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Effect of post harvest treatments and harvesting stage on vase life and flower quality of cut Oriental lily

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Abstract: An investigation was carried out to study the effect of post harvest treatments and harvesting stage on vase life and flower quality of cut Oriental lily cv. Avocado. The results showed that highest vase life (15.83 days) and vase solution uptake (49.17 ml) was recorded with sucrose (2%) + 5-SSA (200ppm), whereas maximum flower diameter (15.17 cm) was recorded in vase solution containing sucrose (2%) + 5-SSA (100ppm). Earliest opening of florets (4.42 days) reported under sucrose (2%) + 5-SSA (200ppm). Effect of treatments was found non-significant in respect to opening of florets. Harvesting at green bud stage exhibited extended vase life (14.33 days) and higher vase solution uptake (40.43 ml), whereas maximum flower diameter (14.25 cm) recorded at 75% colour development stage. Based on the results it is concluded that 5-SSA could be an inexpensive and potential chemical for delaying senescence and for extending the keeping quality of cut liliums commercially.

Keywords: 5-SSA, Harvest stage ,Oriental lily, Vase life

INTRODUCTION

Oriental lilies have long been produced for use as cut flowers and have gained popularity in recent years owing to their large flowers, pleasant scent and attractive white, pink, and cream colours. Oriental lily derived from *Lilium auratum*, *L. speciosum*, *L. japonicum* and *L.Rubellum.*The flower sizes are the largest and most spectacular among all the lilies. These features make them of great value as cut flowers. Moreover, the waxy texture of Oriental lily extends the vase life and are now the most important and cultivated group (Grassotti and Gimelli 2011). *Lilium* is the second to *Tulipa* among flower bulbs crop produced and ranks fourth among top ten cut flower of the world next to rose, chrysanthemum and tulip. The annual turnover of *Lilium* in Dutch market was € 137 million in 2012.

Short vase life of flower is related with the wilting, ethylene production and vascular blockage by air and micro-organisms (Elgimabi, 2011). Preservative solution generally provides energy source, prevent microbial growth and vascular blockage, increase water uptake of stems. Incorporation of different chemical preservatives to vase solution is recommended to prolong the vase life of cut flowers. In the past, researchers have used several preservatives to enhance keeping quality of cut flowers. Earlier results suggested that Salicylic acid (SA), Nickle (Ni), Cobalt (CO) and sucrose increase the vase-life by improving the membrane stability and reducing the oxidative stress damages during lily flower senescence (Kazemi and Ameri, 2012). The holding solution containing sucrose (2%)+ 8-HQ (150ppm) + GA_3(100ppm) significantly extended vase life of Oriental hybrid lily cv. Solaila (Bharathi, *et al*. 2009). However work on post harvest handling of cut Oriental lily is very limited. Moreover standardization of optimum stage of harvest and post harvest chemical treatments is crucial for extending the longevity of cut Oriental lily. Keeping the above facts in view, the present investigation has been planned to study the effect of post harvest treatments and harvest stage on vase life and flower quality of cut Oriental lily.

MATERIALS AND METHODS

The present investigation was carried out at experimental farm of Directorate of Floricultural Research, Indian Agricultural Research Institute, New Delhi and Division of Plant Physiology, IARI, New Delhi during November 2011-2012 to April 2013-2014. Cut Oriental 'Avocado' lilies growing under polyhouse were harvested at different colour development stage. Stage of harvesting included S_1: Green bud stage, S_2: 25% colour development, S_3: 50% colour development, S_4:

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75% colour development. They were quickly brought to laboratory, where the room temperature was maintained at 20°C and each stem was trimmed to 45cm and then placed for post harvest studies in an individual 25mm tubes containing vase solution. The mouth of the tube was plugged with non-absorbent cotton plug, which effectively prevented transpirational water loss. The treatments imposed were: T_1: Control (Double distilled water), T_2: Sucrose (2%) + Hydroxyquinoline Citrate (HQC) (200ppm) + Abscisic acid (ABA) (10ppm), T_3: Sucrose (2%) + HQC (200ppm) + ABA (50ppm), T_4: Sucrose (2%) + HQC (200ppm) + ABA (100ppm), T_5: Sucrose (2%) + 5-sulfosalicylic acid (5-SSA) (200ppm), T_6: Sucrose (2%) + 5-SSA (100ppm),T_7: Sucrose (2%) + 5-SSA (150ppm).Experiment was arranged in a factorial completely randomized design with three replicates (stems) per treatment. Data were analyzed by using SAS General Linear Model procedure (SAS Institute, 1999). A probability of $P \leq 0.05$ was considered significant.

RESULTS AND DISCUSSION

Vase life (Days): Perusal of data (Table 1) showed that vase life was significantly affected by treatment and harvesting stage. Highest vase life (15.83 days) was reported with (T_5) sucrose (2%) + 5-SSA (200ppm) and found at par with (T_7) sucrose (2%) + 5-SSA (150ppm) (15.75 days) over untreated and other treatments containing ABA, irrespective of harvesting stage. The vase life recorded under (T_5) sucrose (2%) + 5-SSA (200ppm) was 5.33 days and 3.58 days higher than recorded under (T_4) sucrose (2%) + HQC (200ppm) + ABA (100ppm) and control (T_1), respectively. These results are in agreement with finding of Ezhilmathi *et al*. (2007) who reported that treatment of gladiolus cut flowers with 5-SSA, delayed the senescence of flowers and improved the flowers opening and induction of antioxidant enzymes. Yadav *et al.* (2015) were reported that 5-sulfosalicylic acid resulted in improvement of vase life in gladiolus. Kumar *et al.* (2013) alsorecorded maximum vase life (11.75 and 12.00 days) with salicylic acid (100 ppm) + sucrose

Table 1. Effect of post harvest treatment and stage of harvest on vase life (days) of cut Oriental lily 'Avocado' .

Treatment	Harvest stage				
	S_1	S_2	S_3	S_4	Mean
T_1	13.33	12.67	12.33	10.67	12.25
T_2	12.67	12.33	12.00	10.33	11.83
T_3	12.33	12.00	11.33	10.00	11.42
T_4	11.33	10.67	10.33	9.67	10.50
T_5	17.33	16.33	15.33	14.33	15.83
T_6	16.33	15.33	14.33	13.67	14.92
T_7	17.00	16.33	15.33	14.33	15.75
Mean	14.33	13.67	13.00	11.86	
$CD_{0.05}$	Treatment (T)	0.44	Stage (S)	0.33	S x T NS

Table 2. Effect of post harvest treatment and stage of harvest on vase solution uptake (ml) of cut Oriental lily 'Avocado'.

Treatment	Harvest stage				
	S_1	S_2	S_3	S_4	Mean
T_1	40.67	38.33	36.67	35.67	37.83
T_2	37.67	35.67	35.33	34.33	35.75
T_3	36.33	34.67	33.33	32.33	34.17
T_4	34.67	33.33	31.67	30.33	32.50
T_5	51.00	50.33	48.67	46.67	49.17
T_6	40.33	39.67	37.67	36.33	38.50
T_7	42.33	40.67	39.67	38.67	40.33
Mean	40.43	38.95	37.57	36.33	
$CD_{0.05}$	Treatment (T)	0.49	Stage (S)	0.37	S x T NS

Table 3. Effect of post harvest treatment and stage of harvest on flower diameter (cm) at full expansion of cut Oriental lily 'Avocado'.

Treatment	Harvest stages				
	S_1	S_2	S_3	S_4	Mean
T_1	13.07	14.27	15.17	15.50	14.50
T_2	12.40	13.53	14.33	14.67	13.73
T_3	12.20	12.57	13.00	13.30	12.77
T_4	12.00	12.33	12.50	12.77	12.40
T_5	13.47	13.67	13.83	13.83	13.70
T_6	14.27	15.23	15.43	15.73	15.17
T_7	13.20	13.57	13.73	13.93	13.61
Mean	12.94	13.60	14.00	14.25	
$CD_{0.05}$	Treatment (T)	0.17	Stage (S)	0.13	S x T 0.34

Table 4. Effect of post harvest treatment and stage of harvest on days to opening of florets of cut Oriental lily 'Avocado'.

Treatment	Harvest stages				
	S_1	S_2	S_3	S_4	Mean
T_1	8.33	6.67	5.67	4.00	6.17
T_2	6.33	5.33	5.33	4.33	5.33
T_3	6.67	5.67	5.33	4.67	5.58
T_4	6.33	5.67	5.00	4.33	5.33
T_5	5.33	4.67	4.33	3.33	4.42
T_6	5.67	4.67	4.33	3.67	4.58
T_7	5.67	4.67	4.33	4.00	4.67
Mean	6.33	5.33	4.90	4.05	
$CD_{0.05}$	Treatment (T)	0.45	Stage (S)	0.34	S x T NS

Table 5. Effect of post harvest treatment and stage of harvest on opening of florets (%) of cut Oriental lily 'Avocado'.

Treatment	Harvest stages				
	S_1	S_2	S_3	S_4	Mean
T_1	100.0	100.0	100.0	100.0	100.0
T_2	100.0	100.0	100.0	100.0	100.0
T_3	100.0	100.0	100.0	100.0	100.0
T_4	100.0	100.0	100.0	100.0	100.0
T_5	100.0	100.0	100.0	100.0	100.0
T_6	100.0	100.0	100.0	100.0	100.0
T_7	100.0	100.0	100.0	100.0	100.0
Mean	100.0	100.0	100.0	100.0	
$CD_{0.05}$	Treatment (T)	NS	Stage (S)	NS	S x T NS

(4%) during two consecutive years in gladiolus cultivar Sunayna.. Nasibi *et al*. (2014) observed that Vase solution containing Arginine, Cysteine or 5-SSA significantly increased vase life and opened flowers in Tuberose 5-sulfosalicylic acid is the SA driven compound with sulfur group which may act more effective than SA because of its probable antimicrobial effect. In this regard 5-SSA prevents the vascular blockage by air and micro-organisms. *Lilium* is considered as an ethylene sensitive species (Jones and Moody, 1993) and it reduces the longevity of lily cut flowers. SA can prevent ACC-oxidase and extend the vase life of cut flowers by decreasing reactive oxygen species (ROS) and ethylene (Zamani *et al*., 2011). Results of present investigation showed that the effect of ABA was negatively correlated with respect to vase life and quality of flowers. The results are in harmony with findings of Hunter *et al*. (2004) who found that rise in ABA content in tepal coincided with the appearance of visual signs of senescence in Daffodil. The treatments contain ABA resulted in early senescence of flowers in comparison to control as ABA seems to increase the production of ethylene. Harvesting at green bud resulted in longest vase life (14.33 days), as less mature bud take longer time to open in comparison to more mature stage.

Vase solution uptake (ml): Perusal of data (Table 2) showed that significantly higher vase solution uptake (49.17 ml) recorded under (T_5) sucrose (2%) + 5-SSA (200ppm) followed by (T_7) Sucrose (2%) + 5-SSA (150ppm) (40.33 ml) in comparison to 32.50 ml and 37.83 ml in (T_4) sucrose (2%) + HQC (200ppm) + ABA (100ppm) and control, respectively. The result was in accordance with the findings of Kumar *et al.* (2013) who found that maximum uptake of vase solution (89.50 and 90.40 ml/spike) was recorded in cultivar Sunayna (Gladiolus) with salicylic acid + sucrose (4%) during two consecutive years. Similar results were also obtained by Ezhilmathi *et al*. (2007) who found that vase solution containing 5-sulfosalicylic acid result increased uptake of solution.. Wilting of flowers is caused by an imbalance between water uptake by the flowering stem and water loss via transpiration from leaves and other organs (Halevy and Mayak 1981, Van Doorn 1997). The results suggest that 5-SSA either reduced transpiration rate or enhance water uptake. The stage effect showed that maximum vase solution uptake (40.43 ml) recorded at green bud stage.

Flower diameter at full expansion (cm): Results (Table 3) showed that largest flower diameter (15.17 cm) was recorded with (T_6) sucrose (2%) + 5-SSA (100ppm), which was also at par, with control (14.50 cm). Harvesting at 75% colour development stage had significantly increased the flower diameter (14.25 cm) over other stage of harvest. The interaction effect showed that maximum flower diameter (15.73 cm) recorded at 75% bud colour under (T_6) sucrose (2%) + 5-SSA (100ppm).

Days to opening of florets: Results (Table 4) depicted that earliest bud opening (4.42 days) was found in (T_5) sucrose (2%) + 5-SSA (200ppm) compared to untreated (6.17 days) and other treatments containing ABA. The stage effect showed earliest bud opening (4.05 days) was recorded at 75% bud colour development stage. This could be attributed to improved water uptake, lower respiration rate and improved water balance (Ezhilmathi *et al*. (2007).

Opening of florets (%): Results of (Table 5) depicted that the effect of treatments, harvesting stage and interaction of treatment and stage were found non-significant in respect to opening of florets. Each and every bud reached to full blooming, suggesting that they contain sufficient carbohydrate for bud opening and for maintaining flower longevity even at green bud stage (Han, 2003).

Conclusion

Results of present investigation suggest that vase solution containing sucrose (2%) + 5-SSA (200ppm) significantly increased vase life (15.83 days) and post harvest quality of cut Oriental lily. 5-SSA could be an inexpensive and potential chemical for delaying the senescence and for extending the keeping quality of cut lily commercially. It is advised to growers that harvesting of Oriental lily even at green bud stage exhibited longer vase life (14.33 days) without abscission of florets and buds.

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