Original Research Article

Effect of Different Organic and Inorganic Fertilizers on Growth, Yield and Quality of Black Cumin (*Nigella sativa* L.)

ABSTRACT

Black cumin is spices crop rich in nutrients such as protein, healthy fats (including omega-3 and omega-6 fatty acids), dietary fiber, and various vitamins and minerals. They are particularly high in thiamine (vitamin B1), niacin (vitamin B3), calcium, iron, and magnesium. The present investigation was carried out at the Central Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh during *Rabi* 2022 with a view to identify the effects of different doses of organic and inorganic fertilizers and its role in growth, yield and quality of Black Cumin variety AN-1. The experiment was laid in Randomized block design with 14 treatments and 3 replications with different combination in organic and inorganic fertilizers. Under this experiment, overall, 14 treatment was taken including control. According to the current research, the use of combination of organic manures and inorganic fertilizers had a significantly positive impact on the growth and development of black cumin. Among the various treatments that were evaluated, T_7 yielded the most favourable results in terms of growth viz., plant height, number of flowers, capsules per plant, early flowering and maturation and yield viz., number of seeds per umbel, and seed yield per plant. T_7 consisted of NPK 50% + Farmyard Manure 50%.

Keywords: *Poultry manure, Vermicompost, Farmyard manure, Black cumin.*

INTRODUCTION

Black cumin (vernacular name: *Mangrella or Shahi Jeera*), botanically known as *Nigella sativa* (L.) is one of the well-known plants belonging to Ranunculaceae. It is a diploid self-pollinated dicot plant species with chromosome number 2n=12. Archaeological evidence about the earliest cultivation of N. sativa dates back three millennia, with black Cumin seeds found in several sites from ancient Egypt, including the Tomb of Tutankhamun (Zohary *et al.*, 2012). Seeds were found in a Hittite flask in Turkey from the second millennium BC (Saliha *et al.*, 2009). Black Cumin may have been used as a condiment of the Old World to flavor food. The Muslim Persian physician Avicenna described N. sativa as a treatment for dyspnea in his The Canon of Medicine. It was used in the Middle East as a traditional medicine. As per National Institute of Nutrition (NIN, 2008), nutritional composition of black cumin is rich in essential fatty acids like omega-3 and omega-6, which support brain function, heart health, inflammation control, and hormonal balance. It also provides plant-based protein for tissue repair, immune support, and enzyme and hormone production. With a good amount of dietary fibre, black cumin aids digestion, promotes bowel regularity, satiety, and heart health through cholesterol control. Additionally, it offers antioxidants such as thymoquinone, protecting against oxidative stress and reducing the risk of chronic diseases. Black cumin is a source of vital vitamins and minerals like thiamine, niacin, calcium, iron, magnesium, and zinc, supporting energy production, nerve function, immune system, and maintaining healthy bones and teeth. Black cumin grows plentiful throughout the country, but most widely in Egypt and Niger, and in lesser amounts in other African countries. In India Black cumin is predominantly cultivated in various states of India, including Uttar Pradesh, Rajasthan, Gujarat, Madhya Pradesh, and Jammu and Kashmir. These regions have favorable climatic conditions for black cumin cultivation (*Source: Spice*

Board India, Ministry of Commerce and Industry, Government of India, 2020-21). The availability of nutrients from farmyard manure is like that of inorganic sources and applying it to soil improves fertility. On average, well-decomposed farmyard manure contains 0.5% nitrogen, 0.2% phosphate, and 0.5% potassium. Kumar *et al*. (2019) examined the effect of FYM on the growth and yield of chili pepper and reported that the application of FYM significantly influenced the growth and yield of chili pepper plants. Vermicompost is a nutrient-rich product of the worm composting process that uses earthworms to decompose vegetable or food waste, bedding materials, and vermicast. It is high in NPK (nitrogen 2-3%, phosphorus 1.55-2.25%, and potassium 1.85-2.25%), micronutrients, beneficial soil microbes, and plant growth hormones and enzymes. Vermicompost is a scientifically proven growth promoter and plant protector against pests and diseases. Suthar and Pandey (2017) investigated the effect of vermicompost on the growth and yield of okra. Poultry manure contains higher nitrogen and phosphorus compared to other bulky organic manures. The average nutrient content is 3.03 per cent N; 2.63 per cent P_2O_5 and 1.4 per cent K_2O. Yadav *et al.*, (2020) investigated the effect of poultry manure on the growth and yield of cucumber. The researchers applied poultry manure to the soil and evaluated various growth parameters and yield components. Combining organic manure and inorganic fertilizers benefits black cumin growth and yield. Organic manure provides slow-release nutrients, improving soil fertility over time, while inorganic fertilizers supply readily available nutrients for immediate absorption. Organic manure enhances soil structure, moisture retention, and microbial activity, supporting nutrient uptake and reducing waterlogging risk. Inorganic fertilizers, though lacking these benefits, offer quick nutrient supply. The combination ensures balanced nutrient availability and promotes optimal plant growth. Additionally, organic manure promotes environmental sustainability, reducing reliance on synthetic chemicals and mitigating negative impacts. The specific combination and ratio should be determined based on soil conditions and farming practices through expert consultation.

MATERIAL AND METHODS

The present investigation entitled was done to understand the plant growth, fruit yield and quality of fruit of different treatment combinations of organic and inorganic fertilizers on Black cumin variety AN-1. The details of the materials used, and the methods adopted in the investigation, which was carried out at Horticultural Research Farm (CRF), Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj during the *Kharif* season of 2022. The different combination doses of organic and inorganic fertilizers mentioned in table 1 and replicated thrice. Observations were recorded at different stages of growth periods. The data were statistically analysed by the method suggested by Fisher and Yates, 1963**.**

Table 1 Details of different doses of organic and inorganic fertilizers used.

Treatment Symbols	Treatment combination	Treatment Symbols	Treatment combination
T_0	Control	T_7	NPK 50% + Farmyard Manure 50%
T_1	Vermicompost (VC) 100%	T_8	NPK 75% + Vermicompost 25%
T_2	Poultry Manure (PM) 100%	T_9	NPK 75% + Poultry Manure 25%
T_3	Farmyard Manure (FYM) 100%	T_{10}	NPK 75% + Farmyard Manure 25%
T_4	NPK (Urea-SSP-MOP) 100%	T_{11}	NPK 25% + Vermicompost 75%
T_5	NPK 50% + Vermicompost 50%	T_{12}	NPK 25% + Poultry Manure 75%
T_6	NPK 50% + Poultry Manure 50%	T_{13}	NPK 25% + Farmyard Manure 75%

Table 2 Performance of different treatment of organic and inorganic fertilizers on growth and yield parameters studied for Black cumin.

		Days to germination	Plant height (cm) [90 DAS]	Plant height (cm) [120 DAS]	Days to flower bud initiation	Days to 50% flowering	Days to Maturity	No of flowers per plant	No of capsules per plant	No of umbellets per plant	Umbels diameter (cm)	No of seeds per umbel	Seed yield per plant (g)	Test weight (g)
T0	Control	15.00	71.99	101.51	67.86	77.73	152.73	27.22	22.29	44.17	3.22	78.09	0.21	2.75
T1	Vermicompost (VC) 100%	10.33	99.40	141.62	49.61	59.49	134.45	27.66	22.73	45.00	4.24	85.71	0.28	3.30
T2	Poultry Manure (PM) 100%	11.67	84.15	114.02	61.83	71.86	146.86	34.51	29.58	47.02	4.04	87.21	0.27	3.09
T3	Farmyard Manure (FYM) 100%	10.67	84.63	114.54	53.32	63.19	138.08	32.30	27.37	45.83	3.51	78.36	0.23	2.98
T4	NPK (Urea-SSP-MOP) 100%	13.00	86.19	116.06	48.80	58.67	133.67	30.27	25.34	45.59	5.25	83.09	0.36	4.28
T5	NPK 50% + Vermicompost 50%	12.67	91.41	121.28	50.01	59.92	134.93	33.27	28.36	44.92	5.34	92.88	0.36	3.75
T6	NPK 50% + Poultry Manure 50%	11.00	87.61	117.48	48.91	58.77	133.68	31.10	26.09	45.00	5.06	78.47	0.34	4.29
T7	NPK 50% + Farmyard Manure 50%	8.33	112.29	142.16	47.00	57.09	132.09	39.82	34.89	49.88	7.33	99.42	0.49	4.91
T8	NPK 75% + Vermicompost 25%	10.36	97.98	127.85	51.25	61.12	136.04	30.96	26.03	45.83	5.07	89.57	0.34	3.75
T9	NPK 75% + Poultry Manure 25%	9.63	100.98	130.85	48.49	58.33	133.33	39.43	34.48	49.80	6.74	95.40	0.45	4.71
T10	NPK 75% + Farmyard Manure 25%	10.33	80.82	110.69	65.07	74.94	149.94	30.67	25.72	48.94	4.71	85.77	0.31	3.61
T11	NPK 25% + Vermicompost 75%	11.33	93.65	122.51	57.79	67.66	142.66	39.33	34.35	44.58	4.87	86.77	0.32	3.78
T12	NPK 25% + Poultry Manure 75%	12.33	99.65	129.27	48.78	58.89	133.89	34.68	29.75	46.42	5.22	82.14	0.35	4.24
T13	NPK 25% + Farmyard Manure 75%	12.00	89.21	119.17	49.98	59.96	134.96	33.49	28.56	48.44	4.69	83.63	0.31	3.74
'F' test		NS	S	S	S	S	S	S	S	S	S	S	S	S
CD (5%)		NA	3.24	3.20	2.94	2.87	2.91	2.14	2.12	2.71	0.34	3.64	0.02	0.03
SEm±		0.67	1.12	1.10	1.01	0.99	1.01	0.74	0.73	0.93	0.12	1.26	0.01	0.01
C.V.		10.07	2.11	1.56	3.26	2.69	1.26	3.85	4.49	3.48	4.08	2.51	3.62	0.24

RESULTS AND DISCUSSION

Growth Parameters

Survival percentage and Plant height (cm) [at 90 DAS and 120 DAS]

The days to germination varied non-significantly among different treatment combinations. The minimum days to germination (8.33 days) was observed with treatment T_7 (NPK 50% + Farmyard Manure 50%) followed by T_9 (NPK 75% + Poultry Manure 25%) with 9.63 days. Maximum days to germination (15.00 days) was observed in T_0 (Control). The application of organic and inorganic fertilizers might have improved the soil physical and chemical properties and leading to the adequate supply of nutrients to the plants which might have promoted the early germination. Similar findings were reported by Melkie *et al.,* (2008); Rahimi *et al.,* (2009); Valadabadi and Farahani (2011); Sheikh *et al.,* (2012); Bakhsh *et al.,* (2014); Singh and Singh (2016); Hossain *et al.,* (2018) and Ghosh *et al.,* (2019) in Black Cumin. The height of plant significantly varied among different treatment combinations. The maximum plant height at 90 DAS (112.29 cm) was observed with treatment T_7 (NPK 50% + Farmyard Manure 50%) followed by T_9 (NPK 75% + Poultry Manure 25%) with 100.98 cm. Minimum plant height at 90 DAS (71.99 cm) was observed in T_0 (Control), while the remaining treatments were moderate in their growth habit. The height of plant significantly varied among different treatment combinations. The maximum plant height at 120 DAS (142.16 cm) was observed with treatment T_7 (NPK 50% + Farmyard Manure 50%) followed by T_9 (NPK 75% + Poultry Manure 25%) with 130.85 cm. Minimum plant height at 120 DAS (101.51 cm) was observed in T_0 (Control), while the remaining treatments were moderate in their growth habit. The improved plant height observed in black cumin when treated with organic and inorganic fertilizers such as farmyard manure (FYM), vermicompost, poultry manure, and recommended dose of fertilizer (RDF) can be attributed to several factors. These fertilizers provide essential nutrients and micronutrients that promote healthy growth and development. Organic fertilizers enhance soil fertility, microbial activity, and nutrient availability, resulting in better nutrient uptake by plants. Inorganic fertilizers supplement specific nutrients lacking in the soil. The combined effect of these fertilizers enhances plant vigour, increases nutrient absorption, and stimulates overall plant growth, leading to better plant height in black cumin. Similar findings were reported by Melkie *et al.,* (2008); Rahimi *et al.,* (2009); Valadabadi and Farahani (2011); Sheikh *et al.,* (2012); Bakhsh *et al.,* (2014); Singh and Singh (2016); Hossain *et al.,* (2018) and Ghosh *et al.,* (2019) in Black Cumin.

Earliness parameter

Days to flower bud initiation, days to 50% flowering and days to maturity

Among the different applications of organic and inorganic fertilizers, the minimum days to flower bud initiation was seen in T_7 (NPK 50% + Farmyard Manure 50%) with 47.00 days, followed by T_9 (NPK 75% + Poultry Manure 25%) with 48.49 days whereas maximum days to flower bud initiation 67.86 days was recorded in T_0 (Control). Among the different applications of organic and inorganic fertilizers, the minimum days to 50% flowering was seen in T_7 (NPK 50% + Farmyard Manure 50%) with 57.09 days, followed by T_9 (NPK 75% + Poultry Manure 25%) with 58.33 days whereas maximum days to 50% flowering 77.73 days was recorded in T_0 (Control). Among the different applications of organic and inorganic fertilizers, the minimum days to maturity was seen in T_7 (NPK 50% + Farmyard Manure 50%) with 132.09 days, followed by T_9 (NPK 75% + Poultry Manure 25%) with 133.33 days whereas maximum days to maturity 152.73 days was recorded in T_0 (Control). The earliness in flower bud initiation of black cumin under the influence of organic and inorganic fertilizers

such as farmyard manure (FYM), vermicompost, poultry manure, and recommended dose of fertilizer (RDF) can be attributed to several factors. These fertilizers enrich the soil with essential nutrients, promoting vigorous plant growth. Organic fertilizers, like FYM and vermicompost, improve soil structure, nutrient availability, and microbial activity. This enhances nutrient uptake by plants and supports hormonal regulation, resulting in accelerated flowering processes. Inorganic fertilizers, such as RDF, supplement specific nutrients required by the plants, further enhancing their growth and development. The combined effect of these fertilizers provides the necessary resources for black cumin plants to undergo early flowering maximizing their productivity. Similar findings were reported by Melkie *et al.,* (2008); Rahimi *et al.,* (2009); Valadabadi and Hossein (2011); Sheikh *et al.,* (2012); Bakhsh *et al.,* (2014); Singh and Singh (2016); Hossain *et al.,* (2018) and Ghosh *et al.,* (2019) in Black Cumin.

Yield Parameter

Number of flowers per plant, Number of capsules per plant, number of umbellets per plant, umbels diameter (cm).

Among the different applications of organic and inorganic fertilizers, the maximum number of flowers per plant was seen in T_7 (NPK 50% + Farmyard Manure 50%) with 39.82 flowers, followed by T_9 (NPK 75% + Poultry Manure 25%) with 39.43 flowers whereas minimum number of flowers per plant 27.22 flowers was recorded in T_0 (Control). Among the different applications of organic and inorganic fertilizers, the maximum number of capsules per plant was seen in T_7 (NPK 50% + Farmyard Manure 50%) with 34.89 capsules, followed by T_9 (NPK 75% + Poultry Manure 25%) with 34.48 capsules whereas minimum number of capsules per plant 22.29 capsules was recorded in T_0 (Control). Among the different applications of organic and inorganic fertilizers, the maximum number of umbellets per plant was seen in T_7 (NPK 50% + Farmyard Manure 50%) with 49.88 umbellets, followed by T_9 (NPK 75% + Poultry Manure 25%) with 49.80 umbellets whereas minimum number of umbellets per plant 44.17 umbellets was recorded in T_0 (Control). Among the different applications of organic and inorganic fertilizers, the maximum Umbels diameter was seen in T_7 (NPK 50% + Farmyard Manure 50%) with 7.33 cm, followed by T_9 (NPK 75% + Poultry Manure 25%) with 6.74 cm whereas minimum Umbel's diameter 3.22 cm was recorded in T_0 (Control). The application of organic and inorganic fertilizers, such as FYM, vermicompost, poultry manure, and RDF, leads to an increased number of flowers, capsules and umbellets per plant in black cumin through various mechanisms. These fertilizers enrich the soil, ensuring an ample supply of essential nutrients that stimulate vigorous plant growth. Organic fertilizers enhance soil fertility, microbial activity, and nutrient availability, fostering improved flower production and subsequent formation of umbellets. Inorganic fertilizers supplement specific nutrients crucial for plant development, further bolstering the growth of umbellets. The synergistic effect of these fertilizers provides the necessary resources for black cumin plants to yield a higher number of umbellets per plant. Similar conclusions were drawn earlier by Melkie *et al.,* (2008); Rahimi *et al.,* (2009); Valadabadi and Farahani (2011); Sheikh *et al.,* (2012); Bakhsh *et al.,* (2014); Singh and Singh (2016); Hossain *et al.,* (2018) and Ghosh *et al.,* (2019) in Black Cumin.

Number of seeds per umbel, seed yield per plant (g), Test weight (g)

Among the different applications of organic and inorganic fertilizers, the maximum number of seeds per umbel was seen in T_7 (NPK 50% + Farmyard Manure 50%) with 99.42 seeds, followed by T_9 (NPK 75% + Poultry Manure 25%) with 95.40 seeds whereas minimum number of seeds per umbel 78.09 seeds was recorded in T_0 (Control). Among the different applications of organic and inorganic fertilizers, the maximum seed yield per plant was seen in T_7 (NPK 50% + Farmyard Manure 50%) with 0.49 g/plant, followed by T_9 (NPK 75% + Poultry Manure 25%) with 0.45 g/plant whereas minimum seed yield per plant 0.21 g/plant was recorded in T_0 (Control). Among the different applications of organic and inorganic fertilizers, the maximum test weight was seen in T_7 (NPK 50% + Farmyard Manure 50%) with 4.91 g, followed by T_9 (NPK 75% + Poultry Manure 25%) with 4.71 g whereas minimum test weight 2.75 g was recorded in T_0 (Control). The better yield and test weight observed in black cumin under the influence of organic and inorganic fertilizers such as farmyard manure (FYM), vermicompost, poultry manure, and recommended dose of fertilizer (RDF) can be attributed to several factors. These fertilizers enhance soil fertility, providing essential nutrients that promote robust plant growth and development. Organic fertilizers improve soil structure, nutrient availability, and microbial activity, resulting in improved nutrient uptake and assimilation by the plants. Inorganic fertilizers supplement specific nutrients lacking in the soil, further supporting optimal growth and grain filling. The combined effect of these fertilizers contributes to a better test weight in black cumin, indicating improved seed quality. The findings were in close conformity with earlier findings of Melkie *et al.,* (2008); Rahimi *et al.,* (2009); Valadabadi and Hossein (2011); Sheikh *et al.,* (2012); Bakhsh *et al.,* (2014); Singh and Singh (2016); Hossain *et al.,* (2018) and Ghosh *et al.,* (2019) in Black Cumin.

Summary and Conclusion

According to the current research, the use of combination of organic manures and inorganic fertilizers had a significantly positive impact on the growth and development of black cumin. Among the various treatments that were evaluated, T_7 yielded the most favourable results in terms of growth viz., plant height, number of flowers, capsules per plant, early flowering and maturation and yield viz., number of seeds per umbel, and seed yield per plant. T_7 consisted of NPK 50% + Farmyard Manure 50%.

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