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Effect of soaking and foliar application of salicylic acid and ethrel on growth, yield and biochemical traits of garlic (*Allium sativum* L) cv G-282

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ABSTRACT

The experiment was conducted during Rabi season of 2014-15 at Department of Vegetable Science, Jhalawar, Rajasthan on the soaking influence of salicylic acid and ethrel on morphological growth, biochemical traits and yield components of garlic (*Allium sativum* L). The experiment consisted of two phyto-hormones viz salicylic acid and ehtrel each at three different concentrations (100, 200 and 300 ppm as soaking or foliar spray) with three replications. Significant differences were observed for various morphological, biochemical and yield attributes. The days to emergence, plant height, number of leaves per plant, length of leaves and chlorophyll content of leaves, clove diameter, clove length, bulb yield per plot, dry matter and pungency increased significantly at 90 days after planting (DAP) due to the application of salicylic acid (soaking at 200 ppm + 200 ppm foliar spray). The other yield and biochemical traits viz number of cloves per bulb, total soluble solids (TSS), ascorbic acid, nitrogen and protein content increased significantly due to application of ethrel (soaking with 200 ppm + 200 ppm foliar spray).

Keywords: Salicylic acid; ethrel; garlic; soaking; spray

INTRODUCTION

Garlic (*Allium sativum* L) is the most widely used cultivated *Allium* species after onion belonging to the family Amaryllidaceae. It is consumed both as fresh as well as in dried form as an important ingredient for flavouring various vegetarian and non-vegetarian dishes. In the Indian subcontinent people use fresh leaves of garlic as salad and a good tasty pickle is also prepared from garlic cloves. Garlic has higher nutritive value as compared to other bulbous crops. It is a rich source of carbohydrates (29%), proteins (6.3%), minerals (0.3%) and essential oils (0.1-0.4%) and also contains fat, vitamin C and sulphur (Memane et al 2008). Garlic productivity in India is comparatively low as compared to the world. So in the recent

years due attention has been given to improve the plant growth and yield with the application of plant growth regulators as they modify plant characters like plant height, number of leaves per plant, number and size of cloves and bulbs, biomass yield, net bulb yield etc by influencing the physiological processes within the plant which ultimately affect the yield and quality of garlic. As the garlic is reproduced exclusively by vegetative means plant characters such as clove weight or size used for propagation also affect the bulb size, yield and quality of the produce significantly (Memane et al 2008).

India ranks second in area and third in production of garlic in the world. The total production of garlic in India is 1259.27 thousand MT from an area of 247.52 thousand hectares with the productivity of 6.6 tons/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 where it is grown on an area of 59.45 thousand hectare with an annual production of 235.98 thousand tons (Anon 2013). In recent years scientists have given due attention to improve the plant growth, yield and quality of garlic with the application of plant growth regulators.

There is a great need to standardize the size of garlic cloves used for propagation in order to get cost effective results in garlic production (Castellanus et al 2004). Therefore the present investigations have been undertaken to study the soaking and foliar application effect of salicylic acid and ethrel on growth, yield and biochemical traits of garlic.

MATERIAL and METHODS

The experiment was carried out at protected cultivation unit, Department of Vegetable Science, College of Horticulture and Forestry, Jhalawar, Rajasthan in open condition during October 2015 to March 2016.

The experiment consisted of 13 treatments having two growth regulators viz T_0 (control), T_1 (salicylic acid 100 ppm as soaking), T_2 (salicylic acid 200 ppm as soaking), T_3 (salicylic acid 300 ppm as soaking), T_4 (ethrel 100 ppm as soaking), T_5 (ethrel 200 ppm as soaking), T_6 (ethrel 300 ppm as soaking), T_7 (salicylic acid 100 ppm as soaking and foliar spray), T_8 (salicylic acid 200 ppm as soaking and foliar spray), T_9 (salicylic acid 300 ppm as soaking and foliar spray), T_{10} (ethrel 100 ppm as soaking and foliar spray), T_{11} (ethrel 200 ppm as soaking and foliar spray) and T_{12} (ethrel 300 ppm as soaking and foliar spray) having two growth regulators viz salicylic acid and ethrel @ 100, 200 and 300 ppm given as foliar spray on the leaves at 90 days after planting (DAP) and soaking of seed cloves before planting according to the treatment along with water spray and without soaking as control respectively. The experiment was

laid out in randomized block design with three replications. Stock solution was first prepared for each growth regulator by diluting with distilled water and acetone.

The solution of required concentration was prepared by further dilutions of the measured volume of stock solution with distilled water. Spraying was done as per treatment for each plant taking equal volume of the solution. Spraying was done in the morning with a compressed air hand sprayer. The control plants were sprayed with distilled water. The garlic seed cloves were soaked in the buckets with same solution of growth regulator 12 hours before planting. The data generated were subjected to statistical analysis of variance.

RESULTS and DISCUSSION

Growth parameters (Table 1)

The results indicate that the plant growth parameters increased significantly due to use of different levels of salicylic acid and ethrel as compared to control. Minimum days to emergence (3.47) and maximum plant height (92.56 cm), number of leaves per plant (11.20), length of leaves (60.67 cm) and chlorophyll content of leaves (0.76 mg/100 g) at 90 DAP were recorded under treatment T_8 (cloves soaking with 200 ppm + 200 ppm with foliar spray of salicylic acid) as compared to maximum days to emergence (6.47) and minimum plant height (81.48 cm), number of leaves per plant (10.07), length of leaves (53.74 cm) and chlorophyll content of leaves (0.61 mg/100 g) at 90 DAP under control.

Sakhabutdinova et al (2003) established that salicylic acid increased the level of cell division within the apical meristem of seedling roots which caused an increase in plant growth. Peroxidase activity was gradually decreased by the application of decreasing salicylic acid concentration in sunflower cotyledons. The results are supported by the work of Kang et al (2005) and Wilson (2007).

Yield parameters (Table 2)

The maximum clove diameter (1.10 cm), clove length (3.78 cm) and bulb yield per plot (3.57 kg/plot) were recorded under treatment T_8 (cloves soaking with 200 ppm + 200 ppm with foliar spray of salicylic acid) as compared to minimum clove diameter (0.93 cm), clove length (2.16) and bulb yield per plot (1.97) recorded under control. Maximum number of cloves per bulb (26.22) was recorded in treatment T_{12} (cloves soaking with 200 ppm + 200 ppm with foliar spray of ethrel) and minimum (21.59) in control.

It may be due to the reason that increase in number of leaves lead to more accumulation of food. Moreover the primitive effect of salicylic acid and ethrel can be attributed to their bio-regulator effects on physiological and biochemical processes in plants such as ion uptake, cell elongation, cell division, cell differentiation,

Table 1. Effect of salicylic acid and ethrel on plant growth parameter of garlic var G-282

Treatment	Plant height (cm) at 90 DAP	# leaves/plant at 90 DAP	Length of leaf (cm) at 90 DAP	Leaf chlorophyll content (mg/g) at 90 DAP	Days to emergence
T_0	81.48	10.07	53.74	0.61	6.47
T_1	85.68	10.60	56.78	0.72	4.27
T_2	87.49	10.80	57.74	0.73	4.27
T_3	85.29	10.53	56.57	0.69	4.33
T_4	85.15	10.67	57.20	0.69	4.33
T_5	86.66	10.80	57.59	0.72	4.40
T_6	88.00	10.93	58.74	0.73	3.93
T_7	87.19	10.87	58.53	0.72	3.87
T_8	92.56	11.20	60.67	0.76	3.47
T_9	85.32	10.67	56.09	0.70	3.93
T_{10}	85.46	10.67	56.71	0.71	4.60
T_{11}	86.95	10.87	57.44	0.73	3.80
T_{12}	89.12	10.93	59.37	0.75	3.73
SEm±	1.48	0.23	0.93	0.01	0.25
$CD_{0.05}$	3.06	0.49	1.92	0.03	0.52

T_0 (control), T_1 (salicylic acid 100 ppm as soaking), T_2 (salicylic acid 200 ppm as soaking), T_3 (salicylic acid 300 ppm as soaking), T_4 (ethrel 100 ppm as soaking), T_5 (ethrel 200 ppm as soaking), T_6 (ethrel 300 ppm as soaking), T_7 (salicylic acid 100 ppm as soaking and foliar spray), T_8 (salicylic acid 200 ppm as soaking and foliar spray), T_9 (salicylic acid 300 ppm as soaking and foliar spray), T_{10} (ethrel 100 ppm as soaking and foliar spray), T_{11} (ethrel 200 ppm as soaking and foliar spray), T_{12} (ethrel 300 ppm as soaking and foliar spray)

cell wall plasticity and sink/source regulation (Dat et al 1998, Tseng et al 2000, Islam 2007 and Bai et al 2006).

Biochemical traits (Table 3)

The TSS, ascorbic acid, dry matter, nitrogen, protein content and pungency in bulbs increased significantly with increasing levels of salicylic acid as compared to control. The application of T_8 (cloves soaking with 200 ppm + 200 ppm with foliar spray of salicylic acid) recorded maximum dry matter of bulb (47.22%) and pungency (67.44 µmol/g) and minimum dry matter (39.64%) and pungency (62.94 µmol/g) were recorded under control. However total soluble solids (TSS) (42.35°Brix), ascorbic acid (11.66 mg/100 g of edible portion), nitrogen (3.27%) and protein content (20.42%) were recorded maximum with spray of T_{12} (ethrel 300 ppm with double spray) as compared to minimum TSS (36.80°Brix), ascorbic acid (9.29 mg/ 100 g of edible portion), nitrogen (1.88 %) and protein content (11.77%) recorded in control.

From the study it was concluded that exogenous application of salicylic acid at 200 ppm by way of soaking or foliar

Table 2. Effect of salicylic acid and ethrel on plant yield parameters of garlic var G-282

Treatment	Clove length (cm)	Clove diameter (cm)	Bulb yield per plot (kg)	# cloves/bulb
T_0	2.16	0.93	1.97	21.59
T_1	3.50	1.02	2.60	25.22
T_2	3.76	1.05	2.86	25.78
T_3	2.97	1.01	2.52	25.11
T_4	2.33	0.95	2.51	24.00
T_5	2.55	0.97	2.62	25.11
T_6	2.55	0.99	2.63	26.18
T_7	3.62	1.05	3.14	25.77
T_8	3.78	1.10	3.57	25.55
T_9	3.37	1.03	2.32	25.55
T_{10}	2.66	0.98	2.87	25.33
T_{11}	2.87	0.99	2.89	25.92
T_{12}	3.01	1.00	3.05	26.22
SEm±	0.29	0.02	0.34	1.10
$CD_{0.05}$	0.60	0.04	0.71	2.28

T_0 (control), T_1 (salicylic acid 100 ppm as soaking), T_2 (salicylic acid 200 ppm as soaking), T_3 (salicylic acid 300 ppm as soaking), T_4 (ethrel 100 ppm as soaking), T_5 (ethrel 200 ppm as soaking), T_6 (ethrel 300 ppm as soaking), T_7 (salicylic acid 100 ppm as soaking and foliar spray), T_8 (salicylic acid 200 ppm as soaking and foliar spray), T_9 (salicylic acid 300 ppm as soaking and foliar spray), T_{10} (ethrel 100 ppm as soaking and foliar spray), T_{11} (ethrel 200 ppm as soaking and foliar spray), T_{12} (ethrel 300 ppm as soaking and foliar spray)

Table 3. Effect of salicylic acid and ethrel on plant qualitative attributes of garlic var G-282

Treatment	TSS (°Brix)	Vitamin C (mg/100 g)	Dry matter (%)	Nitrogen (%)	Protein (%)	Pungency (µmol/g)
T_0	36.80	9.29	39.64	1.88	11.77	62.94
T_1	39.97	10.28	44.54	2.36	14.77	66.49
T_2	37.39	10.37	45.90	2.46	15.38	66.73
T_3	38.33	9.59	45.01	2.26	14.13	65.01
T_4	40.43	9.94	44.31	2.37	14.79	65.59
T_5	41.13	11.12	44.66	2.39	14.96	65.93
T_6	41.30	11.24	44.19	2.67	16.71	66.57
T_7	38.93	10.78	46.78	2.44	15.27	66.83
T_8	40.77	10.80	47.22	2.67	16.69	67.44
T_9	38.30	11.34	46.96	2.43	15.19	64.24
T_{10}	41.17	10.45	45.20	2.70	16.88	65.93
T_{11}	41.73	11.60	44.27	2.84	17.75	66.45
T_{12}	42.35	11.66	45.84	3.27	20.42	66.28
SEm±	1.30	0.69	1.62	0.27	1.74	1.11
$CD_{0.05}$	2.38	1.44	3.35	0.57	3.60	2.30

T_0 (control), T_1 (salicylic acid 100 ppm as soaking), T_2 (salicylic acid 200 ppm as soaking), T_3 (salicylic acid 300 ppm as soaking), T_4 (ethrel 100 ppm as soaking), T_5 (ethrel 200 ppm as soaking), T_6 (ethrel 300 ppm as soaking), T_7 (salicylic acid 100 ppm as soaking and foliar spray), T_8 (salicylic acid 200 ppm as soaking and foliar spray), T_9 (salicylic acid 300 ppm as soaking and foliar spray), T_{10} (ethrel 100 ppm as soaking and foliar spray), T_{11} (ethrel 200 ppm as soaking and foliar spray), T_{12} (ethrel 300 ppm as soaking and foliar spray)

spray was effective in improving growth, yield and biochemical traits of garlic.

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