May 31, 2016

Docket ID: **EPA-HQ-OPP-2016-0187**

Environmental Protection Agency
Office of Pesticide Programs (OPP) Docket
EPA Docket Center (28221T)
1200 Pennsylvania Avenue, NW
Washington, DC 20460-0001

Subject: **EPA-HQ-OPP-2016-0187-0012,** "Dicamba: New Use on Herbicide-Tolerant Cotton and Soybean"

The Weed Science Society of America (WSSA) and its affiliates, the Aquatic Plant Management Society, the Northeastern Weed Science Society, the North Central Weed Science Society, the Southern Weed Science Society, and the Western Society of Weed Science represent over 3000 members from around the world. Members include academic, governmental, and private industry research scientists, university extension professionals, educators, graduate students, and federal, state, county, and private land managers. Our scientific societies welcome the opportunity to comment on certain aspects of the proposed registration of dicamba on dicamba-tolerant cotton and soybean. The societies are not taking a position on whether the proposed registration should be approved. We trust an objective science-based decision will be reached following the Agency's consideration of the benefits and risks of these new uses for dicamba.

However, the National and Regional Weed Science Societies do wish to comment on features of the proposed registration that have broad implications for weed management that go far beyond dicamba specific issues. In a separate letter, the societies provided comments on the Resistance Management Plan (EPA-HQ-OPP-2016-0187-0012, pages 7-16) that was included as part of proposed dicamba registration.

In this letter, the National and Regional Weed Science Societies wish to communicate our concerns and objections to:

1. Tank Mix Prohibitions

2. An in-field buffer in all directions, regardless of wind direction

3. Only single nozzle allowed for use

1. Tank Mix Prohibition

Because of an uncertainty raised by synergism claims from uncited academic research and patent application filings (EPA-HQ-OPP-2016-0187-0016, pages 21 and 22), the Agency is proposing to prohibit the tank mixing of other herbicides with M1691 (the diglycolamine salt of dicamba, hereafter referred as dicamba). It is unfortunate the Agency does not list the specific references for this uncertainty; it would be more possible to evaluate and respond to them if they were cited. We encourage the Agency to do this in the future.

The approach the Agency is proposing is a divergence from the guidelines proposed in the National Research Council (NRC) report on "*Assessing Risks to Endangered and Threatened Species from Pesticides"* (McDowell et al. 2013). In the opening comments of the section of this report dealing with pesticides mixtures, the authors wrote: "*The toxicity of a chemical mixture probably will not be known, and it is not feasible to measure the toxicity of all pesticide formulations, tank mixtures, and environmental mixtures. Therefore, combined effects must be predicted on the basis of models that reflect known principles of the combined toxic action of chemicals*" (El-Masri et al. 1997). The following points regarding pesticide mixtures are made in the Conclusions and Recommendation section (pages 133-135) in Chapter 4 "Effects" of the NRC report:

1. *The toxicity of the pesticide active ingredient is central to the assessment. Other chemicals are relevant only if they modify the toxicity of the pesticide active ingredient or the susceptibility of the species of concern to the active ingredient.*
2. *The toxicity end point most relevant to the species of concern must be determined before initiation of the effects analysis.*
3. *Mixture components that do not elicit the relevant response in the species of concern do not need to be considered in the effects analysis. Mixture components that do elicit the relevant response need to be considered in the effects analysis.*
4. ***In the absence of any data that would support the hypothesis of a synergistic interaction between the pesticide active ingredient and other mixture components, the effects analysis should proceed on the assumption that the components have additive effects.***
5. *For chemicals that have common mechanisms of action and parallel slopes in the concentration-response curves, concentration addition is a reasonable approach for modeling additive effects. However, caution should be exercised in using concentration-addition modeling as a default approach when no mechanistic data or concentration-response data are available.*
6. *For chemicals that have different mechanisms of action, response addition (a zero correlation of individual tolerances) is a reasonable approach for modeling additive effects. For this case, mixture components will contribute to the response only when present in the environment in concentrations that elicit the response. That is, such components do not need to be considered at concentrations below their toxic thresholds.*
7. *Potential synergistic interactions need be considered only when a synergist is present in the environment above its interaction threshold concentration. In the case of synergism, it is probably prudent to generate information on toxic interactions to ensure accurate evaluation of potential responses of the species of concern.*

8. *In the case of antagonism, uncertainties associated with both exposures and toxic interactions will seldom justify a quantitative modification of the effects analysis.*
9. ***The use of uncertainty factors to compensate for the absence of information on potential interactions of mixture components is not recommended.*** *When data are available, quantitative methods can be used to evaluate the interactions.*

At a minimum, we interpret the NRC report recommendations to imply that dicamba, a synthetic auxin, could be mixed with other herbicides, or other pesticides, that are not synthetic auxins (Point #6). Or, it could be mixed with other synthetic auxins if additive action was assumed (Point #5). Finally, many potential dicamba tank mix partners would not elicit the "relevant response in the species of concern" (Point #3) and need not be considered in the effects analysis. This would indicate that insecticides and fungicides need not be considered as they do not cause plant injury (the "relevant response"). In addition, as dicamba is a broadleaf plant herbicide, other herbicides, like ACCase inhibitors, that are grass specific herbicides should also not be included in any tank mix prohibition. Finally, if uncertainty concerning potential injury to endangered plant species is driving the tank mix prohibition proposal, then this should only apply to those counties containing endangered plant species of concern.

Perhaps the most telling statement concerning mixtures in the report was: "**The committee (National Research Council) emphasizes that the complexity of assessing the risk posed by chemical mixture should not paralyze the process**".

Beyond the departure from the NRC recommendations, the proposed prohibition on tank mixes flies in the face of the 50 years of experience with dicamba and the first two benefits cited by the registrant for the use of postemergence applied dicamba on soybeans and cotton and which we agree with (EPA-HQ-OPP-2016-0187-0012, page 2):

1. *To "provide a broad spectrum of weed control, especially for weeds that are resistant to glyphosate"*

2. *To "reduce or delay resistance to other herbicides that might be used such as acetolactate synthase (ALS) or protoporphyrinogen oxidase (PPO) inhibitors".*

However, it is now well established that tank mixes, including two or more effective herbicide mechanisms of action (MOAs), in a simultaneous application is one of the most effective herbicide strategies for delaying the evolution of herbicide resistance (Beckie 2006, Diggle et al. 2003, Dill et al. 2008, Gustafson 2008, Green and Owen 2011, Norsworthy et al. 2012). There are numerous publications showing this but Beckie and Reboud (2009) serves as an often-cited example. When they used a herbicide by itself just one time over a 4-year period, they observed a nearly 8-fold increase in resistant weed seed production. However, if they applied the same herbicide every year, but mixed it with another effective herbicide, resistant weed prevalence remained statistically the same as if they had never used the herbicide at all.

While herbicide (MOA) use rotation, rather than tank mixtures, is often recommended as a useful strategy for delaying resistance evolution, it is not considered as effective as tank mixing for this objective. A part of the best management practices for delaying resistance outlined in

Norsworthy et al. (2012), rotations were seen as "useful but not sufficient because they subject a weed population to a single [herbicide mode of action] at a time". However, recent work (Evans et al. 2016) suggests that rotation actually increases the likelihood of finding herbicide-resistant weeds.

Evans et al. (2016) surveyed glyphosate-resistance waterhemp incidence, as well as landscape, soil, weed, and farm-management data that included almost 500 site-years of herbicide application records collected between 2004 and 2011 from 105 central Illinois grain farms. They found that weed management decisions were the most important factor in predicting the presence of glyphosate resistance. Rotating herbicide MOAs actually increased the frequency of glyphosate resistance. On the other hand, farmers who used multiple herbicides per application were the least likely to have resistance on their farms. **When tank mixing an average of 2.5 MOAs per application, farmers were 83 times less likely to have glyphosate resistance** compared to those who used only 1.5 MOAs per application.

This outcome is not surprising and parallels findings in other areas of pest and disease management where mixtures of multiple pesticides or drugs administered simultaneously can slow or halt the evolution of resistant traits (Palumbi 2001). These measures are the most effective because the probability of evolving target-site resistance to multiple pesticide or drug MOAs is the multiplication of the individual resistance probabilities.

Not allowing tank mixing as part of a proposed herbicide registration that is intended to help manage known herbicide-resistant weeds, especially glyphosate-resistant weeds, and to delay the evolution of additional herbicide-resistant weeds is at best contradictory, but more likely counterproductive to these objectives. It is entirely predictable that this prohibition will promote the evolution of dicamba-resistant weeds. As acknowledged in the review of benefits for this proposed registration (EPA-HQ-OPP-2016-0187-0012, page 4), dicamba-resistant weeds already exist and the expansion of dicamba use without effective tank mix partners will likely lead to their expansion and further resistance evolution. Further, from a farmer's perspective, a restriction on tank mixing will likely lead them to choose the most effective, broad-spectrum herbicide at their disposal. Reasonable farmers will choose glyphosate. Farmers will not choose to make separate applications of separate products instead of a single application of a broad-spectrum herbicide. The unintended outcome of a ban on tank mixing could be a further increase in glyphosate use and selection for glyphosate-resistant weeds, rather than the opposite. Timeliness is critical for the most effective weed control and the need for sequential applications raises the potential for poor timing for applications relative to weed size (too large) or susceptibility.

Apparently, beyond the impact that tank mix prohibition would have on resistance management, the Agency understands some of the other implications such a decision would have on the practical aspects of weed management. The Agency's language in the material associated with the Proposed Registration Decision for the New Active Ingredient Halauxifen-methyl (EPA-HQ-OPP-2012-0919-0013, page 9) includes the statement:

> *"The practice of tank mixing can result in **significant economic benefits** to the grower by allowing control of a wider variety of pests in a single application without incurring the*

> *expense of sequential applications. Additionally, by reducing the number of visits to the agricultural field, the grower is also* ***reducing fossil fuel use*** *and emissions from large agricultural equipment,* ***as well as the potential exposure to pesticides*** *that can result from multiple visits to the same area being treated. It is also widely accepted that the* ***practice of mixing products with different modes of action is essential to the management of weed resistance****. Because weed resistance is known to have a very costly impact to overall crop yields, which in turn negatively impacts growers' harvests and the price of commodities to the consumer, tools that aid in the prevention of resistance are considered to be a very important benefit to agriculture".*

Yet, despite these certainties, the Agency has proposed the tank mix prohibition for both dicamba and halauxifen-methyl. Unfortunately, it is our opinion that the value growers experience from tank mixing compared with the "uncertainty" they will have concerning the proposed prohibition will lead them to ignore it. For example, costs of herbicide ground application are estimated at $6.00 to $9.00 per acre (Halich 2016, Ibendahl 2016). Individually, a grower could be faced with an additional cost of thousands to tens of thousands of dollars for an operation for which they do not see a value. Of course, collectively, the tank mix prohibition could cost farmers millions of dollars. The agency could be creating a situation that will encourage growers and others to disregard the label.

The uncertainty concerning any practical synergism between dicamba and potential tank mix partners is puzzling to us. For example, the label for the herbicide Clarity™, which is identical to the formulation for M1691in this proposed registration, lists 77 other registered herbicides that can be used in tank mixes with dicamba. Yet, nowhere on the label is there an indication of synergism between the dicamba and any of these other materials. Further, dicamba has been used for more than 50 years but there is no practical synergism between it and any other herbicides recognized by the weed science community. Rather, dicamba is applied in tank mixes to broaden the spectrum of weed control achieved, the components each controlling a spectrum of the weed population (Barnett et al. 2013). In assessing the risk to non-target plants, the Agency "*considered a variety of lines of evidence, including past experience with other dicamba formulations and associated spray drift reporting*" (EPA-HQ-OPP-2016-0187-0016, page 21). Historically, dicamba off-target movement has been known to cause damage to sensitive plants. However, to our knowledge, there has never been an indication that this damage was more severe from applications of dicamba in a tank mix versus its application alone. Since much of this experience is associated with soybean injury from dicamba applied to corn, and soybean was the most sensitive non-target plant species tested (EPA-HQ-OPP-2016-0187-0016, page 17), concerns or uncertainty about synergy appear overstated by the Agency. The weight of the practical experience with dicamba use does not support the suggestions or implications of synergism in field applications.

The National and Regional Weed Science Societies urge the Agency to reconsider the prohibition on tank mixing. It is counterproductive for herbicide resistance management, will result in significant economic costs to growers, will increase the carbon-footprint associated with weed management, and could be, frankly, ignored by many practitioners.

2. In-field in all directions buffer, regardless of wind direction

Because of concern with insufficient detail to verify measurements of dicamba volatility submitted by the registrant, the Agency is requiring language on the label specifying an in-field buffer of 110 - 220 feet (depending on the rate of dicamba applied) in all-directions to the edge of the field (EPA-HQ-OPP-2016-0187-0016, page 17). However, large buffers such as these severely limit the practical use any herbicides for weed management and will severely impact herbicide resistance management. These buffers will not likely be fallow; growers will still need to mange weeds in the buffers to produce a crop. At a minimum, they will require applications of alternative herbicides that are, possibly, less effective than dicamba and increase the potential for a second herbicide application to the field. If one of the benefits of dicamba use is to manage or prevent glyphosate resistance (EPA-HQ-OPP-2016-0187-0012, page 4), how will leaving these large buffers contribute to that objective? These buffers potentially leave a reservoir of glyphosate-resistant weeds in the field. Growers cannot use a tool effectively to manage herbicide-resistant weeds if using the herbicide comes at the cost of leaving refuges where resistant weeds will reproduce.

We understand that the proposed buffers are based on concern over spray drift and the potential for volatilized dicamba to move off-site. Because of the size of the buffers to prevent volatile movement off-site, there is also no expectation that spray drift will move off-site.

The National and Regional Weed Science Societies offer two recommendations to improve the practicality of the proposed buffers:

- Encourage additional testing by the registrant to address the deficiencies of the data already submitted. If, after analysis of new data, smaller buffers are found to be sufficient to prevent off-site volatile movement of dicamba, work with the registrant to quickly and easily make this change to the label language.

- Allow flexibility in the buffers. If the intent is to protect non-target sensitive plants (other crops or wild plants, especially endangered species), why not only require the stated buffers on the side(s) of a field adjacent to these plants? Other sides of the field would be governed more by spray drift reduction concerns and, if they were upwind, might not require a buffer at all. This flexibility should not reduce the protection for non-target plants from volatile movement of dicamba but could greatly increase the practicality of its use.

3. Only Single Nozzle Allowed for Use

We understand that this restriction is based upon the data supplied by the registrant being confined to the Tee Jet® TTI11004 nozzle, which produces the coarsest droplet sizes of any broadcast nozzle currently available. While there are no other equivalent broadcast nozzles currently available, we believe that if another company can demonstrate the same droplet size distribution with another nozzle, then that nozzle could be substituted without changing the threat of spray drift. Although the formulation can change the droplet distribution coming from a particular nozzle, this effect should be similar across nozzles of similar droplet size performance.

Removing this restriction will remove a barrier to dicamba use and will allow the intended benefits to be more widely realized. At a minimum, if more data are supplied by the registrant or nozzle manufacturers, then additional nozzles should be allowed and this information could be relayed to applicators via a website similar to: "2016 Product Use Guide for Enlist™ corn and soybeans", page 13.

Cited References

Barnett, K. A., T. C. Mueller and L. E. Steckel. 2013. Glyphosate-resistant giant ragweed (Ambrosia trifida) control with glufosinate or fomsafen combined with growth regulator herbicides. Weed Tech. 27:454-458. http://dx.doi.org/10.1614/WT-D-12-00155.1

Beckie, H. J. 2006. Herbicide-resistant weeds: management tactics and practices. Weed Tech. 20:793-814. http://www.jstor.org/stable/4495755

Beckie, HJ and Reboud, X (2009) Selecting for weed resistance: Herbicide rotation and mixture. Weed Tech. 23:363-370. doi: http://dx.doi.org/10.1614/WT-09-008.1

Diggle, A. J., P.B. Neve and F.P. Smith. 2003. Herbicides used in combination can reduce the probability of herbicide resistance in finite weed populations. Weed Res. 43:371-382. http://onlinelibrary.wiley.com/doi/10.1046/j.1365-3180.2003.00355.x/abstract

Dill, G. M., C. A. CaJacob and S. R. Padgette. 2008. Glyphosate-resistant crops: adoption, use and future considerations. Pest Management Sci. 64:326-331. http://onlinelibrary.wiley.com/doi/10.1002/ps.1501/abstract

El-Masri, HA, Reardon KF, and Yang RS (1997) Integrated approaches for the analysis of toxicologic interactions of chemicals mixtures. Crit. Rev. Toxicol. 27:175-197. http://www.ncbi.nlm.nih.gov/pubmed/9099518

Evans, JA, Tranel, PJ, Hager, AG, Schutte, B, Wu, C, Chatham, LA, and Davis, AS (2016) Managing the evolution of herbicide resistance. Pest. Manag. Sci.72:74–80. doi: 10.1002/ps.4009

Green, J.M. and M.D.K. Owen. 2011. Herbicide-resistant crops: utilities and limitations for herbicide-resistant weed management. J. Agric. Food Chem. 59:5819-5829. doi: 10.1021/jf101286h

Gustafson, D. I. 2008. Sustainable use of glyphosate in North American cropping systems. Pest Management Sci. 64:409-416. http://onlinelibrary.wiley.com/doi/10.1002/ps.1543/abstract

Halich, G (2016) Custom machinery rates applicable to Kentucky (2016). University of Kentucky Cooperative Extension Service. AEC 2016-01

Ibendahl, G (2016) Custom Rate Comparison for 2016. Kansas State University Department of Agricultural Economics. Publication: GI-2016.1

McDowell, JE, Akcakaya HR, Angelo MJ, Durkin P, Fairbrother A, Fleishman E, Goodman D, Graf WL, Gschwend PM, Hope BK, Leblanc GA, Quinn TP, and Reed NR. (2013) National Research Council. *Assessing Risks to Endangered and Threatened Species from Pesticides*. Chapter 4: Effects. Washington, DC: The National Academies Press, 2013. doi:10.17226/18344.

Norsworthy, JK, Ward SM, Shaw DR, Llewellyn RS, Nichols RL, Webster TM, Bradley KW, Frisvold G, Powles SB, Burgos NR, Witt WW, and Barrett M (2012) Reducing the risks of herbicide resistance: best management practices and recommendations. Weed Sci. 60(sp1): 31-62. http://www.wssajournals.org/doi/pdf/10.1614/WS-D-11-00155.1

Palumbi SR, (2001) Humans as the world's greatest evolutionary force. Science 293:1786–1790. http://www.ncbi.nlm.nih.gov/pubmed/11546863

Sincerely,

Dr. Kevin Bradley
President
Weed Science Society of America

Dr. Rob Richardson
President
Aquatic Plant Management Society

Dr. Anita Dille
President
North Central Weed Science Society

Dr. Shawn Askew
President
Northeastern Weed Science Society

Dr. Peter Dotray
President
Southern Weed Science Society

Dr. Kirk Howatt
President
Western Society of Weed Science

cc: House Committee on Agriculture
Senate Committee on Agriculture, Nutrition & Forestry
Dr. Sheryl Kunickis, USDA Office of Pest Management Policy