



***Parthenium* invasion in Rawalpindi, Pakistan**

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ABSTRACT

Parthenium hysterophorus, is an annual herb that aggressively colonizes disturbed sites. In Pakistan, this weed is spreading very fast especially in north eastern parts of the province, Punjab. Due to lack of information on its spread, a survey was carried out in the district Rawalpindi where 8 sites were selected for sampling. The survey revealed very high density of *P. hysterophorus* at all sites and a total of 33 plant species were associated with *P. hysterophorus*. The relative density of weed in different sites of the district ranged from 8.2-64.5% while the relative frequency ranged from 14.2-29.6%. The extent of infestation was highest in denuded and fallow lands, especially in areas where soil has been disturbed. It was concluded that *Parthenium* is an extremely aggressive and prolific invasive weed in district Rawalpindi and coordinated efforts are needed to manage this weed to stop its further spread.

Key words: Distribution, Invasive alien species, *Parthenium*, Spread

Parthenium hysterophorus is highly invasive species of global significance. This plant is native to southern United States and Mexico, Central and South America and it has been accidentally introduced into several countries, and has become a serious agricultural and rangeland weed in parts of Australia, Asia and Africa and Pacific Islands (Adkins *et al.* 2010). It grows on any type of soil and in a wide range of habitats. It affects the production of crops, animals, human and animal health, and biodiversity. (Nath 1981, McFadyen 1995, Shabbir and Bajwa 2006). In Pakistan, the first documented report of *P. hysterophorus* date back in 1980 from the Gujarat district of Punjab Province (Razaq *et al.* 1994). It is thought that since then the weed has rapidly spread throughout the province of the Punjab, the Islamabad Capital Territory (ICT) and parts of the Khyber Pukhtunkhwa (KPK) province (Shabbir *et al.* 2012). *Parthenium* is found mostly in naturally disturbed areas and in areas that have poor ground cover such as wastelands, cleared lands, and grazed pastures (Shabbir and Adkins 2008). Other common habitats for this weed include many types of crops, orchards, plant nurseries, public lawns and open spaces in towns, sides of roads, rivers, canals and railway tracks, on construction sites and in forests (Shabbir *et al.* 2012). The core infestations of this weed are in the central and northern districts of the Punjab, including the district of Rawalpindi. As yet little information is available on its spread in this region and its impacts on the local vegetation. The present study is therefore, designed to document the spread of *P. hysterophorus* and its impacts on local plant communities.

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MATERIAL AND METHODS

Rawalpindi is a heavily populated district of the Punjab province, located in the Pothohar region of Pakistan. It is very close to the national capital city of Islamabad, and that's why both cities are well known as twin cities. The climate of the district is a humid subtropical with long and very hot summers, and mild winters, the average annual rainfall is 1100 mm most which fall in summer monsoon. The mean maximum temperature in summer is over 38°C, while mean minimum temperature is 4°C winters. Rainfed agriculture and livestock production is the main economy of the district. Most of the selected field sites in Rawalpindi were wastelands and situated at 33°35' - 33°45'N and 73° - 73° 5.7'E (Table 1).

Floristic data were collected from 40 randomly selected plots (1 × 1 m) from 8 field sites selected in the district Rawalpindi. Most of the selected sites were wastelands except Ayub National Park and Morgah (a rainfed pasture, Table 1) and there were five plots at each location. The data was collected in the summer (July – September). All plant species growing in these plots were counted and identified by referring work of Stewart (1972) and Nasir *et al.* (1987). The collections of National Herbarium, NARC and Natural History Museum, Islamabad were also consulted for identification of plants.

RESULTS AND DISCUSSION

The survey revealed a total of 33 plant species belonging to more than 16 angiospermic plant families accompanied with *P. hysterophorus*. Most of the sites in district Rawalpindi were heavily infested with *P.*

Table 1. Locations and characteristics in district Rawalpindi

Sites	Latitudes (Decimal deg.)	Longitudes (decimal deg.)	Site characteristics
Dhoke khaba	33.608 N	73.081 E	Wasteland
Satellite town	33.635 N	73.072 E	Wasteland
Pirwadhai	33.616 N	73.022 E	Wasteland
Chaklala	33.632 N	73.039 E	Wasteland
Ayub National Park	33.582 N	73.092 E	National park
Tench bhata	33.571 N	73.083 E	Wasteland
Westridge	33.588 N	73.035 E	Wasteland
Morgah	33.531 N	73.084 E	Pasture

hysterophorus. In general, plants associated with *P. hysterophorus* in different sites showed independent associations, which over all reflect the herbaceous flora of these habitats in the district Rawalpindi.

At the Westridge site, *P. hysterophorus* was found to be dominated weed species which was accompanied by twelve other plant species. *Lantana camara* and *Cynodon dactylon* were co-dominant with *Parthenium* at this site. *Amaranthus viridus* was observed to be a common weed of wastelands and roadsides, having third highest relative density (10.2%) after *Parthenium* (17.9%) and *C. dactylon* (15.3% (Table 2). *Convolvulus arvensis*, *Alternanthera pungens*, *Achyrenthes aspera*, *Sacchrum spontaneum* and *Cassia occidentalis* had overlapping values of relative frequency of occurrence i.e. 5.1%. The Westridge site is among one of the highly populated suburban areas of the district Rawalpindi and *P. hysterophorus* was generally found in disturbed and unmanaged lands.

The herbaceous vegetation of wastelands of Pirwadhai site recorded a total of 16 weed species in association with *P. hysterophorus*. *Parthenium hysterophorus* was again the most dominant weed species of wastelands with the highest relative density (39 %) followed by *C. dactylon* (21 %) and *A. pungens* (7 % (Table 2). *Elucine indica*, *A. aspera*, *Datura innoxia*, *C. occidentalis*, *Atylosia mollis*, *Boerhaavia procumbens*, *Euphorbia prostrata*, *Sida cordata*, *Desmostachya bipinnata*, were found in limited associations. The relative frequency of occurrence of plant species other than dominants ranged from 2.7-5.5%. This site is adjacent to Islamabad Capital Territory and a general bus stand is also situated in this area. The high density of *P. hysterophorus* at this site could be due to seed spread by vehicles as this weed has been reported to be spread mainly by vehicles and farm machinery (Parsons and Cuthbertson 1992).

At the satellite town, the most dominant plant species was *A. pungens* with highest relative density (29%) followed by *C. dactylon* (28%) and *D. bipinnata* (19%).

Parthenium hysterophorus in this sector had frequent to occasional level of occurrence that was significantly lower than the other dominants (Table 2). *Alternanthera pungens* is another alien plant species spreading very fast in this region and is very common along the roadsides and in horticultural parks.

The floristic composition of the Chaklala site indicated that *P. hysterophorus* was the most dominant species accompanied by twenty other plant species (Table 2). As most of the long distance dispersal of this weed is by vehicles and farm machinery, huge infestations were recorded along the roadsides and eroded sites, particularly the G.T. road and Airport link road, Islamabad (Chaklala).

The Ayub National Park is situated at southeast corner of the Rawalpindi at a distance of 4.5 km from the city. *Acacia modesta*, *Prosopis juliflora* and *Olea cuspidata* were common woody species of this national park. The survey of this site revealed a heavy infestation of *P. hysterophorus* especially as a part of vegetation under the forest cover. Twenty three herb species were recorded from the park. *P. hysterophorus* exhibited highest relative frequency value (13.7%) followed by *M. corromendelianum* (8.2%) and *C. occidentalis* (6.8%). Around the world *P. hysterophorus* has become a major threat to many protected areas, forest reserves and national parks including the Kruger National Park, South Africa (Strathie *et al.* 2011), Chitwan National Park, Nepal (Bharat person. comm.), Van Vihar and Corbet National Park, India (Sushilkumar 2010, 2013), and the Masai Mara/Serengeti ecosystem, in Kenya and Tanzania (Anonymous, 2011).

At the Dhoke Khaba site, *P. hysterophorus* was most frequent species accompanied with fifteen other plant species. *Cannabis sativa* exhibited a good sociability with *P. hysterophorus* especially in the shady places. *Cannabis sativa* has third highest relative density value (6.1%) after *P. hysterophorus* and *Malvastrum coromendelianum* (Table

Table 2. Datasheet showing the relative frequency and relative density of wasteland plants in selected sites of Rawalpindi

Wasteland plant species	Relative density (%)								Relative frequency (%)							
	1	2	3	4	5	6	7	8.	1	2	3	4	5	6	7	8
<i>Abutilon indicum</i>	1.1	-	-	-	-	-	-	-	1.3	-	-	-	-	-	-	-
<i>Agropyron repens</i>	0.9	-	-	-	-	0.4	-	-	2.7	-	-	-	-	3.2	-	-
<i>Alternanthera pungens</i>	4.7	-	3.5	-	-	2.8	-	7.0	5.4	-	5.1	-	-	3.2	-	11.1
<i>Atylosia mollis</i>	3.1	-	0.7	-	-	2.2	22.9	2.0	5.4	-	2.5	-	-	4.8	17.8	5.5
<i>Boerhaavia procumbens</i>	0.6	0.8	0.7	-	-	-	-	1.4	1.3	2.5	2.5	-	-	-	-	5.5
<i>Cassia occidentalis</i>	7.9	1.6	2.5	-	-	6.5	1.3	3.5	6.8	5	5.1	-	-	11.2	3.5	2.7
<i>Conyza canadensis</i>	1.1	-	-	-	-	0.2	-	1.4	2.7	-	-	-	-	1.6	-	5.5
<i>Cynodon dactylon</i>	6.7	2.7	17.6	28.2	46.6	-	22.5	21.2	4.1	5	15.3	25.9	16.6	-	14.2	11.1
<i>Cyperus rotundus</i>	1.3	-	-	-	-	2.0	-	0.8	2.7	-	-	-	-	4.8	-	2.7
<i>Datura innoxia</i>	0.9	0.5	-	1.9	-	0.4	0.4	0.2	4.1	2.5	-	11.1	-	3.2	3.5	2.8
<i>Desmostachya bipinnata</i>	8.0	4.7	-	2.7	11.7	3.6	19.3	1.4	5.4	5	-	3.7	4.2	6.4	14.2	2.7
<i>Elusine indica</i>	3.1	-	-	-	-	2.8	-	1.4	5.4	-	-	-	-	6.4	-	2.8
<i>Erigeron conyzanthus</i>	0.6	1.1	-	-	-	-	-	-	1.3	2.5	-	-	-	-	-	-
<i>Euphorbia hirta</i>	2.9	-	-	-	-	1.4	-	-	5.4	-	-	-	-	3.2	-	-
<i>Euphorbia indica</i>	2.0	-	-	-	-	-	-	-	2.7	-	-	3.7	-	-	-	-
<i>Euphorbia prostrata</i>	1.1	-	-	2.3	-	1.6	-	0.8	2.7	-	-	-	-	4.8	-	2.7
<i>Lantana camara</i>	3.6	-	-	11.5	-	0.8	-	-	4.1	-	15.3	-	-	3.2	-	-
<i>Lepediza juncea</i>	0.9	1.6	1.0	-	-	5.5	-	-	2.7	5	2.5	-	-	6.4	-	-
<i>Malvastrum coromendelianum</i>	8.8	9.1	-	-	13.3	-	15.7	1.7	8.2	15	-	-	4.7	-	17.8	2.7
<i>Parthenium hysterophorus</i>	30.9	64.1	35.9	53.7	8.2	60.6	13.0	38.9	13.7	25	17.9	29.6	2.9	16.1	14.2	22.2
<i>Rhynchosia minima</i>	2.4	-	-	-	3.5	2.0	1.3	1.7	2.7	-	-	-	1.2	3.2	3.5	2.7
<i>Sida cordata</i>	2.7	-	-	-	-	1.4	-	3.5	2.7	-	-	-	-	1.6	-	5.5
<i>Solanum nigrum</i>	3.1	-	-	2.7	-	2.4	-	-	5.4	-	5.1	11.1	-	4.8	-	-
<i>Convolvulus arvensis</i>	-	1.1	1.7	-	-	0.6	-	-	-	5	7.6	-	-	1.6	-	-
<i>Setaria glauca</i>	-	1.6	3.2	-	-	2.2	1.3	-	-	5	-	3.7	-	6.4	7.1	-
<i>Cannabis sativa</i>	-	6.1	-	1.9	16.4	-	1.8	-	-	10	-	7.4	-	-	3.5	-
<i>Heteropogon contortus</i>	-	-	-	5.1	-	-	-	-	-	-	5.1	3.7	5.8	-	-	5.5
<i>Saccharum spontaneum</i>	-	-	1.7	0.7	-	-	-	1.4	-	-	-	-	-	-	-	-
<i>Achyranthes aspera</i>	-	-	3.2	-	-	-	-	-	-	-	5.1	-	-	-	-	5.5
<i>Amaranthus viridus</i>	-	-	11.1	-	-	-	-	1.7	-	-	10.2	-	-	-	-	-
<i>Ipomoea cornea</i>	0.5	-	-	-	-	-	-	-	-	2.5	-	-	-	-	-	-
<i>Tribulis terrestris</i>	-	1.9	-	-	-	-	-	-	-	5	-	-	-	-	-	-
<i>Trichodesma indicum</i>	-	1.3	-	-	-	-	-	-	-	2.5	-	-	-	-	-	-
<i>Barleria cristata</i>	-	0.5	-	-	-	-	-	-	-	2.5	-	-	-	-	-	-

2). An earlier study conducted in the neighboring city of Islamabad, Shabbir and Bajwa (2006) revealed that a transition phase of competition was underway between *P. hysterophorus* and *C. sativa*, both species very invasive in the capital city, Islamabad.

Data collected from Morgah site revealed that the weed *P. hysterophorus* was associated with very few other plant species. The most dominant species of the site was *C. dactylon* with highest relative frequency of 46% followed by *Cannabis Sativa* (16.4%) and *M. coromendelianum* (13%). The remaining plant species at this site had appreciably low level of relative frequency of occurrence ranging from 1.2 to 4.2 % (Table 2). Once

become a dominant species, *Parthenium* weed has known to form monoculture stands and very little or no vegetation is found in such stands (Navie *et al.* 2006). Similarly, at the Tench bhata site, *P. hysterophorus* was again the most dominant weed species and very little vegetation was seen associated with the weed.

Despite the fact that *Parthenium hysterophorus* is spreading at an alarming rate in most parts of the country, it has not yet attracted the attention of any city district government. There is little action taken to stop its further spread and no weed management plan developed, as a result the weed is continued to expand its range, both in the northern and southern parts of the country. Furthermore, there is

lack of coordination among various research organizations and agriculture extension departments. A national management plan against this is needed otherwise the problem of *Parthenium* weed may become out control.

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