Organic seed production technique with different date of sowing in black cumin (*Nigella sativa* L.)

ABSTRACT

Field experiments were conducted at the D' block of the Seed Unit, University of Agricultural Sciences, Dharwad, during the rabi seasons of 2021–22 and 2022–23. ~~These study~~This study focused on "Organic seed production techniques with different date of sowing in black cumin (*Nigella s~~S~~ativa* L.). Pooled data indicated that irrespective of soil application of organic manures and foliar spray of liquid bio-fertilizer application, the effect of dates of sowing was found ~~significant for~~significant for the seed yield and its components. Crop sown on November 1st fortnight (D_2) recorded a significantly higher number of ~~capsule~~capsules per plant (18.14), number of seeds per capsule (90.45), seed yield per plant (3.06 g), thousand seed weight (2.90 g) and seed yield per hectare (849.43 kg) which was superior over October 1st fortnight (D_1) (15.33, 86.93, 2.34g, 2.35g and 768.17kg, respectively).Soil application of 125% N equivalent through vermicompost + foliar application of cow urine spray @ 10% at flowering and 15 ~~Day~~ daysafter flowering (N_4) recorded significantly more number of capsules per plant (22.42), number of seeds per capsule (101.00), seed yield per plant (3.59 g), thousand seed weight (3.32 g) and seed yield per hectare (880.08 kg)superior over (50% N equivalent through FYM + 50% N equivalent through vermicompost)+ Foliar application of cow urine spray @ 10% at flowering and 15 days after flowering (N_6) (13.33,78.50, 2.01, 2.22and 757.67kg, respectively). The results highlighted the profound impact of organic manures and biofertilizers on improving black cumin seed production and quality.

Key words: Black cumin, vermicompost, cow urine spray, foliar biofertilizers, seed yield and organic manures.

UNDER PEER REVIEW

1. INRODUCTION

Black cumin (*Nigella sativa* L.), also known as Kalaunji, is a valuable minor seed spice crop having a chromosome number of 2n =14 and belonging to the Ranunculaceae family. This winter annual herb grows 20–90 cm tall, featuring finely divided leaves and delicate flowers in white, yellow, pink or pale purple hues. Its black, angular seeds are slightly aromatic, bitter and rich in fixed (36–38%) and volatile oils (0.5–1.0%), containing key bioactive compounds like thymoquinone, nigellidine and alpha-hederin. These compounds make black cumin a cornerstone in traditional medicine systems like Ayurveda, Unani and Siddha, where it is used to treat asthma, bronchitis, skin diseases and digestive disorders. The seeds also hold promise as antibacterial and anticancer agents, underscoring their importance in pharmaceutical applications (Paarakh, 2010).

India, known as the land of spices, grows 76 varieties of spices, with seed spices like coriander, cumin, fennel and fenugreek forming the economic backbone of the industry. Black cumin is cultivated in northern and eastern regions, including Punjab, Gujarat, Bihar and thrives in arid and semi-arid zones. States like Rajasthan and Gujarat dominate seed spice production, contributing over 80% of the country's output. The demand for organic black cumin cultivation is rising, driven by health-conscious consumers and export markets with strict organic standards. Sustainable practices such as crop rotation, vermicomposting, FYM, and organic foliar sprays like Panchagavya and cow urine are gaining prominence for enhancing soil fertility, plant health and seed yield while minimizing environmental impact (Singh and Solanki, 2015).

Seed spices play a significant role in our national economy because of their large domestic consumption and growing demand for export. Presently, a 43.00 lakh ha area is under seed spices cultivation with a production of 10.98 M metric tonnes annually in the country (Anon., 2023). Being seasonal crops, these are grown extensively in rotation with food crops and also as inter/mixed crops under rainfed/irrigated conditions. Seed spices are mainly cultivated in the states of Madhya Pradesh, Gujarat, Andhra Pradesh, Rajasthan whereas Karnataka produces 380.50 thousand ha of area is under seed spices cultivation with a production of 7.63 lakh metric tonnes annually and stands in fifth position in India. They also have sizeable areas in the states of, Haryana, Punjab, and Uttar Pradesh etc. Though 17 seed spices are grown in the country, coriander, cumin, fennel and fenugreek are pillars of economic importance. Ajwain seed, dill seed, celery, black cumin and poppy seeds too alsocontribute a minor share.

UNDER PEER REVIEW

Despite its growing importance, research and development on black cumin cultivation remain limited, especially in South India, where scientific guidance on optimized practices is scarce. Farmers in Karnataka's Northern Transition Zone are eager to adopt this high-value crop due to its rising global demand and premium pricing. Studies are now focusing on developing agro-techniques for organic seed production and identifying ideal sowing periods, typically October–November, to ensure optimal growth and yield. Such efforts aim to expand the cultivation of black cumin beyond its traditional northern strongholds, making it a significant contributor to sustainable agriculture and economic development in southern regions.

2. MATERIALS AND METHODS

The field experiment was conducted during *rabi* season of 2021-22 and 2022-23 in spilt plot design involving with two dates of planting *viz.*, October-I fortnight (D_1) and November-I fortnight (D_2)) and seven nutrition application *viz.*, 100% N equivalent through FYM + Foliar application of Panchagavya @ 3% at flowering and 15 ~~Day~~ days after flowering (N_1), 125% N equivalent through FYM + Foliar application of Cow urine spray @ 10% at flowering and 15 ~~Day~~ days after flowering (N_2), 100% N equivalent through vermicompost + Foliar application of Panchagavya @ 3% at flowering and 15 ~~Day~~ days after flowering (N_3), 125% N equivalent through vermicompost + Foliar application of Cow urine spray @ 10% at flowering and 15 ~~Day~~ days after flowering (N_4), (50% N equivalent through FYM + 50% N equivalent through vermicompost) + Foliar application of Panchagavya @ 3% at flowering and 15 ~~Day~~ days after flowering (N_5), (50% N equivalent through FYM + 50% N equivalent through vermicompost)+ foliar application of cow urine spray @ 10% at flowering and 15 days after flowering (N_6) and 100% recommended dose of fertilizers (Control) (N_7) in three replications.

2.1 Observations recorded

Observations on yield parameters were recorded using five labeled plants per plot selected randomly by avoiding the border plants. Observations on the following yield parameters*viz.*, Number of capsules per plant, n~~N~~umber of seeds per capsules, s~~S~~eed yield per plant (g), t~~T~~housand seed weight (g) and s~~S~~eed yield per plot (kg)were recorded at harvest.The seed yield obtained per plot was converted into seed yield per hectare and expressed in (kg ha^{-1}).

3. RESULTS AND DISCUSSION

In a crop like black cumin, seed yield is a function of yield attributes, irrespective of soil application of organic manures and foliar spray of liquid bio fertilizer application. Irrespective of soil application of organic manures and foliar spray of liquid bio fertilizer application, pooled data indicated that the effect of dates of sowing was found significant for the marked and consistent variation due to date of sowing ~~were~~

UNDER PEER REVIEW

that wasobserved for the seed yield and its components. Crops sown on November 1st fortnight (D_2) recorded a significantly higher number of capsules per plant (18.14), number of seeds per capsule (90.45), seed yield per plant (3.06 g), thousand seed weight (2.90 g) and seed yield per hectare (849.43 kg) superior over October 1st fortnight (D_1) (15.33, 86.93, 2.34g, 2.35g and 768.17kg, respectively). It might be attributed to better growth and development of plants in the optimum planting and it resulted ~~into~~ in abetter source to sink relationship due to the availability of balanced plant nutrition and adequate soil moisture unlike earlyOctober 1stplanting, which experienced adverse growth conditions and yielded less seed per hectare. Similar results were also observed by Kadhum (2009) while studying the effect of different sowing dates (15th October, 1st November, 15th November, 1st December, 15th December and 1st January) on yield and its components in nigella in Abu– Ghraib, Iraq. Vaseghi*et al*. (2013) also found that the planting dates had a substantial impact on the majority of attributes, with the first planting date (16th November) producing the highest yield in Isfahannian and Indian black cumin kinds. Kauser *et al.* (2016) also found similar results with fenugreek crop.

Seed yield components differed significantly due to soil application of organic manures and foliar spray of liquid manures in pooled data and individual two years experiments. Soil application of 125% N equivalent through vermicompost + foliar application of cow urine spray @ 10% at flowering and 15 ~~Day~~ daysafter flowering (N_4) recorded significantly more number of capsules per plant (18.14), number of seeds per capsule (90.14), seed yield per plant (5.05 g), thousand seed weight (2.90 g) and seed yield per hectare (849.43 kg)significantly more number of capsules per plant (22.42), number of seeds per capsule (101.00), seed yield per plant (3.59 g), thousand seed weight (3.32 g) and seed yield per hectare (880.08 kg)superior over (50 % N equivalent through FYM + 50% N equivalent through vermicompost)+ foliar application of cow urine spray @ 10% at flowering and 15 days after flowering (N_6) (13.33, 78.50, 2.01g, 2.22g and 757.67kg, respectively). This might be due to increased yield parameters like yield per plant, number of pods per plant, number of seeds per pods, weight of 1000 seeds, due to enhanced rates of photosynthesis and ~~the~~ biomass production (Roy and Singh, 2006). The better production of yield attributes and yield could be due to the supply of nutrients in balanced amount and available form. The increased growth in terms of plant height, branches per plant and expansion of leaf lamina provided greater sites for photosynthesis and diversion of photosynthates towards sinks. These results are in conformity with the findings of Darzi *et al*. (2012) in *Pimpinella anisum.* The present results are in agreement with the report of Darzi *et al*. (2007) in *Foeniculum vulgare,* Moradi *et al*. (2010) in *Foeniculum vulgare* and Nuthana (2017) in black cumin.

5. CONCLUSION

The study highlights the impact of sowing dates and organic nutrient management on black cumin (*Nigella sativa* L.) seed production. Sowing during the first fortnight of November (D_2) outperformed

UNDER PEER REVIEW

October sowing (D_1), resulting in higher seed yield and improved yield components such as the number of capsules per plant, seeds per capsule, and thousand-seed weight. Among nutrient treatments, applying 125% N equivalent via vermicompost combined with foliar cow urine spray (N_4) delivered the best results, significantly enhancing seed yield and quality. These findings emphasize that optimizing sowing schedules and adopting organic fertilization strategies can substantially boost black cumin production.

UNDER PEER REVIEW

Table 1. Effect of dates of sowing andapplication of nutrition on numberofcapsulesperplant in black cumin

Treatment	Numberofcapsulesperplant								
	2021-22			2022-23			Pooled		
	D_1	D_2	Mean	D_1	D_2	Mean	D_1	D_2	Mean
N_1	11.00	13.00	12.00	15.33	19.00	17.17	13.17	16.00	14.58
N_2	12.33	14.67	13.50	16.00	21.67	18.83	14.17	18.17	16.17
N_3	14.33	17.33	15.83	18.00	22.00	20.00	16.17	19.67	17.92
N_4	16.00	19.67	17.83	24.00	30.00	27.00	20.00	24.83	22.42
N_5	10.33	14.33	12.33	16.67	15.33	16.00	13.50	14.83	14.17
N_6	10.00	12.67	11.33	15.67	15.00	15.33	12.83	13.83	13.33
N_7	15.67	16.33	16.00	19.33	23.00	21.17	17.50	19.67	18.58
Mean	12.81	15.43	14.12	17.86	20.86	19.36	15.33	18.14	16.74
Factors	S.Em±	CD at 5%		S.Em±	CD at 5%		S.Em±	CD at 5%	
D	0.41	2.52		0.42	2.56		0.31	1.90	
N	0.90	2.63		1.50	4.39		0.85	2.49	
D×N	1.27	NS		2.13	NS		1.21	NS	

Legend: NS: Non-significance **Date of sowing (D)**: D_1- October I fortnight D_2- November I fortnight

Nutrition Application (N):

N_1:100 % N equivalent throughFYM + Foliar application of Panchagavya @ 3 % at flowering and 15 Day after flowering
N_2:125 % N equivalent throughFYM + Foliar application of Cow urine spray @ 10 % at flowering and 15 Day after flowering
N_3:100%Nequivalentthroughvermicompost + Foliar application of Panchagavya @ 3 % at flowering and 15 Day after flowering
N_4:125 % N equivalent through vermicompost + Foliar application of Cow urine spray @ 10 % at flowering and 15 Day after flowering
N_5:(50 % N equivalent throughFYM + 50 % N equivalent through vermicompost) + Foliar application of Panchagavya @ 3 % at flowering and 15 Day after flowering
N_6:(50 % N equivalent throughFYM + 50 % N equivalent through vermicompost)+ Foliar application of Cow urine spray @ 10 % at flowering and 15 Day after flowering
N_7:100 % Recommended Dose of Fertilizers (control)

UNDER PEER REVIEW

Table 2. Effect of dates of sowing andapplication of nutrition on numberofseedspercapsule in black cumin

Treatment	Numberofseedspercapsule								
	2021-22			2022-23			Pooled		
	D_1	D_2	Mean	D_1	D_2	Mean	D_1	D_2	Mean
N_1	75.67	84.67	80.17	82.00	91.00	86.50	78.83	87.83	83.33
N_2	78.33	86.67	82.50	84.00	93.00	88.50	81.17	89.83	85.50
N_3	90.33	90.33	90.33	96.67	96.67	96.67	93.50	93.50	93.50
N_4	96.00	99.67	97.83	102.33	106.00	104.17	99.17	102.83	101.00
N_5	83.00	80.00	81.50	89.33	86.33	87.83	86.17	83.17	84.67
N_6	74.00	76.67	75.33	80.33	83.00	81.67	77.17	79.83	78.50
N_7	89.33	93.00	91.17	95.67	99.33	97.50	92.50	96.17	94.33
Mean	83.81	87.29	85.55	90.05	93.62	91.83	86.93	90.45	88.69
Factors	S.Em±		CD at 5%	S.Em±		CD at 5%	S.Em±		CD at 5%
D	0.54		3.30	0.52		3.15	0.53		3.22
N	4.03		11.77	4.04		11.79	4.04		11.78
D×N	5.70		NS	5.71		NS	5.71		NS

Legend: NS: Non-significance **Date of sowing (D)**: D_1- October I fortnight D_2- November I fortnight

Nutrition Application (N):

N_1:100 % N equivalent throughFYM + Foliar application of Panchagavya @ 3 % at flowering and 15 Day after flowering
N_2:125 % N equivalent throughFYM + Foliar application of Cow urine spray @ 10 % at flowering and 15 Day after flowering
N_3:100%Nequivalentthroughvermicompost + Foliar application of Panchagavya @ 3 % at flowering and 15 Day after flowering
N_4:125 % N equivalent through vermicompost + Foliar application of Cow urine spray @ 10 % at flowering and 15 Day after flowering
N_5:(50 % N equivalent throughFYM + 50 % N equivalent through vermicompost) + Foliar application of Panchagavya @ 3 % at flowering and 15 Day after flowering
N_6:(50 % N equivalent throughFYM + 50 % N equivalent through vermicompost)+ Foliar application of Cow urine spray @ 10 % at flowering and 15 Day after flowering
N_7:100 % Recommended Dose of Fertilizers (control)

UNDER PEER REVIEW

Table 3. Effect of dates of sowing andapplication of nutrition on seedyieldperplantin black cumin

Treatment	Seedyieldperplant(g)								
	2021-22			2022-23			Pooled		
	D_1	D_2	Mean	D_1	D_2	Mean	D_1	D_2	Mean
N_1	1.94	2.60	2.27	1.99	3.16	2.58	2.09	2.92	2.50
N_2	2.13	2.72	2.42	2.28	3.37	2.83	2.24	3.08	2.66
N_3	2.16	2.78	2.47	2.62	2.74	2.68	2.43	2.80	2.62
N_4	2.86	3.90	3.38	3.31	4.15	3.73	3.12	4.07	3.59
N_5	1.92	2.60	2.26	2.20	3.07	2.63	2.10	2.87	2.49
N_6	1.41	2.19	1.80	1.64	2.64	2.14	1.57	2.45	2.01
N_7	2.50	2.87	2.69	3.02	3.54	3.28	2.80	3.23	3.02
Mean	2.13	2.81	2.47	2.44	3.24	2.84	2.34	3.06	2.70
Factors	S.Em±		CD at 5%	S.Em±		CD at 5%	S.Em±		CD at 5%
D	0.09		0.56	0.10		0.58	0.11		0.64
N	0.27		0.77	0.22		0.65	0.21		0.60
D×N	0.38		NS	0.32		NS	0.29		NS

Legend: NS: Non-significance **Date of sowing (D)**: D_1- October I fortnight D_2- November I fortnight

Nutrition Application (N):

N_1:100 % N equivalent throughFYM + Foliar application of Panchagavya @ 3 % at flowering and 15 Day after flowering

N_2:125 % N equivalent throughFYM + Foliar application of Cow urine spray @ 10 % at flowering and 15 Day after flowering

N_3:100%Nequivalentthroughvermicompost + Foliar application of Panchagavya @ 3 % at flowering and 15 Day after flowering

N_4:125 % N equivalent through vermicompost + Foliar application of Cow urine spray @ 10 % at flowering and 15 Day after flowering

N_5:(50 % N equivalent throughFYM + 50 % N equivalent through vermicompost) + Foliar application of Panchagavya @ 3 % at flowering and 15 Day after flowering

N_6:(50 % N equivalent throughFYM + 50 % N equivalent through vermicompost)+ Foliar application of Cow urine spray @ 10 % at flowering and 15 Day after flowering

N_7:100 % Recommended Dose of Fertilizers (control)

UNDER PEER REVIEW

Table 4. Effect of dates of sowing andapplication of nutrition on 1000seedweightin black cumin

Treatment	1000seedweight(g)								
	2021-22			2022-23			Pooled		
	D_1	D_2	Mean	D_1	D_2	Mean	D_1	D_2	Mean
N_1	2.16	2.62	2.39	2.11	2.84	2.48	2.14	2.73	2.43
N_2	2.01	2.79	2.40	2.20	3.00	2.60	2.10	2.90	2.50
N_3	2.45	2.78	2.61	2.75	2.90	2.83	2.60	2.84	2.72
N_4	2.96	3.89	3.42	2.75	3.70	3.23	2.85	3.80	3.32
N_5	1.92	2.52	2.22	2.03	2.74	2.39	1.98	2.63	2.30
N_6	1.98	2.31	2.14	2.23	2.35	2.29	2.10	2.33	2.22
N_7	2.56	2.94	2.75	2.78	3.18	2.98	2.67	3.06	2.86
Mean	2.29	2.84	2.56	2.41	2.96	2.68	2.35	2.90	2.62

Factors	S.Em±	CD at 5%	S.Em±	CD at 5%	S.Em±	CD at 5%
D	0.06	0.39	0.08	0.51	0.07	0.42
N	0.13	0.38	0.14	0.41	0.10	0.30
D×N	0.18	NS	0.20	NS	0.14	NS

Legend: NS: Non-significance **Date of sowing (D)**: D_1- October I fortnight D_2- November I fortnight

Nutrition Application (N):

N_1:100 % N equivalent throughFYM + Foliar application of Panchagavya @ 3 % at flowering and 15 Day after flowering

N_2:125 % N equivalent throughFYM + Foliar application of Cow urine spray @ 10 % at flowering and 15 Day after flowering

N_3:100%Nequivalentthroughvermicompost + Foliar application of Panchagavya @ 3 % at flowering and 15 Day after flowering

N_4:125 % N equivalent through vermicompost + Foliar application of Cow urine spray @ 10 % at flowering and 15 Day after flowering

N_5:(50 % N equivalent throughFYM + 50 % N equivalent through vermicompost) + Foliar application of Panchagavya @ 3 % at flowering and 15 Day after flowering

N_6:(50 % N equivalent throughFYM + 50 % N equivalent through vermicompost)+ Foliar application of Cow urine spray @ 10 % at flowering and 15 Day after flowering

N_7:100 % Recommended Dose of Fertilizers (control)

UNDER PEER REVIEW

Table 5. Effect of dates of sowing andapplication of nutrition on Seedyield in black cumin

Treatment	Seedyield(kgha^{-1})								
	2021-22			2022-23			Pooled		
	D_1	D_2	Mean	D_1	D_2	Mean	D_1	D_2	Mean
N_1	723.33	801.67	762.50	751.00	826.00	788.50	737.17	813.83	775.50
N_2	769.33	806.33	787.83	797.00	834.00	815.50	783.17	820.17	801.67
N_3	786.33	810.67	798.50	814.00	838.33	826.17	800.17	824.50	812.33
N_4	808.33	921.00	864.67	836.00	955.00	895.50	822.17	938.00	880.08
N_5	701.00	800.33	750.67	728.67	829.33	779.00	714.83	814.83	764.83
N_6	688.33	798.33	743.33	716.00	828.00	772.00	702.17	813.17	757.67
N_7	803.67	907.67	855.67	831.33	935.33	883.33	817.50	921.50	869.50
Mean	754.33	835.14	794.74	782.00	863.71	822.86	768.17	849.43	808.80
Factors	S.Em±		CD at 5%	S.Em±		CD at 5%	S.Em±		CD at 5%
D	8.45		51.43	8.34		50.74	8.39		51.08
N	14.32		41.78	14.27		41.67	14.24		41.57
D×N	20.24		NS	20.19		NS	20.14		NS

Legend: NS: Non-significance **Date of sowing (D)**: D_1- October I fortnight D_2- November I fortnight

Nutrition Application (N):

N_1:100 % N equivalent throughFYM + Foliar application of Panchagavya @ 3 % at flowering and 15 Day after flowering
N_2:125 % N equivalent throughFYM + Foliar application of Cow urine spray @ 10 % at flowering and 15 Day after flowering
N_3:100%Nequivalentthroughvermicompost + Foliar application of Panchagavya @ 3 % at flowering and 15 Day after flowering
N_4:125 % N equivalent through vermicompost + Foliar application of Cow urine spray @ 10 % at flowering and 15 Day after flowering
N_5:(50 % N equivalent throughFYM + 50 % N equivalent through vermicompost) + Foliar application of Panchagavya @ 3 % at flowering and 15 Day after flowering
N_6:(50 % N equivalent throughFYM + 50 % N equivalent through vermicompost)+ Foliar application of Cow urine spray @ 10 % at flowering and 15 Day after flowering
N_7:100 % Recommended Dose of Fertilizers (control)

UNDER PEER REVIEW

REFERENCE

Anonymous, 2023, Agriculture Statistics at a Glance 2023, Agriculture statistics division, department of agriculture and farmers' welfare, Ministry of Agriculture and Farmers Welfare, Goverment of India, New Delhi.

Darzi M T, Ghalavand A, Rejali F and Sephidkon F, 2007, Effects of vermicompost application on yield and yield components in fennel (*Foeniculum vulgare* Mill.). *Iranian Journal of Medicinal and Aromatic Plants Research,* 22(4): 276-292.

Darzi M T, Haj Seyed Hadi M R and Rejali F, 2012, Effects of the application of vermicompost and phosphate solubilizing bacterium on the morphological traits and seed yield of anise (*Pimpinella anisum* L.). *Journal of Medicinal Plants Research*, 6(2): 215-219.

Kadhum M H, 2009, Evaluation yield of some varieties of *Nigella sativa* L. under different climatic conditions. *Anbar Journal of Agricultural Sciences*, 7(1): 255-261.

Kauser H, Bhoomika H R and Ibaad M H, 2016, Effect of sowing dates and stage of pinching on growth, seed yield and quality of Fenugreek (*Trigonella foenum–graecum* L.). *Environmental Research*, 9(9): 1076-1078.

Moradi R, Rezvani M P, Nasiri M M And Lakzian A, 2010, The effect of application of organic and biological fertilizers on yield, yield components and essential oil of *Foeniculum vulgare* (Fennel). *Iran Journal of Agronomy Research*, 7(2): 625-635.

Paarakh P M, 2010, Nigella sativa Linn. A comprehensive review. Indian Journal of Natural Products and Resources, 1: 409–429.

Roy D K and Singh B P, 2006, Effect of level and time of nitrogen application with and without vermicompost on yield, yield attributes and quality of malt barley (*Hordeum vulgare*). *Indian Journal of Agronomy*, 51: 40-42.

Singh B and Solanki R K, 2015, Status of seed spices research and development in India. Indian Journal of Agricultural Sciences, 85 (2): 151–156.

UNDER PEER REVIEW

Vaseghi A, Ghanbari A, Heydari M and Davazdahemami S, 2013, Effect of sowing date and growing season on agronomical characters of Isfahanian and Indian black cumin. In: *Proceedings of 2nd National Congress on Medicinal Plants*, 15-16 May 2013, Tehran, Iran. 494.

UNDER PEER REVIEW

UNDER PEER REVIEW