

Australia Field Trial

RESEARCH UPDATE / MAY 2018

Large-Scale Field Trial of XtendiMax with VaporGrip Technology Confirms Volatility is Not a Major Factor in Dicamba Off-Target Movement.

OVERVIEW

Extensive pre-launch testing of Monsanto's XtendiMax Herbicide with VaporGrip Technology (XtendiMax) confirmed that the formulation reduces volatility potential by 90 percent compared to older formulations. Monsanto research, data, and analysis from multi-year and environment testing confirms that volatility from applied XtendiMax is minimal and does not result in substantial movement from the applied area.

Starting in December 2017, Monsanto scientists used the methodology described below to conduct a trial on nearly 40 acres of soybeans in eastern Australia. Researchers from the University of Nebraska collaborated in performing the study, and weed scientists from Mississippi State University and Purdue University provided input into the methodology. The results of the study further confirm the low volatility potential of XtendiMax.

Conducting the trial in Australia, where the temperatures reached 106°F during the three-day duration of the study, allowed researchers to test XtendiMax in extreme conditions. The team also detected nightly temperature inversions after application, which can increase risk of off-target movement.

Together with data from extensive Good Laboratory Practice (GLP) studies conducted in Texas and submitted to the U.S. EPA, this Australia study confirms the following:

1. Dicamba volatility is a minor component of off-target movement; total mass loss is extremely low (\leftarrow 0.2%; see Figure 2)
2. Results from commercial-scale applications made under high-heat conditions are consistent with results from previous GLP studies conducted in Texas and elsewhere in the United States [see Figure 2]
 - a. Air temperatures \rightarrow 100°F do not increase volatility, of XtendiMax, relative to reported conclusions from previous U.S. studies
 - b. Results from 36-acre applications are consistent with previous studies conducted over 4 to 10 acres; therefore, small-scale field flux results are representative of large-scale commercial applications
3. Peak volatility occurs within 24 hours of application [see Figure 2]
4. Off-target dicamba air concentrations are not sufficient to result in widespread plant symptomology [see Figure 3]

STUDY DETAILS

- Location: Rowena, NSW, Australia
- Nozzles: TeeJet TTI 11004 @ 20" spacing
- Tank Mix: Roundup Powermax (32 oz/ac), XtendiMax (22 oz/ac), and Intact (0.5% v/v)
- Plot Size: 1260 ft x 1280 ft
- Spray Volume: 15 gal/ac
- Boom Height: 24 inches above canopy
- Wind Direction and Speed: From the north at approx. 6 to 8 mph
- Sprayer: John Deere 8335R with 80' boom
- Ground Speed: 9.9 mph

FLUX

Flux is the rate of dicamba volatility. Flux represents the mass of dicamba that is lost per unit area over time, reported in units of $\mu\text{g}/\text{m}^2/\text{second}$. Flux results can also be presented on a percent (%) of applied basis. Reporting on a percent applied basis enables standardization and comparison across studies that may utilize different application rates, sample period durations, or field sizes, and therefore takes these variables into account. Measurements of dicamba air concentrations, wind speed/direction, and temperatures from various heights are required to determine flux.

METHODOLOGY

A counter-season flux study was conducted in Australia to measure flux for commercial-scale dicamba applications (~ 40 acres) and under high heat environmental conditions ($\rightarrow 100^{\circ}\text{F}$). To measure flux under these conditions, and to be consistent with previous GLP field volatility studies, researchers collected air samples at 5 heights (0.15, 0.33, 0.55, 0.9, and 1.5 m) in the center of the treated area. Samples were collected from seven time periods during the study. Sample periods were approximately 0-6, 6-12, 12-24, 24-36, 36-48, 48-60, and 60-72 hours post application. Additionally, wind speed/direction and temperature were continuously monitored at four heights (0.33, 0.55, 0.9, and 1.5 m) for the duration of the study (3 days). The layout of the Australia field flux study is provided in Figure 1.

RESULTS & DISCUSSION

The results reaffirmed that most dicamba is detected in the first 24 hours, and by 72 hours after application, detected concentrations are very low. Indeed, dicamba is either readily absorbed by plant tissue or degraded by soil microbes, which further reduce the amount of dicamba that could potentially volatilize. The results from this study were within the range of previous field flux studies and confirmed that volatility is not a significant contributor to off-target movement.

The flux data measured in Australia for a tank mix of XtendiMax + Roundup PowerMax + Intact, on a percent of applied basis, was consistent with flux measurements for XtendiMax + Roundup PowerMax from Texas in 2016 (see Figure 2). The results of this Australia trials, combined with results from various other trial locations, including Texas (see Figure 2), confirm that even under extreme conditions (max air temperature of 106°F ; see Table 1), only small amounts of dicamba are lost, within the sprayed area, due to volatility ($\leftarrow 0.2\%$). Furthermore, only a small fraction of the dicamba lost to volatility moves off-target due to vertical mixing and rapid degradation in the environment (see Figure 3).

In Texas, the cumulative mass of dicamba that was lost due to volatility was $\leftarrow 0.2\%$; in Australia, the cumulative mass loss was $\leftarrow 0.1\%$ (see Figure 2). These flux results, when used with EPA air dispersion models, indicate that dicamba off-target air concentrations are not sufficient to result in widespread symptomology (see Figure 3). Together, these results from the commercial-scale Australia study and the GLP Texas field flux studies confirm the following:

1. Dicamba volatility is a minor component of off-target movement; total mass loss is extremely low ($\leftarrow 0.2\%$; see Figure 2)
 2. Results from commercial-scale applications made under high-heat conditions are consistent with results from previous GLP studies conducted in Texas and elsewhere in the United States (see Figure 2)
 - a. Air temperatures $\rightarrow 100^{\circ}\text{F}$ do not increase volatility, of XtendiMax, relative to reported conclusions from previous U.S. studies
 - b. Results from 36-acre applications are consistent with previous studies conducted over 4 to 10 acres; therefore, small-scale field flux results are representative of large-scale commercial applications
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NOTE REGARDING AIR CONCENTRATION DATA AND ACCURATE MEASUREMENTS OF VOLATILITY

Air concentration alone is important for studying symptomology and relating plant observations to potential exposure. In fact, we utilize our measured flux rates in standard EPA dispersion models to estimate air concentrations outside the application area. However, air concentrations alone are not sufficient to characterize volatility. To determine a rigorous measure of volatility potential, high quality data on wind speeds and air temperatures at several heights above the application area are also required to determine flux. This then enables the following:

1. A robust estimate of volatility rate
2. Determination of the amount of vapor that could be transported downwind (flux is a key input variable for air dispersion modeling)
3. Comparison of volatility across regions, locations, field sizes, or formulations