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EFFECT, MANAGEMENT AND ACTIVITY OF PARTHENIUM HYSTEROPHORUS

***Shewale Darshan V.**

India.

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***Corresponding Author**

Shewale Darshan V.
India.

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ABSTRACT

Parthenium hysterophorus is a very invasive annual weed in the Asteraceae family that is a global hazard to agriculture, human health, and biodiversity. Parthenium has become one of the most destructive weeds in the world, affecting ecosystems in Africa, Asia, and Australia due to its abundant seed production and quick growth. This thorough analysis looks at parthenium's physical traits, biological activity, and detrimental impacts on a range of environmental factors and living things. The effects of the weed on soil health, animals, humans, crops, biodiversity, and soil health highlight the critical need for efficient management techniques. The usefulness of physical, chemical, and biological control techniques in reducing Parthenium infestations is highlighted. The overview summarizes the complex issues raised by parthenium and highlights the significance of teamwork in addressing its broad.

Figure 1: Parthenium Hysterophorus.

INTRODUCTION

Parthenium hysterophorus, an annual weed belonging to the Asteriaceae family, is found all

over the world. This harmful plant is well-known for having detrimental effects on human health, agriculture, and biodiversity.[1] This invasive and toxic species is regarded as one of the worst weeds that exists today. This weed is extremely problematic for biodiversity and is also a major cause of serious health problems for humans and animals, including dermatitis, asthma, and bronchitis. It also causes agricultural losses. There is a popular belief that the seeds of this weed were brought to India by grains imported from the United States under the US PL 480 scheme, also called "Food for Peace," a food assistance program run by the US government. From there, the weed spread alarmingly like wildfire to nearly every state in India, becoming a naturalized weed.[2] The plant is an extremely prolific seed producer, yielding up to 25,000 seeds per plant.[3] Although it is a new species in India, Roxburgh, the father of Indian botany, first mentioned it in his book Hortus Bengalensis.[4] in 1814.

Scientific classification

Kingdom: Plantae Clade: Angiosperms Clade: Eudicots Clade: Asterids Order: Asterales Family: Asteraceae Genus: Parthenium

Species: Parthenium hysterophorus.

Biology of pharthenium weed

Allocation. The region around the Gulf of Mexico, Central America, southern North America, the West Indies, and central South America are the native habitats of parthenium.[6] By today, the weed has spread to over 20 countries worldwide, encompassing five continents and several islands. According to recent events, there is a considerable risk of invasion for African nations. It has now spread to eight Chinese provinces and is growing at a frightening rate. Parthenium most likely got into India around 1910 (by tainted grain of cereal), but it wasn't discovered until 1956. India has seen the plant spread like wildfire since 1956.[7] Name. The Latin term parthenice is the source of the genus name Parthenium, which refers to the plant that is currently known as Tanacetum parthenium (L.) Bernh., or "feverfew." The Greek words hystera (womb) and phoros (bearing) are the source of the name hysterophorus, which refers to the plant's prodigious seeding behavior.[8] Common names for it include feverfew, whitetop, escobar amarga, and bitter weed in India; ragweed parthenium and false ragweed in the USA; and carrot weed, broom bush, and congress grass in the Caribbean. Parthenium hysterophorus L., often known as parthenium weed, is a member of the Asteraceae family's Heliantheae tribe, which is a highly varied family with a global distribution.[9]

Morphology of Plant

Parthenium hysterophorusL. is a perennial or annual herb that grows quickly, is upright, and has many branches. It depicts two distinct life stages: the rosette, or juvenile, stage, which is asexual, and the adult, or mature, form, which is generative. A badge with great, dark green, simple, radicle, and pinnatisect somewhat leaves deficient in flowering is seen in the young phase (Figure 1(a)). Without allowing any other plant to smother it, the huge lower leaves are dispersed across the ground like a mat.[10] With a deep tap root system that stretches up to two meters in height, the adult stage is upright and heavily divided (Figure 1(b)). As the plant grows into a sturdy bush, the hairy, octangular, longitudinally fluted stem becomes strong and woody. Simple, alternating, pinnately or bipinnately divided leaves measure 20–30 × 12–25 cm and get smaller as they approach the apex of the branches (Figure 1(a)). The creamy white, 4 mm-diameter flowers emerge from the leaf fissures. A vast quantity of anemophilous, or airstream-pollinated, pollen grains—624 million per plant—are produced. Four to five black, piece-shaped seeds (Figures 1(c) and 1(d)) that are 2 mm long and with tiny white scales and are invisible to the unaided eye are produced by each flower. With up to 25,000 seeds produced per plant, it is an extremely prolific seed producer that builds quite a sizable seed bank in the soil.[11]

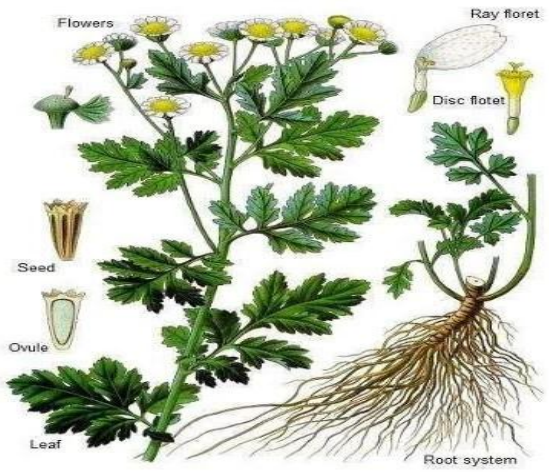

Figure 2: Morphology of Parthenium hysterophorus.

Activity of parthenium hysterophorous

Anti-inflammatory activity Oral delivery Parthenium hysterophorus extract at 10, 20, and 40 mg/kg of body mass had significant antinociceptive and anti-inflammatory effects against acetic acid-induced struggle in mice and carrageenan-induced paw edema in rats, respectively. In carrageenan-stimulated mitt edema rats, 200 mg/kg of fresh leaf ethanolic

extract showed significant anti-inflammatory effects. Administration of parthenolide at a dose of 1–2 mg/kg of body weight similarly produced antinociceptive and anti-inflammatory effects. An inhibitor of cellular phospholipases, which prevents the synthesis of arachidonic acid in response to appropriate physiological stimuli, may be cause of the the anti-inflammatory characteristic.[12]

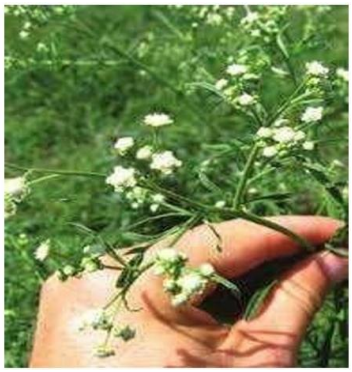

Figure 3: Activity of P.H.

Anti Microbial Activity

Despite the fact that Parthenium hysterophorusis poisonous, it is used to make traditional drugs in a variety of biospheres, including Jamaica, Trinidad, Mexico, the United States Virgin Islands, Alaska, and India. Parthenium is used to treat injuries, diabetes, ulcerated wounds, fever, diarrhea, anemia, inflammatory conditions, urinary infections, skin rashes, neurological disorders, and female generative issues. This is linked to the fact that parthenium creates subordinate plant metabolite compounds with strong antibacterial action.[13]

Antioxidant activity

The antioxidant phytochemicals protect cells against oxidative damage induced by free radicals. The DPPH (2, 2-diphenyl-1-picrylhydrazyl radical) seeking assay revealed that Methanolic and ethanolic abstracts of Parthenium hysterophorusexhibited antioxidant activity of 78.25561% and 66.28858%, respectively.[14] However, the second time, acetone citation was found to have superior anti-oxidant action over methanol and chloroform extracts.[15] In rats, 200mg/kg body mass of fresh leaves ethanolic extract shown substantial antioxidant activity.[20]

- **Antiamoebic activity**

Anti-amboebic action Parthenin from Parthenium hysterophoruswas tested in vitro for

antiamoebic activity, as well as Entamoeba histolytica's axenic and polyxenic activities. Parthenin has been found to be extremely harmful to cultivated organisms. Parthenin has action similar to that of metronidazole.[17]

Pesticidal activity

Pesticidal Activity Antifeedent bioassay revealed that lactone was originated to be about 2.25 times more energetic than parthenin against sixth-instar larvae of Spodoptera litura, while pyrazoline adduct was discovered to be the most active as a pesticide against the adults of supply grain pest Callosobruchus maculatus.[18] Hypoglycemic activity : The administration of an aqueous extract of Parthenium hysterophorusflower significantly lowered serum glucose levels in normal and alloxan-induced diabetic mice. In rats, oral treatment of fresh leaf extract resulted in a slight drop in plasma glucose levels.[19]

Harmful effects of parthenium

A. Impact on Biodiversity

This plant has the potential to alter natural ecology because it may produce throughout the year in practically all extreme situations, overwhelming indigenous vegetation. It poses a threat to natural variety because it lacks true natural opponents, has an allelopathic effect, and is photosensitive and thermosensitive. Parthenium's rapid proliferation can distract natural ecosystems because it has a high invasion capability and allelopathic capabilities, making it capable of disrupting any sort of natural environment.

B. Impact on Crop production

The Parthenium hysterophorusplant has infected a considerable part of India.[21] Given the unpleasant nature and imagined repercussions of parthenium weed, there is fear that weather change, specifically increasing [CO2] and temperature, may change its demography, small capacity, and organization (Fig.). For example, biological controller agents can be negatively artificial by increasing temperature.[22,23]

C. Impact on Soil

Parthenium is renowned for inhibiting the development and activity of many nitrogen-integrating bacterial species such as Rhizobium and Azotobacter, as well as nitrifying bacteria such as Nitrosomonas. Aqueous extracts of Parthenium inhibit the growth of Rhizobium, Nitrosomonas, and Azotobacter. It lowered the amount of leghemoglobin in root

nodes, affecting the Rhizobium-legumes symbiosis. Leaf and root leachates and their chemical components prevent nitrate formation.[24]

D. Effects on Human

Beings Human allergies caused by parthenium pollen particles, airborne dry plant parts, and roots include contact dermatitis, hay fever, asthma, and bronchitis. This weed contains the common allergens parthenin, coronopilin, tetraneuris, and ambrosin. Parthenium pollens induce asthma (allergic bronchitis), especially in youngsters who play outside, as well as adults and the elderly. Interaction of the plant with the body roots dermatitis, and the feast of the problem all over the body (indicated in figure), produces considerable discomfort.[25]

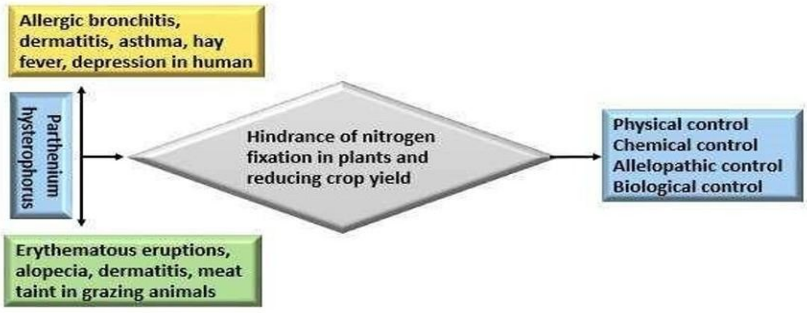

Fig.4 Harmful effects of parthenium 1

Control of parthenium

1. Physical control
2. chemical control
3. Biological control

PHYSICAL CONTRTOL

Physical control. The most efficient way is to manually uproot partheniums before flowering and seeding. Uprooting the weed after seeding will expand the area of infestation. Some landowners have had success plowing the parthenium weed in the rosette stage before it seeds, but this must be followed by spreading a crop or directly seeding the perennial grassland. Physical control entails manual weeding, which is time-consuming and unpleasant, compounded by the health risks associated with handling parthenium weed. Burning, another weed-management approach, is ineffective against parthenium. However, research indicates that burning for other objectives (such as woody weed removal) will not result in an increased parthenium infestation if the pasture is allowed to heal before stock is brought. This, too, has proven inadequate for two reasons: it takes a huge amount of fuel and, when

burned, destroys all other commercially important plants growing nearby.[26,27]

CHEMICAL CONTROL

Chemical control is a useful strategy for controlling parthenium in locations where natural enemies are few. Chemical herbicides such as chlorimuron ethyl, glyphosate, atrazine, ametryn, bromoxynil, and metsulfuron have been shown to be quite efficient in suppressing this weed. According to references,[28-30] the application of 2,4-D EE (0.2%) and metribuzin (0.25 and 0.50%) was found to be more effective for suppressing parthenium 15 days after spraying (DAS), resulting in full mortality of the parthenium population and no weed emergence. Khan et al.[31] stated that the stage/time of parthenium weed for herbicidal management is critical, and the weed was efficiently eliminated at the rosette stage in wasteland, noncropped regions, railway tracks, water channels, and roadsides. Glyphosate and metribuzin were the most effective treatments for parthenium weed control, with higher mortality at 4 weeks after treatment (WAT) at both rosette and bolted stages than 2, 4-D, triasulfuron + terbutryn, bromoxynil + MCPA, and atrazine + smetolachlor, atrazine, s-metolachlor. Pendimethalin was the least effective therapy across both growth stages. Overall, herbicide efficacy was higher on rosette parthenium plants than on bolted plants. Table 1 shows the mortality rate of several herbicides at the rosette and bolted phases. Spraying a solution of common salt (Sodium chloride) at 15-20% concentration has been shown to be effective in open waste areas, non- cropped regions, railway tracks, and roadsides. Biological control is an environmentally sound and active method of diminishing or justifying pests and pest qualities through the use of natural enemies. In the last three to four years, there has been widespread consensus on the necessity of controlling parthenium using a variety of biocontrol agents such as microbial diseases, insects, and botanicals.[32, 33]Among the different biocontrol strategies, biological control of weeds by plant diseases has gained popularity as a practical, safe, and environmentally beneficial strategy suited to agro-ecosystems.[34]

BIOLOGICAL CONTROL

In regions without natural adversaries, parthenium can be effectively controlled through chemical means. It is well known that using chemical herbicides to suppress this weed, such as glyphosate, metsulfuron, ametryn, atrazine, and bromoxynil, works incredibly well. According to,[35–37] at 15 days after spraying (DAS), the application of 2,4-D EE (0.2%) and metribuzin (0.25 and 0.50%) was found to be more effective for controlling parthenium,

inducing full mortality of the parthenium population and preventing any emergence of weed. According to Khan et al.[38], parthenium weed's stage and timing are crucial for herbicidal management; in wasteland, uncultivated regions, alongside railroad tracks, river channels, and roadside places, the weed was successfully eradicated during the rosette stage. With greater mortality at 4 weeks after treatment (WAT) at both the rosette and bolted phases compared to 2, 4-D, triasulfuron + terbutryn, bromoxynil + MCPA, and atrazine + s-metolachlor, atrazine, s-metolachlor, the most successful treatments for parthenium weed control were glyphosate and metribuzin. The least successful treatment for both growth stages was pendimethalin. Overall, rosette parthenium plants showed more promise for herbicide efficacy than bolted plants did. Table 1 shows the mortality rate caused by several herbicides at the rosette and bolted phases. Spraying a common salt solution (15–20% concentration) along railway tracks, roadsides, open wastes, and uncropped areas has been found to be effective.

DISADVANTAGES OF HERBICIDES

The use of chemical herbicides has a number of drawbacks, including the potential harm to the environment and the emergence of herbicide resistance to a variety of substances, including glyphosate, atrazine 2, 4-D, metribuzin, paraquat (Gramoxone), trifluralin, and diphenamid.[39] One of the most harmful herbicides is glyphosate; even little doses of less than 10 micrograms per plant can harm or kill a variety of wild plant species. Furthermore, glyphosate has the potential to harm wild plants more than a lot of other herbicides. Because of its potential to contaminate groundwater, atrazine has been proven to be extremely persistent in soil and is now categorized as a restricted use pesticide (RUP) in the USA.[40]

Biodiversity loss due to P. hysterophorus

Parthenium hysterophorus possesses alleolopathic qualities and the ability to invade, which makes it capable of upsetting natural ecosystems. A P. hysterophorus-dominated environment.

fig.5 Loss of Biodiversity 1

may have very little or no other vegetation. Native Australian grasslands, open forests, river banks, and flood plains have all been found to be completely altered in terms of habitat (Lakshmi and Srinivas 2007). These weeds seriously threaten India's biodiversity as they spread quickly into new areas and frequently supplant native plants. An detailed survey of invasive alien species (IAS) and their effects on several land use types in Bangladesh, such as roadside, low land, fallow land, homestead, and railway track, was carried out by Akter and Zuberi (2009). Among other things, Parthenium hysterophorus shown the capacity to colonize and adjust to novel environments, consequently diminishing the quantity of native flora. The weed is considered an invasive alien species because to its more active reproduction strategy and variety of secondary metabolites.

Bioherbicidal Approach

practices, and the pathogen needs to be effective under enough different environmental conditions to allow In the same manner that chemical herbicides are used to manage weeds, plant pathogenic fungi are created and employed as "living products that control specific weeds in agriculture as effectively as chemicals.[41] Typically, they are administered by periodically dispersing different quantities of the virulent inoculum, much like chemical herbicides (therefore called bioherbicides).[42, 43] Mycoherbicides were first proposed by Daniel et al., who showed that if an endemic pathogen was applied in large quantities at a particularly vulnerable growth stage, it may be totally destructive to its weedy host. The pathogen needs to be culturable in artificial media, the inoculum needs to be able to produce large amounts of the final product through traditional methods like liquid fermentation, the final product needs to be genetically stable and specific to the target weed, the handling, storage, and application techniques need to be compatible with current agriculturalfor a feasible application window in order to be successful.[44] Numerous attempts have been made

in the past to use mycoherbicides or fungal agents to control weeds.[45] A number of these treatments are currently on the market (Table 3) and many more are in development.

Table 2: Succesful example of control of weeds through classical biocontrol agents.

Weed	Bioagent	Kind of bioagent	Reporting country
Chondrilla juncea	Puccina chondrillina	Rust	Australia
Cyperus rotundus	Bactra verutana	Shoot boring moth	India, Pakistan
Eupatorium riparium	Entyloma compositarum	Plant pathogen	USA
Hydrilla verticillata	Hydrellia pakistanae	Shoot fly	USA
Parthenium hysterophorus	Puccinia abrupta var. partheniicola	Rust	Mexico
Parthenium hysterophorus	Zygogramma Bicolorata Epiblema strenuana Conotrachels sp.	Leaf eating bettle, Stem galling insect, Stem galling insect	Mexico Australia Australi

Table 3: Example of vweed control using bioherbicidal approach (liquid formulations).

Serial number	Target weed	Fungus	Product name	Year of registration	Formulation type
1.	Persimmon (Diospyros virginiana) trees in rangelans	Acremonium diospyri	Acremonium diospyri	1960	Conidial suspension
2	Dodder (Cuscuta chinesis and C. australis) in soybeans	Colletotrichum gloeosporioides f. sp. Cuscutae	Lubao	1963	Conidial suspensio
3	Milkweed vine (Morrenia odorata)	Phytophthora palmivora (P. citrophthora)	DeVine	1981	Liquid spores suspension
4	Yellow nutsedge (Cyperus esculentus)	Puccinia canaliculata	Dr. Biosedge	1987	Emulsified suspension
5	Turf grass (Poa annua) in golf courses	Cylindrobasidium leave	Stumpout	1997	Liquid (oil) suspension
6	Woody plants Blackberry weed (Prunus serotina)	Chondrostereum purpureum	BioChon	1997	Mycelial suspension in water
7	Hakea gummosis and H. sericea in native vegetation	Colletotrichum acutatum	Hakatak	1999	Conidial suspension
8	Deciduous tree species	Chondrostereum purpureum	Mycotech Paste	2004	Paste
9	Alder, aspen, and other hardwoods	Chondrostereum purpureum	Chontrol (Ecoclear)	2004	Spray emulsion
10	Dodder species	destruens	Smolder	2008	Conidial suspension
11	Soda apple (Solanum viarum)	Tobacco mild green mosaic virus	Solvinix	2009	Foliar spray

Table 4: example of weed control using bioherbicidal (solid formulation).

Serial number	Targeted weed	Fungus	Product Name	Year of regesteration	Formulation type
1	Northern jointvetch (Aeschynomene virginica)	Colletotrichum gloeosporioides f. sp. aeschynomene	Collego LockDown	1982	Wettable powder
2	Sickle-pod and coffee senna (Cassia spp.)	Alternaria cassia	Casst	1983	Solid
3	Water hyacinth (Eichhornia crassipes)	Cercospora rodmanii	ABG-5003	1984	Wettable powder
4	Velvet leaf (Abutilon theophrastus)	Colletotrichum coccodes	Velgo	1987	Wettable powder
5	Round-leaved mallow (Malva pussila)	Colletotrichum gloeosporioides f. sp. malvae	BioMal	1992	Mallet wettable

Table 5: Insect biocontrol agents released to control parthenium weed in different countries.

Biological control agent	Feeding habits	Native country	Released country
Bucculatrix parthenica	(Leaf mining moth	Mexico	Australia
Conotrachelus albocinereus	(Stem galling weevil)	Mexico	Australia
Epiblema strenuana	(Stem galling moth)	Mexico	Australia
Listronotus setosipennis	(Stem boring weevil)	Argentina and Brazil	Australia
Platphalonidia mystica	(Stem boring moth)	Argentina	SriLanka
Smicronyx lutulentus	(Seed feeding weevil)	Mexico	Pakistan, Australia
Stobaera concinna	(Parthenium sap feeder plant hopper)	Mexico	Australia

Integrated Weed Management

When used alone, the traditional and bioherbicidal methods are insufficient to control this weed. However, integrated pest management, or IPM, has drawn more attention recently as a way to lessen pest-related losses and rely less on chemical pest control, supporting

agricultural systems' long-term sustainability. The native Mitchell grass (Astrebella squrossa) and the introduced butterfly pea (Clitoria ternatea), along with two biological control agents—a leaf and seed feeding beetle (Zygogramma bicolorata) and a stem galling moth (Epiblema strenuana—have been used to suppress parthenium weed in Australia as part of integrated weed management strategies to supplement the traditional biological control approach with other management techniques. Without the biological control agents, the suppressive plants greatly reduced the growth of weeds. However, the presence of one of the two biological agents indicated above may further amplify this suppressive capacity. Research conducted in Australia has shown that using suppressive plants in addition to currently used biological control measures can result in a more successful management of parthenium weed.[46]

CONCLUSION

Parthenium hysterophorusis a noxious plant that may thrive in a wide range of settings and alter the nutrients in soil both above and below ground.It has the ability to outcompete both native and nonnative palatable plants that are crucial for cattle. Additionally, modifications to the flora and nutrients in the soil may eventually affect other trophic levels, changing how the ecosystem functions. Parthenium hysterophorusmanagement strategies must be appropriate in order to prevent potential hazards to biodiversity and financial losses. The application of biological control using allelopathy, insects, and fungal diseases is an effective and environmentally beneficial substitute for other labor-intensive, expensive, hazardous, physical, and chemical approaches.

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