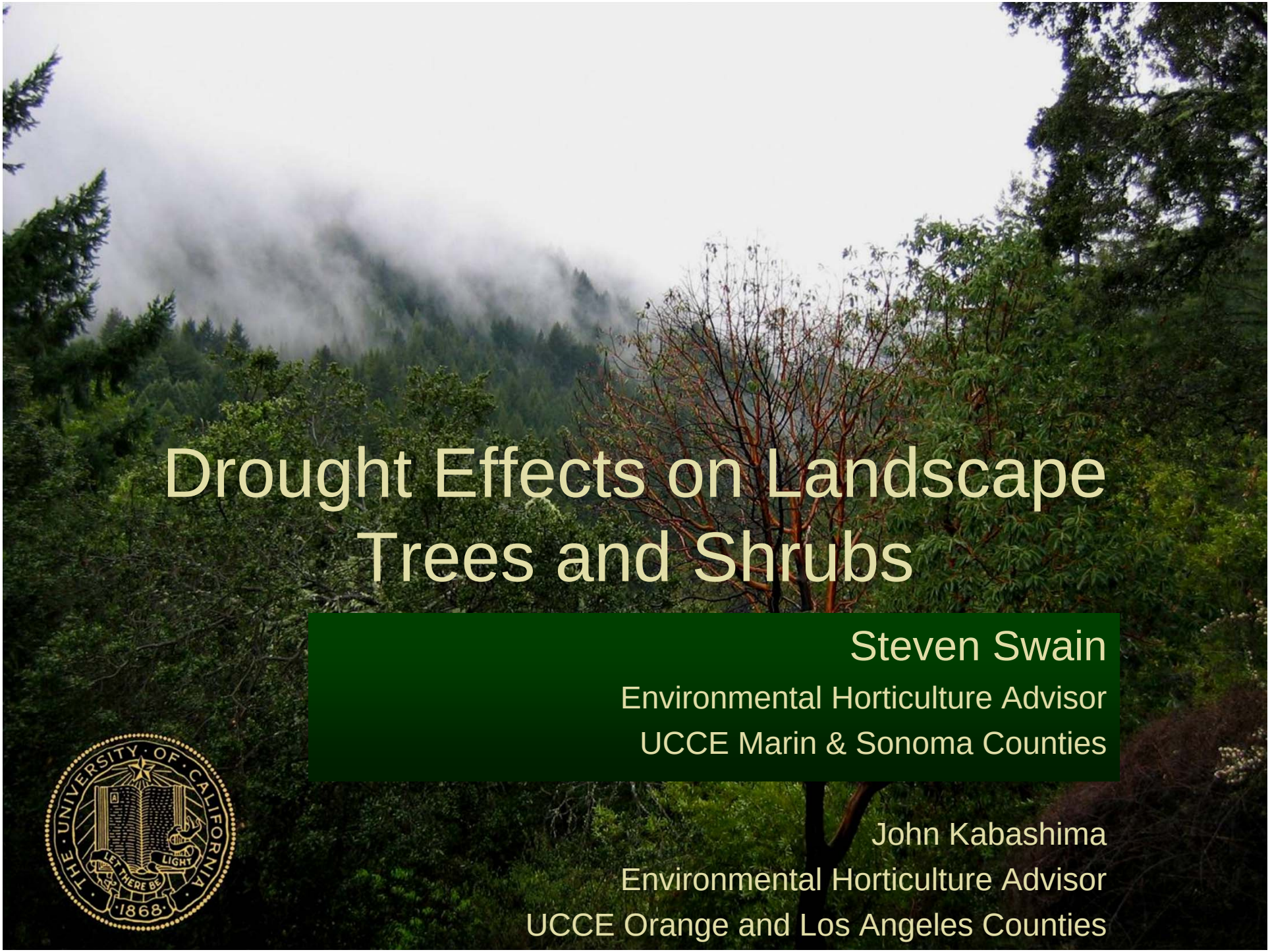

Drought Effects on Landscape Trees and Shrubs

Steven Swain

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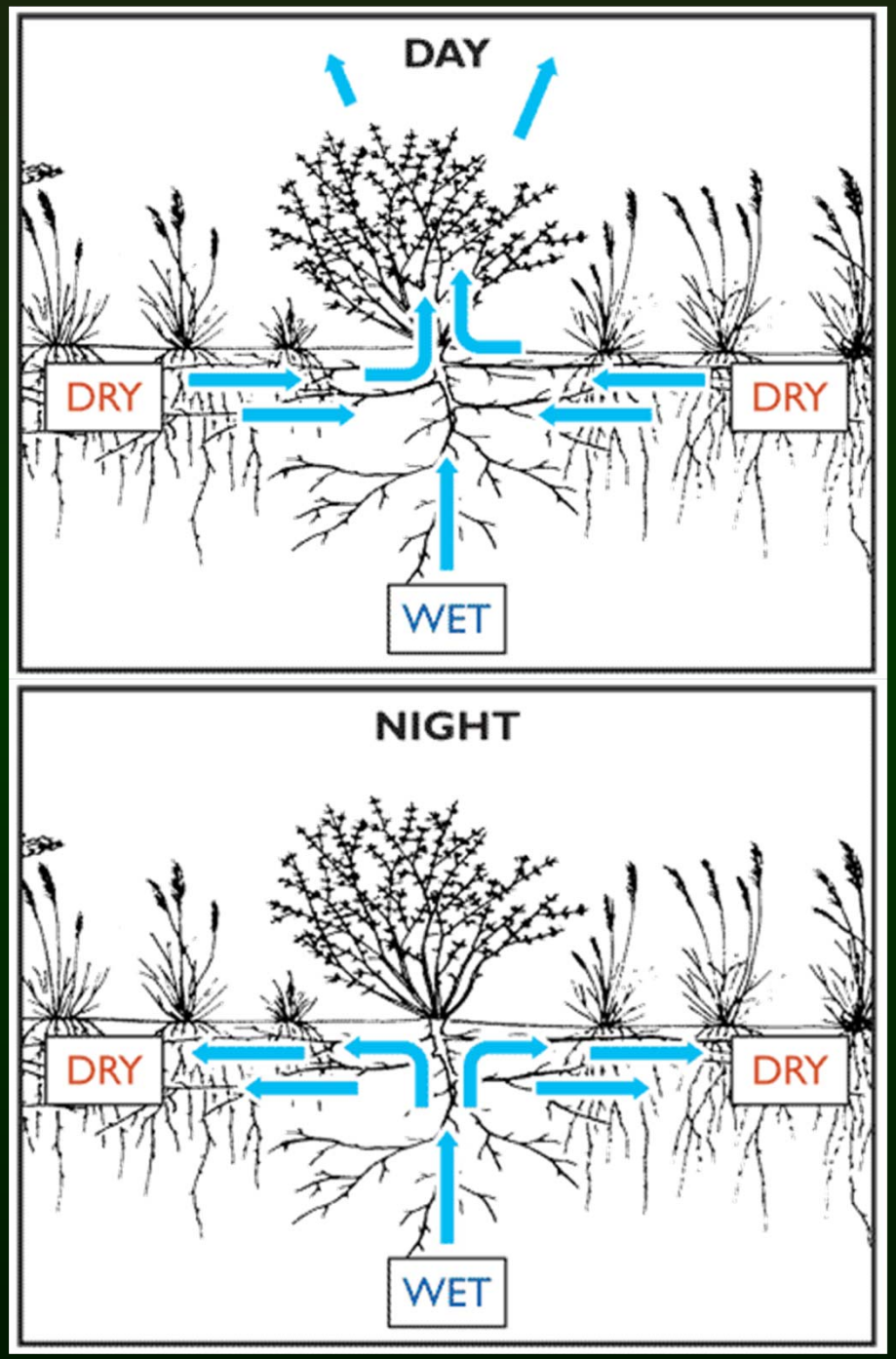
UCCE Orange and Los Angeles Counties

Tree Physiology

- All of the biological processes that allow an organism to function
- Trees make their food (sugars) from sunlight
  - Red and blue light drive two different photosystems
  - Green light reflected
- Trees metabolize these same sugars to live, grow, and reproduce
  - Must live within an energy budget
- All of this requires water
  - A lack of water requires tradeoffs

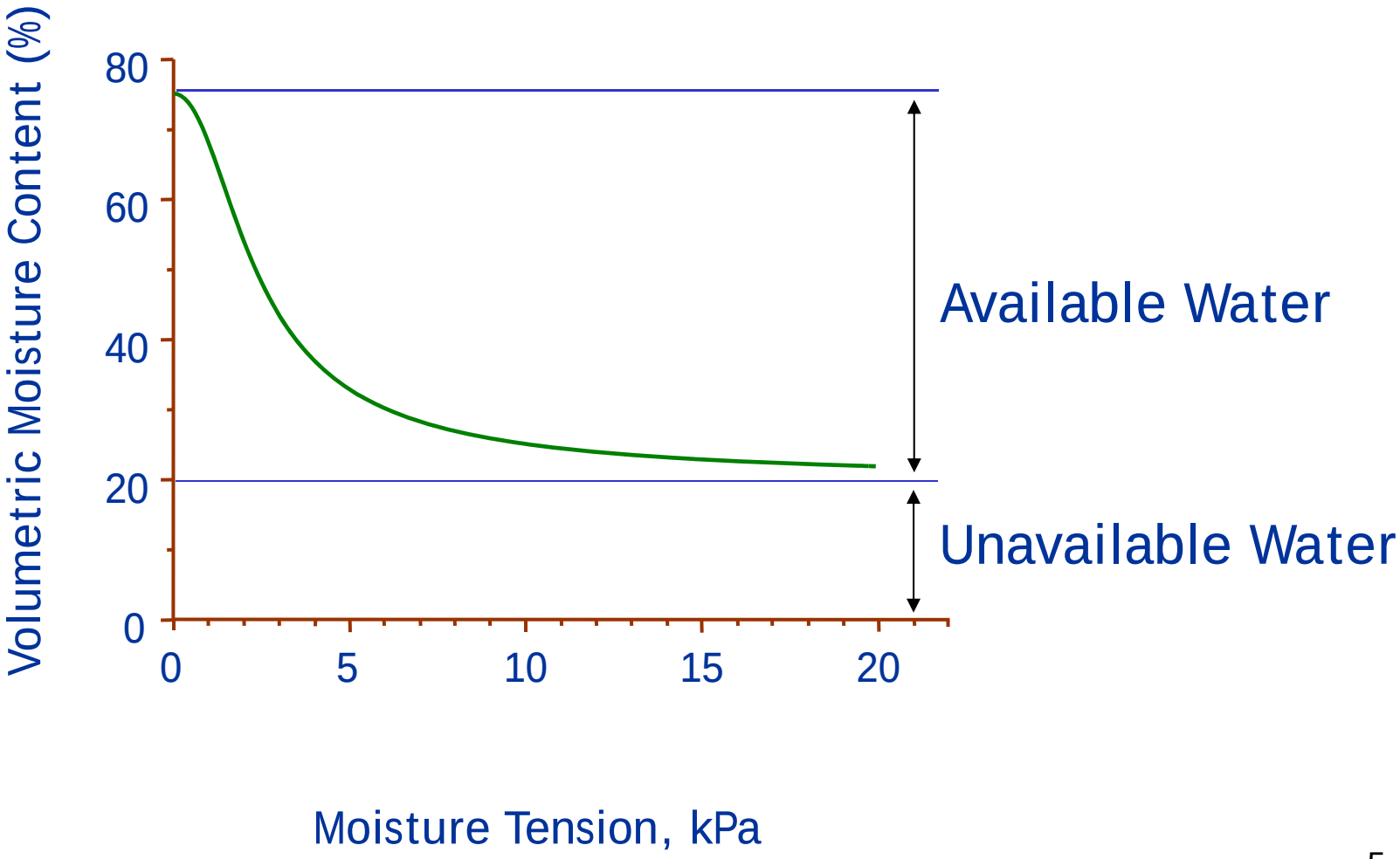


Trees as water managers

- Hydraulic lift
- Uptake from sinker roots during day
- Redistribution via mycorrhizae at night
- Soils 12” down stay moist
- “Island” effect

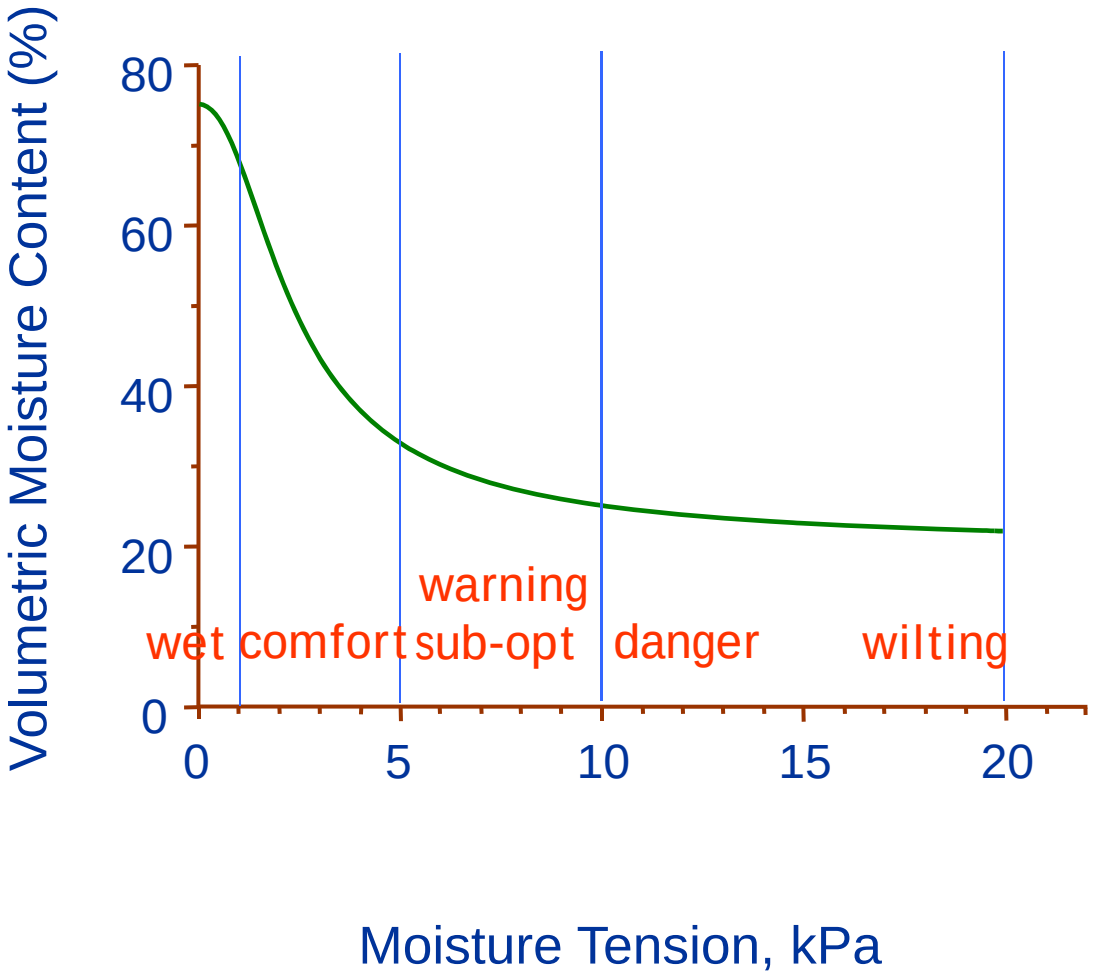
Water Deficit

Moisture Retention Curve



Graphic adapted from J.H. Lieth

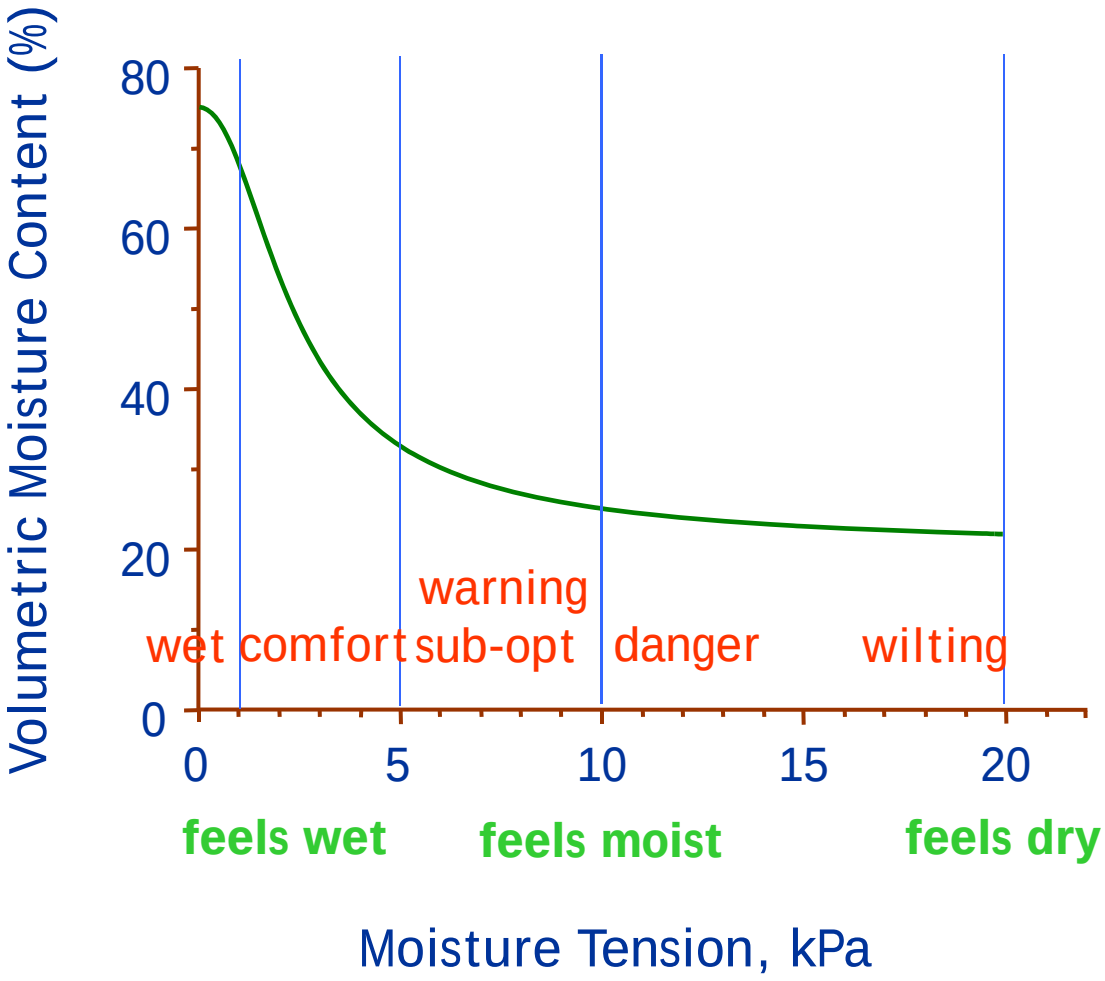
Moisture Retention Curve



- Note how plants "feel" about different levels of moisture

Graphic adapted from J.H. Lieth

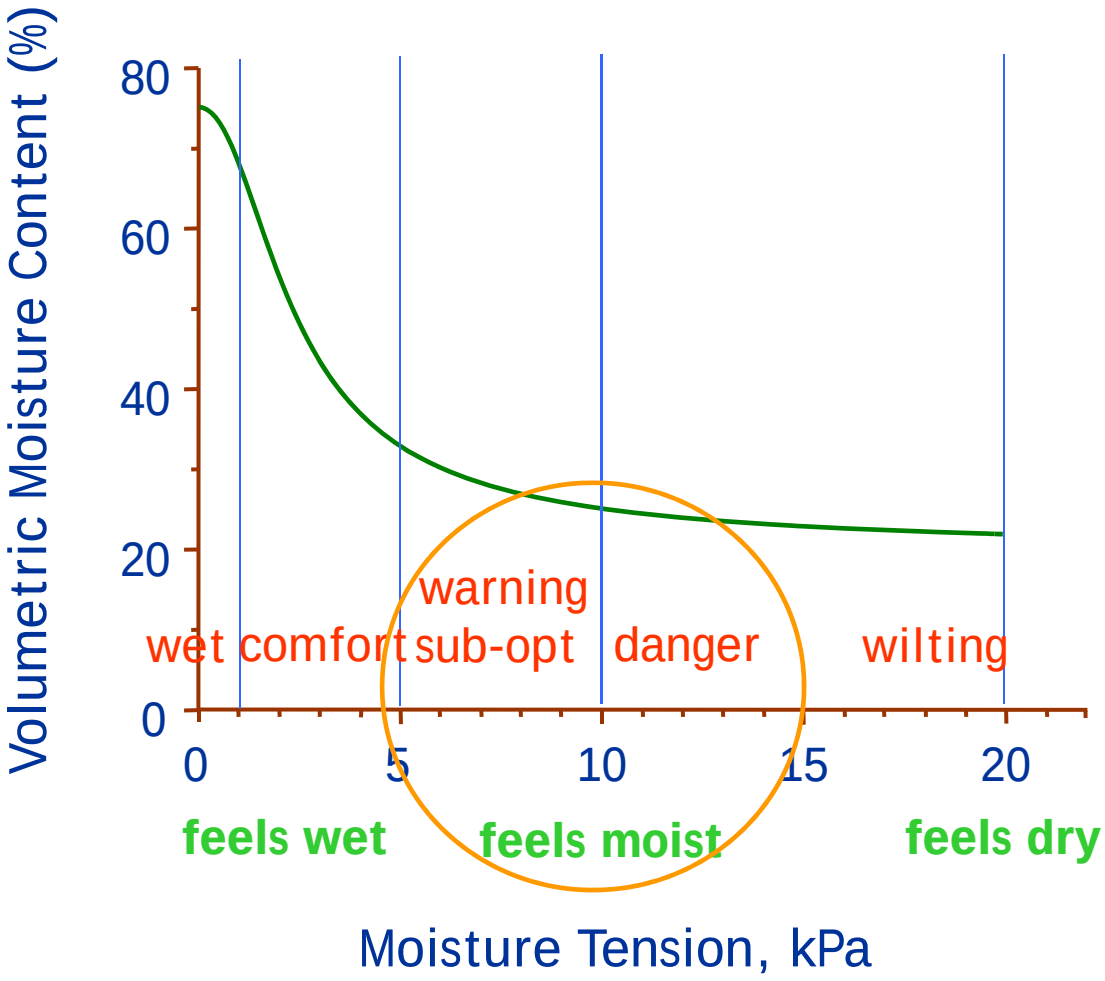
Moisture Retention Curve



- How people are able to sense moisture levels

Graphic adapted from J.H. Lieth

Moisture Retention Curve



- How people are able to sense moisture levels
- Note that although the soil feels moist, it is already suboptimal or dangerously low in water!

Graphic adapted from J.H. Lieth

Drought Effects (direct)

- Stomata close
- Cellular water loss
  - Leaves curl, wilt, and/or sunburn
  - Cell membranes pull away from walls

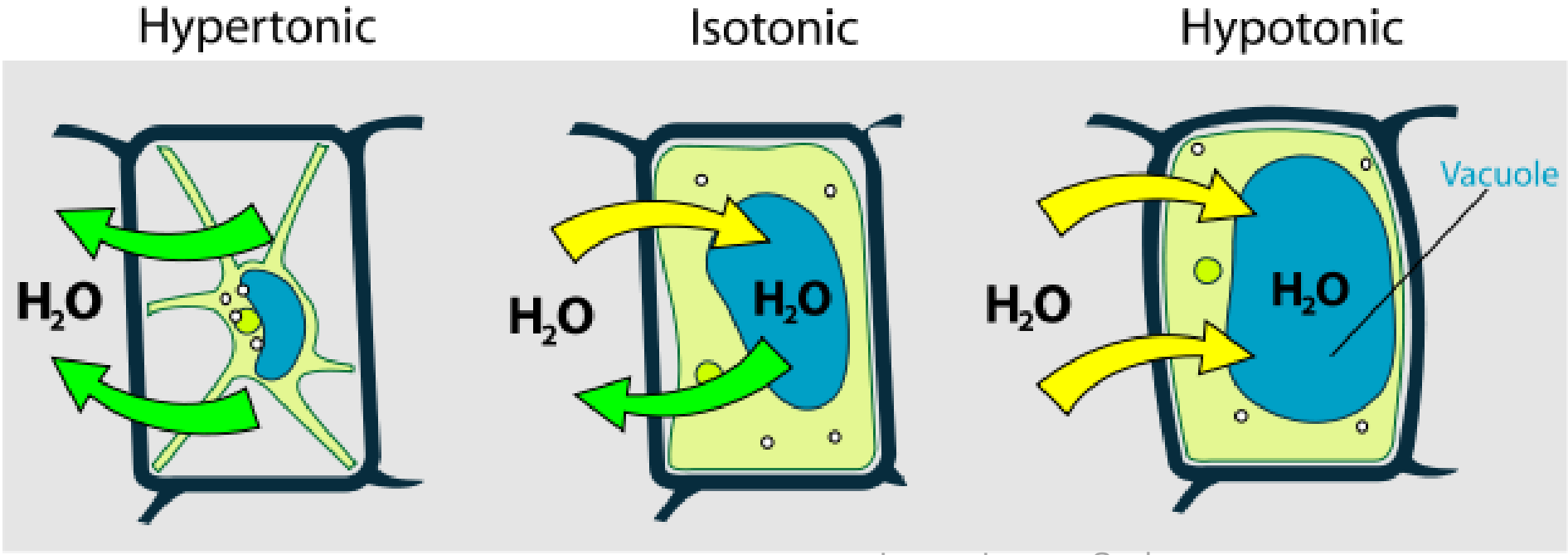
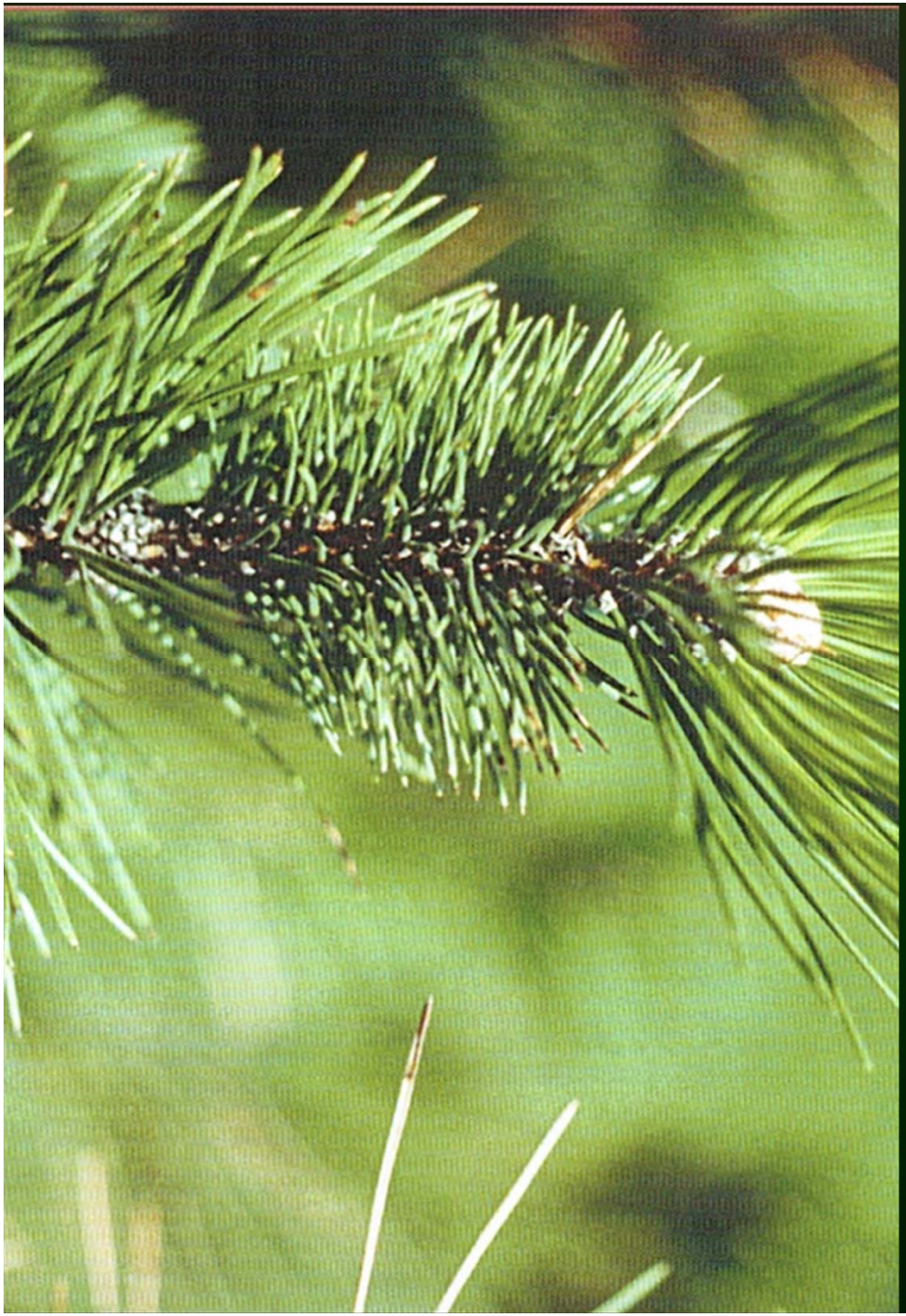


Image: Lawren Sack, UCLA

Photo courtesy Igor Lacan, UCCE Advisor



Drought Response

- Smaller leaves
- Abbreviated growth
- Trees “remember”
- Next years:
  - Fewer leaves
  - Budget (sugar) reallocation to roots
- “Stunted” above ground
  - Maybe bigger below ground!

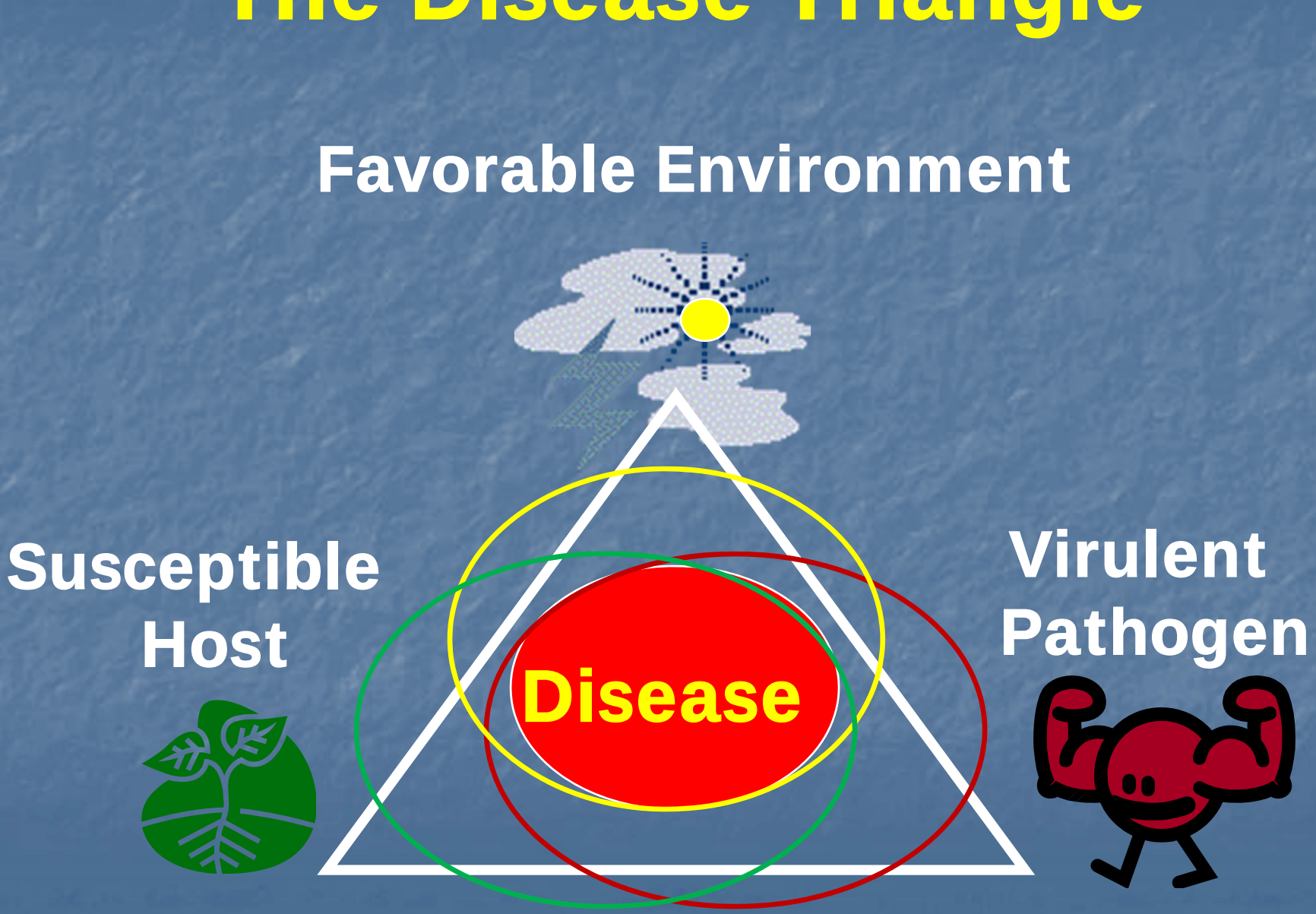
Drought Response

- Feedback loops between
  - genes & environment
  - metabolism
  - production of:
    - drought specific metabolites
    - chemical defenses
  - may affect tree for life
- Water is key for sugar production
- No water, no defense
  - Pests & pathogens
  - Fire

Pest & Disease Terms

- Primary pathogens
  - Attack regardless of the state of the tree's health
    - Tend to be exotics
  - Prefer healthy trees
  - Treatment difficult
- Opportunistic pathogens
  - Attack weakened trees
    - Tend to be natives
  - Improve conditions

The Disease Triangle

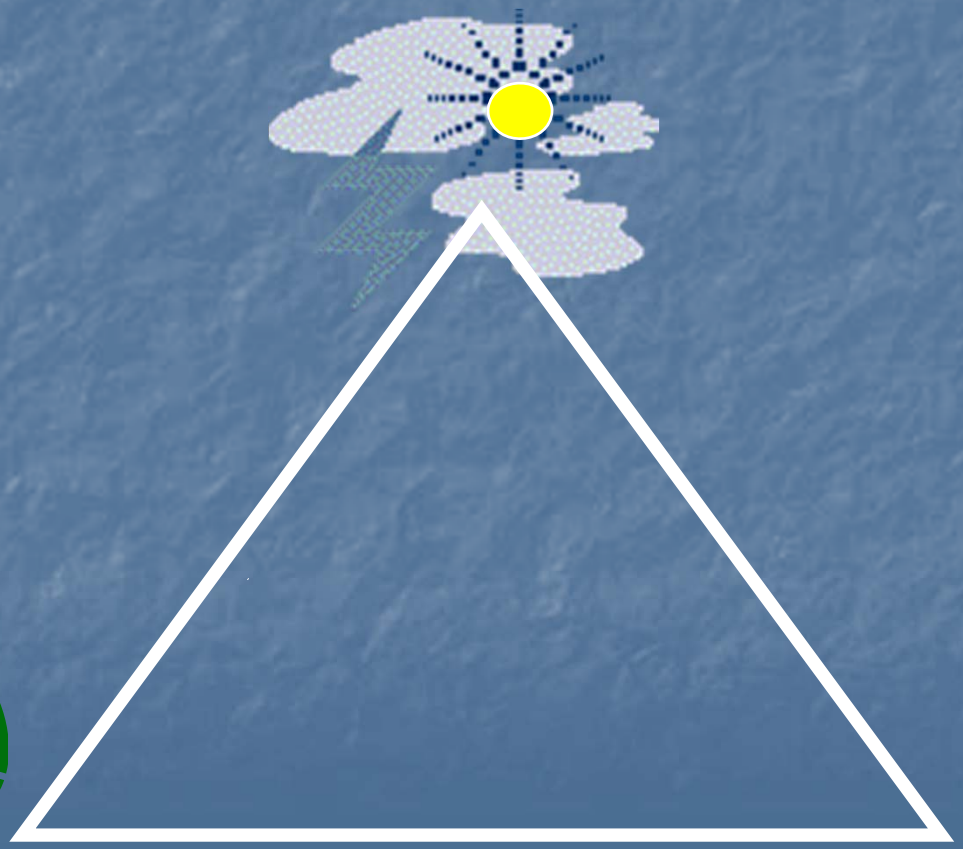


The Disease Triangle

Host

The Disease Triangle

Favorable Environment



Host

The Disease Triangle

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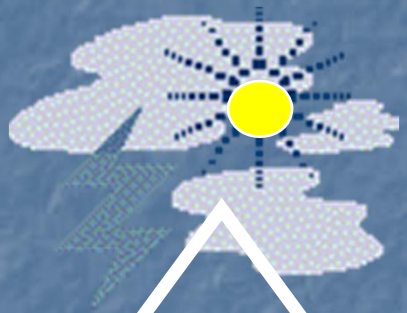

Host

The Disease Triangle

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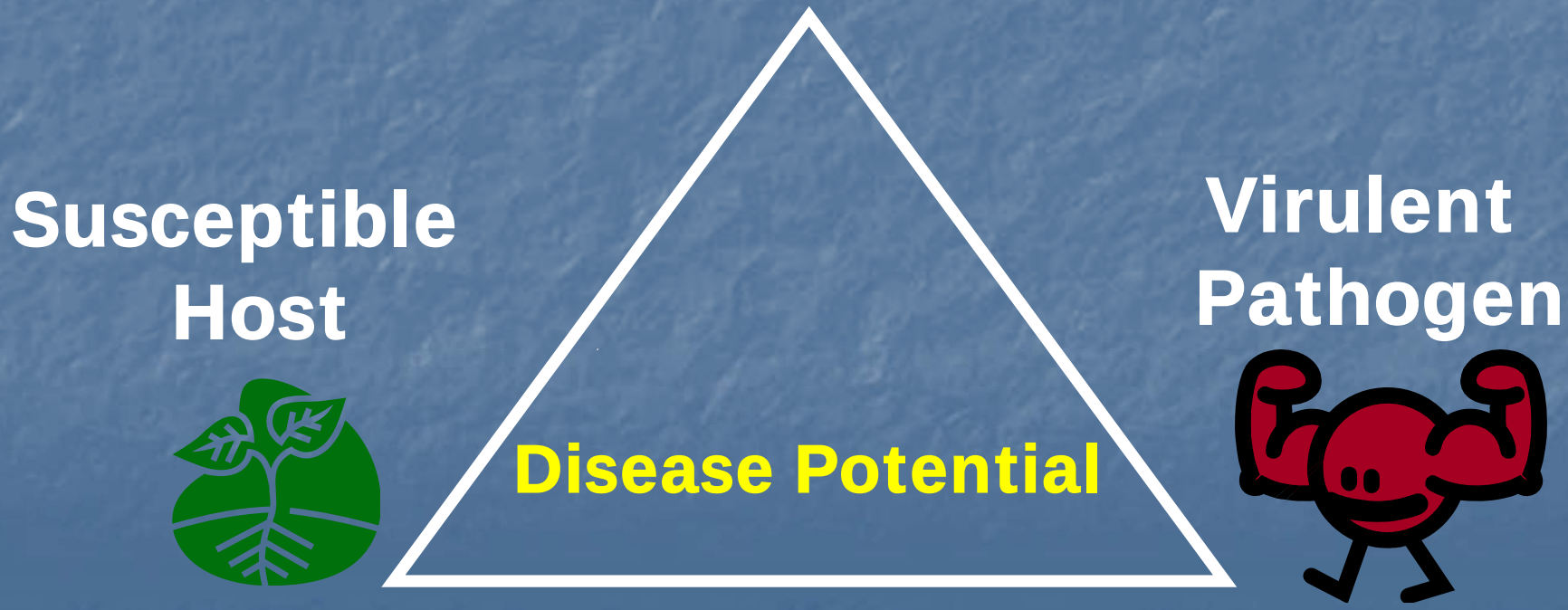

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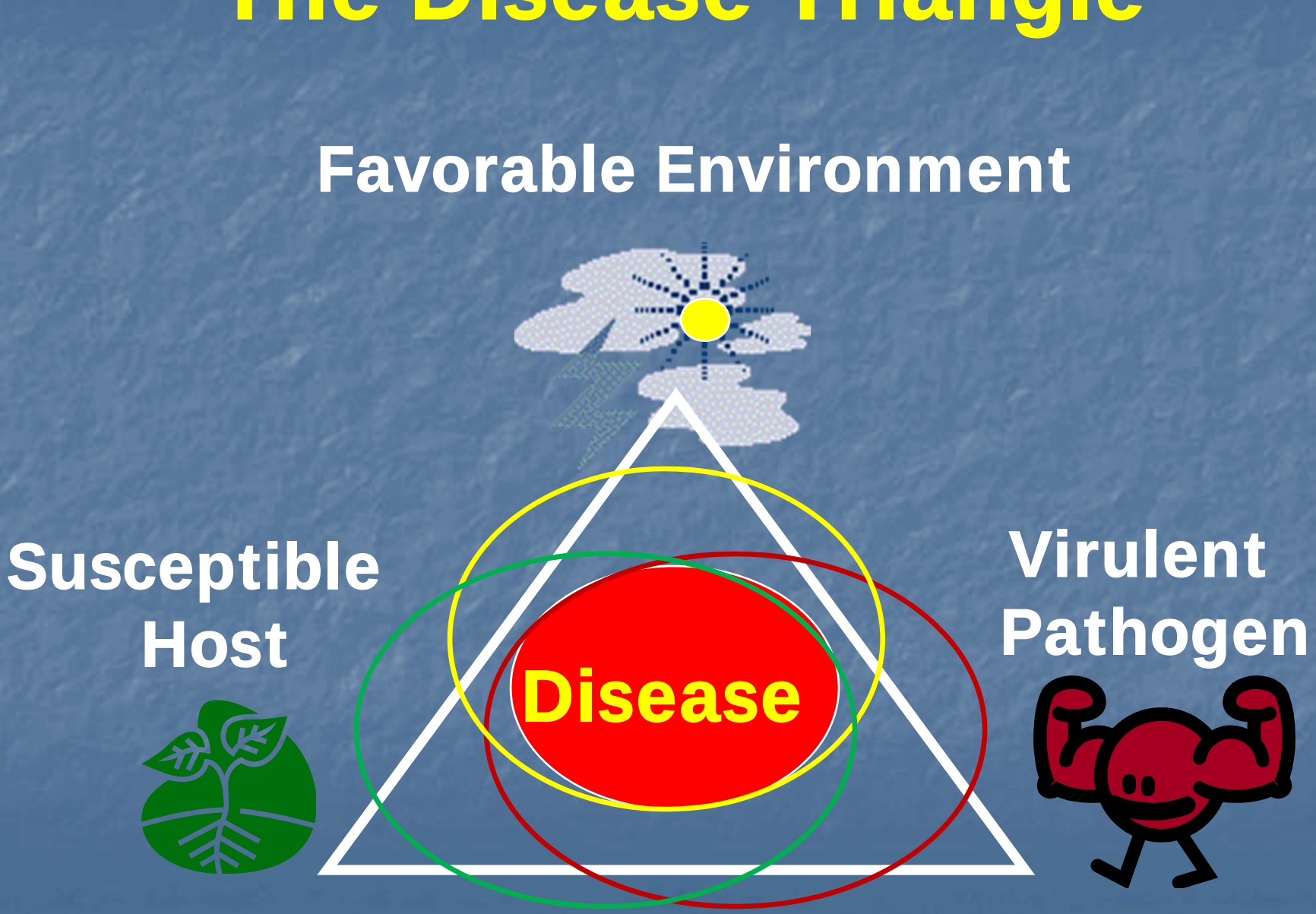

The Disease Triangle

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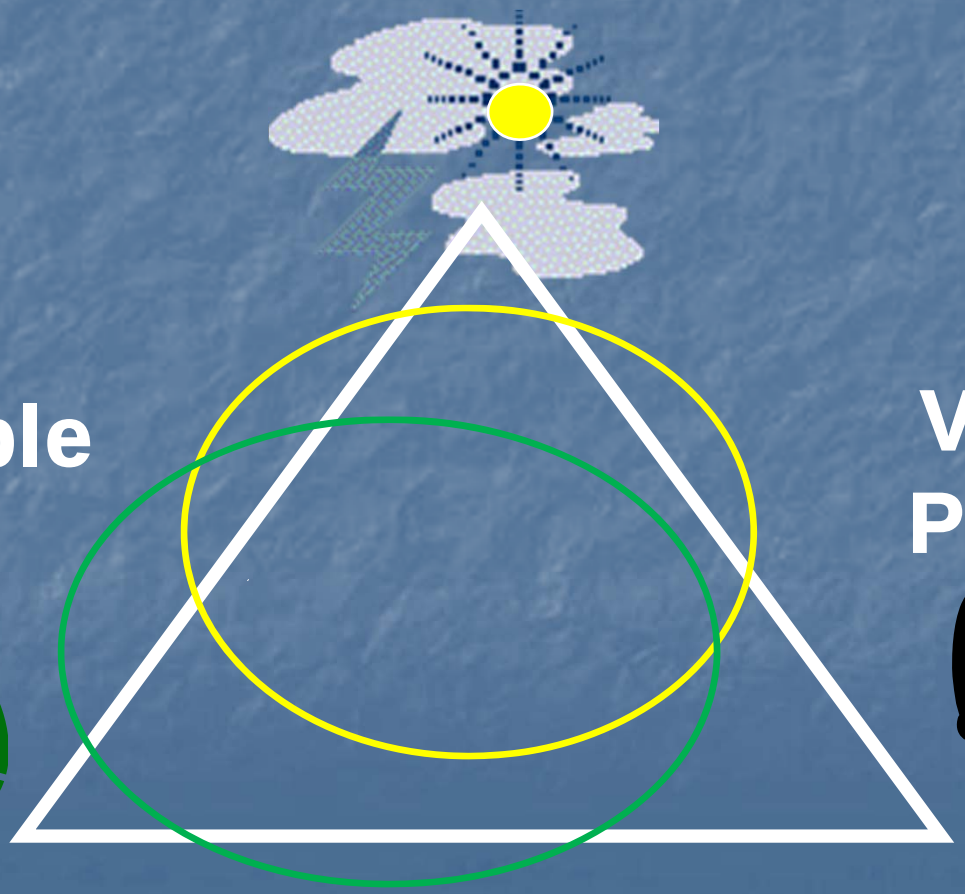
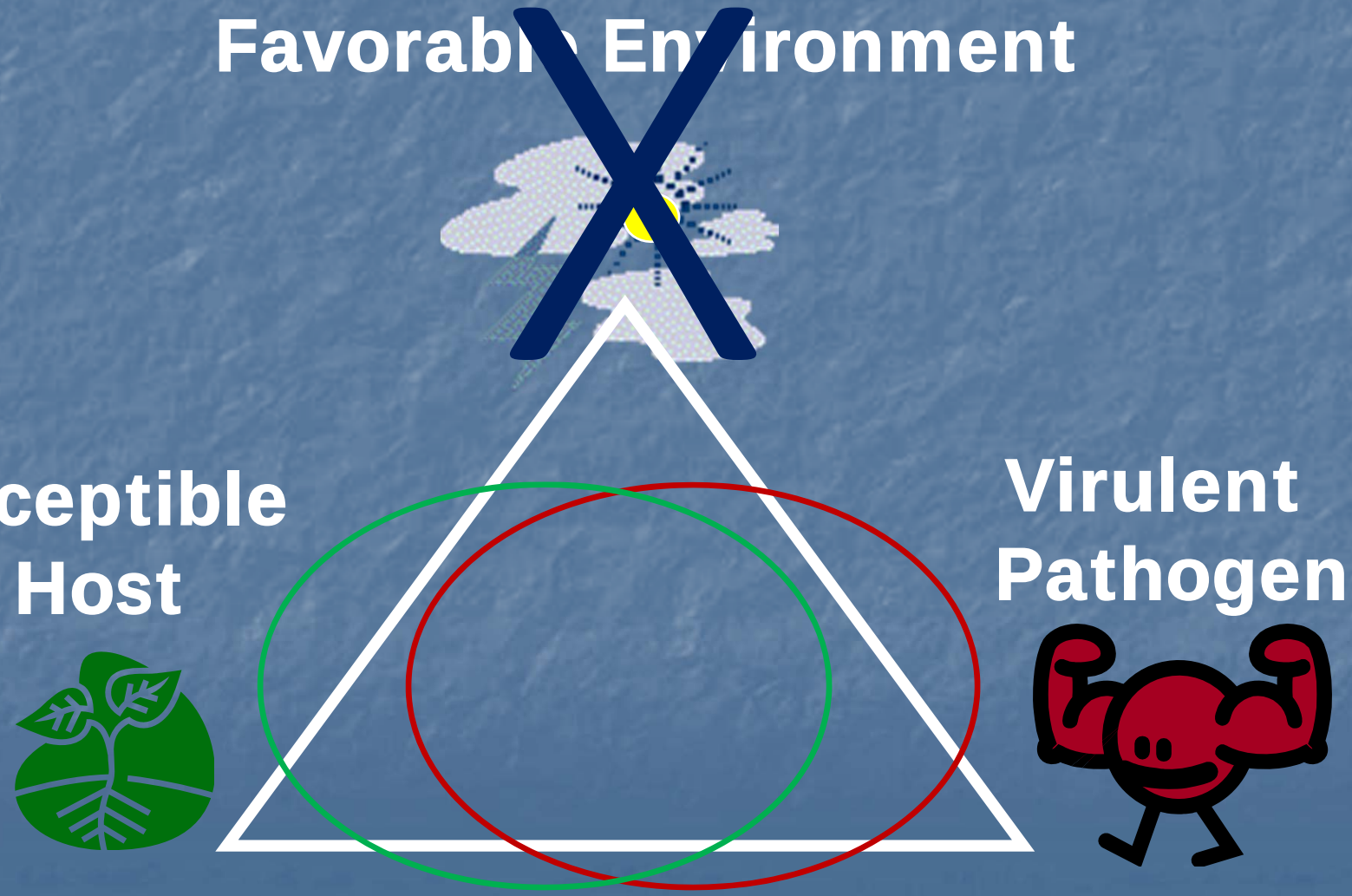


Susceptible Host

Virulent Pathogen

The Disease Triangle



The Disease Triangle

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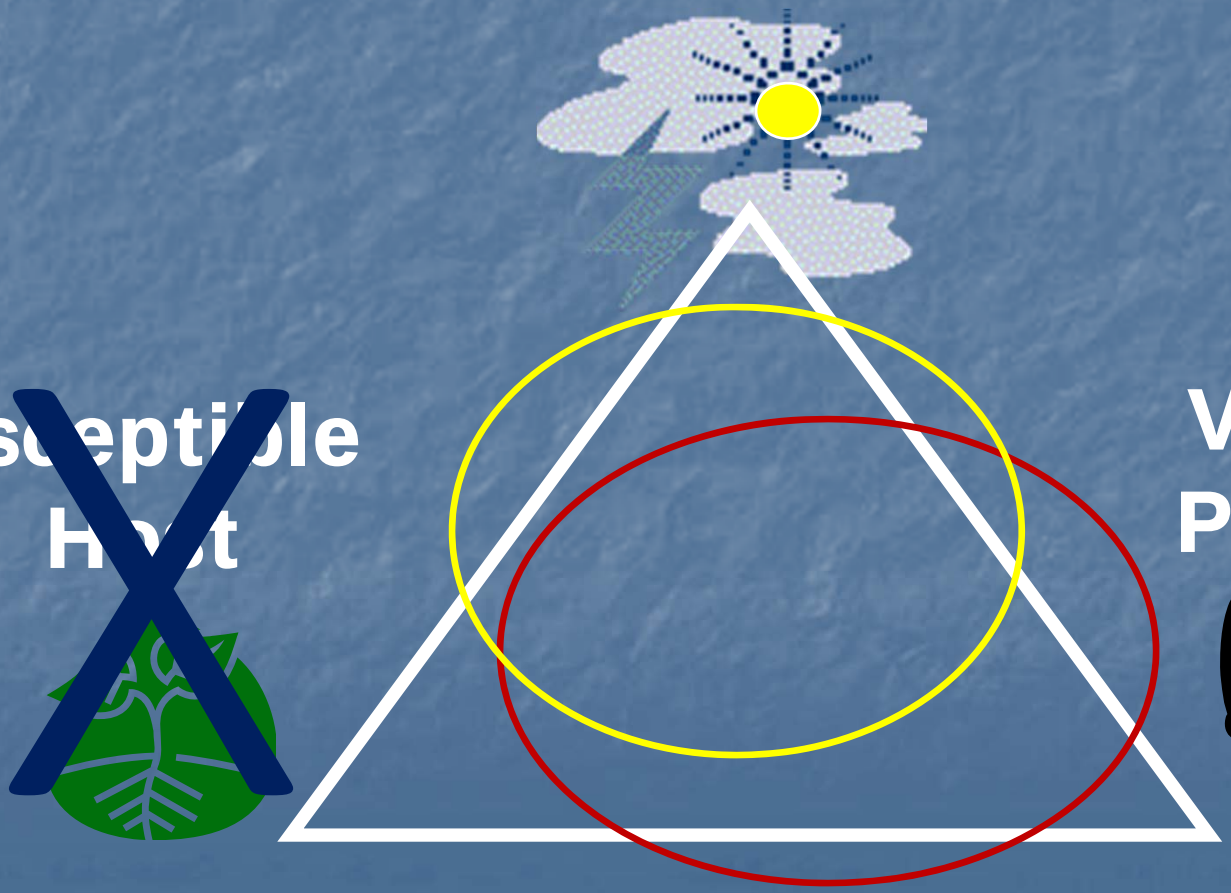

Susceptible Host

Virulent Pathogen

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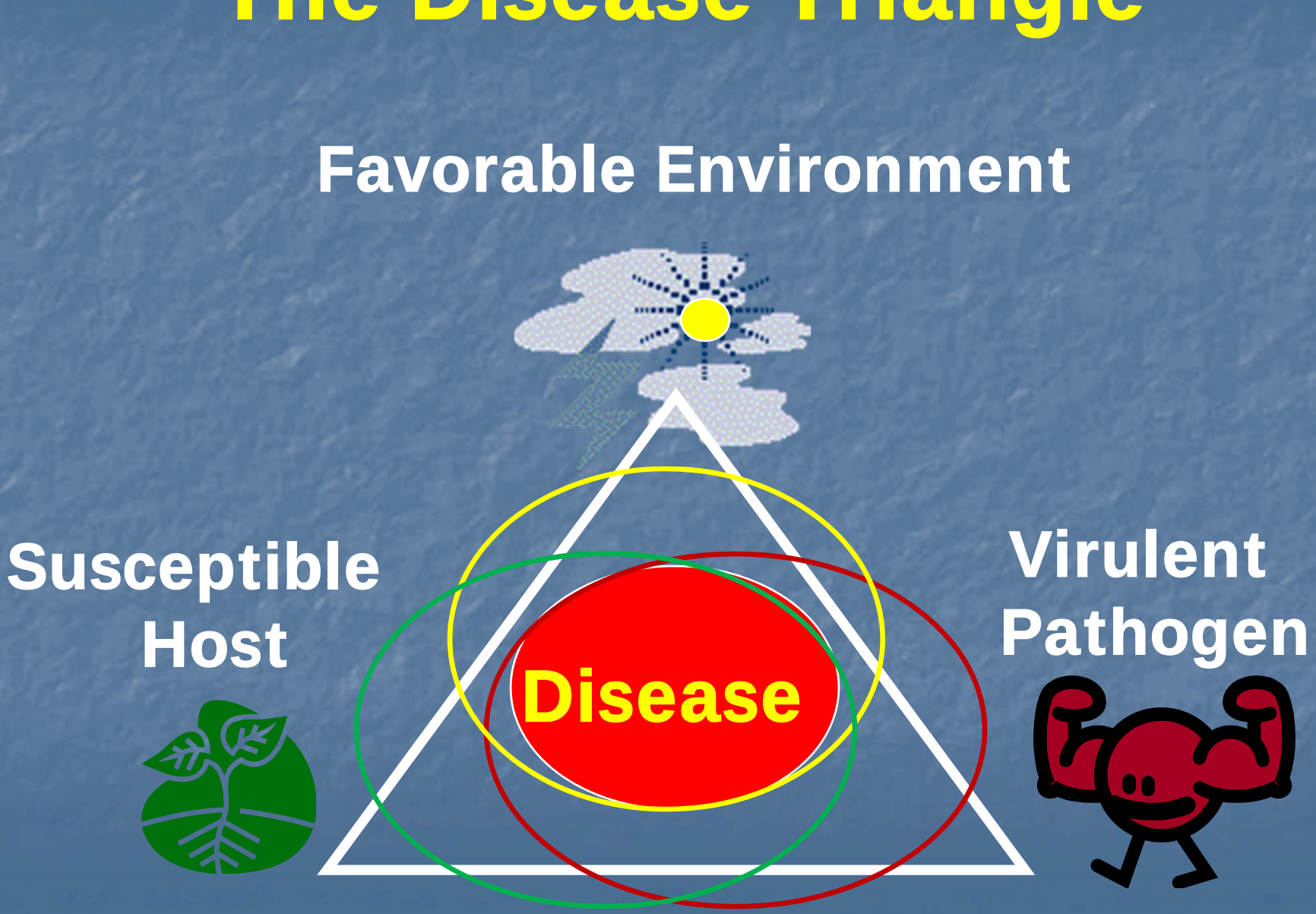

Botryosphaeria (Diplodia)

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

Phytophthora

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

Armillaria (oak root rot)

- Opportunist > Primary
- Common in California soils
- Likes:
  - Summer irrigation
    - Consistently warm moist conditions
    - Droughts, hot summers
    - Vineyards
    - Lawns
  - Injured roots
    - Especially larger roots
- Fungicides ineffective

Armillaria

- “Oak Root Rot”
- White mycelia
- Usually bark is soft where disease is advanced
- Smells like fresh mushrooms
  - Often subtle
- Sometimes clumps of tan mushrooms
  - White spores


SPEED
LIMIT
25

Armillaria Management

- Water
  - Timing, amount, and location
  - Let things dry
- Chemical Tx not shown effective
  - Despite labels
- Removal
- Air spade
  - If caught early enough


Photo: Larry Costello, UCANR

Verticillium

- Soil borne wilt
- Opportunistic
- Wide host range
  - Maples
  - Olives (no black streaks)
  - Strawberries
  - Tomatoes
  - Several weed species
- Provide optimal growing conditions

Ambrosia beetle

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

Ambrosia beetle

- The last part of SOD
- Don’t need *Phytophthora* to kill trees
  - See and smell drought stress
    - Outbreaks in low rainfall years
    - Deep, infrequent summer water
    - Preventative pyrethroid insecticides
- Tunnels may flux

Homopterans

- Aphids
- Scales
- Leafhoppers
- Treehoppers
- Mealybugs
- Whiteflies

- Sucking mouthparts
- Looking for nitrogen
  - Lots of sugars in sap

Homopterans

- Thrive on new growth
  - Fertilized
  - Thoroughly watered
- Controls
  - Parasites
  - Predators
  - Slower growth

Example:

Eugenia psyllid

- New growth in spring
  - Lightly shear to remove eggs
- Keep summer growth reduced
  - Less water
  - No fertilizer
- Let parasites work in the fall

Eugenia psyllid

- **New growth in spring**
  - **Lightly shear to remove eggs**
- **Keep summer growth reduced**
  - **Less water**
  - **No fertilizer**
- Let parasites work in the fall

Yellow and Homoptorans

Why are homoptorans attracted To yellow sticky traps?

They locate plants on which
they feed by using visual cues.

- Insects see reflected light, instead
  of green, they see varying hues of
  Yellow and Blue.

- They are strongly attracted to reflected light
  in the 500-600 nm range (yellow).

  A greater amount of his light is reflected from new growth
  than older growth.

Sticky Trap

Tanglefoot Barrier

Eugenia psyllid

- New growth in spring
  - Lightly shear to remove eggs
- Keep summer growth reduced
  - Less water
  - No fertilizer
- **Let parasites work in the fall**

Red Gum Lerp Psyllid

- Eucalyptus irrigation trial
  - Irrigated
  - Un-irrigated
  - Lakeside
- Parasitoid wasp
- Damage much lower on irrigated (& lakeside) trees
  - Better parasitoid survival?
  - Better tree defenses?
  - Both?

Photo: Jack Clark

Longhorned Eucalyptus borer

- Attacks drought stressed soft barked Eucalyptus
  - Blue gum
  - *E. viminalis*
  - Others
- Egg parasitoid
- Damage not always lethal
  - Branch dieback
  - Kino production
    - Requires water
  - No water, no defense
    - Hydrated logs more resistant than dry logs

Conifers and beetles

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

Trees & shrubs are not passive

- They actively manage water and pests
- Pathogens need an angle to survive
  - Opportunistic pathogens and pests attack stressed trees (we give ‘em plenty)
  - Primary pathogens attack other trees in certain specific cases
    - Warm, moist soils; etc.
- Diagnosing the problem
  - The disease triangle
  - UC IPM

Management Recommendations

- Assess water status 12” below grade
  - Hydraulic lift
- Let the tree tell you how it’s doing
  - Look at current growth
  - Effects occur over years
  - A tree is the physical manifestation of a dance between its genes, the environment, and time

References

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Thanks!

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