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Response of Tomato (*Solanum lycopersicum* L.) to Salicylic Acid and Calcium

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Authors' contributions

This work was carried out in collaboration between all authors. Author NA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MMI and MEH managed the analyses of the study. Authors NM, RN, MAH and SP managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The current piece study was conducted to find out the role of exogenous foliar application of salicylic acid (SA) and calcium (Ca^{2+}) on growth, reproductive behavior and yield of tomato.
Study Design: The single factor experiment was laid out in Randomized Complete Block Design (RCBD) with three replications.
Place and Duration of Study: At the experimental farm of Sher-e-Bangla Agricultural University, Dhaka, during the winter season of November 2013 to April 2014.
Methodology: BARI Tomato-15 was used as planting material. Six different treatments viz., A_0=0 mM of SA and 0 mM Ca^{2+}, A_1=0.25 mM SA and 0 mM Ca^{2+}, A_2=0 mM SA and 5 mM Ca^{2+}, A_3 =0.25 SA and 5 Ca^{2+}, A_4 =0 of SA and 10 Ca^{2+} and A_5 = 0.25 SA and 10 mM Ca^{2+} were applied in the morning at 15, 30, and 45 days after transplanting (DAT). Data of plant height, branch plant^{-1}, cluster plant^{-1}, flowers plant^{-1}, fruits plant^{-1}, fruit length (cm), fruit diameter (cm) and yield were recorded and analyzed for logical interpretation.

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Results: The morphological and yield contributing characters as well as yield of tomato were positively influenced with single and combined application salicylic acid (SA) and calcium (Ca^{2+}). Significant increase of plant height and number of leaves plant^{-1} at 20, 40 and 60 DAT was observed with the application of A_3 treatment. Application of A_3 treatment also showed significant influence on production of cluster plant^{-1} (20.44), flowers plant^{-1} (168.1), and fruits plant^{-1} (99.42) as well as fruit yield (72.57 t ha^{-1}). However application of A_4 treatment failed to improve the morphological and yield contributing characters as well as yield of tomato over the A_0 treatment (control).

Conclusion: Results suggest that combined application of SA and Ca^{2+} successfully increase the tomato fruit yield by altering the morphological and reproductive characters.

Keywords: Tomato; salicylic acid (SA); calcium (Ca^{2+}); winter season and yield.

1. INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is one of the most important fruit vegetable belong to the family Solanaceae which is grown throughout the world including Bangladesh. It is the world's largest vegetable crop after potato. In terms of human health, tomato is a major component in the daily diet and serves as an important source of nutrients including antioxidants like lycopene, a carotenoid phytonutrient that act as an anti-carcinogen and improves skin's ability to protect against harmful ultra violet (UV) rays. It is rich in vitamins, minerals and dietary fiber [1].

The average yield of tomato in Bangladesh 9.96 ton ha^{-1} was reported by Bangladesh bureau of statistics BBS, 2013 [2]. This fruit yield is lower in contrast with other tomato producing countries like China (49.87 ton ha^{-1}), India (20.11 ton ha^{-1}) and USA (87.96 ton ha^{-1}). The yield of tomato of Bangladesh is not enough in comparison to requirement. The low yield of tomato in Bangladesh is not the indication of low yield potentiality of this crop but the fact that this may be attributed due to different abiotic and biotic stresses including temperature, salinity, insects, pathogens, residual effect of pesticides, improper application of plant nutrients and plant growth regulators (PGRs) etc. The proper use of PGRs along with nutrients is believed to be effective and modern agricultural techniques to improve the fruit yield of tomato under the existing climatic conditions.

Salicylic acid (SA) is considered to be the potent plant hormone because of its diverse regulatory roles in plant metabolism [3]. It is synthesized in cells; can move freely in and out of the cells, tissues and organs and this movement is finely regulated by reactive oxygen species (ROS) and Ca^{2+} [4]. Arberg [5] stated that both abiotic and biotic stress tolerance increases in plants to fungi, bacteria, viruses, chilling, heat, drought, salinity in presence of SA. Fariduddin et al. [6] reported that lower concentrations of SA were found to be beneficial in enhancing the photosynthesis, growth and various other physiological and biochemical characteristics of plants. On the other hand, at higher concentrations, SA itself may cause a high level of stress in plants. Therefore, it suggests that SA alters various physiological functions and biochemical processes in plants for regulating their growth and productivity in relation to change of plant environment.

Calcium (Ca^{2+}) is an essential macro nutrient for vigorous plant growth which fulfills a fundamental role as a second messenger in plant membrane stability and cell wall-stabilization [7,8]. In 2003, White and Broadley elaborated that though it is an essential structural element in strengthening plant cell walls and membranes, it is also a well-known secondary messenger to mitigate the abiotic stress in plants [9]. Hao and Papadopoulos [10] reported that Ca^{2+} nutrition showed an encouraging effect on growth, fruit yield and quality of tomato. Holder and Cockshull [11] clarified that Ca^{2+} deficiency in tomato reduces leaf size, causes necrosis of young leaves and yield loss. The low Ca^{2+} supply leads to blossom-end rot in the fruit of tomato [12]. On the other hand, excessive supply of Ca^{2+} to fruit causes gold spot, cells containing a granular mass of tiny calcium oxalate crystals which not only affects the appearance of the fruit, but also reduces its shelf life [13]. Usten et al. [14] reported that Ca^{2+} enhances resistance to bacterial and viral diseases. Therefore, this experiment was conducted to examine the influence of Salicylic acid (SA) and Calcium (Ca^{2+}) on morpho-physiology and yield of tomato.

2. MATERIALS AND METHODS

The experiment was conducted at the experimental farm of Sher-e-Bangla Agricultural

University, Dhaka, during the period from November 2013 to April 2014. The location of the experimental site is 23°74'N latitude and $90^0$35'E longitude at an altitude of 8.6 meter above the sea level under the agro-ecological zone of Modhupur Tract, AEZ-28. BARI Tomato 15, a high yielding variety of Tomato was developed by the Bangladesh Agricultural Research Institute (BARI) Joydebpur, Gazipur, Bangladesh was used as a planting material. Seed was collected from respected research organization and seedlings were grown in 3 m x 1 m standard seedbed. The single factor experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Six different treatments viz., A_0 = 0 mM of SA and 0 Ca^{2+}, A_1 = 0.25 SA and 0 Ca^{2+}, A_2 = 0 SA and 5 Ca^{2+}, A_3 = 0.25 SA and 5 mM Ca^{2+}, A_4= 0 mM SA and 10 mM Ca^{2+} and A_5= 0.25 mM SA and 10 mM Ca^{2+} were applied exogenously (foliar spray) in the morning at 15, 30, and 45 DAT (Days After Transplanting). The total number of unit plots was 3*6=18. The size of each plot was 1.8 m x 1.5 m = 2.7 m^2. The space provided between block to block and plot to plot was 1 m and 0.5 m respectively. Seeds were sown in 15 November and 25 days old healthy seedlings were transplanted in each unit plot maintaining 50 cm x 60 cm planting distance. Agronomic practices like irrigation, weeding and stalking were conducted whenever necessary. Experimental data for morphological characters: plant height (cm), and number of leaves plant^{-1} were recorded at 20, 40 and 60 days after transplanting (DAT). Number of branches plant^{-1} were recorded at 60 DAT. Data on number of flower clusters plant^{-1}, number of flowers plant^{-1}, number of fruits plant^{-1}, fruit length (cm), fruit diameter (cm) were recoded all through the reproductive phase and final harvest. Fruits were harvested at 3 days interval at early ripening stage when they developed slightly red color. Fruit yield obtained from sample plants was used to calculate fruit yield plant^{-1} (kg) as well as yield (t ha^{-1}). No serious diseases were observed during this experiment, but bird attack was a potential problem at fruit ripening stage which was managed by assigning a watchman at the research site.

The data obtained were statistically analyzed using MSTAT software to observe the significant difference among the different treatments. The mean values of all the characters were calculated and factorial analysis of variance was performed. The significance of the difference among the treatment means was estimated by the Least Significant Difference (LSD) test at 5% level of probability(p= .05) [15].

3. RESULTS AND DISCUSSION

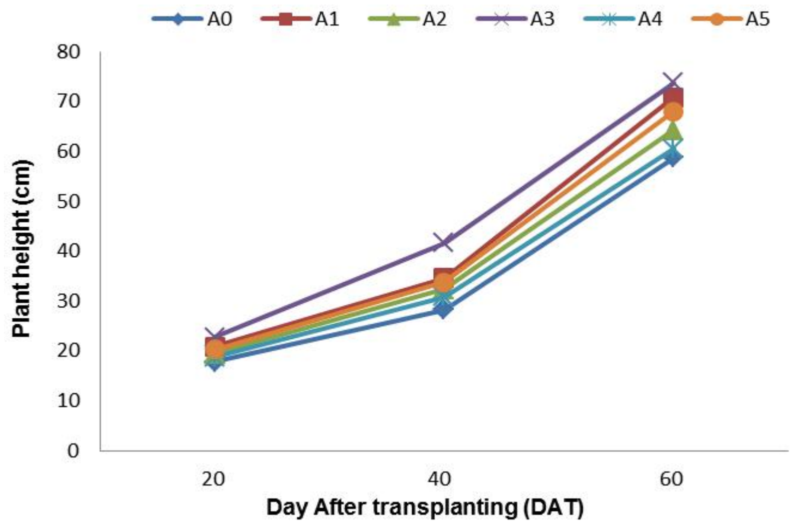
3.1 Plant Height

The exogenous application SA and Ca^{2+} showed a significant influence on plant height of tomato at 20, 40, 60 days after transplanting (DAT). At 20 DAT, the highest plant height (22.71 cm) was recorded from A_3 (0.25 mM SA + 5 mM Ca^{2+}) treatment which was statistically significant over other treatments whereas the lowest plant height (17.83 cm) was recorded from A_0 (0 mM SA + 0 mM Ca^{2+}) treatment. Plant height of tomato was also significantly higher at 40 DAT (41.62 cm) and 60 DAT (73.74 cm) with the application of A_3 treatment. In both cases shortest plant was observed with A_0 treatment (28.28 cm and 58.77 cm at 40 DAT and 0 DAT respectively). Plant height obtained at 60 DAT with application of A_0 and A_4 treatments was statistically identical. Application of SA with high concentration of Ca^{2+} (A_5 treatment) produced plants with significantly lower plant height at different days after transplanting compared to application of SA with lower concentration of Ca^{2+} (A_3 treatment). These results suggest that higher doses of foliar application of Ca^{2+} inhibits the plant height whereas lower concentration of Ca^{2+} promotes the plant height with SA because the rate of photosynthesis may be reduced by higher cellular concentration of Ca^{2+} that regulates stomatal movement. Javaheri et al. [16], and Ilyas et al. [17] also reported that both SA and Ca^{2+} independently increased the plant height of tomato.

The temperature of this experimental site showed a gradually falling trend during winter, November to January. This may possibly cause low temperature injury that regulates the plant height of tomato. Combined application of SA and calcium may act an alleviating agent of cold injury in tomato in case of plant growth.

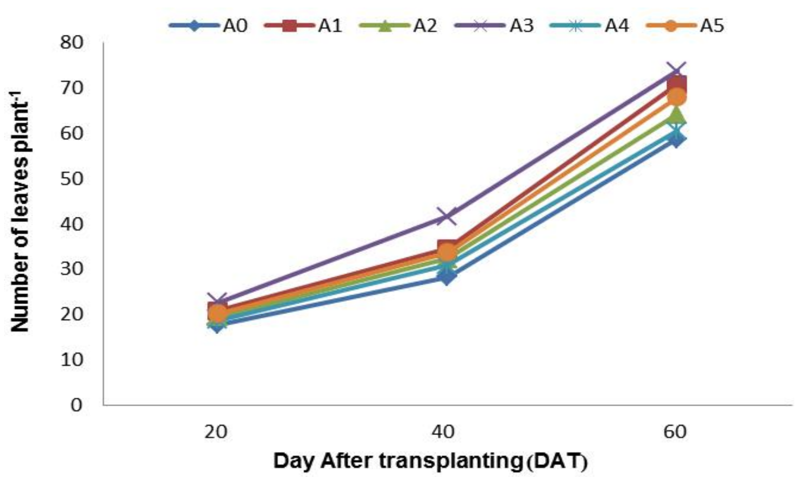
3.2 Leaves Plant^{-1}

Numerous authors reported that cell division promoted with plant growth regulators which influenced considerable stem elongation, bud and leaf formation etc. As an alleviator of cold stress, SA and Ca^{2+} were used in this study. Application of SA and Ca^{2+} played a significant role on production of leaves plant^{-1} of tomato (Fig. 2). At 40 DAT, the highest number of leaves plant^{-1} (10.78) was found from A_3 (0.25 mM SA + 5 mM Ca^{2+}), treatment which was statistically similar with A_1 & A_5 treatments. The lowest value (8.70 leaves plant^{-1}) was observed from A_0 (0 mM SA + 0 mM Ca^{2+}) treatment which was statistically similar with A_2 & A_4 treatments. At 60 DAT, the highest number of leaves plant^{-1} (54.04) was recorded from A_3 which was statistically similar with A_2 (51.11) treatment whereas the lowest value (41.30 leaves plant^{-1}) was found from A_0 treatment which was statistically similar with A_2 & A_4 treatments. Thus, these results suggest that simultaneous application of SA and Ca^{2+} produced higher number of tomato leaves. This result was supported by many authors like Kazemi [18] and Salem [19].



A_0 = 0 mM SA + 0 mM Ca^{2+}
A_1= 0.25 mM SA + 0 mM Ca^{2+}
A_2 = 0 mM SA + 5 mM Ca^{2+}
A_3 = 0.25 mM SA + 5 mM Ca^{2+}
A_4 = 0 mM SA + 10 mM Ca^{2+}
A_5= 0.25 mM SA+ 10 mM Ca^{2+}

Fig. 1. Effect of different levels of SA and calcium on plant height of tomato ($LSD_{0.05}$ = 0.91, 2.56 and 2.42 for plant height at 20, 40 and 60 DAT respectively)



A_0 = 0 mM SA + 0 mM Ca^{2+}
A_1= 0.25 mM SA + 0 mM Ca^{2+}
A_2 = 0 mM SA + 5 mM Ca^{2+}
A_3 = 0.25 mM SA + 5 mM Ca^{2+}
A_4 = 0 mM SA + 10 mM Ca^{2+}
A_5= 0.25 mM SA+ 10 mM Ca^{2+}

Fig. 2. Effect of different levels of SA and calcium on leaves number plant^{-1} of tomato ($LSD_{0.05}$= 0.51, 1.06 and 4.04 for leaves plant^{-1} at 20, 40 and 60 DAT respectively)

3.3 Branches Plant^{-1}

Application of different SA and Ca^{2+} composition showed statistically significant effect on branches number of tomato plant (Table 1). The highest number of branches plant^{-1} (8.44) was observed from the A_3 treatment which was statistically similar with A_1 treatment. The lowest number of branches (6.48 plant^{-1}) was observed from A_0 treatment which was statistically identical with A_2, A_4 & A_5 treatments. Kazemi [18], and Yildirim et al. [20] also observed significant effect of SA and Ca^{2+} in increasing the number of branches plant^{-1} in tomato.

3.4 Flower Clusters Plant^{-1}

Significant variation was observed in production of flower clusters plant^{-1} of tomato with exogenous application of different levels of SA and calcium (Table 1). The highest flower clusters plant^{-1} (20.44) was found with A_3 treatment which was statistically varied with other treatments. The control (A_0) plants produced the lowest flower clusters plant^{-1} (8.34) and varied significantly with other treatments. Javaheri et al. [16] reported that SA promoted the number of flower clusters in tomato plant. White and Broadly [9] also observed the positive influence of Calcium on flower initiation.

3.5 Flowers Plant^{-1}

Statistically significant variation was observed for the number of flowers plant^{-1} of tomato for different composition of SA and Ca^{2+} (Table 1). The highest number of flowers plant^{-1} (168.1) was observed from the A_3 treatment which varied significantly with other treatments whereas the lowest flower plant^{-1} (125.1) was observed from A_0 treatment which was statistically identical with A_4 treatment. These results are in consistency with the findings of Martin-Mex et al. [21] and Kumar et al. [22] found separately that Salicylic acid (SA) induced flowering in plants such soybean, *Wolffia microscopia* and *Oncidium* sp. flower.

3.6 Fruits Plant^{-1}

Statistically significant variation was recorded for number of fruits plant^{-1} of tomato with application of different composition of SA and Ca^{2+} (Table 1). The highest fruits number plant^{-1} (99.42) was observed from the A_3 and the lowest fruit plant^{-1} (62.70) was observed from A_0 treatment. The exogenous combined application of SA and Ca^{2+} had a great regulatory influence on number of fruits plant^{-1} and increased the fruit yield as suggested by Javaheri et al. [16], Hayat and Ahmad [17], Plasencia et al. [18], Ilyas et al. [23] and Kazemi [24].

3.7 Fruit Size

Fruit size (diameter and length) of tomato varied significantly with exogenous application of different level of SA and Ca^{2+} on fruit diameter of tomato (Table 1). The highest fruit diameter (5.75 cm) was observed from the A_3 treatment which was statistically similar with A_1 treatment but varied significantly with other treatment. The lowest fruit diameter (5.11 cm) was observed from A_0 treatment. On the other hand exogenous application SA and Ca^{2+} showed significant influence on fruit length of tomato. A_3 treated plants produced maximum fruit length (5.62 cm) whereas control (A_0 treated) plants produced fruits with lowest diameter (5.62 cm) and significantly lower with other treatments. Previously many authors reported that SA and Ca^{2+} played an important role in the fruit development and setting in many crops. Current result suggest that SA and Ca^{2+} has positive functions on fruit diameter (cm) as supported by the findings of Javaheri et al. [16], Herrera-Tuz et al. [21], Martin-Mex et al. [25], Rab and Haq [26]. Significant increase in fruit length with exogenous application of SA and Ca^{2+} was reported by Javaheri et al. [16], Abbasi et al. [19] and Salem [27].

3.8 Fruit Yield (t ha^{-1})

Exogenous application of Salicylic Acid and Ca^{2+} showed a significant effect to promote the fruit yield tomato under cold stress (Fig. 3). The highest fruit yield 72.57 t ha^{-1} were observed from the A_3 treatment which was statistically significant with other treatments. The lowest fruit yield 47.45 t ha^{-1} were observed from A_0 treatment which was statistically similar with A_2 and A_4 treatments. An insignificant variation of fruit yield of tomato was obtained from A_1 and A_5 treatments. Kazemi [18], Lolaei [28] and Shehana et al. [29] also reported that application of SA and Ca^{2+} increased the yield of tomato. Hossain [30] testified that SA increased fruit set of tomato. Therefore, altogether these results suggest that combined application of SA and Ca^{2+} increased the fruit yield of tomato.

Table 1. Reproductive characters and yield of tomato as influenced by different level of salicylic acid and calcium (Ca^{2+})

Treatments	Branches plant^{-1}	Cluster plant^{-1}	Flower plant^{-1}	Fruit plant^{-1}	Fruit size	
					Diameter (cm)	Length (cm)
A_0	6.48 c	8.34 e	125.10 e	62.70 e	5.11 d	5.62 f
A_1	7.85 ab	16.07 b	145.90 b	87.85 b	5.52 ab	6.33 b
A_2	7.26 bc	13.06 c	136.70 cd	76.78 cd	5.37 bc	6.09 d
A_3	8.44 a	20.44 a	168.10 a	99.42 a	5.75 a	6.51a
A_4	6.88 c	10.70 d	132.30 de	72.85 d	5.26 cd	5.90 e
A_5	7.22 bc	14.67 bc	141.30 bc	84.04 bc	5.41 bc	6.21 c
LSD $_{(0.05)}$	0.81	2.08	8.83	8.32	0.24	0.11
CV (%)	11.71	15.91	6.60	10.92	4.86	1.94

** Values with same letter were statistically similar*

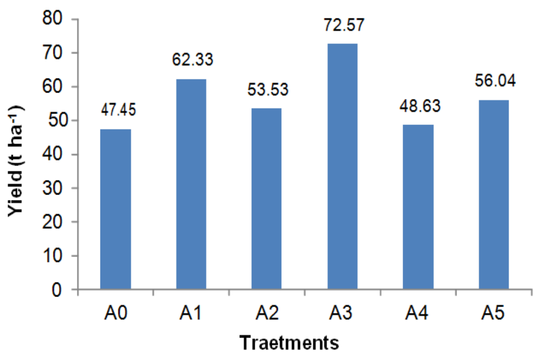


Fig. 3. Effect of different level of SA and Ca^{2+} on the yield of tomato ($LSD_{0.05}$ = 6.94)

4. CONCLUSION

The current peace of research work was conducted to find out effect of Salicylic acid (SA) and calcium (Ca^{2+}) on vegetative and reproductive characters as well as fruit yield of tomato under winter cold stress condition. Results showed that Salicylic acid (SA) and calcium (Ca^{2+}) had significant influence on improving vegetative and reproductive behavior of tomato. In all parameter studied including fruit yield of tomato, best results were obtained from A_3 (0.25 mM SA + 5 mM Ca^{2+}) treatment indicating at lower concentration (5 mM) of calcium (Ca^{2+}) was synergistic with Salicylic acid. Therefore, it can be suggested that combined application of Salicylic acid (SA) and calcium will significantly increase growth and yield performance of tomato under winter cold condition.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Olaniyi JO, Akanbi WB, Adejumo TA, Akande OG. Growth, fruit yield and nutritional quality of tomato varieties. African Journal of Food Science. 2010;4(6):398-402.
2. BBS (Bangladesh Bureau of Statistics). Statistical Yearbook of Bangladesh Bur. Stat, Div., Mini. Plan. Govt. People's Repub. Bangladesh; 2013.
3. Popova L, Pancheva T, Uzunova A. Salicylic Acid: Properties, biosynthesis and physiological role. Bulg. J. Plant Physiol. 1997;23:85-93.
4. Chen HJ, Kuc J. Ca^{2+}- dependent excretion of salicylic acid in tobacco cell suspention culture. J. Exp. Bot. 1999;52: 1219-1226.
5. Arberg B. Plant growth regulators. Monosubstituted benzoic acid. Swed. Agric. Res. 1981;11:93-105.
6. Fariduddin Q, Hayat S, Ahmad A. Salicylic acid influences net photosynthetic rate, carboxylation efficiency, nitrate reductase activity and seed yield in *Brassica juncea*. Photosynthetica. 2003;41:281.
7. Hirschi KD. The calcium conundrum. Both versatile nutrient and specific signal. Plant Physiol. 2004;136:2438–2442.
8. Kadir SA. Fruit quality at harvest of 'Jonathan' apple treated with foliar applied calcium chloride. Journal of Plant Nutrition. 2004;27:1991-2006.
9. White PJ, Broadley MR. Calcium in plants. Annals of Botany. 2003;92:487-511.
10. Hao X, Papadopoulos AP. Effects of calcium and magnesium on plant growth, biomass partitioning and fruit yield of winter greenhouse tomato. Hort. Science. 2004;39(3):512-515.

11. Holder R, Cockshull KE. Effect of humidity on the growth and yield of glasshouse tomatoes. J. Hort. Sci. 1990;65:31-39.
12. Saure MC. Blossom-end rot of tomato (*Lycopersicon esculentum Mill*) –A calcium or stress related disorder. Sci. Hort. 2001;90:193-208.
13. Ho LC, Hand DJ, Fussel M. Improvement of tomato fruit quality by calcium nutrition. Acta Hort. 1999;481:463-468.
14. Usten NH, Yokas AL, Saygili H. Influence of potassium and calcium level on severity of tomato pith necrosis and yield of greenhouse tomatoes. ISHS Acta Hort. 2006;808:345-350.
15. Gomez KA, Gomez AA. Statistical procedure for agricultural research. Second Edn. Intl. Rice Res. Inst., John Wiley and Sons. New York. 1984;1-340.
16. Javaheri M, Dadar A, Babaeian M. Effect of salicylic acid spray in seedling stage on yield and yield components of tomato. Journal of Applied Science and Agriculture. ISSN 1816-9112 Journal Home Page; 2014.
17. Ilyas M, Ayub G, Hussain Z, Ahmad M, Bibi B, Rashid A, Luqma. Response of tomato to different levels of calcium and magnesium concentration. World Applied Sciences Journal. 2014;31(9): 1560-1564.
18. Kazemi M. Foliar application of salicylic acid and calcium on yield, yield component and chemical properties of strawberry. Bull. Env. Pharmacol. Life Sci. 2013;2(11):19-23.
19. Salem MAA. Improved growth, productivity and quality of tomato (*Solanum lycopersicum* L.) plants through application of shikimic acid. Saudi. J. Biol. Sci. 2013;20(4):339–345.
20. Yildirim E, Turan E, Guvenc MI. Effect of foliar salicylic acid application on growth, chlorophyll and mineral content cucumber grown under salt stress. Journal Plant Nutrition. 2008;31:593-612.
21. Martin MR, Villanueva-Couoh E, Uicab-Quijano V, Larque-Saavedra A. Positive effect of salicylic acid on the flowering of gloxinia. In: Proceedings 31st Annual Meeting, August 3–6. Plant Growth Regulation Society of America, Vancouver, Canada. 2003;149–151.
22. Kumar P, Lakshmi NJ, Mani VP. Interactive effects of salicylic acid and phytohormones on photosynthesis and grain yield of soybean (Glycine max L. Merrill). Physiol. Mol. Biol. Plants. 2000;6: 179–186.
23. Hayat Q, Hayat S, Irfan M, Ahmad A. Effect of exogenous salicylic acid under changing environment. Environmental and Experimental Botany. 2010;68:14.
24. Plasencia J, Vicente MRS. Salicylic acid beyond defense: Its role in plant growth and development. J. Expl. Bot. 2011;18.
25. Herrera-Tuz R. Reguladores de crecimiento XXI. Efecto del acido salicilico en la productividad de papaya maradol (*Carica papaya* L.). Tesis de Licenciatura. Instituto Tecnologico Agropecuario, Conkal, Yucatan, Mexico; 2004.
26. Rab A, Haq I. Foliar application of calcium chloride and borax influences plant growth, yield, and quality of tomato (*Lycopersicon esculentum* Mill.) fruit. Turk J Agric. 2012;36:695-701.
27. Abbasi NA, Zafar L, Khan HA, Qureshi AA. Effects of naphthalene acetic acid and calcium chloride application on nutrient uptake, growth, yield and post- harvest performance of tomato fruit. Pak. J. Bot. 2013;45(5):1581-1587.
28. Lolaei A. Effect of calcium chloride on growth and yield of tomato under sodium chloride stress. Journal of Ornamental and Horticultural Plants. 2012;2(3):155-160.
29. Shehata SAM, Ibrahim SI, Zaghlool AM. Physiological response of flag leaf and ears of maize plant induced by foliar application of kinetin (kin) and acetyl salicylic acid (ASA). Ann. Agric. Sci. Ain Shams Univ. Cairo. 2001;46(2):435-449.
30. Hussein MMM, Balba LK, Gaballah MS. Salicylic acid and salinity effects on growth of maize plants. Research Journal of Agriculture and Biological Science. 2007;3(4):321-328.

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