Spread of Soybean Rust within a field – *what happens after the spores arrive*

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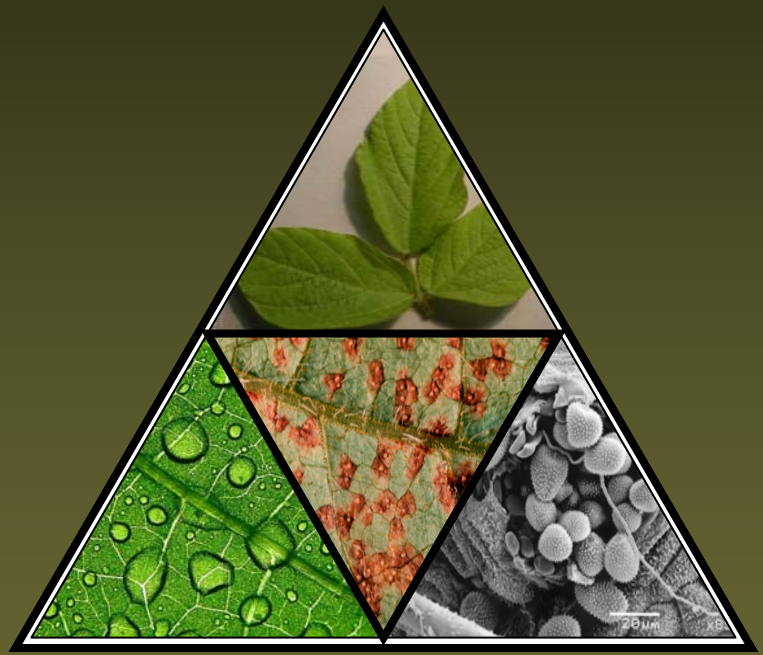
SOYBEAN RUST

Host

Soybean (*Glycine max*)



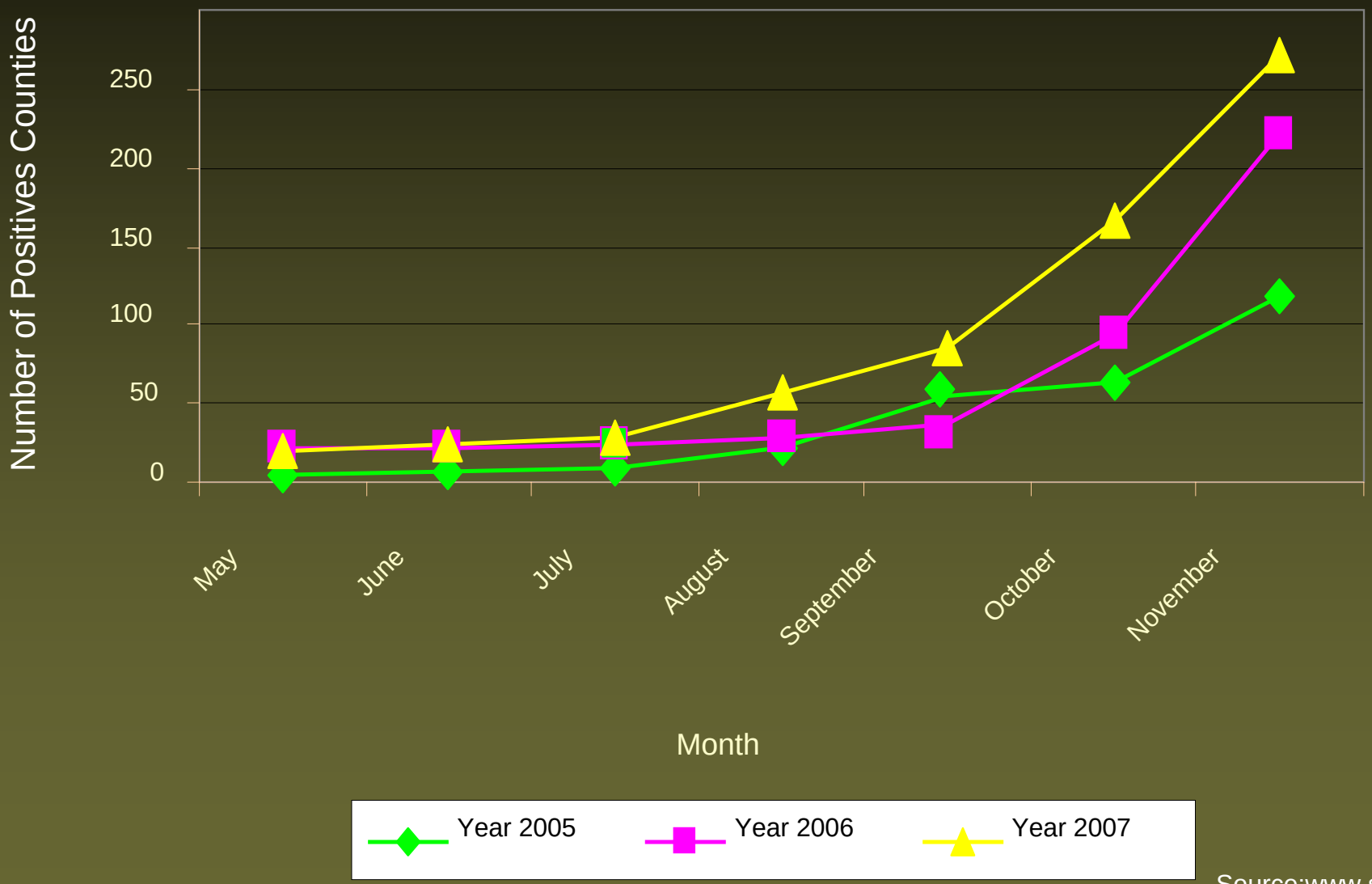
Environment

Cool temperatures (18-21ºC)
Prolonged wet weather (6-12h)
High relative humidity

Pathogen

Phakopsora pachyrhizi

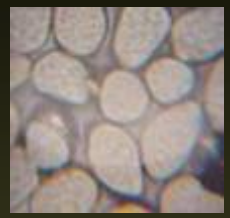
Spread of Soybean Rust in North America



Source:www.sbrusa.net

Soybean Rust Infection Cycle

Urediniospores



Spores germinate

Spore germination
- 80% in 1 hr
- 90% in 2 hr

Penetration & Infection

Direct & appressorium

10 to 12 hr

Pustules

5 to 10 days

Urediniospores

Pustule forms spores for 10- 14 days

Multi-cyclic Disease

Environment and soybean rust

- Temperatures between 59° F to 86 ° F
  - Maximum infection at 68 to 74^0 F
  - Temperatures >90^0 F suppress soybean rust
- Relative humidity between 75-80% required for spore germination and infection
- Frequency of rain events
  - 12-15 rain days per month
  - Late vegetative to late reproductive growth stages
- Duration of leaf wetness
  - 6-12 continuous hours required for infection by soybean rust pathogen

The influence of Row Spacing and its Canopy Micrometeorology on the Spread of Soybean Rust

Research motivated by the producers questions about changing crop production practices to address soybean rust

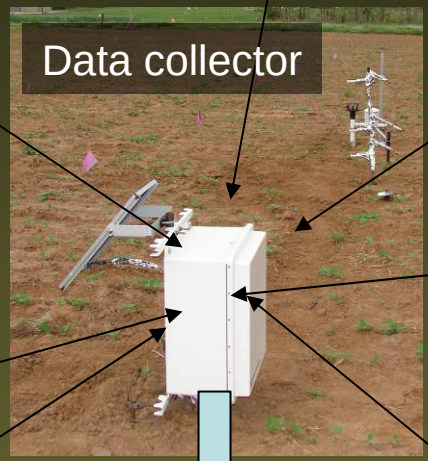
- Determine the effects of row spacing (7, 15, 30 inch rows) on microclimate variables and the architecture of soybean canopies
- Determine the effect of row spacing on the spatial distribution and rate of spread of an induced soybean rust epidemic in soybean canopies.
- Correlate relationships between microclimate variables and soybean rust spread within canopies at different row spacing.
- Evaluate the extent to which soybean rust infection alters the microclimates of soybean canopies.

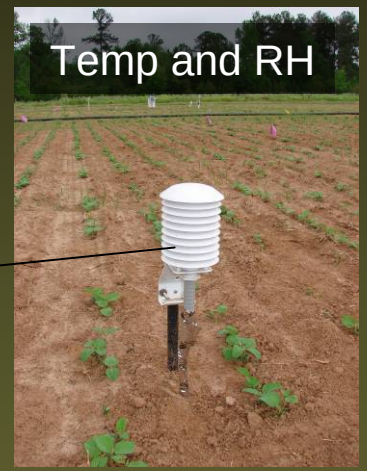

Wind speed & direction


Solar radiation


Rain

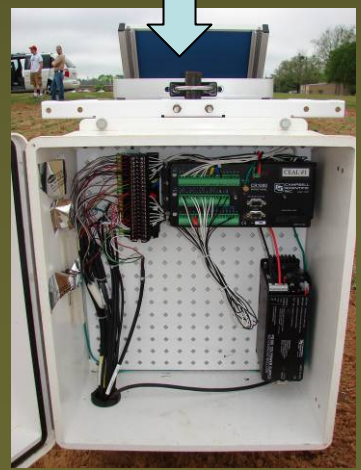

Spore movement


Data collector


Temp and RH


Leaf wetness

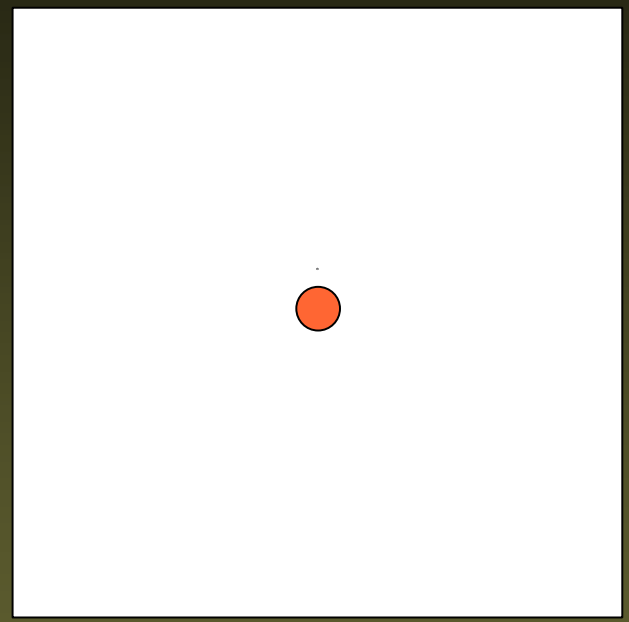

Temp




Wind speed & direction

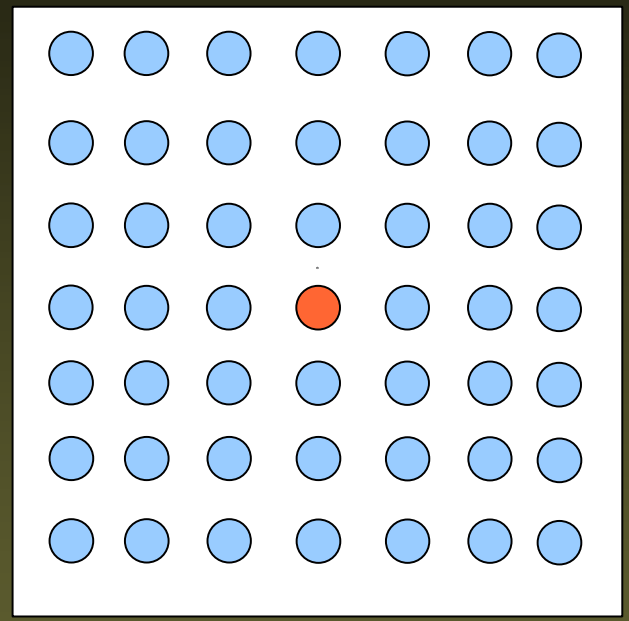
Disease Establishment

- Inoculate plots in early reproductive stages of growth (R1-R2)
- Single heavily infected plant placed into the center of each plot



Monitoring Disease

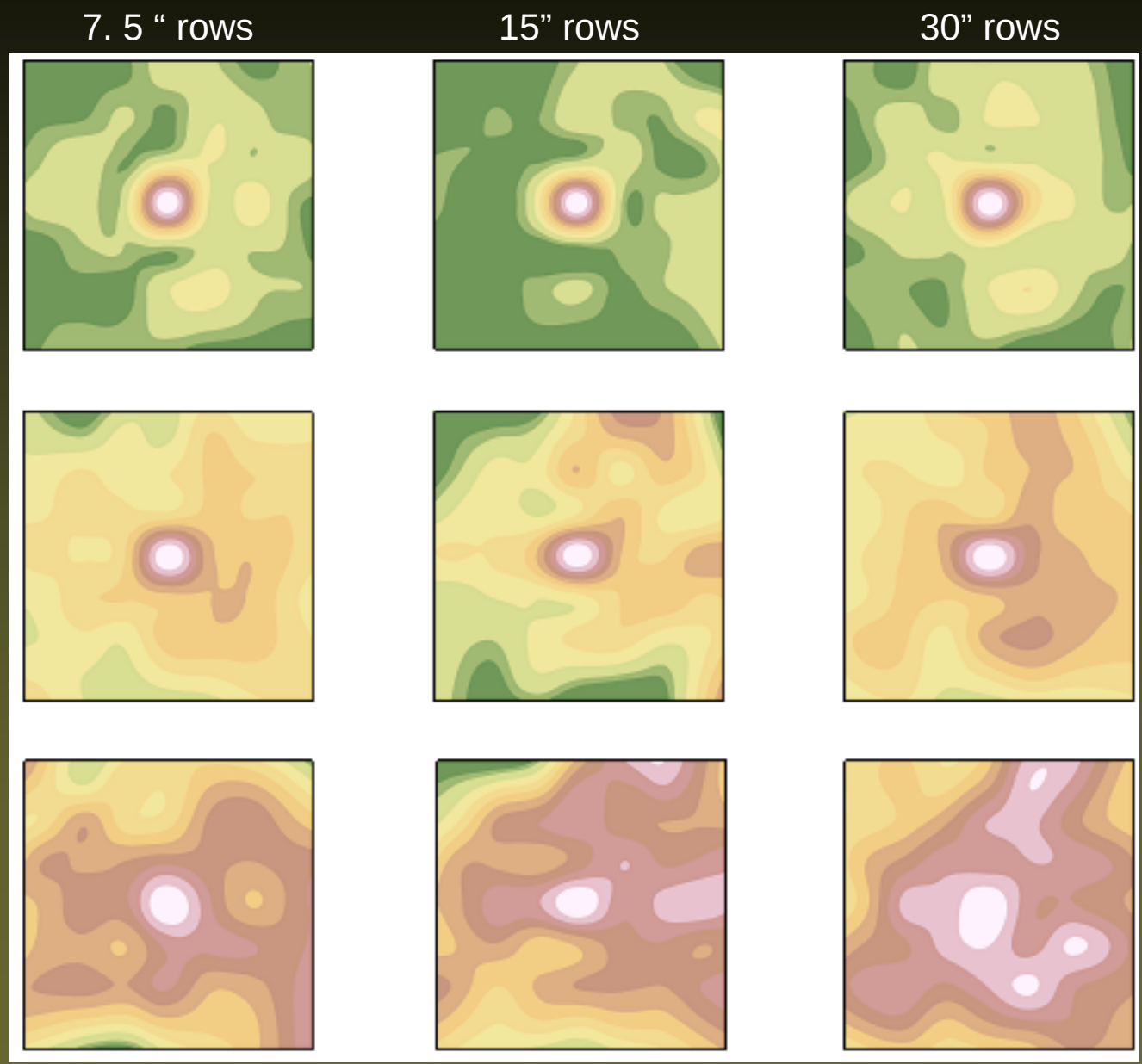
- Monitor disease on a 49 point sampling grid within each plot
- Evaluate the severity of 5 leaves in lower, middle and upper canopy (here we combine)
- Assessments made 23, 30, 40, 44, 51 & 59 days after inoculation



Spatial Distribution of Soybean Rust

2006

59 days after inoculation of single point



Annalisa Ariatti, Penn State University

Spatial Distribution of Soybean Rust

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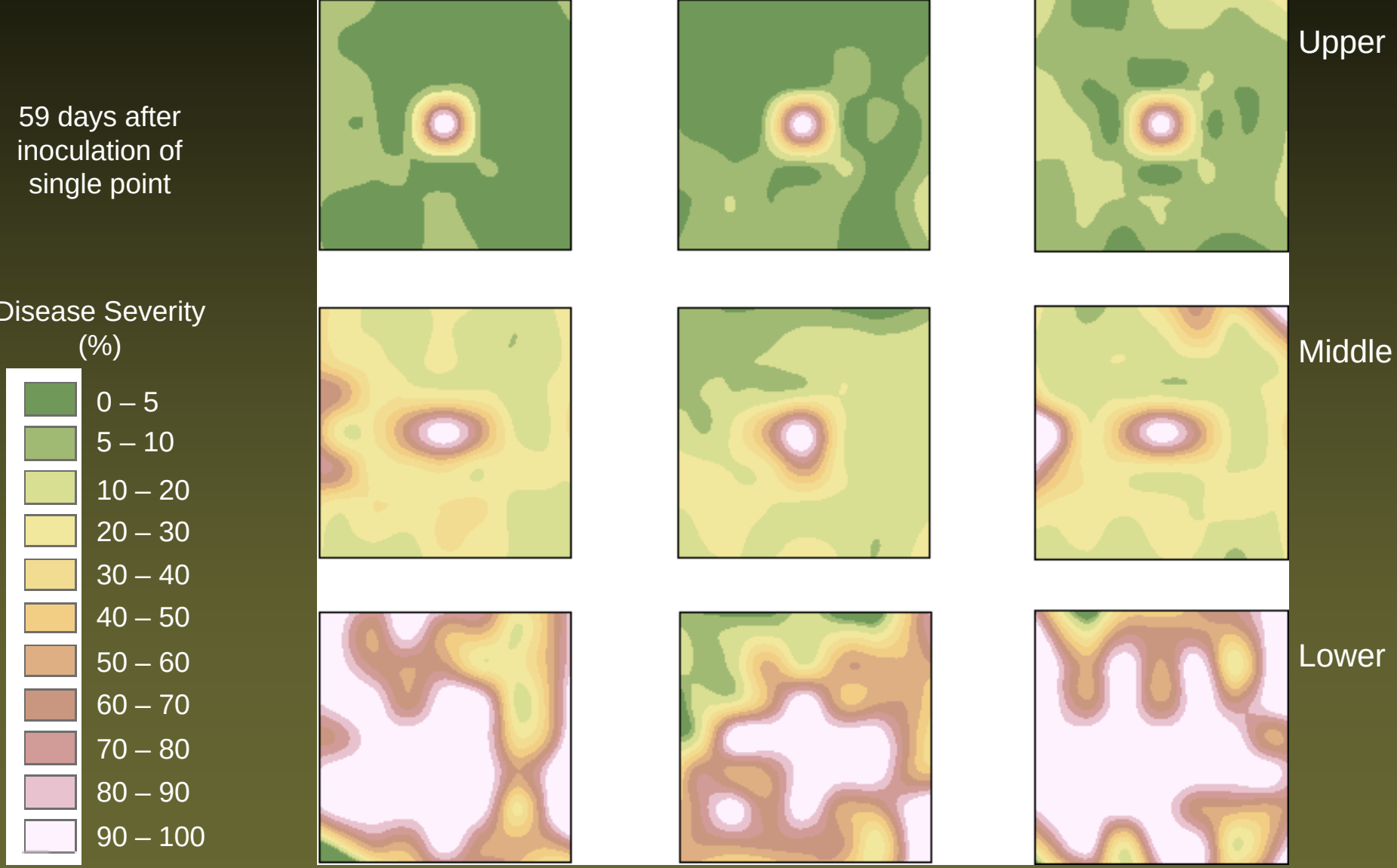
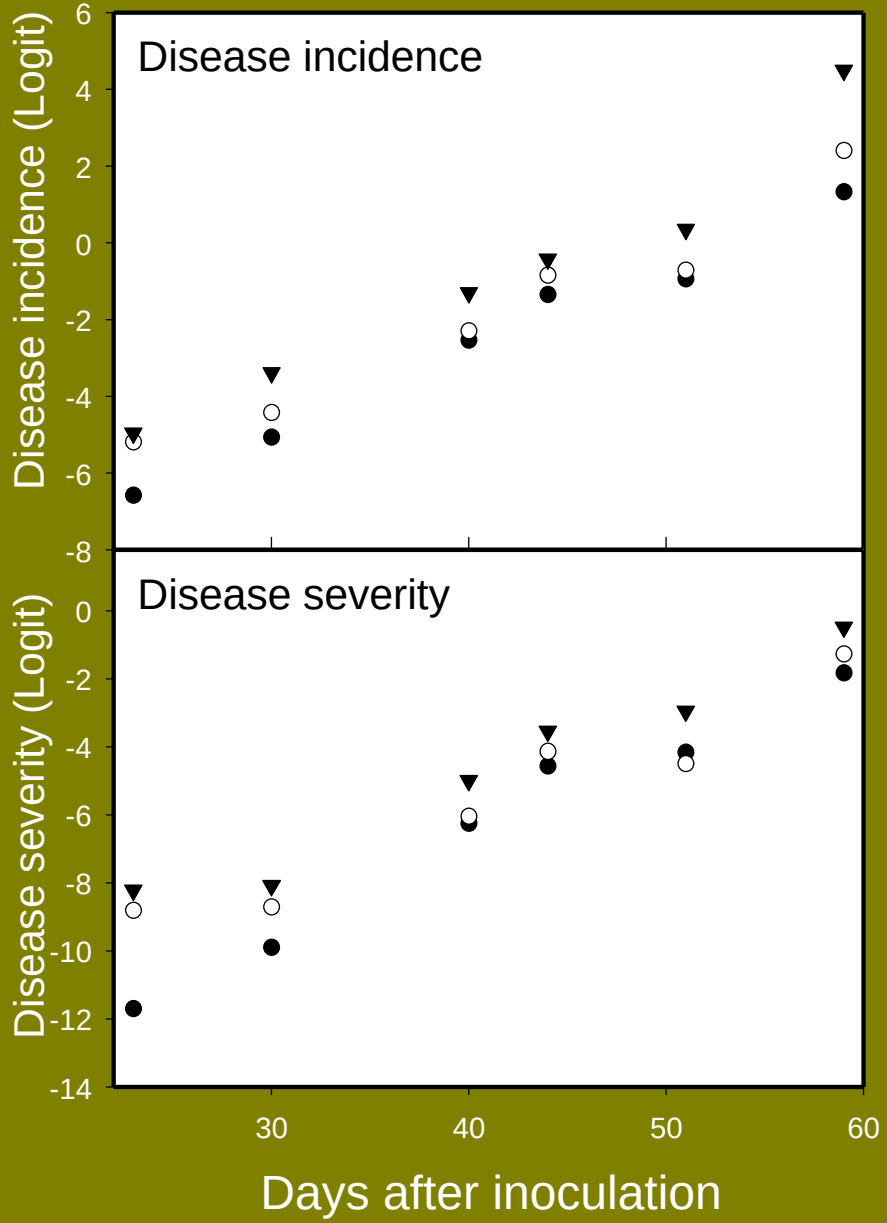


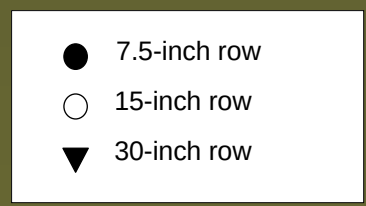
Annalisa Ariatti, Penn State University

Disease progress over time with different row spacing



-Logistic model has slightly better fit than exponential

-Rate of disease progress does not vary with the row spacings considered



Air Temperatures

- Not much difference in air temperatures between 2006 and 2007

Relative Humidity

- Its was drier in 2007 then 2006 in mid canopy.
- The number of hours with RH > 90% was less.
- The RH in the 7.5 row spacing treatment was relatively low in 2007, maybe because the soil was very dry and the mixing with the air above limited by the dense canopy.

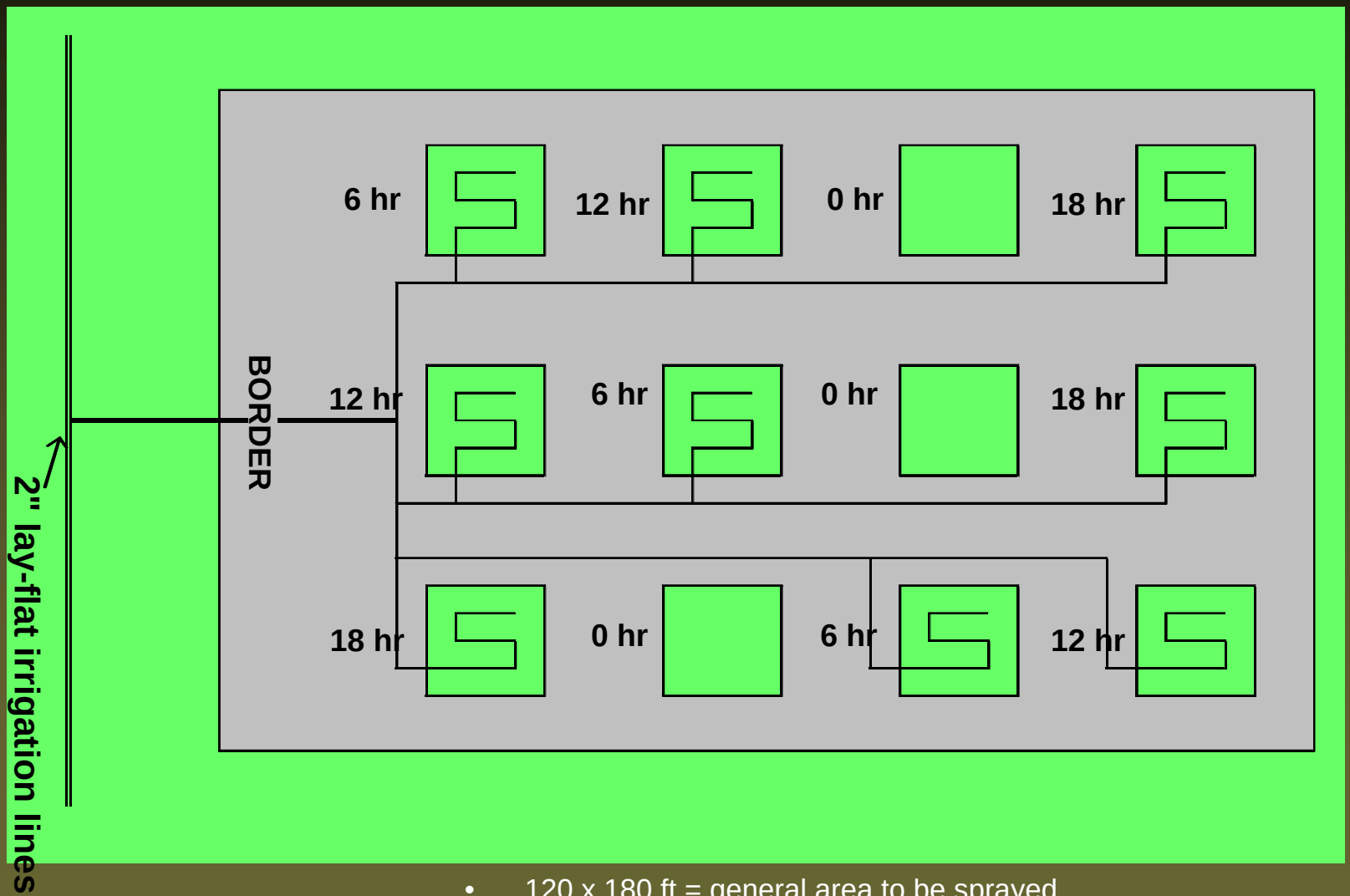
Conclusions

- Results from 2006 and 2007 are consistent and show similar disease spread pattern
- Growing soybeans in 7.5, 15 or 30 inch rows did not significantly alter the rate of disease spread or disease increase over time.
- Rate of disease progress does not vary with the row spacings considered

Effect of Leaf Wetness on the development of Soybean Rust

- Determine the spatial and temporal dynamics of SR in sentinel and field plots
- Evaluate specific microclimates within the plant canopy that could be more conducive to disease.
- Evaluate the effect of four different leaf wetness duration periods on the development and spread of Soybean Rust

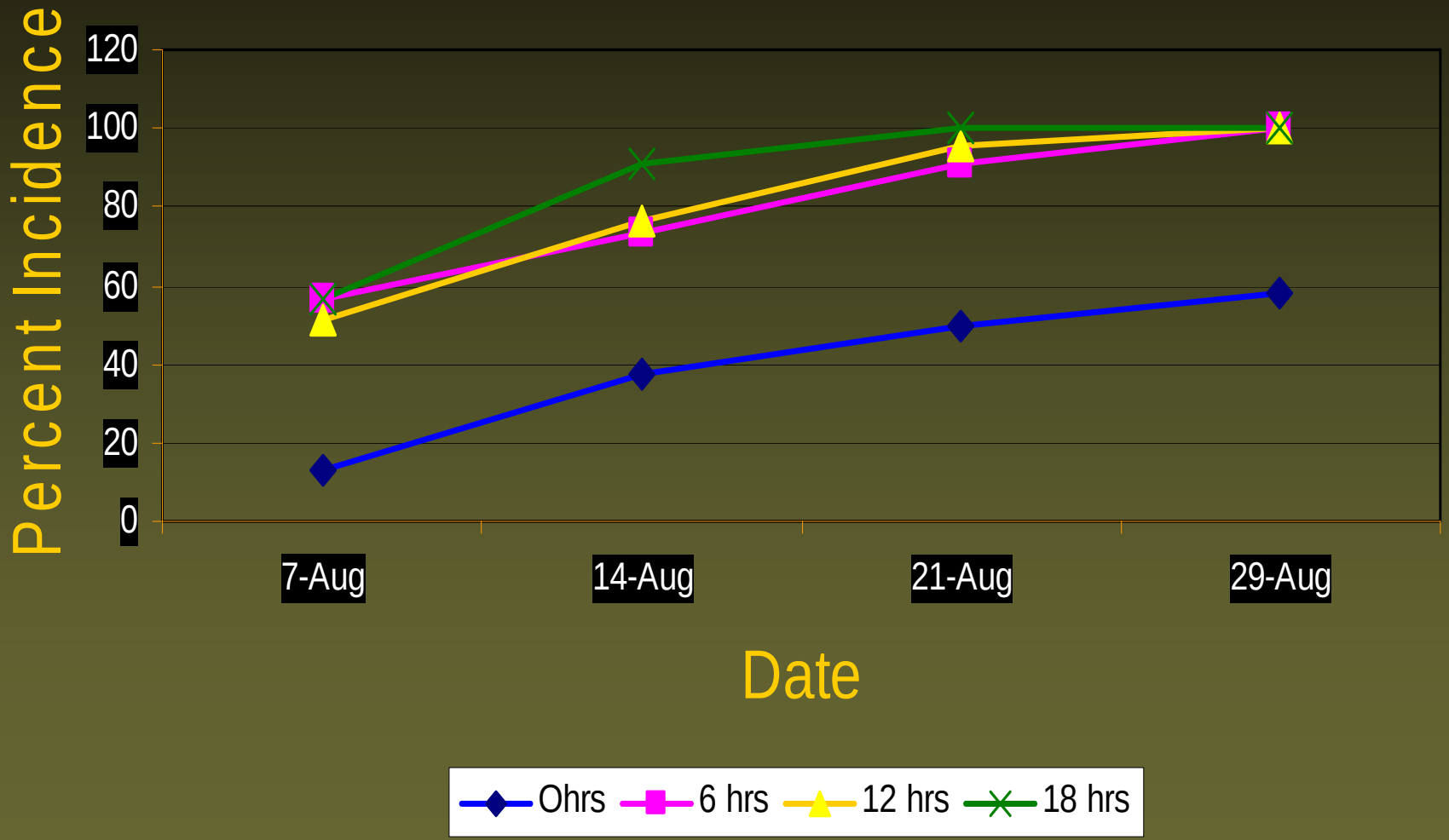
Misting Irrigation System



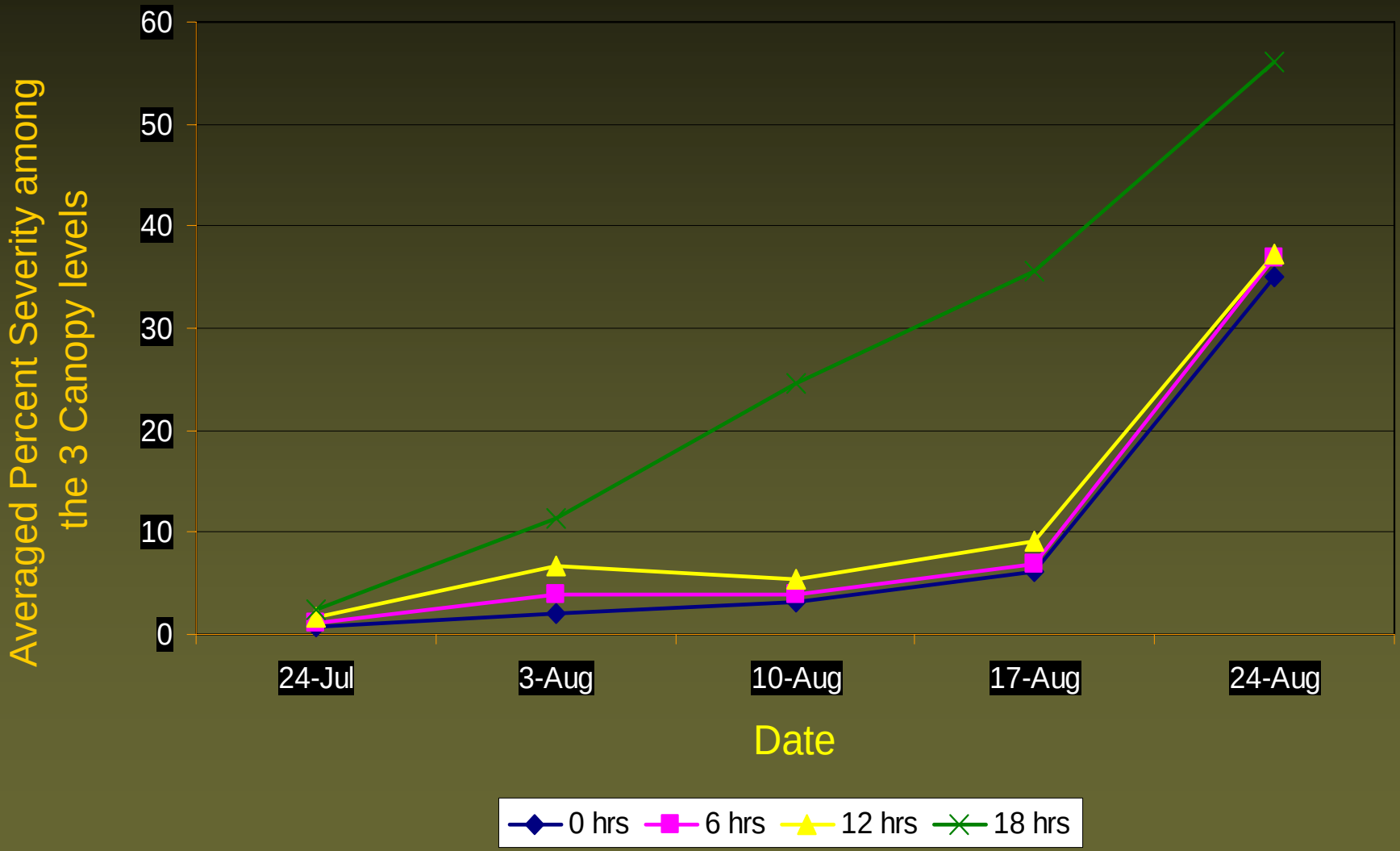
- 120 x 180 ft = general area to be sprayed
- Plots are 20 x 20 ft, 17 rows 15 in apart within a plot
- Misted areas are approximately 15 x 15 ft

Effect of Leaf Wetness on SBR Incidence (Inoculated)

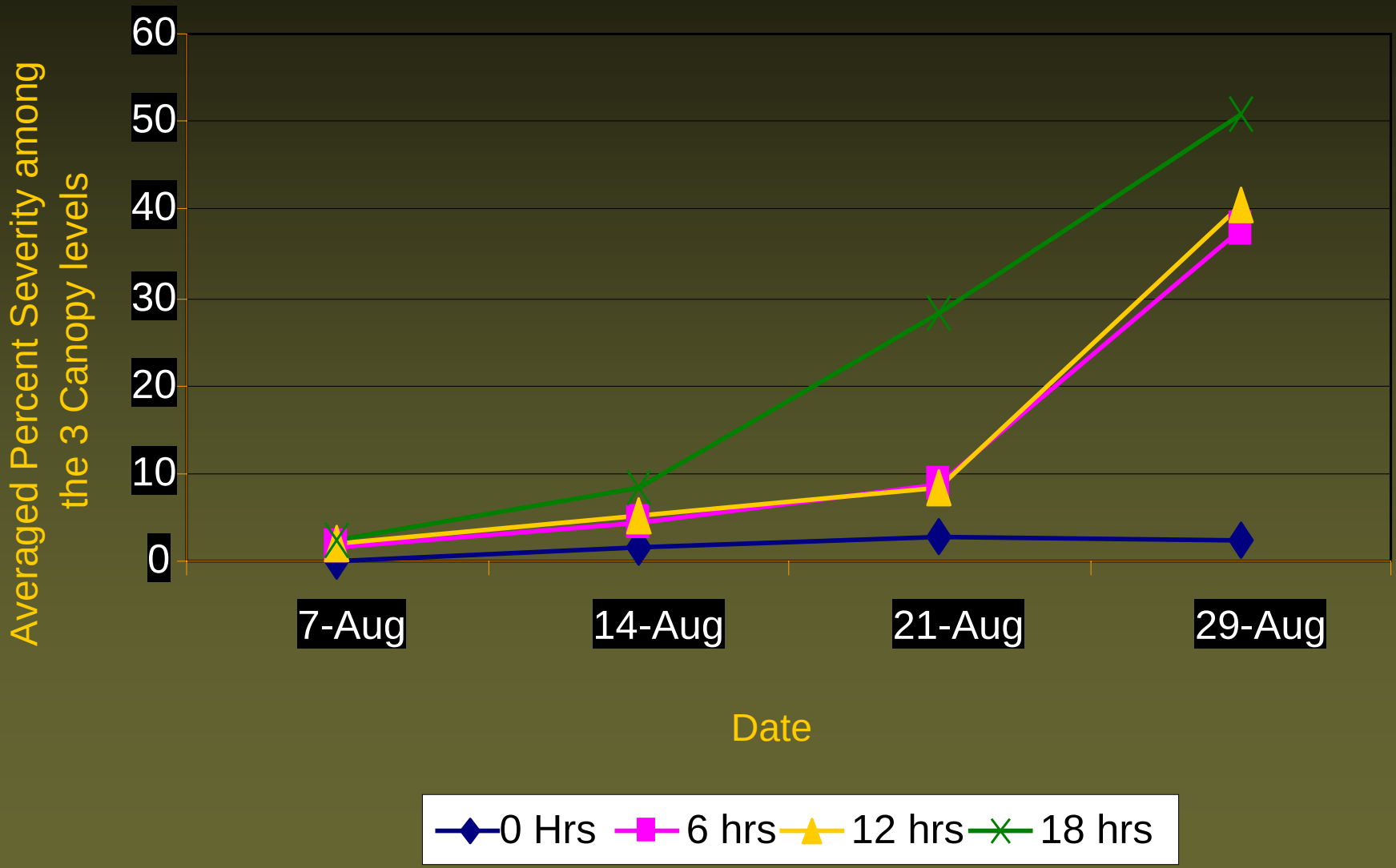
Effect of Leaf Wetness on SBR Incidence (Non-Inoculated)



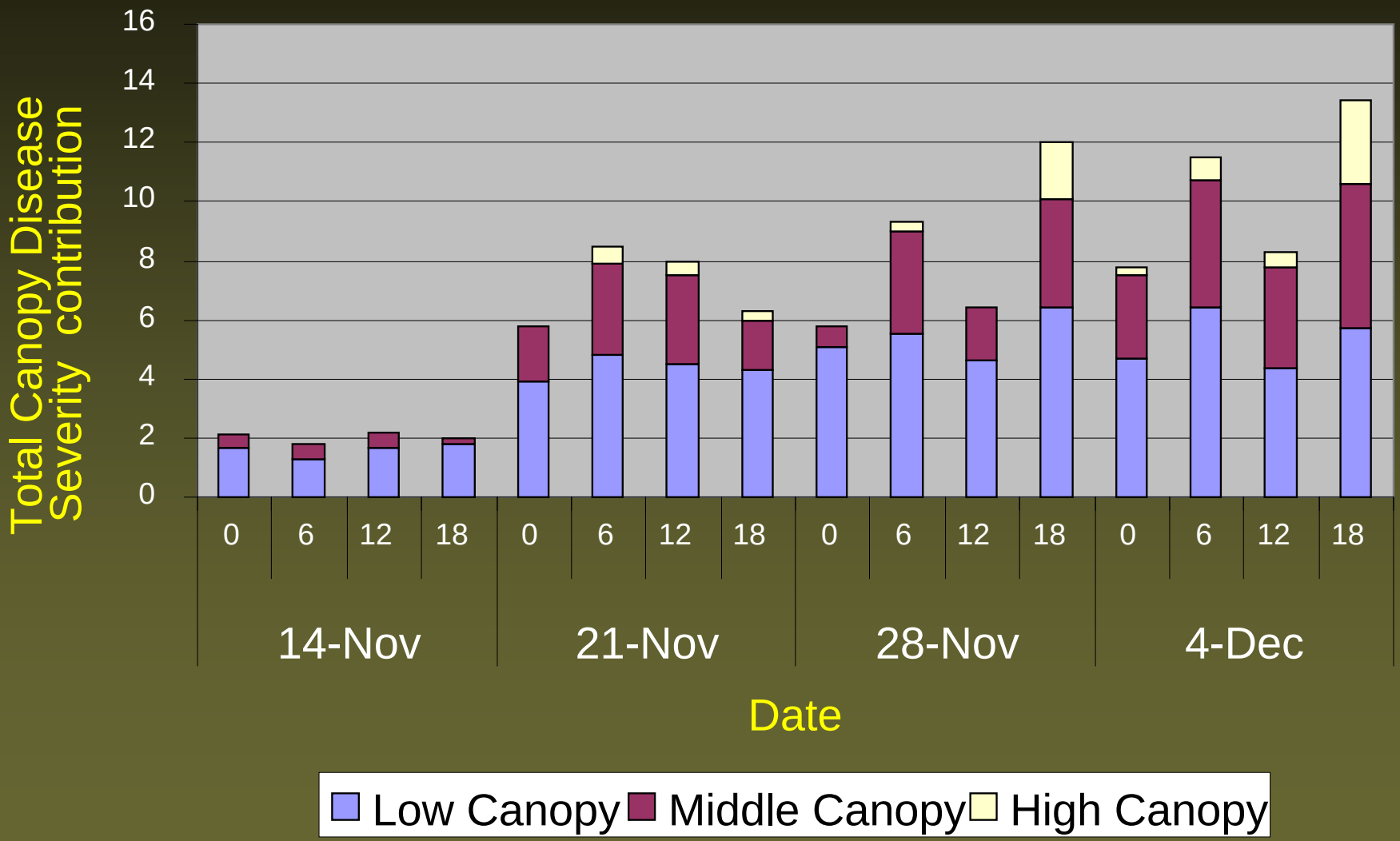
Influence of Leaf Wetness on SBR Severity (Inoculated)



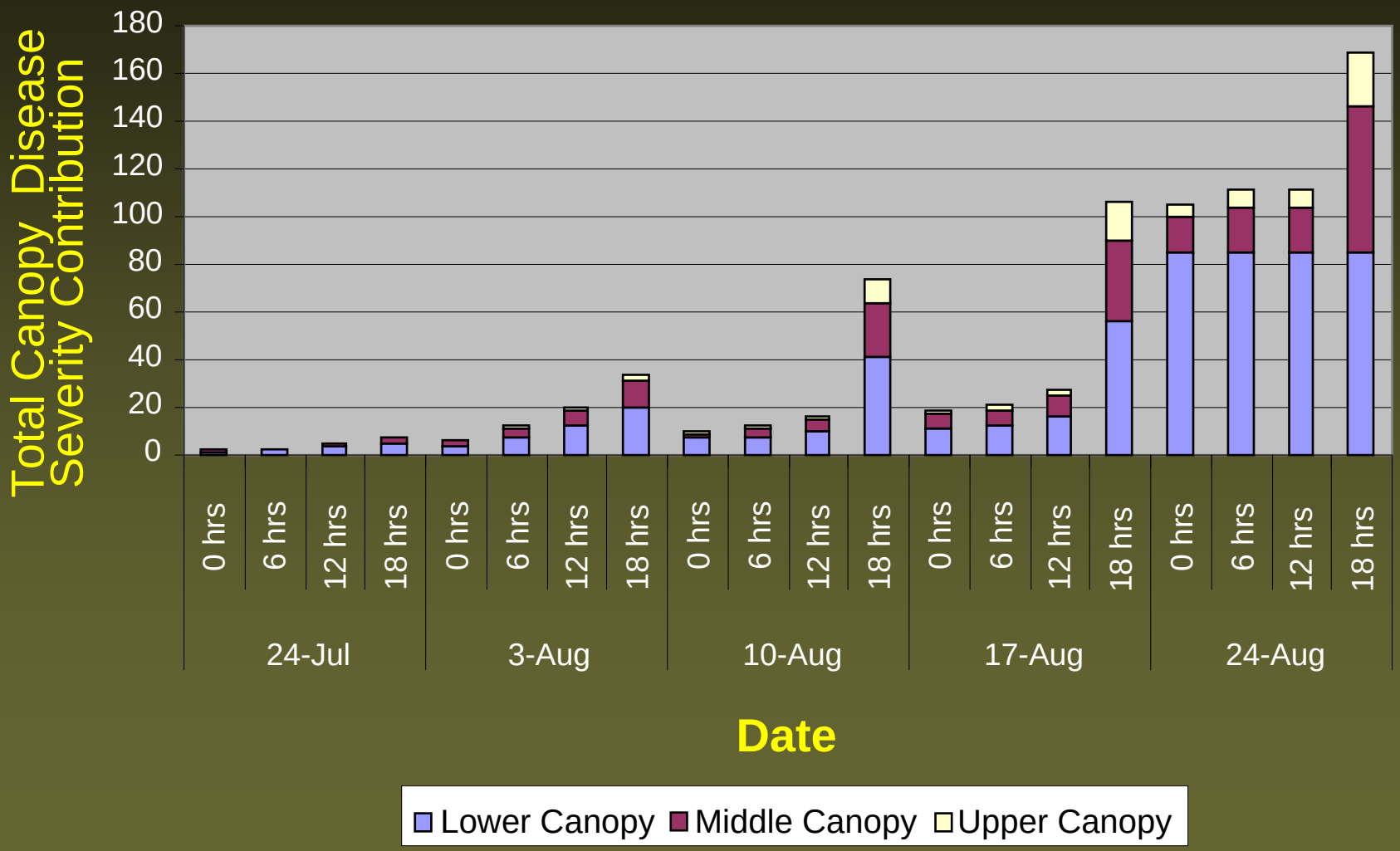
Influence of Leaf Wetness on SBR severity (Non Inoculated)



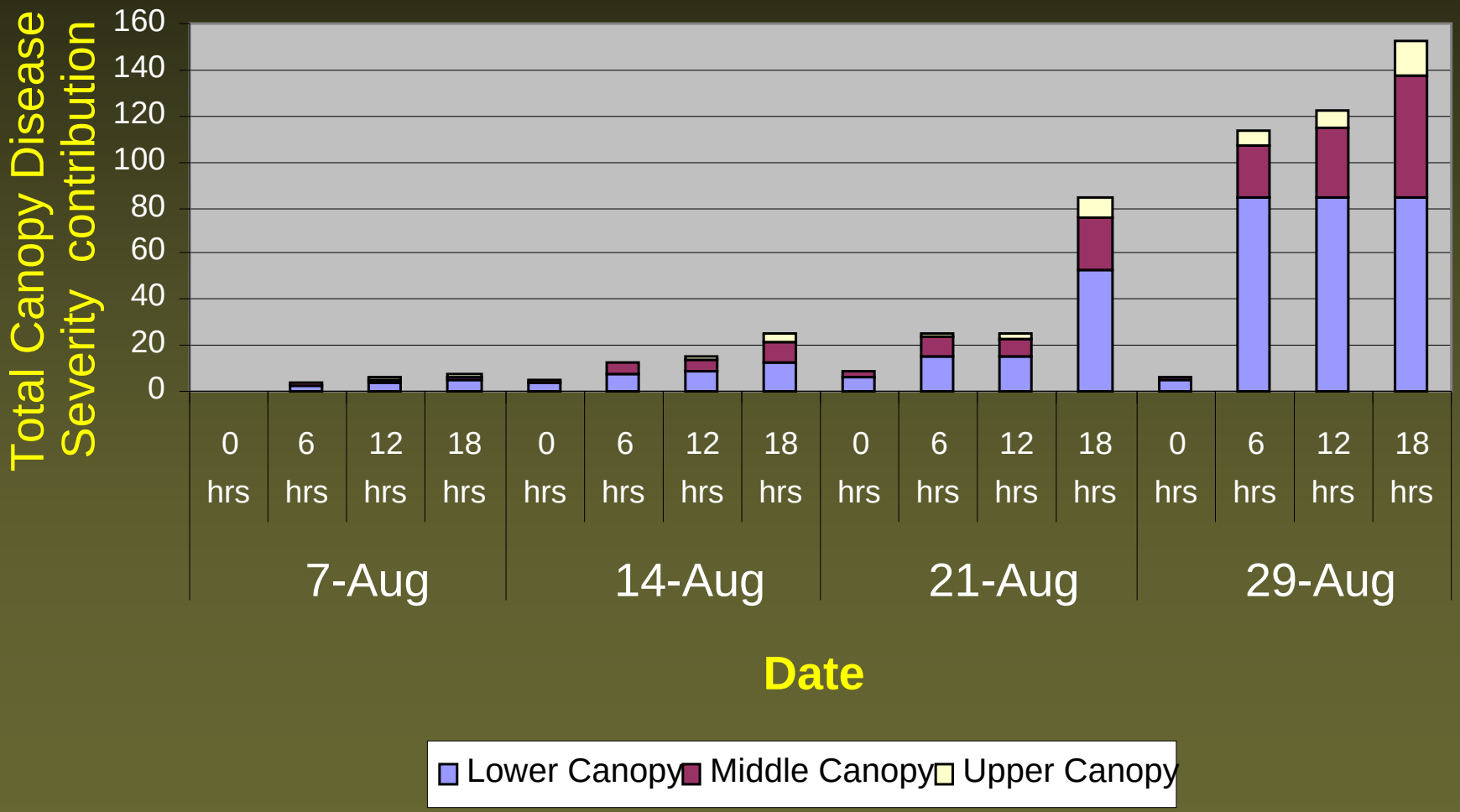
Effect of Leaf Wetness on Soybean Rust Development 2006 (Inoculated)



Effect of Leaf Wetness on Soybean Rust Development 2007 (Inoculated)



Effect of Leaf Wetness on Soybean Rust Development 2007 Non Inoculated



Conclusions

- Our data partially corroborated previous findings that a minimum of 6-7 hr of continuous leaf wetness was required for SR lesions to develop at favorable dew temperatures (18-26.5C). However, our results shows that leaf wetness is not strictly required for SR development but play an important role in the increase of incidence and severity of the disease.

- The 18 hr leaf wetness period was the treatment that shows more increase on disease severity.

- Results show that prolonged leaf wetness periods not only increases disease incidence but increases the severity and spread of the disease to upper soybean canopy levels.

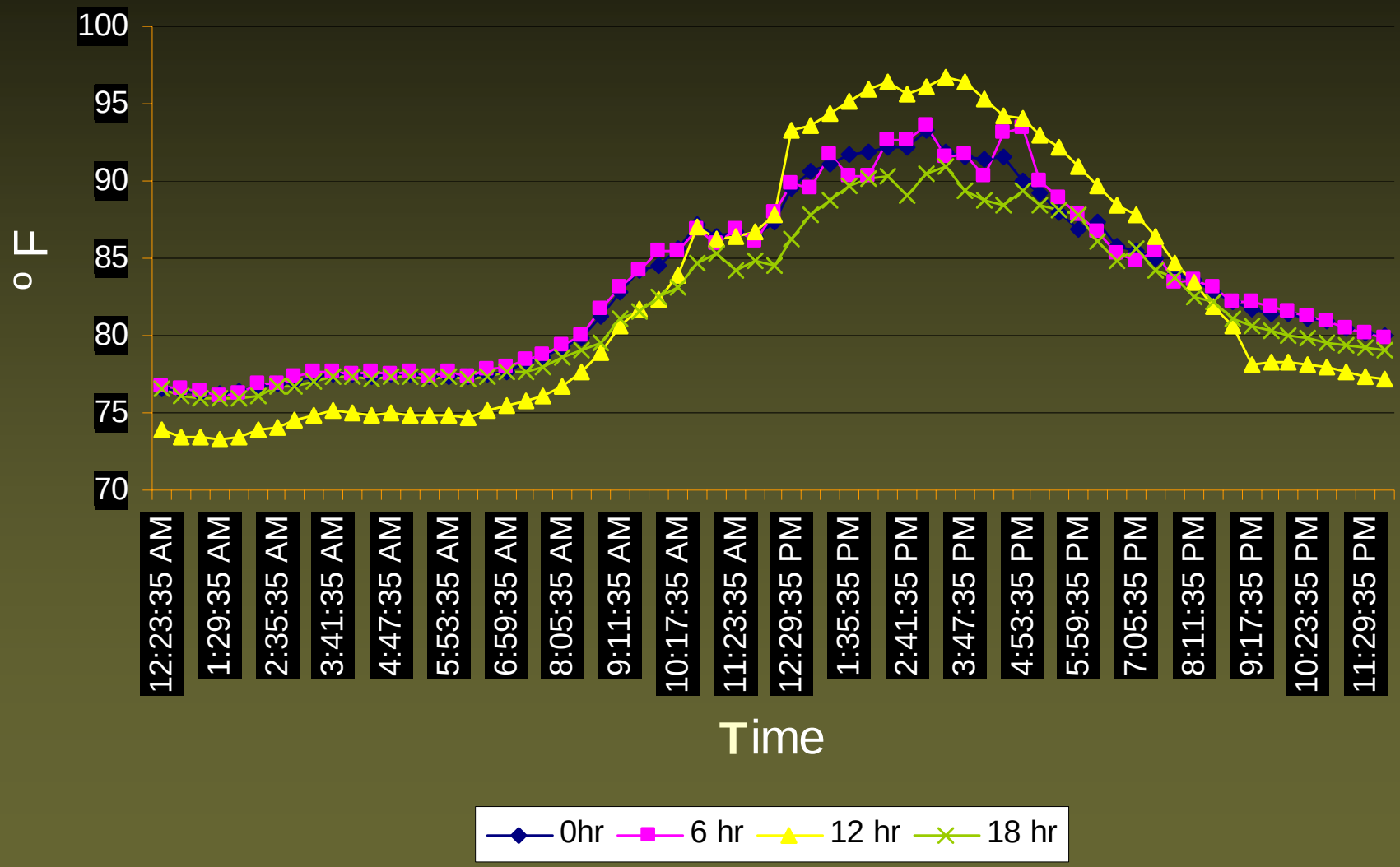
Conclusions

- Growing soybeans in 7.5, 15 or 30 inch rows did not significantly alter the rate of disease spread or disease increase over time
- Natural conditions can provide sufficient free water as dew for soybean rust disease development, but additional moisture increases disease progress.

Acknowledgements

- North Central Soybean Research Program (NCSRP)
- Scott Isard — Penn State
- Paul Eskert — University of Wisconsin - Madison
- NFREC-IFAS — Quincy, FL

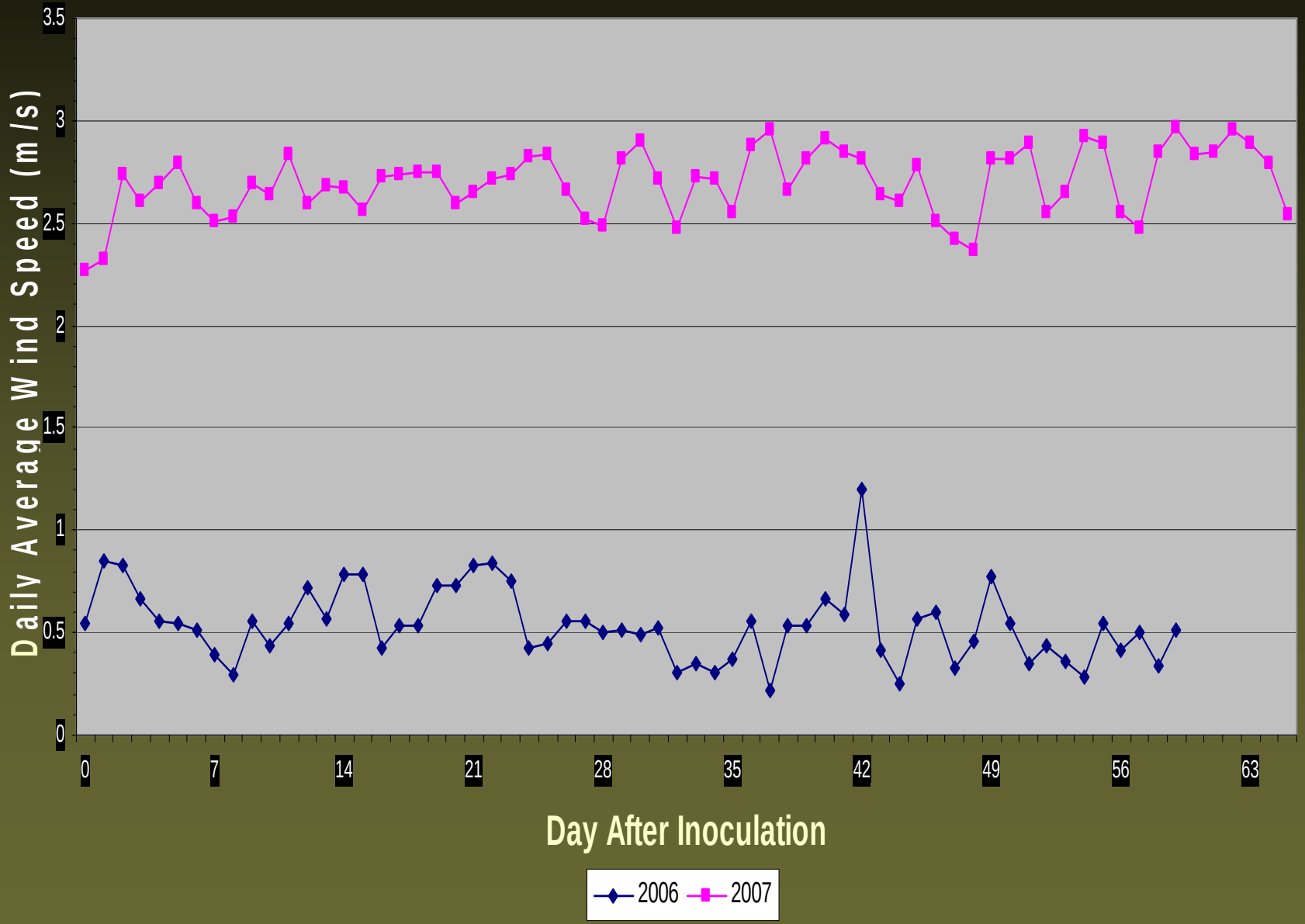
Dew Point during a 24 hr Studied Period



Misting times

- 0 hr treatment: No misting applied
- 6 hour treatment: on at 12:00 am off at 6:00 am
- 12 hour treatment: on at 9:00 pm, off at 9:00 am
- 18 hour treatment: on at 6:00 pm, off at 12:00 pm (noon)

Wind Speed Above Soybean Canopy



Wind Speed

- In 2007 we changed the location of the study field and it is very much reflected in the mean daily wind speed. In 2006, the field was more sheltered. Noted by the large number of hours with zero wind speed. We did not have a single completely calm hour at the 2007 site.