VASELIFE ANALYSIS OF GLADIOLUS USING DIFFERENT VASE SOLUTIONS

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ABSTRACT

Postharvest loss of cut flower in developing countries is very high. So an experiment was conducted in the Horticulture Laboratory of IAAS, Lamjung Campus to identify the best vase solution that enhance and prolongs the better flower quality and the longevity of gladiolus. Experiment was carried out with the nine treatment viz. T1(distilled water), T2 (150 ppm HQS+ 4% sucrose), T3 (250 ppm citric acid), T4 (150 ppm GA3+ 4% Sucrose), T5 (150 ppm HQS+ 150 ppm AgNO3+ 4% sucrose),T6(4% sucrose), T7(150 ppm AgNO3+4% sucrose), T8(250 ppm citric acid + 4% sucrose), T9 (150 ppm salicylic acid+ 4% sucrose) under CRD with three replications. Gladiolus spikes were harvested at 2-3 floret color break stage and two spikes after the slanting cut were kept in each vase. Effect of different solutions on vase life and flower quality was found significant. The vase solution 150 ppm HQS+150 ppm AgNO3+4% sucrose showed maximum water uptake; longer days for basal floret senescence(8days) with the maximum floret opening during basal senescence (9.76), maximum flowering 83.20 %, minimum fresh weight loss (18.03% at 12 days) and the longest vase life of 15 days as compared to other treatments.

Key words: *Antimicrobial, Ethylene inhibitor, Gladiolus, Sucrose, Vase life*

Introduction

Gladiolus (Gladiolus grandiflorus L.) a "Queen of bulbous flowers" belonging to Iridaceae family is a glamorous flower, a flower of perfection also known as 'sword lily' because of shape of its leaves. This flower symbolizes strength of character, faithfulness and honor and signifies remembrance. It is one of the renowned cut flower in the world (Bai et al., 2009) as well as in Nepal. It is popular not only for the beauty and the aesthetic values but also for the economic value as sale of flowers (loose or cut bloom) and for the extraction of essential oils. It is the first commercially grown cut flower crop in Nepal since 1988 (10 ropani) and ranks number one in terms of production and consumption in Nepal occupying about 365 ropani (CBS 2012) of land under its cultivation. About 6000-8000 sticks of gladiolus are demanded daily in Kathmandu (FAN 2011/2012). Short postharvest vase life is one of the most important problems in cut flowers (Zamani et al., 2011). But with the increasing production value of cut flower, it is imperative to achieve a good keeping quality of harvested cut flower. Short vase life of cut flowers is related to wilting, ethylene production which accelerates the senescence of many flowers and vascular blockage by air and micro-organisms (Elgimabi, 2011) that causes continuing water uptake and transpiration by leaves of cut flowers results in net loss of water of flower and stem tissue (Hassan, 2005) thus reduce the vase life of cut. The typical life of these florets spike placed in water using as vase solution is 4 to 6 days (Mayak et al., 1973). Using appropriate preservatives could help to extend these vaselife of the floret spikes for consumer satisfaction and exploitation of the business. Preservative solutions are generally required to supply energy source, reduce microbial build up and vascular blockage, increase water uptake of the stem, and arrest the negative effect of ethylene (Nigussie, 2005).

Thus, preservative containing the sugar, germicides and ethylene inhibitor as a vase solution would prolongs the vase solution. Sucrose that supplies the needed substrates for respiration and prolongs vase life, enables cut flowers harvested at the bud stage to open (Pun and Ichimura, 2003), citric acid that act as a pH regulator reduces bacterial proliferation and enhances the water conductance in xylem of cut flowers (van Doorn, 2010), HQS an antimicrobial agent (Ketsa et al., 1995), AgNO3 both potent to antimicrobial and ethylene inhibitor(Figueroa et al., 2005), Salicylic acid that inhibit ethylene production(Vahdati Mashhadian et al., 2012), GA3 that endure membrane stability, and delays senescence (Emongor, 2004), improve the water, carbohydrate contents of cut flower and can used for the improvement of longevity of cut flowers as commercial purpose. So this experiment setup was done to identify the best vase solution that enhance and prolongs the better flower quality and the longevity of gladiolus.

Material and Methods

The experiment was conducted at the Department of Horticulture and Plant Protection, Institute of Agriculture and Animal Science, Tribhuwan University, Lamjung Campus, Nepal during the month of March-April, 2015. White colored uniform gladioli spikes were harvested when 2–3 florets showing color from Chitwan, Nepal. After that spikes were pulsed in sugar solution for two minutes and were wrapped by newspaper and were loosely tied with a rope. They were brought to horticulture lab of IAAS, Lamjung Campus after three hours of transportation from Chitwan to Lamjung. After that the flower stem was given slanting cut under water and put in the vase containing vase solution. The experiment was laid out in the Completely Randomized Design (CRD) which was replicated thrice. There were nine treatments viz. distilled water (T1); 150ppmHQS + 4%sucrose (T2); 250ppmcitric acid (T3);100ppmGA3 + 4%sucrose (T4); 150ppmHQS + 150ppmAgNO3 + 4%sucrose (T5); 4%sucrose (T6); 150ppmAgNO3 + 4%sucrose (T7); 250ppmcitric acid + 4%sucrose (T8); 150ppm salicylic acid+ 4%sucrose (T9). Two spikes were kept in each vase solution and kept in room temperature (mean 27oC) during the period of experiment and the vase solutions were changed after six days. Fresh weight of cut gladioli was measured before treating. Data regarding the weight gain or loss, water uptake, days to basal senescence, number of floret opening during basal senescence and floret opening percentage, and flower longevity was taken and calculated. Data were tested to meet the assumptions of ANOVA, those that did not met the assumptions were subjected to log transformation. Data was analyzed by using SPSS 16.0 version and means were separated by using Duncan's test at 0.05 level.

Results and Discussion

Effect of different treatments on water uptake (g) and fresh weight gain or loss (%) of gladiolus

Water Uptake

Water uptake was varied significantly among the different treatment at 6th day. Maximum water uptake 7.89g was found in 150 ppm AgNO3+ 4% sucrose followed by 150 ppm HQS + 150 ppm AgNO3 + 4% sucrose with the minimum 1.51g in control (Table 1). Similarly the variation in water uptake was non- significant among the different treatments at 12thdays but mean comparison showed maximum water uptake in 150 ppm HQS + 150 ppm AgNO3 + 4% sucrose while zero in control (Table 1). Results of the present study can be explained on basis of antimicrobial property of HQS and AgNO3 that play an important role in improving the water uptake of gladioli cut flowers by preventing the growth of microorganism in xylem and thus maintained water uptake by flower stems. As xylem vessels blockage due to air or microorganisms accumulation in vase solution (Hardenburg, 1968; Hassan, 2005) reduce the water uptake. This result is also supported by the Singh and Tiwari (2002) finding that AgNO3 enhanced vase life and solution uptake in rose cut flowers. And Reddy et al. (1996) and Ketsa et al. (1995) demonstrate that HQS an antimicrobial agent which can lead to increase water uptake.

Fresh Weight Gain or Loss Percentage

At 6th day the different treatment had no significant effect in fresh weight gain of gladioli spikes. The highest fresh weight gain of 30.79% was observed in 150ppmHQS+ 150 ppm AgNO3+ 4% sucrose followed by 150ppm AgNO3+ 4%sucrose and 150ppm HQS+ 4% sucrose while 9.8% weight loss by control. But at 12th day there was significant effect on fresh weight loss with the minimum fresh weight loss (18.03%) by 150ppm HQS + 150 ppm AgNO3+ 4% sucrose followed by 150ppm AgNO3 +4% sucrose and 150ppm HQS +4% sucrose while maximum weight loss (44.26%) by control (Table 1). Among all the treatments; 150ppm HQS+ 150 ppmAgNO3+ 4% sucrose afforded minimum fresh weight loss (%), this might be due to maximum uptake of water with reserve food. As HQS and AgNO3 in vase solution act as a germicide improving the water uptake and sucrose act as reserved food. Result is supported by Pun and Ichimura (2003) suggested that when HQS is used in coupled with sucrose more effective result on vaselife as well as fresh weight of cut flower is obtained. Similarly Ohkawa et al. (1999) found that Silver nitrate reduced bacterial proliferation and maintained the hydraulic conductance of stem in cut gladiolus flowers thus resulting longer vaselife and more fresh weight gain.

Table 1. Effect of different vaselife solution on water uptake and fresh weight gain or loss percentage of gladiolus in Lamjung Campus, 2015

Treatments	Water uptake at 6th day(g)	Water uptake at 12th day(g)	Fresh weight gain or loss at 6th day (%)	Fresh weight gain or loss at 12th day (%)
$T_{1\ (distilled\ water)}$	1.51[f]	-3.48	-9.8	-44.26[d]
$T_{2\ (HQS+sucrose)}$	5.78[bc]	1.19	16.30	-22.96[ab]
$T_{3\ (citric\ acid)}$	3.25[de]	4.62	4.94	-35.11[cd]
$T_{4\ (GA3+Sucrose)}$	4.42[cd]	0.90	2.84	-35.46[cd]
$T_{5\ (HQS+AgNO3+sucrose)}$	6.31[ab]	6.69	30.79	-18.03[a]
$T_{6\ (sucrose)}$	1.99[ef]	5.10	0.41	-35.46[cd]
$T_{7\ (AgNO3+sucrose)}$	7.48[a]	1.82	22.03	-20.23[ab]
$T_{8\ (citric\ acid+sucrose)}$	4.52[cd]	1.07	14.12	-27.73[ab]
$T_{9\ (salicylic\ acid+sucrose)}$	4.94[cb]	4.37	7.67	-31.27[bc]
significance	**	**	NS	*

Means in columns followed by the same letter(s) are not significantly different at P=0.05.

Effect of different vaselife solution on days to first basal senescence, no of floret open during basal senescence, maximum flowering and longevity of gladiolus

Days to Basal Floret Senescence

Days to basal floret senescence was varied significantly among the different treatments. The maximum days (8 days) for basal senescence was observed in 150ppmHQS + 150ppmAgNO3 + 4%sucrose followed by 150ppm salicylic acid+ 4% sucrose(7.33days), which was statistically at par with 150ppmHQS + 4%sucrose and 150ppmAgNO3 + 4%sucrose, whereas minimum in control (3.67 days) (Table 2). It is due to the fact that treatment with anti-ethylene compounds and anti-microbial compounds in combination with the sucrose increased the amount of carbohydrates to flower, water uptake by flower thus maintaining the turgidity of cut flower; inhibit the ethylene production that caused the early senescence resulting delay senescence. As AgNo3 is both potent ethylene inhibitor and antimicrobial agent and salicylic acid is ethylene inhibitor (Vahdati Mashhadian et al., 2012), treatment containing these take a longer day to basal floret senescence than other. These results about the effectiveness of anti-ethylene compounds on qualitative indexes of cut flowers are in accordance with Edrisi et al. (2012), Kiamohammadi (2011) and Hosseinzadeh Liavali and Zarchini (2012). Abdul-Wasea (2012) findings about the effectiveness of antiethylene and antimicrobial compound on better snapdragon cut flower quality (Antirrhinum majus) are also in agreement with our results. Our finding is also supported by the Burzo and Dobrescu (1995) as their studies found that pulsing the cut carnation flowers with Silver + 10% sucrose inhibited the ethylene synthesis and improved the postharvest quality.

Number of Floret Opening During Basal Floret Senescence

At the period of basal floret senescence, the number of floret opening was significant among the different treatments. Maximum number of floret (9.67 florets) was opened during basal floret senescence in 150ppmHQS + 150-ppmAgNO3 + 4%sucrose treatment while least (4.33 florets) was in control (Table 2). It is also due to the combination of sucrose that provides carbohydrate for floret development and antimicrobial agents (HQS+ AgNO3) that reduce the bacterial proliferation and increase water uptake by flower thus maintaining the turgidity of cut flower enhancing improved postharvest life of gladioli.

Floret Opening Percentage

Floret opening was significantly varied among the treatments at 12th days after treating. However, floret opening percentage was highest in150ppmHQS+ 150ppmAgNO3+ 4%sucrose (83.20%) which was statically at par with 150ppmsalicylic acid+ 4% sucrose(78.12%), 150ppmHQS + 4%sucrose(76.95%) and 150ppm AgNO3 + 4%sucrose (74.99%) while minimum 32.28% was in control (Table 2). It is due to the fact that development of flower buds requires carbohydrates. Sucrose enables cut flowers harvested at the bud stage to open, which otherwise could not occur naturally (Pun and Ichimura, 2003) as it provides the essential substrate for respiration, structural material and carbon skeletons needed for bud opening (Halevy and Mayak, 1979); also evident by (Mayak et al., 1973) but as it also favor the microbial growth if used alone, use of the preservatives that suppress the microbial growth that causes plugging of vascular tissue gives best result. Because of these combination of sucrose and antimicrobial agent (HQS+AgNO3) gave maximum floret opening percentage.

Flower Longevity

Highly Significant variation was found on flower longevity among treatments (Table 2). Cut gladioli were stayed maximum 15 days in flower vase when treated with 150ppm HQS+ 150ppm AgNO3+4% sucrose followed by 150ppm salicylic acid +4% sucrose(11.67days), 250ppm citric acid+4% sucrose(10.67 days) while short vaselife of 5 days was observed in control. It is due to the fact that short vase life of cut flowers is generally related to wilting, ethylene production and vascular blockage by air and micro-organisms (Elgimabi, 2011). But when sucrose in combination with antimicrobial agent and ethylene inhibitor is used a synergistic effect, which improves the water balance and osmotic potential since HQS and AgNO3 inhibits the microbial growth, arrest the negative effect of ethylene (Nigussie, 2005) and sucrose was observed to reduce moisture stress in cut flowers by affecting stomata closure, preventing transpiration and water loss as well as it provides energy required by flower, thus resulting in longer vaselife. Asrar (2011) found longer vaselife (14days) for snapdragon treating with 200pppmHQS+sucrose on vase life while only 3-4 days in pure water and Cho and Lee (1980) found doubled vase life in cut rose when treated with 3% Sucrose+50 ppmAgNO3 compared to control that justify the current finding.

Table 2. Effect of different vaselife solution on days to first basal senescence, no of floret open during basal senescence, maximum flowering and longevity of gladiolus in Lamjung Campus, 2015

Treatments	Days to first basal senescence	No. of floret open during basal senescence	Floret opening % at 12th days	Flower Longevity (Days)
$T_{1(distilled\ water)}$	3.66d	4.33c	32.28c	5e
$T_{2(HQS+sucrose)}$	6.66ab	7.67abc	76.95a	9cd
$T_{3(citric\ acid)}$	5.33cd	4.67c	47.91bc	6.33de
$T_{4(GA3+\ Sucrose)}$	5.66bc	6abc	51.04bc	8.67cd
$T_{5(HQS+AgNO3+sucrose)}$	8a	9.67a	83.20a	15a
$T_{6(sucrose)}$	5.33cd	5.67bc	37.49c	9.33cd
$T_{7(AgNO3+sucrose)}$	6.66ab	9.33abc	74.99a	8.67cd
$T_{8(citric\ acid+sucrose)}$	5.66bc	6.67abc	67.83ab	10.67bc
$T_{9(salicylic\ acid+sucrose)}$	7.33ab	8.67ab	78.12a	11.67bc
significance	**	*	**	**

Means in columns followed by the same letter(s) are not significantly different at P=0.05.

Conclusion

With the changing life style, urban affluence and modernizations gladiolus is emerging as a new agri-venture in Nepal but the short postharvest life is the major problem. But by using the appropriate preservatives or vase solution postharvest flower quality and the longevity can be enhanced and prolongs. Sucrose in combination with antimicrobial (HQS and AgNO3) and ethylene inhibitor (AgNO3) agent increased carbohydrate to flower, increased water uptake, delay senescence, maintain turgidity of flower, reduced bacterial proliferation and xylem blockage resulting in better flower quality and longevity.

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