Early Warning Systems for Rust Diseases

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Early Warning Systems for Rust Diseases

Lessons learned from the Soybean Rust experience

Preparing for “in-season” management of new wheat stem rust races
Situation regarding SBR in 2004 prior to entry into US

- Potential to be the most destructive foliar disease of soybean in the U.S.
- Had caused significant yield losses worldwide. 2003 yield losses in Brazil exceeded 5% of the annual production (Miles et al. 2003)
- Soybean rust resistant/tolerant cultivars were unavailable
- Foliar fungicides required frequent applications and add significantly to production costs
Soybean Rust Spread
Cumulative wet deposition of *P. pachyrhizi* spores from northern South America soybean-growing region for a hypothetical 10 July 2003 release.

Cumulative wet deposition of *P. pachyrhizi* spores from northern South America soybean-growing region for a hypothetical 19 August 2001 release.

Hurricane example

Cumulative wet deposition of *P. pachyrhizi* spores from northern South America soybean-growing region for a hypothetical 21-27 August 1999 release.

Cumulative wet deposition of *P. pachyrhizi* spores from northern South America soybean-growing region for a hypothetical 22-29 August 2003 release.
2004 Soybean Rust Incursion into Southeastern U.S.
USDA Soybean Rust Coordinated Framework
From planning to management in 2004/2005

Participants

USDA
Industry
Consultant
University
Grower
Distributor

Planning
Training
Education
Research
Modeling
Monitoring & Scouting
Information Dissemination
Management

Components & Participants
Combining Information Technology and IPM Paradigms

Tasks

Dissemination

Interpretation

Integration

Modeling

Data Management

Host

Disease

Pathogen

Environment

Field Observations
Pest Information Platform for Extension & Education (PIPE)

1. **Observation**
   - Field Observations of Pest, Hosts & Environmental Factors throughout Pest’s Potential Range

2. **Data Management**
   - Standardized Documentation and Platforms for Inclusion of Observations in National Computer Database

3. **Modeling & Integration**
   - Integration, Analysis, Modeling and Mapping

4. **Interpretation**
   - Standardized Platform for Information Interpretation by Specialists

5. **Dissemination**
   - Timely Decision Support by Specialist for Growers throughout Pest’s Potential Range

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Knowledge Base/Research

Information flows

**Restricted-Access Interface**

Feedback flows

**Public Interface**

People and computers linked by “state-of-the-art” Information Technology
Spore Transport Modeling:
Adding value to observations

Restricted Access Website
IAMS Output

Spore Deposition Modeling: Adding value to observations
Restricted Access Website

Wet Deposition of Spores
8 Sept 2007
Disease Severity Modeling
Adding value to observations

By August 24th, rust is expected to be light to moderate to heavy in Georgia, part of Alabama and Florida. New light infestation is expected in Louisiana. All other states are expected to have either latent or no infection.
Comparison of IAMS Spore Deposition Predictions and SBR Spore Collections (16-22 August 2007)

NADP Rainwater Collector

County with SBR infected sites (21 August 2007)

IAMS Wet Deposition Output
Viable SBR Spores/Land Area (#/ha)

SBR Spore Collections (spores/m²)
- 0 - 20
- 21 – 80
- 81 – 320
- >321

Positive, # of spores unknown

Research: Integration and Model Validation
Education, Integration and Interpretation
Interpretation & Communication by Specialists
(maps, textboxes, uploads)

Florida Commentary
Crop Growth Stage
Most commercial soybeans are planted and at late vegetative stages or early reproductive stages.

Observation and Outlook - Disease
A soybean sentinel plot in Jefferson County in North Florida was PCR positive for soybean rust on MG77 leaves collected 7/27/06. Two MG77 leaves were found to have 2% disease severity; another MG7 leaf from the same plot was PCR positive for soybean rust. It is expected to have some amount of disease.

Scouting and Management - Disease
Start scouting when you reach R1 or when nearby infections are identified. You should be ready to act in case disease does develop in your region.

Florida Hyperlinks
- [FDACS Information](http://www.fdacs.state.fl.us/soybean.htm)
- [SPOR Information](http://mapdx.ifas.ufl.edu/soybean_sus.html)
- [FL Soybean Pest page](http://mapdx.ifas.ufl.edu/Florida_Soybean)

Save Changes

Restricted Access Website
Public Website: Observation Map

United States Department of Agriculture

Public Access Website

Soybean Rust Information Site

Sign Up For Alerts
Sep 09, 2005

Observation

State Update Map

Chronology of Positive Detections

SBR Forecast (09/09/05)
Tropical storm Ophelia brings new spore depositions to the southeastern U.S. coast. Click for details...

Public Access Website
Crop Growth Stage  
Harvesting has begun in many of the soybean growing areas especially with early maturing varieties or those planted early. Some late planted beans are in the early reproductive stage.

Observation and Outlook - Disease  
ASR was found in Concordia Parish in a commercial field (which also contains the soybean sentinel plot) of Group V soybeans at the R6 stage. Incidence and severity levels were low. This brings to eight the number of parishes in which ASR has been found on either soybeans or kudzu. Please check the federal public website http://www.sbrusa.net/ to see where ASR has been confirmed in the US.

Observation and Outlook - Insect  
Commentary Not Available

Scouting and Management - Disease  
ASR was found in Concordia Parish in a commercial field (which also contains the soybean sentinel plot) of Group V soybeans at the R6 stage. Incidence and severity levels were low. This brings to eight the number of parishes in which ASR has been found on either soybeans or kudzu.

The recommendation is for soybeans in the R1 through R5 growth stages and have a good yield potential be treated with a rust fungicide. The fungicides for rust control have a triazole alone or in combination with a strobilurin. These products are listed in the 2006 Plant Disease Management Guide and are on the LSU AgCenter Rust website, http://www.lsuagcenter.com/soybeanrust.

Again, it is especially important at this time to monitor your crop very carefully and be alert for reports of disease outbreaks in the area. You can monitor the AgCenter’s website (http://www.lsuagcenter.com/soybeanrust/), contact your county agent, or call the Asian Soybean Rust Hotline at 1-800-516-0865.

Scouting and Management - Insect  
Commentary Not Available
National Soybean Rust Management Guidelines
Last Updated May 01, 2006

Vegetative Growth Stages
Current data indicate that fungicide applications are not needed in the early vegetative growth stages. Spraying just prior to crop flowering (R1) may be prudent if disease is increasing. This is especially true for late-planted crops and/or very late-maturing varieties that may develop a large canopy before flowering.

R1-R5 Reproductive Stages
Soybean rust symptoms are most prevalent, and increase most rapidly, during crop reproductive growth stages. The first fungicide application should be made before rust has appeared on more than 2% of the leaves in the crop canopy. One, two, or three applications may be needed, depending upon what growth stage the disease is first detected and subsequent environmental conditions. Consecutive applications of either strobilurins or triazoles alone should never be made due to resistance concern. Refer to fungicide labels for specific directions and restrictions.

R6 and later
Spraying at late growth stages is not recommended due to lack of yield response. In addition, many fungicides have days to harvest (preharvest intervals) or growth stage restrictions. Refer to fungicide labels for specific directions and restrictions.
Automatic Notification Functions

E-Mail Alert Signup

The USDA Soybean Rust email notification system will send an email alert each time new information about soybean rust is made available for the region and/or states you specified.

* Email: 
* Region:  --- Please Select One --- 
* State:  --- All States in Region --- 
* Affiliation: --- Please Select One --- 

Required

Sign Up

Sign Up For Alerts

Oct 01, 2006

Legumes/Kudzu
Soybean Rust

SB Rust Observation

SB Rust State Update

Chronology of Positive Detections

SBR Forecast
Click For Details...

Management Toolbox
- Tactics - USA
- Guidelines - USA
- GFP Tool
- Insurance Docs
- Commentary Chron
# Detection Chronology

## Chronology of Positive Detections

Click either **Date** or **State - County** to sort entries and click again to switch between ascending and descending order.

<table>
<thead>
<tr>
<th>Date</th>
<th>State - County</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007-01-17</td>
<td>Georgia - Lowndes</td>
<td>Confirmed</td>
</tr>
<tr>
<td>2007-01-12</td>
<td>Alabama - Houston</td>
<td>Confirmed</td>
</tr>
<tr>
<td>2007-01-12</td>
<td>Alabama - Geneva</td>
<td>Confirmed, No Longer Found</td>
</tr>
<tr>
<td>2007-01-10</td>
<td>Georgia - Miller</td>
<td>Confirmed</td>
</tr>
<tr>
<td>2007-01-10</td>
<td>Georgia - Brooks</td>
<td>Confirmed</td>
</tr>
<tr>
<td>2007-01-10</td>
<td>Georgia - Grady</td>
<td>Confirmed</td>
</tr>
<tr>
<td>2007-01-10</td>
<td>Georgia - Thomas</td>
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</tr>
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<td>Alabama - Mobile</td>
<td>Confirmed</td>
</tr>
<tr>
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<td>Alabama - Montgomery</td>
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<td>Alabama - Baldwin</td>
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<td>2007-01-08</td>
<td>Florida - Leon</td>
<td>Confirmed</td>
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<tr>
<td>2007-01-05</td>
<td>Florida - Gadsden</td>
<td>Confirmed</td>
</tr>
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<td>2007-01-05</td>
<td>Florida - Hernando</td>
<td>Confirmed</td>
</tr>
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<td>2007-01-05</td>
<td>Florida - Marion</td>
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</tr>
<tr>
<td>2007-01-05</td>
<td>Florida - Alachua</td>
<td>Confirmed</td>
</tr>
</tbody>
</table>
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First time users are strongly encouraged to read the instructions prior to using this documentation tool.

Preparer Name: 
Grower Name: 
State: Mississippi
County: 
Farm Description: 
Field ID(s): 
Crop: Soybeans
Crop Stage: 

Mississippi Scouting and Management Commentary

**Soybean Rust**

- August 02, 2006: Producers in the SW portion of that state that have soybeans that are in reproductive growth stage R5.5 or a younger reproductive stage, need to consider application of a fungicide, particularly a triazole or a mix. Soybean growers in our major growing areas in North Mississippi and the Delta have nothing to be concerned about at this time. It's been hot and extremely dry in those areas, unfavorable for rust development. Scouting will continue, and these management suggestions will be modified based on the scouting results and weather conditions. Concentrate scouting efforts along areas of the field that can have longer dew periods and cooler conditions. Focus the scouting more intensely during the reproductive stage.

- August 01, 2006: Producers in the SW portion of that state that have soybeans that are in reproductive growth stage R5.5 or a younger reproductive stage, need to consider application of a fungicide, particularly a triazole or a mix. Rust has been confirmed on both kudzu and soybeans in that county. This is the first report of rust from Mississippi in 2006. Please consult the appropriate state commentary for more information. Currently rust has been found on this تعد soybeans in eight
National Commentary

National Soybean Rust Commentary (updated)

- University SBA Site
- USDA SBA Site
- Private/Industry SBA Site
- International SBA Site

- National Soybean Aphid Commentary: Not Available

- National Map Commentary: Not Available

Management Toolbox
- Guidelines - USA
- QPP Tool
- Insurance Docs
- Commentary Chron

Terms and Conditions

Sources of Geographic Data

2006-2007
IPM PIPE
What Made the Soybean Rust Information System/ipmPIPE So Attractive

Simple design - flexible and expandable

Empowers the State Extension Specialists (protocols & dissemination)

Enhances communications among stakeholders

Provides “one-stop” rapid access to information in easy-to-use formats
Challenges associated with providing “state-of-the-art” IT for effective “in-season” management of wheat rusts
Challenges Associated with Providing an Effective Early Warning System for New Races of Stem Rust

New races of WSR are not known to be present in Western Hemisphere and IAMS model simulations suggest that they will not likely survive aerial transport across the Atlantic or Pacific Oceans.

Tropical western Africa is the most likely source area for aerobiota that are blown to the Western Hemisphere. However as far as we know, wheat/barley production is very low in this region. IAMS simulations suggest that it is likely that spores from heavily infected Mexican wheat production regions would be blown to U.S. wheat fields on a seasonal basis.
Challenges Associated with Providing an Effective Early Warning System for New Races of Stem Rust

Regardless of how new races are transported to the North America, they are likely to cause a sudden and dramatic alarm.

How to expand existing surveillance programs? Effective “inseason” management of new virulent wheat stem rust races would require a high resolution (spatial and temporal) monitoring network of either 1) disease severity in potential inoculum source regions, 2) spore deposition throughout the region potentially impacted by the pathogen, or better yet, 3) both.

Overall, 17,797 observations of the presence and severity of soybean rust were submitted to the national soybean rust database in 2006 from over 2000 different geographic locations throughout the U.S., southern Canada, and Mexico. More than 15,000 observations were submitted to the system in both 2007 & 2008.

disease incidence and/or severity observations from:
  sentinel plots
  commercial fields
  mobile scouts
  industry plots
  diagnostic labs

spore collections from:
  Industry passive vane trap network
  NADP rainwater trap network
Challenges Associated with Providing an Effective Early Warning System for New Races of Stem Rust

The IT functionality to manage, interpret, and communicate a large volume of wheat rust observations from diverse sources is not currently needed.

How do we prepare an IT system to anticipate a potential “overnight” onslaught of observations and demands for information.

**Tasks**

- Dissemination
- Interpretation
- Integration
- Modeling
- Data Management

**Potential Bottlenecks**

Agreement among stakeholders regarding who will take responsibility for each of the 6 tasks.

Agreement among stakeholders regarding information dissemination (public vs restricted-access)

Development and deployment of rapid diagnostic tools

Agreement on field scouting and information dissemination protocols

Answers to anticipated stakeholder questions
- What are the variety reactions?
- What is my potential for yield loss?
- What can I spray?
- Is my current technology going to be effective?
Early Warning Systems for Rust Diseases

Integration of Observations and Model Output

State-of-the-art IT Platform

Risk Assessment

One Stop Information Shop for Stakeholders

Integration of Observations and Model Output

Risk Assessment

State-of-the-art IT Platform

One Stop Information Shop for Stakeholders