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Effect of different concentrations of aqueous extract of bindweed, *Convolvulus arvensis* on initial growth of Abidar barley (*Hordeum vulgare*) cultivar in greenhouse

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Abstract. In order to evaluate the allelopathic effects of aqueous extract of bindweed, *Convolvulus arvensis* different organs on germination and growth of barley, *Hordeum vulgare* (cv. Abidar), an experiment was conducted as factorial based on completely randomized design with three replications in the laboratory and greenhouse of Islamic Azad University, Miyaneh Branch. Experimental factors comprised bindweed organs at four levels (leaf, root, stem and flower) and aqueous extracts of bindweed organs at 2.5, 5 and 10% concentrations and distilled water was considered as a control. Traits including germination rate, stem and root length, and fresh and dry weight of barley seedlings were measured. Analysis of variance results showed significant effects of interaction of bindweed extract concentrations and organs on all above mentioned traits. Abidar was considered as a very sensitive barley cultivar to *C. arvensis* allelochemicals, so that its germination and initial growth were affected by weed organs' extracts. Allopathic effect of weed extracts on barley germination and growth was increased as the extract concentrations increased. Based on the results, extracts of the bindweed different organs showed the same toxic effects on barley germination rate, fresh weight and dry weight of barley seedlings. However, the least adverse effects of bindweed allelochemicals on barley stem and root length were caused by leaf extract of the weed. Based on the results, extension of farming Abidar cultivar most probably will increase allelopathic induced damage of bindweed to barley.

Key words: Allelopathy, Weed organs, *Convolvulus arvensis*, Growth, Germination, Barley, Abidar cultivar.

1. Introduction

Convolvulus arvensis is considered as one of the most dangerous weeds in the world. It may cause 20-70% crop yield loss and makes problems in harvesting (9). Rapid initial growth of plants during early season is of importance for optimum yield production. Allelochemicals may result in crops failure in competition with weeds duo to their effects on seeds germination and initial growth of crops (13).

Weeds have high competition potential due to good adaptation with the environment and so, they are one of the most important factors that reduce crops yield (3). Economic damage of weeds in the world has been reported over than 100 billion dollars (4). Besides competition with crops, weeds reduce crops' growth and yield by releasing allelopathic substances (4). Weeds may disrupt germination and growth of agricultural crops by chemicals production leading to lower yield production (10). Allelopathy is an important mechanism in which plants disperse toxic substances in the environment as their competitive strategies (7, 8). Allelochemicals were released in different ways such as leaching from plant tissues by rain and dew and excretion from plant roots (9). Allelopathy is an important environmental friendly approach to weeds control, to yield increase and herbicide application reduction (10, 11).

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Red-root bindweed, *Amaranthus retroflexus* is considered as one of the most hazardous weeds in all over the world and its allelopathic effects is well known. Bindweed extracts contains allelochemicals such as Aldehydes, Alkaloids, Apocarotenoids, Flavonoids, Steroids, Xyloids, Clerogenic acid and Saponyns (2). Allelochemical substances is secreted by aerial organs of bindweed and released to the soil through washing by rain or irrigation water (3, 5). Many researchers evaluated the allelopathic effects of bindweed on different crops. Bindweed extracts reduced soybean and corn growth (2). Reduced seed germination rate, stem length, root length and seedling dry weight has also been reported by extracts from bindweed stems and roots (5). Letournea *et al.* (1956) reported that the extract derived from bindweed in 2 grams dry matter in 100 ml water reduced seed germination and seedlings root length in barley (11).

Allelopathy determination in weeds and studying their effect on germination and initial growth of crops is very important for optimum yield production, and so the present study was carried out for evaluating the allelopathic effects of different concentrations of *C. arvensis* organs' extracts on germination and growth of barley (cv. Abidar).

2. Material and methods

2.1. Sampling and plant extract preparation

Bindweed was collected from fields of different crops in Miyaneh region and the weed leaves, stems, roots and flowers were blended separately after drying in an oven with 50˚C for 72 hours. For extract preparation, 10 grams of powdered plant material were suspended in 100 ml distilled water and mixed for 24 hours by a horizontal rotary shaker for producing uniform extract. Finally, centrifugation was performed using a Mikro22R centrifuge (Hettich, Germany) at 6000 rpm for 30 minutes at 10˚C and the obtained extract was considered as 10% concentration.

2.2. Laboratory and greenhouse studies

To investigate the allelopathic effect of bindweed organs' extracts on germination of Abidar barley cultivar, barley seeds were disinfected superficially by 70% ethanol for 1 minute and by 2.5% sodium hypochlorite solution for 3 minutes and then were washed four times by sterile distilled water. Twenty seeds were placed in Petri dishes with sterile filter paper inside and 5 ml of the extract were added on and incubated in 25 ± 1 ˚C in dark condition. Petri dishes were sealed with Parafilm for reducing evaporation. Seed germination percentage was recorded after 15 days incubation. In greenhouse, Twenty barley surface sterilized seeds were planted in pots (20 cm diameter) filled with autoclaved (121 ˚C, 15 minutes), sand, soil, peat (1:1:1) soil mixture and then incubated in a greenhouse at 25 ± 3 ˚C temperature and 70 ± 5% relative humidity. After four days, emerged plants were abated to 10 by selecting equally well-developed seedlings. Every three days, the seedlings were irrigated with 2.5, 5 and 10 % aqueous extracts of bindweed organs and plants irrigated with distilled water was considered as check plants. Fifteen days after, root and stem length and fresh and dry weight of barley seedlings were measured.

2.3. Experimental design and data analysis

The research was carried out in greenhouse of Miyaneh Branch, Islamic Azad University as factorial based on completely randomized design with three replications in 2010. Experimental factors comprised bindweed organs at four levels (leaf, root, stem and flower) and aqueous extract of bindweed organs at 2.5, 5 and 10% concentrations and distilled water was considered as a control. The experiment was conducted as factorial based on completely randomized design with three replications. The data were analyzed using GLM procedure by SAS software and Duncan's multiple range test was used for mean comparisons at 1% probability level.

3. Results and discussion

According to results of variance analysis (table 1), there was significant difference among different bindweed organs' extracts for root length and seedling fresh weight of barley. The effect of bindweed extract concentrations and the interaction of bindweed organs with extract concentrations were significant on all growth related traits at 0.01 probability level.

3.1. Seed germination

Regarding to figure (1) Abidar barley cultivar was very susceptible in germination to *C. arvensis* allelochemicals. A decreased barley seeds germination trend was observed in response to weed organs' extracts. Seed germination percentage was decreased substantially by 10% extract concentrations of all weed organs tested. However, 2.5% concentration also significantly decreased barley germination in comparison to the control. Seed germination inhibition caused by 10% concentration was considerable, so that all weed organs' extracts inhibited seeds germination more than 95% at the mentioned concentration. Regarding to figure (1), all four bindweed organs caused the same effect on barly germination.

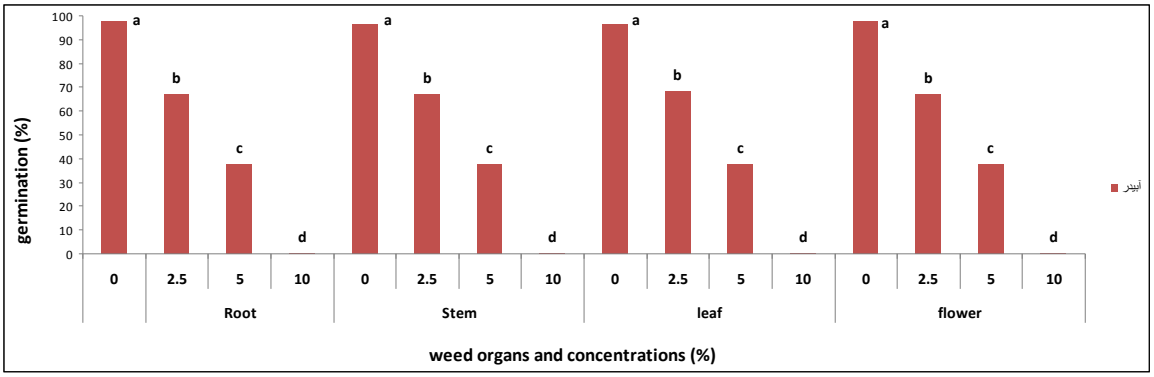

Fig.1. Effect of different extract concentrations of bindweed organs on barley (cv. Abidar) germination percentage

3.2. Root and stem length

Table (2) shows the effect of different concentrations of bindweed organs' extracts on root length of Abidar barley cultivar. The results revealed an increased allelopathic effect of *C. arvensis* organs as the extracts concentration increased. The weed leaf, stem, root and flower extracts caused considerable adverse effects on barley root length and reduced it up to 46.15, 42.03, 45.96 and 53.34% at 10% concentration extracts, respectively. However, weed root, stem and leaf extracts did not affect barley root length at low concentration (i.e. 2.5%) most probably duo to its less allelochemicals contents.

According to figure (3), higher concentrations of *C. arvensis* organs' extracts caused more allelopathic effects on barley stem length. The weed leaf and stem extracts at 10% concentration caused as high as 32.12 and 41.87% reduction in barley stem length, respectively. The trait was also reduced by 10% concentration of bindweed root and flower extracts up to 50.40 and 34.11%, respectively. Results revealed that extract of bindweed's leaf and flower at 5 and 10% concentrations showed the same effect on barley stem length, statistically. However, stem and root extracts were more effective than leaf extract at 10% concentration.

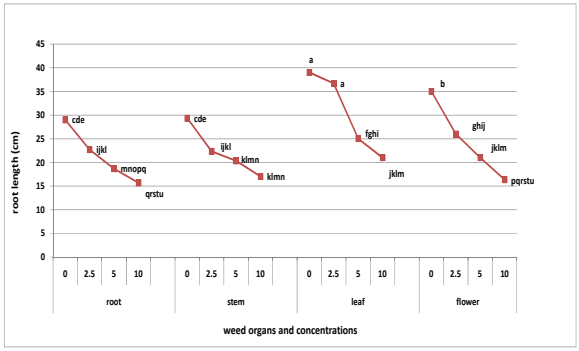

Fig.2. Effect of different extract concentrations of bindweed organs on barley (cv. Abidar) root length

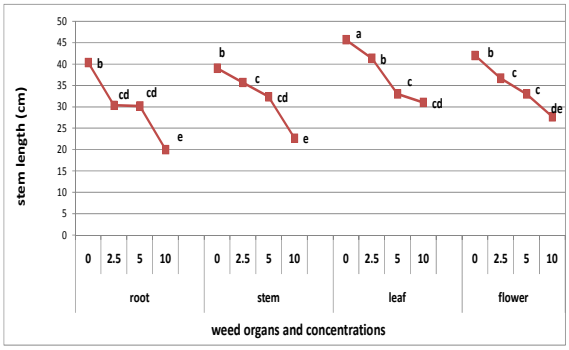

Fig.3. Effect of different extract concentrations of *C. arvensis* organs on barley (cv. Abidar) stem length

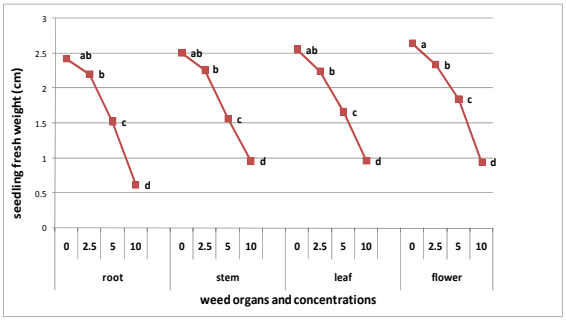

Fig.4. Effect of different extract concentrations of bindweed organs on barley (cv. Abidar) seedlings'fresh weight

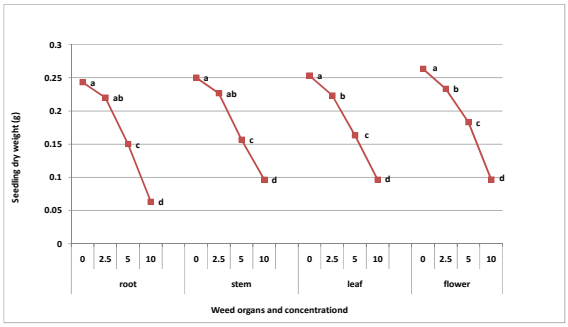

Fig.5. Effect of different extract concentrations of bindweed organs on barley (cv. Abidar) seedlings'dry weight

3.3. Seedling fresh and dry weight

According to figure (4), extracts of all tested four bindweed organs significantly reduced barley seedling fresh weight at higher concentrations studied. However, root, leaf and stem extracts at 2.5% concentration showed no allelopathic effect on barley seedlings' fresh weight. Based on the results, the trait inhibition was increased at higher bindweed extract concentrations, so that 10% leaf, root, stem and flower extracts decreased barley seedlings' fresh weight as high as 62.39, 74.51, 61.77 and 64.26%, respectively. *C. arvensis* stem, root, leaf and flower extracts caused the same statistical effect on barley seedlings' fresh weight at all concentrations tested.

Figure (5) shows a decreased trend of barley seedlings' dry weight as extract concentrations of *C. arvensis* organs increased. All concentrations reduced the trait, significantly. The weed extract at 10 % concentration caused the most inhibition in barley seedling dry weight as well as the other growth related traits measured. Leaf and flower extracts reduced barly seedlings' dry weight even at 2.5% concentration.

Growing susceptible barley cultivars to bindweed allelochemicals may results in an increased herbicides application rate duo to decreasing weed economic injury level (EIL). In conclution, based on the results, it seems that planting Abidar cultivar may increase allelopathic induced damage of bindweed to barley.

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