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Growth, Yield and Quality of Garilic (*Allium sativum* L.) Influenced by the Application of Sulphur and Salicylic Acid

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A research experiment was conducted at vegetable research Complex, Maharajpur, Department of Horticulture, College of Agriculture, JNKVV Jabalpur. The experiment was done to study the effect of sulphur and salicylic acid on Yamuna safed -2 variety of Garlic. The growth, yield, and quality of garlic can be influenced by various factors, including nutrient availability and plant growth regulators like salicylic acid. Sulphur is an essential nutrient for plant growth and plays a crucial role in the development of garlic plants. The experiment was conducted in Randomized Block Design with combination of different concentrations of sulphur (0 kg/ha, 30 kg/ha and 45 Kg/ha) and salicylic acid (60 ppm and 120 ppm). Growth parameters like plant height, number of leaves and pseudostem diameter were found maximum in treatment T-9 (sulphur 45kg/ha and SA 120ppm). Yield parameters like average bulb weight (22.27 gm), Polar diameter (4.41 cm) and Equatorial diameter (3.79 cm) average weight of 10 cloves (9.10 gm), Total soluble solids and Pyruvic acid

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were also maximum in T-9 (Sulphur 45kg/ha and SA 120 ppm) (42.30 ^{o}Brix and 66.09 µmol/gm respectively). From the above findings it can be concluded that for garlic plant the best doses for salicylic acid and sulphur were found to be 120 ppm and 45 kg/ha. Also with graded levels of salicylic acid and sulphur various parameters increased effecttively.

Keywords: Garlic; Sulphur; Salicylic Acid (SA); nutritional benefits.

1. INTRODUCTION

Garlic, belonging to the family Amaryllidaceae (Alliaceae), is an annual herbaceous plant. After the onion, it is the second most important bulb crop. The bulb, which is the most developed section of the plant, provides the economic yield. Garlic is a popular bulb crop because of its nutritional benefits as a spice. It is included in Indian system of medicines as a carminative and gastric stimulant to help in digestion and absorption of food.

In terms of area and production, India is the world's 2nd largest producer of garlic. Garlic is farmed extensively in Madhya Pradesh, particularly in Mandsaur, Ratlam, Neemuch, Shajapur, and Ujjain (Malwa region).

Salicylic acid (SA) is a signal molecule that modulates plant response to stress [1]. Salicylic acid is a phenolic derivative that is distributed in a wide range of plant species. Salicylic acid is a natural product of phenyl propanoid metabolism. It has basal levels differing widely among plant species with up to 100-times differences recorded [2]. SA is directly involved in plant growth, thermogenesis, flower induction and uptake of ions. It also affects biosynthesis of ethylene, stomatal movement and reverses the effects of Abscisic acid (ABA) on leaf abscission. After Nitrogen, Phosphorus and Potassium, Sulphur is the fourth major plant nutrient. It is important for the synthesis of amino acids like cystine, cysteine, and methionine, a component of vitamin A. It also activates certain enzyme systems in plants [3]. Application of Sulphur in garlic increases the uptake of NPK and Ca by the crop [4]. Apart from NPK fertilizer, report is available that sulphur can play a vital role in increasing the yield of garlic [5].

2. MATERIALS AND METHODS

A research experiment was conducted at vegetable research Complex, Maharajpur, Department of Horticulture, College of Agriculture, JNKVV Jabalpur in rabi season 2021-22. The experiment was conducted in Randomized Block Design with combination of different concentrations of sulphur (0 kg/ha, 30 kg/ha and 45 Kg/ha) and salicylic acid (60 ppm and 120 ppm). There was total 9 plots of combination along with a control plot. Sowing of garlic was done in plots (2m x 2m) at a spacing of 10cm x 15cm. Cloves of garlic bulbs were sown on December 2nd 2021. Graded level of sulphur was applied as basal along with the recommended dose of NPK (100:50:50 kg/ha) and after 30 days of planting, salicylic acid was applied as foliar spray. Harvesting was done on 23 April 2022 when the crop attained maturity and showed drying up of most leaves. After harvesting data on growth, yield and quality attributes were analysed statistically.

3. RESULTS AND DISCUSSION

Growth parameters: Plant height at 60 DAP was significantly influenced by the application of sulphur and salicylic acid. Maximum pant height (43.20cm) was observed in T-9 (Sulphur 45Kg/ha + SA @ 120 ppm) and was at par with treatment T-7 and T-8 while the minimum was observed in Control Plot T-1 (36.70 cm). At 90 DAP the maximum height of plant reached (63.43 cm) which was significantly superior to other treatments and was at par with T-7 and T-8 while the minimum was recorded in T-1 (58.73 cm). These results are also supported by Zaman et al., [6].

Number of leaves per plant were also significantly influenced by sulphur and SA application. At 60 DAP Maximum number of leaves (6.10) were observed in T-9 which was at par with T-8 and minimum number of leaves were 4.80 in T-1 Control pot. Similarly, 90 DAP these were found maximum in T-9 (Sulphur 45Kg/ha + SA @ 120 ppm) (8.63) at par with T-7 and T-8 and minimum in control plot (6.70) [6].

Application of sulphur and SA influenced the diameter of Psedo-stem significantly. Pseudo-stem diameter was maximum (0.98 cm) in T-9 (Sulphur 45Kg/ha + SA @ 120 ppm) 60 DAP. Similarly, it was maximum (1.25 cm) in T-9 90 DAP. Minimum diameter of pseudo-stem was recorded in the control plot. Zaman et al., [6].

Table 1. Effect of Sulphur and Salicylic acid on growth, yield and quality of garlic

Treatment		plant Height (cm)		No. of leaves		Pseudo-stem Diameter (cm)		Polar diameter (cm)	Equatorial Diameter (cm)	Bulb Weight (g)	Bulb Yield (q/ha)	TSS (°Brix)	Pyruvic acid (µmol/gm)
		60 DAP	90 DAP	60 DAP	90 DAP	60 DAP	90 DAP						
T-1	**Control**	36.70	58.73	4.80	6.70	0.73	1.03	3.18	3.11	14.73	98.00	37.27	**62.76**
T-2	**SA @ 60 ppm**	38.63	59.20	5.10	6.73	0.77	1.12	3.28	3.43	15.03	99.46	37.70	62.93
T-3	**Sulphur 15Kg/ha + SA @ 60 ppm**	39.47	61.27	5.37	6.97	0.81	1.14	3.61	3.54	16.30	106.27	38.73	63.58
T-4	**Sulphur 30 Kg/ha + SA @ 60 ppm**	40.53	61.87	5.50	7.53	0.83	1.15	3.76	3.56	18.27	112.45	39.50	64.70
T-5	**Sulphur 45Kg/ha + SA @ 60 ppm**	41.47	62.03	5.53	7.67	0.85	1.18	3.78	3.63	19.40	110.16	39.90	64.28
T-6	**SA @ 120 ppm**	38.97	60.23	5.30	7.77	0.80	1.13	3.52	3.44	15.93	114.81	38.67	63.65
T-7	**Sulphur 15Kg/ha + SA @ 120 ppm**	42.40	62.10	5.60	7.97	0.95	1.19	3.83	3.68	20.13	115.64	40.03	65.67
T-8	**Sulphur 30Kg/ha + SA @ 120 ppm**	42.93	62.77	5.97	8.40	0.96	1.23	4.14	3.75	21.67	118.85	41.70	65.56
T-9	**Sulphur 45Kg/ha + SA @ 120 ppm**	43.20	63.43	6.10	8.63	0.98	1.25	4.41	3.79	22.27	122.34	42.30	66.09
	SEm	**0.54**	**0.46**	**0.08**	**0.27**	**0.03**	**0.02**	**0.35**	**0.22**	**0.77**	**1.09**	**1.31**	**0.381**
	CD at 5%	**1.61**	**1.37**	**0.25**	**0.82**	**0.10**	**0.05**	**1.05**	**0.67**	**2.33**	**3.30**	**3.92**	**1.142**

The above growth parameters may be found higher with the increasing amount of sulphur as we know sulphur is an essential macronutrient required by plants for various physiological processes, including protein synthesis and the formation of certain amino acids, vitamins, and enzymes. Adequate sulphur availability can promote healthy vegetative growth in garlic plants. A deficiency in sulphur may lead to stunted growth, yellowing of leaves (chlorosis), and reduced plant vigor.

SA can modulate growth in garlic plants by affecting various growth-related processes. It may promote or inhibit certain growth aspects depending on the concentration and timing of application.

Yield parameters: All the yield parameters viz., polar diameter (cm), equatorial diameter (cm), bulb weight (g), bulb yield (q/ha) were significantly affected by the different treatments. For yield parameters, maximum polar and equatorial diameter of garlic bulb were reported in T-9 (Sulphur 45Kg/ha + SA @ 120 ppm) (4.41 cm and 3.79 cm respectively) while the minimum was observed in the control plot T-1. Average bulb weight (22.7 gm) was found maximum in T-9 (Sulphur 45Kg/ha + SA @ 120 ppm) while minimum bulb weight was observed in the control plot T-1 (14.73 g). The maximum bulb yield (122.34 q/ha) was recorded in treatment T9 (Sulphur 45Kg/ha + SA @ 120 ppm), while it was recorded minimum in control T1 (98.00 q/ha). (Above results were also supported by Bableshwar et al., [7].

Sufficient sulphur levels are necessary for optimal garlic bulb development. A lack of sulphur can result in smaller bulb size and decreased yield. The influence of SA on garlic yield can vary depending on the specific conditions and concentrations used. In some cases, SA application may lead to increased yield by enhancing stress resistance and disease resistance.

Quality Parameters: Sulphur also plays a role in garlic flavor and pungency. Adequate sulphur levels can contribute to the characteristic strong flavor and aroma of garlic. SA can influence the quality of garlic by potentially enhancing its phytochemical content, such as allicin (a bioactive compound responsible for garlic's health benefits). However, the impact on quality may also depend on factors like SA concentration and timing.

All the quality meters were also differ significantly using different treatments. Quality parameters like TSS observed maximum in T-9 (Sulphur 45Kg/ha + SA @ 120 ppm) (42.30 ^{o}Brix) and minimum in T-1 (37.27 ^{o}Brix) supported by Mallik et al., (2021) and Pyruvic acid was also observed maximum in T-9 (Sulphur 45Kg/ha + SA @ 120 ppm) (66.09 µmol/gm) however it was found minimum in the control plot T-1 (62.76 ^{o}Brix) [8-10].

4. CONCLUSION

From the above findings it can be concluded that for garlic plant the best doses for salicylic acid and sulphur were found to be 120 ppm and 45 kg/ha. Also with graded levels of salicylic acid and sulphur various parameters increased effecttively.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Bideshki A, Arvin MJ. Effect of salicylic acid (SA) and drought stress on growth bulb yield and allicin content of garlic (*Allium sativum*) in field. Plant Ecophysiology. 2010;2:73-79.
2. Raskin I. Role of salicylic acid in plants. Ann. Rev. of Plant Physiol. Mol. Biol. 1992;43:439 - 463.
3. Havlin JL, Beaton JD, Tisdale SL, Nelson WL. Soil fertility and fertilizers. An introduction to nutrient management. 7th ed.Person Education, Singapore. 2004;221.
4. Hossain MM. Effect of different levels of nitrogen and potash on the growth and yield of garlic. M.S. Thesis. Dept. Hort. Bangladesh Agril. Univ., Mymensingh. 1997;65.
5. Ahmad A, Abraham G, Gandotra N, Abrol YP, Abdin MZ. Interactive effect of nitrogen and sulphur on growth and yield of rapeseed-mustard (*Brassica juncea* [L.] Czern 527 and Coss. and *Brassica campestris* L.). J Agron Crop Sci. 1998;181:193-199.
6. Zaman MS, Hashem MA, Jahiruddin M, Rahim MA. Effect of sulphur fertilization on the growth and yield of garlic. Bangladesh Journal of Agricultural Research. 2011; 36(4):647-656.

7. Babaleshwar SB, Koppad SR, Math KK, Dharmatti R. Influence of sulphur on growth and yield of garlic (*Allium sativum* L.). Journal of Pharmacognosy and Phytochemistry. 2017;6(5):450-452.
8. Malik, Geetika, Yousuf, Shabeena & Wani, Hassan &Shabir, Alima& Shah, Rafiq& un nabi, Sajad& Sharma, Anil. Effect of Sulphur supplementation on Yield and Quality Enhancement of Bolting Garlic (*Allium sativum* L. spp. ophioscorodon) in Indian Himalayan Long Day Temperate Climate; 2021. DOI:10.37273/chesci.cs205110219.
9. Farooqui MA, Naruka IS, Rathore SS, Singh PP, Shaktawat RPS. Effect of nitrogen and sulphur levels on growth and yield of garlic (*Allium sativum* L.). Asian Journal of Food Agriculture. 2009;Special Issue:S18-23.
10. Patidar, Manish, Shaktawat, RPS, Naruka, I.s. Effect of Sulphur and Vermicompost on Growth, Yield and Quality of Garlic (*Allium sativum* L.). Journal of Krishi Vigyan. 2017;5:54. DOI:10.5958/2349-4433.2017.00012.5.

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