Efforts to Monitor the Dispersal of Soybean Rust

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Brief Outline

- Introduction
  - Why monitor the dispersal?
  - Examples of spore trapping in other systems?
- Spore trapping efforts for soybean rust
  - Local dispersal
  - Long distance dispersal
Why Monitor for Soybean Rust?

- Potential for early warning system
  - Alert growers of significant dispersal events prior to symptom development
  - Validation of aerobiology models for spore transport
    - Modeling goal to enhance spatial resolution of local observations
    - Possible to eventually replace spore traps?
Examples Pathogen Monitoring

- NDSU Small Grains Forecasting System
  - Provides predictions for four diseases of wheat
  - Monitoring for *Gibberella zeae* ascospores and macrocondia to predict risk of head scab
  - Spore monitoring can be combined with models of pathogen reproduction
NDSU Small Grains Forecasting System: Risk of Pathogen Reproduction

Fusarium Head Blight - Ohio State Model I

July 14, 2003

Fusarium Head Blight Risk

M. McMullen, NDSU
# Key Differences

<table>
<thead>
<tr>
<th>Factor</th>
<th>Head Scab</th>
<th>Soybean rust</th>
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<tbody>
<tr>
<td></td>
<td>Eastern U.S.</td>
<td>Northern state</td>
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<tr>
<td>Potential for local survival</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Source of initial inoculum</td>
<td>Local (Regional)</td>
<td>Distant</td>
</tr>
<tr>
<td>Importance of inoculum timing relative to host growth</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Potential for Secondary cycles</td>
<td>Low</td>
<td>High</td>
</tr>
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NDSU Experience

- Growers value information about the presence of spores
- Detection of inoculum is reasonable
- Difficult to translate number of spores trapped into clear risk of disease (infection efficiency of inoculum)
- Combination of prediction models and spore monitoring effective
Realistic Expectations for Soybean Rust

- Relationship between inoculum and disease took multi-state effort to develop initial concepts
- Several more years of operational use before pathologists and growers gained sufficient confidence
- Expect some growing pains with soybean rust
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Monitoring Local Dispersal

- Monty Miles, Glen Hartman and Scott Isard
- Ray Schneider, and Paul Mumma

- Objectives
  - Evaluate different methods of spore trapping to assess local movement of the pathogen
  - Examine relationship between trapped spores and disease development
Types of Spore Traps

- Trap type
  - Burkard vortex
  - Burkard tape
  - Rotorod (model 20)
  - Passive trap (greased slide/EM stub)
  - Super sniffer

- Method of Quantification
  - Light or EM microscope
  - RT-PCR
Spore Monitoring Progress

- Monitoring fields with soybean rust in FL, AL and GA
- Diurnal patterns in spore release within and outside crop canopy
- Relationship of spore release with weather variables
- Dispersal distance from known point sources with different trap types
Results To Date

- Trapping successful
  - Multiple trap types and on many surfaces
- Spore counting is still on-going
  - Spore catches during mid-morning and early afternoon greater than at night
  - Presence of dew is key limiter of spore release
Results of PCR Quantification

- RT-PCR methods detect ~10 spores
  - Detection in the presence of silicon grease
  - Calibrating spore numbers with RT-PCR
Plans for Continued Work

- Evaluation of spore monitoring already accomplished
- Refinement and focus on trapping methods
- Additional spore trapping
  - South America
  - Spore release from Kudzu (Florida)
Plans for Continued Work

- Finding overwinter sites and monitoring spore movement is critical
Prototype of Passive Trap for 2006
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Spore Deposition in Rain

- Trapping network in OH, PA, MD, NY and DE
- Rain trap: funnel, pvc pipe, filtering device
- Recover filter and send to central location
- Extract DNA and subject to RT-PCR
Results: Refining Methods

- Adapted extraction procedures for use with paper or membrane type filters
- Detection level ~10 live spores
- Dead spores did not produce same signal strength
- Positive and negative controls and repeated samples allow confirmation
Results of Spore Trapping

- 68 total samples collected across 5 states
- Some samples did test positive for the pathogen, but replicate sample negative
- Results of monitoring need to be compared with spore transport models
Conclusions

- Spore trapping has been used for pathogen detection and combined with prediction models to estimate disease risk for other systems.
- Tremendous amount of research effort address critical issues.
- Realistic expectations needed while research develops methods and establishes relationship with disease.