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Some changes in germination and morphological traits of black seed under different soil types and common bean densities

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Abstract

A split-factorial experiment on the basis of randomize complete block design with three replications was conducted in 2012, to assess the effects of different common bean (*Phaseolus vulgaris* L.) densities (0, 1, 2 and 4 per pot) and soil types (soil of wheat and barley fields) on some changes in germination and morphological traits of black seed (*Nigella sativa* L.). Results indicated that with increasing common bean density in soil of barely field, shoot length of black seed was significantly decreased. However, the lowest shoot length of black seed in soil of wheat field was obtained from the control density of common bean. In both of soil type day up to flowering of black seed was increased with increasing density of common bean. Maximum shoot dry weight and pod number of black seed in soil of barley and wheat fields was recorded under 2 and control density of common bean, respectively. Interaction of soil type and black seed density showed that the most shoot dry weight and day up to germination (germination rate) under barely soil was recorded in 2 densities of black seed. But, under wheat soil, those traits were obtained from 3 and 0 (control) densities. Pod number of black seed with increasing of this plant density was significantly declined.

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Introduction

Black seed or black cumin (*Nigella sativa* L.) is a spicy plant that is widely used in North Africa and the Middle East. Its seeds are used mostly for edible purposes such as for seasoning on many kinds of bread, yoghurt and cookies. Nigella seed is a good source of oil and protein, containing significant amounts of sterols (Atta, 2003). Common bean (*Phaseolus vulgaris* L.) is a warm- season crop that does not tolerate frost during growth season (Buruchara, 2007). It is a major source of protein in many developing countries throughout the world (FAO, 2005). When the weeds interfered with common bean during the entire growing-season, seed yield was reduced about 60% (Hemss, 1985).

Allelopathy is an ecological and chemical interaction characterized by stimulatory and inhibitory effects among different plant families. Worldwide, the inhibitory properties of the extracts and residues of many herbal species co-habiting with desired crops on the same field have been a major source of concern (Nazir*et al.,* 2007). Allelopathic materials prevented the growth and development of plants and decrease their yield in field (Putnam, 1986).When susceptible plants are exposed to allelochemicals, germination, growth and development may be affected (Xuan *et al.*, 2004). The most frequent reported gross morphological effects on plants are inhibited or retarded seed germination and effects on coleoptile elongation and shoot and root development (Kruse *et al.,* 2000).

According to pristine studies by Porheidar-Ghafarbi *et al.*, (2012 a,b) on allelopathic effects of wheat and Hassannejad *et al.*, (2013) on allelopathic effects of wheat and barley that indicated these crop have allelopathic and inhibitory effect on other plant. These allelochemical material after harvested wheat and barley may be released in soil, thus the main objectives of this study were to I) evaluating the allelopathic effects of barley and wheat soil on black seed morphological traits and contend of this plant with common bean, and II) demonstrate the allelopathic and contend effects of common bean on black seed.

Material and methods

Experimental site

In order to determine the effects of different common bean densities and soil types on some changes in germination and morphological traits of black seed a split factorial experiment was carried on the basis complete randomized block design with three replications in University of Tabriz.

Experimental procedure

Two type of soil from the fields that past year cultured with wheat and barley provided. Half of all pots were filled by soil of wheat and another half was filled by barley soil. Three densities of black seed (1, 2, and 4 per pot) and four densities of common bean (0, 1, 2, and 4 per pot) selected and plants were promoted in those pots.

Measuring of treatments

In all pots first day that germination, flowering and pod filling of black seed occurred was recorded. At the end of test all plants harvested and shoot length and dry weight and number of pod for each treatment at each replicate was determined.

Statistical analysis

All the data were analyzed on the basis of experimental design, using SAS 9.1 software. The means of each trait were compared according to Duncan multiple range test at P≤0.05 and standard error values. Excel software was used to draw figures.

Results

Interaction between type of soil and common bean densities indicated that shoot dry weight of black seed in wheat soil was more than that of barley soil. However, maximum number of pod per black seed was obtained from plants that cultured in barley soil. The most shoot dry weight and pod number of barley and wheat soil was showed in common bean density of 1 and 0 (control) per pot, respectively (Tab. 1).

Table 1. Mean shoot dry weight and pod number of black seed under different soil types.

Treatment		Shoot dry weight	Pod number
Soil of	Common bean		
Barley	0	0.17 b	2.22 a
	1	0.29 a	2.22 a
	2	0.14 b	1.55 b
	4	0.17 b	2.11 a
Wheat	0	0.31 a	2.77 a
	1	0.20 b	1.66 b
	2	0.26ab	1.77 b
	4	0.22 b	1.33 b

Different in letters in each column indicate significant difference at $P \leq 0.05$

Interaction of soil type and black seed density was showed that shoot dry weight of black seed under wheat soil was more than that of barley. Seed of black seed in soil of barely had high germination rate in comparison to wheat soil. Maximum shoot dry weight and day up to germination was recorded for plants cultured in barley soil. But, in wheat soil shoot dry weight was increased with increasing black seed densities, in contrast germination rate was declined in this condition (Tab. 2).

Table 2. Mean shoot dry weight and day up to germination of black seed under different soil types.

Treatment		Shoot dry weight	Day up to germination
Soil of	Blackseed		
Barley	1	0.18 b	9.91 b
	2	0.21 a	10.75 b
	4	0.18 b	12.5 a
Wheat	1	0.24 b	14.16 a
	2	0.2bc	14.05 a
	4	0.31 a	12.83 b

Different in letters in each column indicate significant difference at $P \leq 0.05$

Soil type × common bean density × black seed density interaction indicated that with increasing common bean density in soil of barely shoot length of black seed was significantly decreased. However, the lowest shoot length of black seed in soil of wheat was obtained from the control density of common bean. In both of soil type, day up to flowering of black seed was increased with increasing density of common bean (Tab. 3). Pod number of black seed was decreased with increasing density of this plant. Number of pod in both density of 2 and 4 plant per pod was similar (Fig. 1).

Table 3. Mean shoot length and day up to flowering of black seed under different density of common bean and soil types.

Treatment			Shoot length	Day up to flowering
Soil of	Common bean	Black seed		
Barley	0	1	56.66 a	47.66 bcd
		2	47.66 ab	48 bcd
		4	34.33 bcde	48 bcd
	1	1	36.66 bcde	48.66 bcd
		2	38.33 bcd	48.66 bcd
		4	41 bc	47 bcde
	2	1	22 ef	48 bcd
		2	36.6 bcde	48 bcd
		4	28 cde	48.33 bcd
	4	1	30 cde	48.66 bcd
		2	26 cde	48.33 bcd
		4	31 cde	49.33 bc
Wheat	0	1	10 f	49 bcd
		2	30 cde	46.33 cde
		3	29 cde	46.33 cde
	1	1	35 bcde	45 de
		2	30.33 cde	43 e
		3	46.66 ab	49 bcd
	2	1	31.66 cde	50 bc
		2	24 de	51 ab
		3	32 cde	48 bcd
	4	1	30 cde	49 bcd
		2	29.33 cde	48 bcd
		3	30.66 cde	54 a

Different in letters in each column indicate significant difference at $P \leq 0.05$

Discussion

Black seed in soil of barley had low shoot dry weight in comparison to wheat soil. In contrast day up to germination (Tab. 2) pod number (Tab. 1) in wheat soil was more than that of barley soil (Tab. 1). These results showed that soil of wheat have more allelopathic effect than barley soil. Black seed under wheat soil have more shoot dry weight and low pod number, indicated in this condition plant reserve photosynthetat in shoot and have low harvest index. Similarly Hassannejad *et al.*, (2013) indicated that barley had more allelopathic material than wheat. These results are in accordance with other studies which reported that allelopathicity may vary among plant parts (Economou *et al.*, 2002) and in accordance with the data of Turk and Tawaha (2002), who reported that barley leaves had the greatest inhibitory effect on lentil (*Lens culinaris*Medik.). Rice (1984) and Porheidar-Ghafarbi *et al.*, (2012a,b) reported that several crops such as wheat and barley have allelopathic effects on other crops. Liu and Lovett (1993) found lower germination of white mustard (*Sinapisalba* L.), when it was grown alongside germinating barley seeds.

Day to flowering in wheat soil was more than that barley soil (Tab. 3) and it caused to increasing shoot length and dry weight of black seed (Tab. 1). No significantly interaction among soil type × common bean density × black seed indicated that maximum pod number and grain yield of black seed was produced in the lowest density of this plant in both soil type and different common bean seed densities. Pod number of black seed was decreased with increasing common bean density (Tab. 1). This may be are resulted from contend and allelophatic material of common bean. Allelopathy is a two-way interaction; therefore, common bean allelopathic effects on black seed are through release of allelochemicals and thereby affecting the growth and establishment of this plant.

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