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ALLELOPATHIC EFFECT OF VARIOUS ORGANS OF WALNUT (*JUGLANS REGIA*) ON SEED GERMINATION OF WHEAT

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ABSTRACT

This study is an attempt to analyze the allelopathic effect of various organs of walnut on germination of wheat experimentally and in a quiet accidentally frame of 10 treatments and 4 replications for it. The treatments of the experiment included an aqueous extract of the root, leaf, and fruit's green skin (each of them in concentrations of 25, 50, and 100% percent) and distilled water (control). The Results showed that the strong allelopathic effect of the extract of various organs of walnut on germination of wheat seeds in such a way that the statistical comparison indicates the reduction of germination percentage of seeds in treating the aqueous extracts in comparison with control in the level of one percent. Moreover, the results indicated that the extract of the fruit's green skin has a stronger allelopathic effect comparable with the leaf and root.

Keywords: Aqueous extract, allelopathy, germination, walnut's various organs.

INTRODUCTION

Regarding the widespread and indiscriminate use of chemical poisons, especially herbicides in the last decade taking use of allelopathic plants and also their remainders in the soil in order to control the plants and provide the suitable condition of growth has been considered (Inderjit and Keating, 1999). Broad and extensive researches have been done on this issue. The researches show significant reduction of the parameters which are relevant to germination of various numbers of wheat in reaction to the allelopathic activity of aqueous extract of some weeds (Kiarostami, 2004). In other experiments the extract of aerial organ and saffron chromium (Eghbali *et al*., 2008) and walnut leaf (Roohi *et al*., 2009) were tried on wheat plant and all of them indicated the reduction of germinating speed of wheat. In another research the allelopathic effects of wheat on weeds have been proved (Lehman and Blum, 1997; Alsaadawi *et al*., 1998).

Walnut is an important tree with multi-purpose uses so that it can be used in gardening for the fruit, in the forest for its valuable wood and in pharmacy as an herb (Ebrahimi *et al*., 2009). This research was done in order to compare and analyze the allelopathic effect of various organs of the walnut tree in different concentrations on the germination characteristics of wheat.

MATERIALS AND METHODS

In order to study the allelopathic effect of the extract of various organs of walnut trees on germination of wheat, an experiment was conducted in a completely accidental plan with 10 treatments and 4 replications in the Laboratory of Department of Agriculture and Resources of I.A.U of Broujerd. The experimental treatments contained 25, 50, and 100% of the extract of organs like the root, leaf and the green skin of walnut fruit. The root organ was taken from a three year old tree and it was drained with the purpose of abstaining extract from the mentioned organs. The action of draining was done in the shadow and it continued until reaching to the stable weight. Out of each organ ten percent strong weight extract – a mass (50g with 500ml water) was prepared by putting it on the shaker machine for 24 hours. Four layers of cotton fabric have been used to separate the plant's tissues and solid organs from the extract (Ghorbani *et al*., 2008). Then it was centrifuged with the speed of 2000rpm for 15 minutes. In the next step, by adding distilled water to these strong extracts, aqueous extracts with the concentrations of zero (control) 25, 50, and 100% were made. Thirty wheat seeds were placed in every Petri dish containing filter paper and for each treatment four replications were repeated. According to the plan, 7ml from the prepared aqueous extract from every organ with various concentrations was added to the Petri dishes containing seeds. The Petri dishes were placed inside the garments and in temperature of 20 ^{0}C. The first count of germinated seeds was done 48 hours later. The seeds which were germinated for 2ml were considered as grown seeds.

At the end of the experiment of germination rate, the percentage of germination, the length of the root, the shoot and fresh and dry weight of the seedling were measured. In this experiment, the total weight of the

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seedling has been considered as the seedling weight. To measure the dry weight, 7 days after the beginning of the experiment, the samples were kept in the oven for 24 hours at the temperature of 70^0C. The following parameters, previously reported by others, such as Jefferson and Pennacchio (2003).

Rate of germination (RG) = $\sum_i^d = 1 \frac{ni}{di}$

Where,
N is a daily increase in seedling number
D is the number of days from seed placement

The data analysis was done by a piece of software called SPSS 15. Moreover, the average of the data was compared by use of Duncan and with the probability level of 1%.

RESULTS AND DISCUSSION

The results indicate that the studied wheat seeds reacted differently toward the extract received from various levels of organs of walnut tree. Results depicted that various organs of walnut tree by having an allelopathic effect on the total number of germinated seeds reduced the germinated seeds in each day. The percentage and the rate of germination decreased significantly by increasing the concentration of extracts when compared with control. Previous studies also revealed that allelopathic materials of the walnut leaf reduced wheat germination (Rohi *et al*., 2009). Scott and Sullivan (2007) in their experiment proved that Juglone and the extract of walnut leaf have a deterrent effect on photosynthesis, respiration, growth speed of the root and the stem in corn and soya plants which are cultivated in hydroponic environments (Jose and Gillespie, 1998). The results indicated that the extract of walnut's organs prevents germination moreover it prevents the stem's growth so that in the concentration of 100 percent, a reduction of 73/64 to 97/04 was observed.

Percentage and Rate of Germination

The results indicated that the percentage of the germination of wheat seed significantly reduces under the influence of the extract of walnut's organs. 100% concentration of root's extract reduced the percentage of germination of 26/7% and the 100% concentration of the fruit reduced the germination to 84/17% compared with Control. Among the used treatments, the least reduction of germination after Control treatment belongs to 25-percent- treatment of root extract (Fig. 1).

The results show that different concentrations of the extracts of walnut tree's organs have a significant effect on germination rate of wheat seed (Fig. 2). The achieved results from comparing the means of germination rates of wheat seeds indicate that by increasing the concentration of the extract, germination rate decreases, this amount was respectively, for concentrations of 25, 50 and 100 percent for the root of 13/5, 16/2 and 27/83, for the leaf of 4/1, 9/65 and 25/4 and for the extract of fruit's green skin 1/35, 7/05 and 23/55. The increasing of growth rate in low concentrations decreased remarkably because of the delay in germination and its notable reduction in high concentrations was because of not germinating (Fig. 2).

Length of Shoot and Root: Results show the length of the shoot and root, notably decrease under the influence of the extract of walnut tree's organs. Results gained from comparing the means indicate that the tallest length of the root (5/896cm) is related to control treatment and the shortest length of the shoot is related to 100-percent-treatment of the extract of walnut fruit's green skin (/04 cm) (Fig. 3).

The results achieved by comparing the means show the longest length of the stem (4/535 cm) belongs to control treatment and the shortest one belongs to 100% treatment of fruit's green skin (039 cm) (Fig. 4).

Seedling's Fresh and Dry Weights: The extracts of various organs in 25% concentration had the least influence on seedling's weight, this amount is respective for the concentration of 25% of root, leaf and fruit's green skin 34/14, 36/61 and 44/87% (Fig. 5).

Moreover, seedling's dry weight remarkably reduced under the influence of different extracts of walnut's organs (Fig. 6). This amount for concentrations of 100% of root, leaf and the fruit's green leaf is 73/34, 93/75 and 97/09%, respectively. The smallest percentage of reduction of seedling's dry weight belongs to the treatment of 25% of the root 22/67% (Fig. 6).

The result of this research indicates the allelopathic effects not only lead to the reduction of germination rate but they also cause delay in germination, decrease of the length of the root and stem and reduction of seedling's weight. Delay in germination can have a negative effect in comparison with other plants which in turn can exacerbate the allelopathic effects and plant's being weaker. A plant which owns weaker roots will fail in terms of environmental stresses such as low soil moisture or nutritional stresses with other plants. Moreover, allelopathic compounds can be effective on hairy roots and other roots of the plant and this phenomenon is a reason of reduction of water uptake in the plant (Chon *et al*., 2005).

Walnut leaks juglone to its environment during its lifelong time (Scott and Sullivan, 2007). Juglone has been isolated from many plants in the walnut family (Juglandaceae) including *Juglans nigra*, *Juglans regia* and others (Prataviera *et al*., 1983). Juglone is phytotoxic,

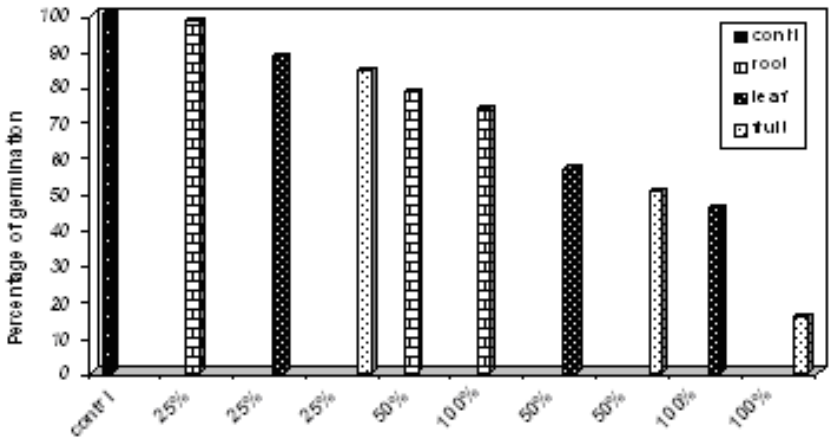

Fig. 1. The percentage of germination of wheat in various concentrations of walnut's organs.

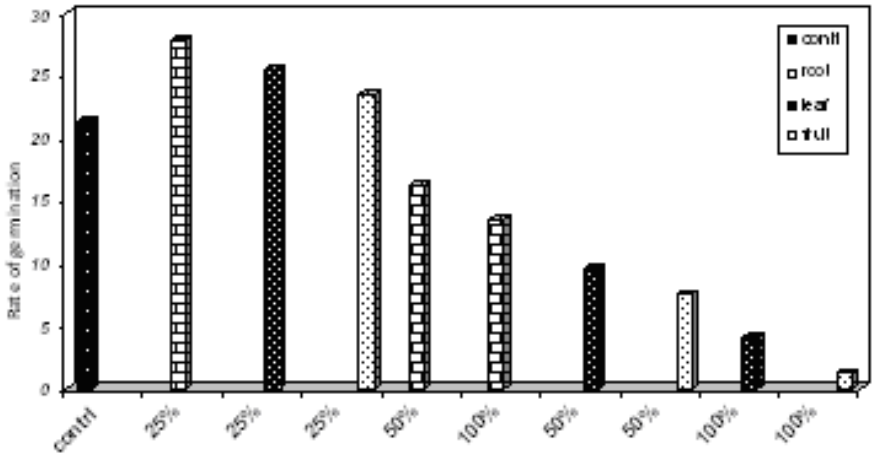

Fig. 2. The rate of germination of wheat in various concentrations of walnut's organs.

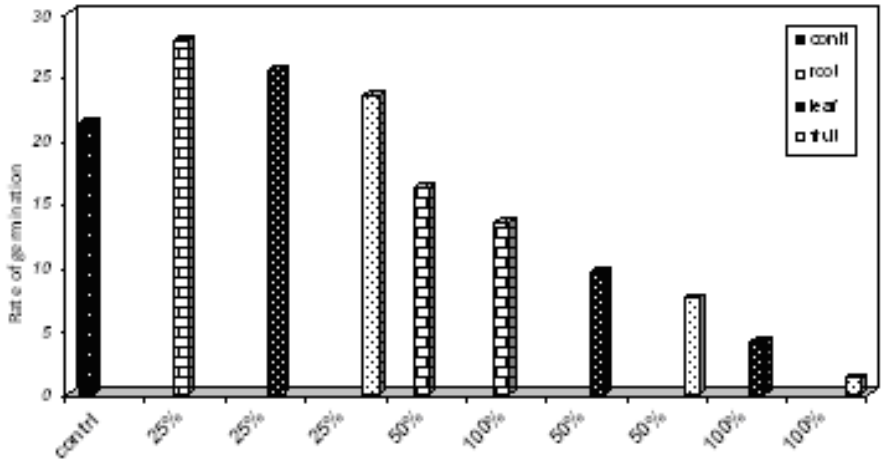

Fig. 3. The average of the fresh weight of wheat in various concentrations of walnut's organs.

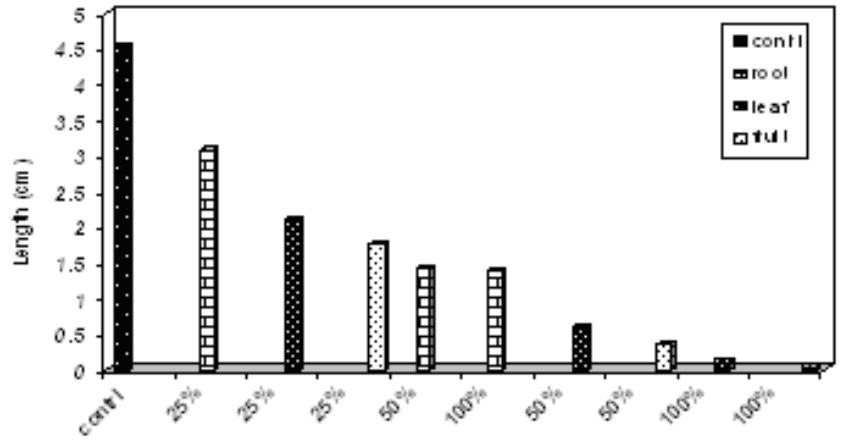

Fig. 4. The percentage of the length of the stem of wheat in various concentrations of walnut's organs.

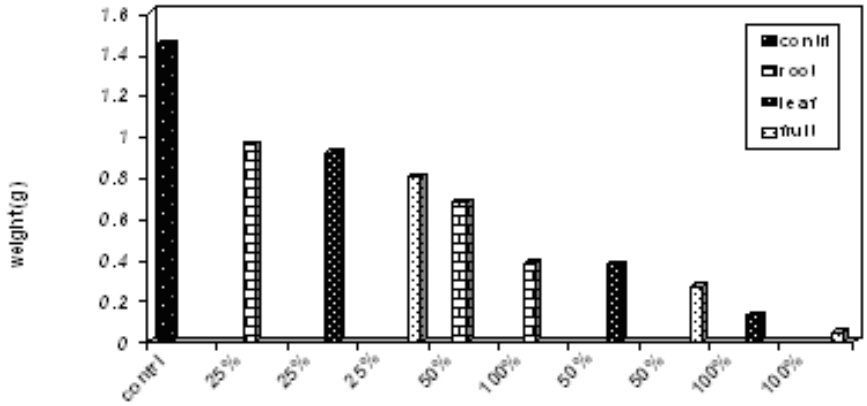

Fig. 5. The average of the fresh weight of wheat in various concentrations of walnut's organs.

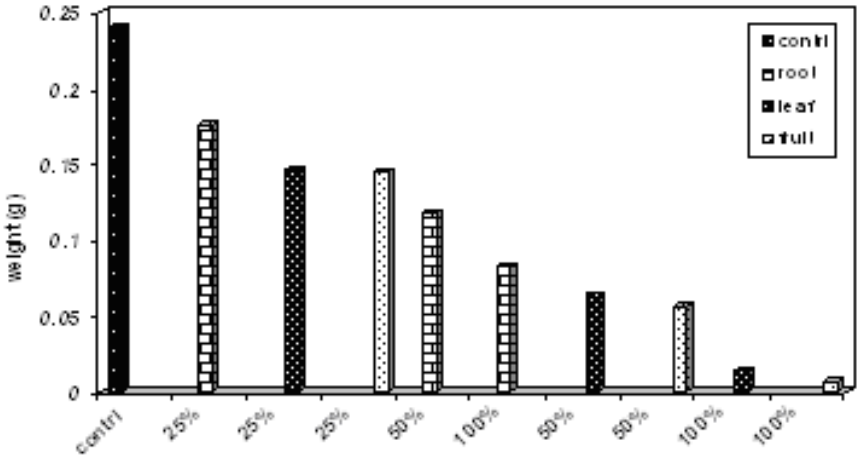

Fig. 6. The average of dry weight of wheat in various concentrations of walnut's organs.

but the mechanisms of growth inhibition have not been fully explained (Hejl and Koster, 2004). Juglone (5-hydroxy-1,4-napthoquinone) is a chemical compound in walnut's allelophathy (Terzi and Kocacaliskan, 2009). Juglone exists in the leaves, stem, tree's skin, fruit's skin and roots which are oxidized to 5-hydroxy-1,4-napthoquinone when exposed to soil or air (Rietveld, 1983). So far, the effect of juglone has been studied in a lot of studies. In an experiment, it is mentioned that juglone and the extract of walnut leaf leads to quality and quantity yield reduction of strawberries.

The results gained by this study show that wheat plant reacts differently toward the extracts of various organs of the walnut and these reactions increases by increasing the percentage of the used extract and this is because of the difference in the amount of Juglone in various organs during the growth season. With more researches on this issue, it is possible that by using juglone in preparing poisons and herbicides to take use of this compound as a suitable substitute for pest control, diseases and weeds. Also, by studying the various organs of wheat and analyzing their sensitivity degree to this compound we can begin to produce resistant varieties to it. More information on this issue is in need of more researches.

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