**The 2006 New York On-Farm Soybean Rust / Soybean Aphid Monitoring Network**

**Principle Investigators:** Gary Bergstrom[1], Mary McKellar[1], Keith Waldron[2]
[1]Cornell University, Department of Plant Pathology, Ithaca
[2]New York State Integrated Pest Management Program, Cornell University, NYSAES

**Cooperators:**
Brian Aldrich, Janice Degni, Julie Dennis, Mike Dennis, Bob DeWaine, Kevin Ganoe, Nancy Glazier, Nate Herendeen, Mike Hunter, Chuck Kyle, Joseph Lawrence, Chanda Lindsey, Jeff Miller, Dean Sprague, Mike Stanyard, Bruce Tillapaugh, Martin Vandergrinten, Ken Wise.

**Objectives**
1) Establish soybean sentinel sites to enable timely collection of soybean crop growth and development and specific pest data from representative areas of NY soybean production.
2) Share results of sentinel plot surveys with NY producers and national soybean rust and soybean aphid websites: USDA SBA/SBR PIPE (www.sbrusa.net) and Stop Soybean Rust www.stopsoybeanrust.com.
3) Survey soybean sentinel sites for presence of soybean cyst nematodes.

**Background and Justification:**
Soybean production is of increasing interest to New York field crop growers. Soybeans fit well with our typical cash grain and dairy production systems, providing a useful crop rotation option, an excellent on-farm addition to dairy and livestock rations, and provide a valuable cash crop. Soybean production has increased nearly 6 fold in NY since 1989 with an estimated 198,000 acres planted in 2006 (1989-2006 NYS Ag Stats). The trend in soybean acreage expansion is expected to continue as producers incorporate soybean feedstuffs into dairy rations and local markets are enhanced by availability of commercial roasters and oil processing plants.

Soybean pest concerns have historically been minimal in the northeast, generally restricted to weed competition, with relatively few insect, disease and vertebrate pests affecting crop yields. Two new pest species have recently been introduced which threaten US soybean production: the Asian soybean aphid and Asian soybean rust. Soybean aphid populations were first detected in the US in 2000 and in NY in 2001. Soybean rust was detected in the southeastern US in November 2004. Fortunately this disease has not, to date, been found in NY.

In 2005, the USDA initiated efforts to establish a coordinated national system of soybean sentinel plots to assist in the early detection of soybean rust across the soybean producing region of the US. Thirty-one states and several Canadian provinces participated. Gary Bergstrom of the Cornell University's Plant Pathology department coordinated the 2005 New York effort with assistance from Cornell Cooperative Extension personnel in 10 counties. In 2006, this USDA sponsored effort was expanded to include monitoring for soybean aphid and other pest issues. Dr. Bergstrom again coordinated the NY soybean sentinel plot monitoring effort in 2006. The NYS IPM Program collaborated with Dr Bergstrom on this project which also engaged CCE, industry and USDA personnel in 17 counties across NY. Sentinel plot efforts in New York have been voluntary for these two seasons.

The national sentinel plot effort was funded in 2006 by the US Department of Agriculture (USDA), the United Soybean Board (USB), and the North Central Soybean Research Program (NCSRP). A total of 35 states had sentinel plots for monitoring soybean rust (SBR) and soybean aphid (SBA). Five Canadian provinces were also involved in the monitoring effort this year. Some states had a single leader for the sentinel plot program while in other states, such as in NY, the responsibility was shared among multiple individuals. A single SBR monitoring protocol has been developed for the USB/NCSRP, USDA, and Canadian plots. Data from all sentinel plots was uploaded to the USDA - Legume Pest Information Platform for Extension and Education (PIPE) website.

The sentinel program served three important functions. The primary function is to serve as a warning network for tracking the spread of the soybean rust in North American soybean production regions. For this reason and because 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. The second function is to quantify the timing and amount of spore production in over-wintering 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 were maintained after first detection unless other considerations dictate otherwise.

**New York SBR/SBA Sentinel Plot Procedures:**
CCE personnel were contacted and provided an overview of the objectives of the sentinel monitoring network and invited to participate. Interested CCE staff contacted local commercial field crop producers to identify situations where a local soybean field could used as a sentinel plot. Protocols for establishing, monitoring and sampling sentinel plots were provided by USDA. The following information is adapted from their protocol released in March 2006.

*Variety selection in soybean sentinel plots*
Soybean varieties were planted that were adapted for each geographic location representing at least 2 maturity groups across the state.

*Soybean sentinel plot size and planting date*
Sentinel plots should be at least 25' x 50' for each cultivar/host. Larger plots were encouraged, especially if deer are likely to cause damage to the crop. Multiple planting dates are encouraged, but not required. Sentinel plots should be planted as early as feasible for the specific geographic region.

*Frost and insect control measures*
Sentinel plot managers were asked to communicate with sentinel project coordinators prior to any insecticidal applications.

*Scouting interval, Soybean Rust (SBR)*
Scout at a 2 week staggered interval until: 1) first bloom, 2) SBR is reported in the region, or 3) environmental conditions become conducive to rust development. Scout weekly after one of the above conditions is met. After plots reach R6, scouting intensity may be scaled back.

*Scouting interval, Soybean Aphid (SBA)*

Scout as above for soybean rust until 1) SBA is reported in the region, or 2) populations of SBA appear to be increasing or requiring significantly more monitoring. Scout weekly after one of the above conditions is met. In most cases, weekly scouting will be necessary for no more than 8-10 weeks.

*Pre-detection SBR monitoring protocol*

Scout for the presence of SBR by arbitrarily collecting or observing a minimum of 100 leaflets from the lower canopy (oldest, main-stem terminal leaflets) at each site. If a site has multiple cultivars, collect leaflets from the earlier cultivars until the later cultivars reaches reproductive stage. Thereafter collect at least 100 leaflets including some from all the cultivars. Leaf samples were sent to the Cornell Plant Pathology Diagnostic clinic for evaluation.

At the diagnostic clinic technicians incubated the soybean leaf samples for 24-48 hr in a plastic bag containing a moist paper towel and/or inspection of leaves under a dissecting microscope (40-60X) is recommended for early detection of SBR.

The first suspected positive find of SBR by visual inspection in each sentinel plot should be confirmed by diagnostic clinic or state designated expert. The first suspected positive find of SBR in a state must be sent to the USDA lab (Dr. Mary Palm, Beltsville, Maryland) for confirmation for each host. All data from sentinel plots must be entered into the USDA PIPE national database. When uploading data, be sure to include date, plot id, cultivar, number of leaflets examined, plant stage, and disease assessment (presence, incidence, and/or severity).

*Post-detection SBR monitoring protocols*

Once SBR has been identified in a sentinel plot or commercial field, it is important to estimate the severity of the disease at larger spatial scales to enable prediction of its spread. The following post-detection SBR assessment procedures differ depending on the size of the unit being scouted.

Sentinel plots – Scout on a weekly basis, inspecting 10 leaflets from each canopy level (lower, mid and upper). Determine disease severity using the 0-100% severity scale (http://aphis.zedxinc.com/sbr/SoybeanRust.pdf) and incidence (# leaflets infected) for each canopy level. Growth stage and canopy closure (% of soil covered by the soybean canopy) are to be collected as well. More observations may be collected if desired. Scout all varieties planted in a sentinel plot, focusing your efforts on the variety that becomes infected first. Maintain that focus until defoliation. If your plan is to destroy a sentinel plot once soybean rust is detected, please consider collecting disease severity data for 2 weeks post-detection. This will allow for the determination of the extent of infection event at that site**.**

Commercial fields – From a vantage point along the field border, "guesstimate" where infection in the field is likely to be most severe. Determine disease severity at this location for the lower, middle, and upper canopy (http://aphis.zedxinc.com/sbr/SoybeanRust.pdf). From this location, or a better vantage point, divide the field visually into 4 quadrants of approximately equal area. Estimate a representative (or average) level of disease severity for each of the 4 quadrants (none (0), low (1), moderate (2), heavy (3)).Do not consider the lower, middle, and upper canopy levels separately, make an overall judgment for each quadrant. In addition to the disease observations, note the date and physical location of the field (GPS latitude and longitude) or distance (in miles)

from the nearest cross-roads. Although the disease observations for the quadrants are only very rough "guesstimates", when they are coupled with the observations from the heavily infected site in the same field and the field location data, they become extremely valuable for calibrating the aerobiology model and for estimating the aerial extent of the disease during the growing season. County level assessment – Estimate the percentage of soybean acreage infected in county (based on specialist's perception). Also estimate the percentage of the total soybean acreage, not the infected acreage, treated with a fungicide (based on specialist's perception). Please note that these county-level disease observations are important for calibrating the aerobiology model and estimating the aerial extent of the disease during the growing season. All data from post-detection surveys must be entered into the USDA PIPE national database.

*Assessment of other diseases and pests on SBR hosts*

Assessment of the following disease/organism is encouraged: Septoria brown spot, frogeye leaf spot, target spot, downy mildew, Cercospora blight, bacterial pustule, and bacterial blight. Record presence/absence of the disease/organism. Disease incidence and/or severity ratings may also be collected at the cooperator's discretion. If incidence and/or severity data is collected, the same rating scales used for soybean rust is to be used. Additional disease damage and other pertinent information may be recorded in the notes field on USDA PIPE data entry forms.

*Assessment of soybean aphid (SBA) Protocol*

1) Note the latitude and longitude in the sentinel plot with the GPS unit.
2) Select 20 plants at random, each from a different location (not consecutive down the row) so that the 20 plant-sample is representative of the entire variety. Identify the average growth stage.
3) Examine the entire plant beginning with the growing point (newest trifoliate) for soybean aphids. If plants are in vegetative growth (no pods or flowers) generally only the growing point needs to be examined. As flowering and pod set occur, examine the entire plant, including pods. Spend no more than 30 sec to examine an individual plant.
4) Count aphids per plant when they are below 250. Apterous (wingless) aphids are assumed to be present. Note whether alate (winged) aphids were also observed. If only winged aphids are present (very rare, but possible), make a note in the space for optional notes. Notes could also be used to indicate if any predators or parasitized aphids (mummies) are present or other general relevant observations.

*Destruction of sentinel plots infected with SBR*

The decision to spray or destroy sentinel plots after SBR detection is the responsibility of individual states. If the decision is made to destroy a plot the eradication date must be uploaded to the USDA PIPE database. This information will give modelers a better idea of the level of SBR inoculum production in a geographic area. If the sentinel plot has been destroyed due to SBR, please inform your extension entomology counterpart as this will also end SBA monitoring.

*Data input to USDA-PIPE website*

CCE collaborators shared New York SBR/SBA sentinel site scouting reports weekly. These data were uploaded by Mary McKellar (Cornell Plant Pathology Diagnostic laboratory) in a timely manner consistent with scouting frequency. Data for the first find of soybean rust in a state in 2006 should be submitted within 24 hours of final confirmation. (Note: The first suspected

positive find of SBR in a state must be sent to the USDA lab, Dr. Mary Palm, Beltsville, Maryland, for confirmation for each host). Data for the first find of soybean rust in a county in 2006 should be submitted within 72 hours of final confirmation. More timely data submission is always encouraged. Observations were uploaded using an on-line excel file form.

Disease severity was assessed using a 0-100% severity scale. However, because most leaves drop when severity reaches around 50 percent and the assessment does not take into account necrotic tissue, most values will fall within 0-50% range. Photographic definitions are available by clicking images on USDA PIPE website (http://aphis.zedxinc.com/sbr/SoybeanRust.pdf). Multiple protocols are available for uploading data for SBR. The **pre-detection** protocol is for general use for sentinel plots prior to detection. The **post-detection** protocol is used for sentinel plot post detection and epidemiological data.

Soybean aphids were assessed for estimated number of SBA per plant. In addition, the following rating scale used to document ASB population severity. SBA rating = Aphids observed on one 1 plant in 30 sec or less. : "0" = no aphids observed; "1" = 1-39 aphids observed; "2" = 40-149 aphids observed; "3" = 150-249 aphids observed; "4"= 250-499 aphids observed; "5" = >500 aphids observed.

**Results and Discussion:**

Thanks to the efforts of Cornell Cooperative extension personnel and cooperating soybean producers 19 soybean rust / soybean aphid sentinel sites were established in17 New York counties in 2006 (Chautauqua, Genesee, Wyoming, Ontario, Wayne, Seneca, Chemung, Cayuga, Tompkins, Onondaga, Oswego, Jefferson, Oneida, Chenango, Herkimer, Montgomery and Columbia).

Season long sampling for soybean rust did not detect presence of this serious disease. Weekly scouting efforts did, however, provide detailed and timely insights into the occurrence of other diseases in NY soybean fields including three diseases previously unreported in NY*. The following foliar diseases were detected on samples submitted by cooperators this season: *Low Incidence*: frogeye leaf spot* and bacterial blight; *Moderate Incidence*: Septoria, downy mildew, and bacterial pustule; Single location: Alternaria leaf spot, and alfalfa mosaic virus. In addition to foliar diseases, white mold, sudden death syndrome* and brown stem rot* were observed in *Low Incidence* at two or less locations. It should be noted that frog eye spot, sudden death syndrome and brown stem rot are first detections for these diseases in New York by the Cornell Plant Pathology Diagnostic laboratory. End of season sampling for soybean cyst nematodes proved negative for all 19 sites.

Soybean aphid (SBA) populations were observed at all sentinel site locations in 2006. Fortunately, SBA populations remained very low across all sample sites, only exceeding the 250 SBA per plant action threshold late in the growing season in two locations in central NY. The first SBA sighting occurred June 5 in V2 stage soybeans in a WNY Soybean TAg meeting (Farmington). The next earliest detection was made on V4 stage soybeans in research plots at the Cornell Musgrave farm in Aurora, June 20. The first fields over threshold were detected in R5 stage soybeans in the Cayuga county sentinel plot August 7 and 15. The first detection of white dwarf SBA's (a weather induced stress related SBA morph) was reported in reproductive stage

soybeans in the Wyoming county sentinel plot on in August 3. White dwarf SBA populations did not exceed the action threshold. In addition to soybean aphids, bean leaf beetle, an insect not previously reported to occur in NY were observed in some soybean fields in Ontario county.

Although the SBR/SBA sentinel monitoring program did not, fortunately, detect presence of soybean rust in 2006, it did however, create an opportunity that strengthened communication among CCE personnel in soybean producing regions of the state. The regularly scheduled field monitoring efforts detected the presence of three diseases and one insect previously unreported in NY. The sentinel project also provided the opportunity to test for presence of soybean cyst nematode. This information was shared among CCE personnel, other outreach multipliers and with soybean production and industry clientele.

An archive of New York SBR and SBA sentinel plot 2006 observations can be found at the USDA SBA/SBR PIPE (www.sbrusa.net) and Stop Soybean Rust www.stopsoybeanrust.com websites.

It is likely that USDA will sponsor another SBR/SBA sentinel network program in 2007. There have been discussions regarding possible funding to continue and perhaps enhance our effort in NY.

**Acknowledgements**: The authors wish to thank Cornell Department of Plant Pathology program assistants Molly Swartwood (June-August) and Kari Richards (August-October) and cooperating soybean producers.