INTERNATIONAL JOURNAL OF ADVANCED BIOLOGICAL RESEARCH

www.scienceandnature.org

STUDIES ON THE EFFICIENCY OF SALICYLIC ACID (SA) AS FOLIAR SPRAY ON GROWTH, YIELD AND YIELD COMPONENTS OF ONION (*ALLIUM CEPA* L.)

*Saurabh Dixit, A.K. Dubey and H.V. Dube
Department of Vegetable Science, C.S. Azad University of Agriculture & Technology, Kalyanpur, Kanpur-208 024
*Present Correspondence Address: Senior Research Fellow's, Department of Vegetable Science, C.S. Azad University of Agriculture & Technology, Kalyanpur, Kanpur-208 024
*Corresponding author email: sdixit307@gmail.com

ABSTRACT
A field experiment was conducted at the Vegetable Research Farm, C.S.A. University of Agriculture and Technology, Kalyanpur, Kanpur during *rabi* season in 2012- 2013 to study the efficacy of exogenous foliar application of salicylic acid (SA) at different time on plant growth, yield and yield components of onion under subtropical condition of Central Uttar Pradesh. In the present investigation, the results indicated that foliar application of salicylic acid at 30 DAS, II spray at 30 DAT & III spray at 60 DAT of onion crop to significantly increases the bulb yield both marketable and total bulb yield (22.0 and 23.0 t ha^{-1}, respectively) was recorded in T_5 and foliar application of salicylic acid at 30 DAS and II spray at 60 DAT for significantly reduced the incidence of purple blotch disease (9.26 %) as well as tolerance to thrips infestation (7.80 thrips $plant^{-1}$) was recorded in T_3. Hence, it may be concluded that application of SA at 30 DAS, II spray 30 DAT and III spray 60 DAT to increases the bulb yield and better growth performances of onion crop.

KEY WORDS: Salicylic acid, bulb yield, growth, onion.

INTRODUCTION

Onion (*Allium cepa* L.*)* is a high-value cash crop and one of the most important vegetable crops in India due to its multifarious use in local consumption, food processing and exportation. Onion plays an important dietary, as well as medicinal role for centuries. It is consumed universally in small quantities and used in many homes almost daily, primarily as a seasoning for flavoring of dishes, sauces, soup, and sandwiches. Besides, it is rich in flavonoids like quercetin and sulfur compounds, such as ally propyl disulphide perceived to be of benefit to human health (Griffiths *et al.,* 2002) and used as a possible cancer preventive (Krest and Keusgen, 1999). The production of cash crops like onion proved to be income generating for farmers, especially for those cultivated in limited lands or small holder farmers (FAO, 2006).

Salicylic acid (SA) or ortho-hydroxy benzoic acid is a common plant-produced phenolic compound. It is an endogenous growth regulator, which contributes in the regulation of physiological, biochemical and molecular processes and there and therefore it affects the plant growth, development and productivity (Hayat *et al.,* 2005). Salicylic acid 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, salicylic acid (SA) is a phenolic group which plays an important role in plant defense. In the plant tissue, salicylic acid is a transduction signal molecule in plant resistance mechanisms (Malamy and Klessig, 1992; Ryals *et al.,* 1996; Vlot *et al.,* 2009). This work is an attempt to evaluate the importance of spraying of salicylic acid on growth, bulb yield attributes as well as reactions to pests and diseases in onion crop.

MATERIALS & METHODS

The investigation was carried out at the Vegetable Research Farm, C.S.A. University of Agriculture and Technology at Kalyanpur, Kanpur for during *Rabi* season in 2012- 2013. The experiment site is located at 26° 29 N latitude and 80° 18 E longitudes with an altitude of 125.9 m above from mean sea level. The soil of the experimental field was clay loam with pH value of 7.65. The climate of this zone is subtropical with a short winter spell during December to February. The experiment was laid out in Randomized Block Design with four replications and consisting of six treatments are presented in Table 1. The onion variety Agrifound Light Red (ALR) seedlings were raised in nursery bed. Salicylic acids (AR grade) @ 250 mg l^{-1} of water were given as foliar spray at different days intervals except the control treatment. The seedlings of seven weeks old were transplanted at a spacing of 15×10 cm in flat beds. All the recommended package of practices was adapted uniformly to all the treatments to raise a good onion crop. The data was recorded on ten randomly selected plants from each treatment on vegetative parameters like plant height, number of leaves $plant^{-1}$; bulb parameters like neck thickness, average bulb weight, polar diameter, equatorial diameter, total bulb yield, marketable bulb yield (A, B and C grade bulbs), as well as reactions to pests and diseases. The mean data collected on various aspects were subjected to statistical analysis according to standard procedure.

TABLE: 1 Treatment details of salicylic acid (SA) application at different days intervals in onion crop

Notations	Treatment details
T_1	Foliar application of Salicylic Acid at 30 DAS & II spray at 30 DAT
T_2	Foliar application of Salicylic Acid at 30 DAS & II spray at 45 DAT
T_3	Foliar application of Salicylic Acid at 30 DAS & II spray at 60 DAT
T_4	Foliar application of Salicylic Acid at 30 DAS, II spray at 30 DAT & III spray at 45 DAT
T_5	Foliar application of Salicylic Acid at 30 DAS, II spray at 30 DAT & III spray at 60 DAT
T_6	Control (Water spray only)

* **DAS**: Days after sowing; ***DAT**: Days after transplanting

RESULTS & DISCUSSION

There was significant effect on growth, yield and yield contributing characters of onion bulb as influenced by foliar application at different time of salicylic acid (Table 2). Among the treatments, significantly highest plant height was recorded in T_4 (58.65cm) with the foliar application of salicylic acid at 30 DAS, II spray at 30 DAT and III spray at 45 DAT and was at par with T_3 (53.90cm). The results from the present experiment revealed that there was no significant difference between treatments on plant height. A crop should produce sufficient number of leaves to harness light energy and synthesize adequate photo assimilates for biomass production. It was observed from the present experiment that more number of leaves was noticed in plots received for foliar spray of salicylic acid at 30 DAS, II spray at 30 DAT & III spray at 60 DAT in T_5 with the value of 7.9 leaves plant^{-1}, closely followed by T_3, and T_4, where statistical parity was observed. The present study clearly also indicated the beneficial impact of SA on crop growth, which might be due to the involvement SA in regulation of several physiological processes in plants such as stomata closure, ion uptake, inhibition of biosynthesis and transpiration (Khan *et al.,* 2003 and Shakirova *et al.,* 2003). Moreover, increased plant growth of onion with exogenous application of SA might be due to directly or indirectly influences on the activity of certain enzymes such as Sucrose –P- Synthase, Sucrose Synthase and amylases.

TABLE: 2 Effect of salicylic acid application on growth and bulb yield attributes characters of onion

Treatments	PH	NOL	NT	PD	ED	ABW	AGB	BGB	CGB	MY	TY	PDI	TI
T_1	53.20	6.6	0.96	4.01	4.85	57.7	36.8	30.3	27.4	19.6	20.4	16.26	13.73
T_2	52.05	7.1	0.95	4.11	4.83	56.0	38.2	33.8	26.5	20.3	21.1	14.70	11.60
T_3	53.90	7.5	0.64	4.45	5.11	61.7	39.0	32.2	24.9	21.1	21.9	9.26	7.80
T_4	58.65	7.3	1.10	3.88	4.97	58.0	41.2	33.5	26.4	20.3	21.2	13.10	11.20
T_5	52.90	7.9	0.95	4.19	5.04	59.3	40.3	31.5	34.5	22.0	23.0	12.00	12.40
T_6	50.25	7.0	0.76	3.62	4.18	55.3	37.2	31.5	27.6	18.4	19.1	21.43	22.93
CD (*P =0.05*)	5.67	0.61	0.15	0.69	0.32	5.02	4.39	5.15	4.75	1.56	11.48	1.42	1.54
CV %	7.03	5.62	8.83	9.47	3.68	4.76	6.26	8.80	9.36	3.53	26.19	5.42	6.40

PH=Plant Height (cm); **NOL**= Number of Leaves plant^{-1}; **NT**= Neck Thickness (cm); **PD**= Polar Diameter (cm); **ED**=Equatorial Diameter (cm); **AGB**=%A grade bulbs; **BGB**=%B grade bulbs; **CGB**=%C grade bulbs; **MY**=Marketable Yield (t/ha); **TY**= Total Yield (t/ha); **PDI**=Plant disease index (%), **TI**= Thrips incidence/plants.

On the other hand the results on yield attributing parameters of onion like *i.e.* neck thickness, bulb polar and equatorial diameter, average weight of bulb, marketable bulb yield along with percentage of A, B and C grade bulbs and total yield were significantly influenced by salicylic acid at different times of spraying. In the present experiment, the heights neck thickness of the bulb was observed in T_4 with the foliar application of salicylic acid at 30 DAS, II spray at 30 DAT and III spray at 45 DAT with the value of 1.10 cm and was significantly superior to control but statistically similar to other treatments. Bulb diameter (polar and equatorial) in onion is an important character, because it indicates bulb storage ability. The onion with thin polar diameter, store better than skin diameter of bulbs. There was significantly maximum polar diameter of 4.45 cm was recorded in T_3 followed by T_5 (4.19 cm). Similarly, maximum equatorial diameter was also recorded in T_3 (5.11cm) followed by T_5 (5.04 cm) with the application of salicylic acid at 30 DAS & II spray at 60 DAT and 30 DAS, II spray at 30 DAT & III spray at 60 DAT, respectively. The results also indicated that both the diameter (polar and equatorial) was significantly reduced in control plot, without application of salicylic acid. The increased bulb weight in the present study by application of salicylic acid might be due to the better utilization of photosynthesis and increased allocation of photosynthesis towards the economic parts, the bulb in onion. However, the maximum average weight of bulbs observed in T_3 (61.7 g) which is followed by T_5 (59.3 g) and T_4 (58.0 g), respectively. These results are in accordance with the findings of (Amin *et al.,* (2007) and Bideshki and Arvin (2010) in onion and garlic respectively. The ultimate goal to be achieved in any management system is the maximization of yield. However, the grading of bulbs is an important operation to fetch premium prize in the market. Therefore, significantly highest percentage of A grade bulbs was recorded in T_4 (41.2 %) with the foliar application of salicylic acid at 30 DAS, II spray at 30 DAT and III spray at 45 DAT than rest of the treatments. Similarly, the highest percentage of B and C grade bulbs were recorded in T_2 and T_5 with the value of 33.8 and 34.5 %, respectively. Similar result was earlier reported by (Sathiyamurthy *et al.,* 2017). On the other hand the results also showed that different treatments effect were significant in case of both marketable and total bulb yield in onion. Significantly highest marketable and

total bulb yield was recorded in T_5 (22.0 and 23.0 t ha^{-1}, respectively) than rest of the treatments. The increase in yield of onion plants by using growth promoter (SA) might be due to enhancing assimilation nutrient uptake, nitrate reduction and photosynthesis, improved flow assimilates (translocation and cytoplasmic streaming) and increased cell integrity and in turn reflected on the increasing yield of onion plants. However, Abd El-Samad *et al*., 2011 indicated that foliar application of salicylic acid at the concentration of 200 ppm and 300 ppm increased yield of onion. These results are in agreement with those results obtained by Pradhan *et al*., (2016) and Prajapati *et al.,* (2016). The results on purple blotch incidence and infestation of thrips revealed significant variations among the different treatments due to exogenous application of salicylic acid. The results revealed significantly minimum incidence of purple blotch was observed in T_3 (9.26 %) which is followed by T_5 and T_4 with the value of (12.00 and 13.10 %, respectively). Similarly, results were noted significantly minimum infestation of thrips $plant^{-1}$ (7.80) in T_3 with the application of salicylic acid at 30 DAS & II spray at 60 DAT. A positive influence of exogenous application of these compounds increased significantly ion contents, i.e. N, P, K and Ca which reflects to increasing the plant growth and resistance to pests due to its role in plant metabolism such as promote the development of thicker outer walls and stability of plant membrane in epidermal cells, thus preventing the pest attack reported by Marschner (1986).

CONCLUSION

It may be concluded from the investigation that among the treatments under study, foliar application of salicylic acid at 30 days after sowing during nursery seedling stage, subsequently second spray at 30 days after transplanting and third spray at 60 days after transplanting was better performance of yield and yield attributing characters. However, the present investigation showed that foliar spray of SA @ 250 mgl^{-1} at two or three times had better performance on vegetative growth, bulb yield as well as reduced the pest and disease of onion under Central U.P. condition.

REFERENCES

Abd El-Samad, E.H., Khalifa, R. Kh. M., Lashine, Z. A. and Shafeek, M. R. (2011). Influence of urea fertilization and foliar application of some micronutrients on growth, yield and bulb quality of onion. Australian Journal of Basic and Applied Sciences, **5**(5): 96-103.

Amin, A. A., EL-Sh., Rashad, M., EL-Abagy, H.M.H. (2007) Physiological Effect of Indole - 3 - Butyric acid and salicylic acid on growth, yield and chemical constituents of onion plants. Journal of Applied Sciences Research, **3**(11): 1554-1563.

Bideshki, A., Arvin, M.J., (2010) Effect of salicylic acid (SA) and drought stress on growth bulb yield and allicin content of garlic in field. Plant Ecophysiology, 2, 73−79.

FAO (2006) Food security in Ethiopia, Agriculture and Consumer Protection Department.

Griffiths, G., Griffiths, T.L., Trueman, G.L.T., Crowther, B., Thomas, B. and Smith, B. (2002) Onions- A global benefit to health. John Wiley and Sons, Ltd.

Hayat, S., Fariduddin, Q., Ali, B. and Ahmad, A. (2005) Effect of salicylic acid on growth and enzyme activities of wheat seedlings. Acta Agronomica Hungarica, 53: 433–437.

Khan, W., Prithiviraj, B. and Smith, D.L. (2003) Photosynthetic responses of corn and soybean to foliar application of salicylates. Journal of Plant Physiology 160, 485−492.

Keusgen, I.K. (1999) Quality of herbal remedies from *Allium sativum* deference between *Allinase* from garlic powder and fresh garlic planta medica **65**(2): 139-143.

Malamy, J. and Klessig, D.F. (1992) Salicylic acid and Plant Disease Resistance. *The Plant Journal*, 2 (5): 643 – 654.

Marschner, H. (1986) Mineral nutrition of higher plants. Acad. Press. London.

Pradhan, M., Tripathy, P., Mandal, P., Sahoo, B.B., Pradhan, R., Mishra, S. P. and Mishra, H. N.(2016) Effect of salicylic acid on growth and bulb yield of onion (*Allium Cepa*, L.). *International Journal of Bio-resource and Stress Management*, **7**(4):960-963.

Prajapati, S., Jain, P.K. and Akhilesh, T. (2016) Effects of Salicylic acid (SA) and Azospirillum on growth andbulb yield of Onion (*Allium cepa* L.) cv. Agrifound Light Red. International Journal of Agriculture, Environment and Biotechnology, **9**(3): 393-402.

Ryals, J. A., U. Neuenschwander, M. Willits, A. Molina, H.Y. Steiner, and M. Hunt. (1996) Systemic Acquired Resistance. *Plant Cell*, **8**: 1809-1819.

Sathiyamurthy,V.A., Saraswathi, T., Tamilselvi, N.A., Thingalmanian, K.S., Beaulah, A., Rohini, N. and Arumugam, T. (2017) Effect of salicylic acid on growth, yield and storage quality of onion (*Allium cepa* L.). *Int. J. Curr. Microbiol. App. Sci.*, Special Issue- **4**: 78-86.

Shakirova, M.F., Sakhabutdinova, A.R., Bezrukova, M.V., Fathutdinova, R.A., Fathutdinova, D.R. (2003) Change in the hormonal status of wheat seedling induced by salicylic acid and salinity. Plant Science 164(3), 317−322.

Vlot, A.C., Dempsey, D.A. and Klessig, D.F. (2009) Salicylic Acid, A Multifaceted Hormone to Combat Disease. *Ann. Rev. Phytopathol*, 47: 177-206.