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Managing Herbicide Resistance: Listening to the Perspectives of Practitioners. Procedures for Conducting Listening Sessions and an Evaluation of the Process

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Managing Herbicide Resistance: Listening to the Perspectives of Practitioners. Procedures for Conducting Listening Sessions and an Evaluation of the Process

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Abstract

Seven half-day regional listening sessions were held between December 2016 and April 2017 with groups of diverse stakeholders on the issues and potential solutions for herbicide-resistance management. The objective of the listening sessions was to connect with stakeholders and hear their challenges and recommendations for addressing herbicide resistance. The coordinating team hired Strategic Conservation Solutions, LLC, to facilitate all the sessions. They and the coordinating team used in-person meetings, teleconferences, and email to communicate and coordinate the activities leading up to each regional listening session. The agenda was the same across all sessions and included small-group discussions followed by reporting to the full group for discussion. The planning process was the same across all the sessions, although the selection of venue, time of day, and stakeholder participants differed to accommodate the differences among regions. The listening-session format required a great deal of work and flexibility on the part of the coordinating team and regional coordinators. Overall, the participant evaluations from the sessions were positive, with participants expressing appreciation that they were asked for their thoughts on the subject of herbicide resistance. This paper details the methods and processes used to conduct these regional listening sessions and provides an assessment of the strengths and limitations of those processes.

Introduction

Weed scientists' efforts to educate and inform farmers, advisers, and others about the need to diversify weed management and adopt best management practices (BMPs) to combat herbicide-resistance evolution have produced mixed results. We do not know or understand the reasons farmers do not implement these BMPs or the challenges they have had in adopting them. To change this, we felt it was important to understand the grassroots concerns and challenges, plus successful and unsuccessful approaches to herbicide-resistance management (HRM) implemented by farmers and others who are dealing directly with herbicide resistance. As a first attempt to gather this kind of information on a national scale, the Herbicide Resistance Education Committee (HREC) of the Weed Science Society of America (WSSA), with the help of local weed scientists and professional facilitators, conducted seven regional listening sessions around the United States. The objective was to connect with stakeholders and hear their challenges and recommendations for addressing herbicide resistance. This paper details the methods and processes used to conduct these regional listening sessions and provides an assessment of the strengths and limitations of those processes. The companion paper "Innovative Approaches to Manage Wicked Herbicide Resistance: Lessons from the Field" describes and discusses the key outcomes from the listening sessions (Schroeder et al. 2018).

Methods

Process to Develop Listening-Session Timeline, Goals, and Agenda

A three-member coordinating team, the HREC chair and two members, led the planning and work process throughout the project. They communicated regularly by phone and email and coordinated with the professional facilitators hired to lead the sessions to ensure progress was being made. Strategic Conservation Solutions, LLC, was the group contracted for facilitation services. The HREC invited and received the endorsement of the U.S. regional weed science society presidents as well as their suggestions for leaders within the identified listening-session regions to coordinate the sessions. The HREC solicited financial support for the listening sessions from the U.S. Department of Agriculture Animal Plant Health Inspection Service (USDA-APHIS), the United Soybean Board (USB), and the WSSA. The HREC then reached out to selected leading academic weed scientists within each identified region, all of whom agreed to serve as coordinators for their sessions (Table 1).

Initial Planning Meeting

The HREC and regional coordinators conducted conference calls and email exchanges in preparation for a 1-day planning meeting in August 2016. Before the meeting, the regional coordinators were asked to provide input into the goals for the listening sessions, the stakeholders who should be involved, the listening-session topics, and their definition of success. The regional coordinators from the Northeast, Great Plains, Midwest, and Southwest were able to respond and provided perspectives that formed the basis for a rich discussion at the planning meeting (Table 2).

Representatives of the HREC, one regional coordinator per region, and representatives from the USB, the USDA-APHIS, the USDA Office of Pest Management Policy, and the U.S. Environmental Protection Agency Office of Pesticide Programs attended the August planning meeting. The objectives of the planning meeting were to determine the desired outcomes of the listening sessions; to delineate the roles and responsibilities of the facilitators, the HREC,

Table 1. Regions and regional coordinators for the herbicide-resistance listening sessions.

Region and states included	Date and location[a]	Coordinators[b]
Midsouth MO, TN, AR, MS, LA	December 5, 2016 Starkville, MS	Darrin M. Dodds Larry E. Steckel
Northeast PA, MD, DE, NY, VA, WV	January 18, 2017 Lancaster, PA	William S. Curran Mark J. VanGessel Annie E. Klodd
Northwest WA, OR, ID, MT, UT, NV	January 24, 2017 Pasco, WA	Ian Burke Don W. Morishita
Southwest CA, AR, NM	February 15, 2017 Tulare, CA	Bradley D. Hanson Brian J. Schutte
Great Plains KS, NE, CO, WY, MT	February 17, 2017 Holyoke, CO	Phillip W. Stahlman Todd A. Gaines Andrew R. Kniss Cody F. Creech Prashant Jha Sandra McDonald
Midwest IA, IL, IN, OH, MN, WI, ND, SD, KS, KY, MI, MO, NC, NE, TN	March 4, 2017 San Antonio, TX	Christy L. Sprague Jeffrey L. Gunsolus
Southeast GA, FL, NC, SC, AL	March 30, 2017 Waynesboro, GA	Ramon G. Leon Stanley Culpepper

[a]The Midsouth meeting was held in conjunction with the Mississippi State University Row Crop Short Course; the Northwest meeting was held in conjunction with the Far West Agribusiness Association meeting; the Southwest meeting was held in conjunction with the World Ag Expo; the Great Plains meeting was held in conjunction with the Farming Evolution 2017 conference; and the Midwest meeting was held in conjunction with the Commodity Classic, which was located outside the region in Texas.
[b]D. M. Dodds, Mississippi State University; L. E. Steckel, University of Tennessee; W. S. Curran, Penn State University; M. J. VanGessel, University of Delaware; A. E. Klodd, Penn State University; I. Burke, Washington State University; D. W. Morishita, University of Idaho; B. D. Hanson, University of California, Davis; B. J. Schutte, New Mexico State University; P. W. Stahlman, Kansas State University; T. A. Gaines, Colorado State University; A. R. Kniss, University of Wyoming; C. F. Creech, University of Nebraska–Lincoln; P. Jha, Montana State University; S. McDonald, Mountain West PEST; C. L. Sprague, Michigan State University; J. L. Gunsolus, University of Minnesota; R. G. Leon, North Carolina State University (formerly University of Florida); S. Culpepper, University of Georgia.

Table 2. Responses from four of seven regions on regional goals, stakeholders, and meeting objectives before the planning meeting August 2016.

Question 1.	**What is/are the goal(s) for you and your region in hosting this listening session?**
Northeast	To help inform the direction of the summit with more regional and local information. We also want to provide education to our clientele. What do we need to do differently to get the message out? Need to think about how we deal with different clientele groups—dealers vs. farmers. We want to influence state, regional, and national policy. We hope this effort leads to real change in the field.
Southwest	To provide an opportunity for stakeholder discussions on the strategies and situations that prevent or enhance the development and spread of herbicide-resistant weeds in croplands and infrastructure environments across Arizona, California, and New Mexico.
Great Plains	Achieve a better understanding of farmer and land manager decision-making considerations and processes and identify the greatest impediments and needs to implement herbicide-resistance management.
Question 2	**Who are the major stakeholders who influence the weed management decision-making process—both directly and indirectly in your region, and who should be represented in the listening sessions?**
Northeast	Ag retailers, private consultants, commodity agronomists, farmers first; crop protection sales second; extension and federal and state agencies third.
Southwest	Growers, retailers, university extension specialists, pest-control industry representatives, grower group and commodity organization representatives, pest control advisers, agronomists employed by food processors, irrigation district managers, vegetation management specialists with state or local departments of transportation.
Great Plains	Neighbors, advisers, crop consultants, and local retailers have the greatest influence within the regulations of federal programs (NRCS, FSA, etc.) and constraints of landowners (many unaware or uncaring about resistance issues). The latter group are often unwilling to share increased costs associated with resistance management in crop share arrangements. University research and extension specialists influence many directly and many more indirectly. Most advisers and crop consultants get much of their information from university and industry reps.
Midwest	Farmers
Question 3	**What questions/topics would you like to ask the group attending your listening session and are there things we can address in common across all seven sessions?**
Northeast	Economics—How do you sell prevention? What is HRM to you? How can we promote non-chemical approaches? What are the university resources to aid IWM [integrated weed management]? Provide regional success stories that include management diversity; what about importing vs. selecting for resistance? What motivates someone to adopt IWM or more ecologically based weed management?
Southwest	How prevalent are herbicide-resistant weeds in each of the regions and cropping systems discussed at the listening sessions? For crops and regions with few reports of herbicide-resistant weeds, how are weeds managed? What are the primary weed management strategies used in crops and regions with severe resistance problems? For crops and regions with severe resistance problems, are there examples of successful resistance management interventions? For these scenarios, what are the details with respect to practice, farm, and farmer? How do growers with and without herbicide-resistant weeds perceive the threat of herbicide resistance relative to other problems challenging crop production? What is the level of knowledge on herbicide-resistant weed management (HRM) among growers and consultants? Do they consider the full suite of practices presented in Norsworthy et al. 2012? For participants with direct financial connections to crop production (growers), what prevents adoption of HRM practices? What accelerates adoption of HRM practices? For participants with indirect connections to crop production (irrigation districts, DOTs [departments of transportation]), what prevents adoption of HRM practices? What accelerates adoption of HRM practices? Is the adoption of HRM practices influenced by conservation programs, contracts with food processor and/or government regulations? If so, how? How can industry and university resources be used to promote HRM adoption? According to growers and consultants, where do herbicide-resistant weeds originate?
Great Plains	What are the major impediments to implementing proactive weed management practices? What are their needs from research institutions and industry that are not being addressed adequately or at all? Other than new herbicides (a given), what do they need from industry? What is the best way to communicate to reach and educate those on the fringes—those not practicing HRM?
Midwest	Who do you think the key stakeholders should be? What are the major farm economic influences that affect HRM? What industry incentives are available and do they pose any barriers? Are enough university resources available to aid HRM? Are there existing community resources/networks that can be tapped to assist with HRM? Would you share any regional success stories regarding HRM as well as failures? Are the messages received on HRM from different sources in agreement? What is the sense of importance in your region concerning HRM? Are the approaches to HRM in your region working, being adopted? What is needed from the different sources to address resistance?
Question 4	**How do you define success for your listening session?**
Northeast	Attendees think it's worth their time; good attendance with the right people; engaged audience; accomplish what the WSSA needs; identify the current state of HRM in our region; the information actually benefits our stakeholders—doesn't just remain internal; helps us develop a needs assessment for our region.
Southwest	Constructive dialogue that encourages input from individuals with different points of view. A report summarizing expert-derived knowledge on the severity, attitudes, and possible solutions for herbicide-resistant weeds in crop fields and supporting lands in the Southwest. A list of potential speakers for the Herbicide Resistance Summit scheduled for 2018.
Great Plains	Did the listening session reach stakeholders who seldom attend traditional extension and industry education? Did the organizers learn anything from stakeholder input they were not already aware of or become aware of need for different approach(es) and information?

Table 3. Regional descriptions of their approach to identifying invitees.

Midsouth	The coordinators held the listening session the morning before the start of an existing meeting. They invited individuals who had been past attendees of the meeting, advertised in local and regional media as well as through blogs, etc. The non-targeted approach resulted in a mix of consultants, dealers, farmers, private industry, and others.
Northeast	In Pennsylvania and New York, the coordinators identified about 35 individuals that they wanted to personally invite and included mostly ag chemical dealers and consultants from companies like Helena and Growmark as well as independent consultants. In addition, the coordinators invited Department of Ag, Farm Bureau, and a few targeted farmers. They also contacted several organizations and asked if they could send out a general invite to their membership. These organizations included Penn Ag Industries, an organization that represents the major agriculture retailers in the state, the PA Soybean Board (board members only), Pennsylvania Agronomic Education Society, and the Keystone Crops Conference attendance list. In addition, the coordinators recruited Pennsylvania county-based extension educators and weed scientists from Cornell and Rutgers to help facilitate the listening session. In Delaware, a targeted group of 20 farmers and 5 agronomists from vegetable processing companies were invited; 10 ag chemical dealers were contacted as well as the Delaware Noxious Weed Specialist.
Northwest	The coordinators worked with the Far West Agribusiness Association (FWAA) to select an initial list of about 95 invitees. They identified 5 participant categories: field or account managers who were thought to know something about herbicide MOA, research biologists with regional companies, active farmers on commodity commission groups, public research scientists, and governmental workers that made herbicide-related policy decisions.
Southwest	In an attempt to represent the diversity of views on HRW [herbicide-resistant weeds] in the Southwest, invitees were targeted using an online survey advertised via blog posts, Social Media, and several Cooperative Extension newsletters; a request for potential invitees was sent out to Cooperative Extension colleagues via direct emails and also discipline- and crop system-based university internal message boards; personal invitations to individuals on the coordinators' own contact lists; and several direct solicitations to additional individuals to ask them to represent specific sectors, regions, or industries.
Great Plains	Committee members were responsible for inviting participants from their states. However, they agreed to try for stakeholder group diversity with a target of 50% farmers. Stakeholder groups contacted for nominations included Farm Bureau, county extension agents and area agronomists, corporate offices of Crop Quest, Servi-Tech, Frontier Ag, Independent Crop Consultant, blind phone calls, and following leads from a variety of sources.
Midwest	The highest priority was inviting corn and soybean farmers, and as a result, we held the listening session at the Commodity Classic in San Antonio, TX. This venue also attracts crop consultants, agrichemical manufacturers, and retail dealers. State corn and soybean commodity board leadership and selected farmers, crop advisers and agribusiness contacts received approximately 225 email invitations. The coordinators contacted Extension Weed Scientists in Midwestern states for input regarding the contact information for potential attendees. We expanded our invitations to include several seed companies, machinery manufacturers, bankers, Practical Farmers of Iowa, and the Nature Conservancy.
Southeast	Participants were invited in two ways: (1) open invitations at extension meetings and (2) directly contacting via phone and email potential participants that the organizers knew were very familiar with HR [herbicide-resistance] issues in the area, and that represented different groups (i.e., farmers, sales reps, extension agents, local regulatory agencies, etc.). The first approach was to try to have a large number of participants, and the second approach was to ensure a diverse and representative group. The majority of stakeholders invited were directly or indirectly associated with row-crop production, predominantly cotton, corn, soybean, and peanut. However, fruit and vegetable growers and industry representatives were directly contacted to ensure their participation.

and the regional coordinators; to develop an agenda framework for the listening sessions; to discuss the target audience; and to set a timeline for preparing for the sessions. Strategic Conservation Solutions, LLC, facilitated the planning meeting, and the planning group reviewed the desired outcomes submitted by the Northeast, Great Plains, Midwest, and Southwest regions (Table 2) and agreed on three goals for the listening sessions. These were: (1) to gain an understanding of the stakeholders and their goals and concerns related to HRM; (2) to gain an understanding of regional differences in herbicide-resistance issues and solutions, including successes and failures as well as challenges and needs; and (3) to identify decision-maker needs for addressing barriers and how key stakeholder groups can assist in meeting those needs.

Roles and Responsibilities—Regional Coordinators

The key roles of the regional coordinators were to work with the facilitators to select the locations and dates for their listening sessions, develop the participant lists, issue invitations, and organize and host the meetings (Table 1). After much discussion about the range of stakeholders who could either contribute to or learn from the listening sessions, the planning committee decided that the coordinators were in the best position to determine the participant lists, because key stakeholders could differ between regions. The approaches taken by each region for identifying individuals to invite are described in Table 3.

Roles and Responsibilities—HREC

The HREC, led by the coordinating team, was responsible for communication with the full planning committee, weed science societies, and funders. In addition, the HREC developed a template of an invitation letter for the regional coordinators to use. HREC members would attend each session to represent WSSA, arrange for audio recording and transcription of recordings, take notes of the discussion, collect and summarize session reports and evaluations, and draft the final report covering all sessions. The HREC worked with the facilitators to draft the materials used at each listening session. Social scientists Raymond A. Jussaume and David Ervin volunteered that one of them would attend each of the listening sessions to provide an evaluation from a social science perspective. The rest of attending committee members provided assistance where needed. The role of the social scientists and HREC members was to listen to the conversations of invited participants, not to participate themselves. Individual HREC members volunteered to have the table notes summarized, to have the session evaluations summarized, and to have the recordings of group discussions transcribed for all the sessions. One WSSA

volunteer took photographs of flip charts generated at each session and shared them with the core writing committee.

Roles and Responsibilities—Facilitators

Strategic Conservation Solutions, LLC, facilitated the development of the agenda by the HREC and the regional coordinators, developed instruction guides and session materials in coordination with the planning committee, led pre-session planning calls for each region, and facilitated each regional listening session. The materials prepared for the regional listening-session coordinators are included in Appendixes A–K in the Supplementary Material. The materials include instructions to the coordinators and HREC participants, agendas, worksheets, and forms—basically a step-by-step approach for each listening session. The planning committee agreed after considerable discussion that all regions should use the same agenda for their listening sessions to allow comparisons across regions (Table 4).

Table 4. The template for the agenda for regional listening sessions.

Regional Herbicide Resistance Listening Session of the Weed Science Society of America Date Location AGENDA template	
45 minutes	Check-in and Refreshments
15 minutes	Opening: Setting the Stage • Welcome – Regional Listening Session Meeting Coordinators • WSSA Goals & Plans for the Regional Listening Sessions – WSSA Representative • Listening Session Overview and Ground Rules – Meeting Facilitators Julie and Bruce Knight, Strategic Conservation Solutions, LLC
30 minutes	A Herbicide Resistance Conversation: Some Stakeholder Perspectives Name, affiliation Name, affiliation Name, affiliation Name, affiliation Name, affiliation Questions for 20–30 Minute Conversation, Moderated by Bruce Knight, Strategic Conservation Solutions, LLC: • What is your "story" related to herbicide resistance management? Have you changed any of your weed management approaches as a result of concern for herbicide resistance? • How would you define the herbicide resistance management issue? How pervasive do you feel the issue is in your area? • What is working for you? What is working in your area? • What do you perceive to be the biggest challenge facing the ag sector on herbicide resistance management?
30 minutes	Table Discussion: Personal Perspectives and Defining the Issues
30 minutes	Group discussion captured on flip charts: Sharing Table Insights
15 minutes	Break
45 minutes	Table Discussion: How to Manage the Herbicide Resistance Problem • Challenges and Barriers • Experiences and Successes • Wants and Needs
60 minutes	Group discussion captured on flip charts: Report Out and Facilitated Discussion followed by voting on top three within categories.
15 minutes	Sharing our Voices: New Perspectives (conversation with representative stakeholders)
20 minutes	A New Approach: Sharing Linkages, Connections and Recommendations (captured on flip charts)
10 minutes	Wrap Up Adjourn and Turn in Evaluation/Feedback Forms
THANK YOU FOR YOUR ACTIVE PARTICIPATION!	
Special thanks to our sponsors:	

Process over the Course of the Listening Sessions

The HREC chair organized a debriefing call for the planning committee after the first listening session in the Midsouth. As a result of the call and the assessment of the Midsouth coordinators, portions of the agenda were revised. The "Sharing our Voices" session was initially conceived as simply asking stakeholders to share any new perspectives they had gained during the day. After the Midsouth listening session, this activity became a conversation about new perspectives on weed management between three or four representative stakeholders who were attending the listening session and were identified by HREC observers and the facilitator, Bruce Knight, during the session. The final section, "A New Approach: Sharing Linkages, Connections and Recommendations," was initially designed as a quick "popcorn" style sharing of ideas among the group. The Midsouth coordinators recommended adopting a different approach or dropping this section entirely. The final section was revised so that the participants were asked to make recommendations to universities, industry, government, and other groups regarding what is needed to address herbicide resistance. Other adjustments made after the Midsouth listening session included slight changes to the report-out sessions in which participants were asked to "vote" on their top three challenges and barriers and their top three wants and needs using colored dots.

The coordinating team arranged for an individual debriefing call or discussion with the other session coordinators after each listening session to learn their assessment of the listening session they coordinated. The HREC coordinating team also identified a core writing team who then discussed by phone the report format, issues of concern, and responsibilities before writing the final report draft. The core writing team (seven persons from the HREC) met in April 2017 to outline the first draft of the report. Once the draft was complete, the draft report was sent to the full planning committee (regional coordinators and the HREC) for review. The core writing team met again in August 2017 to discuss the reviews and begin the revision process. A second draft was sent to the planning committee in November 2017 for review before finalizing the document and drafting an executive summary for public distribution.

Discussion and Evaluation

Assessment of the Invitation Process

The regional coordinators were asked to provide information about the process used to identify potential participants in their sessions (Table 3). In addition, they were asked to provide their assessments of how well their processes worked and who they might have missed as a result of their approaches (Table 5). The regional coordinators were limited, in many cases, by their relationships with potential

Table 5. Regional input on invitation process: assessment of the approach and who was missed by the coordinators.

Midsouth	The Midsouth region included the states of Missouri, Tennessee, Alabama, Mississippi, Arkansas, and Louisiana. The coordinators felt their process of identifying attendees worked very well. The crowd size was very large, at close to 180 attendees; however, the attendees were very influential. We had 40,000 acres represented at one table and there were 22 tables in the room. The coordinators wanted more political figures and regulatory agencies so they could see the impact of herbicide resistance. We reached out to these folks in a number of ways but did not get them to attend. I suspect this was due to previous commitments more than anything else.
Northeast	The Northeast region is diverse, with PA having lots [of] dairy, poultry, and crop and vegetable farms. PA also has a large Anabaptist (Amish and Mennonite farm population that is unique and can be a communication problem. This group is usually dairy/livestock based and tend to have smaller farms and a very close-knit community. A program specifically directed to these farmers is needed. A number of our initial Palmer amaranth infestations in PA have occurred with these farmers. We did have an Anabaptist retailer at our session. The eastern shore (Delmarva) tends to have larger grain farmers and a large poultry industry. Vegetable agriculture is also big on the Delmarva, and they have been impacted greatly by ALS-resistant [acetolactate synthase] pigweed species. As mentioned above, many of the livestock farmers rely heavily on consultants and the industry for their pest management decisions, as they have too many things going on to be very knowledgeable about herbicide selection. This is less true for the larger grain farmers. Herbicide-resistant weeds are widespread in the region with a 30-year history of triazine resistance. Farmers do not think about triazine resistance with the exception of common chickweed that recently evolved triazine resistance and is a problem in wheat and alfalfa. Glyphosate-resistant horseweed is widespread from Delaware north to central PA but is still rare in NY and New England. It is our number one resistant weed, and no-till agriculture is common in the region it infests. We have pockets of glyphosate/ALS-resistant common ragweed, and Palmer amaranth and waterhemp have been invading our region for the last 5+ years. Palmer amaranth is more common in southern DE, MD, and NJ (Delmarva), and Palmer amaranth and waterhemp have been identified on 40+ farms in PA mostly centered in the southeastern part of the state. We have been conducting educational programs on HRM [herbicide-resistance management] for the last 25 years. However, it is very much a situation where farmers will not spend the time or money on prevention. If they have the problem, they tend to look for the easiest herbicide solution. I think our method of identifying participants worked well. Bill and Mark have both been in the region for many years, so we have a good understanding of who we wanted at the meeting. We wanted a balance between grain producers and vegetable farmers. The southern part of the region does not have many independent crop consultants, and that role is often filled by ag chemical dealers. We missed many farmers, and it would have been nice to have more farmers in the room. Farmers are reluctant to attend a meeting where they will have to travel a greater distance unless they really think they will benefit. We also did not attract custom harvesters (combine) or equipment dealers and we did not have Department of Transportation (DOT) people or some other natural resource agencies present. We did have NRCS [Natural Resources Conservation Service] representation. We did offer CCA [certified crop adviser] credits, which helped bring in the ag professionals. We offered travel reimbursement to the New Yorkers and a few others that requested it.
Northwest	The PNW [Pacific Northwest] is second in production crop diversity only to California. The primary crops include wheat, tree fruit, and irrigated crops like potatoes, but crops for seed are incredibly important. Very few soybeans are produced, and there are about ~150,000 acres of primarily sweet corn. The Pacific Northwest has a very diverse crop system. Rainfall ranges from 40–45 inches in western Oregon and western Washington to 8–10 inches in southeastern Idaho. In addition, there are irrigated field and vegetable crops as well as orchards, vineyards, and other crops. It's really impossible to collect people from all of the different agricultural areas of the PNW in one group. I think the process of identifying the participants worked well for us. My original plan, devised in early August, was to hold the listening session with the FWAA [Far West Agribusiness Association] meeting in Pasco. The target audience would already be in attendance. That meeting was planned for mid-December, but our facilitators indicated they could not meet then. Our participation would have been greater. We also had a pretty significant series of winter storms, including lots of ice, that impeded participation. Commodity commission meetings were also scheduled on the same day, including the Wheat Commission and Tree Fruit Commission. We missed western Oregon and southern Idaho farmers and field managers. They just didn't respond, largely, I think, because of the location in central Washington. For the size of the group we were limited to, I don't know that we missed many others. The only other group that I can think of was the crop consultants. I don't think we had many or any represented. The size of the geographical area, in my opinion, was the biggest limitation. However, I understand that it was not feasible to have a listening session in every state.
Southwest	The Southwest region included California, Arizona, and New Mexico. The Southwest region encompasses a large geographic region with diverse cropping systems (including some dryland production, irrigated agronomic crops, and a huge array of high-value fruit, vegetable, and nut crops). The region also has huge tracts of public lands, transportation and water infrastructure, and areas of large urban and suburban populations. Suffice to say, weed management needs and, specifically, herbicide-resistant weed issues and concerns are also diverse across the region. The Southwest workshop was conducted at the same time as the World Ag Expo in Tulare, CA. The rationale for this time was that we were hoping to capture interest of a diverse group of ag industry personnel who might already be traveling to the area (the Expo draws in over 100,000 attendees from around the region and world). The biggest challenges for the SW region were: (1) trying to represent the huge diversity of crop and non-crop sectors in which weed management is conducted, and (2) getting good participation from important and influential weed managers during a busy time of year at a meeting that was often hundreds of miles from their location. The diversity of sectors in the SW region includes some cropping systems that are highly impacted by HRW (e.g., flooded monoculture rice), some that are affected, but mostly by increased cost rather than total failure (e.g., orchards, transportation corridors), and some that are not affected to any great degree due to intense use of chemical, mechanical, and hand-weeding efforts (e.g., strawberry, vegetables). One colleague who works in vegetable crops offered the analogy that "It's like you're inviting people to a meeting to discuss what to do about leaky roofs. People who aren't having roof problems will not attend." This is a good point, and we hope the final report will acknowledge that the population sampled in the SW region, and probably all the other regions as well, will be biased toward those with resistance problems and does not necessarily represent all of agriculture. In much of the SW region, there is not really a consistent "off season" due to relatively mild winters and extremely diverse cropping systems. Trying to scheduling [*sic*] a meeting for a diverse audience will always have this challenge. In particular, we missed participation of a number of really good and thoughtful pest managers because of critical tasks needed during almond bloom. Our scheduled meeting happened to coincide with an important meeting for the rice industry, and we had little representation of that industry, even though it is arguable [*sic*] the most affected by HRW in the region. Further, we had no representation from New Mexico pecan production—a cropping system with documented evidence of herbicide-resistant weeds. New Mexico pecan's absence might

Table 5. (*Continued*)

	have been caused by the listening session's timing (the invitations were distributed during the conclusion of pecan harvesting), as well as the listening session's location. Meaningful input from New Mexico pecan farmers would likely require a listening session at a regional pecan meeting (e.g., Western Pecan Growers); however, a listening session at such a meeting would likely discourage participation from other agricultural sectors. Finally, in hindsight, holding the meeting at the same time as the World Ag Expo was probably a net loss rather than a benefit. We don't feel that we got many workshop attendees who were already planning to come to the Expo (although many probably did go to the expo while in the area for the workshop). For those not already planning to come to the Expo, the challenges related to getting hotel rooms in the area were large. At least several attendees from northern California elected to drive 3–5 hours the morning of the workshop (which started at 8:30 AM) because it was too difficult to get rooms nearby. While certainly grateful for the dedication of those who did drive in for the day, we probably also lost many more who might have attended if it had been easier to travel. For potential attendees from New Mexico and Arizona, the distance and relatively small level of HRW issues were a significant barrier (e.g., nearly 1000 miles from Albuquerque to Tulare).
Great Plains	The Great Plains region included the states of Colorado, Kansas, Montana, Nebraska, Oklahoma, Wyoming. Asking extension agents to nominate individuals still seems logical to me, but perhaps they would have been more responsive if the request would have come from extension administration. If personal phone don't [*sic*] work, I don't know how you reach some of the groups that were underrepresented. Participants came from six states: Colorado 35; Kansas 39; Montana 4; Nebraska 24; Oklahoma 2; and Wyoming 3. Attending participants were categorized by primary stakeholder group as follows: producers 44; agronomists & crop consultants 21; university & ARS [Agricultural Research Service] 17; retail sales and service 8; county government/departments 4; industry 3; commodity & farm organization 3; DOT 2; other 2; BLM [Bureau of Land Management] 1; ag media 1. Several of the producers also serve on commodity and farm organization boards and are leaders in their communities. Most of the university/ARS attendees served as table hosts; about 2/3 of them were effective in that capacity. Generally, the only groups that I considered adequately represented were farmers and crop consultants followed by industry and retailers. State and federal agencies were underrepresented as were non-agricultural stakeholders. Region 8 EPA and WY State Dept. of Ag said they would attend but didn't. Trying to cover the entire Great Plains region in one meeting was a mistake because of distance and diversity in cropping systems. There needed to have been one in the northern Great Plains as well as in the central/southern Great Plains. The HR issues in the two areas differ. We heard after the fact that there was discussion at individual tables that didn't get reported out. The person doing the reporting tended to say what was on their mind and [that] was not always representative of the group discussion. Recordings of the table discussion would have captured fuller outcomes. Also, the ranking of outcomes on flip charts was problematic in that there was a join-the-crowd tendency. It would have been better and a more accurate reflection of individual thoughts for someone to have captured the outcomes and projected those onto a screen and ask persons to "vote" their preferences privately rather than publically [*sic*], using Turning Point or other crowd response technology. Many participants commented what they like best and gained the most from was the diversity of viewpoints at individual tables. This was achieved by carefully pre-assigning participants to specific tables in order to achieve both geographic and stakeholder diversity. There was some expressed disappointment/frustration that not much new was learned. It seems many came thinking they would hear solutions rather than contributing their own experiences, ideas, etc.
Southeast	The Southeast region included NC, SC, GA, FL, and AL. In this region, agriculture is an important component of the economies of each state. Major crops include cotton, soybean, peanut, and wheat, but tobacco and horticultural crops such as vegetables (sweet potatoes, potatoes, peppers, tomatoes, watermelons), peaches, and blueberries are not only important for the local economies, but also for supplying markets at the national level. Recruitment efforts were successful to attract a diverse group of participants, which included 20 growers, 3 crop and pest control advisers, 10 extension agents, 6 sales representatives from the seed and agrichemical industries, 2 local government officials involved in agricultural issues, 2 commodity groups, 2 farm-financing representatives, and 11 representatives from universities and research institutions. However, the number of participants was lower than expected. The listening session was conducted in northeast GA to encourage attendance from the Carolinas, but unfortunately for several potential participants from southwest GA, FL, and AL, the travel time to the chosen location prevented them from attending. Participants provided a good balanced sample of groups dealing with HR issues in different ways and cropping systems. Unfortunately, representation from North Carolina and South Carolina [was] very small. Colleagues from those states that helped recruit participants indicated that the distance to the event was the main obstacle.
Midwest	We defined the Midwest region as encompassing the following 12 states: IA, IL, IN, KY, MI, MN, MO, ND, NE, OH, SD, and WI. The challenge for the Midwest listening session was to find a location and venue that would be relatively easy and cost-efficient for participants to attend and stay within the budget allocated for the Midwest session. We placed the highest priority on hearing from farmers who grow corn and soybean, and as a result we held the session at the Commodity Classic in San Antonio, TX. This is a venue that would draw a large number of farmers, and crop consultants, agrichemical manufacturers, and retail dealers also attend this event. As we anticipated, our choice of venue and location did limit the diversity of agricultural-related industries that participated, however, we did meet our objective of having farmers as the primary participants. At the listening session we had representation from 10 of the 12 states plus attendees from KS, NC, and TN. In total we had 37 participants; 27 were farmers; 6 from industry and 4 retail dealers. Due to the large geographic area and our lack of direct contacts outside of the corn and soybean production/agribusiness sector, we were challenged in generating a diverse audience, but as coordinators we do feel we did meet our primary goal of a farmer-focused event.

participants and their spheres of influence when developing their invitation lists. It was a challenge to get assistance from a wider variety of groups for a number of reasons, including privacy issues around sharing mailing lists and a lack of urgency about herbicide resistance in external groups approached for help. Participant diversity was limited at some listening sessions based on the location of the session and the size of the region, cropping system, farm size, connection with organizers, or other reasons. The coordinators indicated that the participant populations in the regions also may have been biased toward those with experience or knowledge of herbicide resistance. Finally, some regions do not have an "off-season," so it was difficult to get the desired diversity due to ongoing field work and obligations.

Discussions at the sessions revealed that some stakeholder groups who impact HRM were not at the sessions. These groups may not even be aware of the issues, even if they significantly

impact evolution and spread of resistant weed species. Some of the groups missing from some or all of the sessions include absentee landowners, non-crop managers, state departments of transportation and rights-of-way managers, lenders, state departments of agriculture and other governmental agencies, farmers who normally do not attend meetings or who are not impacted by herbicide resistance, organic farmers, other farmer organizations, equipment dealers, custom pesticide applicators, policy makers, government officials, members of the general public, "nontraditional" farm owners (women, minorities, small-scale), and farm laborers.

Regional Format of the Meetings

The regional meetings brought out viewpoints about herbicide resistance and weed management from crops besides corn (*Zea mays* L.), soybean [*Glycine max* (L.) Merr.], and cotton (*Gossypium hirsutum* L.). Participants generally appreciated talking to individuals from other parts of the region/sectors. The fact that the regions were large and/or listening sessions were often held in remote locations meant that participant diversity was limited for some sessions due to the time required to travel to a location. Funding was available to reimburse some participants for their travel to attend the sessions; however, travel distance and time limitations still prevented broader participation for some of the regions. For example, at the Midwest meeting held in conjunction with the Commodity Classic (San Antonio, TX), participation was limited to individuals who were already attending the Classic and who had the money and time available on their schedule to travel to and participate in the Classic. For the Southwest meeting held in Tulare, CA, farmers from New Mexico were invited, but the distance to the session was more than 1000 miles. The meeting was held during a busy time of year for New Mexican agriculture. Some coordinators reported that finding locations and venues for the listening sessions was challenging. We do not know what the relative impacts are of tying a listening session to another venue versus hosting it as a stand-alone meeting. In addition, lodging availability was a challenge for some of the sessions held in conjunction with another large event.

Perspectives of Members of the HREC and Regional Coordinators

Approvals for the Meeting

One important oversight was not to secure approval for the listening sessions from an Institutional Review Board (IRB) from one committee member's academic institution. IRB approval was needed because the listening sessions included human "subjects," and IRB review is necessary when people are used as research subjects. For example, the University of Kentucky IRB requires review of a research protocol in which "any activity that meets either (a) the Department of Health and Human Services (DHHS) definition of both 'research' and 'human subjects' or (b) the Food and Drug Administration (FDA) definitions of both 'clinical investigation' and 'human subjects.'" The primary purpose of the IRB is to protect the rights and welfare of human (research) subjects. In line with IRB approval, the participants were informed that their involvement was voluntary, and their identity and responses were confidential if included in any publication. These assurances may also affect the nature of responses given at the meetings. Failure to apply for IRB approval means that any information from listening-session participants cannot be published as research, although the information could be used for internal guidance to WSSA, such as determining the next initiatives for the HREC. Advanced review is required if there is "interpersonal communication between the investigator and subject through surveys, interviews, administration of educational tests, or other forms of interaction." Any effort similar to the listening sessions should secure IRB approval at its outset. Generally, an IRB will not approve a project post facto. In our case, after consultation and review of information regarding the listening sessions, the University of Kentucky IRB Committee determined the listening sessions did not require IRB review and approval. This allowed us to proceed with publication of the findings from the listening sessions after consultation and review of information regarding the listening session.

Meeting Format

This was an interesting exercise for most of the weed scientists involved; it turned our typical notion of a grower meeting, that of "experts" giving information to clientele, on its head. Instead, we were listening to the audience and did not participate beyond assisting with logistics and taking notes to ensure that the views of the participants were heard and documented. While the approach was more familiar to the social scientists involved and has some similarities to the focus group interviews that industry uses, it was new to most of the weed scientists on the planning team. Most of the invited participants enjoyed being able to share their thoughts and ideas. Participation and engagement was very good in all the listening sessions, and participants asked for more meetings using the "listening" format. The few negative comments from participants suggested some of them did not realize the meeting was intended to solicit concerns and suggestions to help formulate a path forward and would not include presentation of management solutions.

The coordinators were generally pleased with the meeting format. Several said they would consider doing similar meetings as part of their ongoing programs and that they had gained ideas for extension programming from the regional listening sessions. At the same time, some coordinators also commented that this type of meeting took much more work and preparation than a typical extension meeting and they would be cautious about, if not adverse to, doing something similar in the future. Some coordinators reported that they would have developed different agendas for their sessions, although they did not elaborate on what they would have done differently. The coordinators did a great job and the planning group worked well together and with the facilitators to develop the listening sessions and to adapt as we learned from each session. Regional coordinators worked hard to get good participation, and their influence and personal invitations were key to attracting participants.

The sessions benefited from having professional facilitation and from having HREC members present to observe, take notes, and assist as needed. Having a common agenda and holding the "same" meeting at each location, with the same facilitators, allowed for regional comparisons that would have been difficult if each region had developed its own agenda. However, some flexibility was lost because of the uniform agenda across all sessions; the facilitators held closely to the agenda, so some spontaneity and ability to adjust to the unique character of each regional group was lost. Because each listening session covered a large geographic region and because of funding limits, coupled with time constraints for the members of the planning committee, the meetings could not be organized in a way that would allow us to

specifically address targeted social science research questions. In addition, the social scientists suggested that revisions were needed to improve the "think and ink" surveys (Appendixes F–I, Supplementary Material) that participants filled out at the beginning of the first table discussion about personal perspectives and defining the issues.

Final Thoughts

A major insight we gained from the listening sessions was the fact that many of the participants felt they needed one or more new herbicides with unique mechanisms of action to address their weed management needs. The core writing team spent a great deal of time during one of our meetings discussing this response and wondering where the thinking originated. This was a concern in light of the fact that no new herbicide with a unique mechanism of action has been registered for over 20 years, and none are on the horizon according to industry experts. We asked ourselves whether the organizers and facilitators should have done more to take the hope for new chemistry off the table for discussion. However, this was information that was important to hear—farmers and dealers are still looking for a simple and familiar solution to the problem of herbicide resistance.

The concept and structure of this project was new to everyone involved; we had never attempted to hold listening sessions across the country. The HREC members and the regional coordinators agreed that the project was much more involved and time-consuming than we anticipated when we agreed to implement the project. That being said, most felt that the effort was worthwhile and that we have gained a new perspective and valuable information from these sessions. We are most grateful to the participants who took time out of their very busy schedules to attend and contribute their perspectives to the discussion.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/wet.2018.53

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