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Response of plant growth regulators on growth and yield traits of garlic (*Allium sativum* L.) Cv. Yamuna Safed

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Abstract

A field experiment, aimed to study the effect of plant growth regulators on growth, yield and quality traits of garlic (*Allium sativum* L.) Cv. Yamuna Safed" was carried out in *Rabi* season 2023-24 at the Instructional Farm, AKS University, Satna (MP). Result revealed that all the growth parameters viz. plant height, leaves length, neck thickness and collar diameter were observed maximum values when the crop was imposed to T₅ (Gibberellic Acid @ 150 ppm) which was significantly superior over rest of the treatments. While control plot recorded the lowest values with respect to all above parameters. The crop stand was not significantly influenced due to application of plant growth regulators. The data on various yield parameters of garlic like equatorial and polar diameter of bulb, fresh bulbs yield, dry bulb weight, fresh bulb weight, fresh clove weight and marketable bulb yield were recorded maximum values under T₅ (Gibberellic Acid @ 150 ppm) which was significantly superior over rest of the treatments whereas, minimum values of these parameters were observed when treatment was imposed to control plot at different period of observations. The quality parameters of garlic with respect to protein content, nitrogen content, total soluble solid (°Brix), vitamin C and oleoresin content of garlic were recorded the highest values of above parameters in application of T₅ (Gibberellic Acid @ 150 ppm). On the other hand, the lowest values of above parameters recorded when plots were kept in control condition. The treatment T₅ (Gibberellic Acid @ 150 ppm) had the highest fresh bulb yield and marketable garlic bulb yield (14.87 and 7.15 t ha⁻¹, respectively) observed which was at par to T₈ (indole-3-acetic acid @ 150 ppm). Conversely, the control plot had the lowest fresh and marketable bulb yield which was 10.93 and 5.25 t ha⁻¹, respectively. The maximum gross return, net return and benefit-cost ratio recorded when treatment imposed to T₅ (Gibberellic Acid @ 150 ppm) (Rs 715053, Rs 526553 ha⁻¹ and 1:3.79), respectively. Likewise the minimum gross return, net return and benefit-cost ratio were recorded in control with (Rs 525189, 340189 ha⁻¹ and 1:2.84), respectively.

Keywords: Plant growth regulators, growth, yield, garlic

Introduction

Garlic (*Allium sativum* L.) is an important condiment crop grown in winter season. It is well known that, optimum doses of PGR have a great influence on the yield and quality of garlic. Garlic is the second most widely used cultivated vegetable crop after onion, under the genus *Allium* and belongs to the family Alliaceae. The native place of garlic is Central Asia and Southern Europe, especially the Mediterranean region. Garlic is a herbaceous annual crop whose underground edible stem is a composite bulb made up of numerous smaller bulbs known as cloves. In Madhya Pradesh garlic occupied 1305 hectare area and production is 405751.73 MT. In Satna area under garlic is 1305 hectare, production 14411 MT and productivity 11.4 MT per hectare as reported by Anonymous (2022) ^[1]. To enhance productivity and food safety, Indian Agriculture become more mechanized and science based by using inputs and the plant growth regulators are among of them; plant growth regulators has quicker impact on vegetative as well as yield of the crops. Kaur *et al.* (2018) ^[6] concluded that PGRs regulate physiological process to the crop plants like rooting, flowering, growth, sprouting, ripening and beneficial for yield and yield contributing characters of various vegetable crops.

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The bio-regulators comprise of both retardants and promoters which when used in appropriate. However not much work has been done on suitable application of PGRs with optimum doses in garlic for growth and yield in MP. Therefore, it is essential to evaluate different plant growth regulators in garlic cultivation. Keeping the above facts in view, the present investigation entitled “Effect of plant growth regulators on growth, and yield traits of garlic (*Allium sativum* L.) Cv. Yamuna Safed” was carried out in Rabi season 2023-24 at the Instructional Farm, AKS University, Satna (MP) in order to evaluate plant growth regulators on growth and yield parameters of garlic.

Materials and Methods

The experiment was conducted at the Instructional Farm, Aks University, Sherganj, Satna (M.P.) where adequate facilities of irrigation as well as provision of good drainage were available for rabi season 2023-24. The experimental site is situated at the latitude of 23°58' N and longitude of 80°81' East in mid northern part of Rewa division of M.P. State of India. The experiment was conducted with ten treatments of application of PGRs which comprising Garlic variety Yamuna Safed (G-1) was used as test crop for experiment. The application of PGR based on respective formulated treatments. Stock solution was first prepared for each growth regulator by diluting with plain water. The solution of required concentration was then prepared by further dilutions of the measured volume of stock solution with water. The control plant was sprayed with plain water. The first spray of growth regulators were done at 45 days after planting while second spray was done at 90 days after planting. About 8-10 mm diameter cloves were sown at a spacing of 15 cm x 10 cm in a plot having size of 2.0 x 2.0 m² accommodating 266 plants per plot. The standard cultural practices recommended were followed to ensure a healthy crop stand. Growth parameters viz. plant height, leaves length, neck thickness and collar diameter and the data on various yield parameters of garlic like equatorial and polar diameter of bulb, fresh bulbs yield, dry bulb weight, fresh bulb weight, fresh clove weight and marketable bulb yield were recorded and statistically analyzed.

Result and discussions

The data on various growth parameters of garlic like crop stand, plant height, leaves length, neck thickness, collar diameter and dry matter production was recorded and computed to evaluate the influenced of effect of plant growth regulators on these parameters.

Growth parameters of garlic

The data on crop stand of garlic recorded at 30 and 140 DAS were not significantly influenced by application of different plant growth regulators. The corresponding data are presented in Table 1. The higher crop stand was achieved by application of T₅ (Gibberellic Acid @ 150 ppm) followed by T₂ (Nephthalene Acetic Acid @ 150 ppm) of experimentation at 30 and 140 DAT during 2023-24. While, the lowest crop stand of garlic was recorded in control treatment. Significantly taller plants and maximum leaf length of garlic were observed in T₅ (Gibberellic Acid @ 150 ppm) during 2023-24. However, it was at par to T₂ (Nephthalene Acetic Acid @ 150 ppm) and T₈ (Indole-3-acetic acid @ 150 ppm) during 2023-24 of experimentation at 60, 90 and 120 DAS of observation. While, the lowest plant height and minimum leaf length of garlic were recorded in control treatment where water was spray only. The increase in plant height may be due to cell division and promotion of cell division and cell elongation in the meristemic region which could be associated with GA₃ causing increase length of the internodes

and increase in number of cells resulting in the increase of height. These results are in conformation with the findings of Castaneda *et al.* (2002) [3].

The data pertaining to the neck thickness indicate that T₅ (Gibberellic Acid @ 150 ppm) exhibited significantly maximum neck thickness (1.16cm) which was statistically superior over rest of the treatments. However, the minimum neck thickness was recorded in control plot with 0.65 cm. It gradually increases collar diameter with the concentration of plant growth regulators viz T₅ (Gibberellic Acid @ 150 ppm) exhibited significantly maximum collar diameter (8.35 cm) which was at par to T₂ (Nephthalene Acetic Acid @ 150 ppm) and T₈ (Indole-3-acetic acid @ 150 ppm). On the other hand, the minimum collar diameter was measured in control plot with 4.82 cm. NAA increase in growth rate of shoot and root and finally increase in yield as reported by Patel *et al.* (2010) [9]. Indole-3-acetic acid (IAA) is the main auxin in plants, controlling many important physiological processes including cell enlargement and division, tissue differentiation. It increases the root number, root length and root weight, bulb diameter and bulb weight, Govind *et al.* (2015) [5]. Gibberellic acid (GA₃) is a growth stimulating substance which promotes cell elongation and cell division thus help in the growth and development of many plants. GA₃ has the potentiality to break dormancy and accelerates the sprouting of garlic Lemdor and Deepanshu, 2022) [7]. Gibberellic acid play a major role in diverse growth processes including seed development, organ elongation, senescence and control of flowering time.

Yield parameters of garlic

The data on various yield parameters of garlic like equatorial and polar diameter of bulb, fresh bulbs yield, dry bulb yield, fresh bulb and marketable bulb yield were recorded and computed to evaluate the effect of plant growth regulators. Significantly the largest equatorial and polar diameter of bulb (5.83 and 3.23 cm) was measured in T₅ (Gibberellic Acid @ 150 ppm) which was at par to T₈ (Indole-3-acetic acid @ 150 ppm) during experimentation of 2023-24. On the other hand, the lowest values of equatorial and polar diameter of bulb were recorded in control plot with 3.98 and 1.80 cm. Regarding to fresh bulb yield, T₅ (Gibberellic Acid @ 150 ppm) had observed the highest (14.87 t ha⁻¹) which was at par to T₂ (Nephthalene acetic acid @ 150 ppm) and T₈ (indole-3-acetic acid @ 150 ppm). Conversely, the control plot had observed the lowest fresh bulb yield (10.93 t ha⁻¹). The highest marketable bulb yield (7.15 t ha⁻¹) recorded in T₅ (Gibberellic Acid @ 150 ppm) which was at par to T₂ (Nephthalene acetic acid @ 150 ppm) and T₈ (Indole-3-acetic acid @ 150 ppm). Conversely, the control plot noted the lowest marketable bulb yield (5.25 t ha⁻¹). Among different levels PGRs, the data on dry and fresh bulb yield and other yield attributing parameters were recorded the higher values under T₅ (Gibberellic Acid @ 150 ppm) at all the stages and period of observations due to Gibberellic Acid more accumulate photosynthates thus increases crop growth as well yield traits. Similar observation has been also reported by Singh (2018) [10] where in increasing volume of garlic bulb. This result is concordant with the findings of Das *et al.* (2006) [4] and Islam *et al.* (2007) [8] who reported that highest yield attributes per plant of onion. A perusal of data on economic analysis of garlic are being described here like cost of cultivation, gross return, net return and B:C ratio of garlic. The maximum gross return, net return and benefit-cost ratio recorded in T₅ (Gibberellic Acid @ 150 ppm) (Rs 715053, Rs 526553 ha⁻¹ and 1:3.79), respectively. Likewise the minimum gross return, net return and benefit-cost ratio were recorded in control with (Rs 525189, 340189 ha⁻¹ and

1:2.84), respectively.

Table 1: Growth and yield parameters of garlic as influenced by plant growth regulators

Notations	Treatments	Plant height (cm)			Leaf length (cm)			Neck thickness (cm)	Collar diameter (cm)	Number of cloves bulb ⁻¹	Equatorial diameter (cm)	Polar diameter (cm)	Fresh bulb yield (t ha ⁻¹)	Marketable bulb yield (t ha ⁻¹)	Fresh bulb yield (ton ha ⁻¹)	Marketable bulb yield (ton ha ⁻¹)
		60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS									
T ₀	Control	29.85	37.75	54.64	26.33	29.74	33.89	0.65	4.82	15.26	3.98	1.80	3.64	1.75	10.93	5.25
T ₁	Naphthalene Acetic Acid @ 100 ppm	32.73	41.76	57.98	30.57	33.93	36.29	0.88	5.59	17.93	4.99	2.18	3.98	1.91	11.95	5.74
T ₂	Naphthalene Acetic Acid @ 150 ppm	38.22	51.24	62.21	34.88	40.43	42.12	0.93	8.11	24.35	5.68	3.06	4.79	2.30	14.37	6.90
T ₃	Naphthalene Acetic Acid @ 200 ppm	35.56	45.94	57.57	32.43	37.08	39.38	0.87	6.67	20.53	5.35	2.58	4.40	2.11	13.20	6.35
T ₄	Gibberellic Acid @ 100 ppm	33.74	42.66	61.66	30.83	34.04	38.24	0.77	5.80	18.72	5.05	2.30	4.00	1.92	12.02	5.78
T ₅	Gibberellic Acid @ 150 ppm	38.94	52.47	63.52	36.21	40.97	44.19	1.16	8.35	25.04	5.83	3.23	4.95	2.38	14.87	7.15
T ₆	Gibberellic Acid @ 200 ppm	35.91	48.61	59.67	32.98	37.28	39.00	0.76	6.95	21.76	5.51	2.75	4.61	2.22	13.84	6.66
T ₇	Indole-3-acetic acid @ 100 ppm	32.06	41.55	56.75	29.61	32.57	36.31	0.79	5.27	16.94	4.60	2.09	3.87	1.86	11.63	5.59
T ₈	Indole-3-acetic acid @ 150 ppm	37.66	50.51	61.65	34.41	39.77	40.45	0.93	7.99	23.51	5.62	2.91	4.74	2.28	14.23	6.83
T ₉	Indole-3-acetic acid @ 200 ppm	34.43	42.94	56.67	31.66	35.39	38.87	0.59	6.12	19.04	4.72	2.39	4.23	2.03	12.70	6.10
SEm±		0.33	0.45	1.22	1.13	0.80	0.95	1.51	0.31	0.27	1.01	0.22	0.11	0.05	0.32	0.15
CD (0.05)		1.04	1.33	3.64	3.36	2.37	2.82	4.49	0.92	0.85	3.00	0.67	0.32	0.15	0.96	0.46

Conclusions

The findings of studies could be concluded that yield parameters of garlic like equatorial and polar diameter of bulb, fresh bulbs yield, dry bulb weight, fresh bulb weight, fresh clove weight and marketable bulb yield were recorded maximum values under T₅ (Gibberellic Acid @ 150 ppm) which was significantly superior over rest of the treatments whereas, minimum values of these parameters were observed when treatment was imposed to control plot at different period of observations. The maximum gross return, net return and benefit-cost ratio recorded when treatment imposed to T₅ (Gibberellic Acid @ 150 ppm) (Rs 715053, Rs 526553 ha⁻¹ and 1:3.79), respectively. Likewise the minimum gross return, net return and benefit-cost ratio were recorded in control with (Rs 525189, 340189 ha⁻¹ and 1:2.84), respectively.

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