# Factors influencing postharvest life of ornamentals

- Postharvest life
  - Definition and symptoms
- Factors affecting the postharvest life of ornamentals
  - Temperature and atmosphere
  - Water and food supply
  - Ethylene (effects and control of responses)
  - Growth tropism
  - Light
  - Mechanical damages
  - Disease

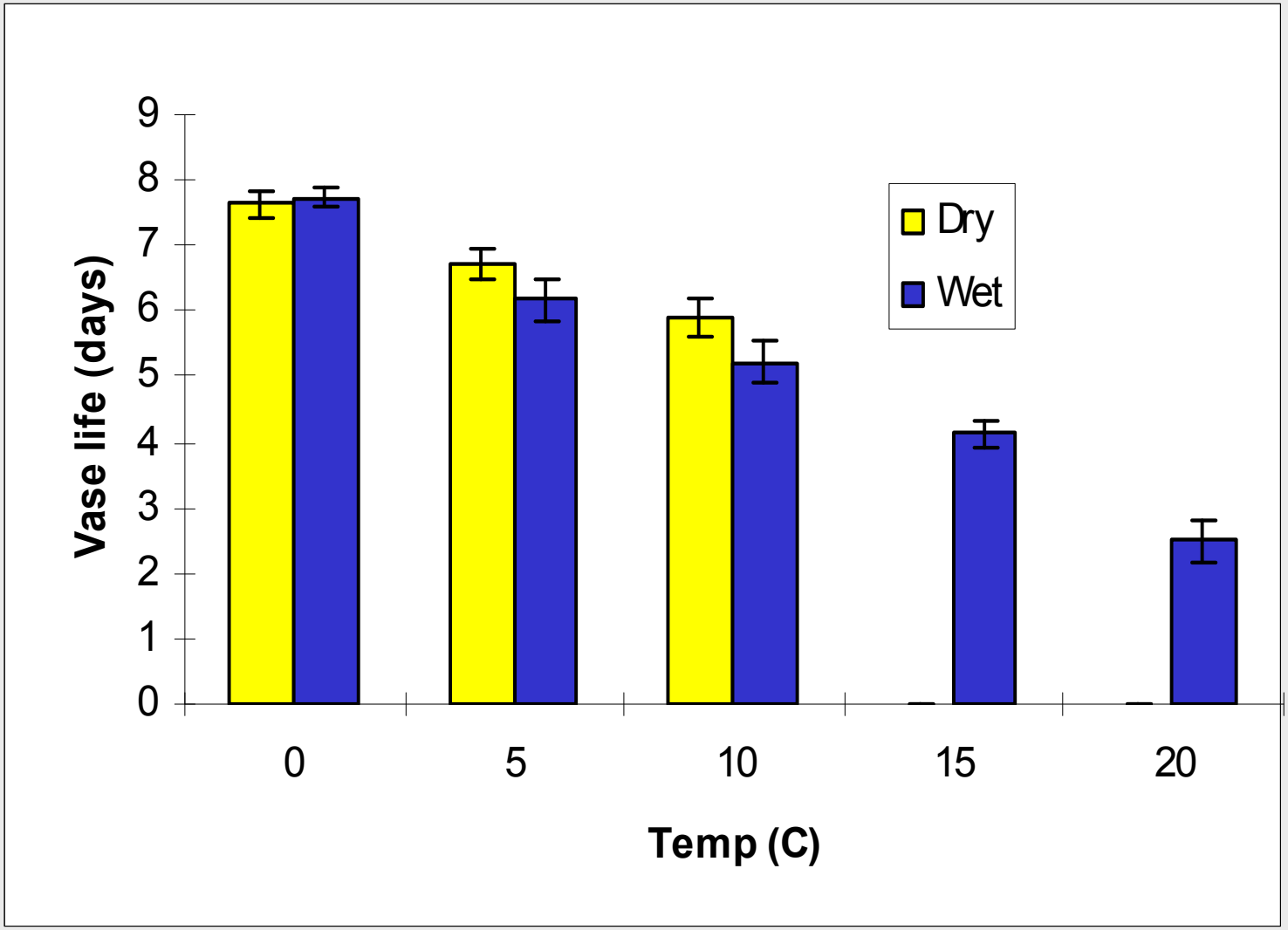
# What is postharvest life of flowers or plants ?

***Period of time from harvest until the flower or plant has lost its decorative value***

# Symptoms of poor keeping quality

- bud drop / drying
- flower abscission / senescence
- petal abscission
- leaf abscission / senescence
- leaf yellowing

# Carnations, 6 days, dry & wet



# Chilling injury

- Tropical crops: *Anthurium*, bird-of-paradise, some orchids, ginger, *Poinsettia,* bromeliads, african violets
  temperature > 10 C

- Symptoms:
  - darkening of petals
  - water soaking of leaves and petals (look transparent)
  - collapse and drying of leaves and petals

# Effects of CA on cut flowers

- Recommendations: 2-3% $O_2$ and 2-3%$CO_2$
- Beneficial effects
  - Reduced $O_2$: delayed senescence, inhibition of ethylene synthesis
  - Increased $CO_2$: disease reduction if product tolerates high levels. Inhibition of ethylene action
- Injurious level
  - $O_2$: 0-2% may cause leaf discoloration and petal collapse and petal browning
  - $CO_2$: above 3-5% (for many crops) may cause bluening of petals, browning of leaves and stems

# Summary

- Temperature
  - Postharvest life of flowers is improved by storing at optimal tp
    - Most of cut flowers 0 C
    - Tropical crops > 10 C
    - Potted plants ??  Suggestion: 5-7 C
  - Respiration can be used to predict the effect of storage temperature on vase life
  - Wet storage extends vase life only under non-optimal temperatures
- Controlled atmosphere
  - Reducing respiration
  - Inhibiting production and action of ethylene
  - Reducing the growth of gray mold (*Botrytis cinerea*)
  - Killing quarantine insects
  - Preventing chilling injury in tropical and sub-tropical foliage plants
  - Recommendations: 2-3% $O_2$ and 2-3%$CO_2$

# Factors affecting the postharvest life of ornamentals

- **Temperature and atmosphere**
- **Water and food supply**
- **Ethylene**
- **Growth tropism**
- **Light**
- **Mechanical damages**
- **Disease**

# Why do cut flowers wilt?

- Air embolism
- Bacterial plugging
- Hard water

# Summary: Maintaining water supply

- Good quality water
- Bactericide
  - chlorite
  - HQC, HQS, Aluminum sulfate (bacteriostats)
  - Citric acid
- Clean buckets
  - detergent wash
  - rinse with chlorite

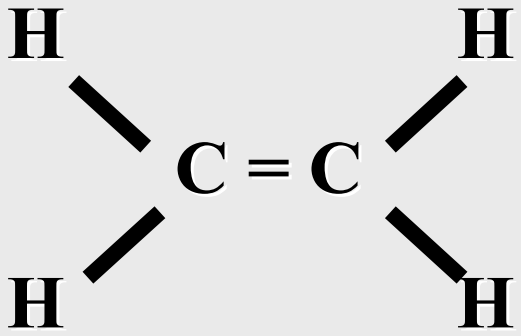
# Carbohydrates in the vase solution

- Carbohydrates
  - Improve bud opening
  - Increase flower color
  - Improve stem strength
  - Increase flower life
- Glucose and sucrose normally used
- How much is required?
  - 1.5% usual
  - ca. 50% for energy, 50% for osmoticum

# Summary: Water and food supply

- Water supply
  - Reduction of water loss
    - Storage at relative humidity 95%, especially during long-term storage
    - Low temperatures
  - Water uptake depends on
    - Emboli
    - Poor water quality
    - Bacterial contamination
- Food supply
  - Starch and sugar stored in the stem, leaves and petals: food needed for flower opening and maintenance.
  - Carbohydrate levels highest when plants grown in high light
  - Carbohydrate levels highest in the late afternoon

# Ethylene




- hydrocarbon gas
- colourless
- sweetish odour
- flammable or explosive limits in air: 3.1 -32.00%

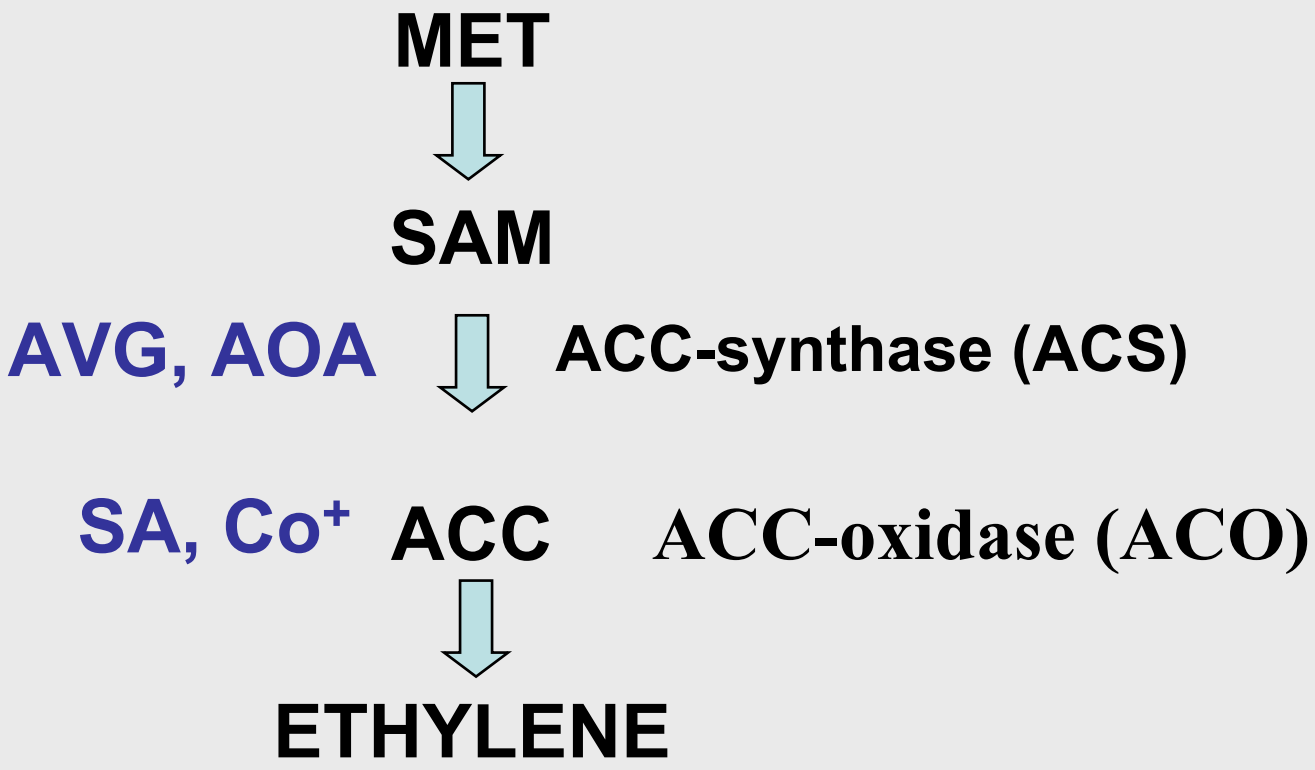
# Ethylene sensitivity of different crops

- Very sensitive
  - Azalea
  - Begonia
  - Bouganvillea
  - Calceolaria
  - Campanula
  - Dianthus
  - Hibiscus
  - Pelargonium
  - Schlumbergera
  - Rhipsalidopsis
  - Streptocarpus
- Less sensitive
  - Aeschynanthus
  - Columnea
  - Crossandra
  - Cyclamen
  - Eustoma
  - Exacum
  - Impatiens
  - Jasminum
  - Petunia
  - Primula
  - Saintpaulia

# Sources of ethylene

- endogenous (synthesised in plants)
- exogenous (common air pollutant):
  - stressed, oxidized or combusted organic materials
  - car and aircraft exhaust
  - cigarette smoke
  - rubber materials exposed to heat or UV light
  - virus infected plants
  - ripening fruits

# Control of ethylene biosynthesis

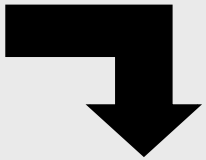


# Ethylene perception

## Endogenous ethylene

(synthesised in plants)

- NBD, 2,5-norbornadiene
- STS, silver thiosulfate
- DACP, diazocyclopentadiene
- 1-MCP, 1-methylcyclopropene



Receptor

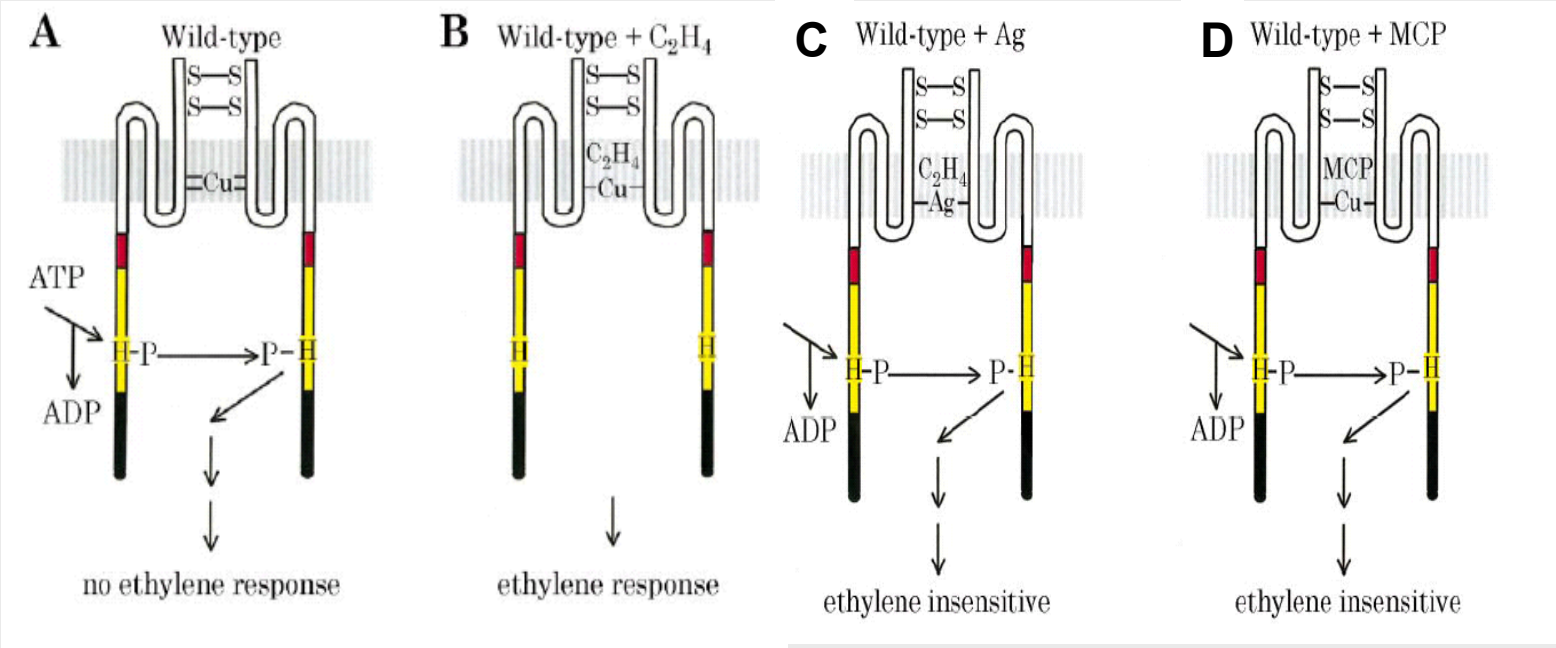
Senescence
Abscission

## Exogenous ethylene

(air pollutant)

# Model of ethylene, 1-MCP or $Ag^+$ action

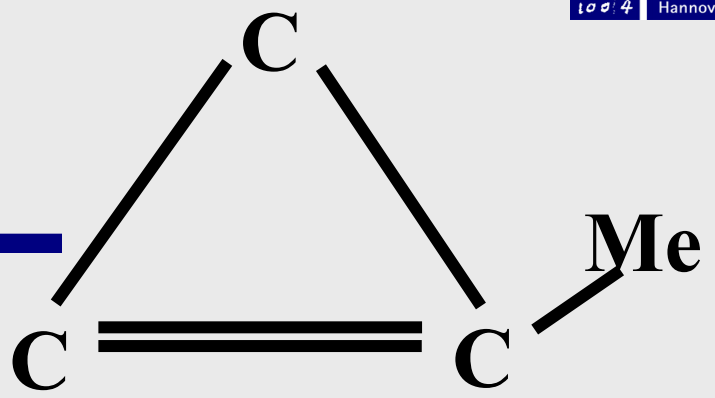
$AgNO_3$, 1-MCP inhibits ethylene from binding to receptors

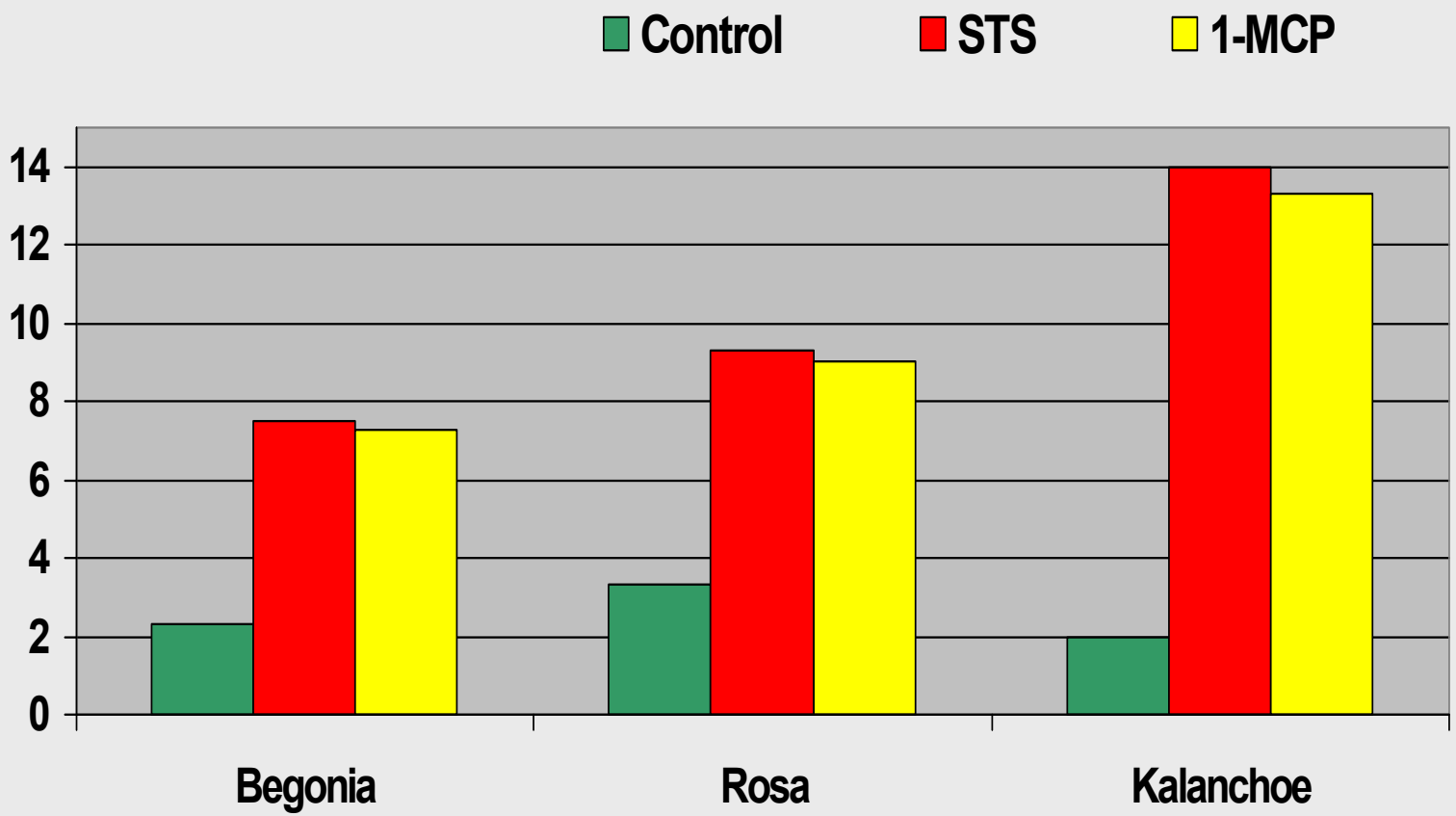



ETR1 receptor

(Source: Ciardi and Klee (2001), modified)

# Effect of 1-MCP

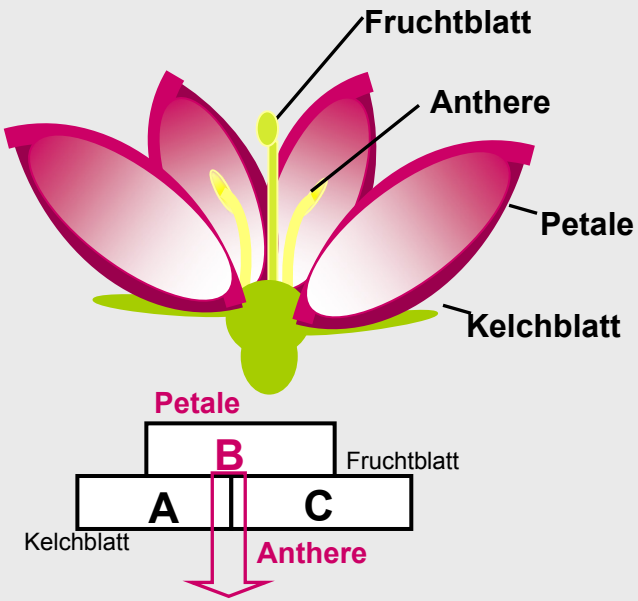


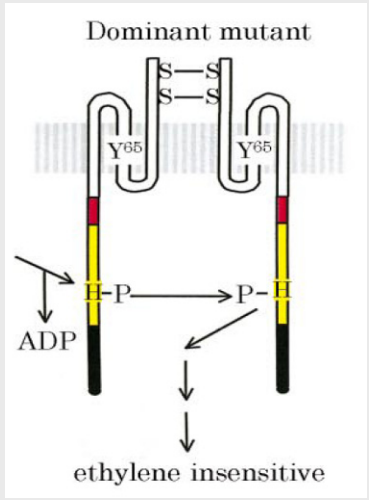
# Control the function of the receptor by mutation

- *ETR*1 gene isolated from *Arabidopsis*-plants codes for ethylene receptor
- *Arabidopsis* plants show different ethylene sensitivity
- Dominant ethylene insensitive mutants: *etr1-1*

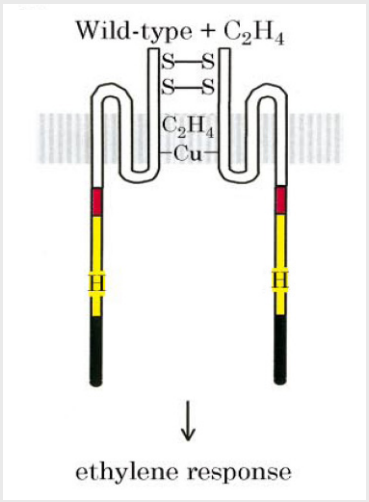
# Genetic manipulation *(etr1-1)* significantly delays flower senescence in *Kalanchoe blossfeldiana*




***Fbp1* = B- Funktionsgen von *Petunia***

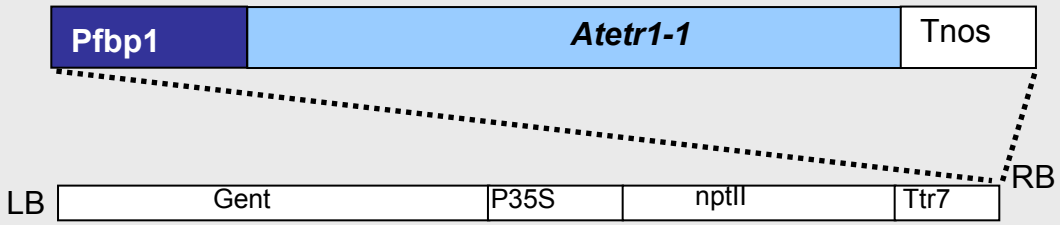



*Atetr1-1*




*AtETR1*

(Ciardi and Klee 2001)




(Bovy et al. 1999)

# Summary: Ethylene

- Endogenous ethylene concentration can be regulated by using inhibitors of ethylene biosynthesis (AOA, AVG, SA, Cobalt)
- Manipulation of ethylene dependent gene expression (*etr*1-1)
- Ethylene analogs ($Ag^-$, 1-MCP), high $CO_2$ conc., low oxygen conconcentration
- Removal of exogenous ethylene, e.g. ventilation or chemicals binding ethylene (potassium permanganate $KMnO_4$)

# Growth Tropisms

- Geotropism:

  bending away from gravity, effect of redistribution of auxin in response to gravity

  – Spike-type cut flowers (gladiolus, snapdragon, *Kniphofia*) and potted plants (*Kalanchoe)*

  – Flowers and spike bend upward when stored

- Phototropism:

  bending towards light

  – Caused by directional light or low light during marketing of flowering plants at warm temperature

# Light

- Potted plants:
  - Limiting factor for potted plants ability to maintain photosynthesis
  - If light integral is below light photosynthetic compensation point, the plant will die
- Cut flowers:
  - Light is not important, except where foliage yellowing is a problem
  - Leaf yellowing: chrysanthemum, lily, alstroemeria, marguerite

# Mechanical damage

- Problems:
  - Aesthetic appearance
  - Easy infection by disease organisms through injured areas
  - Respiration and ethylene production higher in injured plants

# Disease

- Problems:
  - Ornamentals are very susceptible to diseases
  - Dead or drying flower or foliage part – nutrient supply for pathogens
  - Easy germination of gray mold (*Botrytis cinerea*) wherever free moisture is present
- Solutions:
  - Proper management of greenhouse hygiene
  - Temperature control
  - Minimizing of condensation on harvested crops

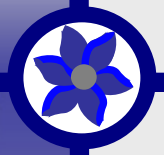
# The pathogen

- Reduce spore load
  - sanitation in field or greenhouse, packing shed
- Prevent spore germination
  - reduce condensation, injury, temperature
- Prevent fungal entry
  - care in handling, sanitation during harvest

# The host

- Maintain in good condition, assists physiological resistance
  - temperature, care, phytoalexins
- Surface fungicides, prevent germination and penetration

# The environment



- Temperature
- Humidity
  - prevent condensation
- Atmosphere
  - remove ethylene, high $CO_2$, CO/low $O_2$

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