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Research Paper

Effect of thidiazuron (TDZ), BA and GA3 on postharvest life of Chrysanthemum (*Dendranthema grandiflora* Ramat.) cv. Candor

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ABSTRACT

The present investigation entitled "Effect of thidiazuron (TDZ), BA and GA3 on postharvest life of Chrysanthemum (*Dendranthema grandiflora* Ramat.)"was carried out with three levels of TDZ (0 µM, 25 µM, 50 µM), three levels of BA (0 mM, 0.2 mM, 0.4 mM) and three levels of GA3 (0 mM, 2 mM, 4 mM) constituting a total of 27 treatment combinations at the Division of Floriculture and Landscape Architecture, SKUAST Kashmir Shalimar during the year 2022 using Completely Randomized Design with three replications. Thidiazuron (TDZ) @ 50 µM resulted in maximum solution uptake on 2nd (10.437 g spike-1), 4th (10.651 g spike-1), 6th (10.814g spike-1), 8th (9.348 g spike-1), 10th (7.296 g spike-1) and 12th day(4.996 g spike-1), maximum solution loss on 2nd (6.431 g spike-1), 4th (7.445 g spike-1), 6th (8.064 g spike-1), 8th (6.215 g spike-1), 10th (5.599 g spike-1) and 12th day (5.299 g spike-1), maximum fresh weight change on on 2nd (17.752 %), 4th (26.121 %), 6th (33.674 g %), 8th (39.974 %), 10th (47.249 %) and 12th day (44.949 %),maximum membrane stability index (MSI) (0.65), minimum ion leakage (21.109 %), minimum flower wilting (0.270 %), maximum chlorophyll content (92.15) and maximum vase life (16.09 day). BA @ 0.4 mM resulted in maximum solution uptake on 2nd (9.8 98 g spike-1), 4th (10.029 g spike-1), 6th (10.234g spike-1), 8th (8.812 g spike-1), 10th (6.771 g spike-1) and 12th day (4.471g spike-1) , maximum solution loss on 2nd (5.444 g spike-1), 4th (6.586 g spike-1), 6th (6.887 g spike-1), 8th (5.561 g spike-1), 10th (4.650 g spike-1) and 12th day (4.350 g spike-1), maximum fresh weight change on 2nd (17.638 %), 6th (33.677 g %), 10th (44.024 %) and 12thday(44.724%), maximum membrane stability index (MSI) (0.563), reduction in ion leakage (31.479 %) and flower wilting (0.439 %), maximum chlorophyll content (76.67) and maximum vase life (14.81 day). GA3 @ 4mM resulted in maximum maximum solution uptake on 2nd (9.596 g spike-1), 4th (9.761 g spike-1), 6th (9.972g spike-1), 8th (8.598 g spike-1), 10th (6.517 g spike-1) and 12th day (4.217 g spike-1) and maximum solution loss on 2nd (4.906 g spike-1), 4th (6.254 g spike-1), 6th (6.502 g spike-1), 8th (5.319 g spike-1), 10th (4.266 g spike-1) and 12th day (3.966 g spike-1), maximum fresh weight change on 2nd (17.177 %), maximum membrane stability index (MSI)(0.524), reduction in ion leakage (35.554 %) and flower wilting (0.492%), maximum chlorophyll content (73.19) and maximum vase life (14.27 day).

Key words: BA, chrysanthemum, GA_3, TDZ, Vase life.

Chrysanthemum (*Dendranthema grandiflora* Ramat.) belongs to the family Asteraceae. It is a herbaceous perennial plant and is a popular flower crop of commercial importance. It is the national flower of Japan and is native to Northern hemisphere, chiefly Europe and Asia. In India, it is popular among the farmers as "Guldaudhi". It is grown as cut flower, loose flower, potted flowering plant, bedding plant and for exhibitions.

In many countries, including the United States and Japan, it is considered as the number one dollar earning flower crop. Amongornamental plants, the demand of chrysanthemum in developed countries is more than 90% (Verma *et al*., 2014). Cut flowers, in general, are highly perishable and chrysanthemums are no exception to it.

In India about 30% post harvest losses occur in flowers annually. Post-harvest management involves the steps taken for the improvement of flower vase life so that the consumer can get the flower in garden fresh condition. The main postharvest problems in chrysanthemum is premature foliage yellowing, wilting and the failure of the flowers to fully open. In order to overcome these problems chemical preservatives and growth regulators are added either to the holding or pulsing solution to preserve the best quality of flower after harvest. TDZ a substitute of phenyl-urea that has cytokinin like activity stronger than BA that delays flower senescence and lasts longer as it is not metabolized by plants (Ferrante *et al*. 2009). BA and GA_3 are also known for delaying processes like fading of flower colour and postponing wilting of flowers bysuppressing proteolysis at senescence (Eason *et al.* 2002). The present investigation was therefore carried out with the objective to improve post-harvest quality of chrysanthemum cut flowers through use of plant growth regulators.

MATERIALS AND METHODS

The experimental material for present study consisted of chrysanthemum cv. Candor at Divisionof Floriculture and landscape Architecture, SKUAST-Kashmir, Shalimar. Three levels of TDZ (0 µM, 25 µM, 50 µM), three levels of BA(0 mM, 0.2 mM, 0.4 mM) and three levels of GA_3 (0 mM, 2 mM, 4 mM) were used as pulsing solution constituting a total of 27 treatment combinations. TDZ @ 25 µM was prepared by dissolving 0.55 mg TDZ in 100 ml water and TDZ @ 50 µM by dissolving 1.10 mg TDZ in 100 ml water. BA @ 0.2mM was prepared by dissolving 4.5 mg of BA in 100 ml of water, 0.4mM BA by dissolving 9.0 mg of BA in water. Similarly GA_3 @2 mM was prepared by dissolving 69.27 mg of GA_3 in 100 ml of water and GA_3 @ 4 mM wasprepared by dissolving 138.54 mg of GA_3 in 100 ml of water. The observations recorded were:

1) Solution Uptake (g spike^{-1})SU = [C+S] 1 - [C+S] 2

C = Weight of container (g)S = Weight of solution (g)
1 = Weight of container + solution on 1st day (g)2 = Weight of container + solution on 2nd day (g)

2) Solution loss (g spike^{-1})

SL= [C+S+F] 1 - [C+S+F] 2
C = Weight of container (g)S = Weight of solution (g) F = Weight of cut spray (g)
1 = Weight of container + solution + cut spray on 1st day (g)2 = Weight of container + solution + cut spray on 2nd day (g)

3) Fresh Weight Change (g spike^{-1})

Fresh weight change = [C+S+F] - [C+S]

4) Membrane stability index:

Leaf discs (100 mg) were thoroughly washed in running tap water followed by washing withdouble distilled water. Thereafter the discs were heated in 10 ml of double distilled water at 40^{0}Cfor 30 min. Then electrical conductivity (C_1) was recorded by EC meter. Subsequently the same samples were placed in a boiling water bath (100^{0}C) for 10 minutes and their electrical conductivity was also recorded (C_2). The MSI was calculated as:
Membrane stability index (MSI) = $1 - C_1/C_2$
where, C_1=Conductivity of sample after exposure to 40°C, C_2=Conductivity of sample after exposure to 100°C.

5) Ion leakage (%)

Six days after the experiment was initiated, 0.5 g of petals were detached in 1 × 1 cm^2 pieces from each treatment and was placed in a Petri dish containing distilled water to be rinsed for a few minutes. Then, they were transferred into tubes containing 22.5 mL of deionised water and were placed in a shaker at the temperature of 25°C and the speed of 150 rpm for 30 minutes. Finally, its EC was recorded as EC_1.

The same tubes were placed at 100°C boiling water for 15 minutes. Then, they were placed in cold water to be cooled down rapidly. After that, their EC was recorded as EC_T. Then, the electrolyte leakage percentage was calculated as follows:
Ion leakage percentage = EC_1/EC_T x 100

6) Flower wilting (%)

Flower wilting percentage = Number of wilted flowers on the final day x 100
Total number of flowers

7) Chlorophyll content (SPAD)

Chlorophyll content was measured by SPAD meter. Average of three measurements from different spots of a single leaf was considered.

8) Vase life (day)

It was measured from the period the flower stems were placed in vase containing distilledwater till the wilting of 50 per cent flowers took place.

RESULTS AND DISCUSSION

Thidiazuron (TDZ) @ 50 µM showed an increasing trend in solution uptake, solution loss and fresh weight change from day 2nd to day 6th and thereafter started decreasing. Thidiazuron (TDZ) @ 50 µM resulted in maximum solution uptake on 2nd (10.437 g spike^{-1}), 4th (10.651g spike^{-1}), 6th (10.814g spike^{-1}), 8th (9.348 g spike^{-1}), 10th (7.296 g spike^{-1}) and 12th day(4.996 g spike^{-1}) and maximum solution loss on 2nd (6.431 g spike^{-1}), 4th (7.445 g spike^{-1}), 6th (8.064 g spike^{-1}), 8th (6.215 g spike^{-1}), 10th (5.599 g spike^{-1}) and 12th day (5.299 g spike^{-1}).

(Fig. 1, 2) Thidiazuron (TDZ) @ 50 µM also resulted in maximum fresh weight change on 2nd (17.752 %),4th (26.121%), 6th (33.674 g %), 8th (39.974 %), 10th (47.249 %) and 12th day (44.949 %).

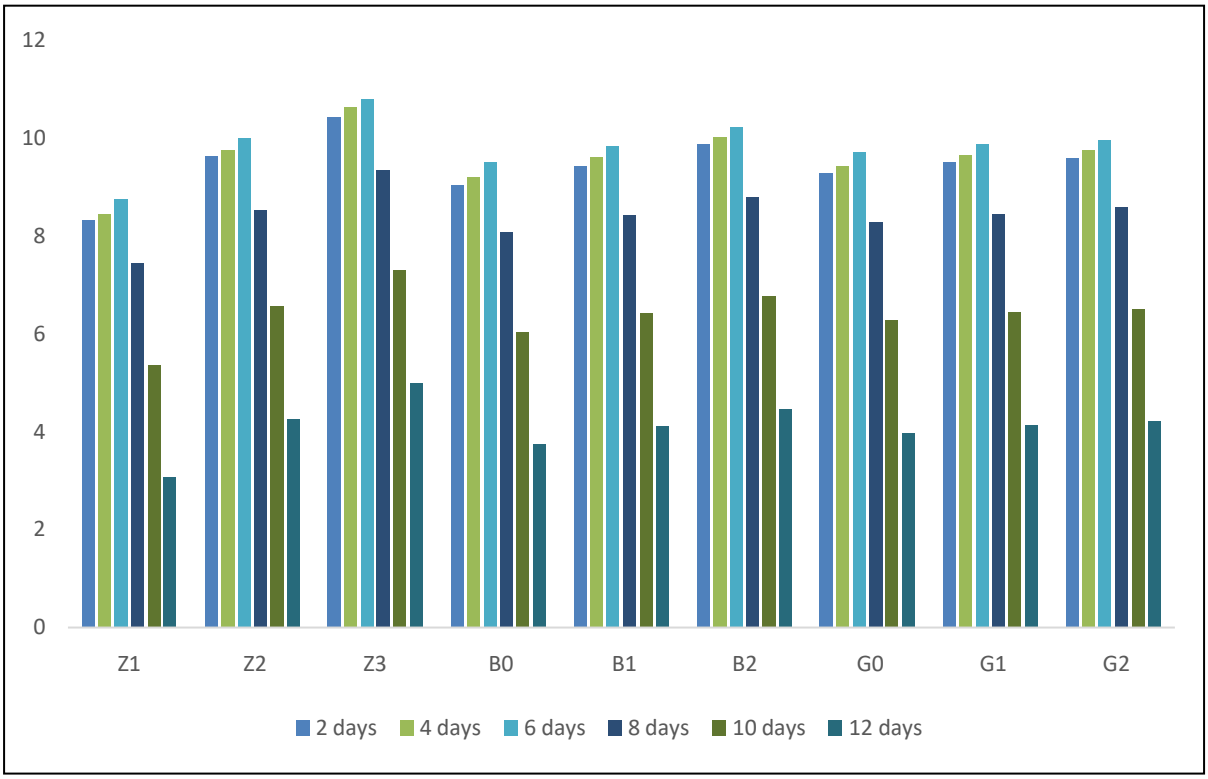

Fig.1: Effect of thidiazuron (TDZ), BA and GA_3 on solution uptake of chrysanthemum cv. candor

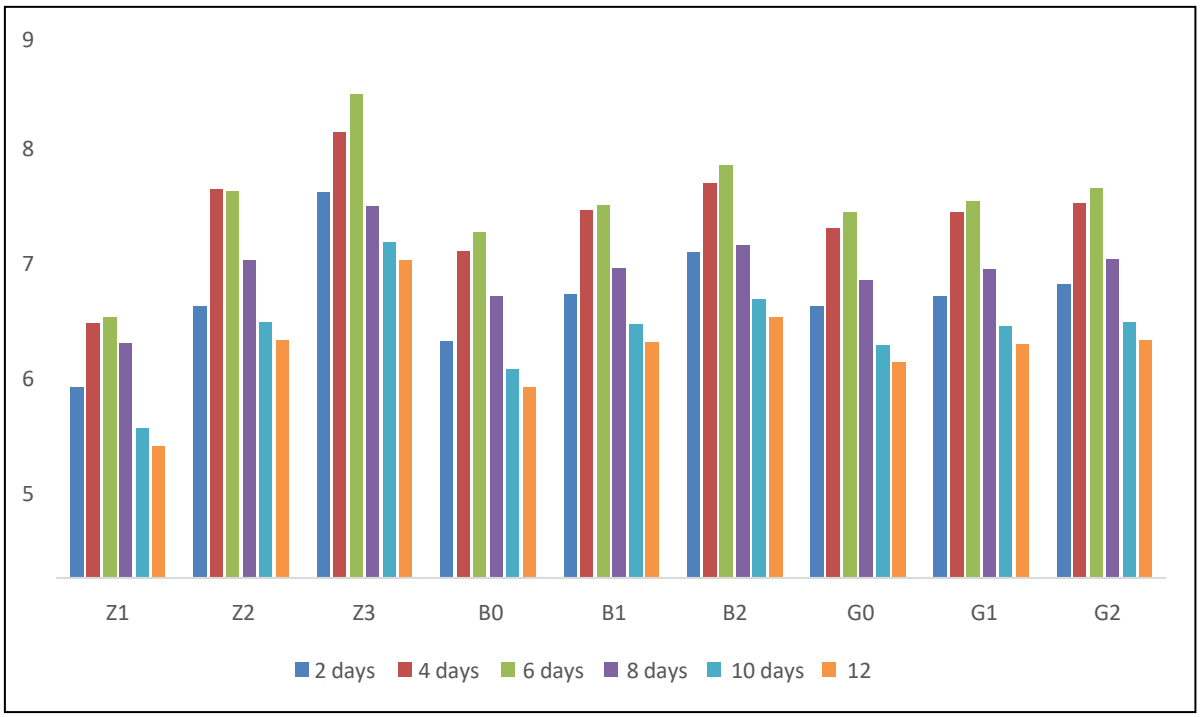

Fig. 2: Effect of thidiazuron (TDZ), BA and GA3 on solution loss of chrysanthemum cv. candor

Figure 3 Thidiazuron (TDZ) @ 50 µM resulted in maximum membrane stability index (0.65), minimum ion leakage (21.109 %), minimum flower wilting (0.270 %), maximum chlorophyll content (92.15) and maximum vase life (16.09 day). (Fig. 4, 5). TDZ a substituteof phenyl-urea that has cytokinin like activity may act as free radical scavenger, thus maintaining membrane integrity for extended life span. TDZ is also able to inhibit carotenoid degradation and retard chlorophyll degradation and thus improving vase life (Hatamzadeh *et al.* 2012). Our results are in conformity with the findings of Ferrante *et al*. 2002 and Ferrante *et al*. 2003 in chrysanthemum, Gupta *et al*. 2018, Singh *et al*. 2021 in gladiolus.

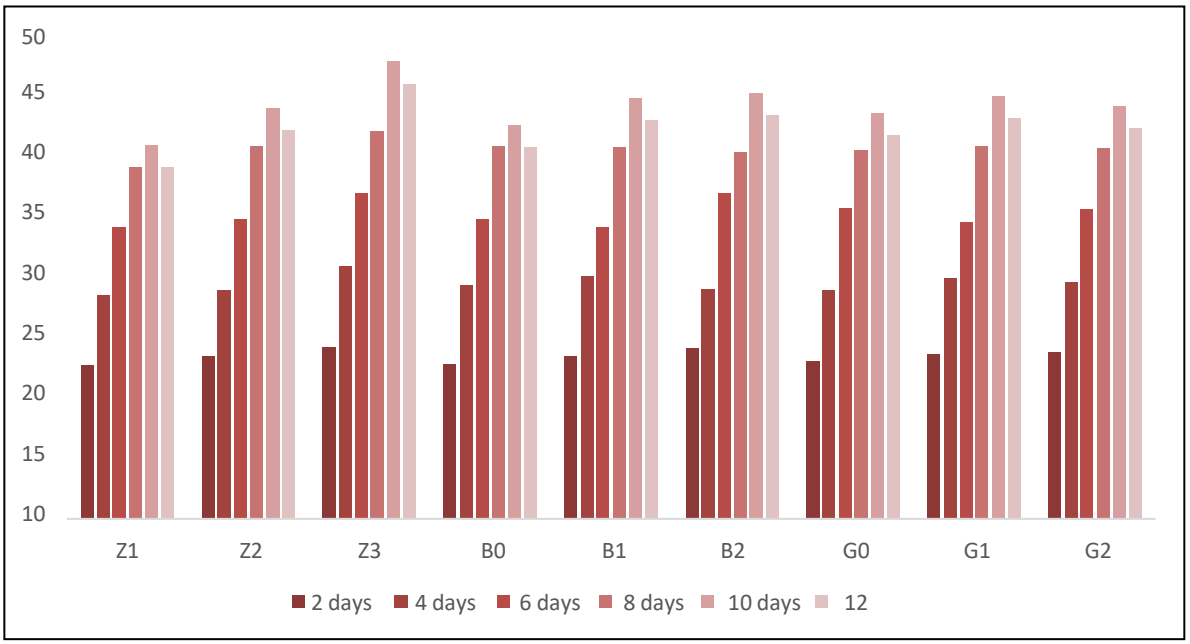

Fig. 3: Effect of thidiazuron (TDZ), BA and GA3 on Fresh weight change of chrysanthemum cv. Candor

BA @ 0.4 mM resulted in maximum solution uptake on 2nd (9.898 g spike^{-1}), 4th (10.029 g spike^{-1}), 6th (10.234g spike^{-1}), 8th (8.812 g spike^{-1}), 10th (6.771 g spike^{-1}) and 12th day (4.471 g spike^{-1}) and maximum solution loss on 2nd (5.444 g spike^{-1}), 4th (6.586 g spike^{-1}), 6th (6.887 g spike^{-1}), 8th (5.561 g spike^{-1}), 10th (4.650 g spike^{-1}) and 12th day (4.350 g spike^{-1}), maximum fresh weight change on 2nd (17.638 %), 6th (33.677 g %), 10th (44.024 %) and 12thday(44.724%).(Fig. 1,2,3).

GA3 @ 4 mM resulted in maximum solution uptake on 2nd (9.596 g spike^{-1}), 4th (9.761 g spike^{-1}), 6th (9.972g spike^{-1}), 8th (8.598 g spike^{-1}), 10th (6.517 g spike^{-1}) and 12th day (4.217 g spike^{-1}) and maximum solution loss on 2nd (4.906 g spike^{-1}), 4th (6.254 g spike^{-1}), 6th (6.502 g spike^{-1}), 8th (5.319 g spike^{-1}), 10th (4.266 g spike^{-1}) and 12th day (3.966 g spike^{-1}), maximum fresh weight change on 2nd (17.177 %). (Fig. 1,2,3). Both GA3 and BA are known for their role in increasing the permeability of cell membrane to glucose, conversion of sucrose and starch intoglucose, leading to decrease in water potential of cells. This leads to increased water uptake (Salisbury and Ross 2010). Similar results were reported by Gaur *et al*. 2022, Singh *et al*. 2008in gladiolus. BA @ 0.4 mM resulted in maximum membrane stability index (MSI) (0.563), reduction in ion leakage (31.479) and flower wilting (0.439 %), maximum chlorophyll content (76.67) and maximum vase life (14.81 day). (Figure 4,5). GA3 @ 4mM also resulted in maximum membrane stability index (MSI) (0.524), reduction in ion leakage (35.554) and flower wilting (0.492), maximum chlorophyll content (73.19) and maximum vase life (14.27 day). (Fig. 4, 5).

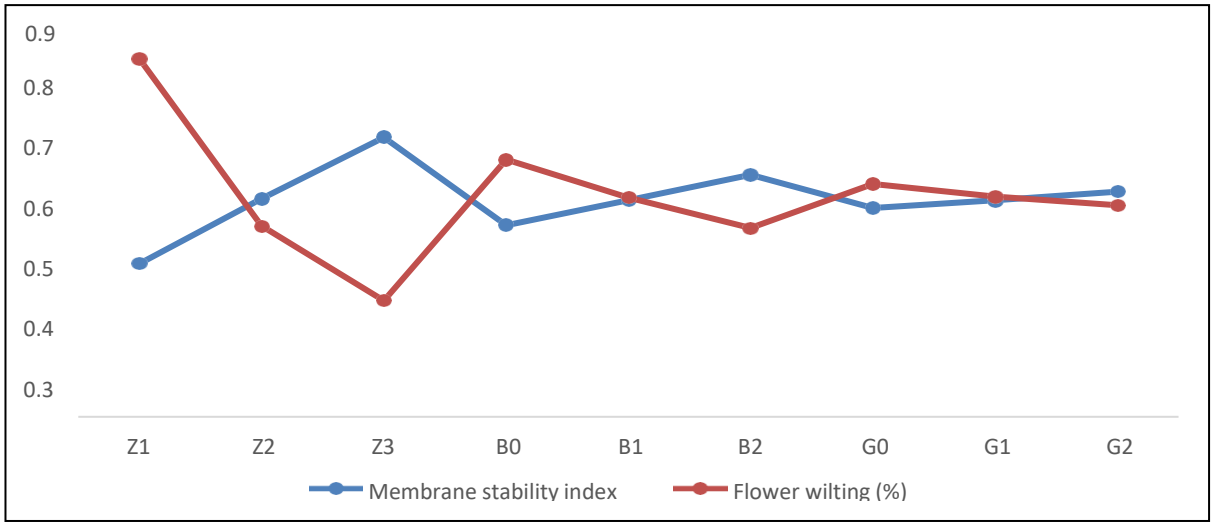

Fig. 4: Effect of thidiazuron (TDZ), BA and GA3 on Membrane stability index, Flower wilting of chrysanthemum cv. Candor

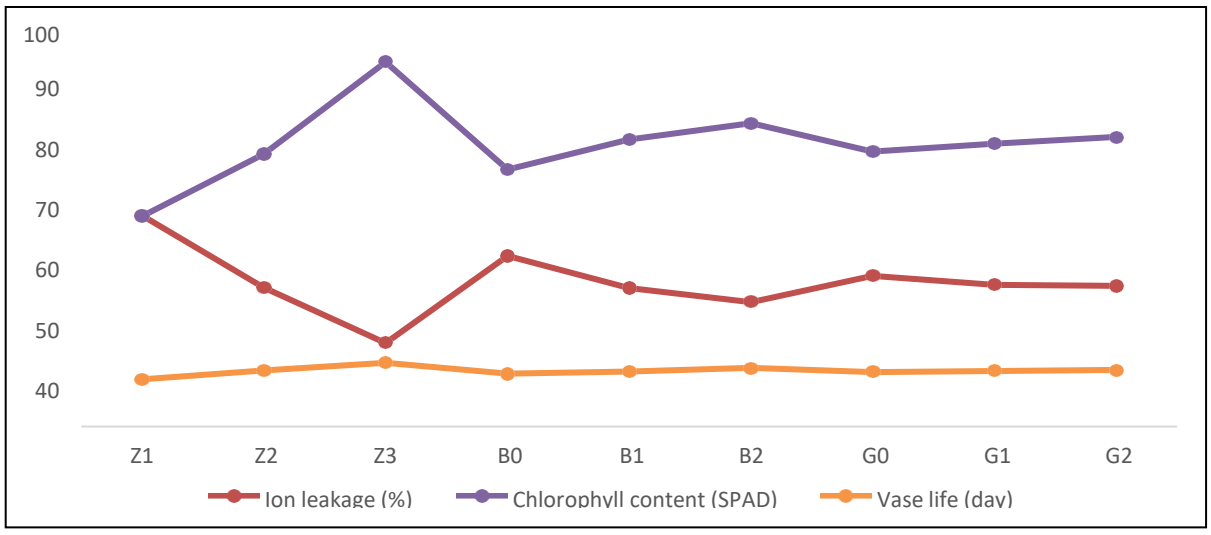

Fig.5: Effect of thidiazuron (TDZ), BA and GA3 on Ion leakage, Chlorophyll content, Vase life of chrysanthemum cv. Candor

The increase in MSI with BA and GA3 treatment can be attributed to its role in increasing calcium uptake by cells which results in reduction in electrolyte leakage. (Jonas and MacMillan 1985). Plant growth regulators have ability to reduce and delay the production of endogenous ethylene hormone (Lukaszewska, 1994), thus reduction in flower wilting and increase in vase life. These results are in line with the findings of Zhang and Guo (1998) in chrysanthemum.

Table 1: Effect of Thidiazuron (TDZ), BA and GA3 on membrane stability index, ion leakage (%), flower wilting (%), chlorophyll content and vase life of chrysanthemum cv. Candor

Treatment	Membrane stability index	Ion leakage (%)	Flower wilting (%)	Chlorophyll content (SPAD)	Vase life (day)
Thidiazuron (TDZ)					
0 µM **(Z1)**	0.356	53.333	0.833	53.16	11.92
25 µM **(Z2)**	0.507	35.130	0.444	68.85	14.11
50 µM **(Z3)**	0.650	21.109	0.270	92.15	16.09
C.D (≤ 0.05)	**0.005**	**0.002**	**0.013**	**8.35**	**0.62**
BA (B)					
0 mM **(B0)**	0.446	43.094	0.598	64.99	13.35
0.2 mM **(B1)**	0.504	34.999	0.510	72.50	13.95
0.4 mM **(B2)**	0.563	31.479	0.439	76.67	14.81
C.D (≤ 0.05)	**0.005**	**0.002**	**0.013**	**8.35**	**0.62**
GA3 (G)					
0 mM **(G0)**	0.486	38.147	0.542	69.48	13.82
2 mM **(G1)**	0.503	35.871	0.512	71.49	14.02
4 mM **(G2)**	0.524	35.554	0.492	73.19	14.27
C.D (≤ 0.05)	**0.005**	**0.002**	**0.013**	**N.S**	**0.62**

CONCLUSION

Post harvest quality of chrysanthemum including solution uptake, solution loss, fresh weight change, membrane stability index, ion leakage, flower wilting, chlorophyll content andvase life was improved by TDZ @ 50 µM , GA3 @ 4mM and BA @ 0.4 mM.

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