Cut Flowers &
Potted Plants

Mark Ritenour
Indian River Research and Education Center, Fort Pierce

Jeff Brecht
Horticultural Science Department, Gainesville

Cut Flowers Include

• Rose

• Carnations

• Gladiolus

• Anthuriums

Cut Flowers Include

• Chrysanthemums

• Delphiniums

• Gypsophila

• Snapdragons
Cut Flowers Include

• Ginger
• Strelitzia
• Gardenia
• Orchids
• etc

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”

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
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

• More varieties are being harvested 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

• 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

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

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

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)
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

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

Rapid Cooling

• Cut flowers have very high $Q_{10}$s (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
Packaging

- Packaging 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.

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.

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.
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)

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
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

Water Supply

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

Air Embolisms

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

Taiz & Zeiger, 2002
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”

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

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

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
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

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

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°C) but can be difficult to dispose of properly
  - 1-MCP (1-methylocyclopropene) is a gas that is effective at parts-per-billion (ppb) concentrations, and can render flowers insensitive to ethylene for ~ 12 days
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

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

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