Plant Archives Vol. 21, Supplement 1, 2021 pp. 1768-1770 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
doi link : https://doi.org/10.51470/PLANTARCHIVES.2021.v21.S1.282

PARTHENIUM HYSTEROPHORUS L. STUDY ANALYSIS WITH SOME COMPETITIVE WEEDS

Jai Knox
Department of Botany, Wilson College, Mumbai, University of Mumbai, India
Email: jaiknox@rediffmail.com

ABSTRACT

This study was conducted to evaluate the seasonal phytosociology of *Parthenium hysterophorus* infested sites in Mumbai region during the year 2018-2019. Among all the plants, *P. hysterophorus* was found to be the most dominant and abundant weed throughout the sites with maximum ecological index like Importance value index (IVI), ranged from (42.86–124.12). A statistically significant interaction (p<0.001) between sites was obtained for mean IVI values of *P. hysterophorus.* Along with *Parthenium hysterophorus*; *Cassia occidentalis* and *Calotropis procera* also showed their presence. The results suggest that these competitive weeds could replace this obnoxious weed through allelopathic mode of action without affecting the nature of the soil and natural habitat.

***Keywords*:** Plant community, Biochemistry, Phenology, Botanic agents

Introduction

Parthenium hysterophorus L. (Asteraceae) commonly called as congress grass or carrot weed is one of the most aggressive weed that has a wide global distribution. Taxonomically it is herbaceous, neotropical, erect, annual plant native of America, introduced accidentally in India in 1955 through imported food grains and at present has occupied almost all parts of India (Ramaswami, 1997). *Parthenium* is also considered as an obnoxious weed because of its allelopathic effect on associated plant species by releasing allelochemicals (Ramesh *et al*., 2003). The weed shows a drastic impact on other plants as a strong competitor and creates health hazards in humans and animals also (Lakshmi and Srinivas, 2007). It is an inhabitant of any ecosystem and proliferates easily in wastelands, roadsides, railway tracks, graveyards, backyards or any vacant land and also has started interfering in agricultural ecosystem. *Parthenium* is an extremely prolific seed producer and its seeds are very persistent in the soil.

The information about plant communities and associated vegetation with *P. hysterophorus* resulting from ecological indices helps in recognizing the severity of weed infestation in the particular area under investigation. Similarly, a phytosociological survey also helps in finding out certain potential plant species in a plant community, which consistently grow in a stable community, resist in varied climatic conditions and also dominate surrounding vegetation. A phytosociological study gives information on the distribution of species as well as affinities between species or groups of species, resulting in a valuable evaluation of the vegetation within the study area (Frenedozo-Soave, 2003).

In this context, the present study is aimed at achieving the following objectives (i) Present status of *P. hysterophorus* infestations and its weed-weed interaction scenario with other plant communities; (ii) Identification and evaluation of some potential competitive plant species. Most importantly the present study gives an insight into the complex mechanism of plant population dynamics at *P. hysterophorus* infested areas, and to pave the way to identify some promising competitive plant species for sustainable management of this dreaded weed.

Materials and Methods

Sites which are heavily populated with *P. hysterophorus* were identified. An average of four sites was considered as a representative data of that particular zone in terms of population dynamics. Sites were marked and surveyed in monsoon season for the year 2018-2019.

At each site, all the plants species were sampled identified and their ecological indices (frequency percentage, density, abundance, relative frequency, relative density, relative dominance, importance value index and importance value index percentage) were estimated (Pound and Clements, 1898). Sampling was done randomly in triplicate at 10 spots at each site by using 1.0 m^2 quadrat. The data was compiled and analyzed for qualitative and quantitative study using following formulae (Hanson and Churchill, 1961):-

$$\text{Frequency \%} = \frac{\text{Total no. of quadrats in which species occured}}{\text{total no. of quadrats studied}} \times 100$$

$$\text{Density} = \frac{\text{Total no. of individual species}}{\text{total no. of quadrats studied}}$$

$$\text{Abundance} = \frac{\text{Total no. of individual species}}{\text{total no. of quadrats in which species occured}}$$

$$\text{RelativeFrequency \%} = \frac{\text{Frequency of the species in a stand}}{\text{Sum of the frequencies for all species in a stand}} \times 100$$

$$\text{Relative Density} = \frac{\text{Total no. of individuals of a species}}{\text{Total no. of individuals of all species}} \times 100$$

$$\text{Average basal area} = \sum \pi r^2 / N$$

Total basal area of a species

$$= \text{Average basal area (sq. mm)} \times \frac{\text{No. of individuals per quadrat}}{\text{size of quadrat}} \times 100$$

$$\text{Relative dominance} = \frac{\text{Total basal area of the species in all quadrats}}{\text{Total basal area of all the species in all quadrats}} \times 100$$

Importance Value Index (IVI)

$$= \text{Relative frequency} + \text{Relative density} + \text{Relative dominance}$$

$$\text{IVI \%} = \frac{\text{IVI of a species}}{\text{IVI of all the species}} \times 100$$

Diversity Index

The Shannon-Weaver Index ($\overline{H}$) or Habitat Suitability Indices is used to compute diversity index of a particular community. It involves log transformations as follows:

$$\overline{H} = -\Sigma P_i \log P_i (P_i = \frac{n_i}{N})$$

Where P_i is the proportion of the individuals belonging to the i^{th} species (Shannon and Weaver, 1949).

Statistical analysis

Two-way ANOVA (analysis of variance) was applied to test variance among the mean values of importance value index (IVI) of prominent plant species at different sites and seasons. Fisher's LSD test was employed to further isolate the group(s) that differed significantly.

Results

A total of 12 plant species were recorded in monsoon season from all the different sites (Table 1). Out of these, five plants were found abundantly in monsoon seasons. *P. hysterophorus* was reported as most abundant and dominant weed while other plants like *Achyranthes aspera, Acalypha indica, Calotropis procera* and *Cassia occidentalis* were found competing with adjoining flora for their survival at sites heavily infested with *Parthenium*. However, *P. hysterophorus* exhibited maximum dominance at all the sites and showed heavily presence.

Parthenium was found to be most densely populated weed exhibiting highest IVI percentage values at Site III i.e. 41.4% > Site IV i.e. 37.7% > Site II i.e. 31.1%> Site I i.e. 14.3% (Table 2). In monsoon season, except at site I, *Cassia occidentalis* was found to be dominant with 34.6 IVI%. Rests of the plants species were not consistent with the site. At other site also it is the *C. occidentalis*, providing tough competition to *P. hysterophorus* and *C. procera* (at Site IV), were the plants, ensuring their presence with relatively high IVI values as compared to rest of the plants during monsoon season. It was observed in Table 2 that as the value of IVI% of *Parthenium* is decreasing the Shannon-Weaver Index (S-W index) is increasing. Highest S-W index was observed at Site I i.e. 1.96, here the IVI% of *Parthenium* is at its lowest value i.e. 14.3 followed by Site II where the IVI% of *Parthenium* was 31.1 and S-W index was 1.65. Least S-W index was observed at Site III i.e. 1.28 whereas, IVI% of *Parthenium* was maximum i.e. 41.4.

From the above data recorded *C. occidentalis* and *C. procera* appears to affect the growth of *P. hysterophorus* along with other plants either through competition or allelopathic interactions or both and were found competing well with *P. hysterophorus* and gradually replacing it in patches, as indicated with closely followed ecological indices.

Discussion

In the present study, phytosociological surveys and diversity indices obtained from selected invaded sites clearly depicts the heavy presence of *P. hysterophorus* whereas there were some naturally occurring plants species, which showed the capability to share the common space at *P. hysterophorus* infestation sites.

Parthenium grows vigorously in all seasons. It is capable of germination and setting up itself at any time of the year and has a potential to grow vigorously even in summer (Dhileepan, 2009). Kumar and Soodan, 2006 and Knox *et al*., 2011 also observed the same pattern of IVI and S-W index for *P. hysterophorus* in their studies. The present study suggests that, *P. hysterophorus* is still a weed of major concern because of its high sociability index values among weed community. Adaptability potential (phenology) may be a reason for its strong establishment and successful survival in a plant community, that strengths this weed in dominating associated flora. However, few species like *C. occidentalis* and *C. procera* emerged as a strong competitive species with *P. hysterophorus*. If the active ingredient from these competitive species is identified against *P. hysterophorus* or other problematic plants, than a powerful bio-herbicides may emerges as viable and sustainable alternative to harmful chemicals.

Table 1 : Recorded plant species from four different sites during monsoon season (2018-2019)

S. No.	Botanical Name	Common name	Family	Monsoon Season
1	*Abutilon indicum*	Indian mallow	Malvaceae	+
2	*Acalypha indica*	Indian nettle	Euphorbiaceae	++
3	*Achyranthes aspera*	Prickly chaff flower	Amaranthaceae	++
4	*Argemone mexicana*	Mexican prickly poppy	Papaveraceae	+
5	*Calotropis procera*	Sodom apple	Asclepiadaceae	++
6	*Cassia occidentalis*	Coffeeweed	Caesalpinaceae	+++
7	*Vernonia cinerea*	Purple feabane	Asteraceae	+
8	*Parthenium hysterophorus*	Santa maria feverfew	Asteraceae	+++
9	*Peristrophe bicalyculata*	Panicled fold wing	Acanthaceae	+
10	*Ricinus communis*	Castor bean	Euphorbiaceae	+
11	*Sida cordifolia*	Flannel weed	Malvaceae	+
12	*Tridax procumbens*	Coat buttons	Asteraceae	+

+++, ++ and + indicate higher (present at 3 sites), average (present at 2 sites) and below average (present at 1 site) abundance of weeds, respectively

Table 2 : Plant community analysis (Phytosociology) at different sites during monsoon season (2018-2019)

Sites	Plants	Frequency	Density	Abundance	Relative Frequency	Relative Density	Relative abundance	IVI	IVI%	S-W Index
I	*A. indicum*	30	0.5	1.6	7.14	3.08	1.67	11.89	3.97	1.96
	C. occidentalis	60	5.5	9.1	14.3	33.9	55.6	103.85	34.6	
	C. procera	20	0.5	2.5	4.76	3.08	3.43	11.27	3.76	
	P. hysterophorus	90	2.1	2.3	21.4	12.9	8.48	45.94	14.3	
	S. cordifolia	30	1.6	5.3	7.14	9.87	9.59	26.6	8.87	
	T. procumbens	10	0.2	2.0	2.28	1.23	0.11	3.72	1.24	
II	*A. aspera*	30	0.4	1.3	8.57	3.50	1.79	13.86	4.62	1.65
	C. occidentalis	50	1.0	2.0	14.3	8.77	14.4	37.45	12.5	
	C. procera	20	0.4	2.0	5.71	3.50	4.04	13.25	4.42	
	P. bicalyculata	10	0.2	2.0	2.85	1.75	0.28	4.88	1.63	
	P. hysterophorus	100	4.2	4.2	28.6	36.8	27.9	93.4	31.1	
	A. indica	40	0.9	2.2	11.4	7.89	5.81	25.12	8.38	
III	*A. aspera*	60	0.7	1.1	18.2	6.08	2.73	26.99	9.00	1.28
	A. indica	30	1.1	3.6	9.09	9.56	10.3	28.91	9.64	
	C. procera	90	1.7	1.8	27.3	14.8	18.2	60.28	20.1	
	C. occidentalis	50	1.9	3.8	15.2	16.5	27.9	59.65	19.9	
	P. hysterophorus	100	6.1	6.1	30.3	53.0	40.8	124.12	41.4	
IV	*C. procera*	100	4.5	4.5	23.3	26.3	19.9	69.49	23.2	1.31
	V. cinerea	40	0.7	1.7	9.30	4.09	1.88	15.27	5.09	
	C. occidentalis	50	3.0	6.0	11.6	17.5	9.63	38.79	12.9	
	P. hysterophorus	100	6.1	6.1	23.2	35.7	54.0	112.9	37.7	
	S. cordifolia	70	1.3	1.8	16.3	7.60	2.56	26.43	8.81	

Acknowledgement

The author is grateful to Prof. (Dr.) Anna Pratima Nikalje, Principal, Wilson College, Mumbai for providing necessary facilities.

References

Dhileepan, K. (2009). Managing *Parthenium* weed across diverse landscapes: limitations and prospects. In: Management of Invasive Weeds (ed. S INDERJIT), 227–260. Springer Science.

Frenedozo-Soave, R.D.C. (2003). Phytosociological studies on natural establishment of vegetation in an unreclaimed limestone mining. Brazilian Achieves of Biology and Technology 46(2): 259- 269.

Hanson, H.C. and Churchill, E.D. (1961).The plant community. Reinhold Publishing Corporation, New York, pp 149–155.

Knox J.; Jaggi, D. and Paul, M.S. (2011). Population dynamics of *Parthenium hysterophorus* (Asteraceae) and its biological suppression through *Cassia occidentalis* (Caesalpinaceae).Turkish Journal of Botany 35: 111–119.

Kumar, R. and Soodan, A.S. (2006). A biodiversity approach to check *Parthenium hysterophorus* L. Journal of Environmental Biology 27(2): 349–353.

Lakshmi, C. and Srinivas, C.R. (2007). Indian Journal of Dermatology, Venereology and Leprology 73: 296–306.

Pound, R. and Clements, P.E. (1898). A method of determining the abundance of secondary weeds species. Minnesota Botanical Studies 2: 19.

Ramaswami, P.P. (1997). Potential uses of *Parthenium*. In: Proceedings of First International Conference of Parthenium Management, University of Agricultural Sciences, Dharwad, India, pp 77–80.

Ramesh, C.; Ravindranath, N.; Das, B.; Prabhakar, A.; Bharatam, J; Ravikumar, K.; Kashinatham, A. and Mcmorris, T.C. (2003). Pseudoguaianolides from the flowers of *Parthenium hysterophorus*. Phytochemistry 64: 841–844.

Shannon, C.E. and Weaver, W. (1949). The Mathematical Theory of Communication. The University of Illinois Press, Urbana, IL, USA.