A Guide for the

Postharvest Handling of Fresh Flowers

to Extend Their Useful Life

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PART III

In this third and final segment of our series on the postharvest handling of fresh flowers and foliages, we will discuss (1) ethylene and (2) the evaluation of new products. The latter section also includes a sample experiment that can serve as a guide for making your own evaluations of new products in the future, rather than depending wholly upon testimonials or the claims of the manufacturers.

Ethylene

Ethylene is one of several known naturally-occurring plant hormones. It regulates various aspects of growth, development and senescence (the aging process). Many plant materials that have begun their senescence give off ethylene as a colorless, odorless gas. Ethylene can sometimes be beneficial; e.g., it is used to control the ripening of such fruits as bananas. To the floral industry, however, the aging effects that ethylene cause are very undesirable. Therefore, it is important to be aware of the sources of ethylene and to know the crops that are most sensitive to it.

The major source of ethylene is the gas given off by aging and decomposing flowers and foliages. Once this process has begun, there is essentially no way to stop it. The old saying that "one bad apple spoils the whole barrel" was based on considerable truth, and certainly applies to a refrigerator with flowers in it. The ethylene given off by aging crops can cause other crops in the vicinity to begin senescing prematurely, particularly if they are sensitive to the effects of ethylene. It is important to recognize the symptoms so that flowers showing them can be promptly discarded.

The symptoms of ethylene damage are numerous. However, some of the most common ones are easy to spot: (1) "sleepiness" (flower petals curve inward and become soft); (2) flower or floret drop; (3) epinasty (leaf bending in abnormal directions); (4) leaf drop; and (5) yellowing of foliage. You would do well to appoint an employee to thoroughly scrutinize flower supplies daily and to discard any that are showing the symptoms of ethylene damage.

Plant materials infested with pathogens can give off substantial amounts of ethylene. Not only do the decaying flowers and leaves give off ethylene at a faster rate, but many fungal organisms also emit ethylene. Fruits and vegetables give off considerable ethylene, too. Other sources of ethylene could be leaking gas lines, gas- or petroleum-fueled space heaters, and automobile or truck exhaust.

Preventing ethylene buildup. Although there are several chemicals on the market for removing ethylene from the refrigerator atmosphere, the best cure of all for ethylene damage is prevention! Following are some practical suggestions to help prevent the buildup of damaging levels of ethylene:

1. Coolers should be cleaned and sanitized regularly, discarding any old, wilting or decaying plant materials, and scrubbing the walls, floors and shelves.
2. Flowers known to produce ethylene should be stored separately from more ethylene-sensitive crops, if possible.
3. Any flowers or foliages showing evidence of pathogen (disease) infestation should be discarded.
4. Fruits and vegetables should be kept out of coolers holding flowers and foliages. Fruit baskets often include apples and oranges—major sources of ethylene. Employees should also keep their lunches and other food items in a separate refrigerator.
5. Storage solutions should be changed frequently, and the containers washed and sanitized after each use.
6. Coolers should not open into an area where there could be an accumulation of truck, automobile or other combustion-engine exhaust. Trucks should be turned off while loading or unloading plant materials of any kind, if their exhaust can enter the loading area.
7. Space heaters should be electrically powered, not fueled with kerosene or heating gases. If fueled generators must be used nearby, have ethylene concentrations checked.
8. Maintain coolers at the optimum crop temperature (usually around 32° to 36°F). Storage at these proper temperatures slows down the emission of ethylene in flowers that produce it and will also reduce the effect of ethylene on flowers sensitive to it.
9. Ventilate your coolers. One air exchange per hour should be sufficient to keep down the levels of ethylene in the air. Some coolers can bring air in from outside and cool it.
10. Purchase bud-cut flowers whenever possible. They produce very little ethylene and are less sensitive to external ethylene.

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Ethylene blockers. The major chemical on the market to help prevent ethylene problems is silver-*thiosulfate* (STS). Commercial STS is mixed with water according to the manufacturer's directions, then the flowers are allowed to stand in the solution for about 2 hours. STS *blocks the action* of ethylene in flowers known to be sensitive to this gas. The use of STS on carnations has yielded dramatic effects, often increasing the vaselife from a few days to several weeks. STS can also be used on any member of the carnation family (Caryophyllaceae), including spray carnations, sweet William, and baby's breath. Snapdragons, which are extremely sensitive to ethylene, likewise benefit from an STS treatment. The material may also be effective on alstroemeria, star-of-Bethlehem, and lilies. If you have never tried STS on anything but carnations, you might consider experimenting with these other crops to determine if it benefits you.

Ideally, flowers should be treated with STS immediately after harvest. If they have not been treated, however, STS can still yield beneficial results at the wholesale or retail level. Note that flowers should be treated with STS only ONCE—more than 1 treatment is often toxic to the flowers. The grower or wholesaler who treats his/her crops with STS should mark each bunch clearly with this information. If, as a retailer, you don't know whether your supply of flowers is STS-treated, ask your wholesaler. It might well be worth considering the use of STS treatments in your business, in order to cut down on ethylene-induced damage to flowers you purchase.

Another chemical now "in the works" for the florist is an ethylene-inhibitor known as amino-oxyacetic acid (AOA). This material *blocks the production* of ethylene, rather than blocking the action of the gas as happens with STS. Keep an eye out for AOA and other products that promise to enter the market in the next few years.

"All these divorces—it's disgraceful. Our marriage works because I make it work!"

Ethylene "scrubbers." The final method that can be used to prevent ethylene buildup is its actual removal from the cooler environment. As mentioned previously, if your cooler is ventilated at the rate of 1 air exchange per hour, this should be sufficient to keep ethylene levels down to a harmless level. However, if your cooler is not well ventilated, there are products available that can "scrub" ethylene out of the storage environment.

Potassium permanganate ($KMnO_4$) is a commonly used "scrubber" material. When air is drawn through the scrubber, ethylene is trapped in a filter, blanket or other device to which the $KMnO_4$ is absorbed. This method is known as *active scrubbing* and is much more effective than the method called *passive scrubbing.* Passive scrubbing involves placing a $KMnO_4$ filter in the storage environment, but air is not drawn through it; therefore, ethylene is not trapped at a fast or consistent rate. Shipping boxes sometimes have bags of $KMnO_4$, in the purple granular form, placed in them. These bags are a form of passive scrubber. While seemingly a good idea, they are not very effective in trapping ethylene.

Active $KMnO_4$ scrubbers are available commercially for installation in florists' coolers. They are not expensive and are well worth investigating, especially if you have only one cooler and cannot separate crops, or if there is insufficient ventilation.

Ethylene unfortunately is a natural product of the florist's environment. The best method for preventing ethylene damage is the avoidance of its buildup. First of all, follow the practical suggestions already given to prevent ethylene accumulation. Then, with the additional use of STS on the appropriate crops and an active $KMnO_4$ scrubber in the cooler (if necessary), damage from ethylene should be nonexistent.

Ethylene-sensitive crops. Following is a list of flowers and flowering plants known to produce high levels of ethylene and which are also quite sensitive to ethylene: alstroemeria, anemone, baby's breath, calceolaria, carnations (including spray types), delphinium, geranium, hibiscus, kalanchoe, lily, orchid, pinks, poinsettia, snapdragon, star-of-Bethlehem, stock & zygocactus. As ethylene research continues, the list will undoubtedly grow, so it is important to keep on top of current research findings.

Evaluating a New Product

Florists are constantly bombarded with new product information in the mails and the trade press, in visits from salespeople, and in phone calls from companies offering to sell their versions of the newest innovation on the market. Determining which products to order—and which to turn down—is only a guessing game, unless there is a systematic method to test new products you might be interested in.

Systematically testing products has several advantages. It allows YOU to determine for yourself if a product performs as its manufacturer claims. And testing can also help you determine which product, among several, would best serve your needs. It can also help you decide on the best way to use a product. Finally, it can aid you in eliminating methods or products that do not benefit your business, or suggest those which would benefit you. In addition, the methods of testing described in this section can be used to evaluate new storage and handling techniques, new marketing angles, and in fact, almost anything new that you wish to try out before committing yourself to it.

Setting up an experiment. Setting up a product-testing experiment (or any type of test, for that matter) isn't difficult. However, several important steps should be included to guarantee meaningful, unbiased results. Following is a list of steps to include, as well as a brief explanation of each:

1. *Determine the question to be answered by the experiment.* This would seem to be an obvious step, but if the question is not clear in your own mind, it will be difficult to effectively set up the experiment.

2. *Decide upon a set of treatments and control.* The treatments are the methods used or steps taken to test a product. The control is also an integral treatment and is handled exactly the same way that all the other treatments are—*except* that the element being tested is left out.

3. *Replicate your treatments.* Replication is the repetition of the procedures to test a product. Replication helps to guarantee authenticity or reliability of your results by correcting for chance errors that may occur. These errors can happen because of the variability that exists in nature; e.g., there is a great deal of variability in environmental conditions such as water quality, temperature, and relative humidity. Even individual flowers may also vary from one to the next. A failure to replicate treatments often results in inaccurate results and conclusions.

4. *Make certain that the environmental conditions for all treatments are as nearly the same as humanly possible.*

5. *Record your observations of the treatments at regular intervals,* preferably at the same time each day and by the same person.

6. *Make conclusions from your observations.* These conclusions should lead to reliable answers for the original experimental question determined in *Step 1.*

7. *Take action based on your experimental evidence and conclusions.*

A sample experiment for clarification. In order to clarify each of the previous steps and to show how they work in an actual test setup, a sample experiment is provided here:

Step 1. Question: "What floral preservatives on the market would work best for my consumers?" Materials needed: 36 roses of the same cultivar, from the same shipment, & with the same stage of development; 12 identical vases; tap water; and the 3 preservatives I am considering for purchase.

Step 2. Set up the treatments, including the control:

Treatment 1: Preservative A
Treatment 2: Preservative B
Treatment 3: Preservative C
Treatment 4: Control (tap water only; no preservative added)

The preservatives will be prepared according to the manufacturers' instructions, using tap water. The treatments will be placed into the vases, each holding 3 roses. (Many commercial evaluations are made using deionized water rather than tap water. However, since this experiment is based on choosing a preservative for consumers to use at home, it would hardly be reasonable to expect them to use deionized water. Therefore, tap water is used for the control, as well as for making up the preservative treatments.)

Step 3. With regard to replication, each treatment (including the control) will be repeated (replicated) 3 times. (Three replications are usually sufficient for most experiments.) In other words, for each preservative treatment and the tap water control treatment, 3 vases will be used, each containing 3 roses. The vases will be marked according to which treatments they contain, but using a coding system so that the person observing the treatment results *won't know* what specific preservative is in each vase. For example, the vases containing Preservative A will be marked A1, A2, and A3.

Step 4. Considering environmental conditions, the 36 roses will all be of the same cultivar, from the same shipment, and handled normally upon arrival. When the vases have been set up and marked, the roses will be recut underwater, then placed at random into the vases, 3 in each. The vase solution in each vase will be changed every 3 days, including the "control" vases. The vases will then be placed, at random, on the same table. A fluorescent light fixture above the vases will remain on 24 hours a day (with the light switch taped "on"). Keep the room temperature at approximately 68°F, or at least within 2 degrees of that level.

Step 5. It is more efficient and much easier to record observations if a record sheet has been made up at the beginning of the experiment. At the time the methods are determined, discuss with the person who will be making the observations just how it will be done. For this preservative experiment, the principle observations made will be in regard to vaselife. When any flower shows signs of wilting, discoloration or petal drop, it will have reached its maximum vaselife. The observation is then recorded, and the flower then removed from the vase. The observation is recorded, and the flower then removed from the vase. These observations will be made at the same time each day (e.g., noon). Snapshots will also be taken every day of the experiment. Remember that only 1 person should take data to en*sure uniformity*, although others can be involved if dif*ficult* decisions must be made.

Step 6. Results and conclusions.

Days of Acceptable Vaselife*

REPLICATIONS	TREATMENTS Preservative A	Preservative B	Preservative C	Water Control
Vase 1				
Rose 1	6 days	4 days	3 days	2 days
Rose 2	7	7	5	2
Rose 3	7	10	8	3
Vase 2				
Rose 1	4	5	5	2
Rose 2	5	5	5	3
Rose 3	10	10	5	3
Vase 3				
Rose 1	5	6	4	2
Rose 2	6	6	5	2
Rose 3	8	7	6	3

* This data is fictitious & is not intended to reflect the performance with any commercial preservative.

From the vaselife observations made, calculations are undertaken to determine the average vaselife for the roses in each vase. For example, the roses in Vase 1 with Preservative B had an average vaselife of 7 days:

$$4 + 7 + 10 = 21$$

Average = 21 ÷ 3 = 7 days
(3 is the number of roses in the vase)

AFS, as part of its '87 Marketing Program, won't feature holiday specials. AFS's new marketing strategy is based on "Freedom of Choice," a concept which enables each individual AFS florist to promote his own business uniquely in his marketing area. In support of this program, AFS will feature a Fine Art Poster series emphasizing the emotions of giving flowers, replacing the traditional holiday special arrangement posters. The above design, by internationally recognized portrait artist & illustrator *Paul Melia,* is the graphic focal point of AFS's new "Freedom of Choice" marketing program.

As you may note, there is a great deal of variability in the vaselife numbers. Consequently, there is a real advantage in using 3 replications for each treatment, with 3 roses in each vase. Any strong deviation is accounted for, but does not greatly alter the "average" vaselife figure.

Average Vaselife (in days) of Roses in Three Preservatives and Water

REPLICATIONS	TREATMENTS Preservative A	Preservative B	Preservative C	Water Control
Vase 1	7 days	7 days	5 days	2 days
Vase 2	6	7	5	3
Vase 3	6	6	5	2

Based on the averages calculated above, it becomes clear that using preservatives did improve vaselife over just using tap water alone. Preservative C was not as beneficial as Preservatives A and B, perhaps partly due to the quality of the tap water. Therefore, I would choose either Preservative A or B which showed almost equally good results.

Step 7. The last step is taking action on the conclusions reached. Since my store had dealt with the company producing Preservative B for several years, I was able to get a better price on it. Consequently, I ordered 5 cases of consumer packets of Preservative B with the confidence that it would yield the same results as the more expensive Preservative A would. During the experiment, I took several snapshots of the various treatments and then used them in making a professional-looking demonstration poster, to be placed close to where customers have their flower purchases wrapped. The poster sparked interest with consumers in becoming aware of the fact that my store uses preservatives, and stresses the importance of using the consumer packets at home. Due to increased usage of preservatives, both by my own store and by my customers, consumer complaints about flower quality and longevity are decreasing rapidly.

Setting up and carrying out experiments on new products and techniques is not time consuming and can be very illuminating and valuable for both you and your employees. Experimenting with new products and methods before making decisions about them can successfully identify "good quality". This can assure you that you are offering top quality products and services to your customers.

Conclusion

Setting up a carefully thought out postharvest program in your own business should be as essential as instituting a good accounting system. It is necessary to give the best possible care to the products that make you a florist—your flowers. Flowers and foliages are living, perishable products. And without your concern and the concern of your employees, you will be throwing money into the garbage can each time flowers are discarded due to improper care.

Approach your setting up of a postharvest program in a systematic way. Perhaps you should go through this Guide, one section at a time, and make a checklist of changes that need to be made, or new techniques you would like to try out. Discuss the checklist with your employees and consider assigning each one a task to complete the checklist. Be sure to follow through on your employees' progress. If you don't show a continued interest in postharvest care, they will not perceive it as an important part of their jobs. Through a team effort, small changes in your daily routines can make a very big difference in the lasting quality of your flowers, and will ultimately result in improved customer satisfaction and greater sales.

Always be alert for new research developments in the care and handling of florist crops. Use the experimental techniques described in this series to check out new products and ideas, and to develop ideas of your own. Ask your grower and/or wholesaler for information on the proper care of crops with which you are unfamiliar. Never hesitate to ask questions of the suppliers of your postharvest chemicals and refrigeration equipment or of your water analysis specialists regarding their products and research they may be conducting on postharvest care. Finally, continue to read articles and attend workshops on the subject of postharvest care. Research is continuous in our universities as well as in commercial firms, seeking new ideas and techniques to prolong the vaselife of fresh flowers. Those carrying out the research are almost always willing and eager to share their new findings with interested florists.

In conclusion, the authors of this series would like to sincerely thank the Illinois State Florists' Association for the funding which made the writing of the Postharvest Guide possible. The Association's continued interest in the completion of this project has been greatly appreciated.