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Differentiating 2,4-D and Dicamba Injury on Soybeans

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Adoption of dicamba-resistant soybeans (aka Xtend soybeans) by Indiana farmers is expected to reach 4.5 million acres in 2019. The approval of Xtend soybeans allowed farmers to spray dicamba herbicides postemergence for management of glyphosate-resistant weeds such as horseweed, giant ragweed, waterhemp, and Palmer amaranth. However, the use of this technology resulted in an increased number of herbicide off-target movement complaints across the Midwest from farmers growing non-dicamba tolerant crops. Most of the complaints involved dicamba injury on glyphosate-(Roundup Ready) and glufosinate-(Liberty Link) resistant soybeans, but also affected horticultural food crops and ornamentals.

The approval of Enlist E3 soybean imports by China and the Philippines earlier this year has allowed for full commercialization in the U.S. and provided farmers with another auxin herbicide (2,4-D choline) in their soybean weed management programs. In 2019, acreage planted with Enlist E3 soybeans is expected to be low due to limited seed supply; however, full market launch and increased adoption is expected for 2020. Both 2,4-D and dicamba herbicides can move off-target due to primary and secondary drift as well as tank contamination. With dicamba and 2,4-D being auxin herbicides, their symptoms on susceptible soybeans may appear similar at first glance. Differentiating between 2,4-D and dicamba symptomology will become increasingly important for farmers and ag professionals as they evaluate complaints of off-target movement of these two herbicides.

Let's first look at how the symptoms of 2,4-D and dicamba are similar. At the field application rate, both dicamba and 2,4-D will cause injury symptoms such as leaf droop and stem twisting, also known as epinasty (Figure 1A). These symptoms will develop quickly after exposure to 2,4-D (within 1 to 2 hours); however, it may take several hours for these symptoms to develop after exposure to dicamba. There are only two practical ways to separate 2,4-D and dicamba at high levels of exposure on soybeans. The first way is by checking records of what was applied. The second way is to look for a gradient of herbicide injury with progressively less injury moving away from the application source.

It's at lower levels of exposure, often associated with drift, that dicamba and 2,4-D symptoms can be distinguished (Table 1). Symptoms that are characteristic of low levels of exposure to 2,4-D during vegetative growth stages include: 1) Stem twisting and leaf droop (Figures 1A and 1E); 2) Leaf strapping (Figures 1B, 1C, and 1D); and 3) Callous tissue formation on the soybean stem (Figure 2). Soybean plants will continue to grow even after fairly high doses of exposure to 2,4-D.

In contrast to 2,4-D, stem twisting and leaf droop may not occur at lower levels of dicamba exposure. Injury symptoms that are characteristic of low levels of dicamba exposure during vegetative growth stages include: 1) leaf cupping (Figure 3), which may persist for several weeks after exposure; 2) Increased number of nodes, which according to research articles does not translate to yield increases; and 3) Height reduction and death of apical meristem (Figure 4), which typically occur only at higher doses of exposure (equal to or greater than 1% and 10% of field rate, respectively). The dicamba injury symptoms listed above may take one to three weeks to develop, depending on dose of exposure and environmental conditions.

Although it is not the objective of this article to discuss potential yield reduction from off-target movement of these herbicides, it is important to understand that soybeans are more sensitive to dicamba than 2,4-D. It requires higher doses of 2,4-D to cause the same levels of injury caused by off-target movement of dicamba. Differences in soybean injury levels and yield reduction in response to 2,4-D and dicamba exposure from a multi-state study are described in Table 2. Keep in mind that the level of injury and yield reduction in response to these herbicides will vary depending on time of exposure and the environmental conditions after exposure. Therefore, it is difficult to accurately predict soybean yield reduction from visual injury ratings.

In conclusion, differentiating 2,4-D and dicamba symptomology is challenging, however, subtle differences do exist. These differences are key for accurate herbicide injury diagnostics.

2,4-D Injury on Soybeans

Figure 1. Soybean injury in response to 2,4-D (10% of Enlist One™ field rate). Leaf strapping and stem twisting are characteristic symptoms of exposure to 2,4-D. Notice that strapped soybean leaves show parallel veins.

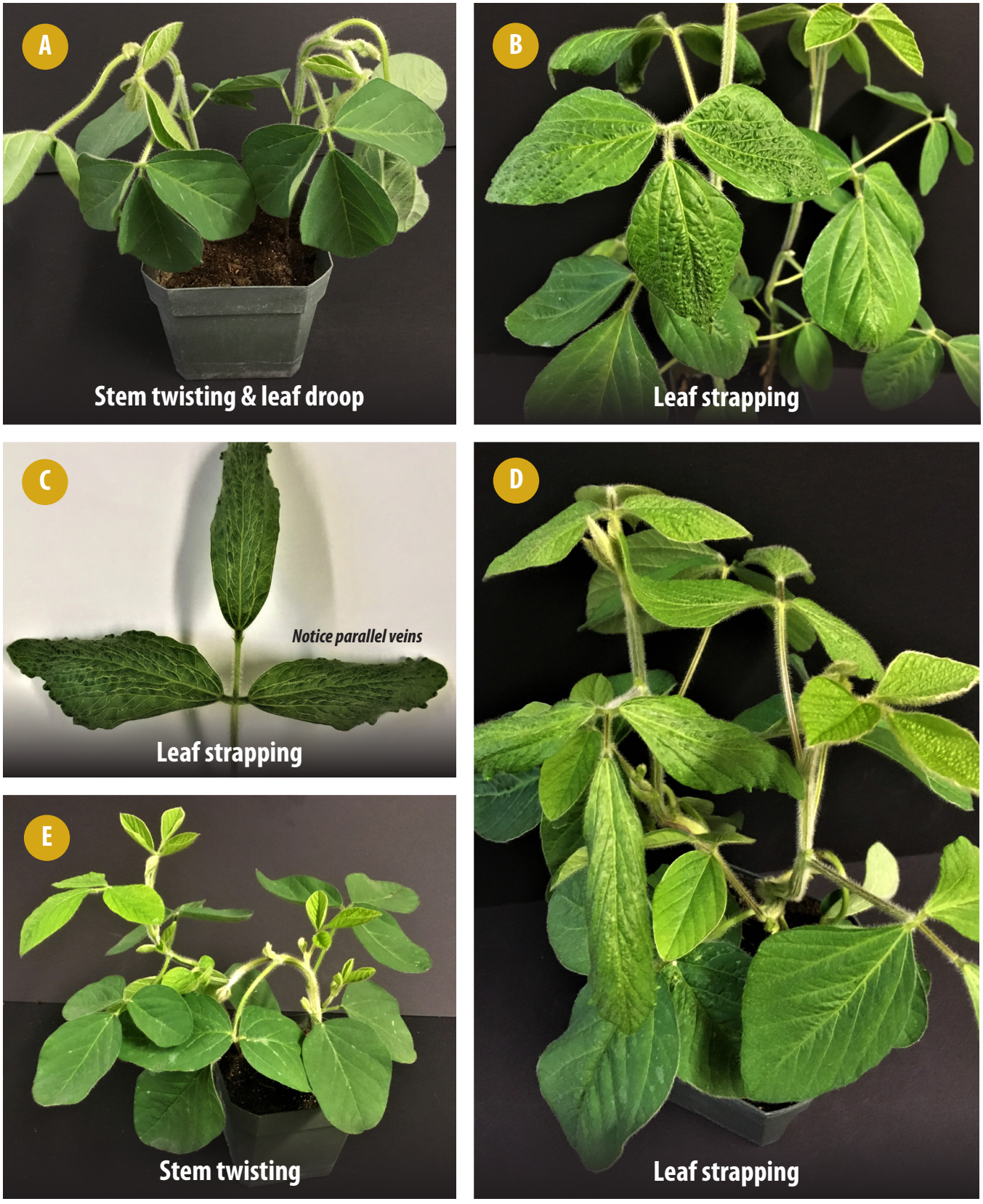
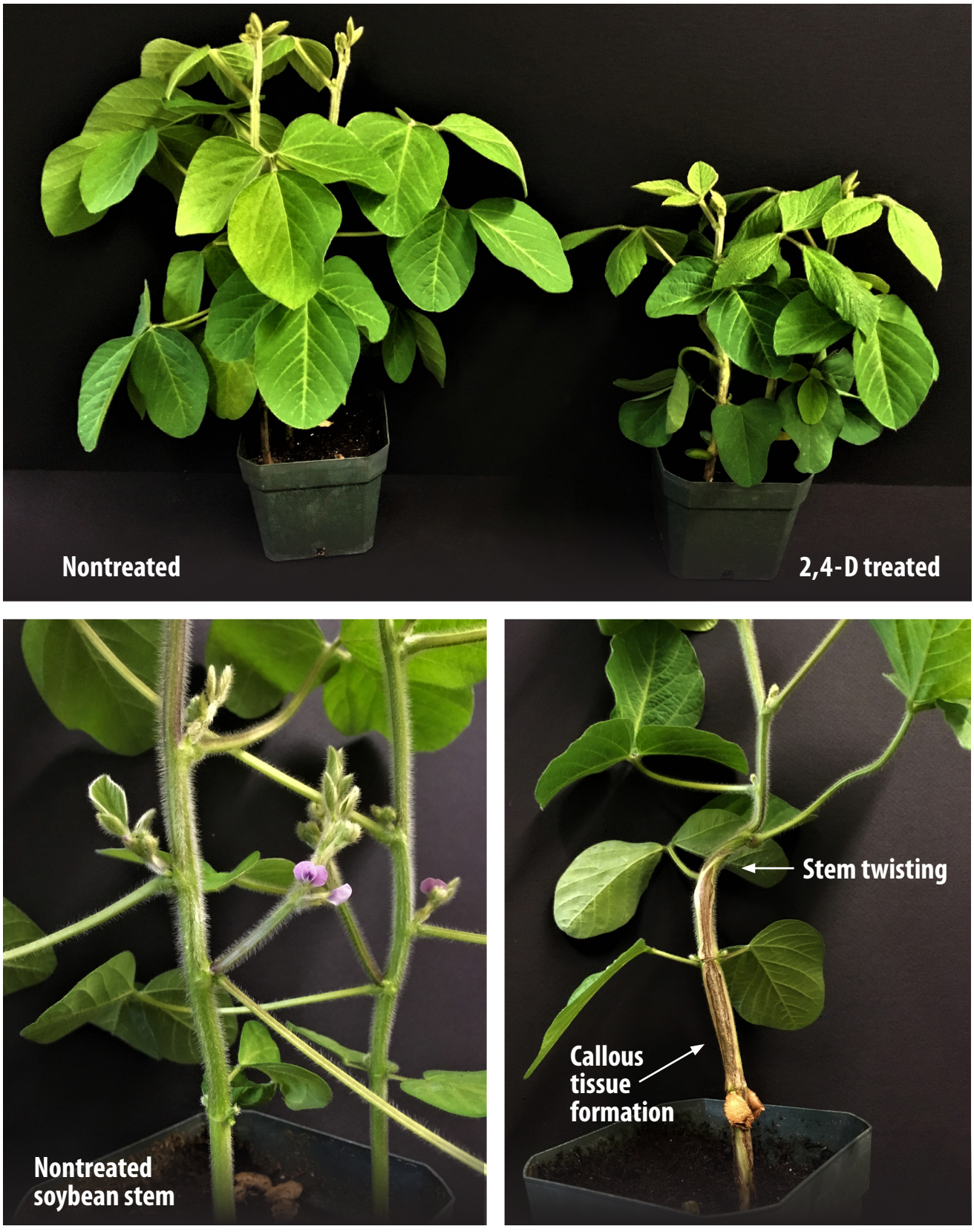


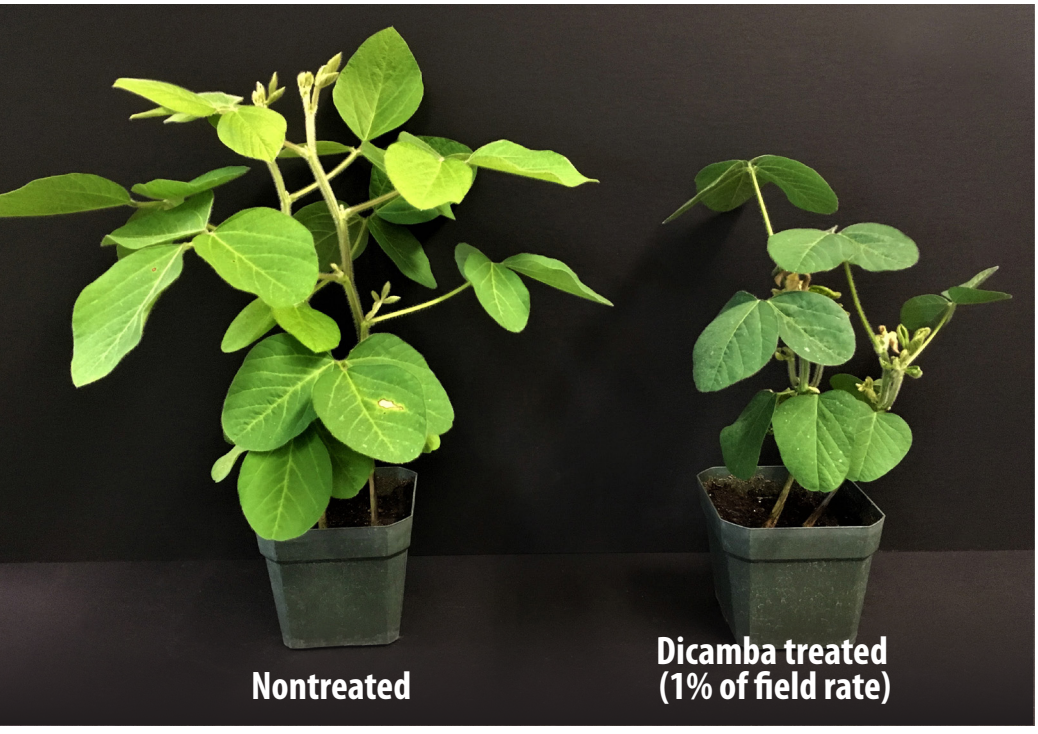
Figure 2. Soybean injury in response to 2,4-D (10% of Enlist One™ field rate) three weeks after treatment. Callous tissue formation on soybean stems can be observed about a week after exposure, depending on dose and environmental conditions.

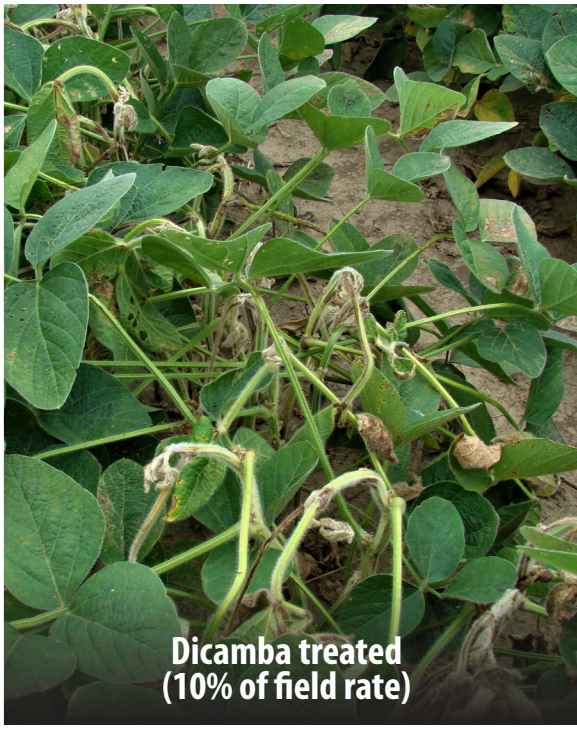


Dicamba Injury on Soybeans

Figure 3. Soybean injury in response to dicamba (0.2% of XtendiMax® field rate) 14 days after treatment. Symptoms can persist for several weeks after exposure as these plants continue to set new growth. Notice that the cupped soybean leaves have a whitish to yellow leaf tip, which is another distinguishing feature of dicamba exposure.

Figure 4. Soybean height reduction at 1% of XtendiMax® field rate (left) and apical meristem death at 10% of XtendiMax® field rate (right) in response to dicamba 14 days after treatment. Notice that soybean plants may show a darker green color and more axillary nodes in comparison to nontreated plants.





Soybean Sensitivity to 2,4-D and Dicamba

Table 1. Differences in symptomology between off-target movement of 2,4-D and dicamba during vegetative growth.

Symptom	*Dicamba*	*2,4-D*
Stem twisting and leaf droop	Requires high levels of exposure associated with tank contamination or direct application.	Low and high doses.
Leaf cupping	Yes. Cupping will occur at very low doses (Figure 3 - Notice whitish/yellowish edges of cupped leaves).	No
Leaf strapping	Not typical	Yes (Figure 1B, 1C, and 1D – Notice parallel veins of strapped leaves).
Stem callous tissue formation	No	Yes (Figure 2).
Height reduction	Yes (Figure 4). Requires dose equal to or greater than 1% of field rate.	Requires high levels of exposure associated with tank contamination or direct application.
Apical meristem death	Yes (Figure 4). Requires dose equal to or greater than 10% of field rate.	Apical meristem continues to grow even at fairly high levels of exposure.
Increased number of nodes	Yes. Soybean plants may produce more axillary branches as a result of apical meristem death. No yield increase has been documented in research experiments.	No

Table 2. Soybean injury 14 days after treatment and yield reduction in response to 2,4-D and dicamba exposure at V2 and R1 growth stages.[1]

Herbicide	Rate (%)	Visual Injury (%)		Yield (Bu/acre)	
		V2	R1	V2	R1
Nontreated	—	0	0	56	56
Dicamba[2]	10	76	71	33	14
	1	49	31	50	42
	0.1	32	22	53	49
	0.01	12	9	54	51
2,4-D[3]	50	83	74	21	22
	5	18	18	49	46
	0.5	6	2	56	56
	0.05	4	1	57	55

[1] Data pooled across 9 site-years in a multi-state study funded by the United Soybean Board (USB).
[2] Dicamba rate as a percentage of the field labeled rate of XtendiMax® (22 oz/A).
[3] Rate of 2,4-D as a percentage of the field labeled rate of Enlist One™ (32 oz/A).

Table 2 illustrates the differences in soybean sensitivity to 2,4-D and dicamba. Notice that it takes a higher rate of 2,4-D to cause the same level of injury and yield reduction caused by dicamba exposure. Timing and dose of exposure, as well as environmental conditions following exposure, will influence the potential yield loss from off-target herbicide movement.

References

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