

Validation Model to Predict Soybean Yield Loss Associated with Dicamba Exposure

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Objectives

- To quantify the severity of injury for fourteen injury criteria as influenced by dicamba rate and soybean growth stage.
- To determine relationship between severity of injury for each criterion and yield and to develop a model to predict yield loss.
- **To validate the model and develop a software package/APP for use in yield loss prediction.**



Value of Yield Prediction Models?

- Any knowledge that a grower would have related to off-target movement of dicamba on crop yield in real time could be helpful in decisions regarding replanting, additional crop inputs, crop insurance claims, and liability issues.
- Tissue sampling does not appear to be the answer other than possibly verifying that plants were exposed
- Symptomology observed with plants exposed to dicamba is a “tell-tale” sign and auxin herbicides will always “tell on you”!



Value of Yield Prediction Models?

- Currently the only method of predicting soybean yield loss associated with dicamba exposure is through one's "gut feeling" or a "SWAG".
- I am aware of several instances where the grower was told that the crop was lost following exposure to dicamba and the crop recovered with minimal yield loss.
- Matt's research has shown that soybeans exposed at the vegetative stage to low rates of dicamba can compensate by increased branching; exposure after flowering does not allow enough growing season for plants to recover.

Variables Included in Models to Predict Soybean Yield Loss in Order of Selection

V3/V4 exposure		R1/R2 exposure	
7 DAA	15 DAA	7 DAA	15 DAA
overall visual height reduction (%)	lower stem lesions/cracking (0-5)	overall visual height reduction (%)	lower stem lesions/cracking (0-5)
lower leaf soil contact (0-5)	overall visual height reduction (%)	lower stem lesions/cracking (0-5)	terminal leaf chlorosis (0-5)
lower stem lesions/cracking (0-5)	terminal leaf epinasty (0-5)	leaf petiole droop (0-5)	leaf petiole base swelling(0-5)
canopy height (inches)	leaf petiole droop (0-5)	upper canopy leaf inversion (0-5)	stem epinasty (0-5)
overall visual injury (%)	leaf petiole base swelling (0-5)	leaf petiole base swelling (0-5)	terminal leaf necrosis (0-5)
upper canopy leaf surf. crinkling (0-5)	stem epinasty (0-5)	stem epinasty (0-5)	terminal leaf cupping (0-5)

Validation of Models

- Experiments conducted in Baton Rouge and St. Joseph, LA in 2016 using 'Asgrow 4835', an indeterminate MG 4.8 cultivar
- Dicamba formulation, rates, and application timings same as used to develop the models
 - Clarity (diglycolamine salt) at 1/64 to 8 oz/A (1/1024x to 1/2x) plus 0.25%v/v NIS
 - V3/V4 (third/fourth node with 2/3 fully expanded trifoliates) and R1/R2 (open flower at any node on main stem/open flower at one of the two uppermost nodes on main stem)



Validation of Models (Continued)

- Data were collected for the six variables specified by the model for each application timing and DAA.
- Plots harvested to determine yield; nontreated yields of 67 Bu/A at Baton Rouge and 82 Bu/A at St. Joseph.
 - Percent yield reduction vs. nontreated was calculated for each dicamba rate.
- Using the models (equations), yield for each dicamba rate was predicted and percent yield reduction vs. nontreated was calculated.
- To test the models, predicted percent yield reduction for each dicamba rate was compared to actual percent yield reduction.



Validation Study Results Averaged Across Locations

15 DAA for V3/V4 Application

Dicamba rate (oz/A)	Average actual yield (Bu/A) / percent yield reduction	Average predicted percent yield reduction	Difference between predicted and actual yield reduction (percentage points)
0	74.3	--	--
1/64 (1/1024 x)	66.1/11%	12%	+1
1/32 (1/512 x)	63.1/15%	17%	+2
1/16 (1/256 x)	59.7/20%	20%	0
1/8 (1/128 x)	56.5/24%	22%	-2
0.25 (1/64 x)	52.8/29%	37%	+8
0.5 (1/32 x)	50.4/32%	52%	+20
1 (1/16 x)	41.7/44%	72%	+28
2 (1/8 x)	18.9/75%	89%	+14
4 (1/4 x)	7.6/90%	99%	+9
8 (1/2 x)	0/100%	99%	-1

Avg =
+1.8

Avg =
+21

Prediction Equation: $Y = \text{Intercept value} - 4.08 \text{ (lower stem lesions/cracking)} - 0.46 \text{ (percent height reduction)} + 5.38 \text{ (terminal leaf epinasty)} - 5.92 \text{ (leaf petiole droop)} + 4.21 \text{ (leaf petiole base swelling)} - 3.77 \text{ (stem epinasty)}$.

Validation Study Results Averaged Across Locations

15 DAA for R1/R2 Application

Dicamba rate (oz/A)	Average actual yield (Bu/A) and percent yield reduction	Average predicted percent yield reduction	Difference between predicted and actual yield reduction (percentage points)
0	73.8	--	--
1/64 (1/1024 x)	64.8/12%	16%	+4
1/32 (1/512 x)	61.8/16%	18%	+2
1/16 (1/256 x)	58.7/21%	27%	+6
1/8 (1/128 x)	54.3/26%	30%	+4
0.25 (1/64 x)	41.9/43%	36%	-7
0.5 (1/32 x)	32.6/56%	60%	+4
1 (1/16 x)	16.3/78%	77%	-1
2 (1/8 x)	8.9/88%	88%	0
4 (1/4 x)	4.8/94%	97%	+3
8 (1/2 x)	0/100%	97%	-3

Avg =
+ 1.2

Prediction Equation: $Y = \text{Intercept value} - 10.37 \text{ (lower stem lesions/cracking)} - 3.92 \text{ (terminal leaf chlorosis)} - 4.68 \text{ (leaf petiole base swelling)} + 3.90 \text{ (stem epinasty)} - 2.46 \text{ (terminal leaf necrosis)} - 1.70 \text{ (terminal leaf cupping)}$

Results - Validation Study



- Ability of the models to predict soybean yield loss was greater 15 days after dicamba application compared with 7 days (data not shown).
- **V3/V4 exposure 15 DAA of dicamba at 1/64 to 0.25 oz/A**
 - Average actual yield loss was of 11 to 29%.
 - The model underestimated average actual yield reduction by 2 percentage points or overestimated by as much as 8 percentage points.
 - Average difference in percentage points between predicted and actual yield was 1.8.
- **R1/R2 exposure 15 DAA of dicamba at 1/64 to 8 oz/A**
 - Average actual yield loss was of 12 to 100%.
 - The model underestimated average actual yield reduction by as much as 7 percentage points or overestimated by as much as 6 percentage points.
 - Average difference in percentage points between predicted and actual yield was 1.2.

Next step – Develop field diagnostic procedure and software package/App

Field Visit to Address the Problem

- Confirm that soybean injury is due to dicamba.
- Determine when exposure occurred:
 - Plants in vegetative stage = vegetative exposure
 - Cupping of leaves in upper canopy and accompanying pale leaf margins in moderate to severe range = vegetative exposure
 - Cupping of terminal leaves (rather than the upper canopy leaves) in moderate to severe range and whitish appearance of canopy due to leaf rollover = reproductive exposure
- Estimate days after exposure (7 days or less or 15 days or more).
- Enter data as requested

Data Entry

Questions asked and data to be entered?

- When did exposure occur?
 - Vegetative or reproductive growth stage
- How long has it been since exposure occurred?
 - 7 days or less or 15 days or more
- For the following injury criteria provide a severity rating on a 0 to 5 scale with 0= no injury; 1= slight; 2= slight to moderate (producer concern); 3= moderate; 4= moderate to severe; and 5= severe.
 - For overall visual height reduction, compare plants in the affected area to those in the same field not affected and enter a value from 0 to 100%.
- As a guide, photos will be provided for each injury criterion with severity ratings assigned.

Results Obtained

- Output received
 - “Based on the information entered predicted soybean yield loss may be as high as x%.”
- Some common sense will have to be used if injury varies across the field.
 - The field may have to be subdivided with data entered for each sub-area to obtain an average yield loss for the field.
- A software package is under development.



Questions for Matt and Jim?

