



Effect of *Cassia occidentalis* on *Parthenium hysterophorus* by way of secondary metabolites

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Abstract: *Cassia occidentalis* is an extensive growing weed in India with some medicinal value. It has been reported to show strong biochemical interaction causing inhibition of *Parthenium hysterophorus* which is an obnoxious weed of today. The present study was performed to confirm its inhibition on *Parthenium*. Biological parameters like Seed germination, Germination velocity index, shoot length and root length of 10 days old *Parthenium* seedlings was recorded. Fresh weight (FW), Dry weight (DW) and Relative water content % (RWC) was recorded after treating the mature *Parthenium* plant with various aqueous leaf leachates of *Cassia occidentalis*. Aqueous leaf leachates of *Cassia occidentalis* which were prepared in different concentrations showed significant inhibition in all biological parameters on *Parthenium*. This study gives a strong clue regarding the potential of suppressive effect of allelochemicals present in *Cassia* on *Parthenium*.

Key words: Allelopathy; Biochemical Interaction; Coffee weed; Feminine weed; Pharmacognosy

Introduction

Parthenium hysterophorus L., an invasive exotic weed is an aggressive colonizer of degraded areas with poor ground cover and exposed soils such as fallow wastelands, roadsides and overgrazed pastures. The weed is highly allergenic causing respiratory problems, dermatitis and asthma. Abandoned cultivated land, open areas of villages and other roadside open patches have become a “Parthenium Bank” in and around natural vegetation and the weed has the potential to establish even in harsh environmental conditions with high yield of viable seeds and high regeneration capacity, invasion and subsequent establishment in all kinds of habitat. In India, it is noticed from the mid-fifties and is presumed to have accidentally introduced in Maharashtra. In India, this weed has spread fast all over covering wastelands, railway yards, marshy patches, unused cultivable lands, grasslands, roadsides, along the canals and other areas. Allelopathy refers to the beneficial or harmful effect of one plant on another plant, both crops and weed species from the release of biochemicals, known as allelochemicals from plant parts by leaching. The first observation that antagonistic competitor plants could replace *P. hysterophorus*, and therefore, had potential for biological control, appears to have been made by Singh, 1983 who noted that *Cassia uniflora* (Leguminosae) moved into areas previously occupied by *Parthenium* weed in the Maharashtra State of India. Research on the impact of other plants on *Parthenium* weed is limited. Therefore, keeping in view the present study was carried out to determine the cumulative effect of *Cassia occidentalis*

on biological parameters of *Parthenium* and to assess the secondary metabolites of this plant on *Parthenium hysterophorus*.

Materials and Methods

Preparation of Aqueous Leachates: The upper part of shoot tips was collected from *Cassia occidentalis*. 100 grams of shoot tips were soaked in 500ml of double distilled water each under aseptic conditions for 10 days and placed in conical flasks in a refrigerator at $8 \pm 1^\circ\text{C}$. 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 Whatmann no. 1 filter paper. Leachates of 25%, 50% and 100% concentration were prepared with sterilized distilled water and used for bioassay.

Seed germination: *Parthenium* seeds were thoroughly washed with tap water to remove dirt and dust and rinsed with mild detergent solution for 5-7 minutes. The seeds were surface sterilized with 0.1% HgCl_2 for 10 minutes and again washed with sterilized distilled water for 4-7 times. Seeds were divided into three replicates of 10 seeds each. Seeds were placed on filter paper moistened with 25%, 50% and 100% of shoot leachates. All the seed lots were allowed to germinate in 5" (12.7cm) petridishes. The relative humidity was $82 \pm 1^\circ\text{C}$. Petridishes were covered and placed in sealed polythene bags to prevent further loss of volatile compound and kept undisturbed for 10 days at $25 \pm$

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2°C. Control received distilled water. Germination percentage was calculated by the following formula- Germination percentage = No. of seeds germinated/Total no. of seeds kept \times 100 and Germination velocity index (G.V.I) was calculated by the following formula of Babely, *et al.*, (1986)- Germination velocity index (G.V.I) = No. of seeds germinated/No. of days

Seedling bioassay: Seedling of *Parthenium* were raised in plastic pots containing sterilized soil, sand and peat (1:1:1) and placed at room temperature $25 \pm 1^\circ\text{C}$. These seedlings were sprayed with 25%, 50% and 100% concentration of aqueous shoot leachates of *Cassia*. Control received distilled water.

Determination of fresh weight, dry weight and relative water content: Viable *Parthenium* seeds were raised in earthen pots of diameter 10cm containing sterilized soil. The plants were allowed to germinate till they reach at the height of 30 cm. Then the aqueous leaf leachates of from *Cassia occidentalis* was sprayed upto one month at one week interval. The quantity of allelochemicals was 50 ml at every spraying of 25%, 50% and 100% concentration. After one month of spraying the *Parthenium* plants were uprooted and first fresh weight was taken, then the dry weight was taken after placing the plants in oven for 24 hours at 74°C temperature. Deef and Abd El-Fattah (2008) equation was used to evaluate the relative water content as shown below:

$$\text{RWC}\% = (\text{FW} - \text{DW}) / \text{FW} \times 100$$

Statistical analysis: Statistical analysis of the data recorded was done. The design is Factorial Completely Randomized Design (FCRD) and conclusion was drawn from the data on the basis of Two Way Analysis of Variance technique. The software used is INDOSTAT; version 98. The calculated values were compared with tabulated value at 5% level of significance for the appropriate degree of freedom.

Results

The allelochemicals present in *Cassia occidentalis* showed a significant effect in all the biological parameters like Germination percentage, Germination velocity index (GVI), Shoot length, Root length, Fresh weight (FW), Dry weight (DW) and Relative water content % (RWC) of *Parthenium hysterophorus*.

Germination percentage and GVI was significantly reduced when the aqueous shoot leachates of *Cassia* was treated on the viable seeds of *Parthenium*. Highest significant inhibition was recorded when the seeds of *Parthenium* (in triplicates) were treated with 100% aqueous shoot leachates of *Cassia* which was found to be only 10% (fig.1). GVI also showed minimum index in 100% aqueous shoot leachates

and was found to be only 1, followed by 50% in which 53.33% of germination was recorded. In 50% aqueous shoot leachates of *Cassia* 1.23 GVI was observed. Minimum inhibition was recorded in 25% aqueous shoot leachates of *Cassia* in which 80% germination was recorded followed by GVI which was 2.83 (fig.1). Control received distilled water.

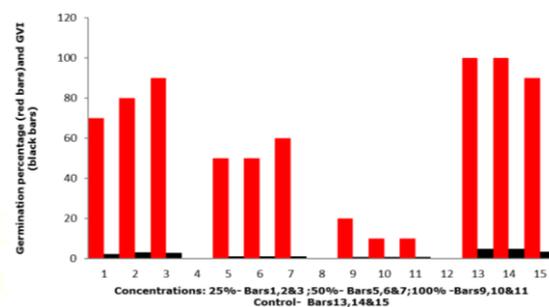


Figure 1: Effect of *Cassia occidentalis* on Germination percentage and Germination Velocity Index of *Parthenium hysterophorus*

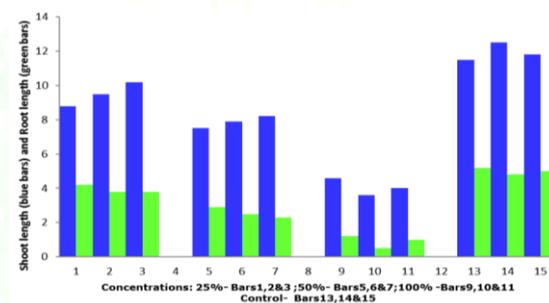


Figure 2: Effect of *Cassia occidentalis* on Seedling bioassay of *Parthenium hysterophorus*

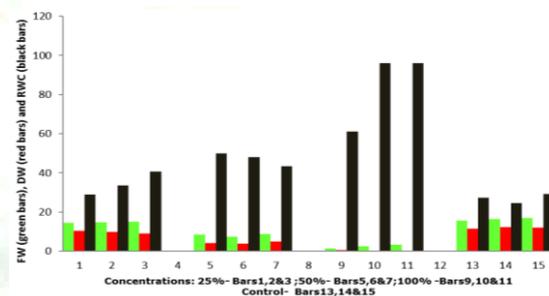


Figure 3: Effect of *Cassia occidentalis* on Fresh weight (FW), Dry weight (DW) and Relative water content% (RWC) of *Parthenium hysterophorus*

Cassia shoot leachates reduced the length of shoot and root of *Parthenium* seedlings. In fig-2. highest inhibition was recorded in 100% aqueous shoot leachates of *Cassia* i.e. 4.86 and 0.9 in the shoot and root length of *Parthenium*, followed by 50% in which 7.86 and 2.56 shoot and root length was recorded, respectively. Lowest inhibition was observed in 25% aqueous shoot leachates of *Cassia* in which 9.5 and 3.93 shoot and root length was observed, respectively. Control received distilled water. Fresh weight, Dry weight and Relative water content of *Parthenium* were highly reduced when 100% aqueous

shoot leachates of *Cassia* were treated (fig-3). Highest inhibition was recorded in 100% aqueous shoot leachates of *Cassia* in which 2.37, 0.26 and 84.36 FW, DW and RWC was recorded, respectively. In 50% aqueous shoot leachates of *Cassia* 8.26, 4.37 and 47.13 FW, DW and RWC was recorded followed by 25% in which 14.76, 9.66 and 34.4 FW, DW and RWC was recorded, respectively. Control received distilled water.

Discussion

The presence of inhibitory or allelopathic substances in aqueous leachates of *C. occidentalis* affects both the germination and growth of *P. hysterophorus*. There followed a spate of publications on the allelopathic effects and the potential of *C. uniflora* for biological control of *Parthenium* weed, in which phenolic leachates were identified (Joshi, 1991 a, b, c). From the reports, it appears that the wholesale propagation of *C. uniflora* was recommended for use in the biological control of *Parthenium* weed.

Leachates from a number of other plants have also been tested for their allelopathic effects on *P. hysterophorus*, including: *Eucalyptus* spp. (Theagarajan *et.al.*, 1995); neem, mulberry and a wide range of woody plants of the Leguminosae (*Acacia* spp., *Albizia lebbek*, *Cassia* spp. & *Prosopis* spp.) (Dhawan *et.al.*, 1996). Most tested positive with significant inhibition of *Parthenium* weed at different growth stages, and have been considered as possible biological control agents. More recent work with marigold (*Tagetes erecta*; Heliantheae) at the National Research Centre for Weed Science (Jabalpur, Madhya Pradesh) has shown that in field trials, this plant can readily outcompete *Parthenium hysterophorus* in mixed stands, probably through allelopathy. Of the total flora studied different species exhibit different competitive abilities, amongst them *Cassia occidentalis* is the most promising species which can compete with *Parthenium* in natural environment (Knox *et.al.*, 2011).

Conclusion

During the course of this present study an effort has been made to assess the biochemical interaction of *Parthenium*. From the present experiments, it is clear that *Cassia* does compete with *Parthenium* through the mode of allelopathy. *Cassia* is considerably toxic to the growth and development of *Parthenium*. An extensive survey with regard to this has already been made at different sites. Thus, it provides eco-friendly

and environmentally safe approach to curb the menace of *Parthenium hysterophorus*.

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