EFFECT OF PRESERVATIVE CHEMICALS AND GROWTH REGULATORS ON THE POST HARVEST PHYSIOLOGICAL AND BIOCHEMICAL PARAMETERS OF GLADIOLUS SPIKES (*Gladiolus grandiflorus* L.) cv. AMERICAN BEAUTY

[1]R. Sudhagar, [2]S. Sowmiya and [3]B. Pamela Elisheba
[1]Assistant Professor, [2]PG Scholar, [3]Ph.D Scholar, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar – 608002, Tamil Nadu, India.

Abstract: The present investigation on the "Influence of preservative chemicals and growth regulators on the post harvest physiological and biochemical parameters of gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty" was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar. The experiment was conducted in a Completely Randomized Design with 13 treatments in three replications. The treatments consisted of two preservative chemicals *viz*., 8-hydroxy quinoline sulphate @ 150, 300, 450 ppm and silver nitrate @ 25, 50, 75 ppm along with benzyl adenine (BA) @ 20, 40 and 60 ppm and gibberellic acid (GA_3) @ 10, 25 and 40 ppm and a control (distilled water) was also maintained. The results of the experiment revealed that the best treatment was T_2 (8- HQS 300 ppm + 4 % sucrose + BA 40 ppm) in terms of all the physiological and biochemical parameters *viz*., water uptake, transpirational loss of water, water balance, fresh weight change and optical density of vase. From the above results it has been concluded that the use of vase solution containing 8 HQS 300 ppm + sucrose 4 per cent + BA 40 ppm found better for maintaining the spike quality of gladiolus cv. American Beauty.

Index terms: 8-hydroxy quinoline sulphate, silver nitrate, sucrose, benzyl adenine, gibberellic acid.

I. INTRODUCTION

Floral senescence is the major problem regarding the postharvest management of cut flowers. Petal senescence is associated with highly physiological and genetically controlled processes that includes membrane leakage, degradation of macromolecules and oxidative stress (Ezhilmathi *et al.* 2007). Gladiolus (*Gladiolus grandiflorus* L.) belonging to the family Iridaceae, is an important ornamental bulbous plant which is very important due to its majestic flower spikes having florets of varying shapes, sizes, colours and excellent keeping quality. Upon detachment from plants, the cut flowers carry on all life processes at the expense of stored food in the form of carbohydrate, protein and fats for a few more days. Gladiolus florets remain fresh for 7-10 days as cut flower. Floral preservatives have been used at all stages of flower handling and marketing to improve the flower quality, longevity and better consumer acceptability (Bhattacharjee, 1999). The basic constituents of such floral preservatives are water that maintains turgidity and sugar as an energy source. Standard vase solutions contain carbohydrates, germicides, growth regulators, mineral salts, and organic acids. Several attempts were made to study the effect of different chemicals, sugars, including growth regulators to extend the vase life of cut flowers having economic value (Halevy and Mayak, 1979). Hence keeping the above problems in view, the present work has been undertaken to study the influence of preservative chemicals and growth regulators on the post harvest physiological and biochemical parameters of gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty.

II. MATERIALS AND METHODS

The investigation on the "Influence of preservative chemicals and growth regulators on the post harvest physiological and biochemical parameters of gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty" was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu. The study was taken up in a completely randomized design with thirteen treatments replicated thrice. The treatments included were T_1 (8-HQS 300 ppm + sucrose 4 % + BA 20 ppm); T_2 (8-HQS 300 ppm + sucrose 4 % + BA 40 ppm); T_3 (8-HQS 300 ppm + sucrose 4 % + BA 60 ppm) T_4 (8-HQS 300 ppm + sucrose 4 % + GA_3 10 ppm); T_5 (8-HQS 300 ppm + sucrose 4 % + GA_3 25 ppm); T_6 (8-HQS 300 ppm + sucrose 4 % + GA_3 40 ppm); T_7 ($AgNO_3$ 50 ppm + sucrose 4 % + BA 20 ppm); T_8 ($AgNO_3$ 50 ppm + sucrose 4 % + BA 40 ppm); T_9 ($AgNO_3$ 50 ppm + sucrose 4 % + BA 60 ppm); T_{10} ($AgNO_3$ 50 ppm + sucrose 4 % + GA_3 10 ppm); T_{11} ($AgNO_3$ 50 ppm + sucrose 4 % + GA_3 25 ppm); T_{12} ($AgNO_3$ 50 ppm + sucrose 4 % + GA_3 40 ppm) and T_{13} - control (Distilled water).

Gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty spikes were of good quality free from mechanical injury, diseases and insect injuries. They were obtained from a local wholesale distributor in Hosur. De-ionised or distilled water was used to reduce experimental variability (Rule *et al*., 1986), therefore all the solutions were prepared with distilled water and such freshly prepared solutions were used for the experimentation. According to Lemper (1981), cleaning the stems and re-cutting the base before placing them in the solutions are essential. In each glass bottle one flower was placed and considered as one replication. The spikes were trimmed under water to 60 cm. After recording fresh weight, the individual flower spikes were placed randomly in the glass bottles containing 200 ml of aqueous test solutions of different treatments. The mouth of the bottles was sealed with aluminum foil, which effectively prevented the evaporation loss of aqueous test solutions. The

weight of each container (bottle) and solution/distilled water with and without flower spikes were recorded once in two days, while recording weights re-cutting the base of floral stems (about 0.5 cm) was done under water. The observations of the flowers were recorded in alternate days. The physiological parameters like water uptake (WU), transpirational loss of water (TLW), water balance (WB) were observed and expressed as gram per flower (g/f) and fresh weight change (FWC) was recorded as percentage of initial weight. The biochemical parameter i.e., optical density (OD) of vase solution was measured at every alternate day using spectrophotometer at 480 nm.

III. RESULTS AND DISCUSSION

The results of the first experiment showed that the use of 8 HQS 300 ppm + sucrose 4 per cent + BA 40 ppm markedly influenced the physiological and biochemical parameters of gladiolus viz., water uptake (12.41 g/f), transpirational loss of water (11.34 g/f), water balance (6.07 g/f), fresh weight change (117.98 %) and optical density of vase (0.0173) on 2nd day of observation (Table 1-5)**.**

3.1. Physiological parameters

3.1.1. Water uptake

The use of preservative chemicals along with plant growth regulators recorded an increase in the rate of water uptake in comparison to control. In the present study, gladiolus held in BA recorded highest rates of water uptake followed by GA_3. This was in accordance with the results of Mayak and Halevy (1974) in cut roses. In the present study on the use of 8-HQS 300 ppm + sucrose 4 % + BA 40 ppm recorded the highest WU while the lowest WU was recorded in control.

BA increased the water absorption capacity of gladiolus and improved the water equilibrium in the stems by increasing the exosmosis of soluble substances in the petals and thereby prolonged the cut flower life. This was supported by the finding that BA delayed the decrease in water content which is associated with senescence of gerbera flowers by Van Meeteren (1978). The findings of Heide and Oydvin (1969) in cut carnations and Lukaszewska (1980) in cut carnation spikes also supported the present results. Benzyl adenine was reported to enhance the keeping quality of cut flowers by maintaining the flower turgidity, reduction in bent neck and delaying flower senescence.

Zeatin-group of cytokinins have a positive effect on the longevity of cut flowers thereby flower petal senescence can be delayed by applying cytokinins as reported by Mor *et al*. (1983) in cut roses.

3.1.2. Transpirational loss of water

Among the best combinations, maximum WU by spikes held in the treatment 8-HQS 300 ppm + sucrose 4 % + BA 40 ppm resulted in higher TLW without any hinderance in the vascular system by plugging followed by 8-HQS 300 ppm + sucrose 4% + GA_3 25 ppm. Significantly lowest TLW was recorded in control compared to all other treatments due to poor water relations. The present results were in accordance with Krishnappa and Reddy (2004) in cut carnations. From their observations, it was reported that normal rate of transpiration is essential for extending the vase life of cut flowers and any process that hinders the normal transpiration will decrease the keeping quality of cut flowers.

Although the total quantity of water uptake and transpirational loss of water was significantly greater in these treatments, the water uptake dominated over TLW thereby improving the water retention in the cut gladiolus spikes. These results were in accordance with the findings of Pobudkiewicz and Nowak (1992) and Yildirim *et al.* (1995) in cut gerbera. Further, Mukhopadhyay (1982) in his investigations reported that GA_3 was effective in increasing the longevity of cut tuberoses which also supported the present results.

3.1.3. Water balance

All the plant growth regulators tested were effective in influencing the water balance in comparison to control. Among the growth regulator treatments, maximum WB was recorded by gladiolus spikes held in 8-HQS 300 ppm + sucrose 4 % + BA 40 ppm.

Treatment with 8-HQS 300 ppm + sucrose 4 % + BA 40 ppm improved membrane stability by reducing membrane permeability and thereby delaying senescence and maintaining cut flower freshness for a longer time, which was in accordance with Zhang *et al*. (1998) in cut chrysanthemum. Further, these results were in confirmation with the results of Rekha *et al*. (2001) in cut gladiolus spikes who reported that benzymidazole which has cytokinin like activity delayed the senescence of cut flowers and increased the flower longevity.

A deterioration in water balance of flower organs leads to rise in endogenous abscissic acid content, leading to early senescence in cut roses as reported by Borochov *et al*. (1976).

3.1.4. Fresh weight change

The present study revealed that the gladiolus spikes held in 8-HQS 300 ppm + sucrose 4% + BA 40 ppm recorded the maximum FWC, followed by 8-HQS 300 ppm + sucrose 4% + GA_3 25 ppm. The gain in fresh weight might be due to increased metabolic activity without loss of quality.

After treatment with BA, the water absorption capacity of cut flowers was higher than that of control, so the water equilibrium in the spike was improved, the exosmosis of soluble substances in the petals increased and cut flower life was prolonged. These results were in accordance with Chen and Chen (1996) in cut roses. 6-BA promoted GA_3 concentration, inhibited ethylene production during vase life of a cut flower. GA_3 and BA both prolonged vase life and delayed premature wilting. The present results were in accordance with the results reported by Guo *et al*. (2003) who observed that 6-BA is the main factor retarding senescence in cut chrysanthemum flowers.

Gladiolus spikes held in control recorded lowest FWC which might beattributed to lowered water uptake levels due to disturbances in transport of water (Halevy and Mayak, 1981) which further might have led to water deficit resulting in reduced fresh weights of the cut flowers till the end of vase life period. The combination of 8-HQS + sucrose recorded similar results in cut chrysanthemums (Lee and Kim, 1994) and cut gladiolus spikes (Zhou *et al.*, 1995).

3.2. Biochemical parameters

3.2.1. Optical density

Among the best combinations of preservative chemicals and growth regulators, gladiolus spikes held in control recorded significantly highest OD on day 8, while spikes held in 8-HQS 300 ppm + sucrose 4% + BA 40 ppm recorded significantly lowest OD might be attributed to lowered turbidity of solutions thereby controlling bacterial populations. These results were in accordance with the findings of Sooch *et al*. (2002) in cut gerbera. The present results suggested that the treatment 8-HQS 300 ppm + sucrose 4% + BA 40 ppm was effective in reducing physiological stem plugging (Aarts, 1957) and effectively controlling microbial growth in the vase solution which might be due to specific germicidal properties of the chemicals in combination, which was in accordance with the findings of Larsen and Frolich (1969) in cut carnations.

From the above results it can be concluded that the use of vase solution containing 8 HQS 300 ppm + sucrose 4 per cent + BA 40 ppm was found better for extending the vase life and maintaining quality of Gladiolus cv. American Beauty.

Table 1. Influence of floral preservatives and growth regulators on water uptake (g/f) of gladiolus cv. American beauty

T.NO	Treatment /days	Water uptake (g/f)			
		2nd day	4th day	6th day	8th day
T_1	8- HQS 300 ppm+4% Sucrose+BA 20ppm	10.25	7.79	6.84	4.06
T_2	8- HQS 300 ppm+4% Sucrose+BA 40ppm	12.41	10.13	9.03	6.40
T_3	8- HQS 300 ppm+4% Sucrose+BA 60ppm	11.74	8.92	7.83	4.65
T_4	8- HQS 300 ppm+4% Sucrose+GA_3 20ppm	9.99	8.39	7.14	4.08
T_5	8- HQS 300 ppm+4% Sucrose + GA_3 25ppm	12.13	9.36	8.40	6.06
T_6	8- HQS 300 ppm+4% Sucrose+ GA_3 50ppm	10.99	8.90	6.50	4.82
T_7	$AgNO_3$ 25 ppm+2% Sucrose+BA 20ppm	9.64	7.88	6.11	3.80
T_8	$AgNO_3$ 50 ppm+2% Sucrose+BA 40ppm	11.48	9.65	8.21	4.69
T_9	$AgNO_3$ 75 ppm+2% Sucrose+BA 60ppm	10.75	8.30	7.45	5.37
T_{10}	$AgNO_3$ 25 ppm+4% Sucrose+GA_3 10ppm	9.48	7.68	5.60	3.65
T_{11}	$AgNO_3$ 50 ppm+4% Sucrose+ GA_3 25ppm	11.24	9.19	7.13	4.43
T_{12}	$AgNO_3$ 50 ppm+4% Sucrose+ GA_3 50ppm	10.54	8.60	7.67	5.44
T_{13}	Control (distilled water)	8.91	5.47	3.42	2.58
	SED	0.12	0.19	0.26	0.16
	CD (P=0.05)	0.24	0.38	0.52	0.32

Table 2. Influence of floral preservatives and growth regulators on transpirational loss of water (g/f) of gladiolus cv. American beauty

T.NO	Treatment /days	Transpirational loss of water (g/f)			
		2nd day	4th day	6th day	8th day
T_1	8- HQS 300 ppm+4% Sucrose+BA 20ppm	9.68	8.10	7.65	5.40
T_2	8- HQS 300 ppm+4% Sucrose+BA 40ppm	11.34	9.41	9.03	7.20
T_3	8- HQS 300 ppm+4% Sucrose+BA 60ppm	10.85	9.08	8.58	6.06
T_4	8- HQS 300 ppm+4% Sucrose+GA_3 20ppm	9.52	8.79	8.28	5.56
T_5	8- HQS 300 ppm+4% Sucrose + GA_3 25ppm	11.10	9.20	8.84	7.04
T_6	8- HQS 300 ppm+4% Sucrose+ GA_3 50ppm	10.28	9.25	8.40	6.10
T_7	$AgNO_3$ 25 ppm+2% Sucrose+BA 20ppm	9.21	8.28	7.52	5.46
T_8	$AgNO_3$ 50 ppm+2% Sucrose+BA 40ppm	10.67	9.85	9.28	6.23
T_9	$AgNO_3$ 75 ppm+2% Sucrose+BA 60ppm	10.07	8.35	8.02	6.39
T_{10}	$AgNO_3$ 25 ppm+4% Sucrose+GA_3 10ppm	9.04	8.13	7.38	5.23
T_{11}	$AgNO_3$ 50 ppm+4% Sucrose+ GA_3 25ppm	10.43	8.67	7.62	6.11
T_{12}	$AgNO_3$ 50 ppm+4% Sucrose+ GA_3 50ppm	9.86	8.80	8.32	6.3

T_{13}	Control (Untreated)	8.67	6.53	5.21	4.51
	SED	0.11	0.06	0.08	0.06
	CD (P=0.05)	0.21	0.11	0.16	0.13

Table 3. Influence of floral preservatives and growth regulators on water balance (g/f) of gladiolus cv. American beauty

T.NO	Treatment /days	WATER BALANCE (g/f)			
		2nd day	4th day	6th day	8th day
T_1	8- HQS 300 ppm+4% Sucrose+BA 20ppm	5.57 (0.57)	4.69 (-0.31)	4.18 (-0.82)	3.66 (-1.34)
T_2	8- HQS 300 ppm+4% Sucrose+BA 40ppm	6.07 (1.07)	5.72 (0.72)	4.99 (-0.01)	4.20 (-0.80)
T_3	8- HQS 300 ppm+4% Sucrose+BA 60ppm	5.89 (0.89)	4.84 (-0.16)	4.25 (-0.75)	3.59 (-1.41)
T_4	8- HQS 300 ppm+4% Sucrose+GA_3 20ppm	5.47 (0.47)	4.60 (-0.40)	3.86 (-1.14)	3.52 (-1.48)
T_5	8- HQS 300 ppm+4% Sucrose + GA_3 25ppm	6.04 (1.04)	5.16 (0.16)	4.57 (-0.43)	4.02 (-0.98)
T_6	8- HQS 300 ppm+4% Sucrose+ GA_3 50ppm	5.71 (0.71)	4.65 (-0.35)	3.10 (-1.90)	3.09 (-1.91)
T_7	$AgNO_3$ 25 ppm+2% Sucrose+BA 20ppm	5.43 (0.43)	4.60 (-0.40)	3.59 (-1.41)	3.34 (-1.66)
T_8	$AgNO_3$ 50 ppm+2% Sucrose+BA 40ppm	5.82 (0.82)	4.80 (-0.20)	3.93 (-1.07)	3.46 (-1.54)
T_9	$AgNO_3$ 75 ppm+2% Sucrose+BA 60ppm	5.68 (0.68)	4.94 (-0.06)	4.43 (-0.57)	3.98 (-1.02)
T_{10}	$AgNO_3$ 25 ppm+4% Sucrose+GA_3 10ppm	5.44 (0.44)	4.55 (-0.45)	3.22 (-1.78)	3.14 (-1.86)
T_{11}	$AgNO_3$ 50 ppm+4% Sucrose+ GA_3 25ppm	5.81 (0.81)	5.51 (0.51)	4.51 (-0.49)	3.32 (-1.68)
T_{12}	$AgNO_3$ 50 ppm+4% Sucrose+ GA_3 50ppm	5.67 (0.67)	4.80 (-0.20)	4.35 (-0.65)	3.70 (-1.30)
T_{13}	Control (distilled water)	5.24 (0.24)	3.94 (-1.06)	3.21 (1.79)	3.07 (-1.93)
	SED	0.01	0.12	0.15	0.08
	CD (P=0.05)	0.03	0.25	0.29	0.16

Figures in the parenthesis represent original values. The data was analysed statistically after uniform addition of a base value 5.0.

Table 4. Influence of floral preservatives and growth regulators on fresh weight change (%) of gladiolus cv. American beauty

T.NO	Treatment /days	Fresh weight change (%)			
		2nd day	4th day	6th day	8th day
T_1	8 HQS 300 ppm+4% Sucrose+BA 20ppm	107.42	103.97	99.12	86.26
T_2	8 HQS 300 ppm+4% Sucrose+BA 40ppm	110.86	117.98	106.68	98.93
T_3	8 HQS 300 ppm+4% Sucrose+BA 60ppm	109.95	106.43	101.46	88.30
T_4	8 HQS 300 ppm+4% Sucrose+GA_3 20ppm	107.05	111.57	98.32	85.29
T_5	8 HQS 300 ppm+4% Sucrose + GA_3 25ppm	110.37	117.26	105.10	91.49
T_6	8 HQS 300 ppm+4% Sucrose+ GA_3 50ppm	108.70	112.72	91.42	81.06
T_7	$AgNO_3$ 25 ppm+2% Sucrose+BA 20ppm	106.52	109.99	86.17	82.62
T_8	$AgNO_3$ 50 ppm+2% Sucrose+BA 40ppm	109.47	114.09	100.54	87.22

T_9	$AgNO_3$ 75 ppm+2% Sucrose+BA 60ppm	108.24	114.70	104.16	96.59
T_{10}	$AgNO_3$ 25 ppm+4% Sucrose+GA_3 10ppm	106.13	110.05	89.26	79.14
T_{11}	$AgNO_3$ 50 ppm+4% Sucrose+ GA_3 25ppm	109.01	112.56	88.19	84.56
T_{12}	$AgNO_3$ 50 ppm+4% Sucrose+ GA_3 50ppm	107.87	114.59	102.71	89.41
T_{13}	Control (Untreated)	105.75	108.34	83.46	76.09
	SED	0.19	0.17	0.64	1.13
	CD (P=0.05)	0.38	0.34	1.27	2.87

Table 5. Influence of floral preservatives and growth regulators on optical density of vase solution of gladiolus cv. American beauty

T.No.	Treatment /days	Optical density of vase solution			
		2nd day	4th day	6th day	8th day
T_1	8- HQS 300 ppm+4% Sucrose+BA 20ppm	0.0264	0.1198	0.1797	0.1989
T_2	8- HQS 300 ppm+4% Sucrose+BA 40ppm	0.0173	0.0785	0.0902	0.1122
T_3	8- HQS 300 ppm+4% Sucrose+BA 60ppm	0.0188	0.0852	0.1278	0.1415
T_4	8- HQS 300 ppm+4% Sucrose+GA_3 20ppm	0.0270	0.1224	0.1837	0.2034
T_5	8- HQS 300 ppm+4% Sucrose + GA_3 25ppm	0.0182	0.0825	0.1119	0.1214
T_6	8- HQS 300 ppm+4% Sucrose+ GA_3 50ppm	0.0126	0.0980	0.1469	0.1627
T_7	$AgNO_3$ 25 ppm+2% Sucrose+BA 20ppm	0.0289	0.1311	0.1966	0.2177
T_8	$AgNO_3$ 50 ppm+2% Sucrose+BA 40ppm	0.0197	0.0891	0.1336	0.1479
T_9	$AgNO_3$ 75 ppm+2% Sucrose+BA 60ppm	0.0228	0.1031	0.1547	0.1713
T_{10}	$AgNO_3$ 25 ppm+4% Sucrose+GA_3 10ppm	0.0309	0.1399	0.2099	0.2324
T_{11}	$AgNO_3$ 50 ppm+4% Sucrose+ GA_3 25ppm	0.0206	0.0933	0.1399	0.1549
T_{12}	$AgNO_3$ 50 ppm+4% Sucrose+ GA_3 50ppm	0.0240	0.1088	0.1633	0.1808
T_{13}	Control (distilled water)	0.0360	0.2075	0.2732	0.2897
	SED	0.0002	0.0011	0.0073	0.0043
	CD (P=0.05)	0.0004	0.0023	0.0147	0.0085

REFERENCES

[1] Aarts, J.F.T.H. 1957. Over de houdbaarheid van snibloeen (on the keepability of cut flowers). Meded Van de land bouwhogeschool te Wageningen 57: 1-62

[2] Bhattacharjee, S. K. 1999. Postharvest management of cut flowers, cut foliages and post production management of potted plants. *J. Orna. Hort.* 2(1): 32-39.

[3] Borochov, A., S. Mayak and A H. Halevy. 1976. Combined effects of acid and sucrose on growth and senescence of rose flowers. *Physiologia Plantarum*, 36: 221.

[4] Chen W. H, and W H. Chen, 1996. Effect of 6-BA on senescence of cut Chinese rose. *Plant Physiology Communications* 32(4): 260-262.

[5] Ezhilmathi K, V. P. Singh, A. Arora, R. K. Sairam. 2007. Effect of 5-sulfosalicylic acid on antioxidant activity in relation to vase life of Gladiolus cut flowers. *Plant Growth Regulation.* 51: 99-108.

[6] Guo W. M., L. Zheng, Z. H. Zhang and W.Q. Zeng. 2003. Phytohormones regulate senescence of cut chrysanthemum. *Acta Hort*., (624): 349-353.

[7] Halevy, A. H., and S. Mayak . 1979. Senescence and postharvest physiology of cut flowers – Part 1, p.204-236. In: J., Janick (ed.) Hort. Rev., Vol.I, AVI Publishing, Westport, Conn.

[8] Halevy, A. H., and S. Mayak, 1981. Senescence and postharvest physiology of cut flowers – Part II. *Hort. Rev*. 3: 59-143.

[9] Heide O. M, and J .Oydvin, 1969. Effects of 6-benzylamino purine on the keeping quality and respiration of glass house carnations. *Hort. Re*s. 9: 26-36.

[10] Krishnappa K .S. and N S. Reddy 2004. Effect of cultivars, fertigation levels and floral preservatives in extending vase life of carnation cut flowers. Mysore *J. Agri. Sci.* 38(3): 314-318.

[11] Larsen F .E. and M. Frolich. 1969. The influence of 8-hydroxyquinolene citrate, N-dimethylamino succinamic acid, and sucrose on respiration and water flow in 'Red Sim' carnation in relation to flower senescence. *J. Amer. Soc. Hort. Sci.* 94: 289-291.

[12] Lee J S and O. S. Kim 1994. Effects of plant growth regulators on the change of optical colours in cut flowers of *Rosa hybrida* L. cv. Red Sandra. *J. Korean Soc. Hort. Sci*. 35: 657-664.

[13] Lemper, J. 1981. Post harvest handling of cut flowers. *Land Witskammer Hanuover, German Federal Republic*.

[14] Lukaszewska A, 1980. Effect of exogeno us chemical substances on the vase life and ornamental value of cut greenhouse carnations. *Acta Agrobotanica* 23: 217-228.
[15] Mayak. S ,and A. H. Halevy.1974 .The action of kinetin in improving the water balance and delaying senescence processes of cut rose flowers. *Physiology Plantarum* 32: 330-333.
[16] Mor Y., F. Johnson and J D. Faragher .1983. Preserving the quality of cold-stored rose flowers with ethylene antagonists. *Hort Sci*., 24(4): 640-641.
[17] Mukhopadhyay. T. P. 1982. Effect of chemicals on the floral development and vase life of tuberose (*Polianthus tuberose* L.) var. Single. *South Indian Hort*. 30:281-284.
[18] Pobudkiewicz, A., and J. Nowak. 1992. Effect of flurprimidol and silver thiosulfate (sts) on the growth and flowering of 'prima lilies grown as a pot plants. In; vi international symposium on flower bulbs. 325: 193-198.
[19] Rekha M K, V. Shankaraiah, K. C. Reddy, D. Srihari and P S. Sarma. 2001. Effect of preservative solutions with sucrose on vase life of cut gladiolus spikes at room temperature. *J. Res. ANGRAU* 29(2):44-49.
[20] Rule, D. C., R. N. Arnold, E. J. Hentges, and D. C. Beitz. 1986. Evaluation of urea dilution as a technique for estimating body composition of beef steers in vivo: validation of published equations and comparison with chemical composition. *Journal of Animal Science*, 63(6), 1935-1948.
[21] Sooch M., K. Singh, R. Kumar, P. Singh, R. L. Misra and M. Sanyat. 2002. Effect of chemicals on vase life of gerbera. *Floriculture Research Trend in India*: 321-322.
[22] Van Meeteren, U. 1978. Water relations and keeping quality of cut gerbera flowers. II. Water balance of ageing flowers. *Scientia Hort* 9: 189-197.
[23] Yildirim, T B., A. Hatipoglu, B. Zager and B. Gulgun .1995. Research on the effects of the preservative chemicals used for extending the vase life of some cut flowers. *Ege Universitesi Ziraat Fakultesi Dergisi* 32(9): 175-182.
[24] Zhang Z H., W. M. Guo, Z. H. Zhang and W.M. Guo. 1998. Regulation of 6-BA on membrane permeability of cut chrysanthemum in vase periods. *Adva Hort.* 2(15): 697-701.
[25] Zhou W. Z., B. Li, Y. Wang, C. L. Zhang, M. Xu, W. Z. Zhou, B. Li, Y. Wang, C. L. Zhang and M. Xu. 1995. Experiments on a preservative for flower of vase gladiolus (*Gladiolus hybridus* Hort.). *J. Jiangsu Agr. College*, 16(4): 27-30.