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Effect of Sowing Time and Plant Geometry on Growth, Yield and Quality of Black Cumin (*Nigella sativa* L.)

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A B S T R A C T

A field experiment was conducted during *rabi* season 2017-18 at the Research Farm, College of Horticulture, Mandsaur (Madhya Pradesh) to find out the effect of sowing time and plant geometry on growth, yield and quality of black cumin (*Nigella sativa* L.) under Malwa plateau condition. The experiment was laid out in factorial RBD design with three replications including four sowing time and three plant geometry. The different treatments significantly influenced the growth, yield and quality attributes of black cumin. Sowing of black cumin on 15th October and crop geometry of 30x10 cm significantly influenced the plant height (cm), number of branches plant^{-1}, fresh weight of plant (gm), dry weight of plant (gm), biological yield (q ha^{-1}), test weight (gm), seed yield plant^{-1} (gm), seed germination (%), chlorophyll content (SPAD) and oil content (%) in seed. Therefore, sowing of black cumin on 15th October at 30x10 cm of plant geometry gave the maximum growth, yield and quality of black cumin.

Introduction

Black cumin (*Nigella sativa* L.) It is known by many common names *viz*., Fennel Flower, Nutmeg Flower, Black seed, Black Caraway, Roman Coriander, Damascena, Devil in-the-bush, Wild Onion Seed (Sultana *et al*., 2015). It is a cross-pollinated crop and has a somatic chromosome number is 2n = 12. It is largely grown during rabi season. It is an annual herb native to Mediterranean region, belongs to the family Ranunculaceae (Jansen, 1981). Nigella seed is used as seasoning of vegetables, legumes and different type of baked products (Atta, 2003). In India nigella seeds used as preservative in all sorts of homemade pickles. The oil of nigella seed has also demand in the pharmaceutical and perfumery industry. The main alkaloids present in nigella seeds are nigellmin, nigellidin, nigellicine and possess anticarcinogenic properties. It has been traditionally used for a variety of conditions and treatments related to respiratory health, stomach and intestinal health, kidney and liver function (Gholinezhad and Abdolrahimi, 2014). India is known to be the largest producer and exporter of nigella in the world. In India, it is commercially cultivated in Punjab, Himachal Pradesh, Madhya Pradesh, Bihar, Jharkhand, Assam, West Bengal and

Andhra Pradesh. To realise the full yield potentiality of nigella, agro-techniques have to be standardized and optimized for realising higher yield. Non monitory input also affect growth and yield of nigella. Non monitory inputs plays very important role in securing higher yield of a crop in particular set of agro climatic condition. Time of sowing and crop geometry is important non monitory input which affects growth performance and yield of crop (Meena *et al.,* 2011).

Materials and Methods

The experiment was undertaking to study the effect of sowing time and plant geometry on growth, yield and quality of black cumin at the Farm, College of Horticulture, Mandsaur, Madhya Pradesh during rabi season of 2017-18 using cultivar NRCSS-AN-1. Twelve treatment combinations comprising four dates of sowing (*viz*., 1st October, 15th October, 30th October, 15th November) and three crop geometry (*viz*., 20 x 10 cm, 30 x 10 cm and 40 x 10 cm). The experiment was conducted in RBD factorial design. The experimental soil was light black loamy in texture with 8.36 pH, EC 0.18 dS/m, low in available nitrogen (192 kg ha^{-1}), low in available phosphorus (7.6 kg ha^{-1}) and medium in potassium (145 kg ha^{-1}). Recommended dose of fertilizers as well as other standard agro-techniques were used for raising good crop. 40 kg nitrogen and 20 kg P_2 O_5 ha^{-1} were supplied through urea and DAP, respectively.

Full dose of phosphorus and half dose of nitrogen was applied as basal at the time of sowing and remaining nitrogen was given 30 DAS. The observations on growth, yield and quality parameters were taken on plant height (cm), number of branches plant^{-1}, fresh weight of plant (gm), dry weight of plant (gm), biological yield (q ha^{-1}), test weight (gm), seed yield plant^{-1} (gm), seed germination (%), chlorophyll content (SPAD) at 60 DAS and oil content (%) in seed. The experimental data recorded were subjected to statistical analysis using analysis of variance technique suggested by Pansey and Sukhatme (1984).

Results and Discussion

Sowing time

Perusal of data reveals (Table 1, 2 and 3) that date of sowing significantly influenced the plant height, number of branches plant^{-1}, fresh weight of plant, dry weight of plant at various periodical growth stages, biological yield, test weight, seed yield plant^{-1}, seed germination, chlorophyll content (SPAD) at 60 DAS and oil content in seed.

Sowing of black cumin on 15th October exhibited the highest plant height (7.26, 39.13, 76.00 cm and 80.00 cm) at 30, 60, 90 DAS and at harvest, number of branches plant^{-1} (7.76, 8.52 and 8.59) at 60, 90 DAS and at harvest, fresh weight of plant (1.26, 13.04, 53.88 and 68.66 gm), dry weight of plant (0.14, 3.57, 14.00 and 19.06 gm) at 30, 60, 90 and at harvest as well as yield attributes like biological yield (25.8 q ha^{-1}), test weight (2.32 gm), seed yield plant^{-1} (4.71 gm) and quality attributes of seed germination (88.73 %), chlorophyll content (41.44) at 60 DAS and oil content (0.75 %) in seed. The highest growth parameters, yield attributes and seed yield of nigella was recorded at 15th October which might be due to favourable agro-climatic conditions available during the period which facilitated better germination, crop establishment and less chances of occurrence of diseases and pest which might have occurred in late planting situation. Similar findings were also reported by Meena *et al.,* (2012) in nigella, Giridhar *et al.,* (2017) in black cumin and Sowmya *et al.*, (2017) in fenugreek.

Table.1 Effect of sowing time and plant geometry on growth, yield and quality of black cumin (*Nigella sativa* L.)

Treatments	Plant height (cm)				Number of branches plant^{-1}		
	30 DAS	60 DAS	90 DAS	Harvest	60 DAS	90 DAS	Harvest
Date of sowing							
D_1 (1st October)	5.89	27.51	67.52	71.93	6.02	7.01	7.32
D_2 (15th October)	7.26	39.13	76	80	7.76	8.52	8.59
D_3 (30th October)	6.34	34.02	71.06	74.41	6.96	7.52	7.63
D_4 (15th November)	4.56	16.6	62.42	67.42	5.66	6.71	7.11
S.Em±	**0.11**	**0.84**	**1.15**	**0.95**	**0.16**	**0.12**	**0.15**
CD at 5%	**0.32**	**2.47**	**3.38**	**2.77**	**0.46**	**0.36**	**0.44**
Plant geometry							
S_1 (20 X 10 cm)	5.16	26.07	65.07	70.73	6.05	7.01	7.2
S_2 (30 X 10 cm)	6.78	32.04	71.74	75.53	7.37	8.05	8.13
S_3 (40 X 10 cm)	6.1	29.84	70.94	74.06	6.38	7.26	7.66
S.Em±	**0.1**	**0.73**	**1.00**	**0.82**	**0.14**	**0.11**	**0.13**
CD at 5%	**0.28**	**2.14**	**2.93**	**2.40**	**0.40**	**0.31**	**0.38**
Interaction							
D_1S_1	5.37	23.67	65.07	70.17	6.27	7.23	7.43
D_1S_2	6.53	32.62	67.63	72.17	6.47	7.27	7.33
D_1S_3	5.77	26.23	69.87	73.47	5.33	6.53	7.2
D_2S_1	6.29	36.57	71.07	73.03	6.33	7.17	7.23
D_2S_2	7.89	41.00	80.47	86.8	8.9	9.9	9.93
D_2S_3	7.61	39.83	76.47	80.17	8.03	8.5	8.6
D_3S_1	4.95	27.97	65.63	73.33	6.61	7.21	7.28
D_3S_2	7.4	37.2	75.6	75.87	7.53	8.00	8.13
D_3S_3	6.67	36.9	71.93	74.03	6.75	7.33	7.47
D_4S_1	4.05	16.07	58.5	66.4	5.00	6.43	6.83
D_4S_2	5.28	17.33	63.27	67.3	6.57	7.03	7.13
D_4S_3	4.36	16.4	65.5	68.57	5.4	6.67	7.37
S.Em±	**0.19**	**1.46**	**2.00**	**1.64**	**0.27**	**0.21**	**0.26**
CD at 5%	**0.56**	**4.27**	**5.85**	**4.81**	**0.80**	**0.63**	**0.76**

Table.2 Effect of sowing time and plant geometry on growth, yield and quality of black cumin (*Nigella sativa* L.)

Treatments	Fresh weight of plant (gm)				Dry weight of plant (gm)			
	30 DAS	60 DAS	90 DAS	Harvest	30 DAS	60 DAS	90 DAS	Harvest
Date of sowing								
D_1 (1st October)	1.04	10.78	44.61	61.16	0.07	2.34	10.78	12.81
D_2 (15th October)	1.26	13.04	53.88	68.66	0.14	3.57	14	19.06
D_3 (30th October)	1.17	12.34	47.94	65.76	0.11	2.67	12.13	15.28
D_4 (15th November)	0.99	9.21	41.04	55.18	0.05	1.57	9.79	12.22
S.Em±	**0.03**	**0.33**	**0.86**	**1.59**	**0.01**	**0.13**	**0.74**	**0.49**
CD at 5%	**0.10**	**0.96**	**2.51**	**4.67**	**0.03**	**0.38**	**2.18**	**1.45**
Plant geometry								
S_1 (20 X 10 cm)	1.05	10.31	43.46	55.53	0.07	1.94	9.68	12.95
S_2 (30 X 10 cm)	1.17	12.08	49.2	66.83	0.11	3.03	13.01	16.18
S_3 (40 X 10 cm)	1.12	11.64	47.95	65.72	0.1	2.64	12.34	15.4
S.Em±	**0.03**	**0.28**	**0.74**	**1.38**	**0.01**	**0.11**	**0.64**	**0.43**
CD at 5%	**0.08**	**0.83**	**2.17**	**4.04**	**0.02**	**0.33**	**1.89**	**1.26**
Interaction								
D_1S_1	1.03	10.00	44.83	54.17	0.07	1.73	9.13	12.17
D_1S_2	1.00	11.00	45.5	63.53	0.06	2.97	10.83	13.13
D_1S_3	1.07	11.33	43.49	65.79	0.08	2.34	12.37	13.13
D_2S_1	1.07	10.77	42.47	54.8	0.08	3.04	11.37	15.6
D_2S_2	1.43	14.67	61.1	78.17	0.2	4.23	16.13	21.4
D_2S_3	1.29	13.7	58.07	73.00	0.14	3.43	14.5	20.17
D_3S_1	1.13	11.5	47.87	59.6	0.09	1.6	9.2	12.2
D_3S_2	1.24	13.17	49.7	70.00	0.13	3.23	14.00	17.5
D_3S_3	1.13	12.37	46.27	67.67	0.11	3.17	13.2	16.13
D_4S_1	0.97	8.97	38.67	53.53	0.04	1.4	9.00	11.83
D_4S_2	1.00	9.5	40.5	55.6	0.05	1.67	11.07	12.67
D_4S_3	1.00	9.17	43.97	56.4	0.06	1.63	9.3	12.17
S.Em±	**0.06**	**0.57**	**1.48**	**2.76**	**0.01**	**0.23**	**1.29**	**0.86**
CD at 5%	**NS**	**1.66**	**4.35**	**8.09**	**0.04**	**0.66**	**NS**	**2.51**

Table.3 Effect of sowing time and plant geometry on growth, yield and quality of black cumin (*Nigella sativa* L.)

Treatment	Biological yield (q/ha)	Test weight (gm)	Seed yield plant^{-1} (gm)	Seed germination (%)	SPAD value (Chlorophyll content)	Oil content (%) in seed
Date of sowing						
D_1 (1st October)	20.56	2.04	4.09	84.43	39.22	0.64
D_2 (15th October)	25.80	2.32	4.71	88.73	41.44	0.75
D_3 (30th October)	20.78	2.27	4.31	87.22	39.33	0.65
D_4 (15th November)	14.52	1.90	3.10	75.89	37.22	0.53
S.Em±	**0.73**	**0.05**	**0.22**	**0.40**	**0.30**	**0.02**
CD at 5%	**2.09**	**0.15**	**0.64**	**1.16**	**0.87**	**0.06**
Plant geometry						
S_1 (20 X 10 cm)	18.44	2.01	3.67	82.62	38.67	0.52
S_2 (30 X 10 cm)	21.08	2.23	4.38	85.15	39.75	0.74
S_3 (40 X 10 cm)	20.22	2.16	4.12	84.44	39.5	0.66
S.Em±	**0.62**	**0.05**	**0.19**	**0.34**	**0.26**	**0.02**
CD at 5%	**1.81**	**0.13**	**0.55**	**1.00**	**0.76**	**0.05**
Interaction						
D_1S_1	22.33	2.00	4.03	83.83	38.67	4.03
D_1S_2	20.33	2.1	4.17	84.37	38.67	4.17
D_1S_3	19.00	2.03	4.07	85.1	40.33	4.07
D_2S_1	22.28	2.03	3.53	85.7	38.67	3.53
D_2S_2	28.00	2.53	5.73	90.5	43.00	5.73
D_2S_3	27.00	2.4	4.87	90.00	42.67	4.87
D_3S_1	17.45	2.2	4.07	85.93	40.33	4.07
D_3S_2	23.55	2.33	4.53	88.57	40.00	4.53
D_3S_3	21.33	2.27	4.33	87.17	37.67	4.33
D_4S_1	13.55	1.79	3.03	75.00	37.00	3.03
D_4S_2	14.69	1.97	3.07	77.17	37.33	3.07
D_4S_3	15.33	1.93	3.20	75.5	37.33	3.20
S.Em±	**1.02**	**0.09**	**0.38**	**0.68**	**0.52**	**0.38**
CD at 5%	**2.99**	**NS**	**NS**	**2.01**	**1.52**	**NS**

Plant geometry

Data revealed (Table 1, 2 and 3) that plant geometry significantly influenced the plant height, fresh weight of plant, dry weight of plant, number of branches plant^{-1} at various periodical growth stages, test weight, biological yield, seed yield plant^{-1}, seed germination, chlorophyll content (SPAD value) at 60 DAS and oil content in seed. Sowing of black cumin at 30 cm row to row and 10 cm plant to plant spacing exhibited the highest plant height (6.78, 32.04, 71.74 and 75.53 cm) at 30, 60, 90 DAS and at harvest, number of branches plant^{-1} (7.37, 8.05 and 8.13) at 60, 90 and at harvest, fresh weight of plant (1.17, 12.08, 49.20 and 66.83 gm), dry weight of plant (0.11, 3.03, 13.01 and 16.18 gm) at 30, 60, 90 and at harvest as well as yield attributes like biological yield (21.08 (q/ha), test weight (2.23 gm), seed yield plant^{-1} (4.38 gm) and quality attributes of seed germination (85.15 %), chlorophyll content (39.75) at 60 DAS and oil content (0.74 %) in seed. However, sowing of black cumin at 30 X 10 cm row to row and plant to plant spacing remained at par with rest of the crop geometry in respect to growth, yield and quality parameter. The better performance of crop with respect to growth parameters, yield attributes and seed yield at 30 X 10 cm geometry might be due to optimum space availability for growth and development of individual plant which, might not be possible in close spacing where severe competition for light, nutrient and water may result drastic reduction in per plant yield that may not be compensated with higher plant population. Similarly wider spacing though may result higher seed yield plant^{-1} but on account of less population, the increased yield plant^{-1} cannot compensate yield loss on account of thin plant population. Similar results were reported by Singh *et al.,* (2002) in nigella, Meena *et al.,* (2013) in dill, Goutam *et al.,* (2016) in black cumin.

Interaction of sowing time and plant geometry

The data reveals (Table 1, 2 and 3) that combined effect of sowing time and plant geometry significantly influenced on growth, yield and quality parameters of black cumin. The maximum plant height (7.89, 41.00, 80.47 and 86.80 cm), fresh weight of plant (1.43, 14.67, 61.10 and 78.17 gm), dry weight of plant (0.20, 4.23, 16.13 and 21.40 gm) at 30, 60, 90 and at harvest, number of branches plant^{-1} (8.90, 9.90 and 9.93) at 60, 90 and at harvest as well as yield attributes like biological yield (28 q/ha), test weight (2.53 gm), seed yield plant^{-1} (5.73 gm) and quality attributes of seed germination (90.50 %), chlorophyll content (43.0) at 60 DAS and oil content (0.96 %) in seeds were recorded with sowing of black cumin on 15th October at 30x10 cm spacing being at par with sowing on 1st October at 30x10 cm. The highest growth, yield and quality with sowing on 15th October at 30x10 cm spacing might be due to favorable weather condition and optimum spacing for growth and development of the crop which resulted higher growth, yield. However, Non significant difference was observed on growth attributes of fresh weight at 30 DAS, dry weight at 90 DAS and yield attributes of test weight and seed yield plant^{-1}. These results are in conformity with those reported by Meena *et al.,* (2011) in black cumin, Meena *et al.,* (2015) in dill and Haq *et al.,* (2015) in black cumin.

In conclusion, sowing date on 15th October and plant geometry of 30 X 10 cm found to be the best compared to other dates of sowing and plant geometry with respect to plant growth, seed yield and quality of black cumin.

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