Flowering Potted Plants

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Transporting and storing flowering potted plants challenges commercial growers' continuing ability to provide a high quality product. Quality suffers when plants are exposed to adverse shipping and storage conditions, such as exclusion from light in closed containers and sleeves, exposure to harmful gases and temperature extremes, poor air ventilation, high RH, and vibration. These conditions can lead to deterioration of even the highest quality plants. Further, the environmental and physical stresses imposed on plants during transit are worsened if plants are improperly produced, incorrectly packaged, or mishandled during shipping or upon receipt.

Flowering potted plants represent a significant portion of floriculture production in the United States (20.3% of production), with 53% of the production in six States: California, Florida, Texas, Pennsylvania, North Carolina, and New York. Plants are often produced at locations distant from the point of marketing; Thus shipping, often for long distances, has become commonplace in the industry. The extended shipping or storage times may result in loss of quality and reduced longevity.

Flowering potted plants range from cold tolerant to chilling sensitive and from ethylene insensitive to ethylene sensitive. Quality and longevity are based on flower longevity and leaf quality. A flowering potted plant with yellow leaves has little value even if the flowers last for a long period. Likewise, plant quality is diminished when the flower dies rapidly though the leaves remain green. Problems with shipping may not be apparent immediately following shipping: Buds or flowers may drop several days after unboxing, or leaves may turn yellow or flowers die prematurely 1 to 2 weeks after shipping. Research over the last 25 years has concentrated on factors providing for retention of leaf color while maximizing flower longevity.

Cultivar selection and production conditions affect the response of flowering potted plants to shipping conditions. Chrysanthemum and poinsettia cultivars vary considerably in their ability to withstand shipping. Hibiscus cultivars drop buds and flowers as a result of improper shipping conditions. It is likely that differences in cultivar response of other flowering potted plants to shipping conditions exist, but extensive research has not been conducted to elucidate these responses.

Production conditions can play a major role in the ability of potted flowering plants to withstand shipping conditions. High fertilizer levels during production decreases the quality of chrysanthemums, campanula, poinsettia, and other plants during and following shipping. In chrysanthemum, terminating fertilizer at flower color (3 weeks prior to marketing) resulted in a 7- to 11-day increase in longevity, depending on cultivar and fertilizer rate. With potted roses, overwatering of the plants during the final 1 to 2 weeks of production results in rapid losses in plant and flower quality following shipping as a result of damage to the root system.

Four factors—disease, improper temperature, extended shipping duration, and exposure to ethylene—result in either rapid loss of quality during shipping or reduced longevity and quality

following shipping. All of these factors can be interrelated in their effects. For instance, packing flowering potted plants in a warm greenhouse or packing area then placing the box into a cooler will result in condensation on the flowers and leaves, providing ideal conditions for botrytis, powdery mildew, or other diseases. Similarly, use of optimum temperatures may cause problems during long shipping times.

Production and shipping practices should minimize the potential incidence of diseases. For instance, calcium sprays and reduced fertilizer have been shown to minimize the incidence of poinsettia bract edge burn in the greenhouse, during shipping, and in the retail setting. In most cases, diseases, especially botrytis and powdery mildew, will become worse during shipping because of the high RH microclimate created in the closed shipping box.

Temperature management is one of the best methods of maintaining quality during shipping. Reduced temperatures lead to lower respiration, conservation of carbohydrate reserves, and minimize problems associated with ethylene. Optimum shipping temperature varies with species, but plants should be shipped at the lowest possible temperature (table 1). Chilling-sensitive crops are generally shipped at 50 to 53 °F (10 to 12 °C), while those that are not chilling sensitive are shipped at 35 °F (2 °C) to maximize plant and flower quality.

Ethylene can adversely affect quality. Plants may produce ethylene, or plants may be exposed to ethylene from external sources, such as combustion engines and dead and decaying organic matter (fruit, vegetables, or flowers). Ethylene is a colorless, odorless gas that can cause many undesirable effects on flowering potted plants at very low levels—25 to 100 nL L^{-1} (ppb). Typical ethylene injury symptoms include leaf and bud drop, premature aging, and leaf yellowing, but other disorders have also been identified (table 2).

Regardless of concentration, ethylene becomes more damaging as temperature increases during the exposure period. Of course, injury is worse with higher concentrations and longer exposure periods. For example, open carnations are 1,000-fold more sensitive to ethylene at 21 °C (70 °F) than at 2 °C (36 °F). One of the most effective means of minimizing ethylene damage is to reduce temperature, being cautious not to ship chilling-sensitive crops at too low temperatures. Also, open flowers are often more sensitive to ethylene than buds.

Several chemicals are available commercially that will minimize the detrimental effects of ethylene. Application procedures and effectiveness on ethylene-sensitive crops vary, but these chemicals can be a valuable tool for crops that exhibit ethylene injury. The use of anti-ethylene chemicals is especially valuable on chilling-sensitive crops, since temperature cannot be reduced.

Flowering potted plant quality can be maintained during shipping provided that production practices and cultivar are selected properly and optimum shipping conditions are maintained, including temperature management and prevention of injury from ethylene. However, regardless of the conditions, shipping and storing flowering potted plants for extended periods will lead to decreased longevity. Ideally, flowering potted plants should be stored and shipped for brief periods at optimum conditions.

References

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Table 1. Recommended shipping temperatures for flowering potted plants

Crop	Shipping temperature	
	35 to 40 °F (2 to 5 °C)	**50 to 60 °F (10 to 15 °C)**
Amaryllis	*	
African violet		*
Azalea	*	
Begonia-elatior		*
Bougainvillea		*
Browallia	*	*
Calceolaria		
Christmas cactus	*	*
Chrysanthemum	*	
Cineraria		*
Clereodendron	*	
Crocus		*
Crossandra	*	
Cyclamen		*
Cymbidium	*	
Daffodil		*
Easter cactus	*	
Easter lily		*
Exacum	*	
Freesia		*
Gloxinia	*	
Grape hyacinth		*
Hibiscus	*	
Hyacinth	*	
Hydrangea	*	
Kalanchoe	*	*
Oxalis		
Poinsettia	*	*
Regal geranium	*	
Rose		
Streptocarpus	*	
Tulip		

Adapted from Sterling and Molemaar (1985) and Nell (1993).

Table 2. Response of flowering potted plants to ethylene.[1]

Crop	Symptoms
Achimenes	Flower/bud drop
African violet	Flower wilting
Azalea	Leaf drop
Begonia-elatior	Flower drop

Bougainvillea	Flower/bract drop
Browallia	Flower/bud drop
Carnation	Failure of flower to open
Calceolaria	Flower/bud drop
Clereodendron	Flower/bract drop; leaf drop
Crossandra	Flower drop
Cyclamen	Flower drop; flower wilting
Cymbidium	Wilting of the sepal
Exacum	Flower wilting
Geranium	Floret drop
Gardenia	Flower/bud drop
Gloxinia	Flower drop
Hibiscus	Flower/bud drop
Kalanchoe	Failure of flowers to open; petal drying
Pachystachus	Petal wilting; bud blasting; leaf yellowing
Poinsettia	Petiole droop[2]
Streptocarpus	Flower drop

Adapted from Woltering (1987).

[1] The degree of sensitivity to ethylene varies with plant species, variety, ethylene concentration, and temperature during exposure and duration of exposure.
[2] Petiole droop (epinasty) of poinsettia is caused by upward bending of leaf and bract petioles during sleeving.