may offer potential alternative tool for the control of *Parthenium* population in India.

Key words: Phytosociology, Importatce Value Index, Synergestic effect.

Phytosociological studies of plant community are the first and foremost basis of the study of any piece of vegetation. Each community is characterized by its species diversity, growth forms and structure dominance etc. These parameters are used to express the characteristics of a community, the numerical strength of a species in the community, degree of interspecific competition and distribution of species etc.

The significance of quantitative phytosociological character has been recognized by Braun-Blanquet (1932), Simpson (1949), Raunkiaer (1934), Curtis and Mc.Intosh (1950), Daubenmire (1959, 1966, 1968), Mc. Intosh (1958,1967), Ambasht *et al.* (1984), Singh and Ambasht (1990), Singh and Krishnamurthi (1981) and Srivastava *et al.* (2006).

The present study deals with the quantitative analysis of phytosociety dominated by species of *Senna* as well as the soil characteristics of the various study sites. Parameters like relative frequency, relative density and relative dominance were undertaken to determine the phytosociology of these species. Based on these parameters, Importance Value Index (IVI) was calculated and phytographs of some dominated species were constructed. The present study was undertaken to analyze the distribution and interrelationship of different plant species in phytosociety dominated by some *Senna* species. The influence of different species of *Senna* on *Parthenium hysterophorous* was also examined to asses the role of these species in controlling this obnoxious exotic weed.

MATERIAL AND METHODS

The study area is located in the doab of Allahabad District. It is located in the southern part of Uttar Pradesh, at 25° 45' N latitude and 81° 37' E longitude and at an altitude of about 97 meter above the sea level. The area stands at the confluence of river Ganga and Yamuna. The climatic data were collected for the years 2004-2008 from the meteorological station, at

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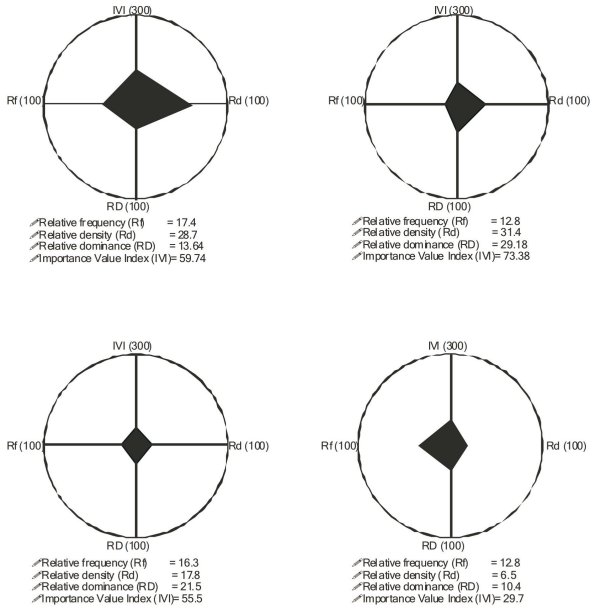

Fig 1. Phytograph showing Imortance Value Index (IVI) of some dominant species of the phytosociety

Bamaraoli, Allahabad.

The study site for the present study is located at the Maghmela parade ground (Site A), Yamuna Bank near Kydganj (Site B), Naini (Site C), Jhunshi (Site D) and Chandra Shekhar Ajad Park (Side D) of Allahabad City where species of *Senna* are growing abundantly. 5 quadrats of 100 x 100 cm on each of the three sites of each locality were laid randomly and average number of individual of each species was recorded for the analysis of plant association in term of density, frequency and dominance.

Phytosociological observations were made during preflowering stage of herbaceous species of *Senna*. The frequency, density, abundance, dominance, relative frequency relative density, relative dominance and Importance Value Index (IVI) were calculated by formula given by Misra (1969). Various species of the community were distributed into five classes (Raunkiaer 1934) on the basis of percentage frequency.

Soil samples were collected from all the five study sites where different species of *Senna* are growing, and the soil samples were examined for various physiochemical properties viz., soil texture, moisture content, pH, organic content, K_2O_5, P_2O_5 and electrical conductivity. All the soil samples were analyzed at CORDET Laboratory, Motilal Nehru Farmers Training Institute, Phulpur, and Allahabad U.P.

Chi-square statistical test analysis was undertaken to understand the association between pair of species of the phytosociety. The Chi-square (χ^2) is calculated as summation of squared difference between each observed frequency (O) and its associated expected frequency (E) divided by the expected frequency (Schefler 1969).

$$\chi^2 = \Sigma (O\text{-}E)^2/E$$

RESULT AND DISCUSSION

In the present study *Senna tora* has been found to have maximum Importance Value Index (IVI) of 73.38, followed by *Cynodon dactylon* (59.74) and *Senna occidentalis* (55.6) respectively. The next position is occupied by *Croton bonplandianum*. *Eclipta erecta* (L.) shows the minimum IVI of 4.55. The three abundantly growing species of *Senna* viz*., S. tora, S. occidentalis and S. obtusifolia occur* in pure and mixed strand. It has been found that *S. tora* has better adaptation and survival potentiality in the community. As a result it is dominant and gregarious of high interception. S. *tora* has always an edge over *S. occidentalis* and *S. obtusifolia i*n characters like anthesis and pods/plant. In interspecific competition, *S. tora* always gains over *S. occidentalis* and its close relative *S. obtusifolia* in edapho-climatic conditions of Allahabad. Similar observation was also made by Sinha and Singh (1981).

The frequency diagrams are prepared for the vegetation studied. When it is compared with Ranuakiaer's normal frequency diagrams, it was noted that the values of frequency class B, D and E are comparatively higher than their respective values in normal frequency diagram

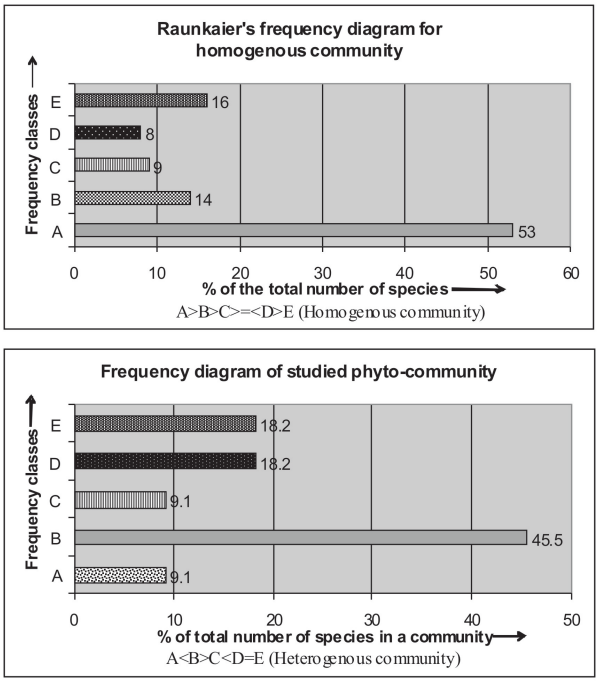

Figure 2. Comparative account of frequency diagrams of studied Phyto-community and Raunkaier's normal frequency diagram.

(Fig. 2). Hence it indicates that the studied community is heterogenous or it is heterogenous phytosociety.

The physiochemical property of the soils show that all the species of *Senna* are growing in slightly alkaline soil, the PH ranges between 8.0-8.40 and electrical conductivity is below 4 mm hos/cm. All the species are growing either in low or very low concentration of phosphorous salts and relatively very high concentration of potassium salts.

The field studies were conducted between years 2005-2009 to assess the effect of suppressing capabilities of *Senna* species on *P. hysterophorous*. *P. hysterophorous* an obnoxious, poisonous, pernicious, aggressive and gregarious weed posing serious threats to human beings, livestocks and to endigenous crop plants. During the present course of studies, it has been observed that the land covered with gregarious growth of *P. hysterophorous,* is being gradually replaced by the population of two abundantly growing weed species of *S. tora* and *S. occidentalis.* But from the existing literature it is evident that it is due to positive (inhibitory) allelophathic effect of these two species of *Senna* on germination and growth of the weed *P. hysterophorous*, causing a real curse to biodiversity. Joshi and Mahadevappa (1986) reported that *S. occidentalis* has gradually replaced the *P. hysterophorous* population in small pockets at many places in Dharwad and Belgaun district. Mamatha and Mahadevappa (1982, 1992) recorded that *S. sericea* and *S. tora* restricted the invasion of *P. hysterophorous* in many states of India. Evidences showed that the higher plants releases chemical exudates called allelochemicals which include phenolics, alkaloids, fatty acids, terpenoids and flavanoids (Rice 1984). The allelopathic effect of these compounds results in inhibitition of seed germination and seedlings growth. These phytochemicals exudates have multiple phytotoxic effects on other plants species growing in vicinity. The shoot leachetes of *S. occidentalis* have significant allelopathic effect against *P. hysterophorous,* effecting diverse biochemical activities (Knox *et al.* 2010). *S. occidentalis* is dominant species cohabiting *P. hysterophorous* successfully (Knox *et al.* 2006). Allelopathic potential of *Senna* can be successfully employed to combat invasive weeds of wheat, mitigating the ill effect of

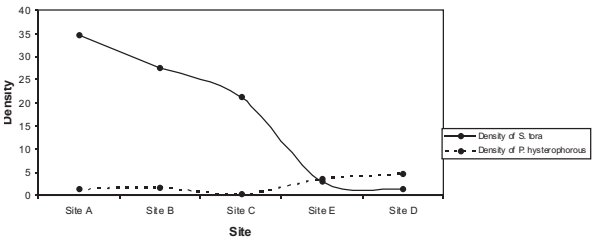

Fig 3a. Density diagram showing the allelopathic impact of *S. tora* on *P. hysterophorous*

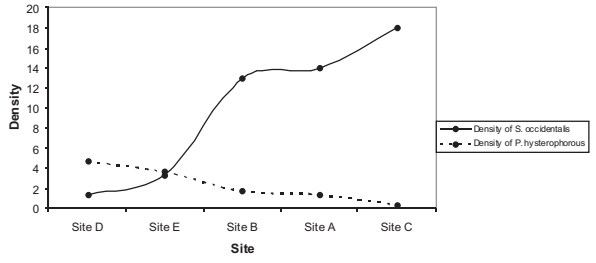

Fig 3b. Density diagram showing the allelopathic impact of *S. occidentalis* on *P. hysterophorous*

herbicidal use on economy, health and environment (Hussain *et al,* 2007). Morris *et al.* (2009) recognized the allelopathic effects caused by inorganic elements on the plants surrounding it. It has been reported that the inorganic content may be concentrated within the rhizosphere to a level at which it can effect the neighbouring plants (Zhang *et al.* 2005 and Morris *et al.* 2009).

In the present course of study it has been recorded that the gregarious growth of *S. tora* and *S. occidentalis* gradually replaces the population of *P. hysterophorous* in edaphoclimatic conditions of Allahabad. Both *S. occidentalis* and *S. tora* have allelopathic capability to inhibit the growth of *Parthenium* (Fig 3a,b). But the former species have better potentiality than the latter. The synergistic allelophathic effect of *S. occidentalis* and *S. tora* on *P. hysterophorous* is more pronounced as compare to effect imposed by individual species.

These two species of *Senna* growing abundantly had gradually replaced growth of *Parthenium* by their more vigorous growth and allelopathic effect and it had completely released the land from the cluthes of the pernicious weed *P. hysterophorous*. It has been also observed that *Croton bonplandianum* Baill. imposes stimulatory effect on the growth of *P. hysterophorous*. The Chi-square test analysis $\chi 2$ for the associatin of the *P. hysterophorous* with *S. occidentalis* and *S. tora* at majority of the study sites is 3.36 and 2.12. respectively. This value is lesser than the critical value (3.84). This indicates that the association between *Parthenium* with the species of *Senna* is insignificant. But the Chi-square value for the association of *P. hysterophorous* and *Croton bonplandianum* is greater than the critical value. This indicates that the association between these two spcieses is significant.

It has also been recorded on the basis of soil analysis that the gregarious growth of *S. occidentalis* and *S. tora* imposes elemental allelopathy by depleting the relative concentration of salts of phosphorous needed for the luxariant growth of *P. hysterophorous*. Probably the depletion of phosphorous salts in the soil adversely affects the nucleotide metabolism resulting in inhibition of the growth and germination of seeds and seedlings of *P. hysterophorous*.

CONCLUSION

From the present study it can be concluded that *S. occidentalis* and *S. tora* are dominant species of the community. It can be grown on all kind of soils and adverse ecological conditions due to better adaptive and survival values. It imposes significant allelopathic effects against obnoxious weed *P. hysterophorous*. Its bio-chemical and elemental allelopathic effect with *P. hysterophorous* provides new but ecofriendly, cheaper, and effective natural replacement strategy of controlling *P. hysterophorous* populations in India.

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