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### Soybean Seedling Damage: Is There an Interaction Between the ILeVO Seed Treatment and Pre-Emergence Herbicides?

By Kiersten Wise, Purdue University; Daren Mueller, Iowa State University; Yuba Kandel, Iowa State University; Bryan Young, Purdue University; Bill Johnson, Purdue University; and Travis Legleiter, Purdue University

Farmers who were lucky enough to plant soybeans and spray pre-emergence herbicides in between rain events may now be seeing discolored or injured seedlings. Reports of fields with these issues are widespread across Indiana, Iowa, and surrounding areas, and many farmers and crop advisors are questioning if damage is more severe when pre-emergence herbicides are applied to fields that have been planted with seed treated with the new fluopyram fungicide seed treatment ILeVO.

#### Fluopyram fungicide

The fungicide fluopyram (ILeVO; Bayer CropScience) is currently marketed as a seed treatment to manage sudden death syndrome (SDS). This seed treatment can result in a discoloration on soybean cotyledons that can resemble disease or other abiotic stress such as herbicide injury (Fig. 1). The discoloration occurs because the fungicide is moderately systemic within the soybean plant, so it will naturally move to the plants "sinks", the roots and cotyledons. This accumulation can result in phytotoxicity, causing the tips of the cotyledons to turn a yellow-brown color. This necrosis is typically uniform and present on every seedling grown from an ILeVO treated seed; however, environmental conditions may impact the frequency, uniformity and severity of the phytotoxicity observed. The phytotoxicity is not usually found on the unifoliate or trifoliate leaves. Research conducted by several Land Grant Universities and Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) demonstrated that this phytotoxicity, also referred to as a "halo effect", does not result in long-term soybean stunting or yield loss.



**Figure 1: The fungicide fluopyram can cause cotyledons to turn yellow or brown. The fields in these images were not treated with a pre-emergence herbicide. Cool, wet conditions can increase the likelihood of seeing this “halo effect” from the fungicide seed treatment.**

## **Pre-emergence herbicides**

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Pre-emergence herbicides can also cause soybean seedling damage, particularly when cool temperatures coincide with rain soon after seedlings begin to emerge from the soil. Pre-emergence herbicides, typically PPO-inhibitors (flumioxazin, sulfentrazone, saflufenacil; group 14) or photosynthetic inhibitors (metribuzin; group 5), can occasionally be injurious to plants growing in cold, wet soils. Soybeans are typically able to metabolize these herbicides, but when metabolism slows due to stress (i.e. cold temperatures) herbicide injury can occur (Fig. 2). Pre-emergence herbicide injury also occurs when heavy rain events splash concentrated droplets of residual herbicide from the soil onto the emerged seedlings. Spotty necrosis can occur on any exposed portion of the plant where the splash event occurred and metribuzin can cause symptoms similar to the phytotoxicity caused by ILeVO. Pre-emergence herbicide injury is more likely to occur in sandy low organic matter (OM) soils than in loam or clay soils with higher OM. Also, some varieties of soybean are more sensitive to these herbicides than other varieties. Herbicide sensitivity information is available from some, but not all, seed companies.



**Figure 2: Symptoms of PPO-inhibitor herbicide damage on soybean seedlings.**

## **Interaction between pre-emergence herbicides and fluopyram (ILeVO)**

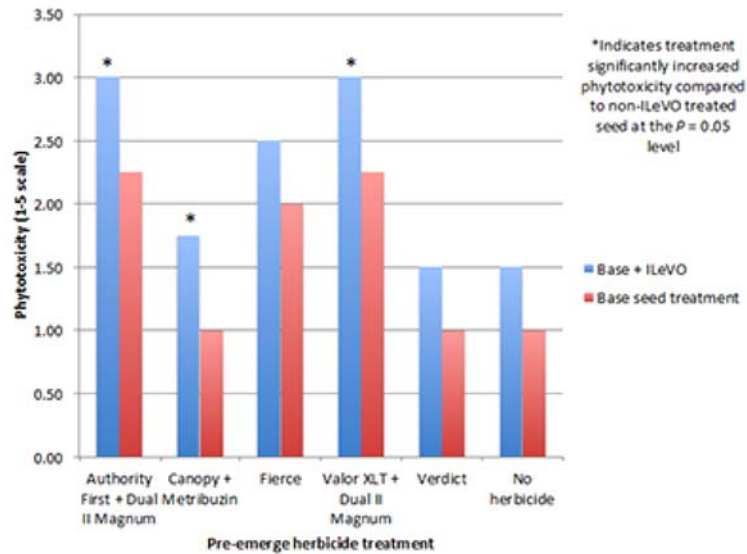
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Research funded by the North Central Soybean Research Program and supported by Bayer Crop Science began in 2014 to determine if phytotoxicity and the “halo effect” of ILeVO was more severe in the presence of pre-emergence herbicides. A trial was established near Wanatah, IN, and common pre-emergence herbicide treatments (Table 1) were applied to plots planted with a base seed treatment + ILeVO, or seed treated with only a base seed treatment (Trilex + Allegiance). The herbicide treatments were selected because of their high potential to cause injury to soybean seedlings. All plots were inoculated with the fungus that causes SDS. Non-herbicide treated checks were included for both ILeVO and base seed treatments. All treatments received a post-emergence application of glyphosate at a rate of 22 oz/A. Data were collected on stand, level of seedling injury (phytotoxicity), a measure of SDS severity (SDS index), and yield.

**Table 1. Pre-emergence herbicides and rates for the 2014 trial near Wanatah, IN.**

Herbicide treatment (group number)	Rate
Authority First (2 & 14) + Dual II Magnum (15)	8 oz + 1.33 pint
Valor XLT (2 & 14) + Dual II Magnum (15)	4.5 oz + 1.33 pint
Fierce (14 & 15)	3.5 oz
Canopy + Metribuzin (2 & 5)	6 oz + 8 oz
Verdict (14 & 15)	5 fl oz
No herbicide treatment (check)	

Phytotoxicity was measured at the emergence-unrolled unifoliate leaves (VE-VC) stage. Phytotoxicity was measured on a 1-5 scale where 1 = healthy seedling, no injury, and 5 = total necrosis of the cotyledon (Fig. 3).



**Figure 3. Phytotoxicity ratings of pre-emergence herbicide treatments for seedlings from ILeVO-treated seed compared to seedlings receiving only Trilex + Allegiance seed treatment in Wanatah, IN, 2014. Ratings were taken at the VE-VC growth stage.**



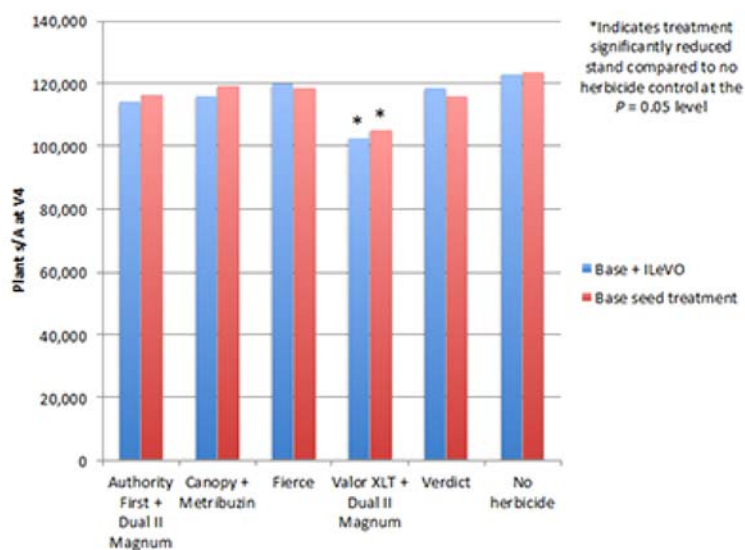
**Figure 4. Seedlings with ILeVO + pre-emergence herbicide treatment**





**Figure 5. Seedlings with base seed treatment + pre-emergence herbicide treatment**

In the 2014 study, increased phytotoxicity was observed in seedlings resulting from ILeVO-treated seed (Fig. 4). Phytotoxicity was more severe than non-ILeVO treated seed with several herbicide treatments (Fig. 5). However, this phytotoxicity did not impact stand by growth stage V4 (Fig. 6).



**Figure 6. Impact of pre-emergence herbicides on soybean stand at growth stage V4 for seedlings with and without ILeVO seed treatment.**

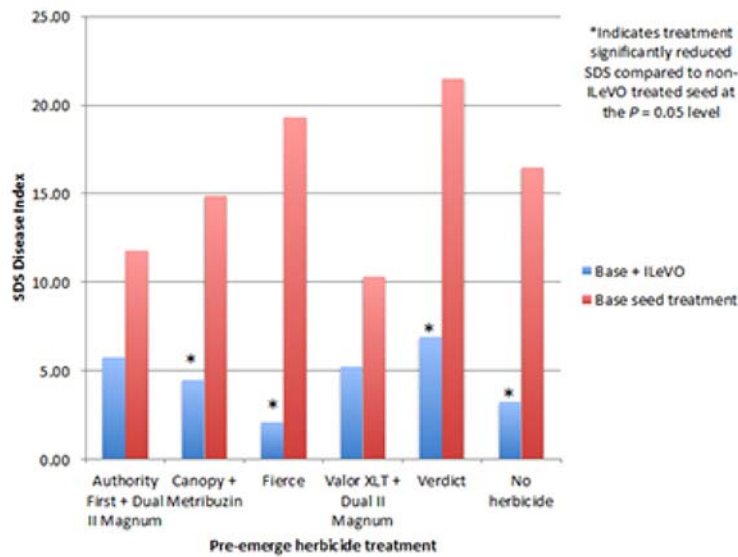


Figure 7. Sudden death syndrome was rated in the trial at growth stage R6. The SDS index is a measure of both SDS incidence and severity and higher index numbers indicate greater amounts of SDS. In 2014, SDS was reduced in treatments that had ILeVO-treated seed.

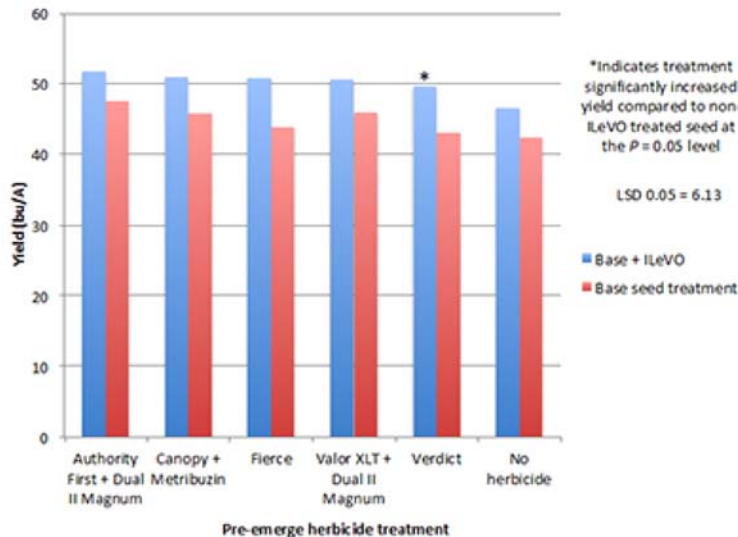


Figure 8. Treatments with ILeVO resulted in an average gain of 5 bu/A compared to the base seed treatment across all treatments.

## Conclusions

This is a one year, one location study, so the results should be interpreted accordingly. However, these preliminary results indicate that although phytotoxicity may be more severe when ILeVO is used with pre-emergence herbicide treatments, there is likely to be no effect on stand, and no reductions in yield. **The conditions that favor the phytotoxicity of the halo effect and pre-emergence herbicide injury are also conditions that favor infection by *Fusarium virguliforme*, the fungus that causes SDS.**

Therefore, if fields that have had a history of SDS and were or will be planted under less than ideal environmental conditions, the inclusion of ILeVO in the seed treatment package may be a benefit that outweighs the short-term injury to seedlings in the cotyledon stage. Furthermore, the use of residual PPO-inhibiting herbicides applied pre-plant or pre-emergence are part of the best recommendations we have for improving management of herbicide-resistant weed species such as waterhemp and Palmer amaranth.

Additional research on the interaction between pre-emergence herbicides and ILeVO seed treatment is underway in Indiana and Iowa in 2015. Early

observations from Iowa and Indiana in 2015 are similar to the 2014 study in Indiana, where ILeVO does cause temporary phytotoxicity and pre-emergence herbicide applications slightly increase this damage. However, although this is visually apparent, preliminary data from 2015 in Iowa indicates that applications of pre-emergence herbicides did not increase damage on seedlings from ILeVO-treated seed when compared to treatments that received no herbicide application. Herbicide by ILeVO interaction was not significant at  $P = 0.10$  for cotyledon damage and plant establishment (Table 2).

**Table 2. Phytotoxicity ratings and plant population at VC growth stage measured at Ames, IA in 2015.** Phytotoxicity was measured on a 1-5 scale where 1 = healthy seedling, no injury, and 5 = total necrosis of the cotyledon.

Herbicide treatment (rate)	Phytotoxicity		No. of plants/sq. meter	
	Base seed treatment*	Base + ILeVO	Base seed treatment	Base + ILeVO
None	1.0	2.0	28.3	26.6
Authority First (7 oz/A)	1.0	2.4	26.0	28.3
Fierce (3 oz/A)	1.1	2.5	23.0	26.4
Verdict (10/A)	1.0	2.4	27.8	27.6
<b>P &gt; F</b>	<b>0.19</b>	<b>0.19</b>	<b>0.05</b>	<b>0.65</b>

\* Base seed treatment is Evergol Energy + Allegiance + Poncho/VOTiVO

Here are a few other observations so far from 2015:

1. The phytotoxicity from ILeVO does appear to be more severe compared to last year. Cool, wet conditions may lead to more phytotoxicity from ILeVO and pre-emergence herbicides.
2. Soybean plants quickly outgrow ILeVO damage on the cotyledons; even a day or two makes a big difference. When we first observed plants at VE, damage appeared quite severe. However, as plants move into VC, the damage is less noticeable because the phytotoxicity does not appear on the unifoliate leaves (Fig. 9). If you are walking your soybean fields and they are at VE, wait a few days to assess the field again. However, injury due to the PPO-inhibiting pre-emergence herbicides may still appear on the unifoliate leaves.
3. Damage from seedling blights such as Pythium root rot, pre-emergence herbicides, and ILeVO can look very similar. ILeVO damage is usually only on the surface of cotyledons, so snap a few cotyledons and look for green on the inside to distinguish from other injuries or diseases. If you are still unsure of the cause of the damage observed, send a sample to a local diagnostic laboratory. Obtaining an accurate diagnosis will allow you to determine the best management strategies for your soybean field.



**Figure 9.** Phytotoxicity due to the ILeVO seed treatment is not commonly observed on the unifoliate leaves. In this image you can see the halo effect on the cotyledon (arrow), but the unifoliate leaves have no injury.

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