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"*Control through Utilization*" Way of Approach to Nullify the Pessimistic Effects of *Parthenium hysterophorus L.* by its Potential Usage in Agriculture

Chakravarthy Thejesh
M. Sc. (Ag) Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (Allahabad), Uttar Pradesh, India
Email: chakravarthythejesh17@gmail.com

Abstract- Parthenium hysterophorus L. is an invasive weed in many countries, due to aggressive supremacy of this weed is threatening biodiversity and crop production is extremely affected because of its allelopathic effect. For decades, activities like burning, biological control, and chemical herbicide application had succeeded but still, the management of parthenium is a big challenge. Recent studies revealed that as harmful effects it also has many beneficial aspects like high nutritious compost, biocontrol, for bioremediation of heavy metals like Cd and Ni, for the eradication of aquatic weeds and as an additive in cattle manure for biogas production. Management of parthenium can be achieved by "Control through Utilization" way of approach by utilizing the parthenium in agriculture to turn (Harmful effects) "Bane" to (Beneficial aspects) "Boon".
Keywords: Control through Utilization; Parthenium compost; Bioremediation; biogas production; Insect repellent.

1. Introduction

Parthenium hysterophorus L. is a pervasive annual herbaceous weed and this ephemeral herb is familiar for its vigorous growth and high fecundity especially in warmer climates is native of North East Mexico and is endemic in America. Parthenium is spreading very fast which infests farmlands and pastures causing recurrently disastrous loss of yield, as emulated in common names such as famine weed, other common names are congress grass, carrot weed, star weed, bitter weed, wild feverfew and white top, which often invades distributed lands, including roadsides. Previously it was a problem of waste and barren land but now it has become a big problem in each and every crop field, orchards, and even in forests. It has become one of the world's seven most devastating, hazardous, obnoxious weed, affecting livestock, crop production, and human health. Parthenium is an exotic weed comes belongs to the Asteraceae family. This alien weed is believed to have been introduced into India as contaminants of cereal grains in PL 480 wheat imported from the USA in the 1950s. (In 1954, Public law 480 was passed to give food grains to developing countries for banishing starvation and malnutrition). Presently, this invasive weed is widely prevalent and occupied almost all parts of India and is engrossing the attention of everyone (Singh et al. 2008) (Dhawan and Dhawan, 1996). This herbaceous menace has infested approximately two million hectares of land (Dwivedi et al. 2009), which is often referred to as "*Scourge of India*". It can tolerate drought conditions also to a certain extent under favourable condition. Parthenium completes about three generations a year and is reported for its prodigious power of regeneration. A single plant can procreate more than 10,000 viable seeds and these seeds can disseminate and germinate to cover vast areas. If weed is left as such in the same area, then it acts as a seed bank because of its higher seed production capacity and extended dormancy period. Parthenium is capable to unsheathe nutrients even from deficient soil and 40% of yield reduction was recorded in cropping land (Swaminathan et al. 1990). Considering the multitude of harms caused by parthenium, its management is necessary to avert future complications. Since parthenium thrives abundantly in many parts of the world it is essential to explore the beneficial aspects if any. The main motive of this review article is to highlight the propitious roles of weed in agriculture by recapitulating the published papers in this area.

2. Utilization of *Parthenium hysterophorus L.* in agriculture:

Parthenium which has been a severe problem for decades causing huge losses to farmers, but when parthenium is utilized in a better way definitely it is considered as a boon to agriculture. Eco-friendly way of approaches as follows:

A. Usage of parthenium for compost preparation:

Due to extensive and continuous usage of synthetic fertilizers, the fertility of the land is gradually depleting. Therefore biofertilizers are boon for soil health and its demand is rising. Parthenium biomass which is abundantly available can be used to prepare compost out of it by farmers with dual utility, one which can increase the productivity of crops by compost made in their own farms and the second is earning money from compost commercially. The following procedure was given by the Directorate of weed science research, Jabalpur.

i. Parthenium compost preparation:

- Select a place where water does not stagnates and make a pit of size 10x 6x 3ft (Length x width x depth) of which length and width can be altered but depth cannot be compromised.
- To prevent, absorption of nutrients from compost shield the surfaces with stone chips or make the soil surface compact.
- 100 kg dung, 10 kg urea or rock phosphate, soil (1-2 Quintals) are added to the pit and arrange at least one drum of water near the pit.
- Collect the parthenium plants from your field and spread about 50 kg of parthenium on the surface of pit and sprinkle 500 gm urea or 3 kg rock phosphate over it.
- All the above components will make one layer and apply pressure by feet on weed biomass to make it compact.
- Add *Trichoderma viridi* or *Trichoderma harziana* (fungi cultured powder) in the amount of 50 gm per layer if possible.
- Several layers are made till the pit is filled up to 1 fit high from the ground surface in a dome shape.
- Add 1012 kg of loamy soil on each layer if there is no soil at uprooted parthenium roots.
- Coat the dome with a mixture of cow dung, soil, and husk.
- From 37- 42 quintals of Parthenium biomass. 37–45% of well-decomposed compost can be obtained after 4-5 months.

ii. Precautions to be taken for parthenium compost preparation:

- Compost made by the unscientific way is the major cause of creating confusion. During a survey, it was found that compost made with flowered Parthenium by NADEP or open-pit or heap method contained more numbers of viable seeds of and 350-500 parthenium seeds can germinate from 300-gram compost made by NADEP or open-pit method.
- Compost made by the scientific way is safe because compost made in unopened pit causes a rise in temperature in the pit up to 60-70 ^{O}C and does not have viable seeds hence good for soil health and crop productivity.
- Pit should be in shady uplands, to prevent dryness of pit make a hole pour water, and close the holes.
- To avoid contamination rough out the fresh parthenium plants near the compost pit.

iii. Comparison of the nutrient composition of parthenium compost with other organic manures and its usage:

Parthenin, a poisonous chemical of parthenium which gets fully degraded during compost preparation and has no harmful effects on crops, human, and environment. It is eco-friendly compost with fewer input costs which enhances the crop productivity by its application and has more N, P, and K than FYM which is also rich in micronutrients. It is applied a basal dressing at 2.5-3.0 t/ha in the field and 4-5 t/ha in vegetable crops.

Table.1 ***Comparison of nutrient composition parthenium compost with Vermicompost and FYM***

Type	Nutrient (%)				
	N	P	K	Ca	Mg
Parthenium Compost	1.05	0.84	1.11	0.90	0.55
Vermicompost	1.61	0.68	1.31	0.65	0.43
Farm yard manure (FYM)	0.45	0.30	0.54	0.59	0.28

B. Usage of Parthenium extracts as biopesticide and bioherbicide:

Parthenium hysterophorus extracts are used as a biopesticide to control various pests and eradication of weeds. Seed germination of Eragrostis tef (Love grass) was effectively inhibited (Tefera, 2002) due to released phytotoxins from Parthenium leaves (Stephen and Sowerby, 1996). A higher concentration of Parthenium extracts was more prone to seed germination of Lepidium pinnatifidum where there was no germination at Parthenium concentration of 30 g L^{-1}. Aqueous extracts of fresh or dry leaf material of Parthenium hysterophorus shown susceptibility to species-specific differences which were reported by Kohli et al. (1996), Mersie, and Singh (1987). This may be due to the fact that broadleaf is more susceptible to Parthenium extracts as compared to grasses. In a similar study, it was reported that species differed substantially in their sensitivity to aqueous extracts of Parthenium hysterophorus for both root growth and germination (Belz et al., 2007; Rashid et al., 2008). Application of Parthenium extracts as pre-emergence was more effective compared to post-emergence application Marwat et al. (2008). These results strengthen that higher concentration of Parthenium decelerates the growth of plants which may be due to cell division inhibition as allelopathic chemicals have been found to inhibit gibberellin and indole acetic acid function (Tomaszewski and Thimann, 1966). Parthenin a chemical is among inhibitors pertinent for residue allelopathy as simulated under laboratory conditions by hindering germination and reducing plant growth (Belz et al., 2007). Parthenium hysterophorus can be used as a bioherbicide, which has influenced the weed population in the rice field by the incorporation of composted organic wastes. Treatments with the composted Parthenium and coir pith recorded the lower weed population. The application of organic waste composts diminished the weed count from 30.5 to 39.8% over NPK at 60 DAT. This could be ascribed to the role of allelopathic compounds such as phenol present in these two plant debris even after composting. The beneficial effect of organic wastes in reducing the occurrence of pests such as stem borer and leaf roller was observed due to the application of organic waste composts. Generally, under the incorporation of organic wastes, pest occurrence was reduced to the extent of 43.4 to 50% at 60 DAT as compared to NPK alone (Son, 1995). A similar effect in the weed population due to Parthenium as green leaf manure for rice was observed earlier by Sudhakar (1984). He reported that the

prevalence of leaf roller in rice crop was the maximum with urea application, whereas it was the minimum with green leaf manure application of Parthenium. Parthenium choked off water bodies suffocating aquatic creatures like Salvinia (*Salvinia molesta Mitchell*), water lettuce (*Pistia stratiotes*) and water hyacinth (*Eichhornia crassipes*). Pandey (1994) observed the effect of dry P. hysterophorus L. leaf powder on these jeopardizing weeds. The application caused wilting and desiccation of the above-water parts of these floating plants.

C. Parthenium for livestock welfare:

Parthenium hysterophorus can be utilized as a flea-repellent for dogs (Maishi et al. 1998) Feverfew (parthenium) flowers contain compounds like pyrethrins, which are known to torpefy fleas. A good insect repellent salve can be made when the flowers are infused in oils. Water infusion (or tea) can be made to use topically on your cat or dog to get rid of fleas. This type of pyrethrin will only remain active for a few hours (whereas some synthetic flea chemicals like Frontline and Advantage may last longer) (Jill Tack 2014) This weed is a treasured for its high-quality protein (HQP), potash, oxalic acids, and which are used as animal feed (Mane et al. 1986).

D. Parthenium as additive with cattle manure in biogas production:

With the rouse of the oil crisis, energy generation from biowastes by anaerobic digestion has engrossed the immense attention. Energy crops are credibly be future sources of digester feed stocks for methane generation. *Parthenium* was mixed with cattle manure at a 10% level and allowed to digest anaerobically at room temperature in 3-l batch digesters. The chemical changes during the course of digestion and the effect of digested slurry (inoculum) on biogas production were examined and a significant increase in methane content was attained. The methane content of the gas varied from 60 to 70% (Gunaseelan 1987). *Parthenium hysterophorus* should be seriously considered as a substrate for biogas production in India via anaerobic digestion, contemplating the abundance of this weed and large quantity of livestock.

E. Bioremediation of heavy metals by P. hysterophorus:

Heavy metals causing environmental pollution which is a global phenomenon. Nickel (II) is a heavy metal which commonly presents in the effluents of silver refineries, storage battery industries, electroplating, and zinc base casting. It causes cancer of lungs, nose, and bone at higher concentrations. Low-cost alternative technologies or absorbents are needed for the treatment of wastewaters which are metal-contaminated especially in developing countries like India. Lata et al. (2008) observed that the solution by varying parameters such as agitation time, Ni (II) concentration, adsorbent dose, and pH the adsorption capacity of *P. hysterophorus* for the removal of nickel from aqueous. The dried biomass of *P. hysterophorus* is used for carbon preparation by mixing it with concentrated sulphuric acid (1:1.5 w/v ratio) and keeping it at 120°C for 24 h, followed by washing and drying. For the elimination of Ni (II) from dilute aqueous solution sulphuric acid-treated carbonized Parthenium (SWC) could be a low-cost effectual adsorbent which easily available.

Cadmium (Cd) is extensively used in electroplating, for manufacturing plastic, metallurgical processes, and industries of pigments and Cd/Ni batteries. However, it is tremendously toxic even in low dosages and responsible for causing renal disorder, high blood pressure, deformity of bones, and RBC destruction. US Environmental Protection Agency considered Cd (II) as a priority pollutant because of bioaccumulation. Ajmal et al. (2006) reported that the dried powder of *P. hysterophorus* as an adsorbent was efficient for removing Cd (II) from wastewater. Dried and crushed mass of *P. hysterophorus was* used for adsorption of Cd (II) ions by employing the batch process. Atomic absorption spectrophotometry (AAS) of the filtrate showed that *P. hysterophorus* is a potent adsorbent extensively for initial Cd (II) concentration. The maximum adsorption of

Cd (II) ions in the pH range 3–4 was 99.7%. When 0.1 M HCl solution was used as effluent 82% recovery of Cd (II) from the adsorbent as showed by desorption studies.

3. Legal barriers on parthenium:

Through the Agricultural Pests and Diseases Act, 1968 management of parthenium was tried first in Karnataka state and declared parthenium as a noxious weed. Under section 4 notices were issued to the public in Bangalore once or twice by the municipal corporation to eradicate parthenium thus in spite of a comprehensive act, it was total failure, and efforts went vain to eradicate parthenium B.K. Tyagi et al. (2014), Stephen W Adkins et al (2018). Under the *Biosecurity Act 2014* parthenium weed is a restricted invasive plant and without a permit, it must not be given away, sold, or released into the environment. The Act requires everyone to take steps to minimize the risks associated with invasive plants and animals under their control. This is called a general biosecurity obligation (GBO).

4. Conclusion:

The objective of "control through utilization" can be attained through combined efforts of researchers, farmers, governmental organizations, and NGOs. Currently, even if P. hysterophorus is considered a weed, indirect eradication of the weed has paved the way after the discovery of the uses of the parthenium in different sectors coming to the limelight. Biopesticide, compost, as agent for bioremediation of toxic metals, herbicide, and source of biogas are some of the recently discovered significances of P. hysterophorus. There is the necessity to encourage the explore the utilization potential of this weed and to assess its efficiency in field trials. On four continents this weed is profusely available. Cost-effective industrial processing and lacking any ecological risks. The amplified deployment of *P. hysterophorus* biomass as an energy source and raw materials is essential for long-endurance, as fossil fuels are inadequate similarly, its usage as manure and pesticide can be acceptable with the rouse of the problems posed by chemicals. Segregation and chemical exploration of the compounds in *P. hysterophorus* are required to interpret their properties and calculate their applications. In this regard, it is touted to become a boon for human beings, animals, and crops in near future.

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