INT. J. BIOL. BIOTECH., 3 (3): 619-622, 2006.

PARTHENIUM WEED – AN EMERGING THREAT TO PLANT BIODIVERSITY IN PAKISTAN

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ABSTRACT

The present study was carried out to investigate that how rapidly *Parthenium hysterophorus* L., a native of tropical America, is colonizing and spreading on new wasteland areas. For this purpose a four hectors piece of land in Punjab University Lahore that has been fallow for the last two years was selected to study the colonization of *Parthenium* in comparison with the local flora. A total of 31 weed species were found at the selected site. Phytosociological study of the site revealed that *Parthenium* has become the third most frequent weed after *Cynodon dactylon* (L.) Pers. and *Malvestrum tricuspidatum* A. Gray and the most densely populated weed only second to *C. dactylon* at this site within the two years. Fast growth rate, high reproductive potential, adaptive nature and interference by allelopathy are the major contributing factors for rapid spread and successful establishment of this weed in any ecosystem.

Key words: *Parthenium hysterophorus*, threats, plant biodiversity, Pakistan.

INTRODUCTION

Parthenium hysterophorus (hereafter referred to *Parthenium*) is an invasive alien weed in Pakistan. It is native to tropical America and has become widespread in North America, South America, the Caribbean, and many parts of Africa, Australia and Asia (Navie *et al*., 1996). The chemical analysis has indicated that all the plant parts including trichomes and pollens contain toxins called sesquiterpene lactones. The major components of toxin being 'Parthenin' and other phenolic acids such as caffeic acid, vanillic acid, anisic acid, chlorogenic acid and parahydroxy benzoic acid are lethal to human beings and animals (Oudhia, 1998, Kadhane *et al*., 1992). In addition to health hazards a lot of available data also highlights its impact on agriculture as well as natural ecosystems (Chippendale and Panetta, 1994; Evans, 1997). There are reports of total habitat change in native Australian grasslands, open woodlands, river banks and floodplains due to *Parthenium* invasion (McFayden, 1992; Chippendale and Panetta, 1994). Similar invasions of national wildlife parks have also been reported in southern India (Evans, 1997).

The weed has been spreading in Pakistan for the last 15-20 years. It has now become a major wasteland weed and rapidly replacing the native flora in rain fed areas of the province Punjab and is also spreading in North Western Frontier Province and Kashmir (Javaid and Anjum, 2005). The weed is also found in some less competitive crops. However, in India and Australia it has also become a major problematic weed both in agricultural and wastelands (Evans, 1997). The present study was carried out to investigate the colonizing potential of *Parthenium* in comparison with local flora on a new piece of wasteland in Punjab University Lahore that has been fallow for the last two years and weeds were abundantly growing there.

MATERIALS AND METHODS

Description of sampling site: A 4 ha area in Quaid-e-Azam Campus, University of the Punjab Lahore, Pakistan, undisturbed for the last one and a half year, was selected for phytosociological study. The soil of the site was sandy loam with pH 7.5, total N 0.06%, available phosphorus 22 ppm, exchangeable potassium 190 ppm and organic matter about 1%. The city of Lahore is located on latitude 31.57 N and longitude 74.31 E. The climate of the region presents extremes of heat and cold. There are four well defined seasons viz. winter (December - February), spring (March - April), summer (May - September) and autumn (October - November). The area receives highest rainfall during monsoon months of July and August. The average maximum and minimum temperatures and rain fall in different months of the year are given in Table 1.

Phytosociological study: Sampling was done with a $1m^2$ quadrate. Twenty quadrates were randomly thrown at the sampling site. The following analytical attributes were calculated: absolute frequency, relative frequency, absolute density and relative frequency. The following formulae were used:

$$\text{Absolute frequency (AF) (\%)} = \frac{\text{Number of quadrates in which species occurs}}{\text{Total number of quadrate}} \times 100$$

$$\text{Relative frequency (RF) (\%)} = \frac{\text{Absolute frequency value for a species}}{\text{Total absolute frequency values for all species}} \times 100$$

$$\text{Absolute density (AD)} = \frac{\text{Total number of individuals of a species in all quadrates}}{\text{Total number of quadrate}}$$

$$\text{Relative density (RD) (\%)} = \frac{\text{Absolute density for a species}}{\text{Total absolute density for all species}} \times 100$$

RESULTS AND DISCUSSION

A total of 31 weed species were recorded at the sampling site. *Parthenium* was found to be the third most frequent weed species with 70% absolute frequency (AF) and 7.3% relative frequency (RF), after *Cynodon dactylon* (90% AF and 9.6% RF) and *Malvestrum tricuspidatum* (80% AF and 8.5% RF). *Achyranthes aspera, Cassia oscidentalis, Chenopodium album, Euphorbia pilulifera, Brachiaria reptans, Dactyloctenium aegyptium, Dicanthium annulatum, Digitaria timorensis, Imperata cylindrica* and *Sorghum helepense* were found to be moderately frequent species with 30-55 AF. The AF of rest of the less frequently occurring species ranged from 10-25% (Table 2).

Parthenium was the second most densely populated species with absolute density (AD) of 35 and relative density (RD) of 22. Earlier Anjum *et al.* (2005) and Javaid *et al.* (2005) have reported 87 and 41 AD of *Parthenium* at other localities in Lahore and 100 km away in district Sialkot, respectively. The most densely populated weed *C. dactylon* exhibited 43 AD and 27 RD. *M. tricuspidatum* was the third most densely populated weed with 14.3 AD and 9 RD. *Brachiaria reptans, S. helepense, Lippia nodiflora* and *I. cylindrica* showed AD ranging from 6-8.3 and RD 3.77-5.22. The rest of the weeds were thinly populated with AD below 5 (Table 2).

Many factors are responsible for rapid spread of *Parthenium* in Pakistan. Firstly, *Parthenium* weed is an extremely prolific seed producer, with up to 25,000 seeds per plant (Navie *et al*., 1996), and with an enormous seed bank, estimated at 200,000 seeds m^{-1} in abandoned fields (Joshi, 1991). Furthermore, seeds can germinate any time of year given suitable moisture levels. The seeds of *Parthenium* remain viable for a long time and can thrive under very harsh environmental conditions (Williams and Groves, 1980). No dormancy and extreme light weight of its seeds armed with pappus are the characteristics which help its extensive spread and establishment (Ramaswami, 1997). Secondly, it is a very fast maturing annual. Generally plants commence flowering when they are 4 to 8 weeks old and may flower for several months. Under unfavourable conditions such as under drought stress the weed can germinate, grow, mature and set seeds in four weeks. The weed also has a very high regenerative potential (Dagar *et al* 1976). Thirdly, *Parthenium* inhibits the germination and growth of other plants by allelopathy. Various allelochemicals such as water soluble phenolics including caffeic, ferulic, vanicillic, anisic and fumaric acids, and sesquiterpene lactones including parthenin and coronopilin, have been identified from the weed (Kanchan 1975; Jarvis *et al* 1985; Picman and Picman 1984). Fourthly, generally animals do not eat *Parthenium.* Above all, the lack of natural enemies of this weed in Pakistan is also contributing to a large extent in the rapid spread of this weed in this country. Over 260 phytophagous arthropods species were collected from *Parthenium* from its native homeland, although 144 species actually fed on the weed (McClay *et al*., 1995). However, there is no earlier report of any pest of *Parthenium* from Pakistan. Recently we have a beetle *Zygogramma bicolorata* Pallister and an unidentified insect larvae feeding on *Parthenium.* Because of these factors, *Parthenium* is rapidly spreading in Pakistan and has become an emerging threat to the plant biodiversity in the region. There is an urgent need to take integrated measures to control the further spread of this noxious alien weed in the country.

Table 1. The average maximum and minimum temperature and rainfall in different months of the year in Lahore, Pakistan.

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average highest temperature (˚F)	65	69	78	91	99	102	93	92	92	88	77	67
Average lowest temperature (˚F)	48	52	62	72	79	84	83	82	79	69	57	49
Average precipitation (inches)	1	0.9	1	0.6	0.7	1.5	6.1	5.3	2.5	0.4	0.1	0.5

Source: http://www.weatherbase.com/weather/weather-php3?s=0046148refer=

Table 2. Frequency and density of *P. hysterophorus* and other weeds at sampling site.

Species	Family	AF	RF	AD	RD
Parthenium hysterophorus L.	Asteracaea	70	7.3	35	22
Ageratum conyzoides L.	″	20	2.1	1.3	0.8
Conyza ambigua DC.	″	15	1.5	1.2	0.8
Xanthium strumarium L.	″	25	2.6	1.2	0.8
Achyranthes aspera L.	Amarantaceae	30	3.2	1.5	0.9
Calotropis procera Br.	Asclepiadaceae	25	2.7	0.40	0.2
Cassia oscidentalis L.	Caesalpiniaceae	35	3.6	2.2	1.4
Chenopodium album L.	Chenopodicaeae	30	3.2	4.2	2.6
Kochia indica Wight	″	10	1.1	1.0	0.6
Euphorbia pilulifera L.	Euphorbiaceae	40	4.2	2.9	1.8
E. prostrate L.	″	20	2.1	2.3	1.4
Oxalis corniculata L.	Geraniaceae	25	2.7	2.8	1.8
Malvestrum tricuspidatum A. Gray	Malvaceae	80	8.5	14.3	9.0
Sida spinosa L.	″	25	2.7	1.2	0.7
Brachiaria reptans (L.) Gard. & Hubb.	Poaceae	35	3.6	8.3	5.2
Cenchrus pennisetiformis Hochest	″	30	3.2	1.8	1.1
Cynodon dactylon Pers.	″	90	9.6	43	27
Dactyloctenium aegyptium Beauv.	″	30	3.2	2.1	1.2
Dicanthium annulatum Stapf.	″	55	5.8	3.6	2.2
Digitaria timorensis (Kunth) Balansa	″	35	3.6	5.2	3.3
Eragrostis poaeoides Beauv.	″	20	2.1	1.65	1.0
Imperata cylindrica (L). Beauv.	″	30	3.2	6.0	3.8
Setaria glauca Beauv.	″	15	1.6	0.6	0.4
Sorghum helepense Pers.	″	30	3.2	8.0	0.5
Datura alba Nees	Solanaceae	10	1.1	0.3	0.2
Solanum nigrum L.	″	20	2.1	0.5	0.3
Solanum xanthocarpum Schrad.	″	15	1.6	0.5	0.3
Withania somnifera Dunal.	″	15	1.6	0.4	0.3
Lippia nodiflora Rich.	Verbenaceae	20	2.1	6.8	4.3
Vebena officinalis L.	″	25	2.7	3.4	2.1
Tribulus terrestris L.	Zygophyllaceae	20	2.1	1.5	0.9

AF=Absolute frequency; **RF**=Relative frequency; **AD** =Absolute density; **RD** =Relative density

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(*Accepted for publication July 2006*)