Soybean Vein Necrosis Virus

Soybean farmers should be aware of a new disease caused by soybean vein necrosis virus (SVNV). The virus has likely been in soybeans for some time, but was probably overlooked or misdiagnosed before recent detections. The disease has been detected across the United States (including many states in the North Central region) and in Ontario, Canada.

SVNV is a *Tospovirus*, a group of viruses capable of causing serious damage in many different crops. The long-term implications of this disease are not yet known, and we are currently working to better understand the disease and potential for yield loss in soybean. Accurately diagnosing SVNV is important, especially because it can easily be confused with other soybean diseases, disorders, or damage.

This publication examines the symptoms of SVNV, describes how SVNV differs from several other plant problems that may look like SVNV, and provides scouting information.

Symptoms

SVNV symptoms are typically randomly distributed throughout the canopy. SVNV lesions start as a yellowing (chlorosis) along the leaf vein. Over time, yellowing becomes red-brown, irregular-shaped lesions, and eventually leads to tissue death (Figures 1 and 2). The yellowing around the lesion may begin to spread beyond the vein but will typically be limited to the area within other major leaf veins. The symptoms are generally not uniform across the leaf.

Figure 1. Early SVNV symptoms include yellowing tissue around leaf veins.

Figure 2. As SVNV progresses, the irregular-shaped lesions become red-brown and leaf tissue begins to die.

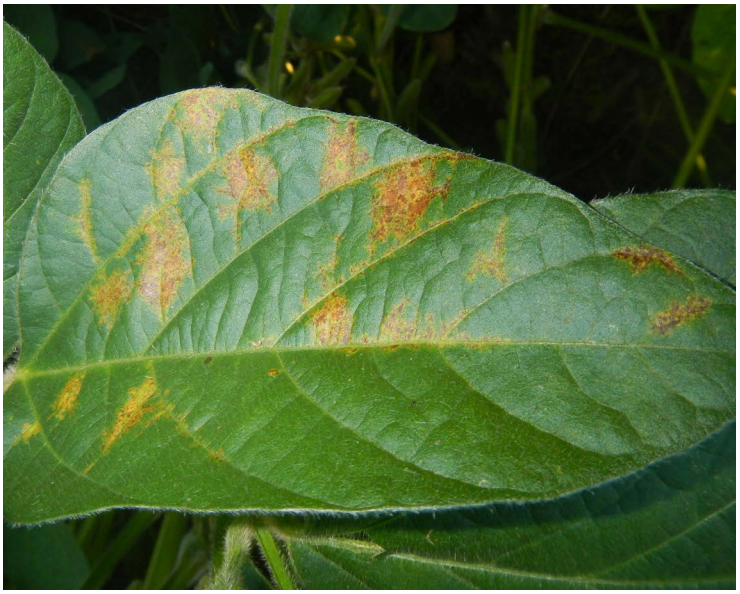

Figure 3. These SVNV lesions have yellow margins that spread from leaf veins.

Figure 4. The underside of this soybean leaf shows vein discoloration from SVNV.

Leaf tissue will die following chlorosis. Lesions typically spread along or from the edge of a vein. The lesions range from ¼ to ½ inch (6 to 12 mm) but can be larger (Figure 3). In affected plants, the veins may appear clear, yellow, or dark brown. Vein discoloration may be especially noticeable on the undersides of leaves (Figure 4).

Although there is little information about soybean varietal response to SVNV, differences in symptoms may be caused by soybean thrips (the insect vector of this disease), which may prefer certain cultivars.

Conditions With Similar Symptoms

Diseases

Several diseases can be confused with SVNV — we describe the seven most commonly confused diseases below. It is important to accurately diagnose SVNV to prevent unwarranted management decisions that will not work against this disease.

Brown Spot (*Septoria glycines*)

Brown spot causes dark brown spots that are scattered on the upper and lower surfaces of leaves in the lower canopy (Figure 5). Adjacent spots can join together to form dead blotches. Late in the season, affected leaves may turn yellow and drop prematurely (Figure 6). Brown spot is very common and is usually one of the first diseases to appear each year.

How to distinguish brown spot from SVNV:
Brown spot lesions are mainly located in the lower canopy and are not associated with leaf veins like SVNV lesions.

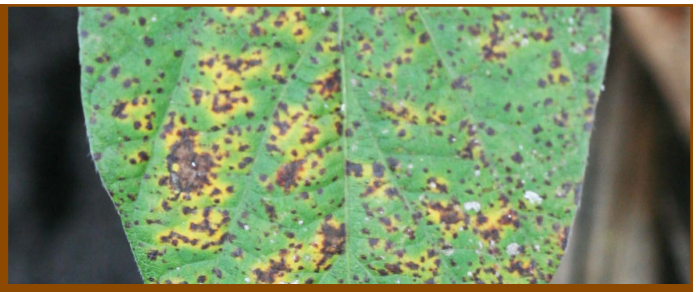

Figure 5. (Top) Brown spot causes dark lesions in the lower canopy.

Figure 6. Leaves with brown spot can begin to yellow and fall from the plant early.

Bacterial Blight (*Pseudomonas savastanoi* pv. *glycinea*)

Bacterial blight causes small, angular, yellow-to-brown spots that are surrounded by yellow halos (Figure 7). The angular spots enlarge and join together to produce large, irregular dead areas. The centers of these dead areas tear away so that infected leaves have a tattered appearance (Figure 8). Bacterial blight is seen on the leaves at the top of the plant. It is common after heavy rains, especially if temperatures remain cool.

How to distinguish bacterial blight from SVNV:
Bacterial blight lesions have yellow halos and are smaller than those caused by SVNV. Leaves affected by bacterial blight appear tattered, unlike those affected by SVNV.

Figure 7. (Top) Yellow halos surround these small, angular bacterial blight lesions.

Figure 8. When bacterial blight lesions die, the tissue separates and the leaves appear tattered.

Bacterial Pustule (*Xanthomonas campestris* pv. *glycinea*)

Bacterial pustule causes small, yellow-green spots with angular, reddish brown centers (Figure 9). You may observe small bumps (pustules) on the undersides of leaf surfaces (Figure 10). Symptoms can be found in the upper canopy. Favorable conditions are high temperatures and above average rainfall.

How to distinguish bacterial pustule from SVNV:
Bacterial pustule is the only common disease in the Midwest that has pustules on the leaf surface.

Figure 9. (Top) Bacterial pustule lesions have reddish brown centers.

Figure 10. A magnified bacterial pustule on the underside of a leaf.

Cercospora Leaf Blight (*Cercospora kikuchii*)

It is easy to confuse a younger SVNV lesion that has not yet formed a distinct lesion with Cercospora leaf blight. Cercospora leaf blight starts as a mottled, purple-to-orange discoloration that becomes orange or bronze (Figure 11). The leaves become leathery in texture. This disease usually occurs on the upper three to four trifoliate leaves and on the upper surfaces of leaves in warm, wet weather. Cercospora leaf blight typically occurs mid- to late season.

How to distinguish Cercospora leaf blight from SVNV:
Cercospora leaf blight symptoms are present only on upper leaf surfaces.

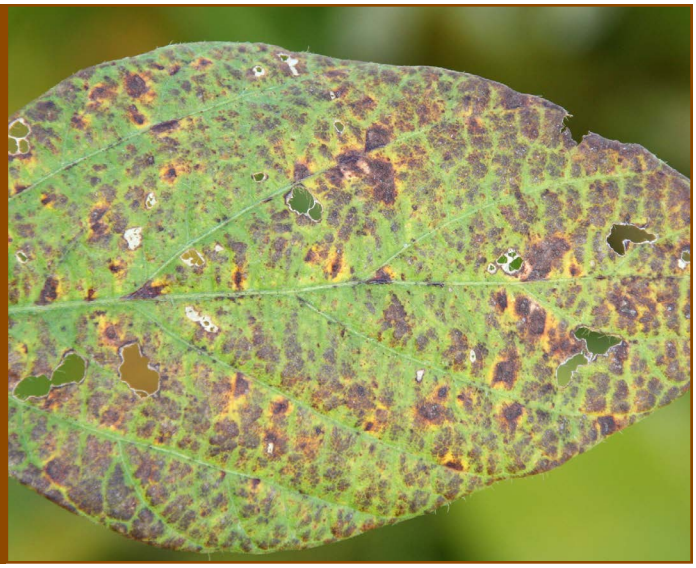

Figure 11. Cercospora leaf blight results in mottled, purple to orange discoloration of the leaf.

Downy Mildew (*Peronospora manshurica*)

Downy mildew causes light green to yellow, irregular-shaped spots on the upper surfaces of the topmost leaves (Figure 12). On the undersides of leaves, the fungus may be seen growing out of the center of the spots (Figure 13).

How to distinguish downy mildew from SVNV:
Downy mildew lesions may have fuzzy fungal growth on the undersides of lesions. Unlike SVNV lesions, downy mildew lesions may not be associated with leaf veins.

Figure 12. (Top) Light green to yellow downy mildew lesions form on leaves in the upper canopy.

Figure 13. Fuzzy growth on the undersides of leaves is a characteristic symptom of downy mildew.

Phyllosticta Leaf Spot (*Phyllosticta sojaecola*)

Phyllosticta leaf spot is a minor disease of soybean. Phyllosticta leaf spot results in circular, irregular- or V-shaped lesions that are gray or tan and have narrow, dark margins (Figure 14). In older lesions, numerous small, black specks may be visible.

How to distinguish Phyllosticta leaf spot from SVNV:
The dark, black fungal structures found in Phyllosticta leaf spot lesions do not appear in SVNV lesions.

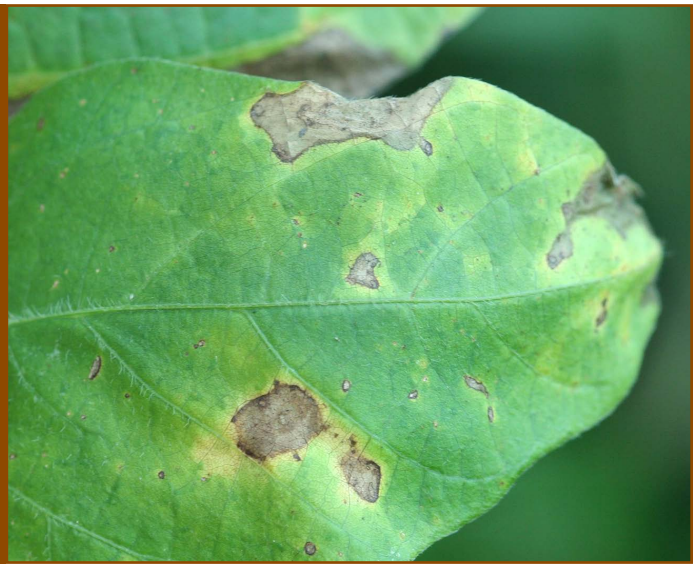

Figure 14. Symptoms of Phyllosticta leaf spot on soybean include irregular lesions with narrow, dark margins.

Sudden Death Syndrome (*Fusarium virguliforme*)

Sudden death syndrome (SDS) symptoms include yellow or dead leaf tissue between the veins of leaflets, while veins remain green (Figure 15). The early yellowing can be confused with SVNV (Figure 16). Leaflets infected with SDS will eventually curl or shrivel and drop off leaving only the petiole.

How to distinguish SDS from SVNV:
Symptoms of SDS occur between the veins rather than on or near the veins.

Figure 15. (Top) Yellow or dead leaf tissue between veins is a symptom of SDS infection.

Figure 16. Early symptoms of SDS include leaf yellowing, which can be confused with SVNV.

Herbicide Damage

SVNV can also be confused with herbicide damage from ALS inhibitor and ACCase inhibitor herbicides.

ALS Inhibitors

ALS inhibitor herbicides are widely used for preemergence and postemergence control for a broad range of weed species in soybean. There are many different herbicide products with this mode of action. ALS inhibitor injury includes stunting, leaf yellowing, inhibition of terminal growth, red veins on the undersides of leaves, and shortened internodes (Figure 17). Damage from ALS inhibitors develops slowly, appearing first on new growth.

How to distinguish ALS inhibitor injury from SVNV:
ALS inhibitor injury symptoms typically appear earlier in the season than SVNV symptoms. Review your herbicide program to determine if carryover from the previous season could occur.

Figure 17. ALS inhibitor herbicides can cause leaf veins to turn red, similar to SVNV.

ACCase Inhibitors

Quizalofop (Assure II®, Targa®) is a postemergence ACCase inhibitor grass herbicide that is commonly used to control volunteer corn and grassy weeds in soybean. Quizalofop can cause damage along the leaf vein that is similar to SVNV symptoms (Figure 18).

How to distinguish ACCase inhibitor injury from SVNV:
Because quizalofop injury is so similar to the symptoms caused by SVNV, it is very important to review the field's weed management program to rule out herbicide injury. Send leaf samples to a diagnostic laboratory to identify SVNV.

Figure 18. The ACCase inhibitor herbicide quizalofop can cause injury along the veins of soybean leaves, making it difficult to differentiate from SVNV symptoms.

Vectors and SVNV

Tospoviruses are transmitted by a group of insects called thrips. To date, as many as 14 thrips species are known to be vectors of *tospoviruses*, but only a smaller subset of these are likely vectors of SVNV. Soybean thrips (*Neohydatothrips variabilis*) have recently been confirmed as a vector of SVNV and additional investigation may reveal other vector species.

Adult thrips are barely visible to the unaided eye (Figure 19). The insect feeds with a rasping-sucking mouthpart that leaves small, dash-like scars on leaves. Thrips development depends on temperature and adult females can survive for three to five weeks.

Figure 19. Adult thrips are very small and slender.

When nymphs emerge from eggs (Figure 20), they can acquire SVNV by feeding on an infected source plant. After pupation, infected adults spread the virus to additional plants. If the virus is acquired by adult thrips, transmission to additional plants is not possible as the virus can only complete its lifecycle when acquired by immature thrips.

Figure 20. Thrips nymphs acquire SVNV when feeding on infected plants.

Eggs from an infected adult do not carry the virus, but the virus may be capable of overwintering in living host weeds and within thrips migrating from the South.

Laboratory Detection

Confirming virus infection is difficult since virus diseases often resemble other foliar diseases or disorders such as herbicide injury or nutrient imbalances. The only way to positively confirm a diagnosis of SVNV (or any virus) is through laboratory testing. The virus is easier to detect in leaf samples with early disease symptoms. Once lesions have turned from yellow to brown, it is difficult to detect the virus in symptomatic tissue. Contact your state's land-grant university or private diagnostic lab for pricing and sampling procedures.

Yield Loss, Economic Impact, Management

If SVNV will limit yields, growers may consider treating soybean with an insecticide to reduce thrips populations; however, we do not currently recommend insecticide applications in response to SVNV detection since vector control of other insect-transmitted diseases has not typically been successful.

Researchers will continue to monitor this disease and assess its potential impact in an effort to determine the best management options. Future recommendations will be developed as we learn more about this disease.

Find Out More

To learn more about soybean vein necrosis virus, visit the Crop Protection Network website (www.cropprotectionnetwork.org) or consult your land-grant institution. Other publications in the Soybean Disease Management series are available by visiting the CPN website or your land-grant institution's website.

Authors

Chris Bloomingdale, University of Wisconsin
Carl Bradley, University of Illinois
Martin Chilvers, Michigan State University
Loren Giesler, University of Nebraska
Russ Groves, University of Wisconsin
Daren Mueller, Iowa State University
Damon Smith, University of Wisconsin
Albert Tenuta, Ontario Ministry of Agriculture and Food
Kiersten Wise, Purdue University

Contributors

Emmanuel Byamukama, South Dakota State University

Anne Dorrance, Ohio State University

Doug Jardine, Kansas State University

Dean Malvick, University of Minnesota

Sam Markell, North Dakota State University

Punya Nachappa, Indiana University-Purdue University, Fort Wayne

Adam Sisson, Iowa State University

Laura Sweets, University of Missouri

Photo Credits

All photos were provided by and are the property of the authors and contributors except: Figure 10 by Alison Robertson, Iowa State University; Figure 18 by Paul Bachi, University of Kentucky Research and Education Center; and Figure 19 by John Obermeyer, Purdue University.

Acknowledgments

This content was originally published as *Soybean Disease Management: Soybean Vein Necrosis Virus* in 2014 as Purdue Extension publication BP-186.

The *Soybean Disease Management* series is a multi-state collaboration sponsored by the North Central Soybean Research Program (NCSRP). Learn more about the NCSRP at www.ncsrp.com.

This publication was developed by the Crop Protection Network, a multi-state and international collaboration of university/provincial extension specialists and public/ private professionals that provides unbiased, research-based information to farmers and agricultural personnel. More information available at www.cropprotectionnetwork.org.

This project was funded in part through *Growing Forward 2* (*GF2*), a federal-provincial territorial initiative. The Agricultural Adaption Council assists in the delivery of *GF2* in Ontario.

The authors thank the United Soybean Board and Grain Farmers of Ontario for their support.

Design and production by Purdue Agricultural Communication.

May 2015