



## Problematic Weed: *Parthenium hysterophorus* and Its Management

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### Abstract

*Parthenium hysterophorus*, also known as parthenium weed, is an invasive species that causes allergic reactions and are distributed to many different countries. Through imported pasture, grain seeds, and livestock feed, they were distributed. In both agricultural and non-agricultural areas, it is also spreading. The parthenium weed causes serious economic losses to people and their interests in numerous countries around the world in addition to endangering the health of people and animals, destroying pastures and crops, and reducing biodiversity in natural plant communities. Various management techniques had been used to reduce the harm this weed was causing. They are physical control, allelopathic effect, chemical control and biological control agents like fungi, stem-boring weevils, stem-galling moths, and leaf-eating beetles. Here, an integrated weed management approach is recommended for the effective management of parthenium weed. Along with the management practice, parthenium weed is utilized through compost preparation.

**Keywords:** Allelopathic effect, Biological control, Integrated weed management, Parthenium weed

### Introduction

Parthenium weed (*Parthenium hysterophorus*) is a noxious and invasive weed that is widely distributed in many parts of the world, in addition to its native range in North and South America and the West Indies. It is well known to be one of the worst weeds that can seriously pollute the environment. The weed has a significant negative impact on pasture and crops. It is commonly known as 'altamisa', carrot grass, bitter weed, star weed, white top, wild feverfew, the "Scourge of India" and congress grass. In India, the weed was first pointed out in Poona (Maharashtra) by Professor Paranjape in 1951. This alien weed is believed to have been introduced into India as contaminants in PL 480 wheat (Public Law 480 passed in 1954 to give food grains to developing countries for eliminating starvation and malnutrition) imported from the USA in the 1950s. Presently, this invasive weed is widely prevalent in India (Singh *et al.*, 2003). *Parthenium hysterophorus* is a global significance responsible for severe human and animal health issues, such as dermatitis, asthma and bronchitis, and agricultural losses besides a great problem for biodiversity. This weed became a menace around the globe, including India; efforts

have been made to manage the weed employing different methods such as mechanical, competitive replacement (allelopathy), chemical, and biological control methods. The recently advocated integrated parthenium management strategy appears to have potential.

### Characteristic of Parthenium Weed

The presence of parthenium in cropped lands results in yield reduction upto 40%. It has a high viability and vigor throughout the year and a large seed production rate. Seeds do not have a dormancy period and are capable of germinating anytime when moisture is available. The highest germination rates are at the temperatures ranging from 12 °C to 27 °C. Persistence tests demonstrated that more than 70% of parthenium seeds buried at 5 cm below the soil surface survived for at least 2 years; whereas, seeds on the soil surface did not survive for longer than 6 months. Seed viability for 20 years has also been reported (Figure 1). A single plant can produce 10,000 to 15,000 viable seeds and these seeds can disperse and germinate to cover large areas. A large single plant produces upto 1,00,000 seeds in its life cycle. More than 340 million seeds ha<sup>-1</sup> can be present in the surface soil.

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Figure 1: *Parthenium hysterophorus*

### Harmful Effects of Parthenium Weed

- Parthenium plant contains chemicals like parthenin, hysterin, hymenin and ambrosin due to the presence of these chemicals the weed exerts strong allelopathic effects on different crops.
- The weed affects nodulation in legumes due to inhibition of activity of nitrogen fixing and nitrifying bacteria like *Rhizobium*, *Actinomycetes*, *Azotobacter*, and *Azospirillum*.
- Causing a total habitat change in grasslands, open woodlands, river banks, and flood plains. Aggressive colonizer of wasteland, road sides, railway sides, water courses, cultivated fields and overgrazed pastures.
- Parthenium weed is toxic to animals causing dermatitis with pronounced skin lesions on various animals including horses and cattles. If eaten, it is responsible for mouth ulcers with excessive salivation.
- The pollen grains, airborne dried plant parts, and roots of parthenium cause various allergies like contact dermatitis, hay fever, asthma, and bronchitis in human beings.
- Pollens of parthenium cause asthma (allergic bronchitis), especially in children playing outdoors and in adults and old-age persons.

### Management of Parthenium Weed

#### Physical Control

Physical control including uprooting, tillage, mowing, flame tossing, burning, hand weeding, etc. are successful in small regions, remote areas, and agricultural fields. The most efficient way is to manually uproot parthenium before flowering and seed germination. When the soil is moist, this is simple to accomplish. It may be effective to plough the weed in before the plants flower and to plant pastures or other vegetation. Parthenium can spread rapidly through the movement of livestock, crops, and automobiles. The spread of seeds can be controlled by washing down vehicles and equipment before entering an area that is not affected. Moreover, parthenium seed contamination needs to be examined when purchasing crop seeds and feed for cattle.

#### Chemical Control

Imazapyr, Oxadiazon, Oxyfluorfen, Pendimethalin, and Thiobencarb are a few herbicides that have been identified to be extremely good against parthenium weed. The most successful post-emergence treatment is bromoxynil + MCPA. More than 93% of the area was controlled by the use of glyphosate, glufosinate, chlorimuron, and trifloxysulfuron during the rosette stage. Diquat @ 0.5 kg ha<sup>-1</sup> and Dicamba @ 2.05 kg ha<sup>-1</sup> are post-emergence herbicides.

#### Allelopathic Control

To reduce parthenium, competitive crops including maize, sorghum, and sunflower are grown. Plants like *Cassia sericea*, *C. tora*, *C. auriculata*, and *Amaranthus spinosus* can be planted to replace parthenium in a competitive manner. The root and shoot extracts of the three allelopathic grasses *Dicanthium annulatum*, *Cenchrus pennisetiformis*, and *Sorghum halepense* decrease Parthenium weed germination and early seedling growth.

#### Biological Control

The stem-galling moth (*Epiblema strenuana*) and buffel grass (*Cenchrus ciliaris* L.) can severely degrade the vegetative and reproductive growth of the plant. In a field study Shabbir *et al.* (2013) demonstrated how biological control agents and suppressive plants can work together to drastically reduce parthenium weed biomass and, more significantly, inhibit seed production. One of the most important methods for managing invasive weeds is classical biological control. To prevent the spread of the weed in the introduced range, plant diseases or insect herbivores from the weed's native range are introduced (Table 1).

#### Classical Biological Control

##### 1. Insects as Classical Biocontrol Agents

Of the various insects, the leaf-feeding beetle and the stem galling moth both imported from Mexico, have shown good potential to control this weed. An insect density of one adult plant<sup>-1</sup> caused skeletonization of leaves within 4-8 weeks.

##### 2. Classical Control by Fungal Plant Pathogens

The most promising fungal agents to manage parthenium weed are *Puccinia abrupta* var. *partheniicola* (Jackson) Parmelee, *Puccinia xanthii* var. *parthenii-hysterophorae* (previously known as *P. melampodii* Diet. and Holw.) (Uredinales), *Entyloma compositarum* De Bary (Ustilaginales), and *Plasmopara halstedii* (Farlow) Berl. and De Toni (Peronosporales).

#### Integrated Weed Management

The most effective way to long-term control of parthenium weed is integrated weed management, which comprises the combination of all possible treatments. Parthenium weed is able to resist separately applied management techniques in many locations, necessitating a more effective combined approach in these areas. Such integrated weed management packages must be effective and economical against the weed, as well as simple to execute and environmentally friendly. In India, Kohli *et al.* (2006) showed that integrating community activities and other land management measures produced an effective management approach for parthenium weed that was more effective than utilizing individual approaches.

Table 1: Biological control agents released around the world to control parthenium weed growth

Sl. No.	Insect/ Pathogen species	Origin	Country released
1.	<i>Epiblema strenuana</i> Walker	Mexico	Australia, Israel, China
2.	<i>Zygogramma bicolorata</i> Pallister	Mexico	Australia, India, Pakistan, Nepal, South Africa, Tanzania
3.	<i>Listronotus setosipennis</i> Hustache	Argentina	Australia, Tanzania
4.	<i>Bucculatrix pathenica</i> Bradley	Mexico	Australia
5.	<i>Puccinia abrupta</i> var. <i>partheniicola</i> (Jackson) Parmelee	Mexico	Australia, India, South Africa, Kenya, Nepal, Ethiopia, China
6.	<i>Puccinia xanthii</i> f.sp. <i>parthenium hysterothorae</i>	Mexico	Australia, South Africa, Sri Lanka
7.	<i>Carmenta nr ithacae</i>	Mexico	Australia

### Management by Utilization

Parthenium can be used for several purposes. But it can most effectively be used in compost and vermicompost making. The compost should only be prepared by pit system. In NADEP method, all the seeds of Parthenium are not killed. The Parthenium biomass should be buried in the pit in layers. On each layer, 5 kg dung slurry and 500 g urea should be used. After filling the pit, it should be closed by the mixture of soil and dung. The compost prepared by Parthenium contains more nutrients than the compost prepared by dung only. Big plants having more fibrous stems and branched can be used to make particle boards and composites.

### Conclusion

Parthenium weed is an extremely aggressive and prolific invasive species with expanding worldwide impact, according to the findings presented in this research. The incorporation of various management approaches such as legislative control, grazing management, seeding of healthy pasture seed, herbicide treatment, and the use of biological control agents have all been found to aid in the management of parthenium weed. In appropriate regions, a limited use of recommended weedicides can be implemented. Biological management is the most effective control technique. Plant species, in particular, should have some economic worth and

should not pose any health or environmental risks. Greatest effort should be put into importing host-specific insects.

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