

NUTRIENT MANAGEMENT ON THE GROWTH AND YIELD OF BLACK CUMIN (*NIGELLA SATIVA* L.)

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Abstract

A field experiment was carried out at the research field of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur, during *rabi* (winter) season of 2016-17 to evaluate the effects of fertilizer treatments on black cumin (BARI Kalozira-1). The field belongs to Shallow red-brown terrace soil of Salna series under AEZ-28 (Madhupur Tract). The experiment was laid out in randomized complete block design (RCBD) with three replications. Results showed that the application of nutrient elements had positive effect on plant height, branches per plant, capsule setting, umbels per plant, capsules per plant, capsule size, seeds per capsule, 1000-seed weight and seed yield of black cumin. The highest seed yield (1277 kg ha⁻¹) was obtained from 75% RDCF + 25% cowdung-N treatment followed by 100% RDCF (N₈₀P₄₅K₅₀S₂₀Zn₅B₂ kg ha⁻¹) and the lowest seed yield (420 kg ha⁻¹) was recorded with 50% RDCF. Thus, the IPNS treatment 75% RDCF + 25% cowdung-N appeared to be the best suitable package for black cumin cultivation in this location.

Keywords: Black cumin, IPNS, seed yield.

Introduction

Black cumin (*Nigella sativa* L.), belongs to the butter cup family Ranunculaceae (diploid, 2n=12) and it has remarkable aromatic and medicinal properties. The black cumin seeds and oil have commercial significance as spice and medicines. Black cumin is generally short-lived annual herb originated in the Mediterranean region and it is widely cultivated throughout the South Europe, North Africa, countries of Middle East, Turkey, Iran, China, Japan and India Sub-Continent (Rana *et al.*, 2012; Bhutia *et al.*, 2015). In Bangladesh, it covers 14742 hectares of land, with total annual production of 16526 tons (DAE, 2017), over the Faridpur, Sariatpur, Madaripur, Pabna, Sirajganj, Jessore, Kushtia, Bogra, Rangpur and Natore districts (Ali *et al.*, 2015; Noor *et al.*, 2008). The average yield of black cumin is low which might be due to disease and insect infestation, weak nutrient management (Bhutia *et al.*, 2015).

A plant nutritional constraint often restricts yield and qualities of crops. Application of cowdung along with chemical fertilizers improves soil health for the production of subsequent crops (Najm *et al.*, 2012). Al-Saadi and Alhalabi (2012)

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reported that application of NPK fertilizers increased yield of black cumin. According to Rana *et al.* (2012), application of $N_{60}P_{120}$ kg ha⁻¹ gave the maximum growth, yield and quality of black cumin with the highest net return per hectare. Girma and Tadesse (2013) found that application of 100 kg N and 50 kg P₂O₅ ha⁻¹ gave maximum dry matter yield, seed yield and essential oil yield of white cumin. Pariari *et al.* (2012) reported that in Gangetic alluvial plains NAA at 100 ppm with $N_{30}P_{40}K_{45}$ kg ha⁻¹ and FYM @ 15 t ha⁻¹ gave the maximum seed yield of black cumin. Ali *et al.* (2015a) reported that the dry matter weight, number of primary branches, number of fruits, 1000-seed weight and seed yield of black cumin genotypes were significantly influenced by different levels of N-P-K fertilizers. The present study was therefore, done to see the response of black cumin to chemical fertilizers and cowdung application in AEZ-28 (Madhupur Tract) soil.

Materials and Methods

The field experiment was conducted at the research field of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur. The experimental field represents on Shallow red-brown terrace soil of Salna series (Plinthic Paleustult) under AEZ-28 (Madhupur Tract). The experiment was set up during rabi (winter) season of 2016-17. The geographic coordinates of the experimental location is 24⁰09' North Latitude and 90⁰26' East Longitude with an elevation of 8.2 m from mean sea level. A description of soil physical and chemical properties of the experimental field is presented in Table 1.

Table 1. Soil properties of the experimental field

Texture	pH	OC (%)	Ca	Mg	K	Total N	P	S	B	Zn	Cu	Mn	Mo
			(meq 100g ⁻¹ soil)			%	(µg g ⁻¹ soil)						
Silty clay loam	6.2	0.86	1.6	0.71	6.0	0.09	10.2	12	0.28	0.9	0.7	8.0	0.05

The experiment was set up in a randomized complete block design (RCBD) with seven treatment combinations having three replications. The treatments were T₁ = 100% RDCF ($N_{80}P_{45}K_{50}S_{20}Zn_5B_2$ kg ha⁻¹), T₂ = 75% RDCF + 25% N from cowdung, T₃ = 50% RDCF + 50% N from Cowdung, T₄ = 150% RDCF, T₅ = 125% RDCF, T₆ = 75% RDCF and T₇ = 50% RDCF; RDCF means recommended dose of chemical fertilizers. The whole amount of cowdung, TSP, MoP, gypsum, zinc oxide and boric acid was applied as basal and 1/3rd urea was applied in three equal at 5th, 9th and 11th week after sowing. The seeds of black cumin cv. BARI Kaloziira-1 were sown on 22 November 2016 in 2.5 m x 2.0 m plot at line to line distance 20 cm. Seeds were soaked in water for 24 hours to facilitate germination, then the seeds dried and treated with Bavistin (carbendazim) @ 2g kg⁻¹ seeds to minimize the primary seed-borne disease. The

seeds were mixed with some loose soil to allow uniform sowing in rows @ 10 kg ha⁻¹ at a depth of about one cm. The seeds were covered with loose soil properly just after sowing and gently pressed by hands with slight watering to enhance proper germination. Continuous sowing was done to maintain plant to plant distance of 10 cm by thinning after 25 DAS. Intercultural operations (four irrigations, three weeding and three times' spray of Bavistin @ 2g L⁻¹ of water spray for controlling damping off disease) were done in the whole cropping period. Observations were done on the growth parameters like plant height and number of branches at 100 DAS. The crops were harvested on 20 March 2017, when as around 50 - 60% of the capsules turned into straw color from green. Ten plants were selected randomly from each plot for counting some growth and yield parameters. The harvested plants were sun dried for four days and threshing was done by beating with sticks. The seeds were winnowed and cleaned for recording data. The seed yield per plot was recorded from 1m² area and then converted to yield per hectare. The data were subjected to statistical analysis by using MSTAT software to find out the significance of variation between treatments. The difference between treatment means were judged by Duncan's Multiple Range Test (DMRT) according to Gomez and Gomez (1984).

Results and Discussion

Plant height

Fertilizer treatments significantly affected the plant height (Table 2). The tallest plant (65 cm) was recorded in treatment T₂ (75% RDCF + 25% N from cowdung) and the smallest plant (23.4 cm) was noted in treatment T₇ (50% RDCF). Similar results were reported by (Ali *et al.*, 2015a, b).

Number of branches per plant

As shown in the Table 2, there was significant difference in number of branches per plant between the treatments, the maximum number of branches per plant (6.7) in treatment T₂ (75% RDCF + 25% N from cowdung) followed by treatment T₁, T₅. The minimum number of branches per plant (4.07) was found in the treatment T₇ (50% RDCF). Additional amount of nutrient applications increased the number of branches which ultimately contributed to the formation of additional number of capsules per plant. Thus, these parameters could be used as good indicators of improving yield potential in black cumin. These results are in agreement with the research findings of Tuncturk *et al.* (2013) and Bhutia *et al.* (2015).

Days to capsule setting

Table 2 shows that the maximum days (70.7) to capsule setting was required in treatment T₂ (75% RDCF + 25% N from cowdung) and the minimum days (63.3) in the treatment T₇ (50% RDCF). These results indicated that early capsule setting occurred in the plants which were inadequately supplied with nutrients.

Number of umbellets per plant

The number of umbellets per plant (Table 2) differed significantly due to variation in application of nutrient treatments. The maximum number of umbellets per plant (67.7) was found with application of 75% RDCF + 25% N from cowdung, while the minimum number of umbellets per plant (31.7) in application of 50% RDCF. The number of umbellets per plant directly influenced the number of capsules per plant. This was probably due to adequate nutrient uptake by plant by resulting in production of more branches as well as more number of umbellets per plant. Rana *et al.* (2012) and Ali *et al.* (2015b) reported similar results.

Table 2. Effects of nutrient management on the growth of black cumin

Treatment	Plant height (cm)	No. of branches per plant	Days to capsule setting	No. of umbellets per plant	No. of capsules per plant
T ₁	58.8b	6.20ab	66.3cd	62.9b	55.5b
T ₂	65.0a	6.70a	70.7a	67.7a	58.9a
T ₃	53.6c	5.40b	68.0b	58.9c	56.9ab
T ₄	45.5e	5.30bc	67.3bc	53.7d	38.8c
T ₅	47.7d	6.17ab	68.0b	61.7bc	54.6b
T ₆	37.1f	4.40cd	65.7d	39.9e	34.2d
T ₇	23.4g	4.07d	63.3e	31.7f	26.2e
CV (%)	2.33	9.84	0.93	3.54	3.20

Legend: T₁ = 100% RDCF (N₈₀P₄₅K₅₀S₂₀Zn₅B₂ kg/ha), T₂ = 75% RDCF + 25% N from Cowdung, T₃ = 50% RDCF + 50% N from Cowdung, T₄ = 150% RDCF, T₅ = 125% RDCF, T₆ = 75% RDCF and T₇ = 50% RDCF

Number of capsules per plant

Table 2 exhibits that the maximum number of capsules (58.9) per plant was produced by treatment T₂ where nutrients were applied as 75% RDCF + 25% N from cowdung and the minimum results (26.2 capsules per plant) in T₇ representing 50% RDCF. Total number of capsules per plant appeared to be the most important component since it is closely related with seed yield. Increase in number of capsules per plant indicates production of more number of flowers per umbel, higher percentage of capsule set and reduced shedding of flowers and capsules which resulted in increased yield. Tuncturk *et al.* (2013) and Rana *et al.* (2012) also recorded similar results.

Capsule size

Capsule size is represented by the length and diameter of the capsule (Table 3). The mean maximum length (1.43 cm) and diameter (1.67 cm) of single capsule was observed in treatment T₂, while the minimum length (0.63 cm) and diameter (0.67 cm) of capsule was found in treatment T₇. Capsule size directly affects the number of seeds per capsule which in turn impacted yield. Bigger size capsule had higher number of seeds.

Number of seeds per capsule

The Table 3 shows that number of seeds per capsule was affected by the fertilizer treatments. The highest number of seeds per capsule (111.9) was obtained when nutrient elements were applied as 75% RDCF + 25% N from cowdung and the lowest number of seeds per capsule (70.2) was observed with 50% RDCF. The results are in agreement with the research findings of Ghanepasand *et al.* (2014) and Bhutia *et al.* (2015).

Table 3. Effects of nutrient management on the yield and yield components of black cumin

Treatment	Capsule size		No. of seeds per capsule	1000-seed weight (g)	Seed yield (kg ha ⁻¹)
	Capsule length (cm)	Capsule diameter (cm)			
T ₁	1.23a	0.97b	96.33b	2.47b	1150.0b
T ₂	1.43a	1.67a	111.9a	2.67a	1277.0a
T ₃	1.27a	0.97b	94.53b	2.40bc	1043.0c
T ₄	1.27a	0.87bc	75.47d	1.97d	593.7e
T ₅	1.03b	0.80c	84.07c	2.27c	656.7d
T ₆	0.90b	0.77cd	70.87d	1.77e	500.2f
T ₇	0.63c	0.67d	70.20d	1.43f	420.3g
CV (%)	9.29	7.98	3.90	4.55	4.02

Legend: T₁ = 100% RDCF (N₈₀P₄₅K₅₀S₂₀Zn₅B₂ kg/ha), T₂ = 75% RDCF + 25% N from Cowdung, T₃ = 50% RDCF + 50% N from Cowdung, T₄ = 150% RDCF, T₅ = 125% RDCF, T₆ = 75% RDCF and T₇ = 50% RDCF

1000-seed weight

The weight of 1000-seed was significantly affected by the fertilizer treatments (Table 3). The maximum 1000-seed weight (2.67 g) was recorded in treatment T₂ and the minimum 1000-seed weight (1.43 g) was noted in treatment T₇. The 1000-seed weight can be affected by several factors such as variety, growing condition, climatic factors, soil properties and cultural and nutrient management. Similar results were obtained by Ghanepasand *et al.* (2014) and Ali *et al.* (2015b).

Seed yield

The data presented in Table 3 revealed that fertilizer treatments affected the seed yield of black cumin. The maximum seed yield (1277 kg ha⁻¹) was obtained when nutrients were applied as 75% RDCF + 25% N from cowdung and the minimum seed yield (420 kg ha⁻¹) in application of 50% RDCF. Similar results were recorded by Ali *et al.* (2015a, b) and Yousuf *et al.* (2014).

Conclusion

Fertilizer application played an important role on the growth and seed yield of black cumin. The fertilizer treatment T₂ (75% RDCF + 25% N from cowdung)

was observed as the best nutrient package for black cumin cultivation in Shallow Red-Brown Terrace Soil of Salna series under AEZ-28 (Madhupur Tract).

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