INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 7, No. 1, p. 14-21, 2015

RESEARCH PAPER OPEN ACCESS

Efficacy of boron and salicylic acid on quality production of sim carnation (*Dianthus caryophyllus*)

Usman Shoukat Qureshi, Sania Izhar, Saman Chughtai, Ali Raza Mir*, Atif Riaz Qureshi

Department of Horticulture, Pir Mehr Ali Shah-Arid Agriculture University Rawalpindi, Rawalpindi, Punjab, Pakistan

Key words: Sim carnation, Boron, Salicylic acid.

http://dx.doi.org/10.12692/ijb/7.1.14-21 Article published on July 14, 2015

Abstract

Flower production is an increasing activity of world's agriculture. Carnation is one of the most important cut flower of the world which ranks only next to rose. It has been extensively cultivated to be used as cut flower because of its excellent keeping quality. The present study is therefore designed with the aim of improving the quality of Sim carnation by applying Boron (0, 5ppm, 10ppm, 15ppm, 20ppm) and Salicylic acid (0,1mM, 2mM, 3mM and 4mM). Different growth and flowering traits which include plant height, number of leaf pairs, intermodal distance, leaf area, leaf chlorophyll content, days to flower emergence, number of flowers/plant, diameter of flower, stalk length and girth, duration of flowering and dry matter content of plants was studied in the experiment. The results reveal that foliar application of boron and salicylic acid has pronounced effect on growth and quality parameters of carnation. Among all the treatment SA @ 3mM exhibited best results and among doses of boron @ 15ppm showed good results.

* **Corresponding Author:** Ali Raza Mir ✉ aliofgujrat@gmail.com

Introduction

Dianthus caryophyllus, a half hardy perennial herbaceous plant, commonly known as carnation is a member of family Caryophyllaceae. The genus Dianthus has about 250 species of which only few are cultivated (Ali *et al*., 2008). Carnation is native to Mediterranean area. Some people believe that it was cultivated by the Muslims of Africa and introduced to Europe from Tunis in thirteen century (Khalighi, 2008). Although Mediterranean in origin, its cultivation in open fields and green house is successful throughout the world. Carnation is one of the most important cut flower of the world. It ranks only next to rose (Sangita, 2008). It has been widely cultivated to be used as cut flower because of its excellent keeping quality, ability to withstand transportation stress, wide variety of forms and colors. Carnation is divided in three groups; on the basis of form of plant, size of flower and flower type, Standards (Sim), Sprays (minis), and Midis (chinensii). The variety under study is Sim carnation. Flower crops response very well to chemical fertilizers. Huge amount of nutrients are exhausted by flower crops from the soil. So, it requires generous amount of fertilizers for obtaining quality production of flowers. For raising commercial crop of carnation application of fertilizer containing both macro and micro nutrients is important. Foliar application of the micro nutrients is effective and economical. The quality of cut flowers directly depends upon the supply of balanced macro and micronutrients (Darling, 1975). Without these micronutrients, the plants are known to suffer from physiological disorders which eventually lead to imbalanced growth and low yield (Mazrou *et al*., 1988). Boron is an important micronutrient because of its part in the fertilization and flowering process. It has been known to be component of plants since 1857. Boron application also significantly influenced physical characteristics of plant. (Ahmad *et al*., 2010).

Vase life is a very important factor that strongly affects the market flexibility of cut flowers. Physio-chemical changes are responsible for short vase life of cut flowers which ultimately results in early senescence. These factors are strongly influenced by dehydration during transportation. Early water loss from the commodity during transportation leads to early senescence which results into poor quality flowers and economic loses (Pompodakis *et al*., 2004). Different treatments and chemicals are used to delay the processes of senescence and increase shelf life of cut flowers. However the use of environment friendly, inexpensive and effective chemical has always been an issue. Salicylic acid (SA), a new potential alternative for this purpose and has been found to affect various physiological and biochemical functions in plants (Raskin, 1992; Métraux, 2002). An active role in delayed senescence and stress responses by salicylic acid has been determined by (Morris *et al*., 2000). It is considered as a vital signaling element involved in local and systematic resistance against pathogen attack (Abdel-Wahed *et al*., 2006). Salicylic acid promotes some physiological processes and inhibiting others depending on its concentration, plant species, development stages and environmental conditions.

The present study was designed to elaborate the impact of boron and salicylic acid application on carnation. The research was also aimed upon the better quality cut flowers with improved shelf life. The project may lead to derive the pathway with economical and balanced use of fertilizers without compromising the quality.

Materials and methods

Experimental site and planting material

The experiment was conducted in the research area of PMAS-Arid Agriculture University Rawalpindi. Seedlings were purchased from a reliable nursery and placed in glass house to provide them suitable environment for proper growth. Regular watering and application of NPK (Grow More @ 2g/L) was done in glass house for better growth of the plants. Transplanting of the seedlings was done with in the evening to minimize the water loss due to evapo-transpiration. Staking of the plants was done to avoid bending of the stem for this purpose bamboos sticks are used and plants were tied with the help of thread. Plants were loosely tied from the base and from the middle of the stem to keep them upright.

Treatments and analytical parameters

Foliar application of boron (0, 5ppm, 10ppm, 15ppm and 20ppm) and salicylic acid (0,1mM, 2mM, 3mM and 4mM) was applied to plants. Different vegetative and floral characters were studied to check the effect of micronutrients and growth regulators, which includes plant height (cm), number of leaf pairs, inter-nodal distance (cm), leaf chlorophyll content, leaf area(cm²), number of flowers per plant, duration of flowering (days), days to flower emergence, flower diameter (cm) and dry matter content of plants(%).

Dry matter content of the plants is measured by using the formula:

Dry matter content%

$$= \frac{(wt\ of\ dry\ sample+container)-(wt\ of\ empty\ container)}{(wt\ of\ wet\ sample+container)-(wt\ of\ empty\ container)} x100$$

Results

Foliar application of boron and salicylic acid exhibited good results on vegetative parameters (Table 1) of Sim carnation.

Table 1. Effect of different doses of boron and salicylic acid on vegetative characters of Sim Carnation.

Treatments	Doses	Plan(t height cm)	No of leaf pairs	Intermodal distance (cm)	Leaf area (cm²)	Leaf chlorophyll content
T_0	CONTROL	47.25 D	45.33 F	5.217 B	4.517 D	52.55 A
T_1	5 PPM Boron	56.17 C	52.33 E	6.692 A	5.658 BC	46.82 A
T_2	10 PPM Boron	58.33 BC	60.67 D	6.825 A	6.400 AB	55.03 A
T_3	15 PPM Boron	64 A	66.00 C	7.133 A	5.275 CD	48.38 A
T_4	20 PPM Boron	60 ABC	94.67 AB	6.317 A	6.192 ABC	47.39 A
T_5	1 mM SA	59 ABC	95.33 AB	6.908 A	6.233 ABC	56.69 A
T_6	2 mM SA	62.42 AB	97.33 A	7.0833 A	6.750 A	51.79 A
T_7	3 mM SA	64.33 A	96.67 AB	7.233 A	5.300 CD	58.13 A
T_8	4 mM SA	61.83 AB	94.33 B	6.867 A	6.209 ABC	46.66 A

Means not sharing an alphabet are significantly different at $p < 0.05$.

The height of the plants was increased significantly by the treatments irrespective of their doses, when compared to control. The highest mean was recorded as 64.33 cm by applying SA @ 3mM, whereas boron @ 15 ppm gives highest mean (64 cm) among the doses of boron. Control plants, with no application of treatments showed great reduction in height (47.25 cm). The number of leaf pair differs significantly as compare to control. The highest mean recorded was, 97.33 from treatment T_6 (3mM SA), among the doses of boron T_4 (20ppm) showed best results (94.67 leaf pairs) and the lowest mean recorded was of control plants (45.33). The inter-nodal distance of the plants shows significant difference when compared to control. But there is no difference within the treatments. The highest value recorded was 7.2333cm by spraying SA @3Mm and 7.13cm by applying 15ppm boron. A significant increase in leaf area was observed with a significant difference among the doses. The highest value obtained by the foliar application of SA @ 2mM was 6.7500 cm², followed by 6.4 cm² by application of boron @ 10ppm. Whereas the lowest value recorded was 4.5167 cm². The chlorophyll content of the leaf shows no significant ($P > 0.05$) difference among the treatments and the control. The highest value of the chlorophyll content was recorded by the application of SA @ 3mM that was 58.133.

Floral attributes also shows an improvement by the application of boron and salicylic acid. Numbers of days were calculated from the time of transplanting to the day when first bud was seen on the plant. A significant difference was observed among the treatments and the control plants. The untreated plants take maximum number of days to produce flowers (99.250 days). However lowest number of days to flowers was recorded by the application of SA @3mM that was 96. 500 days. Among different doses of boron T_1 (5ppm B) gives best results (96.83 days).

Number of flowers per plant was significantly increased by the treatments as compared to control and within treatments. The pertaining data shows that the higher number of flowers per plant was recorded as 10.083 flowers per plant by applying SA @ 3mM whereas 9.25 flowers per plant by applying 15ppm boron. The lowest mean was recorded as 3.917 flowers per plant of control. In case of flower diameter although the results were not significant as compare to control but the highest value were obtained by applying 10ppm boron (T_2) in all treatments.

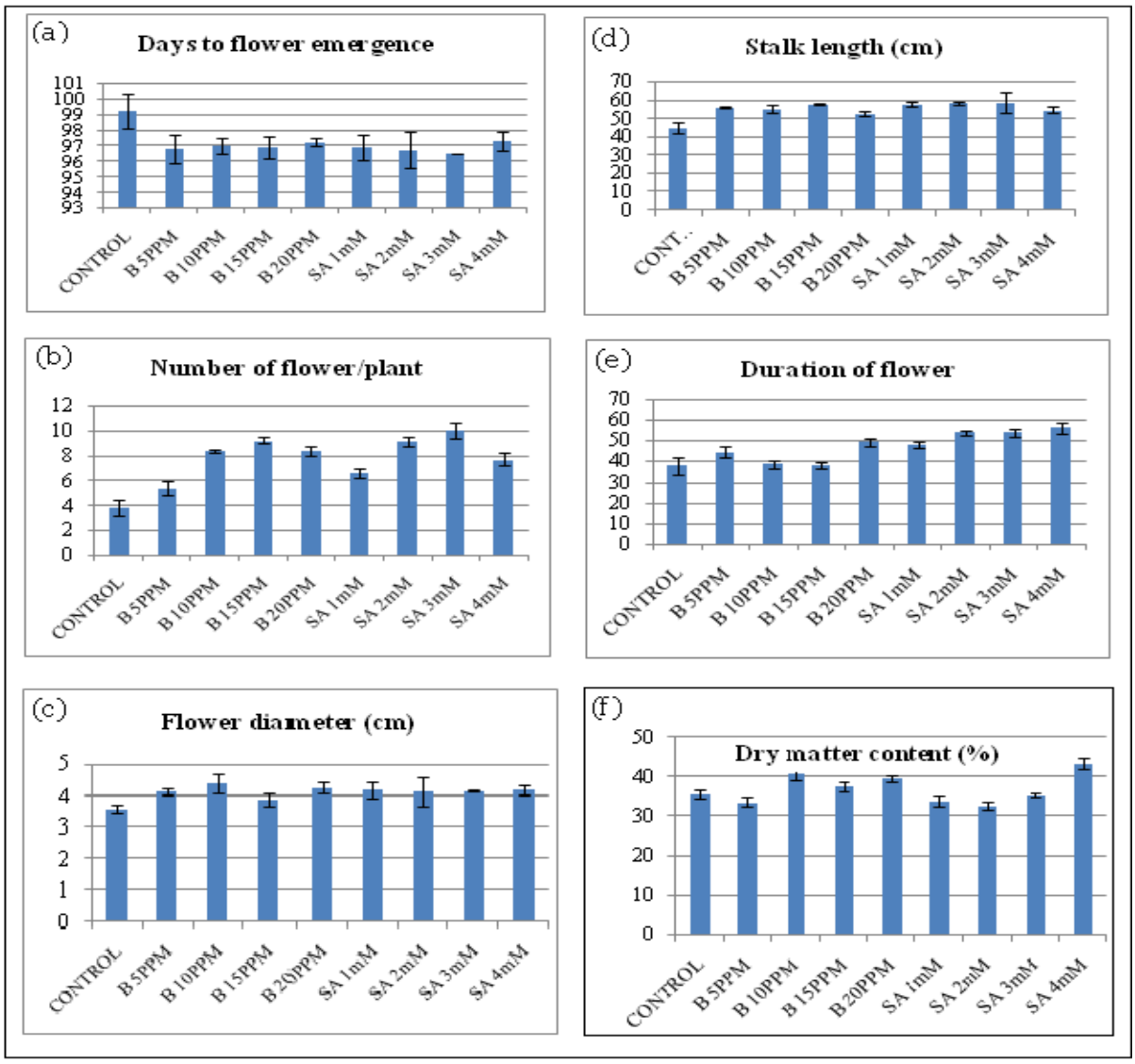

Fig. 1. Effect of boron and salicylic acid on (a) days to flower emergence (b) number of flowers per plant (c) flower diameter (cm) (d) stalk length (cm) (e) duration of flower and (f) dry matter content (%) of 'Sim' carnation.

In case of four doses of salicylic acid T_8 (4mm SA) gives the best results. Smallest flower diameter was found in control plants T_0. Stalk length of carnation flowers showed highly significant results among the plants treated with boron and salicylic acid as compared to control. Although there was no difference among the doses but the results were highly significant as compared to control. The highest value of stalk length obtained in the experiment was 59.083 cm by applying SA @3Mm, followed by boron @ 15ppm (58.17cm). Highly significant results were found in case of duration of flowering of treated plants as compared to the control plants. The highest value recorded was 56.54 days by applying SA @4mM, the highest mean recorded among the doses of boron was 49.33 days by application of 20ppm

boron. Whereas untreated plants reduce duration of flowering to 37.67 days. In case of dry matter content of carnation the results significantly different as compared to control the highest value obtained was 30.44 % by application of 4mM SA followed by 26.96 % dry matter by applying boron @ 20ppm.

Discussion

The vegetative parameters of sim carnation show positive response to the foliar application of boron. The possible reason might be boron performs an essential role in the biosynthesis of auxins within the plant meristem, leading to increased translocation of sugars as a result of auxin stimulated growth. Similar observations were made earlier by Rajput *et al.* (2003) while working with African marigold. The leaf being directly correlated with the photosynthetic efficiency of the plant forms an important parameter in enhancing the plant growth. This might be due to the fact that the optimum dose of boron which besides being involved in the formation of cell wall, also gets tied up with the protein in the protoplasm and accumulation of simple carbohydrate and nitrogen compounds in plant as prime necessities available for the formation of leaves. Misra (2001) observed that soil application of borax will improve the vegetative characteristics of chrysanthemum. Similar finding were also reported by Nath and Biswas (2002). (Karthikeyan *et al.*, 2009) observed an increase in the number of leaves in carnation plant by applying 0.1% borax. Similar findings were reported by (Sakhabut dinova *et al.*, 2003). These findings are also in agreement with those obtained by Mohamed (1992) on *Tagetes minuta* and Al-Humaid (1998) on rose plants. Ahmad *et al.* (2011) showed in an experiment, conducted on rose that application of B produced leaves of maximum area (62.45 cm^2) and control with no micro nutrients application produced leaves having minimum area. Khalifa *et al.* (2011) showed in an experiment conducted on iris plants that the middle doses of boron gives the best results. The increase in number of laterals in early stage of vegetative phase and its stability towards the reproductive stage has been good sign for more flower yield. Taha, (2012) showed that the application of some commercial fertilizers considerably increases the stalk length of plants in case of iris plants these results supports the findings discussed above. Similar results were found by Manoly on iris and Khalafalla *et al.* (2000) on ornithogalum plants. Karthikeyan *et al.* (2009) reported in an experiment conducted on carnation that longest duration of flowering was recorded when plants were treated borax as compared to control. Similar findings were reported by Sirin (2011). Younis *et al.* (2013) showed in an experiment conducted on rose that application of macro nutrients with combination of micronutrients has a significant effect on dry weight of flowers as compared to control. Similar results were reported by Ahmad *et al.*, (2011) who reported a significant increase in dry matter content of cotton by boron application. Data presented in Table 1 showed that the different levels of salicylic acid application significantly affected the vegetative as well as reproductive (Figure 1) parameters during the course of investigation.

The salicylic acid being a growth promoting chemical imparts favorable effect on growth parameters by accelerating the cell divisions. Alaey *et al.* (2011) found an increase in stem height of rose by increasing the dose of SA. An increase in plant height of gladiolus was also observed by Ram *et al.* (2012). According to Gharib (2006), application of SA at low concentration increased photosynthetic activity in basil and marjoram which enhanced their number of inter-nodes. Gutierrez-Coronado *et al.* (1998) showed an increase in plant growth of soybean. And similar findings were reported on maize (Shehata *et al.* 2001, El-Mergawi & Abdel-Wahed 2007). Younis *et al.* (2013) conducted an experiment on rose cultivars showed that in case of leaf area extremely significant results were obtained as compared to control. Alaey *et al.* (2011) proved in an experiment that leaf area was higher in SA sprayed plants. These results are in contracdiction with those of Farahat *et al.* (2007), on cupressus sempervirens and Nahed and Laila, (2007), on salvia farinacea. Many experiments reveal an increase in flowering by the application of SA. Hashemabadi (2010) show an increase in flower yield by applying SA. Yıldırım (2009) found highest yield

of tomato by applying salicylic acid. These results are in a good connection with those reported by Roy (1995) and Halder *et al.* (2007a, b) on Gladiolus plant and corm and cormel production. Sabzi *et al.* (2012) showed in an experiment conducted on vase life of cut rose flowers that an increase in flower diameter was observed in case of flowers treated with 1mM SA as compare to control. These results are in contradiction of the above study. Khandaker *et al.* (2011) showed that increase in stalk length of Red Amaranthus was significantly affected by foliar application of SA as compared to control plants. Similar beneficial results regard to longevity of spike on plant has been reported by Mostafa (1996) in carnation and Chaturvedi *et al.* (1986) in gladiolus. Alaey *et al.* (2011) showed a significant increase in fresh weight of rose plant when sprayed with SA. Khandaker *et al.* (2011) showed a significant increase in plant dry weight of red amaranth by application of SA as a result increase in dry matter content of carnation is observed.

Conclusion

On the basis of conducted investigation we conclude that application of boron and salicylic acid has significant effect on vegetative and floral characteristic of carnation. Increase in plant height, number of flowers per plant and other significant quality parameters were also observed. Among the different doses SA @ 3mM and boron @ 15ppm showed excellent results. Application of boron has showed a tremendous increase in height of plants as well as yield. Salicylic acid has impart good results on duration of flowering by extending the period of flower show on plant. Salicylic acid and boron are potential growth regulator and micronutrient that are recommended for quality production of carnation crop in agro ecological zone of Pothawar plateau, Pakistan.

References

Abdel-Wahed MSA, Amin AA, El-Rashad SM. 2006. Physiological effect of some bioregulators on vegetative growth, yield and chemical constituents of yellow maize plants. World Journal of Agricultural Sciences **2(2),** 149-155.

Ahmad I, Khan MA, Qasim M, Ahmad R, Randhawa MA. 2010. Growth, yield and quality of Rosa hybrida L. as influenced by various micronutrients. Pakistan Journal of Agricultural Sciences **47(1),** 5-12.

Alaey M, Babalar M, Naderi R, Kafi M. 2011. Effect of pre- and postharvest salicylic acid treatment on physio-chemical attributes in relation to vase-life of rose cut flowers. Postharvest Biology and Technology **61(1),** 91–94. http://dx.doi.org/10.1016/j.postharvbio.2011.02.002

Al-Humaid A. 1998. The influence of foliar nutrition and gibberellic acid application on the growth and flower of rose plants. The Second Conference of Ornamental Horticulture, Ismailia, Egypt.

Ali A, Afrasiab H, Naz S, Rauf M, Iqbalan J. 2008. Efficient protocol for in vitro propagation of Carnation (Dianthus Caryophyllus). Pakistan Journal of Botany **40(1),** 111-121.

Chaturvedi OP, Shukla IN, Singh AR. 1986. Effect of agromin on growth and flowering in gladiolus. Progressive Horticulture **18(3-4),** 196-199.

Darling RM. 1975. Plant Physiology. 3rd Ed., Agricultural Research **46(2),** 83-88.

El-Mergawi R, Abdel-Wahed M. 2007. Diversity in salicylic acid effects on growth criteria and different indole acetic acid forms among faba bean and maize. International Plant Growth Substances Association. 19th Annual meeting, Puerto Val-larta, Mexico. 21-25 p.

Farahat MM, Soad MMI, Lobna ST, Fatma El-Quesni EM. 2007. Response of vegetative growth and some chemical constituents of Cupressus sempervirens L. to foliar application of ascorbic acid and zinc at Nubaria. World Journal of Agricultural

Sciences **3(4),** 496-502.

Gharib FA. 2006. Effect of salicylic acid on the growth, metabolic activities and oil content of basil and marjo-ram. International Journal of Agriculture and Biology **4,** 485-492.

Gutierrez-Coronado MA, Trejo-Lopez C, Karque-Saavedra AS. 1998. Effect of salicylic acid on the growth of roots and shoots in soybean. Plant Physiology and Biochemistry **36(8),** 563.

Halder NK, Md. Rafiuddin, Siddiky MA, Gomes R, Begam KAMA. 2007a. Performance of Gladiolus as influenced by boron and zinc. Pakistan Journal of Biological Sciences **10(4),** 581-585.

Halder NK, Ahmed R, Sharifuzzaman SM, Bagam KAMA, Siddiky MA. 2007b. Effect of boron and zinc fertilization on corm and cormel production of gladiolus in grey terrace of Bangladesh. International Journal of Sustainable Crop Production **2(5),** 85-89.

Hashemabadi D, Zarchini M. 2010. Yield and quality management of rose (*Rosa hybrida* cv. Poison) with plant growth regulators. Plant Omics Journal **3(6),** 167-171.

Jabbarzadeh Z, Khosh-Khui M, Salehi H. 2009. The effect of foliar-applied salicylic acid on flowering of African violet. Australian Journal of Basic and Applied Sciences **3,** 4693-4696.

Jamwal M, Parmar AM, Mishra RL, Singh DB. 2008. Effect of foliar application of urea micronutrients on floral growth of gladiolus cv. American beauty. Agricultura-Stiinta si practica, **3(4),** 67-68.

Karthikeyan S, Jawaharlal M, Ganga M. 2009. Effect of boron on calyx splitting in carnation (*Dianthus caryophyllus* Linn.) Journal of Ornamental Horticulture **12(4),** 269-273.

Khalafalla M, Mahrouk E, Nofal E, Nabih A, Goma A. 2000. Effect of growing media and chemical fertilization on growth, flowering, bulb productivity and chemical constituents of *Ornithogalum thyrsoides*, Iacq. Ph.D. Thesis, Horticulture Department, Faculty of Agriculture, Tanta University Egypt.

Khalifa R, Shaaban S. 2011. Effect of foliar application of zinc sulfate and boric acid on growth, yield and chemical constituents of iris plants. Ozean Journal of Applied Sciences **4(2),** 2011.

Khalighi A. 2008. Roozbehan Press., 392 pages. Affiliated East-West Press Put. Ltd., New Delhi.

Khandeker L, Masum Akond ASMG, Oba S. 2011. Foliar application of salicylic acid improved the growth, yield and leaf's bioactive compounds in red amaranth (*Amaranthus Tricolor* L.). Journal of vegetable Crops Research Bulletin **74 (1),** 77-86.

Manoly ND. 1996. Effect of soil type, fertilization, bulb size and growth regulators on growth, flowering and chemical composition of iris plants. Ph.D. Thesis, Faculty of Agriculture, Minia University Egypt.

Mazroua MM, Afify MM, Eraki MA. 1988. Effect of foliar fertilizer on the growth and flowering characters of Chrysanthemum morifolium Ram. Plants. Menofiya Journal of Agricultural Research **13,** 397-413.

Métraux JP. 2002. Recent breakthroughs in the study of salicylic acid biosynthesis. Trends in Plant Sciences **7(8),** 332-334.

Misra HP. 2001. Response of chrysanthemum to zinc and boron on growth, yield and quality of flowers. Scientific Horticulture **7,** 201-208.

Mohamed MA. 1992. The combined effect of foliar fertilizers and growth regulators on growth and volatile oil contents of *Tagetes minuta*, L. plants. M.Sc. Thesis, Faculty of Agriculture, Minia University

Egypt.

Morris K, Mackerness SAH, Page T, John CF, Murphy A, Carr JP, Wollaston VB. 2000. Salicylic acid has a role in regulating gene expression during leaf senescence. The Plant Journal **23(5),** 677-685.

Mostafa MM, Fadi EZIAA, Hussein EH. 1996. Effect of P and B on vegetative growth, flower and corm production and oil yield of tuberose plants. Alexandria Journal of Agriculture Research **41(3),** 93-107.

Nahed GAEA, Laila KB. 2007. Influence of tyrosine and zinc on growth, flowering and chemical constituents of Salvia Farinacea plants. Journal of Applied Sciences Research **3(11),** 1479-1489.

Nath MR, Biswas J. 2002. Studies on effect of boron on vegetative and reproductive growth in tuberose (*Polianthes tuberosa* L.) cv. Single. The Orissa Journal of Horticulture **30(2),** 39-42.

Pompodakis NE, Joyce DC, Terry LA, Lydakis DE. 2004. Effects of vase solution pH and abscisic acid on the longevity of cut 'Baccara' roses. Journal of Horticultural Sciences and Biotechnology **79,** 828–832.

Rajput D, Naresh M, Srivastava PC, Singh SK, Gangwar MS. 2003. Effect of S, B and Zn application and their interactions on growth, yields and nutrient uptake of *Tagetes minuta* L. Indian Perfumer **47(1),** 91-97.

Raskin I. 1992. Role of salicylic acid in plants. Annual Review of Plant Biology **43(1),** 439-463.

Roy CN, Sarker S. 1995. Influence of chemicals on vase life gladiolus. 6th International Symposium on Post Harvest Physiology of Ornamental plants, Norway, 310 p.

Sabzi A, Hadavi E, Hekmati J. 2012. Effect of different levels of malic acid and salicylic acid in preservative solution on the quality and vase life of cut rose flowers cultivars (Utopia). International Journal of Agricultural Sciences **2(5),** 403-407.

SakhabntDinova AR, Kinova DRF, Bezrukova MV, Shakiroga FM. 2003. Salicylic acid prevents and damaging action of stress factors on wheat plants. Bulgarian Journal of Plant Physiology, ISSU, 314-319.

Sangita L. 2008. Floriculture: International Markets. Floriculture Today, 14-23.

Shehata SAM, Ibrahim SI, Zaghlool SAM. 2001. Physiological response of flag leaf and ears of maize plant induced by foliar application of kinetin (kin) and acetyl salicylic acid (ASA). Annals Agricultural Sciences, Ain Shams University Cairo, **46(2),** 435-449.

Singatkar SS, Sawant RB, Ranpise SA, Warhal KN. 1995. Effect of different levels of N, P and K on growth and flower production of gallardia. Journal of Maharashtra Agriculture University **20(3),** 392-394.

Taha RA. 2012. Effect of some soil types and some commercial foliar fertilizers on growth, flowering, bulb productivity and chemical composition of iris plants. Journal of Horticultural Science & Ornamental Plants **4(2),** 221-226.

Yıldırım E, Dursun A. 2009. Effect of foliar salicylic acid applications on plant growth and yield of tomato under greenhouse conditions. Acta Horticulturae **807,** 395-400. http://www.actahort.org/books/807/807_56.htm

Younis A, Riaz A, Sajid M, Mushtaq N, Ahsan M, Hameed M, Tariq U, Nadeem M. 2013. Foliar application of macro- and micronutrients on the yield and quality of *Rosa hybrida* cvs. Cardinal and Whisky Mac. African Journal of Biotechnology **12(7),** 702-708.