

Influence of Salicylic Acid on Growth and Bulb Yield of Onion (*Allium cepa* L.)

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ABSTRACT

Keywords

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The experiment was conducted at University of Agricultural Sciences, Dharwad during *rabi* season of 2014-15. The main aim of experiment was to enhance the production of onion through assess the impact of salicylic acid. Plant height (68.98cm), No. leaves (8.35), collar thickness (15.56 mm), avg. bulb weight (69.32 gm), equatorial (62.72 mm) and polar (54.04 mm) diameter, lower % of bolters (3.06 %) and doubles (2.50 %) were recorded in foliar application of SA at 30 days after sowing and second spraying at 30 days after transplanting and third spray at 45 days after transplanting and marketable yield (39.22 t/ha) and total yield (41.75 t/ha) were recorded in the same treatment then untreated control yield (31.81 t/ha) and total yield (34.10 t/ha). It was observed that foliar application of SA at 30 days after sowing and second spraying at 30 days after transplanting and third spray at 45 days after transplanting exhibited the best growth and yield.

Introduction

Onion (*Allium cepa* L.) is one of the commercial vegetable and spice crops of India and belongs to the family *Alliaceae*. The area and production of onion in India is about 1181'000 hectares and 18924'000 tonnes of bulb, respectively, with an average yield of 16 t ha⁻¹ (NHB, 2015). In India, about 60 percent of onion is predominantly cultivated during winter followed by 20% each in *kharif* and late *kharif* seasons. The reason for lower productivity of onion in India is primarily due to cultivation of low yield potential varieties having susceptibility to both biotic and abiotic stresses. Onion is an important commercial crop exposing to wide array of damaging agents including biotic (pathogens and insects) and abiotic (drought, salinity, heat,

cold and poor soil fertility) environmental aggressions. To cope up with these continuous challenges under field conditions, plants have evolved broad and efficient mechanism to obtain an adequate defense and one more such mechanism against pathogen attack is the synthesis of vast array of low molecular weight components with disparate functions in plant pathogen interactions (Dixon, 2001). SA is recently included in the class of phytohormones for proper plant growth and development and induction of tolerance to both biotic as well as abiotic stresses. In general, SA is an important defensive signal in plants essential for elicitor triggered immunity and establishment of systemic acquired resistance (SAR) (Carr *et*

al., 2010.) Thus, SA is an endogenous growth regulator of several physiological processes in crop plants such as stomata closure, ion uptake, inhibition of ethylene biosynthesis and transpiration (Khan *et al.*, 2003 and Shakinova *et al.*, 2003). In addition to its role towards biotic stress, SA is also believed to play a key role plant responses to many stresses as ozone (Kochroo *et al.*, 2000), heat (Dat *et.al.*, 1998), chilling (Janda *et al.*, 1999 and Metway *et al.*, 2003), drought stress (Senaranta *et al.*, 2000; Singh and Usha, 2003) etc.

These studies clearly suggests the involvement of SA in realization of different anti stress functions in crop plants, but not much information was available on the efficacy of SA in one of the most important export oriented commercial vegetable crop of India, onion. Keeping this in view, a field experiment was conducted under All India Network Project on Onion and Garlic operating at College of Agriculture, Dharwad, Karnataka, India during *rabi* 2014-15 to study the effect of SA on growth and yield of onion.

Materials and Methods

Soil of the experimental site was clay in texture with neutral pH (6.95) low in soluble salts content (EC 1.82 dsm⁻¹), low in available nitrogen (228.5 kg ha⁻¹), medium in available phosphorous (21.10 kg P₂O₅ha⁻¹), high in available potassium (620 kg ha⁻¹), sufficient in available sulphur (30.00 kg ha⁻¹) The field trail was laid out by Randomized Block Design with six treatments replicated four times. The six treatment schedule consisted of foliar application of SA (SA) at 250 mg l⁻¹ at 30 days of sowing (DAS) and second spraying at 30 days after transplanting (DAT) (T₁), foliar application of SA at 30 DAT and second spraying at 45 DAT (T₂), foliar application of SA at 30 DAT and second spraying at 60 DAT (T₃), Foliar application of

SA at 30 days after sowing and second spraying at 30 days after transplanting and third spray at 45 days after transplanting (T₄), Foliar application of SA at 30 DAT and second spray at 60 DAT (T₅), along with untreated control *i.e.*, without SA water spray only (T₆). The onion variety Bhima Shakti seedlings were raised in nursery bed. The seedlings were sprayed with SA @ 250 mg l⁻¹ 30 DAT except the control treatment. Forty five 45 days old seedlings of 10-15 cm height were transplanted in the main field at a spacing of 15cm X 10 cm. the crop was raised by following the recommended package of practice and the treatments were imposed as per the schedule. The data recorded on various parameters were subjected to statistical analysis as per the procedure suggested by Panse and Shukatme (1978).

Results and Discussion

Growth parameters of onion

The data given in table 1 indicated that, different treatments did not significantly influence plant height in onion. However foliar application of SA (SA) at 250 mg l⁻¹ at 30 days after sowing followed by 30 and 45 days after sowing (T₄) recorded higher plant height closely followed by T₃ and T₅. Similarly T₄ recorded the highest number of leaves per plant and was significantly superior to control but statistically similar to other treatments. Numerically the highest collar thickness was recorded in T₄ (15.56 mm) and was followed by T₃ (14.72 mm) control with no SA treatment recorded the lowest value (13.72 mm). These results indicated that foliar application of SA to onion improved crop growth and the extent of improvement was more in the treatment with more number of foliar sprays. The beneficial effect of SA on crop growth might be due to its involvement in several physiological processes in plants such as stomatal opening and closing,

nutrients uptake and inhibition of biosynthesis and transpiration. (Khan *et al.*, 2003 and Shakirova *et al.*, 2003) SA had also prolific effects on both morphology and physiology of plants. (Piperpoint, 1996 and Poncheva *et al.*, 1996) Exogenous application of SA increases photosynthetic activity which enhances the plant height and number of leaves per plant (Gharib, 2006) Similar reports on beneficial effects of SA on vegetative in form of plant height, number of leaves per plant, chlorophyll content of leaves have also been reported in several crops, such as E1- Tayeb (2005) in chilli, Amin *et al.*, 2007 in onion, Gawade and Sirohi (2011) in brinjal and Khandaner *et al.*, (2011) in red amaranthus etc.

Yield and yield attributes and bulb yield of onion

The results on yield attributing parameters of onion variety Bhima Shakti revealed that there was a significant variation in onion bulb diameter (polar and equatorial) and average bulb weight, doubles and bolters percentage due to spaying of SA at different times (Table 2). Significantly maximum polar diameter (PD) of 62.72 mm was recorded in T₄ followed by T₅ (61.41 mm). Similarly, maximum equatorial diameter (ED) was also recorded in T₄ (51.40 mm) followed by T₃ (54.05 mm) as compared to control (47.75 mm).

The average bulb weight was higher in T₄ (69.32 gm) followed by T₅ (68.17 gm) T₃ (68.16 gm) and T₄ maintained statistical purity with all the treatments but significantly superior to control which recorded the lowest value (65.07 gm). Further T₄ also recorded lower values for doubles and bolters percentage (2.50) and (3.06) respectively but control with no SA treatment recorded the highest values (6.25) and (4.71) respectively. The better efficacy of SA increasing the

effective photosynthetic area interms of plant height, number of leaves per plant and chlorophyll content significantly enhance the assimilation of photosynthates in the bulb. Results of higher values of polar and equatorial diameter in onion bulbs also reported by Amin *et al.*, (2007), Pradhan *et al.*, (2016) in onion and Bideshiki and Arvin (2010) in garlic. The increased bulb weight in the present study due to foliar application of SA to onion might be due to the better utilization of photosynthesis and increased allocation of photosynthates towards the economic parts i.e., bulbs in onion. Several studies indicated that SA may have a dramatic effect on sugar metabolism in plants. Sugars, the form of simple carbohydrates are well known for their role in plant metabolism in all living cells (Hirabayashi, 1996). In general, both glucose and fructose are the primary sucrose of carbon and energy for plant cells. In oxygenic photosynthesis and is a transport molecule in plant growth development and storage (Couee *et al.*, 2006). Similar report on better efficacy of SA over control was also reported in onion by Amin *et al.*, (2007), Pradhan *et al.*, (2016), garlic by Bideshiki and Arvin (2010) and green pea by Hak *et al.*, (2012) in green pea.

The results presented on total bulb yield and marketable bulb yield of onion variety Bhima Shakti revealed numerical variations among different treatments due to exogenous application of SA (Table 2). The results indicated that numerical higher total bulb yield of 41.75 t ha⁻¹ in T₄ than rest of the treatments followed by T₃ (40.35 t/ha) and T₅ (37.68 t/ha).

Numerically higher marketable yield was also observed higher in the T₄ (39.22 t/ha) followed by T₃ (38.90 t/ha) and T₅ (34.99 t/ha). Similar report of higher bulb yield in onion with application of SA than the control was also reported by Amin *et al.*, (2007).

Table.1 Effect of SA on growth parameters of onion

Treatment	PH (cm)	NOL	CTh (mm)
T1	66.88	7.45	13.92
T2	67.98	7.65	14.21
T3	68.37	7.80	14.72
T4	68.98	8.35	15.56
T5	68.24	7.95	13.97
T6	64.90	7.20	13.72
SEm	3.93	0.30	0.72
CD @5%	11.85	0.92	2.18
CV %	11.63	7.96	10.18

Table.2 Effect of SA on yield and yield parameters of onion

Treatment	PD (mm)	ED (mm)	Avg. wt of bulb	TBY (t/ha)	MY (t/ha)	Double (%)	Bolters (%)
T1	58.27	47.75	67.66	35.78	33.64	5.25	3.33
T2	60.23	49.29	67.32	35.93	32.91	5.19	3.33
T3	60.65	50.40	68.16	40.35	38.90	5.06	3.11
T4	62.72	54.04	69.32	41.75	39.22	2.50	3.06
T5	61.41	51.40	68.17	37.68	34.99	3.45	3.11
T6	56.01	47.75	65.07	34.10	31.81	6.25	4.71
SEm	0.69	1.08	1.26	3.25	3.60	0.89	0.67
CD @5%	2.08	3.26	3.79	9.81	10.85	2.68	0.02
CV %	2.30	4.35	3.72	17.39	20.53	38.60	9.49

Table.3 Effect of SA on cost of cultivation of Onion

Treatment	Cost of cultivation (Rs/ha)	Yield (t/ha)	Gross income (Rs/ha)	Net returns (Rs/ha)	B:C ratio
T ₁	82,270.5	35.78	10,73,400	9,91,129.5	12.04
T ₂	82,270.5	35.93	10,77,900	9,95,629.5	12.10
T ₃	82,270.5	40.35	12,10,500	11,28,229.5	13.71
T ₄	84,053.5	41.75	12,52,500	11,68,446.5	13.90
T ₅	84,053.5	37.68	11,30,400	10,46,346.5	12.44
T ₆	78,704.5	34.10	10,23,000	9,44,295.5	11.99

The higher marketable yield might be due to enhanced assimilation of nutrient uptake, nutrient reduction and photosynthesis improved flow assimilates and increased cell integrity which in term reflected on the increased bulb yield of the onion plants. Better efficacy of SA in garlic was also reported by Bideshki and Arvin (2010), which might be due to accumulation of more

chlorophyll content in SA treated plants, responsible for the improved fresh and dry matter accumulation there by final bulb yield.

Economics

The findings obtained from table 3, indicated the marked variations among treatments in respect of cost of cultivation. Onion also

reiterates the beneficial effect of foliar application of SA to onion. T₄ recorded the highest gross (Rs. 12,52,500) and net returns (Rs. 11,68,446.5) with higher B:C ratio (13.90) and was followed by T₃ and control recorded the lowest returns. The higher net returns due to foliar application of SA to onion might be attributed to higher total and marketable yields.

From this study it could be concluded that foliar spray of SA (SA) is essential for onion crop. Foliar spray of SA at 30 days after sowing during nursery seedling stage, subsequently second spray at 30 days after transplanting and third spray at 45 or 60 days after transplanting during crop growth stage not only increased the vegetative growth but also the bulb yield of onion variety Bhima Shakti.

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