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Effect of GA_3 and AAA on growth and yield of black cumin [*Nigella sativa* L.]

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India, 'the land of spices' is the largest producer, consumer and exporter of spices in the world. Black cumin [*Nigella sativa* L.] is one of the important seed spices, belongs to family Ranunculaceae and it is called 'kala jeera' in Bengali. In India, black cumin is generally cultivated in the states of Punjab, Himachal Pradesh, Madhya Pradesh, Assam, Bihar and West Bengal. The seed is believed to be carminative, diuretic, lactagogue and vermifuge due to presence of volatile oil. Though India produces the maximum amount of black cumin, but yet the productivity is not satisfactory. Like other crops, application of growth regulators may have an important role in increasing the productivity of black cumin. In this backdrop, the present investigation was undertaken to study the effect of GA_3 and NAA on growth and yield of black cumin.

An investigation was carried out at Bidhan Chandra Krishi Viswavidyalaya, Nadia situated in Gangetic Alluvial Plains of West Bengal, India during 2008-09 and 2009-10. The location is situated approximately at 23^0 N latitude and 80^0 E longitude with an altitude of 9.75m MSL. The soil of experimental field was sandy loam type having organic carbon content 0.41%, total nitrogen 0.05%, available phosphorus 21.11 kg ha^{-1}, available potassium 178.80 11 kg $ha^{-1}$with a soil pH of 6.9.

The experiment was laid out in randomized block design with 9 treatments and 3 replications. Two growth regulators *viz.*, GA_3 and NAA were sprayed with four concentrations (25 ppm, 50 ppm, 75 ppm and 100 ppm) each for two times, whereas, spraying with water was kept as control. The treatment combination were- T_1- GA_3 25 ppm, T_2- GA_3 50 ppm, T_3- GA_3 75 ppm, T_4- GA_3 100 ppm, T_5- NAA 25 ppm, T_6- NAA 50 ppm, T_7- NAA 75 ppm, T_8- NAA 100 ppm and T_9- Control

The recommended dose of fertilizers@ 30:40:45 kg NPK ha^{-1} and FYM @ 15 t ha^{1} was applied to all plots under experimentation. Half dose of Nitrogen and full dose of Phosphorous and Potash were applied during land preparation and remaining half dose of Nitrogen was applied 30 days after sowing. The sources of N, P_2O_5 and K_2O were Urea, Single Super Phosphate and Muriate of Potash respectively. The data pooled over two growing seasons on growth and yield parameters and volatile oil content in seed were recorded and analysed statistically (Gomez and Gomez, 1984). Volatile oil content in seed was estimated by steam distillation method adopting standard procedure (AOAC, 1975).

Among the growth parameters, plant height (65.27 cm) was maximum with the spraying of GA_3 100 ppm followed by GA_3 75 ppm (64.03 cm) and NAA 100 ppm (61.38 cm), whereas, the shortest plant height (44.42 cm) was recorded with water spray. The number of branches per plant (11.94) were found maximum with the spraying of NAA 100 ppm followed by NAA 75 ppm (11.10) and GA_3 100 ppm (10.59) and minimum (6.94) with water spray. The result is supported by Saha (2007), where, the maximum plant height and leaf area were recorded with application of GA_3.

It is well known that GA_3 promotes the vegetative growth by rapid cell division in the apical meristem. It might be the reason behind obtaining the higher plant height with increased concentration of GA_3 rather than NAA. In another experiment, Saha and Samirullah (2007) found that with application of 100 kg N ha^{-1}, GA_3 sprayed plant utilized the available nitrogen from soil more effectively and resulted in better growth attributes.

Number of branches per plants, seed pods per plant and 1000 seed weight are the key factors for determining seed yield of black cumin. In the present study, maximum (61.92) number of pods per plant was recorded with NAA100 ppm followed by GA_3 75 ppm (42.68) and NAA 75 ppm (59.59). Length of fruit, diameter of fruit and 1000 seed weight did not vary significantly with the treatments, though diameter of fruit and 1000 seed weight were found maximum with NAA 100 ppm.

The plants in the control plots showed inferior result in all aspect. The seed yield per hectare was found maximum (13.20 q ha^{-1}) with spraying of NAA 100 ppm and the minimum (8.25 q ha^{-1}) seed yield was observed with spraying of GA_3 50 ppm. Pramanik *et al.* (2007) found that application of GA_3 was found more effective than other growth regulators like IBA, zeatin or kinetin for increasing number of

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capsules and seed yield in black cumin. Volatile oil content is one of the important qualitative parameters for seed spices. The volatile oil content in black cumin seed varied significantly among the treatments. Maximum volatile oil content (1.35%) was associated with spraying of NAA 100 ppm.

Table 1: Effect of growth regulators on growth and yield of black cumin

Treatments	Plant height (cm)	Branches plant^{-1}	Pods plant^{1}	Fruit length (cm)	Diameters of fruits (mm)	1000 seed weight (g)	Seed yield (q ha^{-1})	Volatile oil (%)
GA_3 25 ppm	50.87	7.87	46.54	1.21	3.07	2.36	9.33	0.73
GA_3 50 ppm	54.15	7.34	39.28	1.19	3.31	2.28	8.25	0.83
GA_3 75 ppm	64.03	10.00	42.68	1.25	3.01	2.59	9.18	1.19
GA_3 100 ppm	65.27	10.59	51.66	1.30	3.34	2.45	10.26	1.26
NAA 25 ppm	50.42	7.44	54.23	1.39	3.20	2.28	8.50	1.22
NAA 50 ppm	58.55	7.60	55.67	1.10	3.41	2.22	9.54	1.15
NAA 75 ppm	60.26	11.10	59.59	1.37	3.05	2.55	11.38	1.31
NAA 100 ppm	61.38	11.94	61.92	1.22	3.60	2.69	13.20	1.35
Control	44.42	6.94	48.88	1.31	2.92	2.28	9.21	0.50
SEm (±)	**3.97**	**0.93**	**0.53**	**0.07**	**0.18**	**0.23**	**0.35**	**0.07**
LSD (0.05)	**1.65**	**2.77**	**1.59**	**NS**	**NS**	**NS**	**1.05**	**0.21**

Note: NS-not significant

It is evidenced from the data that growth regulators play a positive role towards increasing the seed yield and to influence the other physical characters. GA_3 has a significant function on cell division in the apical meristem of a plant, whereas, NAA at higher concentration induces the reproductive phase. Hence the vegetative parameters showed better results with increased concentration of GA_3, however, seed yield and other yield attributes showed significant increase with the application of NAA at higher concentration.

Hence, in Gangetic alluvial plains NAA at 100 ppm is recommended to obtain maximum seed yield of black cumin.

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