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Allelopathic Effects of Aqueous Extract of Erodium (Erodium Reichardii) And Xanthium Strumarium on Growth of Wheat, Barley and Maize

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Abstract

*In order to study the allelopathic effect of Erodium and Xanthium strumarium on germination and growth of wheat, barley and maize, an experiment was conducted at the University of Uremia- higher education department of Shahid Bakeri of Miandoaab in 2016. Tests were performed completely randomly in the laboratory and in the greenhouse with three replications. In this study, different concentrations of water extracts of weeds (0, 25, 50, 75 and 100 percent of the base solution w / v 10%) were applied during seed germination and seedling growth of three desired cultivated plants and various traits were measured. The results showed that the triple interaction (weed * Concentration * cultivar) was significant in both laboratory and greenhouse conditions on the studied traits. The greatest potential for deterrence was related to Erodium weed. In general, by increasing the extract concentration, the inhibitory effect was more evident. So that the lowest and highest inhibitory effects on all studied traits were related to control viscosities and 100%, respectively. Totally, the results indicated that the Erodium remnants and Xanthium strumarium available in farm have allelopathic potential on the cultivated plants, so they should be removed from the field before planting.*

Key words: *allelopathy, Erodium, biosynthesis, Xanthium strumarium and Ecology*

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INTRODUCTION

Weeds make a great economic damage to the farming system through competition and reduction of the growth and development of crops, so that they decrease performance by 15% (Gupta, 2000). Many allelochemichal compounds have been known as having strong inhibitory effects on the germination and growth of various plants (Min et al., 2003). There are inhibitors which are directly released from different organs of plants or they are added to environment during the process of decomposition of plant residue. This phenomenon is known as allelopathy, and these compounds are called allelochemichal (Rahimi et al, 2006). Allelochemical presence in the field is a kind of tension, so the plants that are in the vicinity of species with allelopathic potential are always subject to an environmental stress (Min et al., 2003). Since the prevailing climate in our country is dry and semi-dry, it can be expected that allelopathic substances in weeds can make double problems in the structure of crops community; consequently, they can decrease the performance severely. In this study, the allelopathic potential of compounds present in Erodium and Xanthium strumarium weeds that are abundant in various fields on the grow process of three crops was evaluated.

MATERIALS AND METHODS

The study was conducted in the laboratory and greenhouse of Uremia University in a factorial form in a completely randomized design in vitro and in randomized complete block design in greenhouse. Different concentrations of aqueous extract of Erodium and Xanthium strumarium weeds as an allelopathic substance were provided at five levels of zero (control), 25, 50, 75 and 100% , and they were evaluated in the form of separate tests on three important agricultural plants (wheat, barley and maize).

The used Petri dishes were placed in a solution of five percent - sodium hypochlorite for two minutes. In each Petri dish, 30 healthy seeds were planted and 10 ml extract was added to each. The Petri dishes were incubated in a growth chamber at 24 ° C (Chung et al., 2003). After eight days, the length of shoot and root, dry and wet weight of shoot and root as well as plant height were measured. 15 seeds were planted in each nylon pot in the

greenhouse. Treatments were applied as the following that every week for every pot, 250 cc extract was added using a 1000 cc beaker. In addition, irrigation of the pots from the bottom was done from bottom with embedded containers under each pot. At the end of growing season, plant height was measured in centimeters by a ruler. The data was analyzed using EXCELL, MSTAT-C, SAS software and mean comparison was done by Duncan test

Laboratory results

Analysis of variance showed that the simple, double and triple interaction effects on germination characteristics were significant (Table 1).

Shoot length trait: Comparison of triple interaction of weed * cultivar* concentration showed that Erodium and Xanthium strumarium represented different allelopathic potential in different concentrations on shoot length trait of crops. In the case of concentration increase, Erodium, compared to Xanthium strumarium, had considerable deterrent potential on shoot length of the three studied plants (table not included). Maize with 73.47 percent of deterrence and wheat with 63.54 percent of deterrence compared to the control, respectively, had the most sensitive and resistant cultivars against allelopathic potential of Erodium. Also, regarding Xanthium strumarium, the mentioned cultivars were the most sensitive and resistant cultivars against allelopathic potential.

Table 1: Analysis of variance (mean square) effect of different concentrations of water extracts of Erodium and Xanthium strumarium on some traits under laboratory conditions

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S.O.V	Df	Shoot length	Root length	Shoot fresh weight (gr/pot)	Root fresh weight (gr/pot	Shoot dry weight (gr/pot)	Root dry weight (gr/pot)
Weed	1	13.249**	64.173**	2.431**	1.637**	0.095**	**0.037****
cultivar	2	324.377**	271.637**	18.731**	5.137**	1.057**	**0.284****
Extract	4	47.112**	111.523**	17.091**	15.173**	1.211**	**0.796****
cultivar*Weed	4	1.671**	21.183**	0.319**	0.027**	0.0009**	**0.003****
Extract*Weed	4	1.271**	3.476**	0.237**	0.101**	0.0007**	**0.002****
Extract* cultivar	8	3.102**	5.376**	0.773**	0.318**	0.176**	**0.083****
Extract*cultivar*Weed	8	0.379**	1.267**	0.061**	0.019**	0.003**	**0.001****
error	60	0.0437	0.0631	0.0097	0.0056	0.0002	**0.0001**

Table 2: Analysis of variance (mean square) effect of different concentrations of water extracts of Erodium and Xanthium strumarium on some traits under laboratory conditions

S.O.V	Df	Plant lenght	Shoot fresh weight (gr/pot	Root fresh weight (gr/pot	Shoot dry weight (gr/pot)	Root dry weight (gr/pot)
Block	2	68.76**	9.75**	11.76**	3.78**	**2.12****
Extract	1	1928.73**	296.91**	207.67**	4.95**	**24.07****
cultivar	2	64915.37**	4036973**	13823.37**	4012.57**	**1454.84****
Extract	4	5742.23**	2361.01**	1647.17**	402.211**	**224.76****
Weed* cultivar	4	174.18**	29.19**	15.87**	1.79**	**4.03****
Weed* Extract	4	356.46**	40.77**	15.73**	0.97**	**1.41****
cultivar* Extract	8	244.36**	14.73**	30.88**	77.16**	**52.83****
Weed*cultivar* Extract	8	37.67**	6.61**	2.01**	0.53**	**0.37****
error	58	14.61	5.07	3.05	1.47	**0.72****

Radicle length trait: Mean comparisons of the triple interaction of weed * cultivar* concentration showed that the concentrations of erodium weeds and Xanthium strumarium have a different impact on radicle length of the studied crops. Deterrence potential of Xanthium strumarium was less than that of erodium. Among the studied crops, barely with 81.12 percent and wheat with 45.43 percent of deterrence compared to the control group, were the most sensitive and resistant cultivars against allelopathic potential of erodium. In the case of Xanthium strumarium weed, the same results were obtained.

Wet weight trait of plumule: Mean comparisons of the triple interaction of weed * cultivar* concentration had allelopathic potential regarding the influence on plumule wet weight. In different concentrations, erodium and Xanthium strumarium weeds were able to apply different allelopathic potential on wet weight of plumule of the studied crops. If the mentioned character would be exposed to increasing concentrations of aqueous extract of erodium, it shows the procedure of reduction or deterrence. Barley crop with 91.37 percent and maize equal to 78.21 percent of deterrence compared to control were the most sensitive and resistant cultivars against erodium. The most sensitive and the most resistant cultivars against Xanthium strumarium were similar to erodium.

Fresh weight trait of Root: Mean comparisons of the triple interaction of weed * cultivar* concentration represented the different allelopathic potential between different concentrations of Erodium and Xanthium strumarium weeds regarding the effects on root wet weight in all the studied crops.

As it can be erodium and Xanthium strumarium had a deterrent effect by increasing the concentration. As a result, barely with 95.14 percent and wheat with 79.39 percent of deterrence compared to control were the most sensitive and resistant cultivars against allelopathic potential of Erodium. The most sensitive and the most resistant cultivars against allelopathic potential of Xanthium strumarium were also similar Erodium, but Erodium had more allelopathic potential rather than Xanthium strumarium in different concentrations.

Dry weight trait of shoot: Mean comparisons of the triple interaction of weed * cultivar* concentration showed that Erodium weeds represented different allelopathic potential in different concentrations on dry weight trait of crops shoots. In comparison with Xanthium strumarium, Erodium weed, with increasing concentration, had a significant deterrent potential for dry weight of shoot of all the studied crops. Barley with 95.63 percent of deterrence and corn with 83.17 percent of deterrence compared to control were, respectively, the most sensitive and resistant cultivars against erodium that was in accordance with the results obtained from Xanthium strumarium.

Dry weight trait of Root: Mean comparisons of the triple interaction of weed * cultivar* concentration showed that Erodium weeds represented different effects in different concentrations on dry weight trait of roots of the crops. Increasing concentration can reduce the dry weight of roots of crops. The effect of Xanthium strumarium was similar to erodium, but with less severity. Barley with 97.67 percent and maize with 91.58 percent of deterrence were the most sensitive and resistant cultivars to aqueous extract of Erodium. In addition, about Xanthium strumarium, the same results were obtained.

Greenhouse experiments: Analysis of variance showed that the simple, double and triple interaction effects on germination characteristics were significant (Table 2).

Trait of Plant height: Mean comparisons of the triple interaction of weed * cultivar* concentration showed that erodium weeds represented different effects in different concentrations on plant height trait of the crops. With increasing concentration, erodium had a significant deterrent potential for height trait of three studied crops rather than Xanthium strumarium. Maize with 34.11 percent and barely with 91.58 percent of deterrence, compared to the control, were the most sensitive and resistant cultivars to allelopathic potential of Erodium. Maize with 54.55 percent of deterrence and wheat with 18.38 percent were, compared with the control, the most sensitive and resistant cultivars to allelopathic potential of Xanthium strumarium.

Shoot fresh weight trait: Mean comparisons of the triple interaction of weed * cultivar* concentration showed that Erodium weeds represented different effects in different concentrations on shoot fresh weight trait. Increasing concentration of Erodium could reduce shoot fresh weight of the studied crops. These preventive changes of Xanthium strumarium were not significant compared to Erodium. Among the crops, barely with 75.61 percent and maize with 26.27 percent of deterrence were the most sensitive and resistant cultivars against Erodium allelopathic potential and similar results were obtained for Xanthium strumarium.

Fresh weight root trait: Mean comparisons of the triple interaction of weed * cultivar* concentration had allelopathic potential regarding the impact on fresh weight of root. If the mentioned character would be exposed to increasing concentrations of water extract of Erodium, it shows the procedure of reduction or deterrence. It is also true about aqueous extract of Xanthium strumarium weed with a slight difference. Wheat crop with 75.16 percent of deterrence and corn with 36.59 percent of deterrence compared to control were most sensitive and resistant cultivars against Erodium. These results were also obtained about Xanthium strumarium.

Shoot dry weight trait: Mean comparisons of the triple interaction of weed * cultivar* concentration showed that Erodium and Xanthium strumarium weeds represented different effects in different concentrations on shoot dry weight trait. By increasing concentration of Erodium, a significant deterrence potential was observed on shoot dry weight of all crops, and about Xanthium strumarium, this effect was less than Erodium. Maize with 90.28 percent of deterrence and wheat with 55.12 percent of deterrence compared to control were most sensitive and resistant cultivars against erodium. These results were also obtained about Xanthium strumarium.

Root dry weight trait: Mean comparisons of the triple interaction of weed * cultivar* concentration showed that Erodium and Xanthium strumarium weeds represented different effects in different concentrations on root dry weight trait. By increasing concentration of Erodium, a significant deterrence potential was observed on root dry weight of all crops, and about Xanthium strumarium, this effect was less than Erodium. Among various crops, maize with 84.37 percent of deterrence and pea with 68.17 percent of deterrence were respectively most sensitive and resistant cultivars against to water extract of Erodium. These results were also obtained about Xanthium strumarium.

DISCUSSION AND CONCLUSION

Inhibitory effect of extract or the remnants of some of plants on seed germination and plant growth has been reported by researchers. For example, in various studies, it has been shown that allelopathic phenomenon in the early stages of growth has severe negative effects on the target plant (Tiger et al, 2012). At the beginning of growth, due to weakness of the target plant, allelopathic effects can dominate the process of growth and development that is the source of division and cell differentiation and disrupt it. Extract concentration has a direct relation with percentage of deterrence (Han et al, 2008).

In the latest study, it was observed that growth and development of crops decreased significantly by increasing the concentration of the aqueous extract. Allelopathic substance inhibits the growth of shoots and makes a dysfunction in the process of the openings photosynthesis that ultimately, process of photosynthesis and respiration will be impaired. It has been reported that the joglan released from Walnut has various inhibitory effects on leaf photosynthesis, transpiration, stomatal, breathing of radicles and leaves in corn and soybeans (Jose and Gillespie, 1998). Many studies have shown that plant remnants (specially weed species) are effective in growth and development of plants, especially crop plants by releasing allelopathic substance in cultivation environment (Batish et al,

2006a). The mentioned findings are compatible with the findings of the present study, because the aqueous extract of Erodium and Xanthium strumarium weeds decreased the physiological features of plants significantly, so that Erodium weed had higher allelopathic potential.

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