Accepted for publication 27 July 2010. Published 27 August 2010.

Occurrences of Soybean Viruses, Fungal Diseases, and Pests in Illinois Soybean Rust Sentinel Plots

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Hobbs, H. A., Herman, T. K., Slaminko, T. L., Wang, Y., Nguyen, B. T., McCoppin, N. K., Domier, L. L. and Hartman, G. L. 2010. Occurrences of soybean viruses, fungal diseases, and pests in Illinois soybean rust sentinel plots. Online. Plant Health Progress doi:10.1094/PHP-2010-0827-01-BR.

After soybean rust, caused by *Phakopsora pachyrhizi*, was confirmed in the USA in 2004 in soybean (*Glycine max*) (4), "sentinel" plots were established in 2005 in 26 soybean-producing states to monitor its spread. Funding for establishing, sampling, and monitoring the plots came from the USDA, national, regional, and state soybean commodity boards, and state departments of agriculture, extension services, and universities. Sentinel plots were a minimum of 8 m × 16 m in size, planted as early as possible for a particular area, and represented either separate plots or marked areas in commercial fields that were monitored regularly by scouts primarily from state universities and extension services for soybean rust.

The presence of sentinel plots for soybean rust monitoring provided the potential for reducing the time and expense of extensive statewide travel for collection of soybean leaf samples for monitoring the incidence of other foliar diseases of soybean in Illinois. In many Midwestern states, including Illinois, *Bean pod mottle virus* (BPMV) is the most prevalent virus infecting soybean (1). Other soybean-infecting viruses in Illinois include *Alfalfa mosaic virus* (AMV), *Soybean dwarf virus* (SbDV), *Soybean mosaic virus* (SMV), *Tobacco ringspot virus* (TRSV), and *Tobacco streak virus* (TSV). Common foliar diseases present include bacterial pustule (*Xanthomonas axonopodis* pv. *glycines*), Cercospora leaf blight (*Cercospora kikuchii*), downy mildew (*Peronospora manshurica*), frogeye leaf spot (*C. sojina*), and Septoria brown spot (*Septoria glycines*) (2).

Since first being reported in the USA in 2001, soybean aphids (*Aphis glycines*) have become a significant pest throughout the Midwest (3). Feeding by large numbers of these aphids can significantly reduce yields and increase virus incidence (AMV, SbDV, and SMV). Whiteflies (*Bemisia tabaci*) also can cause yield losses in soybean through feeding damage, and indirectly through transmission of a number of viruses none of which have been reported on soybean in the United States.

Scouts of sentinel plots were requested to make a single collection per season in mid to late August consisting of three subsamples: (i) one randomly selected lower leaflet from each of 10 randomly selected plants regardless of symptoms; (ii) one randomly selected upper leaflet from each of 10 randomly selected plants regardless of symptoms; and (iii) one randomly selected leaflet from 10 plants with virus-like symptoms from either the lower or upper part of the plant. These samples were mailed to the University of Illinois for identification of diseases and pests. Samples from 25 to 30 sentinel plots (one plot per county) were evaluated each year. Leaflets from 2006 and 2007 sentinel plots were examined using stereomicroscopes for bacterial and fungal diseases and insect pests. *Bean pod mottle virus* was detected by immunological assays of individual leaf samples. Other viruses were detected from pooled samples as described below.

In addition to sentinel plots, commercial fields in five (2006) and eight (2007 and 2008) counties were intensively surveyed for viruses only. The first five counties were selected because northern Illinois had a history of high soybean aphid populations as measured by the North Central Regional Soybean Aphid Suction Trap Network (ncipmc.org/traps), which increased the expectation of detecting aphid-transmitted viruses. In 2007 and 2008, three counties were added to provide more geographic diversity. From each county, one leaflet was collected regardless of symptoms at growth stages R5 to R7 from 30 different plants in 10 fields, for a total of 300 samples per county. For virus detection, 60 to 90 leaflets representing 2 to 3 fields were pooled, and total RNA was extracted and analyzed by quantitative real-time reverse transcriptase polymerase chain reaction. Previous testing in our laboratory showed that AMV, BPMV, SbDV, SMV, TRSV, and TSV could be detected at 1:100 dilutions of infected to healthy leaf tissue.

BPMV was found in 40% of sentinel plots in 2006 and 2008, and 19% in 2007 (Fig. 1). SbDV and TRSV were each found in one sentinel plot in 2006. In the intensive surveys, BPMV, SbDV, and AMV were the three most frequently detected viruses in commercial soybean fields (Fig. 1). BPMV and SbDV were found in all eight counties examined and AMV was found in four counties in 2007. Septoria brown spot was the most common fungal disease and was found in 100% and 96% of sentinel plots in 2006 and 2007, respectively (Fig. 2). Cercospora leaf blight (89%, 2007), downy mildew (96% and 67%), and frogeye leaf spot (60% and 78%) were also common in sentinel plots (Fig. 2). Bacterial pustule was rare and was found in only 4% of sentinel plots in 2007. Soybean rust was not found in sentinel plots in 2006 or 2007, but was detected in Illinois at other locations.

Soybean aphids were detected in 32% and 56% of sentinel plots in 2006 and 2007, respectively (Fig.2). All counts were below the economic threshold of 250 aphids per plant, and too low to cause yield losses directly by feeding damage. However, transmission of viruses (AMV, SbDV, and SMV) can be accomplished by feeding of single aphids. Whiteflies were found in 52% of sentinel plots in 2007 (Fig. 2).

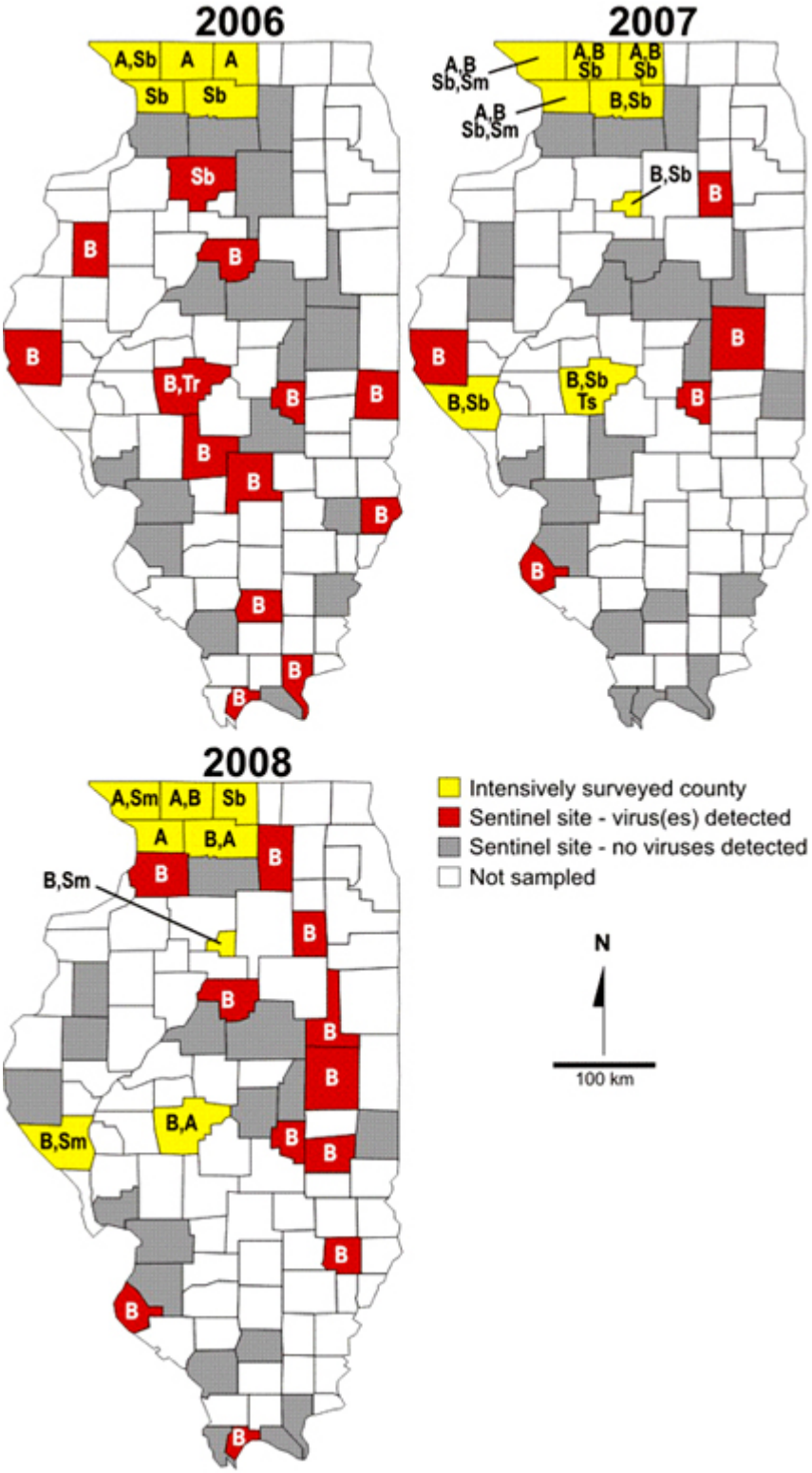

Fig. 1. Virus detection in leaflets of soybean from sentinel plots and commercial fields sampled from various counties across Illinois in 2006, 2007, and 2008 (A = *Alfalfa mosaic virus*, B = *Bean pod mottle virus*, Sb = *Soybean dwarf virus*, Sm = *Soybean mosaic virus*, Tr = *Tobacco ringspot virus*, and Ts = *Tobacco streak virus*).

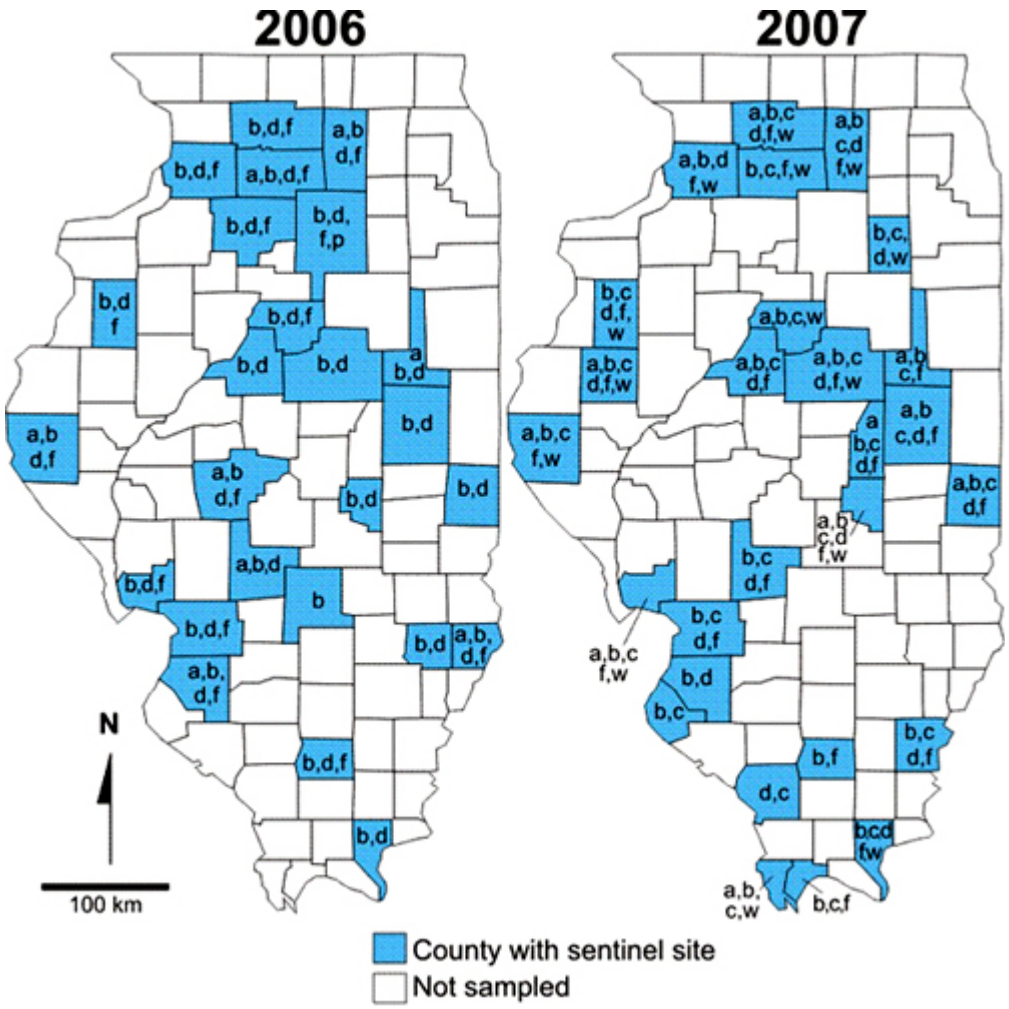

Fig. 2. Fungal and bacterial disease and insect pest incidence on soybean in sentinel plots sampled from various counties across Illinois in 2006 and/or 2007 (a = soybean aphid, b = Septoria brown spot, c = Cercospora leaf blight, d = downy mildew, f = frogeye leafspot, p = bacterial pustule, and w = whitefly).

With the sampling protocol we employed, sentinel plots were useful for detecting diseases and insects which were relatively common (e.g., BPMV), but less informative for less common diseases and insects, such as SbDV. Intensive surveys involved the collection of 300 leaflet samples per county, in contrast to the 20 collected per county for sentinel plots. In intensive surveys, SbDV was found 12 times in individual counties over the three year period, and only once in a sentinel plot during the same period (Fig. 1). The greater number of detections of SbDV in the intensive surveys occurred despite covering commercial fields in only 5 or 8 counties each year, compared to 25 or 30 counties each year for sentinel plot.

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The authors wish to acknowledge the many individual sentinel “scouts” listed below, who collected and sent in tissue samples to make this research possible:

County	Sentinel Scout
Adams	M. Roegge
Alexander	J. Bond, A. Vick
Bureau	J. Donnelly
Champaign	T. Slaminko
Coles	L. Kull
DeKalb	L. Paul
Edgar	T. Slaminko
Fayette	L. Deal
Ford	T. Slaminko, T. Herman
Franklin	D. Epplin
Grundy	R. Higgins
Jackson	J. Bond, A. Vick
Jersey	R. Bellm
LaSalle	J. Martin
Lawrence	R. Waldrop
Lee	J. Morrison, D. Baird
Macon	T. Herman
Madison	R. Bellm
McDonough	L. Ortiz-Ribbing
McLean	T. Slaminko
Monroe	R. Krausz
Montgomery	K. Bassett
Moultrie	T. Slaminko, T. Herman
Ogle	B. Lindenmier
Piatt	T. Slaminko
Pope	R. Hines, S. Ebelhar, C. Hart
Pulaski	J. Bond, A. Vick
Richland	R. Waldrop, J. Tharp
Sangamon	M. Montgomery
Shelby	T. Slaminko
St. Clair	R. Krausz
Tazewell	T. Slaminko
Warren	E. Adee
White	J. Bond
Whiteside	D. Feltes, G. Clark
Woodford	P. Fandel