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## A STUDY ON OUTSTRETCHED, MENACE AND GOVERNANCE OF *Parthenium hysterophorus*

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*Parthenium hysterophorus* also commonly known in Indian languages like chatak chandani, nakshathra gida, osadi, gajari-kasa, phandriphulli and safed topi is a luxuriant weed sometimes called as carrot grass, congress grass, fever few, star weed etc. (Bhowmick, 2000) besides the common name in English Santa-Maria (Reported by: Botanical Society of England and Ireland, 2015) belongs to Asteraceae (Compositae) family is one of the most harmful alien invasive annual weed which is herbaceous and erect in nature responsible for both economical and ecological problems (Khaket *et al.*, 2015). It is native to the North American tropics (Reported by: United States Department of Agriculture, 2010). *Parthenium* is a C<sub>3</sub>-C<sub>4</sub> intermediate plant (Mahadevappa, 2009a) and particularly the species *hysterophorus* has a chromosome number of 2n=18 (Hakoo, 1963). It is a weed of semi-arid, subtropical, tropical, and warmer temperate regions and is most aggressive in degraded pastures in semi-arid environments. *Parthenium* thrives in alkaline, clay-loam to heavy black clay soils (Berry, 1984) but it tolerates a wide range of soil types with favorable pH being 5.5-7.0 and can emerge at wide range of temperatures ranging from 10 to 25 degrees Celsius (Tamado and Milberg, 2002). The rainfall of amount 500 mm annually favors their germination and growth (Chamberlain, 2004). Drought also creates favorable conditions due to less pasture coverage beside countries prone to flood can also be threatened by its growth due to the plant's wide range of adaptability towards various climate and soil conditions. Integrated managerial approaches proved more successful in controlling *parthenium* plants.

### Distribution

Today *parthenium* has spread over 40 countries due to its fast-spreading ability and wider adaptability under various climatic conditions such as Australia, Gulf of Mexico, Central America, South, and Northern America, West Indies, and Oceania along with other

countries of the pacific region (Navie *et al.*, 1996). It has been reported from Asian countries like Bangladesh, Israel, Pakistan, Nepal, Southern China, Sri Lanka, Taiwan, and Vietnam. Recent studies showed its invasion of African countries like New Caledonia, Papua New Guinea, Seychelles and Vanuatu, Kenya and many districts of Uganda have been infested in the last few years (Dhileepan and Senaratne, 2009). In India, it arrived in 1955 through the import of food grains under the US PL 480 scheme which was a food treaty between the US and India (Vertak, 1968) and later, identified and reported by Rao (1956) in Poona now Pune, Maharashtra. During 1810, it was reported that Parthenium was first maintained at Botanical Garden, Shibpur, Howrah (West Bengal) in India under the programme of collection and *ex situ* conservation of alien plants (Mukhopadhyay *et al.*, 1993). Also, accordingly it was first reported in Arunachal Pradesh, India in 1810 (Gnanavel, 2013). Since then it spread to each corner of the country. In about 50 years, it has established its roots throughout India under the climate of extreme cold and heat. During 1975, it was first observed in few quantities near Dankuni rail yard, Hooghly, West Bengal (Mukhopadhyay *et al.*, 1993). Now it covers approximately 35 m ha of land in India which is a serious issue (DWSR Annual Report, 2010c). It is being observed in the northern parts of India like Kargil region of Jammu & Kashmir, Himachal Pradesh, southern regions of India at Port Blair in Andaman & Nicobar along with Kanyakumari, in the western regions of Gujarat, Maharashtra and finally in the eastern states of West Bengal, Assam etc. (ICAR-DWSR, 2012, Lok Sabha, 2014) which is an indication of its widespread in India. Due to the lightweight of seeds, they are easily dispersed through various means such as air, water, agricultural implements, grains, stock feed, pasture feeds, humans, animals, vehicles, etc. (Monaco *et al.*, 2001). The seed germination occurs from 8°-30° C. Parthenium is an annual, herbaceous, erect, fast-maturing plant that forms a basal rosette of leaves during the early stage. It is having shorter life span as it germinates, grows, and produces seeds within 50 to 80 days a single plant can produce 15000-25000 seeds and an average of 1,00000 in large plants can be seen and so considered as a luxuriant seed producer which is their only mode of reproduction (Gnanavel, I., 2013) and can annually complete up to 3-4 life cycles from (February-May, June-September and October-January) or more with each seed viability up to 4-6 years has been observed in many cases even when buried while the seed on surface does not have or little dormancy are recorded (Navie *et al.*, 1996). The weed has the potential to produce as high as 1, 54000 seeds per m<sup>2</sup>. The plant seeds can germinate from up to 0-3 cm deep.

### Ill effects of Parthenium

*Parthenium hysterophorus* causes both ecological and economical damage to the environment. In India, about 4-7% of people are having clinical symptoms due to contact with parthenium and 42-52% suffers without showing any symptoms as reported by Towers and Rao, 1992. The sesquiterpene lactones in parthenium which is a bitter glycoside parthenin (Maishi *et al.*, 1998) cause allergic reactions when people or animals come into its contact. It is poisonous, allergic, and problematic to both humans and livestock (Kaur *et al.*, 2014). The plants and their pollen dust, when coming in contact with humans, causes several health issues such as dermatitis (Morin *et al.*, 2009), infections, skin rashes, allergic bronchitis asthma, allergic reactions on the sole, severe dermatitis, allergic eczematous, allergic papules, hay fever, and depression in human (Mahadevappa, 2009). The allergens found in parthenium are parthenin, coronopilin, tetranurin, ambrosin. The pollen mainly causes bronchitis in human beings. Similarly, the plant also causes a problem in livestock as these are not palatable for grazing animals such as bitter milk, tainting of milk, meat taint as reported by (Lakshmi and Srinivas 2007), (Ayele, 2007) if eaten with grass or pasture causes ulcers in the mouth (Aneja, K.R., 1991). Dermatitis with skin lesions also occurs in grazing animals along with anorexia, pruritus, diarrhea, edema, alopecia, skin depigmentation. It produces toxic chemicals parthenin, hysterin, caffeic, hymenin, ambrosin, vanillic, ferulic, kumarin, chlorogenic, phenolics acid which exert a strong allelopathic effect on other crops thus prohibiting the growth of other crop plants and reducing the palatability of food grains grown in parthenium infested areas. Parthenin is an allelopathic chemical that is a water-soluble phenolics compound that inhibits the germination and growth of a wide variety of crops. Parthenium plants reduce the yield of field crops by 40% and 90% in forage crops as per report (Ghosh *et al.*, 2018). It has been reported that pollens of parthenium affect brinjal, tomato, maize, beans, capsicum etc., regarding their fruit setting thus reducing the yield causing economic loss to the farmers (Directorate of Weed Science Research, ICAR, 2010).

### Utilization of Parthenium

- Parthenium can be an excellent source of plant nutrient as it contains N, P and K along with other macro and micro nutrients such as Ca and Mg (Khan *et al.*, 2011). Parthenium can be converted into compost which contains 1.05-1.21% of N, 0.84-0.89% of P and 1.11-1.34% of K as reported by ICAR-DWSR, 2017. Pit system method of compost preparation is safe and reliable method to convert parthenium into

compost which can result in increasing yield and productivity of field crops. The dosage for use as basal application is 2.5-3.0 t/ha and for vegetables 4-5 t/ha is sufficient in adding nutrient to the field as reported by (Directorate of Weed Science Research, Jabalpur, 2012). Parthenium manure or mulch should be made from those plants which are in vegetative stage i.e., before flowering. 5t/ha of parthenium mulch is sufficient to increase soil fertility status and crop productivity as reported by (Dolai *et al.*, 2019).

- Parthenium contains many treatments for different ailments such as used by different tribes for skin rashes, fever, anemia, ulcerated sores, facial neuralgia (Venkataiah *et al.*, 2003). It also act as an analgesics in muscular rheumatism aqueous extracts exhibits hypoglycemic activity acting as an antidiabetic medicine, treat fever, diarrhoea, neurologic disorder, dysentery, urinary tract infection. *P. hysterophorus* leaf paste showed wound healing action when applied externally as reported by Kumar *et al.*, 2011.
- Parthenium act as an herbicide against *Digitaria sanguinalis*, *Cynodon dactylon*, *Cyperus rotundus*, *Portulaca oleracea*, *Ecchinochloa crusgalli*, *Xanthium stramonium* etc.
- It is a good antifeedent for *Spodoptera litura* and *Callosobruchas aculatus* can be controlled by parthenium (Datta and Saxena, 2001).
- There are several other benefits from parthenium. It is a cost effective source for removal of heavy metals like cadmium, nickel, nitrates, phenols and dyes which causes serious ailments in humans released from industries (Patel, 2011).

### Managemental Approaches

There are various methods for controlling parthenium plants in our surroundings. Scientists and researchers are still finding new methods for complete eradication so to minimize crop loss in India. After so many years of research, they discovered a few methods which are effective in checking their growth in India.

1. **Mechanical or Physical** method: Burning is not a permanent method but is effective in non-cropped areas or before sowing of the crop in agricultural lands as burning can damage necessary crop plants along with heavy fuel consumption is observed

(Kushwaha, V.B.; Maurya, S., 2012). But not a useful control strategy for parthenium, however, scientists suggest that burning for other purposes will not result in an increased infestation of parthenium as long as the pastures are allowed to recover before the stock is introduced. Parthenium can be uprooted before flowering and seed setting as after seed setting when the plants have uprooted the seeds spread on the ground causing the serious infestation. Ploughing the parthenium plant while in the rosette stage before the seed appears is effective in its control. Hand weeding is not safe as it is hazardous to human health also it is labour intensive and consumes time (Kushwaha, V.B.; Maurya, S., 2012).

2. **Cultural method:** Researchers found some plant species which can gain upper hand by competitive replacement of parthenium can be achieved like planting with *Cassia tora*, *Cassia sericea*, *Cassia occidentalis*, *Croton bonplandianus*, *Croton sparsiflorus*, *Amaranthus spinosus*, *Sida acuta*, *Tephrosia purpurea*, *Cassia auriculata*, *Stylosanthes scabra*, *Alternanthera sessilis*, *sida acuta*, *Chenopodium album* etc., (Gnanavel, I., 2013) which can positively reduce parthenium infestation by checking their growth. At the roadside, the children's park Marigold plant (*Tageta* spp.) can be grown along with *Croton* spp., *Amaranthus* spp. by simply broadcasting their seeds @ 2500 g ha<sup>-1</sup>. Marigold is also grown in crop rotation in Indian fields during the rainy season.
4. **Chemical method:** Weeds in non-cropped areas, open wasteland, and along railway tracks could effectively be managed with the post-emergence application of total killer herbicides (Paraquat 25 WSC at 1.0 kg a.i. ha<sup>-1</sup>) in combination with 2, 4-D sodium salt 80 WP at 1.5 kg a.i. ha<sup>-1</sup> (Bhowmick *et al.*, 2017). Apply post-emergence herbicides like 2,4-D Sodium Salt @ 1.5 kg a.i. ha<sup>-1</sup> or oxyfluorfen (ready mix) @ 2 g liter<sup>-1</sup>, Dolai *et al.*, 2014b reported earlier on this matter. Spraying of diuron 80 WP @ 15 kg ha<sup>-1</sup>, Glyphosate 71 SG + Oxyflurofen 23.5 EC @ 2g liter<sup>-1</sup> of water or Glyphosate 71 SG @ 3kg ha<sup>-1</sup> + 2,4-D EE @ 500 g ha<sup>-1</sup> if 2-3 sprays are applied in repetition per year as reported (Ghosh, *et al.*, 2018).
5. **Biological method:** Researchers have tried different natural agents from time to time then in 1983 biological control was initiated in India with the introduction of the Mexican beetle *Zygogramma bicolorata* (leaf-feeding beetle) from Mexico (Jayanth, K.P., 1987) which came to be most successful. The moth *zygogramma* emerges in the

late spring and remains active till autumn. The beetles hibernate in winter and feed only on the foliage and are available in June-July. Mexican beetle is no doubt an excellent agent for parthenium control in any season except in high humid condition and winters as it was observed that in winter and humid condition the egg laying grubs infest less quantity of parthenium plants due to their lack of adaptation in such climatic condition (Dolai *et al.*, 2016). Other bio-agents such as stem galling moth (*Epiblema stenuana*) are also introduced. *Listronotus sestosipenis* (seed feeding weevil), *Smicronyx lutulentus* (seed feeding weevil), *Bucculatrix parthenica* (leaf mining moth), *Carmenta ithacae* (stem boring moth) etc., all have excellent parthenium controlling capability (Javaid, A. and Shafique, S., 2010). A fungus *Puccinia abrupta* var. *partheniicola* urediniospores are also introduced to control parthenium (Fauzi *et al.*, 1999) along with *Fusarium* spp., *Alternaria* spp., *Rhizoctonia solani*, *Colleotrichum capsici* (Laxmi and Srinivas, 2007).

6. **Preventive approach:** As per the report of Dolai and Bhowmick, 2018, parthenium free crop seeds, stock feeds, vehicles and farming implements are necessary to avoid its spread to non-infested areas. Checking of parthenium infestation during drought periods is also important.
7. **Legal Control:** Karnataka was the 1<sup>st</sup> state in India to adopt legal act for the management of parthenium. Necessary preventive actions must be adopted by both state and central government to restrict its growth and spread in wastelands, roadsides, canal sides, railway tracks, irrigation bunds etc. Awareness among people should be build up by the State/Central government by declaring it as a noxious weed and implement proper law on it as per report by (ICAR-DWR, 2020).

## Conclusion

As a result of its allelopathic tendency toward crop plants and the generation of allergens that are harmful to both humans and animals, parthenium control is extremely important. This write-up discusses about parthenium's positive and negative effects on the environment and living things, as well as the health risks, crop losses, and control measures for this noxious weed. Here, we'll talk about integrated control methods, but there may be other ideas out there. Although biological control methods are typically used, additional eco-safe, cost-effective strategies should be added to promote sustainability. Due to their excessive competition with parthenium, many plants are employed to control it, but only

marigold has been widely used due to its ease of availability and aesthetic appeal. To further understand its biology, behavior, competitiveness, and eco-safe management, more research should be done. A community-based strategy is important to control parthenium because of its great reproductive potential. The National Parthenium Awareness Week is recognized during the second week of August. Similarly, the State Parthenium Awareness Week may be observed in each State depending on the level of Parthenium infestation there.

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