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Calls, photos, and plant samples have been coming in over the last week or so with soybeans exhibiting abnormal growth including leaf cupping and strapping. Some of the symptoms look very similar to soybean mosaic virus (SMV) giving the leaves a somewhat bumpy and rippled appearance (Fig. 1). However, further investigation has yielded clues that the cause of the symptoms is not SMV. Samples coming into the diagnostic lab are actually lacking few symptoms of virus but exhibiting symptoms of growth regulator herbicide injury.

There have been several viruses identified in soybean fields this season in Wisconsin. *Alfalfa mosaic virus* (AMV; Fig. 2) and *Bean pod mottle virus* (BPMV; Fig 3) have both been observed in soybean fields. However, SMV has not yet been identified. This isn't to say that SMV isn't out in fields in Wisconsin, we simply haven't seen symptoms or positively identified the presence of the virus. Keep in mind the following points about these three viruses of soybeans:



Figure 1. Mosaic symptoms on soybean caused by *Soybean mosaic virus*. Photo Credit: Craig Grau.

Soybean mosaic virus

Soybean mosaic virus can be transmitted in seed (Hill, 1999). Aphids can also transmit SMV. Yield loss from SMV infection can be as high as 66-86% in susceptible cultivars (Hill, 1999). Symptoms of SMV can vary from leaf deformation, to more pronounced mosaic symptoms, and reduced pod yield or malformed pods. Symptoms can be less severe at moderate temperatures (~75 F) and non-existent at high temperatures (>86 F). Management includes using SMV-free seed and also planting late.



Alfalfa mosaic virus

Alfalfa mosaic virus is transmitted in low levels in soybean seed (Tolin, 1999). Aphids transmit AMV. Symptoms of AMV can vary from localized dead lesions on leaves, to large areas of yellowing. The impact of AMV infection on soybean yield is unknown (Giesler and Ziem, 2006).

Figure 2. Mosaic symptoms on a soybean caused by *Alfalfa mosaic virus*. Photo Credit: Craig Grau.



Figure 3. Irregular leaf growth as a result of infection by *Bean pod mottle virus*. Photo Credit: Craig Grau.

Bean pod mottle virus

Bean pod mottle virus is transmitted in low levels (0.1%) in soybean seed (Gergerich, 1999). Some perennial weeds have also been found as hosts. Leaf-feeding beetles are vectors of BPMV. Beetles can acquire the virus during feeding and immediately transmit particles (Gergerich, 1999). Management of BPMV includes controlling broadleaf weeds at field edges, utilizing a trap crop for leaf feeding beetles at field edges, and resistant cultivars.

Regardless of the viruses present this year, most symptoms on soybean plants being sent to the diagnostic lab are mostly not indicative of the viruses described above. While symptoms included some bumpiness on the surface, most of the leaves on the plants exhibited cupping, strapping, and shoe-stringing which is more indicative of growth regulator-herbicide injury. In addition, the incidence (number of plants exhibiting



Figure 4. Leaf epinasty and cupping as a result of injury by a growth regulator herbicide. Photo Credit: Craig Grau.

symptoms) within fields this year in Wisconsin is often very high (>75%). Giesler and Ziem (2006) conducted a survey of AMV, BPMV, and SMV in Nebraska in 2001 and 2002. In that survey it was possible to find an occasional field with incidence of these viruses as high as 90-100%. However, the majority of fields that tested positive for one or more of these viruses, had incidence levels of 50% or less. High incidence levels (>50%) are considered unusual for these viruses in soybean fields. Therefore, incidence of leaf cupping or other abnormal leaf growth at incidence levels of 90% or 100% are more likely suggestive of an abiotic disorder, such as herbicide injury.

While insect vectors can transmit these viruses, thereby increasing observed incidence in the field, it isn't likely that insects have played a major role this season in transmission. Soybean aphid populations were approaching economic thresholds in the southern portions of Wisconsin in June and early July. However, once cooler, wet weather moved in, populations have fallen to nearly non-existent. The same has been true for other insect vectors this season. So again it is unlikely that significant transmission of viruses via insect vectors has occurred.

Mild to severe leaf cupping and epinasty are suggestive of damage from a growth regulator herbicide (Fig. 4). Growth regulator herbicides commonly used in corn and other grass crops include 2,4-D, dicamba, and clopyralid. Damage can occur on soybean after being exposed by these herbicides through spray drift during nearby applications or by carryover from an application in a previous crop on the same field. Due to the drought last year, herbicide carryover might be playing a larger role this year than expected following normal growing conditions. Issues from drift this time of year would most likely come from 2,4-D or dicamba products,



Figure 5. “Shoe-stringing” of leaves on a soybean plant.
Photo credit: Damon Smith.

whereas damage from carryover are more likely to be from herbicides containing clopyralid. In addition to herbicide damage from growth regulator herbicides, several samples from counties in the northern soybean production tier of the state have also been sent in exhibiting “shoe-stringing” or “draw-stringing” symptoms (Fig. 5). These symptoms are commonly observed when conditions are cool and wet after chloroacetamide herbicides like *S*-metolachlor, acetochlor, or diamethenamid are used as pre or post-emergence herbicides to soybeans.

To learn more about herbicide carryover visit, <http://corn.agronomy.wisc.edu/Management/pdfs/A3819.pdf>, to download a PDF of a UWEX fact sheet.

To learn more about dicamba injury on soybean click on this link, <http://ipcm.wisc.edu/download/pubsPM/dicamba2004.pdf>.

Information on other types of herbicide injury can be downloaded at this link, http://ipcm.wisc.edu/download/pubsPM/herbicideinjury_new.pdf.

To cross reference herbicides active ingredients present in herbicide and herbicide tank-mix trade names, access the Corn and Soybean Herbicide Chart at this link, <http://ipcm.wisc.edu/download/pubsPM/Herbicide-MOA-CornSoy-3parts.pdf>.

References

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