Flower School: This month we're kicking off a 5-part series on extending flower life and maintaining flower quality.

WATER, WATER EVERYWHERE

> Like people, flowers are mostly water, with 60 to 70 percent of each cell comprised of water. Water allows flowers to maintain normal metabolism, so they can use stored sugars for flower opening and for energy to move water up the stem. Water absorbed by cut flowers expands the cells in the petals, just as air inflates a balloon. Flower petals will open only partially if they do not have adequate water. The importance of water to flowers is often taken for granted. Just submerging stems in buckets is not sufficient.

If cut flowers lose 10 to 15 percent of their internal water supply, premature death becomes a likely possibility. Flowers lose water during shipping and storage and — when shipped long distances — can lose roughly half this amount (4 to 6 percent). Dry storage for extended periods may cause them to lose even more, **so proper re-hydration, with clean water and the right additives, is critical.** Commercial hydration and flower food solutions have a proven track record when it comes to improving flower quality and longevity. And don't forget storing flowers in coolers with high humidity (80 percent) and using clean tools will also help assure that water moves up the stem and into the leaves and flowers.

The Science Behind Hydration

How does water move from the base of the stem to the leaves and flowers?

Water is pulled up the stem by pressure differences between the leaves and the base of the stem. As the stomata (pores) on the leaves and petals open, water is pulled up the stem in the xylem. Think of the xylem as a series of straws that go from the base of the stem into the leaves and petals. As the water runs up the stem, it moves into the cells of leaves and petals. And when you use flower foods, the cells also get a boost from sugar for extra energy and optimum flower longevity.

Bacterial Blockage

Any blockage of the stem (xylem) restricts water uptake and lowers the amount of water that can reach the flower petals. Most commonly, the xylem is blocked by bacteria —microbes that can build up in holding or vase solutions. Microbes can collect on dirty buckets, knives and clippers or they might already be present on flower stems and leaves themselves. Commercial hydration solutions or flower foods lower the solution pH, which restricts the growth of these microbes. They also contain wetting agents to accelerate water absorption. That is why they are so effective.

To Cut Or Not To Cut?

When flower stems are cut under water (a common practice in many floral operations), stem parts, dirt or other minute materials in the water may also block the stem. To address this problem, researchers have developed new hydration and flower food solution technologies that increase water absorption without the need to cut stems. Wholesale and retail florists have found these new products to be effective.

If you don't use these new products, we recommend cutting 1 to 1.5 inches from the base of the stem with a sharp knife or clippers to remove dried out tissue at the base of the stem. Do not, however, recut stems underwater, since microbes and stem cells in the tank will also get sucked into the stems, thus restricting water uptake.

And please do not even consider the old practice of smashing woody stems with a hammer to expose more water-absorbing tissue! This damages the xylem in the stems and releases many fine plant pieces in the water that cause blockage and reduce water uptake.

Natural science writer Loren Eiseley once said, "if there is magic on this planet, it is contained in water." Take his words to heart. Share the magic with your flowers, and they will thank you.

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Flower School: This is the second in a five-part series on extending flower life and maintaining flower quality.

KEEP IT CLEAN

> Cleanliness is a key component in flower care and handling. Flowers — and everything that touches them — should be as clean as possible for best performance. Dirty conditions in coolers, work/design rooms, buckets used for hydrating flowers and even delivery trucks translates to opportunities for disease and shorter vase life. Let's look at a cleanliness program that works for growers, wholesalers and retailers.

Clean Water, Buckets and Vases

As we discussed last month, water is essential for flower life and flower opening. Water is pulled up the stem by a pressure differential between the leaves and the base of the stem. Microbial growth occurs when there are dirty conditions in vases or hydration containers, or if vase solutions are reused. These microbes block the flow of water up the stem. Using clean buckets with properly mixed hydration and flower food solutions will minimize microbial growth and maintain a steady flow of water up the stem. Many discussions of cleanliness end with the discussion of clean buckets. But this is just the beginning.

Clippers, Cutters, Knives, Work Surfaces, Hands and Clothing

Microbes and disease spores collect on clippers, work surfaces and coolers. Aggressive and frequent cleaning is the only approach that works to prevent contamination from spreading to petals, leaves and stems. Use an alcohol solution or disinfectant to clean clippers and knives and antibacterial solutions on cutting surfaces and design tables. As you'll recall from last month's column, cutting stems underwater leads to contamination quickly. When researchers cut 300 rose stems under water, vase life was reduced by 40 percent compared to stems cut dry and placed directly in properly mixed hydration solutions. And keep in mind that disease spores can reside on hands or on clothes too — so wash your hands and aprons frequently.

Disease Spores: They're Everywhere

Disease spores are not visible to the human eye except at very high infestation levels, but they are always present and are easily dispersed in the air. Picking up flowers in the cooler may release spores into the air, onto clothing, and onto cooler benches, the floor and the walls. These disease spores may remain for at least a year, unless you remove them by cleaning. At the present time, there is no scientific evidence that air-scrubbing devices are sufficient to solve the problem of airborne contamination of disease spores, so it's key that you deep-clean your shop regularly.

Cleanliness Checklist

Avoid flower loss and increase profits by following these recommended practices:

- Wash hands frequently.
- Sterilize cutting tools as often as you can.
- Clean and sterilize buckets between each use.
- Wash design tables with antibacterial solution several times daily.
- Remove flower waste remaining from designs and dead and diseased flowers from the processing and design area frequently.
- Cover garbage cans containing flower and plant debris.
- Sweep floors several times daily.
- Avoid underwater cutters.
- Wash walls, floors and tables/benches in coolers monthly.
- Clean the interior of delivery trucks at least weekly.

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GO DEEPER

For additional information, read the American Floral Endowment's report "The Three C's of Success With Fresh Cut Flowers – Cleanliness," at **safnow.org.moreonline.**

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PROPER FLOWER CARE FROM BEGINNING TO END

> How flowers are handled as they move from farm to consumer largely determines whether your customers get a good return on their investment in fresh flowers. Flower care protocols assure water absorption, which is necessary for both bud opening and flower longevity.

Get Everything Ready

Clean and sanitize buckets and clippers. Fill buckets with 4 to 5 inches of the proper solution (more about this soon). Some companies perform this step the night before processing and place prepared buckets in the cooler overnight. Although warm water has been recommended in the past, recent research has shown that cold water is best for water absorption when using commercial hydration and flower foods. The primary exceptions are (1) if you want flowers to open rapidly and (2) you are working with woody stems, which hydrate best in warm water.

Inspect Flowers

Inspect for insects and diseases on flowers, leaves and foliage. Generally, if insects are present, they will be on the underside of leaves or on the petals. Diseases most often appear on the petals or leaves as a discoloration or blackening that will generally become worse after processing. In severe cases, some diseases will exhibit white blemishes. If you see this, you should report the problem to your supplier immediately because the damage will likely reduce the vase life or result in flowers that are not marketable. Also, look for leaves that are yellow or beginning to yellow. Color will not be restored to yellow leaves once processed.

Hydration and Food

Flowers lose 4 to 8 percent or more of the water in the stem, leaves and petals as they are transported from farms to their final destination. Since water is critical to flower life and opening, the lost water must be restored.

Commercial hydration solutions and flower foods are designed to extend flower longevity and to promote flower opening. And they work! So, what is the difference in these solutions and when should they be used?

Hydration solutions and flower foods contain many of the same ingredients (possibly at different ratios and concentrations). The difference is that flower foods contain sugar and hydration solutions do not. Hydration solutions are used generally by wholesale florists to provide quick absorption of water. Once hydrated for two to four hours (according to label directions), flowers can be moved to a solution with flower food to provide energy needed to move water up the stem and to expand petals as the flower opens.

Each solution lowers the water pH, which reduces growth of microbes that may block the flow of water up the stem. The pH of the final solution should be 3.5 to 5. Suppliers of hydration and flower foods can analyze your water and assist in getting the optimum pH.

Some consider these professional products to be too expensive, despite the fact that the price breaks down to less than a penny per stem. We do not hesitate to spend a dollar or more to buy a soda or bottled water to quench our thirst. Shouldn't the costs to rehydrate flowers be equally important?

Finally, remove the leaves that will be below the solution when cut and remove 1 to 1.5 inches from the stems with a sharp, clean knife or cutter, unless you are using one of the newest hydration and flower food solutions, which do not require stem cutting.

Keep Flowers Cold

Cold temperatures reduce respiration (use of stored sugars), minimize the sensitivity of flowers to ethylene and lower the internal production of ethylene. Storing flowers in a cooler maintained at 34 to 36 F will extend flower life. Once flowers have been placed in a properly mixed solution, move them to the cooler, unless flowers need to be opened promptly.

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Flower School: This is the fourth in a five-part series on extending flower life and maintaining flower quality.

ETHYLENE: PUBLIC ENEMY NO. 1

> Ethylene can quickly shorten flower life and even destroy flowers. Common effects of ethylene exposure include premature wilting; flower, bud and leaf drop; and premature death. Recent research attributes bluing, bent neck and leaf wilting in some varieties of cut roses to ethylene. Symptoms of ethylene damage vary by flower type and variety; regardless of what it looks like, it unleashes significant losses to the floral industry.

The good news? Today, there is no reason to experience ethylene damage or death, thanks to specialized treatments to prevent it.

Where Does Ethylene Come From?

Ethylene is a naturally occurring plant hormone that is odorless and colorless. Ethylene damage occurs at very low concentrations (one part per billion or less). There are two common ways that flowers become exposed to ethylene:

1. Presence of atmospheric ethylene in coolers, shipping containers or retail facilities. Ethylene gas is a natural byproduct from plant and flower debris, dead and dying flowers, combustible engines and fruits and vegetables. These gases can build up in any closed area.

2. Presence of internally produced ethylene. Stress caused by temperature, water, vibration and mechanical damage triggers the internal production of ethylene in flowers and plants. Our products become more sensitive to ethylene as they age, or at warmer temperatures.

Today, there may be more damage from stress-produced ethylene than from atmospheric ethylene. Why? Because of shipping conditions. Flowers grown in one part of the world are often shipped long distances to other markets, exposing them to vibration, temperature fluctuations, and water stress during the extended journey — all triggers for ethylene production. Then, if they're stored for a long time, the aging flowers become more susceptible to ethylene.

Atmospheric ethylene is less of a problem because the industry years ago recognized the need to discard old flowers and avoid storing flowers in the same cooler with fruits and vegetables. It is less common to measure ethylene in wholesale and retail floral coolers today, as doors are opened frequently and the turnover of flowers is rapid. As a result, ethylene scrubbers (equipment that removes ethylene from the cooler) may be less necessary today than in the past.

Minimize Ethylene Damage

There are three ways to eliminate or reduce damage from ethylene:

Grow or purchase varieties that are not ethylene-sensitive. Some varieties simply do not have genes that are sensitive to ethylene. Ask your suppliers for recommendations rather than trying to guess. Neither color nor fragrance has any correlation to ethylene sensitivity — a common misconception!

Use flowers that have been treated with anti-ethylene products. Effective anti-ethylene products include silver thiosulfate and 1-Methylcyclopropene (1-MCP). Commercial products containing these ingredients are readily available from postharvest care and handling companies and are easy to use. Once treated, flowers are protected from both atmospheric and internally produced ethylene.

Cold temperatures. Flowers are much more sensitive to ethylene at warm temperatures. Keeping flowers cold provides greater resistance. For all nontropical flowers, the storage temperature should be 34 to 36 F.

It's as easy as that! Help improve your brand's reputation (as well as the industry's!) by taking steps to avoid damage. Choose resistant varieties, purchase ethylene pre-treated flowers, maintain flowers at cold temperatures, and avoid all sources of ethylene.

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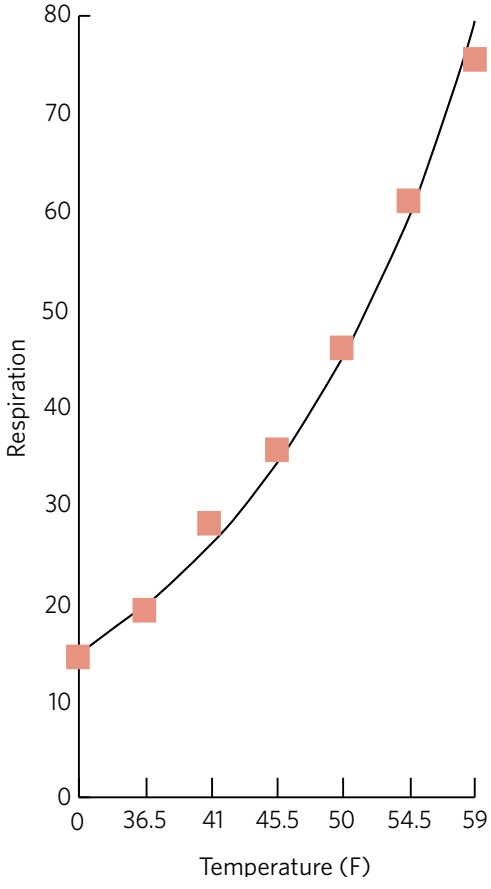
SHUTTERSTOCK/FUSIONSTUDIO

Flower School: This is the fifth in a five-part series on extending flower life and maintaining flower quality.

CHILL OUT: THE IMPORTANCE OF KEEPING FLOWERS COLD

> In the floral industry, there's increasing recognition of the importance of cold temperatures — and providing cold temperatures for every flower from the point of harvest to the point of sale. (One notable exception to this rule: tropical flowers.) And, just for clarity, "cold" means 34 F to 36 F.



Why is the cold so important? Low temperatures extend vase life and optimize the performance of cut flowers. Moreover, cold temperatures are easily managed by adjusting the thermostat and monitoring the temperature in the cooler. Sounds simple enough, right? In theory, yes, but in reality, and for various reasons, it is not unusual to observe flower shop coolers at 42 F to 45 F. Those higher temperatures reduce flower life, which can lead to disappointed customers.

Why does cold temperature have such a big influence on the performance of flowers? Three factors help explain the science.

Respiration

Flowers use stored sugar and starch to maintain the structure and function of cells in the flowers, leaves and stems. Sugars provide the energy for flowers to open and to extend flower life. Without sugar, cells starve, blooms fail to open, and death occurs prematurely. Cold storage temperatures lower the respiration rate and allow sugars to be conserved. See the graph for an illustration of how rapidly consumption of sugars and starch increase as temperatures rise. Flower foods provide sugar to supplement the stored sugars used by the flower during storage, shipping and handling.

Ethylene

Ethylene kills flowers. At cold storage and shipping temperatures, however, flowers are less sensitive to atmospheric ethylene and do not produce as much ethylene internally. In fact, flowers are 1,000 times more sensitive to ethylene at 65 F than they are at 35 F.

Diseases and Microbial Activity

Spread of diseases such as botrytis on flower petals and growth of microbes in bucket and vase solutions are reduced significantly at cold temperatures. Botrytis spores grow and destroy flowers rapidly at warm temperatures. These spores are not killed by cold temperatures, but the spread of the disease is much slower. Microbes block the flow of water up the stem. Microbes present in bucket and vase solutions grow much faster in warmer water.

Realizing how cold temperatures affect respiration, ethylene and disease makes it possible to extend the life of flowers. But temperature is only one of the key factors in flower life. Equal priority needs to be placed on the other factors affecting the absorption of water, particularly scrupulous sanitation, ethylene management and the use of properly prepared hydration and flower food solutions.

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