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Effects of Holding Solutions and Gamma Radiation on Flower Longevity of Chrysanthemum (*Dendranthema grandiflora*) cv. Little Pink

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ABSTRACT

The present study was carried out for the evaluation of different holding solutions and gamma radiation in extending the vase life of chrysanthemum flowers cv. Little Pink. The flowers was obtained by treating the plants (rooted cuttings) with various doses of gamma radiation and were placed in seven different holding solutions. It was observed that both, doses of irradiation as well as holding solutions, have a significant effect independently on enhancing the vase life of chrysanthemum cut flower. Effect of the interaction of two factors on enhancing the vase life of flower has also been observed to be significant. The results have revealed that the maximum vase life of flower and foliage, maximum diameter of flower, total solution uptake was observed to be the highest for the plants treated with 1Kr gamma radiation and HQS 200 ppm holding solutions. The lowest number of bacterial colony counts in holding solutions was measured with HQS 200ppm.

Key words: *Chrysanthemum, Gamma radiation, Holding solutions, Hydroxyquinoline sulphate,*

INTRODUCTION

Chrysanthemum (*Dendrenthema grandiflora*) is a herbaceous, flowering plant widely grown all over the world and florist beautiful flowers having excellent vase life. It is a perennial flowering herb which is a member of family Asteraceae and inhabitant of northern hemisphere, particularly of Europe and Asia[2]. Among the various commercial cut flower in the world chrysanthemum has one of the most important place[3]. A cut chrysanthemum occupies the place next to rose among the flower crops in the international market and many cultivars are evolved which are suitable for growing throughout the year. The longevity of cut chrysanthemum and the improvement in the vase life of flowers are positively effected by various vase solutions (HQS, Citric Acid, Silver Nitrate, Tea extract etc.). For the purpose of genetic improvement of plant varieties and ornamentals by changing flower/foliage, color/shape and other important traits without altering the whole Genotype, gamma irradiation is a boon[9]. Stem end blockage causes the reduction in the vase life of the cut chrysanthemum[4,5] counteract this effect different biocidal agents:

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(a) Hydroxyquinoline (HQ) compounds, such as 8-hydroxyquinoline citrate (HQC)[6] and 8-hydroxyquinoline sulphate (HQS)[7] (b) silver compounds, such as silver nitrate (AgNO3)[8] etc. have been put in holding solutions to enhance vase life of cut flowers. The chrysanthemum, cv.'Little Pink', a cut flower variety having purple flowers[9] was the experimental material under our study and the purpose of the same is to observe the effect of holding solutions on the vase life of cut flowers exposed from plants which were pretreated with gamma radiation at different doses.

MATERIAL AND METHODS

In our present study we used cut flowers harvested from irradiated plants (rooted cuttings which were treated with 1 to 1.5 Kr doses of gamma radiation) chrysanthemum cv. Little Pink. The experiment was laid out in Completely Randomized Design with two factors, holding solutions and irradiation doses, and treatments were placed in three replicates. Various characters such as vase life of flowers and foliage, diameter of flowers, fresh and dry weight of flowers and total solution uptake were observed by applying standard protocols and analysis methods. The Horticulture Research Farm, Department of Applied Plant Science, BBA University, Lucknow was the research field where the plants were grown and cut chrysanthemum flowers from these treated plants were harvested at flowering stage from the farm and transferred to the departmental laboratory in the month of January 2016. 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%) were half bloomed, 30 cm long flower stems placed in the flask. The optimum physiological conditions were maintained in the laboratory i.e., photoperiod of 10 hours day length and 20 ±5 °C temperature and 60 to 70% RH was given to samples. To reduce the evaporation loss top of the conical flask was wrapped with aluminium foil. For weighing fresh and dry weight of flowers electrical balance was used, the diameters of flowers were measured with digital verniercallipers and solution uptake was measured by using a measuring cylinder. The quality of flower was analyzed on visual basis. For the count of bacterial colony and study sampling from each vase-solution was taken at 25th day. After 5 serial dilutions, samples of vase-solutions were spread onto nutrient agar and incubated. To determine the number of Colony Forming Units ml^{-1} (CFU ml^{-1}) the number of micro-organisms was counted by the standard plate counting method[18]. By using statistical software data were analyzed and comparison of means was performed at 5% level of probability[10].

Fig. 1: Vase life study of chrysanthemum cv. 'Little Pink' 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

RESULTS AND DISCUSSION

Various treatments of holding solutions significantly effect the vase life and floral parameters of chrysanthemum cut flowers. It was observed that longest vase life of flower, vase life of foliage (Table 2), diameter of fresh flowers at harvest, dry weight of flower, (Table 1), maximum diameter of cut flowers (Table 3) and maximum total solution uptake was recorded in T_3 (HQS 200 ppm). The highest number of bacterial colonies were recorded in T6 and the least count were analyzed in T3 (Table 2).

The treatments of different doses of irradiation (0, 1 and 1.5Krad) on the rooted cuttings of chrysanthemum cultivar significantly affected the vase life and the performance of cut flowers obtained from these plants[9] (Table 2). 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 showed significant effects on improving vase life of cut chrysanthemum[1.]In the obtained results the diameter of flower, size of ray florets and flower weight increased with the lower doses of gamma radiation, similar findings were were reported in chrysanthemum that gamma radiation increased flower head shape in cv.'Lalima' and 'Jaya'[19,20]. The number of bacterial colony count was highest for control followed by 1.5 Kr whereas minimum number of bacterial colony counted in 1Kr (Table 2).

It was observed and analyzed from the results that the two factors viz., holding solution and gamma irradiation independently shows their effect which was significant. Besides the significant independent effect of the two it was also observed that interaction between irradiation and holding solutions also increases the vase life of chrysanthemum in the present study significantly.Vase life of flower and foliage, weight of flowers, diameter of flowers (Table 1) and total solution taken up was recorded to be maximum under T_3 with 1Kr followed by T_4 with 1.5Kr (Table 3), This finding similarly collaborated with finding of Khalid, 2011. Minimum vase life of flower was recorded in T_6 with 1Kr and foliage was recorded in T_6 and 1.5Kr (Table 2), minimum weight of flowers was recorded in T_6 with 0Kr and minimum diameter was recorded in T_6 with 1Kr. Maximum number of bacterial colony in holding solution was counted in T_6 with 0 Kr followed by T_1 with 0 Kr and minimum number of bacterial colony was counted in T_3 with 0Kr followed by T_3 with 1Kr, (Table 3).

It may be relevant to mention that in the present study tea extract (T_6) does not show the positive and significant effect on the vase life of cut chrysanthemum. This finding is contradicting with finding of[22] 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.

For the continuous occurrence of various metabolical processes it is quite necessary to maintain the high level of turgidity in the cut flowers[11] which can be maintained by uptake of holding solutions through optimum vascular function. The process of polymerization involves various biochemical catalysts i.e., enzymes which results in the deposition of lignin and suberin, which ultimately causes the vascular occlusion in stem, and it is inhibited at low pH[11] .The same happens with the bacterial growth[2] which may cause bacterial plugging of the stems[13]. In the present work we analyzed that HQS and silver nitrate by acidifying the holding solutions enhances the flower and foliage longevity[15,16]. These compounds also contain various germistatic and germicidal[17] properties which are important in maintaining the vascular function and in turn metabolic activities in the cut stems. These two HQS and $AgNO_3$ also inhibit the ethylene activity. These compounds increase the water uptake quantity of the flowers stem. Because of the reduction in bacterial population size and decreased enzyme activity there occurs gain in diameter and fresh weight of flower and a significantly higher vase life.

Table 1: Effect of holding solutions and gamma radiation on average fresh and dry weight of flowers (g), diameter of fresh flowers (cm), in vase life study of Little Pink

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)	8.190	8.457	8.617	8.421	1.550	1.357	1.397	1.434	4.423	4.603	4.340	4.456
T1 (CA 200 ppm)	8.023	8.250	8.067	8.113	1.633	2.273	1.387	1.764	4.363	4.687	3.967	4.339
T2 (CA 200 ppm)	8.890	9.583	8.470	8.981	1.737	2.000	1.673	1.803	3.807	4.817	4.353	4.326
T3 (HQS 200 ppm)	8.953	8.507	8.663	8.708	1.887	2.670	2.167	2.241	4.437	4.863	4.223	4.508
T4 (SN 200 ppm)	8.620	8.473	8.217	8.437	1.850	1.833	2.023	1.902	4.383	4.717	4.387	4.496
T5 (TE10%)	7.403	8.253	8.340	7.999	1.663	2.297	2.037	1.999	4.477	4.587	4.457	4.507
T6 (TE 20%)	7.277	8.363	8.057	7.899	2.040	2.040	1.907	1.996	4.457	4.550	4.483	4.497
Mean	8.194	8.555	8.347		1.766	2.067	1.799		4.335	4.689	4.316	
Factors	C.D.	SE(d)	SE(m)		C.D.	SE(d)	SE(m)		C.D.	SE(d)	SE(m)	
Factor(A)	0.240	0.119	0.084		0.271	0.134	0.095		N/A	0.095	0.068	
Factor(B)	0.157	0.078	0.055		0.177	0.088	0.062		0.127	0.062	0.044	
Factor(A X B)	0.416	0.206	0.145		0.469	0.232	0.164		0.335	0.165	0.117	

Table 2: Effect of holding solutions and gamma radiation on vase life of flowers and leaves (days), number of bacterial colony per ml-^{3} in vase life study of Little Pink

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 (1.5Kr)	Mean	VgM0 (0Kr)	VgM1 (1Kr)	VgM2 (1.5Kr)	Mean
T0 (DW)	18.667	20.070	19.983	19.57	8.403	9.470	9.320	9.064	723.33	663.33	750	712.22
T1 (CA 200 ppm)	20.297	21.367	21.460	21.04	9.387	9.843	9.403	9.544	370	350	400	373.33
T2 (CA 200 ppm)	21.543	22.673	23.240	22.48	9.683	9.993	9.810	9.829	383.33	356.66	371.66	370.55
T3 (HQS 200 ppm)	23.107	24.947	23.933	23.99	10.000	12.040	10.333	10.79	183.33	184.33	200	188.88
T4 (SN 200 ppm)	22.333	23.333	23.103	22.92	9.370	10.333	10.283	9.996	283.33	166.66	266.66	238.88
T5 (TE 10%)	13.000	12.667	13.073	12.91	7.967	7.853	8.000	7.996	636.33	616.66	668	641.00
T6 (TE 20%)	12.073	12.023	12.443	12.81	7.620	7.357	7.250	7.409	726.66	723.333	723.333	724.44
Mean	18.717	19.583	19.605		8.919	9.556	9.200		427.61	437.14	482.81	
Factors	C.D.	SE(d)	SE(m)		C.D.	SE(d)	SE(m)		C.D.	SE(d)	SE(m)	
Factor(A)	0.525	0.259	0.183		0.453	0.224	0.158		44.59	22.02	15.57	
Factor(B)	0.344	0.170	0.120		0.297	0.146	0.104		29.19	14.41	10.19	
Factor(A X B)	0.909	0.449	0.317		0.785	0.388	0.274		N/A	38.14	26.96	

Table: 3 Effect of holding solutions and gamma radiation on maximum diameter of flowers (cm), maximum diameter observed at day and total solution consumed (ml) of Little Pink

Treatments	Maximum diameter of flowers (cm)				Maximum diameter observed at day				Total solution consumed (ml)			
	VgM0 (0Kr)	VgM1 (1Kr)	VgM2 (1.5Kr)	Mean	VgM0 (0Kr)	VgM1 (1Kr)	VgM2 (1.5Kr)	Mean	VgM0 (0Kr)	VgM1 (1Kr)	VgM2 (1.5Kr)	Mean
T0 (DW)	4.457	5.456	5.084	4.999	7.66	8.33	8	8.000	30.700	32.110	31.667	31.492
T1 (CA 200 ppm)	4.610	5.622	5.214	5.149	7.66	9.33	8.33	8.444	32.183	32.740	32.373	32.432
T2 (CA 200 ppm)	4.639	5.622	5.404	5.222	8.33	8.56	8.50	8.333	36.667	35.000	34.870	35.512
T3 (HQS 200 ppm)	4.872	5.850	5.651	5.458	8.333	9.36	8.66	8.778	41.073	42.333	38.777	40.728
T4 (SN 200 ppm)	4.630	5.581	5.498	5.236	6.333	7.66	8.33	7.444	40.000	41.553	41.373	40.976
T5 (TE10%)	4.520	5.151	5.327	4.999	5	6.66	5.5	5.444	14.110	14.000	13.887	13.999
T6 (TE 20%)	4.298	5.023	5.184	4.835	5.667	6.33	5.73	5.444	13.000	13.000	14.333	13.444
Mean	4.575	5.472	5.338		7.000	7.714	7.524		29.676	30.105	29.611	
Factors	C.D.	SE(d)	SE(m)		C.D.	SE(d)	SE(m)		C.D.	SE(d)	SE(m)	
Factor(A)	0.235	0.116	0.082		0.564	0.279	0.197		1.440	0.711	0.503	
Factor(B)	0.154	0.076	0.054		0.369	0.182	0.129		N/A	0.465	0.329	
Factor (A XB)	N/A	0.201	0.142		N/A	0.482	0.341		N/A	1.232	0.871	

CONCLUSION

The present experiment reveals the results which were significant. The result obtained shows that the plants treated with 1Kr gamma radiation have 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 and their flowers placed in T_3 (HQS 200 ppm) holding solutions followed by T_4 ($AgNO_3$ 200 ppm). Thus it may be concluded that the lower dose of gamma radiation is useful in increasing vase life as well as various floral parameters. 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. So, for enhancing the vase life of cut flowers a certain minimum dose of gamma radiations and suitable as well as proper amount of holding solutions are beneficial.

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