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Consideration of allelopathic effects of *Artemisia annua L.* on morphological characteristics of *Lactura sativa L.*

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Abstract

Flowering and germination are important step of plant life. To study the allelopathic effect of aqueous extracts of *Artemisia annua L.* on early growth of lettuce, an experiment was designed in a completely accidental plot with 5 treatments (control, 25%, 50%, 75% and 100% of concentration of aqueous extracts) and four times repetition in the laboratory. SAS software was used to analyze the data and Duncan test at 5% of probably level indicated that the effect of different concentrations of extract was significant on morphological characters such as germination rate and percentage, plumule and radicle lengths and fresh and dried weights of seedlings.

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Introduction

Allelopathic had been applied by Molisch at the first time in 1937. He also used this word for chemical interaction of live creatures, and chemical compounds which involve in this process named allelochemical.

Allelopathy is a biochemical interaction between 2 or more plants and their microorganisms which in releasing natural chemical materials (allelopathins) by a plants, will affect on physiological process of plants or other creatures (Challa and Ravindra, 1998; Hartman *et al.*, 1990)..

While extracts, roots and also the rest of *Cardaria draba* added to soil directly, in an experiment, Qasem (2001), avoids from germination and growth of 2 agronomical plants such as barley and wheat.

Kiemnec and mcinnis (2002) considered the effect of aqueous extract of *Cardaria draba* root on germination of winter wheat, *Medicago sativa*, *Agropyrum repens* and *Psudoroegneria spicata*, and resulted that by increasing *Cardaria draba* root extract, germination and radicle length of all 4 spices will decrease in comparison with control (distilled water), but wheat and wheat grass were more tolerance than other 2 spices.

Herbal and aromatic plants contain materials which have deterrence on plants germination and growth (Hartman *et al.*, 1990). Impact of tea leaf extract on cotton growth showed that this plant is under effect of tea extract (Grummer and Beyer, 1960). *Artemisia annua L.* from Asteraceae family is an annual plant which containing many kinds of extracts and glycoside and alkaloid component are using as an herbal plant (Challa and Ravindra, 1998). Allelopathins which are in poisonous plants have phenolic, glycoside and alkaloid components (Fujii and Hiradate, 2005; Putnam, 1984).

Recognizing weed with allelopathic characteristics and its effect on germination and early growth of crops in each zone has special important. So this experiment's goal is considering *Artemisia annua L.* allelophatic potential on morphological characteristics of *Lactuca sativa L.* seedlings which had been done in laboratory circumstances.

Material and methods

This research had been done to consider allelopathic effect of *Artemisia annua L.* extract on germination and early growth of *Lactuca sativa L.* It had been done in completely randomize plan with 4 replication in agronomy laboratory of Tehran in 2011.

Collecting Artemisia annua L. organs

Firstly, to do this experiment, organs had been collected from Gorgan research center farm, and after cleanse, they had been sent to become dry. They dried in 75°C in oven, and then the organs divided to 2-4 cm, and 50 gr of dried organs weighted by digital scale. In the next step, they had been putted in 65% ethanol for 10 min. Finally they had been washed by districted water several times.

Providing the solvent

500 ml of distilled water added to 50 gr of antibacterial organs, and shook by shaker 500 for 24h. After that the solvent had been filtering by Wattman filter paper. All dishes which were needed for experiment had been sterilization by autoclave in 120°C. To do this experiment, there were 5 treatments included control or pure distilled water, 25%, 50%, 75% and 100% of *Artemisia annua L.* extract.

Seed culture

In this stage of experiment, firstly realty seeds had been separated and had been put in sodium hypo chlorite solvent. After the proper time, they had been washed by distilled water for several times. Then they had been put in Petri dishes which had filter papers in each Petri dish we cultured 20 seeds. This work did near alcoholic light (to reduce environmental pollutions percentage). After cultivating, we added provided solvent, and then we closed Petri doors by Para films. Since 1 day after cultivating, germinated seed had been counted for 9 days.

We studied following characteristics

Germination Percentage (GP)

From second day, we started counting the germinated seeds daily in specific time. At that time, those seeds were considered germinated which their radical length was more than 3 mm. Counting continued till we could count more germinated seeds and the resulted final counting considered as final germination percentage.

GP: Ni / N × 100

Ni: number of germinated seed till i^{th} day)

N= total number of seeds.

Germination Race (GR)

In order that, from the second day to 7^{th} once a 24 hours we counted germinated seeds and its race was determined by Maguire equation (1962):

$$GR = \sum_{i=1}^{n} \frac{Si}{Di}$$

GR: Germination Race (number of germinated seed in each day)

Si: number of germination seeds in each numeration

Di: number of days till n^{th} numeration.

n: number of numeration times.

At the end of experiment we chose 10 plants from each Petri dish, separated their radicle and plumule and measure each plat's radicle and plumule length separately. Then we put each repetition on the filter separately. In order to make them dry and measure its dry weight, we put them in oven with 75°C temperature for 24 hours, after we achieved pure numbers, we used SAS software for analyzing them and used Excel software to draw graphs.

Results

Results of data statistical analysis had been shown in table 1 and results of comparison between characteristics mean had been shown in table 2. These results showed that *Artemisia annua L.* extracts have deterrence effect potential on germination and early growth of *Lactuca sativa L.*.

Germination percentage and race on different concentration of Artemisia annua extract

Results of analysis in 1% of probable levels showed that there is significant difference between different concentration of *Artemisia annua L.* for percentage and race of germination in *Lactuca sativa L.* (Table 1). Comparison between means of different concentration effects percentage and race of germination had been showed in table 2. As you see in different extract concentration, the most germination percentage is related to control (0%) with 93.33%, and the least is related to 100% of extract with 51.67%.

Table 1. Result of variance analysis on germination and growth of seedling *Lactuca sativa L.* under different extract concentration of *Artemiasia annua L.*

		Mean Square					
S.O.V	**df**	**GP (%)**	**GR**	**RL (cm)**	**PL (cm)**	**FW (g)**	**DW (g)**
Treatment	4	818.33**	26.27**	2.2**	1.53**	0.0028**	0.00052**
Error	15	25	1.1	0.66	0.012	0.00013	0.000009
C.V (%)		6.86	14.11	7.47	5.89	3.62	7.4

Note: * and ** indicate significant difference at 5% and 1% probability level, respectively.

GP: Germination percentage, GR: Germination rate, PL: plumule length, RL: Radicle length, FW: Fresh weight, DW: Dry weight.

Also, in germination race the most races were related to control treatment (0% of extract concentration), and the least was related to 100% of extract (Table 2).

Resulted of researcher's studies show that extract of *Artemisia annua L.* plant, leads to reduction in race and percentage of germination in *Avena lodoviciana* and *Ameranthus retroflexus* (Ghorbanli *et al.*, 2008).

Radicle and pumule length in different Artemisia annua L. extract concentration

Results of variance analysis showed that in 1% of probable level, was significant difference about pumule and radical length (Table 1). Comparison between radicle and pumule length means in different extract concentration (0%, 25%, 50%, 75% and 100%) showed that by increasing extract concentration pumule and radicle length will decrease. The most reduction in pumule and radicle length had been observed in 100% of extract concentration.

Fresh and dry weight of seedling in different extract concentration

Impact of different extract concentration on fresh and dry weight of all spices was significant ($P<0.01$) (Table 1).

Table 2. Effect of different extracts concentration of *Artemiasia annua L.* on germination and growth of seedling characteristics in *Lactuca sativa L.*

Extract concentration (%)	GP (%)	GR	RL (cm)	PL (cm)	FW (g)	DW (g)
0	93.33a	10.92a	4.3a	3a	0.17a	0.06a
25	80b	8.95b	3.53b	2.06b	0.14b	0.043b
50	66.67c	5.7c	3.13b	1.74c	0.12c	0.032c
75	60cd	5.15cd	2.61c	1.55c	0.1d	0.028cd
100	51.67d	3.72d	2.07d	1.07d	0.092e	0.026d

Note: Similar letters in each column hadn't any significant statistical difference.

GP: Germination percentage, GR: Germination rate, PL: Plumule length, RL: Radicle length, FW: Fresh weight, DW: Dry weight.

Effects of extract concentration on seedling dry and fresh weight had been shown in table 2. As have being seen, by increasing extract concentration, fresh weight of *Lactuca sativa L.* decreased; in this case, the minimum fresh weight was related to 100% of extract concentration. Also, about seedlings dry weight, results were the same by increasing extract concentration till 100% dry weight amount had been decreased.

Discussion

Allelochemicals put the plants or creatures physiological process under effect existing compounds in *Artemisia annua L.* extract has deterrence role on germination and growth of *Lactuca sativa L.*, although this effect on germination, pumule and radicle length growth and dry and fresh weight was different a wide range of active biological compounds which had been produced by different *Artemisia annua L.* spices, had been reported (Macro and Barbera, 1990). One of the most important active compounds is artemisinin, sesquiterpene lactone has toxicant role which deters lettuce and *Portulaca oleracea L.* growth (Duke *et al.*, 1987).

For instance, Lydon *et al.* (1997) reported that chloride methylene extract of *Artemisia annua L.* includes artemisinin, and this extract's impact in plot soil on growth and germination of *Amaranthus retroflexus* was similar to that time when *Artemisia annua L.* leaves mixed with plot soil and its avoidance on *Chenopodium album* and *Amaranthus retroflexus* was more than soybean and maize. Romongi *et al.* (2000) and Tworkoski (2002) showed that some of compounds which exist in herbal plants extracts have strong deterrence feature, and in more than 1% of concentration leads to avoided germination of plants which are around them.

Results of this consideration and according to Hartman *et al,* (1990) showed that *Artemisia annua L.* extract has impact on radicle and pumule length of experimental plants. As extract has direct contact with radicle it has more impact on radicle length. Reduction in radicle growth in comparison with

pumule have been observed in high concentration which it is more because of extract features, plants spices and chemical features of all allelochemicals.

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