Drought & Pest Effects on Forest Trees

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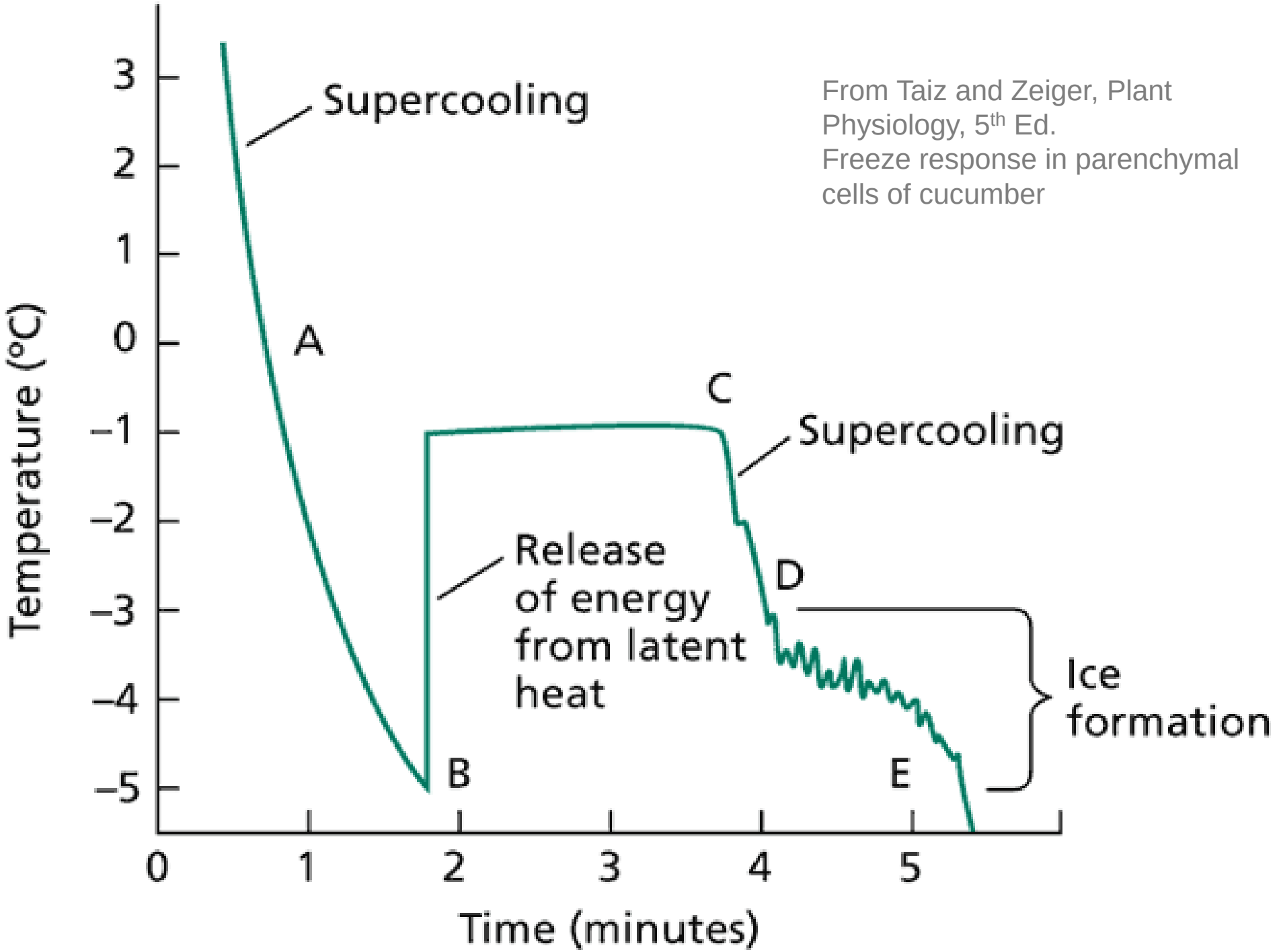
Tree Physiology

- All of the biological processes that allow an organism to function
- Photosynthesis
  - Trees make their food (sugars) from sunlight
  - Red and blue light drive two different photosystems
    - Green light reflected
  - Chlorophyll is a delicate molecule
    - Broken by high light levels
    - Accessory pigments
- Trees metabolize these same sugars to live, grow, and reproduce
  - Energy budget

Freeze Effects

- Broadleaf evergreens
- All plants affected
  - Most temperate and boreal species adapted
  - Proteins and sugars act as antifreeze
  - Physiological limit -40 deg. (both F and C)
  - Leaves most vulnerable
- Water protects in several ways



From Taiz and Zeiger, Plant Physiology, 5th Ed.
Freeze response in parenchymal cells of cucumber

Drought Response

- Obvious responses
  - Wilting
    - Protects from sunburn
  - Sunburn
  - “Stunted” growth
    - More energy to roots
    - Permanent alteration of growth pattern
- Not all plants show stress
- Water is key for sugar production
- No water, no defense
  - Pests & pathogens
  - Fire

Drought Response

- Evolving field
- Feedback loops between:
  - gene expression
  - fluctuations in ion and hormone levels
    - stomatal closure
  - photosynthesis
  - metabolism
  - production of drought specific metabolites
    - e.g: Osmolytes maintain normal cell volume

Drought Response

- Drought deciduous
  - Blue oak
  - Buckeye
  - Water retention and nutrient storage
- *Not* drought deciduous
  - Evergreens / conifers
  - Often don’t show symptoms of drought stress until too late
    - e.g: Xmas trees
  - Drought recorded in redwood needles (next slide)
- A quick tour of drought associated pests & pathogens

Botryosphaeria (Diplodia)

- Opportunistic
- Huge host range
  - Oaks (Diplodia)
  - Redwoods, Sequoias, other conifers (Botryosphaeria)
  - Madrone, Manzanitas
  - … and on …
- Improve growing conditions
- Consult UC IPM

Phytophthora

- Sudden oak death
  - Primary
  - Not much spread in drought
  - Infected oaks and tanoaks tend to die in drought

Phytophthora

- Other species more worrisome
  - e.g., P. cinnamomi
  - Many more being discovered
- Most are soil borne
- All require water to infect
- Thrive in “Drench and Drought” irrigation
  - Know your plants
  - Monitor your soil
  - Let things dry without stressing the plant

Conifers and beetles

- Monterey pine
  - Red turpentine beetle *Dendroctonus valens*
    - Red tunnel entrances at tree base
      - Turn white with age
  - Five spined Ips *Ips paracofusus*
    - Attack higher in the canopy
    - Distinctive Y shaped galleries
- Provide summer water
- Mulch / compost

Conifers and beetles

- Douglas fir invades oak woodlands in normal years
  - Saplings don’t require a lot of water
  - Big trees do

Conifers and beetles

- Douglas fir engraver

Dendroctonus brevicomus

  - Attacks Douglas fir on sub-optimal sites
  - Outbreaks occur in dry years
  - Almost routine occurrence in California
  - Natural stand-in for fire

Ambrosia beetle

- California native
- Farms the *Ambrosiella* fungus
- They kill drought stressed oaks
- No curative treatment

Ambrosia beetle

- The last part of SOD
  - Doesn't need *Phytophthora* to kill trees
- See and smell drought stress
  - Outbreaks in drought
  - Deep, infrequent summer water
  - Mulch within drip-line
  - Preventative pyrethroid insecticides?
- Tunnels may flux

Management Recommendations

- Proper cultural care (?)
- Don’t assume that brown trees are dead
  - Look for decay fungi
  - Look for beetle attack
  - If none, prune and wait
    - Blue gum frost damage (Oakland 1991?)
    - Drought deciduous blue oak
- If trees are dead:
  - Reduce the amount of *standing* fuels
    - CalFire clearances
  - Downed fuels
    - Lop to below knee height
    - Chip

Thanks!

- UC IPM: http://www.ipm.ucdavis.edu/
- Presentation on-line at:
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