Research Article

Effect of Foliar Application of Salicylic Acid and Ethrel on Growth, Yield and Quality of Garlic (*Allium Sativum* L.) var. G-282

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Abstract

In order to study the effect of salicylic acid and ethrel on growth, yield and quality of garlic as a randomized block design with three replications each with 13 treatments viz. Control (T_0), salicylic acid 200 ppm with single spray (T_1), salicylic acid 200 ppm with single spray (T_2), salicylic acid 300 ppm with single Spray (T_3), ethrel 100 ppm with single spray (T_4), ethrel 200 ppm single spray (T_5), ethrel 300 ppm with single spray (T_6), salicylic acid 100 ppm double spray (T_7), salicylic acid 200 ppm double spray (T_8), salicylic acid 300 ppm double spray (T_9), ethrel 100 ppm double spray (T_{10}), ethrel 200 ppm double spray (T_{11}) and ethrel 300 ppm double spray (T_{12}) .The growth regulators salicylic acid and ethrel with 100, 200 and 300 ppm each were used and sprayed at 45 and 60 DAP with 13 treatment and three replication. The application of treatment T_8 (salicylic acid 200 ppm with double spray) in parameters *i.e.* plant height (91.56 cm), length of leaves (59.49cm), clove length (3.74), clove diameter (1.10cm), yield of bulb per plot (3.57 kg), While T_{12} (ethrel 300 ppm with double spray) in parameters *i.e.* neck diameter (1.17 cm), number of cloves per bulb (27.71), vitamin C in bulb (12.0 mg/100 g of edible portion), nitrogen content in bulb (2.97 per cent) and protein content in bulb (18.54 per cent) were found most effective as compare to control.

Keywords: Garlic, Salicylic acid, Ethrel, Growth and Yield

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Introduction

In India garlic have a prominent place after onion among cultivated *Allium* belonging to Amaryllidaceae family grown in tropical and sub-tropical regions. Garlic has been used as spice and food ingredient in cooking all over the world because it combines well with an enormous range of food, adding its own aroma and flavour as well as enhancing the flavour of the foods with which it is mixed. India has ranks second in area and third in production of garlic in the world. The total production of garlic in India is 1259.27 thousand metric tonnes from an area of 247.52 thousand hectares with the productivity of 6.6 MT/ha which is far less than that of China and Egypt. In Rajasthan, major garlic growing districts are Baran, Kota, Bundi, Jhalawar, Chittorgarh, Jaipur and Sikar in an area of 59.45 thousand hectare with an annual production of 235.98 thousand tons [1]. In recent years, scientists have given due attention to the idea of improving the plant growth, yield and quality with the application of plant growth regulators. Today, the use of natural plant phytohormones is in progress. Salicylic acid and ethrel have been recently added and have shown as potential tool in enhancing growth of plant [9].Salicylic acid is a phenolic growth regulator, which participates in the regulation of physiological and molecular mechanism to adjust plant in adverse environmental conditions. Ethrel, particularly has an interesting role in modern agriculture. It has been found to improve the bulb yield and its quality [8]. In the same respect, foliar spray of ethrel increases plant height, number of leaves, and leaf weight of bulbous plant [6]. At the same time it also increases length, diameter as well as weight of bulbs. The information on the effect of salicylic acid and ethrel in bulbous crop like garlic under agro-climatic conditions of

Rajasthan in black cotton soils merge. Therefore, an attempt was made to evaluate the growth, yield and biochemical characteristics of garlic var. G-282 under Jhalawar condition of Rajasthan.

Materials and Methods

Experimental design

The experiment was carried out at Protected Cultivation Unit, Department of Vegetable Science, College of Horticulture and Forestry, Jhalrapatan city, Jhalawar in open condition during September, 2014 to March, 2015. The experiment was consisting of 13 treatments having two growth regulators i.e. salicylic acid and ethrel @ 100, 200 and 300 ppm was given as foliar spray on the leaves in the morning according to the treatment at 45 and 60 DAP for single and double spray along with water spray as control, respectively. The experiment was laid out in randomized block design with three replications.

Preparation of treatment solution

Stock solution was first prepared for each growth regulator by diluting with distilled water and acetone. The solution of required concentration was then prepared by further dilutions of the measured volume of stock solution with distilled water. The first spray of growth regulators were done at 45 days after planting while second spray was done at 60 days after planting. Spraying was done as per treatment for each plant taking equal volume of the solution. Spraying was done in the evening with a compressed air hand sprayer. The control plant was sprayed with distilled water. The data generated during the experimentation were subjected to statistical analysis of variance.

Analysis of treatments

The significance of the treatments was tested through 'F' test at 5 per cent level of significance by method suggested by panse and sukhatme [7].

Results and Discussion

Plant Growth Characteristics

The result of present study clearly indicate that plant height, leaf length and neck thickness increased significantly due to application of different levels of salicylic acid and ethrel as compared to control. The maximum value of growth parameters *i.e.* plant height at 90 DAS (91.56 cm)and length of leaves at 90 DAS (59.49cm) was recorded under treatment T_8 (salicylic acid 200 ppm with double spray) as compared to minimum plant height at 90 DAS (79.91cm) and length of leaves at 90 DAS (50.66 cm) under control, respectively. However, the maximum neck diameter at harvesting (1.17) was recorded under the treatment T_{12} (ethrel 300 ppm with double spray) as compare to control (0.89), respectively. Further, treatment T_7 for plant height and T_7 and T_{12} for length of leaves was found at par with the treatment T_8 while, treatment $T_{11,}T_{8,}$ $T_{6,}$ T_7 and T_5 was found at par with T_{12} for neck diameter, respectively.

This may be due to fact that salicylic acid is considered to be a potent plant hormone and plays diverse regulatory roles in plant metabolism. It potentially generates a wide array of metabolic responses in plants which enhance plant growth. It may, therefore be concluded that the sustained increase in the observed parameters expectedly culminated in maximization of the process of biomass accumulation leading to higher growth. Thus adequate supply of salicylic acid on crop resulted in increased metabolic activity at the cellular level might have increased the nutrient uptake and accumulation in the vegetative plant parts which in turn resulted in improved plant growth attributes [2, 10].

Yield Characteristics

Application of different levels of salicylic acid and ethrel significantly increased the maximum clove length (3.74 cm), clove diameter (1.10cm) and yield of bulb per plot (3.57 kg) was found under treatment T_8 (salicylic acid 200 ppm with double spray) and minimum clove length (2.40cm), clove diameter (0.93cm) and yield of bulb per plot (1.86 kg) was recorded under control, respectively. However, number of cloves per bulb (27.71) was found maximum under application of treatment T_{12} (ethrel @ 300 ppm with double spray) and minimum number of cloves per bulb (20.98) was recorded under control, respectively. Further, treatment T_2 T_7 and T_1 for clove length was found at par with the treatment $T_{8.}$ While, treatment T_8 for number of clove per bulb was found at par with treatment $T_{12,}$ respectively. It may be due to the fact that salicylic acid and ethrel are important regulator of photosynthesis because

it affects leaf and chloroplast structure, stomatal closure, chlorophyll and carotenoid contents and the activity of enzymes such as RuBisCO (ribulose-1,5bisphosphate carboxylase/oxygenase) and it may be resulting in greater transfer of photo-assimilates to the bulb and increasing in number of leaves per plant with increase in plant growth characters may be attributed in large part to the augmented effect on cell division in the sub apical meristems and cell enlargement growth regulator on cell division in the sub apical meristems and cell enlargement, photosynthetic parameters, and plant water relations causing increase in yield and weight of bulb [3, 8].

Quality Characteristics

The application of T_{12} (ethrel 300 ppm with double spray) recorded maximum, vitamin C in bulb (12.00 mg/100g of edible portion), nitrogen content (2.97%) and protein content (18.54%) and minimum vitamin C in bulb (9.29 mg/100g of edible portion), nitrogen content (2.14%) and protein content (13.40%) was found in control..Further, treatment T_{11}, T_{10}, T_8, T_2 and T_7 for nitrogen contents and T_{11}, T_{10}, T_8, T_2 and T_7 for protein content was found at par with T_{12}

Table 1 Effect of foliar application of salicylic acid and ethrel on plant height, neck diameter, length of leaves, vitamin-c content, nitrogen content and protein content in bulb of garlic var. G-282

Treatments	Plant height (cm)	Neck diameter (cm)	Length of leaves (cm)	Vit-C (mg/100g)	Nitrogen content in bulb (%)	Protien content in bulb (%)
T_0	79.91	0.89	50.66	9.29	2.14	13.40
T_1	85.57	1.09	56.45	10.28	2.36	14.77
T_2	87.44	1.11	57.18	10.37	2.63	16.42
T_3	85.51	1.06	55.57	9.47	2.33	14.56
T_4	83.06	1.10	55.53	9.61	2.37	14.79
T_5	84.23	1.12	55.93	10.12	2.39	14.96
T_6	85.21	1.13	56.32	10.58	2.45	15.29
T_7	88.52	1.12	58.06	10.44	2.53	15.81
T_8	91.56	1.13	59.49	10.82	2.67	16.69
T_9	85.18	1.11	56.70	9.97	2.48	15.50
T_{10}	85.13	1.11	55.94	10.12	2.70	16.88
T_{11}	86.57	1.13	56.44	10.26	2.95	18.44
T_{12}	87.97	1.17	57.85	12.00	2.97	18.54
CD at 5%	1.38	0.02	1.04	0.56	0.22	1.42
SEm±	2.85	0.05	2.16	1.16	0.46	2.93

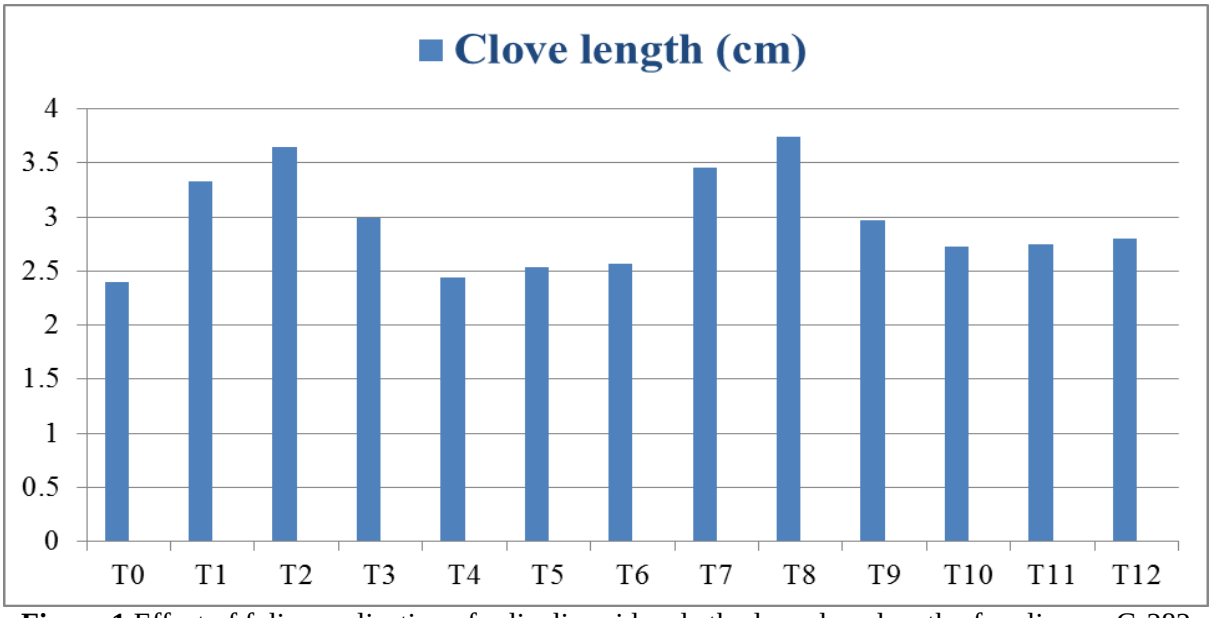

Figure 1 Effect of foliar application of salicylic acid and ethrel on clove length of garlic var. G-282

It may be due to the increasing in number of leaves leading to increase in more accumulation of food. Moreover, the promotive effect of ethrel could be attributed to their bio-regulator effects on physiological and biochemical processes in plants such as ion uptake, cell elongation, cell division, cell differentiation, cell wall plasticity, sink/source regulation, enzymatic activities and protein syntheses as well as increase the antioxidant capacity of plants and it is also increased the bulb quality by overcoming adverse effect of fungal development and ethylene production and it was presumed to be enhanced activation of some enzymes such as ascorbate peroxidase which increases antioxidant ability and ascorbic acid amount, increase in nitrogen, proteins, total soluble solids content and it may be directly or indirectly affect in qualitative attributes of garlic bulb [4, 5].

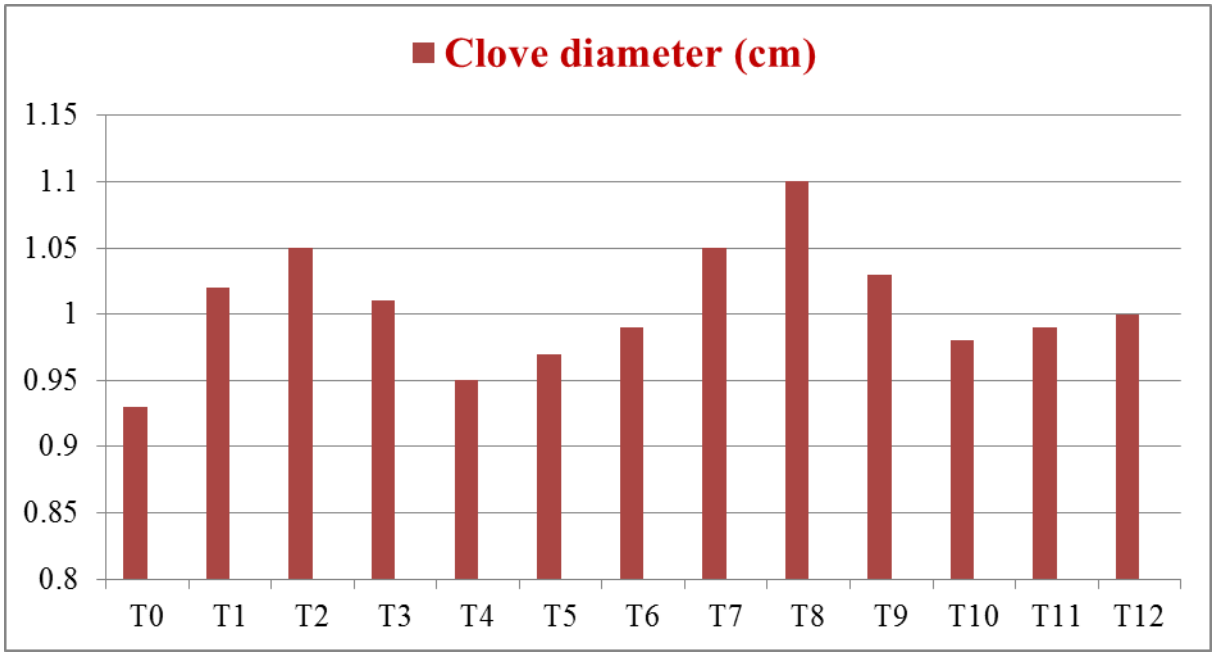

Figure 2 Effect of foliar application of salicylic acid and ethrel on clove diameter of garlic var. G- 282

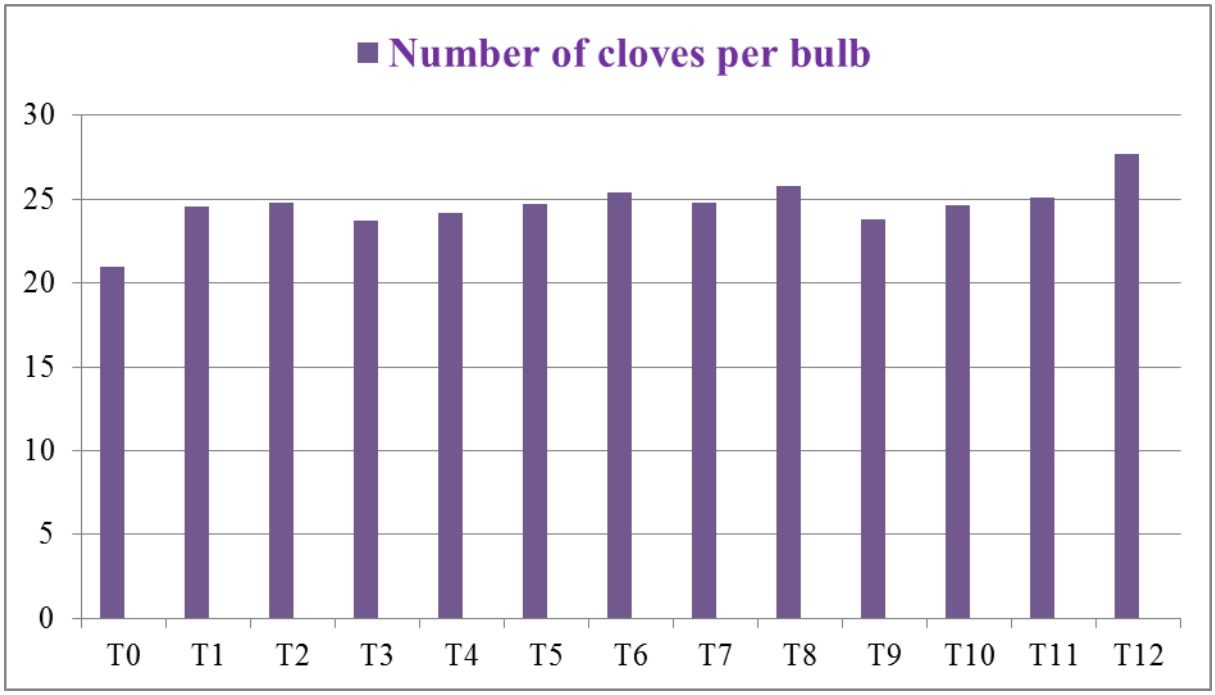

Figure 3 Effect of foliar application of salicylic acid and ethrel on number of cloves per bulb of garlic var. G-282

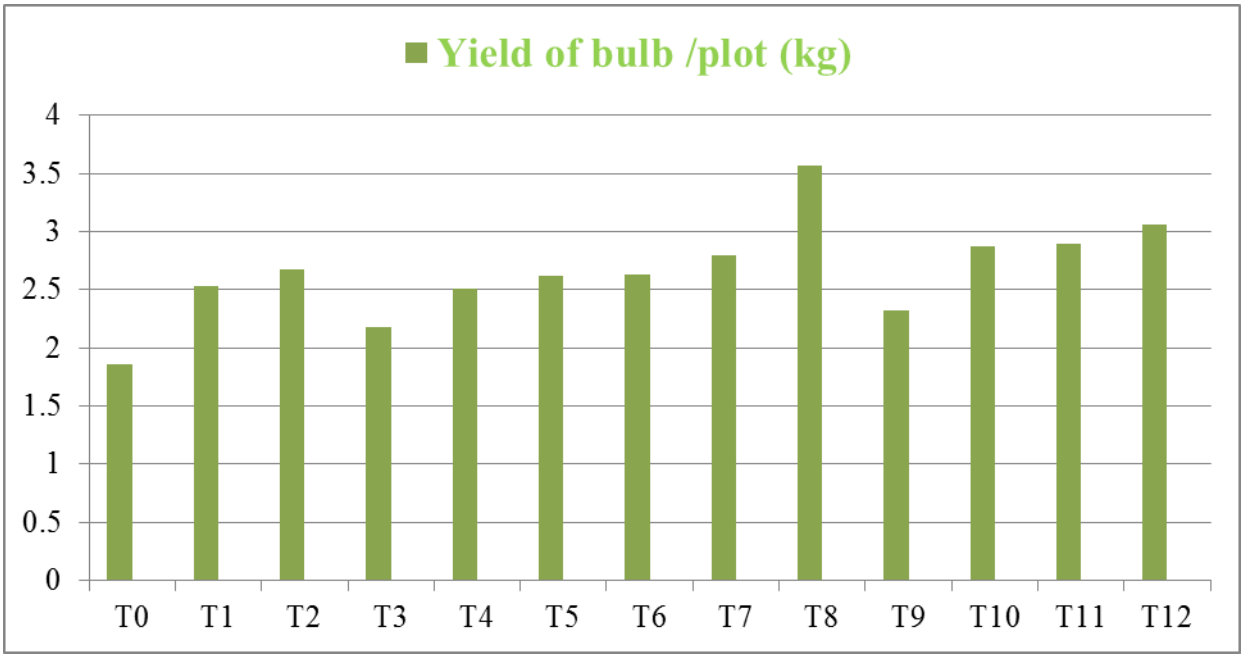

Figure 4 Effect of foliar application of salicylic acid and ethrel on yield of bulb per plot of garlic var. G-282

Conclusion

It could, therefore, be said that the application of salicylic acid 200 ppm with double spray can be used for significant leads to better growth and yield, while ethrel 300 ppm with double spray can used for better quality of garlic cultivation.

References

[1] Anonymous, Indian Horticulture Data base. National Horticulture Board, Gurgaon, 2013, pp. 299.
[2] Amin, AA, Rashad, M. and Abagy, MH, Physiological effect of indole -3- butyric acid and salicylic acid on growth, yield and chemical constituents of onion plants. Journal of applied sciences research, 2007, 3(11), p 1554-1563.
[3] Arfan, M., Athar, HR and Ashraf, M., Does exogenous application of salicylic acid through the rooting medium modulate growth and photosynthetic capacity in two differently adapted spring wheat cultivars under salt stress. Journal of plant physiology, 2007, 164, p 685-694.
[4] Dat, JF, Foyer, CH and Scott, IM, Changes in salicylic acid and antioxidants during induced thermo tolerance in mustard seedlings, Plant physiology, 1998, 118, p 1455-1461.
[5] Hoyos, TE and Zhang, PC, A rapid and simple method for the determination of ethephon residue in agricultural products by GC with headspace sampling. Journal of food and drug Annals, 2000, 8(3), p 213-217.
[6] Habba, A., Physiological studies of some growth regulators on the growth, yield and chemical constituents of onion plants. Journal of agriculture science, 2003, 28 (3), p 1645-1653.
[7] Panse VG and Sukhantme PV, Statistical methods for agricultural workers. Published by ICAR, New Delhi, 1967.
[8] Slaymaker, DH, Navarre, DA, Clark, DO, Martin, GB and Klessig, DF, The tobacco salicylic acid-binding protein 3 (SABP3) is the chloroplast carbonic anhydrase, which exhibits antioxidant capacity and plays a role in the hypersensitive response. Proceedings of the national academy of sciences, 2002, p 11640–11645.
[9] Tiwari, RS, Ankur, A and Sengar, SC, Effect of bio regulators, bulb yield, quality and storability of onion cv. Pusa Red. Indian journal of plant physiology, 2003, 8 (4), p 411-413.
[10] Yildirim, E, Turan, E, and Guvenc, MI, Effect of foliar salicylic acid application on growth, chlorophyll and mineral content cucumber grown under salt stress. Journal of plant nutrition, 2008, 31, p 593-612.

[11] Wang H, Cao G and Prior RL, Total antioxidant capacity of fruits. Journal of Agricultural and Food Chemistry, 1996, 44, p 701-705.

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