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**Original article**

## **Allelopathic effect of pistacia khinjuk leaf extracts on chenopodium album, physalis alkekengi and amaranthus retroflexus**

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### ABSTRACT

A weed is a term applied to any plant considered as one major problem in farm fields and gardens. Weeds cause serious damages to farmers per year, bringing about heavy losses in farm and garden yield. Thus, in order to contain the growth and spread of weeds, farmers have no way but using chemical weed killers known as herbicides. As chemical methods have had serious negative effects in recent decades, using allelopathies, combined with other species within intercropping systems, to control unwanted plants and providing a good cultivated setting has attracted great attention. To reduce using chemical herbicides in farms and garden and developing sustainable agriculture, this article studies the Allelopathic effects of Pistacia khinjuk leaf extract on seed germination of Chenopodium album, Physalis alkekengi and Amaranthus Retroflexus in Jahrom. The research indicated that the leaf extract from Pistacia khinjuk contains materials decreasing the growth parameters in Amaranthus Retroflexus. However, in Physalis Alkekengi and Chenopodium album L., any process of germination did not affected by the density of Pistacia khinjuk extract. Extract with high density reduced significantly the extent of seed germination by 95%. The results revealed that weeds have the same influence on various factors of growth, excluding weight and length of seedling. To put it another way, there is no significant difference between Physalis Alkekengi and Amaranthus Retroflexus with Chenopodium Album over some factors from germination rate to

intermediate germination periods, germination speed, and length of their hypocotyls and radical roots. However, a significant difference is observed between them and *Amaranthus Retroflexus* L. in confident level of 95%.

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## 1. Introduction

One of the most important subjects researchers are now studying is the emergence of a phenomenon called herbicide tolerant weeds and the wide range of weed species. Allelopathy refers to deterrent effects of one plant on another plant; both crop and weed species, from the release of biochemical, known as allelochemicals, from live plants or decayed remainders of plants in soil. Allelopathy is a form of intervention attracted great attention in recent years. Compounds generated by a plant in an environment may have deterring or stimulating effects on surrounding creatures (Vahedi, 2005). A huge amount of literature exists on influences of allelopathic plant over each other. In a research conducted about allelopathic effects of leaf and fruit extract from *Atriplex canescens* on germination properties of *Salsola rigida*, including ultimate percent of germination, germination speed, intermediate germination period, and the rate of stimulation or deterrence in the 1% level of Duncan's test (Dehdari and Jafari, 2009).

In another research, the Allelopathic effects of *Helianthus annuus* remnants on germination and initial growth of *Chenopodium Album* were studied. Results revealed the significance of all traits. Means were compared to observe that aboveground organs have the most deterrent effect in relation to roots. And the highest rate of deterrent was observed at the 80% density of aboveground oranges. Finally, the aboveground remnant of *Helianthus annuus* can be used as a method for controlling *Amaranthus retroflexus* L. (Zareh et al., 2010). A test was conducted to study the allelopathic effects of methanol extracts from *Eucalyptus camaldulensis* on germination and initial growth of two weeds, called *Secale montanum* and *Malva sylvestris*. The measured parameters included germination traits such as germination percent, germination speed, germination index, seed vigor, shoot length, radical root length, dry weight, and wet weight. Ultimate results suggest that the methanol extracts have deterrent effect on both but it is higher for *Malva Sylvestris* (Heydari et al. 2010).

The repellent and deterrent effects of *Peganum harmala* L. extracts on seed germination and growth of *Urtulaca Oleracea* L. and *Chenopodium album* L. were examined and assessed. The results indicated that the water extracts from different organs in *Peganum harmala* L. would have repellent influences on seed germination and growth of these two weeds (Naghdi Abadi et al., 2009).

As *Artemisia annua* L. was checked out on weeds in corn fields, test results disclosed that allelopathic effect of this plant on germination and growth rate of *Sorghum Halapense* and *Artemisia annua* L. is low and it is in connection with osmotic pressure. However, its deterrent effect on *Amaranthus Caudatus* and corn is as a result of allelopathic effects. The effects of *Artemisia annua* L. extracts on corn seedling were assessed as allelopathic (Alipour et al., 2010). Allelopathic effect of *Brassica nigra* on development of *Hordeum spontaneum* L. was also studied. It was displayed that under allelopathic effect of this plant, the growth, germination rate and the height of *Hordeum spontaneum* L. were significantly reduced (Tawaha et al., 2007).

In this regard, allelopathic effect of *Eucalyptus* leaf extracts on morphological and physiological parameters of monocots and dicots was studied and evaluated. Deterrent effect of this plant on germination and other morphological and physiological traits was higher for dicots than monocots (Mohammadi et al., 2012).

The general purpose of this research is studying allelopathic effect of *Pistacia khinjuk* leaf extract on seed germination of *Chenopodium Album*, *Physalis Alkekengi* and *Amaranthus Retroflexus* in Jahrom. *Pistacia khinjuk* is a medical plant, of *Pistacia Atlantica* kind in Iranian plateau. It is of wooden species found in vegetative areas of Zagros Mountains, Fars Province (Negahdar Saber et al, 2007; Zohary, 1996). *Chenopodium album* is a one year plant from beetroot species reproduced by seed. It has straight stem with abundant branches. Stem lengths sometime reach one meter (Karimi, 1995). *Amaranthus Retroflexus* is a one year plant reproduced by seed and of weeds developing in fruit gardens, cultivation of summer crops, kitchen gardens, and farming lands. *Physalis Alkekengi* is a plant of Solanaceae is sexually propagated.

## **2. Materials and methods**

### **2.1. Region of study**

This research was carried out in Jahrom County with a longitude of 53°33', latitude of 28°30' and the height of 1050 m from sea level in geographic coordinate system.

### **2.2. Collecting leaves and drying them off**

To do the test, fresh leaves were gathered during the growth season. They were then completely dried off in oven at 60 degrees Celsius for 48 hours.

### **2.3. Extraction process**

Drying stage is followed by extraction process. Pistacia khinjuk leaves are ground and mixed with distilled water in different ratios of weight to volume (zero, 5, 10, and 15%) to obtain a solution containing leaf extracts with different rate of density. Densities were 0% as instance, and 5%, 10% and 15% leaf extracts. After 24 hours, solutions were passed through filter paper and the ultimate extract was used in the test.

### **2.4. Treatment**

The test was performed as a completely randomized design with 3 iterations and 2 coefficients. The first coefficient is the density of Pistacia khinjuk leaf extracts in four levels of 0% (as sample), 5%, 10%, and 15%. And the second one is weeds including Amaranthus retroflexus, Chenopodium album, and Physalis alkekengi. First, to break the dormancy and to sterilize, 5.25% Sodium hypochlorite was used for 10 minutes at 25 degrees Celsius. In this research, extracts in different percents were added to petri dishes containing Whatman filter paper. Then, 20 seeds from all three weeds were placed inside each petri dish with 3 iterations. Samples were then treated and put into growth rooms at 25 degrees Celsius.

### **2.5. Measured variables**

Five days after treatments, dependent variables, including seed germination percent, germination speed, intermediate germination period, and the rate of stimulation or deterrence, hypocotyl length, radical root length, seedling length, and wet weight of seedling were measured after 15 days. Having finished the research and gathering information, treatments and data analysis were performed by SPSS. Means were then compared by Duncan's Multiple Range test.

## **3. Results and discussion**

Results revealed that materials existing in Pistacia Khinjuk can reduce the growth parameters of Amaranthus Retroflexus. However, seed germination rate in Chenopodium album, and Physalis alkekengi was not affected by Pistacia khinjuk extracts at any of density. Table 1 summarizes the mean values of measured factors after 5 to 15 day treatment. The results of Duncan's test for each factor are also shown by Latin letters.

As table 1 shows the higher the density of extract, the lower the growth rate of shoots than radical roots. This refers to the higher effect of osmotic potential reduction on shoot than on radical root. This may also be as a result of higher influence of deterrent power over the growth rate of shoot than radical root or the higher sensitivity of the former in comparison with the latter. We can also relate this event to the indirect relation of shoot in connection with tension source in terms of time and location. In this case, for a limited source such as humidity, farther organ (shoot) is more affected and has further sensitivity. These results and Omid's findings (2005) are well matched.

In this research, the effect of density on generation factor was significant. This means that by increasing the density of extracts, the generation rate would increase. The reason is that mean germination time was estimated low. In most scientific resources, mean duration of germination and germination coefficient have been named as two parameters of seed quality. However, as said before, these two traits are general and the number of germinated seeds (germination rate) is all the same. Table 2 summarizes the mean values for three types of weed in sample treatment and the results of Duncan's test by Latin letters.

**Table 1**

Mean values of measured factors for treatment of *Pistacia khinjuk* and the results of Duncan's test (similar Latin letters are indicators of significant difference in the level of 95%).

	Sample	<i>Pistacia khinjuk</i>		
		5%	10%	15%
Germination Percent	100 <sup>a</sup>	95 <sup>a</sup>	45b <sup>c</sup>	28.33 <sup>c</sup>
Germination Period	4 <sup>a</sup>	3.8 <sup>a</sup>	1.8b <sup>c</sup>	1.13 <sup>c</sup>
Germination Speed	6.95 <sup>a</sup>	5.53 <sup>b</sup>	3.2 <sup>cd</sup>	1.95 <sup>de</sup>
Deterrence Percent	-	5 <sup>d</sup>	55b <sup>c</sup>	71.67 <sup>b</sup>
Hypocotyls Length	0.161 <sup>a</sup>	0.017 <sup>c</sup>	0.004 <sup>d</sup>	0.000 <sup>d</sup>
Radical Root Length	0.260 <sup>a</sup>	0.112 <sup>de</sup>	0.114 <sup>d</sup>	0.105 <sup>d<sup>ef</sup></sup>
Seedling Wet Weight	0.104 <sup>a</sup>	0.076 <sup>c</sup>	0.000 <sup>d</sup>	0.000 <sup>d</sup>
Seedling Length	1.83 <sup>a</sup>	1.242 <sup>c</sup>	0.000 <sup>e</sup>	0.000 <sup>e</sup>

**Table 2**

Comparing the measured factors in three types of weed for sample treatment and the results of Duncan's test (similar Latin letters are indicators of significant difference in the level of 95%).

Growth Parameters	<i>Amaranthus retroflexus</i>	<i>Chenopodium album</i>	<i>Physalis alkekengi</i>
Germination Percent	100 <sup>a</sup>	30 <sup>b</sup>	30 <sup>b</sup>
Intermediate	4 <sup>a</sup>	1.2 <sup>b</sup>	1.2 <sup>b</sup>
Germination Period			
Germination Speed	6.95 <sup>a</sup>	1.42 <sup>b</sup>	1.86 <sup>b</sup>
Hypocotyls Length	0.482 <sup>a</sup>	0.167 <sup>b</sup>	0.334 <sup>ab</sup>
Radical Root Length	0.260 <sup>a</sup>	0.176 <sup>b</sup>	0.173 <sup>b</sup>
Seedling Wet Weight	0.011 <sup>a</sup>	0.044 <sup>b</sup>	0.011 <sup>a</sup>
Seedling Length	3.358 <sup>a</sup>	3.406 <sup>a</sup>	3.464 <sup>a</sup>

As table 2 shows, weeds have the same effect on different factors, excluding weight and length of seedling. To put it another way, there is no significant difference between *Physalis Alkekengi* and *Amaranthus Retroflexus* with *Chenopodium Album* over some factors from germination rate to intermediate germination periods, germination speed, and length of their hypocotyls and radical roots. However, a significant difference is observed between them and *Amaranthus Retroflexus* L. in confident level of 95%.

A huge amount of literature exists on influences of allelopathic plant over each other. Rouhi et al., (2009) have reported the deterrence effect of *Juglans regia* allelopathic material on seed germination of plants such as *Triticum aestivum*, *Triticum aestivum*, and *actuca sativa*. Kocacaliskan and Teriz (2009) concluded that *Juglans regia* and *Juglans Regia* leaf extracts had serious deterrence effect on germination of potato and alfalfa seeds while this effect was not critical for *Triticum aestivum*, barley and bean. Teriz et al. (2003) stated that radical root length (30% reduction) is more vulnerable against *Juglans Regia* than shoot length (22% reduction). This became apparent here as well.

About *actuca sativa*, Jefferson and Penacchio (2003) found out that germination rate, radical root growth, and shoot growth are negatively affected by high density of spongy species. Masoudi Khorasani et al. (2005) realized that water extracts from different organs of *Sinapis arvensis* reduced the shoot and radical root length of *Brassica napus* L. This effect on growth of radical root and shoot was at highest rate. By reducing the formation of capillary roots or major roots, Allelopathic compounds may reduce the extent of water absorption in plants. These researchers' results justify the findings of this research.

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