



Effect of different growth stimulants on growth and flower quality of zinnia (*Zinnia elegans*) var. Benery's giant

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Abstract

Zinnia elegans is an elegant flower of Asteraceae family which holds eminent position in cut flower industry due to its versatility, everlasting colors and exceptional vase life with the aid of plant growth stimulators. Plant growth and development is altered by modification of its physiological processes due to these stimulants via acting inside cells to regulate or inhibit enzyme systems and trigger plant metabolism. The aim of this experiment was to evaluate morphology and flowering of *Zinnia elegans* by applying different concentrations of growth stimulants including salicylic acid (100, 150 and 200mg/L) vegetable extract (2, 3 and 4ml/L) isabion (2, 3 and 4ml/L) and organic fertilizer wokozim (2, 3 and 4ml/L) respectively. The study was laid out in factorial arrangement with three replications. It was opined that salicylic acid (200mg/L) exhibited a positive impact particularly on plant height, inter nodal distance, flower emergence, flower stalk length and girth, number of florets and buds, flower diameter, fresh and dry weight whereas wokozim (3ml/L) increased the number of leaves, inter nodal distance and length of flower stalk. Vegetable extract (4ml/L) proved more effective for increasing plant height, number of leaves, fresh flower weight, whereas isabion (3, 4ml/L) enhanced the plant height, flower emergence, diameter of flower and vase life of the flower.

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Introduction

Zinnia elegans is a widespread wonderful summer annual flower which is attaining instantaneous status for its numerous colorful blooms. It belongs to family *Asteraceae* (Dole, 1999) and is native to grassland areas encompassing south western United States and Mexico to Central America (Baloch *et al.*, 2010). The genus *Zinnia* comprises of 20-30 species among which *Zinnia elegans* and *Zinnia haagaena* are the most thriving one with bright and charismatic colors of flowers along with extended vase life (Javid *et al.*, 2005). As a warm season crop it can tolerate extremely high temperature but need adequate irrigation. Mostly propagated through seed which are sown directly in field or nursery is prepared. Soil pH should be 5.8-6.2 (Memon *et al.*, 2014) and an optimum temperature required ranges from 25-30°C. Germination occurs within five to seven days (Nasir, 2004). *Zinnia* are cultivated throughout Pakistan; it is sown from December to the end of March in Karachi followed by March- April and then again in August- September plantation in Lahore, Rawalpindi and Islamabad (Nasir, 2004). Flower business is flourishing gradually due to enhancement in aesthetic perception of the societies (Saleem *et al.*, 2015).

Many plant growth regulators have known effect to enhance the vase life of flowers and they can be competently utilized to boost the shelf life of flowering crops (Peng *et al.*, 2007). Salicylic acid (SA) was first extracted from the willow trees and named *Salix* by Rafacle Piria in 1938. SA functions as a plant regulator which is phenolic in nature and mainly contributes in the regulation of numerous physiological processes such as plant enlargement and maturity in response to environmental stress (Hayat *et al.*, 2009). Salicylic acid induces a large variety of responses such as flowering and tuberization. Wokozim an organic fertilizer is a very distinctive invention of microbiology which is derived from seaweed (*Ascophyllum nodosum*).

It has natural growth promoters which contain Indol-3-acetic acid (IAA), Indol-3-butyric acid (IBA), cytokines, trace elements; vitamins and amino acid

(Rao, 1991) when applied as a foliar spray promote the growth of a plant. Wokozim aids in uptaking of complex molecules from soil (Turan and Köse, 2004), increasing antioxidant properties (Verkleij, 1992), enhancing photosynthetic activity and caters nutritional elements in all plant growth stages especially seed germination. Isabion is constituted of amino acid which directly or indirectly stimulates the plant growth by regulating the physiological activities of plant growth (Boras *et al.*, 2011).

This is also an environment friendly chemical do not harm the soil or a crop (Syngenta, 2015). In addition, it was reported that the foliar application of amino acids instigated an augmentation in plant growth, fruit yield and its constituents (Kamar and Omar 1987) on cucumber (El-Shabasi *et al.*, 2005) on garlic (Awad *et al.*, 2007) on potato, (Al-Said and Kamal, 2008) on sweet pepper and (Faten *et al.*, 2010) on Squash. Vegetable extract is an organic extract of vegetables prepared by the fermentation of vegetables with sugar solution.

The extract prepared, collected and utilized as organic fertilizer for vegetables, fruit and flowers. Vegetables such as onion, cucumber, Brussels sprout, broccoli, kale, eggplant, and spinach are considered high amount of antioxidants (Shyamala, 2005) are generally used in its production. In Korea vegetable extract is used to produce good quality fruits and vegetables and also prevent them from deterioration. Besides nutrients vegetable extract also contains antioxidant. These plant growth stimulants have a revolutionary importance in horticulture sectors providing an improved production and good quality to the crops.

The objectives of current study were to evaluate the effect of different growth stimulants on growth and flower quality of zinnia. Another objective of this research was to production of a superior quality crop. The experiment may also guide to develop the pathway with reasonable and fair application growth stimulants without compromising its quality.

Materials and methods

The experiment was conducted in an Ornamental nursery, Department of Horticulture, PMAS- Arid Agriculture University Rawalpindi of geographical coordinates 33° 36' 0" North, 73° 4' 0" East and 1,660 feet elevation during the year 2015-2016. The seed of zinnia (*Zinnia elegans*) of variety Benary's giant was obtained from the Green Impex seed store, Islamabad. Mixture of soil and FYM 1:1 respectively was made to sow the seed into the earthen pots of about a size of 10 inch. After germination when seedlings attain a size of 4- 6 inch then transplanted most favorably at evening time in already prepared soil beds.

Transplanting was done after 20 days germination. Irrigation was applied regularly. Foliar application of NPK was sprayed evenly to all plants. Grow green (fertilizer) at the rate of 2g/L was applied twice during the entire experiment. First spray of all treatments were applied 10 days after the transplantation and second at the time of bud formation. Regular cultural practices including weeding, irrigation and hoeing was uniformly provided to all plants.

Treatments

Foliar application of Salicylic acid, Vegetable Extract, Isabion and Wokozim was given to the plants with following concentration.

Parameters

Morphological and floral characteristics of zinnia crop were analyzed during the experiment. Parameters were plant Height, no of leaves, internodal distance, no of buds, flower emergence, stalk length, fresh and dry weight of flower.

Statistical analysis

Experiment designed according to Factorial Randomized Complete Block Design (RCBD) and the data analysis was carried out with the help of ANOVA (Analysis of Variance) process and means was compared with the help of least standard Division (LSD) test at 5% level of significance on software Statistix 8.1 as described by (Chase and Bown, 1997).

Results and discussion

Plant height (cm)

The statistical analysis of variance revealed that growth regulators significantly impact the height of zinnia plants also shown in Table no. 2. The highest mean (46.57) of the data was recorded as by the application of Salicylic acid 200mg/L. There is an immense reduction in plant height in case of control plants. Among four doses of Vegetable extract 4ml/L showed the best result (44.57) while other concentrations were not significant to each other. In case of isabion, highest recorded mean (40.6) by applying 4ml/L isabion while other two were not significant to each other. Last applied treatment was wokozim where highest recorded mean (41.90) as a result of 4ml/L wokozim second highest (37.65) while lowest recorded mean in this treatment is 29.26.

Table 1. Treatments along with concentration of growth stimulants applied.

Treatments	Concentration
T ₀	Control
T ₁	100mg/L Salicylic acid
T ₂	150mg/L Salicylic acid
T ₃	200mg/L Salicylic acid
T ₄	2ml/L Isabion
T ₅	3ml/L Isabion
T ₆	4ml/L Isabion
T ₇	2ml/L Vegetable Extract
T ₈	3ml/L Vegetable Extract
T ₉	4ml/L Vegetable Extract
T ₁₀	2ml/L Wokozim
T ₁₁	3ml/L Wokozim
T ₁₂	4ml/L Wokozim

The current results of the experiment are in line with the studies conducted on wheat (Shakirova *et al.*, 2003), maize (Gunes *et al.*, 2007), and chamomile (Kovačik *et al.*, 2009). Another study performed on the carnation flower by applying Salicylic acid (SA) and Butyric acid (BA) in different concentration also suggested that total height of the plant increase by increasing the doses of Salicylic acid (Ramtin *et al.*, 2015). Salicylic acid facilitates in uptake the ion and transport, membrane permeability (Barkosky and Einhellig, 1993), as well as photosynthetic and growth rates, transpiration and stomatal conductance (Khan *et al.*, 2003) which result in enhancing plant height.

Similar results were obtained by Ram *et al.*, (2012) that maximum height (104 cm) of gladiolus attained by application of 50 ppm. Gamal el-din *et al.*, (2005) investigated the effect of amino acids (Isabian) on the growth and essential oil contents on Chamomile plant and results indicated that application of amino acid surged the height of a plant and also number of shoots per plant significantly. Plant growth regulator like has pronounced effect on the height of zinnia. While observing positive affects these growth stimulants can be used as a commercial production with good quality.

Table 2. Effect of Different Growth Stimulants on Plant height (cm), No. of leaves plant⁻¹, Internodal distance (cm) and No. of flowers plant⁻¹ of Zinnia.

Treatments	Doses	Plant Height (cm)	No of Leaves plant ⁻¹	Internodal distance (cm)	No. Flower buds plant ⁻¹
T ₀	Control	34.30 E	14 DE	2.50 E	2.66 G
T ₁	100ppm Salicylic acid	33.8EF	16.1 D	3.61 CD	6.41A
T ₂	150ppm Salicylic acid	39.46C	15 DE	3.58 CD	2.65G
T ₃	200ppm Salicylic acid	44.58A	15DE	3.33 DE	2.71 G
T ₄	2ml/L Isabion	31.56 G	16.7D	3.08 DE	2.40 G
T ₅	3ml/L Isabion	33.4EF	22BC	3.91DCB	3.75 E
T ₆	4ml/L Isabion	40.61C	20CD	4.41ABC	4 CDE
T ₇	2ml/LVegetable extract	32.2FG	27BC	3.91BCD	3.7EF
T ₈	3ml/L Vegetable extract	40.4BC	29AB	4.41 ABC	4.0 DF
T ₉	4ml/L Vegetable extract	44.57A	29.6B	4.78 AB	5.0BC
T ₁₀	2ml/L Wokozim	29.26H	26AB	5.31 A	6.0AB
T ₁₁	3ml/L Wokozim	37.65D	31.0A	4.38 AB	5.0BC
T ₁₂	4ml/L wokozim	41.90 B	33.2A	4.58 AB	2.7FG

Number of Leaves (per Plant):

The number of leaves differ significantly among treatments (Table no. 2). The highest recorded mean (32.25) T₁₂ wokozim (4ml/L) and the lowest recorded mean (14.33) was of control plant T₀. Among the three doses of Vegetable Extract the best recorded mean (31) which comes from dose of 4ml/L Vegetable Extract applied. It was observed that highest mean (5.31) was obtained at 2ml/L wokozim and control gave lowest mean (2.50). Best results were gained with wokozim and afterwards vegetable extract has showed comparatively better results but the mean value increased with increasing dose. The recent findings are in concord with Mawoaud *et al.*, (2010) who conducted a study on a, where different concentration of wokozim was applied at watermelon results directed that all morphological parameters including no. of leaves was increased by elevating the concentration of wokozim.

Application of seaweed extract increased chlorophyll content (Whapham *et al.*, 1993; Thirumaran *et al.*, 2009) which results in more production of food reserves and enhance growth of plant. Another study was investigated by Shehata *et al.*, (2011) on the celeriac plant check the yield, quality and noticed that application of seaweed extract (Wokozim) increased number of leaves significantly along with other quality parameters. Wokozim also has positive effect on plant growth (Kowalczyk and Zielony, 2008). Shalaby *et al.* (2014) also supported that application of amino acid on the garlic results in increase in number of leaves significantly as compared to control. Vegetable extract is also a growth stimulator help the plants to promote the vegetative growth by increasing more number of leaves.

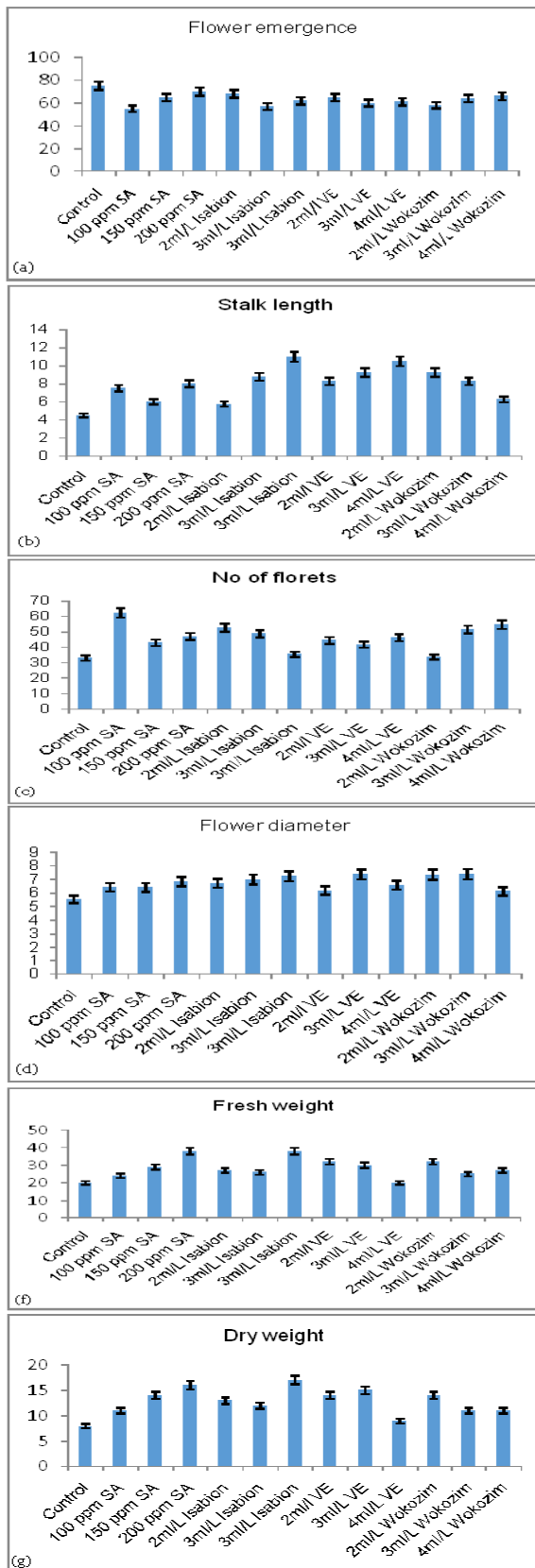


Fig. 1. Effect of different concentrations of Salicylic Acid, Vegetable Extract, Isabion and Wokozim (a) Flower emergence (b) Stalk length (c) No of florets (d) Flower diameter (e) Fresh weight (f) Dry weight (g) Vase life.

Internodal distance

The table below describes the effect of different growth stimulants on internodal distance of zinnia (Table no. 2). Four growth regulators were used by developing three treatments for each growth regulator and a single for control. It was observed that highest mean (5.31) was obtained at 2ml/L wokozim and control gave lowest mean (2.50). Best results were gained with wokozim and later vegetable extract has showed comparatively better results but the mean value increased with increasing dose. However, the treatments with dose of Salicylic acid showed that mean value decreased with increasing concentration. Moreover, in case of Isabion results were better than salicylic acid but here the mean value increased with increasing concentration. These results are also in agreement with Ram *et al.*, (2010) who observed that Salicylic acid enhances the flowering and vegetative parameters of Gladiolus crop significantly. The applications of Salicylic acid at low concentrations according to the Gharib (2006) which increased the photosynthetic activity in basil which increased their internodal distance. These results are also supported by Gutierrez-Coronado *et al.*, (1998) showed an increase in stem length of soybean and similar results were found on maize (Shehata *et al.*, 2001; EL-Mergawi and Abdul-Wahed, 2007).

Number of Flower buds (per plant):

In case of total no of flower buds, the highest mean recorded value (6.41) from the T₃200ppm of Salicylic acid (Table no. 2). Among the three values of Salicylic acid T₃200ppm was the best and T₁ and T₂ was non-significant to each other while control showed lowest mean value accounts (2.40). Of all growth stimulants wokozim has showed second best results with increasing dose. Furthermore, Vegetable extracts T₉ gave the best results. On the other hand, Isabion and has showed significant mean values but among all treatments of growth regulators the worst was counted by Isabion given (2.66) at 2ml/L. These results are also in line with Hashemabadi (2010), who revealed the increment of flower bud by the application of salicylic acid. Another study conducted by Ram *et al.*, (2010), he applied salicylic acid in different on Gladiolus and results exhibited that by

increasing the concentration number of florets per spikes were increased significantly. Nofal *et al.* (2015) also suggested that application both salicylic acid and wokoziim (seaweed extract) at the sapling stage number of flowers per plant was enhanced significantly.

Flower emergence (Days):

The statistical analysis of data revealed (Figure 1. (a)) that among all the treatments applied minimum time for flower emergence was taken by Salicylic acid at 200mg/L while other concentrations of Salicylic acid 100mg/L (57.98) and 150 mg/L (55.00) also showed remarkable difference among them. Figure 1 (a) showed that by applying Salicylic acid flowers of zinnia would be emerging in minimum possible days. Application of Isabion significantly affects emergence of zinnia. Among its treatment applied they showed insignificant difference with each other but significantly differ with other growth stimulators. By applying 4ml/L of Isabion flower emergence took little bit more time as compared to 2ml/L (55.66) and 3ml/L Isabion (58.33). Treatment of growth stimulator Wokoziim and Vegetable Extracts showed that they are not as useful for growth of zinnia as SA and Isabion. 2ml/L of Wokoziim had flower emergence value of 64.89, 3ml/L had 65.66 and 4ml/L had 60.33. While 2ml/L, 3ml/L and 4ml/L V.E had means of 71.66, 69.66 and 68.00 respectively. Control gained maximum days for flower emergence (78). Similar results were observed by application of different concentration of Salicylic acid on the Gladiolus (Ram *et al.*, 2012) and African violet (Jabbarzadeh *et al.*, 2009) it shows a significant difference in the emergence of first flower bud. Salicylic acid is also helpful in increasing the practice of flower initiation in angiosperm (Raskin, 1992). SA also has constructive effects in photosynthetic rate, chlorophyll concentration and uptake of minerals in plant grown under stress condition (Karlidag, 2009). The results attained by Gamal el-din *et al.* (2005) the effect of amino acid (Isabian) on the growth and essential oil contents on Chamomile plant had showed increase in the height and promoted the earlier flower emergence significantly.

Flower stalk length (cm)

Analysis of data in Fig. no. 1 (b) indicates that application of growth stimulants showed significant difference in flower stalk length. Among the treatments applied Wokoziim performance was admirable. All three concentrations (2ml/L, 3ml/L and 4ml/L) show significant difference with all other treatments. Among all treatments applied, Wokoziim having 3ml/L had maximum flower stalk (8.80) followed by 4ml/L of Wokoziim (8.36). Salicylic acid being good growth stimulator represents encouraging results among all treatments applied. The treatment having 2ml/L of Wokoziim had mean value of 7.69. Wokoziim is followed by Vegetable extract having 2ml/L (8.31). There is no significant difference between statistical value of 4ml/L Wokoziim concentration (8.36) and 2ml/L of Vegetable extract (8.31) and 2ml/L of Wokoziim (7.69) and 3ml/L of Vegetable extract (7.71). 100mg/L of Salicylic acid (7.60) had no significant difference with 2ml/L of Wokoziim (7.69) and 3ml/L of Vegetable extract (7.71). While all other concentration of Salicylic acid showed significant difference with other treatments applied. 150mg/L and 200mg/L of Salicylic acid had statistical value of 6.73 and 7.19 respectively. Minimum results were found by applying all concentrations of Isabion. Among Isabion applied treatments, 3ml/L of Isabion showed lowest value (5.49). 2ml/L and 4ml/L of Isabion had 6.10 and 6.06 mean values respectively. Control had lowest among all of treatment applied with mean of 3.91. these findings are in accord with Aziz *et al.*, (2011) who applied wokoziim (*Ascophyllum nodosum*) on the Amaranths tricolor to check the performance under salt stress condition where he interpreted that stalk length significantly increased even under salt stress condition along with other parameters. Similar results are depicted by Hajizadeh *et al.* (2013) applied salicylic acid (SA) on the *Lilium* Flower with varying the concentration. He mentioned that 50ppm and 200ppm concentration of SA significantly increase the length of flower stalk as compared to the others. Similar results observed in Gladiolus with the application of 50ppm SA.

No of florets (per flower)

The statistical analysis of data illustrated in figure no. 1 (c) that 150 mg/L of Salicylic acid had highest no of florets (54), followed by 100 mg/L (51) and 200 mg/L (50) of Salicylic acid respectively. All concentrations of Vegetable extract had no comparable difference between them except for 2ml/L of Vegetable extract (42.66) while mean values for 3ml/L and 4ml/L of Vegetable extract were 45.33 and 44.66 respectively. Isabion and Wokozim had no positive response on number of florets of zinnia but significantly gave better response than control (31). The performance of Isabion is better than Wokozim.

There is no significant difference between all applied treatments of Isabion and for 2ml (41), 3ml (40.66) and 4ml/L (40.33) concentrations. Statistical mean values for 2ml, 3ml and 4ml/L of Wokozim were 38.00, 38.33 and 35 respectively while control had statistical value of 31. Pal *et al.*, (2015) noticed effect of salicylic acid (SA) on the vegetative and flowering characteristics of Gladiolous. 100 ppm concentration was best flower emergence, no of flowers and florets. These results are in line with different scientists (Gutierrez-coronado *et al.*, 1998; Quiroz *et al.*, 2001; Ahmad *et al.*, 2013) who observed the influence of SA on induction of flowering, closing of stomata, somatic embryogenesis, flowering initiation, promote the thermogenesis, stimulation of root and shoot growth. SA is also helpful in increasing the practice of flower initiation in angiosperm (Raskin, 1992). Prominent effect of SA on the flowering plant is reported on different description of flower, elongations of lamina of flower (Khurana and Cleland, 1962), stimulation of flowering in phaseolus (Lagoa and Pereira, 1991) and regeneration of flower bud in *Streptocarpus* (Handro *et al.*, 1997).

Flower diameter (cm)

The analysis of data revealed that flower diameter was differing significantly among all applied treatments also shown in fig. no. 1 (d). Highest mean value was recorded 7.63 from T₃ (150mg/L) SA while the lowest mean value (4.04) was recorded from control plants. Among three doses of Isabion highest mean value was recorded from T₅ (3ml/L) Isabion which was 5.35.

While in case of vegetable extract mean values were almost non-significant to each other. Additionally wokozim also gives good results from 2ml/L wokozim where mean value was 6.35. The findings of current study are in line with an experiment was performed by Sabzi *et al.* (2012) on the rose's cut flower and illustrated that diameter of flower was also increased with the 1Mm application of salicylic acid. Hadi *et al.* (2011) also noticed that application of combined dose of vermicompost with amino acid (Isabion) on the *Matricaria chamomile* to check the results in significantly increases flower head diameter up to 20.8. Another experiment conducted by Naggar *et al.* (2009) on growth of Amaryllis (*Hippeastrum vittatum*, herb) by light intensity also with the application of amino acid. Some plants were placed in high light intensity with no treatment application while in an open environment plants were treated with amino acid. Amino acid treated plants showed good results.

Fresh Weight of Flower (g)

Following figure no. 1 (e) showed effect of plant growth stimulator on fresh weight of zinnia flower. There is significant difference among all the growth stimulators applied. Highest fresh weight (29.00) was attained by application of 200mg/L of Salicylic acid followed by 3ml of Vegetable extract (28.33). There is no significant difference among 150mg/L of Salicylic acid (27.00), 2ml/L and 4ml/L of Vegetable extract (27.00) but comparably differ with all other treatments applied. The statistical values for 4ml/L of Isabion was 25, followed by 100 mg/L of Salicylic acid (24.33), 2ml/L (23.00) and 3ml/L of Wokozim (24.00) respectively. The statistical value for 4ml/L of Wokozim was 21.33 and for 3ml/L of Isabionis 23.00. 4ml/L of Wokozim had minimum response (21.33) among all the growth stimulators. The statistical values for 4ml/L of Isabion was 25.0 followed by 100 mg/L of SA (24.33), 2ml/L 23.00 and 3ml/L (24.00) of Wokozim respectively. The statistical value for 4ml/L of Wokozim was 21.33 and for 3ml/L of Isabionis 23.00. 4ml/L of Wokozim had minimum response among all the growth stimulators. The statistical value for 4ml/L of Wokozim was 21.33.

However for control, the value was 19. Lower fresh weight loss was also observed in anthurium with 2mM application of Salicylic acid (Hashemabadi *et al.*, 2012). Result is in accord to Gharib (2006) that fresh weight was increased in basil and marjoram by the application of Salicylic acid (SA). Alaei *et al.*, (2011) also demonstrated that a considerable increase in fresh weight of a rose when sprayed with SA. Like our conclusions SA along with other growth stimulants can appreciably increase the fresh weight of a flower hence improve high quality of flower.

Dry weight of Flower (g)

The given figure no. 1 (f) investigated how dry weight of zinnia is affected by using different growth regulators. Like other parameters controls showed lowest mean value i.e. 9.33 while Salicylic acid (SA) has showed highest mean value 14.33 at concentrations 3ml/L. Followed by control Isabion 2ml/L has showed least dry weight among all growth regulator accounts 10.33. Vegetable extract has reacted insignificantly while in case of Isabion and Salicylic acid (SA) mean values were strongly significant with mean values ranging from 10- 14. Similarly, wokoziim has significant rate in dry weight of zinnia. Like fresh weight SA application also increased the dry weight. Like our results Mady (2009) also observed that salicylic acid application on tomato significantly increased the dry weight. Chandra *et al.* (2007) interprets the same results increment in dry weight of in a several cultivars of cowpea.

Vase Life of Zinnia (Days)

The statistical analysis of data indicated (Figure 1 (g)) that different growth stimulants significantly affect vase life of zinnia. Among treatments applied 200mg/L Salicylic acid had highest vase life (10.33), followed by 100mg/L and 150mg/L Salicylic acid having 9.66 statistical mean values. Both have no significant difference between them but significantly differ with all other treatments applied. However, 4ml/L Isabion and 4ml/L VE had no comparable difference between them with numerical value of 8.00.

The statistical value of 3ml/L Isabion was 7.66, followed by 2ml/L Vegetable extract (6.66) and 2ml/L Wokoziim (6.66). 2ml/L Isabion, 3ml/L Isabion, 3ml/L Wokoziim and 4ml/L Wokoziim have mean values of 6.33, 6.00, 6.00 and 6.00 respectively while results of control showed significant decrease in growth while comparing with growth stimulants with statistical mean of 4.33. the results of study are in line with Mashhadian *et al.* (2012) who applied salicylic acid and citric acid on the chrysanthemum flower to improve the vase life of cut flower he found that flowers which were treated from the SA have the highest number of shelf life of 12 days in case of chrysanthemum flower. Another experiment was performed by Rehmani *et al.* (2015) he suggested that by the exogenous spray of Salicylic acid (SA) on the gladiolus flower at both stages pre and post-harvest stages of flower. The results showed that 0.5Mm SA significantly increases the vase life of a flower as compared to the untreated spikes of a Gladiolus. Roodbaraky *et al.* (2012) also performed another experiment on the vase life of carnation cut flower by applying SA he interpreted that SA increased the vase life of cut carnation. Flowers are the very valuable produce of horticulture. To preserve the good quality of cut flowers and extending the shelf life are considered significant for having satisfactory products for the markets. These results are in line with different scientists (Redman *et al.*, 2002; Macnish *et al.*, 2008; Solgi *et al.*, 2009; Zencirkiran, 2010) who observed many experiments for this purpose.

Conclusion

Results concluded that the exogenous application of different growth stimulants i.e. Salicylic Acid (SA), Isabion, Wokoziim and Vegetable Extract considerably effect the growth and flowering parameters of a zinnia as compared to control. Plant height, number of leaves, Internodal distance, no of buds, flower emergence, no of florets, length of flower stalk, girth of a flower stalk, diameter of a flower stalk, fresh and dry weight of a flower and vase life of a flower significantly increased by the application of these stimulants. Salicylic acid was found best among all other growth stimulants followed by Isabion.

Hence the studies verified that the foliar application of these growth stimulants on zinnia is favorable for raising superior quality of commercial crop.

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