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Effect of different chemicals on vase life of gladiolus varieties (*Gladiolus hybridus* Hort.)

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Abstract
An experiment was carried out to study the "Effect of Different Chemicals on Vase Life of Gladiolus Varieties (*Gladiolus hybridus* Hort.)" during December,2016 to February, 2017 at the laboratory of Department of Floriculture and Landscaping, College of Horticulture & Forestry, Jhalarapatan City, Jhalawar (AU, Kota). The experiment consisted of 56 treatment combinations in which seven varieties (African Star, Snow Princess, Hunting Song, Legend, Darshan, Pusa Srijana, Pusa Kiran), two chemicals (SNP, $AgNO_3$) and their three levels, Sucrose 5% and distilled water was laid out in Completely Randomized Design (CRD) with three replications. Treatment with $AgNO_3$ 300 ppm in combination with 5% sucrose was observed to be best in terms of vase life and quality parameters of flowers *i.e.* solution uptake, number of basal florets open at a time, numbers of florets open at senescence of basal florets, in all the varieties except, 'Darshan', where SNP 100 ppm in combination with 5% sucrose can also be used as it showed better performance for most of the parameters. Among the varieties, cv. 'Hunting Song' can be used as it showed best performance for all the parameters than other varieties used for investigation. Based on the B: C ratio, chemical SNP was found better for increasing the vase life of gladiolus as compared to $AgNO_3$.

Keywords: Vase life, gladiolus, $AgNO_3$, SNP.

Introduction
Gladiolus hybridus Hort. belongs to the family Iridaceae. It has the basic chromosome number n = 15. It is native to South Africa. It is commonly known as "Sword lily" and also known as the "Queen of the bulbous plants". It is winter season flower and cultivated as commercial cut flower throughout the world as well as India.
Gladiolus is very much liked for its majestic spikes containing attractive, elegant and delicate florets. These florets open in sequence over a longer duration and hence have a good keeping quality of cut spikes. Normally, gladiolus floret spikes last for only 6-7 days, which is too less a post-harvest life for marketing of gladiolus for distant market.
Nearly 20-40 per cent of the cut flowers are lost due to improper post-harvest handling. These post-harvest losses can be reduced by adopting suitable harvesting, post harvesting techniques namely by temperature management during storage and following strict sanitation procedures in the grading and packing rooms. Further vase life can be doubled by the judicious use of floral preservatives in the vase solutions. If a greater importance can possibly be assigned to any of the needs of the cut flowers, maintenance of turgidity would have the highest priority (Rogers, 1973) [12]. As cut flowers, unlike most agricultural commodities are harvested before they are fully developed, they are expected to continue their growth in consumers home.
To supply fresh cut flowers to the distant markets is a big deal for the growers as most of the cut flowers have short vase life. The addition of chemical preservatives to water is therefore recommended to increase flower vase life. Realizing the role of extended vase life in the trade of cut flowers, the present research work is therefore designed to explore maximum longevity of the flower spikes of the gladiolus by using various vase solutions.

Material and Methods
The present investigation was carried out during December, 2016 to February, 2017 at the laboratory of Department of Floriculture and Landscaping, College of Horticulture & Forestry, Jhalarapatan City, Jhalawar (AU, Kota). The whole experiment was conducted in Completely Randomized Design (CRD).
Briefly, the gladiolus cut flowers procured for vase life study, were harvested when two florets at the bottom showed colour. Flowers, immediately after harvest, were placed in clean water and brought carefully to the laboratory without causing any damage.

Then they were imposed with set of treatments. Further, after re-cutting of 1cm cut at the base of each spike was placed in 500 ml flask containing 500 ml of aqueous solutions of different preservative solutions were used individually or in combination as described separately in each experiment. To decrease experimental variability, distilled water was used to prepare different preservative solutions.

Results and Discussion

The analysis of variances of examined parameters revealed a significant level (CD=5%) of effect of different chemicals on quality parameters of gladiolus varieties. According to experimental results we concluded that each parameter reacts differently toward the different treatments. All treatments were found significantly superior in terms of extending vase life over control (Table 1). The early floret opening was recorded in treatment (sucrose 5%+ $AgNO_3$ 300 ppm) as compared to control. Minimum number of days taken for basal floret opening was recorded in 'Hunting Song' (1.33 days) followed by 'Snow Princess' (1.66 days), 'Darshan' (1.66 days) 'Pusa Kiran' (1.66 days), 'African Star' (2 days), 'Legend' (2 days) and 'Pusa Srijana' (2) days as compared to their respective control. This might be due to the fact that sucrose provides energy for growth and accelerated the opening of flower bud (Farnham *et al.,* 1972) [7].

Maximum number of basal floret open at a time was recorded in 'Hunting Song' (6.67) followed by 'African Star' (6.33), 'Snow Princess' (6.33), 'Legend' (6.33), 'Pusa Kiran' (6.33) and 'Pusa Srijana' (6.33) as compared to control. The maximum number of florets opening at a time was recorded in treatment (sucrose 5%+ $AgNO_3$ 300 ppm) whereas the minimum was recorded in control. In cv. Darshan SNP 100 ppm with 5 per cent sucrose showed better results. The effect of $AgNO_3$ on maximum number of florets open at a time were apparent due to its antimicrobial nature, which helped in preventing vascular blockage and finally increasing water uptake. Likewise, SNP act as vase solution disinfectants and inhibited the pathogen growth, followed by increasing water uptake and TSS (Lazer *et al.,* 2008) [9]. The findings of this investigation confirm the observations of earlier workers, Choudhary *et al.* (2011) [5] in gladiolus, and Lalge *et al.* (2016) [8] in heliconia.

$AgNO_3$ 300 ppm with 5 per cent sucrose observed maximum vase life as compared to control. Whereas, highest vase life was recorded in 'Hunting Song' (19.67 days) followed by 'Legend' (18.67 days), 'Pusa Kiran' (18.34 days), and 'Snow Princess' (17.67 days), African Star' (16.67 days) and minimum was recorded in 'Pusa Srijana' (15.67 days). This improvement in vase life by using $AgNO_3$ may probably due to the anti-ethylene effect of silver applied as $AgNO_3$. The findings of this investigation confirm the observations of earlier workers, Abadi *et al.* (2013) [1] in gerbera and Selvaraj *et al.* (2014) [13] in tuberose.

In 'Darshan' 100 ppm SNP with 5 per cent sucrose showed maximum vase life (17.67) compared to control. Nitric oxide (NO) acts as a natural senescence delaying plant growth regulator primarily by down regulating ethylene production (Sankhla *et al.,* 2016).

Treatment with $AgNO_3$ and SNP had significantly increased floret diameter as compared to control. 'Hunting Song' showed maximum floret diameter (9.59) followed by 'Pusa Kiran' (8.56), 'Snow Princess' (8.46), 'Legend' (8.43), 'African Star' (8.36) 'Darshan' (8.36) and 'Pusa Srijana' (8.36) compared to other treatments and control. Sucrose acted as food material by providing respiratory substrate (Coorts, 1973) [4], which provide energy for all metabolic activities, thus helped in increasing flower diameter and maintaining turgidity for expansion (Acock and Nichols, 1979) [2]. The results are in agreement with Awasthi *et al.* (2013) [3] in gladiolus and Talebi *et al.* (2013) [14] in rose.

Maximum solution absorption was recorded in treatment with sucrose 5%+ $AgNO_3$ 300 ppm. Whereas, 'Hunting Song' showed maximum solution absorption (65ml, 113.34ml and 130ml) followed by 'Pusa Kiran' (55ml, 98.33ml and 120ml), 'Snow Princess' (55ml, 98.33ml and 120ml), 'African Star' (51.67ml, 96.67ml and 113.33ml), 'Legend' (51.67ml, 96.67ml and 120ml), and 'Pusa Srijana' (46.67ml, 86.67 and 101.67ml) on 4th, 8th and final day, respectively. Variation in solution uptake might be due to disturbance in transpiration pool, bacterial and fungal spp. gaining predominance in vase solution. (Destigter and Broekhuyseh, 1986) [6]. This solution water uptake by flower might be due to germicidal action of $AgNO_3$ and prevention of stem blockage leading to better water flow through the stems. Sucrose helped in increasing water uptake might be due to translocated sugars accumulated in flowers which increased the osmotic potential and improved the ability of spikes to absorb water and decreased the transpiration loss by decreasing stomatal opening thereby maintaining turgidity of flowers (Nair *et al.,* 2003) [11]. The findings of this investigation were in line with those of Kumar and Awasthi (2012) in gladiolus, and Selvaraj *et al.* (2014) [13] in tuberose.

In case of number of florets open when 1st floret wither, treatment with $AgNO_3$ 300 ppm in combination with 5% sucrose showed best results in all the varieties except, Darshan where, treatment with SNP 100ppm in combination with 5% sucrose showed best results regarding studied parameter.

Table 1: Effect of Different Chemicals on Vase Life of Gladiolus Varieties (*Gladiolus hybridus* Hort.).

Treatment description	No. of days taken for opening of basal floret	No. of basal florets opens at a time	Vase life (days)	Floret diameter (cm)	No. of florets open at senescence of basal florets	Solution uptake (ml)		
						4th day	8th day	Last day
Distilled water+ African Star (Control)	4.67	1.00	9.67	6.64	2.33	20.0	40.0	50.0
Sucrose (5%)+ African Star	3.83	2.67	10.34	7.09	4.0	25.0	50.0	60.0
African Star+ $AgNO_3$ 100ppm	3.00	3.33	12.34	7.48	6.0	33.34	70.0	80.0
African Star+ $AgNO_3$ 200ppm	2.67	5.67	14.67	7.91	8.0	40.0	76.67	90.0
African Star+ $AgNO_3$ 300ppm	2.00	6.33	16.67	8.36	9.34	51.67	96.67	113.33
African Star+ Sodium Nitroprusside50ppm	3.33	3.00	11.34	7.44	5.0	30.0	60.0	76.67
African Star+ Sodium Nitroprusside 100ppm	2.33	6.00	15.67	8.03	8.67	45.0	86.67	103.33
African Star+ Sodium Nitroprusside 150ppm	2.67	4.33	13.67	7.55	7.0	36.67	73.0	85.0
Distilled water+ Snow Princess	5.00	1.00	10.67	6.70	2.67	21.67	43.33	56.67

(Control)								
Sucrose (5%)+ Snow Princess	4.00	2.67	11.34	7.17	4.67	26.67	53.33	66.67
Snow Princess+$AgNO_3$ 100ppm	3.00	4.33	13.34	7.58	6.67	36.67	70.0	90.0
Snow Princess+$AgNO_3$ 200ppm	2.33	5.33	15.67	8.01	8.0	43.34	83.33	103.33
Snow Princess+$AgNO_3$ 300ppm	1.66	6.33	17.67	8.46	9.67	55.0	98.33	120.0
Snow Princess+ Sodium Nitroprusside 50ppm	3.33	3.67	12.34	7.54	5.34	31.67	63.33	83.33
Snow Princess + Sodium Nitroprusside 100ppm	2.00	6.00	16.67	8.13	9.0	51.67	93.33	113.33
Snow Princess+ Sodium Nitroprusside 150ppm	2.33	5.00	14.67	7.61	7.34	40.0	80.0	100.0
Distilled water+ Hunting Song (Control)	4.67	1.00	12.67	7.99	2.34	23.34	46.67	63.33
Sucrose (5%)+ Hunting Song	3.67	2.33	13.34	8.35	4.67	30.0	60.0	81.67
Hunting Song+ $AgNO_3$ 100ppm	3.00	3.67	15.34	8.72	7.34	43.33	83.33	106.67
Hunting Song+ $AgNO_3$ 200ppm	2.67	5.67	17.67	9.00	8.33	51.66	100	123.34
Hunting Song+ $AgNO_3$ 300ppm	1.33	6.67	19.67	9.59	10.0	65.0	113.34	130.0
Hunting Song+ Sodium Nitroprusside 50ppm	3.00	3.33	14.67	8.68	6.34	40.0	76.67	93.34
Hunting Song+ Sodium Nitroprusside 100ppm	1.67	6.33	18.67	9.27	9.34	61.66	105.0	126.67
Hunting Song+ Sodium Nitroprusside 150ppm	2.67	4.67	16.67	8.60	8.0	50.0	93.34	103.34
Distilled water+ Legend (Control)	5.00	1.00	11.67	6.65	2.34	20.0	40.0	56.67
Sucrose (5%)+ Legend	4.00	2.33	12.34	7.15	4.0	25.0	50.0	66.67
Legend+ $AgNO_3$ 100ppm	3.00	3.33	14.33	7.55	6.0	33.34	70.0	90.0
Legend+ $AgNO_3$ 200ppm	2.67	5.67	16.67	7.98	8.0	40.0	76.67	103.33
Legend+ $AgNO_3$ 300ppm	2.00	6.33	18.67	8.43	9.34	51.67	96.67	120.0
Legend+ Sodium Nitroprusside 50ppm	3.33	3.00	13.34	7.52	5.0	30.0	60.0	83.34
Legend+ Sodium Nitroprusside 100ppm	2.33	6.00	17.67	8.08	8.67	45.0	86.67	113.34
Legend+ Sodium Nitroprusside 150ppm	2.66	5.33	15.67	7.59	7.0	36.67	73.34	100.0
Distilled water+ Darshan (Control)	4.67	1.00	10.67	6.64	2.34	16.67	33.34	40.0
Sucrose (5%)+ Darshan	3.83	2.33	11.34	7.09	3.67	23.34	46.67	53.34
Darshan+ $AgNO_3$ 100ppm	3.00	3.33	12.34	7.44	5.34	26.67	53.33	66.67
Darshan+ $AgNO_3$ 200ppm	2.33	5.00	14.67	7.55	6.67	30.0	63.34	76.67
Darshan+ $AgNO_3$ 300ppm	1.66	6.00	16.67	8.03	7.67	43.33	83.34	96.67
Darshan+ Sodium Nitroprusside 50ppm	3.33	3.67	13.34	7.48	6.0	30.0	60.0	73.34
Darshan+ Sodium Nitroprusside 100ppm	2.00	6.33	17.67	8.36	8.34	46.67	86.67	101.67
Darshan+ Sodium Nitroprusside 150ppm	2.33	5.33	15.67	7.91	7.0	40.0	76.67	86.67
Distilled water+ Pusa Srijana (Control)	4.67	1.00	8.67	6.64	2.0	16.67	33.34	38.0
Sucrose (5%)+ Pusa Srijana	3.83	2.33	9.34	7.09	3.0	23.34	46.67	51.67
Pusa Srijana+ $AgNO_3$ 100ppm	3.00	3.67	11.34	7.48	5.0	30.0	60.0	70.0
Pusa Srijana+ $AgNO_3$ 200ppm	2.67	5.67	13.67	7.91	7.0	40.0	76.67	85.0
Pusa Srijana+ $AgNO_3$ 300ppm	2.00	6.33	15.67	8.36	8.34	46.67	86.67	101.67
Pusa Srijana+ Sodium Nitroprusside 50ppm	3.33	3.33	10.34	7.44	4.0	23.34	53.34	65.0
Pusa Srijana+ Sodium Nitroprusside 100ppm	2.33	6.00	14.67	8.03	7.67	43.34	83.33	95.0
Pusa Srijana+ Sodium Nitroprusside 150ppm	2.67	5.00	12.67	7.55	6.0	30.0	60.0	70.0
Distilled water+ Pusa Kiran (Control)	4.66	1.00	11.34	6.84	2.67	21.67	43.33	56.67
Sucrose (5%)+ Pusa Kiran	3.83	2.67	12.67	7.29	4.67	26.67	53.33	66.67
Pusa Kiran+ $AgNO_3$ 100ppm	3.00	4.33	14.34	7.68	6.67	36.67	70.0	90.0
Pusa Kiran+ $AgNO_3$ 200ppm	2.33	5.67	16.67	8.11	8.0	43.33	83.33	103.34
Pusa Kiran+ $AgNO_3$ 300ppm	1.66	6.33	18.34	8.56	9.67	55.0	98.33	120.0
Pusa Kiran+ Sodium Nitroprusside 50ppm	3.33	3.33	13.67	7.64	5.34	31.66	63.33	83.34
Pusa Kiran+ Sodium Nitroprusside 100ppm	2.00	6.00	17.34	8.23	9.0	51.67	93.33	113.34
Pusa Kiran+ Sodium Nitroprusside 150ppm	2.33	5.00	15.67	7.75	7.34	40.0	80.0	100.0
SEm±	0.32	0.45	0.58	0.072	0.66	3.52	5.16	5.88
CD (P=0.05)	0.64	0.90	1.15	0.14	1.32	6.97	10.23	11.65

Conclusion

Treatment with $AgNO_3$ 300 ppm in combination with 5% sucrose was observed to be best in terms of vase life and quality parameters of flowers *i.e.* solution uptake, number of basal florets open at a time, numbers of florets open at senescence of basal florets, in all the varieties except, 'Darshan' where SNP 100 ppm showed better performance for all the parameters. SNP 100 ppm in combination with 5%

sucrose showed at par performance for most of the parameters. Among the varieties, cv. 'Hunting Song' showed best performance for all the parameters than other varieties used for investigation.

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