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RESEARCH PAPER

Influence of plant bio-regulators on growth and yield of garlic (*Allium sativum* L.)

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Abstract : An experiment was carried out at Horticulture Research Farm, Department of Applied Plant Science, Babasaheb Bhimrao Ambedkar University,Lucknow during November 2012 to April2013 to study the influence of plant bio-regulators on growth and yield of garlic cv. Yamuna Safed- 4 (G232). The experiment consisted of foliar application of different doses of PBRs *i.e.* BA (25, 50, 75 and 100 ppm), NAA (100, 200, 300 and 400 ppm) and GA_3 (50, 100,150 and 200ppm).The experiment was arranged in Randomized Block Design and the treatments were replicated thrice. The result showed thatmaximum plant height (70.53 cm), number of leaves per plant (8.43), length of leaves (36.12 cm) and basal diameter of plant (14.60 mm)were recorded under the treatment T_9 *i.e.* application of GA_3@ 50 ppm. The yield attributing parameters were also observed better in terms of diameter of bulb(5.42 cm), number of cloves per bulb (40.55 cm), fresh weight of bulb(47.85 g) and yield (22.75 ton/ha) under GA_3@ 50 ppm treatment followed by NAA @ 100 ppm.

Key Words : Garlic, Bio-regulators, BA, NAA, GA_3, Growth and yield

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INTRODUCTION

Garlic (*Allium sativum* L.) is the foremost alliouaus vegetable belongs to family Alliaceae (Leliaceae). It is a frost hardy bulbous perennial, erect herb having white narrow flat leaves and bears small white flower and bulbils. Central Asia and Southern Europe especially Mediterranean region is believed to be the origin of garlic (Thompson and Kelly, 1957). Garlic is the second most widely used cultivated Alliums after onion. It has long been recognized all over the world as a valuable spice for foods and a popular remedy for various ailments and physiological disorders. Garlic is also belived to be one of the most important medicinal plant which have broad nutroprotective properties. The important medicinal properties of garlic are mentioned in Egyptian text CodexEmber's (1500BC), Chinese literature and charak sanhita, Manu Sanhita and also in Indian clinical tradition *viz.*, Tibbi, Unani and Aurveda. The study (Bakri and Douglas, 2005;Rees *et al.*, 1993;Yoshida *et al.*,1998;Augusti and Sheela, 1996; Anwar and Meki, 2003; Kiesewetter *et al.*, 1991; Ali and Thompson, 1995; Bordia *et al.*, 1975; Thompson *et al.*, 2000; Ali *et al.*, 2000), revealed that garlic exhibits antibiotics,antioxidants, anticoagulant, hypocholesterolarmic and hypoglycemic activities. It has potentiality to reduce blood pressure level. Garlic could have a protective nature against gastrointestinal neoplasis and also be usefull as co-adjuvant therapy in the treatment of diabetes and some of its physiological complications. It has a significant effect in both ventricular and super ventricular arrhythmias, protective effect on the elastic properties of the aorta related toaging in human.

To enhance the garlic production and productivity as well as quality various package of practices are being adopted among them Plant bio regulators (PBRs) have been known to play vital role in bulbing of garlic. It has also been reported

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that foliar application of PBRs stimulates to form lateral buds and increase the no. of cloves per bulbs. The bio- regulators comprise of both retardants and promoters which when use in appropriate concentration, much influence on the plant architecture in a typical form. It is evident from the literature that the time and the site of application along with concentrations and formulation of different exogenously applied growth regulators are considered as beneficial factor for improving the productivity and quality of horticultural crops, but a little information is available for their effect of garlic. Therefore, an attempt was made to evaluate the effectiveness of different concentration of PBRs on the growth and yield of garlic which might be help for substantial contribution to the nation.

MATERIAL AND METHODS

The experiment was conducted to assess the influence of foliar application of Plant bio- regulators on growth and yield of garlic at the Horticulture Research Farm, Department of Applied Plant Science, Babasaheb Bhimrao Ambedkar University, Lucknow 226025 during the year November 2012 to April 2013.There were 13 different treatments comprising three different Plant Bio-regulators (BA, NAA and GA_3) each in four different doses *i.e.* 25, 50, 75 and 100 ppm of BA; 100,200,300 and 400 ppm of NAA and 50,100,150 and 200 ppm of GA_3 and one control (water spray). Each of them applied at 30, 60 and 90 days after planting (DAP).The experiment was laid out in the Randomized Block Design (RBD). The treatment was replicated three times and the whole plot was divided in to three blocks each representing a replication. Each block was then divided in to thirteen units plot of 0.75×0.75 m^2 in sizes. The blocks were separated from each other by one meter and each plot within the same block was also separated from each other by 50 cm. Seed cloves of a cultivar G-323 (Yamuna Safed-4) of garlic, collected from National Horticulture Research and Development Foundation (NHRDF) Kanpur were used as the propagating materials in this experiment. The cloves of uniform size were selected for planting. The cloves were planted in rows with 15 x15 cm spacing. The experimental plot were fertilized with FYM, Urea and DAP (Di- ammonium phosphate) and MOP (Muriate of potash) @ 25t/ha, 120kg/ha, 100kg/ha, and 80 kg/ ha, respectively. Total amount of FYM and DAP were added to the soil at the time of final land preparation. Urea and MOP were top dressed in two equal splits at 30 and 60 days after planting the cloves. After harvesting the bulbs and cloves were kept for drying in the dryer about 65 ± 5^0C temperature for 48 hours after taking the fresh weight. The observed data were statistically analyzed using Analysis of variance as formulated by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect of PBRs on growth parameters of garlic :

The maximum plant height (Table 1) at 45, 75, 105 and 135 days after planting (DAP) was 38.63cm, 50.72cm,68.98cm and 70.53cm, respectively were observed in the treatment T_9 (GA_3 @ 50 ppm) followed by T_5 (NAA @ 100 ppm) and T_{10} (GA_3 @ 100 ppm). Whereas the least mean plant height values noted at 45, 75, 105 and 135 DAP were (28.43cm, 41.53cm, 58.35cm and 63.77cm, respectively) in the untreated control.These results are in conformation with the findings of Maurya and Lal (1975), Bhople *et al*. (1999), Shakhda and Gajipara (1998) and Tiwari *et al*. (2003).

The data presented in Table 1 showed that the maximum number of leaves (4.70, 6.77, 7.77 and 8.43, respectively at 45, 75, 105 and 135 DAP) were observed with the application of GA3@ 50 ppm while the minimum number of leaves (3.70, 4.32, 6.17 and 7.23, respectively) were obtained in the untreated control plants. Similar trend was also observed by Maurya and Lal (1975) and Shakhda and Gajipara (1998).

Data recorded on leaf length showed that GA_3 @ 50 ppm has positive effect on improvement of leaf length at 45, 75, 105, and 135 DAP (30.61 cm, 33.11 cm, 35.11 cm and 36.12 cm, respectively).Whereas, the least mean length of leaves was noted under the control. These results corroborated with the finding of Mandal *et al*. (2003) and Patel *et al*. (2010). The increase rate of leaf length was decreased at 135 DAP might be due to increase in temperature (data not shown) during this period. The basal diameter was recorded at 45, 75, 105 and 135 DAP (Table 1) and the maximum mean diameter at basal portion (7.03 mm, 10.40 mm, 13.83 mm and 14.60 mm, respectively) was noted with T_9(GA_3@ 50 ppm) .The minimum mean diameter was recorded (4.80 mm, 7.53 mm, 9.30 mm and 10.43 mm, respectively recorded at 45, 75, 105 and 135 DAP) in untreated control.

Such growth behavior might be due to enhancement of growth and apical dominance. The growth regulators are involved in enhancing photosynthetic activity, efficient assimilation of photosynthetic products and it resulted in rapid cell division and cell elongation in the growing portions of the plant or stimulation of growth besides increasing uptake of nutrients.

Effect of PBRs on yield and its attributes :

The result of this study indicated significant variation due to effect of growth regulators in yield and it's attributes (Table 2) *viz.*, equatorial and polar diameter of bulb, fresh and dry weight of bulb, number of cloves, fresh and dry weight of 10 selected cloves, yield per hectare etc. all these component were consistently found superior in all the growth regulators treatments compared to control. These were significantly the highest (5.42cm and 4.38cm, 47.85g and16.15 g, 45.33, 15.17g

Table 1 : Effect of PBRs on growth parameters of garlic

Treatments	Plant height (cm)				No. of leaves/plant				Length of leaves (cm)				Basal diameter of plant (mm)			
	45 DAP	75 DAP	105 DAP	135 DAP	45 DAP	75 DAP	105 DAP	135 DAP	45 DAP	75 DAP	105 DAP	135 DAP	45 DAP	75 DAP	105 DAP	135 DAP
T_0-Control	28.43	41.53	58.35	63.77	3.70	4.32	6.17	7.23	24.38	26.88	28.88	29.88	4.80	7.53	9.30	10.43
T_1 - BA @25 ppm	32.75	43.57	61.33	65.95	4.63	6.20	7.30	7.90	28.12	30.62	32.62	33.62	6.23	9.43	12.95	13.57
T_2 - BA @ 50 ppm	33.97	46.67	64.47	67.12	4.57	6.03	7.47	7.93	29.22	31.72	33.72	34.72	6.43	10.47	13.23	13.93
T_3 - BA @ 75 ppm	33.67	44.93	63.50	65.58	4.62	6.23	7.33	7.80	27.09	29.59	31.59	32.59	6.37	9.63	12.80	13.67
T_4 - BA @ 100 ppm	32.50	41.83	62.78	66.52	4.43	6.20	7.05	7.87	26.69	29.19	31.19	32.19	6.07	9.37	12.46	13.27
T_5 - NAA@ 100 ppm	37.48	49.35	67.90	69.97	4.67	6.77	7.50	8.13	29.32	31.82	33.82	34.82	6.70	10.40	13.67	14.16
T_6 -NAA@ 200 ppm	35.87	48.10	65.28	68.08	4.67	6.37	7.39	7.97	27.72	30.22	32.22	33.22	6.63	9.73	12.78	13.90
T_7 -NAA@ 300 ppm	35.20	47.68	66.71	67.07	4.60	6.27	7.37	7.87	26.51	29.01	31.01	32.01	6.47	9.43	12.39	13.73
T_8 -NAA @ 400 ppm	34.47	46.47	65.73	66.90	4.60	6.67	7.37	7.57	26.46	28.96	30.96	31.96	6.13	9.13	12.23	13.31
T_9- GA_3 @ 50 ppm	38.63	50.72	68.98	70.53	4.70	6.57	7.77	8.43	30.61	33.11	35.11	36.12	7.03	10.83	13.83	14.60
T_{10}- GA_3 @ 100 ppm	36.30	49.03	66.95	68.63	4.63	6.33	7.63	8.33	28.84	31.34	33.34	34.34	6.87	10.57	13.43	14.03
T_{11} –GA_3@ 150 ppm	35.43	46.49	65.97	67.30	4.70	6.50	7.60	8.27	28.15	30.65	32.65	33.65	6.43	9.93	13.01	13.97
T_{12} - GA_3@ 200 ppm	34.53	45.53	65.47	67.17	4.77	6.47	7.40	8.23	27.40	29.9	31.9	32.9	6.17	9.30	12.57	13.53
S.E. ±	0.53	0.48	0.57	0.58	0.11	0.23	0.24	0.22	0.93	0.78	0.76	0.79	0.28	0.27	0.37	0.29
C.D. (P = 0.05)	1.56	1.41	1.67	1.70	0.32	0.67	0.69	0.64	2.72	2.29	2.21	2.30	0.81	0.80	1.07	0.84

Table 2 : Effect of PBRs on yield and its attributes

Treatments	Diameter of bulb (cm)		No. of cloves/ bulb	Weight of bulb (g)		Maximum weight of clove (g)		Yield/ha (tones/ ha)
	Equatorial	Polar		Fresh	Dry	Fresh	Dry	
T_0 - Control	3.40	2.93	27.67	32.27	10.14	8.67	3.97	11.35
T_1 - BA @ 25 ppm	4.45	3.87	33.33	38.53	12.43	11.67	5.87	17.13
T_2 - BA @ 50 ppm	4.83	3.98	35.35	40.18	13.63	12.17	5.97	17.86
T_3 - BA @ 75 ppm	4.57	3.88	34.57	39.23	13.33	11.47	5.38	17.43
T_4 - BA @ 100 ppm	4.40	3.65	31.93	38.22	12.27	11.20	5.17	16.98
T_5 – NAA @ 100 ppm	5.10	4.33	38.95	46.62	15.95	14.23	6.63	22.30
T_6 - NAA @ 200 ppm	5.08	4.32	36.35	45.58	15.53	13.13	5.87	20.59
T_7 - NAA @ 300 ppm	4.92	4.29	35.36	44.67	15.04	12.37	5.50	19.85
T_8 - NAA @ 400 ppm	4.68	4.15	33.96	43.87	14.67	12.10	5.14	19.50
T_9- GA_3 @ 50 ppm	5.42	4.46	40.55	47.85	16.15	15.17	7.13	22.75
T_{10}- GA_3 @ 100 ppm	5.03	3.98	37.93	46.18	15.13	14.27	6.20	21.77
T_{11} - GA_3 @ 150 ppm	4.75	3.67	35.94	44.56	14.48	13.50	6.00	20.40
T_{12} - GA_3 @ 200 ppm	4.53	3.40	34.47	42.49	13.95	12.73	5.17	11.35
S.E. ±	0.22	0.11	0.90	0.96	0.59	0.67	0.32	1.01
C.D. (P=0.05)	0.66	0.33	2.64	2.79	1.73	1.95	0.92	2.95

and 5.14 g , 22.75 t/ha, respectively) in GA_3@ 50 ppm as against control (3.40cm and 2.93cm, 32.27g and10.14g, 32.67, 8.67g and 3.97 g 11.35 ton /ha, respectively found minimum). It might be due to fact that GA_3 initiate the physiological process such as cell division, cell elongation and permeability of cell membrain. The positive role of bioregulators on fruiting of rose apple was also studied by Das *et al*. (2006).

Conclusion :

The present study recorded that the use of Plant Bio-regulators improved the performance of garlic in general compared to untreated control. The vegetative growth of garlic with respect to height of plant, number of leaves, maximum length of leaves, basal diameter etc. and yield and yield attributes *viz.*, diameter of bulb, fresh and dry weight of bulb, number of cloves, fresh and dry weight of cloves and yield per hectare were obtained maximum with the foliar application of GA_3 @ 50 ppm among the bio- regulators in the present study under Lucknow condition.

Therefore, it may be concluded that foliar application of GA_3 @ 50 ppm can be recommended to garlic growers for obtaining better growth and yield improvement of garlic cv. Yamuna Safed- 4 (G-232) under Lucknow condition.

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