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EFFECT OF PLANT HORMONES ON GROWTH, AND YIELD OF BLACK CUMIN (*NIGELLA SATIVA L.*)

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An interesting very much important potable trial was carried out to study the effect of foliar spray of 0 (de-ionized water), 10^{-6}, 10^{-5} and 10^{-4} M each of gibberellic acid (GA3),Abscisic acid (ABA),Zeatin (Zea) or Kinetin (KIN) at 40 days after sowing (vegetative stage) on growth and yield of black cumin (*Nigella sativa* L.) Application of GA at 10^{-5}M concentration was found to be more effective than K or the other plant growth hormones in promoting root, shoot length, plant dry weight, leaf number, leaf area and branch number observed 70 days after sowing (DAS). Application of 10^{-5}M GA, resulted in more capsule number, seed yield and seed yield merit, which was found increased by 43.33, 43.85 and 53.62% respectively.

Keywords: Abscisic acid; Black cumin; Gibberellic acid; Growth; Kinetin; Zeatin.

Hormones are organic compounds naturally synthesised in higher plants that influence growth and development.They are usually active at the site different from where they are produced and are only present and active in very small quantities. India is the home to a number of spices, prominent among which is black cumin, locally known as 'kalonji'. The herb is extensively used as food as well as medicinal formulations[1]. It has a high remedial medicinal value as a carminative, stimulant, diaphoretic, emanagogue and galactagogue, as well as in curing gastrointestinal disorders, urinary tract infections, kidney or bladder stones, toothache[2] and even cancer[3].It is of great medicinal properties and values, it acts as an anticancer drug plant. Ironically the economic cultivation of this miraculous herb has not been realized. Most of its supply still comes from wild resources. There is a need to augment its productivity to cope with the increasing demand and to fulfill the human ever ending need.. In this context, the use of plant growth regulators particularly KIN and GA and other growth regulators/hormones could be useful, as they have been shown to possess potential and great capacity to enhance crop yield and productivity. Therefore, this study was aimed at comparing and characterizing the effects of GA and KIN on the growth and yield of black cumin.

A completely randomized block design experiment was carried out in the Department of Horticulture, Hulimavu, Govt. of Karnataka, Bangalore. The soil of the experimental pots was slightly alkaline, sandy loamy in texture and moderate in available N, P and K.A uniform basal dose (450,300 and 78 mg) of N, P and K, in the form of urea of potash and other forms of biofertilizers, single super phosphate and marinate of potash, was applied at the time of sowing in each pot. Seeds were obtained from the Regional Research Institute of Unani Medicine and Indian Institute of Horticulture Research (IIHR) Bangalore. They were surface sterilized with 0.01% mercuric chloride and 70% alcohol solution followed by repeated washings, with double distilled water. The seed were then sown in earthen pots filled with soil and farmyard manure, mixed in a ratio of 9.1. At 40 days after sowing, the plants were sprayed with 10^{-6}, 10^{-5} or 10^{-4}M each of GA_3 or KIN at the rate of 5 cm^3 $plant^{-1}$. The control set was sprayed with de-ionized water and each treatment was replicated thrice.

Observation were recorded for shoot length, leaf number, leaf area, dry weight and branch number $plant^{-1}$. Leaf area was calculated according to Watson[4]. Dry weight was noted carefully and with great accuracy, recorded by drying the plants at 80°C until constant weight. At maturity (130 DAS), capsules $plant^{-1}$, seeds $capsule^{-1}$, 100-seed weight, seed yield $plant^{-1}$ and harvest index (HI) were determined accurately and precisely. Three plants from each treatment were removed and capsule number was recorded. Random samples were taken from threshed seeds for determination of 100 seed weight. The seed yield from three randomly selected plants was noted after threshing the seeds. Harvest index was determined by dividing the seed yield with that of the biological yield. Seed yield (SYM) was obtained using the method given by Imsande[5].

Table 1. Effect of phytohormones applied at 40 days after sowing (DAS) on shoot length, leaf number, leaf area, dry weight and branch number plant $^{-1}$ of *Nigella sativa* L. at 70 DAS.

Phytohormones (P)	Molar concentrations (C)				
	0	10^{-6}	10^{-5}	10^{-4}	Mean
			Shoot length plant $^{-1}$ (cm)		
Kinetin	42.21	51.25	66.11	65.13	56.18
GA_3	44.51	60.24	78.51	75.12	64.60
Mean	43.36	55.75	72.31	70.13	
L.S.D.at 5%	P=2.4	C=2.8	PXC=5.1		
			Leaf number plant $^{-1}$		
Kinetin	28.02	32.10	37.81	36.62	36.64
GA_3	29.01	34.71	42.15	40.02	36.47
Mean	28.51	33.41	39.98	38.32	
L.S.D.at5%	P=2.1	C=2.4	PxC=4.1		
			Leaf area (cm^{2}plant $^{-1}$)		
Kinetin	285.11	333.41	385.12	370.14	343.45
GA_3	295.16	354.11	430.25	412.17	372.92
Mean	290.13	343.76	407.68	391.15	
L.S.D.at 5%	P=21.2	C=24.2	PxC=42.3		
			Dry weight (g plat $^{-1}$)		
Kinetin	1.66	1.98	2.48	2.39	2.13
GA_3	1.78	2.24	2.83	2.79	2.41
Mean	1.72	2.11	2.66	2.59	
L.S.D.at 5%	P=0.18	C=0.21	PxC=0.36		
			Branch number plant $^{-1}$		
Kinetin	7.60	8.62	9.95	9.38	8.89
GA_3	7.55	9.05	10.90	10.50	9.50
Mean	7.57	8.83	10.43	9.94	
L.S.D at 5%	P=0.41	C=0.52	PxC=0.71		

Analysis of variance was carried out and LSD (P=0.05) was calculated[6].

The study revealed that application of GA_3, or KIN at 10^{-5} M concentration was most promotive for shoot length, plant dry weight, leaf number, leaf area, and branch number plant^{-1}, in comparison with all other treatments of GA_3, or KIN, which proved either ineffective or supra optimal or no proper response in growth and development.However, the effect of KIN was comparatively subdued. Which may be, because endogenous cytokinine is seldom limiting in crop plants[7] and hence exogenously applied KIN seems relatively less effective.

Gibberellins are normally used in plant regeneration,GA_3 is essential for meristem culture of some species.In general,gibberellins induce elongation of internodes and the growth of meristems or buds *in vitro*. Gibberellins usually inhibit adventicious root as well as shoot formation. GA_3 is a well known causative of wall extensibility[8], leading to cell expansion, elongation of internodes[7] and ultimately increased shoot length (Table 1). Moreover, GA_3 also induces leaf area expansion, which

Table 2. Effect of phytohormones applied at 40 days after sowing (DAS) on yield attributes of *Nigella sativa* L.

Phytohormones	Molar concentrations (C)				
(P)	0	10^{-6}	10^{-5}	10^{-4}	Mean
			Capsules plant $^{-1}$		
Kinetin	16.20	18.35	21.5	20.90	19.24
GA_3	16.51	19.70	23.75	23.01	20.74
Mean	16.36	19.02	22.62	21.96	
L.S.D.at 5%	P=1.0	C=1.2	PxC=2.1		
			100 seed weight (mg)^{1}		
Kinetin	245	240	251	245	245.3
GA_3	250	245	255	252	250.5
Mean	247.5	242.5	253.0	248.5	
L.S.D.at 5%	P=NS	C=NS	PxC=NS		
			Seeds capsule $^{-1}$		
Kinetin	52.10	52.90	54.01	53.701	53.18
GA_3	52.01	53.12	55.22	55.74	54.02
Mean	51.05	53.014	54.61	54.72	
L.S.D.at5%	P=NS	C=NS	PxC=NS		
			Seed yield (g plant^{-1})		
Kinetin	1.12	1.25	1.50	1.41	1.32
GA_3	1.20	1.32	1.72	1.52	1.44
Mean	1.16	1.29	1.61	1.74	
L.S.D.at 5%	P=0.10	C=0.12	PxC=0.21		
			Harvest index (%)		
Kinetin	40.35	41.50	42.85	43.03	41.93
GA_3	40.50	41.92	43.41	42.86	42.17
Mean	40.42	41.71	43.13	42.95	
L.S.D.at 5%	P=0.18	C=0.26	PxC=0.37		
			Seed yield merit		
Kinetin	45.36	51.87	64.37	60.67	55.57
GA_3	48.60	55.33	74.66	65.14	60.93
Mean	46.98	53.6	69.51	62.90	
L.S.D.at 5%	P=2.3	C=2.9	PxC=4.7		

NS=not significant.

inturn manifests itself in the form of more dry matter (Table 1). This postulation is supplemented by the observed strong positive correlation between leaf area and dry matter(r =0.921**).Similar stimulatory effects of KIN, on the aforesaid parameters, can be like wise accounted by the promotion of the growth of new buds and tillers due to cytokinins[9] and the stimulation of cell division and enlargement by KIN[10, 11].

With reference to various yield attributing characters taken under study, viz number of capsules, seed yield merit (Table 2), GA_3 was found to outperform KIN, with 10^{-5} concentraiton of both hormones proving relatively more effective than others. On the contrary, 100-seed weight and number of seeds capsule^{-1}, were not influenced. Such finding is in accordance with that of Khan *et al.*[12,13].The influence of GA_3 on the above mentioned parameters may be ascribed to the stimulation of growth causing an overall increase in yield. KIN also increased

the formation of new capsules through prevention of pre mature abortion of flowers and pods[14], resulting in increased overall yield at maturity. Thus, the importance of the plant growth hormones are well understood in the growth and development.

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