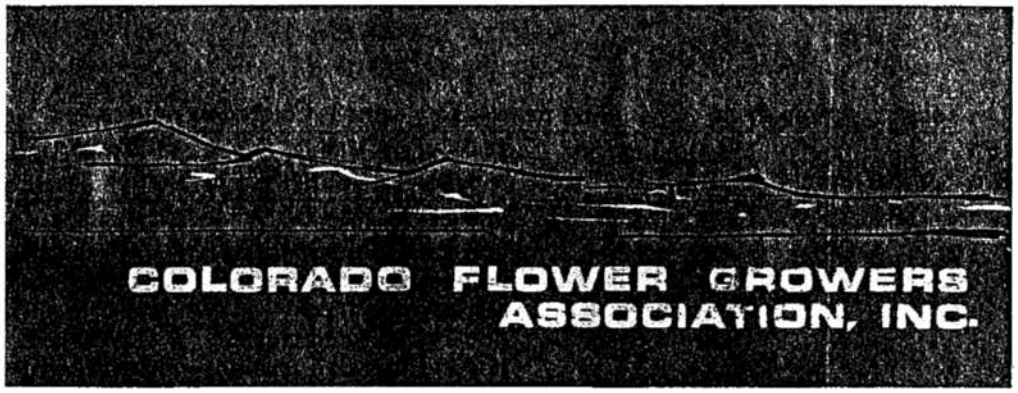


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# Postharvest Handling of Cut Carnations From Harvest Through Consumer Use

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Keeping life of cut carnations has been estimated to be influenced one-third by the preharvest environment and two-thirds by postharvest handling. A recent study has indeed failed to show a major influence of the preharvest environment. Most keeping problems of carnations therefore likely stem from improper handling and/or adverse environmental conditions en route through the market chain to the ultimate consumer. Problems at the consumer level also contribute to keeping problems.

Postharvest handling has been and will continue to be the focus of good research programs in floriculture. Information is available that if put into practice can almost assure consumer satisfaction in use of cut flowers. The success of the floriculture industry depends on this satisfaction.

A series of tests are reported that illustrate the positive influence that can be shown through good postharvest treatment and handling. Recommendations are summarized as simple procedures involving handling at the grower, wholesale, retail, and consumer levels.

## Materials and Methods

Cv. CSU White was used in all tests. Keeping life for individual flowers of a test was determined as the difference between the day the flower was placed in the keeping room and the day the flower was removed from the vase at senescence. Flowers were checked daily and considered senesced when the petals lost their turgor and were beginning to curl. All flowers were recut to a length of 18" before being placed in a vase. The test preservative used in subsequently reported tests was standardized as 400 ppm 8-Hydroxyquinoline Citrate (HQC) and 5% sugar. A test solution was standardized as 400 ppm HQC. Keeping room temperatures were 70±1F.

## Grower and Wholesale Level

Colorado carnation growers do a good job of handling their flowers after harvest. This is confirmed by a comparison of eight commercial growers in Table 1 which summarizes handling practices. Carnations are harvested, graded, and then held dry in refrigeration until delivered, usually the next morning, to the wholesale outlet. Certain growers have the service of a refrigerated truck which most often picks up the flowers the day of harvest and delivers them to the wholesale house. This procedure of fast movement and refrigeration is certainly optimal.

At the wholesale level, flowers are frequently placed in water until orders are filled. Dry storage is used to accumulate the product for major holiday periods. It has been shown that carnations can be successfully stored dry at least one week without serious reduction in keeping life of the flowers. A test was designed to re-evaluate the effects of dry storage.

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Table 1. Comparison of handling methods by sample Colorado growers

| Grower | Method of grading | Method of delivery to wholesale outlet | Time from cut to wholesale outlet | Flowers held dry or in water |
|---|---|---|---|---|
| 1. | self | not wholesaled | 1-3 hrs. | dry |
| 2. | self | non-refrigerated truck | overnight | dry |
| 3. | self | non-refrigerated truck | overnight | both |
| 4. | centralized | refrigerated truck | 4-6 hrs. | dry |
| 5. | self | non-refrigerated truck | overnight | dry |
| 6. | self | non-refrigerated truck | overnight | dry |
| 7. | self | non-refrigerated truck | overnight | dry |
| 8. | centralized | refrigerated truck | 4-6 hrs. | dry |

Flower samples were taken from a single harvest. One sample was taken immediately to the keeping room and placed in the test solution. The remaining flowers were all placed in a standard shipping box, wrapped in newspaper, and covered with plastic. The box was placed in 33-34F refrigeration. Flower samples were subsequently removed to the keeping room and placed in the test solution after a 5-, 7-, 9-, and 11-day storage period. The results are summarized in Table 2.

Table 2. Effects of length of dry storage on keeping life of cut carnations.

| Treatment | No. flowers sampled | Mean keeping life |
|---|---|---|
| 1. HQC control | 31 | 7.8 |
| 2. 5-day storage | 20 | 7.2 |
| 3. 7-day storage | 20 | 6.8 |
| 4. 9-day storage | 20 | 6.7 |
| 5. 11-day storage | 21 | 6.0 |

An immediate observation from Table 2 is that after harvest, the keeping life of cut carnations is reduced over time. Every effort to achieve the least possible time between harvest and flower use will be rewarded by carnations of better keeping life. However, Table 2 also indicates that carnations can be successfully stored dry for five days without serious reduction in keeping life. A seven-day storage period resulted in the loss of one day of life; an 11-day period showed a 1.8-day reduction. A general rule of thumb is suggested — an approximate reduction of one day's keeping life can be expected for each week in dry storage. Of course, this can be influenced by numerous factors such as refrigeration temperature, condition of flowers at harvest, conditions between harvest and placement in refrigeration, and how the flowers are handled after being removed from dry storage.

A comparison of dry storage and storage in water is made in a test whose results are illustrated in Fig. 1. A single harvest was divided into six groups of 20 flowers each. Three groups were placed in dry storage (as described above) and three groups were placed in warm tap water and then placed in refrigeration. A group from each storage treatment was removed after three, five, and seven days and placed in the test solution. Flowers from the dry storage treatment were recut before being placed in the test solution.

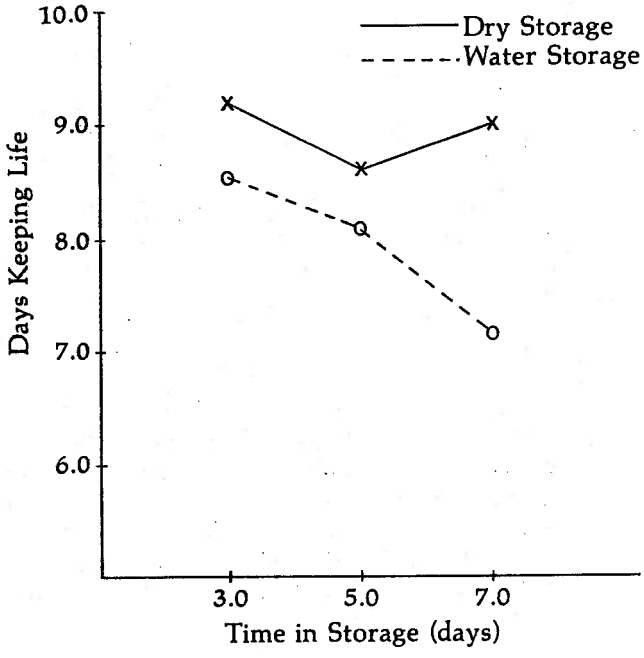


Fig. 1. Comparison of dry storage and water storage on keeping life of cut carnations.

Groups from the dry storage treatment had better keeping life in each instance. The greatest difference occurred after the seven-day period of storage. Carnations should never be held for long periods of time in water. Dry storage should be utilized if possible when extended periods of holding are desired.

A problem of handling carnations in water is that often containers are neglected and become dirty. This can be a source of keeping problems if the vascular system becomes blocked, preventing uptake of water. A test was designed to study the effects of a bactericide, HQC, in the use of holding in water. Use of HQC would provide a bacteria-free holding solution.

Flowers of cv. CSU White were again taken from a single harvest. An 18-flower sample was taken directly to the keeping room and placed in tap water. A group of the remaining flowers was placed in a container of the test solution (400 ppm HQC); another group was placed in a container of tap water. Both test containers were put in refrigeration for an approximate 24-hour holding period. After the holding period, the flowers from the container of tap water were removed to a vase of tap water in the keeping room. Flowers in the container of HQC solution were divided into two samples; one sample was removed to a vase of tap water, and the other to a vase of the test solution. Results are presented in Table 3.

Table 3. Effectiveness of HQC when holding cut carnations in water.

| Treatment | Number flowers sampled | Mean keeping life |
|---|---|---|
| 1. Tap water | 18 | 5.6 |
| 2. Flowers held in water in refrigeration approximately 24-hrs. then removed to tap water | 17 | 6.4 |
| 3. Flowers held in HQC solution in refrigeration approximately 24-hrs. then removed to tap water | 18 | 7.0 |
| 4. Flowers held in HQC solution in refrigeration approximately 24-hrs. then removed to HQC solution | 16 | 7.4 |

Use of HQC in this test had a positive effect on keeping life of cut carnations. The best keeping occurred when the flowers were handled entirely in the HQC solution. It is recommended that wholesalers and retailers make a practice of using a proven bactericide whenever flowers are placed in water. At the very least, active use of a bactericide will keep containers clean and free from contamination that occurs so easily with tap water.

A previous test shown in Fig. 1 comparing storage in water versus storage dry shows a benefit from utilizing dry storage. It is suggested that placing carnations in water will cause a reduction in keeping life; the senescence process is hastened as opposed to carnations held dry. A test was designed to study the effects of a holding period in water and then a simulated shipping treatment before keeping life was measured.

A 20-flower sample was removed directly to the keeping room and placed in the test solution. The remaining flowers of that harvest were placed in tap water in 33-34F refrigeration. Samples were removed after 6, 12, and 48 hours to a standard shipping box. Flowers were wrapped in newspaper and covered with plastic on being placed in the box. The simulated shipments were of varying times, but all took place under very optimum conditions of 33-34F. Few shipments in practice could achieve this optimum. Flowers were removed from the shipping box after the designated shipping time and placed in the test solution for measurement of keeping life. Table 4 presents the results.

Table 4. Effects of shipping on carnation keeping life after being held in water

| Treatment | Number of flowers in sample | Mean keeping life |
|---|---|---|
| 1. Test solution control | 20 | 8.0 |
| 2. Flowers held in water for 6 hrs., shipping simulation for 26 hrs. | 20 | 7.3 |
| 3. Flowers held in water for 12 hrs., shipping simulation for 33 hrs. | 21 | 7.0 |
| 4. Flowers held in water for 48 hrs., shipping simulation for 20 hrs. | 25 | 6.3 |

The longer the flowers remained in water prior to shipping, the more reduction in keeping life. A test is needed comparing flowers that have been held dry before a shipping treatment.

Shipping is one of the very serious problems facing wholesalers. Delays and extreme temperatures cause serious damage to cut flowers of good quality. Until a shipping box is designed that can maintain an adequate temperature, shipping will remain a major problem. If adverse conditions occur en route that cause visible damage, whether the flowers have been held dry or in water is of little consequence. Tight buds have shown resistance to some adverse problems in shipping; however, the industry at this time is reluctant to harvest in the tight bud stage.

## Retail Level

Retail florists should be cognizant of the fact that, at best, the carnations they receive are slowly undergoing the senescence process. Proper handling by the florist is essential if the consumer is to receive a satisfactory product. Much information on proper handling has been published. The essential tool to successful handling by the florist is a good flower preservative. This preservative must contain sugar as a source of food and a good bactericide. The bactericide must be strong enough to prevent microbe growth that would occur in a sugar solution. Use of a

good preservative can overcome many problems that may have occurred since harvest.

Two separate tests illustrate the effectiveness of a good preservative (Table 5). Flower samples were divided into two equal groups. In Test 1 the flowers were placed in a vase containing the test solution as a control and in a vase containing the test preservative. Test 2 was identical except a tap water control was used.

Table 5. Effects of a flower preservative on carnation keeping life.

| Treatment | Test number | |
|---|---|---|
| | 1. | 2. |
| Control | 7.8 | 6.5 |
| Preservative | 11.0 | 9.5 |

Upon arrival of a flower shipment, the florist should unpack the flowers and check their condition. If the flowers have been handled dry, they will be somewhat flaccid. Shipping problems, especially delays in the summer, can occasionally result in flowers that are obviously damaged. If damaged, flower petals may be seriously curled and dehydrated, petal burn may have occurred, and the stem will suffer from obvious dehydration. A severely damaged lot of carnations should not be utilized.

The immediate objective before using a shipment of flowers is to restore turgidity. This is easily accomplished by recutting the stems and placing them in a warm preservative solution in refrigeration. Allow a minimum of 6-8 hours conditioning period before use. If the flowers do not take water, the shipment is suspect.

A series of tests were conducted showing the results that can be obtained through effective use of the test preservative.

Samples of 18 flowers were used in the following handling treatments: 1) test preservative control, 2) conditioned in water 16-18 hours in refrigeration then to a vase containing water, 3) conditioned in water 16-18 hours then to a vase containing the test preservative, and 4) conditioned in the test preservative then to a vase containing the test preservative. The effectiveness of handling in a preservative is illustrated in Table 6.

Handling entirely in the preservative gave keeping life equal to those flowers taken directly from harvest to a preservative solution. Excellent life was also obtained when the preservative was used in the final holding solution even after being in water.

Other tests further exemplify the excellent results on keeping shown by use of preservative. Flowers were

Table 6. Effectiveness of postharvest handling of carnations with a preservative.

| Treatment | Mean keeping life |
|---|---|
| 1. Preservative | 11.0 |
| 2. Conditioned in water, to vase of water | 7.6 |
| 3. Conditioned in water, to vase of preservative | 10.5 |
| 4. Conditioned in preservative, to vase of preservative | 10.9 |

divided into two groups of 20 with two treatments per group. Also included was one water and one test preservative control. One group of flowers was conditioned 20 hours in tap water with half being removed to a vase of tap water and the other half to a vase of test preservative. The second group of flowers was conditioned 20 hours in the test preservative. Accordingly, half were removed to a vase of tap water and half to a vase of test preservative. A comparison of the resulting effects on keeping life is presented in Table 7.

Table 7. Comparison of conditioning carnations in water versus preservative — the effects on keeping life.

| Treatment | Mean keeping life |
|---|---|
| 1. Tap water | 6.5 |
| 2. Test preservative | 9.5 |
| 3. 20 hrs. conditioning in tap water then to vase of tap water | 5.5 |
| 4. 20 hrs. conditioning in tap water then to test preservative | 8.9 |
| 5. 20 hrs. conditioning in test preservative then to tap water | 6.7 |
| 6. 20 hrs. conditioning in test preservative then to preservative | 9.2 |

Handling entirely in the test preservative again resulted in keeping life almost equal to the preservative control. Also illustrated again is the positive influence of the preservative in final usage even after they had been held in water for a period. This test supports the recommendation that a flower preservative should be used by all retail outlets.

## Consumer Level

The chain of movement of carnations at all levels can contribute to the assurance of quality flowers. The consumer has the right to demand that a good preservative was utilized in the treatment of the flowers purchased. Many florists supply small packages of preservative with the flower sale.

In use of the flowers, the consumer should check the preservative solution supply daily and replenish when necessary. Arrangements should be kept in as cool location as possible. Flowers kept in hot kitchens, sunny locations and on top of T.V.'s cannot be expected to last as long. Fresh fruit in the immediate area of the arrangement can emit enough ethylene to cause premature senescence of the blooms.

## Summary

An extensive commercial test of these results as well as other practical situations is needed to confirm and amend the presented recommendations. One major problem not satisfactorily resolved is the effect of commercial shipping and if the recommendations hold true under actual conditions. For example, are flowers held dry more, or less susceptible to the adverse conditions that can occur? Actual shipping tests could prove to be beneficial in amending these recommendations.

A simplified summary of these recommendations is enumerated:

Grower level:

1. Carnations should be harvested daily, every other day at the least.
2. Carnations should be graded as quickly as possible and placed in 33-34F refrigeration if possible. They should be covered with newspaper and then covered with plastic.
3. Carnations should not be placed in water.
4. Carnations should be delivered to shipping outlet as soon as possible after harvest.

Wholesale level:

1. If good cooling is available (33-34F optimum) carnations should be dry stored until orders are filled.
2. Carnations being held in water should be moved as quickly as possible.
3. A proven bactericide should be used in the water any time carnations are placed in water.

Retail level:

1. Check shipment on arrival to assure flowers are in good condition.
2. When ready for use, carnation stems should be recut, put in a warm preservative solution in refrigeration overnight if possible.
3. Preservatives should be used exclusively, especially in final use as it goes to the consumer.
4. Keep refrigerated until used unless opening tight flowers.

Consumer level:

1. Replenish with preservative solution as needed.
2. Keep in as cool a location as possible and out of drafts.
3. Keep vases clean.
4. Do not keep fresh fruit in immediate area of flowers.