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Parthenium As A New Menace Endangering Indian Agro-Biodiversity and Its Management-A Critical Review

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ABSTRACT
Parthenium hysterophorus L. commonly known as Congress grass is an aggressive and noxious weed among top worst weeds in the world. *Parthenium* has achieved major weed status in India. It is now widely distributed in all the crops of almost all the states of the country threatening natural agro-ecosystems and biodiversity. This weed can rapidly invade into new surroundings often it can replace the native indigenous species and pose a serious threat to biodiversity.Various approaches viz., physical, mechanical, agronomical, chemical and biological have been employed for *Parthenium* management but most of them are ineffective due to their limitations. Integrated management practices have been found effective to minimize such invincible. An attempt has been made to review its impact on loss of Indian biodiversity effective management.
Key words:Noxious, biodiversity, agro-ecosystem, forage.

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INTRODUCTION

Parthenium hysterophorus L., commonly known as carrot weed, white top orcongress grass in India. It belongs to family Asteraceae (Compositae). It is most popularly known as gajarghas due to its appearance like carrot plant. *Parthenium* was introduced to India in seed form as a contaminant of food grains imported from Mexico. It was first time reported from India in 1956, growing as stray plants at waste places in Pune (Maharashtra). It is now widely distributed in all the crops of almost all the states of the country threatening natural agro-ecosystems and biodiversity. *Parthenium* has invaded almost all the states and areas of our country in agricultural lands, crops, orchards, pastures and waste lands like tracts of railways, canals, roadsides, industrial areas, forest areas and even National parks and residential colonies. Within a decade it had spread so vigorously in the plains of India that it became a problematic weed and it has achieved the status of the country's "worst weed".
It is profusely branched, leafy herb resembling a bush or shrub because of its height (1-2.5m). The stem becomes tough and woody as the plant matures into a hardy bush. Its flower can produce millions of pollen grains per plant and carried to spread to other areas by wind**.** It is an extremely prolific seed producer with an average 10,000to 25,000 seeds per plant. The plant is photo-thermo insensitive hence; it grows round the year except in severe winters. It grows in almost all types of ecosystemsexcept high salinity as the saline soil is not conducive to *P. hysterophorus* flowering [1].

HARMFUL EFFECTS OF *PARTHENIUM HYSTEROPHORUS* ON AGRICULTURE AND ECOSYSTEM

This weed has infested about 35 million hectares of land in India.Its infestation in crop area in recent past is alarming [2].The 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 [3]. *Parthenium* affects root nodulation in leguminous crops due to inhibition of activity of nitrogen fixing and nitrifying bacteria, viz., *Rhizobium, Actinomycetes, Azotobacter,* and*Azospirillum.*Itproduces enormous numbers of pollens (on an average 624 million/plant), which are carried away at least to short distance in clusters of 600-800 grains, and settles on the vegetative and floral parts, including stigmatic surface, inhibiting fruit setting in many crops viz.maize, brinjal, capsicum, tomato, and sunflower.This weed can rapidly invade into new surroundings often it can replace the native indigenous species and pose a serious threat to biodiversity [4]. It is an aggressive colonizer of roadsides, wasteland, railway sides, water courses, and cultivated fields.

Parthenium known to cause severe detrimental effect on mankind by causing many skin and respiratory disorders. The other skin problems include is mixed pattern combining of air borne contact dermatitis and chronic actinic dermatitis which shows as scattered infiltrated scaly papules over the exposed parts and dermatitis over eyelids, flexures of extremities on neck. The other problem is photosensitive lichenoid eruption pattern which presents with violaceous papules, and plaques over sun exposed parts such as cheek, forehead, ears, upper chest and back, dorsae of hands [5]. *Parthenium* extracts responded with positive skin reaction to mAb2 and also involvement of TH type cytokines in *Parthenium* dermatitis [6]

In addition, it causes anorexia, pruritus, alopecia, diarrhea, and eye irritation in dogs besides causing acute illness. When grazing animals fed on grass mixed with *Parthenium*yield bitter milk and tainted meat from buffaloes, cows and goats [7].

Management of *Parthenium hysterophorus*

Various methods, viz., preventive, physical, cultural, chemical, biological, and integrated approaches are being practiced to manage this weed around the globe. Singh *et al.* [8] considered that use of bio prospecting tools like using insects, microorganisms and competitive plants are the most economic way of managing *P. hysterophorus*. The new concept emerging in the use of botanical extracts which can affect germination and growth of *P. hysterophorus*. Studies are also attempted to extract the active ingredient responsible for weed controlling property of botanical components.

Preventive measures for management

It encompasses all measures taken to prevent the introduction andor establishment and spread of weeds in local, regional or national level. No weed control programme is successful if adequate preventive measures are not taken to reduce weed infestation. *Parthenium*management success is based on integration of all the available techniques and their implementation throughout years given below:

1. Physical management

Hand uprooting and burning of the weed are most effective methods to reduce the seed bank in future. Uprootingshould be done during rainy season or in wet soil. The best time to uproot the plants is before flowering. It is not effective after flowering. During summer and winter, it is hard to uproot the plant and if tried, plants are broken, from which further regeneration take place, however, burning becomes more effective.It is known that about 4% population is sensitive to *Parthenium.* If any symptoms are reflected about itching, swelling of skin etc. such persons should not be employed for *Parthenium* uprooting programme.

2. Mechanical management

In many crop fields *Parthenium* germinate profusely when left as fallow for one season. In such situation, mechanical deep ploughing before flowering is good and economical. The weed will be turned as green manure. Precaution should be taken to give spot chemical treatment over those plants which remain on surface as such plants not buried completely may rejuvenate.

3. Cultural management

Fast growing crop like sorghum, and *Sesbania* (daincha) should be grown to suppress the growth of *Parthenium*in their crop field, particularly when fields are supposed to keep as

fallow. Several cultural practices like thorough land preparation, use of crops and varieties which have smothering effect, maintaining optimum plant population, crop rotation, mulching, soil solarisation, stale seed bed technique and proper fertilizer and water management are important in controlling this weed [9, 10].

4. Legal management

State and Central government should declare *Parthenium* as Noxious Weed and a Weed of National Significance and implement law to held responsible the owner of a vacant field or plot. Municipalities in towns or cities, ministry of transport on road side, railway ministry on railway tracks side; irrigation departments on the bunds of irrigation canals should take appropriate step to control the weed by available methods.

5. By use of chemicals

Physical control of *Parthenium* is labour and cost intensive while manual control become ineffective in several conditions. Khan *et. al.*(2012[11])reported thatitcan be controlled by the use of chemicals like use of Glyphosate (2.5kg a.i./ha) or Paraquat (0.51 kg a.i./ha),Metribuzin (0.3 to 0.5%) or 2,4-D (2-2.6 kg a.i ./ha) or Hexazinone (3.5 kg a.i ./ha). The similar results were observed by Ramamoorthy*et. al.*[12] and Reddy *et. al.*[13].

Alaclor (2.0 kg a.i/ha) can be used as pre-emergence to control *Parthenium* in soybean, rajmaha, banana and tomato crop while Metribuzin (0.50 to 0.75 a.i/ha) can be used as pre-emergence just after sowing to control *Parthenium* in potato, tomato and soybean crop. Atrazinis effective to control *Parthenium* in maize. There are some limitations using chemicals like herbicidal effect of chemicals does not last long; it ends with only one germination. Sometimes the plants so suppressed by chemicals have regenerated after remaining dormant for a few days. Thus killing of established plants clear the way early only for the next flushes of *Parthenium* plants to emerge. The remnant seeds invaded land as well as newly deposited seeds are always ready for germination with a slight moisture becoming available to them in the soil medium.

6. By use of biological control agent

(A) Maintenance of natural biodiversity

Biological control is the intentional manipulation of natural enemies by man for the purpose of controlling harmful weeds. Biological control is inexpensive and poses no threat to non-target organisms, environment and biodiversity. There may be different types of bio-control agents like competitive plants, insects, fungi, nematodes, viruses etc [2, 8]. Insects have received maximum attention in biological control of *Parthenium*followed by competitive plants and pathogens. It is self-perpetuating and can spread on its own while other control measures require inputs periodically. It is easy to integrate with other control measures [14].

A botanical survey in relation to *Parthenium* control across the country has revealed an interesting factor that the *Parthenium* cannot penetrate into areas where the natural flora have not been disturbed. Wherever there is indiscriminate destruction of naturally existing plant species, the chances of *Parthenium* proliferation are more. In Maharashtra, *Stylosanthess cabra* has been found to compete with *Parthenium* though allelopathic effect. This has been confirmed by the field observation made by the Officers of the Department of Forests, Karnataka. Several other plant species were also identified as having similar impact but with varying degrees. The strongest species effective for *Parthenium* control listed in the order are (i) *Cassia sericea*(ii) *Tephrosia purpurea* (iii) *Stylosanthess cabra* (iv) *Croton sparsifiorus* (v) *Hyptis spp.* (vi) *Cassia tora* (vii) *Amaranthus spinosus.* Further, *Parthenium* growth is very intensive in places where new constructions (like extensions in cities and towns) are going on. All these observations lead to the conclusion that maintenance of biodiversity, that is natural flora wherever possible, is important to check *Parthenium* entry or invasion and its growth as weed [15].

(B) Use of Insects

There are so many insect and non-insect pests controlled through bio-control approach. Control of *Opuntia* in India through the introduction of Cochineal insect from Australia is a successful instance in India. In India, more than 50 insects have been reported on *P. hysterophorus* weed control but none of the insect has been found to be host specific yet. The classical approach was started by Jayanth in 1987 from Mexico with the introduction of host specific leaf feeding *Zygogramma bicolorata pallister* (Coleoptera: Chrysomelidae) and the stem galling moth *Epiblema strenuana.* These two insects have showed good potential to

manage this weed [16]. Both adult and larvae of *Zygogramma bicolorata* feed on leaves. In early stage, larvae feed on the auxillary and on the terminal buds and move on to the leaf blades as they grow and the fully-grown larvae enter the soil and pupate. The density of insect's one adult per plant caused skeletonization of leaves within 4-8 weeks. But, little successful was made due to very high germination of weed and moreover the insect is not a host specific and found that this insect can attack to other crops like sunflower in India [17, 14]. In India, insect species have been reported on *Parthenium,* but none of the indigenous insects was found host-specific yet. Based on well documented success by Mexican beetle, *Zygogramma bicolorata* Pallister (Coleoptera: Chrysomelidae), in other countries where they were introduced, beetle were imported from Mexico to India. After in-depth laboratory and field studies, it was found host specific, which can eat only Parthenium, hence, its use was permitted by Government of India. Therefore, Mexican beetles can be multiplied and released anywhere in India for *Parthenium* suppression.

(C) Use of Viruses

Some agricultural scientists expressed their view that there may be few viruses that can be used in bio-control of *Parthenium. Parthenium* phyllody disease is very common on *Parthenium* weed in India. The leafhopper (*Orosius albicinctus*) population in the field is positively correlated with the incidence of this disease. The phyllody disease of *Parthenium* is transmitted by *O. albicinctus* and the active transmission is found to be 55%. The minimum acquisition access period is found to be 20 minutes and the inoculation access period is 15 minutes. Incubation period in the vector varies from 15 to 20 days. The pathogen persists throughout the life of the *O. albicinctus*. *Parthenium* phyllody was transmitted by *O. albicinctus* to aster, cowpea, blackgram, greengram, horsegram, Limabean, redgram, sunhemp, fieldbean and soybean.

(7) **Other methods**

Cultivation of competitive crops is also not practicable because *Parthenium*is not such a big problem in cultivated lands where regular weeding operation is done. Further, cropping pattern has to be decided based on the suitability, cropping sequence, crop compatibility and marketability and changing the crop for the sake of *Parthenium* control is not going to become practicable. One possibility of using a plant enemy in intensively cultivated land to control *Parthenium*is only growing of *Stylosanthusscabra* and *Tephrosea spp.* in lands exclusively devoted to forage production. Some information of relevance to this aspect can also be found in the section relating to biological control of *Parthenium*through plants [15].

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