

**DRAFT 5/1/2006**

**A Coordinated Framework for Soybean  
Rust and Aphid  
Surveillance, Reporting, Prediction,  
Management and Outreach**

**May 1, 2006**

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INTRODUCTION

In response to the introduction of soybean rust (SBR) *Phakospora pachyrhizi* and soybean aphid (SBA) *Aphis glycines* into the United States, USDA is facilitating a federal/state/industry coordinated framework for surveillance, reporting, prediction, management and outreach. The original plan was announced at an USDA-APHIS-sponsored meeting with stakeholders from industry, federal, state and universities on February 4, 2005 in Indianapolis, Indiana. The multi-agency group assigned to develop the plan included: USDA-APHIS (Roger Magarey, Coanne O'Hern) ; USDA ARS Rick Bennett, Richard Wilson, Doug Luster, Glen Hartman, Monte Miles; National Plant Board (Geir Friisoe), USDA CSREES (Kitty Cardwell), Iowa State University (X.B. Yang), Pioneer (Bill Dolezal ), Penn State University (Scott Isard), Don Hershman University of Kentucky (Don Hershman), North Central Soybean Program Research (David Wright) (NCSR), Bev Paul (American Soybean Association) and Stephen Muench (United Soybean Board).

The framework draws, in part, from ideas and material presented and discussed at the following meetings with the November 2006 meeting planned to review the function of the system after the 2006 growing season:

| Meeting                             | Date Held             | Location         |
|-------------------------------------|-----------------------|------------------|
| USDA-ARS Strategic Planning Meeting | December 1-2, 2004    | Baltimore, MD    |
| USDA-APHIS Stakeholder Meeting      | February 4, 2005      | Indianapolis, IN |
| APS Meeting                         | November 15-16 , 2005 | Nashville, TN    |
| USDA-CSREES Stakeholder Meeting     | February 22-23, 2006  | Kansas City, MO  |
| USDA-CSREES Stakeholder Meeting     | April 7-8, 2006       | St. Louis, MO    |
| APS Meeting                         | November 29-30, 2006, | St Louis, MO     |

**OVERALL FRAMEWORK COORDINATION**

Parallel to the Federal Coordination Committee is a National Framework Coordination Committee. This committee is comprised of representatives from the Federal Coordination Committee, the IPMC, and national and regional coordination committee chairs. These committees coordinate activities in the regions and report to their respective federal agency with weekly or bi-monthly phone conferences (see Appendix A of committee leaders and schedules).

Regional sub-committees (Northeast, Southern, North Central, and Western) provide input into the protocols, training schedules, and operations in their areas, coordinating cooperative extension specialists with sentinel plot leaders, laboratory diagnostics, data entry training and management, and conduct bi-weekly conference calls with all members of the respective operatives in that region. During the growing season, these conference calls provide a forum to discuss framework operations as well as to report findings from each state.

The diagnostic sub-committee associated with the NPDN and APHIS develops and trains personnel in diagnostic and communications protocols.

Stakeholders in general and soybean industry representatives specifically have called for a strategically directed, real time information platform to assist the industry prepare for and manage soybean rust, and other pests of concern. Thus the PIPE was created.

A proposed PIPE coordinator framework is shown in Figure 1 below.

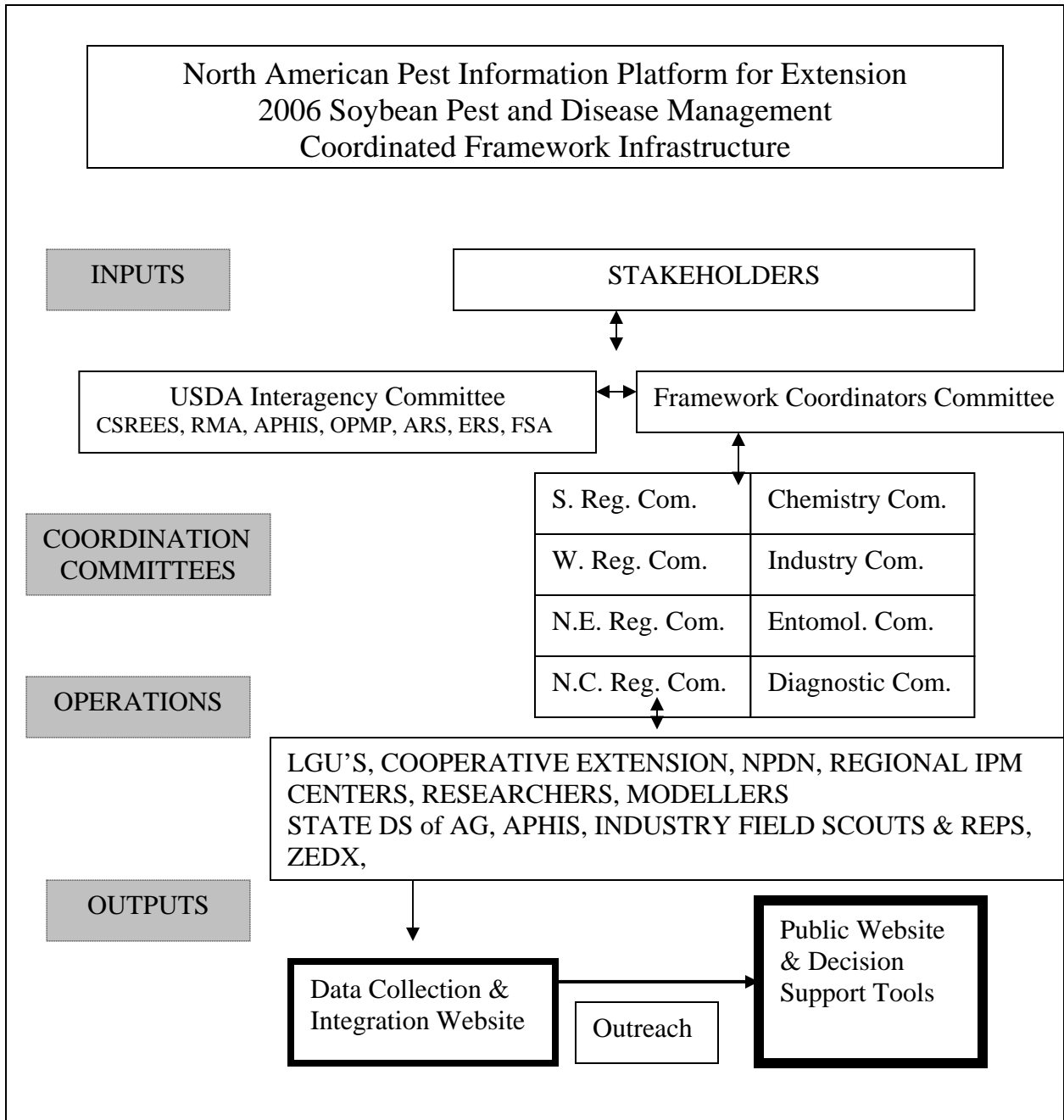


Figure1.

Organization at the Federal level is coordinated in an interagency working group under USDA Departmental leadership, with representatives of each the Cooperative State Research Education and Extension Service (CSREES), the Risk Management Agency (RMA), the Animal & Plant Health Inspection Agency (APHIS), the Office of Pest Management Policy (OPMP), the Agricultural Research Agency (ARS), and the Economic Research Agency (ERS). Each of the respective USDA agency representatives

report at weekly or bimonthly intervals to the interagency working group and to their respective agency administrations.

The National Coordination will be done via the USDA with CSREES lead. The CSREES coordinates the National Plant Diagnostic Network (NPDN) and administrative field support, outreach and evaluation through Integrated Pest Management Centers (IPMCs) and partners with Land Grant University Extension services.

*Duties of the National Coordinator*

- Maintain a list of soybean specialists coordinating information dissemination in each state. This list includes the NC-504 soybean rust group.
- Coordinate documentation related to operations of the monitoring and surveillance system.
- Review monitoring observations and predictions weekly with regional coordinators.
- Supervise and coordinate the use and application of prediction models.
- Write at least weekly interpretations of the soybean rust monitoring and prediction web site for department leadership. Work with NC IPMC to create a pre-season interpretation guide to assist stakeholders in use of the web site.
- Be responsible for having the regional and state coordinators write additional interpretation messages for their regions and states as needed.
- Lead weekly or biweekly phone conferences with regional coordinators.
- Coordinate the SBR diagnostic activity of the NPDN.
- Oversee evaluation of user acceptance of the Soybean Rust Monitoring and Prediction Web site through the creation of focus groups consisting of farmers, industry representatives, agronomists, and crop consultants etc to evaluate the Soybean Rust Monitoring and Prediction web site's ease of use.
- Coordinate outreach and extension through Regional IPM centers.
- Coordinate diagnostic workshops and training, fungicide application education, printing of a fungicide manual, reprints of the SBR ID card, training videos/DVD, reprinting the SBR Pest Alert, adequately supporting the NPDN infrastructure to assure surge capacity is accommodated (i.e. calc. 2000 samples to be processed by each lab in 26 States, within a two week period at peak season), in- field application technology education material, fungicide efficacy demonstration, and an epidemiological education resource guide needs to be developed and distributed.
- Bimonthly or weekly conference calls as needed with NPDN and IPM centers.
- Coordinate scenario training exercises for state specialists. The SBR web site will be used as a tool to conduct the training session. The purpose of the training is to see if specialists make provide comparable management guidelines across states, regions and times of year. Risk management and insurance issues will be incorporated.
- The CSREES National Program Leader, Plant Pathology, is the technical point of contact for all coordinating groups.

*Duties of the Regional IPM Centers*

- Administration: The Southern Region IPM Center (SRIPMC) located at North Carolina State University will provide overall project oversight and management of subcontracts for all project components including the sentinel plot network, website and database development, and modeling.
- Communications and outreach: SRIPMC will coordinate communications among state-level research and Extension specialists, project modelers and programmers of the national database and website. SRIPMC will serve as a liaison between state level specialists and national USDA leadership as necessary. SRIPMC will coordinate with other IPM Centers to provide communications, outreach, and training.

The RMA coordinates the development and deployment of crop insurance decision support, documentation and educational tools.

- Assists in the development of educational information for all stakeholders deployed through the SBR website.
- Promotes the use of the SBR web site to all crop insurance policyholders through approved insurance providers and the RMA web site.
- Makes available tutorial instruction for crop insurance policyholders and other stakeholders through approved insurance providers and the RMA web site.
- Develops grower guidance regarding appropriate documentation of good farming practices.

The APHIS representatives coordinate the information management and surveillance systems through APHIS regional and state personnel and industry cooperators.

*Duties of APHIS*

- Permitting
- First state find confirm

2006 Transition:

- Assist states to coordinating with industry and crop consultants to supply monitoring data.
- Create an informal manual describing the monitoring protocols including a list of non-soybean hosts.
- Assist regional coordinators in dealing with technical issues relating to data uploading from diverse sources.
- Lead weekly or biweekly phone conferences with regional coordinators.
- Supervise the development of the Soybean Rust Monitoring and Prediction web site, including the PDA tool, data uploading and technical support.
- Supervise the development of the USDA Soybean Rust Prediction model.

The OPMP coordinates, with the Environmental Protection Agency (EPA) and the states, the chemical registration and response information.

The ARS representative coordinates the activities of government, university and industry researchers related to decision criteria, prediction modeling and surveillance, and management solution research.

The ERS provides economic assessment of the cost effectiveness and utility of the Framework system.

The chemistry sub-committee reviews pesticide registries and chemical efficacy research.

The industry sub-committee reviews protocols for data management and....

Website and database management are operated by ZedX Inc. located in State College, PA. The ZedX team is comprised of full-time programmers and professional database managers. The soybean rust map website is occasionally modified in response to focus group activities. In 2005 the public website was available at the [www.sbrusa.net](http://www.sbrusa.net). The website will be reviewed at the end of each growing season to assess access, use, and with focus groups, ease of use. Terms and Conditions of use of the website are attached (Appendix B). ZedX Inc. will house the PIPE technical support specialist.

*Duties of the PIPE Technical Support Specialist*

A national technical support specialist (SRMP-TSS) for data uploading and downloading from the national website site. The specialist will work with regional monitoring coordinators to address and communicate data uploading and down loading issues.

The Specialist will:

- Assist in conducting specialist website-training programs.
- Coordinate with researchers who want to receive the monitoring data and use the research site.
- Test PDA software for industry, sentinel plots and mobile program.
- Implement a File Transfer Protocol for receiving CSV or Microsoft Excel files for industry, sentinel plots and mobile program.
- Implement a file transfer protocol so University and USDA researchers can download monitoring data.
- Implement a protocol for display of monitoring observations. This includes ensuring data is not reported twice and suspect data is eliminated or flagged as questionable.

*Duties of Regional Coordinators*

The responsibilities of the “soybean rust regional coordinator” is (1) to periodically inform the stakeholders of the status of operations and the performance of cooperators at the state level and (2) to communicate directly with the national coordinator on a day-to-day basis. The regional coordinators are responsible for state “specialists” in their respective regions (Appendix A).

The Regional Specialists will:

- Participate in weekly conference calls with Extension specialists in their region, technical support specialists and the national coordinators.
- Identify the appropriate state specialists and sentinel plot coordinators and substitutes. (NB: there may be two state coordinators for sentinel plots, USDA and NCSRP but in most cases there will be a single coordinator for sentinel plots).
- Facilitate (weekly or bimonthly) regional conference calls with state specialists and sentinel plot coordinators to address any operational issues.
- Implement and coordinate protocols for the soybean rust web site:
  - Monitoring;
  - Data uploading - (PDA and forms)
  - Information management for state specialists.
- Develop “mutual aid” procedures among the state specialists. It is necessary to provide backup between specialists in cases of illness, vacations etc.
- Coordinate the training of state specialists.
- Notify state specialists of any technical problems or informational errors as received from either the “data manager,” national coordinator, steering committee coordinator, or supervisor.

*Duties of the State Soybean Rust Specialist*

The responsibility of the state soybean rust specialist is to control and update the maps and other information for their respective state so that it appears on the USDA SBR Public web site.

The Specialist will:

- Control the observation, scouting and disease management commentaries on the USDA SBR public web site.
- Update daily, the public observation map by checking the observation map available from the specialist web sites. They will also update the PDF file describing the confirmed observations in the state.
- Update the public scouting map three times per week by checking the simulation scouting map available from the specialist web site. Protocols are found under the “tools” button on the web site.
- Update the management recommendations maps as needed using the simulation scouting and disease severity maps and create a PDF file to describe management recommendations/commentaries.
- Create and edit web links to state soybean rust pages for display on the USDA SBR public web site.
- Participate in regional conference calls and email correspondence with state coordinators to address any operational issues.
- Communicate with state coordinators of sentinel plots and diagnostic labs.
- Implement “mutual aid” procedures among other state specialists. It is necessary to provide backup between specialists in cases of illness, vacations etc.

**DRAFT 5/1/2006**

This Coordinated Framework provides an output of public services that integrates research, real-time disease and insect risk information, and decision support. During the 2005 growing season, under the leadership of APHIS, this pilot framework was very well received by the US soybean industry. It is expected with time and experience, and also more significant disease pressure, to provide invaluable information in support of producer's decisions.

### DELIVERABLES

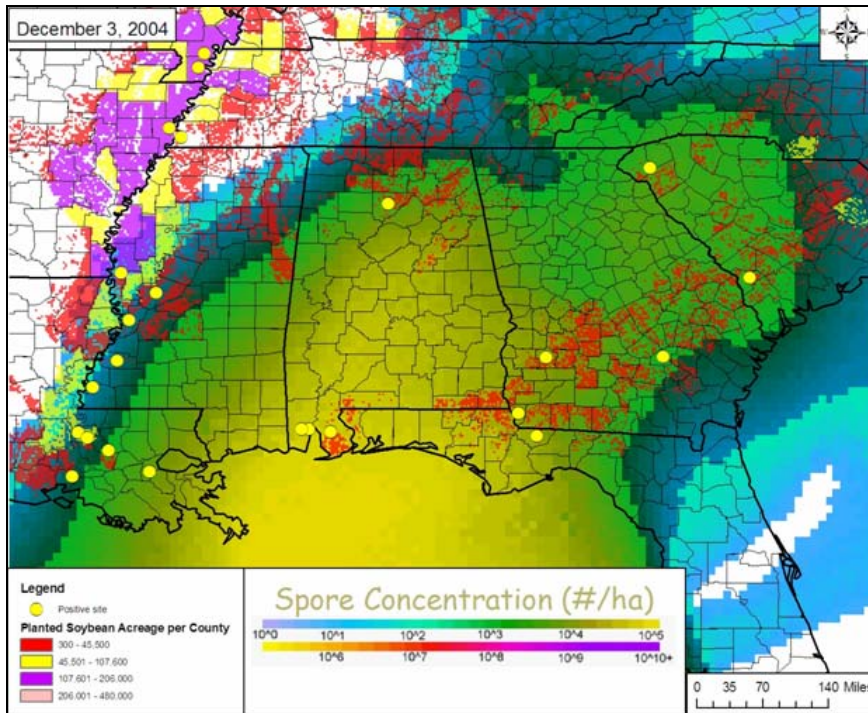
The goal of the framework is to provide stakeholders with valid and timely information to support their decisions for managing soybean rust during the 2006 growing season. We intend to achieve this goal through consensus-building and commitment of cooperating parties to our respective roles and responsibilities, and prompt delivery of contributions (i.e. disease observations, diagnostic results, decision support paradigms, models, etc.), through means that hold all parties accountable, and provide communication with stakeholders. The basic deliverables of the framework are outlined below.

- Maintain a surveillance and monitoring network to provide timely information of the incidence and severity of soybean rust and soybean aphid in the United States, Canada, Mexico, Caribbean basin, and Central America.
- Provide a web-based system (Pest Information Platform for Extension – PIPE) for information management of monitoring observation maps, forecasts, and decision criteria to stakeholders.
- Post up-to-date information in a ‘One Stop Shop’ easy to access location on the website that includes: decision criteria for pesticide application, weather forecasts, links to other relevant websites, diagnostic facility locations, good farm practice documentation, and crop insurance support tools.
- Develop capacity to include predictive modeling of aerial transport of SBR spores from active source regions to soybean growing areas in the U.S.
- Provide outreach and training, on use and interpretation of web-based SBR monitoring and prediction displays, and dissemination of information.

APHIS PPQ was the lead agency on soybean rust in 2005. A transition from APHIS to CSREES and the Regional IPM Centers is planned for 2006 (see Appendix C), while plans for sustaining the framework for future years involving federal, state and industry contributions is currently under development.

**BACKGROUND**

Soybean rust was introduced into the continental United States in the fall of 2004, presumably as a consequence of hurricane activity. Model predictions indicated that soybean rust had been widely dispersed throughout the southeastern United States, and subsequent field and laboratory observations confirmed this distribution. Figures 1 and 2 provide information on spore deposition in late 2004 and overwintering areas for soybean rust in the continental United States.



**Figure 1.** Estimated initial distribution of soybean rust, based on spore deposition and confirmed observations (yellow circles) as of December 3, 2004.

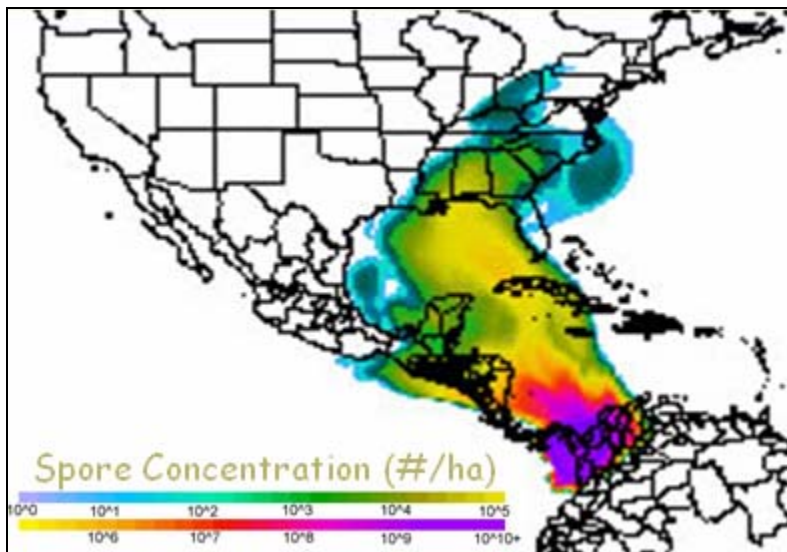


Areas Shaded in Dark Blue Represent the Region Where 2005-2006 Minimum Temperatures Remained Above 28 Degrees F.

The Light Blue Line Represents the Southernmost extent of 28 Degree Temperatures During 2004-2005.

**Figure 2.** Estimated overwintering area for soybean rust based on the number of accumulated days with the minimum daily temperature less than 28 °F as of January 28, 2005. Overwintering areas for hosts of soybean rust exist south of the 28°F isopleth.

A comparison of predicted spore deposition (Figure 1) and overwintering areas (Figure 2) indicates rust survival will be limited, but present in the continental United States. It is important to note that the predicted area of soybean rust deposition included the western Caribbean, south-eastern Mexico and Central America (Figure 3). **Soybean rust has been confirmed in Mexico but potential host density and spore production throughout these regions is unknown. If present, the sub-tropical and tropical climates of these regions are likely to ensure year round survival of the pathogen.**



**Figure 3.** Simulated deposition of soybean rust spores during September 2004 during atmospheric conditions associated with the passage of hurricane Ivan through the Gulf of Mexico. The simulation assumes a source area in northern South America.

Experience with other aeriually dispersed pathogens such as tobacco blue mold and wheat stem rust, confirms the potential of the western Caribbean the Yucatan peninsula, and central Mexico to act as overwintering source areas for the initiation of crop epidemics in the continental United States.

**DOMESTIC AND INTERNATIONAL SBR SURVEILLANCE AND MONITORING SYSTEM**

The following describes a framework for a coordinated national monitoring system.

The monitoring program will be a cooperative effort between State Departments of Agriculture, Land Grant Universities, industry, the National Plant Diagnostic Network (NPDN) and the USDA. The objective is to build a framework on which individual monitoring efforts can be coordinated. A list of participating states including names of key personnel are listed in Appendix A.

Protocols for the monitoring effort including resource allocation, data collection and data communication were developed with specialists in 2005, with modifications in 2006 based on user feed-back (See Attached protocols document). It is important to note the suggested distribution of resources is subject to negotiation and also represents the contribution of USDA, leaving states free to deploy additional resources at their own discretion.

The monitoring program includes six components:

- 1) A fixed-site sentinel plot program in overwintering and growing season source areas;
- 2) Mobile surveys in commercial fields and other hosts to confirm new source areas;
- 3) Surveys and spore trappings by industry to provide additional rust detection;
- 4) Passive surveillance system through public and private sample submission to the National Plant Diagnostic Network (NPDN);
- 5) International monitoring, where available, to determine the importance of off-shore SBR source areas.
- 6) A program involving spore sampling in rain that will provide early warning and assist with model calibration of predicted spore deposition concentrations.

NOTE: Sentinel network Sentinel plots are being funded by the USDA and the North Central Soybean Research Program (NCSRP). The USDA program covers 31 soybean growing states (also 4 states which have other bean production areas) and the NCSRP program 20 states (Table 2 & Figure 5). In some states there maybe a separate leader for NCSRP and USDA sentinel plots, and in other states there may be a single leader for both. One protocol has been developed for both NCSRP and USDA plots and data from both programs will be uploaded to the USDA SBR database for viewing on the SBR public web site.

There are three important functions of the sentinel program for monitoring soybean rust and aphid. The primary function is to serve as a warning network for tracking the spread of the pest and disease in North American soybean production regions. In the case of soybean rust the pathogen can only over-winter in subtropical regions, Southern and Mississippi Valley states have higher numbers of sentinel plots relative to their soybean acreages than states in other regions. Soybean aphid occurs primarily in North Central and will be monitored using the same plots as soybean rust. The second function is to quantify the timing and amount of spore production in overwintering and growing season

source areas, an important input for the soybean rust aerobiology prediction system. A third function of the sentinel plot system is to collect data for epidemiological research. For this reason, sentinel plots should be maintained after first detection unless local considerations dictate otherwise. States are encouraged to establish sentinel plots in addition to the USDA and USB/NCSRP allotments (Table 1). Non-soybean hosts including other legumes (e.g., common bean, lima bean, lentil, chickpea) and kudzu may also be planted in sentinel plots.

Following the recent findings of the first report of soybean rust caused by *Phakopsora pachyrhizi* on dry beans in South Africa (Du Preez, 2005, Plant Disease Notes, APS) there has been an effort to add additional states to the program that have dry bean production. These states include Idaho, Washington, Oregon and Colorado. If this plot is deemed successful all states with large dry bean acreages may be included. Additional details on monitoring programs in these states are being collected. (see Table 1)

It is likely sentinel plots would need to be maintained over a 3 to 4 month period. Where possible sentinel plots should be maintained at an unsprayed site or at a grower site as an unsprayed strip should be left so that observations can continue. As well as allowing the monitoring program to continue, the strip often provides a visual reminder of the importance of fungicide application. The cost of the sentinel plot system has been estimated at an average of \$1,500.00 per plot per season, but since Southern plots could be managed longer than Northern plots, funding will be provided on the basis of the number of weeks a sentinel plot may take to establish and monitor.

## MONITORING PROGRAM GENERAL INFORMATION

### *Sentinel Plots*

- Where practical, can be delineated in existing production fields rather than custom planting of plots.
- Should be planted earlier than commercially planted fields, especially in areas south of the 28° F overwintering line or on legumes that survive winter.
- May include pigeon pea, yam beans, kudzu and leguminous winter cover crops in addition to dry beans and soybeans.
- Should be strategically placed near large reservoirs of overwintering inoculum that may be proximal to production areas
- Should be observed at least once per week. When model predictions or observations indicate rust appearance is imminent then observations should be every three days. Once rust has been detected in the plot, shift to post detection protocol for state.
- Preferably are planted to early maturing varieties of soybean
- A certain proportion of plots will be designated ‘epidemiological’ plots. The protocol for these plots will dictate more intensive disease observations than in the regular sentinel plots. The data from the epidemiological plots will also be used to drive the decision support system for farmers.
- The first positive or suspected positive in each sentinel plot should be confirmed by the diagnostic lab or USDA certified expert according to national protocols. New state confirmations should be confirmed by sending samples to the APHIS-PPQ National Identification Services, but only through the State and/or Land Grant University (NPDN) lab as a first screen (see Federal/State Responsibility for Identification of *Phakopsora pachyrhizi*, USDA-APHIS-PPQ, December 6, 2004; reissued on February 10, 2005. (Appendix D or [www.aphis.usda.gov/ppq/ep/soybean\\_rust/2-10policy.pdf](http://www.aphis.usda.gov/ppq/ep/soybean_rust/2-10policy.pdf)).

### *Mobile Field Monitoring*

The function of the mobile field monitoring is to determine how wide-spread soybean rust and aphid are once they are found in sentinel plots. These monitoring surveys will help calibrate the predicted spore deposition and infection as estimated by an aerobiological model by observing disease incidence. This calibration will enable the model outputs to be used with greater confidence by stakeholders. Observations are used to define new source areas to begin the model forecast run for each day.

- Mobile teams are deployed beginning with the first soybean pest and/or disease emergence in their state or region. Their deployment ends once the pattern of initial spore deposition and infection incidence has been established.
- Either soybean or alternative hosts may be scouted in the mobile survey.
- The disease forecast models will be available on the web and will include models provided by USDA, Iowa State University and North Carolina State University. The USDA model will predict spore deposition ranging from light to heavy on a

logarithmic scale. In the days following deposition the model will track infection severity based on weather-driven epidemiological model (see prediction section for more details).

- Mobile teams must seek diagnostic confirmation of suspected positive observations if soybean rust has not had previous laboratory confirmation in that county.

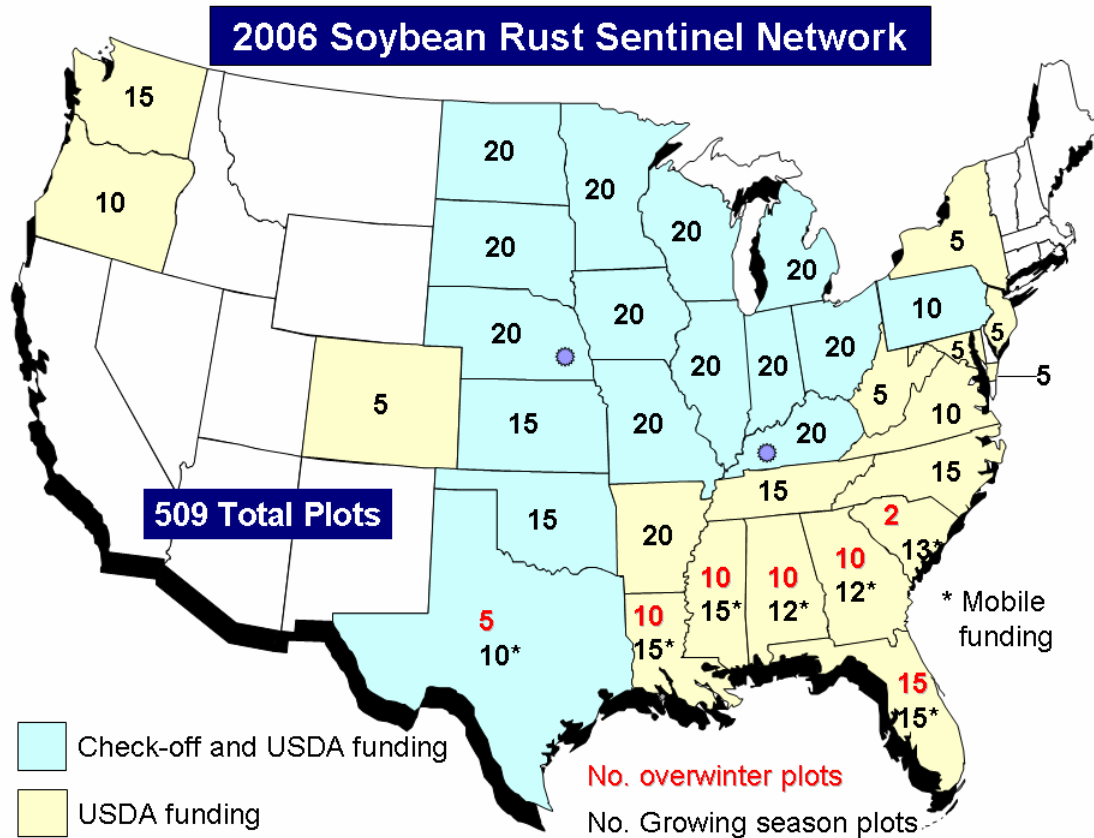
**Table 1.** State soybean production, kudzu acreage and proposed sentinel plot information.

| State              | Soybean Acreage 2004 <sup>a</sup> | Average Planting Date <sup>b</sup> | Kudzu Acreage <sup>c</sup> | USDA Sentinels | NCRSP Sentinels <sup>d</sup> |
|--------------------|-----------------------------------|------------------------------------|----------------------------|----------------|------------------------------|
| Alabama            | 190                               | May 25 to June 25                  | 117510                     | 10             | 20                           |
| Arkansas           | 3150                              | May 25 to June 20                  | 10091                      | 15             | 20                           |
| Delaware           | 208                               | May 28 to June 26                  | 1                          | 5              |                              |
| Florida            | 17                                | May 15 to June 15                  | 12449                      | 15             | 20                           |
| Georgia            | 270                               | May 27 to June 27                  | 151318                     | 10             | 20                           |
| Illinois           | 9900                              | May 15 to June 9                   | 529                        | 10             | 20                           |
| Indiana            | 5520                              | May 15 to June 5                   | 98                         | 10             | 20                           |
| Iowa               | 10150                             | May 14 to June 2                   |                            | 10             | 20                           |
| Kansas             | 2710                              | May 25 to June 20                  | 6                          | 10             | 20                           |
| Kentucky           | 1300                              | May 25 to June 25                  | 18051                      | 10             | 20                           |
| Louisiana          | 990                               | May 15 to June 15                  | 4824                       | 15             | 20                           |
| Maryland           | 495                               | May 28 to June 26                  | 134                        | 5              |                              |
| Michigan           | 1980                              | May 18 to June 3                   |                            | 10             | 20                           |
| Minnesota          | 7050                              | May 16 to June 3                   |                            | 10             | 20                           |
| Mississippi        | 1640                              | April 25 to May 25                 | 250632                     | 15             | 20                           |
| Missouri           | 4960                              | May 25 to June 1                   | 1166                       | 10             | 20                           |
| Nebraska           | 4750                              | May 18 to June 4                   | 51                         | 10             | 20                           |
| New Jersey         | 103                               | June 14 to July 14                 | 9                          | 5              |                              |
| New York           | 172                               | No data                            |                            | 5              |                              |
| North Carolina     | 1500                              | May 20 to June 30                  | 57660                      | 10             |                              |
| North Dakota       | 3570                              | May 19 to May 29                   |                            | 10             | 20                           |
| Ohio               | 4420                              | May 10 to June 7                   | 58                         | 10             | 20                           |
| Oklahoma           | 290                               | May 18 to June 22                  | 31                         | 5              |                              |
| Pennsylvania       | 425                               | May 20 to June 10                  | 1                          | 5              |                              |
| Puerto Rico        |                                   | No data                            |                            | 5              |                              |
| South Carolina     | 530                               | May 27 to June 27                  | 73742                      | 10             |                              |
| South Dakota       | 4120                              | May 20 to June 6                   |                            | 10             | 20                           |
| Tennessee          | 1180                              | May 30 to June 25                  | 64862                      | 15             | 20                           |
| Texas              | 270                               | May 3 to June 14                   | 50817                      | 10             |                              |
| Virginia           | 530                               | May 20 to June 30                  | 11357                      | 5              |                              |
| West Virginia      | 18                                |                                    | 1318                       | 5              |                              |
| Wisconsin          | 1550                              | May 15 to June 20                  |                            | 10             | 20                           |
| <b>Total</b>       | <b>73598</b>                      | -----                              | <b>826717</b>              | <b>300</b>     | <b>400</b>                   |
| <b>Dry bean</b>    |                                   |                                    |                            |                |                              |
| State              | Production '000s acres            | Average Planting date              | Sentinels                  |                |                              |
| Colorado           | 219                               |                                    | 5                          |                |                              |
| Idaho              | 31                                |                                    | 5                          |                |                              |
| Oregon             |                                   |                                    | 5                          |                |                              |
| Washington         | 20                                |                                    | 5                          |                |                              |
| <b>Total</b>       | <b>270</b>                        |                                    | <b>20</b>                  |                |                              |
| <b>Grand Total</b> | <b>73868</b>                      |                                    | <b>320</b>                 |                |                              |

<sup>a</sup>NASS 2004. <sup>b</sup>NASS, 2002 <sup>c</sup> Data from Daryl Jewett, APHIS. <sup>d</sup> States participating in Proposed North Central Soybean Research Fund project on monitoring (XB Yang and D. Wright, Personal Communication).

**Table 2.** Partial list of cooperating agricultural companies and industry organizations.

| <b>Company and Industry Organizations</b>   | <b>Key Contacts</b>                              |
|---|--|
| Agrelant Genetics   | Robert Waller                                    |
| American Seed Trade Association   | Dick Crowder                                     |
| Bayer Crop Science  | Jim Bloomberg                                    |
| Beck's  | Denny Cobb                                       |
| Dairyland Seed Co., Inc.  | Hunt Wiley                                       |
| Delta & Pine Land Company   | Kelly Whiting                                    |
| Diener Seeds  | Mike Diener                                      |
| Harris Moran  | Chester Kurowski                                 |
| Hornbeck Seed Co., Inc.   | Terry McCullars                                  |
| Hyland Seeds  | Henry Olechowski                                 |
| Indiana Crop Improvement Assn.  | Joe Deford                                       |
| Monsanto  | Andrew Nickell, Scott Stein                      |
| Pioneer   | Bill Dolezal Wolfgang Schuh, Tom Hall            |
| Royster-Clark   | Greg St. Clair                                   |
| Syngenta  | Marshall Beatty, Mary Wigglesworth, Alison Tally |
| * Cooperation between USDA and individual companies are at different stages of negotiations |  |



**Figure 5.** 2006 Soybean Rust Sentinel Network

*Industry Monitoring*

Industry monitoring refers to survey data collected in commercial soybean production fields as part of commercial services, research or variety trials or extension programs that are conducted with an industry sponsor/partner. The data may be collected by extension agents, field agronomists, crop consultants or individual growers. The industry data provides additional confirmation of the spatial extent of disease spread as a supplement to other survey data.

- It is anticipated that the industry data will be the “presence or absence of SBR”, although industry collaborators may also collect more detailed information if required.
- Estimation of the current distribution of cooperating industry scouts is provided below (Table 2).
- Aerial spore trap sampling data will be considered and integrated into the monitoring system when confirmatory diagnostic procedures are available for spores. In the absence of the host plant, visual symptoms on a host, PCR confirmation, or other diagnostic method, spores caught in traps can only be viewed as suspect, and must be communicated as such on the public website.
- Industry monitoring data may be provided as a diagnostic sample through the National Plant Diagnostic Network (NPDN).

- New state confirmations should be confirmed by sending samples to the APHIS-PPQ National Identification Services, but only through the State and/or Land Grant University (NPDN) lab as a first screen. For a partial list of cooperating agricultural companies and industry organizations see Table 2.

*Passive Surveillance through Laboratory Samples*

Passive surveillance through the National Plant Diagnostic Network (NPDN)  
The NPDN is a collective of Land Grant University (LGU) plant disease and pest diagnostic facilities from across the United States and is coordinated by CSREES. The network allows Land Grant University diagnosticians and faculty, State Regulatory personnel, and first detectors to efficiently communicate information, images, and methods of detection throughout the system in a timely manner. Regional Centers are located at Cornell University (Northeast region), Michigan State University (North Central region), Kansas State University (Great Plains region), University of Florida at Gainesville (Southern region), and University of California at Davis (Western region). The National Agricultural Pest Information System (NAPIS) located at Purdue University has been designated as the central repository for archiving select data collected from the regions.

- CSREES and its Land Grant University (LGU) partners, the NPDN and Cooperative Extension Services are preparing extension messages urging county extension agents, growers and private crop consultants to scout for SBR and to bring samples to the closest LGU diagnostic laboratory.
- In many soybean production states, growers have been trained to recognize suspected soybean rust symptoms and in diagnostic sample submission.
- Data from soybean rust samples will be uploaded to either of the 2 systems used by the NPDN which are the Plant Diagnostic Information System (PDIS) ([www.pdis.org](http://www.pdis.org)) or the Southern Plant Diagnostic Network (SPDN) database. It will be then transfer to NAPIS. The incidence data will be uploaded daily to the USDA Soybean Rust Monitoring Web site.
- It has been estimated that the additional costs for diagnostic services for soybean rust in 2005 will be \$45,000 per state or \$1,170,000 for 26 states, particularly in the years when the first infections occur in the state. The need for formal diagnostics should diminish with time. (See Appendix A for list of labs) Protocol for sample submission Cooperative extension agents, field scouts, crop consultants, or anyone conducting surveys of soybean rust on legume hosts, for sample sub mission to state or university diagnostic laboratories are described in the Standard Operating Procedure(s) (Appendix D&E).
- A list of university diagnostic laboratories is available on the SBR website and at [www.apsnet.org/directories/univ\\_diagnosticians.asp](http://www.apsnet.org/directories/univ_diagnosticians.asp)
- State Department's of Agriculture contacts are available at the National Plant Board website: [www.nationalplantboard.org/](http://www.nationalplantboard.org/)
- A 48-hour turnaround time is anticipated for diagnosis and communication of the results for soybean rust samples.

- Samples submitted to the NPDN diagnostic clinics and diagnosed either as positive or negative for SBR will be entered and uploaded via the NPDN communications systems every 24 hours to a data repository in the National Agriculture Pest Information System (NAPIS).

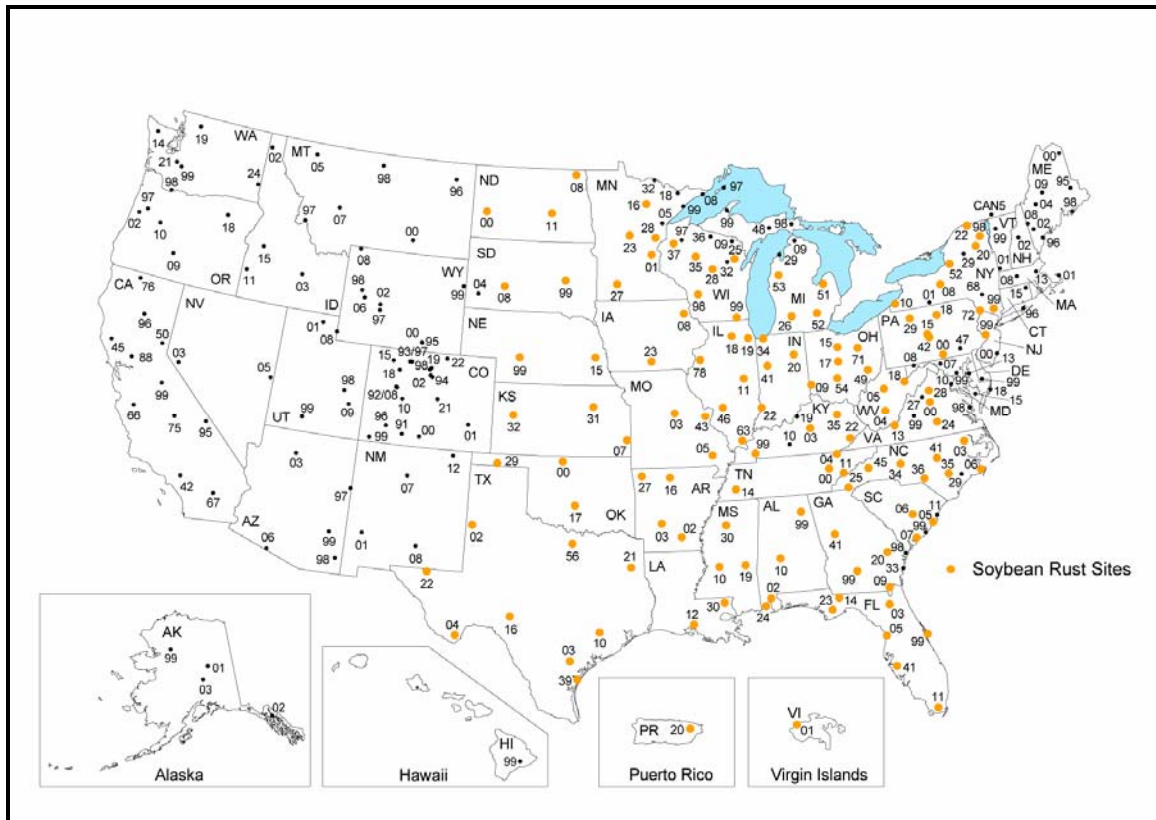
### *International Monitoring*

International monitoring efforts are being coordinated by Doug Luster, ARS. The focus of international monitoring will be in Mexico and the Caribbean, with particular emphasis on regions which may provide a source of wind-blown rust spores early in the Northern Hemisphere growing season that could impact the U.S. on an annual recurring basis.

- The NPDN has established a state-equivalent plant diagnostic laboratory in the Southern Plant Diagnostic Network (SPDN) at the University of Puerto Rico, Mayaguez, PR.
- Locations in the Caribbean (Dominican Republic, St. Thomas) and Mexico (Yucatan peninsula) will be surveyed for rust by Dr. Jose Hernandez, USDA ARS Systematic Botany and Mycology Laboratory, Beltsville, MD. No plans are yet in place to include Cuban agricultural scientists in monitoring rust outbreaks.
- Pioneer also has diagnostic capability in Salinas, Puerto Rico Diagnostic Laboratory. The contact there is Isabel Marrero (isabel.marrero@pioneer.com). The laboratory has a digital diagnostic linkage with their Johnston, IA laboratory. Additionally, Pioneer maintains a laboratory in Puerto Vallarta which will also monitor for soybean rust.
- It is anticipated that neighboring countries, Canada and Mexico, will also adopt the sentinel plot system, and will join hands to create a true North American Pest Information Platform for Education and Extension.

### *Spore Sampling in Rain*

A sixth component of monitoring will be spore sampling in rain to assist in early detection and model calibration by determining observed spore deposition concentrations and timing prior to symptom development in the field. Examination of rain samples was shown to be a reliable method for predicting first wheat stem rust infections dates in the Northern Plains. Real-time PCR methodology now allows for rapid and more precise identification of plant pathogens. A PCR assay has been developed by Dr. Les Szabo (USDA ARS Cereal Disease Lab and University of Minnesota) to detect wheat stem rust urediniospores in rain samples. The lower limit of the current assay is about 10 spores per sample. It is proposed to develop a national sampling program using 124 National Atmospheric Deposition Program sites (Figure 6). Samples will be collected weekly and mailed to a central processing lab (NADP, Illinois State Water Survey) where they will be filtered to trap deposited fungal spores. Filters will be sent to Dr. Szabo's lab for analysis on a weekly basis.



**Figure 6.** National Atmospheric Deposition Program collection sites for soybean rust ([nadp.sws.uiuc.edu/](http://nadp.sws.uiuc.edu/)).

### Data Upload

There are four options for data uploading to USDA Soybean Rust Monitoring and Prediction System database.

- 1) Laboratory sample: Submission is made through a State or National Plant Diagnostic Network (NPDN) laboratory. The NPDN will provide USDA with daily data feeds of date, county, presence or absence of the disease as an Excel file or CSV format.
- 2) Paper form: The data can then be entered manually using the on- line forms located on the USDA SBR restricted web site.
- 3) PDA device: USDA is in the process of developing some proprietary PDA software through North Carolina State University and the information technology company ZedX. The PDA software will be available for free download from the USDA web site. The PDA software will include forms for data entry as described by the three protocols in the framework. The PDA software includes the capability for uploading of both data and pictures.
- 4) File transfer. (For presence or absence of disease data only). The data can be sent to USDA in Comma Separated Value CSV or MS Excel formats. The format for the data should be observer ID number, date, latitude (decimal degrees), longitude (decimal degrees), presence of the disease (0 = absent, 1 = present) and PCR confirmation (0 = no, 1 = yes).

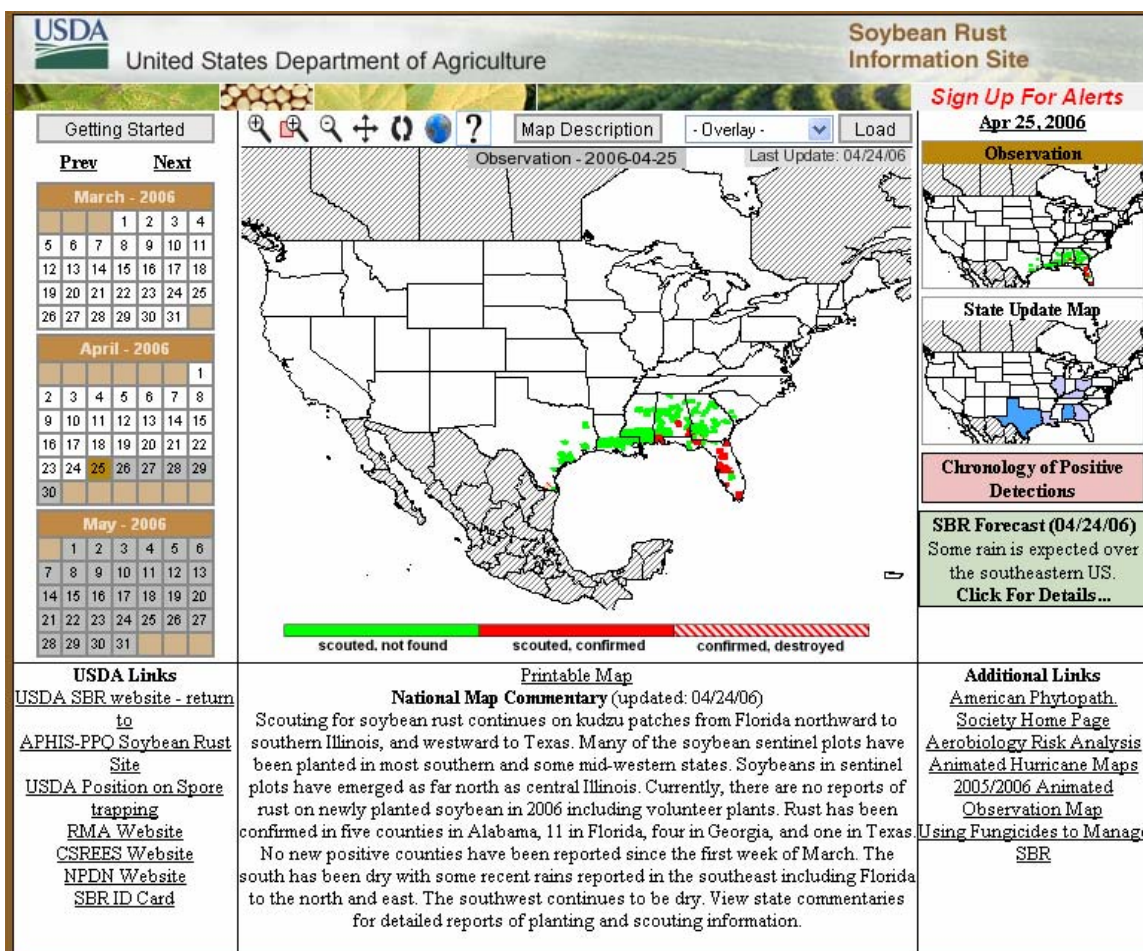
**Information Management Of Decision Criteria, Observations Of Soybean Rust, And Predictive Model Output To Stakeholders.**

A PIPE web site has been created to disseminate information to stakeholders (Figure 7). The URL address for the site is [www.sbrusa.net](http://www.sbrusa.net) is a collaborative project between Penn State University, North Carolina State University and the information technology company ZedX, Inc.

- The USDA web site is comprised of separate public, specialist, researcher and observer views although only the public site is available without an ID and password.
- The web-sites feature a user interface which is zoomable from the national to the sub-county scale.
- A calendar will allow users to see the daily progression of disease severity and crop phenology and allows users to move forward or backwards through time.
- Reference overlays include interstate highways, soybean growing areas, county boundaries and major cities.
- Good farm practice and crop insurance tools

**Public Site**

- Viewers on the public site will see maps of disease management recommendations, survey observations and scouting to the county scale. There will also be useful links to local experts, to management solutions, and crop insurance reporting forms.
- Each map is controlled at the county scale by the state specialist. Public viewers will NOT see model output but only state specialist interpretation of it under a commentary section on the page. The web site will be linked to the USDA website and to Land Grant University, American Phytopathological Society and IPM center webpages.



**Figure 7.** A view of the public USDA soybean rust web interface. The main features of the interface are a calendar, a zoomable map, national commentary, and disease management and scouting information.

Restricted Sites – Observer, specialist, researcher, and industry sites.

- The researcher, observer and specialist views display observed and predicted disease severity and spore deposition. Predicted disease severity will be shown as a color scale from nil to severe based upon the proportion of diseased leaf area. Latent infections (those that have not yet appeared) will also be indicated on the color scale. The predicted and observed severity will use the same color coding scheme.
- The observer site allows uploading of data to the USDA web site. The specialist site allows a state specialist to control what information is displayed at county scale in their state. The researcher site allows soybean pathologists to conduct epidemiological research and provide advice to specialists. Industry cooperators will have a site that will allow them to see and download a restricted set of observations, data input and model output.
- Observers will be provided with user ID and password to USDA SBR web site.

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PDA users: PDA software is available for downloading from USDA web site. Uploading of data will be by syncing the PDA to a computer.

Other users: Excel spreadsheets with data templates can be downloaded from the USDA observer website. Observations are entered into the spread sheet which can then be uploaded as CSV file.

Alternatively, an online web form can be filled out.

- Interpretations and commentaries for the public maps will be provided by a national ARS specialist. When a user clicks on an individual state, an interpretation from the designated state soybean specialist will also appear if one exists otherwise the national commentary will appear.

### DECISION CRITERIA FOR FUNGICIDE APPLICATION

Fungicides will be the primary tools in the management of soybean rust in the United States. Guidelines for managing the disease are based on data from Africa and South America where it was found that the crop should be protected from the flowering stage through the grain fill stage. The most effective management programs were those that were preventative: that is, where the first application was applied before soybean rust was seen in the field. The efficacy of the products available in the U.S. (under either Section 3 or Section 18 registration) has been proven in trials in South America and Africa. The products that have proven efficacy include chlorothalonil, strobilurin and triazole products.

Each product has different strengths and weaknesses and they differ in how and when they should be used to manage soybean rust. None of the products can eradicate the fungus. The triazole products have curative activity (can inhibit but not eradicate existing infections) and are protectants while the chlorothalonil and strobilurin products only are protectants and only prevent new infections. The chlorothalonil and strobilurin products need to be applied before infection, and once the disease exceeds 1% incidence, yield losses may occur even with a subsequent application of a strobilurin product. Triazole products can be applied prior to or after the disease appears, but once the disease is at a 10% incidence or is in the mid-canopy, yield loss will be expected.

Monitoring the fields will be critical in the decisions of when and what fungicides apply. Predictive forecasting, although in its first year of validation and testing may also provide useful data for decision making. Based on experience in South America and South Africa, a typical management program may require two application of fungicides based on phenology of the plant at the reproductive growth stages. The first application should be made at growth stage R1-R2 and the second 14 to 20 days later. The program could also be based on a calendar with the first application at 50 days after planting and the second to 20 days later. Monitoring data and predictive forecasts could be used to time fungicide applications, thereby possibly delaying the first application and/or eliminating the second.

Decision criteria are influenced by many factors:

- Soybean rust is a rapidly spreading disease. Studies in Africa and South America have demonstrated that fungicides need to be applied before or as soon as the disease is detected in a production field.
- Late diagnosis of the disease could result in substantial crop loss. If heavy spore deposition occurs along with spore germination and colonization, it may be too late to effectively control the disease.
- Crop loss may occur if fungicides are applied late and if few curative fungicides are available.
- The disease is difficult to observe and can be mistaken for other disorders or diseases.
- Soybean rust treatments should be applied at approximately 50 days after planting and 14 to 20 days later. An application should only be missed if disease was absent

from the production area. If spore showers are likely then these treatments are essential regardless of whether disease has been yet observed in the actual grower field.

- By using ground-trusted prediction models there is potential to provide decision information to producers and other decision makers well before disease is observed in local fields and in time to apply timely and effective fungicide treatments.

Other comments

- To help evaluate the management program, growers should be encouraged to leave a strip of the field unsprayed and mark it clearly.
- Risk communication efforts would be made before the 2005 growing season by land grant university extension personnel to educate soybean producers on many issues including;
  - the correct interpretation of monitoring data and predictive models;
  - the limitations and uncertainties associated with monitoring systems and predictive models;
  - decision criteria and risk management; and
  - fungicide selection and timing.

### PREDICTIVE MODELS

- The Soybean Rust Aerobiology Prediction System (SRAPS) is collaborative project between Penn State, North Carolina, and Iowa State Universities and the information technology company ZedX, Inc.
- The soybean rust prediction system displays predicted rust severity at a 10 km<sup>2</sup> resolution across North America.
- The components of the model include:
  - source area delineation based on soybean crop and kudzu distributions,
  - overwintering survival of rust in source areas,
  - NDVI-calibrated, temperature-driven greening function for North America,
  - evaluation of spore aerial transport potential using data sets derived from the National Weather Service including pressure, wind and temperature fields with 6 hour resolution and corresponding cloud cover and precipitation records,
  - soybean crop growth model driven by daily temperature and precipitation data from past 5 years, and
  - soybean rust epidemiology model driven by daily temperature and leaf wetness data from past 5 years.
- Observations primarily from sentinel plots will be used to quantify the distribution of spore production in domestic and off-shore source regions.
- The system will display observed and predicted disease severity and spore deposition. Predicted disease severity will be shown as a color scale from nil to severe based upon the proportion of diseased leaf area. Predicted latent (infected but not yet appeared) will also be a severity class. The predicted and observed severity will use the same color coding scheme.
- The North American Disease Forecast Center at NCSU will also provide disease forecasts using the HYSPLIT modeling system. The forecasts will be similar to those it has provided operationally for nine years.
- Iowa State University is also in the process of developing forecast models and will participate in the national forecasting efforts. Predicted daily weather data from an atmospheric model (MM5) will be used as inputs to make short term prediction of soybean rust risk in different geographic areas.

**FUNDING AND TRANSITION PLANS**

The cost of the USDA framework includes outreach, monitoring, information management, predictive modeling, and developing decision criteria for fungicide applications. Outreach includes state extension, regional and national efforts. In subsequent years the cost of the monitoring program can be reduced since experience with the disease will be gained. In addition, it is expected that by watching disease progression across sentinel plots for several years, the system can be fine-tuned so that fewer monitoring observations will be needed as input to the predictive model. The 2006 USDA Soybean Rust Transition Plan can be found in Appendix C.

**SUMMARY**

- The five components of the plan are:
  - 1.) an operational surveillance and monitoring network;
  - 2.) a web-based system for information management;
  - 3.) decision criteria for fungicide application; and
  - 4.) predictive modeling and
  - 5.) communication and outreach.
- The monitoring component includes sentinel plots, mobile surveys and spore sampling. Sentinel plots provide quantification of spore production in source regions and mobile surveys provide calibration of predicted model output with disease observations.
- Sustained monitoring resources will be needed in seasons 2006 - 2009. Plans should incorporate university and industry cooperators to provide the required monitoring resources.

TIMELINE

2004

**September**

- Soybean rust believed to have entered United States, possibly as a result of Hurricane Ivan or other tropical storms.

**November**

- Soybean Rust first identified in United States

**December**

- Working group begins to draft a Coordinated Framework for Soybean Rust.

2005

**February**

- Roll out of Coordinated Framework Document to stakeholders in Indianapolis.
- PDA program for industry protocol completed. First test of PDA program
- Soybean Rust Monitoring and Prediction System Public web site up and available and linked to USDA web site.
- National, regional, and state coordinators identified.
- Preseason climatological assessment of three scenarios using the Soybean Rust Aerobiology Prediction System available.

**March**

- USDA Soybean Rust Web Portal online.
- Refinement of monitoring plan at meeting of soybean researchers in Scottsdale, Arizona.
- PDA program for industry protocol released. Testing and release of program for mobile and sentinel plots protocols
- Soybean Rust Monitoring and Prediction Web Site active for data entry and PDA access. Interactive demonstration by Joe Russo in Riverdale (March 1).
- File transfer protocol available for users of industry protocol.
- State coordinators supply web links for state based information.
- Soybean Rust Aerobiology and Prediction system goes on-line with near real time and forecast data.
- Observations from NPDN available in map form and on- line.
- User evaluation of web site.
- NC 504 Guidelines fungicide Manual (PDF file format) linked to USDA web site.
- Pre-season interpretation guide written.

**April**

- SRMP web site tutorial available.
- Soybean Rust Monitoring and Prediction Web Site active for Research users. Observations from all collection protocols available in map form and on-line
- File transfer protocol available users of mobile and sentinel plots protocols.
- User evaluation of web site.
- Data transfer protocols available for monitoring data access by researchers.

**May**

- User evaluation of web site.

## **DRAFT 5/1/2006**

- Widespread planting and emergence of soybean in southern states.

### **June**

- Widespread planting and emergence of soybean in northern states.

### **October**

- APS symposium on soybean rust to discuss lessons learned.

### **November**

- 

### **December**

- 

## **2006**

### **January**

- 

### **February**

- 

### **March**

- 

### **April**

- Data transfer protocols available for monitoring data access by researchers.
- Roll out of 2006 Coordinated Framework Document to stakeholders.
- Pre-season interpretation guide written.
- Soybean Rust/PIPE Monitoring and Prediction Web Site active for Research users.
- File transfer protocol available users of mobile and sentinel plots protocols.
- User evaluation of web site.
- Data transfer protocols available for monitoring data access by researchers.

### **May**

- User evaluation of web site.
- Widespread planting and emergence of soybean in southern states.

### **June**

- Widespread planting and emergence of soybean in northern states.

### **July**

- 

### **August**

- 

### **September**

- Review appropriations for program funding and assess adjustments, where necessary.

### **October**

- APS symposium on soybean rust to discuss lessons learned.

### **November**

- 

### **December**

-

APPENDICES

**Appendix A:** 2006 Soybean Rust Coordinated Framework Personnel

**Appendix B:** PIPE Website Terms and Conditions of Use

**Appendix C:** USDA Transition Plan 2005 Coordinated Framework for Soybean Rust, 2006 Legume Pest Information Platform for Extension and Education (Draft)

**Appendix D:** NPDN Standard Operating Procedure (SOP) for Plant Diagnostic Laboratories – Soybean Rust *Phakopsora pachyrhizi* and *P. meibomia*e Version 1.9

**Appendix E:** NPDN Standard Operating Procedure (SOP) for Plant Diagnostic Laboratories – Soybean Aphid *Aphis glycines* Matsumura Draft 1.1

**Appendix F:** APHIS Federal/State Responsibility for Identification of *Phakopsora pachyrhizi* December 6, 2004 (Slightly Revised and Reissued February 10, 2005)  
*Phakopsora pachyrhizi*, cause of Asian soybean rust (SBR), was found for the first time in the United States in Louisiana, November 6, 2004. It was subsequently found in additional southeastern states on soybeans as well as kudzu. The disease is likely to spread very rapidly to other soybean-growing areas in the US during the 2005 growing season by means of windborne spores. Therefore, APHIS is not attempting to prevent its spread via a domestic quarantine regulation. State regulatory officials, growers, extension agents, and others are very interested in quick detection of SBR in order to effectively manage the disease. In this regard, APHIS will be allowing States to conduct their own diagnostics as they deem necessary after APHIS confirms the first detection on a host in a State. Permits for importation and interstate movement of *P. pachyrhizi* and *P. meibomia*e are still required, as would be the case for any plant pest. APHIS has been working closely with stakeholders for several years to prepare for the arrival of SBR. A number of diagnosticians with the National Plant Diagnostic Network and State departments of agriculture have been trained to morphologically identify *P. pachyrhizi* and they have trained first responders. A few scientists have been trained to use real-time PCR to identify *P. pachyrhizi* and differentiate it from the morphologically similar but less aggressive *Phakopsora meibomia*e. The latter species has not been found in the continental US and therefore any *Phakopsora* species on soybean in the US is highly likely to be *P. pachyrhizi*. Ultimately, the soybean grower may not care to know if the soybean rust symptoms are caused by one or both of the *Phakopsora* species. States should decide whether identifications, after the initial PPQ-confirmed state/host records, are based on morphology, or morphology and PCR.

**Responsibilities for Identifying *Phakopsora pachyrhizi***

**Issue State APHIS-PPQ Outcome**