



***Parthenium* infestation and yield losses in agricultural crops**

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ABSTRACT

Parthenium hysterophorus L. (family Asteraceae), commonly known as *Parthenium* weed is known for its notorious role as an environmental, medical and agricultural hazard. The study was carried out to see the status of *Parthenium* infestation and its effect on yield losses caused to various cereals, oil, pulse, forage, sugar, vegetable, agroforestry and flowering crops cultivated in Haryana and some parts of Punjab, Uttar Pradesh and Delhi. Of the total 25 crops surveyed in different seasons, *Parthenium* was recorded in three cereals viz. rice (*Oryza sativa*), wheat (*Triticum aestivum*) and sorghum (*Sorghum vulgare*). However, it was not recorded in maize (*Zea mays*) and pearl millet (*Pennisetum typhoides*), the other commonly grown cereals in the States. Among different crops, the severe infestation of *Parthenium* was recorded in *Saccharum officinarum* (64.15%) followed by *Eruca sativa* (63.35%), *Helianthus annuus* (57.85%), *Brassica campestris* (57.63%), *Trifolium alexandrinum* (56.91%) and *Populus* sp. (54.63%). The vegetable crop infested by *Parthenium* weed included lady's fingers (*Abelmoschus esculentus*), onion (*Allium cepa*), garlic (*A. sativum*), carrot (*Daucus carota*), cucumber (*Cucurbita maxima*), potato (*Solanum tuberosum*) and leguminous fodder Egyptian clover (*Trifolium alexandrinum*). Maximum loss due to *Parthenium* infestation was observed in *E. sativa* (55%) and sunflower (52.5%).

Key words: *Parthenium hysterophorus*, Infestation, Agriculture crops, *E. sativa*, Yield loss

Parthenium hysterophorus L. weed belongs to the family Asteraceae (tribe: Heliantheae and subtribe: Ambrosiinae). This weed is native to the area of Neotropical origin and has now invaded more than 34 countries globally, including five continents and numerous islands (Adkins and Shabbir 2014). In India *Parthenium* has invaded about 35 million hectares of land (Sushilkumar and Varshney 2009) since its introduction at Pune in 1955 (Rao 1956).

It has been reported as an extremely aggressive colonizer of crops causing a yield decline upto 40% (Khosla and Sobti 1979) and reducing forage production in grasslands upto 90% (Nath, 1988). The disseminated pollen grains of the weed deposited to the aerial parts of the neighbouring plants are said to cause pollen allelopathy that inhibit pollen germination and fruit setting in *Crotolaria perlida*, *Desmodium heterocarpon*, brinjal, chilli and tomato (Kanchan and Jaychandra 1980). They also cause reduction in chlorophyll contents in leaves and abnormalities on flower heads and other parts of the plant (Gosal 1988). The allelopathic influence of *Parthenium* plant on succeeding crops like pulses and cereals has also been reported. It is an important weed of upland rice and caused more than 40% yield loss in India (Oudhia

1998). Due to very aggressive in nature, this weed may cause up to 90% loss in pasture production in Australia (Anonymous, 2011). Sorghum grain yield losses were reported between 40 to 97% in Ethiopia, if *Parthenium* is left uncontrolled throughout the season (Tamado *et al.*, 2002). Accumulation of *Parthenium* pollen clusters on floral parts of maize cause 50% reduction in grain filling (Mahadebvappa 1997).

Parthenium not only competes with cultivated crops but also deplete the nutrient pool of the soil in which they grow (Aneja *et al.* 2014). Earlier, *Parthenium* was considered a problem in waste and vacant land but reports started to appear about its infestation in field crops after 1970 (Narasimhan *et al.* 1977). *Parthenium* infestation in crops increased from 0.50 million hectares during 1980 to 14.25 million hectares in 2010 (Sushilkumar and Varshney 2010). The overall average infestation of *Parthenium* varied in different states of India. In general, overall spread in terms of density and infestation level was highest in Andhra Pradesh, Bihar, Chhattisgarh, Delhi, Haryana, Karnataka, Maharashtra, Madhya Pradesh, Punjab, Tamil Nadu and Uttar Pradesh; medium in Assam, Gujrat, Himachal Pradesh, Jharkhand, Jammu & Kashmir, Uttarakhand, Odisha, West Bengal and Rajasthan; low in Andaman & Nicobar, Arunachal Pradesh, Goa Kerala, Lakshadweep, Manipur, Mizoram,

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Mehgalaya, Nagaland, Pondicherry and Sikkim (Sushilkumar 2012, 2014).

Studies showing losses by *Parthenium* in crops are limited. Das (2008) observed severe *Parthenium* competition between 15 to 45 days after sowing while Tamado *et al.* (2002) found between 5 to 59 days after emergence in sorghum. Grain yield reductions due to infestation of *Parthenium* up to 40% in agricultural crops, like rice, wheat, maize, pigeonpea, blackgram, sorghum *etc.* are known (Khosla and Sobti 1979). Parsons and Cuthbertson (1992) reported that *Parthenium* caused a substantial yield loss in sunflower and sorghum in central Queensland, Australia. Angiras and Saini (1997) reported sorghum grain and forage yield losses of 40 and 90%, respectively by *Parthenium*. The adverse impacts of *Parthenium* weed on environment and agriculture have also been reviewed by Kassa (2016) in context to Ethiopia.

This study was carried out to determine the status of *Parthenium* infestation and losses in yield caused in various agricultural crops of North India.

MATERIALS AND METHODS

Surveys were conducted between 2008 to 2014 during different crop seasons to see the infestation status of *Parthenium* in various economically important agricultural crops cultivated in Haryana and some parts of Punjab, Uttar Pradesh and Delhi. A total of 25 different crops including cereal, oil, vegetable, fodder, sugar, agroforestry and flower yielding crops were surveyed to see the per cent occurrence and per cent infestation of *Parthenium* weed. Surveys were also conducted in search of *Parthenium* infestation in orchards of different fruits. The per cent occurrence and infestation of *Parthenium* was calculated as follows:

$$\% \text{ Occurrence} = \frac{\text{No. of fields having } \textit{Parthenium}}{\text{Total number of fields surveyed}} \times 100$$

$$\% \text{ Infestation} = \frac{\text{Total no. of quadrates in which } \textit{Parthenium} \text{ weed occurred}}{\text{Total number of quadrates used}} \times 100$$

The per cent infestation of *Parthenium* was determined by presence and absence of the weed in the selected crop fields. The crop fields were selected on the basis of seasons as well as commonly grown crops in that particular area. The no. of fields visited for different crops were ranged between 20 to 200. Quadrates were used to determine number of *Parthenium* in each of the selected fields and 20 quadrates of 50 x 50 cm² were randomly located at approximately 2 meter intervals throughout the 50 meter length of the field. The number of *Parthenium*

plants was counted within 20 randomly placed quadrates across 20 x 50 m of the fields. The losses in crop yields were also estimated in different crops fields by collecting information from farmers of the field on average crop production of last three to four years with and without *Parthenium*.

RESULTS AND DISCUSSION

Parthenium infestation

Of the total 25 crops surveyed during 2008 to 2014, *Parthenium* was recorded in three cereals, viz. rice (*Oryza sativa*), wheat (*Triticum aestivum*) and sorghum (*Sorghum vulgare*). However, it was not recorded in maize (*Zea mays*) and pearl millet (*Pennisetum typhoides*), the other commonly grown cereals in the states. The vegetables infested by *Parthenium* weed include lady's fingers (*Abelmoschus esculentus*), onion (*Allium cepa*), garlic (*A. sativum*), carrot (*Daucus carota*), cucumber (*Cucurbita maxima*), potato (*Solanum tuberosum*) and fenugreek (*Trigonella foenum graecum*). *Parthenium* weed was found in three oil yielding crops namely sunflower (*Helianthus annuus*), rocket salad or arugula (*Eruca sativa*) and mustard (*Brassica campestris*). Horse gram (*Cicer arietinum*) was the only pulse and Egyptian clover (*Trifolium alexandrinum*) was the only leguminous fodder crop infested by this weed. Sugarcane (*Saccharum officinarum*), the sugar yielding crop; marigold (*Tagetes erecta*) a flowering crop and poplar (*Populus* sp.) a timber yielding crops agro forestry were also found infested by *Parthenium*. Among different crops, the severe infestation of *Parthenium* was recorded in *Saccharum officinarum* (64.15%) followed by *E. sativa* (63.35%), *H. annuus* (57.85%), *B. campestris* (57.63%), *T. alexandrinum* (56.91%) and *Populus* sp. 54.63% (Table. 1). Tiwari and Bisen (1982) also reported infestation of *Parthenium* in field crops like soybean, millets and paddy. In North America, *Parthenium* weed has been recorded in several crops including sugarcane, maize, cotton, sorghum, onion and citrus orchards (Dale 1981).

Infestation of *Parthenium* in sugarcane was much higher (64.2%) than that recorded in other states such as Karnataka (38%) by Patil *et al.* (1997). *Parthenium* has been found to suppress the yield of sunflower and sorghum in sufficient amount (Parsons and Cuthbertson 1992). In Tamil Nadu, crop losses due to heavy infestation of *Parthenium* weed in cotton were found in the range of 300 kg of seeds per ha. Low infestation of *Parthenium* in rice was recorded.

Table 1. Percentage occurrence and infestation of *P. hysterophorus* in various agricultural crops

Crops name	No. of fields visited	No. of fields having weed	% Occurrence of the weed	% Infestation in crops fields
Cereal crops				
<i>Triticum aestivum</i>	200	10	5	52.34
<i>Oryza sativa</i>	200	08	4	11.45
<i>Zea mays</i>	55	0	0	0
<i>Sorghum vulgare</i>	100	25	25	32.45
<i>Pennisetum typhoides</i>	60	0	0	0
Oil crops				
<i>Eruca sativa</i>	30	05	17	63.35
<i>Brassica campestris</i>	100	30	30	57.63
<i>Helianthus annuus</i>	100	20	20	57.85
Pulse crop				
<i>Cicer arietinum</i>	20	03	15	37.40
Vegetable crops				
<i>Pisum sativum</i>	170	0	0	0
<i>Solanum tuberosum</i>	100	05	5	49.79
<i>Allium cepa</i>	75	08	11	30.47
<i>Allium sativum</i>	40	03	8	28.35
<i>Colocasia</i> sp.	35	08	23	15.40
<i>Abelmoschus esculentus</i>	100	05	5	35.48
<i>Cucurbita maxima</i>	100	12	12	12.45
<i>Momordica charantia</i>	100	0	0	0
<i>Cucumis melo var. utilissimus</i>	95	0	0	0
<i>Cucumis sativus</i>	100	0	0	0
<i>Daucus carota</i>	25	06	24	13.45
<i>Trigonella foenum-graecum</i>	30	04	14	52.45
Fodder crop				
<i>Trifolium alexandrinum</i>	100	30	30	56.91
Sugar crop				
<i>Saccharum officinarum</i>	100	87	87	64.15
Timber yielding crop				
<i>Populus</i> sp.	50	20	40	54.63
Flower yielding crop				
<i>Tagetes erecta</i>	50	10	20	17.50

Towers *et al.* (1997) reported the infestation of *Parthenium* in vegetables like beans, tomato, lady's fingers, chilli (*Paprica*), brinjal and potato. Later, Basak (1984) reported that the vegetable crops like bean, chilli, tomato, gourd, lady's fingers, brinjal, potato has also been found infested with *Parthenium* weed. In Haryana, the maximum infestation of this weed has been recorded in fenugreek (52.45%) followed by potato (49.79%), while minimum in pumpkin, *Cucurbita maxima* (12.45%). No infestation was recorded in pea (*Pisum sativum*), bitter gourd (*Momordica charantia*), snake cucumber (*Cucumis melo var. utilissimus*) and cucumber

(*Cucumis sativus*). The reason for no infestation of *Parthenium* in these crops may be due to intensive management practices being adopted because of the low acreage. Patil *et al.* (1977) also reported least spread (8.8%) of *Parthenium* in vegetable crops. In Pakistan, this weed proven to be problematic in a range of agricultural crops namely wheat, rice, sugarcane, sorghum, maize, squash, gourd and watermelon (Shabbir 2012).

Parthenium infestation has also been recorded in the orchards situated at Kandhla town of Muzaffarnagar district in Uttar Pradesh. The orchards of banana (*Musa paradisiaca*), papaya (*Carica papaya*), peach (*Prunus persica*), pear (*Pyrus* sp.), pomegranate (*Punica granatum*) and loquat (*Eriobotrya japonica*) were heavily infested with *Parthenium*. Mahadevappa (1997) also found the profuse growth of *Parthenium* in guava, coconut, grapes, sapota, mango, and cashew; and papaya orchards where weeding was not done frequently and systematically as in the continuous cropped fields. During 2008 - 2009, weed was found infesting sugarcane followed by wheat in succession. In another case, this weed was recorded in rocket salad or arugula (*Eruca sativa*) crop followed by sunflower in the same field.

Losses in crops yield due to *Parthenium*

Study revealed losses in crop yield ranged between 6.5 to 55% (Table 2). The maximum losses were observed in rocket salad or arugula (55%) and sunflower (52.5%). The minimum losses were recorded in *Oryza sativa* (6.5%). The reason for the lowest infestation in rice could be the water logging.

Table 2. Per cent losses in crops yields due to *P. hysterophorus*

Crops name	% Losses in yield
<i>Abelmoschus esculentus</i>	25.0%
<i>Allium cepa</i>	15.0%
<i>Allium sativum</i>	7.5%
<i>Brassica campestris</i>	35.0%
<i>Cicer arietinum</i>	15.0%
<i>Colocasia</i> sp.	7.5%
<i>Cucurbita melo var. utilissimus</i>	7.5%
<i>Eruca sativa</i>	55.0%
<i>Helianthus annuus</i>	52.5%
<i>Oryza sativa</i>	6.5%
<i>Populus</i> sp.	52.5%
<i>Saccharum officinarum</i>	22.5%
<i>Solanum tuberosum</i>	35.0%
<i>Sorghum vulgare</i>	25.0%
<i>Trifolium alexandrinum</i>	27.5%
<i>Trigonella foenum-graecum</i>	25.0%
<i>Triticum aestivum</i>	35.0%

Channappagoudar *et al.* (1990) reported that presence of *Parthenium* in irrigated sorghum in India reduced grain yield by 4.2 to 6.47 to tons/hectare and decreased grain weight by almost 30%. A farmer around Hubli-Dharwar area in Karnataka failed to harvest even two bags of sorghum grains due to heavy *Parthenium* infestation (Krishnamurthy *et al.* 1977).

This findings indicated that *Parthenium* infestation will pose a serious threat in future in agricultural, plantation and vegetables crops in our country. No single management option would be adequate to control this weed across all habitats. There is a need to integrate various management strategies like grazing management, competitive displacement, and culture practices under biocontrol as a core management option.

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