

# Physiological Disorders in Closed, Controlled Environment Crops

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# Physiological Disorders--Definition

- Problems resulting from the influence of environmental and horticultural factors on plant development.
- A disorder caused by factors other than a pathogen; abiotic disorder.

## Topics Addressed:

- Calcium-Related Disorders
- Oedema (Intumescence)
- Long-Photoperiod Injury
- Light Spectral Quality Effects
- Super-Elevated CO<sub>2</sub> Injuries
- Ethylene
- Other Disorders
- Considerations for Closed Space Environments



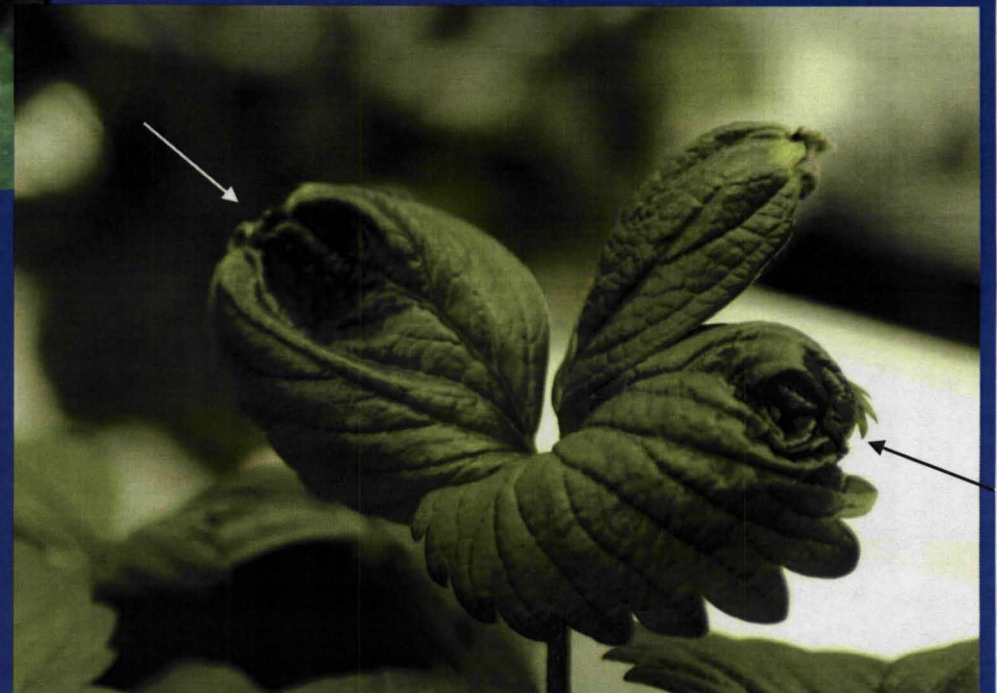
# Leaf Tipburn -- Other Species



Potato cv Russet Burbank

*Note cupping or puckering of leaves at the margins*

Strawberry  
cv. Tribute



# Blossom-End Rot (BER)

Pepper cv. Fruit Basket



Early Stage



Late Stage

Also common in tomato

# Other Ca-Related Disorders

- Black heart in celery
- Internal brown spot in potato tubers
- Bitter-pit in apple fruits
- Pillowing in cucumber fruits
- Black heart in peanut

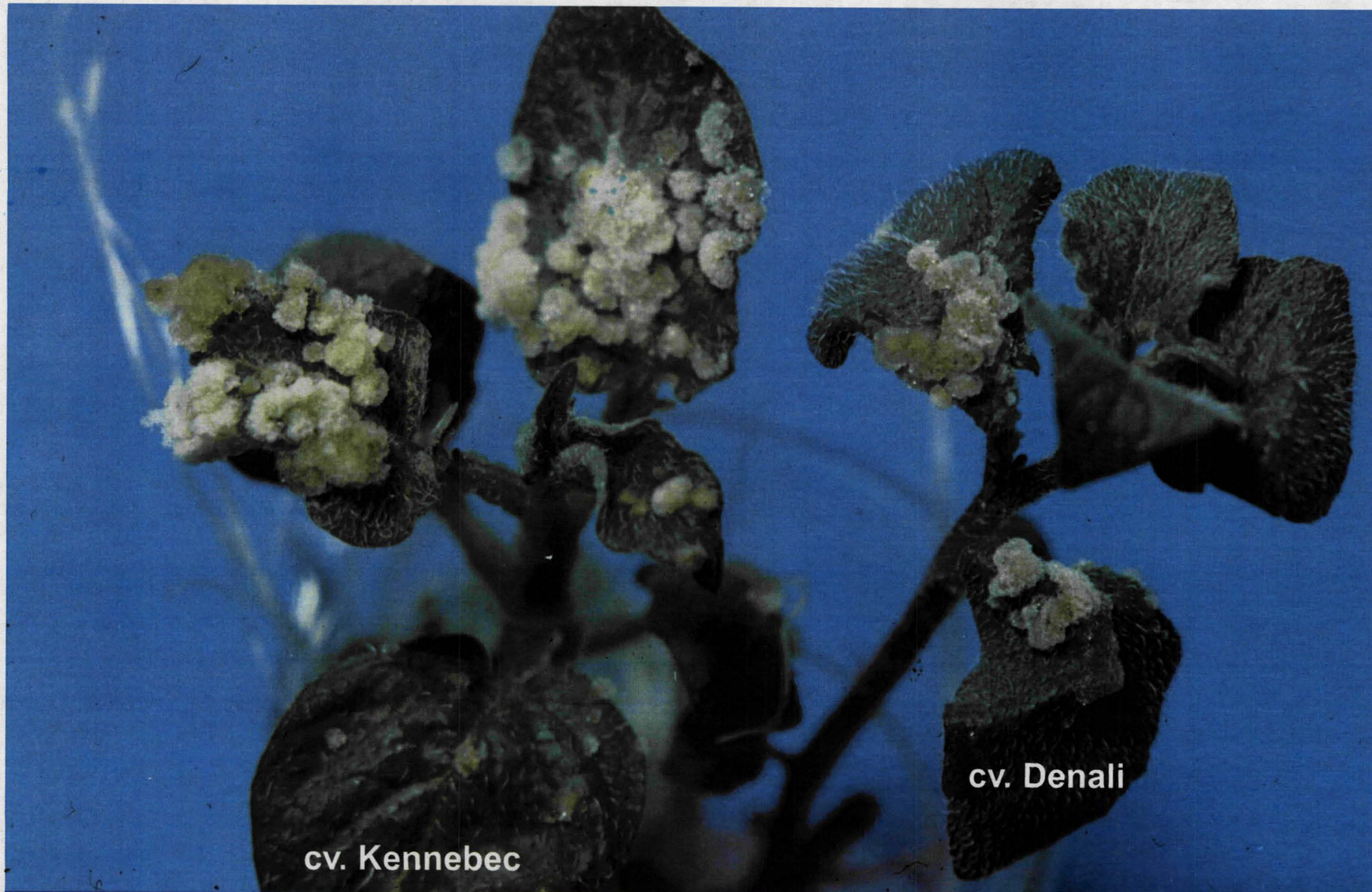
## Remedial Measures for Ca-Related Disorders

- Increase air circulation to promote transpiration (Goto and Takakura, 1992; Frantz et al., 2004)
  - Temperature and humidity adjustments (Ho, 2004; Saure, 2005)
  - Direct Ca solution applications
  - Use resistant cultivars
  - Reduce the rate of growth
- ⇒ Increased Ca nutrition is typically ineffective





Potato cv. Denali



cv. Kennebec

cv. Denali

Oedema on Potato Leaves in Tissue Culture

## Oedema--Remedial Measures

- Provide near UV (UV-A and or UV-B?) radiation, e.g., unshielded fluorescent or MH lamps; or remove UV absorbing barriers in chambers.
- Decrease the red / far-red radiation
- Avoid over-watering
- Reduce humidity and increase air circulation
- Use resistant cultivars



**Plant Responses to Extended Photoperiods  
or Continuous Light**

**Potato cv. Russet Burbank  
--note upright leaves**

# Spectral Quality Considerations



45  $\mu\text{mol m}^{-2} \text{s}^{-1}$  Blue Light



0  $\mu\text{mol m}^{-2} \text{s}^{-1}$  Blue Light

Bleaching of Radish Leaves under Red (640 nm) Light  
⇒ Addition Blue (440 nm) Prevents Injury



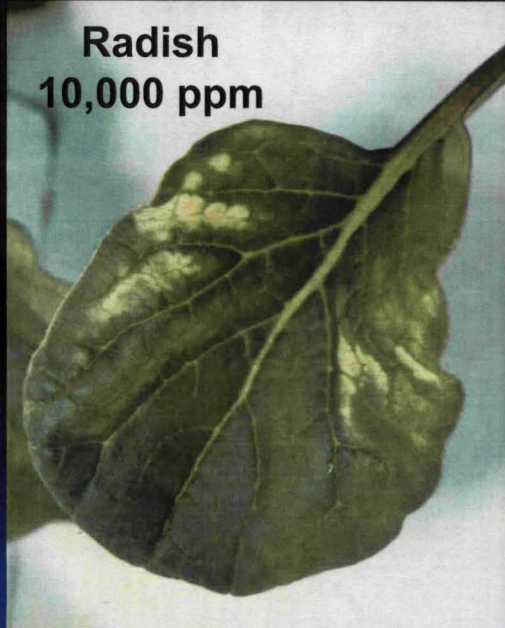
*Triticum aestivum* L. cv. Yecora rojo  
continuous red light (660 nm)  
500  $\mu\text{moles m}^{-2} \text{s}^{-1}$

Wheat seedlings without chlorophyll--Grown under red light

## Other Spectral Effects

- Far-red rich environments...longer stems
  - remove incandescent lamps
- Blue deficient environments...longer stems
  - (e.g., HPS at low PPF; LPS lamps, red LEDs)
- UV-B injury from certain types of unshielded lamps (leaf burning or scorching)

# Super-Elevated CO<sub>2</sub> Injury to Leaves



⇒ Leaf bleaching;  
pre-mature necrosis



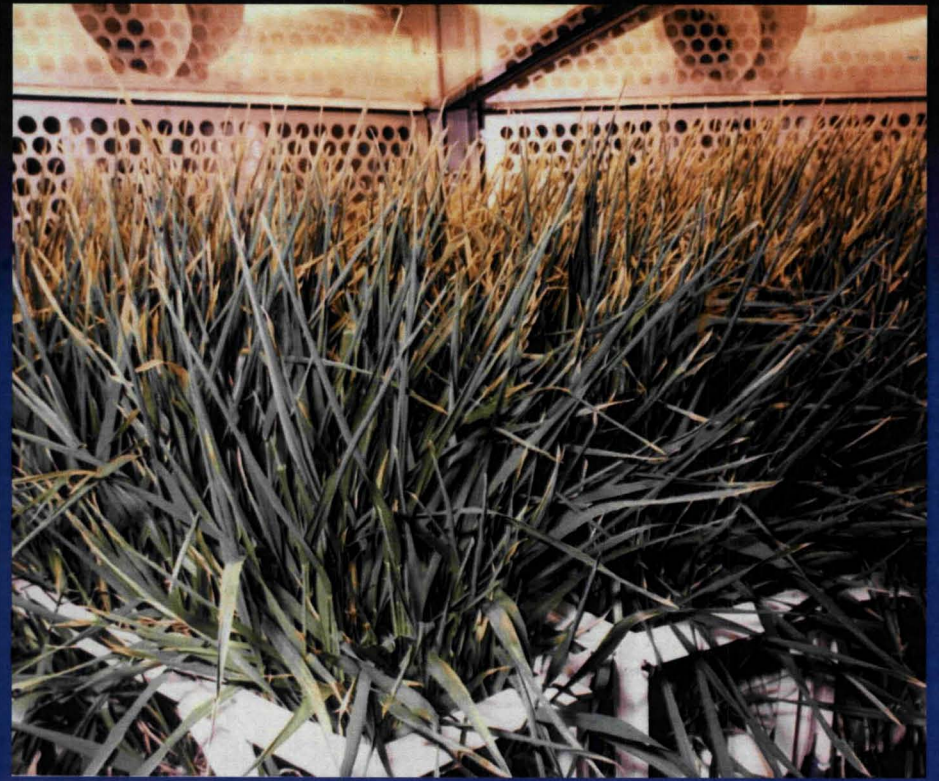
# Ethylene Effects

- Fruit Ripening
- Flower Development / Abortion
- Floral Sex Expression in Cucurbits
- Stem Swelling
- Seedling Hook Opening
- Leaf Epinasty
- Leaf Abscission
- Reduced Growth

# Leaf Epinasty from Ethylene



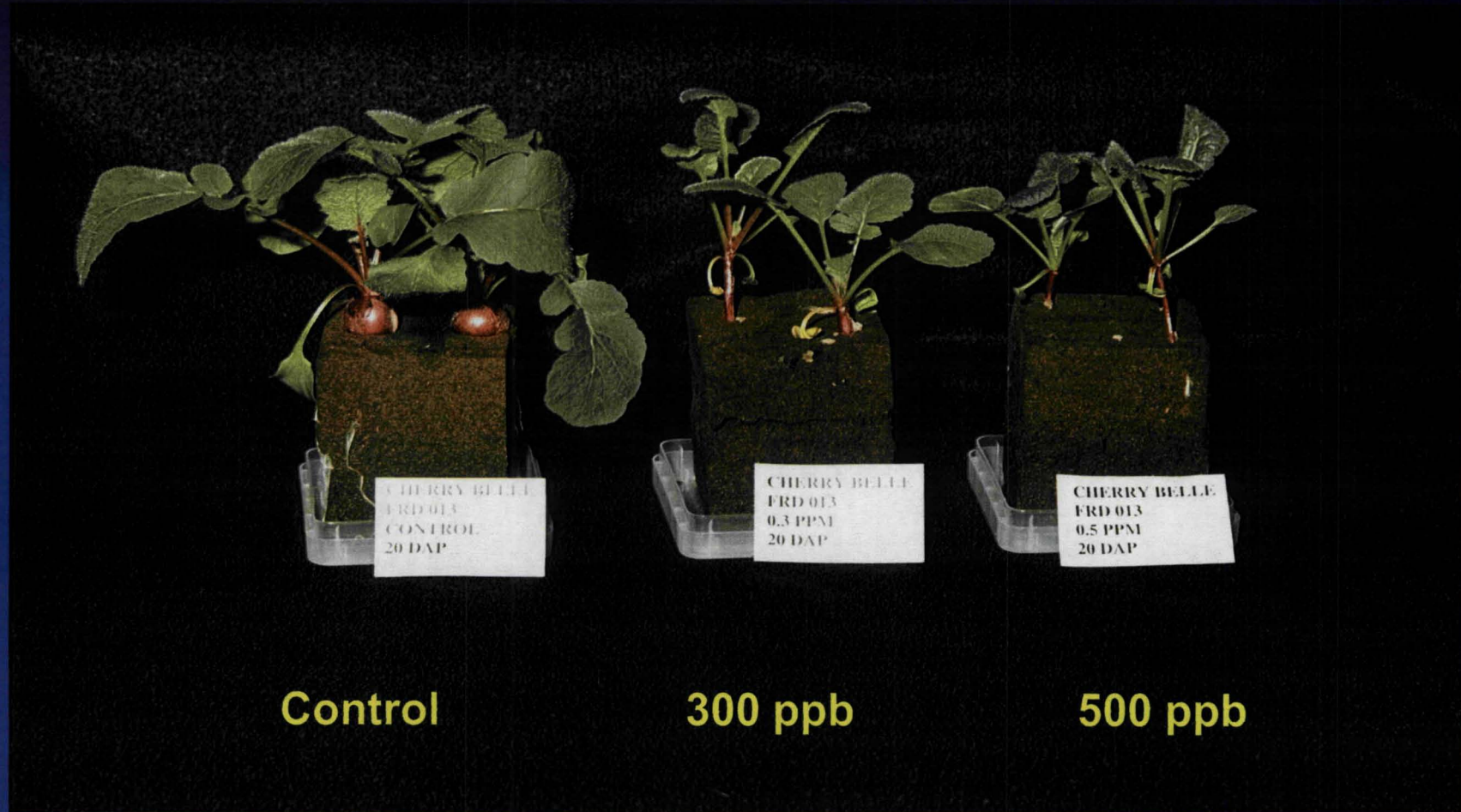
Potato cv. Denali



Wheat cv. Yecora Rojo

⇒ *Provide ventilation;  $KMnO_4$  filters; catalytic converters*

# Reduced Growth at High Ethylene



(see also Klassen and Bugbee, 2004)

# Growth Cracking

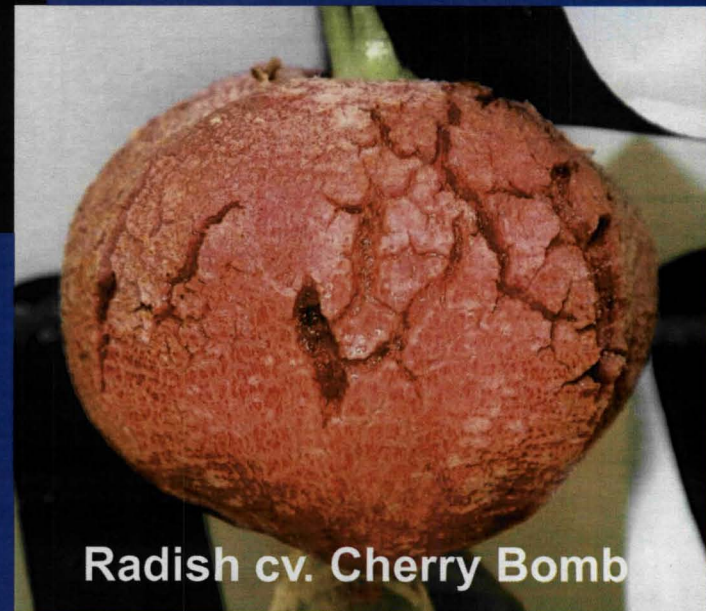
Potato cv. Norchip



(15 cm )

- ⇒ Harvest at earlier age
- ⇒ Avoid changes in watering regime
- ⇒ Use resistant cultivars

Can also occur in fruits, e.g., tomato



Radish cv. Cherry Bomb