Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.4001

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (3):** 522-529 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Effect of Vase Solutions and Gamma Radiation on Vase Life of Chrysanthemum (C*hrysanthemum morifolium* R.) cv. Vasantika

Anurag Bajpay* and Deepa H. Dwivedi

Department of Applied Plant Science (Horticulture) Babasaheb Bhimrao Ambedkar University, Lucknow-226025, UP India

*Corresponding Author E-mail: anuragbajpai850@gmail.com

Received: 7.06.2017 | Revised: 18.06.2017 | Accepted: 19.06.2017

ABSTRACT

The chrysanthemum flowers cv. 'Vasantika' obtained from plants treated with varying doses of gamma radiation (control), 1Kr gamma radiation and 1.5 Kr gamma radiation placed in seven different holding solutions viz., distilled water, two levels of citric acid (200 ppm and 300 ppm), hydroxyquinoline sulphate (200 ppm), silver nitrate, (200 ppm) and two concentrations of tea extract (10% and 20%). These different holding solutions extend the vase life of the plants. The various doses of irradiation as well as holding solutions both have an independent highly significant effect on enhancing the vase life of chrysanthemum cut flower. The interactive effect of two factors on enhancing the vase life of flower has also been observed to be significant. The results which we obtained shows that the maximum vase life of flower (22.66 days), maximum vase life of foliage (12.66 days), maximum diameter of flower (5.08 cm), maximum fresh weight (9.57 g) and dry weight (2.33 g) of flowers and total solution uptake (25 ml) was observed to be the highest for the plants treated with 1Kr gamma radiation followed by 1.5 Kr and their flowers placed in T_3 (HQS 200 ppm) holding solutions. The lowest number of bacterial colony counts in holding solutions ($143x10^4$cfu ml^{-1}) was measured in T_3 with 0Kr and maximum ($143x10^4$cfu ml^{-1}) was counted in T_0 with 0 Kr.

Key words: *Gamma radiation, Vase solutions, Chrysanthemum, Vasantika, and Vase life.*

INTRODUCTION

Chrysanthemum is a beautiful and attractive flowering plant widely grown all over the world with excellent vase life. It is a short day herbaceous plant. The plant is annual as well as perennial in habit with good flowering observed in the early winter. It belongs to the family-Asteraceae and is native of northern hemisphere, mainly Europe and Asia[10]. Chrysanthemum (*Chrysanthemum morifolium* R.) is one of the most important commercial cut flower in the world[13]. Among the flower crops in the international market, cut chrysanthemum ranks next to rose and its various cultivars which are suitable for growing throughout the year have been evolved. Now a day's one of the most critical issues in the floriculture industry is to maintain the quality and longevity of cut flowers.

Cite this article: Bajpay, A. and Dwivedi, D.H., Effect of Vase Solutions and Gamma Radiation on Vase Life of Chrysanthemum (*Chrysanthemum morifolium* R.) cv. Vasantika, *Int. J. Pure App. Biosci.* **5(3):** 522-529 (2017). doi: http://dx.doi.org/10.18782/2320-7051.4001

Holding solutions (HQS, Citric Acid, Silver Nitrate, Tea extract etc.) are reported to improve the vase life of ornamentals and have significant effect on longevity of cut chrysanthemum. Gamma irradiation is a useful tool for genetic improvement of plant varieties and ornamentals where flower/foliage, color/shape and some important traits have been changed without disturbing the whole genotype[3] and may show significant effects on improving vase life of cut chrysanthemum. Stem end blockage reduces the vase life of the cut chrysanthemum[5,17] and thus, various biocidal agents like (a) Hydroxyquinoline (HQ) compounds, such as 8-hydroxyquinoline citrate (HQC) [14] and 8-hydroxyquinoline sulphate (HQS) [11]; (b) silver compounds, such as silver nitrate (AgNO3) [6] etc. have been added in holding solutions to enhance vase life of cut flowers. The present study has been conducted on chrysanthemum, cv.'Vasantika', as a cut flower variety having yellow color, to study the effect of holding solutions on the vase life of cut flowers obtained from plants pretreated with gamma irradiation at different doses.

MATERIALS AND METHODS

In our present study we use Chrysanthemum (cv.'Vasantika') plants which are treated with 1 to 4.5 Kr doses of gamma radiation.. The experiment was conducted in Completely Randomized Design with two factors, holding solutions and irradiation dose, and treatments were placed in three replicates. Traits viz., vase life of flowers and foliage, fresh and highest diameter of flowers, fresh and dry weight of flowers, number of bacterial colony and total solution uptake were measured using standard techniques. The plants were grown at Horticulture Research Farm, Department of Applied Plant Science, Babasaheb Bhimrao Ambedkar University, Lucknow, and cut chrysanthemum flowers from these treated plants were harvested at flowering stage from Horticulture Research Farm and transferred to the Ph.D. laboratory of the department in the year 2016. Healthy, half bloomed flowers of chrysanthemum having 30 cm stem length were kept in 150 ml conical flask containing seven different holding solutions (100 ml each) viz., T_0 (distilled water), T_1 (citric acid 200 ppm), T_2 (citric acid 300 ppm), T_3 (hydroxyquinoline sulphate 200 ppm), T_4 (silver nitrate 200 ppm), T_5 (tea extract 10%) and T_6 (tea extract 20%). Photoperiod of 8-10 hours day length was maintained in the laboratory and the samples were maintained at 20 ±5 °C temperature and 60 to 70% RH. Top of the conical flask was wrapped with aluminium foil to prevent evaporation loss. Electrical balance was used for weighing fresh and dry weight of flowers, the diameters of flowers were measured with digital Verniercalliper's (Mitutoyo, Japan), and solution uptake was measured at 2 day intervals using a measuring cylinder. Flower quality was observed on visual basis. At 25th day sampling from each vase-solution was carried out for bacterial study. After 4 serial dilutions, samples of vase-solutions were spread onto nutrient agar and incubated. The number of micro-organisms was counted by the standard plate counting method to determine the number of Colony Forming Units ml^{-1} (CFU ml^{-1}) [12,18]. Data were analyzed using statistical software and comparison of means was performed at 5% level of probability.

Table: 1 Effect of holding solutions and gamma radiation on fresh, dry weight and flowers diameter of Chrysanthemum cv. 'Vasantika'

Treatments	Fresh weight of flowers (g)				Dry weight of flowers (g)				Diameter of fresh flowers (cm)			
	VgM0 (0Kr)	VgM1 (1K)	VgM2 (1.5K)	Mean	VgM0 (0Kr)	VgM1 (1Kr)	VgM2 (1.5Kr)	Mean	VgM0 (0Kr)	VgM1 (1Kr)	VgM2 (1.5Kr)	Mean
T0 (DW)	6.353	7.227	7.147	6.909	1.463	1.720	1.113	1.432	4.187	4.330	3.870	4.129
T1 (CA 200 ppm)	8.237	8.730	4.627	7.198	1.693	2.000	1.367	1.687	3.963	4.350	4.127	4.147
T2 (CA 300 ppm)	7.537	6.293	5.563	6.464	1.750	1.983	1.900	1.878	4.227	4.247	3.540	4.004
T3 (HQS 200 ppm)	8.403	9.570	7.743	8.572	1.667	2.337	2.033	2.012	4.317	4.527	4.407	4.417
T4 (SN 200 ppm)	7.970	7.953	7.743	6.687	1.683	1.937	1.717	1.779	3.453	3.907	4.027	3.796
T5 (TE10%)	5.070	6.517	3.523	5.037	1.467	1.543	1.487	1.499	3.453	3.990	3.657	3.700
T6 (TE 20%)	7.750	5.730	8.263	7.248	1.993	1.677	1.950	1.873	3.850	3.747	4.157	3.918
Mean	7.331	7.431	5.858		1.674	1.885	1.652		3.921	4.157	3.969	
Factors	C.D.	SE(d)	SE(m)		C.D.	SE(d)	SE(m)		C.D.	SE(d)	SE(m)	
Factor(A)	0.377	0.186	0.132		0.380	0.188	0.133		0.250	0.123	0.087	
Factor(B)	0.247	0.122	0.086		N/A	0.123	0.087		0.164	0.081	0.057	
Factor(A X B)	0.653	0.323	0.228		N/A	0.325	0.230		0.433	0.214	0.151	

Table: 2 Effect of holding solutions and gamma radiation on vase life of flowers, foliage and growth of bacteria

Treatments	Vase life of flower (days)				Vase life of leaves (days)				Number of bacterial colony 10^{-4}cfu ml^{-1}			
	VgM0 (0Kr)	VgM1 (1Kr)	VgM2 (1.5K)	Mean	VgM0 (0Kr)	VgM1 (1Kr)	VgM2 (1.5K)	Mean	VgM0 (0Kr)	VgM1 (1Kr)	VgM2 (1.5Kr)	Mean
T0 (DW)	16.000	17.000	16.333	16.444	6.333	6.667	7.000	6.667	686.667	663.333	683.333	677.778
T1 (CA 200 ppm)	16.667	18.667	17.000	17.444	7.333	7.333	7.667	7.444	370.000	350.000	366.667	362.222
T2 (CA 300 ppm)	21.000	20.333	18.333	19.889	7.667	9.000	8.000	8.222	296.667	323.333	371.667	330.556
T3 (HQS 200 ppm)	21.333	22.667	22.000	22.000	11.667	12.667	12.667	12.333	183.333	143.333	200.000	175.556
T4 (SN 200 ppm)	19.333	20.000	21.333	20.222	10.667	12.000	9.333	10.667	233.333	166.667	266.667	222.222
T5 (TE 10%)	17.000	17.667	15.667	16.778	8.000	7.000	8.000	7.667	538.333	500.000	468.000	502.111
T6 (TE 20%)	12.667	13.333	15.333	13.778	6.333	6.000	6.667	6.333	523.333	523.333	456.667	501.111
Mean	17.714	18.524	18.000		8.286	8.667	8.476		404.524	381.429	401.857	
Factors	C.D.	SE(d)	SE(m)		C.D.	SE(d)	SE(m)		C.D.	SE(d)	SE(m)	
Factor(A)	2.182	1.077	0.762		1.323	0.653	0.462		53.664	26.499	18.737	
Factor(B)	N/A	0.705	0.499		N/A	0.428	0.302		N/A	17.347	12.266	
Factor(A X B)	N/A	1.866	0.499		N/A	1.132	0.800		N/A	45.897	32.454	

Table: 3 Effect of holding solutions and gamma radiation on maximum diameter and total solution consumed of Chrysanthemum cv. 'Vasantika'

Treatments	Maximum diameter of flowers (cm)				Total solution consumed (ml)			
	VgM0 (0Kr)	VgM1 (1Kr)	VgM2 (1.5Kr)	Mean	VgM0 (0Kr)	VgM1 (1Kr)	VgM2 (1.5Kr)	Mean
T0 (DW)	4.353	4.570	4.203	4.376	17.000	21.667	16.333	18.333
T1 (CA 200 ppm)	4.297	4.570	4.427	4.436	21.000	22.000	22.000	21.667
T2 (CA 300 ppm)	4.360	4.480	4.207	4.349	20.333	18.000	22.000	20.111
T3 (HQS 200 ppm)	4.477	5.080	4.720	4.759	23.000	25.000	24.000	24.000
T4 (SN 200 ppm)	3.927	4.573	4.227	4.242	22.000	22.333	15.333	19.889
T5 (TE10%)	3.533	4.223	4.090	3.949	12.667	16.333	11.667	13.556
T6 (TE 20%)	3.850	3.747	4.157	3.918	17.667	12.667	9.333	13.222
Mean	4.114	4.465	4.290		19.095	19.714	17.238	
Factors	C.D.	SE(d)	SE(m)		C.D.	SE(d)	SE(m)	
Factor (A)	0.360	0.178	0.126		13.222	0.859	0.607	
Factor (B)	0.236	0.116	0.082		1.138	0.562	0.397	
Factor (A X B)	N/A	0.308	0.218		3.012	1.487	1.052	

RESULTS AND DISCUSSION

Factor-A

Vase life of chrysanthemum cut flowers and the flower parameters under study were found to be significantly affected by the holding solutions in which they were placed. The longest vase life of flower (22 days), vase life of foliage (12.33 days) (Table 2. fig.2. a and b), diameter of fresh flowers (4.41cm) at harvest, fresh (8.54 g) and dry weight (2.01 g) of flower, (Table 1. fig.2 and 3. c, e and f), maximum diameter (4.75 cm) of flowers (Table 3. Fig.2. d), total solution uptake (24 ml) was recorded in T_3 (HQS 200 ppm) and minimum was recorded in T_5, T_6 and T_0 (Table 3. Fig.3). Minimum number of bacterial colonies (175) were counted for T_3 Followed by T_4 and maximum (677.77) were recorded in T_0 (Table 2. Fig. 2 and 3).

High level of turgidity is necessary for continuation of metabolic activities in the cut flowers[15]. The various enzymes which are involved in the process of polymerization leads to the deposition of lignin and suberin, which results in the vascular occlusion in stem, and it is inhibited at low pH the same happens with the bacterial growth which may cause bacterial plugging of the stems[19]. In the present experiment it appears that HQS and silver nitrate promote flower and foliage longevity by acidifying the holding solutions[8] and besides the germistatic and germicidal[16]

properties of these compounds, which has helped to maintain vascular function and in turn metabolic activities in the cut stems. Thus, HQS and $AgNO_3$ in addition to ethylene inhibition may have helped in higher water uptake by flowers stem, due to the low bacterial population and decreased enzyme activity, resulting in gain in flower diameter and fresh weight of flower and a significantly higher vase life.

It may be pertinent to mention that in the present study tea extract (T_6 and T_5) has not performed effective for enhancing the vase life of cut chrysanthemum, contrary to studies in chrysanthemum flowers. This finding is contradicting with finding of Hashemabadi and who reported the 10% tea extract (17.56 days) increased the vase life of chrysanthemum flowers, possibly because of destruction of the tea alkaloids, reported as having germicidal effect, due to over boiling.

Factor-B

Exposure of chrysanthemum cuttings to different doses of irradiation (1 to 4.5Krad) at the time of planting was found to have affected the vase life and the performance of cut flowers obtained from these plants significantly (Table.2 and fig.1) (Banerji, 2014) has reported gamma irradiation as a useful tool for genetic improvement of plant varieties and ornamentals where important traits have been changed without disturbing the whole genotype and may show significant effects on improving vase life of cut chrysanthemum. The maximum vase life (18.52 days) of flower, foliage (8.66 days), (Table 2. fig.2 a and b), fresh weight (7.43 g) and dry weight (1.88 g), fresh diameter of flower head (4.15 cm), (Table 1. and fig. 2 and 3. e, f, c), maximum diameter of flowers (4.22 cm), total solution consumed (17 ml), (Table 3. and fig. 3. g and h), was recorded for flowers exposed from 1Kr gamma radiation dose followed by 1.5Kr gamma radiation dose and minimum recorded in cntrol. Minimum number of bacterial colony (456 $x10^4$cfu ml^{-1}) was measured in 1.5 Kr radiations and maximum (523 $x10^4$cfu ml^{-1}) counted in control. (Lower doses of gamma radiation in the present study increased flower diameter, size of ray florets and flower weight which corroborate with the findings of Banerji and Datta[1] and Banerji and Datta[2] that gamma radiation increased flower head shape in chrysanthemum cv.'Lalima' and 'Jaya,. Highest number of bacterial colony was counted for control followed by 1.5 Kr gamma radiation whereas minimum number of bacterial colony counted in 1 Kr gamma radiation (Table 2. fig. 3. h).

Factor-A x B

In present study it was observed that the significant independent effect of the two factors viz., holding solution and gamma irradiation, significant interaction between irradiation and holding solutions on enhancing the vase life of chrysanthemum has also been observed in our study.Vase life of flower (22.66 days) and foliage (12.66 days), (Table 2. and fig.2. a and b), fresh (9.57 g) and dry weight (2.33g) of flowers, diameter of flowers (5.08 cm), ((Table 1. fig. 2 and 3, e, f, c and d) and total solution taken up (25 ml) was recorded to be maximum under T_3 with 1 Kr gamma radiation followed by T_4 with 1.5 Kr radiation (Table 3. fig. 3. g), and minimum in T_6 0Kr followed by T_0 with 0Kr. Maximum number of bacterial colony in holding solution was counted in T_0 0 Kr and minimum number of bacterial colony was counted inT_3 1Kr gamma radiation (Table 2. fig. 3.h).

Fig. (A), (B) and (C)

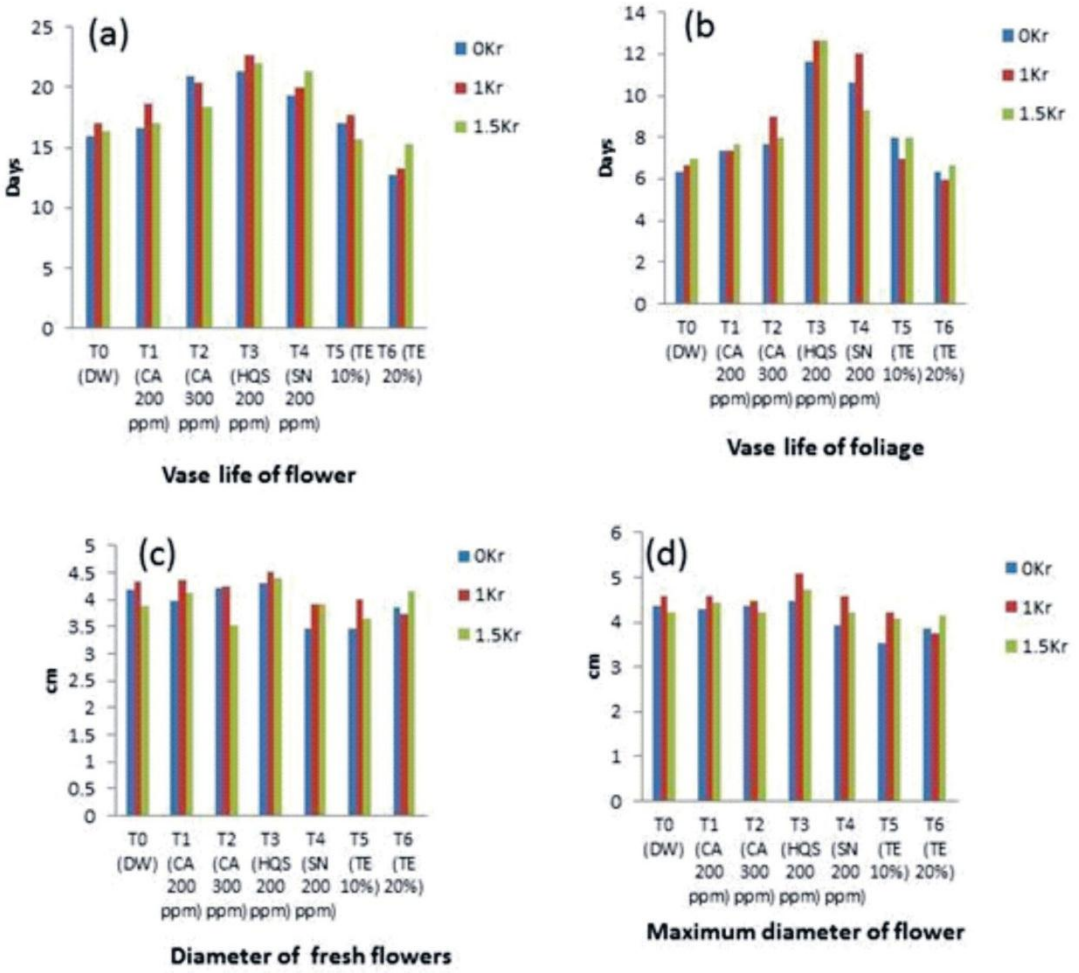

Fig.2. (a), (b), (c) and (d)

Fig. 1: Vase life study of chrysanthemum cv. 'Vasantika' after irradiation with three doses of gamma radiation (A): 0 Kr gamma radiation, (B): 1 Kr gamma radiation and(C): 1.5 Kr gamma radiation) placed in seven different holding solutions

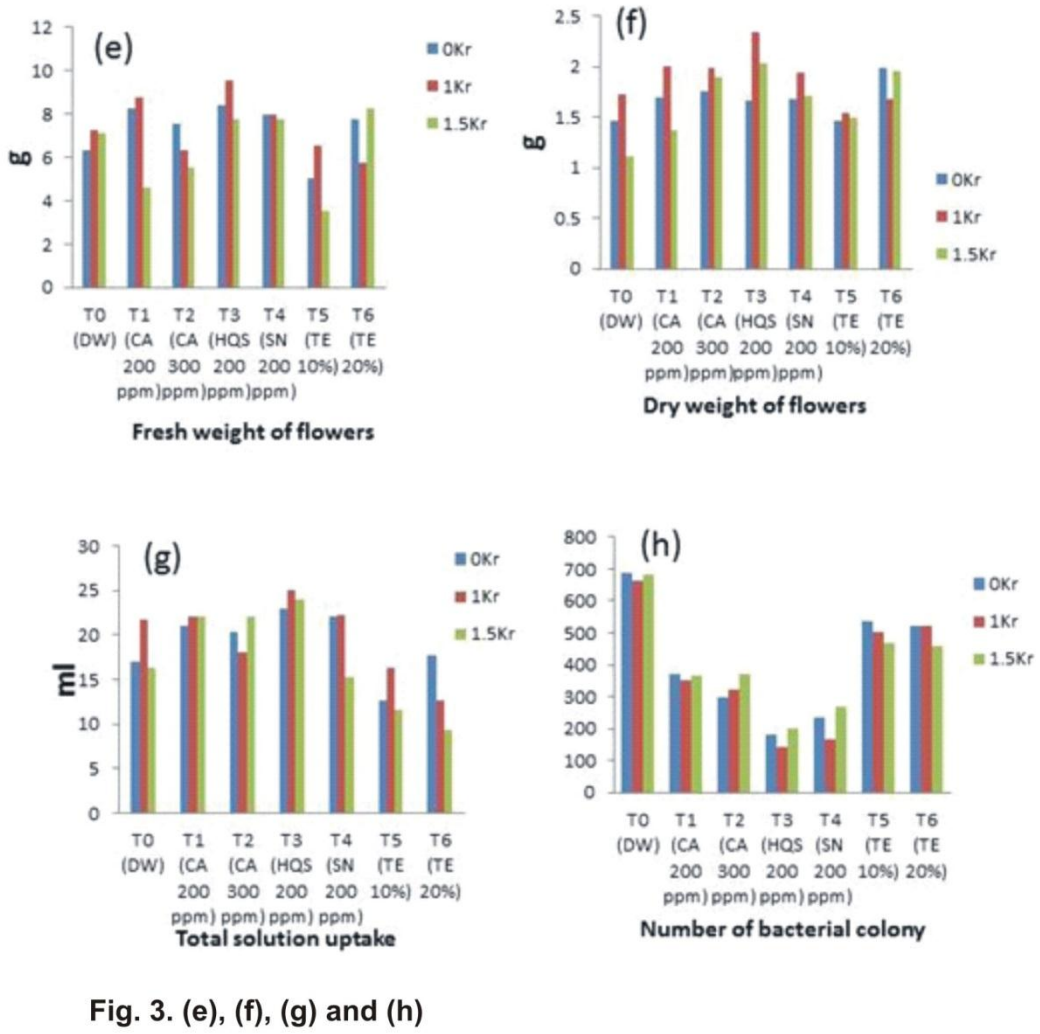

Fig. 3. (e), (f), (g) and (h)

Fig. 2 and 3: Effect of vase solutions and gamma radiation on (a) Vase life of flowers, (b) Vase life of foliage, (c) Fresh diameter of flowers, (d) Maximum diameter of flowers, (e) Fresh weight of flowers, (f) Dry weight of flowers, (g) Total solution uptake, (h) Number of bacterial colony

CONCLUSION

The results obtained from present experiment were significant. The result shows that the maximum vase life of flower and foliage, maximum diameter, fresh weight, total solution consumed and minimum number of bacterial colony in holding solution of chrysanthemum cut flower are observed to be the highest for the plants treated with 1Kr gamma radiation(VgM_1) .This implies that the minimum dose of gamma radiation increases and enhances the vase life and associated parameters and their flowers placed in T_3 (HQS 200 ppm) holding solutions followed by T_4 ($AgNO_3$ 200 ppm) and (Citric Acid 200 ppm.) HQS and $AgNO_3$ are easily available and economically affordable and thus, can be used on a commercial level by florists, farmers and also for further experiments. Thus by using optimum dose of gamma radiations and appropriate holding solutions concentrations the vase life of cut flowers can be enhanced.

REFERENCES

1. Banerji, B.K. and Datta, S. K., Induction and analysis of gamma ray induced flower head shape mutation in ‘Lalima’ chrysanthemum (*Chrysanthemum*

morifolium). *Indian Journal of Agriculture Science*, **72 (1):** 6-10 (2002).

2. Banerji, B. K. and Datta, S. K., Gamma rays induced flower shape mutation in chrysanthemum cv. 'Jaya'. *J. Nuclear Agric. Biol.* **21:** 73-79 (1992).
3. Banerji B.K., Mutation breeding and mutants of ornamental plants: the role of NBRI for economic gains, *Mutagenesis exploring genetic diversity of crop* (eds.) N.B. Tomlecova, M.I. Kozgar and M.R. Wani, **15:** 307-328, (2014).
4. Davood Hashemabadi1 and HamidehBagheri, Comparison Tea Extract, 8-Hydroxy Quinoline Sulfate and Rifampicin on the Vase Life of Cut Chrysanthemum (*Denderanthemagrandiflorum*L. cv. Purple) *Journal of Ornamental Plants* **4 (1):** 43-39, (2014).
5. Edrisi B, (2010). *Postharvest Physiology of Cut Flowers. PayamDigar Press*., In Persian, 150 P.
6. Fujino, D. W., Reid, M. S. and Kohl, H. C., The water relations of maidenhair fronds treated with silver nitrate. *Sci. Hort*. **19:** 349–355 (1983).
7. Gunjan Sharma and Ranjan Srivastava, Postharvest Life of Cut Chrysanthemum Cultivars in Relation to Chemicals, Wrapping Material and Storage Conditions, *Tropical Agricultural Research* **26 (1):** 195 – 201 (2014).
8. Halevy, A. H. and Mayak, S., Senescence and postharvest physiology of cut flowers—Part 2. *Hort. Rev.* **3:** 59–141 (1981).
9. Hoogerwerf, A. and Van Doorn, W.G., Number of bacteria in aqueous solutions used for postharvest handling of cut flowers, *Postharvest Biology and Technology*, **1:** 295-304 (1992).
10. Honfi, P., Rooting in cuttings of chrysanthemum varieties. *Biologia,* **59:** 99-01. (2004)
11. Hussein, H. A. A., Varietal responses of cut flowers to different antimicrobial agents of bacterial contamination and keeping quality. *Acta Hort*. **368:** 106–116. (1994).
12. Jowkar MM., Water relations and microbial proliferation in vase-solutions of Narcissus tazettaL. cv. 'Shahla-e-Shiraz' as affected by biocide compounds. *J Hortic Sci Biotech* **81:** 656–660, (2006).
13. Khaligi A, Floriculture. *Rouzbehan Press*., *In Persian*, 392 P. (2010).
14. Knee, M., Selection of biocides for use in floral preservatives. *Postharvest Biol. Technol.* **18:** 227–234. (2000).
15. Kim, Y. and Lee, J. S, Changes in bent neck, water balance and vase life of cut rose cultivars as affected by preservative solution. *Journal of Korean Society of Horticultural Science*. **43(2):** 201-207. (2002).
16. Nowak, J. And R.M. Rudnicki, Postharvest of rose cut flowers. *Intl. J. Hortic. Sci.*, **8(3-4):** 29-32. (1990).
17. Van Doorn, W. G., Water relations of cut flowers. *Hort. Rev*. **18:** 1–85 (1997).
18. Van Doorn, W. G. and Vaslier, N., Wounding-induced xylem occlusion in stems of cut chrysanthemum flowers: Roles of peroxidase and cathechol oxidase. *Postharvest Biol. Technol*. **26:** 275–284 (2000).
19. Vander Molen, G. E., J.H. Labavitch, J.J. Strand, and J.E. DeVay, Pathogen-induced vascular gels: Ethylene as a host intermediate. *Physiol. Plant*. **59:** 573-580 (1983).
20. Wouter G. van Doom and René R.J. Perik, Hydroxyquinoline Citrate and Low pH Prevent Vascular Blockage in Stems of Cut Rose Flowers by Reducing the Number of Bacteria, *J. Amer. Soc. Hort. Sci*. **115(6):** 979-981 (1990).