

## **SUMMARY REPORT**

### **Resistance Management: Whose Problem and Whose Job?**

**Iowa State Conference Center  
Scheman Building, Room 220-230  
Ames, Iowa  
January 30<sup>th</sup>, 2015**

## **BACKGROUND AND MAJOR RECOMENDATIONS**

Given increased attention on the impacts of pesticide-resistant pests on agronomic practices and the changing national regulatory framework to address resistance management, Iowa State University, College of Agriculture and Life Sciences (ISU/CALS) and the Iowa Department of Agriculture and Land Stewardship (IDALS) facilitated a one-day meeting to discuss pesticide resistance management options in Iowa crop systems. The meeting included representatives from the Iowa community of farmers, agriculture support networks, and pesticide technology providers. Planning for the workshop included input from Iowa farm organizations, cooperatives, agricultural retailers, certified crop advisors, independent crop advisors, land management firms, and pesticide companies.

Based on the collaborative planning effort, the meeting was designed to address:

- Extent to which emergence of resistant pests is considered to be a problem in Iowa that requires action
- What strategies and approaches are available to address resistance management
- What challenges exist in addressing resistance management in Iowa crop production
- What options exist to address those challenges and what roles can members of the agriculture community play in addressing them

The expected outcomes for the meeting included:

- Understanding of agriculture community perspectives on the value of resistance management to support Iowa corn and soybean production
- Shared understanding of the challenges and trade-offs related to resistance management efforts for crops in Iowa
- Outline of next steps for multi-party discussions to advance resistance management in Iowa

The major recommendations from the meeting included:

- Developing a state-wide pesticide resistance management plan, coordinated by the state, that includes broad participation from all sectors of Iowa agriculture
- Establishing a unified, consistent message to increase awareness for action
- Engagement of meeting participants with their organizations in discussing the meeting outcomes

## **MEETING FORMAT**

The Agenda for the meeting is provided in Appendix A. The morning plenary addressed the status of pest resistance in Iowa corn and soybean production, pesticide-resistance management tactics, and socio-economic and regulatory considerations. During the afternoon, breakout sessions addressed three topics: 1) individual experiences with resistance management; 2) challenges currently faced in addressing resistance and resistance management in Iowa; and 3) important steps that can be undertaken to address resistance management and the roles each sector in the agriculture community can play. The meeting concluded with a plenary summary and synthesis session.

The week prior to the meeting participants received six background papers. These papers included: a summary of an informal survey of representatives from organizations across Iowa agriculture concerning pesticide resistance; a review of pesticide-resistance evolution; the status of herbicide resistant weeds, Western corn rootworm Bt resistance and fungicide resistance in Iowa; and economic considerations of pesticide resistance and management.

## **SYNOPSIS OF MEETING DELIBERATIONS**

### MORNING SESSION

The meeting started with opening remarks from Dean Wendy Wintersteen from CALS and Deputy Secretary Michael Naig from IDALS. The Dean and Deputy Secretary stressed the importance of addressing the issue at this juncture to ensure Iowa maintains efficient and economically sound corn and soybean production. As the nation's leader in corn and soybean production, the importance of Iowa to show leadership in developing a multi-disciplinary strategy for pesticide resistance management was highlighted. The Dean and Deputy Secretary also stressed that while resistance may not be new, it is an issue that has not been solved. They further stressed that collective and collaborative partnerships across the agricultural community could develop and implement a voluntary, science-based solution to pest resistance in Iowa.

Following these opening remarks a panel discussion and plenary dialogue completed the morning session. Presentations and discussion addressed a survey of Iowa corn and soybean farmers; the status of weed, corn rootworm, and pathogen resistance in Iowa; economic considerations for pesticide resistance and management; and regulatory issues from a state and federal perspective. A summary from the morning panel is provided below.

Farmer and Stakeholder Perspectives on Pesticide Resistance. Random sample surveys of Iowa farmers and informal polling of stakeholder representatives indicate that Iowa farmers, agricultural retailers and advisors, and members of pesticide/biotechnology companies have similar perspectives on pesticide resistance and management. Farmers and representatives across the agriculture sectors consider the evolution of pesticide resistance a significant issue for corn and soybean production in Iowa. There is general agreement that farmers have the greatest responsibility for the evolution and management of resistance, but pesticide companies and agriculture retailers and advisors, followed by public universities and governmental agencies,

also have important roles. There is also agreement that farmers look first to agricultural retailers for information to help them make pest management decisions. Later in the meeting it was pointed out that data show agricultural retailers work closely with ISU extension and research for education and information on these issues. Overall, results from random sample surveys of farmers and informal polling of stakeholder group representatives indicate similar perspectives on pesticide resistance and management, suggesting that there is much common ground on which to build coordinated approaches to resistance management.

Herbicide Resistance. Many aspects of crop production create selective pressure(s) that influence the weed community. Continuous crop systems can result in the greatest selection pressure and the quickest change within the weed community. Herbicides exert specific selection pressure and thus can cause faster evolution within the weed community - weeds can adapt to herbicides. The evolution of herbicide resistance is not a herbicide problem or a genetically-engineered trait problem, but rather a management problem. The extent and breadth of herbicide-resistant weeds currently in Iowa highlights the mobility of weed populations and the socio-economic changes in Iowa agriculture – fewer farmers, larger farms with considerable distances between fields and time constraints that hamper the adoption of fundamental weed management tactics (e.g., scouting).

Western corn rootworm resistance to Bt traits. Western corn rootworm resistance to Cry3Bb1 and mCry3A corn is present in Iowa. Cross-resistance has been identified between Cry3Bb1 corn and mCry3A corn. Laboratory studies indicate that three generations of selection is sufficient to generate Bt-resistant western corn rootworm for some traits. Field populations of western corn rootworm with Bt resistance are typically associated with a history of continuous corn cultivation and continuous use of the same Bt trait. Fields with Bt-resistant western corn rootworm will typically display high levels of pest survival and high levels of feeding injury to Bt corn in subsequent growing seasons. Rotating among a diversity of management tactics over multiple growing seasons and using non-Bt refuges will help to delay the evolution of Bt resistance.

Fungicide Resistance. At this time there are no confirmed reports of fungicide resistance for corn and soybean pathogens in Iowa. However, fungicide-resistant pathogens have been identified for some soybean pathogens in neighboring states (Illinois and Missouri). Reports of fungicide “failures” in Iowa are often due to applicator error or poorly timed applications; however, attention to resistance management practices is important. Fungicide resistance management strategies include managing diseases using a variety of tactics (e.g. resistant hybrids) and applying fungicides only when the risk of disease is elevated. Using premixes of multiple fungicides have a lower risk for fungicide resistance compared to using single mode of action fungicide products.

Economic Considerations to Pesticide Resistance Management. Standard pest management practices using a single mode of pest control may be simple, flexible, convenient and less costly in the short run. However, it is well established that single mode of action pest control tends to increase likelihood of pest resistance; e.g., widespread glyphosate use on glyphosate tolerant corn and soybeans contributed to evolution of glyphosate resistant weeds; continuous corn production with the same Bt trait leading to resistant western corn rootworms; and the development of fungicide resistant Frogeye leaf spot pathogen in soybeans in neighboring states.

If farmers adopt resistance management practices (RMPs) in pest control, increased management costs are immediate and certain, but many benefits of RMPs come later and are uncertain. The direct costs and benefits of adopting resistance management RMPs in corn and soybean production remains an open question. If pests were immobile between farms, the farmer would independently bear costs and capture benefits of pest control decisions. Many weed, insect, and fungi pests in corn and soybean production are mobile between farms and therefore benefits and costs of pest management are influenced by neighbors' behaviors. Thus, increased resistance management costs by a farmer may benefit their neighbor, while a neighbor's standard pest management practices may impose spillover costs on a farmer already employing RMPs. Developing longer term resistance management options to address "common" or shared mobile pests is the challenge at hand.

Considerations for Regulatory Agencies. While USDA's role is generally one of advancing research, incentives and outreach to promote resistance management, EPA and state pesticide agencies have a potential regulatory role to address resistance development and management under the Federal Insecticide, Fungicide, and Rodenticide Act. For Plant Incorporated Protectants, EPA has required resistance management practices (e.g., refuges) through conditions of registration. EPA is currently asking public comment on greater specificity to management requirements for Bt corn traits. For conventional pesticides, federal pesticide labels can include advisory language regarding resistance management and combined with state pesticide applicator training and pesticide stewardship training, generally represents the extent of current regulatory oversight. At both the state and federal level there is increasing attention to resistance management. The extent to which current regulatory approaches are effective and the extent to which adjustments may be needed in terms of education and/or increased regulatory requirements are being evaluated. There is a general sense that regulatory agencies will continue to support enhanced education and training. Agencies may be less likely to invoke mandatory resistance management requirements if viable community-based resistance management programs were developed and implemented.

### BREAK OUT GROUPS

Eight breakout groups, each of which included a cross section of participants, discussed three different topics and reported out to the larger group.

*Breakout Topic 1: What are the individual experiences of people with resistance management?*

Among the meeting participants there were some who had or are experiencing pesticide resistance issues first hand, especially with regard to glyphosate resistant weeds (i.e., waterhemp), but less so with western corn rootworm resistance to Bt toxins. All the breakout groups indicated that while direct experience may be limited with those in attendance, there is heightened concern about resistance and the mindset that evolution of resistance will not happen has changed, even if the number of farmers reporting resistance is lower than what surveys by ISU extension would suggest. However, they reported that there remains some perceptions that it 'won't happen on my farm.'

The breakout groups also reported a common theme with regard to the economic constraints and complexity of implementing resistance management practices; e.g., IPM and scouting increase

input costs; less net revenue with crop and/or mode of action rotations; management constraints in rental agreements, etc. A related theme that emerged from across the groups was the need to change the mindset from a short-term view on input costs to a longer-term view on costs and returns. The groups indicated that resistance management techniques need to be simplified if possible and likely will require demonstration of utility and the tradeoffs of short term increases in expenses and potential long term gain, which could be considered differently between older and younger farmers.

Finally there were some comments and questions concerning the degree and nature of Bt refuge implementation; the need to enhance education on resistance management practices and the need to consider re-balancing societal investments in new pest management technology vs. investments to advance cost-effective resistance management techniques.

*Breakout Topic 2: What are the challenges that we currently face in addressing resistance management in Iowa?*

The economic constraints of resistance management were re-emphasized in the discussions (see *Breakout Topic 1* summary) and included additional concerns that rental agreements and financial institutions are important drivers in decision-making. Some breakout groups noted a lack of financial resources to develop resistance management guidance and/or assistance to defray the costs of implementing resistance management practices. Others remarked that in some cases there is limited access to specific pest management products or seed traits, which hampers implementation of resistance management practices. It was also noted that social pressure and a desire to have clean fields could influence individual behavior and the adoption of resistance management measures.

At the social/community level, there were comments from several breakout groups concerning the need for leadership within the agriculture community to help advance a state strategy, which will need to recognize the need for different resistance management tactics across the state. These suggestions stressed leadership is needed from both the private and public sectors.

Regardless of the mechanisms by which community resistance management efforts might be realized, the need for consistent, clear information and messaging was expressed by many of the breakout groups. They noted that, currently, inconsistent information is provided to farmers and other sectors of the agriculture community – the resulting confusion undercuts acknowledgement that resistance development is serious and that management is important. Lack of consistent communication also creates confusion regarding the nature of specific resistance management practices. Participants indicated that consistent communication and educational information for farmers is needed regardless of the source; i.e., ISU Extension, agricultural retailers, certified crop advisors, independent advisors, pesticide and seed companies. Additional challenges mentioned included NRCS and insurance programs that undercut the implementation of resistance management practices.

*Breakout Topic 3: What are the most important things that can be done to address resistance and resistance management and what roles can each sector play in addressing them?*

Several breakout groups recommended the development of a state strategy that would recognize different approaches for different pests and regions of the state. Several groups stressed that the

effort should be farmer led, but would require a state government umbrella to facilitate a cross-organizational effort in developing and implementing a cohesive strategy.

The need for consistent educational materials/information was stressed by several groups with a suggestion that some existing state/regional/national sources of information and web-based platforms could be leveraged to create Iowa-specific information. The use of on-farm demonstrations that illustrate the practical aspects of resistance management practices and related economic analyses was also pointed out as an important facet to an educational effort.

Specific recommendations for different sectors within the agriculture community were also suggested; e.g.; pesticide companies and retailers creating internal incentives for promoting resistance management, ensuring common/consistent messaging and advice, ensuring sufficient supply of products are available that support mode of action and/or crop rotations; farmers participating in demonstrations, providing data and feedback on feasibility of practices, leading and promoting peer to peer discussions on the issue; ISU continuing to develop data on resistance and resistance management practices, including economic feasibility, and being the hub for developing educational materials that the agriculture community can employ.

#### AFTERNOON SYNTHESIS AND NEXT STEPS SESSION

The final session of the meeting provided the participants an opportunity to synthesize the afternoon's breakout discussions and propose next steps. A summary of the specific points raised during this session are provided in Appendix B.

In brief, the group's discussion centered on the need to develop a state-wide pesticide resistance management strategy. Participants felt that a strategy, coordinated by the state (perhaps in a manner similar to the Iowa Nutrient Reduction Strategy), should bring together broad participation across the agriculture community. It was noted that development and implementation of such a strategy would require strong leadership from Iowa's farmer, commodity, agriculture retailer, crop advisor and crop consultant organizations, in association with the state and Iowa State University. It was further noted that a strategy, with clearly defined roles across all sectors in agriculture and flexibility for different parts of the state, could minimize the potential for regulatory intervention.

The meeting participants also discussed some initial perspectives on the tactical aspects of implementing a state resistance management strategy. For example, the need to include socio-economic analyses to inform problem definition and potential solutions was deemed critical. Identifying funding options and establishing effective means to deliver information and tools were highlighted.

While building a coalition of organizations to work with the state to develop a resistance management strategy may take some time, the participants indicated that increasing awareness for the need to take action can be addressed immediately. In this regard, the need to develop and deliver a unified message and increase outreach to farmers and their advisors was stressed.

Finally the participants noted that it was essential that they take back to their organizations the messages from the day's meeting. This was viewed by several participants as the key, immediate next step to help increase awareness of the issue and for organizations across Iowa to explore the potential development of a state resistance management strategy.

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## **APPENDIX A. MEETING AGENDA**

**Resistance Management: Whose Problem and Whose Job?**  
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**Ames, Iowa**  
**January 30<sup>th</sup>, 2015**

### **AGENDA**

**8:00** Registration

**8:30 – 9:00** Welcome and Perspectives

ISU/CALS- Wendy Wintersteen

IDALS- Michael Naig

**9:00 – 9:10** Overview of Meeting Agenda, Goals and Ground Rules

Larry Elworth, RESOLVE

**9:10 – 10:00** Summary of ISU 2012/2013/2014 Farmer Polls and Planning Discussions

J. Arbuckle, ISU

**10:00 – 10:15** Break

**10:15 – 12:00** Panel Discussion with Q/A: Status of current knowledge on resistance and resistance management in Iowa. Status of weed, corn rootworm, pathogen resistance in Iowa and resistance management approaches; key economic considerations; current and potential regulatory issues

Weed resistance – Micheal Owen, ISU

Insect resistance – Aaron Gassmann, ISU

Pathogen resistance – Alison Robertson, ISU

Economic issues – John Miranowski, ISU

Regulatory context – Gretchen Paluch, IDALS, Pesticide Bureau; Steve Bradbury, ISU

**12:00 – 12:10** Overview of Afternoon's Agenda - Elworth

**12:10 - 12:15** Move into eight breakout groups

**12:15 – 1:00** Working Lunch and breakout discussion topic 1: What are the individual experiences of people with resistance management?

**1:00 - 1:30** Breakout group reports on discussion topic 1

**1:30 – 2:30** Breakout discussion topic 2: What are the challenges that we currently face in addressing resistance and resistance management in Iowa? (30 minutes of breakout group discussion; 30 minutes for report outs and plenary discussion)

**2:30 – 2:45** Break

**2:45 – 4:00** Breakout discussion topic 3: What are the most important things that can be done to address resistance and resistance management and what roles can each sector play in addressing them? (30 minutes of breakout group discussion; 45 minutes for report outs and plenary discussion)

**4:00 – 4:45** Synthesis of Afternoon Dialogue and Discussion of Next Steps

**4:45 – 5:00** Wrap-up



## APPENDIX B. MEETING NOTES FROM SYNTHESIS AND NEXT STEPS PLENARY

- Develop a state-wide resistance management strategy
  - State ownership to minimizing regulatory intervention by EPA
  - Coordination should be at state level (perhaps modeled like the Iowa Nutrient Reduction Strategy); realize one size does not fit all; i.e., resistance management plans could be different across the state
  - Requires strong leadership and coordination within and across organizations
  - Not bottom up or top down approach - it needs to work for farmers and be sustainable and cohesive
  - Broad participation
  - Coordinated approach with industry
  - Defined roles for all sectors in agriculture
  - Include: weeds, insects, pathogens, economics, society, community, culture, geography, climate, cultural and management practices
    - Other examples may be instructive to forming a state resistance management program e.g., boll weevil (but pest specific), Australia glyphosate resistance (but different socio-economic/regulatory environment); citrus greening in Florida
  - Care in public communication of the plan; need to establish progress first
- Potential tactical aspects of developing and implementing a state resistance management strategy
  - Socio-economic dimensions of problem and solution; understand and evaluate incentives – economic, personal and social
  - Appeal for simple solutions and need to address ‘old school’ versus new generation pest management approaches – both will likely play a role
  - Broaden definition of ‘community’ to include precision agriculture and financial institutions
  - Role of check-off or other mechanisms to provide funding
  - Delivery of information and tools will be a key aspect
- Awareness and opportunity to take action
  - Near term- Need to provide unified message on resistance management for the state
  - How to ensure resistant management is a priority on farm for all organizations?
  - Education across groups; key role for ISU extension to be a hub of information to support farmers and their advisors
    - Education/Outreach could include:
      - CCA education
      - Pesticide Certification Education
      - Other audiences
- Critical for meeting participants to take messages from the meeting to constituent groups now