

## Status of green stem syndrome in Wisconsin

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The incidence of green stem syndrome (unofficial common name) has been observed for years, but has increased dramatically since 1995. The name is descriptive of plants that retain green stems well past the point of normal maturity (Figure 1).



**Figure 1. Symptoms of green stem at harvest**

**Symptoms** Leaf and petiole retention are common symptoms of the disorder. Leaf distortion and green and yellow mosaic patterns on leaves have also been observed in many regions of Wisconsin. The leaf symptoms are similar to those associated with injury from several herbicides. Pod symptoms include small, distorted pods, one or two seeded pods, and shattering.

Frequently, seed coats are stained with pigments that originate from the seed hilum (**Figure 2**). It should be noted that "bleeding hilum" or seed coat mottling is associated with virus infection, but is not the sole cause of this disorder that results in bicolored seed. We are working to resolve this issue.

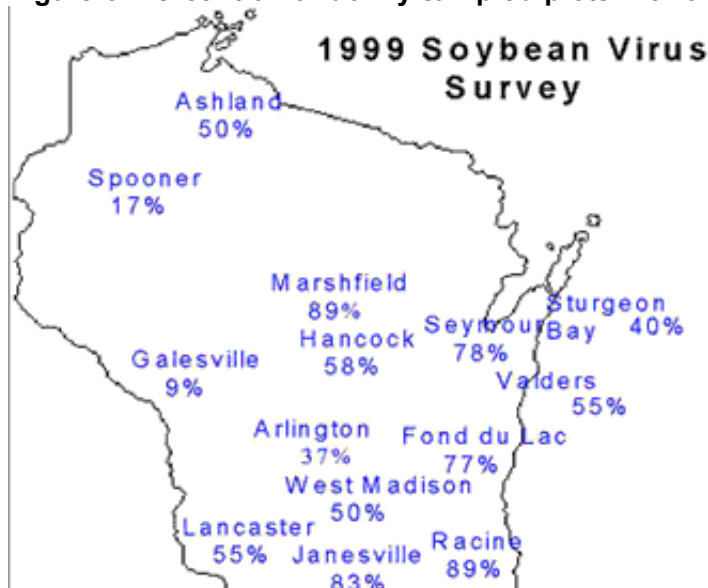
This year's work has focused on viruses and phytoplasma as possible causes of unexplained symptoms in soybean fields. We are beginning to differentiate between herbicide injury

and green stem/virus symptoms, which can be very similar (see [Typical Symptoms of Virus Infection in Soybeans](#) and [How to Distinguish Herbicide Injury from Virus Infection](#)). We are beginning to collect data on the prevalence and effect of soybean viruses and phytoplasma on soybean production in Wisconsin.

### Viruses Detected in Wisconsin

A state-wide survey indicated a higher incidence of soybean viruses in Wisconsin than previously believed (Figure 3). Specific viruses found in soybean were *Alfalfa mosaic virus* (AMV), *Bean pod mottle virus* (BPMV), *Bean yellow mosaic virus* (BYMV), *Soybean mosaic virus* (SMV), *Tobacco ringspot virus* (TRSV), and *Tobacco streak virus* (TSV). AMV, BPMV and TSV were found in Wisconsin soybeans for the first time.

**Figure 3. Percent of randomly sampled plots with one or more viruses detected.**





### Incidence of Green Stem

Green stem incidence varies by location and year. In 1998, Whitewater plots averaged 10.2% green stem incidence, compared to less than 1% at Arlington and East Troy. In 1999, a high incidence of green stem hindered harvest at Whitewater but was very low at Arlington and East Troy. Varieties differ in the amount of green stem as well.

### Variables Affecting Green Stem

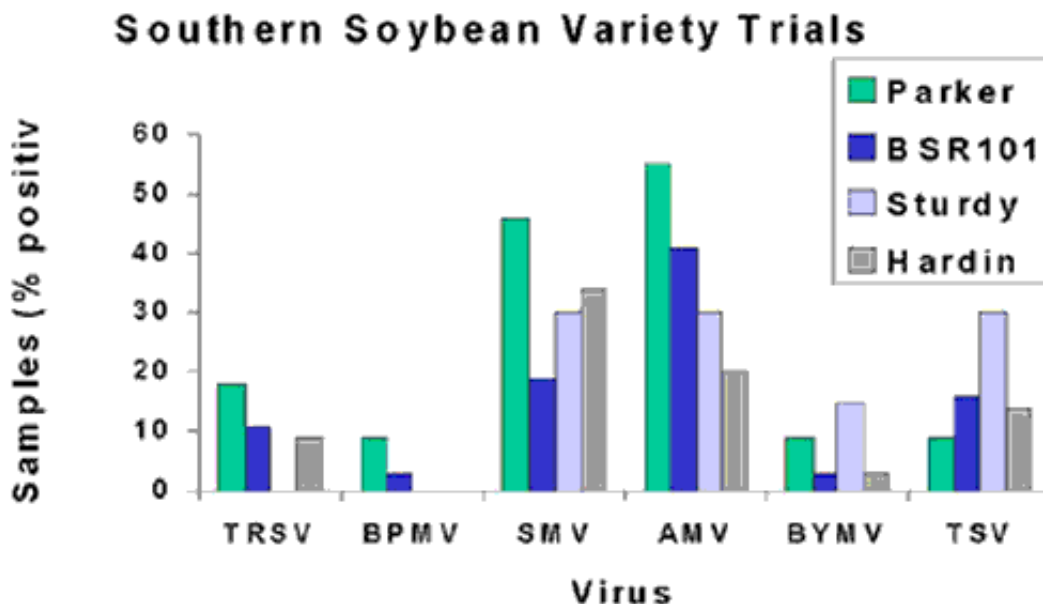
Factors that modify canopy density, such as low soil moisture, are associated with an increase in the amount of green stem observed in a field. Delayed planting resulted in an increase in incidence of green stem, and also a decline in yield.

Biotic factors such as viruses cause green stem, but not all green stem plants test positive for viruses. Unknown viruses may also cause green stem. Varieties differ in the incidence of green stem and infection by

specific viruses (Figure 4).

Incidence of green stem and leaf and pod symptoms increase as soybean canopy is slow to close or does not close completely. Green stem incidence is more prevalent at 30 inch row spacing than at 7 inch spacing. Low plant populations are associated with greater insect pressure, which may serve as vectors of virus. The extent of seed transmission is not known.

**Figure 4. Soybean varieties differed in the amount of virus infection present.**



Soybeans grown near forages such as alfalfa or near ditches and waterways with volunteer forage legumes have a higher incidence of green stem and leaf symptoms. Many forages harbor viruses that can infect soybean, such as alfalfa and AMV. Insect vectors could be transmitting viruses from the forage to the soybeans, however the extent of this situation needs to be researched.

### Herbicide Injury and Viruses

Herbicide injury and viral symptoms appear very similar (Figure 5). Rugosity, cupping, twisting and distortion of leaves are associated with both. These symptoms in the absence of a herbicide application may indicate a virus. Soybeans with herbicide injury should grow out of the symptoms, while virus infected plants continue to show symptoms throughout the growing season. See [Typical Symptoms of Virus Infection in Soybeans](#) and [How to Distinguish Herbicide Injury from Virus Infection](#).

**Figure 5. Diagnosing herbicide injury versus virus infection can be difficult due to the similarity of symptoms. Dicamba injury (left) causes cupping up of the leaves, while SMV infection(right) is characterized with downward cupping of the leaves.**



### Conclusions from the 1999 Green Stem research

- Green stem syndrome of soybeans is a disorder caused by some viruses and exacerbated by management practices such as wide rows, low plant populations, insect pressure and a variety's tendency to retain a green stem.
- Viruses new to Wisconsin have been confirmed and are being characterized.
- It is important to distinguish herbicide injury from symptoms caused by viruses due to their similarity.
- Control measures may include variety selection and use of insecticides to control the vectors of the viruses.
- Research will continue to determine specific control recommendations.

Questions? Please contact Craig Grau (<mailto:cg6@plantpath.wisc.edu>) or Mary Lee ([mel@plantpath.wisc.edu](mailto:mel@plantpath.wisc.edu)), University of Wisconsin-Madison, Department of Plant Pathology, 1630 Linden Drive, Madison, WI 53706.

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