Long-term Cut Flower Storage Now Possible

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When florists can successfully store their roses for several weeks instead of several days, their carnations and mums for a month instead of a week, and when they make the same relative progress in the storage of other cut flowers, the efficiency of handling and marketing flowers will be increased and the potential scope of the industry will be broadened. Holiday peaks can then be anticipated and handled more easily and quality production during "gluts" can be held for a more favorable market. Our many timing and distribution problems will be simplified. Greater quantities of flowers will be sold at more uniform prices. The consumer will benefit through better buys of better quality flowers and the industry will benefit through greater volume and dollar sales. Some of the long-term storage techniques for accomplishing these aims are now known and can be applied to commercial situations.

A previous article suggested that the problems of mold injury and ethylene damage in cut flower storage may be reduced through proper low temperature control. Now, the general factors of respiration and maturation that cause the aging and breakdown of flowers in storage must be considered. Control of these factors is of primary importance in facilitating successful long-term storage.

Studies of the "aging" of flowers lead us to the crux of the storage problem. As mentioned, one of the characteristics of "pickled" flowers is their old appearance. Why do flowers "grow old"? How can their developmental processes be suspended so that they remain in a young and fresh condition? If we know these answers, we know the important answers to long-term storage problems.

Temperature control is most important

Acceleration or retardation of flower aging is directly controlled by temperature. A rose may open overnight in a warm home but in 45°F storage the opening will be delayed for a week. During the same week, the flower in the home has died. This is the basis for the present and the proposed refrigeration practices. Development and aging are slowed as the temperature is reduced.

Respiration is a plant process that is directly controlled by temperature and is connected with aging. Respiratory activity takes place in all living things. Flowers are no exceptions. Respiration goes on while flowers are growing. It continues after they are cut and are in storage. And the process is still in action after the flowers are sold. Flower respiration never stops until the material dies.

While the plant is growing, respiration supplies the necessary energy for life processes. When the flower is developing in the home after it has been sold, respiration is still necessary for the perfect maturation of the bloom. But in the storage interim, respiration should be maintained at as low a rate as possible. Low respiration in storage means less aging and a better quality of flowers for the consumer.

The precise effect of temperature on respiration of flowers has received no study. But it is reasonable to assume that flowers respond as does other plant material, such as fruits and vegetables. Fruits, for example, show a 2 to 3 fold increase in their respiratory rate with a temperature increase of 18°F. So practically speaking, it is undoubtedly correct to assume that respiration of flower materials at 50° is about three times that at 32°F. At 60°F the rate would be six times that of 32°F and at 70°F or normal room temperature a respiratory rate of at least ten times that of the 32°F temperature would be expected.

Assuming that a florist makes no change in his storage operations, except to lower the temperature of his unit, a reduction of 18°F in temperature (say from 50 to 32) would cut respiration of plant material to a third and increase effective storage life three times. Thus, if a florist had previously stored his roses successfully for two days in a 50°F cooler, he could increase the storage life of the flowers to six days merely by lowering the temperature to 32°F.

With most crops florists could undoubtedly double successful storage life simply by dropping their refrigeration temperatures to 32°F. The total storage life would be increased and in cases where flowers stood for less than the maximum storage period, the quality of such flowers after storage would surpass that of flowers stored at higher temperatures. Aging would be reduced by proper temperature control.

Low temperature storage of cut flowers was first suggested by Neff (1). He reported better keeping of carnations at 33°F than at 40°F. Results at Cornell confirm the fact that carnations stored at temperatures as low as 31°F are superior in quality to those stored at higher temperatures. Considering the temperature factor alone, we have found similar beneficial results with 31°F storage of pompon chrysanthemums, peonies, roses and lily-of-the-valley. While long-term storage trials with the latter two materials

have not ended in complete success, we have noted no anomalous cold storage effects, and flowers stored at the low temperature have been markedly superior to flowers stored at 35-40°F. We feel certain that future trials will demonstrate the superiority of 31°F storage for most other crops.

Does low temperature damage flowers?

The possibilities of complications naturally must be considered. It has been realized for a long time in the fruit and vegetable business that products such as bananas and tomatoes cannot be stored at low temperatures for extended periods. Below 50°F, both of these products show abnormal breakdowns of tissue.

The problems suggest the chance of similar disintegration with florists crops. Florists often attribute sleepiness in carnations or bluing of roses to low temperature storage. Our trials show no such ill-effects of 31°F on these flowers. In fact, in comparison to temperatures up to 40°F, there were no harmful effects of temperatures as low as 31 on the two mentioned materials, as well as peonies, pompons, lilies, and lily-of-the-valley. With all of these crops, storage life and post storage keeping quality were superior at the lower temperature. Orchids alone showed breakdown at temperatures below 40°F. The industry has long realized that temperatures, even below 45°F, will cause breakdown of these flowers.

Do flowers freeze at 31°F?

The danger of freezing has been considered as one of the complications of 31°F temperature storage. Our results show that with constant temperature control in the range of 30-32°F, there has been no freezing of flowers. However, air circulated must be carefully considered in refrigeration design so that cold or warm spots cannot develop. Some system of forced air circulation, as opposed to simple gravity cooling methods, appears to be necessary.

Should we store cut flowers with their stems in water?

Water supply to the cut flower is the factor of second importance in affecting the aging and development of flowers in storage. The first suggestions of this were again made by Neff. He observed that carnations kept better when stored in a dry condition with no water supply available to the flowers than when they were stored in the conventional manner with their stems in water. He accomplished dry storage, while still preventing desiccation of the material by enclosing flowers in a moistureproof container. The flowers had no water supply, but the container prevented water loss from the flowers.

Neff accounted for the better keeping quality of dry packed flowers with the assumption that a high degree of turgidity in plant cells is necessary for cell development and differentiation. If the flowers have no available source of free water, the turgor cannot develop and cell development cannot long continue. Thus, obvious signs of aging, such as unfolding of a rose, or the opening of the flowers on a gladiolus spike, cannot take place if the flowers are stored in a dry condition. However, the development will take place if the flowers are stored with their stems in water.

In the work at Cornell, flowers were stored dry by overwrapping them with moistureproof cellophane and the ends and sides of the cellophane were sealed. The flowers were thus enclosed in a moistureproof container with no free water supply. Cellophanes used in this work were DuPont 300MSAT 86 and DuPont 450K202. The latter seemed somewhat more effective.

Comparison of Conventional and dry storage

Roses and peonies held in water at temperatures from 31-40 opened in the storage. The degree of development was reflected by dropping their petals, after removal to the air, faster than comparable flowers held in the dry pack. Carnations also were of poorer quality after storage in water. Lilies were much poorer after storage in water. Garden lilies, Henryii and Tigrinum species, when stored with their stems in water, even at 31°F showed a development of buds in the storage period, while comparable dry packed flowers showed no further bud development until flowers were removed from storage. Dry storage was superior in every case.

The degree of turgidity of flowers at the time they were packed was considered in trials with all of the flowers. Our trials show no marked differences in flowers that have been hardened in water before storage, those packed without hardening and those packed with a slight preliminary wilting of the flowers. Flowers packed in any of these conditions show a slight wilting at the end of the storage period, even in the waterproof container. Water from the flowers condenses on the inner walls of the cellophane overwrap. This dehydration effect may be overcome by lightly misting the flowers before they are enclosed.

Principles summarized

The principles that seem important in making possible the long-term storage of cut flowers are these:

(a) The storage temperature should be maintained at 30-32°F. This can be accomplished without danger of freezing and without abnormal effects on the flowers if proper air circulation is provided. The low temperature reduces respiration, water loss, growth, and gas production from the flowers and therefore reduces the aging of the material.

(b) The flowers should be stored with their stems out of water and in a moisture and vapor-proof container.

How long can flowers be held in storage?

We have indicated that the storage life of many cut flowers can probably be doubled or tripled, simply by lowering the temperature of conventional storage units. The added effect of dry packaging in increasing the storage life of cut flowers can only be estimated. However, with the proper application of the storage conditions we have accomplished successful storage of carnations, pompon chrysanthemums, and some garden lilies for at least a month, rose storage for three weeks, and peony storage for several months. Post storage keeping quality of these materials appeared normal. Roses lasted 5 days, carnations a week, and pompons as long as 10 days following their removal from storage to room temperatures. In most cases, floralife has been used in the water after the flowers were removed from storage, and keeping quality of most flowers mentioned has been improved by its use.

"Prepackaged" flowers in long-term storage

Prepackaged flowers are generally boxed in a moisture and vapor-proof container. They have no source of free water. These are conditions identical to those required for long-term storage. It would seem that merely prepackaged flowers could be handled in more extended storage by lowering of the storage temperature to 31° rather than using the recommended storage.

Meeting the bulk demand with long-term storage

The greatest application of long-term storage may eventually come in storing of materials in bulk for several weeks or a month in order to meet heavy seasonal demands. This would mean the storage of many flowers in larger containers. There are several possibilities for such an operation. Simply enlarging on the prepackaging idea, it is possible to completely line corrugated boxes with cellophane, pack the flowers as is the practice today, seal over the top of the cellophane to complete the moistureproof atmosphere and refrigerate at 31°. Other ideas include the storage of flowers in large metal or waxed drums. This carries the advantage that the flowers may be held in an upright position and the danger of crushing the blooms is thereby minimized. Florists should have no trouble in applying the basic principles in any number of ways to fit their specific needs.

Dry packs mean economies in storage operation

Dry storage is superior to our conventional storage procedure because quality is improved. An additional consideration makes this method of even greater value.

Dry storage of cut flowers can be a big space saver. Present storage methods with flowers in cans of water waste space. At best florists utilize refrigeration room only by using expensive shelving devices. Storage under dry conditions would permit tiering or relatively close packing of flowers. This factor alone is a valuable one and a distinct advantage for the methods. Flowers can surely be more easily handled by some dry storage technique.

Conclusions

1. Roses, carnations, pompons, peonies, garden lilies, and lily-of-the-valley stored in better condition at 31° F than at higher temperatures. It is believed that low temperature storage will prove beneficial with most other flowers. Orchids alone were damaged by low temperatures.

2. Bad effects of low temperature on the flowers mentioned were not observed. At 30-32 storage no freezing of flowers was noted. However, temperature control should be precise so that this danger may be avoided. The use of air circulation units or fans in the storage units help maintain uniform temperature control. Boxes of flowers in storage should be spaced to allow free air movement around them to assure uniform desired temperature.

3. Storage of the flowers in a moisture-proof pack with no free water supply was superior to conventional storage of flowers with their stems in water. Withholding water supply seems to stop cell development and thus reduce aging of the materials.

4. Probably prepackaged flowers could be held in storage for longer periods simply by reducing the temperature of the storage unit. Bulk storage of cut flowers will be possible by application of the basic principles to meet specific circumstances.

(1) Neff, M. S. Problems in the storage of cut carnations. Plant Phys. 14: 271-284. 1939.

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New Jersey Takes Kohl

Harry C. Kohl completed work for his Ph.D. during September. He is extension floriculturist of the New Jersey State College and will work with florists in that state.

Dr. Kohl did a splendid job as an assistant in the soils laboratory at Cornell. His special thesis problem was to determine the relationship of soil moisture tension and soil nutrient concentration to the availability of water to rose plants.

You boys in New Jersey will certainly gain much from Dr. Kohl. We ask that you keep him loaded with problems. Harry, we wish you the greatest of success.

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Your Editor,

Kenneth Post