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Influence of pre-treatments, growth promoters and application of sulphur on growth and bulb yield of garlic (*Allium sativum* L.)

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Abstract
The present study entitled "Impact of pre-treatment of garlic (*Allium sativum* L.) cloves with growth promoters and application of sulphur on growth, bulb yield and quality**"** was undertaken during 2021-22 at Herbal Garden, College of Agriculture, Raichur. The experiment was laid out in factorial randomized block design with three replications. The factors include pre-treatment of cloves (G_1: No pre-treatment, G_2: IBA @ 100 ppm for 6 hours and G_3: GA_3 @ 100 ppm for 6 hours) and sulphur application (S1: No sulphur application, S2: Soil application with sulphur @ 2ml, S3: Soil application with sulphur @ 4ml and S4: Foliar application of sulphur @ 2ml). The results revealed that pre-treatment of cloves with GA_3 @ 100 ppm along with foliar application of sulphur @ 2ml (G_3S_4) recorded maximum plant height (61.49cm), number of leaves per plant (7.71), leaf area index (0.72), dry matter accumulation per plant (6.92 g) at the time of harvest with increased fresh weight of bulbs (25.58 g), number of cloves per bulb (15.67), weight of 10 cloves (14.69), yield per plot (4.53 kg) and yield per hectare (9.92 t) whereas, minimum of these parameters were recorded with untreated plots (G_1S_1 *i.e.* no pre-treatment and no sulphur application).

Keywords: Garlic, GA_3, IBA, Sulphur

Introduction
Garlic (*Allium sativum* L.) is the second most widely used cultivated bulb crop after onion, belongs to family Alliaceae with chromosome number 2n=16. It is grown and consumed as spice or a condiment throughout India. It is native to Central Asia and North Eastern Iran. Garlic cloves contain carbohydrates (33.06 g), sugar (1 g), protein (6.36 g), fat (0.5 g), fiber (2.1 g), calcium (18%), iron (13%), magnesium (7%), manganese (80%), phosphorus (22%), sodium (1%), zinc (12%), vitamin B_6 (1.24 mg) and vitamin C (31.2 mg) as per Upadhyay 2017.
Plant growth promoters when used as soaking of seed bulbs or cloves stimulate sprouting, bulbing and its development apart from improvement in vegetative growth with increased bulb fresh weight, total fresh weight, and cured yield (Ahmed and Hemada, 2012) [1].
Sulphur is the fourth major plant nutrient after nitrogen, phosphorus, and potassium. It is essential for building up sulphur containing amino acids like cystine and methionine and activates certain enzyme system in plant. It can also play vital role in increasing plant height, number of leaves per plant, cloves per bulb, diameter and weight of bulb and bulb yield (Nasrin *et al.* 2007) [8].

Materials and Methods
The experiment was conducted during *late rabi s*eason of 2021 at Herbal Garden, College of Agriculture, Raichur, situated in the North Eastern dry zone *i.e.,* Zone- II of Karnataka state. The location is corresponding to the $16^0 15^1$ North latitude and $77^0 33^1$ East longitude. The climate is semi-arid with an average annual rainfall of 722 mm and is at an elevation of 409 m above mean sea level.
The experiment was laid out in factorial randomized block design with three replications. The factors include pre-treatment of cloves (G_1: No pre-treatment, G_2: IBA @ 100 ppm for 6 and G_3: GA_3 @ 100 ppm) for 6 hours and sulphur application (S1: No sulphur application, S2: Soil

application with sulphur @ 2ml, S3: Soil application with sulphur @ 4 ml and S4: Foliar application of sulphur @ 2ml).
Observations were recorded from five randomly selected and labeled plants for growth parameters such as plant height (cm), number of leaves per plant, leaf area index and dry matter accumulation per plant (g) and yield parameters like fresh weight of bulbs (g), number of cloves per bulb, weight of 10 cloves (g), yield per plot (kg) and yield per hectare (t).

Results and Discussion

Effect of Pre-Treatment

Among different growth promoters used, pre-treatment of garlic cloves with GA_3 @ 100 ppm recorded significantly maximum plant height (53.37cm), number of leaves per plant (5.93), leaf area index (0.57) and dry matter accumulation per plant (6.05 g) at the time of harvest (Table 1). Whereas minimum growth attributes were recorded in untreated plots (G_1). Similar results were noted by memane *et al*. 2008 [7] in garlic and Ouzounidou *et al.* 2011 [9] in onion.
Soaking of cloves in GA_3 (G_3) exhibited significantly higher yield parameters *i. e.,* fresh weight of bulbs (21.14 g), number of cloves per bulb (13.68), weight of 10 cloves (12.42 g), yield per plot (3.78 kg) and yield per hectare (8.27 t). On the contrary, lower yield attributes were observed in G_1 *i. e.,* no pre-treatment (Table 2). The results corroborate the findings of Kashyap 2012 [5] in onion and Gautam *et al.* 2014 [3] in garlic.
Maximum growth and yield parameters were recorded in pre-treatment of garlic cloves with GA_3 (G_3) might be due to its role in cell division and cell elongation. GA_3 affects the photosynthesis, respiration and catalase activity of leaves. GA_3 leads to faster elongation and rapid proliferation of cells in growing portion of plants resulting in encouragement of new growth and might also leads to transport of food reserves to storage organ there by increase the dry matter accumulation. GA_3 speeds up the nutrient partitioning towards cell and active growth sites, along with increasing nutrient and mineral absorption and their related bio-molecules acceleration in leaves and apical shoot passing active growth and development.

Effect of Sulphur

Foliar application of sulphur @ 2ml (S_4) recorded significantly maximum plant height (56.66cm), number of leaves per plant (6.34), leaf area index (0.61) and dry matter accumulation per plant (6.39 g) at the time of harvest (Table 1). However, no sulphur application (S_1) recorded least of growth attributes. The results are in accordance with Zaman *et al.* 2011 [14] and Bableshwar *et al.* 2017 in garlic.
Significantly maximum bulb characters like fresh weight of bulbs (22.76 g), number of cloves per bulb (14.04), weight of 10 cloves (13.00 g), yield per plot (4.09 kg) and yield per hectare (8.99 t). On the contrary, non-sulphur treated plot (S_1) recorded lower yield attributes (Table 2). The results were in harmony with those reported by Veer *et al.* 2021 [13] and Malik *et al.* 2021 [6] in garlic.
Foliar application of sulphur might increase production of metabolites and meristematic activities that gives better plant growth. Sulphur is an essential plant nutrient, its role in balanced fertilization and consequently in crop production. It performs many physiological functions like synthesis of sulphur containing amino acids resulting in increased growth attributes. sulphur increases the yield of garlic mainly by enhancing protein synthesis because sulphur is central element in essential amino acids like cystine, cystenine and methionine. Sulphur is also required for chlorophyl synthesis, which makes it critical for photosynthesis and therefore increasing the optimal yield.

Interaction Effect

Pre-treatment of garlic cloves with GA_3 @ 100 ppm along with foliar application of sulphur @ 2 ml (G_3S_4) significantly influenced the growth attributes like plant height (61.49cm), number of leaves per plant (7.71), leaf area index (0.72) and dry matter accumulation per plant (6.92 g) at the time of harvest (Table 1). Whereas, minimum growth characters observed in plots without pre-treatment and sulphur application (G_1S_1).
Significantly improved yield parameters like fresh weight of bulbs (25.58 g), number of cloves per bulb (15.67), weight of 10 cloves (14.69), yield per plot (4.53 kg) and yield per hectare (9.92 t) were recorded from pre-treatment of garlic cloves with GA_3 @ 100 ppm along with foliar application of sulphur @ 2 ml (G_3S_4). On the contrary, G_1S_1 *i. e.,* no pre-treatment and no sulphur application recorded lower yield attributes(Table 2). Similar studies were done by Tyagi and Yadav 2007 [11] in onion and Hore *et al.* 2014 [4] in garlic.
Thakur *et al.* (2018) [10] opined that increase in bulb fresh weight might be due to better carbon assimilation and better accumulation of carbohydrates in the plants as a result of increase in the vegetative characters due to enhanced cell division and quick cell multiplication. Foliar application of sulphur @ 2 ml (S_4) might have effectively absorbed by the leaves and under the influence of GA_3 @ 100 ppm (G_3) the plants might have produced the larger sized bulbs coupled with increased size of cloves.

Table 1: Effect of pre-treatment cloves with growth promoters and sulphur application on growth attributes of garlic

Factors	Plant height (cm)	Number of leaves per plant	Leaf area index	Dry matter accumulation per plant (g)
Pre-treatment with growth promoters				
G_1	46.96	5.22	0.47	5.32
G_2	51.97	5.48	0.53	5.81
G_3	53.37	5.93	0.57	6.05
Mean	50.76	5.54	0.52	5.73
S. Em±	0.95	0.18	0.01	0.11
C.D at 5%	2.79	0.53	0.04	0.31
Application of sulphur				
S_1	46.36	5.15	0.46	5.13
S_2	49.79	5.31	0.51	5.64
S_3	50.00	5.36	0.52	5.74
S_4	56.66	6.34	0.61	6.39
Mean	50.76	5.54	0.52	5.73
S. Em±	1.10	0.21	0.02	0.12
C.D at 5%	3.22	0.61	0.04	0.36
Interaction effect				

G_1S_1	45.16	5.14	0.45	5.09
G_1S_2	46.50	5.18	0.47	5.36
G_1S_3	47.91	5.24	0.48	5.40
G_1S_4	48.29	5.30	0.50	5.45
G_2S_1	45.27	5.15	0.46	5.09
G_2S_2	49.63	5.36	0.51	5.61
G_2S_3	51.97	5.41	0.53	5.73
G_2S_4	60.20	6.00	0.62	6.80
G_3S_1	48.64	5.16	0.47	5.21
G_3S_2	53.25	5.40	0.54	5.96
G_3S_3	50.11	5.43	0.55	6.10
G_3S_4	61.49	7.71	0.72	6.92
Mean	50.76	5.54	0.52	5.73
S. Em±	1.90	0.36	0.03	0.21
C.D at 5%	5.58	1.06	0.08	0.62

Factor 1: Pre-treatments with growth promoters
G_1: No pre-treatment
G_2: IBA @ 100 ppm (6 hours)
G_3: GA_3 @ 100 ppm (6 hours)
S_4: Foliar application of sulphur @ 2 ml

Factor 2: Application of Sulphur
S_1: No sulphur application
S_2: Soil application with sulphur @ 2 ml
S_3: Soil application with sulphur @ 4 ml

Table 2: Effect of pre-treatment cloves with growth promoters and sulphur application on yield attributes of garlic

Factors	Fresh weight of bulbs (g)	Number of cloves/bulbs	Weight of 10 cloves (g)	Yield/plot (kg)	Yield/hectare (t)
Pre-treatment with growth promoters					
G_1	17.00	11.05	10.66	3.15	6.90
G_2	20.02	13.02	11.68	3.55	7.84
G_3	21.14	13.68	12.42	3.78	8.27
Mean	19.38	12.58	11.58	3.49	7.67
S. Em±	0.41	0.25	0.21	0.09	0.20
C.D at 5%	1.19	0.72	0.61	0.27	0.59
Application of sulphur					
S_1	15.50	10.86	10.09	2.78	6.15
S_2	19.22	12.67	11.34	3.51	7.66
S_3	20.07	12.76	11.92	3.58	7.87
S_4	22.76	14.04	13.00	4.09	8.99
Mean	19.38	12.58	11.58	3.49	7.67
S. Em±	0.47	0.29	0.24	0.10	0.23
C.D at 5%	1.37	0.84	0.70	0.31	0.69
Interaction effect					
G_1S_1	14.75	10.67	9.89	2.53	5.63
G_1S_2	17.20	10.90	10.63	3.22	7.00
G_1S_3	17.64	11.02	10.95	3.51	7.70
G_1S_4	18.40	11.06	11.17	3.32	7.27
G_2S_1	15.27	10.93	10.00	2.74	6.09
G_2S_2	19.72	13.10	11.23	3.31	7.35
G_2S_3	20.77	13.20	12.36	3.74	8.13
G_2S_4	24.29	14.87	13.13	4.43	9.79
G_3S_1	16.46	11.00	10.39	3.07	6.74
G_3S_2	20.73	14.00	12.16	4.00	8.62
G_3S_3	21.78	14.07	12.44	3.50	7.78
G_3S_4	25.58	15.67	14.69	4.53	9.92
Mean	19.38	12.58	11.58	3.49	7.67
S. Em±	0.81	0.49	0.42	0.18	0.41
C.D at 5%	2.37	1.45	1.22	0.53	1.19

Factor 1: Pre-treatments with growth promoters
G_1: No pre-treatment
G_2: IBA @ 100 ppm (6 hours)
G_3: GA_3 @ 100 ppm (6 hours)

Factor 2: Application of Sulphur
S_1: No sulphur application
S_2: Soil application with sulphur @ 2 ml
S_3: Soil application with sulphur @ 4 ml
S_4: Foliar application of sulphur @ 2 ml

Conclusion

Among different growth promoters used pre-treatment of garlic cloves with GA_3 @ 100 ppm was found to be superior with regarding growth and yield attributes. Foliar application of sulphur @ 2ml had maximum influence on growth and yield parameters. Interaction between pre-treatment of garlic cloves with GA_3 @ 100 ppm along with foliar application of sulphur @ 2 ml (G_3S_4) was found to be best regarding growth and yield of garlic.

References

1. Ahmed SI, Hemada AA. Effect of pre-planting treatment of garlic (*Allium sativum* L.) cloves on growth and yield under middle Egypt conditions. J Plant Prod Mansoura Univ.

2012;3(6):971-986.
2. Babaleshwar SB, Koppad SR, Math KK, Dharmatti R. Influence of sulphur on growth and yield of garlic (*Allium sativum* L.). J Pharm Phytochem. 2017;6(5):450-452.
3. Gautam N, Kumar D, Kumar R, Kumar S, Sharma S, Dogra B, *et al*. Growth and yield of garlic (*Allium sativum* L.) as influenced by clove weight and plant growth regulators. Int J Farm Sci. 2014;4(3):49-57.
4. Hore JK, Ghanti S, Chanchan M. Influence of nitrogen and sulphur nutrition on growth and yield of garlic (*Allium sativum* L.). J Crop Weed. 2014;10(2):14-18.
5. Kashyap K. Studies on effect of plant growth regulators on growth, yield and quality of onion. M.Sc. Thesis, IGKV, Raipur; c2012. p. 37.
6. Malik G, Yousuf S, Wani SH, Shabir A, Shah RA, Nabi SU, *et al*. Effect of sulphur supplementation on yield and quality enhancement of bolting garlic (*Allium sativum* L. spp. Ophioscorodon) in Indian Himalayan long day temperate climate. Chem. Sci. Rev Lett. 2021;10(38):295-298.
7. Memane PG, Rukums TDK, Kakde G, Kulkarni U, Kulkarni, Chovatia RS, *et al*. Effect of clove weight and plant growth regulators on growth and yield of garlic cv. GG3. The Asian J Hort. 2008;3(1):82-86.
8. Nasrin S, Hossain MA, Farid ATM. Integrated nutrient management for garlic (*Allium sativum* L.). Bangladesh J Agril Sci. 2007;34(1):45-48.
9. Ouzounidou G, Giannakoula I, Asif M, Iliasi I. Plant growth regulators treatments modulate growth physiology characteristics of onion. Pak Bot. 2011;40:1195-1199.
10. Thakur O, Kumar V, Singh J. Pruning and gibberellic acid on growth and yield attributes of onion (*Allium cepa* L.) cv. Agrifound Light Red. Int. J Curr. Microbiol. Appl. Sci. 2018;7:2319-7706.
11. Tyagi AK, Yadav SK. Effect of growth regulators on growth and yield of onion (*Allium cepa* L.) cv. Pusa Red. Plant Arch. 2007;7(1):371-372.
12. Upadhyay RK. Nutritional and therapeutic potential of allium vegetables. J Nutr Ther. 2017;6:18-37.
13. Veer DR, Jagtap VS, Wankhede SS, Kharade MR, Chavan SS. Effect of sources and levels of sulphur on growth and yield of garlic (*Allium sativum* L.). Pharma Innov. 2021;10(10):754-757.
14. Zaman MS, Hashem MA, Jahiruddin M, Rahim MA. Effect of sulphur contents on growth and quality of garlic sprout. Plant Nutr Fertilizer Sci. 2011;17(5):1288-1292.