BIBLIOGRAPHY

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ABSTRACT

This study was conducted to determine the postharvest characteristics of lisianthus cutflowers harvested at different stages of flower development, and to determine the best holding solution and best stage of harvest that will prolong the postharvest life of cut lisianthus flowers.

Lisianthus cutflowers harvested at different stage of flower development were held in various concentration of calamansi juice ml/l water and 250 ppm citric acid solution used as the control.

Results showed that a holding solution with 10 ml calamansi juice/l water was the best holding solution to prolong the vaselife of lisianthus cutflowers harvested at 50% anthesis.

For cutflowers harvested at 25% anthesis, vaselife can be lengthened with the use of 15 ml calamansi juice/liter water and can be further opened to 50% using 10 ml calamansi juice per liter water.

To prolong the vaselife of lisianthus cutflowers harvested at 75% anthesis, place them in a solution with 5 ml calamansi juice per liter water.

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INTRODUCTION

Lisianthus (*Eustoma grandiflorum)* is a North American wild flower. It is a native to the prairies of Nebraska, Colorado and Texas. They are also known as Prairie Gentian or Texas Blue Bell, the latter name a reference to the blue flowers of the wild species. Cultivars in production today offer a wide range of colors, including purple, rose, pink, white and various colors (Fox, 1998).

Lisianthus has the qualities of an "ideal cutflower" (attractive flowers) and should continue to increase in popularity throughout the next century (Gill, undated). According to Hermano (2006), the vase life range from two to three weeks from harvesting of the cutflowers.

Plant breeders have done a wonderful job of developing outstanding flower colors and introducing single and double flowering forms, adding to the beauty of this flower. The flower is elegant in form and easily mistaken for rose. Hybrids developed in Japan provide a wide range of colors, color patterns, and both single and double forms. Lisianthus become very popular as a cut flower, because of the range of colors available, and the fact that each inflorescence comprises a long, straight stem bearing as many as ten individual flowers.

Although there have been many studies of the environmental conditions required for lisianthus production, there has been little examination of the post harvest characteristics of the flowers. Lisianthus is usually harvested commercially when the first one or two flowers on the stem have opened. A good quality inflorescence will usually have ten or more buds and flowers. If the flowers are placed in water, few if any

of these buds open, and the longevity of the inflorescence is therefore determined by the life of the open flowers.

Since the primary objective of every farmer and trader is to have higher income, the quality of the cutflowers harvested must then be preserved from harvesting to consumption in order to get higher prices and thus, increase the farmer's income. It is also necessary to prolong the quality of the harvested cutflower as long as possible.

The study was conducted to determine the postharvest characteristics of lisianthus cutflowers harvested at different stages of flower development; and to determine the best holding solution and best stage of harvest that will prolong the postharvest life of cut lisianthus flowers.

This study was conducted at the Ornamental Horticulture Service Laboratory, College of Agriculture, Benguet State University, La Trinidad, Benguet from October 2008 to November 2008.

REVIEW OF LITERATURE

The Plant

Eustoma grandiflorum is a perennial plant that is treated in most areas as annual. The seed is relatively small (19,000 seeds/gm) or (545,000 seeds/oz) and is hard to handle in field plantings. Because of its small size, seedlings are generally started in plug trays and transplanted into the field. A plug size of 288 or 392 mm has been successful for commercial procedures. Plants are moved to the field when they have developed 2 to 3 sets of the true leaves (approximately 3 months from seedling time). Although for some varieties, terminal cuttings are used plants from seeds are more common (Gill).

Harvesting and Postharvest Handling

Lisianthus cutflowers are harvested when one flower is open. Harvesting is done in the morning; when the flowers and plant tissues are cool (Pan American Seed, undated). Hermano (2006) stated that on non-pinch plants, stems are cut above the third node from the ground. Similarly, the stems are cut above the third node of the lateral shoots on pinched plants. This site of cut allows the plants to produce laterals shoots for the second flush of laterals for flower production. Upon cutting, the cut flowers are soaked in clean water or in warm pulse solution (40^{o}C). Flowers are sorted and graded according to stem length.

Floral Preservatives

Chemicals used to prolong the postharvest life of cutflowers and aesthetic value for a longer period are called floral preservatives (Reid, 2000). According to Agricarta (1999), there are three basic components of floral preservatives; agent for acidifying the solution, food source (Sucrose) and biocides.

Food or Energy Source

Sucrose (sugar) is the best food source for the flowers to be held in the solution. The sugar concentration however depends on what the purpose of the solution is. If flowers are wilted and stems are in a dehydration solution, sugar should not be used. Pulse solution and bud opening solutions must contain the correct concentration for the flower being treated. Typically, all purpose preservative solutions contain 1.5-2% sugar. This will vary with flower types (Agricarta, 1999). In addition, sucrose had been shown to increase the fresh weight and longevity of cut flowers. Sucrose also reduces moisture stress in cut flowers by decreasing the size of leaf stomata. Flowers held in sucrose were comparable to field open flowers.

Biocides

Few "biocides" available actually kill all the microorganisms present in water. The material 8-HQ6 (hydroxyl quirnoline citrate) which is used to adjust water pH is fortunately the most commonly used biocide. It prevents rapid growth of bacteria, but does not kill them.

Vaselife

As reported by United States Department of Agriculture (USDA, 2000), the vaselife of the different cutflowers can be prolonged as long as proper methods and care are applied. Below are some ways that could prolong the vaselife of cut flower produce.

a. Cutting the stem everyday to eliminate decayed parts of the stem.

b. Placing the flower in cool and treated holding solution.

c. Avoiding the use of metal containers because it can cause unfavorable reaction with the holding solution.

d. Keep the flowers away from ripening fruits and vegetables.

e. Cutting the stem in a 45^{o} angle instead of crushing or splitting it.

f. Placing the flowers in a favorable atmosphere – away from direct sunlight and warm temperatures.

g. Replace the water used everyday. Also, it is recommended that the container must be cleaned everyday.

h. Placing the flower away from the circulation of conditioned air, especially for wide-leafed flowers. Although lower temperatures favor the longevity of flowers, those placed in air-conditioned rooms tend to dry and wilt faster than that placed in a room with normal air circulation.

i. Draughty positions are also unfavorable spots to locate the flowers. The petals tend to dry out and respire more quickly in these areas.

j. For flowers grown in tropical areas, subjecting them to temperatures lower than 4^{o}c can be very detrimental.

k. For arranged flowers on vases, remove the flowers that have signs of deterioration because these emit ethylene.

Water pH

Acidity alteration is the most important of the three considerations of components of a floral preservative since alkaline or high pH water/solution is damaging to cut flowers. Reduced water potential of the holding solution usually influences and decrease pH of water and sugar uptake. A low pH inhibits indigenous enzymes essential for stem plugging (Reid, 2000) and tends to minimize physiological stem blockage.

Various chemicals are used to increase the acidity of a solution. The most available chemical is vinegar. However, vinegar whitened the stem included in the holding solution.

MATERIALS AND METHODS

Materials

The materials used in the study are the following:

a. Lisianthus cutflowers harvested at different stage of flower development at 25%, 50%, 75%

b. graduated cylinder (200 ml)

c. beaker

d. pH meter

e. thermometer

f. foot ruler

g. catsup bottles

h. labeling materials

i. holding solutions (sucrose and citric acid using calamansi juice).

j. camera (for documentation)

k. pruning shear/cutter

Methods

The Lisianthus cutflowers were harvested at three different stages of flower development at: 25%, 50% and 75%. Before the treatments, the stems were recut in slanting manner; all cutflowers have 45 cm stem length and pulsed-feed with 10% sucrose for twenty four (24) hours. Calamansi juice of various concentrations was used as treatments. Distilled water + 250 ppm citric acid was used in S_0 as control. The study

was laid-out in completely Randomized Design (CRD) with the stage of harvest as factor A and holding solution as Factor B. Each flower represents a treatment replication and it was held in 200 ml holding solution in catsup bottles. Each treatment was replicated three times.

The different treatments are as follows:

First treatment

Factor A – stage of flower development at harvest (%)

T_1 – 25 – close/tight bud with color

T_2 – 50 – half-opened

T_3 – 75 – more than half opened

Factor B – Sugar concentration for pulse – feeding (%/liter)

S_0 – 0 (control; distilled H_20 only)

S_1 – 5

S_2 – 10

S_3 – 15

S_4 – 20

Data to be Gathered

1. Vase life. The vase life of the cutflowers was measured from the day of immersion of stem ends in holding solutions to the termination of the aesthetic value of the flower. Vase life was terminated when the outer most petals have lost their turgidity and have started to discolor.

2. Final volume of the solution. This was obtained by measuring the volume of the solution per treatment at the termination of the postharvest life of the cutflowers or samples.

3. Maximum flower diameter attained (cm). This was measured when the flower attained its maximum flower diameter.

4. Visual quality rating

a. Flower quality rating – each flower was observed daily using the following index.

Rating	Description
1	No damage, field fresh
2	10-20% petals with damage
3	30-40% petals with damage
4	50-70% petals with damage
5	80-100% petals with damage

b. Leaf quality – the same with flower quality was observed everyday using the following index:

Rating	Description
1	All green
2	25% discoloration/yellowing
3	50% discoloration/yellowing
4	75% discoloration/yellowing
5	100% discoloration/yellowing

c. Stem quality rating. The stem of each flower was rated using the following index

Description	Rating Index
Deep green, no injury	1
Deep green and rotting at the base (<2.54 cm)	2
Deep green and rotting at base the (>2.54 cm)	3
Green and rotting at the base (<5.08 cm)	4
Green and rotting at the base (>5.08 cm)	5
Yellow green and rotting at the base (<7.62 cm)	6
Yellow green and rotting at the base (>7.62 cm)	7

5. Initial and final pH of holding solution. The pH of holding solution was measured at holding and at the termination of the post harvest life of the cutflower samples using a pH meter.

6. Daily temperature of the holding room (^{o}C). These was obtained twice a day (10 AM and 2 PM) using a thermometer.

7. Documentation of the study in pictures.

Figure 1. Lisianthus cutflowers harvested at 25% anthesis held in different holding solutions

Figure 2. Lisianthus cutflowers harvested at 50% anthesis held in different holding solutions

Figure 3. Lisianthus cutflowers harvested at 75% anthesis held in different holding solutions

Figure 4a. Top view of lisianthus cutflowers at 3rd day of observation.

Figure 4b. Top view of lisianthus cutflowers held in different holding solutions during the 3rd day of observations

Figure 4c. Top view of lisianthus cutflowers held in different solutions during the 3rd day of observation

Figure 5. Overview of the cutflowers used in the experiment

Figure 6. Cutflowers harvested at (a) 25% (b) 50% and (c) 75% anthesis at day 1 of observation

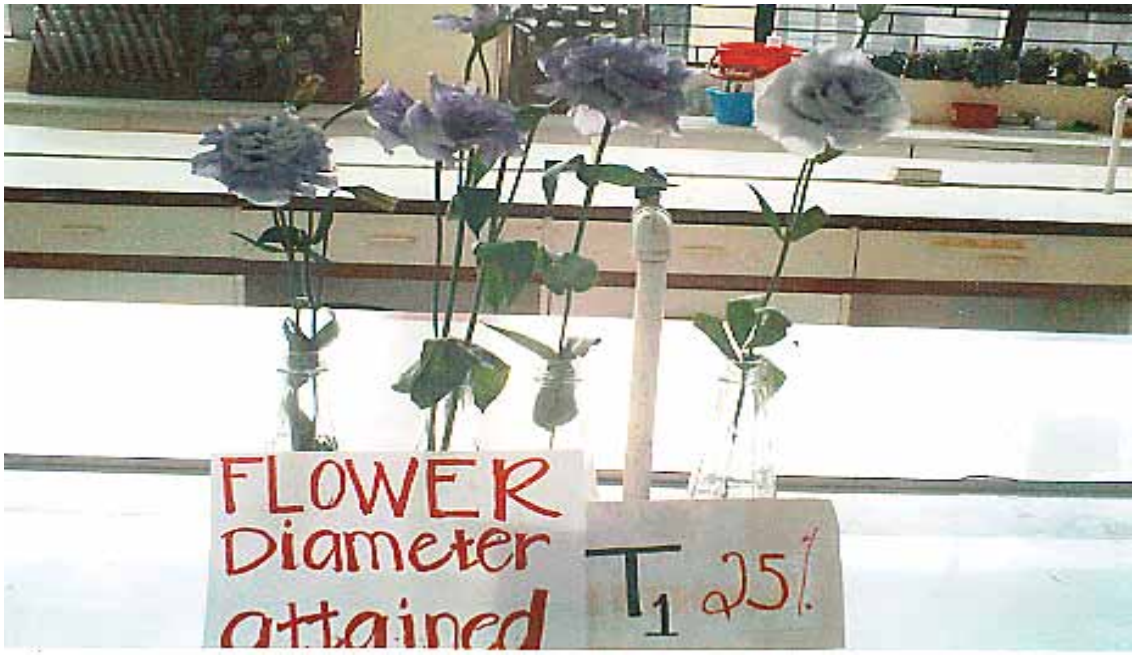

Figure 7a. Maximum flower diameter attained by Lisianthus cutflowers harvested at 25% anthesis

Plate 7b. Maximum flower diameter attained by lisianthus cutflowers harvested at 50% anthesis

Figure 7c. Maximum flower diameter attained by lisianthus cutflowers harvested at 75% anthesis

RESULTS AND DISCUSSION

Vaselife

Effect of stage of flower development at harvest. Table 1 shows that lisianthus cutflowers harvested at 50% flower opening stage had the longest aesthetic life of 13.47 days to the first sign of senescence from holding followed by 25% flower opening stage with a mean of 13.20 days while 75% flower opening stage has the shortest vaselife with a mean of 11.47 days. Statistically, there were no significant differences obtained on the vaselife of lisianthus as affected by the different stages of flower maturity at harvest.

Effect of concentration of calamansi juice. Statistical analysis showed no significant differences on the effects of the different holding solutions on the vaselife of lisianthus cutflowers. Cutflowers held in solutions with 10 ml calamansi juice/l of water had the longest vaselife of 13.33 days followed held in solution 5 ml calamansi/a of water and in holding solution of 20 ml calamansi juice/l of water with a mean of 12.89 days and 12.56 days respectively. Shortest vaselife was recorded in cutflowers held in holding solution 15 ml calamansi juice/1 of water with a mean of 12.33 days.

Interaction effect. There were no significant interaction effects between the stage of flower development and effect of holding solution in the vaselife of lisianthus cutflowers.

Table 1. Vaselife

TREATMENT	MEAN (days)
Stage of Flower Opening (%)	
25	13.20[a]
50	13.47[ab]
75	11.47[b]
Concentration of Calamansi juice (ml/liter)	
250 ppm citric acid (control	12.44a
5	12.89a
10	13.33a
15	12.33a
20	12.56a

Means with the same letter are not significantly different at 5% level by DMRT

Volume of Solution Taken Up

Effect of stage of flower development at harvest. Table 2 shows that the stage of flower development at harvest had no significant effects on the volume of solution taken up measured after the termination of observations. However, cutflowers harvested at 50% anthesis had higher rate of solution uptake compared to flowers harvested at 25% and 75% anthesis.

Effect of concentration of calamansi juice. Statistical analysis showed that there were no significant differences in the volume of holding solution taken up by the cutflowers as affected by the different holding solutions. Lisianthus cutflowers held in

solutions with 15 ml calamansi juice/l of water had higher rate of absorption taking up 64.44 ml at the termination of observations.

Interaction effect. Likewise there were no significant effects obtained between the different varieties of Lisianthus cutflowers and the different concentrations of calamansi juice in the holding solution with regards to the volume of solution taken up.

Table 2. Final volume of the solution taken up (ml)

TREATMENT	MEAN
Stage of Flower Opening (%)	
25	41.33[a]
50	57.33a
75	48.33[a]
Concentration of Calamansi juice (ml/liter)	
250 ppm citric acid (control	38.39[a]
5	44.44[a]
10	52.22[a]
15	64.44[a]
20	44.44[a]

Means with the same letter are not significantly different at 5% level by DMRT

Maximum Flower Diameter Attained (cm)

Effect of stage of flower development of harvest. Table 3 shows the observed maximum cutflower diameter attained. Cutflowers harvested at 75% anthesis displayed a maximum flower diameter of 9.29 cm and were significantly bigger compared to the cutflowers harvested at 25% and 50% anthesis. The smallest blooms were measured from cutflowers harvested at 25% anthesis with a mean of 6.99 cm.

Effect of concentration of calamansi juice. Differences obtained on the effect of holding solution did not significantly affect the maximum flower diameter attained. However, Lisianthus cutflowers held in 5 ml calamansi/l of water had smaller blooms attaining a diameter of 7.36 cm only. The results imply that the concentration of calamansi juice in the holding solution did not affect further flower opening in lisianthus cutflowers harvested at different stage of development.

Interaction effect. Statistical analysis showed that there were no significant effects between the three stages of flower development and the different holding solutions with regards to the maximum flower diameter attained. However, cutflowers harvested at 75% anthesis which were held in 250 ppm citric acid solution attained the biggest blooms with maximum flower diameter of 10.03 cm, while cutflowers harvested at 25% anthesis and held in 250 ppm citric acid solution had the smallest blooms with maximum flower diameter of only 5.83 cm.

Table 3. Maximum flower diameter attained (cm)

TREATMENT	MEAN
Stage of Flower Opening (%)	
25	6.99[c]
50	7.81[b]
75	4.29[a]
Concentration of Calamansi juice (ml/liter)	
250 ppm citric acid (control	7.90[ab]
5	7.36[b]
10	8.04[ab]
15	8.59[a]
20	8.26[ab]

Means with the same letter are not significantly different at 5% level by DMRT

Flower Quality

Effect of stage of flower development at harvest. Table 4 shows the observed flower quality rating of lisianthus cutflower from day 1 to day 14. Statistical analysis showed that there were significant differences obtained on the effect of stage of flower development at harvest on the flower quality rating of lisianthus cutflowers from day 4 today 10. The lowest flower quality ratings observed at 1.80, 2.46 and 3.80 were from day 4, 7 and day 10 respectively, which means that lisanthus cutflowers had 30-40% petals with damage; while on day 13 to day 14 there were no significant differences noted.

Effect of concentration of calamansi juice. There were no significant differences observed from day 1 to day 14 with regards to the effect of the different holding solutions on flower quality rating.

Interaction effect. Likewise, there were no significant interaction effects obtained between the different stage of flower development of lisianthus cutflowers at harvest and different holding solutions with regards to flower quality rating from day 1 to day 14 of observations.

Table 4. Flower quality

TREATMENT	NUMBER OF DAYS					
	1	4	7	10	13	14
Stage of Flower Opening (%)	M E A N					
25	1.00[a]	1.07[b]	1.27[b]	2.47[b]	4.20[a]	5.00[a]
50	1.13[a]	1.33[ab]	1.60[b]	2.47[b]	4.13[a]	4.80[a]
75	1.13[a]	1.80[a]	2.47[a]	3.80[a]	4.47[a]	5.00[a]
Concentration of Calamansi Juice (ml/liter)						
250 ppm citric acid (control)	1.11[a]	1.78[a]	1.89[a]	2.67[a]	4.33[a]	5.00[a]
5	1.00[a]	1.22[a]	1.56[a]	2.78[a]	4.22[a]	4.89[a]
10	1.11[a]	1.33[a]	1.89[a]	2.67[a]	4.11[a]	4.89[a]
15	1.11[a]	1.33[a]	1.78[a]	3.33[a]	4.33[a]	4.89[a]
20	1.11[a]	1.33[a]	1.78[a]	3.11[a]	4.33[a]	5.00[a]

Means with the same letter are not significantly different at 5% level by DMRT.

Leaf Quality

Effect of stage of flower development at harvest. Table 5 shows that on day 7 and day 9 no significant differences obtained on the leaf quality rating as affected by the different stages of flower development at harvest. However, starting on the 11th day significant differences were noted. Lisianthus cutflowers harvested at 25% anthesis had the highest leaf quality rating of 2.73 followed by 50% anthesis with a leaf quality rating of 2.87 which is 25% discoloration and Lisianthus cutflowers harvested at 75% anthesis had the lowest leaf quality rating. Likewise, on day 13 and d ay 14, no significant differences were obtained, on day 13, lisianthus cutflowers harvested at 50% anthesis had the highest leaf quality rating of 3.93 which is 50% yellowing; while at day 14 it was observed that lisianthus cutflowers had the poorest leaf quality rating of 4.87.

Effect of concentration of calamansi juice. It was observed that from day 7 to day 11 lisianthus cutflowers held in 5 ml calamansi juice/1 water solution had the best leaf quality rating of 2.77, while in day 13 to day 14; cutflowers held in 5 ml calamansi/1 water had the highest leaf quality rating of 3.89 that was observed in day 13 followed by lisianthus cutflowers held in 10 ml calamansi juice/1 water with a leaf quality rating of 4.67. On the other hand, cutflowers held in 250 ppm citric acid solution, and three with 20 ml calamansi juice/l of water; had the highest defects of leaves with a mean of 5.00 after the termination of observation.

Interaction effect. There were no significant interaction effects noted between the different stage of flower development at harvest and effects of the different concentrations of calamansi juice on the holding solution on leaf quality of lisianthus cutflowers from day 1 to day 14.

Table 5. Leaf quality

TREATMENT	NUMBER OF DAYS 7	9	11	13	14
Stage of Flower Opening (%)					
25	1.13[a]	1.67[a]	2.73[b]	4.00[a]	4.80[a]
50	1.00[a]	1.67[a]	2.87[ab]	3.93[a]	4.80[a]
75	1.00[a]	1.60[a]	3.93[a]	4.33[a]	4.87[a]
Concentration of Calamansi Juice (ml/liter)					
250 ppm citric acid (control)	1.00[a]	1.89[a]	3.22[a]	4.11[a]	5.00[a]
5	1.11[a]	1.44[a]	2.78[a]	3.89[a]	4.67[a]
10	1.00[a]	1.78[a]	3.22[a]	4.00[a]	4.67[a]
15	1.00[a]	1.67[a]	3.56[a]	4.33[a]	4.78[a]
20	1.11[a]	1.44[a]	3.11[a]	4.11[a]	5.00[a]

Means with the same letter are not significantly different at 5% level by DMRT

Stem Quality

Effect of stage of flower development at harvest. Table 6 shows that there were no significant differences obtained on the stem quality rating as affected by the different stages of flower developmental at harvest. At day 1 lisianthus cutflowers harvested at 75% anthesis had the lowest stem quality rating of 2.67 (deep green and rotting at the base (>2.54 cm) while higher stem quality ratings were recorded in cutflowers harvested at 25% anthesis with a mean of 2.26 (deep green and rotting at the base (<2.54 cm). At day 14 cutflowers harvested at 50% anthesis had the highest stem quality rating of 6.46 (yellow green and rotting an the base (<7.62 cm) while those harvested at 25% anthesis

and 75% anthesis had the lowest stem quality rating of 6.53 and 6.66 respectively which is (yellow and rotting at the base 1 >7.62 cm).

Effect of concentration of calamansi juice. No significant differences were likewise obtained on the stem quality rating of lisianthus cutflowers as affected by the different holding solutions used at day 1. Results show that ratings range from 2.22 to 2.88 which is (deep green and rotting at the base <2.54 cm. However from day 4 to day 14, highly significant differences were obtained on the stem quality rating of lisianthus cutflowers as affected by the holding solution. On the 4th day, cutflowers held in 5 ml calamansi/l of water had the highest stem quality rating of 3.11 (deep green and rooting at the base (>2.54 cm); while cutflowers held in 250 ppm citric acid solution had the lowest stem quality rating of 7.0, which was yellow green and rotting at the base (>7.62 cm). At day 13 to 14 still cutflowers held in 5 ml calamansi juice/1 water had the highest stem quality rating compared to those held in 250 ppm citric acid, and in 20 ml calamansi/1 water had the lowest stem quality rating of 7.0 which is yellow green and rotting at the base (>7.62 cm).

Interaction effect. There were no significant differences between the different stages of flower development at harvest and the different concentrations of calamansi juice in the holding solution on the stem quality rating of lisianthus from the duration of observations.

Table 6. Stem quality rating

TREATMENT	NUMBER OF DAYS 1	4	7	10	13	14
Stage of Flower Opening (%)			M E A N			
25	2.27[a]	4.93[a]	5.73[a]	5.87[a]	6.53[a]	6.53[a]
50	2.40[a]	4.67[a]	5.27[b]	5.67[a]	6.27[a]	6.47[a]
75	2.67[a]	5.07[a]	5.40[ab]	5.67[a]	6.67[a]	6.67[a]
Concentration of Calamansi Juice (ml/liter)						
250 ppm citric acid (control)	2.89[a]	6.44[a]	7.00[a]	7.00[a]	7.00[a]	7.00[a]
5	2.22[a]	3.11[d]	4.00[d]	4.22[d]	5.22[b]	5.44[b]
10	2.22[a]	4.00[c]	4.56[c]	5.00[c]	6.44[a]	6.56[a]
15	2.44[a]	5.33[b]	5.89[b]	6.11[b]	6.78[a]	6.78[a]
20	2.44[a]	5.56[b]	5.89[b]	6.33a[b]	7.00[a]	7.00[a]

Means with the same letter are not significantly different at 5% level by DMRT.

Final pH of Holding Solutions

Effect of stage of flower development at harvest. Statistical analysis showed that there were no significant differences on the final pH of holding solution as affected by the stage of harvest of lisianthus cutflower. However, the holding solution where cutflowers harvested at 50% anthesis were held had the highest final pH of 6.03 while the holding solution of cutflowers harvested at 25% anthesis and the holding solutions where cutflowers harvested at 75% anthesis had the lower pH of 5.81 (Table 7).

Effect of calamansi juice. Highly significant differences were obtained on the final pH of the different holding solutions. Solution of 5 ml calamansi juice/l of water

had the highest pH reading of 6.57, followed by 10ml calamansi juice/1 water with a pH of 6.14 while solution of 2.50 ppm citric acid solution and 20 ml calamansi juice/1 water had the lowest pH reading of 5.19 and 5.44 respectively.

Interaction effect. Statistical analysis shows no significant interaction effects between the stage of flower development at harvest and the different holding solution with regards to final pH of the holding solution at the termination of observations.

Daily Temperature (^{o}C)

The daily temperature of the holding room was recorded every 10:00 a.m. to 2:00 p.m. Observations show that there were no drastic fluctuations in the temperature of the holding room which ranged from 21oC to 22oC.

Table 7. Initial and final pH of holding solution

TREATMENT	INITIAL	FINAL
Stage of Flower Development at Harvest (%)		
25		5.81[a]
50		6.03[a]
75		5.81[a]
Concentration of Calamansi Juice (ml/liter)		
250 ppm citric acid (control)	6.2	5.19[c]
5	6.1	6.57[a]
10	5.9	6.14[ab]
15	5.2	6.05[b]
20	5.2	5.44[c]

Means with the same letter are not significantly different at 5% level by DMRT

Table 8. Daily temperature (^{o}C)

DATE	TEMPERATURE (^{o}C)	
	10:00 a.m.	2:00 p.m.
October 21, 2008	21	22
October 22, 2008	22	22
October 23, 2008	22	22
October 24, 2008	22	22
October 25, 2008	22	22
October 26, 2008	22	22
October 27, 2008	21	21
October 28, 2008	21	22
October 29, 2008	21	22
October 30, 2008	22	22
October 31, 2008	22	22
November 1, 2008	22	22
November 2, 2008	22	22
November 3, 2008	22	22
November 4, 2008	21	22
November 5, 2008	22	22
November 6, 2008	22	22

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

Lisianthus cutflowers were harvested at their different stages of flower development at 25%, 5% and 75% and were pulsed – fed with 10% sucrose in 24 hours. It was held in various concentration of calamansi juice and .25 grams of citric acid that was used in S_0 as control.

Result show that Lisianthus cutflowers harvested at 50% anthesis held in 10 ml/1 of water had longer vaselife compared to cutflowers harvested at 25% and 75% anthesis and held in different holding solutions.

In terms of maximum flower diameter, Lisianthus harvested at 25% antehsis held in 5 ml/1 of water had the smallest diameter of 6.26 cm while the biggest blooms were attained by those cutflowers harvested at 75% anthesis with a mean of 10.03 cm.

Good stem qualities were recorded in cutflowers harvested at 25%, 50% and 75% anthesis held in 5 ml/1 of water. For the flower quality cutflowers harvested at 25%, 50% and 75% anthesis held in 5 ml/1 of water, 10 ml/l of water and 15 ml/l of water solution had the highest quality rating showing a lesser damaged in flowers. Likewise showing a lesser damaged in leaf quality.

Conclusion

Results show that calamansi juice at 10 ml/1 of water of the holding solution only can be used to prolong the vaselife of Lisianthus cutflowers harvested at 50% anthesis for 15.0 days; while concentrations of 10 ml calamansi juice/1 water and 15 ml calamansi

juice/1 of water can be used in cutflowers harvested at 25% anthesis for 14 days of vaselife.

Recommendation

It is therefore recommended, that holding solutions with calamansi juice at the rate of 10 ml/1 of water only, can be used to prolong the vaselife of lisianthus cutflowers harvested at 50% anthesis. In terms of maintenance of flower quality; calamansi juice at the concentration of 5, 10 and 15 ml/1 of water can be used. Further studies on the use of other sources of acidifiers are recommended to prolong the vaselife of lisianthus cutflowers.

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APPENDICES

Appendix Table 1. Vaselife (days)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	10	14	14	38	12.67
S_1	10	14	10	34	11.33
S_2	14	14	14	42	14.00
S_3	14	14	14	42	14.00
S_4	14	14	14	42	14.00
50%					
S_0	14	9	14	37	12.33
S_1	14	14	17	45	15.00
S_2	17	14	14	45	15.00
S_3	10	17	10	37	12.33
S_4	14	10	14	38	12.67
75%					
S_0	14	9	14	37	12.33
S_1	9	14	14	37	12.33
S_2	9	10	14	33	11.00
S_3	14	9	9	32	10.67
S_4	14	10	9	33	11.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	35.378	17.689	3.10 ns	3.32	5.39
Factor B	4	5.911	1.478	0.26 ns	2.69	4.02
A x B	8	42.622	5.328	0.93 ns	2.25	3.17
Error	30	171.333	5.711			
TOTAL	44	255.244				

Ns – not significant Coefficient of variation = 18.80%

Appendix Table 2. Final volume of solution taken-up (ml)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	40	30	40	110	36.67
S_1	30	50	30	110	36.67
S_2	30	40	40	110	36.67
S_3	50	100	30	180	60.00
S_4	40	30	40	110	36.67
50%					
S_0	30	40	40	110	36.67
S_1	40	40	50	130	43.33
S_2	150	50	40	240	80.00
S_3	30	140	50	220	73.33
S_4	30	90	40	160	53.33
75%					
S_0	50	40	40	130	43.33
S_1	50	80	30	160	53.33
S_2	50	40	30	120	40.00
S_3	50	110	40	180	60.00
S_4	50	50	30	130	43.33

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	1937.778	17.689	3.10 ns	3.32	5.39
Factor B	4	3533.333	1.478	0.26 ns	2.69	4.02
A x B	8	2840.000	5.328	0.93 ns	2.25	3.17
Error	30	25133.333	5.711			
TOTAL	44	33444.444				

Ns – not significant Coefficient of variation = 59.20%

Appendix Table 3. Maximum flower diameter attained (cm)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	4.5	8.0	5.0	17.5	5.83
S_1	5.6	7.7	5.5	18.8	6.27
S_2	8.0	5.5	6.0	19.5	6.50
S_3	7.5	8.9	8.0	24.4	8.13
S_4	8.2	8.0	8.5	24.7	8.23
50%					
S_0	7.5	9.0	7.0	23.5	7.83
S_1	6.0	7.5	8.2	21.7	7.23
S_2	9.2	8.0	8.0	25.2	8.40
S_3	7.5	7.5	9.4	24.4	8.13
S_4	8.0	9.8	5.5	23.3	7.77
75%					
S_0	10.0	10.2	9.9	30.1	10.03
S_1	9.5	8.0	8.2	25.7	8.57
S_2	9.5	9.8	9.4	28.7	9.57
S_3	9.5	10.0	9.0	28.5	9.50
S_4	8.5	8.9	8.9	26.3	8.77

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	40.556	20.278	18.31**	3.32	5.39
Factor B	4	7.517	1.879	1.69ns	2.69	4.02
A x B	8	13.272	1.659	1.49ns	2.25	3.17
Error	30	33.407	1.113			
TOTAL	44	94.752				

ns – not significant Coefficient of variation = 13.14%

Appendix Table 4. Flower quality rating day 1

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	1	1	1	3	1.00
S_1	1	1	1	3	1.00
S_2	1	1	1	3	1.00
S_3	1	1	1	3	1.00
S_4	1	1	1	3	1.00
50%					
S_0	1	2	1	4	1.33
S_1	1	1	1	3	1.00
S_2	1	2	1	4	1.33
S_3	1	1	1	3	1.00
S_4	1	1	1	3	1.00
75%					
S_0	1	1	1	3	1.00
S_1	1	1	1	3	1.00
S_2	1	1	1	3	1.00
S_3	1	2	1	4	1.33
S_4		1	2	4	1.33

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	0.178	0.089	1.00ns	3.32	5.39
Factor B	4	0.089	0.022	0.25ns	2.69	4.02
A x B	8	0.711	0.089	1.00ns	2.25	3.17
Error	30	2.667	0.089			
TOTAL	44	3.644				

ns – not significant Coefficient of variation = 27.38%

Appendix Table 5. Flower quality rating of day 41

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	2	1	1	4	1.33
S_1	1	1	1	3	1.00
S_2	1	1	1	3	1.00
S_3	1	1	1	3	1.00
S_4	1	1	1	3	1.00
50%					
S_0	1	4	1	6	2.00
S_1	1	1	1	3	1.00
S_2	1	2	1	4	1.33
S_3	2	1	1	4	1.33
S_4	1	1	1	3	1.00
75%					
S_0	1	4	1	6	2.00
S_1	2	1	2	5	1.67
S_2	2	1	2	5	1.67
S_3	1	2	2	5	1.67
S_4	1	2	3	6	2.0

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	4.133	2.067	3.44*	3.32	5.39
Factor B	4	1.689	0.422	0.70ns	2.69	4.02
A x B	8	0.978	0.122	0.20ns	2.25	3.17
Error	30	18.000	0.600			
TOTAL	44	24.800				

ns – not significant
* - highly significant

Coefficient of variation = 55.32%

Appendix Table 6. Flower quality rating at day 7

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	2	1	1	4	1.33
S_1	2	2	1	5	1.67
S_2	2	1	1	4	1.33
S_3	1	1	1	3	1.00
S_4	1	1	1	3	1.00
50%					
S_0	1	4	1	6	2.00
S_1	1	1	1	3	1.00
S_2	1	4	1	6	2.00
S_3	2	1	1	4	1.33
S_4	1	3	1	5	1.67
75%					
S_0	1	4	2	7	2.33
S_1	4	1	1	6	2.00
S_2	4	1	2	7	2.33
S_3	2	4	3	9	3.00
S_4	2	2	4	8	2.67

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	11.511	5.755	4.64*	3.32	5.39
Factor B	4	0.667	0.167	0.13ns	2.69	4.02
A x B	8	0.267	0.533	0.43ns	2.25	3.17
Error	30	37.333	1.244			
TOTAL	44	53.778				

ns – not significant
* - highly significant

Coefficient of variation = 62.75%

Appendix Table 7. Flower quality rating at day 10

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	5	1	1	7	2.33
S_1	5	2	5	12	4.00
S_2	3	1	1	5	1.67
S_3	3	2	1	6	2.00
S_4	2	3	2	7	2.33
50%					
S_0	1	5	1	7	1.33
S_1	1	3	1	5	1.67
S_2	1	4	1	6	2.00
S_3	5	1	5	11	3.67
S_4	1	5	2	8	2.67
75%					
S_0	2	5	3	10	3.33
S_1	5	1	2	8	6.67
S_2	5	5	3	13	4.33
S_3	3	5	5	13	4.33
S_4	3	5	5	13	4.33

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	17.778	8.889	3.25*	3.32	5.39
Factor B	4	3.200	0.800	0.20ns	2.69	4.02
A x B	8	20.667	2.583	0.95ns	2.25	3.17
Error	30	82.000				
TOTAL	44	123.644				

ns – not significant
* - highly significant

Coefficient of variation = 56.79%

Appendix Table 8. Flower quality rating at day 13

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	5	1	1	13	4.33
S_1	5	4	5	14	4.67
S_2	4	4	4	12	4.00
S_3	4	4	4	12	4.00
S_4	4	4	4	12	4.00
50%					
S_0	4	5	4	13	4.33
S_1	4	4	4	12	4.00
S_2	3	4	4	11	3.67
S_3	5	3	5	13	4.33
S_4	4	5	4	13	4.33
75%					
S_0	4	5	4	13	4.33
S_1	5	4	3	12	4.00
S_2	5	5	4	14	4.67
S_3	4	5	5	14	4.67
S_4	4	5	5	14	4.67

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	0.933	0.467	1.31 ns	3.32	5.39
Factor B	4	0.356	0.089	0.25 ns	2.69	4.02
A x B	8	2.844	0.356	1.00 ns	2.25	3.17
Error	30	10.667	0.356			
TOTAL	44	14.800				

ns – not significant Coefficient of variation = 13.97%

Appendix Table 9. Flower quality rating at day 14

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	5	5	5	15	5.00
S_1	5	5	5	15	5.00
S_2	5	5	5	15	5.00
S_3	5	5	5	15	5.00
S_4	5	5	5	15	5.00
50%					
S_0	5	5	5	15	5.00
S_1	5	5	4	14	4.67
S_2	4	5	5	14	4.67
S_3	5	4	5	14	4.67
S_4	5	5	5	15	5.00
75%					
S_0	5	5	5	15	5.00
S_1	5	5	5	15	5.00
S_2	5	5	5	15	5.00
S_3	5	5	5	15	5.00
S_4	5	5	5	15	5.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	0.400	0.200	3.00 ns	3.32	5.39
Factor B	4	0.133	0.033	0.50 ns	2.69	4.02
A x B	8	0.267	0.033	0.50 ns	2.25	3.17
Error	30	2.000	0.067			
TOTAL	44	2.800				

ns – not significant Coefficient of variation = 5.23%

Appendix Table 10. Leaf quality rating at day 7

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	1	1	1	3	1.00
S_1	2	1	1	4	1.33
S_2	1	1	1	3	1.00
S_3	1	1	1	3	1.00
S_4	1	1	1	4	1.33
50%					
S_0	1	1	1	3.00	1.00
S_1	1	1	1	3.00	1.00
S_2	1	1	1	3.00	1.00
S_3	1	1	1	3.00	1.00
S_4	1	1	1	3.00	1.00
75%					
S_0	1	1	1	3.00	1.00
S_1	1	1	1	3.00	1.00
S_2	1	1	1	3.00	1.00
S_3	1	1	1	3.00	1.00
S_4	1	1	1	3.00	1.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	0.178	0.089	2.00 ns	3.32	5.39
Factor B	4	0.133	0.033	0.75 ns	2.69	4.02
A x B	8	0.267	0.033	0.75 ns	2.25	3.17
Error	30	1.333	0.044			
TOTAL	44	1.9112.800				

ns – not significant Coefficient of variation = 20.18%

Appendix Table 11. Leaf quality rating day 9

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	2	1	2	5	1.67
S_1	3	1	2	6	2.00
S_2	2	1	2	5	1.67
S_3	1	2	2	5	1.67
S_4	1	2	1	4	1.33
50%					
S_0	3	2	2	7	2.33
S_1	1	1	2	4	1.33
S_2	1	2	1	4	1.33
S_3	3	1	2	6	2.00
S_4	2	1	1	4	1.33
75%					
S_0					
S_1					
S_2					
S_3					
S_4					

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	0.400	0.200	3.00 ns	3.32	5.39
Factor B	4	0.133	0.033	0.50 ns	2.69	4.02
A x B	8	0.267	0.033	0.50 ns	2.25	3.17
Error	30	2.000	0.067			
TOTAL	44	2.800				

ns – not significant Coefficient of variation = 5.23%

Appendix Table 12. Leaf quality rating at day 11

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	5	1	2	8	2.67
S_1	5	2	5	12	4.00
S_2	3	1	4	8	2.67
S_3	2	2	3	7	2.33
S_4	1	3	2	6	2.00
50%					
S_0	3	5	3	11	3.67
S_1	1	2	2	5	1.67
S_2	2	3	2	7	2.33
S_3	5	1	5	11	3.67
S_4	3	5	1	9	3.00
75%					
S_0	2	5	3	10	3.33
S_1	5	1	2	8	2.67
S_2	5	5	4	14	4.67
S_3	4	5	5	14	4.67
S_4	3	5	5	13	4.33

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	12.978	6.489	3.14*	3.32	5.39
Factor B	4	2.800	0.700	0.34 ns	2.69	4.02
A x B	8	22.800	2.850	1.38 ns	2.25	3.17
Error	30	62.000	2.067			
TOTAL	44	100.578				

ns – not significant
* - significant

Coefficient of variation = 45.23%

Appendix Table 13. Leaf quality rating at day 13

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	5	3	4	12	3.00
S_1	5	4	5	14	4.67
S_2	4	3	4	11	3.67
S_3	4	4	4	12	4.00
S_4	3	4	4	11	3.67
50%					
S_0	4	5	4	13	4.33
S_1	3	3	4	10	3.33
S_2	3	4	4	11	3.67
S_3	5	3	5	13	4.33
S_4	4	5	3	12	4.00
75%					
S_0	3	5	4	12	4.00
S_1	5	2	4	11	3.67
S_2	5	5	4	14	4.67
S_3	4	5	5	14	4.67
S_4	4	5	5	14	4.67

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	1.378	0.689	1.07 ns	3.32	5.39
Factor B	4	0.078	0.244	0.38 ns	2.69	4.02
A x B	8	5.956	0.744	1.16 ns	2.25	3.17
Error	30	19.333	0.644			
TOTAL	44	27.644				

ns – not significant Coefficient of variation = 19.60%

Appendix Table 14. Leaf quality rating at day 14

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	5	4	5	14	4.67
S_1	5	5	5	15	5.00
S_2	5	4	5	14	4.67
S_3	4	5	5	14	4.67
S_4	4	5	5	14	4.67
50%					
S_0	4	5	5	14	4.67
S_1	4	4	4	12	4.00
S_2	4	5	4	13	4.33
S_3	5	4	5	14	4.67
S_4	5	5	4	14	4.67
75%					
S_0	4	5	5	14	4.67
S_1	5	2	4	11	3.67
S_2	5	5	5	15	5.00
S_3	5	5	5	15	5.00
S_4	4	5	5	14	4.67

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	0.533	0.267	0.71 ns	3.32	5.39
Factor B	4	1.689	0.422	1.12 ns	2.69	4.02
A x B	8	3.244	0.405	1.07 ns	2.25	3.17
Error	30	11.333	0.378			
TOTAL	44	16.800				

ns – not significant Coefficient of variation = 13.36%

Appendix Table 15. Final pH of the holding solution

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	4.9	5.2	4.4	14.5	4.83
S_1	6.6	6.8	6.5	19.9	6.63
S_2	6.2	6.3	6.0	18.5	6.17
S_3	6.1	6.3	6.3	18.7	6.23
S_4	6.0	5.0	4.5	15.5	5.17
50%					
S_0	4.8	6.2	4.7	15.7	5.23
S_1	6.9	6.5	6.8	20.2	6.73
S_2	6.8	6.6	5.5	18.9	6.30
S_3	6.0	5.8	6.3	18.1	6.03
S_4	6.2	6.1	5.2	17.5	5.83
75%					
S_0	4.5	6.0	6.0	16.5	5.50
S_1	6.1	6.4	6.5	19.0	6.33
S_2	6.0	6.1	5.8	17.9	5.97
S_3	5.5	6.4	5.8	17.7	5.90
S_4	5.3	4.8	5.9	16.0	5.33

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	0.484	0.242	0.97 ns	3.32	5.39
Factor B	4	11.156	2.789	11.19**	2.69	4.02
A x B	8	1.511	0.189	0.76	2.25	3.17
Error	30	7.480	0.249			
TOTAL	44	20.632				

ns – not significant
** - highly significant

Coefficient of variation = 8.49%

Appendix Table 16. Stem quality rating day 1

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	2	4	2	8	2.67
S_1	2	2	2	6	2.00
S_2	2	2	2	6	2.00
S_3	2	2	2	6	2.00
S_4	2	4	2	8	2.67
50%					
S_0	2	4	2	8	2.67
S_1	2	2	2	6	2.00
S_2	2	2	2	6	2.00
S_3	2	2	4	8	2.67
S_4	2	2	4	8	2.67
75%					
S_0	4	2	4	10	2.33
S_1	4	2	2	8	2.67
S_2	4	2	2	8	2.67
S_3	2	4	2	8	2.67
S_4	2	2	2	6	2.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	1.244	0.622	0.78ns	3.32	5.39
Factor B	4	2.667	0.667	0.83	2.69	4.02
A x B	8	3.200	0.400	0.50ns	2.25	3.17
Error	30	24.000	0.800			
TOTAL	44	255.244				

Ns – not significant Coefficient of variation = 36.59%

Appendix Table 17. Stem quality rating at day 4

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	6	6	6	18	6.00
S_1	2	2	4	8	2.67
S_2	6	4	4	14	4.67
S_3	6	4	6	16	5.33
S_4	6	6	6	18	6.00
50%					
S_0	7	6	7	20	6.67
S_1	2	4	2	8	2.67
S_2	4	2	4	10	3.33
S_3	4	6	6	16	5.33
S_4	4	6	6	16	5.33
75%					
S_0	7	6	7	20	6.67
S_1	4	4	4	12	4.00
S_2	4	4	4	12	4.00
S_3	6	4	6	16	5.33
S_4	6	6	6	14	4.67

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	1.244	0.622	0.74ns	3.32	5.39
Factor B	4	63.111	15.778	18.68**	2.69	4.02
A x B	8	6.755	6.844	1.00ns	2.25	3.17
Error	30	25.333	0.844			
TOTAL	44	96.444				

ns – not significant
** - highly significant

Coefficient of variation = 18.79%

Appendix Table 18. Stem quality rating at day 7

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	7	7	7	21	7.00
S_1	4	4	4	12	4.00
S_2	6	4	6	16	5.33
S_3	6	6	6	18	6.00
S_4	6	7	6	19	6.33
50%					
S_0	7	7	7	21	7.00
S_1	4	4	4	12	4.00
S_2	4	4	4	12	4.00
S_3	6	6	6	18	6.00
S_4	4	6	6	16	5.33
75%					
S_0	7	7	7	21	7.00
S_1	4	4	4	12	4.00
S_2	4	4	6	14	4.67
S_3	6	6	6	18	6.00
S_4	6	6	6	18	6.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	1.644	0.822	2.85ns	3.32	5.39
Factor B	4	50.355	12.589	43.58**	2.69	4.02
A x B	8	2.578	0.322	1.12ns	2.25	3.17
Error	30	8.667	0.289			
TOTAL	44	63.244				

ns – not significant
** - highly significant

Coefficient of variation = 9.75%

Appendix Table 19. Stem quality rating at day 10

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	7	7	7	21	7.00
S_1	4	4	4	12	4.00
S_2	7	6	6	19	6.33
S_3	6	6	6	18	6.00
S_4	7	7	7	21	7.00
50%					
S_0	7	7	7	21	7.00
S_1	4	4	4	12	4.00
S_2	4	6	6	16	5.33
S_3	6	6	7	19	6.33
S_4	6	7	7	21	6.33
75%					
S_0	7	7	7	21	7.00
S_1	7	4	6	17	5.67
S_2	7	4	6	17	5.67
S_3	6	7	7	20	6.67
S_4	6	6	7	19	6.33

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	0.844	0.422	0.86ns	3.32	5.39
Factor B	4	34.311	8.578	17.55**	2.69	4.02
A x B	8	7.822	0.978	2.00ns	2.25	3.17
Error	30	14.667	0.489			
TOTAL	44	57.644				

ns – not significant
** - highly significant

Coefficient of variation = 11.48%

Appendix Table 20 Stem quality rating at day 13

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	7	7	7	21	7.00
S_1	7	4	7	18	6.00
S_2	7	6	6	19	6.33
S_3	7	6	6	19	6.33
S_4		7	7	21	7.00
50%					
S_0	7	7	7	21	7.00
S_1	4	6	4	14	4.67
S_2	6	7	7	20	6.67
S_3	7	7	7	21	7.00
S_4	7	7	7	21	7.00
75%					
S_0	7	7	7	21	7.00
S_1	7	4	6	17	5.67
S_2	7	7	6	20	6.67
S_3	7	7	7	21	7.00
S_4	7	7	7	21	7.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	0.311	0.156	0.29 ns	3.32	5.39
Factor B	4	15.111	3.778	7.08 **	2.69	4.02
A x B	8	3.689	0.461	0.86ns	2.25	3.17
Error	30	16.00	0.533			
TOTAL	44	35.111				

ns – not significant
** - highly significant

Coefficient of variation = 11.14 %

Appendix Table 21 Stem quality rating day 14

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
25%					
S_0	7	7	7	21	7.00
S_1	7	4	7	18	6.00
S_2	7	6	6	19	6.33
S_3	7	6	7	20	6.67
S_4	7	7	7	21	7.00
50%					
S_0	7	7	7	21	7.00
S_1	4	6	4	14	4.67
S_2	6	7	7	20	6.67
S_3	7	7	7	21	7.00
S_4	7	7	7	21	7.00
75%					
S_0	7	7	7	20	7.00
S_1	7	4	6	17	5.67
S_2	7	7	6	20	6.67
S_3	7	7	7	21	7.00
S_4	7	7	7	21	7.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE	TABULAR F 0.05	0.01
Factor A	2	0.311	0.156	0.29 ns	3.32	5.39
Factor B	4	15.644	3.911	7.33 **	2.69	4.02
A x B	8	3.022	0.378	0.71 ns	2.25	3.17
Error	30	16.000	0.533			
TOTAL	44	34.978				

ns – not significant
** - highly significant

Coefficient of variation = 11.10 %