

## Parthenium Management using the Mexican Beetle: An Eco-friendly Approach of Parthenium Control

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### Abstract:

*Parthenium hysterophorus* L., a herbaceous annual plant in the family Asteraceae (compositae). Its appearance is similar to that of the carrot plant, thus the common name "Carrot Weed" or "Gajar Ghas." It's also known as broom bush, congress grass, bitter plant, and carrot weed. Humans and animals alike are adversely affected by it, with symptoms including dermatitis, asthma, and bronchitis; in addition, agricultural yields are reduced, other effects include devastating effects on the ecosystem, including the reduction or extinction of biodiversity<sup>[1]</sup>. It is commonly thought that this weed was introduced to India when the US PL 480 scheme allowed US grain to be transported to India<sup>[2]</sup>. Various chemical, biological and cultural methods are available to manage parthenium. Biological management may be used to get rid of weeds by enlisting the aid of natural predators and parasites. Cost-effective and environmentally benign, biological management may be used in place of chemical methods. The biological management of Parthenium has mostly focused on insects. Among them, the use of the Mexican beetles (*Zygodontia bicolorata*) has been found to be a highly effective biological control approach that can be easily integrated with other systems.

### Introduction:

*Parthenium hysterophorus* L., a herbaceous annual plant in the family Asteraceae (compositae). Because it looks like a carrot plant, it is often referred to as Gajar Ghas or Carrot Weed. It is also known as congress grass, broom bush, bitter weed and carrot weed.

It is a major threat to biodiversity and causes serious problems for humans and animals like dermatitis, asthma, and bronchitis, as well as agricultural losses. *Parthenium hysterophorus* L., (Asteraceae) is a weed of international concern that can be found in a wide variety of locations across the world, including: Asia (Bangladesh, India, Israel, Pakistan); Africa (Ethiopia, Kenya) South Africa, Somalia, Swaziland, and Zimbabwe); Australia<sup>[3]</sup>.

The seeds of this weed are widely believed to have been introduced to India with grains imported from the United States under the US PL 480 scheme and to have since spread alarmingly like a wildfire to nearly all of the states in India, where they have become naturalised weeds. Professor Paranjape, 1951, identified the carrot weed in Pune (Maharashtra) as plants growing wild on garbage dumps; Rao <sup>[2]</sup> later confirmed the same <sup>[2]</sup>. It is generally known that parthenium is very harmful to human and animal health, causes agricultural losses, and has devastating effects on the ecosystem, including the reduction or extinction of biodiversity <sup>[1]</sup>. With the help of natural predators and parasites, undesirable weeds may be eradicated through biological management. Biological management offers an alternative to chemical approaches that is both cost-effective and non-detrimental to biodiversity.

Insects have been the primary focus of study on Parthenium's biological control, however, viruses and rivals have also been investigated. Unlike other types of regulation, which need continuous upkeep, it could duplicate and expand on its own. There is no difficulty in integrating it with other systems of control. *Zygogramma bicolorata* has been shown to be a very effective biological control method.

### **Biological control of Parthenium:**

Humans use biological control to get rid of unwanted weeds by manipulating natural predators and parasites. Cost-effective and safe for the environment and biodiversity, biological management is a viable alternative to chemical methods. Insects, fungi, nematodes, snails, slugs, and plants that compete with weeds are all examples of potential biocontrol agents <sup>[4]</sup>.

Most research on Parthenium's biological control has focused on insects, while viruses and competitors have also been studied. It may replicate and spread on its own, unlike other forms of control that need regular maintenance. Combining it with other forms of regulation is straight forward. One of the most promising approaches so far is the use of *Zygogramma bicolorata* for biological control. In the context of a biological control programme, host-specific bioagents from the country of origin of an invasive weed are sent to nations where the plant has spread and become a problem. So, we've gone into further depth about it <sup>[4]</sup>.

Mexican beetle <sup>[7]</sup>*Parthenium hysterophorus* L.

### An introduction to *Zygogramma bicolorata*:

- More than fifty insect species are known to feed on Parthenium in India, however so far no native Indian insects have been proven to be host-specific. The *Zygogramma bicolorata* beetle, native to Mexico, has been introduced to India.
- The *Zygogramma bicolorata* Pallister (Coleoptera: Chrysomelidae) beetle was brought to India from Mexico because of its well-documented success in other nations <sup>[4]</sup>.
- In-depth laboratory and field research revealed that it is host specific, feeding only on Parthenium; as a result, the Indian government approved its usage.

### *Zygogramma bicolorata*, a biological insight:

- *Zygogramma bicolorata* grubs and adults feed on Parthenium leaves.
- The beetles range in colour from off-white to light reddish, and they are around 6 mm in length.
- Typically, the eggs are placed on the underside of the leaves and take 4–7 days to hatch. Four instars have been identified.
- After 10–14 days of eating leaves, the grubs will burrow down to pupate in the soil. After 8–12 days, adult beetles appeared.
- In about 22–32 days, the beetle will have completed its whole life cycle.
- A typical insect population in the wild will have 5–6 generations.
- The female may produce up to 2500 eggs during the course of her lifetime.

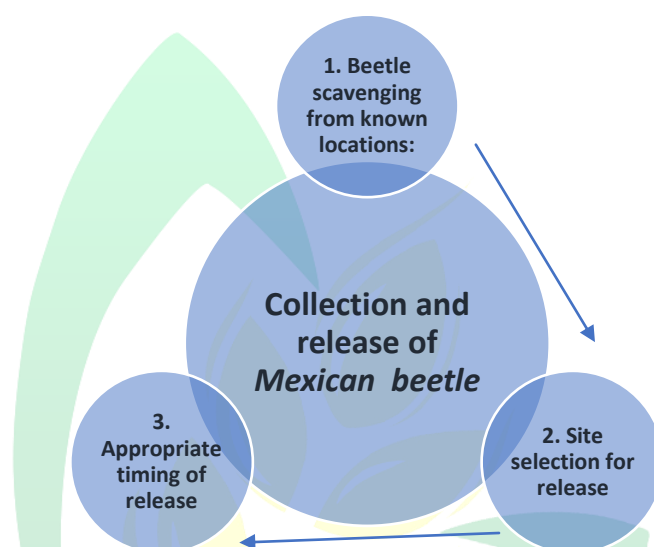
### How do Mexican beetles decimate the Parthenium?



- Parthenium leaves are edible to both adults and grubs. Soon after hatching, grubs begin feeding on tender new leaves, but as they develop, they switch to eating the older leaves <sup>[5]</sup>.
- When released in a Parthenium-infested environment, it might lead to widespread defoliation of the weed <sup>[4]</sup>.
- Defoliating Parthenium perennially helps deplete its seed bank and make way for the regrowth of other plants.
- There seems to be a demographic correlation between Parthenium defoliation and severity. There is a reciprocal relationship between precipitation and population growth <sup>[4]</sup>.
- Population growth begins after June and July rainfall, but a prolonged dry period may significantly diminish the beetle population. High defoliation across a wide region by the end of August is the consequence of either continuous or intermittent rainfall from June to September, although the same defoliation may occur after a dry period of 15 to 20 days in June or July <sup>[5]</sup>.
- Inadequate defoliation of Parthenium might be the result of a lack of moisture or drought during the rainy season. With repeated bioagent treatment over the course of three to four years, once-lost biodiversity may be re-established at the place in question.
- Parthenium's second and third flush flower output is severely hampered by gregarious feeding by the early larval stages of the beetle on the terminal and axillary buds during the wet season. The young plants are snipped in the bud since this feeding prevents them from developing <sup>[4]</sup>.
- The beetle destroys the Parthenium's new growth just as it begins to bloom.
- Although the Mexican beetle doesn't consume flowers themselves, it does help to destroy them by severing the flower's pedicle as it chews on the softer tissues underneath it. Within 10 days of being released, 5 beetles successfully harvested 25-37 flowers from 115-137 (mean: 119.8) on flowering Parthenium plants kept in a cage. Where from 30 to 150 days, a single beetle can directly pollinate and clip the stems of an average of 6.2 flowers in only 10 days <sup>[4]</sup>.

- After being under constant beetle release on a given site for three to four years, the Parthenium's maximum seed bank has been depleted and other plants have begun to fill the void. However, Parthenium still manages to sprout amongst the rest of the flora, either from the leftover seeds or from external seeds. The full defoliation of these plants by the Mexican beetle contributes to the diminishing seed supply <sup>[5]</sup>.

#### Collection and release of beetles:



#### Beetle scavenging from known locations:

- From June to September, it is simple to collect the beetles from the predetermined locations <sup>[6]</sup>.
- Simple plastic or polythene bags with holes punched in them may be used for collection <sup>[5]</sup>. To prevent the polythene from shrinking and to offer a resting spot for the beetle, upper parthenium twigs without leaves should be put inside the bag. Insects that must be transported long distances should not come into contact with leaves, since this might lead to the condensing of moisture and the subsequent development of fungi that kill the insects <sup>[5]</sup>.
- Initial releases should be made on modest, succulent parthenium growth in undisturbed places far from human habitations. Ploughing the field after initial release may disrupt the pupation process, leading to poor survival and subsequent establishment <sup>[5]</sup>. Pupation occurs in soil, thus regions prone to flooding should be

avoided as well. When new parthenium plants are abundant in June, July, and August, it is the best time to carry out releases <sup>[6]</sup>.

- Beetles might be dispersed over parthenium in areas close to water supplies.

#### **Site selection for release:**

- Initial releases should be made cautiously in undisturbed regions, away from any manual or chemical control efforts <sup>[5]</sup>.
- Since the disturbance of the pupation process caused by ploughing the field might lead to poor survival and establishment, initial releases should be avoided on cultivated areas <sup>[5]</sup>.

#### **Appropriate timing of release:**

- During the rainy season, releases should be carried out shortly after the rains have begun. That's when you may find a plethora of natural *Parthenium* succulents.

#### **Mass multiplication**

- Plastic jars/buckets, beakers, etc., may be used for small-scale beetle multiplication. You should make a bouquet out of twigs and some of those delicious *Parthenium* leaves <sup>[4]</sup>.
- The lowest part of the leaves and any twigs may be stored in a damp cotton swab for at least a week to maintain their freshness.
- While just one male and one female may be maintained in a tiny container, up to four couples can be housed in a big one <sup>[4]</sup>.
- In two to three days, the eggs will hatch into larvae that feed on the leaves. Old leaves should be replaced with new ones once a week or as needed <sup>[4]</sup>. Baby caterpillars need to be carefully brushed onto new leaves. Larvae reach maturity in 12–18 days. The dirt is necessary for the pupation process right now. Soil filled containers/jars should be set aside for the sole purpose of pupation. The earth may be lightly compacted if desired.
- These pupal chambers are used for the transfer of fourth-stage larvae and may also be used to store *Parthenium* leaves for later feeding <sup>[4]</sup>. Once the fourth instar has completed its development, the larva will excavate a pupal chamber <sup>[4]</sup>.
- The mature beetle will make a circular hole in the ground after 5-8 days and crawl out. This approach is time-consuming and demands constant monitoring. Over the

course of two months, you may collect between 50 and 60 beetles from one of these pots <sup>[4]</sup>.

#### **Rearing Mexican beetles (*Zygogramma bicolorata*) in large numbers:**

- The beetle may be mass-produced in mosquito cages in a straight forward and cost-effective manner <sup>[4]</sup>. Cages may be manufactured in various sizes to accommodate specific requirements and the available area.
- These cages are ideal for cultivating Parthenium, which may be started from seed or transplanted from the affected area. If enough Parthenium plants are grown in the cages, 10 beetle couples may be released into an area 6 feet by 6 feet <sup>[4]</sup>.
- Female beetles will soon begin laying eggs within the cages, marking the beginning of the beetle life cycle. Keep a steady supply of fresh Parthenium plants available to swap for any that are consumed. It's an easy method <sup>[4]</sup>. During that time, you may collect anywhere from 400 to 800 beetles from a 2 by 2 feet area. Within two months, you may have 10,000 to 15,000 beetles in a net home that's around 10 by 20 metres in size <sup>[4]</sup>.

#### **How many beetles required to release:**

- Defoliation of a single parthenium plant by a single adult was discovered to take place in a span of 6-8 weeks. Since there are 40-70 plants per square metre of weeds, releases at this pace would need somewhere between 0.4 and 0.7 million insects per hectare <sup>[5]</sup>.
- Only **500–1,000** released beetles are needed for establishment and ultimate dominance <sup>[5]</sup>.
- Once the plants at the release site have been devoured, the insects will move on to other nearby places. With this in mind, many release sites in a single geographic area or metropolis might serve as a focus point <sup>[5]</sup>.
- Better control may be achieved by releasing as many beetles as possible in the first few years after introduction. This strategy shortens the number of years needed for the beetle population to grow and facilitates rapid population expansion. Putting out just one or two releases in a heavily infected region is the cheapest option <sup>[5]</sup>.

#### **Conclusions:**

It is concluded that the Mexican beetle (*Zygotogramma bicolorata*) was shown to have promising potential for biological control of Parthenium, at least in regions with more frequent and heavier rainfall. Take into account the indirect advantages gained, such as improved environmental security and improved human health, and the financial gains that will increase dramatically. For the sake of farmers everywhere, extension services should actively advocate for the biological control of parthenium using the Mexican beetles.

**References:**

1. Sushilkumar. 2005. Biological control of parthenium through the Mexican beetle (*Zygotogramma bicolorata*), National Research Centre for Weed Science, Jabalpur : 87p.
2. S. Rao, "Parthenium, a new record for India," *Journal of the Bombay Natural History Society*, vol. 54, pp. 218–220, 1956.
3. Dhileepan K, Setter SD and McFadyen RE. 2000. Response of the weed Parthenium hysterophorus (Asteraceae) to defoliation by Char MBS, Nagendran CR and Ganesh D. 1975. Mealy bug on the roots of parthenum weed. *Current Science* 44: 207. 13
4. <https://dwr.icar.gov.in/AdvisorynoteonParthenium.pdf>
5. Kumar, Sushil. *Biological Control of Parthenium Bulletin*. Jabalpur, Madhypradesh, ICAR-DWR, 2022, [dwr.icar.gov.in/Image/Parthenium\\_Posters/BiologicalControl.pdf](https://dwr.icar.gov.in/Image/Parthenium_Posters/BiologicalControl.pdf).
6. "Mexican Beetle for Parthenium Management." *Vikaspedia*, [vikaspedia.in/agriculture/agri-inputs/bio-inputs/mexican-beetle-for-parthenium-management](https://vikaspedia.in/agriculture/agri-inputs/bio-inputs/mexican-beetle-for-parthenium-management). Accessed 27 Nov. 2022.
7. "Parthenium Beetle." *Project Noah*, [www.projectnoah.org/spottings/1872436002](https://www.projectnoah.org/spottings/1872436002). Accessed 2 Dec. 2022.