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Best Practices For Shipping & Storage of Fresh Cut Flowers

The concentration of flower growers in the equatorial regions means that flowers are being shipped further than ever before to reach the consumer markets. Shipping and storage times have also been extended to meet market demands, especially during holiday periods. Flowers sold in retail outlets today are often 10 days old or older. At the extreme, flowers may be stored prior to processing by bouquet manufacturers, wholesalers and retailers for 14 - 21 days or in ocean liner shipping containers for 10 - 21 days. Consumers want flowers that will perform nicely and last 7 days or longer despite the challenges of shipping and storage stresses.

Cut flowers continue metabolic functions after they are harvested. They absorb water through translocation up the stem to leaves and flower, converting stored carbohydrates and sugars into usable energy. However, cut flowers are susceptible to environmental and mechanical stresses. Damage to plant cells prevent normal metabolic functions, which result in a reduction of vase life and quality of flowers. Therefore, a good postharvest care and handling protocol is very important to the health and well being of your flowers.

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Visual appearance is not a reliable predictor of flower longevity or health. With the exception of evidence of disease, changes in the structure and function of the flower are hidden. The impact on the appearance of flower quality and vase life may not be immediately identifiable. Before the flowers are boxed, the following concerns must be addressed.

Drying Out

Leaves and flowers are 70 - 95% water, and hydration is a key factor in the health of a plant cell. Water is required for petals to expand and flowers to open. Loss of water within the plant cells causes them to stop functioning efficiently and, in extreme cases, to die. Cut flowers are highly susceptible to desiccation due to the difficulties of maintaining hydration because of the high surface-to-volume area and the thin, waxy surface on the leaves and flower petals. Fresh, non-stored cut flowers will often lose 5 - 8% of the water in their leaves, stems and flowers during a 6 - 8 day shipping period. Depending upon the temperature and humidity in the cooler, stored cut flowers will lose even more water in shipping than fresh cut flowers.

Humidity has an important role in maintaining water content. Research has shown that the flower life of carnations can be extended up to 6 - 8 days by raising humidity in storage and shipping to 80% or higher. However, *Botrytis* can become a significant problem at 93% humidity or greater, so the best storage and shipping humidity level appears to be in the 80 - 85% range. Cut flowers experience more moisture loss as temperatures rise and when the humidity levels fall below 80%. In addition, cut flowers that are precooled with low humidity air will dry out faster.

Loss of stored carbohydrates

Carbohydrates and sugars provide energy for cell expansion and for the normal functioning of cells (including, the movement of water up the stem, opening of stomata, and the movement of stored sugars from the leaves and stems to the petals, as well as numerous other metabolic functions). Flowers store the sugars produced during growth. To maintain necessary metabolic functions, they continue to use these sugars throughout storage and shipping. Carbohydrates are depleted during storage and shipping. The flowers will die prematurely, since they lack the energy to perform these essential functions. Flower foods replenish the carbohydrates that were lost during shipping and storage.

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Lowering the storage temperature reduces the loss of stored sugars by reducing flower respiration rates. The respiration rate doubles for each 10° C rise in temperature. Keep the flowers cold to conserve stored sugar and starch.

Hormonal changes

Leaf yellowing, bud and flower drop, short vase life and failure of flowers to open are just a few of the negative impacts due to the imbalance of plant hormones ethylene, gibberellins and cytokinins have on flowers. As flowers age during extended shipping and storage periods, they become increasingly sensitive to hormone activity. Lowering temperatures, raising humidity and preserving sugar levels in the leaves and petals can minimize the detrimental effects of plant hormones.

Hormones are produced within the plant. Hormone concentrations, such as ethylene, may not be measurable in flower boxes or coolers. It is widely recognized that ethylene is produced by external sources such as dead and decaying fruits, vegetables and flowers. Although a fact that is often ignored, the flower itself can also produce ethylene. Mechanical injury to the flower, such as vibration during transport, can trigger the production of ethylene internally and cause premature death of the flower.



Left: Roses affected by *Botrytis*
Right: Example of leaf yellowing



Whether ethylene is produced internally or as the result of external exposure, the use of commercial postharvest treatments, such as EthylBloc™ and EthylGuard, can protect the flower from damage. Similarly, hormone substitution treatments can prevent leaf yellowing. However, once hormone injury is observed, it is often too late to treat flowers.

Disease

Damage from diseases, especially *Botrytis*, during storage and shipping may be the biggest challenge for the industry. Factors such as water on leaves and flowers at time of boxing, humidity of 93% or greater in the box, and mechanical injury to leaves and petals contribute to growth of *Botrytis*. *Botrytis* continues to grow slowly even with cold storage temperatures. Using a fungicides has limited control over the spread of *Botrytis*.

Once *Botrytis* has damaged flower petals, there is no cure and no way to restore the petal to a non-diseased condition. However, several steps can be taken prior to boxing to curtail the moist conditions which encourage *Botrytis* development. Cooling the fresh cut flowers and allowing water to dry from the base of the stems prior to sleeving and boxing reduces the moisture within the box. Packing the flowers in the cooler and maintaining uniform temperatures reduces condensation on the sleeves. When used in the boxes during storage and shipping, Floralive TransportCARE® sheets release chlorine dioxide gas that prevents the development of *Botrytis*.

Steps for Successful Shipping and Storage

- Establish a **care and handling protocol** for your flowers during the flower chain and make sure all suppliers adhere to the protocol.
 - Hydration / Treatment
 - Feeding
 - Disease protection
 - Sanitation
 - Water quality control
 - Air quality
 - Humidity and temperature control

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- Use a commercial **hydration solution and / or treatment** following harvest
- **Maintain cooler humidity at 85 - 90%** to maintain the internal water content
- **Prevent ethylene** damage by treating with anti-ethylene products
- **Prevent *Botrytis*** before it attacks by maintaining sanitary conditions in the postharvest area
- **Pack Cold, Keep Cold and Avoid Temperature Fluctuations.** Cool flowers before boxing, and pack flowers in the cooler. Keep flowers cold once boxed and avoid fluctuating temperatures during storage and shipping
- Wholesaler and retailers alike should **process their flowers** immediately upon receipt