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SPREAD OF PARTHENIUM WEED AND ITS BIOLOGICAL CONTROL AGENT IN THE PUNJAB, PAKISTAN

Asad Shabbir^{1,2}, Kunjitapatham Dhileepan³ and Steve W. Adkins¹

ABSTRACT

*Parthenium weed is invasive in many regions worldwide. In Pakistan, parthenium weed was first reported from Gujarat district of Punjab Province in 1980s. After 20 years of slow spread, it has spread rapidly in the past 10 years into many districts of Punjab and Khyber Pukhtunkhwa and possibly to Sind Provinces. Parthenium weed is now a dominant weed in wastelands and is becoming a problematic weed in irrigated and rainfed cropping systems, pasture lands, forests and national parks. Studies conducted prior to 2000 indicated that parthenium weed was only infesting the northern districts of Punjab. However, a recent survey carried out in 2009 on distribution of parthenium weed and its biological control agent *Zygogramma bicolorata*, a leaf defoliating beetle, had revealed that this weed has rapidly spread while biological control agent is spreading in a zone behind that of weed. The weed has now moved from northern to southern districts of Punjab and is threatening many other districts such as Okara, Pakpattan, Sahiwal, Khanewal, Multan and Bahawalpur. The presence of parthenium weed in southern Punjab is a potential threat to cotton and dairy industries of Punjab.*

Keywords: Parthenium weed, *Zygogramma bicolorata*, Pakistan, Punjab, distribution

INTRODUCTION

Parthenium weed (*Parthenium hysterophorus* L.) is an annual herb of Asteraceae family, originating from tropical Americas and now a weed of global significance in many countries around the world (Dhileepan, 2009; Fig. 1). It reduces crop and pasture productivity, reduces native plant community biodiversity and negatively affects human and animal health (Nath, 1981; McFadyen 1995; Shabbir & Bajwa 2006). Parthenium weed was first reported from Gujarat district of Punjab Province in 1980 (Razaq *et al.*, 1994) and since then it is rapidly spreading throughout the Province of Punjab, the Islamabad Capital Territory (ICT) and parts of Khyber Pukhtunkhwa Province

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(Shabbir, 2002; Adkins and Navie, 2006; Shabbir and Adkins, 2008). In Pakistan, parthenium weed is mainly found in wastelands, along the roadsides, and abandons fields but recently the weed was found in pasture and crop lands (Shabbir, 2002). The weed is threatening natural and agricultural ecosystems and has been reported from national parks and forest reserves. The core infestations of this noxious weed were reported in central and northern districts of Punjab and ICT, though its exact distribution is not well documented. As yet, it has not been reported from southern districts of Punjab province. However, given parthenium weed's highly invasive nature and changing climatic conditions of Punjab, it is hypothesized that the weed has spread to southern districts of this province and possibly to the bordering province of Sind.

A leaf defoliating beetle, *Zygogramma bicolorata* Pallister (Chrysomelidae: Coleoptera), was found in forest reserves near Lahore, Pakistan (Javaid and Shabbir, 2007). The *Z. bicolorata* had been tested and released as a classical biological control agent in 1980 in Queensland, Australia, where this biological control agent had a significant effect on parthenium weed (Dhileepan, 2001/2003). The beetle was independently tested and released as a biological control agent against parthenium weed in India in 1984 (Jayanth, 1987). Presumably the agent arrived in Pakistan from India after its release there. To date, there is very little data on present distribution of *Z. bicolorata* in the core parthenium weed infestations of Pakistan. The main objective of this study was to record the current distribution of parthenium weed and its biological control agent, *Z. bicolorata*, in Punjab, Pakistan to aid in future weed management planning.

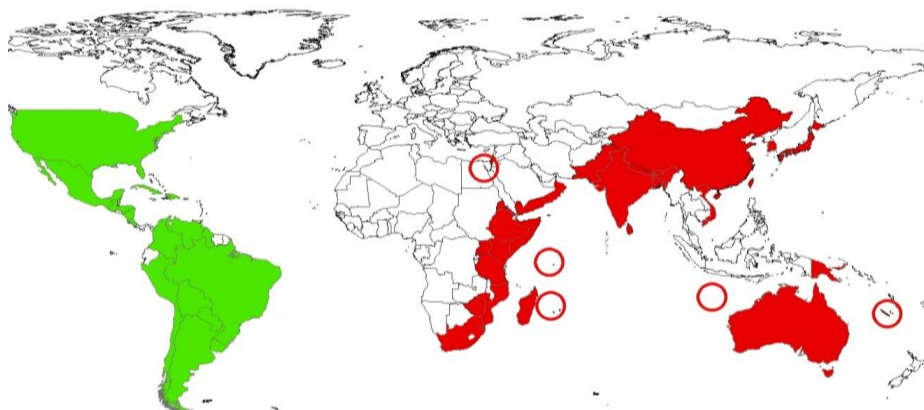


Figure. 1. A worldwide map of Parthenium weed distribution. Parthenium weed is invasive in the countries shaded or circled red; countries shaded green are considered its native range.

MATERIALS AND METHODS

Surveys for parthenium weed and *Z. bicolorata* were carried out throughout Punjab Province and ICT in March-May 2009; however the more extensive surveys were undertaken in central Punjab. The surveys followed the major road networks out from the core infestation of parthenium weed. Wastelands and cropped areas outside of the core infestation were also surveyed. In every 10 km, the presence/absence of parthenium weed and *Z. bicolorata* was recorded. If parthenium weed was present, its density per square metre was also recorded (i.e. low, 1-2 plants/m²; medium, 2-4 plants/m²; high, >4 plants/m²). The geographical coordinates and altitudes of all the survey sites were recorded using a GPS navigator (Garmin Model – 60CSx) and ArcGIS v. 9.3 software (ESRI) was used to map the distribution of parthenium weed and *Z. bicolorata*.

RESULTS

The survey revealed that parthenium weed is now more widespread in Punjab province and ICT (Table 1). Earlier studies (Shabbir, 2002; Shabbir and Adkins, 2008) have shown that the core infestation of parthenium weed was centred in north eastern districts of Punjab province, including ICT. Current surveys show parthenium weed is moving from north eastern districts to southern districts of Punjab (Fig. 2). The southern districts with parthenium weed infestations include Okara, Pakpattan, Sahiwal, Khanewal, Multan and Bahawalpur. The occurrence of parthenium weed in the southern districts such as Sahiwal and Khanewal present potential threats to agriculture and dairy industries of the Province. Similarly, parthenium weed in the south (Sahiwal, Khanewal, Multan and Bahawalpur) is a threat to cotton industry of the country.

Parthenium weed was growing in North West districts of Chakwal, Mianwali and Attock but not found in the salt range of Potohar plateau. In Kasur district, the town of Pattoki had a high density of parthenium weed. Parthenium weed infestations were not found in most of southern districts bordering the Baluchistan (such as DG Khan and Rajanpur) and Sind (such as Rahim Yar Khan). However, it was found near sale points of nurseries in southern districts including Bahawalpur, a district remote from any other parthenium weed infestation.

The major clusters of *Z. bicolorata* were found in northern Punjab and in ICT. One cluster lies close to eastern districts (Lahore, Narowal, Gujrat and Sialkot) on the Indian border and other in North West districts (Attock, Chakwal). The beetle was not recorded from central and southern districts of Punjab province (Fig. 2).

Table-1. *Parthenium* weed density and occurrence of *Z. bicolorata* in different districts of the Punjab province and the ICT, Pakistan, as surveyed in March-May 2009.

Survey number	Districts	<i>Parthenium</i> weed density ^a	<i>Z. bicolorata</i> ^b
1	Attock	M	+
2	Bahawalnagar	Nil	-
3	Bahawalpur	L	-
4	Bhakkar	Nil	-
5	Chakwal	L	+
6	Dera Ghazi Khan	Nil	-
7	Faisalabad	M	-
8	Gujranwala	H	+
9	Gujrat	H	+
10	Hafizabad	H	+
11	Jhang	M	-
12	Chiniot	M	-
13	Jhelum	M	+
14	Kasur	H	+
15	Khanewal	L	-
16	Khushab	M	+
17	Lahore	H	+
18	Layyah	Nil	-
19	Lodhran	Nil	-
20	Mandi Buhaudin	H	+
21	Multan	L	-
22	Muzzafargarh	Nil	-
23	Mianwali	L	-
24	Nankana	H	+
25	Narowal	H	+
26	Okara	H	-
27	Pakpatan	M	-
28	Rahim Yar Khan	Nil	-
29	Rajan Pur	Nil	-
30	Rawalpindi	H	-
31	Sahiwal	M	-
32	Shekhupura	H	+
33	Sialkot	H	+
34	Sargodah	H	+
35	Toba Tek Singh	H	-
36	Vehari	Nil	-

^a L = low, M = medium, H = high, Nil = absent

^b + = present, - = absent

DISCUSSION

In late 1990s, *Parthenium* weed was reported only in eastern districts of Punjab province and ICT (Shabbir, 2000). Now parthenium weed is present in 28 of 36 districts of Punjab province, having spread from northern to southern Punjab. It is still at a relatively low density in Southern districts (Table 1). *Parthenium* weed harbours a number of insect pest and crop diseases, including the Tobacco Streak Virus

(TSV) which affects important crops such as cotton (Kishun and Chand, 1987; Pandey *et al.*, 1991). Parthenium weed is the principle source of TSV epidemics in Australia (Sharman *et al.*, 2009). In Pakistan, TSV has caused severe yield declines in cotton crops (Ahmed *et al.*, 2003). The spread of parthenium weed in southern cotton belt poses a new and grave threat to cotton industry, the backbone of Pakistan's agricultural based economy.



Figure 2. Distribution of *Parthenium* weed and *Zygotogramma bicolorata* in Punjab, Pakistan as surveyed in 2009. The red circles indicate the sites where both *Parthenium* weed and *Zygotogramma* beetle were recorded.

Seed transport by vehicles is a major factor in long distance dispersal of parthenium weed in Australia (Nguyen unpublished data). The spread of parthenium weed in Punjab may likewise be due to frequent vehicle movement and goods transport between districts, as all districts have a network of major and minor roads. Parthenium weed is now a threat to agriculture and pastoral lands of Khyber

Pakhtunkhwa Province (Hasan, 2009), probably due to spread of the weed from bordering districts of Punjab.

Parthenium weed was found near plant nurseries in almost all major towns in Punjab province, including the remote southern Bahawalpur district. Large populations of *parthenium* weed were also growing in Pattoki floriculture farms in Kasur district. Pattoki is a floriculture business hub of the country and farms here supply plants not only to Punjab but also other provinces, including ICT. The soil used for potting plants may be contaminated with *parthenium* weed seeds.

The biological control agent *Z. bicolorata* is present in northeast and north-west districts of Punjab, as predicted by CLIMEX model (Dhileepan and Senaratne, 2009). Areas in KPK and some southern districts of Punjab province also seem suitable to this beetle, but so far it has not been observed there. The current data about distribution of *parthenium* weed and *Z. bicolorata* is therefore not only useful for mapping but also for further climate suitability studies to aid effective redistribution of biological control agent in Pakistan.

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