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Economics of black cumin (*Nigella sativa* L.) cultivation as influenced by different elicitors and manual pinching under Bangalore conditions

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Abstract
Black cumin is an important spice cum medicinal crop mostly grown in northern parts of India and is being grown on small scale in south India, more specifically in certain areas of Karnataka as a *rabi* season crop owing to its high medicinal value. Considering the importance, demand and price offered for this spice cum medicinal crop across the country, farmers in the non-traditional areas like Karnataka are fascinated for the cultivation of black cumin. For profitable cultivation of this crop under Bengaluru conditions, efforts are needed to understand cultivation practices on scientific lines to realize maximum returns per unit area and time. In the recent years, the use of elicitors was found to be one of the best possible ways to achieve spectacular progress in increasing production, productivity and quality of seed spices. Hence, the study was taken up with foliar application of different elicitors and manual pinching in black cumin during *Rabi* seasons of 2018-19 and 2019-20 with an objective to study the cost-economics of elicitors in black cumin cultivation. The results of the investigation inferred that, the maximum gross returns (Rs 3,49,500 ha^{-1}) and net returns (Rs. 3,05,974 ha^{-1}) was from black cumin plants applied with salicylic acid at 50 ppm resulting in highest B:C ratio of 8.02. While, the treatment involving the application of ancymidol at 50 ppm had inferior effect and resulted in least net returns of Rs 1,21,248 ha^{-1} with a B:C ratio of 2.64, owing to its high cost of cultivation due to high price of chemical.

Keywords: black cumin (*Nigella sativa* L.), elicitors, gross returns, net returns, B:C ratio

Introduction
Black cumin (*Nigella sativa* L.) is an annual spicy herb, belongs to the *Ranunculaceae* family and native to Southern Europe, North Africa and Southwest Asia. It is a cool season crop, grows best at temperature ranging from 15 – 25 °C and can tolerate 5 – 30 °C with an annual rainfall of 400-500 mm (Kant *et al*., 2010) [4]. Black cumin is an important spice cum medicinal crop mostly grown in northern parts of India and is being grown on small scale in south India, more specifically in certain areas of Karnataka as a *rabi* season crop owing to its high medicinal value. It can be used as safe and effective herbal medicine for human benefit. Hence, the demand is on the rise with premium price in the market and the requirement is met out of material procured from distant north Indian markets. For profitable cultivation of this crop under Bengaluru conditions, efforts are needed to understand cultivation practices on scientific lines to realize maximum returns per unit area and time.

The use of elicitors may be one of the best possible ways to achieve spectacular progress in increasing production, productivity and quality of seed spices. Elicitors are the substances which induce physiological changes in the plant. Plants respond to these elicitors by activating an array of mechanisms, similar to the defence responses to pathogen infections or environmental stimuli, affecting the plant metabolism and enhancing the synthesis of phytochemicals (Baenas *et al*., 2014) [3]. These elicitors enhance the plant-secondary-metabolite synthesis and could play an important role in biosynthetic pathways for enhanced production of commercially important compounds that contribute for the quality of raw material (Angelova *et al*., 2006) [1]. Elicitation is relatively a recent strategy to induce bio-chemical and physiological changes in crop plants. Biotic (biological origin) and abiotic (chemical or physical origin) elicitors have been applied singly or in combinations at different growth stages of the crop plants. Understanding as to how plant tissues and their specific secondary metabolic pathways respond to specific elicitor at a particular crop growth stage would be the novel basis for designing protocols to enhance the production of secondary metabolites, in order to achieve higher quality in the product. Hence, it is apt to study the effect of different elicitors and manual pinching on growth, yield and quality of black cumin under Bangalore conditions, with an objective to study the cost-economics of elicitors in black cumin cultivation.

Material and Methods

The investigation entitled "Effect of elicitors and organic nutrient management on growth, yield and quality of black cumin (*Nigella sativa* L.)" was carried out during *rabi* season of 2018-19 and 2019-20 at the Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, University of Horticultural Sciences campus, Gandhi Krishi Vignana Kendra post, Bengaluru. The experiment was laid out in a randomized complete block design with 12 treatments and 3 replications and the seeds of black cumin variety Ajmer Nigella - 1 were procured from National research center on seed spices, Tabiji, Ajmer, Rajasthan and sown on 26th November, 2018 during first season and 20th October, 2019 during second season. The plots were watered immediately after sowing at alternate days till germination, thereafter the irrigation was given through drip irrigation system with 16 mm inline laterals with drippers of discharge 2 liters per hour spaced at 30 cm apart and laid in alternate rows.

Thinning was done at 30 days after sowing. The plots were kept free from weeds by regular hand weeding at three intervals *i.e.,* 30, 45 and 60 days after sowing. Elicitors were sprayed at 50 days after sowing (DAS) *viz*., Salicylic acid - 50 ppm, Chitosan - 100 ppm, Dry yeast – 5000 ppm, Potassium silicate - 200 ppm, NAA - 25 ppm, Kinetin - 25 ppm, Humic acid - 500 ppm, PGPR - 5000 ppm, Ancymidol - 50 ppm and Paclobutrazol - 50 ppm as foliar spray and pinching was done at 50 days after sowing, since the elicitors were sprayed at 50 DAS. Five plants in each treatment and in each replication were selected randomly and tagged for recording observations for plant characters and yield attributes. Damping off and collar rot diseases were observed at 30 and 40 DAS. Control measures are taken by drenching Capton at 1.5 g/l and Copper oxy chloride at 3 g/l at 30 and 40 DAS respectively. Harvesting was started based on the maturity of capsules, and the plants were cut back to the ground level by using secateurs and were tied into small bundles and stacked in threshing yard for drying with frequent turnings till moisture level was reduced.

Cost of cultivation (Total cost)

The prices of all the inputs and the labour cost that were prevailing at the time of their use were taken into consideration while estimating the cost of cultivation and presented in table 1. The quantity of elicitors used during the experimentation and their cost are described in table 2. The cost involved in cultivation of black cumin as influenced by application of different elicitors and manual pinching are presented in table 3 and expressed in rupees per hectare.

Gross returns

The gross income was worked out based on the prevailing market price of black cumin seeds (Rs. 250 per kg).

Net income

Net income per hectare was obtained by subtracting the cost of cultivation in gross income per hectare.

Benefit cost ratio

The benefit cost ratio was worked out by using the following formula.

$$\text{Benefit:cost ratio (B:C ratio)} = \frac{\text{Gross returns (Rs. ha}^{-1}\text{)}}{\text{Cost of cultivation (Rs. ha}^{-1}\text{)}}$$

Table 1: Cost of labour and inputs used for raising black cumin (*Nigella sativa* L.) in one hectare

Particulars	Number/Quantity	Unit cost (Rs.)	Total cost (Rs.)
Land preparation (Tractor)	8 hours	600/hour	4,800
FYM	5 t/ha	1850/t	9,250
Seeds	8 kg/ha	200/kg	1,600
Fertilizers (40:20:20 kg NPK/ha)			
Urea	86.8 kg	6.4/kg	556
SSP	125 kg	8.4/kg	1050
MOP	33.2 kg	16/kg	531
Sowing	5 labours	275/labour	1,375
Weeding	15 labours	275/labour	4,125
Plant protection chemicals			
Blitox	4 kg	760/kg	3,040
SAAF	6 kg	750/kg	4,500
Application of plant protection chemicals	4 labours	275/labour	1,100
Harvesting and processing	30 labours	275/labour	8,250
Packaging material	50 gunny bags	20/bag	1,000
Miscellaneous	Transportation and others	1500	1,500
Total			42,677

Table 2: Quantity and cost of elicitors used per hectare

Sl. No.	Particulars	Number/Quantity	Unit cost (Rs./g or ml)	Cost of elicitor (Rs.)	Cost of spraying (Rs.)	Total cost (Rs.)
1	Pinching at 50 days after sowing	10 labours	275/labour	-	-	2,750
2	Salicylic acid 50 ppm	20 g	1.2 /g	24	825	849
3	Chitosan 100 ppm	133 g	0.6/g	80	825	905
4	Dry yeast 5g/l	2 kg	3668/kg	7,336	825	9,161
5	Potassium silicate 200 ppm	235 ml	0.354/ml	83	825	908
6	NAA 25 ppm	10.5 g	9.6/g	101	825	926
7	Kinetin 25 ppm	10 g	566.4/g	5,664	825	6,489
8	Humic acid 500 ppm	220 g	0.3/g	66	825	891
9	PGPR 5000 ppm	6 kg	150/kg	900	825	7,725
10	Ancymidol 50 ppm	20 g	1500/g	30,000	825	30,825
11	Paclobutrazol 50 ppm	87 ml	8/ml	696	825	1,521

Note: Spray solution used per hectare was 400 litres

Table 3: Cost of cultivation of black cumin (*Nigella sativa* L.) as influenced by different elicitors (Rs. ha^{-1})

Treatments	FYM	Land preparation	Seeds	Sowing	Fertilizers	Elicitors	Weeding	Plant protection	Harvesting and threshing	Packaging material	Miscellaneous	Total cost
T_1	9,250	4,800	1,600	1,375	2,137	-	4,125	8,640	8,250	1,000	1,500	42,677
T_2	9,250	4,800	1,600	1,375	2,137	2,750	4,125	8,640	8,250	1,000	1,500	45,427
T_3	9,250	4,800	1,600	1,375	2,137	849	4,125	8,640	8,250	1,000	1,500	43,526
T_4	9,250	4,800	1,600	1,375	2,137	905	4,125	8,640	8,250	1,000	1,500	43,582
T_5	9,250	4,800	1,600	1,375	2,137	9,161	4,125	8,640	8,250	1,000	1,500	50,838
T_6	9,250	4,800	1,600	1,375	2,137	908	4,125	8,640	8,250	1,000	1,500	43,585
T_7	9,250	4,800	1,600	1,375	2,137	926	4,125	8,640	8,250	1,000	1,500	43,603
T_8	9,250	4,800	1,600	1,375	2,137	6,489	4,125	8,640	8,250	1,000	1,500	49,166
T_9	9,250	4,800	1,600	1,375	2,137	891	4,125	8,640	8,250	1,000	1,500	43,568
T_{10}	9,250	4,800	1,600	1,375	2,137	7,725	4,125	8,640	8,250	1,000	1,500	44,402
T_{11}	9,250	4,800	1,600	1,375	2,137	30,825	4,125	8,640	8,250	1,000	1,500	73,502
T_{12}	9,250	4,800	1,600	1,375	2,137	1,521	4,125	8,640	8,250	1,000	1,500	44,198

T_1 - Untreated control, T_2 - Pinching at 50 DAS, T_3 - Salicylic acid 50 ppm, T_4 - Chitosan 100 ppm, T_5 - Dry yeast 5g/l, T_6 - Potassium silicate 200 ppm, T_7 - NAA 25 ppm, T_8 -Kinetin 25 ppm, T_9 - Humic acid 500 ppm, T_{10} - PGPR 5000 ppm, T_{11} - Ancymidol 50 ppm, T_{12} - Paclobutrazol 50 ppm

Results and Discussion

The data on the economics of black cumin cultivation as affected by the usage of various elicitors and manual pinching at 50 days after sowing the crop is presented in table 4. The perusal of data clearly reveals that, the cost of cultivation was maximum (Rs 73,502 ha^{-1}) due to the application of ancymidol at 50 ppm owing to the high cost of chemical. Application of salicylic acid at 50 ppm caused for an expenditure of Rs 43,526 ha^{-1} and the least expenditure of Rs 42,677 ha^{-1} was for cultivation of black cumin without any elicitor treatment (control).

The gross returns was maximum from black cumin plants applied with salicylic acid at 50 ppm (Rs 3,49,500 ha^{-1}), followed by NAA at 25 ppm (Rs 3,26,500 ha^{-1}). On the other hand, the gross returns was least from plants applied with ancymidol at 50 ppm (Rs 1,94,750 ha^{-1}), followed by PGPR at 5000 ppm (Rs 1,97,500 ha^{-1}) and control plants gave a gross returns of Rs 2,05,250 ha^{-1} which was higher than the application of ancymidol at 50 ppm.

Net returns was maximum (Rs. 3,05,974 ha^{-1}) from plants treated with salicylic acid at 50 ppm, resulting in highest B:C ratio of 8.02, followed by NAA at 25 ppm (Rs 2,82,897 ha^{-1}) with a B:C ratio of 7.48 and plants pinched at 50 days after sowing gave a net returns of Rs 2,31,323 ha^{-1} with a B:C ratio of 6.09.

The increased net returns and benefit cost ratio with the foliar application of salicylic acid may be attributed to low cost of the chemical resulting in lower cost of production coupled with maximum seed yield obtained on spraying salicylic acid as compared to other elicitors tried during the course of investigation. It is very pertinent to note that, the chemical was very effective even at very low concentration of only 50 ppm. Similar trends were reported by Verma and Sen (2008) [7], Singh *et al.* (2012) [5] and Meena and Singh (2005) [5] in coriander.

The treatment involving the application of ancymidol at 50 ppm had inferior effect and resulted in least net returns of Rs 1,21,248 ha^{-1} with a B:C ratio of 2.64, owing to its high cost of cultivation due to high price of chemical. A similar conclusion was also made by Arpitha (2019) [2], where, application of methyl jasmonate resulted in negative B:C ratio in black cumin cultivation.

Table 4: Economics of black cumin (*Nigella sativa* L.) cultivation as influenced by different elicitors and manual pinching

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C ratio
T_1 – Control	42,677	2,05,250	1,62,573	4.80
T_2 - Pinching at 50 DAS	45,427	2,76,750	2,31,323	6.09
T_3 - Salicylic acid 50 ppm	43,526	3,49,500	3,05,974	8.02
T_4 - Chitosan 100 ppm	43,582	2,26,250	1,82,668	5.19
T_5 - Dry yeast 5000 ppm	50,838	2,24,250	1,73,412	4.41
T_6 - Potassium silicate 200 ppm	43,585	2,62,500	2,18,915	6.02
T_7 - NAA 25 ppm	43,603	3,26,500	2,82,897	7.48
T_8 - Kinetin 25 ppm	49,166	2,44,750	1,95,584	4.97
T_9 - Humic acid 500 ppm	43,568	2,35,250	1,91,682	5.39
T_{10} - PGPR 5000 ppm	44,402	1,97,500	1,53,098	4.44
T_{11} - Ancymidol 50 ppm	73,502	1,94,750	1,21,248	2.64
T_{12} - Paclobutrazol 50 ppm	44,198	2,31,250	1,87,052	5.23

Note: Selling price of seed: Rs 250/kg, Gross returns was worked out for pooled yield of two years experiment

Conclusion

From the above results it can be inferred that, the highest expenditure of Rs 73,502 ha^{-1} was incurred on spraying the black cumin with ancymidol at 50 ppm and least expenditure of Rs 42,677 ha^{-1} was incurred for control plants. The gross returns of Rs 3,49,500 ha^{-1} was maximum for black cumin plants applied with salicylic acid at 50 ppm. On the other hand, the gross returns of Rs 1,94,750 ha^{-1} was least for the plants applied with ancymidol at 50 ppm. Net returns of Rs. 3,05,974 ha^{-1} was maximum for crop sprayed with salicylic acid at 50 ppm, resulting in highest B:C ratio of 8.02, followed by NAA at 25 ppm with net returns of Rs. 2,82,897 ha^{-1} and B:C ratio of 7.48.

References

1. Angelova Z, Georgiev S, Roos W. Elicitation of plants. Biotechnol and Biotechnol Eq 2006;20(2):72-83.
2. Arpitha HS. Studies on varietal performance and effect of elicitors on growth, yield and quality of black cumin

(*Nigella sativa* L.). M.Sc. (Hort.) Thesis, Univ. Hort. Sci., Bagalkot (India) 2019.
3. Baenas N, Garcia-Viguera C, Moreno DA. Elicitation: A tool for enriching the bioactive composition of foods. Molecules 2014;19:13541-13563.
4. Kant K, Anwer MM, Meena SR, Meena RS. Advance production technology of nigella, 1st Edition, Ajmer 2010.
5. Meena, Singh S. Studies on effect of sowing dates, nitrogen and plant growth regulators on growth, yield and quality of coriander (*Coriandrum sativum* L.) cv. RCr-41. M.Sc. Thesis, Maharana Pratap Univ. Agric. and Technol., Udaipur (India) 2005.
6. Singh D, Singh PP, Naruka IS, Rathore SS, Shaktawat RP. Effect of plant growth regulators on growth and yield of coriander. Ind J Hort 2012;69(1):91-93.
7. Verma P, Sen NL. The impact of plant growth regulators on growth and biochemical constituents of coriander (*Coriandrum sativum* L.). J herbs spices and medicinal Pl 2008;14(3-4):144-153.