7-1-2002

Dicamba and soybean yields

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Abstract
The widespread use of dicamba in corn, combined with the high sensitivity of soybean to this herbicide, results in numerous examples of soybean injury each year. Although there is evidence that soybean may develop cupped leaves typical of dicamba or other growth regulator herbicides in the absence of these chemicals, the majority of fields exhibiting abnormal leaf growth involve a growth regulator herbicide.

Keywords
Agronomy

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences | Weed Science

INTEGRATED CROP MANAGEMENT

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The widespread use of dicamba in corn, combined with the high sensitivity of soybean to this herbicide, results in numerous examples of soybean injury each year. Although there is evidence that soybean may develop cupped leaves typical of dicamba or other growth regulator herbicides in the absence of these chemicals, the majority of fields exhibiting abnormal leaf growth involve a growth regulator herbicide.

When dicamba injury occurs, whether from spray drift, volatilization or sprayer contamination, the common question is, "How much will yields be affected"?' As with any source of crop stress, it is impossible to accurately predict yield loss potential from dicamba injury that happens early in the growing season. This article summarizes results of controlled studies on the effect of dicamba on soybean yields to help evaluate situations that occur in the field.

Soybean leaf cupping can be triggered by growth regulator herbicides.

Enlarge [1]

One of the best studies was conducted by Behrens and Leushen at the University of Minnesota (Behrens, R. and W.E. Lueshcen. 1979. Dicamba volatility. Weed Science 27: 486-493). Quarter-acre plots of corn were planted within soybean fields and treated with the dimethylamine salt of dicamba (Banvel). They reported that significant injury to soybean due to volatilization from cornfields could occur up to 3 days after application. In one of five experiments, they observed minor injury due to volatilization on the 4th day after application. Rainfall events after application greatly reduced vapor movement of dicamba. I suspect that volatilization could occur at longer periods after application when large acreages of corn are treated (rather than a quarter acre as in these studies), but the greatest risk is in the first few days after application.

The researchers reported that low levels of foliar injury (leaf cupping) did not influence yield potential (Table 1). Soybean injury was evaluated 3 weeks after dicamba drift by using a scale of 0 (no injury) to 100 (complete kill). Slight leaf malformations (injury rating of 10) were observed up to 200 ft downwind of treated corn. More severe injury was observed closer to the corn (injury ratings of 60-70), with terminal bud kill and axillary bud release resulting in short, bushy beans and delayed maturity. Significant yield losses were not observed unless severe early-season injury was observed.

Weidenhamer and coworkers (Dicamba injury to soybean. 1989. Agronomy Journal 81: 637-643) concluded that there was no yield reduction without height reduction, regardless of foliar

symptoms. "Yield reductions greater than 10 percent were indicated by severe morphological symptoms of injury, such as terminal bud kill, splitting of the stem, swollen petioles, and curled, malformed pods. Symptoms such as crinkling and cupping of terminal leaves occurred at rates much lower than those required to cause yield reductions."

A third study was conducted in South Dakota during the mid-70s by Auch and Arnold (Dicamba use and injury on soybeans in South Dakota. 1978. Weed Science 26: 471-475). They reported that the yield response varied widely from year to year, and that exposure of soybean to dicamba during the bloom stage is much more likely to affect yields than exposures made during the vegetative stage of growth.

The most recent study was conducted in Kansas (Al-Khatib, K. and D. Peterson. 1999. Soybean response to simulated drift from selected sulfonylurea herbicides, dicamba, glyphosate and glufosinate. Weed Technology 13: 264-270). Dicamba was applied to soybean at the V2-V3 growth stage at 1/100, 1/33, 1/10, and 1/3 of the label rate (16 ounces per acre). Experiments were conducted in 1997 and 1998. Data presented in Table 2 are averaged over the 2 years because results were similar. Visual injury ratings were higher 30 days after application (DAA) than at 7 DAA. As would be expected, the level of injury increased with increasing rates. The lowest rate resulted in 35 percent visual injury 30 DAA, but yields were reduced only by 2 percent. The 1/33 rate (0.5 ounces of Banvel) resulted in a 10 percent yield loss. Several other herbicides (Beacon, Basis, Exceed, Roundup, and Liberty) were evaluated at equivalent fractions of their label rates (data not shown). Dicamba was the most injurious of the herbicides evaluated. Roundup and Liberty did not affect yields at 1/3 of the label rate, whereas Beacon and Accent caused less than a 20 percent yield loss at this rate. Exceed was the second most damaging herbicide, but the yield loss differed significantly between the two years. In 1997, the 1/3 rate of Exceed reduced soybean yields approximately 35 percent, whereas in 1998 an 85 percent loss occurred.

In summary, dicamba injury to soybean is a common problem throughout Iowa in most years. Research has shown that minor distortion of soybean leaves that occurs before bloom usually will not affect soybean yields. However, each situation is different and it is impossible to predict the final impact on yield from symptoms that develop shortly after application. Remember that other factors can induce symptoms typical of dicamba, complicating diagnosis of this problem. I suspect that the cupping that frequently shows up following early-season postemergence applications on soybean is merely a cosmetic response as reported in the above-mentioned research with dicamba, although I am unaware of any research on this response.

Table 1. Relationship between early-season dicamba injury and yields of two soybean varieties.

Soybean Injury Rating (3 WAA)	% Yield Loss[a]	
	Corsoy	Hodgson
0	0	0
10	0	(2)
20	(4)	(2)

30	2	(2)
40	(2)	5
50	8	11
60	(4)	16
70	--	23
LSD	NS	14

NS, not significant; WAA, weeks after application.

[a] Yield in parentheses indicates increased yield compared with untreated control.

Source: Weed Science (1979) 27: 486-493.

Table 2. Response of soybean to simulated dicamba drift.

Fraction of Label Rate[a]	% Visual Injury 7 DAA	% Visual Injury 30 DAA	% Height Reduction 60 DAA	% Yield Loss
1/100	18	35	15	2
1/33	23	50	27	10
1/10	33	70	50	45
1/3	70	95	63	80

[a]Label rate:16 ounces of Banvel/acre; 0.5 lb of dicamba/acre.

Source: Weed Technology (1999) 13: 264-270.

This article originally appeared on page 130 of the IC-488(15) -- July 1, 2002 issue.

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