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Evaluation of allelopathic effects of different parts of *Sesamume indicum* seeds on germination of *Hordeum vulgare* seeds

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Abstract: To evaluate the effect of seed size on reduction of allelopathic effects of different parts of *sesamume indicum* was carried out experiments in the form of factorial and completely randomized design with four replications at the Islamic Azad University of Shooshtar in 2014. The treatments are including: *Hordeum vulgare* seeds, *aqueous extract of different parts of sesmume indicum (leaves, shoot and root) and different concentrations of aqueous extract (0, 15, 20 and 25%).* The result showed that root extract of *sesamume indicum* had significantly more negative effect on germination characteristics of fine and coarse *hordeum vulgare* than shoot extract. *Sesamume indicum extract with 25% concentration had the highest percentage inhibition (43%) on germination of hordeum vulgare that inhibition on the fine seeds was more than coarse seeds. The coarse seeds were superior to the fine seeds for all the studied characteristics. Generally, results showed that the use of coarse seeds reduces the negative effects of germination inhibitors in sesamume indicum*.

Key words: *Allelopathic; Inhabitation; Seed size; Sesamume indicum*

1. Introduction

The interaction between plants reduces and increases growth too, through the release of secondary metabolites by decomposing plant residues, root exudates or leaching by rain is named allelopathic (Siddiqui et al, 2009). *Sesamume indicum* is well known as an important oil plant and allelopathic properties of this plant have been considered by the most researchers.

The yield reduction of the crops after *sesamume indicum* cultivation has been observed by farmers. The negative effect of *sesamume indicum* residues is extreme on neighboring plants so that more than 200 substances of allelochemicals have been identified in different parts of *sesamume indicum*. In addition to, the reducing number of weeds in *sesamume indicum* fields and crops in the rotation after the plant has also been reported. Decreasing germination, biomass and yield of four plants in rotation of *sesamume indicum* including zea mays, sorghum bicolor, millet and beans have been reported. The results of study on allelopathic effects of *sesamume indicum* on physiological characteristics of hordeum vulgare show that *sesamume indicum* leaves increased the content of protein, proline, chlorophyll, peroxidase and superoxide in *hordeum vulgare*. In this study, aqueous extract of leaf was more effective than the root extracts and the lowest inhibitory effect was observed in the shoot extract. Different results of the effect of seed size on reaction of seed germination have been reported from various plants at different environmental conditions. Also, fine seeds can geminate and grow faster than coarse seeds (Tavakkol Kakhki et al, 1389). Lafond and Baker (1986) believe that fine seeds not only germinate faster than coarse seeds but also plumule green more rapid. *Hordeum vulgare* as the main supplier of food in the world has been allocated a large area under cultivation. This plant is usually in rotation with *sesamume indicum* where *sesamume indicum* cultivation is common. Since the significant portion of *sesamume indicum* residues remains after harvest in the field and due to the high-potential allelopathy of *sesamume indicum*, there is low information about effects of these residues on *hordeum vulgare* germination.

2. Materials and Methods

Experiment was carried out in the form of factorial and completely randomized design with four replications at the Islamic Azad University of Shooshtar in 2014. The treatments are including: size of hordeum vulgare seeds, aqueous extract of different parts of sesamume indicum (leaves, shoot and root) and different concentrations of aqueous extract (0, 15, 20 and 25%). Different organs of sesamum indicum were dried at room temperature and under the shadow and were powdered and milled individually. To prepare a solution, 100 g powdered organs mixed with 1000 ml distilled

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water and per 6 hours stirred for 10 minutes, after 72 hours, first solution smoothed by a velvet cloth and then was passed through the filter paper. The other concentrations were prepared from this solution. To separate fine seeds of hordeum vulgare used from 1.5 mm sieve and for coarse seeds used 3 mm sieve. After separation of the seeds in two sizes fine and coarse, it was sterilized with 5% sodium hypochlorite solution for 30 seconds and immediately was washed 3 times with distilled water. After that, 25 seeds were used in sterilized petri dishes that filter paper was placed at the bottom of them. Petri dishes were transferred to an incubator with 25 ° C and then was reviewed every 12 hours and were recorded the number of germinated seeds (seeds with a radical length higher than 2 mm). After a week of cultivating seeds, was measured radical and plumule length. In order to determine the dried weight of radical and plumule, each organ was separately put in the oven at 70 ° C for 48 h and was measured its weight. Germination percentage was calculated from the following formula, which G: The number of germinated seeds and N is the total number of seeds and decreased germination percentage was calculated from the following formula which Nx is the number of germinated seeds under stress conditions (Sesamume indicum extract) and Nc is the number of germinated seeds in control conditions (control treatment). Statistical calculations were performed for studied attributes, and data was analyzed using SAS software, and the means were compared by LSD test.

$$GP = \sum_{i=1}^{7} \frac{G}{N}$$

$$RPG = \left[1 - \left(\frac{N_x}{N_c}\right)\right] \times 100$$

3. Results and Discussion

3.1. Germination percentage

The analysis of variance showed that the germination percentage of hordeum vulgare is affected by extract, concentration and seed size of hordeum vulgare (Table 1).

Table1: The values of the degrees of freedom and significance probability levels for germination percentage, reduction percentage of germination, plumule length, radical length, dried plumule weight and dried radical weight.

Significant F							
Plumule dried weight	Radicle dried weight	Radicle length	Plumule length	Reduction of germination (%)	Germination (%)	DF	Sources of variation
NS	**	NS	NS	**	NS	1	(A) Seed Size
NS	NS	**	**	*	**	2	(B) Organ Type
NS	**	**	**	**	**	3	Concentration (C) Extract
NS	NS	NS	NS	NS	NS	2	A*B
NS	*	NS	NS	*	NS	3	A*C
*	NS	NS	NS	NS	**	6	B*C
**	NS	NS	NS	NS	NS	6	A*B*C
						72	Error

*,** and NS significant at 5 and 1 % of probability and non significant, respectively.

Increasing the amount of extract decreased germination percentage linearly. The highest germination percentage was observed in control treatment (90.66), and the lowest germination percentage was observed in treatment with concentration of 25 percent extract. Increasing concentrations treatment contains 25% extract decreased 43% germination; higher and lower amount had similar effects on time reach to 50% germination.

According to organs, it was also observed that inhibitory effect of root residuals is more than shoot and leaves residues so that increasing amounts of root residues from 8 to 16 percent decreased germination percentage while about the shoot residuals wasn't a difference between the amounts of residuals. The maximum inhibitory effect on the germination related to shoot extract. There was no statistically significant difference between shoot and root extract but the inhibitory effect of roots was more than shoot. The study (Cruz et al., 2000) has shown that secreted inhibiting substances from different plant organs reduce germination percentage and increases intensity of this inhibition with increasing concentration. It is reported that production of allelochemicals in the crops and releasing them in the soil by crops can affect the germination and growth of the species plant. This effect is selective and depends on the concentration and type of the residuals can cause inhibition or stimulation of growth in the crops or weeds.

Table 2: helianthus annuus effect on germination characteristics of wheat

Plumule dried weight (mg)	Radicle dried weight (mg)	Radicle length (cm)	Plumule length (cm)	Reduction of germination (%)	Germination (%)	Organ Type
0.064 a	0.019 a	6.19 b	6.55 b	27.62 b	70.66 a	**Leaf**
0.044 a	0.02 a	7.41 a	7.95 a	27.90 b	70.05 a	**Root**
0.039 a	0.06 a	5.87 b	6.02 b	42.47 a	60.83 b	**Shoot**

Means followed by the same letter for each attribute do not significant differ (LSD= 0.05).

Coarse seeds had germination percentage more than fine seed, although, statistically, significant differences were observed between fine and coarse seeds (Table 3).

Table 3: Effect of wheat seed on germination characteristics

Plumule dried weight (mg)	Radicle dried weight (mg)	Radicle length (cm)	Plumule length (cm)	Germination (%)	Organ Type
0.064 a	0.019 a	6.19 b	6.55 b	70.66 a	**Coarse**
0.044 a	0.02 a	7.41 a	7.95 a	70.05 a	**Fine**

Means followed by the same letter for each attribute do not significant differ (LSD= 0.05).

It seems that amount of allelopathic substance or level of seed that is exposed to allelopathic substance in fine seeds is more than coarse seeds because of the higher ratio of surface to volume in fine seeds. This reduces the percentage of germination in fine seeds. Different results have been reported from effect of seed size on germination characteristics in different crops. According to percentage of germination was observed at all concentrations of the sesamume indicum extract, coarse seeds were more superior to the fine seeds (Figure 1). It seems seedlings obtained from heavy seeds have growth potential greater than seedlings obtained from smaller seeds were that probably this difference resulted from ATP higher respiration rate and production of seeds (McDaniel, 1966).

3.2. Dried weight of radical and plumule

Dried weight of radical and plumule wasn't affected by seed size (Table 1). There isn't statistically significant difference between coarse and fine seeds. Although dried weight of the radicle for both kinds of seed was same, approximately, but dried weight of plumule in coarse seeds was more than the fine seeds (Table 3).

It seems that lack of significant statistical difference is because of larger length of plumle and radicle in fine seeds than coarse seeds that increased dried weight in fine seeds and compensated transporting nutrients. Similar results were observed for the effect of different sesamume indicum organs on dried weight of radicle and plumule. Different concentrations of sesamume indicum extract had similar effects on dried weight of redicle and plumle and weren't observed significant differences between treatments.

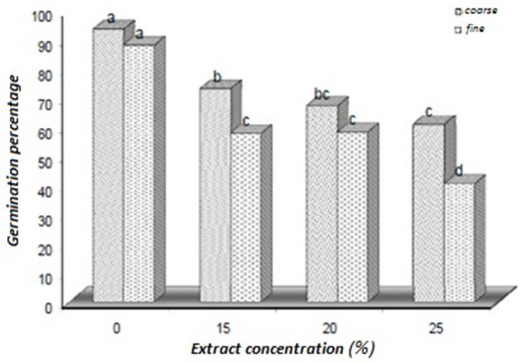

Fig. 1: Interaction effect of seed size and extract concentration on Germination percentage.
= Means with the same letters were not significantly different about each attribute

Only control treatment had the highest dried weight radicle and plumule, although dried weight of

radicle in the control treatment had significantly a difference in different concentrations of the extract. Dried weight trend of radicle and plumule was such a length trend of radicle and plumule. Coarse sesamume indicum seeds at all concentrations of aqueous extract had dried weight of radicle and plumule more than the fine seeds; however, reduction dried weight trend of radicle and plumule in the fine seeds was lower than coarse seeds. The results showed that aqueous extracts of different parts of sesamume indicum affected germination and characteristics of hordeum vulgare seedling. Allelopathy effects of different parts depend on the type of the organ and totally allelopathy effects of different organs was root> leaf> shoot. The grade of inhibition germination depends on the concentration of the aqueous extract and with increasing concentration of the extract this trend increased inhibition. In higher concentrations, accumulation and releasing of allelochemical substance was more significant, which reduced the germination percentage.

Length of radical and plumule, dried weight of the radicle was more significant in fine seeds, while plumule length was more significant in coarse seeds, and in all levels of the aqueous extract of coarse seed had more favorable characteristics, although the decreasing trend in coarse seeds was more significant than fine seeds. Accordingly, it can be concluded when residues of sesamume indicum especially root remains in the field; using of coarse seeds is more appropriate.

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