

## *Parthenium hysterophorus*: Perspectives and Prevention Measures

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### 1. Introduction

*Parthenium* is a genus of North American annuals, biennials, perennials, subshrubs, and shrubs in the tribe Heliantheae within the family Asteraceae and subfamily Asteroideae. It is a large and diversified species with a worldwide distribution. The name *Parthenium* is an evolution of the Ancient Greek name (*parthenion*), which referred to *Tanacetum parthenium*. The name is possibly derived from the Greek word (*parthenos*) which means "virgin". *Parthenium hysterophorus* is an invasive weed species that produces many seeds and has spread widely throughout Asia and other areas beyond its native range in Central and South America and the southern USA. *Parthenium* (*Parthenium hysterophorus* L.) *Parthenium* has become a major problem as a weed in agro-habitats in over 30 nations during 1955. It infects a variety of landscapes, including farmsteads, fallow ground, orchards, and railway tracks. It spreads very quickly because of its short life cycle of 90–120 days, adaptability to photo-thermal conditions, a lack of natural enemies and rapid growth, ability to spread via waterways and roadways. *Parthenium* weed poses a significant threat to most countries around the world in the temperate and tropical regions. Therefore, the restriction of the weeds spread has become important at national and international level.



Fig. 1. *Parthenium* plant

*Parthenium hysterophorus* is a prolific weed belonging to Asteraceae family, producing thousands of small white capitula each yielding five seeds on reaching maturity. Within the past century it has found its way to Africa, Australia, Asia and Pacific Islands (Fig. 1) and has now become one of the world's seven most devastating and hazardous weeds. This noxious weed is often spotted on abandoned lands, developing residential colonies around the towns, railway tracks, roads, drainage and irrigation canals, etc. This weed grows luxuriantly in established gardens, plantations and vegetable crops. Due to its high fecundity a single plant can produce 10,000 to 15,000 viable seeds and these seeds can disperse and germinate to cover large areas.

## 2. Indian Perspective

*Parthenium hysterophorus* possibly entered India in 1910 (with infected cereals germplasm) however, went unrecorded until 1956. The food-grain was obtained under the PL 480 (food for peace) programme of the USA. But the wheat that was shipped to India was of inferior quality, and it was mixed with seeds of the parthenium weed. Thus, from this shipment from the USA, the dangerous weed spread in India. The weed was first revealed in India in 1955 and now happens everywhere the in around 35 million hectares of land. In India, this weed has serious problem in approximate all states like Karnataka, Andhra Pradesh, Haryana, Bihar, and Madhya Pradesh and Uttar Pradesh. *Parthenium hysterophorus* occurred in all states of country and presenting a serious threat in many states those have large areas of agriculture land, non-cropping areas and grazing land. At present time India has becomes one of the most infested countries of world.

## 3.The Harmful Effects of Parthenium:

### 3.1 Effects of Parthenium on human, agriculture and livestock

*Parthenium hysterophorus* is a noxious weed. This weed is considered to be a cause of allergic respiratory problems, contact dermatitis, mutagenicity in human and livestock Some of the most significant chemical compounds in Parthenium plants exhibit allelopathic activity. Allelopathy is a mechanism through which phytochemicals are produced by one plant, which increases or decreases the germination rate of another plant. Allelopathy describes the beneficial or harmful effects of one plant on another plant, e.g., crop and weed species interact allelopathically. Allelopathy is caused by the release of biochemicals known as allelochemicals from plant parts through leaching, root exudation, volatilization, residue decomposition, and other processes in both natural and agricultural systems. Allelopathic plants emit chemical compounds into the soil from their roots, and as nearby plants absorb these chemicals, they are inhibited or even destroyed. While an allelopathic effect is generally considered to be harmful, there may also be some beneficial effects, depending on the allelochemical target and other factors. Allelochemicals produce cytotoxicity through physiological effects. Allelochemicals cause a variety of physiological effects, such as water absorption, leaf area expansion, and mineral nutrient absorption, which all decrease plant growth. Various allelochemicals were shown to reduce the absorption of indole-3-acetic acid (IAA) oxidase and other important



macronutrients and micronutrients in germinating mustard seedlings by inhibiting root dry weight and root moisture content. This plant is not only harmful to agriculture but also is a major factor in multiple human diseases. Among these are asthma, cancer, allergies, and stomach diseases. It is reported that feeding the weed to buffalo and bull calves at different levels causes both acute and chronic forms of toxicity. Ulcerations were caused both in the mouth and digestive tract. It may also affect grazing animals' welfare, milk production, and meat quality. *P. hysterophorus* fed buffalo and hybrid calves develop atrophic eruptions, alopecia, skin depigmentation, and anemia. In mature livestock, continuous feeding of *P. hysterophorus* for up to 12 weeks can cause anorexia and dermatitis (Osmanabadi). When cattle consume Parthenium or they come into contact with the weed on a regular basis, poisoning may result. Death, rashes on the body and udders, alopecia, loss of skin pigmentation, allergic skin reactions, dermatitis, diarrhea, anorexia, and pruritus are all possible outcomes for those animals. The psychological behavior of animals can also be influenced by Parthenium. Parthenium silage has nutritional value that is fairly similar to that of a sheep's normal dietary requirements, and the seeds of Parthenium obtained from the silage did not germinate.

### **3.2 Effects of Parthenium on Soil**

Soil collected from a parthenium weed-invaded area was shown to reduce seedling emergence of a wide range of plant types, including both crop and pasture plants, introduced and native species, but it had no effect on their subsequent growth. Thus, parthenium weed infestations have the potential to reduce plant populations through a reduction in their germination rate. Compost amended with parthenium weed leaf litter was also shown to reduce seedling emergence of a wide range of plant types, but it had no effect on their subsequent growth. This inhibition of germination by leaf litter has the potential to reduce the population size of other plant species in a parthenium weed-infested site. This study demonstrates the significant ability of parthenium weed to suppress the seedling density of crops and pasture species due to its allelopathic capacity.

### **3.3 Effects of Parthenium on Crop**

Parthenium plant contains chemicals, like parthenin, hysterin, hymenin, and ambrosin, and due to the presence of these chemicals, the weed exerts strong allelopathic effects on different crops. Parthenin has been reported as a germination and radical growth inhibitor in a variety of dicot and monocot plants.

### **3.4 Effect of Parthenium Ecosystem**

Rapid spread of Parthenium can disturb natural ecosystem because it has very fast infestation capacity and allelopathic potential which have the ability to disrupt any type of natural ecosystem. Species richness, evenness a local biodiversity gradually decreases where this plant is present, this situation clearly indicates the native biodiversity loss of weeds and other crop plants due to Parthenium infestation. Its infestation is coupled with its allelopathic potential and the absence of its natural



inhibitors such as pathogen, insects and their larvae, these are some important factors which are the reason of its luxurious growth and spread.

#### 4. Control of Parthenium

The control of Parthenium weed is a serious challenge due to its vigorously spreading nature. Immediate actions are being quite necessary to eradicate the plant since it has more hazardous impact on environment as well as to public health. India has great risk of rapid invasion of the weed in agricultural lands, for which it might give proper attention towards the remedy to control Parthenium.

The spread of Parthenium would be controlled by the following method:

- a. Controlling Overgrazing
- b. Grassland Management
- c. Burning
- d. Manual control
- e. Herbicide Control and Management
- f. To make farmers and general public aware of the menace of Parthenium and organizing the activities like Parthenium uprooting, releasing Mexican beetles, student rallies demonstration exhibition etc.

#### 5. Utilization and Value addition of Parthenium

The potential benefits have been identified by various researchers. It is used as an antioxidant, an anticancer agent, and an antitumor agent, and its extracts are often used as pesticides to control diseases. It is often used as an organic fertilizer because the proportions of N, Mg, Ca, K, and other nutrients are high in this plant, so it provides value to plant growth. Parthenium improves seed germination, seedling growth, biomass, and yield indices for certain crops. Parthenin, hysterin, hymenin, and ambrosin comprise important compounds found in Parthenium plants. Researcher have reported many positive and beneficial potentiality of parthenium as follows

##### 5.1 Antidiabetic Effects

*P. hysterophorus* aqueous extract showed strong hypoglycemic action. Within 2 h, fasting blood glucose levels in alloxan-induced diabetic rats dropped significantly. As a result, this treatment may be helpful, mainly for type II diabetics who are insulin-independent. Fever, neurological conditions, diarrhea, urine infections, malaria, and emmenagogue have all been treated with distilled *P. hysterophorus* liquor in traditional medicine, and women's vaginal and urinary disorders have sometimes been treated using tea produced from the leaves and roots of *P. hysterophorus*. In addition, some tribal people use it to treat itching, skin conditions, rheumatic pain, eczema, heart complications, and reproductive problems.



### 5.2 Antioxidant Activity

Due to their carcinogenic effects, free radicals are considered to be contributors to certain diseases. Synthetic antioxidants are regarded as contributing factors. That is why natural antioxidants have drawn scientists' interest. When compared to Stevia's (*Stevia rebaudiana* Bertoni) effect, the methanolic extracts of *P. hysterophorus* demonstrated significant antioxidant activity. As a result, this plant could be a suitable natural antioxidant source. A new, potent natural antioxidant could be made commercially available after investigating Parthenium for its active antioxidant ingredient(s).

### 5.3. Antitumor

*Parthenium hysterophorus*'s methanolic extract obtained from flower revealed antitumor activity in mice having transplantable lymphocytic leukemia. Level of neoplastic markers like glutathione, cytochrome P-450, glutathione transferase and UDP-glucuronyl transferase adjusted significant consequently backing off the advancement of tumors and expanded survival of animals.

### 5.4. Antimicrobial Activity

Medically, Parthenium is known chiefly for its anticancer properties, but it may also be used for hepatic amoebiasis. It has antibacterial, antifungal, and antiviral properties against *P. aeruginosa*, *E. coli*, and *Candida albicans*, respectively.

### 5.5. Larvicidal

*P. hysterophorus* root and stem extracts are effective against mosquito larvae, particularly *Aedes aegypti*. Chemical components extracted from leaves have significant effects on both the lifespan and the production of adult *Lipaphis erysimi*. A new depolarizing neuromuscular junctional block was observed on rats if Parthenium leaf extract was used as an alternative to anticholinesterase agents, such as neostigmine.

### 5.6. Parthenium Compost

The *Parthenium hysterophorus* is a good source of micro and macro-nutrients and thus can be used as alternative of compost. Furthermore, it also improves nutrient quality, which could be beneficial for organic farming and bioremediation.

### 5.7. Herbicidal Effects

Sastri and Kavathekar 1990 reported that despite this problem it has also been used in industry for its noxious, insecticidal, nematocidal and herbicidal properties as well as for composting. There is substantial evidence that Parthenium extract could be used as a possible herbicide, given its effects on weed germination, density, and biomass. Hence, environmentally friendly, natural herbicides based on Parthenium could be derived as alternatives to synthetic herbicides.

### 5.8. Pesticidal Effects

Parthenin is the major volatile compound of Parthenium having phytotoxic and insecticidal activity against different insects such as *Spodoptera litura*, *Callosobruchus aculatus*, *Cassia tora* and *Meloidogyne incognita*, and their larvae. Pyrazoline adduct, saturated lactone, and propenyl





derivatives of parthenin showed remarkable phytotoxic and nematocidal activities. The efficacy of Parthenium as an inoculum source was tested. *P. hysterophorus* is a serious pasture-invading weed that reduces pasture production 90% of the time. It suppresses the growth of other plants in grasslands and pastures, thereby reducing fodder supplies.

### 5.9. Heavy Metal and Dye Removal

The degradation of the environment caused by heavy metals has become a global issue. Nickel (II) and cadmium (Cd) are used in silver factories, electroplating, zinc-based manufacturing, and Cd/Ni battery industries. Heavy metals which can experimentally absorbed by Parthenium are Ni, Cd, Cu, Co and Zn etc. Activated carbon prepared from Parthenium showed cresol (a phenol derivative) adsorbing ability comparable to commercial grade activated carbon. Parthenium has shown the ability to absorb both nickel and methylene blue dye from wastewater and industrial waste. However, the highly toxic metals it absorbs can cause kidney disease, elevated blood pressure, bone deformity, and red blood cell (RBC) destruction. Ni and Cd can cause cancer and other diseases. Parthenium is a safe, affordable, and environmentally friendly absorbent of such industrial waste

### 5.10. Substrate for enzyme production

Xylans are almost as ubiquitous as cellulose in plant cell walls and contain predominantly  $\beta$ -D-xyllose units linked as in cellulose. Xylans are cleaved by the hydrolytic enzyme Xylanases. The end products of xylan degradation can be used as a source of energy (biofuel), as a sugar alternative, textile industry, bakery products and in the clarification of fruit extracts. It can be used in paper industries also.

### 5.11. *Hysterophorus* as substrate for biogas production

*Parthenium hysterophorus* can be used for the production of biogas. It can be used with cattle manure and apply to anaerobically digest at room temperature in batch digesters. Production of biogas when Parthenium is digest with cattle manure anaerobically. *Parthenium hysterophorus* can be used as a substrate for the production of biogas, it will not only control this weed but can be useful and eco-friendly alternate of limited energy sources.

### Conclusion:

Parthenium weed poses a significant threat to most countries around the world in the temperate and tropical regions. Thus, the restriction of the weeds spread has become important at national and international level. This alien weed is believed to have been introduced into India as contaminants in PL 480 wheat imported from the USA in the 1950s. Presently, this invasive weed is widely prevalent in India. Approximately two million hectares of land in India have been infested with this herbaceous menace. Looking at the multitude of harms caused by *P. hysterophorus*, its management is necessary to prevent future problems. Since *P. hysterophorus* grows luxuriantly in many parts of the world, it is important to explore its parallel beneficial uses also.



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