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RESEARCH ARTICLE

Allelopathic Effects of Wild Mustard and Wild Oat on Seed Germination and Seedling Growth of Wheat

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ABSTRACT

Allelopathic effects of two dominate weeds like wild mustard (*Sinapis arvensis* L.) and wild oat (*Avena ludoviciana* L.) on seed germination and seedling growth of wheat (*Triticum aestivum* L. Var. Chamran) were investigated at Department of Botany, University of Pune (M.S.), India in 2011. The results revealed that aqueous extracts of wild mustard and wild oat had caused drastic reduction in seed germination percentage, shoot and root length as well as dry weight of wheat seedlings. Maximum reduction was recorded at highest concentration of weed extracts. The extract of wild mustard had shown highest reduction in seed germination percentage, shoot length and seedling dry weight as compare to the extracts of wild oat and combination of wild mustard and wild oat. Amongst the three different types of weeds extracts, wild oat (100%) had caused highest negative effect on root length only. Amongst the different parameters studied root length showed highest sensitivity towards the treatments of weed extracts. The present investigation had clearly shown the negative influence of both the weeds on seed germination and seedling growth of wheat.

INTRODUCTION

Different types of weeds release variety of beneficial or harmful allelochemicals in to their surrounding environment, and influence the crop growth as well as yield (Rao, 2000). Studies on crop-weed interaction, weed-weed interaction and crop-crop interaction are pivotal in agriculture for improving the yield and maintaining the soil health. Allelopathy has come into lime light in sustainable agriculture. Tanveer *et al*. (2010) evaluated the allelopathic effects of dominant weed like *Euphorbia helioscopia* on wheat (*Triticum aestivum* L.) chickpea (*Cicer arietinum* L.) and lentil (*Lens culinaris* Medic.) and recorded that fields infested with this weed have caused negative effects on seedling vigor index, seedling emergence, total dry weight of test crops. The root length of wheat and lentil and shoot length of lentil were significantly reduced due to allelopathic effects of *E. helioscopia*. Similar results were obtained by Marinov-Serafimov (2010). They noted the allelopathic effects of *Amaranthus retroflexus* L., *Chenopodium album* L., *Erigeron canadensis* L. and *Solanum nigrum* L. on *Glysine max* L., *Vicia sativa* L. and *Pisum sativum* L. and concluded that aqueous extracts of fresh and dry biomass of all the weeds were responsible to reduce the seed germination of all legume crops.

The reduction percentage in seed germination of *Glysine max* L., *Vicia sativa* L. and *Pisum sativum* L.treated with fresh biomass extracts varied from 28.8% to 81.5% and for dry biomass extracts varied from 26.8% to 89.2%. Ghosh *et al*. (2000) reported that the seed germination, shoot and root length of groundnut (*Arachis hypogaea* L.) were significantly decreased due to treatments of aqueous extracts of *Lantana camera*, *Digera muricata*, *Chenopodium album*, *Ageratum conozoides*, *Ciscium arvense*, *Abutilon indicum* and *Cyperus rotundus*. Several researchers like Schumacher *et al*. (1983) and Larsen (1981) reported that weeds of brassicaceae and poaceae have allelopathic activities which suppresses the seed germination and growth of different crops. Weeds belonging to above mentioned families contain different types of secondary metabolites like glucosinolate and scopoletin as well as vanilic acid respectively. Present investigation was attempted to investigate the allelopathic influences of wild mustard and wild oat on seed germination and seedling growth of wheat.

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MATERIALS AND METHODS

Seed germination bioassay

Response of wheat to aqueous extract of wild mustard and wild oat was studied at Department of Botany, University of Pune, India in 2011. Seeds of wheat (*Triticum aestivum* L. Var. Chamran) were obtained from Agriculture Research Station of Khuzestan-Iran. Healthy seeds were used for seed germination bioassay. The experimental design was factorial, based on randomized complete block design with three replications. The treatments consist of aqueous extract of wild mustard, wild oat and mixture of both weeds using four different extract concentrations (0, 25, 50 and 100%). For preparation of weed extracts fresh weed samples were collected, washed with distilled water and dried in shade for a weed at room temperature (25±2 ^{o}C). After drying the weed species, they plants were chopped into small pieces in grinder and extracts were prepared by soaking 5 g of crushed weeds in 100 ml of distilled water (1: 20 w/v) for 24 hours at room temperature (Tanveer *et al*., 2010). The extracts were filtered through Whatman paper no. 1 and used for seed germination bioassy. This solution was considered as stock solution (full strength 100%) and a series of concentrations were made from the stock solution (25, 50 and 100%). Distilled water treatment was considered as control. The seeds of wheat were sterilized in 2% sodium hypochlorite for 15 minutes. After that, they were rinsed with distilled water (Abu-Romman *et al*., 2010). Ten uniform seeds of

wheat were placed on filter paper no.1 in petri dishes (9 × 1.5 cm). In each petri dish, 10 ml of extract or distilled water was added according to the treatments. The percentage of seed germinated, shoot length, root length and dry weight of wheat seedlings were measured after 7 days. The recorded data was analyzed statistically by using MSTATC computer software. For comparison of recorded data Duncan's multiple range tests at Alfa level 5% was used.

RESULTS AND DISCUSSION

Allelopathic effects of extracts of weeds on seed germination of wheat

Allelopathic effects of Seed germination percentage in wheat was significantly affected by extracts of both the weeds and the reduction was more in extract of wild mustard as compared to wild oat and mixed extracts of both the weeds. Seed germination in wheat was less effected by wild oat extract (Table 1). A progressive reduction in seed germination was observed with a successive increase in concentration of aqueous extracts. The extract concentration at 100% caused 20.2% reduction in the mean of seed germination (Table 1). The interaction effects of weeds extracts and their concentrations indicated that the germination percentage decreased by increasing extract concentration. The highest concentration of wild mustard, wild oat and mixed extract of both reduced the seed germination by 29.2, 12.3 and 19.1 % as compared to control respectively (Fig 1. A). This finding was in agreement with Mansouri *et al*. (2005) who reported that increasing extract concentrations of seed, root, leaf and flower of wild mustard (*Sinapis arvensis* L.) reduced the seed germination percentage of canola (*Brassica napus* L.). Amongst these extracts, the seed germination percentage was less affected by root extract. Tanveer *et al*. (2010) also reported that seedling vigor index, root and shoot length, root and total dry weight of wheat (*Triticum aestivum* L.) chickpea (*Cicer arietinum* L.) and lentil (*Lens culinaris* Medic.) seedlings were significantly reduced by the treatments of aqueous extract of root, stem, leaf and fruit of *Euphorbia helioscopia* as compared to control.

Allelopathic effects of extracts of weeds on shoot length

The statistical analysis of data showed that different types of weed extracts had non-significant effect on shoot length of wheat. But their different concentrations had significantly negative impact. Average shoot length was 9.86, 10.43 and 10.09 cm in the treatment of extract of wild mustard, wild oat and mixture of both weeds respectively. The shoot length of wheat in control was 29.02% higher than shoot length in 100 % concentration of weeds extracts (Table 1). The data pertaining to shoot length as affected by the interaction of different weeds extract and concentrations indicated that the highest extract concentration of wild mustard, wild oat and combined extract of both weeds reduced the shoot length by 31.4, 27.3 and 28.5% as compared to control respectively (Fig 1. B). Results of present investigation are inconformity with Perez and Ormeno-Nunez (1991). They also reported that the root and coleoptile growth of spring wheat seedlings were inhibited by root exudates of wild oat. Mansouri *et al*. (2005) stated that the different plant parts of wild mustard had inhibitory effect on length of canola coleoptile. They observed maximum inhibitory effect on coleoptile length due to treatment of flower extract.

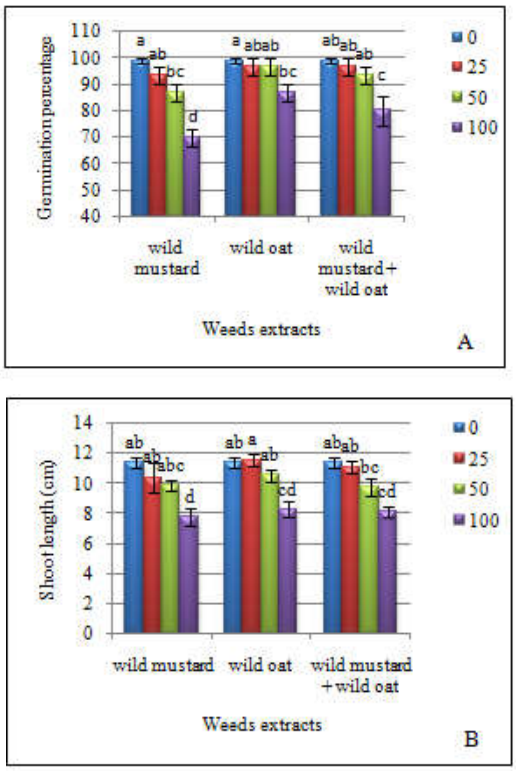

Fig. 1. Effect of different concentration extracts of weeds on seed germination (A) and shoot length (B) of wheat

Allelopathic effects of extracts of weeds on root length

The results on mean comparison of root length revealed that the difference among weeds extract was not significant. However increasing concentrations of extracts significantly decreased the root length of wheat seedlings. Average root length in 0, 25, 50 and 100% concentration was 12.2, 10.59, 8.69 and 4.34 cm respectively. The highest concentration reduced the root length by 64.4% as compared to control (Table 1). The interactive effects of weed extracts and their concentrations indicated that the highest root length (12.2 cm) was exhibited by control. On the contrary the lowest root length (3.67 cm) was noted in 100% extract concentration of wild oat. The results showed that the 100% extract concentration of wild mustard, wild oat and mixture of them decreased the root length of seedlings by 60.4, 69.9 and 62.9% as compared to control respectively (Fig 2. A). This finding was supported by Tanveer *et al*. (2010). They concluded that *Euphorbia helioscopia* had inhibitory allelopathic effect on root length of wheat (*Triticum aestivum* L.) chickpea (*Cicer arietinum* L.) and lentil (*Lens culinaris* Medic.). Joshi *et al*. (2009) in their experiment observed that the radicle length and radicle dry weight of wheat significantly decreased by allelopathic effect of *Ageratum conyzoides* L., *Chenopodium album* L., and *Parthenium hysterophorous* L. extracts. Kumar *et al*. (2007) reported that radicle growth of *Oryza sativa* was inhibited due to aqueous leaf extract of *Eupatorium odoratum* and *Ageratum conyzoides* by 41.68 and 17.02%. The radicle growth of *Glycine max* was decreased by 10.71 and 3.76% under allelopathic effects of these weeds respectively.

Table 1. Effect of different weeds extracts and extract concentration on germination and growth of wheat seedling

Treatments		Germination percentage (%)	Shoot length (cm)	Root length (cm)	Dry weight (mg)
Weeds extracts	Wild mustard	87.2 ± 3.4* b	9.86 ± 0.47 a	8.97 ± 0.8 a	115.6 ± 11.0 c
	Wild oat	94.7 ± 1.9 a	10.43 ± 0.44 a	8.87 ± 0.7 a	143.6 ± 9.1 a
	Wild mustard + Wild oat	92.2 ± 2.7 a	10.09 ± 0.43 a	9.02 ± 0.9 a	132.8 ± 8.5 b
Extract concentrations (%)	0	98.9 ± 0.6 a	11.37 ± 0.19 a	12.20 ± 0.1 a	167.0 ± 1.8 a
	25	95.6 ± 1.8 ab	11.02 ± 0.36 a	10.59 ± 0.4 b	142.3 ± 7.9 b
	50	92.2 ± 2.2 b	10.06 ± 0.26 b	8.69 ± 0.4 c	124.3 ± 7.9 c
	100	78.9 ± 3.1 c	8.07 ± 0.25 c	4.34 ± 0.3 d	88.9 ± 5.5 d

Means with different letters are significantly different at P=0.05, using Duncan's Multiple Range Test.
* Standard eroor

Allelopathic effects of extracts of weeds on seedling dry weight

The results of present investigation indicated negative impact on dry weight of wheat seedlings due to aqueous extracts of wild mustard, wild oat and wild mustard + wild oat. Average total dry weight was 115.6, 143.6 and 132.8 mg respectively. Total dry mater significantly decreased by increasing extracts concentrations and 100 % concentrations decreased the dry weight by 46.8% as compared to control (Table 1). Interaction effects between different weeds extract and extract concentrations indicated that the reduction in total dry weight was increased with increasing concentrations in all weeds. The maximum concentrations of wild mustard, wild oat and mixed extract decreased the dry matter of seedling by 56.3, 41 and 43.1% as compared to control respectively (Fig 2. B). Schumacher *et al*. (1983) in their experiment concluded that the extracts of wild oat plants at 2 and 4 leaf development stages significantly decreased the leaf and root dry weight of spring wheat. Tanveer *et al*. (2010) reported root dry weight and total dry weight of wheat (*Triticum aestivum* L.) chickpea (*Cicer arietinum* L.) and lentil (*Lens culinaris* Medic.) seedlings were decreased by the water extracts of root, stem, leaf and fruit of *Euphorbia helioscopia*.

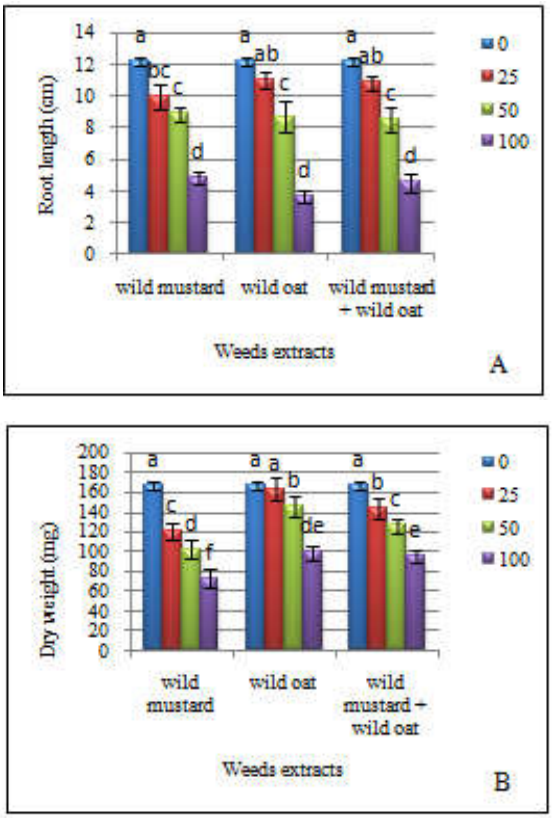

Fig. 2. Effect of different concentration extracts of weeds on root length (A) and seedling dry weight (B) of wheat

Conclusion

Aqoeous extracts of wild mustard, wild oat and wild mustard + wild oat and their increasing concentrations decreased the germination percentage, shoot as well as root length and dry weight of wheat seedlings. From the results of this experiment it can be concluded that wild mustard had comparatively higher allelopathic influence on seed germination percentage, shoot length and dry weight of seedlings. However the extracts of 100% of wild oat had very high negative influence on root length. Amongst the different parameters studied it was found that root length was highly sensitive to the allelochemicals present in the weeds.

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