

Response of Growth, Yield and Oil content of Two Black Seed Species to Nitrogen Fertilizer in Sulaimani District

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Abstract:

The present study was conducted at the field of College of Agriculture Sciences in autumn 2014-2015. A factorial experiment was conducted using completely randomized block design (CRBD) with three replications. The study included two different Black seed species (*Nigella sativa* and *Nigella arvensis*) combined with three Nitrogen fertilizer applications (0kg/h, 30kg/h and 60kg/h). Means of studied characters were compared by using least significant differences LSD ($P \leq 0.05$) to studying the response of two Black seed species to the difference dose of nitrogen fertilizer application on most important vegetative characters, root depth, plant height, number of leaves, stem dry weight, leaves dry weight and total dry weight and yield characters, number of capsule plant⁻¹, number of seeds capsules⁻¹, 1000 seed weight, total seed weight, biological weight and harvest index. The results indicate that the *Nigella sativa* species showed significant values in most of the vegetative, yield and oil content. The application of nitrogen fertilizer in different levels showed significant values in most of vegetative, yield and oil content. The level 30kg/h nitrogen showed the superiorities as compared to all other levels. The interaction of *Nigella sativa* species with 30 kg/h predominated in most of vegetative, yield and oil content.

Keywords: Medicinal plant, Black seed species, Fertilizer, vegetative, yield and oil content.

استجابة نمو، حاصل ومحتوى الزيت في نوعين من البذور الحبة السوداء لسماذ النيتروجين في منطقة السليمانية

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الخلاصة:

نفذت هذه التجربة في كلية العلوم الزراعية، جامعة السليمانية، خلال موسم خريفي 2014-2015. صممت التجربة العملية وفق تصميم القطاعات العشوائية الكاملة (CRBD) بثلاثة مكررات. تضمنت الدراسة نوعين مختلفين من البذور الحبة السوداء (*Nigella sativa* و *Nigella arvensis*) مع تطبيق ثلاثة مستويات للتسميد (0 كغم/ هكتار، 30 كغم/ هكتار و 60 كغم/ هكتار). وتمت مقارنة المتوسطات باستخدام اقل فروق معنوي (LSD) تحت مستوى (5%) لدراسة استجابة نوعين من البذور الحبة السوداء لجرعات مختلفة من الأسمدة النيتروجينية على أهم الصفات النمو الخضري: عمق الجذور، ارتفاع النبات، عدد الأوراق، الوزن الجاف للساق، الوزن الجاف للأوراق والوزن الجاف الكلي و صفات مكونات الحاصل البذور: عدد كبسولة النبات⁻¹، عدد كبسولات البذور⁻¹، وزن الف بذرة، الوزن الكلي للبذور، الوزن البيولوجي ومؤشر الحصاد. تشير النتائج إلى أن *Nigella sativa* أظهرت تأثير معنوي على كل من الصفات النمو الخضري و صفات مكونات الحاصل و البذور. وأظهر تطبيق الأسمدة النيتروجينية بمستويات مختلفة قيم معنوية على كل من الصفات النمو الخضري و صفات مكونات الحاصل و البذور، في حين ان التسميد النيتروجيني 30 كغم / هكتار تفوقت على جميع المستويات الأخرى. التفاعل بين *Nigella sativa* مع التسميد النيتروجيني 30 كغم / هكتار كانت سائدة في معظم من الصفات النمو الخضري و صفات مكونات الحاصل و البذور.

Introduction:

The genus *Nigella* belongs to the family Ranunculaceae, many of the plants of this family have remarkable aromatic properties and medicinal value, and black seed (*Nigella sp.*), is an indispensable constituent of medicinal and food formulations for centuries (1). A little bottle with oil of black cumin seeds was found in the tomb of pharaoh Tutankhamun, which considered being used it in the next life (2). And also is an important of the Greek-Arab/Eastern system of medicines pharmacopoeia with interesting ethno botanical and ethno pharmacological data (3), but depending on the importance of this herb by our Prophet Muhammad, confirmed in his saying that “black cumin is a healing for all diseases except death”, this herb may be even more important to the Muslims than to the Christians and Jews (1). It is the medicinal plant used in the treatment of many diseases, including rheumatism, diabetes and inflammatory diseases as well as improved liver function and kidney in cases of aging, and increases the activity of immune cells (4, 5, and 6). Recently, industry facilities based on the evaluation of medicinal and aromatic plants in which included the black cumin. Industrialists emphasize that the demand to fixed oil of black cumin is much and so, the necessity of increasing local production for the supply of raw material (7).

Black seed is an annual herbaceous plant, it is widely cultivated throughout south Europe, Syria, Egypt, Saudi Arabia, Iran, Pakistan, India and Turkey (8 and 9), but it is not yet widely cultivated in our region, thus keeping the cultivation of this medicinal important crop, we realized the relevance of investigating suitable methods, (10 and 11), and use of nitrogen to control crop growth and productivity has been also one of the contributing key factors for the incremental improvement not only in agricultural but also in medicinal crop production (12). Nitrogen is used in crop cultivation to enable full exploitation of the genetic potential of the

crop. It is the nutrient that has the largest effect on plant physiology (13). And is probably the single most important limiting nutrient for crop growth (14, 15 and 16).

Therefore, the aim of this study was to finding out better utilization of nitrogen fertilization rate on growth, yield and oil content character of two Black seed species.

Materials and Method:

Field experiment was conducted at field of College of Agriculture Sciences in autumn 2014- 2015, it concluded 2 factors first: two species of Black seed (*Nigella sativa* and *Nigella arvensis*) and second: fertilization (no fertilizer, 30 kg/h and 60 kg/h), the field experiment were laid out according to factorial completely randomized design (CRBD), with three replications. Each block contained 6 uniform experimental plots of 2 m² (1*2) m and 0.5 m apart from each other. The seed of both Black seed species were directly sown in the plots in autumn 2014. Soil of the experiment was prepared for cultivation by ploughing the field using mold broad plow and harrow. Weeds were controlled manually whenever necessary, and all other cultural practices were conducted uniformly as needed for all treatment.

Experimental parameters:

Plant sampling was conducted from (March 28th to July 30th) during the growing season (2014 - 2015) in winter and spring. Growth and yield parameters were investigated as follows:

Vegetative growth characters:

Three plants were selected randomly in each plot for measurement of vegetative parameters.

- Root depth (cm): Measured by plugging 3 plants randomly post-flowering.

- Plant height (cm): Calculated by measuring the height of 3 plants randomly taken from each plot from the soil surface up to the highest point of the plant post-flowering.

- Dry matter plant⁻¹: Three random plants from each plot sampled post flowering and dried in oven at 65⁰ for 72 hours was calculated and the dry weight plant⁻¹.

Seed yield Characters:

- No. of seeds capsules⁻¹.

- No. of capsules plant⁻¹.

- 1000 seed weight (g).

- Total seed weight (kg ha⁻¹):

- Biological weight (kg ha⁻¹): The total upper part of plants after harvesting were weighted and converted to kg ha⁻¹.

- Harvest Index: Harvest Index = total seed weight ÷ total biological weight

Seed oil determination:

2gm of the harvested seed of each treatment was powdered by electric blender. Digital soxhlet instrument used for oil distillation, with n-hexane solvent (BDH, UK), (17), the oil samples put in refrigerator until use, the oil content calculated as follows:

$$\text{Oil\%} = [(W2-W1) \times 100] / S$$

W1 = weight of empty flask (g).

W2 = weight of flask and extracted oil (g)

S = weight of sample.

Oil samples kept in refrigerator until use for separation of fatty acids.

Total oil yield (kg ha⁻¹)

Total oil yield (kg ha⁻¹) = Oil% × total seed yield (kg ha⁻¹), (18).

3.3 Statistical Analysis:

Analysis of variance as a general test was done according to analysis of 2 factor analysis in CRBD, and the means were tested according to least significant difference (L.S.D) using significant level of 0.05 confirmed by (19).

Results and Discussion

Effect of black seed species treatments on the vegetative growth character.

The data presented in table (1) showed no significant effects of the treatments of black seed species on vegetative growth characters root depth (cm) and plant height (cm), while *Nigella sativa* showed significant response for each characters number of leaves plant⁻¹, stem dry weight (g), leaves dry weight (g) and total dry weight (g) with the value of 12.481, 0.362g, 0.294g and 0.656g, respectively.

Table 1. Means of vegetative growth character affected by black seed species treatments:

<i>Plant Species</i>	<i>Root Depth cm</i>	<i>Plant Height cm</i>	<i>No. of Leaves/plant</i>	<i>Stem Dry Weight g</i>	<i>Leaves Dry Weight g</i>	<i>Total Dry Weight g</i>
<i>N. sativa</i>	9.353	40.717	12.481	0.362	0.294	0.656
<i>N. arvensis</i>	8.934	36.373	11.741	0.251	0.210	0.461
<i>LSD</i> ($P \leq 0.05$)	n.s	n.s	0.555	0.076	0.057	0.052

Effect of nitrogen fertilization treatments on the vegetative growth character.

Table (2) showed some significant and non significant effect of nitrogen fertilization on the vegetative growth characters. Although, there were no significant effect recorded due to of nitrogen fertilization on the most of vegetative growth characters with the exception of plant height (cm), number of leaves plant⁻¹ and total dry weight (g),

concerning the 30 Kg/h treatment nitrogen application gave maximum value with 9.947cm, 13.907 and 0.647g and the lowest vale was 8.288cm, 11.038 and 0.455 due to 0 Kg/h fertilizer treatment, respectively. However there was some significant effect on vegetative growth characters but most of character were increased due to application of nitrogen, these results were in agreement with [9 and12].

Table 2. Means of the vegetative growth character affected by nitrogen application.

<i>Nitrogen application Kg/h</i>	<i>Root Depth cm</i>	<i>Plant Height cm</i>	<i>No. of Leave</i>	<i>Stem Dry Weight g</i>	<i>Leaves Dry Weight g</i>	<i>Total Dry Weight g</i>
0 N	8.288	32.362	11.038	0.248	0.207	0.455
30 N	9.947	43.228	13.907	0.352	0.295	0.647
60 N	9.197	40.043	11.388	0.320	0.255	0.572
<i>LSD</i> ($P \leq 0.05$)	0.877	n.s	0.680	n.s	n.s	0.064

Effect of combination between black seed species and nitrogen application on the vegetative growth characters

Results in Table (3) showed the presence of non significant effects between the treatment combination of black seed species and nitrogen application on most of the vegetative growth character with the exception of total dry weight (g).

Combination treatment between *N. sativa* species and 30 Kg/h showed significant effect on vegetative growth characters total dry weight with the value of 0.737g, while the lowest value were recorded due to combination treatment between *N. arvensis* and 0 Kg/h with the value of 0.297g.

Table 3. Means of the vegetative growth character affected by interaction between black seed species and nitrogen application.

<i>Plant Species</i>	<i>Nitrogen application Kg/h</i>	<i>Root Depth cm</i>	<i>Plant Height cm</i>	<i>No. of Leave</i>	<i>Stem Dry Weight g</i>	<i>Leaves Dry Weight g</i>	<i>Total Dry Weight g</i>
<i>N. sativa</i>	0 N	8.277	37.357	11.187	0.350	0.363	0.713
	30 N	10.303	44.970	14.590	0.380	0.357	0.737
	60 N	9.747	39.823	11.667	0.357	0.263	0.62
<i>N. arvensis</i>	0 N	8.300	27.367	10.890	0.147	0.150	0.297
	30 N	9.857	41.487	13.223	0.323	0.233	0.556
	60 N	8.647	40.267	11.110	0.283	0.247	0.53
<i>LSD</i> ($P \leq 0.05$)		n.s	n.s	n.s	n.s	n.s	0.083

Effect of black seed species treatments on the some seed yield and its comonents character.

The data presented in table (4) showed the average of the yield components and oil% and oil yield on black seed plants for different level of nitrogen, there were additively in response, being upper limits of characters to the application level of nitrogen in general as compared to the non application of nitrogen.

While the maximum response were caused by the application of 30 kg/h compared to the application 60 kg/h, in most important characters such as: number of capsules plant⁻¹, No. of seeds capsules⁻¹, 1000 seed weight, total seed weight Kg/ha, Biological weight Kg/ha, Oil % and weight of oil Kg/ha with the value of 5.600, 77.678, 2.121, 463.909 Kg/ha, 4068.371 Kg/ha, 22.412 and 104.086 Kg/ha, respectively.

4. Means of the some seed yield and oil content affected by black seed species.

<i>Plant Species</i>	<i>Plant Height</i>	<i>No. of capsules plant⁻¹</i>	<i>No. of seeds capsules⁻¹</i>	<i>1000 seed weight</i>	<i>Total seed weight Kg/ha</i>	<i>Biological weight Kg/ha</i>	<i>Harvest index</i>	<i>Oil %</i>	<i>Weight of oil Kg/ha</i>
<i>N. sativa</i>	51.770	5.600	77.678	2.121	463.909	4068.371	0.143	22.412	104.086
<i>N. arvensis</i>	49.747	4.642	63.071	1.754	414.236	3726.866	0.111	21.736	90.268
<i>LSD</i> ($P \leq 0.05$)	n.s	0.554	3.525	0.257	22.456	143.188	n.s	0.474	5.690

Effect of nitrogen fertilization treatments on the some seed yield character.

The data presented in table (5) showed the average of the yield components and oil% and oil yield on black seed plants for different level of nitrogen, there were additively in response, being upper limits of characters to the application level of nitrogen in general as compared to the non application of nitrogen. While the maximum response were caused by the application of 30 kg/h compared to the application 60 kg/h, in most important

characters such as plant height (cm), No. of capsules plant⁻¹, No. of seeds capsules⁻¹, 1000 seed weight, Total seed weight Kg/h, Biological weight Kg/h, Oil % and Weight of oil Kg/h, with the value of 53.088 cm, 5.787, 75.037, 2.145, 471.295 kg/ha, 4273.570 kg/h, 22.847% and 107.693 kg/ha respectively, which were significant. But the lowest values were 48.298, 4.553, 64.242, 1.675 g, 411.425 kg/h, 3626.708 kg/h, 21.202 and 87.402 kg/ha respectively, which recorded by 0 n application. The similar results were obtained by (20).

Table 5. Means of the some seed yield and oil content affected by nitrogen application.

<i>Nitrogen application Kg/h</i>	<i>Plant Height</i>	<i>No. of capsules plant⁻¹</i>	<i>No. of seeds capsules⁻¹</i>	<i>1000 seed Weight g</i>	<i>Total seed weight Kg/ha</i>	<i>Biological weight Kg/ha</i>	<i>Harvest index</i>	<i>Oil %</i>	<i>Weight of oil Kg/ha</i>
0 N	48.298	4.553	64.242	1.675	411.425	3626.708	0.156	21.202	87.402
30 N	53.088	5.787	75.037	2.145	471.295	4273.570	0.111	22.847	107.693
60 N	50.888	5.028	71.845	1.993	434.407	3792.577	0.114	22.173	96.437
<i>LSD</i> ($P \leq 0.05$)	3.397	0.679	4.316	0.315	27.503	175.369	n.s	0.581	6.969

Effect of combination between black seed species and nitrogen application on the some seed yield characters

Results in table (6) indicate no significant response of the interaction between black seed species and nitrogen application on all of the seed yield and oil content, with the exception

of Biological weight Kg/ha which was responded significantly to combination treatment of *N. sativa* and 30 Kg/ha with the value of 4596.477 kg/ha, while the lowest value was obtained by combination treatment *N. arvensis* and 0 Kg/h with the value of 3595.277 kg/ha. These results were relatively agreed with [15 and 16].

Table 6. Means of the some seed yield and oil content affected by interaction between black seed species and nitrogen application.

Plant Species	Nitrogen application Kg/h	Plant Height	No. of capsules plant ⁻¹	No. of seeds capsules ⁻¹	1000 seed weight	Total seed weight Kg/ha	Biological weight Kg/ha	Harvest index	Oil%	Weight of oil Kg/ha
<i>N. sativa</i>	0 N	50.023	2.887	72.667	1.733	463.516	3658.140	0.204	21.923	95.716
	30 N	53.510	2.953	81.667	2.333	494.000	4596.477	0.108	22.953	113.388
	60 N	51.777	2.107	48.700	2.296	461.210	3950.497	0.117	22.360	103.155
<i>N. arvensis</i>	0 N	46.573	1.440	55.817	1.617	363.333	3595.277	0.108	20.480	79.089
	30 N	52.667	2.330	68.407	1.957	448.591	3950.663	0.114	22.740	101.998
	60 N	50.000	1.553	64.990	1.689	407.783	3634.657	0.112	21.987	89.718
LSD ($P \leq 0.05$)		n.s	n.s	n.s	n.s	n.s	248.009	n.s	n.s	n.s

Conclusions:

Based on the obtained results we can concluded that *N. sativa* species and 30 kg/h nitrogen application surpassed in most of growth and yield character, and also most of the character of the study were significantly affected by the combination between *N. sativa* and 30 kg/h nitrogen application.

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