Care and Handling of Cut Flowers and Foliage

A Course in Design Production

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Course Outline

I. INTRODUCTION

Cut flowers, even though they have been separated from the parent plant, are living, actively metabolizing plant parts. These parts undergo the same basic aging process as the entire plant — only quicker. However, the rate of deterioration can be slowed down considerably by supplying the cut flower with its basic needs. The first and foremost need of a cut flower is water. Second is food. In addition, certain damaging factors such as exposure to ethylene gas, microbial attack and rough handling must be avoided.

From a practical point of view, a controlled rate of opening is needed as well as maintenance of good color. All of these factors must be considered by everyone who handles the product. This includes growers, wholesalers and retailers.

In order to be competitive in the marketplace our product must be desirable to the consumer. Our flower must have plenty of life left in them for the customer to enjoy!

II. FACTORS AFFECTING QUALITY

There are several factors which play a part in keeping the quality of cut flowers at a high level: (1) the grower (2) moisture balance. (3) nutrient balance (4) temperature, (5) humidity, (6) ethylene, and (7) microbial activity. While at first some of the factors seem more important than others, they are all so inter-related that it is difficult to determine which would be the most important. However, if one factor can be considered the most important, once the wholesaler has received the flowers, it would have to be moisture balance.

A. THE GROWER

The grower plays a very important part in determining the post-harvest lasting qualities of cut flowers. The National Floriculture Conference on Commodity Handling says that it has been estimated that 70% of the post-harvest characteristics are predetermined at harvest. This estimation, even if it is high, should make us want to become aware of the practices and procedures that growers are using in producing cut flowers. Even if you provide optimum conditions for your flowers, it will not do much good if you receive them in a state of poor quality.

This production factor (the grower) may be divided into three categories: (1) genetic, (2) environmental (3) management.

Genetic

The genetic material make-up of a flower can determine its lasting ability. Roses are the only flower in which a lot of work has been done to determine and produce only the cultivars which have the longest vase life. This is done out of necessity in order to survive because of their popularity and their short vase life. Growers need to be encouraged to put the same amount of research into their other floral crops.

Environmental

The environmental factor of greatest importance are light intensity, spacing and temperature. The effect of shade cloth on a greenhouse has little effect on the lasting quality of flowers grown in the winter; however, the effect of shade cloth is more pronounced in the summer, where too much shade has been shown to reduce the vase life of Chrysanthemums by five to seven days.

The spacing of plants is important because if spaced too close, the amount of carbohydrates stored will be reduced. This amount of carbohydrates stored is the result of photosynthesis and with plants closer together, less foliage gets direct light and this cuts down on the area which is able to efficiently photosynthesize.

Finally, temperature has an effect on vase life. It has been shown that roses have an increased vase life if grown at 21 degrees Centigrade rather than 15, 18, 24, or 27 degrees Centigrade. Not only does it affect the vase life of roses, but flower pigmentation can be affected. There is less color at higher temperatures.

Management

The management practice which has the most significant effect on the lasting qualities of cut flowers is the application of fertilizer and insecticide. While the plant needs the proper fertilizer to produce a flower of high quality, over fertilization can have detrimental effects. For example, it has been shown that too much nitrogen applied to Chrysanthemums will decrease bloom size and shorten vase life, and that increased potassium causes abnormally thick stems.

B. MOISTURE BALANCE

Once you have received the cut flowers the important thing is to provide water immediately. The flower needs to take up as much water as it is using and losing. This natural loss of water is called TRANSPIRATION. Most flowers are lost through wilt or dehydration because moisture is transpired out of the flower quicker than it is taken in through the stem. A high level of moisture in the petals (turgidity) is necessary for the flowers to develop from a bud into a mature blossom.

Retention of water is very important and can be aided by the use of PRESERVATIVES. One chemical in most commercial preservatives that helps water retention is dextrose. Dextrose helps to keep the leaf pores (stomates) partially closed and this slows down transpiration. Dextrose also acts as food for the flower.

Another important consideration is the quality of the water. Factors such as fluoride, pH and total dissolved salt can play an important role in determining the vase life of cut flowers. It is known that amounts of fluoride in excess of 1 ppm can be detrimental. The resulting damage is a browning and shrinking of areas of both petal and leaf tissue. Vase life will be considerably increased when the pH of the water is in the 3.0 to 5.0 range. The third factor in determining water quality is the amount of total dissolved salts (TDS). It has been shown that water containing over 100 ppm can shorten the vase life of cut flowers.

C. NUTRIENT BALANCE

Once water balance has been established with a solution of water which is of a reasonable quality and a preservative containing dextrose, the next important thing is to establish a nutrient balance. Well, in actuality, the nutrient balance was already established when the moisture balance was established. It is the ingredient of dextrose in the floral preservative that established this balance. Dextrose extends the vase life of flowers by replacing the natural sugars that are used up by the flower.

It is especially important to provide the dextrose now since many growers are making a once over harvest, rather than hand harvesting and judging each flower as to its stage of maturity. Consequently, many tight buds are being cut and shipped. Dextrose is needed as a source of carbohydrates for a bud to mature into a fully open blossom.

(Note: the often used word sucrose, common table sugar, is rarely an ingredient in commercial preservative due to its high cost. Sucrose would also encourage the growth of bacteria.)

D. TEMPERATURE

The next important factor in determining shelf life is temperature. A decreased storage temperature results in decreased transpiration which in turn delays death, thereby resulting in a longer vase life. Respiration is actually the use of food to release energy and produce growth.

It has been found that roses at a temperature of 59° F respire at a rate three times as fast as at a temperature of 41° F. The rate of respiration is six times as fast at 77° F than it is at 41° F. In other words, one day at 77° F is equivalent to six days at 41° F!
As can be seen, the refrigeration temperature plays an important role in determining vase-life; however, not all flowers have the same optimum storage temperature. Such tropicals as orchids, anthuriums, poinsettias, bird-of-paradise, and gingers need to be stored at a warm temperature of about 55° F. On the other hand, flowers such as roses, gardenias, and tulips prefer a storage temperature of about 33-35° F. In the middle are the flowers which are happy at 40° F. Some of these are gladioli, carnations, lilies, and chrysanthemums. For a more complete list see Appendix II.

Because of the differences in temperature requirements, it would be ideal to have three coolers that are kept at each of the above temperatures. The greatest amount of square footage should be cooled to 32 - 35 degrees F, with the second largest being cooled to 40 degrees F and the smallest kept at a temperature of 50 degrees F. Since this may not be practical, one refrigerator set at 35 - 40 degrees F would accommodate most flowers.

E. HUMIDITY = moisture content of the air

Temperature is not the only important factor in the cooler. Humidity plays an important role in extending the vase life of cut flowers by conserving water loss due to transpiration. Low humidity can actually pull moisture from your flowers and the shock of this dehydration accelerates the aging process. A relative humidity of 90% is recommended for most flowers stored in the refrigerator..

F. ETHYLENE

Even though cut flowers may be in the ideal holding solution under ideal refrigeration, they are still susceptible to the death-inducing ethylene gas. Sources of ethylene gas include the normal healthy tissue of the flower, damaged foliage and diseased tissue. In other words, ethylene is produced by the flowers themselves — to hasten the maturing process. The symptoms of ethylene damage are: downward bending of leaves; premature withering or rapid development and aging; dropping of leaves, florets, or berries; yellowing of foliage; changes in petal coloring; and inward curving and closing of opened petals (sleepiness in carnations).

Carnations, roses, snapdragons and several varieties of orchids are sensitive to exposure to ethylene gas and fade as a result. Not all flowers fade in response to ethylene gas. Gladioli and chrysanthemums do not fade but suffer from a reduction in vase life.

There are several things that can be done to keep ethylene damage down to a minimum. Since damaged and unhealthy tissue are ethylene producers, the obvious thing is to remove any tissue falling into that category. Keep the refrigerator clean; do not allow old flowers and foliage to be kept past their usefulness. Do not store evergreens, fruits and vegetables in the refrigerator as they are big ethylene producers. Ethylene production is affected by temperature. At temperatures of 40 degrees F and below, ethylene production is greatly reduced and it takes longer for the gas to affect the flowers. Since most of the refrigerated area is kept at 40 degrees F or below, this is a major step in controlling the damage done by ethylene gas.

G. MICROBIAL ACTIVITY = bacteria

Microbial activity, if allowed to exist, can reduce the vase life of cut flowers considerably. The bacterial organisms do their damage by plugging the stem of the flower. This plugging of the stems reduces the water intake capacity which in turn shortens the vase life.

To prevent or keep the damage at a minimum, the best practice is good sanitation. Flower storage containers should be clean enough so that you would not object to drinking from them! After each use, the cans should be washed and disinfected with a commercial bucket cleaner (such as DCD) or bleach. The refrigerator floor should be washed once per week. All foliage should be removed from the lower stem that would be underwater in the storage container. Foliage that stays under water will rot producing harmful bacteria and releasing ethylene.

III. GENERAL RECOMMENDATIONS

As can be seen, there are many post harvest factors which affect the life of cut flowers and foliage. Each factor is interwoven with the others so consideration must be given to each and to all. The following recommendations are based on the preceding information.

A. KEEP GOOD RECORDS

Keep good up-to-date records so you will be able to rate your suppliers according to the quality of flowers and foliage they provide. Handle the incoming flowers carefully — they are the life-blood of your business.

B. RECEIVING, UNPACKING, AND PROCESSING

Avoid delays in processing the flowers. Remember transpiration is going on even though the flowers are out of water!

When the flowers arrive at the shop, they should be unpacked without delay. Loosen or remove the wrappers because the blossoms will increase in size as they mature and to let ethylene escape. Remove the lower foliage and any damaged or diseased parts.

Give the stems a fresh cut. Most flowers will last longer if the ends of the stems are held underwater and cut with sharp cutters. This practice prevents bubbles of air from being forced into the stem as they are plunged into water. Stems that are too ungainly to be cut underwater should be cut with a knife at an angle. The angular cut prevents the stems from acting like a suction cup on the bottom of the storage container, and makes it easier to insert them into wet floral foam.

Tough woody stems should not be crushed, but pithy stems may be broken, however cutting underwater is the best overall practice.

Be sure to place flowers and foliage into clean containers that hold luke-warm water (approx. 100 degrees F) with preservatives added. If unpacking and processing your flowers must be delayed then open the shipping containers (to release ethylene gas) and set them in the refrigerator. Sprinkle the foliage and blossoms lightly to prevent dehydration.

C. CONDITIONING

All flowers should remain in their warm water solution outside the refrigerator for a period of time until they can absorb water and become turgid. This is called conditioning. Most flowers will absorb a maximum amount of water in one to two hours. You will notice that they feel fresh and "perked up" instead of soft and spongy. Some flowers that are shipped in bud such as gladioli, lilies, alstroemeria, and carnations could sit at room temperature overnight (or even longer) to open up and reach optimum condition.

D. FORCING

Many kinds of flowers can be forced into bloom from the bud stage. This means holding the flowers in the optimum atmosphere. This ideal atmosphere is accomplished with warm preservative solution, high humidity, and light. The preservative provides nutrients for respiration. Creating humidity can be accomplished by covering the flowers with a clear plastic bag or by misting, and this prevents dehydration of the buds and blossoms through transpiration. Light is important for photosynthesis which is required for the plant processes.

E. HARDENING

When the flowers have absorbed the maximum amount of water and reached the preferred stage of maturity, they should be placed in the refrigerator. This act of cooling the flower so that it becomes crisp and "hard" is known as hardening.

F. REFRIGERATION

In the retail shop, the refrigerator is the home of the cut flower until it is passed on to the consumer. So the cooler must be adjusted to provide the best possible conditions for the life of the flowers. Low temperature slows down the activities of the flower. As the temperature goes down, so does the rate of respiration and transpiration, the activity of bacteria, and the effects of ethylene.

Each flower and foliage has its own temperature preference for longevity (See Appendix 1). Several coolers would be the ideal solution because a temperature compromise will shorten the life potential of at least one type of flower at some time.

Humidity in the refrigerator is of equal importance to temperature. High humidity reduces water loss through transpiration therefore preventing dehydration of petals and leaves. Flowers last longer in an atmosphere of 90% humidity.

Air circulation is also important to eliminate any warm spots and to remove the ethylene gases that accumulate in the cooler. The refrigerator is the single most important piece of equipment in the flower shop. Your reputation depends upon it! Don't compromise by settling for a "good deal" on a grocery or produce unit. The investment for a professional floral refrigerator is well worth it.

IV. TIPS FOR HANDLING ROSES

PROCESSING

Immediately upon receipt:

1. Unpack, remove wrapper and inspect:
   Bacteria accumulates, mildew forms, and of course ethylene is trapped inside tight wrappers. Air should be able to circulate freely between flowers and stems.
2. Clean lower leaves (using gloves, towel, potato masher, electric cleaner). Be careful not to cut or damage bark.
3. Recut stems underwater (especially if they have been out of water over one hour).
4. Use good water with preservative (read directions of preservative). Some preservatives lose their activation in metal containers. Place roses in warm water — 100 ° F. Use warmer water to open tight buds — 100-110 ° F. Warmer water — over 120 ° F. — can harm the blossoms.
5. Refrigerate after brief conditioning period at 34 °F.
6. Keep roses in a dark place (either extinguish lights or use black plastic bag).
7. Harden roses for 6 to 12 hours in dark-refrigerator. This allows time for water uptake. This helps to eliminate "bent neck".
8. NEVER TAKE ROSES OUT OF SHIPPING CARTON (DRY) AND USE IMMEDIATELY!

ROSES SOLD IN BOXES

1. Be sure they are properly conditioned (see above).
2. Take roses out of preservative solution and immediately place into a plastic wrapped foam block that has been soaked in preservative. Anchor block in box.
3. Never let stems dry out (this only takes 15 minutes)
4. Use cellophane, wax, or plastic wrapping to hold in the humidity.
5. Refrigerate box at 34 ° F until delivery — boxes can be made up 24 hours ahead.

ARRANGING ROSES

1. Roses should be arranged in a deep vase with ample preservative solution.
2. Roses should be brought directly from cooler to worktable in container of water. Do not let stem ends dry.
3. When using foam:
   - Soak thoroughly in preservative solution.
   - Do not force foam to soak with heavy weights (this allows air to become trapped inside the block.
   - Do not force foam block into container (this collapses the water-holding cells in the block.
   - After inserting stems DO NOT PULL STEM PART-WAY back out.
   - Be sure to leave a reservoir of water surrounding foam block.
4. Enclose a care tag with each arrangement, instruct the delivery person to ask the customer to"add water immediately."

COMMERCIAL FLORAL FOOD

There are many commercial floral foods available on the market and the retail florist, wholesale florist, and grower should take advantage of their life-extending properties for cut flowers and foliage. Brands such as Floralife, Oasis, Chrysal, Rogard, and Florever are names that are commonly seen. With proper use, all of the commercial brands will extend the vase life of cut flowers and foliage.

1. Ingredients

There are three main ingredients in commercial floral preservatives; sugar (food), bactericide, and an acidifier. The sugar used in many commercial preparations is dextrose, however glucose is also sometimes used. Sucrose, common table sugar, is rarely an ingredient in commercial preservatives due to its high cost. The flower is a living organism and, like all living things, it requires a source of energy or food to survive. "Sugar" is the **FOOD** for the flower. Once cut from the plant, the flower has only a limited reserve of food to draw upon for that energy. The sugar (dextrose) added to the water in commercial preservatives, supplies that source of energy so that the flower may continue to mature and open properly.

The drawback of adding sugar to preservatives is that bacteria also thrive on sugar. Bacteria are almost everywhere; on the flower stems, in the air, in the vase, on your hands, etc. Bacteria act as a plug in the bottom of flower stems restricting water flow into the vascular system. The result is a wilted flower. Because of this, it is necessary to add a **BACTERICIDE** along with the sugar to prevent rapid and uncontrolled bacteria growth. The two commonly used bactericides in commercial preservatives are 8-HydroxyQuinoline Citrate (8-HQC) and Physan.

The third major ingredient is an **ACIDIFIER**, usually citric acid or aluminum sulfate. The correct pH of the preservative solution is essential for proper water uptake. Acidic water, (a pH of 3.5-4.5 is ideal), moves more readily within the stem. Citric acid also helps to control bacteria and other microbes in conjunction with the bactericide.

2. Procedure

It is important, when using a commercial preservative, that the solution be completely mixed. A lump of undissolved preservative can clog the flower stem just as bacteria and/or dirt do in unsanitary containers. Always start with a clean, non-metallic bucket or container. Metal containers react chemically with the acidifiers in the preservative and render them less effective. Fill storage containers about 1/3 full, and vases for arranging about 3/4 full. Use tepid water. Cold water traps more air and this dissolved air can collect and impede water flow up the stems. Add the correct amount of floral preservative for the amount of water in the container, (check manufacturer's rate of use), and stir until dissolved. If you are using a clear container and notice a white precipitate settle to the bottom, do not be alarmed. This is simply the preservative at work, combining with harmful salts and minerals and taking them out of solution. This is a little unsightly in clear glass containers, so mix the solution in one container and transfer after the precipitate has fallen to the bottom, or use one of the new “crystal clear” preservatives that will not precipitate out. When adding water to vases, buckets, containers, etc., always replace with a pre-mixed water/preservative solution to assure proper concentration.

3. Why Use Preservative

Why should the retail florist, wholesale florist, or grower invest in a commercial floral preservative? First, a commercial preservative is scientifically blended to the correct proportions of sugar, bactericide, and acidifier. This is not possible for the retail florist, wholesale florist, or grower who needs large quantities. Home-made preservatives are merely "rough" estimates and cannot compare to the accuracy of commercial brands. The

wrong combinations and proportions can mean the difference between longer life and early death. The second reason; in a side-by-side test, commercial preservatives will be 40-80% more effective in extending vase life than the best home-made type. This could mean anywhere from 3-8 additional days of vase life! The third reason for using commercial preservatives is cost. Penny for penny, commercial floral foods are much less expensive to use, especially on a large scale.

Why should the retail florist, wholesale florist, or grower use a commercial floral preservative if turnover of fresh flowers is rapid? The main reason is the customer. The floriculture industry is in business to service and retain their customers and one of the best ways to keep customers satisfied is to provide an excellent product. To the consumer, excellence in cut flowers is not only their beauty, but their longevity, their vase life. If each step of the industry, from the grower to the retail florist neglects to use a floral food, they are decreasing the potential vase life of the flowers and short changing their customers.

Since the effectiveness of a commercial food at room temperature declines due to growth of bacteria over several days, it is recommended that flower storage solutions in containers of tropicals that are not in the refrigerator, be changed every third day. The general public is more educated now than ever before, and they will very quickly stop purchasing a poor quality product that gives little satisfaction.

VI. PRE-TREATMENTS

There are three major cut flower pre-treatments on the market; silver thiosulfate (STS) treatments, 1-methyleopropene (MCP) and citric acid hydration (CA) treatments. All three of these pre-treatments are the result of current technology and an increased awareness for the need to improve cut flowers longevity. "Pre-treatment" is a term used to describe a procedure used PRIOR TO the normal usage of a floral preservative. In other words, a pre-treatment adds one more step to your daily care and handling regime. However, this one additional step can add many days to the vase life of specific flowers. It must be stressed that pre-treatments are to be used in conjunction with the use of a high quality floral preservative, otherwise the maximum benefits of the treatment program are lost.

1. Silver Thiosulfate (STS)

The purpose of using STS is to inhibit the effects of ethylene gas. The unchecked effect of ethylene is different for each type of flower, but in general it causes rapid aging or deterioration of the flowers. In carnations ethylene causes "sleepiness"; lilies - bud drop; dendrobium — bud and flower drop; snapdragon — blossom drop; baby's breath — bud drop. For many flowers, such as alstroemeria and lilies, the effect of STS is not only an extension of individual flower longevity, but a dramatic increase in bud opening too. Some experiments have shown that up to 95% bud opening is possible with 'Connecticut King' lily!

Commercially, STS is being phased out of the floriculture industry. As of July 2001, several manufacturers of STS have stopped production due to strict environmental regulations from the federal government. STS will likely still be available for a period of time as inventories are depleted, but eventually STS will not be commercially available.

2. Ethylene Block

MCP (1-methyleopropene) is an environmentally friendly treatment that prevents the negative effects of ethylene gas. Trade named EthylBloc, MCP has been shown to be nearly as effective in the post-harvest care of ethylene sensitive flowers as STS (silver thiosulfate).

MCP (EthylBloc) is easy to use and a large quantity of flowers may be treated at one time. The product comes in powder form and is mixed with a provided solution that releases the MCP into a gaseous form. The treatment must take place in an enclosed area, such as a cooler or portable plastic tent, to concentrate the gas around the flowers. Treatment time varies with temperature. Once treated, flowers are protected from internal and external sources of ethylene. Toxicity is minimal and generally not a consideration.

3. Citric Acid (CA)

Roses are still one of the most popular cut flowers in the United States and one of the shortest lived. It almost seems that their beauty is intended only for a short time, no matter what we do to prolong our enjoyment. However, CA Pre-treatment may be one step that can increase that vase life.

Water with a lower pH tends to facilitate rapid uptake by the stems. Citric acid has the ability to lower the pH of the water without creating a toxic environment for the flower. Roses, due to their internal stem structure, seem to benefit more from a CA treatment than most other flowers.

The rapid hydration, (water uptake), that occurs using a CA treatment with roses accomplishes two things. First, it assures that the flower will be completely turgid, (full of water), in the shortest time possible, which is critical when processing dehydrated flowers. Second, since the flower is completely saturated with water, a clean, unobstructed pathway is created for the follow-up procedure of using a floral preservative.

The first type of treatment procedure for CA is much like that of STS. Simply place the freshly cut (underwater if possible) stem in the CA solution, and let stand at room temperature for about 1 hour. Then place in a high quality floral preservative solution and put in the refrigerator. DO NOT re-cut stems prior to placing into preservative solution.

The second type of treatment for CA is called a "quick dip". As its name implies, the procedure is to dip the freshly cut stem ends into the quick dip CA solution for 1-2 seconds. Then transfer to a preservative solution without re-cutting stems.

It must be stressed that these two solutions are NOT THE SAME! The quick dip is a much higher concentrate and leaving the stems in this solution for more time than recommended will cause severe stem burning. Follow manufacturer's directions carefully.

4. Pulsing Solutions

These highly concentrated solutions are compounded for the sole purpose of "energizing" flowers that have to be shipped long distances. They are usually used by growers, on only a few kinds of flowers. Pulsing solutions are not used on all flowers. The solution is usually made up of 10-20% sugar (dextrose) for food and 150-200 ppm biocide to prevent or control post harvest diseases.

VII. CARE AND HANDLING TERMS

Acidifier — any chemical that reduces the pH of a solution; citric acid is the most common acidifier in commercial preservatives.

Anti-transpirant — any number of chemicals and/or waxes applied to the surface of plants and cut flowers to reduce transpiration.

Bent Neck — typically a rose disorder which involves weakening of the neck just under the flower head. The leaves are usually unaffected- Caused by some sort of blockage in the vascular system of the stem (air, microbes, etc).

Bio-inhibitor (biocide) — any chemical that retards the growth and activity of bacteria and other microorganisms in cut flower water.

Blueing — a bluish cast which develops on flowers (typically red roses) due to cold damage or ethylene exposure.

Chain of Life — a marketing and educational program sponsored by the Society of American Florists (SAF) to promote proper care and handling of floral crops within each "link" in the chain of distribution. This includes the grower, wholesaler, retailer, and consumer.

Citric Acid — a naturally occurring compound (citrus plants) that acts as an acidifier in many commercial preservatives and bud opening solutions.

Conditioning — process of allowing flowers to take up water at room temperature to insure maximum turgidity.

Desiccate — to dry or to lose water.

Dextrose — the sugar ("food") used in many commercial preservatives.

Dry-Pack — storage or shipping of flowers out of water (dry). Temperature and humidity must be monitored closely for this method to be successful.

Ethylene — a hormone that stimulates (accelerates) the aging process. Colorless and odorless, ethylene can damage many of our commonly used cut flowers such as carnations, snapdragons, lilies, etc (see pre-treatment section for more details).

Field Heat — the heat that remains in the flowers once they have been harvested from the field. Field heat needs to be removed as quickly as possible to prevent loss of vase life.

HQC — 8-hydroxyquinoline citrate, a biocide used in many commercial preservatives.

Hardening — a care and handling process procedure in which the flowers are placed in a cooler for maximum turgidity.

Hydration — the act of a plant taking up water.

Hydration Solution — a solution, usually containing citric acid, that facilitates rapid water uptake, therefore reducing the stress of prolonged dehydration.

pH — the measure of acidity or alkalinity of a solution. 7.0 is neutral with higher numbers indicating alkalinity and lower numbers indicating acidity.

Precipitate — to become insoluble and separate out from a solution.

Preservative — term used to describe a chemical compound used to extend the vase life of cut flowers. Commercial preservatives contain a sugar, biocide, acidifier, and other ingredients.

Pre-cool — the rapid cooling of flowers to remove field heat. Typically accomplished by injecting cold/humid air into cut flower boxes prior to shipping and/or refrigerated storage.

Pre-Treatment — a procedure used PRIOR TO the normal usage of a floral preservative. STS and Citric Acid are two common pre-treatments.

Processing — preparing flowers and foliage and subsequently placing them into a preservative or pre-treatment solution.

Post-Harvest — the period following harvest of a crop.

Pulsing Solutions — contain 10 - 20% sugar and 150-200 ppm biocide. These solutions "load" the flower with sugars (for food) and biocide (for disease control) before they are shipped long distances. Unfortunately these highly concentrated solutions only work on a few cultivars — not all flowers in general.

Relative Humidity — the amount of water vapor present in the air at a given temperature compared to the maximum amount the air could hold at that same temperature.

Respiration — process of breaking down carbohydrates and sugars inside the flowers and plants (cells) to supply energy for survival.

Shrinkage — product that is never sold due to spoilage or breakage ... sometimes referred to as dumpage.

Sleepiness — ethylene induced damage to carnations. Exhibited by inward curving of petals; flowers appear limp.

STS — silver thiosulfate. A pre-treatment to prevent the effects of ethylene gas.

TDS — total dissolved solids. A measure of the number of dissolved solids (salts, etc) in a solution.

Transpiration— the loss of water, usually in gaseous form, from plants through small openings in leaves called stomata. Temperature and humidity directly affect the rate of transpiration.

Turgid — fully engorged with water.

Vascular system — the internal plumbing of a plant that carries water and nutrients.

Vase Life — the useful life of a cut flower after harvesting; also known as keeping quality and shelf life.

Water Quality — the characteristics of water that influence the effectiveness of the addition of preservatives or pre-treatments.

APPENDIX I
CARE AND HANDLING OF CUT FLOWERS

Commodity Flowers	Storage Temp. Degrees F.	Comments
Acacia	40	Keep in plastic bags. Needs humidity. Dries quickly. Use at last minute.
Alstroemeria	40	Refrigerate after opening, long lasting, needs humidity.
Anemone	45	Condition for at least 1 hour before harding.
Anthurium	56	If fresh, store at room temperature. Temperature below 50°P. will damage.
Aster	40	Bent necks are common, does not store well for long periods.
Bird of Paradise	45-55	Open blossoms manually.
Calendula	40	Condition for at least 1 hour before hardening roll.
Calla	40	To straighten stems, roll in newspaper before cooling.
Carnation	33-40	Needs humidity, sensitive to ethylene gas.
Chrysanthemum	33-40	Loosen bunch, handle carefully to prevent shattering.
Cornflower	40	Loosen bunches, remove excess foliage and stems. Buds will open in bright light.
Daffodil, Narcissus	33	Remove rubber band and store in separate container, (their sap will harm other flowers). Needs humidity.
Daisy	33-35	Loosen bunches to prevent crushing.
Delphinium	40	Needs humidity, use immediately as lower petals quickly drop.
Freesia	33 -35	Needs humidity, sensitive to ethylene gas.
Gardenia	33-35	Handle carefully to prevent bruising. Store in waxed boxes. Place wet cotton or facial tissue on petals.
Gerbera	35	Recut stems every 2 days. Suspend from chicken wire into storage container to straighten necks and prevent bruising stem ends. Especially responsive to preservatives.
Ginger	55	Likes humidity, temperature "below 45°F. will damage.
Gladiolus	35-40	Sensitive to fluoride, needs humidity. Especially responsive to preservatives.

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CARE AND HANDLING OF CUT FLOWERS

Commodity Flowers	Storage Temp. Degrees F.	Comments
Gypsophelia	40	Loosen bunch. Keep container clean. Needs humidity. Place in warm water with plastic covering.
Heather		Sheds when dry, needs humidity.
Iris	40	Handle carefully. Needs humidity. Sensitive to ethylene.
Lily	35-40	Remove pollen and most foliage. Change preservative solution every 2 days while forcing.
Lily of the Valley	35 -40	Needs humidity. Especially responsive to spray sealers.
Orchids	33	Store in waxed boxes to prevent damage from air circulation.
Orchids, spray type	45-55	Submerge in room temperature water to condition. Cover flowers in storage vase with plastic bag to retain humidity.
Peony	33-35	Loosen bunches. Drafts are harmful.
Poinsettia	55-60	Sear stem ends with flame immediately after cutting. Completely submerge in room temperature water for several hours before using.
Protea	40-50	Cut stems, use preservative (needs the food)
Ranunculus	40	
Roses	34-36	See "Tips on Handling Roses"
Snapdragon	33-35	Loosen bunches. Very sensitive to ethylene gas.
Statice	33-35	Loosen bunches to prevent mildew.
Stephanotis	40	Needs humidity. Puncture storage box to allow ethylene gas to escape.
Stock	45-50	Cut steins. Loosen bunches to prevent mildew. Likes humidity.
Tulips	40	Retain wrapper. Sensitive to ethylene gas. Store separately from Daffodils and Narcissus.
Woody Stems (Forsythia, Peach, Quince, etc.)	33-35	Cut stems. Place in warm water. Cover with plastic to retain humidity.

Notes

1. Do not store fresh fruit and evergreens in the same refrigerator with flowers unless they are sealed in plastic bags. These materials give off ethylene gas, which causes sleepy Carnations, Gypsophelia, Orchids Roses and petal drop of Snapdragons, and Tulips.
2. Tough woody stems should NOT be crushed. This was thought for many years to be a good way to open up hard stems, but in reality crushing the stems only damages the cells in the vascular system and reduces hydration. (water up-take).
3. Most tropical flowers, especially arithuriums, ginger, helaconia Stephanotis and spray orchids respond to being submerged underwater for 15 to 60 minutes immediately after unpacking.

APPENDIX II
CARE AND HANDLING OF CUT FOLIAGE

Commodity Foliage	Storage Temp. Degrees F.	Comments
Asparagus: Sprengeri Tree Plumosus	40	Needs humidity. Store in moist bag for short periods and in preservative solution with plastic bagcovering for long periods.
Boxwood	33	Keep moist in storage box.
Croton	40-55	Keep stems in shallow water (1/2")
Eucalyptus	35-40	Change water every 3rd day as it is nearly impossible to remove all the lower foliage.
Ferns: Maidenhair Brake (Flat fern) Leatherleaf (Baker) Woodwardia	33-40	Needs humidity. Store in moist bag for short periods and in preservative solution with plastic bag covering for long periods.
Galax	33	Submerge in water for short term and place in moist plastic bags for long periods.
Holly	33	Keep moist in storage box.
Huckleberry	33	Cut stems. likes humidity.*
Ivy, English	33	Submerge in water for short term and moist plastic bags for long periods.
Magnolia	33	Cut stems, likes humidity.*
Mistletoe	35-40	Store in moist bags.
Palm	45	Likes humidity*
Pittosporum	35-40	Likes humidity, cut stems.
Rhodendron	33	Cut stems, likes humidity.*
Salal (Lemon Leaf)	33	Keep in moist storage box for short term. Use preservative and cover with plastic for long term.
Scotch-broom	40	Loosen bunches. Cut stems, likes humidity.
Smilax, Southern	40	Keep moist in storage box.
Smilax, Garland	40	Keep moist in plastic bag.
Evergreens: Cedars Junipers Firs Pines	33	Cut stems and place in preservative solution. For large quantity, keep in storage box. If necessary to store evergreens in same refrigerator as cut flowers, be sure they are tightly sealed in plastic to prevent ethylene gas from damaging other fresh flowers. In northern climates all evergreens can be stored outside. Need high humidity.

* Responds best to storage in plastic bags when possible

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XI. ADDITIONAL SOURCES OF INFORMATION

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