USE OF AUXIN HERBICIDES AS A WEED MANAGEMENT TOOL

FOREWORD

Restrictions and requirements pertaining to the use of auxin herbicides on auxin-resistant [AR] crops are in flux. Therefore, the content of this White Paper will be revised as updates become available.

At this time, there is ongoing debate surrounding the use of auxin growth-regulating herbicides on AR soybean. The debate does not center on the utility of these herbicides that can be used to combat herbicide-resistant [HR] weeds, but rather on their safe use.

A complete and thorough review of the potential issues surrounding the use of the auxin herbicides 2,4-D and dicamba on tolerant crops was published in an article from Purdue University Extension. Especially pay attention to the section "Factors Affecting Off-Site Movement".

Drift and volatility are the two contributing components to off-site movement of these growth-regulating herbicides. The segment on **drift**, which is the physical movement of spray particles by wind away from the target, provides details about the factors that contribute to drift and how these factors can be managed. The segment on **volatility**, which is the movement of the gaseous form of the herbicide after its deposition on the intended target, provides details about factors that contribute to volatility, and how this process can be lessened or minimized. Click here to access resources that discuss these topics in detail.

The Purdue article discusses the background leading to the development and evolution of genetically engineered 2,4-D-resistant technology [Enlist Weed Control System] and dicamba-resistant technology [Roundup Ready Xtend Crop System] in crops, a description of the two technologies, and concerns about, factors affecting, and methods of minimizing off-site movement of the two herbicides when they are used on AR crops.

The Enlist Weed Control System uses soybean varieties that have resistance to 2,4-D, glyphosate, and glufosinate. Enlist Duo herbicide that contains both glyphosate and 2,4-D was developed to be used in this system. Click here for the Enlist Weed Control System website and here for a list of tested and approved Enlist tank mix partners.

The Roundup Ready Xtend System uses soybean varieties that contain traits for resistance to both dicamba and glyphosate. XtendiMax herbicide that contains dicamba is labeled for use in this system.

In the 38-2016 issue of the C.O.R.N Newsletter published by the Agronomic Crops Network of Ohio State University Extension [title: The XtendiMax Label for Xtend Soybeans], authors Drs. Mark Loux and Bill Johnson summarize the important points of the XtendiMax [dicamba product] label for applying dicamba on Xtend [dicamba-resistant] soybeans. They cover the volatility-reducing component of the herbicide, and its application rate and period of allowed application to soybean, its unallowed spray additives, and its application parameters that include required nozzle type, weather conditions, and buffer distances between treated soybean and downwind sensitive areas. It is important to note from their presentation that the ultimate responsibility for adhering to all of the guidelines and restrictions in the label falls on the applicator.

In a Nov. 21, 2016 post from the Univ. of Arkansas Extension Service [title–Explained: Dicamba and its Formulations], Dr. Bob Scott discusses the four formulations of dicamba on the market. The two important formulations to become acquainted with are 1) Clarity [combination of dicamba with diglycolamine, or DGA salt], which is the same formulation being marketed as XtendiMax, and 2) Engenia herbicide, which is dicamba combined with sodium methylamine, or BAPMA salt. The BAPMA salt reduces the volatility of the dicamba molecule.

An article titled "What You Should Know about Newly Approved Dicamba formulations" by Dr. Larry Steckel

presents a general overview of the requirements and cautions when using labeled dicamba products. Specifically, he shows that extremely low rates of this herbicide can be detrimental to off-target plants that are sensitive to dicamba, and how this has dictated the strict dicamba herbicide label restrictions that must be followed. This requirement for additional caution when applying this herbicide has led to mandatory stewardship training in most states. He adds a final cautionary statement about the possible repercussions if proper stewardship is not followed when applying dicamba products. In a UTIA AgCast podcast titled "New Podcast Covers 2017 Dicamba Expectations", he discusses all of the above issues with dicamba.

In an article titled "Arkansas Plant Board votes in favor of tightening dicamba restrictions", David Bennett reported on the action by the Arkansas Plant Board to apply restrictions on the use of dicamba in 2017. This action was in response to off-label applications of dicamba that led to off-target drift issues that damaged considerable acreage of Midsouth crops in 2016. The specific regulations recommended by the Board include 1) a ban on dicamba DMA salt and acid formulations, 2) prohibiting the application of dicamba DGA salt and sodium salt formulations from April 15 to September 15, 3) requiring growers to abide by a quarter-mile downwind buffer and a 100-foot buffer for other directions when applying Engenia herbicide on dicamba-tolerant soybeans and cotton, and 4) a training requirement for anyone using DGA-based herbicides on dicamba-tolerant crops.

The above action was approved by Arkansas Governor Hutchison on Jan. 4, 2017 according to Mr. Bennett's article. Along with the Governor's approval came a request that the Plant Board more clearly define the prerequisite requirements for approval of new formulations. This includes the methods used and the research which the Plant Board relies on for approving new technologies. The governor's specific request was that the Plant Board submit a solution which provides clear rules to industry as to what it expects in terms of prior study and testing by independent third party research.

In an article titled "7 lessons learned from the 'glyphosate era' we must remember", Dr. Eric Prostko presents a few thoughts on the use of dicamba herbicides on dicamba-tolerant crops.

- AR crop technology is an additional tool in the weed control toolbox and will work if properly used.
- Auxin herbicides are not new, and AR weeds have already been identified; thus, auxin herbicides must be used as one tool in combination with already available and used weed management tools to prevent an increase in AR weeds.
- Proper label-specified application of auxin herbicides must be followed to prevent a furtherance of the negativity associated with the use of GMO crops.
- As with all herbicides, all available weed management tools–e.g. different herbicide modes of action, tillage, cover crops, residual herbicides, narrow rows, crop rotation–should be used where needed in combination with the new auxin herbicide systems.

In an article titled "New dicamba labels have interesting highlights you need to know", Dr. Prostko provides a concise summary of highlights from dicamba herbicide labels. They include 1) what can and can't be tank-mixed with the herbicide, 2) required nozzle type, spray volume, ground speed, and spray boom height, 3) range of allowed wind speeds for application, and 4) amount of downwind buffer required when applying the herbicide.

As stated at the beginning of this White paper, the issue of auxin herbicide use on AR crops is in a state of flux. Things to be aware of as this technology becomes widely used are the status of the forthcoming Enlist Duo and Roundup Xtend herbicide labels, a schedule of required training opportunities in the various states, and further restrictions that have been and will continue to be enacted/updated for the application of auxin herbicides.

Remember that 2,4-D-resistant soybeans will be vulnerable to injury from dicamba off-target movement, and dicamba-resistant soybeans will be vulnerable to injury from 2,4-D off-target movement. Again, when either or both of these two

auxin herbicide-resistant systems are used in soybeans, they must not be relied on alone to manage HR weeds. Using a diversified approach of applying herbicides with different modes of action in combination with sound agronomic best management practices will remain the only durable and productive weed management system for soybeans.

Feb. 2017 Update

Dr. Larry Steckel posted an article on the UTcrops.com website that provides an update on using correct nozzles when applying auxin herbicides and on the additional nozzles that have been added to the XtendiMax label. Dr. Steckel's article provides insight into the use of these newly approved nozzles with these herbicides.

The Engenia and XtendiMax websites should be continually monitored in order to keep up with the changes and/or additions in allowed surfactants, tank-mixes, and nozzles.

Dr. Jason Bond posted an article titled "Enlist and Xtend: What Can I Spray and on Which Crops Can I Spray It?" on the MCS blog site. Several points in that article are highlighted below.

- Herbicide products that contain 2,4-D will injure or kill Xtend soybean.
- Herbicide products that contain dicamba will injure or kill Enlist soybean.
- Xtend soybean varieties are not resistant to glufosinate herbicide products.
- The herbicides XtendiMax with VaporGrip Technology and Engenia contain only dicamba–they contain no glyphosate.
- Herbicide resistance traits in the Enlist Weed Control System confer resistance to glyphosate, glufosinate, and 2,4-D choline. Enlist Duo, a premix of glyphosate and 2,4-D choline, is the herbicide labeled for use in this system.
- Roundup Ready 2 Xtend soybean varieties only have resistance to glyphosate and dicamba; they are not resistant to glufosinate.
- Multiple products that contain dicamba [Xtendimax with VaporGrip Technology and Engenia] are labeled for application to Xtend soybean varieties.

Mar. 2017 Updates

Dr. Bond posted an article titled "Enlist and Xtend: What are the Herbicide Rates" on the MCS blog site. In this article, Dr. Bond 1) lists the composition of each auxin herbicide product, 2) the amount of active ingredient(s) in each product, 3) the allowed rates for a single application of each herbicide product, 4) the number of allowed postemergence applications of each product, and 5) the required days between sequential applications. Dr. Bond reminds producers who are planning on purchasing auxin-containing herbicides intended for use on AR crops that they must first complete mandatory online training.

Dr. Bond posted an article titled "Enlist and Xtend: At What Growth Stages Can I Spray?" on the MCS blog site. Key points in this article are shown in the following table.

Allowed application times for Enlist Duo [glyphosate + 2,4-D choline], and Xtendimax plus VaporGrip and Engenia [dicamba herbicide products] to AR soybean.

Herbicide product	Earliest*	Latest
Enlist Duo	burndown	R2
Xtendimax plus VaporGrip, Engenia	burndown	R1

*All shown products may be applied preemergence.

He reminds growers of the following points when using these products.

- The dicamba products do not contain glyphosate and they cannot be tank-mixed with glyphosate.
- There is no more flexibility with weed size when using the above products as there is with any of the other weed control technologies available prior to 2017–i.e. all of the above products must be applied to small weeds for maximum effectiveness.
- See each product's label for weed size restrictions for application.

WWW.MSSOY.ORG ⇒ MSPB WEBSITE WITH UP-TO-DATE SOYBEAN PRODUCTION INFORMATION

On Mar. 16-17, 2017, Dr. Bond posted articles titled "Enlist and Xtend: What Boom Specifications are Required?" and "Preplant Intervals for 2,4-D and Dicamba Applied as Burndown in Mississippi" on the MCS blog site. Key points in these articles follow.

- Minimum spray volume for the above auxin herbicides is 10 gal/acre.
- Ground speed for the dicamba herbicides cannot exceed 15 mph.
- Boom height during Enlist Duo [2,4-D-containing product] applications should be specific to the type nozzle used.
- Boom height during applications of the dicamba herbicide products listed above cannot exceed 24 in.
- Elapsed time between a burndown application of a dicamba product and planting soybean must be at least 14 and 28 days, respectively, when 8 and 16 fl. oz/acre of Clarity are applied.
- Elapsed time between a burndown application of a 2,4-D ester formulation and planting soybean must be at least 7 and 15 days when 0.5 and 1.0 lb. ae/acre are applied, respectively.
- Dr. Bond also posted an article titled "Enlist and Xtend: What Mixtures Are Approved?" on the MCS blog site.

Enlist Duo, Xtendimax with VaporGrip, and Engenia have associated websites that list additives and herbicide products that may be mixed with each herbicide. The information on these websites is considered an extension of the federal label for each product. Use this information to ensure that only approved mixing partners are used with each product.

May 2017 Update

The United Soybean Board [USB] has produced a list of BMP's to use when applying auxin herbicides to AR crops. The article titled "Managing 2,4-D and Dicamba in Enlist E3 and Xtend Soybean" contains pertinent information that should be considered when using these herbicides.

May 2020 Update

Soybean producers now have access to varieties with the Enlist technology trait. These varieties will be tolerant to 2,4-D, glyphosate, and glufosinate herbicides. According to the developers, the Enlist herbicides have near zero volatility and reduced potential for physical drift.

Click here for an article on this website titled "Enlist Soybean Varieties–The Latest Tool for Managing Herbicide-Resistant Weeds". The contents of this article provide a summary of the Enlist trait technology and how it can be used.

The "Focus on Soybean" webcast titled "Weather and Off-Target Dicamba Movement" is presented by Dr. Mandy Bish. In this presentation, Dr. Bish highlights environmental factors that are known to enhance drift and volatilization of auxin herbicides. She spends considerable time on temperature inversions, their causal factors, and how they can be predicted or detected. In the presentation, Dr. Bish provides the following information.

- Explains why inversions are important when applying auxin herbicides;
- Discusses time of day when inversions are most likely to occur, and why this is important;
- Discusses how inversions contribute to particle suspension in the air;
- Discusses how weather, wind, topography, and nearby vegetation may affect inversion formation;
- Presents data about the frequency of inversion occurrence during the growing season at Midsouth locations;
- Shows why sunset time is not a good indicator of inversion potential or formation;
- Discusses tools such as smoke bombs that can be used to detect inversions;
- Shows how air temperature and relative humidity affect herbicide volatility; and
- Explains the need to measure wind speed at the site of application of auxin herbicides.

Even though producers are already keenly aware of the need to control offsite movement of all herbicides, this narrated presentation provides a very concise video summary of the factors contributing to this process, and the tools they can use to reduce the likelihood of offsite drift of herbicides during and after application.

Click here for a tool that can be accessed for estimated conditions that are suitable for spraying at a designated location. Remember, this and similar tools should only be used for planning purposes or to estimate spraying conditions at a location–i.e. they do not replace checking the weather in a field just prior to an actual spray application.

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