BIBLIOGRAPHY

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ABSTRACT

The study was conducted to determine the effect of the different holding solutions on the vaselife and other postharvest characteristics of four varieties of gerbera and to determine the best holding solution that will prolong the vaselife of the four varieties of gerbera.

Gerbera cutflowers at 25 % anthesis of flower maturity were held in distilled water, 20 g sucrose + 5 ml chlorox per liter water, 20 g sucrose + 10 ml chlorox per liter water, 20 g sucrose + 1 g ascorbic acid + 5 ml chlorox per liter water and 20 g sucrose + 250 ppm 7- up + 5 ml chlorox per liter of water.

Results showed that distilled water can be used to prolong the vaselife of gerberas harvested at 25% anthesis. Distilled water also promoted better quality of flower and cutflower and it also lessened the percentage of neck bending and stem browning.

Among the four gerbera varieties, cv. cosmo or a yellow colored gerbera was the best among the different vaieties. This variety had the longest vaselife of 21 days and maintained the best quality in terms of flowers and stems.

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INTRODUCTION

Gerbera (*Gerbera jamesonii L.*) popularly known as Transvaal daisy, is one of the ten most popular commercial cut flowers in the world and according to the global trends in floriculture, it occupies the fourth place among cutflowers (Choudhary and Prasad, 2000). It is in considerable demand in both domestic and export markets.

The blooms are attractive, suitable for any type of floral arrangements and are available in different shades and hues. Besides floral arrangements, gerbera is widely used in bouquets and in dry flower crafts. The cutflowers have a long vaselife, which fetches premium market prices. The flowers are hardy and stand the rigors of transportation admirably. Gerbera comes up well under a wide range of climatic conditions and topographies. Due to changes in social and cultural life style of people, cut flowers have found an important place in various social functions and daily activities.

This flower is associated with star sign Leo (Larson, 1980). The meanings of gerbera flowers stem from those attributed to the general daisy family. These meanings include innocence and purity, and daisies are also a classic symbol of beauty. However, the gerbera variety holds an added meaning of cheerfulness, which stems from the assortment of colors available.

Unlike other cutflower such as anthurium whose flowers are readily available in the market every time it is needed, gerbera is rarely seen in flower shops and if available the quantity is limited even though it is an herbaceous perennial. This is attributed to the few numbers of growers who ventured into the production of this potential cutflower. Related to this, observation show that the vaselife of gerbera is

shorter with 7 to 10 days using tap water only compared to anthurium and chrysanthemum with longer vaselife.

Postharvest techniques to prolong vaselife are important in cutflower production and marketing in advanced countries. Cutflower are stored using either controlled atmosphere and refrigerated storage trucks and van along with preservatives for opening and lengthening the vaselife of cutflowers.

There is lack of information in the postharvest life of these less popular cutflowers in the local market but are being grown and used commercially in the national and international markets. Some growers and florists know some of the postharvest techniques to lengthen the Vaselife of cutflowers but there is lack of facilities and chemicals to use. Lengthening the life of cutflowers is a problem to growers especially when the prise is high and when there is empending bad weather. Consumers and florist also want to prolong the Vaselife of cutflowers by maintaining their aesthetic value for longer periods prior to marketing to wait for higher price.

Keeping quality is an important parameter for evaluation of cut flower quality, for both domestic and export markets. Addition of chemical preservatives to the holding solution is recommended to prolong the vase-life of cut flowers. All holding solutions must essentially contain two components viz., sugar and germicides. The sugars provide a respiratory substrate, while the germicides control harmful bacteria and prevent plugging of the conducting tissues. Therefore, the techniques of prolonging the vase-life of flowers will be a great asset to the growers and users.

Growing gerbera can be developed as a profitable business in Baguio and Benguet. Production of gerbera cutflowers could also provide a good source of income.

Growers of cutflowers are not yet knowledgeable on the issues concerning the postharvest losses and as a result, the country's cutflower industry declines. The cutflower industry must then be quick to adapt to the continually changing market demand if it is to remain viable. This includes the need to respond to the increasing sophisticated cutflowers in terms of quality and volume.

And finally, it is hoped that this study will help gerbera growers in prolonging the postharvest life of their cutflower and make these flowers available in the market throughout the year.

The study was conducted to determine the postharvest characteristics of the four varieties of gerbera held at the different holding solutions and to determine the best holding solutions that will prolong postharvest life of the three varieties of gerbera.

The study was conducted at the Horticulture Service Laboratory of the Department of Horticulture, Benguet State University, La Trinidad Benguet from February to March 2010.

REVIEW OF LITERATURE

The Crop

The Gerbera Daisy or Gerbera is also known as the Transvaal Daisy, African Daisy, Barberton Daisy. Gerbera daisies are colourful plants that belong to the Asteraceae family. It is native to South Africa (the Transvaal and Cape Province) and was named after German naturalist Traugott Gerber in 1743. Gerbera Daisies are now grown commercially in large quantities in California, Florida and also in the Netherlands, Columbia and surrounding countries in South America, and Israel.

The flat-faced, symmetrical, daisy-like flowers, 2-5 inches (5-12 cm) across, possess a beautiful satin sheen. They have a yellow or dark center. The thin, leafless flower stalk varies between 10-24 inches (25-60 cm) in length. Gerbera species bear a large capitulum with striking, two-lipped ray florets in yellow, orange, white, pink or red colors. The capitulum, which has the appearance of a single flower, is actually composed of hundreds of individual flowers. The morphology of the flowers varies depending on their position in the capitulum. The flower heads can be as small as 7 cm (Gerbera mini Harley) in diameter or up to 12 cm (Gerbera Golden Serena).

Gerbera is very popular and widely used as a decorative garden plant or as cut flowers. The domesticated cultivars are mostly a result of a cross between Gerbera jamesonii and another South African species Gerbera viridifolia. The cross is known as Gerbera hybrida. Thousands of cultivars exist. They vary greatly in shape and size. Colors include white, yellow, orange, red, and pink. The center of the flower is sometimes black. Often the same flower can have petals of several different colors

Floral Preservatives

Using a preservative definitely increases the longevity of cut flowers. To survive, flowers need three ingredients: biocides, sugar and acidifiers (Kilkelly, 2009).

A biocide is simply an ingredient that kills bacteria that live in the vase water. The sugars that are in the stem sap and plant food are released into the water when the flowers are added to the vase. Bacteria thrive on these sugars and the bacteria populations increase immediately. When the flowers begin to pull water up the stem during the normal transpiration process, the bacteria clogs the stem and the vase life of the flowers is shortened. A biocide keeps the population of the bacteria under control or very low so the flowers can pull water up the stem without blockage.

Sugar or a sugar-type substance is what is considered the plant "food." This is what the flower uses for energy to stay alive. When a flower is closed or in the bud stage, it needs the energy created by the sugar to open and stay fresh. Sugar also increases bacteria populations so a biocide must be added to the floral preservative to counteract the explosion in bacteria that occurs when sugar is added to the water.

An acidifier is added to the water to lower the pH of the water to as low as 3.0. The reason that flowers last longer in a low pH water environment is that acidic water has an astringent effect that forces the flowers to take up water. Also, acidic water has a sterilizing and disinfecting effect on the vase water. For an acidifier, citric acid is readily available and cheap. It's present in citrus fruits (like lemons, limes and oranges), but these juices color the vase water. Lemon-lime beverages such as Sprite® and 7-Up® are colorless and contain not only citric acid, but sugar. These beverages can be used since carbonation is not important in maintaining flowers.

Holding Solution

Sucrose as a holding solution is beneficial because it is the source of energy due to the closure of stomata and reduction of water loss (Wheally, 1992). Marousky, (1969) found that sucrose solution weight and longevity of cutflower.

According to Rimando (1982), the optimum levels of sucrose must be provided to successfully open cutflowers to quality blooms. Furthermore, the preservatives in addition to extending the vaselife of cutflowers had been used as opening solutions for cutflower harvested at immature stage of flower development.

Organic acids are used to lower the pH of the solution. A low pH was shown favor the activity of the enzyme since acidification of the water tends to minimize physiological stem blockage. A pH of 3.5 to 4.0 extends vaselife because it inhibits indigenous enzymes essential for stem plugging. Citric acid also improves water balance and reduces stem plugging.

Water pH

Acidity alteration is the most important of the three considerations of components of floral preservatives since alkaline or high pH water/solution is damaging to cutflowers. 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 the vinegar. However, vinegar whitens the stem when included in the holding solution (Alacyang, 1998). Citric acid can replace vinegar to increase acidity of the

solution (Anonymous, 2009). Aside from citric acid, ascorbic acid also is used. Ascorbic acid also lowers the pH of the solution and thus it is also used in prolonging the vaselife of cutflowers.

For an acidifier, citric acid is readily available and cheap. It's present in citrus fruits (like lemons, limes and oranges), but these juices color the vase water. Lemon-lime beverages such as Sprite and 7-Up are colorless and contain not only citric acid, but sugar, too. What's more, you can even use these beverages after they've gone flat, since carbonation is not important in maintaining flowers (Greer, 2009).

Vaselife and Longevity of Cutflowers

Temperature is the major factor affecting the storage and vaselife of cutflowers. This is through its influence on the respiration rate of the flowers and their response to ethylene, moisture loss, and physical damage. Cooling is also necessary to reduce other metabolic activities and to slow the rate of opening of flowers. The temperature of flowers and foliage at harvest is normally close to that of the ambient air. At this temperature, respiration activity is very high and storage/ vaselife will be short. Flowers including gerbera are highly perishable and deteriorate quickly when exposed to unfavourable environmental conditions such as adverse temperature. Any technology which ensures cutflowers reach the required low temperature as soon as possible and also maintains this optimal temperature is of considerable benefit to people involved in their production and sale. Rapid cooling is therefore the vital first step in the cool chain of cutflowers (Anonymous, 2009).

Ethylene reduces the longevity of some flowers and foliage by causing rapid wilting of petals, shedding or shattering of petals or other changes to petal tissues such as

loss of change of color. Therefore, flowers which are sensitive to ethylene should not be held in the same cool store as ethylene-producing fruit, vegetable of foliage or be exposed to exhaust fumes.

As cited by Mastalerz (1956), that turgidity of plants and flowers are dependent upon a balance between rate of water supply and plant intake. Turgidity is for the continuance of normal metabolic activity in cutflowers s it is needed for the development of the flower buds to full bloom maturity at high level.

Leopold (1975) also reported that, as distinguished from aging which involves gradual changes in time , same changes may deteriorate but not lethal in themselves. A fresh flower is still a living and actively metabolising entity, whose lifespan is subsequently terminated by senescence that in turn is especially involved in the deteriorating changes that leads to death.

Wheally (1992) stated that free movement of air avoids ethylene build up which greatly affect longevity of flowers.

Rimando (1982) said that for every 10^{o}c rise in temperature, the rate of metabolic processes including the rate of stored food used in respiration is doubled. High temperature favors the opening of flowers and reduces carbohydrate levels which adversely affect flower longevity.

Senescence

A fresh cutflower is still living and actively metabolizing entity whose lifespan is subsequently terminated by senescence as distinguished from aging which involves gradual changes that are deteriorative but not lethal in them (Leopold, 1975). Flower remaining o slower pace plant are also senescing g but at much slower pace. The onset of

senescence maybe related to some antecedents changes that occur before harvest (Mastalerz, 1956).

Senescence is a concept of physiological and biochemical process. The initial event if senescence remains obscure during the development of some cutflower like carnation and rose, a climacteric rise in ethylene production signifies the promotion of senescence. Thereafter, a change in permeability of tissues can be detected (Mayak, 1987).

MATERIALS AND METHODS

The materials used in the study were 4 varieties of gerbera cutflowers harvested at 25% anthesis, catsup bottles, labelling materials, cutter, stirring rod, beaker, weighing balance, aluminum foil and portable pH meter.

Newly harvested gerbera were obtained at 25% anthesis. Before the treatment, the stem ends were cut at the basal ends in a slanting manner before placing them in the different holding solutions. All gerbera cutflowers had a uniform length of 45 cm. All bottles were then covered with aluminum foil.

The study was laid out in a Completely Randomized Design (CRD) in factorial arrangement with varieties as factor A and the different holding solutions as factor B as shown in Figure 1. There were three replications per treatment and one sample cutflower per replication. The volume of the holding solutions was 200 ml per bottle. The cutflowers were held in an ambient room condition for observation.

The different treatments were as follows:

Factor A (Variety)

V_1 - cosmo (yellow)

V_2 – buenavista (orange)

V_3 – figo (figo)

V_4 – carat (yellow-red)

Figure 1. An overview of the experiment 10 days from after setting –up

Factor B (Holding Solutions)

T_1- control (distilled water)

T_2 -20 grams sucrose + 5 ml chlorox / li water

T_3-20 grams sucrose + 10 ml chlorox/li water

T_4-20 grams sucrose + 1 gram ascorbic acid + 5ml chlorox / li water

T_5-20 grams sucrose + 250 ppm uncola pop drink (7-up) +5 ml chlorox/ li water

Data Gathered

1. Vaselife. This was be taken by counting the number of days from holding of the cutflower in the solution up to the onset of senescence.

2. Volume of solution taken up. This was obtained by measuring the final volume of the solution per treatment at the end of the postharvest life of the cut flower and was deducted from the initial volume of 200 ml.

3. Initial and final pH of the holding solution. This measured at holding and termination of the postharvest life of the cutflower using a pH meter.

4. Daily temperature of the room (^{o}C). This was recorded daily.

5. Number of days from holding to 100% anthesis. This was taken by counting the number of days from immersion of the stem ends to full opening of the flower.

6. Maximum flower diameter attained (cm). The maximum diameter of the flower will be measured at full bloom stage.

7. Percentage of neck bending. Percentage of neck bending was taken after the stem ends were soaked in the different holding solutions.

8. Percentage of stem browning. This was taken at the termination of the study using the following index.

Index	Description
10 - 20%	stem browning less than 2.54 cm
21 – 40 %	stem browning at least 2.54 cm
41 – 60 %	stem browning at least 3.81 cm
61 – 80 %	stem browning at least 5.08 cm
81 – 100 %	stem browning at least 6.35 cm

9. Flower quality. This was observed daily for the purpose of evaluation. This was rated using the following rating index.

Index	Description
1	no damage
2	10-20% petals with damage
3	30-40% petals with damage
4	50-70% petals with damage
5	70-100% petals with damage

10. Stem quality. The stem quality of each sample was obtained daily using the following rating index.

Index	Description
1	dark green, no injury
2	green and rotting at the base (<2.54cm)
3	green and rotting at the base (>2.54cm)
4	yellow green and rotting at the base (<2.54)
5	yellow green and rotting at the base (>2.54)

11. Documentation of the study. This was taken through pictures.

RESULTS AND DISCUSSION

Vaselife of cutflowers as affected
by different holding solutions

Vaselife of cutflowers as affected by holding solution is summarized in Table 1.

Effect of variety. Significantly, Cosmo variety exhibited longest vaselife with a mean of 19.600 days followed by the carat, and then the figo while buenavista variety had the shortest vaselife of 14.93 days. This could be attributed to the varietal differences and characteristics affecting the vaselife of cutflowers.

Effect of holding solution. Statistical analysis did not show any significant differences among the different holding solution as far as vaselife is concerned. Numerically however, findings show that gerbera cutflowers held in 20 g sucrose + 5 ml chlorox had the longest vaselife of 16.667 days while those cutflowers soaked in 20 g sucrose + 1 g ascorbic acid + 5 ml chlorox /li water attained the shortest vaselife within 15.50 days.

Rimando (1980) stated that the loss of turgidity, exposure to ethylene, and shortage of respirable substances are most decisive factor, which may trigger the onset of senescence of cutflower at any stage of their development whether they are still attached or already detached from the plant. Waters (1966) concluded that proper storage, methods and postharvest procedures can extend vaselife, but if not correctly used they may do otherwise.

Interaction Effect. No significant differences were observed on the interaction effect among the different varieties and the different holding solution affecting the vaselife of gerbera cutflowers.

Table 1. Vaselife of cutflowers as affected by different holding solutions

TREATMENTS	VASELIFE (days)
Variety	
Cosmo	19.60[a]
Buenavista	12.27[d]
Figo	14.93[c]
Carat	17.80[b]
Holding Solution	
Distilled water (control)	16.58[a]
20 g sucrose + 5 ml chlorox / li water	16.67[a]
20 g sucrose + 10 ml chlorox / li water	15.75[a]
20 g sucrose + 1 g ascorbic acid + 5 ml chlorox /li water	15.50[a]
20 g sucrose + 250 ppm 7 –up + 5 ml chlorox / li water	16.25[a]

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

Initial and Final pH of the Holding Solution

Table 2 shows that initial pH of distilled water is more alkaline compared to the initial pH of the different holding solution which ranges from 6.6 to 6.8.

In the final pH, there was a gradual decrease in the pH of holding solutions containing 20 g sucrose + 1 g ascorbic acid + 5 ml chlorox and 20 g sucrose + 250 ppm 7 – up and including the control or distilled water only while an increase in pH was evident in holding solutions containing 20 g sucrose + 5 ml chlorox and 20g sucrose + 10 ml chlorox.

When the pH of a solution is more acidic, the molecules are more hydrophilic or they tend to stick together more. So, a good preservative includes an agent to lower the pH of the solution, which encourages hydration. This is normally a mild acid such as citric acid or ascorbic acid. Citric acid is readily available and cheap. It's present in citrus fruits (like lemons, limes and oranges), but these juices color the vase water. Lemon-lime

Table 2. Initial and final pH of the holding solution

TREATMENTS	pH	
	INITIAL	FINAL
Variety		
Cosmo		6.66
Buenavista		6.73
Figo		7.03
Carat		6.75
Holding Solution		
Distilled water (control)	7.0	6.88
20 g sucrose + 5 ml chlorox / li water	6.7	6.99
20 g sucrose + 10 ml chlorox / li water	6.6	6.89
20 g sucrose + 1 g ascorbic acid + 5 ml chlorox /li water	6.8	6.62
20 g sucrose + 250 ppm 7 –up + 5 ml chlorox / li water	6.7	6.57

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

beverages such as Sprite and 7-Up are colorless and contain not only citric acid, but sugar too (Greer, 2009).

Volume of Solution Taken – up.

Effect of variety. Statistical analysis show significant differences on the effect of variety to the volume of solution taken –up. Figo gerbera had the highest volume of solution absorbed with a mean of 19.20 ml compared to Cosmo gerbera having the least volume of solution taken –up.

Effect of holding solution. Table 3 shows that gerbera cutflowers held in 20 g sucrose + 5 ml chlorox had significantly faster rate of solution uptake with a mean of 20.42 ml of solution absorbed upon the termination of the study as compared to the flowers held in other solution. On the other hand, cutflowers held in a solution containing 20 g sucrose + 1 g ascorbic acid + 5 ml chlorox had the lowest volume of solution

Table 3. Volume of solution taken-up

TREATMENTS	VOLUME (ml)
Variety	
Cosmo	11.73[b]
Buenavista	17.67[a]
Figo	19.20[a]
Carat	15.73[ab]
Holding Solution	
Distilled water (control)	16.08[ab]
20 g sucrose + 5 ml chlorox / li water	20.42[a]
20 g sucrose + 10 ml chlorox / li water	13.67[b]
20 g sucrose + 1 g ascorbic acid + 5 ml chlorox /li water	14.17[b]
20 g sucrose + 250 ppm 7 –up + 5 ml chlorox / li water	16.08[ab]

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

absorbed with a very slow rate of absorption. Mean was 13.67, which is comparable with those other solution

Interaction effect. Statistical analysis showed no significant interaction on the volume of solution taken – up as affected by the different variety held at the different holding solution. However, yellow gerbera held at 20 g sucrose + 10 ml chlorox absorbed the lowest volume compared to pink gerbera held at 20 g sucrose + 5 ml chlorox absorbing the highest volume of 20.417 ml.

Number of Days to 100% Anthesis

Effect of variety. No significant differences as to the number of days to 100% anthesis prevailed among the varieties tested (Table 4). Buenavista gerbera attained 100% anthesis the earliest in 10.333 days, followed by the carat gerbera with a mean of 10.73 days, the pink with 11.07 days and lastly yellow gerbera attained 100% flower opening in longest day of 11.80.

Table 4. Number of days to 100% anthesis

TREATMENTS	NUMBER OF DAYS
Variety	
Cosmo	11.80[a]
Buenavista	10.33[a]
Figo	11.07[a]
Carat	10.73[a]
Holding Solution	
Distilled water (control)	10.83[a]
20 g sucrose + 5 ml chlorox / li water	10.75[a]
20 g sucrose + 10 ml chlorox / li water	10.83[a]
20 g sucrose + 1 g ascorbic acid + 5 ml chlorox /li water	10.58[a]
20 g sucrose + 250 ppm 7 –up + 5 ml chlorox / li water	11.92[a]

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

Effect of holding solution. As shown in Table 4, there are no significant differences observed on the effect of different holding solutions for the gerbera cutflowers to attain 100% flower opening. However, faster opening was attained by cutflowers held in solution containing 20 g sucrose + 1 g ascorbic acid + 5 ml chlorox with a mean of 10.58. Cutflowers held at 20 g sucrose + 250 7-up opened fully the longest after 11.92 days as shown in Figures 2 to 5.

Interaction effect. No significant differences on the interaction effect of the different varieties of gerbera and the different holding solution. However, cosmo variety when soaked in 20 g sucrose + 250 ppm citric acid + 5 ml chlorox per liter of water will attain the longest days to 100% full flower opening having a mean of 11.92 dayswhile buenavista variety soaked in 20 g sucrose + 5 ml chlorox per liter of water had the shortest days to attain 100% full flower opening with a mean of 10.75days.

Figure 2. Cv. Cosmo (yellow)

Figure 3. Cv. Buenavista (orange)

Figure 4. Cv. Figo (pink)

Figure 5. Cv. Carat (yellow-red)

Maximum Flower Diameter Attained

Effect of variety. Significantly bigger blooms were measured on the buenavista variety with a mean of 9.30 cm. This was followed by the carat with a mean of 8.53 cm which is comparable to the figo having a mean of 8.19cm. Figo gerbera is comparable to the cosmo variety having the smallest bloom of 7.93 cm. Varietal differences and characteristics explain such result.

Effect of holding solution. No significant difference was noted on the effect of holding solution on the maximum diameter of the gerbera cutflower. But, cutflowers held in solutions containing 20 g sucrose + 250 ppm 7-up + 5 ml chlorox had the biggest flower bloom of 8.63 while the smallest flower bloom was noted on the cutflowers held at 20 g sucrose + 1 g ascorbic acid + 5 ml chlorox with a mean of 8.38 cm.

According to Rimando (1982), there are no preservatives, which are equally effective for all types of flowers. The optimum concentrations of different components of preservatives would vary from one flower to another.

Table 5. Maximum flower diameter attained

TREATMENTS	DIAMETER (cm)
Variety	
Yellow	7.93[c]
Orange	9.30[a]
Pink	8.19[bc]
Yellow-red	8.53[b]
Holding Solution	
Distilled water (control)	8.51[a]
20 g sucrose + 5 ml chlorox / li water	8.53[a]
20 g sucrose + 10 ml chlorox / li water	8.40[a]
20 g sucrose + 1 g ascorbic acid + 5 ml chlorox /li water	8.38[a]
20 g sucrose + 250 ppm 7 –up + 5 ml chlorox / li water	8.63[a]

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

The optimum levels of sucrose must be provided to successfully open cutflowers into a quality blooms. Furthermore, the preservatives in addition to extending vaselife had been used as opening solution for cutflowers harvested at immature stage of flower development.

Interaction effect. No significant interaction effect was observed on the maximum flower diameter as affected by the different variety and holding solutions.

Percentage Neck Bending

Effect of variety. Statistical analysis showed that there were significant differences observed. Carat variety showed the highest percentage of neck bending with a mean of 93.33. This is comparable to the cosmo and buenavista. While figo had the lowest percentage of neck bending with a mean of 60.00 percent.

Effect holding solution. Significant differences were observed on the different holding solutions affecting the percentage of stem browning. Cutflowers held in 20 g sucrose + 5 ml chlorox attained 100 percent neck bending compared to cutflowers held in

Table 6. Percentage neck bending

TREATMENTS	PERCENTAGE
Variety	
Yellow	86.67[a]
Orange	86.67[a]
Pink	60.00[b]
Yellow-red	93.33[a]
Holding Solution	
Distilled water (control)	58.33[b]
20 g sucrose + 5 ml chlorox / li water	100.00[a]
20 g sucrose + 10 ml chlorox / li water	75.00[ab]
20 g sucrose + 1 g ascorbic acid + 5 ml chlorox /li water	83.33[ab]
20 g sucrose + 250 ppm 7 –up + 5 ml chlorox / li water	91.67[a]

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

solution containing distilled water only having the lowest percentage of neck bending with a mean of 58.33.

Interaction effect. Significant interaction effect was observed on different varieties of gerbera held at the different holding solutions as shown in Figure 6. Figo variety held at 20 g sucrose + 10 ml chlorox per liter of water had the lowest of zero percentage on neck bending while all the other varieties had all attained 100 percent neck bending when soaked on the different holding solutions except distilled water.

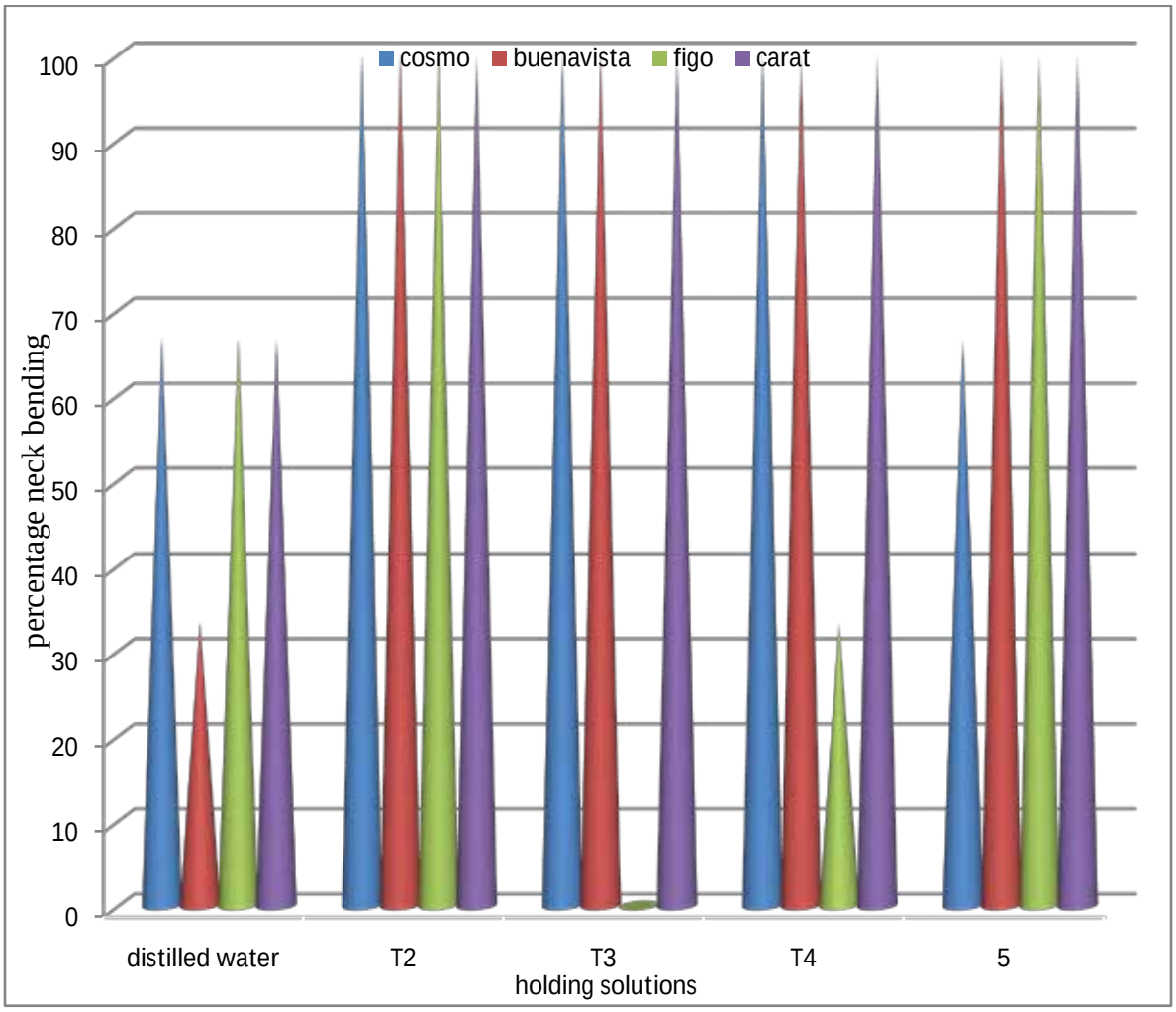

Figure 6. Percentage of neck bending of four varieties of gerbera as affected by different holding solutions

Percentage Stem Browning

Effect of variety. Table 7 shows the effect of variety on the percentage of stem browning. Carat variety attained the highest percentage of stem browning with a mean of 90.33.while cosmo variety maintained the lowest percentage of stem browning.

Effect of holding solution. Statistical analysis showed no significant differences that were observed on the effect of holding solution. However, results showed that the cutflowers that were held in 20 g sucrose + 250 ppm 7 –up + 5 ml chlorox had the lowest percentage of stem browning and cutflowers soaked in a solution containing 20 g sucrose + 10 ml chlorox had the greatest percentage of 77.92 in terms of stem browning.

Interaction effect. No significant interaction effect was noted on the different variety and the different holding solution. However, cosmo soaked in 20 g sucrose + 250 carat soaked in 20 g sucrose + 10 ml chlorox having the greatest percentage of stem browning.

Table 7. Percentage of stem browning

TREATMENTS	PERCENTAGE
Variety	
Yellow	50.00[a]
Orange	78.00[ab]
Pink	68.67[b]
Yellow-red	90.33[a]
Holding Solution	
Distilled water (control)	71.67[a]
20 g sucrose + 5 ml chlorox / li water	72.08[a]
20 g sucrose + 10 ml chlorox / li water	77.92[a]
20 g sucrose + 1 g ascorbic acid + 5 ml chlorox /li water	74.58[a]
20 g sucrose + 250 ppm 7 –up + 5 ml chlorox / li water	62.50[a]

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

Flower Quality

Effect of variety. As shown in Table 8, significant differences were observed on the different varieties in terms of flower quality 10, 15 and 20 days. While there was no different on the 5th day of observation on flower quality. Results reveal that, buenavista gerbera had observed to attain the highest flower quality within the duration of 10 to 20 days. In contrast, cosmo had maintained to have the lesser damage on the flowers within this duration of observation.

Effect of holding solution. Statistical analysis showed that there were no significant differences among the different holding solution on the flower quality of gerbera in the 5th, 10th, 15th, and 20th day of observation.

Interaction effect. No significant interaction effect was obtained between the different varieties and the different holding solutions on the flower quality rating 5, 10 15 and 20 days from holding.

Table 8. Flower quality

TREATMENTS	MEAN 5TH day	10TH day	15TH day	20TH day
Variety				
Yellow	1.00	2.33[b]	3.07[b]	4.40[b]
Orange	1.00	3.00[a]	4.27[a]	5.00[a]
Pink	1.00	2.40[b]	4.00[a]	5.00[a]
Yellow-red	1.00	2.27[b]	3.33[b]	5.00[a]
Holding Solution				
Distilled water (control)	1.00	2.25[a]	3.58[a]	4.75[a]
20 g sucrose + 5 ml chlorox / li water	1.00	2.33[a]	3.50[a]	4.75[a]
20 g sucrose + 10 ml chlorox / li water	1.00	2.75[a]	3.75[a]	5.00[a]
20 g sucrose + 1 g ascorbic acid + 5 ml chlorox /li water	1.00	2.67[a]	3.83[a]	4.92[a]
20 g sucrose + 250 ppm 7 –up + 5 ml chlorox / li water	1.00	2.50[a]	3.67[a]	4.83[a]

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

Stem Quality

Effect of variety. No significant differences were observed on the flower quality after 5 days of holding wherein the different gerbera varieties had all the same stem quality rating of 1. On the other hand, significant differences were noted on the stem quality of the different gerbera on the 10^{th}, 15^{th}, and 20^{th} days of observation.

Effect of holding solution. Statistical analysis reveals that there were not significant differences observed on the stem quality of gerbera after 5 and 10 days from holding. Day 5 had a stem quality rating of 1.00 while in day 10 stem quality rating ranges from 2.00 to 2.50. However, significant differences were noted on the stem quality of gerbera after 15 and 20 days wherein cutflowers soaked in distilled water only showed the lowest stem damage within this period compared to cutflowers held in 20 g sucrose + 10 ml chlorox having the highest stem quality rating.

Table 9. Stem quality

TREATMENTS	MEAN			
	5^{TH} day	10^{TH} day	15^{TH} day	20^{TH} day
Variety				
Yellow	1.00	2.13^{b}	3.00^{b}	3.93^{b}
Orange	1.00	2.53^{a}	3.00^{b}	3.67^{b}
Pink	1.00	2.13^{b}	2.93^{b}	3.80^{b}
Yellow-red	1.00	2.47^{ab}	3.60^{a}	4.60^{a}
Holding Solution				
Distilled water (control)	1.00	2.00^{a}	2.50^{c}	3.08^{b}
20 g sucrose + 5 ml chlorox / li water	1.00	2.50^{a}	3.33^{ab}	4.17^{a}
20 g sucrose + 10 ml chlorox / li water	1.00	2.50^{a}	3.58^{a}	4.50^{a}
20 g sucrose + 1 g ascorbic acid + 5 ml chlorox /li water	1.00	2.33^{a}	3.17^{ab}	4.17^{a}
20 g sucrose + 250 ppm 7 –up + 5 ml chlorox / li water	1.00	2.25^{a}	3.08^{b}	4.08^{a}

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

Interaction effect. Results show that there were no significant differences that were observed between the different varieties and the effect of holding solutions.

Daily Temperature of the Holding Room

Cutflowers of different varieties of gerbera were held for 21 days in the Tissue Culture Laboratory Room in floriculture for observations. The room temperature was gathered daily from holding to the termination of the study. Within the duration of the experiment, the temperature of the holding room ranges from 22- 26 ^{o}C as shown in Table 10.

Table 1.Daily temperature of the holding room

TIME/ DATE	TEMPERATURE(^{O}C) 10:00 am	2:00pm
February 24	22	22
February 25	23	23
February 26	22	23
February 27	23	24
February 28	24	23
March 1	24	25
March 2	24	24
March 3	24	24
March 4	25	25
March 5	24	25
March 6	25	25
March 7	26	26
March 8	22	23
March 9	22	24
March 10	25	25
March 11	22	23
March 12	22	23
March 13	22	23
March 14	26	26
March 15	26	26
March 16	25	25

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Different varieties of gerbera cutflowers harvested at 25% anthesis were held in different holding solutions including distilled water, 20 g sucrose + 5 ml chlorox per liter water, 20 g sucrose + 10 ml chlorox per liter water, 20 g sucrose + 1 g ascorbic acid + 5 ml chlorox per liter water and 20 g sucrose + 250 ppm 7- up + 5 ml chlorox per liter of water.

Results showed that distilled water alone can be used to prolong the vaselife of gerbera cutflowers. But the cosmo variety had attained the longest vaselife of 19.600 days. The volume of solution taken –up was higher in figo gerbera cutflowers held at 20 g sucrose + 5 ml chlorox.

No significant differences are observed on the number of days to attain 100 % flower opening. Nevertheless, orange or the buenavista to be held in the different holding solution will result to a wider flower diameter as compared to the other varieties.

In the percentage of neck bending, pink gerbera held in distilled water alone has the lowest percentage of neck bending as compared to orange gerbera held in 20 g sucrose + 5 ml chlorox for having the highest percentage of 100. On the other hand, 20 g sucrose + 250 ppm 7 –up lessened the percentage of stem browning on the yellow variety while 20 g sucrose + 10 ml chlorox increased the percentage of stem browning in carat gerbera.

As for the flower quality and stem quality, it was obviously noted that yellow or cosmo had the best quality and distilled water only will promote the best quality on cutflowers.

Conclusions

Based on the results, distilled water alone can be used to prolong the vaselife of gerberas harvested at 25% anthesis. Distilled water also promoted better quality of flower and stem on the cutflowers. It also lessened the percentage of neck bending and stems browning.

In the different varieties, cosmo variety or the yellow colored gerbera was the best among the different varieties. This cosmo variety had attained the longest vaselife and maintained the best quality in terms of flower and stem.

Recommendations

Based on the findings, in order to attain longer vaselife, using of holding solutions is not recommended because distilled water alone will prolong the vaselife of cutflowers and for a better flower and stem quality than those cutflowers held in other floral preservatives.

Cosmo variety is also recommended due to its longer vaselife and better quality in terms of flower and stem after 21 days of holding.

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APPENDICES

APPENDIX TABLE 1. Vaselife of cutflowers as affected by holding solutions (days)

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
$V_1 T_1$	21	21	21	63	21.00
T_2	21	19	19	59	19.67
T_3	20	18	19	56	18.67
T_4	21	18	18	57	19.00
T_5	18	20	21	59	19.67
$V_2 T_1$	12	14	16	42	14.00
T_2	12	14	14	40	13.33
T_3	11	11	11	33	11.00
T_4	15	10	11	36	12.00
T_5	11	10	12	33	11.00
$V_3 T_1$	11	13	14	38	12.67
T_2	15	16	16	47	15.67
T_3	14	16	17	47	15.67
T_4	14	15	16	45	15.00
T_5	19	14	14	47	15.67
$V_4 T_1$	20	18	18	56	18.67
T_2	18	18	18	54	18.00
T_3	17	18	17	53	17.67
T_4	19	16	17	52	17.33
T_5	18	20	18	56	18.67

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F_{Com}	F_t	
					0.05	0.01
Factor A	3	467.783	155.928	60.3591**	2.84	4.31
Factor B	4	12.567	3.142	3.142*	2.61	3.83
AB	12	53.967	4.497	4.497**	2.00	2.66
Error	40	103.333	2.583	2.583		
Total	59	637.650				

*= significant Coefficient of variation : 9.95%

**= highly significant

APPENDIX TABLE 2. Final pH of the solution

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
$V_1 T_2$	6.9	6.8	6.9	20.6	6.68
T_2	9.9	6.9	6.7	20.5	6.83
T_3	6.7	6.7	6.7	20.1	6.70
T	6.5	6.5	6.7	19.7	6.67
T_5	6.5	6.6	6.5	19.6	6.53
$V_2 T_1$	6.9	6.9	6.8	20.6	6.87
T_2	6.7	6.9	6.7	20.3	6.77
T_3	6.5	6.9	6.9	20.3	6.77
T_4	6.6	6.9	6.6	20.1	6.70
T_5	6.6	6.8	6.8	20.2	6.73
$V_3 T_1$	6.9	6.9	6.9	20.7	6.90
T_2	6.8	6.8	6.7	20.3	6.77
T_3	6.7	6.6	6.7	20.0	6.67
T_4	6.5	6.4	6.6	19.5	6.50
T_5	6.6	6.4	6.5	19.5	6.50
$V_4 T_1$	6.9	6.9	6.9	20.7	6.90
T_2	6.7	6.9	6.8	20.4	6.80
T_3	6.7	6.9	6.9	20.5	6.83
T_4	6.6	6.7	6.8	20.1	6.70
T_5	6.7	6.7	6.7	20.1	6.70

ANALYSIS OF VARIATION

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F_{Com}	F_t	
					0.05	0.01
Factor A	3	1.186	0.394	1.38ns	2.84	4.31
Factor B	4	1.676	0.419	1.47ns	2.61	3.83
AB	12	3.063	0.255	0.89ns	2.00	2.66
Error	40	11.413	0.285			
Total	59	17.334				

ns= not significant Coefficient of Variation: 7.87%

APPENDIX TABLE 3. Volume of solution taken-up

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
$V_1 T_2$	16	12	12	40	13.00
T_2	14	10	12	36	12.00
T_3	8	9	8	25	8.00
T_4	20	6	10	36	12.00
T_5	16	12	11	39	13.00
$V_2 T_1$	20	18	20	58	19.33
T_2	22	45	13	80	26.67
T_3	10	13	9	32	10.67
T_4	13	18	14	45	15.00
T_5	14	14	16	44	14.67
$V_3 T_1$	10	14	20	44	14.67
T_2	22	28	28	78	26.00
T_3	19	25	14	58	19.33
T_4	18	14	16	48	16.00
T_5	25	21	14	60	20.00
$V_4 T_1$	16	19	16	51	17.00
T_2	14	18	19	51	17.00
T_3	11	19	13	43	14.33
T_4	17	10	14	41	13.67
T_5	10	12	28	50	16.67

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F_{Com}	F_t	
					0.05	0.01
Factor A	3	468.983	156.328	5.1879**	2.84	4.31
Factor B	4	339.500	84.875	2.8166*	2.61	3.83
AxB	12	346.767	28.897	0.96ns	2.00	2.66
Error	40	1205.333	30.133			
Total	59	637.650				

*= significant
**= highly significant

Coefficient of variation: 34.13%

APPENDIX TABLE 4. Number of days to 100 % anthesis

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
$V_1 T_2$	10	14	10	34	11.33
T_2	10	14	12	36	12.00
T_3	11	13	11	35	11.67
T_4	14	10	9	33	11.00
T_5	12	11	16	39	11.00
$V_2 T_1$	9	10	10	29	9.67
T_2	7	15	13	35	11.67
T_3	11	11	12	33	11.00
T_5	8	11	10	29	9.67
$V_3 T_1$	11	11	12	34	11.33
T_2	9	10	11	30	10.00
T_3	10	9	14	33	11.00
T_4	7	10	11	28	9.33
T_5	13	15	13	41	13.67
$V_4 T_1$	11	13	9	33	11.00
T_2	8	10	10	28	9.33
T_3	10	12	11	33	11.00
T_4	10	10	13	33	11.00
T_5	12	12	10	34	11.33

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F_{Com}	F_t	
					0.05	0.01
Factor A	3	17.383	5.794	1.42ns	2.84	4.31
Factor B	4	13.567	3.392	0.83ns	2.61	3.83
AB	12	44.700	3.725	0.91ns	2.00	2.66
Error	40	163.333	4.083			
Total	59	238.983				

ns= not significant Coefficient of Variation: 18.40%

APPENDIX TABLE 5. Maximum flower diameter attained

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
$V_1 T_2$	8.1	8.1	8.1	24.3	8.10
T_2	7.8	8.2	7.7	23.7	7.90
T_3	8.4	8.2	7.2	23.8	7.93
T_4	7.7	7.5	7.4	22.6	7.53
T_5	7.9	8.1	8.5	24.5	8.17
$V_2 T_1$	9.7	9.2	9.2	27.9	9.30
T_2	9.9	8.8	8.8	28.1	9.37
T_3	9.3	9.0	9.1	27.4	9.13
T_4	10.3	9.1	9.0	28.3	9.43
T_5	9.6	8.5	9.7	27.8	9.27
$V_3 T_1$	7.5	8.1	8.0	24.6	8.20
T_2	8.8	7.9	8.8	25.5	8.50
T_3	7.7	8.4	8.4	24.5	8.16
T_4	8.4	8.6	7.9	24.9	8.17
T_5	8.9	8.0	7.8	24.7	8.23
$V_4 T_1$	9.1	8.2	9.0	26.3	8.76
T_2	8.1	8.7	8.2	25.0	8.33
T_3	7.9	9.1	8.1	25.1	8.37
T_4	8.7	8.5	7.5	24.7	8.23
T_5	8.5	8.7	9.4	26.6	8.87

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F_{Com}	Ft	
					0.05	0.01
Factor A	3	15.950	5.317	24.844**	2.84	4.31
Factor B	4	0.521	0.130	0.61ns	2.61	3.83
AB	12	1.731	0.144	0.67ns	2.00	2.66
Error	40	8.560	0.214			
Total	59	26.760				

ns=not significant Coefficient of Variation: 5.45%
**= highly significant

APPENDIX TABLE 6. Percentage neck bending

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
$V_1 T_2$	100	100	100	300	66.67
T_2	100	100	100	300	100.00
T_4	100	100	100	300	100.00
T_5	100	100	-	200	66.67
$V_2 T_1$	-	100	-	100	33.33
T_2	100	100	100	300	100.00
T_3	100	100	100	300	100.00
T_4	100	100	100	300	100.00
T_5	100	100	100	300	100.00
$V_3 T_1$	-	100	100	200	66.67
T_2	100	100	100	300	100.00
T_3	-	-	100	100	33.33
T_4	-	-	100	100	33.33
T_5	100	100	100	300	100.00
$V_4 T_1$	-	100	100	200	66.67
T_2	100	100	100	300	100.00
T_3	100	100	100	300	100.00
T_4	100	100	100	300	100.00
T_5	100	100	100	300	100.00

ANALYSIS OF VARIATION

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F_{Com}	F_t	
					0.05	0.01
Factor A	3	9833.333	3277.778	3.2778*	2.84	4.31
Factor B	4	12333.333	3083.333	3.0833*	2.61	3.83
AB	12	27666.667	2305.556	2.3056*	2.00	2.66
Error	40	40000.000	1000.000			
Total	59	89833.333				

*= significant Coefficient of variation: 38.72%

APPENDIX TABLE 7. Percentage of stem browning

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
$V_1 T_2$	50	30	6.9	160	53.33
T_2	40	60	6.7	175	58.33
T_3	50	50	6.7	180	60.00
T_4	50	75	6.7	145	48.33
T_5	40	30	6.5	90	30.00
$V_2 T_1$	80	45	6.8	225	75.00
T_2	60	70	6.7	230	76.67
T_3	80	90	6.9	270	90.00
T_4	50	80	6.6	230	76.67
T_5	50	70	6.8	215	71.67
$V_3 T_1$	70	50	6.9	210	70.00
T_2	50	100	6.7	190	63.33
T_3	50	70	6.7	210	70.00
T_4	90	30	6.6	220	73.33
T_5	50	50	6.5	200	66.67
$V_4 T_1$	75	95	6.9	265	88.33
T_2	75	100	6.8	270	90.00
T_3	75	100	6.9	275	91.67
T_4	100	100	6.8	300	30.00
T_5	75	95	6.7	245	81.67

ANALYSIS OF VARIATION

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F_{Com}	F_t	
					0.05	0.01
Factor A	3	13004.583	4334.861	9.3223**	2.84	4.31
Factor B	4	1580.833	395.208	0.85ns	2.61	3.83
AB	12	1455.833	121.319	0.26ns	2.00	2.66
Error	40	18600.000	465.000			
Total	59	34641.250				

ns=not significant
**= highly significant

Coefficient of variation: 30.05%

APPENDIX TABLE 8. Flower quality 5 days from immersion

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
$V_1 T_2$	1.00	1.00	1.00	3.00	1.00
T_2	1.00	1.00	1.00	3.00	1.00
T_3	1.00	1.00	1.00	3.00	1.00
T_4	1.00	1.00	1.00	3.00	1.00
T_5	1.00	1.00	1.00	3.00	1.00
$V_2 T_1$	1.00	1.00	1.00	3.00	1.00
T_2	1.00	1.00	1.00	3.00	1.00
T_3	1.00	1.00	1.00	3.00	1.00
T_4	1.00	1.00	1.00	3.00	1.00
T_5	1.00	1.00	1.00	3.00	1.00
$V_3 T_1$	1.00	1.00	1.00	3.00	1.00
T_2	1.00	1.00	1.00	3.00	1.00
T_3	1.00	1.00	1.00	3.00	1.00
T_4	1.00	1.00	1.00	3.00	1.00
T_5	1.00	1.00	1.00	3.00	1.00
$V_4 T_1$	1.00	1.00	1.00	3.00	1.00
T_2	1.00	1.00	1.00	3.00	1.00
T_3	1.00	1.00	1.00	3.00	1.00
T_4	1.00	1.00	1.00	3.00	1.00
T_5	1.00	1.00	1.00	3.00	1.00

APPENDIX TABLE 9. Flower quality 10 days from immersion

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
$V_1 T_2$	2.00	2.00	2.00	6.00	2.00
T_2	1.00	2.00	2.00	5.00	1.67
T_3	3.00	3.00	2.00	8.00	2.67
T_4	3.00	3.00	2.00	8.00	2.67
T_5	3.00	3.00	2.00	8.00	2.67
$V_2 T_1$	3.00	3.00	2.00	8.00	2.67
T_2	3.00	3.00	4.00	9.00	3.00
T_3	3.00	3.00	3.00	9.00	3.00
T_4	3.00	3.00	3.00	9.00	3.00
T_5	3.00	3.00	3.00	9.00	3.00
$V_3 T_1$	3.00	3.00	2.00	7.00	2.33
T_2	2.00	3.00	2.00	7.00	2.33
T_3	3.00	3.00	2.00	7.00	2.33
T_4	3.00	3.00	2.00	7.00	2.33
T_5	3.00	3.00	2.00	7.00	2.33
$V_4 T_1$	2.00	2.00	2.00	6.00	2.00
T_2	2.00	3.00	2.00	6.00	2.00
T_3	3.00	2.00	2.00	8.00	2.67
T_4	3.00	2.00	2.00	8.00	2.67
T_5	2.00	2.00	2.00	6.00	2.00

ANALYSIS OF VARIATION

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F_{Com}	F_t	
					0.05	0.01
Factor A	3	5.133	1.711	7.8974**	2.84	4.31
Factor B	4	2.167	0.542	2.50ns	2.61	3.83
AB	12	3.033	0.253	1.17ns	2.00	2.66
Error	40	8.667	0.217			
Total	59	19.00				

ns=not significant
**= highly significant

Coefficient of variation : 18.62%

APPENDX TABLE 10. Flower quality 15 days from immersion

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
$V_1 T_2$	3.00	3.00	3.00	9.00	3.00
T_2	2.00	3.00	3.00	8.00	2.67
T_3	3.00	3.00	4.00	10.00	3.33
T_4	3.00	4.00	3.00	10.00	3.33
T_5	4.00	3.00	2.00	9.00	3.00
$V_2 T_1$	4.00	4.00	4.00	12.00	4.00
T_2	4.00	4.00	5.00	13.00	4.33
T_3	4.00	4.00	5.00	13.00	4.33
T_4	4.00	4.00	5.00	13.00	4.33
T_5	4.00	4.00	5.00	13.00	4.33
$V_3 T_1$	4.00	5.00	4.00	13.00	4.33
T_2	4.00	5.00	3.00	12.00	4.00
T_3	4.00	4.00	3.00	11.00	3.67
T_4	4.00	4.00	4.00	12.00	4.00
T_5	4.00	4.00	4.00	12.00	4.00
$V_4 T_1$	3.00	3.00	3.00	9.00	3.00
T_2	3.00	3.00	3.00	9.00	3.00
T_3	4.00	3.00	4.00	11.00	3.67
T_4	4.00	3.00	4.00	11.00	3.67
T_5	3.00	4.00	3.00	11.00	3.00

ANALYSIS OF VARIATION

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F_{Com}	F_t	
					0.05	0.01
Factor A	3	14.133	4.711	15.7037**	2.84	4.31
Factor B	4	0.833	0.208	0.69ns	2.61	3.83
AB	12	2.367	0.197	0.66ns	2.00	2.66
Error	40	12.000	0.300			
Total	59	29.333				

ns=not significant
**= highly significant

Coefficient of variation: 14.94%

APENDIX TABLE 11. Flower quality 20 days from immersion

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1 T_2	4.00	4.00	4.00	12.00	4.00
T_2	3.00	5.00	4.00	1200	4.67
T_3	5.00	5.00	5.00	15.00	5.00
T_4	4.00	5.00	5.00	14.00	4.67
T_5	5.00	5.00	5.00	13.00	4.33
V_2 T_1	5.00	5.00	5.00	15.00	5.00
T_2	5.00	5.00	5.00	15.00	5.00
T_3	5.00	5.00	5.00	15.00	5.00
T_4	5.00	5.00	5.00	15.00	5.00
T_5	5.00	5.00	5.00	15.00	5.00
V_3 T_1	5.00	5.00	5.00	15.00	5.00
T_2	5.00	5.00	5.00	15.00	5.00
T_3	5.00	5.00	5.00	15.00	5.00
T_4	5.00	5.00	5.00	15.00	5.00
T_5	5.00	5.00	5.00	15.00	5.00
V_4 T_1	5.00	5.00	5.00	15.00	5.00
T_2	5.00	5.00	5.00	15.00	5.00
T_3	5.00	5.00	5.00	15.00	5.00
T_4	5.00	5.00	5.00	15.00	5.00
T_5	5.00	5.00	5.00	15.00	5.00

ANALYSIS OF VARIATION

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F_{Com}	F_t	
					0.05	0.01
Factor A	3	4.050	1.350	10.1250**	2.84	4.31
Factor B	4	0.567	0.142	1.06ns	2.61	3.83
AB	12	1.700	0.142	1.06ns	2.00	2.66
Error	40	5.333	0.133			
Total	59	11.650				

ns= not significant
**= highly significant

Coefficient of variation: 7.53%

APPENDIX TABLE 12. Stem quality 5 days from immersion

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
$V_1 T_2$	1.00	1.00	1.00	3.00	1.00
T_2	1.00	1.00	1.00	3.00	1.00
T_3	1.00	1.00	1.00	3.00	1.00
T_4	1.00	1.00	1.00	3.00	1.00
T_5	1.00	1.00	1.00	3.00	1.00
$V_2 T_1$	1.00	1.00	1.00	3.00	1.00
T_2	1.00	1.00	1.00	3.00	1.00
T_3	1.00	1.00	1.00	3.00	1.00
T_4	1.00	1.00	1.00	3.00	1.00
T_5	1.00	1.00	1.00	3.00	1.00
$V_3 T_1$	1.00	1.00	1.00	3.00	1.00
T_2	1.00	1.00	1.00	3.00	1.00
T_3	1.00	1.00	1.00	3.00	1.00
T_4	1.00	1.00	1.00	3.00	1.00
T_5	1.00	1.00	1.00	3.00	1.00
$V_4 T_1$	1.00	1.00	1.00	3.00	1.00
T_2	1.00	1.00	1.00	3.00	1.00
T_3	1.00	1.00	1.00	3.00	1.00
T_4	1.00	1.00	1.00	3.00	1.00
T_5	1.00	1.00	1.00	3.00	1.00

APPENDIX TABLE 13. Stem quality 10 days from immersion

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
$V_1 T_2$	2.00	2.00	2.00	6.00	2.00
T_2	2.00	3.00	2.00	7.00	2.33.
T_3	2.00	2.00	2.00	6.00	2.00
T_4	3.00	2.00	2.00	7.00	2.33
T_5	2.00	2.00	2.00	6.00	2.00
$V_2 T_1$	2.00	2.00	2.00	6.00	2.00
T_2	3.00	3.00	2.00	8.00	2.67
T_3	3.00	3.00	3.00	9.00	3.00
T_4	3.00	3.00	2.00	8.00	2.67
T_5	3.00	2.00	2.00	7.00	2.33
$V_3 T_1$	2.00	1.00	2.00	5.00	1.67
T_2	2.00	2.00	3.00	7.00	2.33
T_3	2.00	3.00	3.00	8.00	2.67
T_4	2.00	2.00	2.00	6.00	2.00
T_5	2.00	2.00	2.00	6.00	2.00
$V_4 T_1$	2.00	3.00	2.00	7.00	2.33
T_2	3.00	3.00	2.00	8.00	2.67
T_3	3.00	2.00	2.00	7.00	2.33
T_4	2.00	3.00	2.00	7.00	2.33
T_5	3.00	3.00	2.00	8.00	2.67

ANALYSIS OF VARIATION

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F_{Com}	F_t	
					0.05	0.01
Factor A	3	2.050	0.683	3.1538*	2.84	4.31
Factor B	4	2.067	0.517	2.38ns	2.61	3.83
AB	12	2.200	0.183	0.84ns	2.00	2.66
Error	40	8.667	0.217			
Total	59	14.983				

ns= not significant
*= significant

Coefficient of variation: 20.09%

APPENDIX TABLE 14. Stem quality after 15 days from immersion

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1 T_2	2.00	2.00	3.00	7.00	2.33
T_2	3.00	4.00	3.00	10.00	3.33.
T_3	3.00	4.00	4.00	10.00	3.33
T_4	3.00	3.00	3.00	9.00	3.00
T_5	2.00	3.00	3.00	7.00	2.33
V_2 T_1	2.00	2.00	2.00	6.00	2.00
T_2	3.00	3.00	4.00	10.00	3.33
T_3	4.00	3.00	4.00	11.00	3.67
T_4	3.00	3.00	3.00	9.00	3.00
T_5	3.00	3.00	3.00	9.00	3.00
V_3 T_1	2.00	2.00	3.00	7.00	2.33
T_2	3.00	3.00	3.00	6.00	2.00
T_3	3.00	3.00	3.00	10.00	3.33
T_4	3.00	3.00	3.00	9.00	3.00
T_5	3.00	3.00	3.00	9.00	3.00
V_4 T_1	4.00	4.00	2.00	10.00	3.33
T_2	4.00	4.00	3.00	11.00	3.67
T_3	4.00	3.00	4.00	11.00	3.33
T_4	4.00	4.00	3.00	11.00	3.33
T_5	4.00	4.00	3.00	11.00	3.67

ANALYSIS OF VARIATION

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F_{Com}	F_t	
					0.05	0.01
Factor A	3	4.400	1.467	5.5000**	2.84	4.31
Factor B	4	7.767	1.942	7.2813	2.61	3.83
AB	12	2.100	0.175	0.66ns	2.00	2.66
Error	40	10.667	0.267			
Total	59	24.933				

ns=not significant
**= highly significant

Coefficient of variation: 16.48%

APPENDIX TABLE 15. Stem quality 20 days from immersion

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
$V_1 T_2$	3.00	2.00	4.00	9.00	3.00
T_2	4.00	5.00	4.00	14.00	4.67.
T_3	4.00	5.00	4.00	14.00	4.67
T_4	4.00	4.00	4.00	12.00	4.00
T_5	4.00	4.00	4.00	12.00	4.00
$V_2 T_1$	2.00	2.00	2.00	6.00	2.00
T_2	3.00	4.00	4.00	11.00	3.67
T_3	5.00	4.00	4.00	14.00	4.67
T_4	4.00	4.00	4.00	12.00	4.00
T_5	4.00	4.00	4.00	12.00	4.00
$V_3 T_1$	3.00	2.00	4.00	9.00	3.00
T_2	4.00	4.00	4.00	12.00	4.00
T_3	4.00	4.00	5.00	13.00	4.33
T_4	4.00	4.00	4.00	12.00	3.00
T_5	4.00	4.00	3.00	11.00	3.67
$V_4 T_1$	5.00	5.00	3.00	13.00	4.33
T_2	5.00	5.00	4.00	14.00	3.67
T_3	5.00	5.00	4.00	14.00	3.67
T_4	5.00	5.00	4.00	14.00	3.67
T_5	5.00	5.00	4.00	14.00	3.67

ANALYSIS OF VARIATION

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F_{Com}	F_t 0.05	F_t 0.01
Factor A	3	7.733	2.578	7.7333**	2.84	4.31
Factor B	4	13.833	3.458	10.3750**	2.61	3.83
AB	12	5.100	0.425	1.28ns	2.00	2.66
Error	40	13.333	0.333			
Total	59	40.000				

**= highly significant
ns= not significant

Coefficient of variation: 14.43%