
Regulating Resistance

JACK HOUSENGER

US Environmental Protection Agency

Housenger.Jack@epa.gov

When I think of resistance I always think of Palmer amaranth (I like saying Palmer amaranth rather than pigweed because it sounds like I know what I'm talking about). This plant can get ten feet tall, produces thousands of seeds, and can grow five inches in the course of three days. It is an impressive weed, and it is also glyphosate resistant.

My office is in charge of registering all pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). We also regulate under the FFDCA (Federal Food, Drug, and Cosmetic Act). FIFRA is a risk-benefit statute, and the risk of resistance is considered to be part of our regulatory decision. Obviously not when we register a new AI, because there is no resistance yet, but as we go through a re-evaluation process we will look at resistance, which we consider to be an adverse effect. So we license all pesticides used on crops, on conventionally bred crops as well as on genetically modified crops. USDA deregulates GE crops, but we also license the plant-incorporated protectants (PIPs), e.g., *Bt* crops.

Our goal is to extend the useful life of pesticides for as long as possible, to delay resistance to insecticides, fungicides, and herbicides for as long as we can without putting undue burden on the growers. We have a couple of mechanisms to do this. Anything from requiring a code of action on pesticide labels to informing growers wanting to rotate chemicals as to which chemical they are using and what alternate chemical they can use in the rotation to prevent resistance. There is also generic labeling that we promote for registrants to put on the labels. Most of the major registrants have incorporated this into their labeling, but many of the generics are lagging behind in doing so. We have recently registered an herbicide-resistant crop that is resistant to 2,4-D, so we are requiring resistance management plans for this crop as well, given what has happened over the years with glyphosate. For the PIPs we have been requiring resistance management plans for some time, although we are now starting to see some resistance there anyway.

Enlist Duo is a new pesticide that is applied to cotton, corn, and soybeans. It is a combination product of 2,4-D and glyphosate. This is the first time we have required more extensive resistance management plans for an herbicide-tolerant crop, but we are starting to see more and more herbicide-tolerant crops, and we will have similar plans to what we have imposed here for those. You can see that we are making labeling, training, and education, early identification of resistant weeds, and reporting of resistant weeds to stakeholders a requirement.

These are some of the label elements that I am going to be talking about:

- Mode of action
- BMPs (best management practices)
- Scouting
- Reporting

2,4-D and glyphosate are in groups 4 to 9, and those numbers appear on the label and indicate mode of action.

The BMPs we are requiring were developed by the Herbicide Resistance Action Committee, Weed Science Society of America, as well as Crop Life America. And most of the elements of BMPs describe cultural and mechanical practices to combat the resistant weeds. Some of the examples of BMPs are use of a broad, soil-applied herbicide such as Atrazine before planting; use of different modes of action, such as nonchemical weed controls including cultivation, cover crops, crop rotation, and weed-free crop seeds; and managing the weeds in and around the fields both during and after harvest.

One of the requirements is scouting before and after application to identify what weeds need to be controlled—their size and species. After application, scouting is done to determine the impacts, to determine whether something escaped control and what may be the likely cause.

Finally, reporting all incidents of nonperformance to Dow is required. While we were negotiating for this, we determined that the agreement should be written so that the grower will take care of the performance issue but can also call Dow for help through whatever possible means. The point here is to control the weed that escapes control by the initially applied herbicide.

As part of the terms and conditions that we imposed on Dow, we have them

- Develop a stewardship program for resistance management.
- Provide training and education materials, again so we don't run into resistance with 2,4-D as we did with glyphosate.
- Investigate nonperformance to determine if it is because the spray didn't contact the weed or if it is likely to be resistance.
- Develop a remediation plan if resistance is suspected. It takes some time to actually confirm resistance, so we want to make sure the weeds get controlled even if it is just likely or suspected.
- Annually report to us with enough information so we can hopefully figure out what is going on.

- Provide early notification so we have an early read on whether resistance is happening or not.
- Work to develop a rapid diagnostic system for resistance.

At the end of six years we pause to see whether or not we think resistance is happening despite what we are putting on the labels, despite all the efforts by everybody, and if it is, then we are likely to add additional labeling or restrictions to the product.

Registration review is a way to evaluate older chemistries. We do it every 15 years. We finished reregistration in 1997, so we will finish registration review again, in 2022. Resistance management is one of the things that we are going to be considering during registration review. Glyphosate is high on our list. Glufosinate will probably come out this summer, and you are likely to see similar resistance management plans for those two chemicals.

In the case of PIPs of *Bt* crops, we have had some general success in preventing resistance, and if you look at the requirements back in '96 and going forward, it looks very similar to what we are requiring for 2,4-D: stewardship programs, compliance, resistance monitoring, legal action, and refuge areas. Resistance would have evolved much faster without these requirements. I think for *Bt* cotton it was immediately put into place. For corn it took three years to get into place. Refuge requirements used to be structured, now they are a seed blend where the refuge is in the seed bag itself.

There is an expectation that given how *Bt* acts, resistance will build up. It is a season-long expression, so corn rootworm is exposed to *Bt* toxin throughout the growing season, for multiple pest generations of three or even up to six, and they feed exclusively on *Bt* corn or *Bt* cotton. I know there is a debate if this provides benefits for the environment. We think it does and we want to prolong its life as long as possible. There have been some areas in the country where corn rootworm has become resistant. In Iowa, Illinois, and I guess it is spreading east as well. We went to the scientific advisory panel to get advice back in 2013. They gave us a lot of advice we then turned into a framework proposal in January of 2014, requesting public comment in 2015. That comment period closed in April 2015; you can see some of the areas we are trying to improve upon, and you can go to Docket# EPA-HQ-OPP-2014-0805 (at www.regulations.gov) to look at the actual framework. The comment period is closed. We received 87 comments and we will be taking those comments into consideration as we develop our final framework for managing resistant corn rootworm.

Speaker Profile: Jack Housenger is the director of the Office of Pesticide Programs (OPP) at EPA. Before that, he was with OPP, and from 2011 to 2014, he was director of the Health Effects Division, which is responsible for managing the review of health effects and exposure data for pesticides as well as the development of human-health risk assessments. He was director of the Biological and Economic Analysis Division.