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Original Research

Effect of sunflower extract to control weeds

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ABSTRACT:

Considering the effects of chemical herbicide application, biomarkers have now become more widely considered for controlling weeds. Allelopathy demonstrates the potential for this through the release of trace elements from decomposable plant leaves, seeds, stems and strains. In order to investigate the effects of aqueous extract of sunflower on the germination and morphological characteristics of *Rumex acetosa*, *Lepidium draba* and *Convolvulus arvensis* seedlings as three common weeds in sugar beet fields, a research experiment was carried out in the laboratory of Islamic Azad University, Neishabour, in 2016 as a factorial in the form of completely randomized design with four replications. The experimental treatments were aqueous extract of sunflower (zero, 25%, 50%, 75% and 100%), the type of weed in three levels (*Rumex acetosa*, *Lepidium draba* and *Convolvulus arvensis*), respectively. The results showed that the highest percentage and rate of germination were observed in non-use of sunflower extract (irrigation with distilled water), which in *Rumex acetosa* 97 and 33 percent were higher respectively, in comparison to *Lepidium draba* and *Convolvulus arvensis*. In the study of stem fresh weight, fresh and dry weight of roots, it showed that the field bindweed plant was more resistant compared to *Rumex acetosa*, *Lepidium draba*. The lowest germination and seedling traits were obtained in 100% of sunflower aqueous extract, which affected the weeds of the Ivy and Blacks, and the sorrel was more resistant. According to the results, sunflower extract as a strong combination for weed control can have promising results for sustainable agriculture.

Keywords:

Allelopathy, Sunflower extract, *Rumex acetosa*, *Lepidium draba*, *Convolvulus arvensis*

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INTRODUCTION

Soil contamination and water resources are one of the major problems of using chemical compounds in weed control. In order to prevent the spread of weed resistance, as well as to reduce the environmental problems caused by the use of herbicides, and to reduce production costs, alternative methods such as the use of biological and agronomic methods along with chemical methods should be used. One of these biological methods of plant is allelopathic effects on other plants (weeds). In studying the transgenic properties of plants on each other, it should be noted that the negative effects of these compounds must be minimized and at the same time maximum weed control should be achieved (Abadi *et al*., 2008). In this regard, the use of the allelopathic property of non-target plants can play an important role in the management of weed control. These plants, through the production of secondary metabolites in their surroundings, have a negative effect on the germination of adjacent herbs and thus limit their growth and fertility. Therefore, the use of these types of plants or their residues can reduce the use of herbicides (Mohassel *et al*., 2001). Sunflower is known as an important oilseed plant, and the allelopathic properties of this plant are also considered by most researchers (Ashrafi *et al*., 2008).

Additionally, reduction in number of weeds in sunflower fields and plants in the rotation after the plant has also been reported (Broz, 2011). Studies have shown that sunflower has allelopathic compounds, including phytotoxins. These substances disrupt the hormone balance between ethylene and abscisic acid in the treated seeds. These hormones control root and shoot growth in seeds and as a result, the growth of these organs face severe reduction (Ghiazdowsk *et al.,* 2007). The results showed that the extract of shoot of sunflower contain more alkyl-oxygenic materials than roots so that the germination of weed seeds and lambsquarters decreased by about 43% compared to the control. Therefore, the phenols responsible for the activity of sunflower allelopathy are more concentrated in the leaves (Orouji *et al*., 2008). Weed management and control are in agronomic programs that play a significant role in increasing the yield of crops. However, in most countries, chemical control of weeds is ongoing, but decreasing the quality of crops, the cost of weed control, increasing environmental hazards and, on the other hand, increasing the weed resistance to herbicides indicate the need for revision of weed control methods (Hejazi, 2001). Therefore, new herbicides are now needed to develop plant metabolism (photosynthesis and respiration), to be safe for the environment, to be more efficient, to be active at low concentrations, and to have extensive activity. In this regard, studies of allelopathy of plants can lead to the discovery of new natural herbicides and growth inhibitors (Hejazi, 2001).

MATERIALS AND METHODS

This research was conducted in two phases. The first phase consisted of sunflower planting in a farm in Serbian village of Neyshabur during the growing season of 2014-2015. After sunflower harvest, it was dried and then dried at the flowering stage and then extracted. The second phase of the allelopathic effect on germination of weed plants was performed in the research laboratory of Neyshabur Azad University. This experiment was a factorial based on a completely randomized design with four replications. The treatments consisted of sunflower concentrations in five levels (0, 25%, 50%, 75% and 100%) and weed species in three levels (*Rumex acetosa*, *Lepidium draba* , *Convolvulus arvensis*).

To prepare the sunflower extract, the sunflower was first cultivated on a plot of 300 square meters after the preparation of the land. At the end of the season, after complete maturation, the plants were removed from the soil with roots. Stems and roots of sunflowers were placed in open air for a few weeks until they were

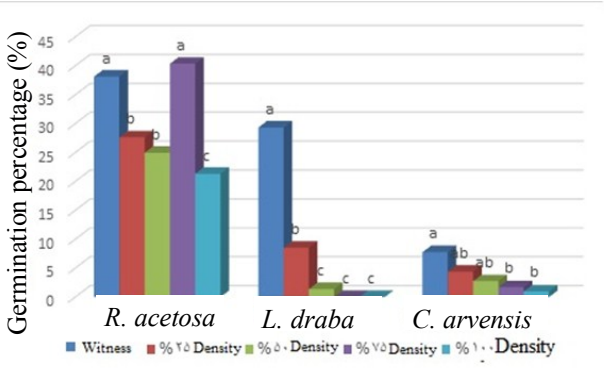

Figure 1. Effect of the sunflower extract on germination percentage

completely dried and then thoroughly crushed with a shredder, then 1.5 kg of crushed sunflower seeds were soaked in 15 liters of water for one week and then filtered through filter paper. After that, sunflower extract was mixed with distilled water to 75% distilled water and 25% sunflower extract, 50% distilled water and 50% sunflower extract and 25% distilled water and 75% sunflower extract. For the level of zero, 100% distilled water was used as control and 100% sunflower extract was used for 100% level until the desired concentrations were obtained (Javaid *et al*., 2006).

Weed Seeds (sorrel, black currant, orchard) were disinfected with 5% sodium hypochlorite solution for 10 minutes. The seeds were then washed with distilled water. Petridishes and filter paper were dispensed for annealing at 120 ° C and 1 bar pressure for 20 minutes. 100 seeds of each treatment were placed in petridish on a filter paper and petri dishes were irrigated at 25°C for 14 days at the concentrations of 0, 25%, 50%, 75% and 100% aqueous extract of sunflower. Seeds were kept in the petri dishes for 14 days. The root germination criterion was considered as two millimeters and counting of germinated seeds was carried out daily for 14 days. From each experimental unit, we selected 20 seedlings for measuring the fresh and dry weight of the root, randomly, and we measured five of them by the length of the root and stem (Mohassel *et al*., 2001).

Percentage and germination rate

Germination percentage and rate were counted every 24 h for the germinated seeds (with a root length of 1-2 mm). At the end of germination, the results were analyzed using Excel software and the percentage and rate of germination were calculated.

$$\text{Germination rate (GS\%)} = \frac{N_1}{1} + \frac{N_2}{2} + \frac{N_3}{3} + \cdots + \frac{N_n}{n} X\ 100$$

where, N =Number of germinated seeds per day; n =The total number of germinated seeds. (Samadani and Baghestani, 2006)

Root and stem length

The length of the stems and root of each of the five random samples were measured from each petri dishes seedling after two weeks using the ruler in millimeters in the laboratory.

Root and stem fresh weight

After 14 days of seedling emergence, 20 samples of root and stem were separated from each treatment; each sample was weighed individually by a digital scale with a precision of 10,000 grams. The average fresh weight of stem and root of 20 samples was considered treatment as root and stem weight.

Root and stem dry weight

After measuring fresh weight, the root and stems were individually placed in paper envelopes. The specimens were transferred to an oven at 70°C. After 24 hours, the specimens were extracted from the oven and their dry weight was measured using a digital scale with a precision of 10,000 (Samadani and Baghestani, 2006).

Statistical analysis

After sampling and recording information in the Excel program, statistical analysis of the data was performed using statix8 statistical software. The mean comparison of studied traits was done using Duncan's multiple range tests. Excel was used to draw the chart (Steel *et al.,* 1996).

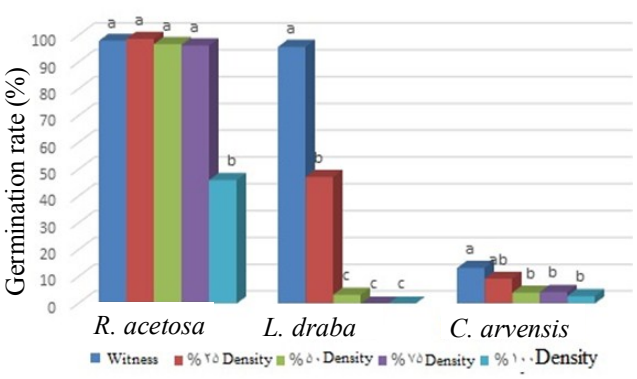

Figure 2. Effect of the sunflower extract on germination rate

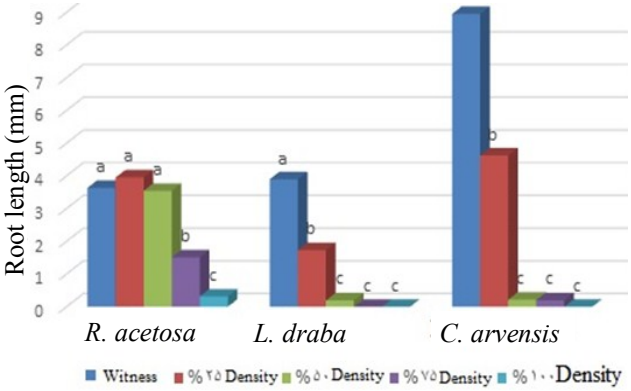

Figure 3. Effect of the sunflower extract on root length

RESULTS AND DISCUSSION

According to the analysis of variance table, the percentage of germination, germination rate, root length, stem length, root and stem fresh weight and root and stem dry weight of important weeds of sugar beet is influenced by 99% probability of weed type interaction and the concentration of sunflower extract as a herbicide. The highest percentage of germination in each of the three weed is when distilled water has been used for irrigation and soaking the seeds, and only *Rumex acetosa* weed increased by 75% (Table 1). However, with increasing extract *in Lepidium draba*, germination percentage was significantly decreased and there is a significant difference between 0% and 100%. In field bindweed, with increasing extract, germination percentage, germination rate, root length, stem length, root and stem fresh weight and root and stem dry weight was significantly reduced and there was a difference between 0% and 100% (Figure 1).

Phenolic compounds as a preventive agent for germination of seeds and growth of the shoots or extension of the seedling root have been reported in many reports. According to researches, phenolic acids reduce water conductivity and absorb nutrients. Azizi *et al*. (2006) reported that the extract after penetration into the embryo was inoculated and, by acting on the alpha-amylase enzyme, prevented germination of the seeds. Investigations of Ghiazdowsk *et al*. (2007) on the properties of sunflower allelopaths on white mustard germination also showed the results of this experiment. So, the application of sunflower leaf extract reduced the germination percentage, germination rate, root and stem length of white mustard.

In the present study, only in *Rumex acetosa* no difference was observed in control treatments at 25%, 50% and 75%, but there is a significant difference between control and 100% on germination rate (Figure 2).

A study on the aqueous extract of sorghum root on seedling growth of *Lepidium draba* showed that when the concentration of aqueous extract of sorghum root increased, germination percentage, germination rate, root length, and stem length (*Lepidium draba*) significantly decreased (Yousefi *et al*., 2010). The presence of allelopathic effects in residues and extracts of many weed species and some crops has been shown to prevent germination and growth of other species or to interfere with plant growth and development processes and reduce the yield of the crop (Orouji *et al.,* 2008).

In the present study, only in *Rumex acetosa* no difference on root length was observed in the control treatments at 25% and 50% but there is a significant difference between control and 100% (Figure 3).

Samadani and Baghestani (2006) reported that with increase in the concentration of Mugworts extract, root length of wild oat decreased. Tafti *et al*. (2008)

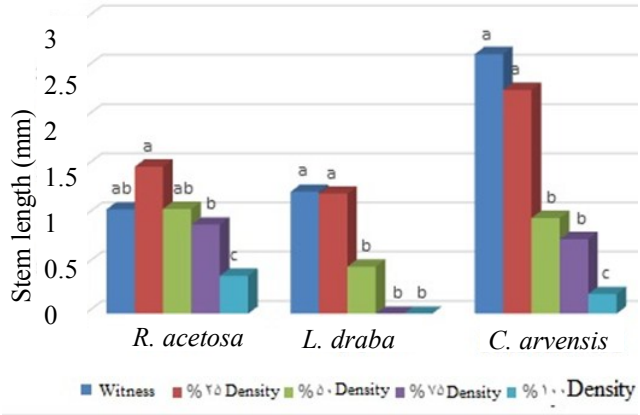

Figure 4. Effect of the sunflower extract on stem length

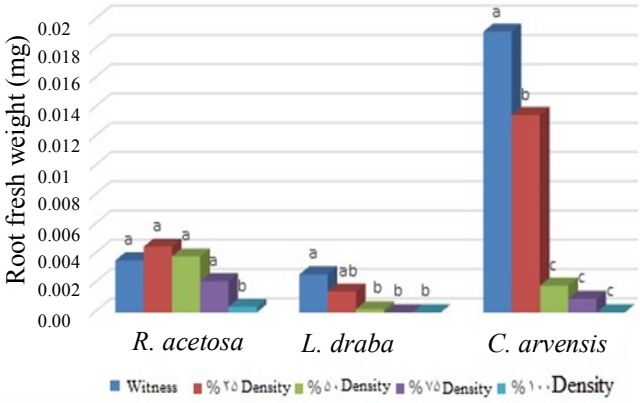

Figure 5. Effect of the sunflower extract on root fresh weight

stated that with increase in the concentration of medicinal plant *Rue* extract, the length root of Purslanes and Amaranth reduced.

The present study results revealed that only in *Rumex acetosa* the highest stem length is when 25% concentration is used but there is a significant difference between control and 100% (Figure 4).

Farhudi *et al*. (2007) stated that reduced growth of wild mustard under the influence of sunflower aqueous extract was caused by cellular degradation in the wild mustard. Rezaie and Yarnia (2009) also reported that the root and shoot extract of red root and *Chenopodium album* extract reduced plant height could be due to the reduced cell division and cell elongation at growth sites or reduced induction effects of indole acetic acid hormones and gibberellin, as a result of the reduction between nodes, caused by alchemists (Yu *et al*., 2003).

Moreover, in the current study, only in *Rumex acetosa* no difference on root fresh weight was observed in the control treatments at 25%, 50% and 75%, but there is a significant difference between control and 100% (Figure 5).

Koloren (2007) reported that aqueous extract of leaves and roots of Alfalfa and mungbean, reduced seed germination and root growth of *Amaranthus retroflexus*, *Lolium rigidum*, and common purslane weeds. By increasing the concentration of aqueous extract up to 50%, the germination of the root of these weeds severely decreased. Mu *et al.* (2005) reported that the aqueous extract of *Artemisia* sp. has an inhibitory effect on the mitotic secretion of wheat top root (*Triticum sativum*), and reduced root growth.

In *Rumex acetosa,* the stem fresh weight showed

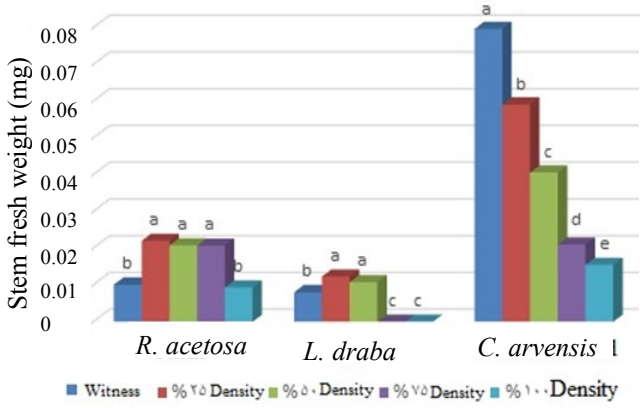

Figure 6. Effect of the sunflower extract on stem fresh weight

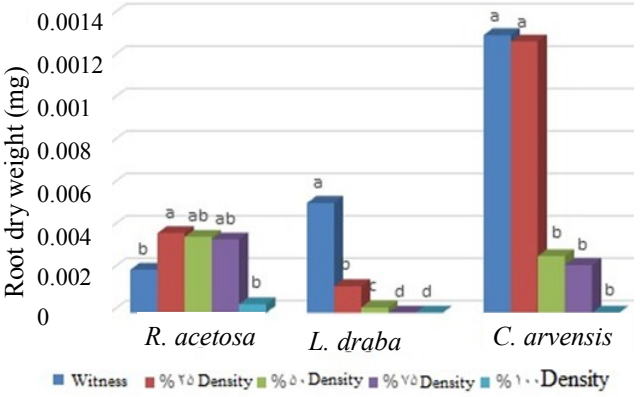

Figure 7. Effect of the sunflower extract on root dry weight

Table 1. Analysis of variance of different traits examined in the experiment

Sources of change	Degrees of freedom	Mean Square							
		The percentage of germination	Germination rate	Stem length	Root length	Root fresh weight	Stem fresh weight	Root dry weight	Stem dry weight
Weed variety	4	554.53**	4825.4**	5.18641**	60.6020**	0.0001607**	0.00137**	0.0000008889**	0.000008355**
Extract concentration	2	4196.05**	34443.7**	3.05497**	15.8121**	0.0002027**	0.00726**	0.000001173**	0.00008871**
Interaction of variety in concentration	8	190.57**	2253.4**	0.65668**	11.7309**	0.00008013**	0.00090**	0.0000006284**	0.000004104ns
Error	42	74.12	30.6	0.15970	0.7586	0.000002823	0.00018	0.0000001650	0.000002754

1-, **, *and ns are significant at 1%, 5% and non-significant levels

no difference in control treatments at 25%, 50% and 75%, but there is a significant difference between control and 100% (Figure 6).

Exudates from different parts of a plant can have different effects on root growth and biomass production in neighboring plants or be in the rotation. These compounds, in addition to reducing the activity of enzymes by reducing plant hormones such as auxin and gibberellic acid, can reduce root and stem growth (Chung and Miller, 1995).

In *Rumex acetosa,* no difference was observed between control and 100% and after control by increasing extract concentration and practically it seems that the use of extract had no significant effect on root dry weight (Figure 7).

Researchers have shown that allelopathic substances in plants decrease the dry matter of crops such as wheat, corn, sunflower and soybeans (Javaid, 2006). Sadeghi *et al.* (2010) Spelling is different from the text reported that by increasing amount of sunflower seed extract, dry root weight of wild mustard increases. The extract from the leaf had more inhibitory effects in all concentration than other organs of sunflowers. So that the dry weight of stems in 20% of the extract decreased by 76% compared to the control treatment.

CONCLUSION

The results of this experiment showed that the use of sunflower aqueous extract is very effective in controlling weeds of *Rumex acetosa, Lepidium draba* and *Convolvulus arvensis*, so that the concentration of 75% to 100% of these extracts effectively reduces all traits by 85-99%. The results showed that the highest percentage and rate of germination were observed in non-use of sunflower extract (irrigation with distilled water), which in *Rumex acetosa* was higher with 97% and 33%, compared to *Lepidium draba* and *Convolvulus arvensis* respectively. In the study of fresh and dry weight of stem, fresh and dry weight of root, it showed

that *Convolvulus arvensis* was more resistant than *Rumex acetosa, Lepidium draba*. The least germination and seedling traits were obtained in 100% of sunflower aquatic extracts, which *Convolvulus arvensis* and *Lepidium draba* were more affected, and *Rumex acetosa* was more resistant. According to the results, sunflower extract as a strong compound for weed control can have promising results for sustainable agriculture. Sunflower showed a high allelopathic potential to control these three weed species. More comprehensive tests are needed at the greenhouse and farm level, as well as identification of the allelopathic effects in the sunflower seems necessary.

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