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PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 4 (11): 1364-1367, 2001

Herbicidal Activity of Aqueous Extracts of *Cirsium arvense* and *Ageratum conyzoides* Against Weeds of Wheat

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Abstract: Aqueous root, stem and leaf extracts of 0, 5, 10 and 15 % w/v of an allelopathic plant species viz. *Cirsium arvense* were evaluated for their potential to control germination and seedling growth of two weed species, *Phalaris minor* and *Poa annua*. All the aqueous extracts reduced germination in two test weeds. However, effect was insignificant statistically. Shoot length in *P. minor* was reduced significantly by 10 % stem extract while shoot length in *P. annua* remained unaffected by all the extracts. Root length was more susceptible to allelopathy and was reduced significantly in both the test weed species. In a similar experiment germination of *P. minor* and *Medicago polymorpha* was significantly reduced by 15 % leaf extract of *Ageratum conyzoides*. In both the test weeds, response of root and shoot length to aqueous extracts of *A. conyzoides* was similar to the response of test weeds to aqueous extracts of *C. arvense* in first experiment.

Key words: Allelopathy, weeds of wheat, *Ageratum conyzoides, Cirsium arvense*.

Introduction

Weeds pose a recurrent and ubiquitous threat to agricultural productivity. In the US, weeds and weed control have an estimated annual economic cost of more than $15 billion (Bridges, 1994) with even greater relative costs in developing countries (Akobunudu, 1991). It is widely known that losses caused by weeds exceed the loss from any other category of agricultural pests. Estimates suggest that weeds are responsible for an over all reduction of somewhat more than 10 % in the yield of the major world crop (Roberts, 1982).

Weeds are considered undesirable for various reasons, mostly connected with decreased economic return from the land. Weeds compete with crop plants for nutrients, soil moisture and sunlight. Reduction in crop yield has a direct correlation with weed competition (Rao, 2000). Quite apart from competition, weeds may affect crop plants as a result of production of chemical compounds that escape into the environment (Hussain and Abidi, 1991; Bajwa and Javaid, 1995). Heavy infestation of perennial weeds can make the land unsuitable or less suitable for cultivation, resulting in loss of its monetary value. The quality of leafy and other vegetable crops suffer in the presence of weeds. Contamination of noxious weed seeds greatly reduces the value of crop seed and grain, and some times even renders them unsalable. Some weeds serve as alternative hosts to several crop insects, nematodes and pathogens (Crafts and Robbins, 1962). Weeds are therefore, required to be controlled to increase agricultural productivity.

Herbicides will continue to be a key component in most weed management systems in wheat and other crops in future. Nevertheless, the increased use of herbicides poses serious environmental and public health concerns (Hileman, 1990; Balogh and Anderson, 1992). Furthermore, herbicide resistant weeds have become common during the last 20 years (Heap, 1999; Friesen, 2000). Because of these problems much attention is being focused on alternative methods of weed control. In the past two decades, much work has been done on plant-derived compounds as environmentally safe alternatives to herbicides for weed control (Lydon and Duke, 1987; Lox *et al*., 1988; Kuk *et al*., 2001).

Wheat is a primary staple food and grown over larger area than any other crop in Pakistan. It occupied an area of 8.33 m.ha. during 1999 with average grain yield of 2238 Kg ha^{-1} (Anonymous, 1999). Among various factors responsible for low wheat yield, weeds play a remarkable role. Recently Siddiqui and Bajwa (2001) have reported 31 weeds species growing in wheat fields of different wheat growing areas of Pakistan. *Phalaris minor, Medicago polymorpha, Coronopis didyma, Melilotus parviflora, Chenopodium album* and *Poa annua* were found to be the most abundant and densely populated weeds. The present study was undertaken to evaluate the herbicidal activity of aqueous extracts of *Ageratum conyzoides* and *Cirsium arvense* against some weeds of wheat. Aqueous extracts of these weeds are known to exhibit allelopathy. (Bajwa and Javaid, 1995; Chuihua *et al*., 1999).

Materials and Methods

Fresh plant material of *Ageratum conyzoides* and *Cirsium arvense* were collected from University of the Punjab, Quaid-e-Azam Campus, Lahore, Pakistan. After thorough washing with sterilized water, plants were separated into root, stem and leaves. Extracts were obtained by soaking 5, 10 and 15 g crushed plant materials in 100 ml sterilized water for 24 hours at 25 °C and filtered. The extracts were stored at 4 °C when not used. However, the extracts were generally used within a week. Seeds of *Phalaris minor* and *Poa annua* were soaked in extracts of *A. conyzoides* and that of *P. minor* and *Chenopodium album* in extracts of *C. arvense* for one hour. Ten presoaked seeds were sown on twice folded filter paper seed bed in sterilized petri dishes. Tests were moisten with respective extracts. Controls were treated similarly with distilled water. Each treatment was replicated thrice. The dishes were incubated at 25 °C for 14 days. Dishes were regularly checked for moisture. Germination as well as root and shoot length was recorded at the end of the experiment. Data were analyzed statistically by applying Duncan's Multiple Range Test (Steel and Torrie, 1980).

Results

Effect of aqueous root, shoot and leaf extracts of *Cirsium arvense* on germination and seedling growth of *Phalaris minor* and *Poa annua*: Germination in both the test species was reduced by all the extracts of *C. arvense*. *P. annua* was found to be more susceptible than *P. minor*. The difference in various treatments was, however, insignificant from control (Fig. 1A and 2A).

Shoot length in *P. minor* was reduced significantly due to application of 10 % stem extract while enhanced when the concentration of the same extract was increased to 15 %. In

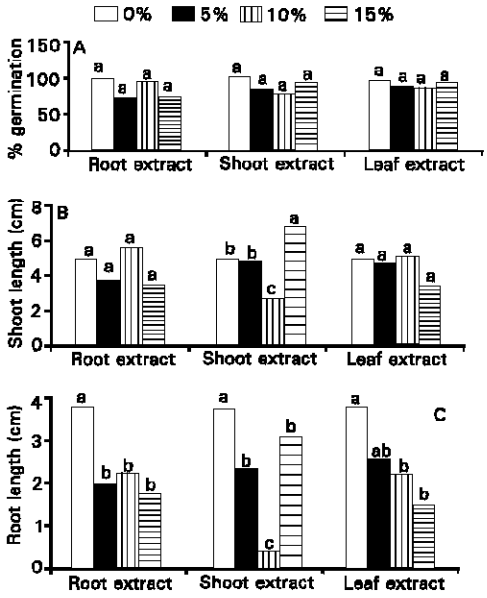

Fig. 1(A-C): Effect of different concentrations of aqueous root, stem and leaf extracts of *Cirsium arvense* on germination and early root and shoot length of *Phalaris minor*. Different letters show significant difference at 5 % level of significance as determined by DMR Test.

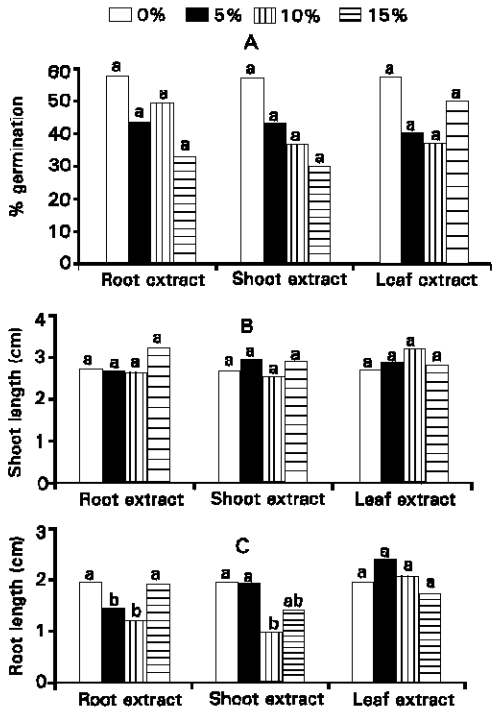

Fig. 2(A-C): Effect of different concentrations of aqueous root, stem and leaf extract of *Cirsium arvense* on germination and early root and shoot length of *Poa annua*. Different letters show significant difference at 5 % level of significance as determined by DMR Test.

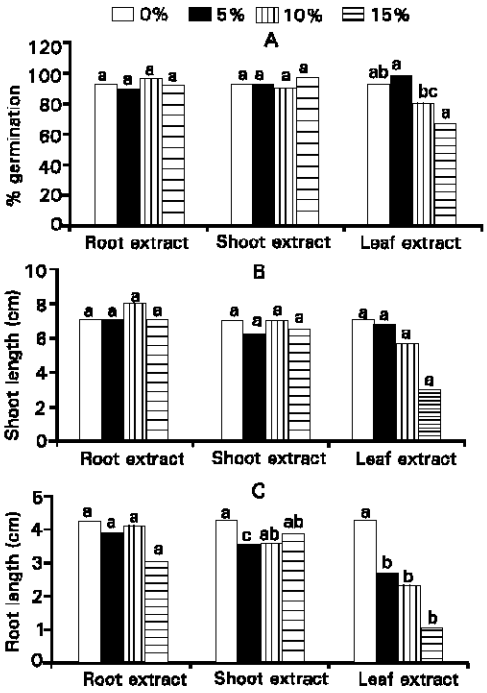

Fig. 3(A-C): Effect of different concentrations of aqueous root, stem and leaf extract of Ageratum conyzoides on germination and early root and shoot length of Phalaris minor. Different letters show significant difference at 5 % level of significance as determined by DMR Test.

root and leaf extracts, the shoot length of this test species showed an insignificant response (Fig. 1 B). Shoot length in *P. annua* remained unaffected due to application of any of the root, shoot or stem extracts (Fig. 2B).

Root length in *P. minor* was reduced invariably and significantly by all the extracts of *C. arvense* (Fig. 1C). Root length in *P. annua* remained unaffected in leaf extract of *C. arvense* while 10 % of stem extract and 5 and 10 % root extracts significantly reduced root length in this test species. Fifteen percent extract had insignificant effect on root length (Fig. 2 C).

Effect of aqueous root, shoot and leaf extracts of *Ageratum conyzoides* on germination and seedling growth of *Phalaris minor* and *Medicago polymorpha*: In both the test weed species germination was significantly suppressed only due to 15 % leaf extract of *A. conyzoides* (Fig. 3A & 4A). Shoot length in *P. minor* showed a response to various extracts similar to that of germination (Fig. 3B). Shoot length in *M. polymorpha*, however, did not show any pronounced response to any of the three types of extracts (Fig. 4B). Unlike shoot length, root length in *M. polymorpha* was markedly suppressed due to all the extracts of *A. conyzoides*. Higher concentrations of 10 and 15 % were proved more inhibitory than 5 % extracts (Fig. 4C). Root length in *P. minor* was less susceptible to root and stem extracts of *A. conyzoides* as compared to leaf extract. Effect of leaf extract was significant (Fig. 3C).

Discussion

Generally germination in the test weeds did not show any

pronounced response to aqueous root, stem and leaf extracts of *C. arvense* and *A. conyzoides*. Effect of aqueous extracts of *C. arvense* on both the test species was insignificant. Similarly effect of root and stem extracts of *A. conyzoides* on germination of *P. minor* and *M. polymorpha* was also insignificant. Only 15 % leaf extract of *A. conyzoides* significantly reduced the germination of both the test species. *M. polymorpha* exhibited similar germination response to same concentration of root extract of *A. conyzoides*.

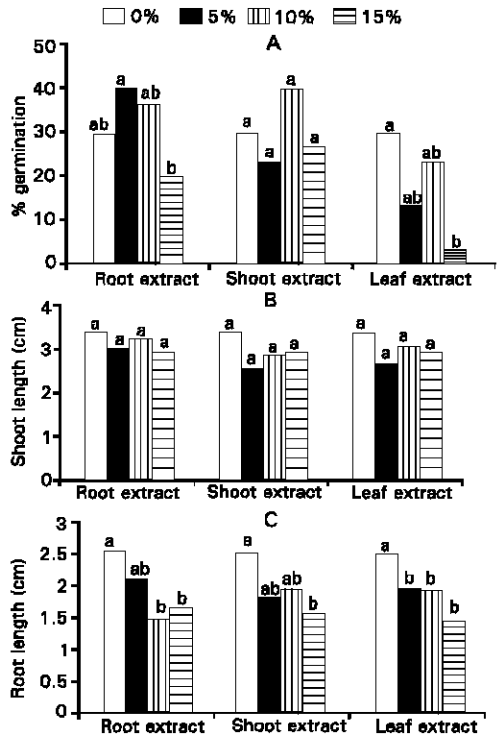

Fig. 4(A-C): Effect of different concentrations of aqueous root, stem and leaf extract of *Ageratum conyzoides* on germination, and root and shoot length of *Medicago polymorpha*.
Different letters show significant difference at 5 % level of significance as determined by DMR Test.

Response of shoot length in different test weeds to various extracts of *A. conyzoides* and *C. arvense* was variable and species specific. Shoot length in *P. minor* and *P. annua* showed an insignificant response to various extracts of *C. arvense* except *P. minor* response to 10 and 15 % stem extract. Similarly shoot length response of *P. minor* and *M. polymorpha* to different extracts of *A. conyzoides* was insignificant except *P. minor* response to 15 % leaf extract, where shoot length was significantly reduced as compared to control. The species specificity of allelochemicals has also been demonstrated by Friedman *et al.* (1977) and Shaukat *et al.* (1983, 1985). This phenomenon is due to inherent differences in physiological and morphological characteristics of the various species involved.

Root length was more susceptible to various extracts of *A. conyzoides* and *C. arvense* than shoot length. Root length in *P. minor* was significantly reduced by all the concentrations of all the three types of extracts of *C. ravens*. Root length in *P. annua* was also suppressed by root and stem extracts of *C. arvense*. Higher concentrations of *A. conyzoides* were highly inhibitory to root length in *M. polymorpha*. Root length in *P. minor* was less susceptible to root and stem extracts of *A. conyzoides* as compared to the same extracts of *C. arvense*. This reduced root growth may be attributed to the ability of allelochemicals to suppress mitosis (Rice, 1984).

The present study reveals that aqueous extracts of various parts of *A. conyzoides* and *C. arvense* were inhibitory to root length in particular and to germination and shoot length of the test weed species in general. These results are in line with the findings of many earlier workers. Rizvi *et al.* (1999a) reported that allelopathic extracts of different wheat varieties caused an inhibition in height of *Avena ludoviciana*, a noxious weed of wheat crop. Similarly Rizvi *et al.* (1999b) found that extract of *Thuja orientalis* could completely inhibit the seed germination, seedling growth and vigor of the test weed *Amaranthus retroflexus*. The herbicidal properties of allelopathic extracts of other plant species have also been reported by other workers (Peterson *et al.*, 1999; Macias *et al.*, 1999; Kojima and Ohkubo, 1999). Cheema *et al.* (1997) and Khaliq *et al.* (1999) have successfully used the allelopathic extracts of sorghum and sunflower to control the weeds of wheat and soybean. There is a need to extend the present study to evaluate the efficacy of aqueous extract of the test species against the target weeds under field conditions.

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