**DETERMINATION OF YIELD AND YIELD COMPONENTS IN DIFFERENT
SOWING TIMES OF BLACK SEED (*Nigella sativa* L.) IN HATAY
ECOLOGICAL CONDITIONS**

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This study was carried out in order to determine the yield and yield components of *Nigella sativa* L. grown in different cultivation periods in Hatay ecological conditions at Mustafa Kemal University, Faculty of Agriculture, Medical Plants trial area in 2018-2019. The experiment was laid out at spilt plot in randomized blocks with three replications. Trial; The parcels split in random blocks were carried out with 3 repetitions according to the trial pattern. In the trial, sowing was carried out on 15 November, 1 January, 15 February, 1 March, 15 March, 1 April, 15 April, 1 May and 15 May. In the study, some properties related to phenological, herbal properties, yield and yield components were examined during field trial and after harvest. As a result of the measurements taken, the plant height is 19.03-54.00 cm, the number of branches is 8.80-3.78 number/plant the number of plant capsules 3.73-20.67 number/plant, thousand grain weight is 3.04-2.10 g, seed yield is 3.65-51.81 kg.da⁻¹, constant oil rate % was found between 22.47-32.07 values. Due to the increase of summer temperatures early in Hatay ecological conditions, the yield and yield factors of summer planting decreased in this period compared to winter planting. For this reason, November 1-15 is recommended as the most suitable sowing time for black seed in Hatay ecological conditions.

Keywords: *Nigella sativa* L., planting time, Hatay.

INTRODUCTION

Black seed (*Nigella sativa* L.), whose homeland is Southern Europe and West Asia, is an annual plant from the Ranunculaceae family. There are 20 species of *Nigella* genus in the world. Black seed is a pile rooted herbaceous plant that is cultivated in many countries, especially in the Eastern Mediterranean. There are 12 species of *Nigella* in Turkey. Among these species, *Nigella sativa* L., *Nigella damascena*, *Nigella arvensis* L. seeds are used in the treatment of snake and scorpion stings, old tumors, abscess treatment and skin rash, inflammation of the head area and the treatment of colds. It is also a milk enhancer, appetizer, spice used on bread and buns (Baytop 1984; Gün, 2012). Since the seeds and oils of black seed have a rich potential for synthetic and new drugs, it is seen that the importance given to black seed cultivation is increasing day by day (Karaman, 1999).

The yields in the provinces where the black seed culture in Turkey; Kahramanmaraş 200 kg.da⁻¹, Denizli 174 kg.da⁻¹, Kilis 161 kg da⁻¹, Afyonkarahisar 159 kg da⁻¹, Antalya 151 kg da⁻¹, Kars 141 kg da⁻¹, Ankara 127 kg da⁻¹, Kayseri 127 kg da⁻¹, Konya 117 kg da⁻¹, Nevşehir 111 kg da⁻¹, Samsun 111 kg da⁻¹, Isparta 108 kg da⁻¹, Kütahya 102 kg da⁻¹, Sivas 101 kg da⁻¹, Eskişehir 100 kg da⁻¹, Kırşehir 100 kg da⁻¹, Çorum kg da⁻¹, Malatya 94 kg da⁻¹, Uşak 89 kg da⁻¹, Balıkesir 86 kg da⁻¹, Burdur 82 kg da⁻¹, Yozgat 70 kg da⁻¹, Bursa 76 kg da⁻¹, ve Karabük 20 kg da⁻¹ (Anonymous, 2019).

Climatic conditions, environment and growing factors, planting time and similar factors affect the cultivation of black seed. For this reason, it is important to determine the breeding characteristics specific to different regions related to black seed. This study was carried out with the aim of determining the yield and yield components of black seed (*Nigella sativa* L.) at different planting times in Hatay ecological conditions.

<https://doi.org/10.24264/icams-2020.II.7>

Determination of Yield and Yield Components in Different Sowing Times of Black Seed (*Nigella sativa* L.) in Hatay Ecological Conditions

MATERIALS AND METHODS

In the experiment carried out, seed of the black cumin (*Nigella sativa* L.) plant obtained from Eskişehir Agricultural Research Institute in Hatay ecological conditions was used as a material. In the district of Antakya in the province of Hatay where the trial was conducted, the Mediterranean climate prevails with hot and dry summers and warm and rainy winters, and it snows only a few days of the year. The temperature ranges between -6.3 and +43°C and the climatic characteristics differ significantly depending on the altitude. Annual rainfall is 877-1174 mm. In Hatay, the wind is light and medium strong from north and northeast directions in winter months, and moderately strong and strongly from south and southwest directions in summer. Climate data for the months of the study are given in table 1.

Table 1. Climate data for the months of the study

	Min. (°C)	Max. (°C)	Average (°C)	Relative humidity (%)	Total precipitation (mm=kg/m ²)
November 2018	4.6	26.4	14.3	76.1	200.7
December 2018	0.6	19.4	10.3	85.9	361.9
January 2019	-0.7	15.8	8.1	76.5	312.1
February 2019	3.8	17.5	10.0	79.7	235.7
March 2019	2.0	24.3	12.6	74.7	222.4
April 2019	5.6	29.5	15.2	73.3	93.7
May 2019	10.1	37.9	22.3	59.2	0.3
June 2019	15.7	38.0	25.6	69.3	5.0
July 2019	20.7	36.4	27.3	66.7	15.6
August 2019	22.5	35.7	28.0	70.6	4.4

In the experiment, black seed seeds were sown in the trial area with 3 replications at 9 different sowing times (15 November, 15 January, 15 February, 1 March, 15 March, 1 April, 15 April, 1 May and 15 May). It was not planted in December due to adverse weather conditions. In the experiment, the plots were formed in 5 rows of 4 m in length and the planting density was applied as 30x30 cm. In the experiment, although it was planted at 9 sowing times, yields were obtained from the plants only in 5 periods. Since there was no germination in the plants planted in the periods of April 1, April 15, May 1 and May 15, data could not be determined from the sowing on these dates. In the experiment, weed control and irrigation were performed as required during the growing period of the plants, and the plants were harvested between July and August. In the experiment, 6 kg da⁻¹ ammonium sulphate ($(NH_4)_2SO_4$ fertilizer was applied during the stalking period of the plants.

In this study, germination period, vegetation period, beginning of flowering, blooming times, plant height, number of branches, number of capsules, thousand kernel weight, seed yield per plant, seed yield, fixed oil ratio, oil yield, fixed and essential oil components were examined. Some of the properties examined were subjected to Duncan test for statistical comparison.

RESULTS AND DISCUSSION

Germination Periods

In the study carried out in different plantings in Hatay climatic conditions, the germination periods were reached as 28 days in 15 November sowing, 20 days in 15 January sowing, 23 days in 15 February sowing, 20 days in 1 March sowing, and 15 March 24 days. It was also understood that different sowing periods do not matter on the germination time of the black cumin plant (Table 2).

Vegetation Periods

The vegetation periods obtained in different plantings under the ecological conditions of Hatay are given in Table 2. According to the results, the longest vegetation period was reached in 15 November sowing and the shortest vegetation period was reached in 15 March sowing. It is thought that the heavy rainfall, which is effective in the long vegetation period in October 15, is due to the fact that the weather is not hot enough and the day time is short. In other sowing dates, it was observed that the weather not too cold and the length of the day were effective in shortening the vegetation period.

Beginning of Flowering

Beginning of flowering times obtained in the experiment conducted in different sowing dates in the ecological conditions of Hatay are given in Table 2. Considering the results obtained, the longest flowering period was obtained from 15 November (189 days) and the shortest flowering period from 15 March (92 days). It was concluded that different sowing days were obtained in different sowing dates and the weather temperature affects the beginning of flowering.

Flowering Days

In this study carried out in different sowing dates under the ecological conditions of Hatay, the flowering period was obtained as 14 days in 15 November sowing, 7 days in 15 January sowing, 6 days in 15 February sowing, 8 days in 1 March sowing and 7 days in 15 March sowing (Table 2). It was concluded that the longest flowering day was 14 days in 15 November sowing and 6 days in 15 February sowing as the shortest time in sowing on different dates. It has been understood that low or high air temperature during flowering is an important factor in different flowering times.

Table 2. Phenological observations of black cumin grown at different sowing times

Sowing dates	Harvest dates	Germination periods (days)	Beginning of flowering (days)	Flowering (days)	Vegetation periods (days)
15 th Nov. 2018	10 th June 2019	28	189	14	207
15 th Jan. 2019	17 th June 2019	20	143	7	147
15 th Feb. 2019	19 th June 2019	23	107	6	126
01 st Mar. 2019	28 th June 2019	20	95	8	120
15 th Mar. 2019	08 th July 2019	24	92	7	109

Determination of Yield and Yield Components in Different Sowing Times of
Black Seed (*Nigella sativa* L.) in Hatay Ecological Conditions

Plant Height

The plant height of black cumin sown in different periods in Hatay ecological conditions varies between 19.03-54 cm, while the highest plant height is 54 cm in 15 November sowing and the lowest plant height is in sowing with 19.03 and 15 February. (Table 3).

Number of Branches

It is seen that the number of branches of black cumin planted in different sowing times in the ecological conditions of Hatay is in the range of 3.78-8.80 pieces/plant. (Table 3). It is seen that the highest value is in 15 November sowing with 8.80 pieces/plant and the lowest value is in 15 February sowing with 3.78 pieces/plant.

Number of Capsules

The number of capsules in the black cumin plant grown in different sowing periods in the ecological conditions of Hatay was between 3.73-20.67 units/plant, and the highest value was obtained from 15 November sowing with 20.67 units/plant and the lowest value 3.73 from 15 February sowing. (Table 3).

Thousand Kernel Weight

One thousand kernel weight of black cumin grown in different sowing periods in Hatay ecological conditions was between 2.10-3.04 g and the highest value was 3.04 g in 15 March sowing and the lowest value was obtained in 2.10 and 15 February sowing. (Table 3).

Seed Yield per Plant

It was determined that the plant yield of black cumin grown in different sowing periods in Hatay ecological conditions varies between 0.21-3.10 g, the highest seed yield per plant was 3.10 g in 15 November sowing and the lowest seed yield per plant was in planting on February 15 with 0.21 g (Table 3).

Table 3. Morphological observations and Duncan groups of black cumin grown in different sowing periods

Sowing dates	Plant height (cm)	Number of branches (pieces/plant)	Number of capsules (pieces/plant)	Thousand kernel weight (g)	Seed yield per plant (g)	Seed yield (kg da ⁻¹)
15 th Nov. 2018	54.00 a	8.80 a	20.67 a	2.20 b	3.10 a	51.81 a
15 th Jan. 2019	21.43 c	4.12 c	5.88 d	2.37 b	0.55 d	9.27 d
15 th Feb. 2019	19.03 d	3.78 c	3.73 e	2.10 b	0.21 e	3.65 e
01 st Mar. 2019	28.87 b	5.33 b	8.52 b	2.73 ab	2.43 b	40.27 b
15 th Mar. 2019	21.33 c	4.18 c	6.90 c	3.04 a	1.25 c	21.65 c

Seed Yield

The seed yield of black seed grown in different sowing periods in Hatay ecological conditions was between 3.65-51.81 kg da⁻¹, and the highest seed yield was obtained in

51.81 kg da⁻¹ in 15 November sowing and the lowest yield was obtained in 3.65 kg da⁻¹ in 15 February sowing. (Table 3).

Fixed Oil Ratio

In the ecological conditions of Hatay, the oil content in black cumin was observed between 22.47-32.07% in different planting periods. The highest oil content was obtained with 32.07% in 15 March sowing and the lowest with 22.47% in 15 January sowing. (Table 4).

Oil Yield

The fixed oil yield of the black cumin grown in different sowing periods in Hatay varied between 2.03-23.05 l da⁻¹ and the highest yield was obtained from 23.05 l da⁻¹ and 15 November sowing. (Table 4).

Table 4. Fixed oil ratio, oil yield and Duncan groups of black cumin grown in different sowing periods

Sowing dates	Fixed oil ratio (%)	Oil yield (l da ⁻¹)
15 th November 2018	24.73	23.05 a
15 th January 2019	22.47	3.74 c
15 th February 2019	30.87	2.03 c
01 st March 2019	26.80	19.41 ab
15 th March 2019	32.07	12.60 b

Fixed Oil Composition

When the main components of fixed oil are examined; It was determined that linoleic acid methyl ester, oleic acid methyl ester, palmitic acid, stearic acid and linoleic acid ethyl ester. It was observed that the fixed oil components of black seed did not show a significant change according to different cultivation periods (Table 5).

Table 5. Fixed oil components of black seed grown in different sowing periods

RT	Components	Cas #	15 th Nov	15 th Jan	15 th Feb	01 st Mar	15 th Mar
5.23	Stearic acid	112-61-8	0.03	1.43	1.35	1.91	1.97
12.94	Palmitic acid	112-39-0	11.56	12.23	10.55	15.27	16.74
18.63	Oleic acid, methyl ester	2345-29-1	21.62	18.75	19.69-	20.73	21.62
20.14	Linoleic acid, methyl ester	56599-58-7	52.24	57.42	58.78	52.61	49.32
24.25	Linoleic acid ethyl ester	544-35-4	2.13	2.68	2.16	2.04	2.03

Essential Oil Composition

When the main components of essential oil are examined; It was determined that linoleic acid methyl ester, o-Cymene, ethyl oleate, α -Thujene and palmitic acid ethyl ester. It has been observed that the essential oil components of black seed oil show significant changes according to different planting periods. (Table 6).

Determination of Yield and Yield Components in Different Sowing Times of
Black Seed (*Nigella sativa* L.) in Hatay Ecological Conditions

Table 6. Essential oil components of black seed grown in different sowing periods

RT	Components	Cas #	15 th Nov	15 th Jan	15 th Feb	01 st Mar	15 th Mar
6.51	α -Thujene	2867-05-2	8.34	9.60	6.74	6.06	3.14
11.11	γ -Terpinene	99-85-4	2.03	3.19	2.14	1.57	0.26
12.65	o-Cymene	527-84-4	20.29	28.19	21.55	16.41	11.32
39.96	Thymoquinone	490-91-5	2.91	2.51	1.88	1.21	0.26
42.37	Palmitic acid ethyl ester	628-97-7	6.65	3.78	4.44	7.99	10.25
46.97	Stearic acid ethyl ester	111-61-5	0.98	0.48	0.56	1.15	1.93
47.75	Ethyl oleate	111-62-6	14.94	9.33	10.59	16.73	23.39
49.19	Linoleic acid ethyl ester	544-35-4	28.36	26.03	39.82	36.26	40.03

As a result, it has been determined that different sowing periods are quite effective on the yield and yield elements of black cumin grown in Hatay ecological conditions. Low or high air temperature, long or short day duration caused different results on yield and efficiency factors. If the black seed cultivation is to be done for oil and seeds in Hatay, it has been determined that the most suitable sowing date is 15 November. In the sowings made on this date, it is better for the plants to branch and form capsules as they complete their development. As a result, it is thought to result in a better result than other sowing dates in terms of seed and oil yields.

Acknowledgements

This study was funded by the Scientific Research Projects Commission of Hatay Mustafa Kemal University. (HMKU-BAP-Project No:19YL013).

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