U.S. EPA Tour of Weed Resistance Management Challenges in the Mid-Atlantic Region
August 21, 2012

Background:

The U.S. Environmental Protection Agency (EPA) and Weed Science Society of America (WSSA) have worked together in recent years on a number of weed management issues facing farmers, natural resource managers, and weed scientists. As part of this ongoing exchange, WSSA participated in a tour for government officials of aquatic weed problems in the waterways of Florida in 2009 and arranged a tour of weed management challenges in irrigation canals, rangeland, and riparian areas of New Mexico in 2010. In 2011, WSSA organized a tour for EPA representatives to discuss the problems associated with herbicide resistant weeds. The 2011 tour focused on weed species resistant to glyphosate [herbicide mechanism of action (MOA) group 9] in cotton and soybean fields in Arkansas, Illinois, and Missouri. These tours were successful in achieving the goal of providing information and increasing our understanding of the relevant weed management issues.

The EPA and WSSA have continued their active dialogue about managing herbicide-resistant weeds. The on-going challenges of managing weeds that have evolved resistance to glyphosate prompted the current discussions. However, the problem of managing weeds that have evolved resistance to other herbicide mechanisms of action cannot be ignored. The last new herbicide MOA was introduced over 20 years ago and no new herbicide MOA's are in development trials. The evolution of weed populations that are resistant to multiple herbicide MOA's have made crop production more management intensive and economically challenging. The problem of mitigating herbicide resistant weeds has received the attention of special interest groups, the agricultural industry, regulatory agencies, academia, and the general public. In addition, the National Academies of Sciences hosted a national summit in May 2012 to discuss strategies for managing herbicide resistant weeds.

The Mid-Atlantic Region of the United States has been dealing with herbicide resistant weeds since 1972 when triazine (MOA group 5) resistance was identified in Maryland. Glyphosate (MOA group 9)-resistant horseweed was identified in 2000 in Delaware and, more recently, acetolactate synthase (ALS; MOA group 2)-resistant smooth pigweed (*Amaranthus hybridus* L.), ALS-resistant common chickweed (*Stellaria media* (L.) Vill.), and glyphosate-resistant Palmer amaranth (*Amaranthus palmeri* S. Wats.) have been confirmed in the region. While, glyphosate-resistant species in grain crops have impacted the largest number of acres, ALS-resistant smooth pigweed remains a very big challenge for their vegetable industry (over 125,000 acres in the Delmarva region). Therefore, a one-day tour was organized to provide an opportunity for EPA staff and WSSA members to discuss herbicide resistant weeds and the impact they are having on agricultural production in this region. Twenty-seven EPA staff representing all of the divisions within the Office of Pesticide Programs participated on the tour along with Mike Barrett, Donn Shilling, Lee VanWychen, and Jill Schroeder representing WSSA. The hosts of the tour were Dr. Mark VanGessel, University of Delaware, and Dr. Ron Ritter, University of Maryland.

Tour Objectives:

- Demonstrate the complexity of herbicide resistant weed management.
- Demonstrate the severity of herbicide resistance in a variety of crops in the Mid-Atlantic region, including vegetable crops.

- Discuss how farmers in the Mid-Atlantic region are dealing with the problem, and discuss some of their constraints to management.
- Discuss how weed resistance has evolved to several herbicide families impacting all crops grown in the region.
- Discuss how approaches to weed management are often site and region specific.

The group departed from the EPA Potomac Yard Building in Arlington, VA early in the morning of August 21, 2012. The agenda included four locations (see photo at left) on the Delmarva Peninsula, where the majority of Delaware is located plus portions of Maryland and two counties of Virginia. "Delmarva" is a portmanteau formed from DELaware, MARyland, and VirginiA. The entire peninsula is a flat sandy coastal plain with very few hills. The area produces significant amounts of corn, soybeans, winter wheat, green beans, tomatoes, and other vegetables. The Delmarva is also known for its poultry farms and is a net importer of feed grains despite the large areas devoted to corn and soybean production.

Stop 1: University of Maryland's Wye Research and Education Center
Hosts: Mark Sultenfuss, Manager of Wye Research and Education Center; Ron Ritter, University of Maryland (pictured below); Mark VanGessel, University of Delaware

The first stop was at the University of Maryland Wye Research Farm where the group viewed research plots testing weed control programs in conventional and herbicide-resistant crops. The hosts discussed selectivity of herbicides as well as the need for herbicide programs designed for the rotation system and the weed complex within a grower's field.

A number of issues were presented and discussed by the group, including:

- Growers in the area often plant three crops (corn, winter wheat, double cropped soybeans) in a two - year program. The primary market for soybeans and corn is the regional poultry industry.
  - Conservation tillage has been practiced in the area for 30 years initially for soil moisture conservation and, more recently, to reduce nutrient movement into the Chesapeake Bay.

- Weed problems include velvetleaf (*Abutilon theophrasti* Medik.), morningglory species (*Ipomoea spp.*), common lambsquarters (*Chenopodium album* L.), giant foxtail (*Setaria faberi* Herrm.), horseweed (*Conyza canadensis* (L.) Cronq.), and smooth pigweed. In addition, small populations of Palmer amaranth are beginning to infest the region.
    - Horseweed produces approximately 250,000 seeds per plant. Seed can travel hundreds of miles aerially; therefore, glyphosate-resistant horseweed has spread throughout the region. Horseweed is a major problem in no-till soybean production and has to be controlled prior to planting.
    - Triazine-resistant smooth pigweed and common lambsquarters (MOA group 5) are found in most production fields.
- Most corn varieties planted in the region carry a gene for glyphosate-resistance; however, the choice of variety is based on agronomic traits more often than herbicide resistance traits.
- The extension programs of MD and DE recommend that growers apply a preemergence herbicide followed by a postemergence herbicide as needed to control weeds in corn.
    - Seven out of ten years the region receives enough timely rainfall to activate preemergence herbicides.
    - 90-95% of growers use atrazine containing products preemergence for corn weed control. The use of atrazine is particularly recommended when morningglory species are present in a field.
    - There are a number of post-emergence alternatives to glyphosate available for corn including mesotrione (MOA group 27), various ALS-inhibiting herbicides (MOA group 2), 2,4-D (MOA group 4), dicamba (MOA group 4), and atrazine, among others. Most growers hire custom applicators to make herbicide applications.
- Soybean crops are planted on a variety of row spacings (6 to 30 inch), the choice depending on the equipment available and tillage regime.
- More growers are planting glufosinate-resistant (Liberty Link™; MOA group 10) soybean because of the prevalence of glyphosate-resistant horseweed in the area.
    - Herbicide program includes a preemergence treatment followed by glufosinate to control horseweed.
- Timing of 2,4-D applications is of concern for high-value crop producers (vegetable industry).
    - Pre-plant burndown treatments of 2,4-D to control horseweed in soybeans are commonly applied in mid-April to mid-May, prior to planting many vegetable crops.
    - Postemergence treatments of 2,4-D and dicamba are not often applied in corn due to concern for potential off-target movement. This concern may affect adoption of crops containing the 2,4-D or dicamba resistance genes in areas where vegetable crops are grown.
- Extension specialists are working to provide many tools for resistance management, presenting information at meetings, and discussing research plots with dealers and applicators. The county agents are very active and partner with growers to address herbicide resistance issues.

Stop 2: near DE/MD state line (Greensboro, MD).

Our hosts were Gary Brown, Aurora Agronomics, and Phillip Sylvester, extension agent, Kent County, Delaware.

The second stop was at a soybean field near the DE/MD state line where the group discussed the program designed by the University of Delaware for management of glyphosate-resistant horseweed and the effect of environmental conditions on the success of that program.

The winter of 2012 was very warm so winter weeds were larger than normal when pre-plant herbicides were sprayed (herbicides are generally applied on the basis of calendar date rather than weed size); the horseweed was only suppressed due to the late application and re-grew in the field (see photo at left). Growers continue to use glyphosate since it remains effective on a broad range of weed species including grasses. Glyphosate is tank-mixed with other recommended herbicides (2,4-D, PPO (MOA group 14) herbicides and ALS (MOA group 2) herbicides.

Some growers in both Maryland and Delaware are planting a forage radish "tillage radish" in the fall to help with soil compaction issues. The plant grows a large tap root that breaks up the compacted soil while abundant vegetative growth provides ground cover to smother winter weeds. This practice is providing an option to growers to diversify their weed management practices.

The group discussed the different problems posed by glyphosate-resistant horseweed, a regional problem due to wide dispersal of seed by wind, and Palmer amaranth which is currently a small local problem. Transport of Palmer amaranth is primarily via equipment. Delaware has placed Palmer amaranth on its Noxious Weed List in an effort to contain the problem and educate growers before it becomes a wide-spread issue. The hosts were asked about grower perception of the next generation of genetically engineered crops. They stressed that growers need additional tools for management of herbicide resistant weeds; however, these new crop varieties will have to be evaluated by extension specialists to determine how they fit in with recommended practices.

Stop 3: near Greenwood, DE - Lima bean field

Hosts: Donnie Calhoun, producer; Luke McConnell, McConnell Agronomics; David Pyne, Delaware Department of Agriculture.

The third stop was at a lima bean field near Greenwood, DE. Lima beans are considered the cornerstone crop of the vegetable processing industry in Delaware, but the management of ALS-resistant smooth pigweed has become a challenge due to the limited herbicide registrations. The preemergence and post-emergence herbicides labeled for broadleaf weeds have the ALS-MOA. When weed infestations are heavy, growers cannot mechanically harvest the crop. Cultivation in vegetable crops is a common practice, but it is not adequate for controlling weeds in the crop row, and the cost of hand labor to remove weed infestations ranges from $30 to $300 per acre depending on the weed density.

Photo credit: Michele Walfred, Univ. of Delaware Communications

The photograph at the left shows Mr. Calhoun's lima bean field that had been sprayed with a pre-emergence application of carfentrazone plus sulfentrazone (Spartan Charge ™; MOA group 14). The strip on the left was inadvertently missed with the spray application. The right side of the photograph shows a section that had been treated with the herbicide. The comparison of the two strips illustrates how effectively this product controls the ALS-resistant smooth pigweed. Spartan Charge was registered for use in lima beans in Delaware through collaborative efforts of the Delaware Department of Agriculture, growers, and the University of Delaware (section 24(c) special local needs registration).

State and university officials discussed the value of the IR-4 program and the importance of Section 24(c) labeling for expanding herbicide options in these minor crops. Lima beans are often double cropped with sweet corn, various processing vegetables, and barley or wheat. Herbicide use in these cropping systems is limited due to label restrictions when rotating to minor crops. Therefore, these crop rotation restrictions further limit the tools for managing herbicide resistant weeds.

Stop 4: near Denton, MD

Hosts: Berl Jastram, Mike Twining, and Travis Stafford of Willard Ag Service, pictured at left. Land that is part of the CRP program is behind the hosts and is a source of weed seed infesting the adjacent production field.

The final stop was at a soybean field near Denton, MD that was planted with soybean rather than corn (original choice, higher income potential) because of the weed spectrum in the field that included Texas panicum (*Panicum texanum* Buckl.), bulbous (tall) oatgrass (*Arrhenatherum elatius* (L.) Beauv. ex J. & K. Presl), glyphosate-resistant horseweed, morningglory species, and ALS-resistant smooth pigweed. Corn was not planted because Texas panicum emerges later in the growing season and, thus, escapes control from most corn herbicides.

The representatives of Willard Ag Service stressed the fact that their approach to management has changed dramatically with the evolution of herbicide resistant weeds as well as the introduction of new weed species. They discussed how younger growers often do not have the experience, background, and tools they need to deal with these new issues; the adoption of Roundup Ready™ crops reduced the need for diversified production practices and valuable knowledge and experience was lost as a result. The

consultants are promoting and encouraging growers to diversify practices and stressing the need to be proactive with their weed management and with scouting of fields to identify new problems early. However, while they agreed that crop varieties with new resistance traits are needed to help growers diversify practices, they stressed that grower adoption of these varieties will be affected by the presence or absence of susceptible crops in the surrounding area.

The group also discussed how these changes in production practices require a life style change by all – growers, retailers, and consultants. The consultants (and custom applicators) must consider the human impact resulting from the evolution of herbicide resistant weeds, particularly issues of the increased work load required, the increase in diversification of practices, and additional herbicide treatments.

The group finished the day with a wrap-up discussion over dinner. The tour participants were very engaged and we had excellent discussions throughout the day. Mark VanGessel surveyed the EPA participants to assess whether the tour provided information of value to their work. Twenty-three surveys were returned and the response was very positive. For the question, "As a result of this tour, do you feel you have a better understanding of issues related to herbicide-resistance?", 17 responded "very much" and six responded "somewhat". The survey results can be found at the end of this report.

Respectfully submitted,
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Evaluation / Assessment of WSSA/EPA Herbicide Resistant Weeds in the Mid-Atlantic States Tour

1. How would you rate the <u>overall</u> educational portion of this tour?

Very informative	19
Somewhat informative	4
Not very informative	0
Nothing new	0

2. As a result of this tour, do you feel you have a better understanding of issues related to herbicide-resistance?

Very much	17
Somewhat	6
A little	0
Not at all	0

3. How likely are you to use information that you gained during this tour in your duties with EPA?

Very much	15
Somewhat	8
A little	0
Not at all	0