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Influence of salicylic acid on the growth and yield in onion Cv. (Akola safed)

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Abstract

An experiment entitled "Influence of salicylic acid on the growth, yield and quality in onion Cv. (Akola safed)" was carried out during *rabi* season of academic year 2016-2017, at Chilli and Vegetable Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The experiment was conducted in Factorial Randomized Block Design, with three replications and 13 treatment combinations with control treatment. There were two factors, main factor being stages of application with 3 levels viz. 30 DAT, 60 DAT, 30 and 60 DAT and another sub factor was concentration of salicylic acid with 4 levels viz. 50, 100, 150, 200 mg l⁻¹. The results of present investigation indicated that, the growth characters like plant height (cm), number of leaves per plant were showed significant influence due to a treatment combination consisting of two applications of spray of salicylic acid at 30 and 60 DAT with an application of salicylic acid @ 100 mg l⁻¹ (A₃C₂). Considering to the cured bulb yield, A, B, C grade bulbs and total marketable yield were recorded maximum, wherein the treatment combination consisting of two applications of salicylic acid at 30 and 60 DAT along with salicylic acid @ 100 mg l⁻¹ (A₃C₂).

Keywords: Influence of salicylic, Salicylic acid, onion

Introduction

Onion (*Allium cepa* L.) belongs to family Alliaceae is one of the oldest bulb crop, known to mankind and consumed worldwide. The onion is preferred mainly because of its green leaves; immature as well as mature bulbs are either eaten raw or cooked as a vegetable. A distinct characteristic of onion is its alliaceous odour, which accounts for their use as food. The pungency in onion is due to a volatile compound known as *Allyl-propyl disulphide*. India ranks 1st in position both in area (127 lakh hectare) and production (215.64 lakh tones) in the world. India's recent export of onion in various forms to the countries like Bangladesh, Malaysia, UAE, Shrilanka, Nepal etc. However, large quantities of onion are consumed internally in India. Although, India enjoys better position in the world scenario but the productivity of Indian onion is very less, only 16 t ha⁻¹ as compared to many other countries in the world. In India, the major onion producing states in country are Maharashtra, Gujarat, Madhya Pradesh, Karnataka, Bihar etc. Maharashtra is the largest producer of onion in the country with an area of 4.71 lakh ha with production 667.31 lakh MT and productivity 14.36 t ha⁻¹. In Maharashtra concentrated mainly in Nashik, Ahmednagar, Pune, Aurangabad and Jalgaon, districts (NHB., Database, 2017).

Salicylic Acid recently included in the class of phytohormones for proper plant growth development and induction of tolerance to both biotic as well as abiotic stresses. The word "Salicylic Acid" was derived from Latin word "Salix" meaning willow tree distributed in the whole plant kingdom and is classified under the group of plant hormone (Raskin, 1992) [14]. Salicylic acid (C₇H₆O₃) has been identified as one of the important phenolic compound in plants (Chandra *et al.*, 2007) [4]. This substance is naturally produced in plants in very low amounts. Various physiological and biochemical effects of salicylic acid on plant systems have been documented. (Raskin, 1992) [14]. In general, salicylic acid is an endogenous growth regulator with phenolic nature, which participates in regulation of several physiological processes in crop plants such as stomata closure, ion uptake, inhibition of ethylene biosynthesis and transpiration (Khan *et al.*, 2003 and Shakirova *et al.*, 2003) [10, 17]. It has already established that, many phenolic compounds play an essential role in the regulation of different physiological processes, including plant growth and development, ion uptake and photosynthesis (Popova *et al.*, 1997; Singh and Usha, 2003) [13, 18].

The present study on the topic "Influence of salicylic acid on the growth and yield in onion

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Cv. (Akola safed)", was undertaken to test the effect of salicylic acid as a foliar spray at different stages of application.

Material and methods

The field experiment was conducted in the farm of Chilli and Vegetable Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during *rabi* season of 2016-17. Akola is situated in sub-tropical region between 22.20 N latitude and 77.02 E longitude. The altitude of place is 307.2 m above mean sea level. The climate of Akola is semi arid and characterized by three distinct seasons. To ascertain physico-chemical characteristics of soil, soil samples were collected

from different spots of the experiment field to a depth of 0-30 cm, before layout and composite soil sample was prepared and analysed for physicochemical properties of soil. The soil analysis indicated that, the soil of experimental plot is medium black soil with uniform texture and structure having good drainage, low in organic carbon and available nitrogen, medium in available phosphorus and available potash. The experiment was laid out in Factorial Randomized Block Design (FRBD) with three replications and thirteen treatments combination. The variety of onion used for the present study was Akola safed, which was developed by Chilli and Vegetable Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during 2016 - 17.

Factor A: Stages of application (03)

A1	:	Single application of salicylic acid at 30 days after transplanting.
A2	:	Single application of salicylic acid at 60 days after transplanting.
A3	:	Two applications of salicylic acid at 30 and 60 days after transplanting.

Factor B: Concentration of salicylic acid (04)

C1	:	50mg/lit
C2	:	100mg/lit
C3	:	150mg/lit
C4	:	200mg/lit

Grading

The 'A' grade bulbs (5.5 - 4.5 cm) were selected from the total cured bulbs obtained from each plot. Then the percentage of 'A' grade bulb was computed. The 'B' grade bulbs (4.5 - 3.5 cm) were selected and the percentage of 'B' grade bulb was computed. The 'C' grade bulbs (3.5 - 2.5 cm) were selected. Then the percentage of 'C' grade bulb was computed on weight basis compared to the total weight of cured bulbs per plot.

Results and discussion

Vegetative growth parameters

Plant height (cm)

From the data presented in the Table 1, it is observed that, at 120 DAT due to various treatments plant height was

influenced significantly. Interaction effect was also found to be significant. Among the stage of application at 120 DAT among the stage of application of salicylic acid A₃ recorded maximum plant height i.e. 63.18. Considering to the various concentrations of salicylic acid at 120 DAT C₂ recorded maximum plant height i.e. 65.02 cm respectively. At 120 DAT interaction effect was also found statistically significant. A₃C₂ recorded maximum plant height at 120 DAT i.e. 70.81 cm. During the present investigation A₀C₀ recorded minimum plant height.

The maximum growth of onion plants in respect of height might be attained in present investigation due to the application of salicylic acid at 30 and 60 DAT along with 100 mg l⁻¹ as compare to the rest of the treatment combination. The salicylic acid had the prolific effects on onion plant morphology and physiology too. There might be increase in the photosynthetic activities of onion plant, due to the application of salicylic acid in the present study. These results are in line with the findings of Gharib (2006)^[7], Amin *et al.* (2007)^[11] in onion.

Table 1

Treatment	Plant height	Number of leaves	Neck thickness	Average bulb yield	Cured bulb yield per plot	Cured bulb yield per ha.	A grade bulb	B grade bulb	C grade bulb	Total marketable bulb
Factor A										
A ₁	57.92	9.32	1.42	79.87	10.90	238.26	8.15 (16.57) [#]	52.13 (46.22) [#]	52.92 (46.68) [#]	90.03 (9.51) [^]
A ₂	57.12	8.70	1.46	79.55	10.62	230.99	8.15 (16.58)	51.63 (45.94)	52.47 (46.42)	88.86 (9.45)
A ₃	63.18	9.93	1.32	83.78	12.17	261.27	8.36 (16.80)	52.98 (46.71)	53.67 (47.10)	90.34 (9.53)
Factor B										
C ₁	56.34	9.87	1.35	81.36	11.61	252.34	7.93 (16.36) [#]	51.36 (45.78) [#]	33.59 (35.42) [#]	88.85 (9.45) [^]
C ₂	65.02	10.53	1.26	83.49	12.31	266.74	8.79 (17.25)	53.30 (46.89)	32.14 (34.54)	92.11 (9.62)
C ₃	63.99	8.60	1.44	78.31	10.79	233.83	8.72 (17.17)	53.02 (46.73)	32.62 (34.83)	91.80 (9.61)
C ₄	52.27	8.27	1.55	81.11	10.21	221.12	7.42 (15.81)	53.02 (46.73)	33.42 (35.32)	86.21 (9.31)
Interaction										
A ₁ C ₁	62.79	9.5	1.35	79.47	10.87	244.17	8.82 (17.28) [#]	52.92 (46.68) [#]	32.65 (34.85) [#]	91.47 (9.59) [^]
A ₂ C ₁	61.00	9	1.40	80.65	10.90	240.03	9.00 (17.46)	52.47 (46.42)	33.19 (35.18)	91.77 (9.61)

A ₃ C ₁	68.19	11.1	1.31	83.96	13.05	272.82	8.56 (17.01)	53.67 (47.10)	32.02 (34.46)	92.15 (9.62)										
A ₁ C ₂	62.79	11.0	1.33	79.14	11.62	251.70	8.64 (17.09)	53.24 (46.86)	32.11 (34.52)	92.13 (9.63)										
A ₂ C ₂	61.46	9.1	1.36	78.76	11.22	243.03	8.52 (16.97)	52.67 (46.53)	32.32 (34.64)	91.21 (9.58)										
A ₃ C ₂	70.81	11.5	1.10	92.56	14.10	305.50	9.00 (17.46)	54.00 (47.29)	32.00 (34.45)	93.00 (9.67)										
A ₁ C ₃	54.77	8.6	1.46	78.13	10.82	234.36	7.78 (16.19)	51.40 (45.80)	33.68 (35.47)	89.49 (9.49)										
A ₂ C ₃	54.72	8.5	1.46	78.69	10.55	228.58	7.76 (16.17)	50.77 (45.44)	34.13 (35.74)	87.80 (9.40)										
A ₃ C ₃	59.52	8.7	1.40	78.11	11.01	238.55	8.27 (16.71)	51.92 (46.10)	32.97 (35.04)	89.24 (9.47)										
A ₁ C ₄	51.33	8.2	1.54	82.74	10.28	222.81	7.78 (16.19)	50.97 (45.56)	34.31 (35.85)	87.02 (9.35)										
A ₂ C ₄	51.30	8.1	1.61	80.11	9.80	212.33	7.76 (16.17)	50.62 (45.36)	33.93 (35.63)	84.67 (9.23)										
A ₃ C ₄	54.19	8.5	1.48	80.47	10.53	228.22	8.27 (16.71)	52.33 (46.34)	32.03 (34.47)	86.95 (9.35)										
	49.90	8.0	1.62	76.95	8.5	210.3	6.43	48.80	35.47	81.7										
	S.E.	CD at 5%	S.E.	CD at 5%	S.E.	CD at 5%	S.E.	CD at 5%	S.E.	CD at 5%										
Factor A	0.46	1.33	0.13	0.38	0.04	-	0.59	1.71	0.20	0.57	3.99	11.65	0.06	0.16	0.03	0.09	0.07	0.20	0.01	0.03
Factor B	0.53	1.53	0.15	0.44	0.05	0.14	0.68	1.98	0.23	0.66	4.61	13.46	0.06	0.19	0.04	0.11	0.08	0.23	0.01	0.03
Interaction	0.91	2.66	0.26	0.76	0.08	-	1.23	3.59	0.39	1.15	7.98	23.31	0.11	0.32	0.07	0.19	0.14	0.40	0.02	0.06
Control (A ₀ C ₀)	0.67	1.96	0.19	0.56	0.06	-	0.86	2.52	0.29	0.86	5.88	17.15	0.08	0.24	0.05	0.14	0.10	0.29	0.01	0.04

#Figures in parentheses are arc sin value transformation

^Figures in parentheses are square root transformation

Number of leaves

It is evident from the data presented in Table 2, it was revealed that, the stages of application and different concentrations of salicylic acid exhibited significantly also interaction effect was also significant at 120 DAT. At 120 DAT among the time of application A₃ recorded maximum number of leaves (9.93). With regards to the various concentrations C₂ recorded maximum number of leaves (10.53). The interaction effect was found to be significant. A₃C₂ recorded maximum number of leaves (11.5). During the present investigation A₀C₀ recorded minimum number of leaves per plant.

It might be due to the fact that, peridined division and enlargement of central cell in the leaf axis would be possible due to the morphactin like salicylic acid. It might also be responsible for increase in numbers of leaves per plant in onion. Similar results were reported by Jones and Mann, (1963)^[9], Khan *et al.* (2003)^[10], Shakirova *et al.* (2003)^[17] in alliums.

Yield attributing parameters

The data indicated that, an interaction effect of stage of application and concentrations of salicylic acid on yield attributing parameters were found to be significant.

Average weight of bulb (g)

The data in regard to average weight of bulb (g) as influenced by different salicylic acid treatments and time of application was presented in Table 4 and revealed significant differences, due to various treatments. A perusal of the data indicated that, it was revealed that the average weight of bulb was significantly influenced due to the various treatments and their combinations. Considering the stage of application maximum average weight of bulb was observed in A₃ (83.78 g). Whereas among the various concentrations of salicylic acid C₂ recorded maximum average weight of bulbs (83.49 g).

However the combination A₃C₂ recorded maximum weight of bulb (92.56 g). The treatment combination A₀C₀ recorded maximum average weight of bulbs (76.95 g).

This might be due to the fact that, salicylic acid would be responsible for better utilization of photosynthesis and ultimately that would be translocated towards the onion bulbs, which ultimately responsible for increase in the average weight of bulbs. The similar results in this regard were reported by Amin *et al.* (2007)^[11] in onion and Bideshki and Arvin (2010)^[13] in garlic.

Cured bulb yield per plot (Kg)

From the data presented in Table 5, it is opined that, cured bulb yield per plant was observed to be significant. Maximum cured bulb yield considering to the stage of application was observed in A₃ (12.17 kg). Among various concentrations of salicylic acid C₂ recorded maximum cured bulb yield per plot (12.31 kg). The treatment combination A₃C₂ recorded maximum cured bulb yield per plot (14.1 kg). However, it was recorded minimum (8.5 Kg), when the salicylic acid was applied with control (water spray) treatment (A₀C₀) combination.

Cured bulb yield per ha (q)

From the data presented in Table 4, it is revealed that, Maximum cured bulb yield considering to the stage of application was observed in A₃ (261.27 q). Among various concentrations of salicylic acid C₂ recorded maximum cured bulb yield per plot (266.74 q). The treatment combination A₃C₂ recorded maximum cured bulb yield per plot (305.50 q). However, it was recorded minimum (210.30 q), when the salicylic acid was applied with control (water spray) treatment (A₀C₀) combination.

This could be attributed with the fact that, enhancement of net photoperiod rate, internal CO₂ concentration and water use efficiency in the crop like onion was supported by moderate

concentration of salicylic acid. These results are in line with the findings of Yadav *et al.* (2018)^[20] in onion.

Grading of onion bulbs (A, B and C grades)

'A' grade bulbs (%)

The data as regard to percent of 'A' grade onion bulbs as influenced by time of application and different salicylic acid concentrations is presented in Table 5. Considering to the data, effect of stages of application, various concentrations of salicylic acid and their interaction was found statistically significant. Among the stage of application A₃ recorded maximum A grade bulbs (8.36 %). Considering to the various concentrations of salicylic acid C₂ recorded maximum A grade bulbs (8.79 %). The treatment combination A₃C₂ recorded maximum A grade bulbs (9.00 %) which was at par with A₁C₃ and A₂C₃.

'B' grade bulbs (%)

The data pertaining to percent of 'B' grade bulbs (%) as influenced by time of application and different salicylic acid concentration is presented in Table 5. Considering to the data, effect of stages of application, various concentrations of salicylic acid and their interaction was found statistically significant. Among the stage of application A₃ recorded maximum B grade bulbs (52.98 %). Considering to the various concentrations of salicylic acid C₂ recorded maximum B grade bulbs (53.30 %). The treatment combination A₃C₂ recorded maximum B grade bulbs (54.00 %).

'C' grade bulbs (%)

The data in regard to percent of 'C' grade bulbs as influenced by different salicylic acid treatments and time of application is presented in Table 5. From the data, it is revealed that, effect of stages of application, various concentrations of salicylic acid and their interaction was found statistically significant. Among the stage of application A₂ recorded maximum C grade bulbs (33.39 %). Considering to the various concentrations of salicylic acid C₃ recorded maximum C grade bulbs (32.62 %). The treatment combination A₃C₂ recorded minimum C grade bulbs (32.00 %) whereas the treatment combination A₀C₀ recorded significantly maximum C grade bulbs (35.47 %).

Total marketable bulbs (%)

The data regarding total marketable bulb (%) as influenced by different concentration of salicylic acid and time of application is presented in Table 5 and exhibited significant difference due to various treatments. Considering to the stage of application stage of application the treatment A₃ recorded maximum marketable yield (90.34 %). Among the various concentrations of salicylic acid C₂ recorded maximum marketable yield (92.11 %). The interaction effect was also found statistically significant. A₃C₂ recorded maximum marketable yield (93.00 %). The treatment combination A₀C₀ recorded minimum marketable yield (81.70 %).

Thereby more photosynthates would get produced in the plant due to improved photosynthesis and increased cell integrity. Which in turn would be more number of A, B and C grade bulbs than D and E grade bulbs in the present study. Dat *et al.* (1998)^[5], Tseng *et al.* (2000)^[19], Islam (2007)^[8] reported the similar results.

Conclusions

On the basis of results obtained from the present experiment, following conclusions could be drawn

1. Stage of application of salicylic acid at 30 and 60 DAT

(A₃) significantly increased the growth in respect to plant height, number of leaves per plant and yield except neck thickness.

2. Application of salicylic acid @ 100 mg l⁻¹ (C₂) significantly increased the growth towards plant height and number of leaves per plant and yield except neck thickness, as compare to the other levels of the concentration.
3. As regards to the interaction effect, out of the total 13 treatment combinations along with the control treatment, the treatment combination consisting of two application at 30 and 60 DAT along with the concentration of salicylic acid 100 mg l⁻¹ (A₃C₂) significantly increased the growth parameters, except neck thickness, yield of cured bulbs

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