Pak J. Weed Sci. Res. 12(4): 265-269, 2006

ALLELOPATHIC PROCLIVITIES OF TREE LEAF EXTRACTS ON SEED GERMINATION AND GROWTH OF WHEAT AND WILD OATS

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ABSTRACT

Pot experiment was conducted in NWFP Agricultural University Peshawar during January 2003. Grinded leaves of Prosopis juliflora, Eucalyptus camaldulensis and Acacia nilotica were soaked in tap water for 5 hl at room temperature. The concentration of each tree species was 150, 100 and 50 g L^{-1}. Completely randomized design having four repeats was used. Ten seeds of each species were sown in pots and then irrigated with the respective extracts soon after sowing. Results showed that germination %age and plant height of both species were significantly affected by different concentrations. Prosopis showed stimulatory effect on germination of both the species. In wheat, maximum germination and plant height of 52.50 % and 32.22 cm, respectively was recorded in Prosopis treated pots as against 15 and 31.50 cm in control however in Eucalyptus @150 g L^{-1} also 15% germination of wheat was recorded. Similarly, for wild oats, maximum germination percentage and plant height of 47.5 % and 51.9 cm was recorded in Prosopis treated pots. Low concentration of Prosopis proved stimulatory as compared to higher concentrations. Eucalyptus showed slighlyt negative effect on the species tested. The effect of other concentrations of tree extracts was comparable to each other in the species tested. Hence it can be concluded from the results that allelopathy of trees can be used as viable weed management technique in the future as allelopathins stimulate the germination of wild oats which give the chance of making soil seed bank weaker.

INTRODUCTION

The word allelopathy derives from two separate words. They are *allelon* which means "of each other", and *pathos* which means "to suffer". Allelopathy refers to the chemical inhibition of one species by another. The "inhibitory" chemical is released into the soil environment where it affects the development and growth of neighboring plants. Allelopathic chemicals can be present in any part of the plant. They can be found in leaves, flowers, roots, fruits, or stems. They can also be found in the surrounding soil. These toxins affect target species in many different ways. The toxic chemicals may inhibit shoot/root growth, they may inhibit nutrient uptake, or they may attack a naturally occurring symbiotic relationship thereby destroying the plant's usable source of a nutrient (Conn, 1980).

Not all plants have allelopathic tendencies. Some, though they exhibit these tendencies, may actually be displaying aggressive competition of a non-chemical form. Much of the controversy surrounding allelopathy is in trying to distinguish the type of competition being displayed. In general, if it is of a chemical nature, then the plant is considered allelopathic. There have been some recent links to plant allelotoxins directed at animals, but data is scarce. Allelopathy is emerging as a new discipline in agricultural

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sciences because it is hoped that the use of this science will be proved environment friendly, cost effective and cheaper. Numerous scientists have argued that detailed study of allelopathy can reduce the reliance on herbicides. Sidhu and Hans (1988) reported that as the concentration of extracts of *Eucalyptus* increased, the growth of the plant decreased. Phlomina and Srivasuki (1996) reported that leaf leachates of 5 multipurpose tree species (*Eucalyptus camaldulensis*, *Acacia nilotica*, *Derris indica*, *Cassia siamea* and *Sesbania grandiflora)* had varying degrees of inhibitory and stimulatory effects on germination percentage. May and Ash (1990) concluded that *Eucalyptus* inhibited the growth of several species. Hunshal *et al.*, (2000) reported the allelopathic studies and chemical composition of tree species. Cheema *et al.*, (2003) have advocated the commercial utilization of sorghum water extracts for weed management in wheat. Khan *et al.*, (2004) reported that *Prosopis*, *Eucalyptus* and *Acacia* retarded the growth and development of several weeds.

There is convincing evidence that allelopathic interactions between plants play crucial role in natural as well as in manipulated ecosystems. In recent times evidence is accumulating that all types of plants viz. herbs, shrubs and trees, allelopathitically affect the patterning of vegetation, largely in their immediate vicinity.

Keeping in view the importance of the allelopathic potential of some forest tree species, an experiment was conducted to investigate the allelopathic potential of some tree species with the following objectives;

a) appraisal of allelopathic status of different forest trees

b) response of wheat and wild oats under the varying regimes of allelopathins.

MATERIALS AND METHODS

Pot experiment was conducted in the Department of Weed Science, NWFP Agricultural University Peshawar during January 2003 to assess the allelopathic proclivities of tree leaf extracts on seed germination and growth of wheat (*Triticum aestivum*) and wild oats (*Avena fatua*). The fresh green leaves of *Prosopis juliflora*, *Eucalyptus camaldulensis* and *Acacia nilotica* were collected in September and dried in shed. The leaves were then grinded with the help of grinder. The grinded material was then soaked in tap water for 5 hrs at room temperature (23 ^{0}C). The concentrations of each tree species were 150, 100 and 50 g L^{-1}. Control (tap water) was also included for comparison. The experiment was laid out in completely randomized design (CRD) and repeated four times. Ten seeds of each species i.e. wheat (Takbeer variety) and wild oats were sown in pots containing 5 kg soil and then irrigated with the respective extracts soon after sowing. The pots were irrigated with the concerned tree leaf extracts as mentioned earlier when needed. No fertilizer was applied during the course of the experiment. Data on germination percentage was recorded three weeks after sowing and plant height (cm) was recorded three months after sowing when the crops reached maturity. Numbers of wheat plants that emerged from the soil were counted in each pot and then average was calculated. To record the plant height, all the tillers present in each pot were measured from ground level to the tip of the spike excluding awns at maturity and then the average was computed.

The data recorded was statistically analyzed according to the design and LSD test was used for means comparison (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Germination percentage of wheat

Statistical analysis of the data showed that seed germination of wheat was significantly affected by different concentrations of different tree leaf extracts (Table 1). The data revealed that maximum germination (52.50 %) was recorded in *Prosopis* treated pots as compared to 15 % germination in the check. However, the germination percentage in all concentrations of *Prosopis* was statistically similar to each other. Thus it can be concluded from the experiment that *Prosopis* stimulated the germination of wheat might be due to presence of certain chemicals that act as germination stimulant. Not only the wheat seeds germination was stimulated but the seeds of wild oats were also stimulated. While all other treatments of different tree extracts were statistically comparable with the check, which shows that these tree extracts have no effect on seed germination of wheat. Maximum germination percentage in the two species studied is low due to the fact that experiment was conducted in January when the temperature is low. While these two species need comparatively high temperature during germination and early growth. Thus from these results, it is concluded that there are some chemicals in *Prosopis* which stimulate the germination of wheat and wild oats. Thakur and Bhardwaj (1992) reported that wheat seeds were exposed to leachates from leaf extracts of *Eucalyptus globulus, Populus ciliata, Juglans regia* and *Robinia pseudoacacia* and germination was not affected. Analogous results were reported by Chellamuthu *et al.*, (1997). They reported that *Prosopis juliflora* stimulated black gram growth. This statement indicates that there are certain chemicals in *Prosopis* which acts as hormone.

Plant height (cm) of wheat

Statistical analysis of the data showed that plant height of wheat was significantly affected by various leaf extracts. Minimum plant height (14.75 cm) was recorded in the pots treated with *Acacia* @100g L^{-1}, followed by *Acacia* @ 150 g L^{-1}. *Prosopis* and *Eucalyptus* leaf extract and Check pots gave statistically the same value of plant height. It can be concluded from the data that *Acacia* at higher concentrations retarded the growth of wheat while other tree leaf extracts have negligible effect on the growth of wheat crop. In the present studies, germination as well as the growth of both the test species was mostly negatively affected by *Eucalyptus* as compared to other tree extracts. Our results are in agreement with those reported by Smith (1989). He reported that some tree extracts negatively affect only seed germination while other affect plant growth. Velu *et al.*, (1996) reported that *Acacia* sp. retard the plant growth and development.

Germination percentage of wild oats

Statistical analysis of the data revealed that germination percentage of wild oats was significantly affected by various tree leaf extract at various levels of concentrations. Table-1 shows that statistically maximum germination percentage of 47.5 was recorded in *Prosopis* @ 50 g L^{-1} treated pots followed by the different concentrations of the same tree species. While all other tree leaf extracts showed similar effect on the germination percentage of wild oats. It is interesting to note that similar stimulatory response was recorded in wheat germinations. Similar results were reported by Mukhopadhyay *et al.*, (1995). They reported that seeds of some species are affected while other remain unaffected by different leaf extracts of the plants. May be the same extract act differently for two different species because physiological and biochemical processes are involved in such cases.

Plant height (cm) of wild oats

The data in table-1 revealed that plant height of wild oats was also significantly affected by various leaf extracts and their concentrations. It was noted that for maximum plant height, Prosopis @150, 100 and Acacia @100 g L^{-1} were statistically at par with 49.50, 51.90 and 50.75 cm, respectively while minimum 17.00 cm plant height was recorded in *Eucalyptus* @ 150 g L^{-1}. It might be due to the presence of allelochemicals in *Eucalyptus*. Our results are in agreement with those of Smith (1989) who reported that allelopathic tree extracts retard germination or growth of crop plants. Similarly, Mukhopadhyay *et al.*, (1995) reported that extracts of *Eucalyptus* decreased the plant growth of rabi crops and concluded that the inhibitory effect of *Eucalyptus* leaf extracts on germination and growth was attributed to the essential oil content.

Table 1. Germination percentage and plant height (cm) of wheat and wild oats as affected by various concentrations of different tree extracts.

Treatment	Germination %age		Plant Height (cm)	
	Wheat	Wild oats	Wheat	Wild oats
Pr 150	42.50 ab	45.00 a	32.22 a	49.50 a
Pr 100	32.50 abc	40.00 ab	31.50 a	51.90 a
Pr 50	52.50 a	47.50 a	32.00 a	44.00 ab
Euc 150	15.00 cd	10.00c	28.08 ab	17.00 c
Euc 100	17.50 cd	7.50 c	22.00 abc	23.00 bc
Euc 50	25.00 bcd	7.50 c	30.33 a	22.25 bc
Ac 150	5.00 d	15.00 c	16.75 bc	39.75 abc
Ac 100	12.50 cd	17.50 c	14.75 c	50.75 a
Ac 50	17.50 cd	7.50 c	28.75 ab	36.00 abc
Control	15.00 cd	20.00 bc	31.50 a	29.25 abc
LSD (5%)	22.27	20.76	13.20	24.07

Means sharing different letters are significantly different from each other
Pr = *Prosopis juliflora*
Euc = *Eucalyptus camaldulensis*
Ac = *Acacia nilotica*

ACKNOWLEDGEMENTS

The authors are grateful to Prof. Dr. Gul Hassan, Department of Weed Science for technical and financial assistance during the course of the experiment.

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