

INVASION OF *PARTHENIUM HYSTEROPHORUS* L. IN DISTRICT NANKANA SAHIB, PAKISTAN

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ABSTRACT: A survey of different areas of district Nankana Sahib, Pakistan was carried out in 2009 to evaluate the invasion of parthenium (*Parthenium hysterophorus* L.), an invasive alien weed that is rapidly spreading in many parts of Pakistan. Eight different localities in the district Nankana Sahib were surveyed. Parthenium was found growing at 90% localities of the district. A total of 64 weed species belonging to 25 angiospermic families were identified in the surveyed area. Parthenium was found to be the second most frequently occurring weed species in the area after the *Coronopus didymus*. The density of the parthenium weed was highest among the 64 identified weed species. The present study clearly indicates that the parthenium has become one of the most dominating weed species in this area. High reproductive potential, conducive environmental factors, allelopathic nature, fast growth rate and lack of natural enemies are the major factors responsible for rapid invasion of parthenium in Pakistan. It is need of the hour to take appropriate measures to contain the further spread of this aggressive weed in the country.

Key words: Aggressive, Angiospermic, Obnoxious, Parthenium, Weed

INTRODUCTION

Parthenium (*Parthenium hysterophorus* L.) is an obnoxious weed of family Asteraceae, native to Tropical America. Now it has been reported to spread many parts of Africa, Asia, Australia (Navie *et al.*, 1996; Dhileepan and Senaratne, 2009; Tang *et al.*, 2009). The weed has occupied a large proportion of waste and grazing lands in Punjab, Khyber Pakhtoon Khwa and Kashmir (Javaid and Anjum, 2005; Riaz and Javaid, 2007; Javaid *et al.*, 2009). It occurs widely along roadsides and railway tracks, abandoned fields, in wide open valleys as well as in and around the crop fields. This species has also been found in the commercial fields of cut flowers (Riaz *et al.*, 2007). It over competes other plant species upon invasion resulting in adverse effect on natural vegetation and standing crops (Kohli and Rani, 1994; Evans, 1997). Parthenium is also a serious health problem for humans causing hay fever, skin problems, and asthma (McFadyen, 1995). The weed is also responsible for transmission of tobacco streak virus (Sharman *et al.*, 2009).

In district Nankana Sahib land use type is largely for agricultural purposes with systematic irrigation systems and the intensity of cultivation is high. Wheat, rice, sugar cane, vegetables, tobacco, roses and marigold are the commercial crops of this district. Earlier work regarding the distribution of Parthenium has been carried out in plains of Punjab including district Lahore, Sialkot, Sheikhupura and Okara (Javaid and Anjum,

2005; Javaid and Riaz, 2007; Riaz and Javaid, 2007, 2011; Javaid *et al.*, 2009). Present study was carried out to investigate the extent of parthenium invasion in district Nankana Sahib.

MATERIALS AND METHODS

Description of sampling site: The district of Nankana Sahib is located at latitude 31.16° N and longitude 73.25° E. The total area of the district is 2960 km². The district is located 80 km away in south west of Lahore and about 75 km from Faisalabad. 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.

Phytosociological study: Eight waste lands were selected in district Nankana Sahib, viz. city, Faqirwala, Chak Buddah, Warburton, Bucheki, Syedwala, Chandpur and More Khunda during April-May 2009. The distance between the two adjacent sampling sites was 2–8 km. At each of the eight selected sites, a 1 ha area was demarcated. Sampling was done with a 1 m² quadrat. Ten quadrates were randomly thrown at each sampling site.

Data regarding prevalence, absolute and relative frequency, and absolute and relative density of weeds were recorded by applying the following formulas:

$$\text{Prevalence (\%)} = \frac{\text{No. of sites in which a species occurs}}{\text{Total No. of sites}} \times 100$$

$$\text{Absolute frequency (AF) (\%)} = \frac{\text{No. of quadrates in which a species occurs}}{\text{Total No. of quadrate}} \times 100$$

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

$$\text{Absolute density (AD)} = \frac{\text{Total No. of individual s of a species in all quadrates}}{\text{Total No. of quadrate}}$$

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

RESULTS

In the present study, 64 weed species belonging to 25 angiospermic families were found growing in wastelands of District Nankana Sahib. Maximum number of species (13) belong to family Poaceae followed by Asteraceae (10), Chenopodiaceae (5), Amaranthaceae (4), Pappillinaeae (4), Euphorbiaceae (3), Solanaceae (3). Two species belong to each of the Caryophyllaceae, Cyperaceae, Malvaceae and Scrophulariaceae. The rest of the families viz. Asclepiadaceae, Brassicaceae, Convolvulaceae, Fumariaceae, Geraniaceae, Nyctaginaceae, Oxalidaceae, Plumbaginaceae, Polygonaceae, Primulaceae, Ranunculaceae, Sapindaceae, Verbenaceae and Zygophyllaceae had one species each (Table 1).

Prevalence: Parthenium was found in the seven studied sites exhibiting 90% prevalence. Eight species namely *Ageratum conyzoides*, *Parthenium hysterophorus*, *Amaranthus viridis*, *Chenopodium murale*, *convolvulus arvensis*, *Brachiaria ramose*, *Cynodon dactylon* and *Dactyloctenium aegyptium* exhibited 90% prevalence each. Among others, 6 species namely *Achyranthes aspera*, *Coronopus didymus*, *Cenchrus pennisetiformis*, *Dicanthium annulatum*, *Eragrostis poaeoides*, *Rumex dentatus*, found in all the eight studied sites and showed 100% prevalence. *Solanum xanthocarpum*, *Echinops echinatus*, *Alhagi mourarum*, *Verbena officinalis* and

Tribulus terrestris showed low prevalence i.e. 30%. *Datura alba* showed the least prevalence i.e. 20%. Prevalence of rest of the species ranged from 40–80% (Table 1).

Absolute and relative frequency: *Coronopus didymus* was found to be the most frequently occurring species in the area with absolute frequency (AF) of 40% and relative frequency (RF) of 3.22%. The alien weed parthenium exhibited the second highest AF and RF of 37% and 2.97%. The other frequently occurring species with AF of 30–34% and RF of 2.73–2.09% were *Cichorium intybus*, *Calotropis procera*, *Achyranthes aspera*, *Cirsium arvense*, *Conyza ambigua*, *Cypreus rotundus*, *Chenopodium album*, *Chenopodium murale*, *Convolvulus arvensis*, *Oxalis corniculata*, *Cynodon dactylon*, *Dactyloctenium aegyptium* and *Rumex dentatus*. The moderately frequent species *Eclipta alba*, *Amaranthus viridis*, *Sonchus asper*, *Kochia indica*, *Suaeda fruticosa*, *Euphorbia pilulifera*, *Boerhavia diffusa*, *Medicago polymorpha*, *Melilotus parviflora*, *Plumbago zeylanica*, *Cenchrus pennisetiformis*, *Dicanthium annulatum*, *Eragrostis poaeoides*, *Poa annua*, *Malvestrum tricuspidatum* and *Solanum nigrum* showed AF of 25–30% and RF of 1.04–1.77%. Rest of the rarely and very rarely occurring species exhibited less than 25% AF. The least frequently occurring species in the area was *Xanthium strumarium* with 6% AF and 0.48 RF (Table 1).

Table 1: Prevalence, frequency and density of Parthenium in District Nankana Sahib during 2009.

Weed Species	Family	P (%)	AF (%)	RF (%)	AD	RD (%)
<i>Ageratum conyzoides</i> L.	Asteraceae	90	27	2.17	2.50	2.06
<i>Cichorium intybus</i> L.	"	70	34	2.73	1.75	1.44
<i>Cirsium arvense</i> (L.) Scop.	"	80	34	2.73	0.75	0.61
<i>Conyza ambigua</i> DC.	"	70	34	2.73	2.25	1.85
<i>Echinops echinatus</i> DC.	"	30	10	0.80	0.87	0.71
<i>Eclipta alba</i> Hassk.	"	60	15	1.20	1.25	1.03
<i>Lactuca dissecta</i> D. Don	"	80	13	1.04	2.0	1.65
<i>Parthenium hysterophorus</i> L.	"	90	37	2.97	4.60	3.79
<i>Sonchus asper</i> Vill.	"	80	22	1.77	1.62	1.33
<i>Xanthium strumarium</i> L.	"	30	06	0.48	0.62	0.51

<i>Achyranthes aspera</i> L.	Amaranthaceae	100	25	2.17	1.50	1.23
<i>Amaranthus viridis</i> L.	"	90	27	1.50	1.23	1.20
<i>A. spinosus</i> L.	"	40	13	1.04	0.20	0.16
<i>Digera arvensis</i> L.	"	60	10	0.80	0.87	0.71
<i>Calotropis procera</i> Br.	Asclepiadaceae	80	30	2.41	2.75	2.62
<i>Coronopus didymus</i> (L.) Sm.	Brassicaceae	100	40	3.22	3.62	2.98
<i>Stellaria media</i> (L) Vill.	Caryophyllaceae	30	10	0.80	1.0	0.82
<i>Sagina apetala</i> Ard.	"	30	10	0.80	0.87	0.71
<i>Chenopodium album</i> L.	Chenopodiaceae	70	34	2.73	1.62	1.33
<i>C. ambrosioides</i> L.	"	40	10	0.80	1.50	1.23
<i>C. murale</i> L.	"	90	27	2.17	3.0	2.47
<i>Kochia indica</i> Wight	"	70	14	1.12	2.25	1.85
<i>Suaeda fruticosa</i>	"	70	13	1.04	1.75	1.33
<i>Convolvulus arvensis</i> L.	Convolvulaceae	90	30	2.41	3.50	2.88
<i>Cyperus rotundus</i> L.	Cyperaceae	80	35	2.81	3.37	2.78
<i>Scirpus roylei</i> (Nees) Duthie	"	40	10	0.80	0.50	0.41
<i>Croton sparsiflorus</i> Morong	Euphorbiaceae	40	30	2.41	1.12	0.92
<i>Euphorbia pilulifera</i> L.	"	40	15	1.20	0.75	0.61
<i>E. heliscopia</i> L.	"	40	10	0.80	1.00	0.82
<i>Fumaria indica</i> Puysley	Fumariaceae.	60	15	1.20	1.62	1.33
<i>Oxalis corniculata</i> L.	Geraniaceae	80	30	2.41	2.37	1.95
<i>Malva parviflora</i> L.	Malvaceae	70	14	1.12	2.12	1.74
<i>Malvestrum tricuspidatum</i> A. Gray	"	80	26	2.09	1.87	1.54
<i>Boerhaavia diffusa</i> L.	Nyctaginaceae	80	14	1.12	1.50	1.23
<i>Alhagi maurorum</i> Medik	Pappillaceae	30	32	2.57	2.25	1.85
<i>Lathyrus aphaca</i> L.	"	40	10	0.80	0.87	0.71
<i>Medicago polymorpha</i> L.	"	70	18	1.44	1.75	1.44
<i>Melilotus parviflora</i> L.	"	70	14	1.12	0.90	0.74
<i>Plumbago zeylanica</i> L.	Plumbaginaceae	60	15	1.20	2.12	1.74
<i>Brachiaria ramosa</i> (L.) Stapf	Poaceae	90	13	1.04	1.00	0.82
<i>Cenchrus pennisetiformis</i> Hochest	"	100	25	2.01	3.50	2.88
<i>Cynodon dactylon</i> Pers.	"	90	27	2.17	3.00	2.47
<i>Dactyloctenium aegyptium</i> Beauv.	"	90	27	2.17	3.62	2.98
<i>Dicanthium annulatum</i> Stapf.	"	100	25	2.01	4.00	3.30
<i>Digitaria timorensis</i> (Kunth) Balansa	"	80	18	1.44	2.62	2.16
<i>Eleusine indica</i> Gaertn.	"	90	13	1.04	1.75	1.44
<i>Eragrostis poaeoides</i> Beauv.	"	100	25	2.01	4.25	3.50
<i>Imperata cylindrica</i> L.	"	70	14	1.12	2.37	1.95
<i>Poa annua</i> L.	"	80	18	1.44	3.12	2.57
<i>Setaria glauca</i> Beauv.	"	40	10	0.80	1.50	1.23
<i>Setaria verticillata</i> Beauv.	"	33	05	0.42	0.05	0.28
<i>Sorghum helepense</i> Pers.	"	80	15	1.20	2.62	2.16
<i>Anagallis arvensis</i> L.	Primulaceae	40	10	0.80	0.75	0.71
<i>Rumex dentatus</i> L.	Polygonaceae	100	26	2.09	4.37	3.60
<i>Ranunculus muricatus</i> L.	Ranunculaceae	40	10	0.80	1.00	0.82
<i>Ganophyllum falcatum</i> Blume	Sapindaceae	70	08	0.64	1.35	1.11
<i>Mazus rugosus</i> Lour.	Scrophulariaceae	60	15	1.20	1.25	1.03
<i>Veronica agrestis</i> L.	"	70	14	1.12	0.37	0.30
<i>Datura alba</i> Nees	Solanaceae	20	10	0.80	1.37	1.13
<i>Nicotiana plumbaginifolia</i> Viv.	"	30	10	0.80	0.62	0.51
<i>Solanum nigrum</i> L.	"	70	14	1.12	0.90	0.74
<i>Solanum xanthocarpum</i> Sch. & Wend.	"	30	10	0.80	0.62	0.51
<i>Verbena officinalis</i> L.	Verbenaceae	30	10	0.80	0.75	0.61
<i>Tribulus terrestris</i> L.	Zygophyllaceae	50	13	1.04	1.12	0.92

P = Prevalence **AF** = Absolute frequency
RF = Relative frequency **AD** = Absolute density **RD** = Relative density.

Absolute and relative density: The most densely populated weed in the area was *Parthenium hysterophorus* that exhibited an absolute density (AD) of 4.60 and relative density (RD) of 3.79%. *Eragrostis*

poaeoides was found to be the second most densely populated weed in the surveyed area with AD of 4.25 and RD of 3.50%. The other densely populated weeds which showed AD 2.0 or above were *Ageratum conyzoides*, *Conyza ambigua*, *Lactuca dissecta*, *Calotropis procera*, *Chenopodium ambrosioides*, *Kochia indica*, *Convolvulus arvensis*, *Alhagi mourarum*, *Digitaria timorensis*, *Imperata cylindrica*, *Poa annua* and *Sorghum helepense*. Other weed species with fairly low AD of 0.62-0.20 were *Xanthium strumarium*, *Scirpus roylei*, *Nicotiana plumbaginifolia*, *Solanum xanthocarpum* and *Amaranthus spinosus* (Table 1).

DISCUSSION

Among the 64 species of 25 angiospermic families recorded in the surveyed area, 10 belonged to family Asteraceae. All these species exhibited 30-90% prevalence and absolute frequency of 6-37% showing that the prevailing edaphic and environmental conditions of the area are highly conducive for the distribution and growth of asteraceous species. The environment is especially well suitable for the alien weed parthenium that exhibited 90% prevalence, 37% AF and a high AD of 4.60 plants m⁻².

Although parthenium was introduced in India in 1950s through imported food grains (Evans, 1997), however, its presence in different parts of the Punjab, Pakistan was noticed only during the last 15-20 years (Javaid and Anjum, 2005). During this short period it has become one of the most frequently occurring and densely populated weeds in the studied area. Similar domination of parthenium at waste and grazing lands has also been reported in districts Lahore, Okara, Rawalpindi and Sheikhpura (Javaid and Riaz 2007, Riaz and Javaid, 2007, 2009; Javaid *et al.*, 2009). This weed is also reported to be rapidly spreading in parts of Khyber Pakhtoon Khaw and Kashmir (Javaid and Anjum, 2005).

Many factors are responsible for rapid spread of parthenium in Pakistan. The most important factor is the very high seed producing habit of this weed species. It can produce up to 25,000 seeds per plant (Navie *et al.*, 1996), and may have an enormous seed bank, estimated at 200,000 seeds m⁻² in abandoned fields (Joshi, 1991). Parthenium is very fast maturing annual, generally plants commence flowering when they are 4 to 8 weeks old and may flower for several months. Allelopathic nature of parthenium also plays an important role in its rapid spread and colonization in an area. It inhibits the germination and growth of neighboring plants by releasing various allelochemicals such as water soluble phenolics and sesquiterpene lactones including parthenin and coronopilin (Belz *et al.*, 2009; Reinhardt *et al.*, 2009; Wakjira *et al.*, 2009). Generally animals do not eat parthenium and thus it spreads very rapidly. 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 Pakistan. Due to its high reproductive and allelopathic potential, fast growth rate and lack of natural enemies, parthenium may attain the status of most dominating weed in the surveyed and surrounding areas in near future. There is an urgent need to take appropriate measures to contain further spread of this alien invasive weed in the area.

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