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Parthenium hysterophorus and its management through botanicals

JAI KNOX AND M.S. PAUL

Department of Botany, St. John's College, Agra, India-282 002
Department of Botany, Wilson College, Mumbai-400 007

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Parthenium hysterophorus L. is one of the worst weed for agriculture, the environment and human health. *Parthenium* is also known as 'Congress grass' and 'Gajar ghas' in India. It is a herbaceous, erect and annual plant belonging to family Asteraceae (Compositae). *Parthenium* was accidentally introduced in India through imported food grains in mid 1950's (Dhawan and Dhawan, 1996). After noticeable occurrence of *Parthenium* in Pune (Maharashtra) it had spreads like 'wild fire' throughout India. Many methods ranging from manual uprooting, chemical herbicides to biological control agents have been proposed to limit the spread of this uncontrollable weed. *Parthenium hysterophorus* contain toxins from the chemical group of sesquiterpene lactone (C15 group) (Oudhia and Tripathi, 1998). The major component of toxin being parthenin and other phenolic acids such as caffeic, vanillic, ferulic, chlorgenic, p-hydrobenzoic acid, p-cumaric acid and anisic acid are lethal to human beings and animals (Mahadevappa, 1998). *Parthenium* contains 35 lactones of the pseudoguaicinolide and xanthanolide skeletal types. Parthenin a major constituent is a sesquiterpenoid having a pseudoguaianolide structure. It contains an α-methylene γ-butyrolactone moiety (ring C) along with other functionalities and five chiral centers (Ramesh *et al.*, 2004).

Parthenium contains sesquiterpene lactones which induce severe allergic reactions in susceptible individuals who are continuously exposed. Parthenin-a sesquiterpene lactone and several phenolic acids like caffeic, vanillic, ferulic, chlorogenic, P-hydrobenzoic, P-coumaric and anisic acids are among the inhibitors identified (Oudhia,1998). The leaves of *Parthenium* contain B-sitosterols and its glucosides compesterol stigmasterol, betulin, urolic acid and saponin composed of oleanolic acid, glucose and galactose. Ever since *Parthenium* started invading newer areas and growing in high population, its numerous ill effects on human and livestock health, native flora and agricultural productivity are being reported. This weed because of its invasive capacity and allelopathic properties has the potential to disrupt natural ecosystem. It has been reported as causing a total habitat change in native Australia grassland, open wood lands, river banks and flood plains. Similar invasion of national wild life parks have been observed recently in southern India. The principal culprit, parthenin has enhanced biological activity due to the presence of a cyclopentene group, which can cause chromosomal damage in animal cells, uncouple phosphorylation and inhibit cellular enzymes. Perhaps an even more sinister effect of *Parthenium* weed on human health has been highlighted by Tanner and Mattocks 1987, who hypothesized that *Parthenium* contaminated animal feed leads to tainted milk and that the hepatoxic parthenin reacts synergistically with copper in causing Indian Childhood Cirrhosis (ICC).

The study was conducted at the Tropical Fieid, St. John's College, Agra, Urban North Central India. The chemical properties of the soil were: pH= 8.10; electrical conductivity: 0.54 (dS m^{-1}); organic matter: 1.1%; available phosphate: 17.5 (kg ha^{-1}); available potash: 393 (kg ha^{-1}) and available nitrogen: 112.896 (kg ha^{-1}). Six quadrats of 1×1 m^2 size were laid out at 10 sites in non-cropped areas and *Parthenium* count per m^2 in association with each suppressing bioagents and the *Parthenium* count without suppressing bioagents were undertaken. The upper parts of shoot tips were collected from the selected plants. 100 g of shoot tips were soaked in 500 ml of double distilled water each under aseptic conditions for 10 days and placed in conical flasks in a refrigerator at 8 °C. The aqueous leachates were filtered through three layers of muslin cloth/ cheese cloth to remove debris. The filtrate was then re-filtered through one layer of Whatman No.1 filter paper. Leachates of 50% and 100% concentration were prepared with sterilized distilled water and used for bioassay. Mature undisturbed *Parthenium* plants were given foliar treatment of 100% aqueous leachates of selected plants for one month at one week interval. Fresh weight was taken and then the dry weight was taken after one month after placing the plants in oven for 24 hours at 74^0C. The mean values of the data were compared with factorial completely randomized design at a significance level of $P< 0.05$ and conclusion was drawn by two way ANOVA.

The data on *Parthenium* count per m^2 in non-cropped areas with suppressing plant species revealed that the average intensity of *Cassia occidentalis* from ten sites was 20 plants/ m^2 and intensity of *Parthenium* in association to it was 3.11 plants/ $m^{2.}$

Short communication
Email: jaiknox@rediffmail.com

The average *C. procera* intensity from 10 sites was 15.2 plants/ m^2 and *Parthenium* count in association to it was 5.57 plants/ m^2. The average *W. somnifera* intensity from 10 sites was 11.3 plants/ m^2 and average *Parthenium* intensity in association to it was 8 plants.m^{-2} (Table-1). *Parthenium* count in absence of suppressing bioagents recorded an average intensity of 69 plants/ m^2. This decline in *Parthenium* intensity in association with suppressing bioagents was due to biochemical interaction among *Parthenium* and bioagents plant species. The fresh weight and biomass of *Parthenium hysterophorus* decreased significantly as shown in the table-2. Maximum significant inhibition in fresh weight and biomass of *Parthenium* was observed in 100% concentration of shoot tips of *Cassia occidentalis* having 1.42 gm and 0.94 gm, respectively followed by *Calotropis procera* in which 3.42 gm of fresh weight and 3.00 gm of biomass was observed. Minimum inhibition was observed in 100% concentration by the shoot tips of *W.somnifera* having 5.45gm and 1.38gm of fresh weight and biomass, respectively. In biomass however, *W. somnifera* was more effective than *C.procera*. In control 15.60 gm and 11.35 gm of fresh weight and biomass was observed, respectively. Similar results were obtained by Kandasamy and Sankaran (1997) who observed different competitive plants, as effective, in suppression of *Parthenium*. Exploitation of dominant crop and plant species to replace *Parthenium* by their allelopathic activity has been successfully demonstrated by Desai and Bhoi (1991) and Mahadevappa and Joshi (1985). Other species of *Cassia* like *Cassia uniflora* and *C. sericea* have also been found to replace *Parthenium* (Devasagayam and Shariff, 1993). Weeds such as *Achyranthes aspera* L., *Datura stramonium* L., *Calotropis procera* Ait., and *Cassia occidentalis* were commonly found in the close vicinity of *Parthenium*. Out of all these weeds at different sites, *C. occidentalis* was dominant, cohabiting with *Parthenium* successfully (Knox *et al*., 2006). A phytosociological survey of Islamabad and Rawalpindi revealed that *Cassia occidentalis* is replacing this weed gradually in patches (Shabbir and Bajwa, 2004). Oudhia (1999) conducted a phytosociological survey in the wastelands of Raipur district during the rainy season. He recorded about 27 weed species associated with *P. hysterophorus.* Among all weeds, *P. hysterophorus* and *Cassia tora* L. showed a high degree of sociability and formed into large colonies under arable soil habitats. Phytosociological structural composition was also assessed at Nemrut mountain (Tel *et al*., 2010). Joshi and Mahadevappa (1986) reported that *Cassia uniflora* had successfully displaced this weed in Dharwad and surrounding areas under natural conditions. Joshi (1991a, 1991b) reported that 5 years after the introduction of *C. uniflora* to a site that was heavily infested with *Parthenium* weed, there is a reduction in the population of *Parthenium*.

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Table 1: *Parthenium* count per m^2 in association with suppressing bioagents plant species

Sites	Association 1 BA_1 + P	Association 2 BA_2 + P	Association 3 BA_3 + P	*Parthenium* count without Bio-agent
1.	20+4.15	10+5.75	10+9	68.5
2.	10+3.25	15+5.65	11.5+8.75	75
3.	15+2.75	20+6	10.5+9.15	68
4.	30+3	15+4.75	12.75+7	64
5.	15+3	10+5	11+5	69
6.	20+3.7	15+5	11+6	71
7.	18+3.18	18+5.85	11.75+8.15	65
8.	22+3.35	15+6	12+8	68
9.	20+2	19+5.9	11.95+8	70.5
10.	25+2.75	15+5.85	11.5+11	69

Note: BA_1=Cassia occidentalis, $BA_{2=}$ Calotropis procera, BA_3= Withania somnifera, P=Parthenium hysterophorus

Table-2. Effect of allelopathic plants on fresh weight and biomass (in gms) of ↔*Parthenium hysterophorus*

Bio-agents	Fresh weight	Biomass
Cassia occidentalis	1.42±(0.10)	0.94±(0.19)
Calotropis procera	3.42± (0.11)	3.00± (0.07)
Withania somnifera	5.45±(0.12)	1.38±(0.16)
Control	15.60± (0.36)	11.35±(0.24)

Note: Values in parenthesis are ± SE of mean