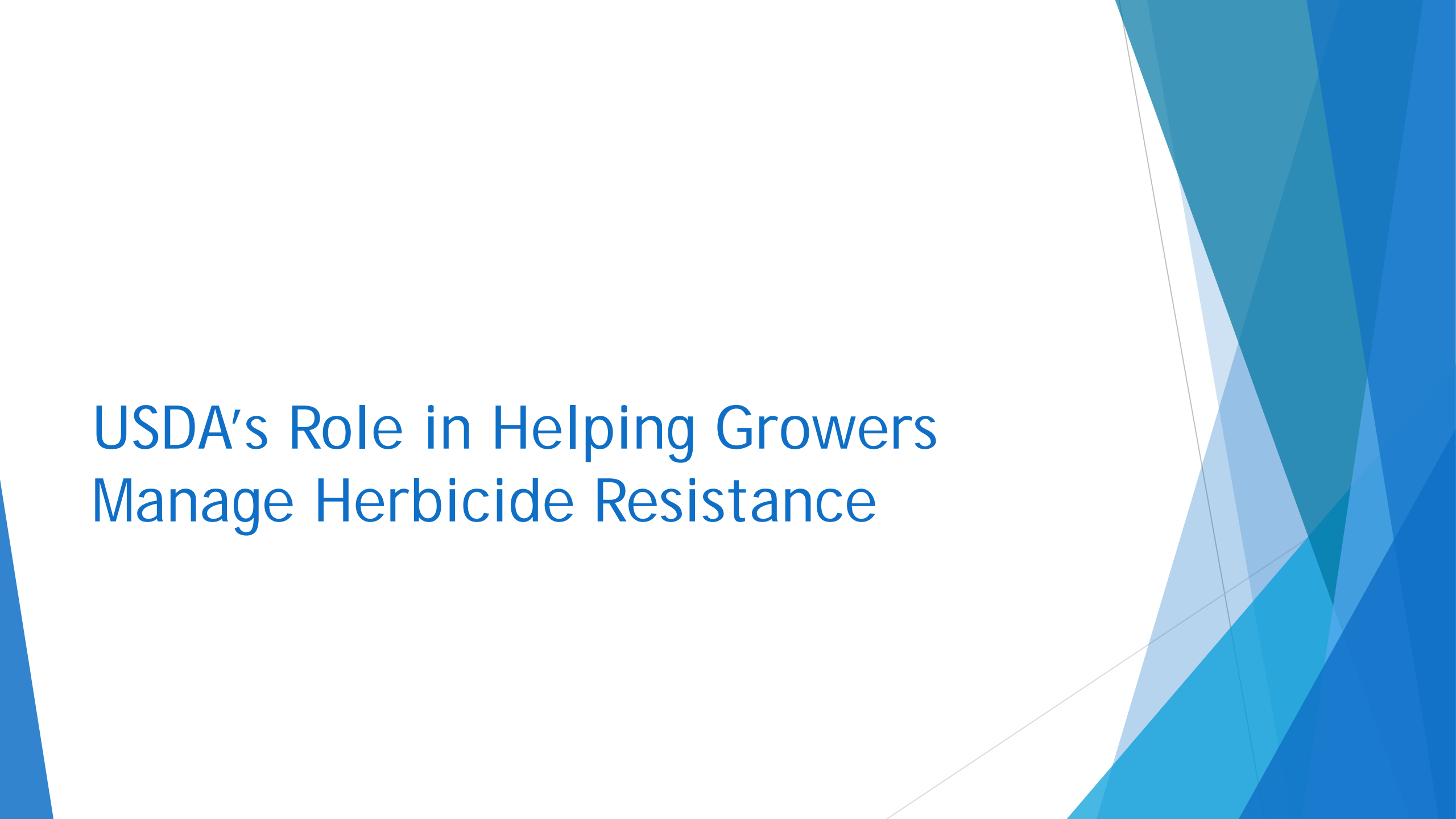


Challenges of Herbicide Resistant Weeds

Jill Schroeder, USDA Office of Pest Management Policy
Washington D.C.

The background features abstract, overlapping geometric shapes in various shades of blue, ranging from light sky blue to deep navy blue. These shapes are primarily located on the right side of the slide, creating a modern, dynamic feel. The text is positioned on the left side of the slide, set against a plain white background.

USDA's Role in Helping Growers Manage Herbicide Resistance

At OneUSDA

- ▶ Office of Pest Management Policy
- ▶ Funding for University/institution research and extension programs
 - ▶ National Institute for Food and Agriculture
- ▶ Research
 - ▶ Agricultural Research Service
 - ▶ Economic Research Service
- ▶ Conservation program assistance
 - ▶ Farm Service Agency - Conservation Reserve Program
 - ▶ Natural Resources Conservation Service
- ▶ Regulatory
 - ▶ Animal and Plant Health Inspection Service - Biotechnology Regulatory Services
 - ▶ APHIS Federal Noxious Weed Program

USDA Research Programs

- ▶ Economic Research Service (ERS)
 - ▶ Economics of herbicide resistant crops
 - ▶ Economics of glyphosate resistance management
- ▶ Agricultural Research Service (ARS)
 - ▶ Basic research
 - ▶ Biology and physiology
 - ▶ Natural product-based bioherbicides
 - ▶ Integrated management
 - ▶ Cultural weed control strategies as part of IWM systems
 - ▶ Cover crop systems for controlling resistant weeds such as Palmer amaranth
 - ▶ IWM systems

USDA Research Programs

- ▶ Agricultural Research Service (ARS)
 - ▶ Area wide project: “An Integrated Pest Management Approach to Addressing the Multiple Herbicide-resistant Weed Epidemic in U.S. field Crop Production” <http://integratedweedmanagement.org/>
 - ▶ 15 states- research and demonstration
 - ▶ IWM systems that include harvest weed seed control, herbicides, cover crops.

Conservation Programs

- ▶ Farm Service Agency
 - ▶ Conservation Reserve Program (CRP; <https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/>)
 - ▶ CRP is administered by the Farm Service Agency, with NRCS providing technical land eligibility determinations, conservation planning and practice implementation.
 - ▶ Conservation Reserve Enhancement Program - partnership between state governments and the federal government to address high priority conservation concern.

Conservation Programs

- ▶ Natural Resources Conservation Service (NRCS)
(<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/>)
 - ▶ NRCS offers voluntary programs to help
 - ▶ reduce soil erosion
 - ▶ enhance water supplies
 - ▶ improve water quality
 - ▶ increase wildlife habitat
 - ▶ reduce damages caused by floods and other natural disasters.

Natural Resources Conservation Service

- ▶ Herbicide Resistance Assistance

- ▶ Conservation Technical Assistance (CTA) - no fees for this service to land user.

- <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/cp/>

- ▶ Conservation Plan development

- ▶ Conservation Practice Design and Implementation.

- ▶ Financial Assistance

- <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/>

- ▶ Voluntary programs

- ▶ Contracts approved for eligible landowners to help plan and implement conservation practices

Natural Resources Conservation Service

- ▶ Herbicide Resistance Financial Assistance - current programs
 - ▶ Programs related to weed management
 - ▶ Environmental Quality Incentives Program (EQIP) - produce Conservation Activity Plans (CAPs) and Conservation Practice implementation.
 - ▶ CAP 114: Integrated Pest Management
 - ▶ CAP 154: IPM Herbicide Resistant Weed Conservation Plan - modification in herbicide use emphasized
 - ▶ Conservation Stewardship Program (CSP) - Payment earned for conservation performance
 - ▶ Goal: conservation enhancement implementation
 - ▶ Payments are available for vegetation management to address a number of conservation issues.

NRCS Program availability

- ▶ Based on a combination of National initiatives and state and local priorities.
 - ▶ State Conservationists with the guidance from National Headquarters and State Technical Committees (which partners can join) set state priorities.
 - ▶ Local Conservation Districts provide input through their local work groups.
 - ▶ Program applications are ranked and funded based on how well they address natural resource concerns.
- ▶ Recommendation: meet your State Resource Conservationist and members of the Technical Committee.
 - ▶ Technical Committee meetings are public meetings.

Animal and Plant Health Inspection Service (APHIS)

- ▶ Federal Noxious Weed Program
(<https://www.aphis.usda.gov/planthealth/fnw>)
 - ▶ Prevent introduction and restrict interstate movement of plants that significantly impact crops, livestock, poultry, irrigation, navigation, natural resources, the public health, or the environment.
 - ▶ Exclusion and permitting
 - ▶ Integrated management - cooperative effort

Animal and Plant Health Inspection Service (APHIS)

- ▶ Biotechnology Regulatory Services (BRS) implements regulations (7 CFR part 340) for GE organisms that may pose a risk to plant health
<https://www.aphis.usda.gov/aphis/ourfocus/biotechnology>
 - ▶ Includes some GE-herbicide resistant (HR) crops with sexually compatible weedy relatives
 - ▶ Regulated field trials include conditions to mitigate potential for outcrossing, spread and persistence of regulated plants
 - ▶ Weediness potential and control of GE HR crop volunteers are assessed, but do not impact decisions to grant nonregulated status
- ▶ Coordinates with other designated federal agencies
 - ▶ Assessment of impacts and benefits from EPA herbicide registrations and label recommendations for their use on HR crops

Animal and Plant Health Inspection Service (APHIS)

- ▶ BRS Activities specific to herbicide resistance
 - ▶ Provide guidance to developers under regulatory oversight
 - ▶ Recommends the use of BMPs during field trials (https://www.aphis.usda.gov/brs/aphisdocs/aphis_bmp_rec_hr_crops.pdf)
 - ▶ Supports external activities
 - ▶ Issues related to HR
 - ▶ WS publications and summits
 - ▶ Support for IWM
 - ▶ HR listening sessions

Animal and Plant Health Inspection Service (APHIS)

- ▶ Farm Bill Section 10007

<https://www.aphis.usda.gov/aphis/resources/farm-bill>

- ▶ Prevent introduction or spread of plant pests and diseases that threaten U.S. agriculture or the environment
- ▶ \$75 mill available for cooperative agreements in FY18 and beyond
- ▶ APHIS encouraged suggestions of weed-related projects in 2017
- ▶ Weed related project submissions increased 2 X - but still low
- ▶ Suggestions must meet at least one of the six goal areas identified in the Farm Bill Implementation Plan to be considered.

Concluding thoughts

- ▶ USDA has many roles that benefit growers who must manage herbicide resistance
 - ▶ Research
 - ▶ Technical and financial assistance programs
 - ▶ Regulatory services
- ▶ Key is understanding these programs, how they can benefit growers locally
- ▶ Effective communication is needed
 - ▶ Among USDA programs
 - ▶ USDA with state and local agencies
 - ▶ USDA with university extension and research
 - ▶ USDA with growers and grower organizations

- ▶ Secretary Perdue has talked about how USDA is OneUSDA
 - ▶ Emphasis is on working to make our excellent programs work even better for agriculture.
 - ▶ Chair: Interagency Task Force on Agriculture and Rural Prosperity <https://www.usda.gov/ruralprosperity>
- ▶ The task force is accepting comments from the agricultural community.
 - ▶ “Pursuant to [Executive Order 13777—Enforcing the Regulatory Reform Agenda](#), the U.S. Department of Agriculture (USDA) is requesting ideas from the public on how we can provide better customer service and remove unintended barriers to participation in our programs in ways that least interfere with our customers and allow us to accomplish our mission. To do this, we are specifically asking for public ideas on regulations, guidance documents, or any other policy documents that are in need of reform, for example ideas to modify, streamline, expand, or repeal those items.”
<https://www.federalregister.gov/documents/2017/07/17/2017-14920/identifying-regulatory-reform-initiatives>

Rural Prosperity

Interagency Task Force on Agriculture and Rural Prosperity



Rural America includes 72% of the nation's land and 46 million people. Rural areas encompass regions that focus on agricultural production as well as places where work is more often found in industries such as manufacturing, mining, and forestry. They include locales that are prosperous and rapidly-growing, locales that are chronically depressed, and everything in between. Rural America is home to many different racial and ethnic demographics and a wide array of economic activities. These residents live in a variety of settings, from counties

bordering suburbs to remote and isolated areas.

We Want to Hear From You

No one feels the effects of harmful and unproductive regulations like the individuals living in rural communities. If there's a regulation that doesn't work for you – speak up. [Inform us of burdensome regulations.](#)



AC York 2010



Managing Herbicide Resistance: Listening to the Perspectives of the Practitioners.

WSSA project in coordination with USDA-APHIS and input from EPA.

A little history of our efforts -

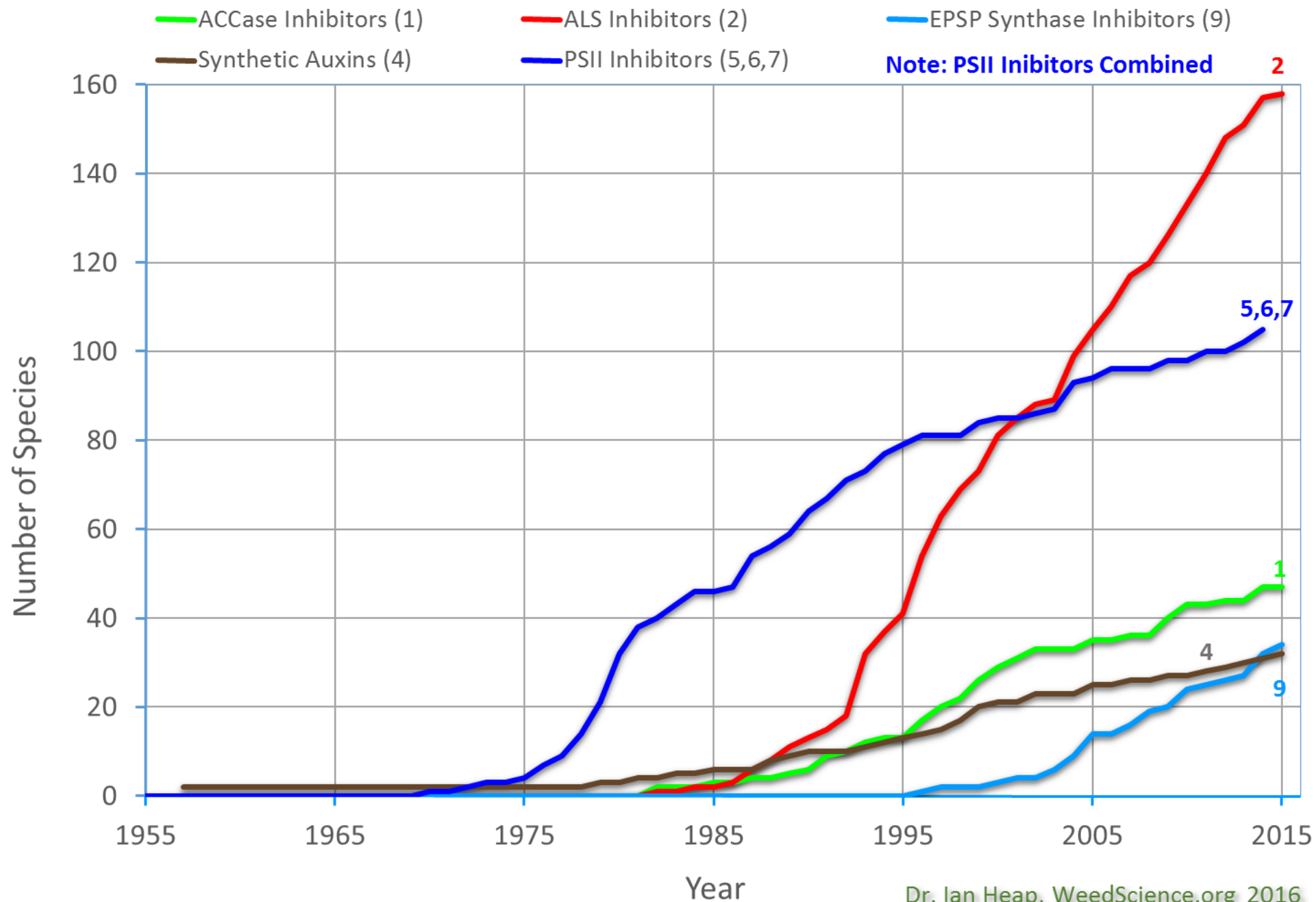
Herbicide Resistance Summit I 2012

sponsored by the National Research Council (NAS)

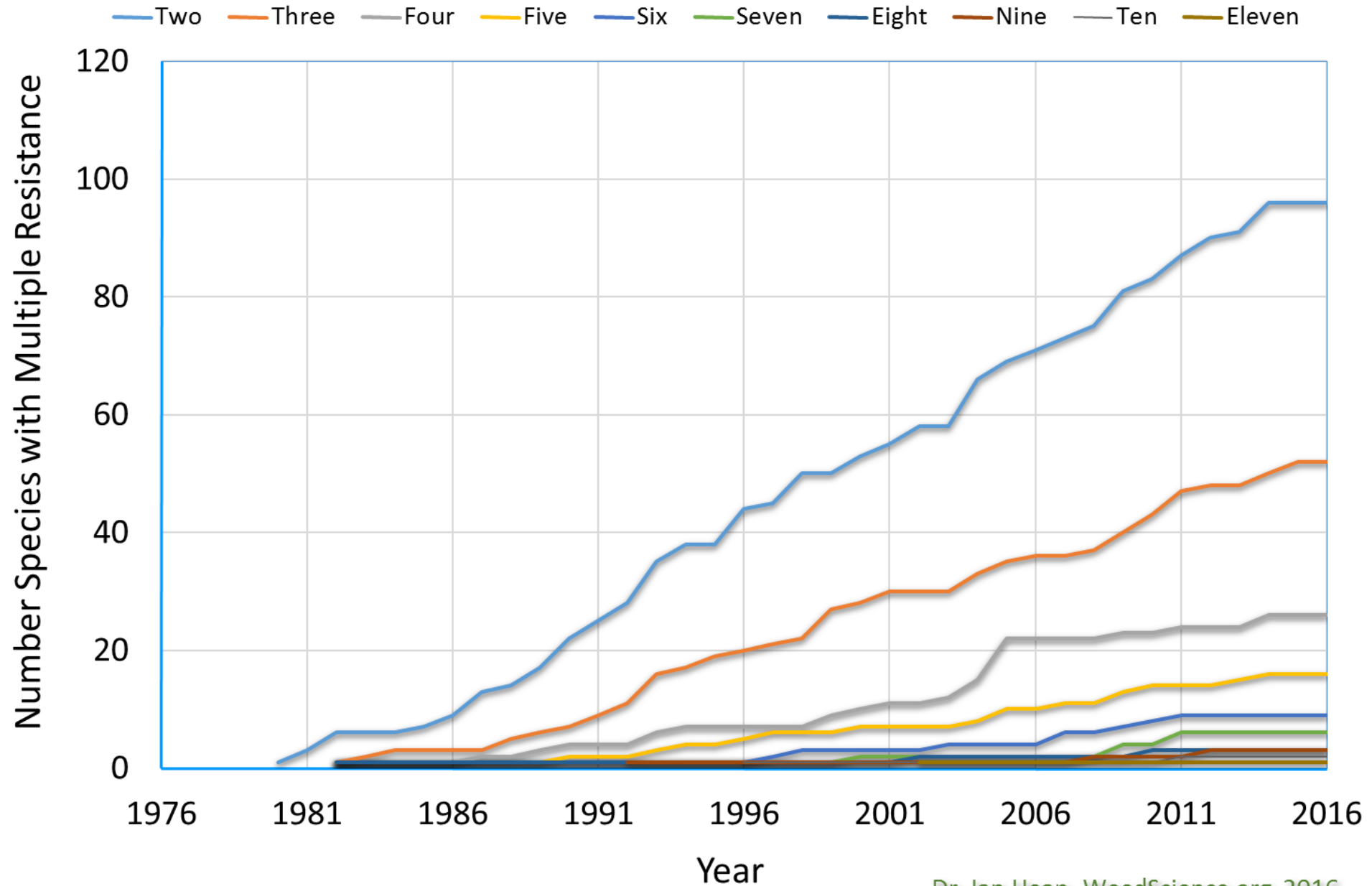
- ▶ Goal
 - ▶ Catalyze action
 - ▶ Foster collaboration
- ▶ Summarized two publications on resistance
 - ▶ Herbicide Resistance: Toward an Understanding of Resistance Development and the Impact of Herbicide-Resistant Crops. Vencill et al. 2012. WS 60 SP1
 - ▶ Reducing the Risks of Herbicide Resistance: Best Management Practices and Recommendations. Norsworthy et al. 2012. WS 60 SP1
- ▶ Explored scientific basis of herbicide resistance
- ▶ Considered perspectives on ways to overcome herbicide resistance
 - ▶ Best Management Practices
 - ▶ Opportunities
 - ▶ Barriers

<http://nas-sites.org/hr-weeds-summit/>

Number Resistant Species for Several Herbicide Sites of Action (WSSA Codes)

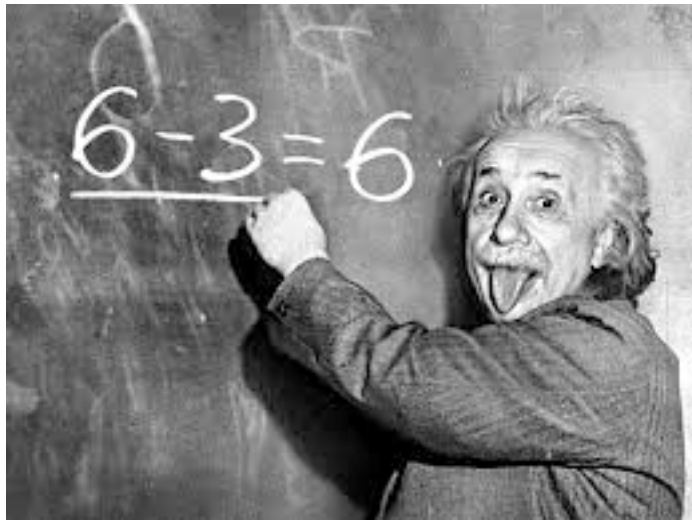


Weed Species with Resistance to More than One Site of Action

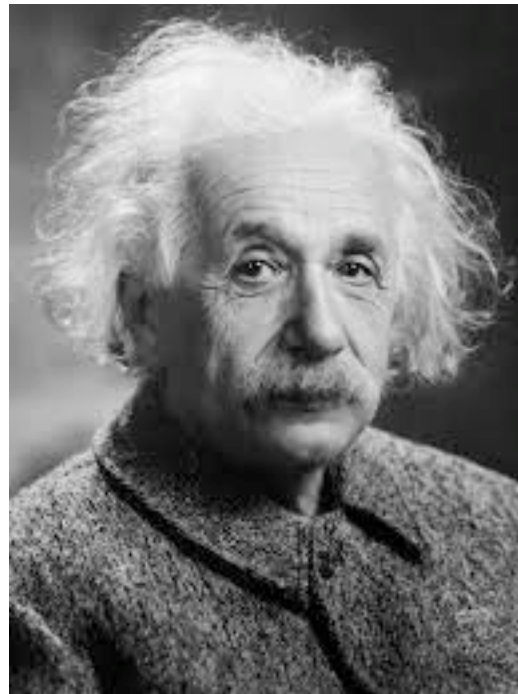


Insanity....

Doing the same thing over and over again and expecting a different result.



Albert Einstein



Herbicide Resistance Evolution

- ▶ A biology problem
- ▶ A technology problem
- ▶ A **HUMAN** problem

“Sole reliance on education, technical assistance, and other incentives aimed at changing individual grower behavior likely will fail to stem the advance of HR.”

Ervin and Jussaume. 2014. Integrating Social Science into Managing Herbicide-Resistant Weeds and Associated Environmental Impacts. *Weed Science* 62(2):403-414.

What do we do Next?

- ▶ We either have to do something “different” or accept that we are insane.
- ▶ The human dimension *MUST* come into play, and be integrated with biology, to guide strategies from here forward.
- ▶ Considerations from a social science standpoint.

National Summit II: Strategies to Manage Herbicide-Resistant Weeds

September 2014

- ▶ Understanding the socio-economic dimensions of the problem
- ▶ Moving to more systems-based solutions
- ▶ Re-evaluate what we have been doing that has NOT worked
- ▶ Every group has a role to play!

Horror beyond Understanding!



Undefinable! Unknowable! Unstoppable!

What is a “Wicked” Problem?

- No definitive formulation
- No final solution
- No true/false or good/bad answers
- No definitive solution set
- Every wicked problem unique
- Multiple potential and viable causes
- Intolerance for ineffective solutions

What next to address the Wicked Problem?

- ▶ Seven regional listening sessions were held to bring in perspectives on herbicide resistance from different geographies and cropping systems.
 - ▶ Improve understanding of who are the stakeholders.
 - ▶ Improve understanding of regional diversity regarding issues and solutions.
 - ▶ Identification of stakeholder wants and needs.
 - ▶ Identification of needed next steps by organizers.

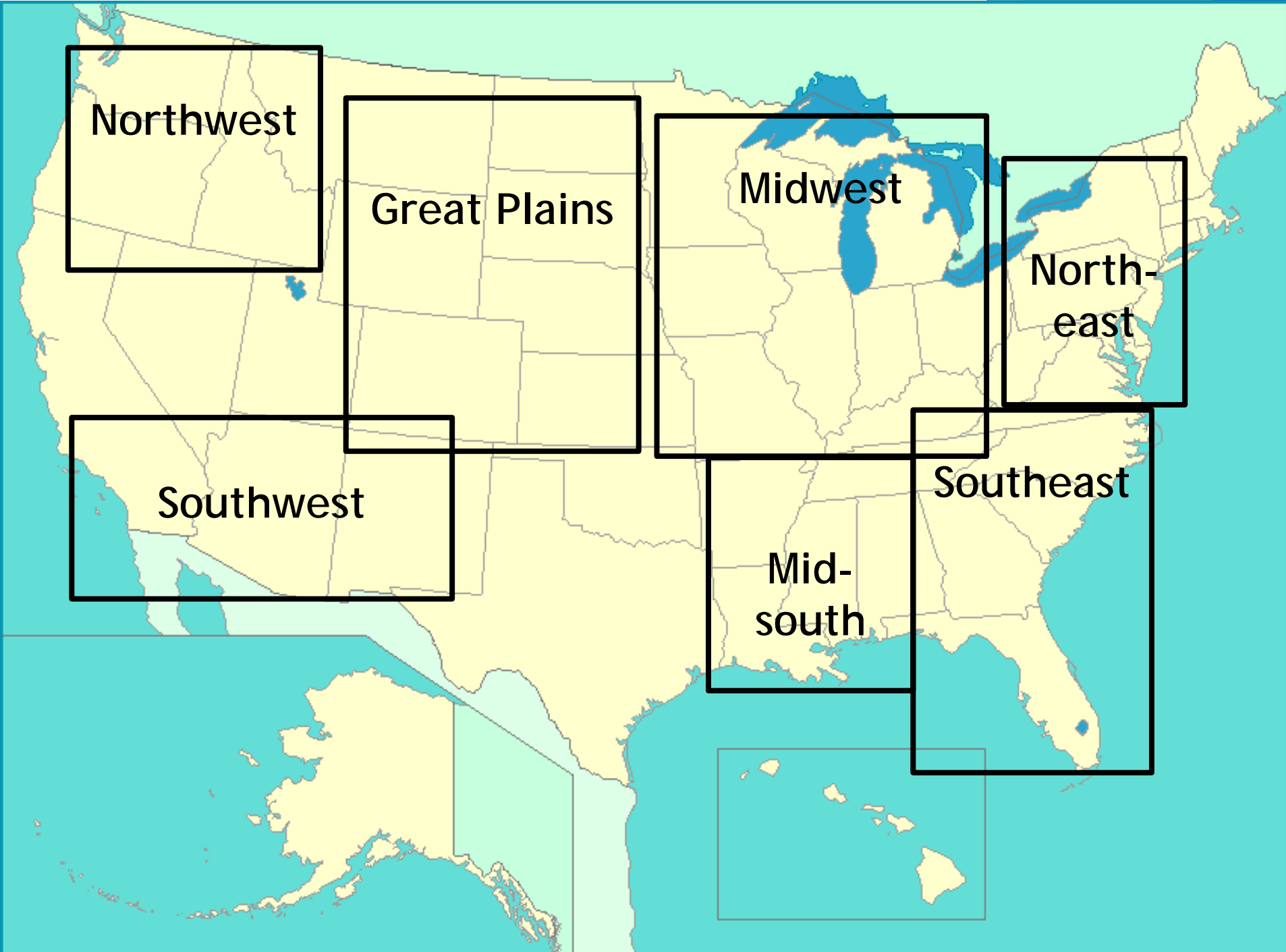
Why Listening Sessions?

- ▶ We told everyone what they needed to do - and the problem continues to increase!!!!
 - ▶ We still do not fully understand the nature of the problem - why aren't things changing?
- ▶ Until you truly understand the problem, you can't find solutions.



Photo by A.C. York 2010

Regions selected for the Listening Sessions



Region/States	Date/Location	Coordinators
<u>MidSouth</u> MO, TN, AR, MS, LA	December 5, 2016 Starkville, MS	Darrin Dodds (MSU) Larry Steckel (UTN)
<u>Northeast</u> PA, MD, DE, NY, VA, WV	January 18, 2017 Lancaster, PA	Bill Curran (PSU) Mark VanGessel (UMD) Annie Klodd (PSU)
<u>Northwest</u> WA, OR, ID, MT, UT, NV	January 24, 2017 Pasco, WA	Ian Burke (WSU) Don Morishita (UID)
<u>Southwest</u> CA, AR, NM	February 15, 2017 Tulare, CA	Brad Hanson (UC - Davis) Brian Schutte (NMSU)
<u>Great Plains</u> KS, NE, CO, WY, MT	February 17, 2017 Holyoke, CO	Phil Stahlman (KSU) Todd Gaines (CSU) Andrew Kniss (UWY) Cody Creech (UNB) Prashant Jha (MSU) Sandra McDonald (Mountain West PEST)
<u>Midwest</u> IA, IL, IN, KS, KY, MI, MN, MO, NC,ND, NE, OH, SD, TN and WI	March 4, 2017 San Antonio, TX	Christy Sprague (MSU) Jeff Gunsolus (UMN)
<u>Southeast</u> GA, FL, NC, SC, AL	March 30, 2017 Waynesboro, GA	Ramon Leon (UFL) Stanley Culpepper (UGA)

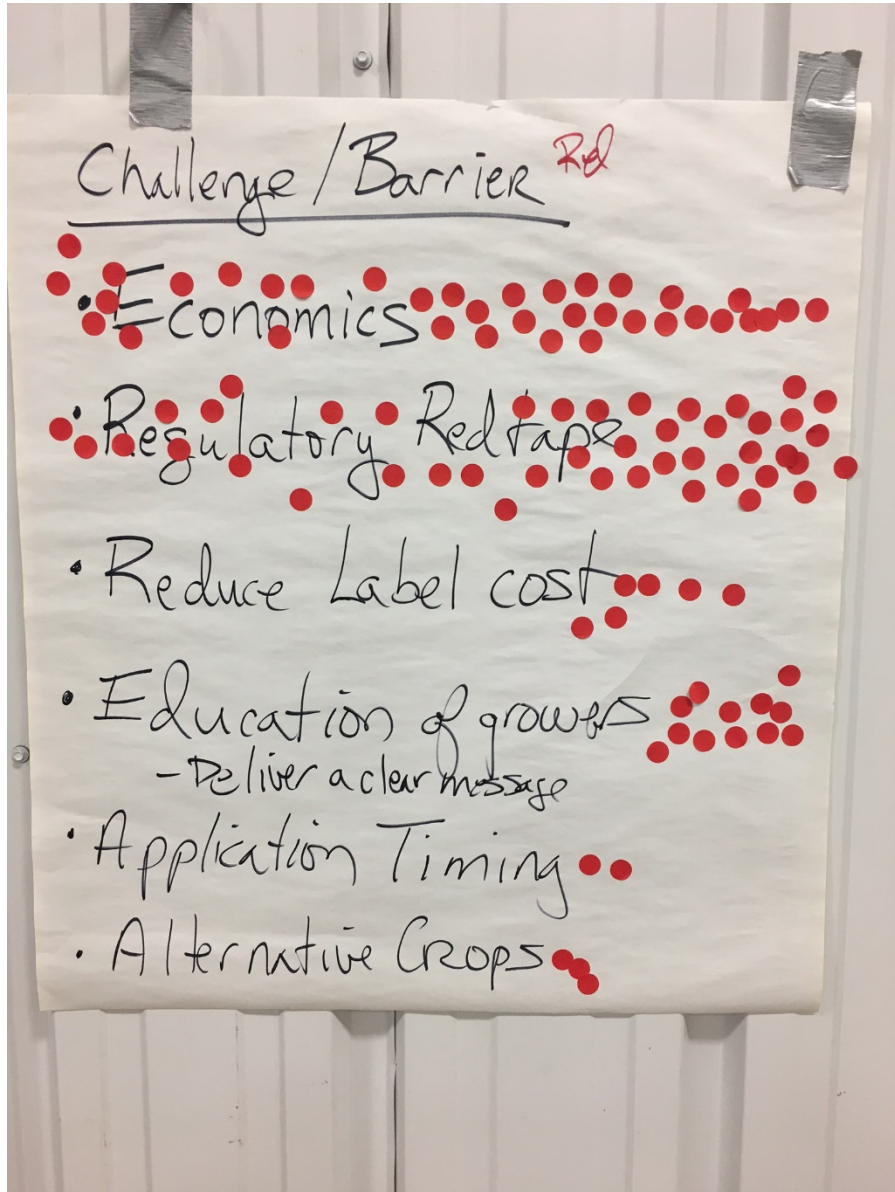
Participants

- ▶ Method of developing invitation list varied by region
 - ▶ Based on regional characteristics, location, other events, demographics
- ▶ Number of attendees varied from 40 to nearly 180 individuals.
- ▶ Participants represented the region's agricultural sector primarily
 - ▶ Growers
 - ▶ Consultants
 - ▶ Retailers
 - ▶ Extension
 - ▶ Other groups included private industry, state/county agencies, DOT, commodity and farm organizations, BLM....

Listening Sessions Agenda

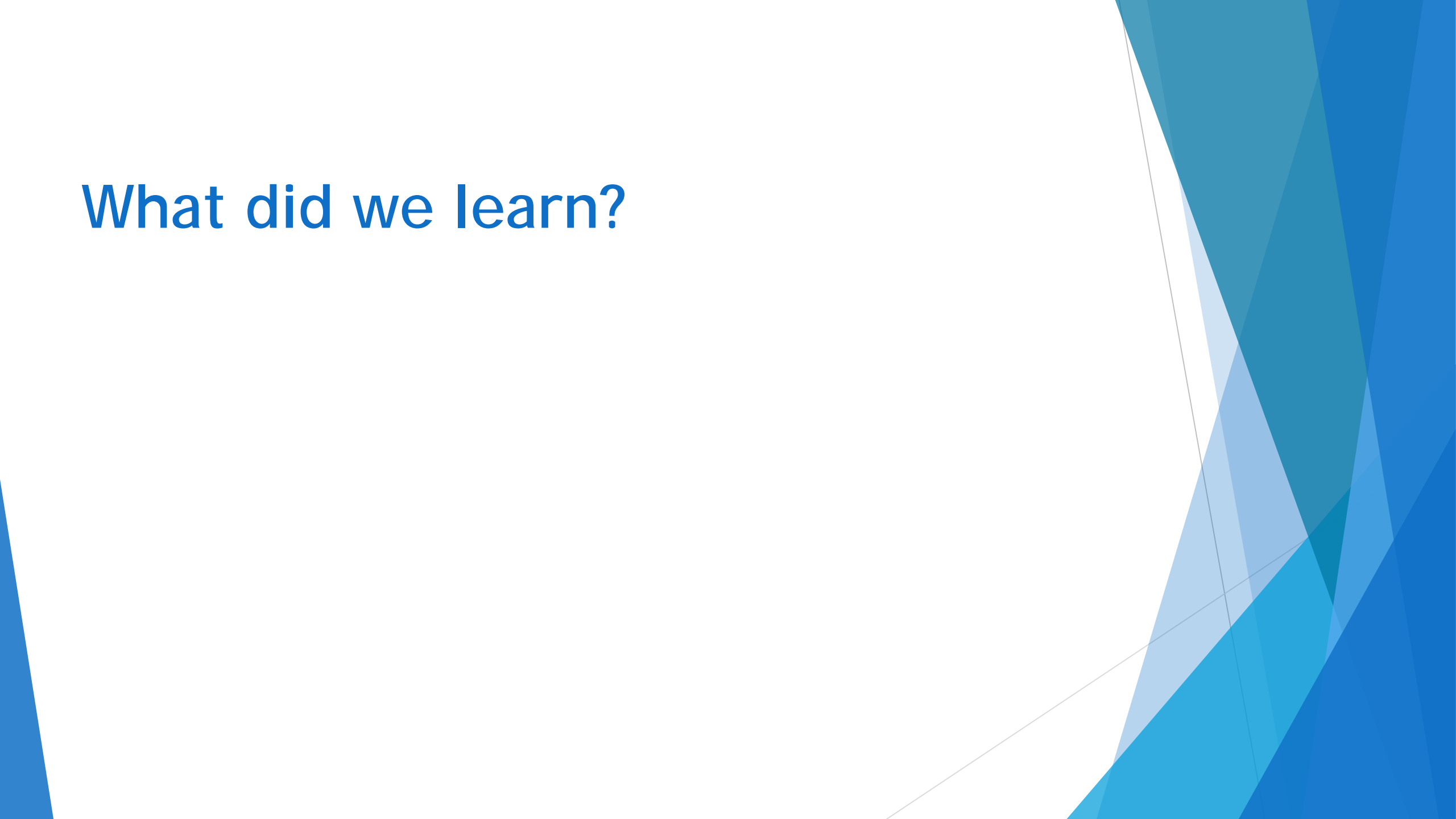
- ▶ Facilitated meeting (Strategic Conservation Solutions, LLC)
- ▶ Agenda
 - ▶ Setting the stage with stakeholder perspectives
 - ▶ Table discussion of personal perspectives regarding HR
 - ▶ Defining level of concern about HR
 - ▶ Level of concern about spread of HR weeds
 - ▶ Describing the challenge of HR
 - ▶ Table discussion about managing HR
 - ▶ Challenges and barriers
 - ▶ Experiences and successes
 - ▶ Wants and needs
 - ▶ New perspectives and recommendations

Information obtained from each listening session



- ▶ Table notes from discussions
 - ▶ Individual participant notes
 - ▶ Table host summary notes
- ▶ Participant evaluations
- ▶ WSSA committee notes of report outs
- ▶ Flip chart notes from report outs
- ▶ Recordings of report outs
 - ▶ Only for verification

What did we learn?



Messages we heard in the Listening Sessions

▶ *Theme 1: We need new herbicides and new herbicide MOAs*

[Why adopt resistance-management practices if you believe new herbicides will soon be available?]

- ▶ Regulatory red tape
- ▶ Cost/time to register

Messages we heard:

- ▶ **Theme 2: There is no need for more regulation!**

[Can the threat of regulation motivate changes in behavior?]

- ▶ Regulation was perceived as a barrier to new technologies.
- ▶ NE was the only region that indicated that regulation could be part of the solution.
 - ▶ Concern for Palmer amaranth invasion

Messages we heard:

- ▶ **Theme 3: There is a need for more education - especially for “others”**

[Non-chemical management approaches are under-supplied by the private sector]

- ▶ Clarification needed: “old/new” chemistry registered on a new crop vs a new MOA.
- ▶ Education about herbicides vs non-chemical methods
 - ▶ How to incorporate both into production system
- ▶ Need for more communication and collaboration between ALL stakeholders
 - ▶ Consistent messaging

Messages we heard:

▶ *Theme 4: Diversity is hard*

[New herbicides fit more easily in current agricultural structure - but growers have been known to make needed changes]

- ▶ Growers expressed concern about the lack of profitable alternative crops and/or challenges in using cover crops
 - ▶ Economics
 - ▶ Equipment needs
 - ▶ Conservation program requirements
- ▶ Immediacy of issue influences response to educational efforts.

Messages we heard:

- ▶ **Theme 5: The current agricultural economy makes it difficult to do things differently**

[Farmers are tempted to delay adoption of HR costs]

- ▶ Lack of affordable financing
 - ▶ Low commodity prices
- ▶ Lack of understanding of long term economic impacts of HR and HRM.
- ▶ Land ownership
- ▶ Resource availability
- ▶ Need for incentives
- ▶ Economics of diversification of practices
- ▶ Economics may guide research directions

Messages we heard:


- ▶ **Theme 6: We are aware of HR but are managing it and we are not in a panic.**

[If they believe that a new herbicide is coming, they will be less likely to be concerned.]

- ▶ The attitude appears to be different between farmers and weed scientists.
 - ▶ 95% agreed that HR is a problem
 - ▶ 95% agreed that spreading HR weeds from field to field is a problem.
 - ▶ 80% concerned about county to county or region to region spread.
- ▶ Concern was raised about the possibility of multiple resistance or resistance to alternative herbicides.

What have we achieved?

- ▶ We gained ground level intelligence on HR conditions
- ▶ We have a framework of stakeholders from producers, industry reps. to regulatory agents and from weed scientists to social scientists who are now working together on HR
 - ▶ Recognition of HR as a problem is widespread in the agricultural community in the U.S.
- ▶ Weed Scientists have begun to talk about the human dimension of HR

- 
- ▶ The listening sessions are an example of a different approach to provide outreach
 - ▶ Many participants expressed a desire for more sessions with a similar format

What needs to be done next?



So what is next? - Questions for your consideration.....

- ▶ Do we truly understand how hard it is for farmers to do what we are suggesting they do????
 - ▶ Weed control is but one business and management decision that farmers must make each year.
- ▶ What do we need to do to understand and address weed management within the larger context of the farming operation?

So what is next? - Questions for your consideration.....

- ▶ How does herbicide resistance relate to the dicamba registration ?
 - ▶ How do we steward the use of dicamba to reduce the selection pressure for resistance to this herbicide?
- ▶ What do we need to do to steward herbicides in order to maintain the tools we need for weed management?

So what is next? - Questions for your consideration.....

- ▶ Consider USDA programs
 - ▶ What does USDA need to know about the issue of HR?
 - ▶ Are there federal or other government programs/policies that make it difficult to adopt BMPs?

So what is next? - Questions for your consideration.....

- ▶ Consider your role-
 - ▶ Do you facilitate communication about resistance and herbicide stewardship between all groups within states and regions?
 - ▶ Is the message consistent and clear?
 - ▶ Resistance management plans
 - ▶ WSSA web portal - links to herbicide resistance information

So what is next? - Questions for your consideration.....

- ▶ How will you address the fact that the HR listening session participants think there will be new MOA?
 - ▶ Do we understand why they have this impression?
- ▶ Materials (such as Take Action) have great information on MOA and other HR strategies:
 - ▶ How are these materials being used?
 - ▶ Are the materials you use impartial?
 - ▶ Are the messages consistent?

So what is next? - Questions for your consideration.....

- ▶ We heard in some sessions that producers do not have profitable rotations.
 - ▶ Are herbicides available for rotation crops?
 - ▶ How do these rotation crops and weed control strategies impact long term weed management?
 - ▶ Do you have the economic information growers need to make suggested changes?

So what is next? - Questions for your consideration.....

- ▶ What do you need to provide science based information on diversification of practices to farmers/advisers?
- ▶ Are your technologies/technology recommendations integrated with other weed management tools to reduce selection pressure on weed populations?

An invitation to join the discussion -

- ▶ TPSA is an excellent forum to coordinate this needed discussion.
- ▶ TPSA can facilitate discussions with
 - ▶ Members
 - ▶ Other professional organizations
 - ▶ WSSA
 - ▶ Government agencies - both state and federal