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# BIOHERBICIDAL EFFECTS OF TREE EXTRACTS ON SEED GERMINATION AND GROWTH OF CROPS AND WEEDS

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## ABSTRACT

*Laboratory based studies were undertaken during November/December. 2003 in Weed Research Laboratory, Department of Weed Science, NWFP Agricultural University, Peshawar. Pakistan to investigate the allelopathic potential of aqueous extracts of leaves of Prosopis juliflora and Eucalyptus camaldulensis and bark of Acacia nilotica. The concentrations studied included 150 g $L^{-1}$ of each species A check, tap water (0 g $L^{-1}$) was also included for the comparison. The fresh green leaves of these trees were dried in shade and grinded The powder of each species were soaked @ 150 g $L^{-1}$ in water. The results showed that the germination percentage, seedling length (mm) and biomass yield (mg) $plant^{-1}$ of Ipomoea sp., Asphodelus tenuifolius, Brassica campestris and Triticum aestivum were significantly affected by tree extracts as compared to control. Eucalyptus and Acacia had stimulatory effect on germination percentage of A. tenuifolius, while P. juliflora and E. camaldulensis had inhibitory effect on B. campestris. All extracts had inhibitory effects on seedling length of T. aestivum and B. campestris. Treatment means indicated that P. juliflora and E. camaldulensis are more allelopathic than Acacia. Effect of Acacia on the test species was statistically comparable with control, exhibiting its non-inhibitory role in the test species. Species means indicated that Ipomoea sp. and T. aestivum were less negatively affected than B. campestris and A. tenuifolius. Hence. P. juliflora and E. camaldulensis can be exploited as bioherbicides for sustainable weed management.*

**Key words**: Acacia, mesquite, wild onion, morning glory, allelopathy, inhibition.

## INTRODUCTION

Allelopathy is a chemical process that a plant uses to keep other plants out of its space. It is a natural and environment-friendly technique which may prove to be a unique tool for weed management and thereby increase crop yields Chemicals with allelopathic potential are present in virtually all plants and in most tissues, including leaves, stems, flowers, roots, seeds and buds. Under appropriate conditions these chemicals may be released into the environment (generally the rhizosphere) in sufficient quantities to affect the neighbouring plants Crop allelopathic interactions may provide weed control in the crops by various ways such as (a) use of phytotoxic crop residues as mulches and cover crops (b) use of allelopathic plants in crop rotations (c) crop mixtures and intercropping

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(d) germplasm selection (e) use of allelopathic crop water extracts. Phytotoxic mulches and cover crops. allelopathy may be utilized in weed management systems through the manipulation of allelopathic cover crop residues in annual and perennial cropping systems. The allelopathic crops may affect the germination of subsequent crops, therefore, those crops should be included which are tolerant. One potential technique of exploiting allelopathy in weed management is the transfer of allelopathic characteristics from wild types or unrelated plants into the commercial crop cultivars i.e. germplasm selection. If the new alielpathic character does not have undesirable effects, this technique could increase the ability of the crop to compete naturally against the weeds. Very few attempts have been made to enhance the weed suppressive potential of crop plants through conservation or non-traditional breeding programmes, even though this is a logical way to integrate the biorational approaches to pest control in the current production systems. The superior weed suppressing genotypes have been reported in cucumber, oat, rice, sunflower, soybean, sorghum, pearl millet and *Brassica campestris* (Ata and Jamil, 2001). These allelochemicals offer great potential for the pesticides because they are free from problems associated with the present pesticides. Therefore, allelochemicals are current area of research for the development of new herbicides. These could be used for weed control directly or their chemistry could be used to develop new herbicides. The water extracts of many crops e.g. sorghum, sunflower, *B. campestris*, *E. camaldulensis* and tobacco etc, contain a number of allelochemicals which are more effective and economical to control the weeds of many crops. In mature sorghum plants, nine water soluble allelochemicals have been identified which are phytotoxic to the growth of certain weeds. Several reports address the importance of allelopathic effect of various trees. *E. camaldulensis*, *Prosopis juliflora*, and *Acacia nilotica*, significantly affected seed germination and seedling growth of several crops and/or weed species (Velu *et al.* 1996; Dhawan and Gupta, 1996, Khan *et al.* 2004). Sundaramoorthy *et al.* (1995) concluded that *P. juliflora* significantly inhibited the seed germination in pearl millet. Ibrahim *et al.* (1999) reported that *E. camaldulensis* has allelopathic effect on crops.

Keeping in view the importance of the allelopathic potential of some forest tree species, these experiments were conducted under the laboratory conditions with these objectives

a) to investigate alleiopathic status of different forest trees.

b) to quantify the response pf crop and weed seeds to different trees extracts

## MATERIALS AND METHODS

Laboratory based experiments were conducted during November/December, 2003 in Weed Research Laboratory, Department of Weed Science, NWFP Agricultural University Peshawar, Pakistan, to investigate the bioherbicidal effects of tree extracts on seed germination and growth of crops and weeds. The experiments were laid out in completely randomized design. The experiment was repeated under the ambient conditions at room temperature around 22 ± 2 °C. Fifteen seeds each of *Triticum aestivum*, *Ipomoea* spp., *A. tenuifolius* and *B. campestris* were placed in the petri dishes on blotting paper. The seeds of the test species were treated with fungicide Topsin-M 70 % @ 2 g kg$^{-1}$ to avoid the fungal attack. The ground dry (in shade) leaves of *P. juliflora* and *E. camaldulensis* and ground bark of *A. nilotica* were soaked for 24 hours in tap water at room temperature. The concentrations of *P. juliflora*, *E. camaldulensis* and *A. nilotica* @ 150 g (ground powder in water) and 0 g L$^{-1}$. Experiment was repeated with the same protocol in December 2003. Each treatment comprised of three pertri dishes planted to any one of the above stated 4 species. The given concentrations of extracts were applied to the respective treatments. Mere tap water was applied to the petri dishes of 0 g $L^{-1}$. After 20 days, the data on seed germination percentage, seedling length (mm) and biomass yield $seedling^{-1}$ (mg) were recorded during the course of studies. Combined analyses of the two experiments for each trait was run and the means were separated by Student Newmann Keul's Multiple Range test by using MSTATC software (Steel and Torrie, 1980).

## RESULTS AND DISCUSSION

### Germination percentage

Analysis of the data showed that germination percentage of all the test species was significantly affected by various extracts and their interaction with the tested species (Table-1). Maximum (85%) germination in *Ipomoea* sp. was recorded under *P. juliflora* and *Acacia* while *A. tenuifolius* showed the least (6.67%) in *P. juliflora* and control treatments. *Triticum* and *Brassica* showed similar results. However, these values were statistically at par with the values of control. Table-1 shows that germination of *B. campestris* was significantly decreased by *P. juliflora* and *E. camaldulensis*. Minimum germination (30%) of *B. campestris* was recorded in *P. juliflora* and *E. camaldulensis* treatments as compared to 95 and 91.7 % in *A. nilotica* and control treatments, respectively. Treatment means showed that minimum germination was recorded in *P. juliflora* treated pots while maximum germination was recorded for *Ipomoea* sp., other species showed statistically similar results to extracts of trees. It can be concluded from the Table-that the effect of tree extracts on seed germination of *Ipomoea* sp. was stimulatory when compared with other species. Similar results have been reported by other scientists. Velu *et al.* (1996) reported the allelopathic effects of *E. camaldulensis*, *P. juliflora* and *A. nilotica* on legumes seeds. Al-Humaid and Warrag (1998) reported that germination percentage of *Cynodon dactylon* seeds decreased with increasing leaf extract concentration of *P. juliflora*. Putnam (1984) reported that *E. camaldulensis* species released volatile compounds such as benzoic, cinnamic and phenolic acids, which inhibit growth of crops and weeds growing near it. *Prosopis juliflora* reduced the germination percentage of gram and sorghum (Chellamuthu *et al.* 1997).

### Seedling length (mm)

Analysis of the data showed that different extracts had significant effects on the seedling length of crops and weeds. Seedling length of *Ipomoea* sp. was significantly decreased by *Eucalyptus* while the rest of the tree extracts showed results that were comparable with the check. Similarly, the values for *A. tenuifolius* were statistically at par with each other in different extracts. In case of *T. aestivum* and *Brassica*, *Prosopis* and *Eucalyptus* showed inhibitory effect on the seedling length when compared with the control. Hence in these findings *Prosopis* and *Eucalyptus* showed inhibitory effect on crops. The treatments means showed that minimum (9.33 and 14.46 mm) seedling length was recorded in *E. camaldulensis* and *P. juliflora* treated treatments as compared to 33.08 mm in control treatment, thus *P. juliflora* and *E. camaldulensis* significantly decreased the seedling length of all the test species (Table-2). Analyzing the species means, the *A. tenuifolius* showed the minimum (11.29 mm) seedling length, while other species showed statistically similar results. It can be concluded from the results that *Prosopis* and *Eucalyptus* are the most harmful plants, inhibiting the crop seed germination and growth. These studies show similar results with Pawar and Chawan (1999) who reported that some forest trees including *E. globolus* reduced up-take of Ca, Zn and Mg in sorghum resulting in reduced growth. They further added that the *E. globolus* caused the greatest reduction in the absorption of Ca in sorghum. Schumann *et al*, (1995) reported that *E. grandis* water extracts significantly reduced weed establishment.

**Biomass yield (mg) plant$^{-1}$**

Table 3 depicts the biomass of different species as affected by different tree extracts. Maximum biomass (125 mg plant$^{-1}$) of *Ipomoea* sp. was recorded in *Acacia* followed by control. In case of *A. tenuifolius and T. aestivum*, the values in all the treatments were comparable. *Prosopis* and *Eucalyptus* negatively affected *Brassica* where 14.5 and 10.33 mg plant$^{-1}$ biomass, respectively was recorded in *Prosopis* and *Eucalyptus* as compared to 37.5 mg in control. It is evident from the treatment means that maximum biomass of 66.79 and 56.13 mg plant$^{-1}$ was recorded in *Acacia* and control treatments as compared to the minimum in *E. camaldulensis* and *P. juliflora* treatments having the values 39.71 and 48.42 mg, respectively. The species means indicated that maximum biomass of 90 mg plant$^{-1}$ was recorded for *T.aestivum* followed by 89.04 mg plant 1 by *Ipomoea* sp. Thus, it can be inferred from the data that *Prosopis* and *Eucalyptus* have consistent negative effect on the germination and growth of crops as well as weeds. It can be concluded from the results that *T. aestivum* has the competitive advantage over the weeds studied. Hence, *T. aestivum* can pove a better competitor if infested with these weeds. Pawar and Chawan (1999) reported that some forest trees including *E. globolus* reduced up-take of Ca, Zn and Mg in sorghum resulting in reduced growth. They further added that *E. globolus* caused the greatest reduction in the absorption of Ca in sorghum. Schumann *et al.* (1995) reported that *E. grandis* water extracts significantly reduced weed establishment. Noor *et al.* (1995) reported that *Triticum aestivum* showed inhibitory response to extracts of *E.s camaldulensis*.

**Table-1. Germination percentage of the test species**

| Species | Treatment | | | | Species Means |
|---|---|---|---|---|---|
| | ***Prosopis juliflora* 150 g L$^{-1}$** | ***Eucalyptus camaldulensis* 150 g L$^{-1}$** | ***Acacia nilotica* 150 g L$^{-1}$** | **Control** | |
| *Ipomoea* sp. | 85.0 ab | 73.3 abcd | 85.0 ab | 73.3 abcd | 79.17 a |
| *Asphodelus tenuifolius* | 6.67 g | 78.33 abc | 55.0 cde | 6.67 g | 36.67 b |
| *Triticum aestivum* | 51.67 def | 43.33 ef | 65.0 bcde | 60.0 cde | 55.0 ab |
| *Brassica campestris* | 30.0 fg | 30.0 fg | 95.0 a | 91.7 a | 61.67 ab |
| Treatment Means | 43.3 b | 56.25 ab | 75.0 a | 57.92 ab | |

Table-2. Seedling length (mm) plant$^{-1}$ of the test species

| Species | Treatment | | | | Species Means |
|---|---|---|---|---|---|
| | *Prosopis juliflora* *150 g L$^{-1}$* | *Eucalyptus camaldulensis* *150 g L$^{-1}$* | *Acacia nilotica* *150 g L$^{-1}$* | Control | |
| *Ipomoea* sp. | 23.83 bcd | 10.67 de | 31.33 abc | 37.67 ab | 25.88 a |
| *Asphodelus tenuifolius* | 5.17 e | 12.67 de | 19.00 cde | 8.33 de | 11.29 b |
| *Triticum aestivum* | 21.00 cde | 8.83 de | 32.00 abc | 40.00 ab | 25.46 a |
| *Brassica campestris* | 7.833 de | 5.167 e | 32.83 abc | 46.33 a | 23.04 a |
| Treatment Means | 14.46 b | 9.33 b | 28.79 a | 33.08 a | |

Table-3. Biomass yield (mg) plant$^{-1}$ of the test species

| Species | Treatment | | | | Species Means |
|---|---|---|---|---|---|
| | *Prosopis juliflora* *150 g L$^{-1}$* | *Eucalyptus camaldulensis* *150 g L$^{-1}$* | *Acacia nilotica* *150 g L$^{-1}$* | Control | |
| *Ipomoea* sp. | 84.0 bc | 60.17 cd | 125.3 a | 86.67 b | 89.04 a |
| *Asphodelus tenuifolius* | 5.167 g | 9.333 fg | 15.67 efg | 4.500 g | 8.667 b |
| *Triticum aestivum* | 90.00 b | 79.00 bc | 95.17 b | 95.83 b | 90.00 a |
| *Brassica campestris* | 14.50 efg | 10.33 fg | 31.00 ef | 37.50 de | 23.33 b |
| Treatment Means | 48.42 bc | 39.71 c | 66.79 a | 56.13 ab | |

## CONCLUSIONS

i. *P. juliflora* and *E. camaldulensis* have the potential to be used as bioherbicides in the future.

ii. The plantation of *E. camaldulensis* in agro-forestry should be discouraged as there could be a risk of dissolved allelopathins in the irrigation water.

iii. Further intensive studies are emphasized to explore the full knowledge of allelopathy in these trees so that we can get rid of huge import bills of herbicides.

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