

Thermal and Light Analysis in Greenhouses

IPRO 344: Jasmeet K. Bains, Mike Langman, Neal Ching, Michael Wokcik

Temperature

Several Options Available

- Misters
- Foggers
- Fans
- Plastic Coatings



Foggers

- Cools greenhouse by generating a cooling fog
- More complex and expensive than misters
 - Price: \$25-\$250/unit
 - Modular units require no tubing
 - Pool of water required



Misters

- Misters attach to hose via attachment
 - Cheap
 - No pumps required; use water pressure to generate mist
- Misters with pumps
 - User defined temperature settings
 - More expensive



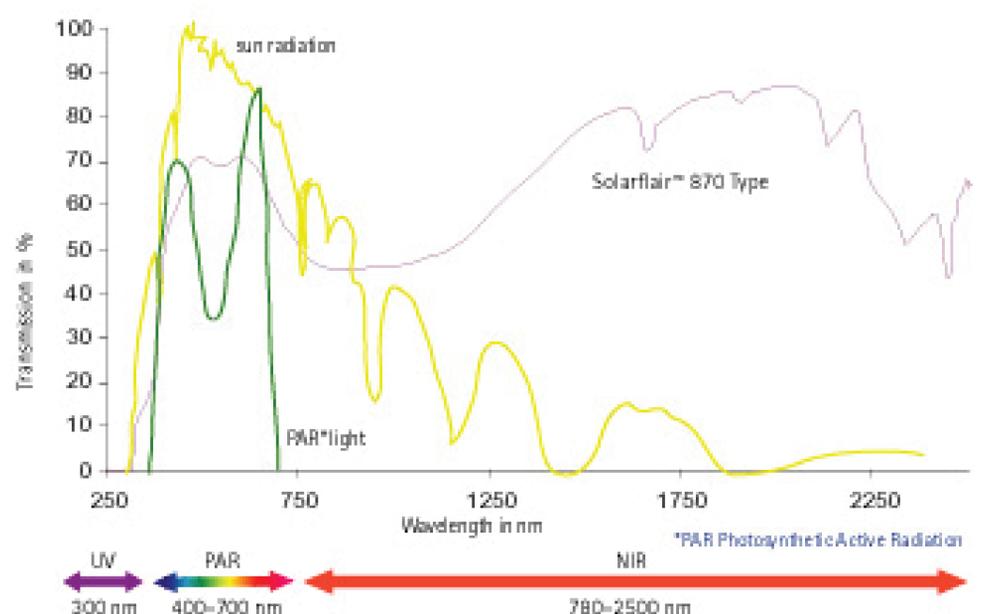
Fans

- All cooling options require a fan
- Serves a double purpose
 - Circulates air within greenhouse
 - Keeps greenhouse inflated
- Size of fan dependent upon size of greenhouse
- Typical circulation in a greenhouse is 1 total air exchange per minute

Plastic Coating

- Solarflair™ 870 is a pigment that offers a way to absorb the "Photosynthetic Active Light" (PAR) which has a wavelength of around 400-800nm.
- Offers a way to reflect most of the UV and IR wavelengths that supply unnecessary heat for the greenhouse.

Transmission Spectrum of Solarflair™ 870



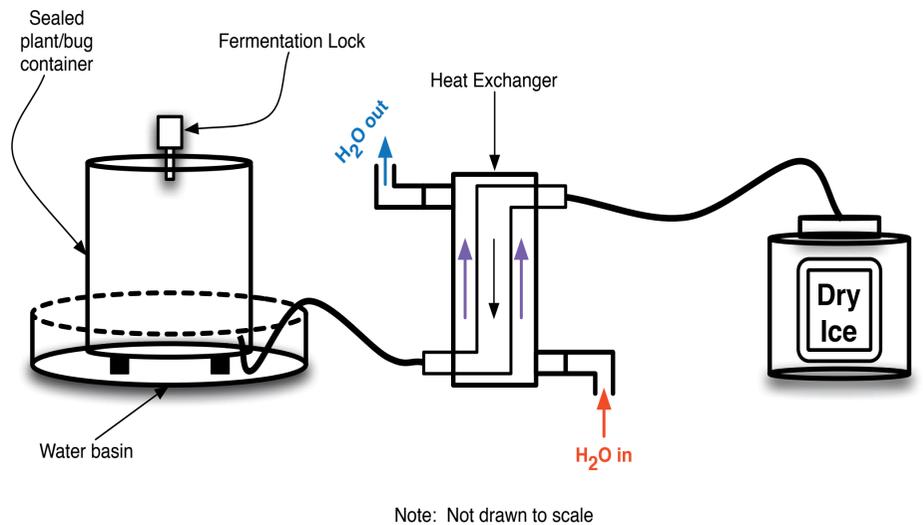
Pest Control in Greenhouses: A Scalable Design

IPRO344: Daniel Crandall, Christie Ferraro, Jeffery Larson, Joshua Nedrud, Xiang Wang

Insect Respiration

- Tracheal respiration through spiracles
- Branches to reach internal tissues
- Small insects use diffusion
- Larger insects forcibly ventilate tracheae

Our experiment, cut off the oxygen supply by creating a high concentration carbon dioxide environment. Coccinellidae (Lady Bugs) died after three hours of oxygen deprivation.

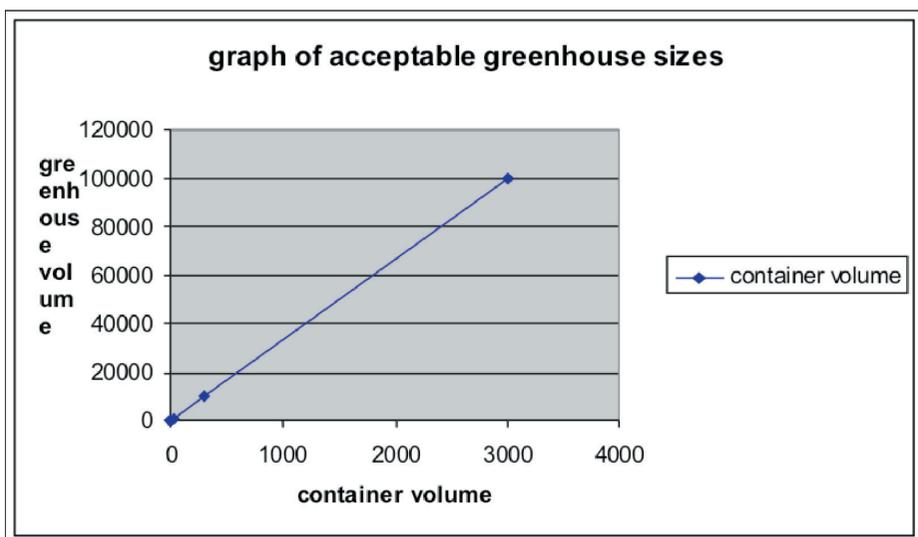


Device

- Goal: Isolate plants from general population of several hours
 - Common Flat Sizes
12" x 12" to 21" x 10"
 - Seedling sizes
<18"
 - Required container size
24" x 24" x 24"

Working Conditions

- Typical atmosphere $[CO_2] = 0.03\%$
- Humans can tolerate up to 4%
- Asphyxiation occurs at 10%
- Well Ventilated Area (preferably outside of greenhouse) or less than 3% of total greenhouse volume



Future Studies:

- Experimentation on a wide range of insects
 - Including internally and externally residing insects
- Research/Experimentation with different pesticides as controls



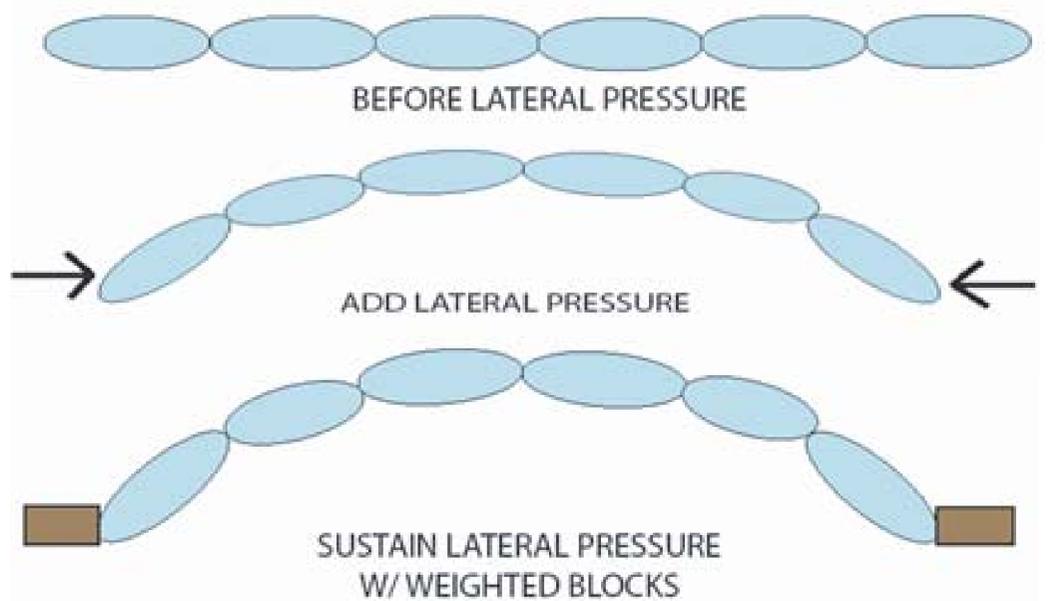
INFLATABLE GREENHOUSE

IPRO344 a green greenhouse

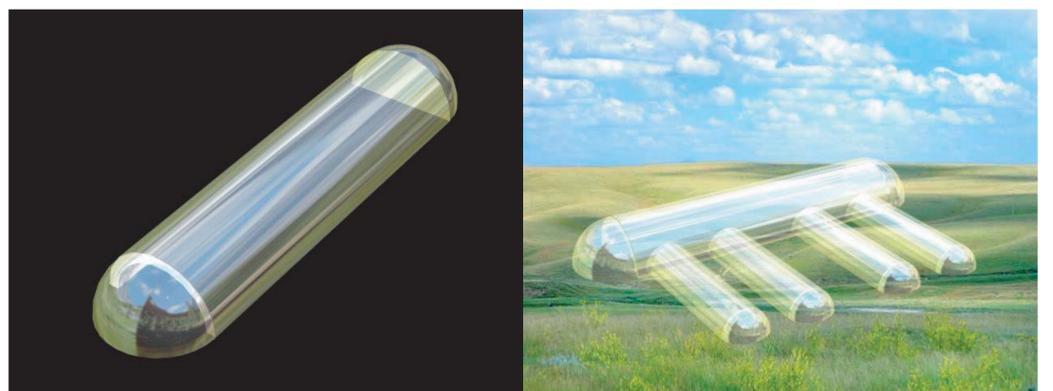
STRUCTURAL INVESTIGATION



The structural group of this IPRO took on the challenge of designing a structure solely supported by air pressure. Greenhouses today use steel supports with polyEthylene plastic stretched over them. Eliminating these supports in our structure proved itself to be a challenge. Through research and our schematic designs we were able to produce a structure that is supported both by air pressure between the two films of poly and with interior air pressure. The air pressure between the two films gives the greenhouse the necessary insulation quality and the interior air pressure provides the green house with strength to resist the weight of the structure.



Through intense research in we found that creating pockets of air running longitudinally the length of the structure allowed us to create a vaulted shape while reducing the appearance of wrinkles. Applying lateral pressure along with interior air pressure forced the plastic into this shape.



The green house we have constructed would be part of a matrix of like green houses that would link to a common spine increasing efficiency in all areas of performance.



To give added rigidity and resistance to horizontal winds a cable net structure would be implemented. This structure would act as a tether to the ground keeping the greenhouse in place.