

PARTHENIUM HYSTEROPHORUS L., AN ALIEN INVASIVE WEED THREATENING NATURAL VEGETATIONS IN PUNJAB, PAKISTAN

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Abstract

Parthenium (*Parthenium hysterophorus* L.) is an invasive weed of family Asteraceae, native to Tropical America. This weed has been rapidly spreading in different parts of Pakistan for the last 20 years. Surveys of different areas of the province Punjab viz. Lahore, Sialkot, Nankana Sahib, Hafiz Abad, Okara, Shekhupura, Wah Cantt, and Attock, were carried out during 2006–2010 to evaluate the invasion of parthenium weed in these areas. Generally, ten localities in each area were surveyed. Different parameters of weed distribution viz. prevalence (presence or absence at different localities in an area), frequency (presence or absence at different sites at a locality) and density (number of plants per meter square) were recorded. *Parthenium* showed 90–100% prevalence in different surveyed areas. The frequency and density of this weed ranged from 36–90% and 1–20 m², respectively in the various studied areas. Present study concludes that parthenium has become a problematic weed in various regions of the Punjab and is rapidly replacing the local flora. High reproductive potential, allelopathic nature, fast growth rate and lack of natural enemies coupled with conducive environmental factors are the major factors responsible for rapid invasion of parthenium in the region. It is the need of the hour to take appropriate measures to contain the further spread of this aggressive weed in the country.

Introduction

Parthenium hysterophorus L., native to tropical America, now has widespread distribution in many parts of Asia, Africa and Australia (Navie *et al.*, 1996). The weed introduced in India in 1955 through imported seed grains and with the passage of time spread in most parts of India (Chandras & Vartak, 1970). Introduction of this weed in Pakistan is possibly from India. *Parthenium* is rapidly spreading in different parts of Punjab, Khyber Pakhtoon Khawa and Kashmir, and is becoming a dominant weed species in different terrestrial ecosystems by replacing the local flora (Javaid & Anjum, 2005; Javaid *et al.*, 2007). The weed is highly invasive in nature and has the ability to form huge monocultural stands. It is a potential major weed for agro-ecosystems in Pakistan (Adkin & Navie, 2006). A number of agricultural and environmental problems have been reported due to parthenium weed (Evans, 1997). It exhibit strong allelopathic potential against the associated plant species (Singh *et al.*, 2002). Parthenin, a sesquiterpene lactone, is the active secondary metabolite, and the major component and the active secondary metabolite of parthenium (Hernández *et al.*, 2011), is responsible for most of the allelopathic activities of this weed (Belz *et al.*, 2007). *Parthenium* is also notorious for the hazards it poses to humans and animals health (Evans, 1997). This weed is the major cause of airborne contact dermatitis, a type IV

hypersensitivity reaction in India. The weed is also known to cause type-I hypersensitivity in atopic individuals in the form of allergic rhinitis and asthma (Kumar *et al.*, 2012). The present study was carried out to investigate the invasion of parthenium in different regions of the province Punjab, Pakistan.

Materials and Methods

Surveys of different regions of the province Punjab viz. Lahore, Sialkot, Nankana Sahib, Hafiz Abad, Okara, Shekhupura, Wah Cantt, and Attock were carried out during 2006–2010 to study the invasion of parthenium weed in these areas. Surveys were conducted during spring and rainy seasons when there was abundance of vegetation. In each of the ten selected regions of the Punjab, about 10 natural localities (waste or grazing lands) were selected which were far apart from each other. Sampling was done with the help of a 1×1 m² quadrat. At each locality, ten quadrates were thrown at random and data regarding various attributes of weeds distribution were recorded. Various studied parameters were prevalence, frequency and density of various weed species. Prevalence describes the distribution of a weed in a selected region. Data regarding prevalence was recorded on the bases of presence or absence of a weed species at different localities of a region using the following formula:

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

Frequency describes the distribution of a weed at a selected locality in a region. Data regarding the frequency was recorded on the bases of presence or absence of a

weed species in different quadrates thrown at a locality by applying the following formula:

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

Density of a weed describes the number of plants of that species in unit area at a locality. Density of various weed species was calculated as follows:

$$\text{Density} = \frac{\text{Total no. of individuals of a species in all quadrates}}{\text{Total no. of quadrate}}$$

Data regarding the various parameters of weeds distribution were recorded for all the weed species observed at each locality. However, for simplicity only the weed distribution data of parthenium and the other most commonly occurring weed species in different regions are presented here.

Results and Discussion

Prevalence: Parthenium found in all the selected localities in Lahore, Wah Cantt and Attock showing 100% prevalence. In all other surveyed regions its prevalence was 90% (Fig. 1A). It was found as prevalent in hilly areas of Wah Cantt and Attock as in plain districts of Lahore and others. Although well planned surveys of

other hilly areas were not a part of this study, however, we observe that this weed is also prevalent in other Pothohar region including Jehlem, Rawalpindi/Islamabad etc. However, weed was not found in Kheora region possibly because of high salinity in this region. Presence of parthenium at 90% localities or more in different surveyed regions reveals very highly adaptability of this weed in different regions of the Punjab. A number of factors are responsible for its high prevalence in various regions. This weed has the potential of producing a large number of seeds. It is estimated that a single plant can produce up to 25000 seeds per season (Navie *et al.*, 1996). Seeds are very light in weight and armed with pappus, which help its far-reaching spread and establishment (Ramaswami, 1997).

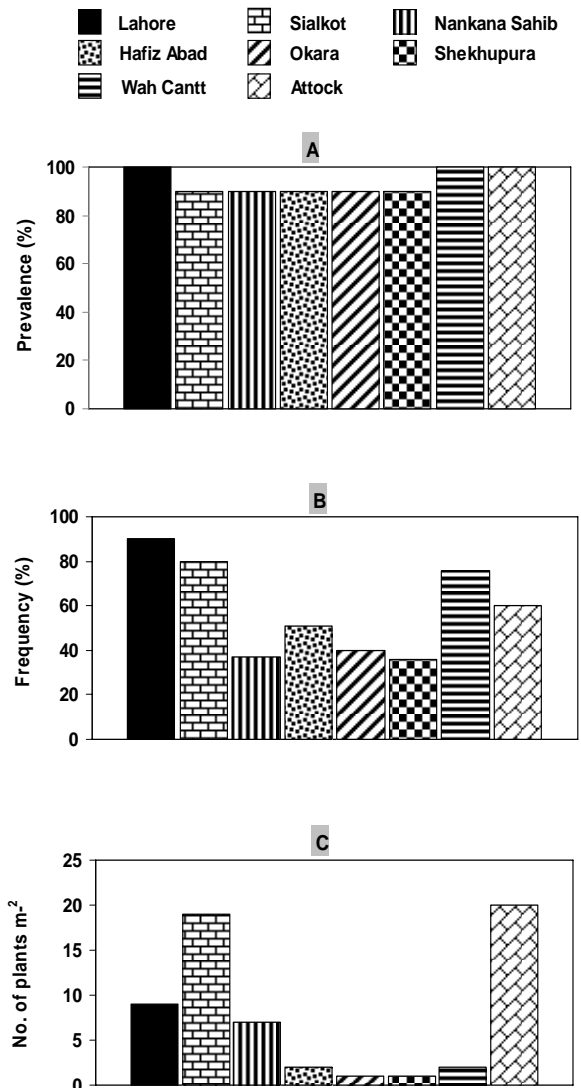


Fig. 1. Prevalence, frequency and density of parthenium weed in different regions of Punjab.

A total of 53, 35, 64, 67, 38, 38, 44 and 58 weed species were found growing in association with parthenium in Lahore, Sialkot, Nankana Sahib, Hafiz Abad, Okara, Shekhupua, Wah Cantt and Attock, respectively (Table 1). Other weeds showing very high prevalence at par with parthenium in one or more of the surveyed regions were *Coronopus didymus* (L.) Sm., *Malvestrum tricuspidatum* A. Gray, *Echinochloa colonum* (L.) Link, *Cynodon dactylon* Pers., *Dactyloctenium aegyptium* Beauv., *Digitaria timorensis* (Kunth) Balansa, *Chenopodium album* L., *C. mural* L., *Eragrostis poaeoides* Beauv., *Ageratum conyzoides* L., *Convolvulus arvensis* L., *Rumex dentatus* L., *Cenchrus pennisetiformis* Hochest, *Achyranthes aspera* L., *Amaranthus viridis* L., *Cyperus rotundus* L., *Tribulus terrestris* L., *Dactyloctenium aegyptium* Beauv., *Oxalis corniculata* L., *Verbena tenuisecta* L., *Canabis sativa* L. and *Dicanthium annulatum* Stapf. (Table 2).

Frequency: Parthenium was found the most frequently occurring weed in Lahore and Attock with 90% and 60% frequency of occurrence, respectively (Table 1, Fig. 1B). The other most frequently occurring weeds in Lahore were *M. tricuspidatum*, *E. colonum*, *C. dactylon*, *D. aegyptium* and *D. timorensis* showing 50–70th frequency. Likewise in Attock *A. asper*, *C. didymus*, *C. rotundus*, *C. dactylon* and *D. annulatum* were the most frequent weed species after parthenium exhibiting 35–58% frequency of occurrence. Although in Wah Cantt, parthenium was the second most frequent weed, however, its frequency was comparatively high i.e., 76% as compared to 83% of the most frequent weed *C. sativa*. In Sialkot and Nankana Sahib, parthenium was also recorded as the second most frequently occurring weed species, the first being the *C. dactylon* and *C. didymus*. In Okara, Shekhupura and Hafiz Abad, parthenium was the 8th, 9th and 11th frequently occurring weed species with 40, 36 and 51% frequency, respectively (Table 1 & 2, Fig. 1B). Similar invasions of parthenium in national wildlife parks in southern India are reported (Evans, 1997). There are also reports of total habitat change in native Australian grasslands, floodplains, river banks and open woodlands invasion of this noxious weed (McFayden, 1992).

Table 1. Status of parthenium distribution in different areas of Punjab as compared to local weed species.

Studied area	Total no. of weed species	Rank of Parthenium		
		Prevalence	Frequency	Density
Lahore	53	1	1	2
Sialkot	35	1	2	1
Nankana Sahib	64	2	2	1
Hafiz Abad	67	2	11	8
Okara	38	2	8	8
Shekhupura	38	1	9	8
Wah Cantt	44	1	2	2
Attock	58	1	1	1

Table 2. Distribution of five most commonly occurring weeds (other than parthenium) in 10 surveyed regions of Punjab.

Species	Family	Prevalence	Frequency	Density
Lahore				
<i>Malvestrum tricuspidatum</i> A. Gray	Malvaceae	100	60	7.8
<i>Echinochloa colonum</i> (L.) Link	Poaceae	100	50	3.1
<i>Cynodon dactylon</i> Pers.	"	100	70	36
<i>Dactyloctenium aegyptium</i> Beauv.	"	100	70	7.3
<i>Digitaria timorensis</i> (Kunth) Balansa	"	100	60	5.3
Sialkot				
<i>Malvestrum tricuspidatum</i> A. Gray	Malvaceae	90	50	12
<i>Cynodon dactylon</i> Pers.	Poaceae	100	70	39
<i>Chenopodium album</i> L.	Chenopodiaceae	100	30	1
<i>C. mural</i> L.	"	100	40	2
<i>Croton sparsiflorus</i> Morong	Euphorbiaceae	80	30	3.6
Nankana Sahib				
<i>Coronopus didymus</i> (L.) Sm.	Brassicaceae	100	40	3.62
<i>Chenopodium album</i> L.	Chenopodiaceae	70	34	1.62
<i>Cyperus rotundus</i> L.	Cyperaceae	80	35	3.37
<i>Oxalis corniculata</i> L.	Geraniaceae	80	30	2.37
<i>Eragrostis poaeoides</i> Beauv.	Poaceae	100	25	4.25
Hafiz Abad				
<i>Ageratum conyzoides</i> L.	Asteraceae	100	69	2.08
<i>Cynodon dactylon</i> Pers.	Poaceae	100	72	2.22
<i>Rumex dentatus</i> L.	Polygonaceae	100	79	2.46
<i>Convolvulus arvensis</i> L.	Convolvulaceae	100	75	1.28
<i>Cenchrus pennisetiformis</i> Hochest	Poaceae	100	76	2.19
Okara				
<i>Achyranthes aspera</i> L.	Amaranthaceae	100	84	0.19
<i>Amaranthus viridis</i> L.	"	100	64	1.52
<i>Cyperus rotundus</i> L.	Cyperaceae	100	84	2.45
<i>Malvestrum tricuspidatum</i> A. Gray	Malvaceae	100	73	1.47
<i>Tribulus terrestris</i> L.	Zygophyllaceae	100	49	0.68
Shekhupura				
<i>Achyranthes aspera</i> L.	Amaranthaceae	100	93	5.3
<i>Amaranthus viridis</i> L.	"	100	96	4.3
<i>Malvestrum tricuspidatum</i> A. Gray	Malvaceae	100	90	4.4
<i>Cynodon dactylon</i> Pers.	Poaceae	100	90	3.6
<i>Dactyloctenium aegyptium</i> Beauv.	"	100	90	4.5
Wah Cantt				
<i>Oxalis corniculata</i> L.	Oxalidaceae	100	66	1.13
<i>Cynodon dactylon</i> Pers.	Poaceae	100	62	0.98
<i>Rumex dentatus</i> L.	Polygonaceae	100	68	1.06
<i>Canabis sativa</i> L.	Urticaceae	100	83	2.0
<i>Verbena tenuisecta</i> L.	Verbenaceae	100	60	1.17
Attock				
<i>Achyranthes asper</i> L.	Amaranthaceae	100	58	16.1
<i>Coronopus didymus</i> (L.) Smith	Brassicaceae	100	35	8.0
<i>Cyperus rotundus</i> L.	Cyperaceae	100	45	7.0
<i>Cynodon dactylon</i> Pers.	Poaceae	100	56	13.7
<i>Dicanthium annulatum</i> Stapf.	"	100	50	12.4

Density: Parthenium was found the most densely populated weed species in Sialkot, Nankana Sahib and Attock with 19, 7 and 20 plants m⁻², respectively. Its density was also very high in Lahore with 9 plants m⁻². It was the second densely populated weed species in Lahore, the first being the *C. dactylon*. It was also the second most densely populated weed species in Wah Cantt, where it exhibited a density at par with the most densely populated weed *C. sativa* (Table 1, Fig. 1C). Many factors are responsible for high population density of parthenium in various surveyed areas. First, it is an aggressive weed due to its allelopathic nature. All parts of plant contain various allelochemicals water soluble phenolics and parthenin (Venkataiah *et al.*, 2003), which are released into the soil both from living as well as decomposing parthenium plants and adversely affect the germination and growth of neighbouring plants and establishes its own colony at the cost of other vegetation (Kholi & Rani, 1994). Second, parthenium is a very fast maturing weed, starts flowering after 4 to 8 weeks growth and may continue flowering for many months. Joshi (1991) reported a very high seed bank up to 200000 seeds m⁻² in abandoned fields. In addition, it also has a very high regenerative potential (Dagar *et al.*, 1976). Third, it is generally a non-grazing weed species, thus grows unchecked in the absence of a grazing pressure. Fourth, pests and diseases which are abundant in its native homeland, are generally absent in Pakistan. In the present study, in Hafiz Abad, Okara and Shekhupura, parthenium was found to be the 8th densely populated weed species with 2, 1 and 1 plants m⁻², respectively (Table 1, Fig. 1C). Although in these areas, number of parthenium plants were lower as compared to local weed species, however, due to its greater height and spread than most of the local weed species, parthenium has attained a dominant status in most of the grazing and waste lands of these areas.

The present study concludes that parthenium is rapidly spreading in many part of the Punjab. There is an urgent need to take appropriate measures to manage this emerging threat to plant biodiversity in the province.

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