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BIOLOGICAL CONTROL OF *PARTHENIUM* IV: SUPPRESSIVE ABILITY OF AQUEOUS LEAF EXTRACTS OF SOME ALLELOPATHIC TREES AGAINST GERMINATION AND EARLY SEEDLING GROWTH OF *PARTHENIUM HYSTEROPHORUS* L.

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ABSTRACT

Aqueous extract bioassays were conducted to evaluate the allelopathic potential of five tree species viz. Azadirachta indica A. Juss. Ficus benghalensis L., Melia azadarach L., Mangifera indica L. and Syzygium cumini (L.) Skeels., for their use in Parthenium hysterophorus L. control one of the world's worst weeds. Aqueous extracts of 2, 4, 6, 8 and 10% (w/v), obtained from dry leaves of test tree species were bioassayed on P. hysterophorus seeds. Toxicity of the aqueous extracts was assessed by recording their effect on germination, radicle and plumule length, and seedling biomass of the test weed species. Aqueous extracts of 8 and 10% concentrations of all the test tree species invariably and significantly ($P \leq 0.05$) suppressed germination of P. hysterophorus seeds. Extracts of F. benghalensis and M. indica were proved more inhibitory than rest of the test species, where extract of lowest concentration of 2% significantly suppressed the germination. Extracts of M. azadarach were found most effective in suppressing the radicle and plumule growth of P. hysterophorus followed by S. cumini and F. benghalensis.

Key words: *Parthenium*, alleleopathy, plant extracts, growth inhibition

INTRODUCTION

Parthenium hysterophorus L., originating in the area around the Gulf of Mexico has invaded Asia, Africa and Australia during the last 50 years. It was introduced in subcontinent in 1955 through imported food grains. At present this weed is rapidly spreading in Punjab and NWFP, Pakistan. It occurs widely along the roadsides, on wastelands and sometimes in field crops. The high dominance of this weed may be attributed to its aggressive behaviour, very high seed production potential and suppressive effects on neighbouring plant through allelopathic interaction (Evans, 1997). This weed is known to have adverse impact on ecosystems and agricultural crops (Chippendale and Panetta, 1994). The chemical analysis has indicated that all the plant parts including trichomes and poliens contain toxins called sesquiterpene lactones. The major components of toxin being 'Parthenin' and other phenolic acids such as caffeic acid, vanillic acid, anisic acid, chlorogenic acid and parahydroxy benzoic acid are lethal to human beings and animals and also cause allelopathic effects on neighbouring plants (Oudhia, 1998).

Allelopathy plays an important role in regulating plant diversity (Chou and Lee, 1991). In the beginning most of the allelopathic research was conducted to investigate the effect of weeds on crops and one crop on another. However, at present the

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allelopathic crop and weed residues are being utilized for weed control in crops. Cheema *et al.*, (1997) found that aqueous extracts of sorghum and sunflower has the potential to suppress the weed infestation in wheat crop. Similarly Akhtar *et al.*, (2001) showed that aqueous extracts of *Cirsium arvense* and *Ageratum conyzoides* could suppress the germination and early seedling growth of some weeds of wheat. Moradshahi *et al.* (2003) found that aqueous extracts of *Eucalyptus camaldulensis* Schlecht. has the potential to suppress growth of *Echinochloa crus-galli* (L.) Beauv., *Avena fatua* L. and *Rumex acetosella*. Similarly Dahiya and Narwal, (2003) found that root exudates of *Helianthus annuus* L. are allelopathic towards *Agropyron repens* (L.) Beauv., *Ambrosia artemsiifolia* L., *Avena fatua* L., *Celosia crustata*, *Chenopodium album* L., *Cynodon dectylon* (L.) Pers. The objective of the present study was to assess the potential of aqueous extracts of five allelopathic trees viz. *A. indica*, *F. benghalensis*, *M. azadarach*, *M. indica and S. cumini* to control the germination and early seedling growth of *P. hysterophorus*.

MATERIALS AND METHODS

Fresh leaves of five allelopathic trees viz. *Azadirachta indica*, *Ficus benghalensis*, *Melia azadarach*, *Mangifera indica* and *Syzygium cumini* (Hussain *et al.*, 1985; Mushtaq *et al.*, 1993; Bajwa *et al.*, 1999) were collected from University of the Punjab, Quaid-e-Azam Campus Lahore, Pakistan. After thorough washing with sterilized water, leaves were dried in an oven at 40 °C till constant weight. To obtain a 10% (w/v) aqueous extract, 10 g crushed dry leaf material of each of the five test species was soaked in 100 ml distilled water for 36 hours at 25 ^{0}C and filtered. Further dilutions of 8, 6, 4 and 2% (w/v) were prepared by adding appropriate quantity of distilled water to the 10% stock solution. The extracts were stored at 4^{0}C.

Seeds of *P. hysterophorus* were sown on a filter paper seedbed in sterilized petri dishes. The filter papers were moistened with aqueous leaf extracts of the test allelopathic trees. Control was treated similarly with distilled water. There were three replicates of each treatment with 10 seeds per petri plate. The plates were incubated at 25 ^{0}C for 14 days. Plates were regularly checked for moisture. Germination, root and shoot length, and seedling fresh biomass were recorded at the end of the experiment. Data were analyzed statistically by applying Duncan's Multiple Range Test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Effect on germination

Aqueous extract of all the five test tree species exhibited allelopathic potential against the germination of *P. hysterophorus*. However, extracts of all test species were not equally toxic against the germination of the test weed. Extracts of *F. benghalensis* and *M. indica* were more inhibitory than extracts of remaining test species. The extract of lowest concentration of 2% of these two test species also significantly retarded the germination of *P. hysterophorus*. The most effective treatment in suppressing germination of test weed was 10% extract of *F. benghalensis* where germination was reduced to 5% as compared to 100% in control (Fig. 1A). Similar inhibitory effects of aqueous extracts of allelopathic grasses viz. *Dicanthium annulatum* Stapf., *Cenchrus pennisetiformis* Hochest, *Sorghum halepense* Pers., *Imperata cylindrica* (L). Beauv. and *Desmostachya bipinnata* Stapf on germination of *P. hysterophorus* have also been reported (Anjum *et al.*, 2005; Javaid *et al.*, 2005; Javaid and Anjum, 2005).

Effect on seedling growth

Aqueous extracts of *M. azaderach* proved most effective in reducing both plumule and radicle length of *P. hysterophorus* seedlings. All the applied concentrations of 2-10%

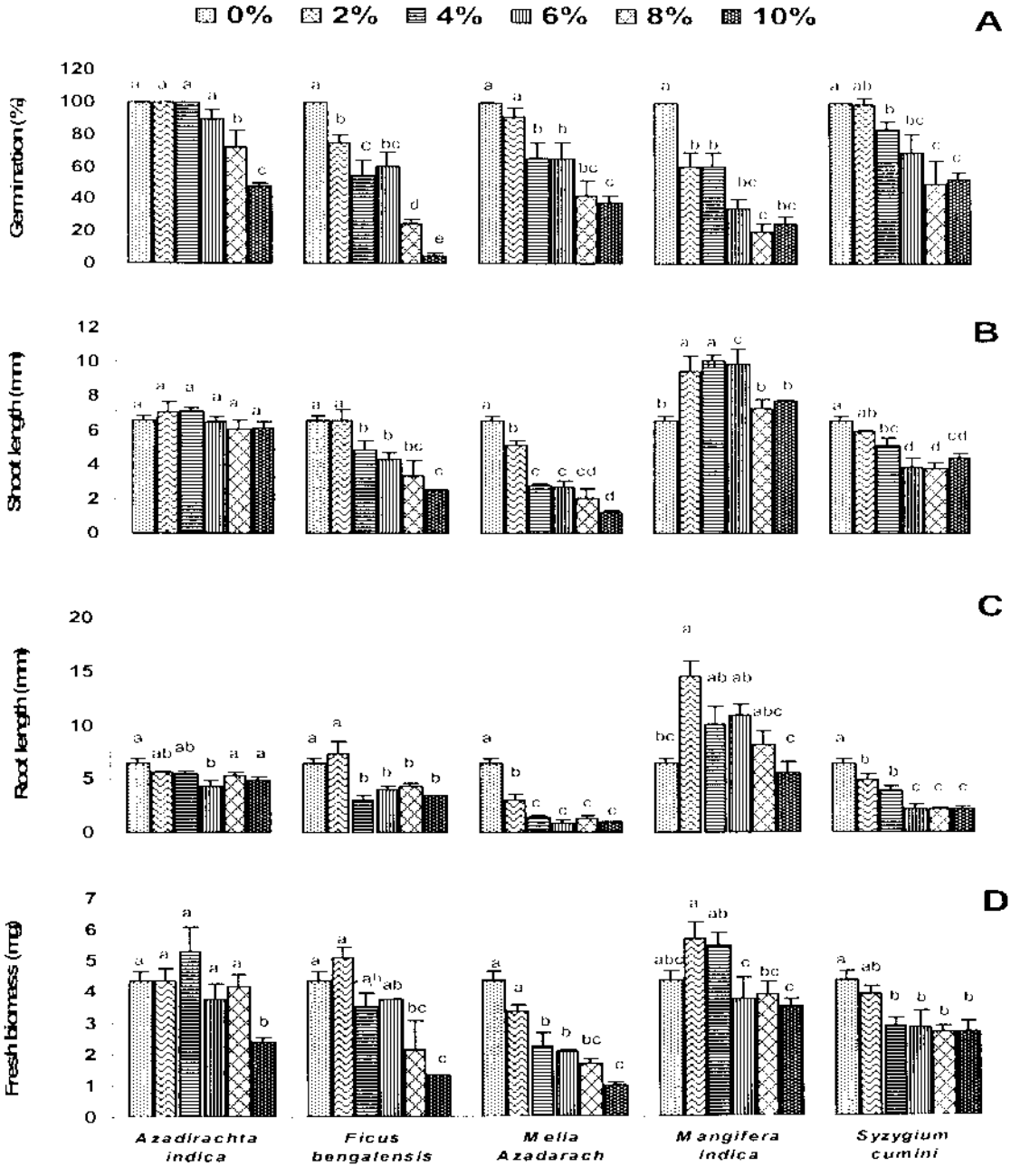

Fig. 1: Effect of aqueous leaf extracts of five allelopathic trees on germination and early seedling growth of *P. hysterophorus*

aqueous extract significantly declined the plumule and radicle length. Generally toxicity of the extract increased by increasing the concentrations (Fig. 1B-D). Among the rest of the tree species, extracts of *F. benghalensis* and *S. cumini* were very effective in retarding plumule and radicle length. All except 2% concentration of these tree species significantly suppressed plumule length (Fig. 1B). Similar impact of *F. benghalensis* extracts was recorded on radicle length also. However, aqueous extracts of all concentrations significantly declined radicle length of test weed (Fig. 1C). Effect of aqueous extract of *M. azaderach*, *S. cumini* and *F. benghalensis* on seedling biomass was similar to that of their effect on plumule and radicle length (Fig. 1D). Recently Anjum *et al.* (2005) and Javaid and Anjum (2005) have also reported similar reduction in seedling growth of *P. hysterophorus* due to aqueous extracts of allelopathic grasses The reductions in seedlings root and shoot length may be attributed to the reduced rate of cell division and cell elongation due to the presence of allelochemicals in the aqueous extracts (Buckolova 1971).

Aqueous extracts of *A. indica* were least toxic exhibiting a non-significant negative impact on both plumule and radicle length (Fig. 1 B & C). However, seedling biomass of *P. hysterophorus* was significantly reduced by 10% extract of *A. indica* (Fig. 1D). Similarly, extracts of *M. indica* failed to significantly retard the plumule and radicle length, as well as seedling biomass of *P. hysterophorus*. Conversely lower concentrations of 2-6% of this test tree species promoted the seedling growth of *P. hysterophorus* (Fig. 1 B-D). Javaid and Anjum (2005) have reported that lower concentrations of 5 and 10% of shoot extract and 5% of root extract of *Sorghum halepense* stimulates plumule length of *P. hysterophorus* seedlings. Similar effect of aqueous extracts of *Inula grantioides* Boiss. and *Capsicum annuum* L. on seedling growth of test weed species has also been reported by Shaukat *et al.* (1983) and Reigosa *et al.* (1999). The present study reveals that the aqueous extracts of *M. azaderach*, *F. benghalensis* and *S. cumini* are highly effective against germination and growth of *P. hysterophorus* and can be used to control this noxious weed.

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