Handling Of Field-Grown Cut Flowers
ROLE OF SUGAR AND ACIDITY IN PRESERVATIVE SOLUTION

As more and more growers are expanding their businesses by rowing field-grown cut flowers, it is important to understand that all handling, from harvesting to marketing, will significantly affect the quality and the longevity of the flowers. Therefore, growing those beautiful field-grown flowers is only part of what it takes to have a successful cut flower business.

Once harvested from the plant, flowers undergo physiological changes that often lead to an early senescence. Steps to delay the process rely on consideration of many aspects of handling. Factors such as the stage and time of day of harvesting, bunching, sleeving, boxing (if necessary), temperature treatment, and the holding solution will all influence the quality and longevity of the flowers. In this article, I will discuss how sugars affect the postharvest quality of cut flowers and what a grower can do to optimize their postharvest performance.

It has long been known to the cut flower industry that flowers produced in the greenhouse during winter, when the natural light intensity is low and the days are short, are often of lower quality than those produced at other times of the year. In the Northeast region, the postharvest quality of many field grown cut flowers declines in the fall season as the temperatures drop and the number of hours for photosynthetic activities is reduced. Providing external sugar to flowers harvested during fall is therefore more crucial than to those harvested in the summer. However, placing all field-grown cut flowers in a preservative solution will extend their postharvest life and keep their quality.

Many flowers are harvested before they are fully developed, to ensure a long postharvest life and minimize mechanical damages that might occur during handling. The development of these flower buds requires food (carbohydrates), which is stored in the leaves and stems. These stored carbohydrates can be mobilized for the flower bud to use but may be insufficient when the buds are harvested at a tight-bud stage. The maintenance of the metabolic activities, including respiration, even for flowers that are harvested when fully developed, requires that adequate reserves are provided in order to achieve a reasonable postharvest life. When the stored carbohydrates are low, leaves and flowers senesce rapidly and petals that develop at low sugar levels have pale colors. Under these situations, supplements can be provided to the flowers by adding table sugar (sucrose) to the vase solutions. However, it is important to remember that a sugar solution is also perfect for the growth of microorganisms, so that a biocide should be added to the vase solution as well (see below).

External sugars can be provided to cut flowers by dissolving a known amount of sugar, along with a biocide , into the vase solution. The optimum concentration of sugar varies significantly depending on the flowers being treated. Most flowers benefit from a continuous supply of 2% sugar in the vase solution. Some flowers, such as Gladioii, have been shown to benefit from higher concentrations, such as a 4 to 6% sugar solution. Other flowers, such as Zinnias and Coralbells, sustain damage when treated with concentrations of sugars higher than 1%. Still others, such as Chrysanthemums and China Asters, do well without any sugar in the keeping solution. Therefore, it is important that before treating the entire batch of flowers, a small-scale experiment be conducted using the information in Table 1 as a guideline. A close approximation of a 1% sugar solution can be obtained by dissolving 2 level teaspoons of sugar into a quart of water. (To be accurate, dissolve 10grams of sugar and bring up to a 1-liter solution with water.) To that, add a biocide to inhibit the growth of microorganisms.

Two common biocides are household bleach and Physan, which is used as a disinfectant in restaurants. A solution of 50 ppm bleach or 100 ppm of Physan works well for most cut flowers. To obtain a 50 ppm bleach solution, add 1 ml or bleach to a liter (quart) of solution and to obtain 100 ppm Physan, add 0.5 ml of Physan to a 1-liter solution. (For measurement of very small quantities, a medicine dropper is useful. This can be obtained from a pharmacy, and usually contains .8 or 1.0 ml, so that one dropper of bleach or approximately half a dropper of Physan per quart or liter will give approximately the desired ppm.) Keep in mind that after a while bleach breaks down and freshly made solutions should be used each day. Both biocides can also cause stem discoloration in some flowers, so pre-testing on a small number is essential.

Another method of providing sugars is to 'load' the stems and leaves with high concentrations of sugars for a short period of time, typically overnight. This practice is referred to as a 'pulse' treatment. The treatment presumably allows accumulation of adequate sugar in the leaves and stem during that time period to aid the development of flowers. A classic example is to pulse Gladiolus stems with a 20% sugar solution before marketing. When Gladioii are pulsed overnight, flowers opening farther up the spike and are larger and the entire stem has a longer vase life. Although pulse treatment works well with some cut flowers, it does not always work with others. In some cases, the stems cannot absorb enough carbohydrate during that short treatment time, so the benefits of a pulse treatment will not be detected.

One key ingredient in a preservative solution that is critical for the handling of field-grown cut flowers is citric acid, which is used to lower the pH. It has been shown that low pH water (pH=3.5) travels faster in the water-conducting system (xylem), thereby preventing or reducing wilting that frequently occurs in field-grown flowers. Commercial rehydration solutions (such as Hydraflor) often contain sufficient citric acid to lower the pH of the solution to 3.5. However, if flowers are showing signs of wilting after harvest, they should be placed in a solution containing only citric acid (no sugars) and be left overnight in a cool location with subdued light, before transferring them to a preservative solution containing sugar. Citric Acid may be ordered from most pharmacies, and currently costs about $8 per pound. For most water (depending on the quality of water), 350 to 500 ppm citric acid is adequate. Unfortunately it is difficult to translate this into teaspoons of citric acid per volume of water, because the size of the crystals (and therefore weight per teaspoonful) may vary from one manufacturer to another. If a gram scale is available, the most accurate way to obtain the solution is to measure the citric acid by weight. (Between 0.35 grams and 0.5 grams of citric acid will make a liter - approx. 1 quart- of 350 to 500 ppm solution) Another method would be to use a pH indicator paper or a pH pen (available through a greenhouse supplier) to find out the adequate amount of citric acid to mix into the solution. (Keep adding the citric acid until the pH of the solution is lowered to 3.5.)

In addition, you may want to give your customers a simple recipe for a preservative solution so that their flowers will have a better postharvest quality. The first formula calls for mixing a can of a non-diet citrus soda with 3 cans of water and 1.2 ml of household bleach (contents of 1 to 1½ droppers). The second formula calls for 2 tablespoons of fresh lime or lemon juice, 1 tablespoon of sugar, ½ tablespoon of bleach and 1 quart of water. Mix the ingredients and the solution is ready for the cut flowers. These solutions contain the major active ingredients necessary for a good preservative solution, i.e. sugar, citric acid, and a biocide. Because these solutions contain bleach, they need to be replaced every day, or at least every other day, to prevent the growth of microorganisms.

Table 1. Concentrations of sugar recommended for use in the vase solution of some field-grown cut flowers

Species	Sugar Concentration
Baby's Breath	Use 1.5% sugar in the vase solution. If harvested at a tight-bud stage, with only 5% of the buds opened, then a 5-10% sugar solution is needed for the development of those buds
Daffodil	Does not benefit from solutions containing sugars. Make sure that the flowers are hardened in a bucket separate from all other cut flowers
Gerbera Daisy	Sugar concentration up to 6% can be used. It can, however, cause stem elongation. In most instances, placing the flowers in a solution containing bleach is sufficient.
Gladiolus*	Place stems in solution containing 4-6% sugar. Pulsing the flowers in a 20% sugar solution will result in a greater number of larger flowers with a longer vase life.
Lily*	A vase solution containing 2-3% sugar will improve the opening of the flower buds. Higher concentrations may cause premature leaf yellowing. A light spray of growth regulator solution containing 25-50 ppm GA_{4+7}, before or immediately after harvest, will prevent leaf yellowing.
Marguerite Daisy	Use no less than 0.5% sugar in the vase solution. Higher concentration can cause leaf injury.
Peony	Sugar increases fresh weight of the flowers and prolongs the vase life. Use 0.5 - 1% Floralife (concentration of sugar not specified).
Physostegia* (False Dragonhead)	2% sugar solution doubles the vase life of the cut inflorescence
Playcodon (Balloon flower)	Some sugar in the vase solution increases the number and size of open flowers as well as prolongs the vase life. Concentration of sugar is unspecified (1-1.5% Florever).
Snapdragon*	1.5% sugar solution will improve the opening and color of the upper buds on the spikes.
Sweet Pea*	Place the flowers overnight in solution containing 4% sugar. Do not use Physan as a biocide as it damages the petals and reduces the vase life.
Tulip	Place flowers in a solution containing a biocide. Sugar in the preservatives is not recommended.
Zinnia	Place flowers in solution containing 1% sugar. Higher concentrations of sugar damage petals and leaves.

Flowers produced in the summer have a longer vase life than those produced in the fall.

Flowers marked with an (*) will benefit from a pulse treatment with STS or other anti-ethylene compound. This subject will be dis cussed in a future article.