Parthenium hysterophorus

Carrot weed

Scientific name: *Parthenium hysterophorus* L.
Common names: Carrot weed, white top, Congress grass, star weed

Taxonomic position:
Division: Magnoliophyta
Class: Magnoliopsida, Order: Asterales
Family: Asteraceae

Distribution: Argentina, Australia, Bangladesh, China, Cuba, Dominican Republic, Ethiopia, Haiti, Honduras, India, Jamaica, Madagascar, Mauritius, Mexico, Mozambique, Nepal, New Caledonia, Pakistan, Papua New Guinea, Puerto Rico, South Africa, Sri Lanka, Swaziland, Trinidad, the United States of America, Venezuela, Vietnam and West Indies. *Parthenium* probably entered India before 1910 (through contaminated cereal grain), but went unrecorded until 1956. Since 1956, the weed has spread like wildfire throughout India. Most of the Indian states are currently under threat by Parthenium. It occupies over 5 million ha of land in the country.

Habit: An annual herb, erect, up to 2 m in height; the stem is branched and covered with trichomes. Leaves are pale green, lobed, hairy, initially forming a basal rosette of strongly dissected leaves that are up to 30 cm in length, close to the soil, alternate, sessile, irregularly dissected and bipinnate, having small hairs on both the sides, resembling the leaves of carrot. The number of leaves per plant ranges from 6 to 55. Flower heads are creamy white, about 4 mm across, arising from the leaf forks. Flowering occurs about a month after germination. The fruit is cypsella. Each flower contains five seeds, which are wedge-shaped, black, 2 mm long with thin white scales. A large single plant produces up to 100,000 seeds in its lifecycle. More than 340 million seeds per ha can be present in the surface soil. Seeds do not have a dormancy period and are capable of germinating anytime when moisture is available. The highest germination rates are at temperatures ranging from 12° to 27 °C. The root system has one main branched taproot and many finer roots.

Seed dispersal: The seeds are mainly dispersed through water currents, animals and the movement of vehicles, machinery, livestock, grain, stock feed and other produce, and to a lesser extent by the wind. Most of the long distance spread is through vehicles, farm machinery and flooding. Germination of Parthenium seeds can occur between 8° to 30° C the optimum temperature for germination being 22° to 25° 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

The Asia-Pacific Forest Invasive Species Network (APFISN) has been established as a response to the immense costs and dangers posed by invasive species to the sustainable management of forests in the Asia-Pacific region. APFISN is a cooperative alliance of the 33 member countries in the Asia-Pacific Forestry Commission (APFC) - a statutory body of the Food and Agricultural Organization of the United Nations (FAO). The network focuses on inter-country cooperation that helps to detect, prevent, monitor, eradicate and/or control forest invasive species in the Asia-Pacific region. Specific objectives of the network are: 1) raise awareness of invasive species throughout the Asia-Pacific region; 2) define and develop organizational structures; 3) build capacity within member countries and 4) develop and share databases and information.

Parthenium leaf

Seed dispersal by vehicles

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Seeds of Parthenium

Threat and damage: Infestation by Parthenium degrades natural ecosystems. It aggressively colonizes disturbed sites and reduces pasture growth and depresses forage production. Its pollen is known to inhibit fruit set in many crops. The germination and growth of indigenous plants are inhibited by its allelopathic effect. In man, the pollen grains, air borne pieces of dried plant materials and roots of Parthenium can cause allergy-type responses like hay fever, photodermatitis, asthma, skin rashes, peeling skin, puffy eyes, excessive water loss, swelling and itching of mouth and nose, constant cough, running nose and eczema. In animals, the plant can cause anorexia, pruritus, alopecia, dermatitis and diarrhea. Parthenium can taint sheep meat and make diary milk unpalatable due to its irritating odour. In Queensland, Australia, losses to the cattle industry due to Parthenium have been estimated to be Au$ 16 m per year in terms of control costs and loss of pasture. In India, an extensive outbreak of weed dermatitis caused by Parthenium allergy involving around 1,000 patients and including some deaths has been reported.

Uses: Parthenium is reported to have insecticidal, nematicidal and herbicidal properties. It is also used for composting. The odour of the plant is apparently disagreeable to bees and they can be easily kept away by carrying a handful of Parthenium flower heads. A root decoction of the plant is used in treating amoebic dysentery. Sub-lethal doses of Parthenin, a toxin recovered from Parthenium, exhibited antitumor activity in mice and the drug can either cure mice completely or increase their survival time after they had been injected with cancer cells. Parthenin is also found to be pharmacologically active against neuralgia and certain types of rheumatism. In the Caribbean and Central America, Parthenium is applied externally on skin disorders and a decoction of the plant is often taken internally as a remedy for a wide variety of ailments. In Jamaica, the decoction is used as a flea-repellent both for dogs and other animals.

Habitat: Parthenium grows luxuriantly in wastelands and vacant lands, orchards, forestlands, flood plains, agricultural areas, scrub/shrublands, urban areas, overgrazed pastures and along roadsides and railway tracks. Drought, and subsequent reduced pasture cover, creates the ideal situation for Parthenium to establish. It prefers alkaline, clay loam to heavy black clay soils, but tolerates a wide variety of soil types. The weed grows well in areas where the annual rainfall is greater than 500 mm and falls dominantly in summer. It can grow up to an elevation of 2200 m above sea level.

Mode of Infestation: Parthenium colonizes disturbed sites very aggressively, impacting pastures and croplands by outcompeting native species. The allelopathic effect, coupled with the absence of natural enemies like insects and diseases, is responsible for its rapid spread in introduced ranges. Growth inhibitors like lactones and phenols are released from this plant into the soil through leaching, exudation of roots and decay of residues. These growth inhibitors suppress the growth and yield of native plants.

Infestation by Parthenium in an agricultural field

Control:

Mechanical and cultural: Manual uprooting of Parthenium before flowering and seed setting is the most effective method. This is easily done when the soil is wet. Uprooting the weed after seed setting will increase the area of infestation. Pulling a plant in flower will aid in the dispersal of pollen grains, resulting in allergic reactions. Ploughing the weed in before the plants reach the flowering stage and establishing pastures or other plants may be effective

Competitive replacement of Parthenium can be achieved by planting species like *Cassia sericea, Croton bonplandianus* and *C. sparsiflorus, Amaranthus spinosus, Sida acuta, Tephrosia purpurea, Stylosanthes scabra and Cassia auriculata*, which will compete with

the weed and reduce its population. Similarly, planting *Cassia tora* will help to cover and suppress the growth of parthenium. In certain parts of India, crop rotation using marigold (*Tagetes* spp.) during rainy season, instead of the usual crop, is found effective in reducing Parthenium infestation in cultivated areas.

Preventing the spread of Parthenium is the most cost effective management strategy. There is a high risk of spreading Parthenium by the movement of vehicles, livestock and crop produce. Washing down vehicles/machinery before entering into a non-infested region will restrict the spread of seeds. Movement of cattle during rainy season will aid in the spreading of seeds in muddy soil. If this is unavoidable, it would be safe to hold cattle in yards or small paddocks to let seeds drop from their bodies and tails before releasing them into larger areas. Also, while purchasing cattle feed and crop seeds these need be checked for contamination by Parthenium seeds.

Burning is not a useful control strategy for Parthenium. However, burning for other purposes (to control woody weeds) may not result in an increased infestation so long as the burned area is allowed to recover before other activities are carried out.

Utilization*:* The large-scale utilization of Parthenium may be one of the effective methods. Parthenium has been well documented for its insecticidal, nematicidal and herbicidal properties. It is also used for mulching and for producing biogas, paper and compost.

Chemical control: A large number of chemicals have been tried. The use of glyphosate, atrazine, and metribuzin has been promising. The timing of chemical control is critical. The plants should be treated before flowering and seed setting and when other plants, especially grass, are actively growing and can recolonize the infested area. In open wasteland, non-cropped areas and along railway tracks and roadsides, the spraying of a solution of common salt (sodium chloride) at 15-20% concentration has been found effective.

Biological: Several insects and pathogens have been tried from time to time. The leaf-feeding beetle *Zygogramma bicolorata* and the stem-galling moth *Epiblema strenuana* are widely used in several countries to manage Parthenium. *Z. bicolorata* is now widely used in India to control Parthenium. In Australia, both the insects have been tried successfully. The moth significantly reduces flower and seed production of the weed. It has a relatively high reproduction in a short period of time and its effectiveness against Parthenium has been validated in the central highlands of Queensland.

Other major biocontrol agents used are *Listronotus setosipennis* (stem-boring weevil), *Semicronyx lutulentus* (seed-feeding weevil), *Bucculatrix parthenica* (leaf-mining moth), *Platphalonidia mystica* (stem-boring moth), *Conotrachelus albocinereus* (stem-galling weevil) and *Carmenta ithacae* (root-boring moth). Another on-going development in the biological control of parthenium is the use of a rust fungus,

Mechanical removal of Parthenium

Puccinia abrupta var. partheniicola. Uredospore suspensions from 3-week old pustules of the rust have been applied to the foliage of *Parthenium* and a consistent control effect has been achieved. This fungus is now being evaluated for development as a mycoherbicide. Pathogens like *Fusarium pallidoroseum*, *Puccinia melampodii* and *Oidium parthenii* also show good potential as biocontrol agents.

Parthenium offers a big challenge to all attempts of control because of its high regeneration capacity, production of huge amount of seeds, high seed germinability and extreme adaptability to a wide range of ecosystems. A single biocontrol agent like *Z. bicolorata* may not be sufficient to manage the weed since its population build up is restricted to July-September, where as Parthenium can germinate throughout the year. Therefore, insects, which remain active during most of the year would be more helpful in managing the weed. Attempts need to be made to assess the potentials of indigenous insects.

Competitive replacement by plants, especially *Cassia tora,* could be treated as one of the avenues for further studies and implementation. The use of herbicides, side by side with other methods of control, also need to be developed and standardized. Development of new cost-effective and persistent herbicides with less residual effects is the need of the day. Also, development of resistance against commonly used herbicides needs to be monitored. Lastly, utilization aspects of the weed as green manure, growth inhibitor and phagostimulant in medicines should be promoted so that the population is controlled through exploitation.

Damage caused by *Z. bicolorata* on Parthenium

Epiblema strenuana-adult

Z. bicolorata-adult