Vol.9 No. 1, 69-73 (2020)

Received: April, 2020; Accepted: May, 2020

Effect of Plant Growth Regulators on Growth and Yield of Garlic

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Abstract

An experiment was conducted in Randomized Block Design with 13 treatments replicated thrice during 2018-19. On the basis of findings it could be concluded that GA_3 100 ppm clove dipping was found most effective treatment among the treatments applied. The plant height, number of leaves, bulb weight (fresh and dry), bulb diameter, clove weight and clove size (Length and diameter) were recorded significantly higher under GA_3 100 ppm clove dipping followed by treatment GA_3 100 ppm foliar spray, NAA 50 ppm clove dipping, and NAA 100 ppm foliar spray. The highest bulbs yield (43.02 q ha^{-1}) was recorded in GA_3 100 ppm clove dipping which was followed by NAA 100 ppm foliar spray. Although, both the above treatments were found statistically at par for bulb yield. GMR, NMR were recorded maximum under GA_3 100 ppm clove dipping while B:C ratio was highest in GA_3 100 ppm clove dipping followed by GA_3 100 ppm foliar spray.

***Keywords**: Garlic, GA_3, NAA, IBA and B:C ratio*

Introduction

Plant growth regulator like Gibberellic acid (GA_3) increase bulb of garlic and plant height in garlic. NAA can bring changes in the phenotypes of plants and affect growth either by enhancing or by stimulating the natural growth regulatory systems from seed germination to senescence. IBA was shown to produce a higher yield of roots compared to the other auxins. Plant growth regulator presents a new possibility to break yield barrier, particularly imposed by the environment and played vital role in modifying the growth behavior of plants resulting in increasing growth, quality and finally increases the yield. The garlic growth, yield and quality may be increased by cloves dipping and foliar application in growth regulator of the same at vegetative stage of growth at different concentrations but information on application and concentration of PGRs in yield optimization of garlic is scanty. Hence, the present investigation was carried out to evaluate the effect of plant growth regulators on growth and yield of garlic.

Material and Method

The present field experiment was carried out during winter (Rabi) season of 2018-19 at Department of Horticulture Research Farm, College of Agriculture, Tikamgarh (M.P.). The experiment was laid out in Randomized Block Design with thrice treatments replicated twice. The experimental material for this study comprised of different growth regulators namely GA3, NAA and IBA and Yamuna Safed-3 (G-282) variety of Garlic.

The cloves were treated with the plant growth regulators viz T1- GA3 (50 ppm) Cloves dipping, T2- GA3 (50 ppm) Foliar spray, T3- GA3 (100 ppm) Cloves dipping, T4- GA3 (100 ppm) Foliar spray, T5- IBA (50 ppm) Cloves dipping, T6- IBA (50 ppm) Foliar spray, T7- IBA (100 ppm) Cloves dipping, T8- IBA (100 ppm) Foliar spray, T9- NAA (50 ppm) Cloves dipping, T10- NAA (50 ppm) Foliar spray, T11 NAA (100 ppm) Cloves dipping, T12

NAA (100 ppm) Foliar spray and T13 Control. Cloves dipping will be done 12 hours before planting and foliar application will be done after 30 days of planting. The cloves wear sown in row to row 20 cm and plant to plant 10 cm apart by hand dibbling method in 3 X 2.5m plots farmyard manures 10-12 t/ha should be incorporated in the soil at the time of initial ploughing and full dose inorganic fertilizer of RDF (100:80:60 Kg NPK ha-1). Entire full dose of P and K along with 1/3 part of N should be applied as basal dose. Reaming N may be applied at two split doses i.e., 30 and 60 day after transplanting. The observations were recorded on growth and yield parameter of garlic. The growth parameters*viz*., plant height, number of leaves per plant, leaves length (cm) at 60, 90, day after planting (DAP) and harvest day stage. The yield parameters *viz.*, fresh and dry (cured) weight of bulbs (g), bulb diameter (cm), no. of cloves per bulbs, cloves length (cm), cloves diameter (cm), cloves weight (g), yield per hectare (tonnes) and economics of crop cultivation were recorded after harvest. Data were statistically analysed.

Results and Discussion

The data presented in table-1 revealed that the plant height (cm), number of leaves per plant and leaves length (cm) of the garlic was significantly influenced by different treatments at 60, 90 and at harvest days after planting. Plant height at different stages of growth was also significantly varied under different treatments at 60, 90 and at harvest. The highest plant height was recorded (41.40 cm) at 60 DAP, (53.96 cm) at 90 DAP and (56.69 cm) at harvest in treatment (T3) GA3 100 ppm clove dipping while the lowest plant height was recorded in treatment (T13) control at 60 DAP (31.66 cm), at 90 DAP (43.92 cm) and at harvest (45.58).Significant variation was also observed in number of leaves per plant among different treatments. The highest number of leaves recorded (5.23) at 60 DAP, (6.53) at 90 DAP, in treatment (T3) GA3 100 ppm clove dipping but treatment (T4) GA3 100 ppm foliar spray recorded in highest number of leaves (6.77). Whereas the lowest number of leaves per plant was recorded in treatment (T13) control at 60 DAP (4.13) and at 90DAP (5.20) but treatment (T10) NAA 50 ppm foliar spray recorded in lowest number of leaves (5.57).

Use of the different treatments on the plant, significantly affected the length of leaves per plant at different growth stage. The maximum leaves length was recorded (25.49 cm) at 60 DAP, (30.42 cm) at 90 DAP and (31.03 cm) at harvest in treatment (T_4) GA_3 100 ppm foliar spray. Whereas the minimum leaves length per plant at 60 DAP was recorded for treatment (T_{13}) control (19.32 cm) but treatment (T_6) IBA 50 ppm foliar sprayrecorded in lowest number of leaves at 90 DAP (22.97 cm) and at harvest (24.75 cm).The maximum plant height was recoded for treatment with GA_3 (100 ppm) clove dipping at 60 DAP, 90 DAP and at harvest stage respectively which was closely followed by treatment GA_3 (100 ppm) Foliar spray, NAA (50 ppm) Cloves dipping and NAA (50 ppm) Foliar spray. While, minimum plant height was recorded in treatment (T_{13}) control at 60 DAP, 90 DAP and at harvest. The increased plant height might be due to rapid increase cell division and cell elongation in the meristemic region. These results were in closely conformity with

findings of many others[1]. The maximum number of leaves recoded at 60 DAP and 90 DAP for the treatment GA_3 (100 ppm) clove dipping which was at par with treatment GA_3 (100 ppm) Foliar spray,NAA (50 ppm) Cloves dippingand NAA (100 ppm) Cloves dippingat 60 DAP and 90 DAP whereas and at harvest it was found maximum in treatment GA_3 (100 ppm) foliar spray and was at par with treatment GA_3 (100 ppm) Cloves dipping. Growth regulators are essential for vegetative growth because it affects apparently the photosynthesis, respiration and catalase activity of leaves[2]. It might be due to their effect on cell division resulting into more number of leaves per plant. Md. The increased Leaves length might be due to rapid in promote cell division, cell growth because they increase hydrolysis of starch, fructose and sucrose into glucose and fructose molecules. Hexose provides energy via respiration which contributes to cell well formation and increase cell wall plasticity (Chakraborty 2007). Maximum leaves length was significantly recorded in treatment GA_3 (100 ppm) foliar spray at 60 DAP, 90 DAP and at harvest. While was at par with treatment GA_3 (100 ppm) Cloves dipping,NAA (50 ppm) Cloves dipping and NAA (100 ppm) Foliar spray.GA_3 affects the rate of cell division and an increased in cell division leading to production of larger leaves.

Table 1 Plant height, number of leaves and leaves length per plant of garlic at different growth stage

Treatments	Plant height (cm)			Number of leaves per plant			Leaves length (cm)		
	60 DAP	90 DAP	At harvest	60 DAP	90 DAP	At harvest	60 DAP	90 DAP	At harvest
T_1 GA_3 (50 ppm) Cloves dipping	35.60	48.33	50.93	4.73	5.87	6.20	22.38	25.83	27.21
T_2 GA_3 (50 ppm) Foliar spray	34.87	47.67	49.53	4.57	5.77	6.27	21.60	24.77	25.40
T_3 GA_3 (100 ppm) Cloves dipping	41.40	53.96	56.69	5.23	6.53	6.70	23.21	28.31	28.57
T_4 GA_3 (100 ppm) Foliar spray	39.47	52.07	53.27	4.87	6.40	6.77	25.49	30.42	31.03
T_5 IBA (50 ppm) Cloves dipping	37.10	46.40	47.80	4.63	5.87	6.17	22.05	25.79	25.94
T_6 IBA (50 ppm) Foliar spray	35.67	44.47	45.60	4.60	5.40	6.00	20.75	22.97	24.75
T_7 IBA (100 ppm) Cloves dipping	35.47	47.80	48.07	4.80	5.90	6.23	23.09	23.74	25.79
T_8 IBA (100 ppm) Foliar spray	34.73	45.80	46.87	4.67	5.53	6.20	21.50	23.95	26.24
T_9 NAA (50 ppm) Cloves dipping	37.93	50.79	52.47	5.07	6.13	6.47	24.80	27.52	28.87
T_{10} NAA (50 ppm) Foliar spray	36.42	49.67	51.61	4.70	5.40	5.57	22.77	27.12	27.86
T_{11} NAA (100 ppm) Cloves dipping	37.00	49.13	50.27	4.53	6.27	6.53	23.30	27.17	27.60
T_{12} NAA (100 ppm) Foliar spray	35.93	46.67	48.67	4.77	5.47	6.37	23.00	28.24	28.91
T_{13} Control	31.66	43.92	45.58	4.13	5.20	5.80	19.32	24.88	25.29
SEM + -	1.4288	1.407	1.8578	0.137	0.155	0.125	0.716	0.836	0.967
CD (5%)	4.1706	4.1069	5.4227	0.4	0.451	0.364	2.0901	2.441	2.822

The data on yield and yield attributes which was significantly affected by the use of various different treatments is presented in Table 2. The highest fresh and dry weight of garlic bulb was noted for treatment (T_3) GA_3 100 ppm clove dipping (15.36 g, 13.20 g respectively) and the minimum fresh and dry weight was recorded in treatment (T_6) IBA 50 ppm foliar spray (9.33 g, 8.87 g respectively).The bulb diameter was significantly affected by different treatments. The maximum equatorial diameter per bulb was recorded for treatment (T_3) GA_3 100 ppm clove dipping (3.30 cm) whereas, the minimum equatorial diameter was observed for treatment (T_8) IBA 100 ppm foliar spray (2.62 cm).The highest number of cloves per bulb was counted under the treatment (T_4) GA_3 100 ppm foliar spray (11.17) while minimum number of clove per plant was recorded under the treatment (T_8) IBA 100 ppm foliar spray (7.07). Possible reason may be the GA_3 and NAA induced cell division and rapid cell elongation in growing portion causing increase the bulb size as well as number of cloves.The highest clove weight was recorded for (T_3) GA_3 100 ppm clove dipping (1.43 g) whereas of the lowest clove weight was recorded under the treatment (T_{13}) control (0.86 g).The increase in weight might be due to better accumulation of food material in plant coupled with increasing growth character by cell division, cell elongation and cell enlargement that might have ultimately increased the clove weight. The maximum clove length of garlic was recorded for treatment (T_4) GA_3 100 ppm foliar spray (2.36 cm) while the minimum length of cloves (1.86 cm) was recorded for treatment (T_7) IBA 100 ppm clove dipping. Whereby to increase the weight and diameter of bulb and enhanced the number of cloves per bulb, weight and length of the cloves[3]. The maximum clove diameter (cm) of garlic was recorded in treatment (T_3) GA_3 100 ppm clove dipping (1.29 cm) while the minimum diameter of cloves (0.88 cm) was under treatment (T_{13}) control. The enhanced rate of photosynthesis and at a consequence growth of whole plant was increased clove diameter also showed the superior result. The highest bulbs yield per hectare was recorded in treatment (T_3) GA_3 100 ppm clove dipping (43.02 q ha^{-1}) while the lowest bulb yield of per hectare was recorded under treatment (T_{13}) control (22.74 q ha^{-1}).Use of GA_3 100 ppm plant growth regulators has increased yield, which is due to the increase in the different types of characters, bulb weight, bulb diameter as well as clove length and clove weight. Better growth of garlic plants, higher photosynthesis and accumulation of metabolites and their ultimate result into higher yield of garlic in the present study was successfully achieved. This could be attributed to greater vegetative growth of plant with more dry matter production which produced bulb of high equatorial and polar diameter resulting into higher average bulb weight.

Table 2 Yield and yield attributes of garlic.

Treatments	Fresh weight (g)	Dry weight (g)	Equatorial diameter (cm)	Number of clove	Clove weight (g)	Clove length (cm)	Clove diameter (cm)	Yield per hectare (q)
T_1 GA_3 (50 ppm) Cloves dipping	11.04	9.40	2.83	10.13	0.90	1.97	0.99	31.022
T_2 GA_3 (50 ppm) Foliar spray	11.03	9.60	2.86	8.27	1.09	2.15	0.96	23.525
T_3 GA_3 (100 ppm) Cloves dipping	15.36	13.20	3.30	10.80	1.43	2.32	1.29	43.022
T_4 GA_3 (100 ppm) Foliar spray	14.62	11.93	3.26	11.17	1.36	2.36	1.20	38.044
T_5 IBA (50 ppm) Cloves dipping	12.89	9.13	2.74	9.67	0.89	2.25	0.97	31.653
T_6 IBA (50 ppm) Foliar spray	9.33	8.87	2.70	7.27	1.11	2.11	0.89	24.000
T_7 IBA (100 ppm) Cloves dipping	10.19	8.87	2.73	8.60	0.98	1.86	1.00	32.311
T_8 IBA (100 ppm) Foliar spray	10.92	9.67	2.62	7.07	1.31	2.14	0.99	25.356
T_9 NAA (50 ppm) Cloves dipping	13.38	11.30	2.87	8.87	1.02	1.96	1.08	28.080
T_{10} NAA (50 ppm) Foliar spray	10.97	9.07	2.89	8.47	1.08	2.05	1.07	29.517
T_{11} NAA (100 ppm) Cloves dipping	14.25	11.67	3.01	8.73	1.03	2.27	1.00	29.842
T_{12} NAA (100 ppm) Foliar spray	10.59	9.07	2.81	9.33	1.24	1.97	1.14	31.864
T_{13} Control	10.15	9.87	2.72	7.80	0.86	1.93	0.88	22.738
SEM + -	0.664	0.518	0.136	0.422	0.073	0.058	0.051	1.809
CD (5%)	1.939	1.511	0.398	1.232	0.213	0.169	0.148	5.281

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