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EFFECT OF SOWING DATES AND PLANT SPACING ON GROWTH AND YIELD PARAMETERS OF BLACK CUMIN (*NIGELLA SATIVA* L.) UNDER NORTHERN DRY ZONE OF KARNATAKA INDIA

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ABSTRACT

A field experiment was carried out in college of horticulture, Bagalkot during rabi season of 2023-24. The experiment was laid out in split plot design with 12 treatments and three replications. The treatment involves four dates of sowing (2nd fortnight of October, 1st fortnight of November, 2nd fortnight of November and 1st fortnight of December) and three levels of spacing ((15 cm × 10 cm, 30 cm ×10 cm and 45 cm × 10 cm) with the variety Ajmer nigella^{-1}. Among different sowing dates the maximum plant height (41.02 cm at harvest), number of secondary branches plant^{-1} (14.22), number of capsules plant^{-1} (13.11), seed yield (227.39 plot^{-1} g and 7.01 q hectare^{-1}), was recorded with 2nd fortnight of November. Among different levels of spacing maximum plant height (39.24 cm), seed yield plot^{-1} (195.95 g) and seed yield hectare^{-1} (6.04 q) was recorded with narrow spacing S_1 (15 cm × 10 cm). Among different treatment combinations M_3S_3 (2nd fortnight of November and 45 cm × 10 cm) recorded maximum number secondary branches plant^{-1}(14.73) and highest seed yield plant^{-1} (2.88 g). The maximum seed yield plot^{-1} (260.53 g) and seed yield hectare^{-1} (8.04 q) was recorded with the treatment M_3S_1 (2nd fortnight of November and 15 cm × 10 cm).
Keywords: *Nigella sativa* L., Sowing dates, Plant spacing, Ajmer nigella^{-1}, Days after sowing, yield parameters.

Introduction

Nigella sativa L. provincially known as kalonji, is an annual diploid (2n=12) minor seed spice crop of South and South West Asian origin. The genus Nigella of family Ranunculaceae includes about 20 different species distributed from Mediterranean to West Asia viz., *Nigella sativa* L., *Nigella damascena* L. and *Nigella arvensis* L. Among these, *Nigella sativa* L. is the only species being widespread and found cultivated in farmers field as a seed spice. Seed resembling the shape of onion seed, is the spice of commerce and therapeutically potent economic part being employed in many middle eastern and far eastern countries as a natural source of drug for past 2000 years (Gamze *et al*., 2006).

It has been traditionally used for a variety of conditions and treatments related to respiratory health, antidiabetic, anticancer, immunomodulator, analgesic, antimicrobial, anti-inflammatory, spasmolytic, bronchodilator, hepato-protective, renal protective, gastro-protective, antioxidant properties, *etc*. Due to its miraculous power of healing, *N. sativa* has got the place among the top ranked evidence based herbal medicines. This is also revealed that most of the therapeutic properties of this plant are due to the presence of thymoquinone which is major bioactive component of the essential oil (Ahmed *et al*., 2013).

The plant being native to Southern Europe, North Africa and South West Asia is found cultivated in India, Pakistan, Bangladesh, Syria, Israel, Lebanon, Turkey and Saudi Arabia (Ahmed *et al*., 2013). In India it is distributed all over, majorly in Punjab, Jammu & Kashmir, Himachal Pradesh, Madhya Pradesh, Bihar, West Bengal, Assam, Rajasthan and Maharashtra (Diwakar *et al*., 2018)

Knowing the importance and high value of black cumin, its cultivation is gradually gaining attention in southern parts of India but presently, the lack of research-based recommendations for different dates of sowing and optimum plant spacing, potentially resulting in poor yields. Therefore, it is crucial to determine the appropriate date of sowing and crop geometry for black cumin cultivation under Northern dry zone of Karnataka. So, keeping all the point in mind, an experiment was carried out on the effect of sowing dates and different spacing for maximum light interception, absorption and utilization by minimizing inter and intra plant competitions and harvest maximum radiant energy as much as possible for developing early crop cover on entire land surface which eventually leading to higher crop productivity per unit area.

Material and Methods

Experimental Site

The experiment was carried out at the Department of Plantation, Spice, Medicinal and Aromatic Crops, College of Horticulture, University of Horticultural Sciences, Udyanagiri, Bagalkot during *rabi* season of 2023-24. The experimental site is located at 16°18' North latitude, 75°69' East longitude, and at an elevation of 542.0 meters above mean sea level (MSL). This region is classified as zone III, representing the Northern dry zone of Karnataka. The soil was light black loamy in texture, with maximum nitrogen available, low phosphorus and high potassium.

Planting Materials, Treatments and Experimental Design

The present experiment was laid out in split plot design with 12 treatments and three replications. The treatment involves four dates of sowing (2nd fortnight of October, 1st fortnight of November, 2nd fortnight of November and 1st fortnight of December) and three levels of spacing (15 cm × 10 cm, 30 cm ×10 cm and 45 cm × 10 cm). In this experiment black cumin variety AN- 1 was used.

Statistical analysis and interpretation of data

The data recorded on various observations on growth, yield and soil parameters were subjected to Fisher's method of "Analysis of variance" (ANOVA). The level of significance as F-test was tested at five per cent and data was interpreted using critical difference values at a profitability level of 0.05 per cent.

Result and Discussion

Sowing dates

Different sowing dates showed the significant effect on growth and yield parameters of black cumin. The maximum plant height (5 41.02 cm) was recorded with the treatment M_3 (2nd fortnight of November) (Table 1). The increase in plant height could potentially be attributed to the average temperature requirement of black cumin which closely coincided with the prevailing temperature in November. The notable reduction of plant height and spread during later sowings can be related to lower minimum temperatures, which inhibited early growth and the accumulation of assimilates. Hafez (1998), Meena *et al*. (2012), El-Mekawy (2012), Jafari (2013) and Giridhar *et al*. (2017) reported similar results in black cumin.

The treatment M_3 (Second fortnight of November) recorded maximum plant spread (446.60 cm^2) (Table 1). This might be due to optimum temperatures during early growth phases. As a result, there is an increase in photosynthetic reserves for plant growth, with an increase in sunny hours and light intensities. These results were supported by the findings of Meena and Malhotra (2006) in coriander.

Maximum number of primary branches plant^{-1} (8.78) and secondary branches plant^{-1} (14.22) was recorded with the treatment M_3 (2nd fortnight of November) (Table 1). The decrease in the number of branches plant^{-1} with delayed sowing beyond the second fortnight of November may be attributed to alterations in the temperature profile and photosynthetically active radiation (PAR) within the crop canopy. This reduced photosynthetic capacity impacts the overall growth and branching of the plant and also results in early flowering and more incidence of pest and disease attack to the crop. Supporting this, similar reductions in branch number with delayed sowing have been documented by Meena *et al*. (2011), Jafari (2013) and Vaseghi *et al*. (2013).

Table 1 : Growth parameters of black cumin as influenced by different dates of sowing and spacing

Treatments	Plant height (cm)	Plant spread (cm^2)	Number of primary branches plant $^{-1}$	Number of secondary branches plant $^{-1}$
Main plot (M: Dates of sowing)				
M_1 - 2nd fortnight of October	37.48	352.51	8.16	11.18
M_2 - 1st fortnight of November	38.76	427.24	8.58	11.98
M_3 - 2nd fortnight of November	41.02	446.60	8.78	14.22
M_4 - 1st fortnight of December	29.78	228.31	6.07	5.44
S. Em ±	**1.30**	**20.35**	**0.38**	0.33
CD at 5%	**4.51**	**70.43**	**1.33**	1.14
Sub plot (S: Levels of spacing)				
S_1 - 15 cm × 10 cm	39.24	257.75	6.67	7.65
S_2 - 30 cm × 10 cm	35.78	411.73	8.42	11.60
S_3 - 45 cm × 10 cm	35.26	421.52	8.60	12.87
S. Em ±	**0.76**	**15.94**	**0.23**	0.31
CD at 5%	**2.29**	**47.81**	**0.71**	0.94
Interaction (M × S)				
M_1S_1	40.60	259.60	6.87	8.47
M_1S_2	35.87	397.87	8.73	11.60
M_1S_3	35.97	400.07	8.87	13.47
M_2S_1	42.37	318.07	7.33	9.13
M_2S_2	37.10	475.73	9.13	13.47
M_2S_3	36.80	487.93	9.27	13.33
M_3S_1	43.00	335.13	7.40	10.00
M_3S_2	40.80	491.87	9.33	14.73
M_3S_3	39.27	512.80	9.60	17.93
M_4S_1	31.00	118.20	5.07	3.00
M_4S_2	29.33	281.47	6.47	6.60
M_4S_3	29.00	285.27	6.67	6.73
S. Em ±	**1.53**	**31.90**	**0.47**	**0.63**
CD at 5%	**NS**	**NS**	**NS**	**1.88**

Table 2 : Number of flowers and number of capsules plant $^{-1}$ of black cumin as influenced by different dates of sowing and spacing

Treatments	Number of flowers plant $^{-1}$	Number of capsules plant $^{-1}$
Main plot (M: Dates of sowing)		
M_1 - 2nd fortnight of October	13.80	11.24
M_2 - 1st fortnight of November	14.71	12.31
M_3 - 2nd fortnight of November	15.58	13.11
M_4 - 1st fortnight of December	9.67	7.20
S. Em ±	**0.53**	**0.49**
CD at 5%	**1.82**	**1.69**
Sub plot (S: Levels of spacing)		
S_1 - 15 cm × 10 cm	8.37	6.30
S_2 - 30 cm × 10 cm	15.70	13.03
S_3 - 45 cm × 10 cm	16.25	13.57
S. Em ±	**0.30**	**0.31**
CD at 5%	**0.91**	**0.94**

Interaction (M × S)		
M_1S_1	8.67	6.40
M_1S_2	16.07	13.47
M_1S_3	16.67	13.87
M_2S_1	8.73	7.07
M_2S_2	17.47	14.47
M_2S_3	17.93	15.40
M_3S_1	9.80	7.27
M_3S_2	18.07	15.73
M_3S_3	18.87	16.33
M_4S_1	6.27	4.47
M_4S_2	11.20	8.47
M_4S_3	11.53	8.67
S. Em ±	**0.61**	**0.63**
CD at 5%	**1.83**	**1.89**

Table 3 : Yield parameters of black cumin as influenced by different dates of sowing and spacing

Treatments	Number of flowers plant $^{-1}$	Number of capsules plant $^{-1}$	Yield plot^{-1}(g)	Seed yield hectare^{-1}(q)
Main plot (M: Dates of sowing)				
M_1 - 2nd fortnight of October	13.80	11.24	171.42	5.29
M_2 - 1st fortnight of November	14.71	12.31	196.66	6.07
M_3 - 2nd fortnight of November	15.58	13.11	227.39	7.01
M_4 - 1st fortnight of December	9.67	7.20	89.82	2.77
S. Em ±	0.53	0.49	6.71	0.21
CD at 5%	1.82	1.69	23.21	0.72
Sub plot (S: Levels of spacing)				
S_1 - 15 cm × 10 cm	8.37	6.30	195.95	6.04
S_2 - 30 cm × 10 cm	15.70	13.03	190.72	5.88
S_3 - 45 cm × 10 cm	16.25	13.57	127.30	3.92
S. Em ±	0.30	0.31	6.22	0.19
CD at 5%	0.91	0.94	18.65	0.57
Interaction (M × S)				
M_1S_1	8.67	6.40	196.99	6.08
M_1S_2	16.07	13.47	188.67	5.82
M_1S_3	16.67	13.87	128.61	3.96
M_2S_1	8.73	7.07	231.27	7.13
M_2S_2	17.47	14.47	221.15	6.82
M_2S_3	17.93	15.40	137.55	4.24
M_3S_1	9.80	7.27	260.53	8.04
M_3S_2	18.07	15.73	257.45	7.94
M_3S_3	18.87	16.33	164.19	5.06
M_4S_1	6.27	4.47	95.03	2.93
M_4S_2	11.20	8.47	95.58	2.94
M_4S_3	11.53	8.67	78.86	2.43
S. Em ±	**0.61**	**0.63**	**12.44**	**0.38**
CD at 5%	**1.83**	**1.89**	**37.31**	**1.15**

The number of days for first and 50 per cent flowering was influenced significantly by various sowing dates. Lowest number of days needed for the first flowering (41.22) and 50 per cent flowering (50.56 days) was recorded with M_4-first fortnight of December. The results of current study indicated that later sowing induced early flowering due to stress conditions prevailed during early crop growth phase. Sadeghi (2009) reported that, environmental conditions significantly influence the flowering stages of plants.

The number of flowers plant^{-1} (15.58), number of capsules plant^{-1} (13.11), seed yield plot^{-1} (227.39 g) and seed yield hectare^{-1} (7.01 q) was maximum with the treatment M_3 (2nd fortnight of November) (Table 3). Early sowing plays a critical role in Nigella cultivation due to favourable agro-climatic conditions, which help in better crop establishment and minimize pest and disease occurrences. Studies by Meena *et al.* (2011) and Waliullah *et al.* (2021) on black cumin support these findings. Significant differences in yield parameters were noted when sowing was done between the second fortnight of November and the first fortnight of December. This is attributed to an increased number of branches, higher dry matter accumulation, and improved growth rates. The importance of early sowing is further emphasized by El-Mekawy (2012). Similar observations were reported by Sultana *et al.* (2018) and Jafari (2013).

Spacing

Different levels of spacing had significant effect on growth and yield parameters of black cumin. Among different spacings S_1 (15 cm × 10 cm) recorded maximum plant height (39.24 cm) (Table 1). The decrease in plant spread was observed with increase in plant population. This may result from plant competition with one another for different resources, such as water, nutrients as well as light. These observations were in accordance with the findings of Pawar *et al.* (2007) in coriander.

The highest plant spread (421.52 cm^2) was noted with spacing S_3 (45 cm × 10 cm) (Table 1). This may result from plant competition with one another for different resources, such as water, nutrients as well as light. These observations were in accordance with the findings of Pawar *et al.* (2007) in coriander.

The maximum number of primary branches plant^{-1} (8.60) and secondary branches plant^{-1} (12.87) was recorded with wider spacing level of S_3 (45 cm × 10 cm) (Table 1). Generally, wider spacing provided more nutrients to the plants compared to closer spacing with the same nutrient status in the soil, resulting in an increased number of branches plant^{-1}. These experimental findings are similar with those of Meena *et al.* (2015), Fekadu *et al.* (2021) and Sarkar *et al.* (2022) in black cumin.

Different levels spacing had a significant effect on days to flower and 50 per cent flowering in black cumin. Sowing black cumin with the spacing of 45cm × 10 cm (S_3) resulted in the maximum number of days to reach first flowering (44.83 days) and 50 per cent flowering (56.25 days). The reduced time to first and 50 per cent flowering with narrow spacing was observed because lower spacing increases competition for resources, providing the plant with less nutrition and resulting in reduced vegetative growth. Giridhar *et al.* (2017) also reported that, the number of days to first and 50 per cent flowering in black cumin increased with an increase in inter-row spacing.

The maximum number of flowers plant^{-1} (16.25), capsule plant^{-1} (13.57) and maximum seed yield plant^{-1} (2.11 g) was recorded with S_3 (45 cm×10 cm) spacing (Table 3). Generally, wider spacing allowed plants to access more nutrients compared to closer spacing, even at similar soil nutrient levels, resulting in a higher number of primary and secondary branches plant^{-1}, flowers and capsules plant^{-1}. Giridhar *et al.* (2017) also reported an increase in the number of capsules plant^{-1} with wider spacing in black cumin.

Maximum seed yield plot^{-1} (195.95 g) and seed yield hectare^{-1} (6.04 q) was recorded with S_1 (15 cm × 10 cm) spacing (Table 3). While wider spacing enhanced yield-contributing traits, closer spacing resulted in maximum yield due to the maximum plant population. These results are in consistent with the studies of Goutam *et al.* (2016) and Sarkar *et al.* (2022) in black cumin.

Interaction effect of different dates of sowing and spacing

The combined effect of varied sowing dates and spacing had significant effect number of secondary branches plant^{-1} which was maximum in treatment combination of M_3S_3 (17.93) (Table 1). This might be due to the favourable agro-climatic conditions combined with wider spacing might allow the plant to establish itself better by reducing competition, leading to more vigorous growth and more secondary branches during the crop growth period. Similar findings were reported by Giridhar *et al.*, 2017.

The combined effect of different dates of sowing and spacing was statistically significant on days to flower and 50 per cent flowering in black cumin. The treatment M_4S_1 (First fortnight of December and 15 cm × 10 cm) recorded least number of days (40.67) to first and 50 per cent flowering (50.00 days) (Table 2).

The highest number of flowers plant^{-1} (18.87), number of capsules plant^{-1} (16.33) and highest seed yield plant^{-1} (2.88 g) was obtained with M_3S_3 (2nd fortnight of November and 45 cm × 10 cm). The maximum seed yield plot^{-1} (260.53 g) and seed yield hectare^{-1} (8.04 q) was recorded with the treatment M_3S_1

(2nd fortnight of November and 15 cm × 10 cm) (Table 3). This is due to adequate supply of nutrients to the plants and less competition for water, food and light among the plants in optimum spacing was observed. Closer spacing gave the higher yield, this might be due to maximum plant population. These results are supported by the experimental findings of Meena *et al.* (2011) and Haq *et al*. (2015).

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