

U.S. Herbicide Resistance Action Committee

May 27, 2016

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

Subject: U.S. Herbicide Resistance Action Committee comments on the proposed Herbicide Resistance Management - Stewardship Checklist

At the Weed Science Society of America (WSSA) annual meeting in San Juan Puerto Rico in February 2016, the Environmental Protection Agency (EPA or the Agency) –Biological and Economic Analysis Division requested review and input from various stakeholders on a draft document entitled “Herbicide Resistance Management – Stewardship Checklist” (Attachment A). The U.S. Herbicide Resistance Action Committee (US HRAC) has reviewed the checklist and provides substantial comments below for your consideration.

The US HRAC is a United States focused organization founded by the agrochemical industry to support a cooperative approach to the management of herbicide resistance. The mission of US HRAC is to foster a responsible approach toward herbicide use. This includes activities to a) support and participate in research, conferences and seminars which serve to increase our understanding of herbicide resistance; b) promote a better understanding of the causes and consequences of herbicide resistance; c) communicate herbicide resistance management strategies and support their implementation through practical guidelines; d) seek a collaboration with public and private researchers, especially in the areas of problem identification and devising and implementing management strategies; and e) facilitate communication among industry representatives on these issues.

US HRAC understood from EPA presentations and discussions at the WSSA meeting that Attachment A was to be published by EPA for public review and comment as a stand-alone document before EPA used it in the registration process. However, with recent proposed registrations, EPA is using this document as a basis for herbicide resistance management plans without first completing that prior and separate review process. US HRAC is thus concerned that the document and guidance may be implemented in a piecemeal process without consistency across different products and registrants, potentially leading to confusion among growers on how best to address resistance.

Regardless, US HRAC is providing these comments for your consideration. Our comments are inserted below within the text of the checklist. In addition, if EPA desires, US HRAC is willing to meet with the Agency to discuss these comments.

Sincerely,



Michael J. Horak
Chair, US HRAC
314-694-3476
michael.j.horak@monsanto.com

US HRAC COMMENTS
May 27, 2016

Herbicide Resistance Management – Stewardship Checklist

As part of the registration and reregistration review of some herbicides BEAD reviews the stewardship and resistance management plans to determine if they have addressed the elements of concern to the Agency. The following table lists items that BEAD will consider when reviewing these plans. Nine of the eleven items will be instructions placed on the label to provide information to the user (elements 1 through 7, 10 and 11 where applicable), and three of the elements will be instructions to the registrant (elements, 8, 9 and 11 where applicable).

US HRAC Comment: For all proposed elements of a resistance management or stewardship plan, EPA should be consistent in the requirements across registrants and products, to avoid confusion for growers.

US HRAC Comment: EPA should indicate the scope of the herbicides and products to which this checklist will apply. This will avoid confusion in various cases. For example: does the guidance apply to agronomic uses, as well as lawn and garden uses? For lawn and garden uses will a homeowner need to scout for resistant weeds?

US HRAC Comment: EPA should indicate how it intends to use the proposed 11 elements for herbicides or herbicide groups for which there are already significant numbers or acreage of herbicide resistant weeds.

Table 1. Elements of resistance management or stewardship plan.

- Element 1. List Mechanism of Action (MoA) Group Number.***
- Registrant is responsible to place on label***

US HRAC Comment: US HRAC supports placement of the MoA group number on labels for all herbicide products for use by the end user.

- Element 2. List season and annual maximum number for applications and amount.***
- Registrant is responsible to place on label***

US HRAC Comment: US HRAC supports this element as a recommendation for all herbicide products, whenever practical.

- Element 3. Resistance Management language from PR Notice 2001-5, and/or Best Management Practices (appropriate to the crop) from Weed Science Society of America (WSSA) & Herbicide Resistance Action Committee (HRAC), and/or HRAC proposed guidelines for herbicide labels.***
- Registrant is responsible to place on label***

US HRAC Comment: US HRAC supports this element as a recommendation for all herbicide registrants. As a clarification to EPA's Appendix 1, US HRAC reminds EPA that recent research indicates that herbicide mixtures are more effective at delaying

selection for herbicide resistance and managing herbicide-resistant weed populations than is herbicide rotation (Beckie 2006, Beckie and Reboud 2009, Evans et al 2015). This should be reflected in Appendix I, Herbicides, Section 2.a.

Element 4. *Include instructions for scouting before and after application.*

- *Registrant is responsible to place on label*
- *User is responsible to follow recommendation*

US HRAC Comment: US HRAC supports this element as a recommendation for all herbicide registrants and products. It should be clear in any label text, however, that scouting is a recommended best practice and not a specific requirement of registration or use. One exception to this recommendation may be in the case of some soil-applied or pre-emergent herbicides where target weeds are not emerged prior to treatment.

Element 5. *Definition of Likely Resistance.*

- *Registrant is responsible to place on label*

US HRAC Comment: Defining “likely resistance” may help users understand the symptomology and may aid identification of herbicide resistant weeds, but it may not be practical to place this definition on the label. If such a definition must be revised or expanded, different label versions may have different definitions. It would be better to refer to an outside source for the current definition (e.g. an EPA website).

Element 6. *User should report lack of performance to registrant or their representative.*

- *Registrant is responsible to place on label*
- *User is responsible to follow recommendation*

US HRAC Comment: US HRAC supports this element as a recommendation for all herbicide registrants and products. EPA’s recommendation for this statement should be consistent across all registrants and products.

Element 7. *List confirmed resistant weeds in a separate table and list effective or recommended rates for these weeds with the table.*

- *Registrant is responsible to place on label*

US HRAC Comment: First, US HRAC cannot support this element as currently stated, as development of a resistant biotype in a previously susceptible weed species would necessitate label modifications. Keeping labels current by repeatedly updating the list of resistant weeds would be a source of confusion for users and would pose a significant burden on registrants and the EPA alike. It would be better to refer to an outside source for this information. US HRAC, however, supports *the overall goal* of this element if it was implemented as a recommendation for helping users understand what weed species have developed resistance to a given herbicide.

Second, as written this element may cause confusion. US HRAC recommends re-stating as: *“Provide information on confirmed resistant weeds via a separate source. If the*

herbicide is a pre-mixture of two or more herbicides, indicate resistant species by herbicide in the pre-mixture where possible."

Third, with regard to EPA's proposal that the table list effective or recommended rates for resistant weeds, US HRAC notes that while a weed population in one area may be resistant, the same species in other areas may still be susceptible. Thus, the recommended rates for those susceptible populations will likely be unchanged. For weeds that are confirmed as resistant, in most cases by definition, there would not be an effective rate.

Element 8. Registrant report new cases of likely and confirmed resistance to EPA and users yearly. This will be in addition to any adverse effects reporting.

- **Registrant is responsible**

US HRAC Comment: As written this is neither a recommendation nor practical. EPA should clarify this recommendation further. It is unclear how EPA would handle the following situations:

- 1) How will EPA be equitable across registrants when there are different levels of support among companies? Companies with fewer or no field representatives will not have the same burden as companies with field representatives;
- 2) For an herbicide with few or no resistant weeds, this can be more manageable than for an herbicide with many resistant species.

To be workable, EPA needs to indicate that, once a weed species is confirmed and reported to EPA as being resistant to an herbicide in a particular area or state, further reporting should not be necessary. In addition, in some cases cross-resistance to another herbicide in a mechanism-of-action group may occur, and resistance is indicated to a herbicide without additional confirmation testing. Otherwise, reports of resistance will continue to be made, even though it is already confirmed that resistance is present in a species. For herbicides in a pre-mixture, resistance should be reported separately for each active ingredient, where possible. In some cases where new active ingredients are available only in pre-mixtures, that differentiation may not be possible.

While US HRAC understands *the overall goal* of understanding where resistance is occurring to aid in the management of herbicide resistant weeds, it is unclear what terms and conditions would apply for this element. EPA should make clear how this new reporting would differ from adverse effects reporting required by FIFRA § 6(a)(2). Any additional *required* reporting must be implemented by modifying the regulations through notice-and-comment rulemaking.

Concurrently, US HRAC recommends clarifying the recommended statement and including in the element that "Registrant should report to EPA and users on an annual basis, all new confirmed cases of resistance to an herbicide (not previously reported) and new cases of likely resistance (until confirmed). This will be in addition to any adverse effects reporting."

- Element 9.** *For sites of high concern provide growers with:*
- *Resistance Management Plan*
 - *Remedial Action Plan (To control resistant weeds this season or next season)*
 - *Educational material on resistance management*
Plans should be locally developed and easily modified. We recommend registrants work with Extension, Consultants, Crop Groups, HRAC, & USDA.
 - *Registrant is responsible to provide educational materials*

US HRAC Comment: US HRAC recommends removing this element from the checklist until further clarification is made.

This element describes a potentially very large program with great reach and impact across agriculture. This element needs to be clarified to indicate:

- 1) who EPA directs the element to,
- 2) what the term “locally” means,
- 3) what an acceptable plan entails, and
- 4) how EPA would notify Extension, Consultants, Crop Groups, US HRAC and USDA of their responsibilities.

Furthermore, the specifics around monitoring, compliance, enforcement must be detailed by the Agency and understood by the user and retailer.

- Element 10.** *For combination products with multiple MoAs, list which herbicide is controlling which weed (a 3 way mixture may only have 1 effective MoA for some problem weeds). List minimum recommended rate if resistance is suspected.*
- *Registrant is responsible to list on label or otherwise provide information*

US HRAC Comment: US HRAC supports *the overall goal* of this element if it was implemented as a recommendation to help users understand which weeds are controlled by a given herbicide in a combination product to aid in herbicide resistance management. However, we cannot support this as currently stated. In element 7, EPA would require listing the resistant weed species on the product label; as commented above, emergence of a new resistant weed biotype would necessitate label modifications. Meeting this element could become very complex and in many cases, with multiple active ingredient products, could result in a long and very confusing list of products and weeds that are controlled or not controlled. In addition, as herbicide premixtures become more prevalent, the idea of monitoring single active ingredients may become obsolete or impossible to address in some products. Keeping labels current by repeatedly updating the list of resistant weeds would be a source of confusion for users and would pose a significant burden on registrants and the EPA alike. It may be better to refer to an outside source (e.g. EPA website) for this information.

Additionally it is important to note that premix rates are constrained by the premix. As stated previously, a weed population in one area may be resistant, while the same species in other areas may still be susceptible. Thus, the recommended rates for those susceptible populations will likely be unchanged.

US HRAC Comment on Elements 1 through 8 and 10. US HRAC recommends that revised and clarified elements 1 through 8 and element 10 (as appropriate) be applied to all herbicides that are within scope of this guidance. This would simplify the instructions and provide fairness across registrants. In addition, applying these elements uniformly across herbicides will avoid using a categorization scheme and the associated challenges with categorization (Table 2). Additional comments on the categorization scheme are included below.

Element 11. *Any additional specific requirements (e.g. mandatory crop rotation, unique agronomic aspects, additional training, time limited registration, etc.).*

- *Registrant is responsible*

US HRAC Comment: US HRAC supports this element as a recommendation for all herbicide registrants and products. Since this element focuses on instructions to a herbicide registrant, each registrant would discuss unique aspects of the product with EPA. Furthermore, EPA will need to be equitable across registrants with products that have similar unique aspects. EPA should consider discussing requirements relating to products with unique aspects with other registrants with similar products perhaps through a separate venue or source (e.g. listing on a web page).

Table 2. Herbicide Resistance Categories of Concern*

US HRAC Comment: US HRAC does not support this categorization scheme and believes that it could be greatly simplified. There are numerous logistical problems with this table. Herbicide products with multiple active ingredients and multiple MoAs would be difficult to categorize, and user guidance will be complex, creating a potential for misapplication of the guidance. This could be simplified into two categories: Category 1 applies to all herbicides; Category 2 - special considerations.

US HRAC recommends that all products should consider following revised elements 1 to 8 and 10 as applicable (Category 1). Category 2 would be special considerations (Element 11). This would eliminate confusion over why an herbicide is categorized as low, medium or high concern, and how that categorization is made. Furthermore, it would reinforce fairness around herbicide resistance management as a recommendation for all herbicides.

Herbicide resistance is an issue of the specific herbicide and its uses; it is not caused by use of an herbicide-tolerant (HT) crop. For this reason EPA should remove that as a factor that defines an herbicide of high concern. All crops are tolerant to some herbicides, i.e., selective herbicides labeled for use in a given crop. Any unique recommendations could be specified under element 11.

References

Beckie, H. 2006. Herbicide Resistant Weeds: Management Tactics and Practices. Weed Tech. 20:793-814

Beckie, H. and X. Reboud. Selecting for Weed Resistance: Herbicide Rotation and Mixture. Weed Tech. 25-363-370

Evans, J., P. Tranel, A. Hager, B. Schutte, C. Wu, L. Chatham, and A. Davis. 2015. Managing the evolution of herbicide resistance. Pest Management Sci. 72: 74-80

End of US HRAC Comment

Attachment "A"

Herbicide Resistance Management – Stewardship Checklist with References

DATE: March 03, 2016

FROM: Chism, Becker, Berwald, Mallampalli, Yourman, and Jones
Biological and Economic Analysis Division,
EPA, Office of Pesticide Programs

As part of the registration and reregistration review of some herbicides BEAD reviews the stewardship and resistance management plans to determine if they have addressed the elements of concern to the Agency. The following table lists items that BEAD will consider when reviewing these plans.

Nine of the eleven items will be instructions placed on the label to provide information to the user (elements 1 through 7, 10 and 11 where applicable), and three of the elements will be instructions to the registrant (elements 8, 9, and 11 where applicable).

Table 1. Elements of resistance management or stewardship plan

Element	Description
1	List Mechanism of Action (MoA) Group Number. ➤ Registrant is responsible to place on label.
2	List seasonal and annual maximum number of applications and amount. ➤ Registrant is responsible to place on label.
3	Resistance Management language from PR Notice 2001-5, and/or Best Management Practices (appropriate to crop) from Weed Science Society of America (WSSA) & Herbicide Resistance Action Committee (HRAC), and/or HRAC proposed guidelines for herbicide labels. ➤ Registrant is responsible to place on label.
4	Include instructions for scouting before and after application. ➤ Registrant is responsible to place on label. ➤ User is responsible to follow recommendations.
5	Definition of Likely Resistance. ➤ Registrant is responsible to place on label.
6	User should report lack of performance to registrant or their representative. ➤ Registrant is responsible to place on label. ➤ User is responsible to follow recommendations.
7	List confirmed resistant weeds in a separate table and list effective or recommended rates for these weeds with the table. ➤ Registrant is responsible to place on label.

8	<p>Registrant report new cases of likely and confirmed resistance to EPA and users yearly. This will be in addition to any adverse effects reporting.</p> <ul style="list-style-type: none"> ➤ Registrant is responsible.
9	<p>For sites of high concern provide growers with:</p> <ul style="list-style-type: none"> • Resistance Management Plan • Remedial Action Plan (to control resistant weeds this season or next season) • Educational materials on resistance management <p>Plans should be locally developed and easily modified. We recommend registrants work with Extension, Consultants, Crop Groups, HRAC, & USDA.</p> <ul style="list-style-type: none"> ➤ Registrant is responsible to provide educational materials
10	<p>For combination products with multiple MoA, list which herbicide is controlling which weed (a 3 way mixture may only have 1 effective MoA for some problem weeds). List minimum recommended rate if resistance is suspected.</p> <ul style="list-style-type: none"> ➤ Registrant is responsible to list on label or otherwise provide information.
11	<p>Any additional specific requirements (e.g. mandatory crop rotation, unique agronomic aspects, additional training, time limited registration, etc.).</p> <ul style="list-style-type: none"> ➤ Registrant is responsible.

Footnote: Mechanism of Action Group number comes from the WSSA.

Table 2. Herbicide Resistance Categories of Concern*

Low Concern	Moderate Concern	High Concern
MOA with no resistance weed species in the U.S.	MOA with a few resistant weed species in the U.S.	<ul style="list-style-type: none"> • Any new herbicide with a new or novel mechanism of action, or • Herbicide resistant crop(s) for that technology (conventionally bred or GM), or • MOA with the most resistant weeds in U.S.
<ol style="list-style-type: none"> 1. MoA on Label 2. List seasonal and annual maximum number of applications and pounds 3. Resistance management language from PRN 2001-5 or BMPs 4. Scout before and after application 	<ol style="list-style-type: none"> Elements 1 through 4 plus 5. Definition of likely and confirmed resistance 6. Farmer should report lack of performance to registrant or its agent 7. List confirmed resistant species in separate table and list effective or recommended rates for these weeds with the table 8. Registrant report new cases of likely and 	<ol style="list-style-type: none"> Elements 1 through 8) plus 9. Provide growers with: Resistance Management Plan, Remedial Action Plan, Educational materials on resistance management 10. For combination products with multiple MoAs, list which herbicide is controlling which weed and minimum recommended rate 11. Any additional specific requirements (e.g. mandatory crop rotation, unique agronomic aspects, time limited registration,

	confirmed resistance to EPA & users yearly	etc.).
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* If new resistant weed species are found a MoA may move to higher level of concern.

REFERENCES

EPA. 2001. Guidance for Pesticide Registrants on Pesticide Resistance Management Labeling. Pesticide Registration (PR) Notice 2001-5. <http://www.epa.gov/sites/production/files/2014-04/documents/pr2001-5.pdf>

HRAC. 2015. Herbicide Resistance Management, Proposed HRAC Stewardship Guidelines for Herbicide Labels. Accessed online on September 24, 2015 at <http://www.hracglobal.com/pages/hracstewardshipguidelinesforherbicidelabels.aspx>

Norsworthy, J.K., S. M. Ward, D. R. Shaw, R. S. Llewellyn, R. L. Nichols, T. M. Webster, K. W. Bradley, G. Frisvold, S. B. Powles, N. R. Burgos, W. W. Witt, and M. Barrett. 2012. Reducing the Risks of Herbicide Resistance: Best Management Practices and Recommendations. Weed Science 2012 Special Issue:31–62. Available online at: <http://www.wssajournals.org/doi/pdf/10.1614/WS-D-11-00155.1>

APPENDIX I. Guidance for Pesticide Registrants on Pesticide Resistance Management Labeling (EPA, 2001)

Herbicides

1. The following general resistance management labeling statements are recommended for herbicide products containing only a single active ingredient or only active ingredients from the same group:
 - a. “For resistance management, (name of product) is a Group (mode of action group number) herbicide. Any weed population may contain or develop plants naturally resistant to (name of

product) and other Group (mode of action group number) herbicides. The resistant biotypes may dominate the weed population if these herbicides are used repeatedly in the same field. Other resistance mechanisms that are not linked to this mode of action but are specific for individual chemicals, such as enhanced metabolism, may also exist. Appropriate resistance-management strategies should be followed.”

For products containing active ingredients from different groups, the statement should be modified to reflect the situation, for example:

- b. “For resistance management, please note that (name of product) is both a Group (mode of action group number) and a Group (mode of action group number) herbicide. Any weed population may contain plants naturally resistant to Group (mode of action group number) and/or Group (mode of action group number) herbicides. The resistant individuals may dominate the weed population if these herbicides are used repeatedly in the same fields.”
2. The following additional resistance management labeling statements are recommended for herbicides, although each bulleted statement may not be appropriate or pertinent for every product label:

“To delay herbicide resistance:

- a. Rotate the use of (name of product) or other Group (mode of action group number) herbicides within a growing season sequence or among growing seasons with different herbicide groups that control the same weeds in a field.
- b. Use tank mixtures with herbicides from a different group if such use is permitted; Use the less resistance-prone partner at a rate that will control the target weed(s) equally as well as the more resistance-prone partner.
- c. Adopt an integrated weed management program for herbicide use that includes scouting and historical information related to herbicide use and crop rotation, and that considers tillage (or other mechanical control methods), cultural (e.g., higher crop seeding rates; precision fertilizer application method and timing to favor the crop and not the weeds), biological (weed-competitive crops or varieties) and other management practices.
- d. Scout after herbicide application to monitor weed populations for early signs of resistance development. Indicators of possible herbicide resistance include: (1) failure to control a weed species normally controlled by the herbicide at the dose applied, especially if control is achieved on adjacent weeds; (2) a spreading patch of non-controlled plants of a particular weed species; (3) surviving plants mixed with controlled individuals of the same species. If resistance is

suspected, prevent weed seed production in the affected area by an alternative herbicide from a different group or by a mechanical method such as hoeing or tillage. Prevent movement of resistant weed seeds to other fields by cleaning harvesting and tillage equipment when moving between fields, and planting clean seed.

- e. If a weed pest population continues to progress after treatment with this product, discontinue use of this product, and switch to another herbicide with a different target mode of action, if available.
- f. Have suspected resistant weed seeds tested by a qualified laboratory to confirm resistance and identify alternative herbicide options.
- g. Contact your local extension specialist or certified crop advisors for additional pesticide resistance-management and/or integrated weed-management recommendations for specific crops and weed biotypes.
- h. For further information or to report suspected resistance, contact (company representatives) at (toll free number) or at (Internet site).”

APPENDIX II. Definition of Resistance and Likely Resistance

According to the Weed Science Society of America “Herbicide resistance is the inherited ability of a plant to survive and reproduce following exposure to a dose of herbicide normally lethal to the wild type. In a plant, resistance may be naturally occurring or induced by such techniques as genetic engineering or selection of variants produced by tissue culture or mutagenesis.” “Herbicide tolerance is the inherent ability of a species to survive and reproduce after herbicide treatment. This implies that there was no selection or genetic manipulation to make the plant tolerant; it is naturally tolerant.” (<http://weedscience.org/documents/resistancecriterion.pdf>).

Indicators of likely herbicide resistance (called possible resistance in Norsworthy et al 2012, Page 39) include (1) failure to control a weed species normally controlled by the herbicide at the dose applied, especially if control is achieved on adjacent weeds; (2) a spreading patch of noncontrolled plants of a particular weed species; and (3) surviving plants mixed with controlled individuals of the same species.

APPENDIX III. Best Management Practices for Herbicide Resistant Weeds

Crop Selection and Cultural Practices:

1. Understand the biology of the weeds present.
2. Use a diversified approach toward weed management focused on preventing weed seed production and reducing the number of weed seeds in the soil seed-bank.
3. Emphasize cultural practices that suppress weeds by using crop competitiveness.
4. Plant into weed free fields, keep fields as weed free as possible, and note areas where weeds were a problem in prior seasons.
5. Incorporate additional weed control practices whenever possible, such as mechanical cultivation, biological management practices, crop rotation, and weed-free crop seeds, as part of an integrated weed control program.
6. Do not allow weed escapes to produce seeds, roots or tubers.
7. Manage weed seed at harvest and post-harvest to prevent a buildup of the weed seed-bank.
8. Prevent field-to-field and within-field movement of weed seed or vegetative propagules.
9. Thoroughly clean plant residues from equipment before leaving fields.
10. Prevent an influx of weeds into the field by managing field borders.
11. Fields should be scouted before application to ensure herbicides and application rates will be appropriate for the weed species and weed sizes present.
12. Fields should be scouted after application to confirm herbicide effectiveness and to detect weed escapes.
13. If resistance is suspected, treat weed escapes with an alternate mode of action or use non-chemical methods to remove escapes.
14. Avoid outcrossing to weedy relatives, in crops that outcross. Control weedy relatives in surrounding field margins. Research has demonstrated that the pollen can move _____ feet.

Herbicide Selection:

1. Use a broad spectrum soil applied herbicide with a mechanism of action that differs from this product as a foundation in a weed control program.
2. A broad spectrum weed control program should consider all of the weeds present in the field. Weeds should be identified through scouting and field history.
3. Difficult to control weeds may require sequential applications of herbicides with alternative mechanisms of action.
4. Fields with difficult to control weeds should be rotated to crops that allow the use of herbicides with alternative mechanisms of action.
5. Apply full rates of this herbicide for the most difficult to control weed in the field. Applications should be made when weeds are at the correct size to minimize weed escapes.

6. Do not use more than two applications of "this herbicide" or any herbicide with the same mechanism of action within a single growing season unless mixed with another mechanism of action herbicide with overlapping spectrum for the difficult to control weeds.
7. Report any incidence of non-performance of this product against a particular weed species to the _____ representative (list contact information here).

Footnote: Most items are taken from the Herbicide Resistance Action Committee / Weed Science Society of America list of Best Management Practices.