

Cut Flowers & Potted Plants

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http://wp.li.ru/flowers/flowers_063.jpg

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http://annflore.typepad.com/photos/fleurs/rose_aqua.jpg





Cut Flowers Include

- Rose
- Carnations
- Gladiolus
- Anthuriums

<http://www.artflower.pe.kr/images/gallery/corsage.carnation-1.jpg>

<http://www.jroses.com/photo2/gladiolus.jpg>

<http://www.alohaorchids.com/flowers/anthuriums/Pastel-Anthuriums.jpg>

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<http://www.peterbrownartist.com/images/fine-art/chrysanthemums-lg.jpg>

Cut Flowers Include

- Chrysanthemums
- Delphiniums
- Gypsophila
- Snapdragons



http://www.delphinium.co.nz/images/garden_delphiniums_anderson4.jpg



http://www.sobkowich.com/products/Proven%20Winners%20Perennials/graphics/gypsophila_festival_star.jpg

<http://msucare.com/news/print/sgnews/sg05/images/sg050120snapspetunia200.jpg>



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http://www.alohafriendsphotos.com/web%20art/flower_ginger_pink002_small.jpg

Cut Flowers Include

- Ginger
- Strelitzia
- Gardenia
- Orchids
- *etc.*



<http://www.strelitziatours.com/images/new%20pics/strelitzia-2.jpg>



http://home.ec.rr.com/mh/dn/gardenia_for_print.jpg



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■ ■ ■ Maturity & Quality Standards

- Mostly based on external, visual quality factors
 - bud development, color, stem length, shape, size, freedom from defects, etc.
- Minimum maturity for cut flowers is “that stage at which the harvested buds can be opened fully and have a satisfactory display life after distribution”



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■ ■ ■ Maturity & Quality Standards

- Quality loss can be due to:
 - Wilting of leaves or petals
 - Abscission or “shattering” of plant parts
 - Yellowing of leaves
 - Geotropic or phototropic bending of plant parts



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■ ■ ■ Maturity & Quality Standards

- Flowers are often harvested at the **bud stage** (petals have not yet expanded)
 - Advantages: reduces growing time, increases product packing density, reduces susceptibility to mechanical damage and desiccation



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■ ■ ■ Maturity & Quality Standards

- More varieties are being harvest at the **tight-bud stage** to extend vase-life
 - Asters, bird-of-paradise, carnations, chrysanthemums, gladioli, iris, roses, and snapdragon
 - Roses may develop more “bent neck” than if harvested more fully open, but this is less of a problem with the newer cultivars and improved postharvest practices
- Some are harvested when the buds are **starting to open** or **nearly fully open**



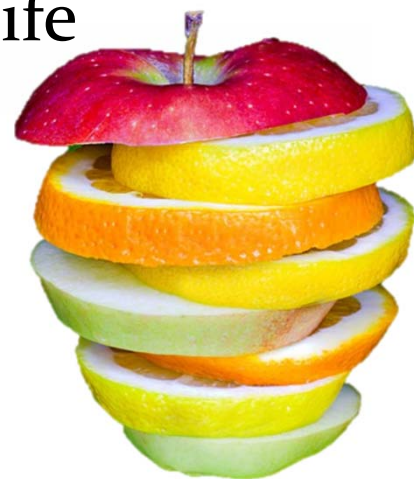
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■ ■ ■ Maturity & Quality Standards

- Stem straightness, length, flower size, vase-life, freedom from defects, maturity, uniformity, and foliage quality are useful grading criteria



■ ■ ■ Factors Affecting Postharvest Quality and Vase Life



Preharvest Factors

- Cultivar – Relatively little work comparing quality and shelf life of different cultivars
- Fertility practices
- Field or greenhouse sanitation
- Endogenous food supply



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Postharvest Factors

- Endogenous food supply
- Light
- Mechanical injury
- Speed of cooling
- Holding temperature and RH
- Water supply
- Water quality
- Decay
- Ethylene



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Food Supply

- Internal carbohydrate reserves are usually highest in the late afternoon
 - => after a full day of sunlight & photosynthesis
- However, flowers are often harvested early in the morning
 - Temperatures are lower, plant water content is higher, and a whole day is available for processing the cut flowers



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Food Supply

- Quality and vase-life often can be improved by:
 - Pulsing cut flowers with a sugar solution immediately after harvest
 - Stand the flowers in the solution, usually <24h and at low temperatures
 - Including sugar in the bud-opening solution used to open bud-cut flowers before distribution
 - Including sugar as part of the vase solution used at the retail and domestic level



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Light

- Lack of light is most important when yellowing of foliage is a problem
 - Especially is stored under warm, dark conditions
- Blacking of *Protea* leaves can be prevented storing in high light (or by giving a sugar pulse)



<http://www.botgard.ucla.edu/html/MEMBGNNewsletter/images/volume3/Protea1.jpg>

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Mechanical Injury

- Cut flowers are **very sensitive to mechanical damage**
 - Leaves, petals, etc. are easily damaged.
 - Besides reduces aesthetics, wounds **increase plant respiration, ethylene production, decay, and water loss**



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■ ■ ■ Mechanical Injury

- Cut flowers are normally harvested by hand
 - Some harvest aids are employed (picking platforms, special cutting tools, etc.)
- Fewer handling steps reduce damage to the fragile tissues



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■ ■ ■ Rapid Cooling

- Cut flowers can have a very high Q_{10} (up to 7)
 - Thus, rapid cooling and maintenance of the cold chain are critical for optimum vase life
- Flowers cool rapidly when they are placed in cold rooms before packing
 - High surface to volume ratio exchanges heat rapidly with surrounding air



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■ ■ ■ Packaging

- Packages for cut flowers are varied but tend to be long and flat
- Venting tends to be limited, with openings at both ends with flaps that can close to help prevent rewarming after cooling



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■ ■ ■ Packaging

- Packers often add wrapping material and cleats to prevent the product from shifting during transport.
- Specialty flowers may have extravagant packaging to protect the product.



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■ ■ ■ Rapid Cooling

- Because cartons have limited venting and packing materials & foliage easily block air passage through the carton, flowers are much more difficult to cool within the packages
 - **Forced air cooling** (cold walls) are required to force the air through the carton => half cooling times take between 10 and 40 minutes



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Optimum Temperature

- Optimum temperature for most cut flowers is close to 32°F (0°C)
- Some flowers such as Anthuriums, tropical orchids, and ginger flowers are **chilling sensitive** and cannot be stored below 50-54°F (10-12°C)



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Optimum Storage Conditions

- Some packages have **insulation** to help maintain cool temperatures within the boxes
- **Ice packets** are sometimes added to provide additional refrigeration
 - To be effective, ice packets must be placed so that they **intercept heat entering to boxes**



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Water Supply

- Cut flowers lose water easily, especially those with large leaves = largest surface to volume ratio
 - However, they can be rehydrated if water can move up the stem
- Always store at **>95% relative humidity**
 - Holding at the **lowest safe temperature** also greatly reduces water loss



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Water Supply

- Barriers to water movement up the stem of cut flowers include:
 - Air Embolisms
 - Poor water quality
 - Bacteria
 - Physiological plugging



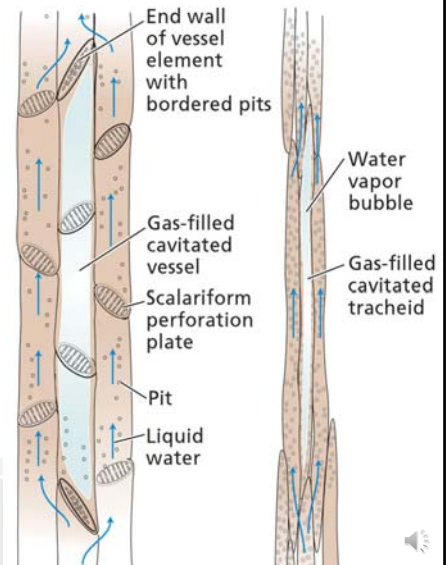
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Air Embolisms

- Air embolisms are air bubbles (emboli) in the stem that interrupt the flow of water up the stem

Taiz & Zeiger, 2002

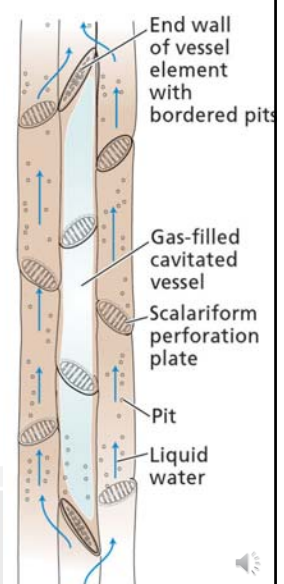


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Air Embolisms

- These can be removed by:
 - Cutting (under water) ~ 2 cm of the stem off the end
 - Acidifying (pH 3 or 4) solution
 - Heating (~40°C) the solution
 - Using an ice-cold solution (0°C)
 - Placing stems in deep (>20cm) water
 - Treating with a detergent “pulse”

Taiz & Zeiger, 2002



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Water Quality

- **Alkaline water** (or **hard water**) does not transport well through cut stems and can reduce flower vase life
 - **Remove minerals** from the water (*e.g.*, use of distiller, deionizer, or RO system)
 - **Acidify** (pH ~3.5) the solution
 - *e.g.*, using citric acid



Bacteria

- Improperly cleaned buckets and vases promote the growth of large bacterial
 - Cut stem surfaces release “food” for bacteria to grow
 - Sugar added to water solutions also promotes bacterial growth



■ ■ ■ Bacteria

- The bacteria or the slime they produce can easily plug vascular tissue
 - => No water movement up the stem



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■ ■ ■ Minimizing bacterial growth

- Use **clean water** for all solutions
- **Clean and sanitize** buckets and other solution containers
- Use **white containers** to better detect dirt
- Use **biocides** in containers & solutions
- **Acidify** solutions



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■ ■ ■ Physiological Plugging

- Some species of flowers will naturally seal off (or plug) vascular tissue when wounded to prevent invasion by external pathogens
- The extent of the problem is **species specific**



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■ ■ ■ Decay Control

- High surface to volume ratio and thin cuticle of petals
 - => **very susceptible to decay**
- **Gray mold (*Botrytis cinerea*)** is the most important disease in cut flowers



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■ ■ ■ Susceptibility to Ethylene

- Some cut flowers are extremely sensitive to ethylene in the environment and senesce rapidly in its presence
 - Carnation, delphiniums, gypsophila, spray carnations, snapdragons and sweet peas



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■ ■ ■ Susceptibility to Ethylene

- Inhibitors of ethylene action are routinely used to extend vase life
 - STS (**silver thiosulfate**) is added to vase solutions (flowers treated for a min. of 16 hrs. at $< 4^{\circ}\text{C}$) but can be difficult to dispose of properly
 - 1-MCP (**1-methylcyclopropene**; **EthylBloc**) is a gas that is effective at parts-per-billion (ppb) concentrations, and can render flowers insensitive to ethylene for ~ 12 days



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Continued Growth

- Many cut flowers still grow after harvest
 - **Geotropism** = growth in response to gravity.
 - Particularly important in spike-flower crops like gladiolus, snapdragon, gerbera, etc.
 - Plants placed on their side grow upwards. **Bent flower spikes are undesirable**
 - **Phototropism** = growth in response to light



<http://cropsci.uiuc.edu/classes/cpsc112/images/PGR/Gravitropism.jpg>

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Potted Plants

- Many of the same factors and handling principles discussed with cut flowers apply to potted plants
- The exceptions arise from the fact that potted plants are still attached to the root system
 - Water supply is much easier to manage, and additional stored “food” reserves for flowers and foliage are available throughout the plant body



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■ ■ ■ Potted Plants

- Similar to cut flowers, exposure to adverse conditions will reduce quality. These include:
 - Exposure to improper temperature
 - Exposure to ethylene
 - Exclusion of light
 - Vibration
 - Poor ventilation
 - High relative humidity

