

A Magical Weed, *Parthenium hysterophorus*: Threats and its Potential

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SUMMARY

Its 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* plant growth.

INTRODUCTION

Parthenium (*Parthenium hysterophorus* L.) is a weed 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. Post-1955, *Parthenium* has become a major problem as a weed in agro-habitats in over 30 nations. *Parthenium* weed is a member of the Asteraceae family, a large and diversified species with a worldwide distribution. Due to its many features, such as its short life cycle of 90–120 days, adaptability to photo-thermal conditions, a lack of natural enemies (usually), and rapid growth, ability to spread via waterways and roadways, it is able to spread very quickly. Due to its allelopathic influence, this weed is thought to cause allergic respiratory problems, mutagenicity in humans and livestock, and severe reductions in crop production. This weed is responsible for multi-million-dollar losses in Australia and is considered a harmful crop in more than 45 countries. 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

Botanical Description:

P. hysterophorus is an annual herbaceous plant that reproduces mostly through seeds following sprouting, the young plant has a basal rosette of bright green and finely lobed leaves that measure about 8–20 cm in length and 4–8 cm in breadth. Both leaves and stems have short and fluffy hair or trichomes, four styles of which have been recognized and considered for their taxonomic significance. The flower heads are terminal and somewhat hairy; they consist of several small white capitula-shaped florets. Usually, each head has five productive ray florets, although occasionally six or eight. Thousands of branches, which develop in separate clusters, produce compressed black seeds about 2 mm in size. Originally, *Parthenium* was found in the Gulf of Mexico, the USA, the West Indies, and Central America. *Parthenium* has now invaded 46 countries and regions.

Harmful Effects of *Parthenium*:

Parthenium roots can cause allergic diseases, such as photodermatitis, asthma, hay fever, skin rashes, excessive water loss, peeling skin, swelling, and itching of the mouth and nose. Some of the main elements contained in *Parthenium* are chlorogenic acid, anisic acid, p-anisic acid, caffeic acid, and benzoic acids, which are very harmful to humans and livestock. Hand weeding in *Parthenium*-infested fields can cause skin diseases, and *Parthenium*-related allergies can also cause malarial infection-related fever. Skin infections, allergies, eczema, fever, allergic rhinitis, dark spots, burning, and swelling around the eyes are all signs of long-term exposure to this herb. Diarrhea, extreme papular erythematous eruptions, and shortness of breath are all symptoms of *P. hysterophorus*. Respiratory symptoms normally start with increased fever and respiratory problems and become more severe after 3–5 years of incremental exposure, resulting in asthma and allergic bronchitis

Effects on Livestock

Parthenium growing in grasslands can be virtually invisible, making it more likely that livestock will consume it, especially if grassland managers fail to manage it. *Parthenium* decreases livestock productivity by reducing the amount of forage. 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.

Effects on Soil

With allelopathic plants present, there are strong correlations between crop development and soil microorganisms. Direct integration of *Parthenium* residues into soil has the potential to have allelopathic impacts on crop development and establishment. Soil nitrogen and organic content were found to be considerably higher in infested plots than in non-invaded plots. The invaded plots had the highest levels of pH, phosphorus, and potassium; the non-invaded plots had low to moderate levels. *Parthenium* weed can take nutrients even from nutrient-depleted soils, resulting in high tissue levels of nitrogen (3%), phosphorus (2%), potassium (4%), and other macronutrients and micronutrients, making it an excellent green manure for field crops.

Effects on Crops

Parthenium can have positive or negative effects on various crops. Germination period, growth rate, and yield reductions of Indian traditional crops resulted from soils being infected by the *Parthenium* weeds because the leaves contain p-coumaric acid and caffeic acid. These are responsible for growth inhibition. *P. hysterophorus* has an influence on bean growth at low concentrations, and *Parthenium* ash concentration levels can boost seed germination, radicle length, and biomass production. When *P. hysterophorus* residues are combined in soil, they have a negative impact on the germination and subsequent seedling growth of native plants. In a number of dicot and monocot plants, parthenin has been described as a germination and radical growth inhibitor.

Other Affected Areas and Animals

A huge number of national parks, tourism sites, and industrial sites may be affected by *Parthenium*, and wild animals may suffer the consequences. For example, most national botanical gardens in Africa, India, South Africa and Ethiopia have been affected by this weed.

The Beneficial Effects of *P. hysterophorus*:

There are a considerable number of beneficial effects of *Parthenium*,

Antidiabetic Effectss

P. hysterophorus aqueous extract showed strong hypoglycemic action. Within 2 h, fasting blood glucose levels in alloxan-induced diabetic rats dropped significantly ($p < 0.01$). 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.

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.

Antitumor Activity:

P. hysterophorus extracts have antitumor potential through in vitro activity, with promising results in terms of tumor size reduction. The levels of neoplastic indicators, such as glutathione, cytochrome P-450, glutathione transferase, and UDP-glucuronyl transferase, were significantly altered, which slowed tumor growth

and enhanced survival. *P. hysterophorus* aqueous extract had hypoglycemic activity in alloxan-induced treated patients.

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.

Parthenium Compost:

P. hysterophorus is high in micronutrients and macronutrients, such as N, P, K, Ca, Mg, and chlorophyll, making it ideal for composting. The plant's early growth, development, and dry matter output are all hampered by its high phenolic content. Hence, the composting of *Parthenium* and *Eichhornia crassipes* (a water weed rich in polyphenol oxidases) causes considerable reductions in phenol content, organic carbon content, and C/N and C/P ratios. Combining *Parthenium* and water hyacinth in compost provides a weed control solution and a path to sustainable organic farming. However, its phytotoxicity prevents plants from growing quickly and reduces dry matter harvests. Vermicomposting of *Parthenium* consumes nutrients and restricts unwanted plant noxiousness. Furthermore, it also improves nutrient quality, which could be beneficial for organic farming and bioremediation.

Phytoremediation

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. *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.

Other Economic Benefits

The capacity of *P. hysterophorus* to generate enzymes such as xylanase has been investigated. *Parthenium* is very effective at removing dyes, dissolved heavy metals, and other contaminants, such as phenolics, from the atmosphere. It has benefited the imaging, mechanical, electronic, drug delivery, and molecular diagnosis industries greatly. Nanotechnology has emerged as a remarkable tool for addressing a variety of challenges in everyday life. It has proved extremely advantageous to the imaging, mechanical, electronic, medication delivery, and molecular diagnosis industries. Synthesis of NPs from *P. hysterophorus*, such as TiO₂, AgNPs, and zinc oxide nanoparticles, has risen recently. These nanoparticles can be antifungal, antibacterial, environmentally safe, and effective at preventing vector-borne diseases. Furthermore, when combined with manure, *Parthenium* has been used very effectively to produce biogas and in treating heavy metal pollutants through bioremediation. Researchers have also found that nitrogen, calcium, magnesium, and potassium are present in high proportions in this plant. Hence, the application of organic manure produced with *Parthenium* could play a great role in production enhancement.

CONCLUSION

The *Parthenium* plant is best known for its effects on natural ecology and its negative impacts on human and animal health. At present, although *P. hysterophorus* is considered a weed, its new uses are coming to the forefront. *Parthenium* can be used as an herbicide, pesticide, insecticide, raw material, or additive in a variety of industries, including paper, pulp, and dye industries, to name a few. Various studies have also revealed that *Parthenium* has potent antioxidant, antimicrobial, and anticancer properties. Its nutritive contents make it a potential composting agent, but more extensive research is needed to investigate it as a source of compost and a natural pesticide for various crops. *Parthenium* is an interesting weed due to having both harmful and beneficial effects in relation to crops, humans, and livestock. Furthermore, *P. hysterophorus* has many phenolic derivatives that are responsible for weed suppression. These phenolic derivatives should be investigated for their bioherbicide potential.

REFERENCES

Agronomy 2021, 11, 1514. <https://doi.org/10.3390/agronomy11081514>

- H. M. Khairul BasharAbdul., Shukor Juraimi., Muhammad Saiful Ahmad-Hamdani ., Md Kamal Uddin., Norhayu Asib., Md. Parvez Anwar., and Ferdoushi Rahaman
- Kaur, R.; Das, T.K.; Banerjee, T.; Raj, R.; Singh, R.; Sen, S. Impacts of sequential herbicides and residue mulching on weeds and productivity and profitability of vegetable pea in North-western Indo-Gangetic Plains. *Sci. Hortic.* 2020, 270, 109456.
- Khaket, T.P.; Aggarwal, H.; Jodha, D.; Dhanda, S.; Singh, J. Parthenium hysterophorus in current scenario: A toxic weed with industrial, agricultural and medicinal applications. *J. Plant Sci.* 2015, 10, 42.
- Patel, S. Harmful and beneficial aspects of Parthenium hysterophorus: An update. *3 Biotech* 2011, 1, 1–9
- Shabbir, A.; Bajwa, A.A.; Dhileepan, K.; Zalucki, M.; Khan, N.; Adkins, S. Integrated use of biological approaches provides effective control of parthenium weed. *Arch. Agron. Soil Sci.* 2018, 64, 1861–1878.