Iowa Pest Resistance Management Plan
Iowa Soybean Conference
September, 2017

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U.S. Herbicide Resistance Action Committee U.S. Fungicide Resistance Action Committee

Pest Resistance Management

Resistance management:

- Slows development of pest adaptation to chemical, genetic and agronomic practices
- Fosters methods of early, resistance detection
- Mitigates resistance as it arises
- Is an on-going way of doing business
- Requires coordinated partnerships

January 2015 Meeting Outcomes

- Develop a state-wide pest resistance management plan, coordinated by the state, that includes broad participation from all sectors of Iowa agriculture.

- Establish a unified, consistent message to increase awareness for action.

January 2015 Meeting Outcomes

- Iowa 'ownership' – minimize regulatory intervention.
- Different approaches for pests/locations
- Works for farmers – sustainable and cohesive
- Strong leadership and coordination within/across organizations
- Tactical Aspects
  - Include socio-economic dimensions – evaluate individual, community and economic incentives
  - Balance simplicity of approaches with effectiveness; consider emerging technology to help reduce complexity/costs
  - Delivery of consistent information/tools

Principles of the IPRMP

- Pest resistance management (PRM) is the effort to slow the evolution of pest adaptation to chemical, genetic, and agronomic control practices.
- Major tenants
  - Voluntary
  - Community based
  - Adaptive management
  - Preserve viability of pest management technologies and farm profitability for the long term

Iowa Pest Resistance Management Plan

- January 2015: State-wide meeting launches Iowa Pest Resistance Management initiative
- June 2015: Iowa agriculture leadership creates multi-organization task force to prepare framework for future plan
- December 2015/March 2016: Iowa agriculture leadership approves plan's conceptual framework and approves plan preparation
- December 2016: Iowa Pest Resistance Management Plan (IPRMP) approved
- January 2017: Plan's public release and pilot project development
- May 2017: Select pilots topics
- Summer 2017: Identify locations and local collaborators
- Fall 2017: increase pilot teams, create local pilot plans: set goals, identify challenges

IPRMP Overview

Main Chapters

- Governance
- State of the Science
- Communication and Outreach
- Pilot Projects

State of the Science

- Insect Resistance
- Weed Resistance
- Disease Resistance
- Economic Considerations
- Sociological Considerations

Rootworm larva

The unique challenge of mobile pests

State of the Science

- Common themes … details vary with pests, management practices and geographic area
- IPM vital
  - Scouting, adaptive management
- There are no ‘silver bullets’

- There is common ground to build coordinated/community approaches
- Likely short-term increase of input costs, time and production complexity that helps preserves long-term productivity and profitability

Governance

- Program Manager with day-to-day IPRMP management responsibilities and coordination with external parties
- The Advisory Council will provide guidance during strategic planning for implementation of the IPRMP and will facilitate communication to and from the program manager to their organizations or committees
- Three supporting committees: Science, Outreach and Communication, and Pilot Projects

Communication and Outreach

- Audience includes farmers, ag professionals, government, and the public
- Pest resistance management and maintaining productivity
- Preserving pest management technologies and farm profitability
- Pilot projects to engage partnerships
- www.ProtectIowaCrops.org will serve as a hub to store progress, resources and news in one central location


PROTECT IOWA CROPS

your choice. your yield. our future.

PROTECTIOWACROPS.ORG

INTRODUCING THE IOWA PEST RESISTANCE MANAGEMENT PLAN

This is an Iowa-specific plan to address pests – including weeds, insects and plant diseases – that can adapt and become resistant to chemical, genetic, and agronomic control practices. The Iowa Pest Resistance Management Plan (IPRMP) outlines approaches for effective, integrated management solutions that will sustainably manage pests. By fostering methods to detect resistance, pest resistance can be delayed or even prevented, limiting its spread.

WHY DOES IOWA NEED A PEST RESISTANCE PLAN?

Pest resistance management (PRM) is the effort to delay pests from developing resistance. Pest resistance has the potential to impact yields, increase the cost of production, and limit farmers' future PRM options. With that in mind, the IPRMP was developed with a broad cross-section of Iowa agricultural partners to address this important issue while remaining flexible enough to incorporate new information.

WHAT ARE THE PLAN'S GOALS?

The Iowa plan seeks to engage farmers on the issue of pest resistance management with the goal of keeping technology and tools – including pesticides for controlling weeds, insects, and disease; seed treatments; and biotechnology products and native traits – available and effective. It is also important that farmers know they are not alone in their effort to address resistance; a wide variety of experts and resources are available to help. The Iowa plan will also include wide participation from all sectors of Iowa agriculture in order to educate and prevent broad applications that could lead to resistance.

HOW WILL THE PLAN BE IMPLEMENTED?

Iowa's 90,000 farmers will play a leading role in PRM through their stewardship of pesticide management technologies and biotechnology traits and tools. Farmers make management decisions each year on more than 23 million row-crop acres. Farmers' proactive adoption of practices is necessary to delay the development of herbicide, insecticide, and fungicide resistance, protect crop traits, and manage existing cases of resistance to help them remain competitive in the global market by maintaining the long-term productivity of Iowa agriculture while reducing pest-associated yield losses.

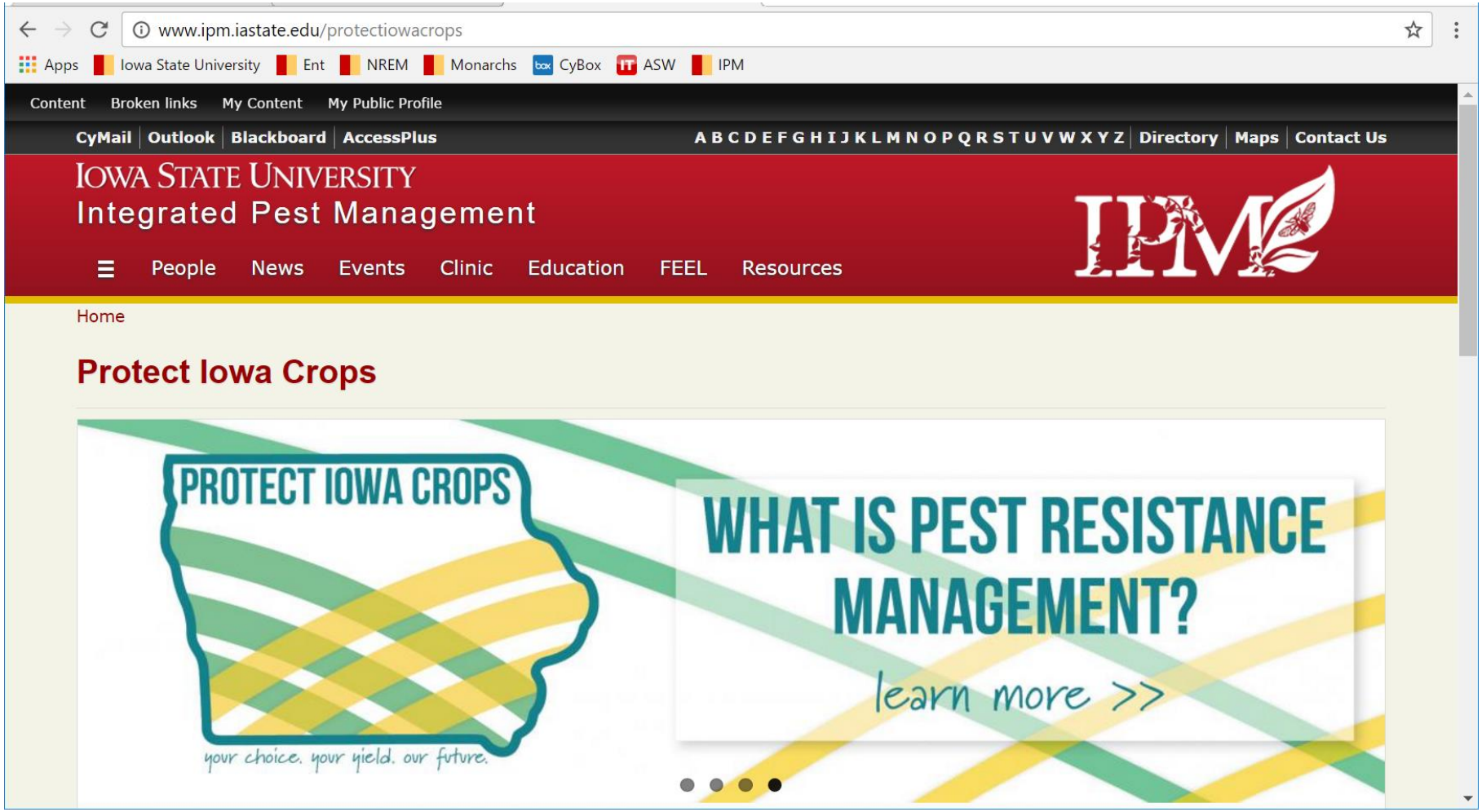
In addition, reaching agricultural professionals, such Certified Crop Advisers, Independent Crop Consultants, seed and pesticide retailers, and agronomic and farm advisors will be critical to the success of the strategy. Ag professionals who can provide multi-year plans that include PRM tactics will provide additional value to their services.

Finally, pilot projects of active PRM will be established. These projects will be focused on utilizing the latest pest resistance management tools and also examine approaches to encourage successful, voluntary PRM adoption. The pilot projects will identify key stakeholders within a defined "community" and will be inclusive, bringing all potential players to the table. The pilot projects will work to establish incentives and novel approaches to encourage the community to work together to address the identified pest-resistant problems (i.e., weeds, insects, and disease).

WHERE CAN I LEARN MORE?

Visit ***ProtectIowaCrops.org*** to see the latest news, plan updates, and to connect with experts.

www.ProtectIowaCrops.org



IPRMP Logic Model

- State of the science
- Leverage existing partnerships, networks and roles within Iowa communities
- Facilitate recognition of individuals, support leaders and “champions” that emerge

	Inputs	Human Behavior (Activities)	Land Management Industry Practice & Crop Production	Pest Resistant Population Outcomes
Ag Industry	• Education tools • Science • Pursue funding sources • Integrated Pest Management	• Support meetings, workshops, and influencers • Compilation of information	• Improve information for decision-making	• Minimize pest resistances • Maintain technologies
Farmers, Farm Managers and Land Owners	• Education and outreach • Provide RM practices • Socioeconomic analysis	• Identify local and regional champions	• Increase numbers of farmers practicing pest resistance management	• Minimize spread and development of pest resistance • Minimize economic impact
General Public	• Central message (safe, healthy, sustainable food supply)	• Identify agriculture and general-public networks	• Education and outreach	• Safe, healthy, and sustainable food supply

Pilot Projects

- Identify incentives that support voluntary, long term and implementation of resistance management for insects and weeds in specific parts of the state
- Developed in 3 phases
  - Phase I: determine criteria for project identification - done
  - Phase II: Identify set of potential pilots and communities based on criteria - done
  - **Phase III: Initiate 2-5 pilot projects**

Pilot Projects

Criteria:

- What are the critical features of the pest pressure, and what are their impacts on farm productivity?
- How is the pest currently managed?
- Is a community-based resistance management system/team already in existence?
- Are there currently any incentives (tangible or intangible) available to encourage community participation?

Pilot Projects

- Western Corn Rootworm in Northeast and North Central Iowa
  - Bt toxins traits
- Soybean Aphid in Northwest Iowa
  - Pyrethroids
- Palmer amaranth in Harrison County
- Waterhemp in Story County

Pilot Project

Western Corn Rootworm in North Central and Northeast Iowa

- Bt toxins traits (Cry3Bb1, mCry3A, eCry3.1Ab and Cry34/35)
- Confirmed resistance/cross-resistance to certain traits
- Risk to resistance increases with
  - Continuous corn
  - Continuous use of same Bt traits
  - High CRW populations
- Implement “Best Management Practices” (BMPs) through community-based adoption system
- Two local groups identified and teams are being assembled: one in Wright County and one in Bremer County

Pilot Project

Soybean Aphid in Northwest Iowa

- Pyrethroids
- Confirmed resistance in Minnesota; threat to Iowa
  - Monitoring in progress
- Challenge: Limited MOAs effective against soybean aphid
- Two pilot options:
  - Educating farmers about the risk of pyrethroid resistant populations
  - Adopting practices that limit the spread of insecticide resistance in soybean aphids
- First goal is to increase ability to test for resistance quickly
  - Research project has been funded by ISA

Pilot Project

Palmer amaranth in Harrison County

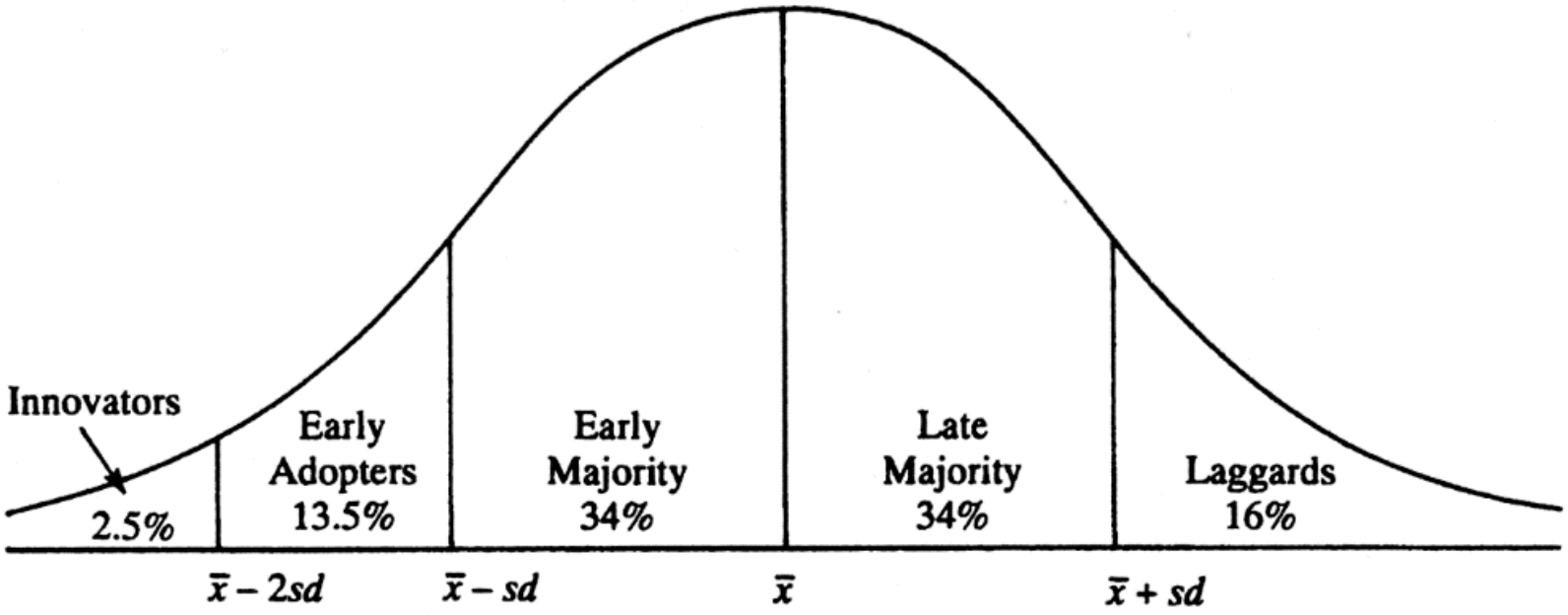
- Introduced through by-product from corn processing
- Could include additional weeds: waterhemp, horseweed (marestail), and giant ragweed
- Project objectives
  - Increasing awareness of weed resistance and management
  - Gaining landowner and farmer support
  - Using resistance management as a factor in annual seed and herbicide selections (mindset shift)
- Local team has been identified; local launch at Sept 11 event

Pilot Project

Waterhemp in Story County

- Widespread herbicide-resistant weed in Iowa
- Story County
  - Has herbicide-resistant waterhemp
  - Many local, major seed companies nearby
  - Farm management companies and cooperatives
- A local teams is being assembled to represent a broad cross section of stakeholders

Figure 7-3. Adopter Categorization on the Basis of Innovativeness



The innovativeness dimension, as measured by the time at which an individual adopts an innovation or innovations, is continuous. The innovativeness variable is partitioned into five adopter categories by laying off standard deviations (sd) from the average time of adoption ($\bar{x}$).

Rogers, 2005. Diffusion of Innovations, 5th ed.

Task Force Contributors

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Harrison County Herbicide Resistance Project

September 2018
Dunlap Crop Fair

Iowa Pest Resistance Management Program
www.ProtectIowaCrops.org

Iowa Pest Resistance Management Program

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Principles

- Pest resistance management is the effort to slow the evolution of pest adaptation to chemical, genetic, and agronomic control practices.
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Iowa Pest Resistance Management Program

Palmer Amaranth and Herbicide Resistance

Harrison County

- First Palmer infestation in Iowa in 2013
- HR waterhemp, marestail, and giant ragweed
- Team includes farmers, coops, lenders, industry reps, ISU extension
- Survey conducted of current management practices
- Two field days highlighting herbicide program comparisons in corn and soybean plots

Harrison County Herbicide Resistance Project

- Larry Buss, Farmer, Iowa Corn Growers Association
- Todd Cohrs, Ag Lender, FCSA Financial Officer
- Greg Christiansen, Ag Lender, Midstates Bank, NA
- Mike Dickinson, Farmer, Harrison County Farm Bureau Vice President
- Matt Handbury, Heartland Coop Agronomist
- Carter Oliver, Harrison County Program Coordinator, ISU Extension
- Jacque Pohl, Iowa State Program Coordinator
- Evan Sivesind, Iowa State IPRMP Program Manager
- Jason Sporrer, Agriland FS Agronomist
- John Swalwell, Asgrow/Dekalb Agronomist
- Pat Warmbier, USDA FSA County Executive Director
- Brent Wiersma, Business Representative, BASF
- Mike Witt, Iowa State Extension Field Agronomist

Herbicide Resistance Screening

- Weed seeds collected from locations in Harrison County
- Weeds grown out in greenhouse at Iowa State
- Plants sprayed with label rates of Roundup, Cobra, or Callisto at 3-4 inches height in Weeds lab spray chamber

Herbicide Resistance Screening Results

			Weed Survival (%)		
Sample	Location	Species	Roundup (9)	Cobra (14)	Callisto (27)
1	NE of Logan	Waterhemp	60	35	--
2	NW of Logan	Waterhemp	36	75	--
3	SE of Logan	Waterhemp	67	10	--
4	SE of Logan	Waterhemp	75	10	--
5	S of Modale	Waterhemp	59	100	--
6	SW of Modale	Palmer amaranth	60	0	100
7	SW of Modale	Palmer amaranth	20	0	30
8	W of Logan	Giant ragweed	23	0	--
9	W of Missouri Valley	Giant ragweed	21	--	100
10	NW of Mondamin	Giant ragweed	78	--	--

0 = Susceptible 100 = 100% Resistant

Harrison County 2018 Field Trials

- Four cooperator fields
  - Tilled, glyphosate resistant corn
  - No-till, dicamba resistant soybean
  - No-till, dicamba resistant soybean
  - Tilled, glufosinate resistant soybean
- 3 reps, 10 treatments at each location
  - Each plot 10 x 100 feet

Corn Herbicide Demonstration

Treatment	PRE	POST
1	Atrazine + glyphosate	glyphosate
2	Acuron + glyphosate	Atrazine + glyphosate
3	Corvus + glyphosate	Atrazine + glyphosate
4	Resicore + glyphosate	Atrazine + glyphosate
5	Verdict + glyphosate	Atrazine + glyphosate
6	Harness Xtra + glyphosate	Atrazine + Status + glyphosate
7	Acuron + glyphosate	Atrazine + Halex GT
8	Corvus + glyphosate	Atrazine + Laudis + glyphosate
9	Resicore + glyphosate	Atrazine + Realm Q + glyphosate
10	Verdict + glyphosate	Atrazine + Armezon PRO + glyphosate

Glyphosate resistant corn, conventional tillage

Soybean Herbicide Demonstration

No-till, dicamba resistant soybean

Treatment	PRE	POST
1	2,4-d + glyphosate	Clethodim + glyphosate
2	Xtendimax + glyphosate	Xtendimax + clethodim + glyphosate
3	Warrant + glyphosate	Xtendimax + clethodim + glyphosate
4	Sonic + glyphosate	Xtendimax + clethodim + glyphosate
5	Zidua Pro + glyphosate	Xtendimax + clethodim + glyphosate
6	2,4-d + glyphosate	clethodim + glyphosate
7	Xtendimax + glyphosate	Xtendimax + Warrant + clethodim + glyphosate
8	Xtendimax + Warrant + glyphosate	Xtendimax + Warrant + clethodim + glyphosate
9	Xtendimax + Sonic + glyphosate	Xtendimax + Warrant + clethodim + glyphosate
10	Xtendimax + Zidua Pro + glyphosate	Xtendimax + Warrant + clethodim + glyphosate

No-till soybeans
Mondamin 6/18/18

Outlook + glyphosate
PRE

2,4-D + glyphosate
PRE

No-till soybeans
Mondamin 7/2/18

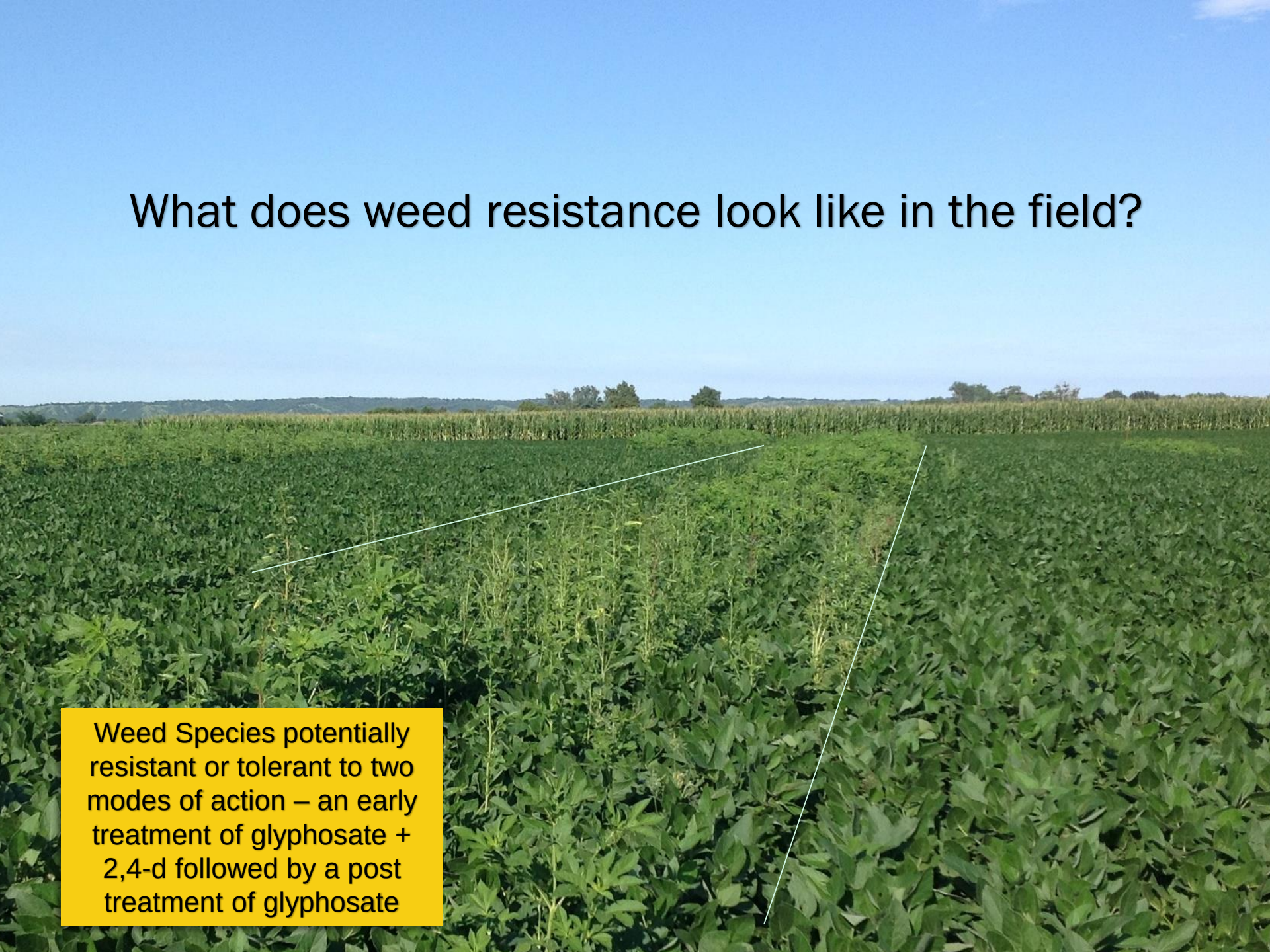
Outlook + glyphosate
PRE

Engenia + glyphosate +
clethodim POST

2,4-D + glyphosate
PRE

glyphosate + clethodim
POST

What does weed resistance look like in the field?



Weed Species potentially resistant or tolerant to two modes of action – an early treatment of glyphosate + 2,4-d followed by a post treatment of glyphosate

Future Plans

- Fall 2018
- 2019

Harrison County Herbicide Resistance Project

Iowa Pest Resistance Management Program

www.ProtectIowaCrops.org

Iowa Pest Resistance Management Program

www.ProtectIowaCrops.org

August 2019
WSSA/ESA Science Policy Experience

Background/History

- Weed challenges and management
- Larry Buss

Palmer Amaranth in Harrison County

- First Palmer infestation in Iowa in 2013
- Eradication efforts
- Facilitated by Iowa Department of Agriculture and Land Stewardship and ISU in 2015
- Launch Iowa Pest Resistance Management Program

Iowa Pest Resistance Management Program

Team Formation

Larry Buss
Local Farmer

Jason Sporrer
Agriland FS

Todd Cohrs
FCSA

Steve Bradbury
Iowa State University

Greg Christiansen
Midstates Bank

David Cooper
ISU Extension Council Chair
Farmer

Mike Dickinson
Farmer

Matt Handbury
Heartland COOP

Carter Oliver
ISU Harrison County Ext.

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Harrison County Pest Resistance Management Project

www.ProtectIowaCrops.org

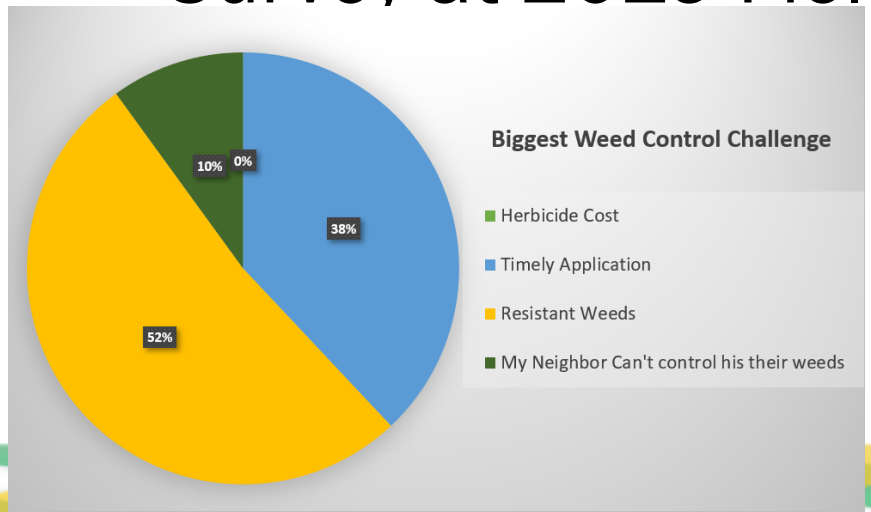
Harrison County Project Activities

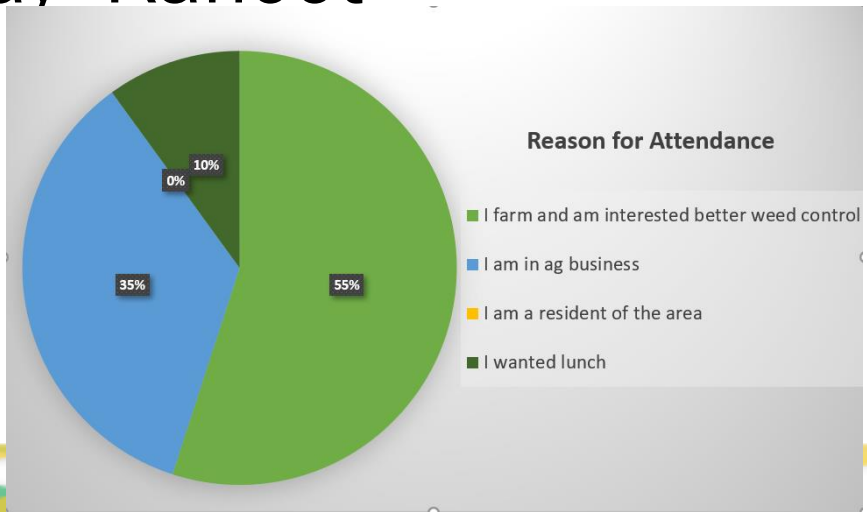
- Survey conducted of current management practices
- Weed seed screenings
- Field trials
- Field days
- Outreach

Disclaimer: Always Read and Follow Label Instructions. Roundup is a registered trademark of Bayer Group. Cobra is a registered trademark of Valent USA LLC. Callisto is a registered trademark of Syngenta Crop Protection. Liberty and Outlook are registered trademarks of BASF Corporation. Products were chosen for demonstration only; no endorsement of any product is intended.

Summary of Surveys

- Initial Survey sent to over 225 Postcard Surveys to Harrison County Farmers
  - 14% Response Rate
  - Top 2 weeds of Issue were Waterhemp and Marestail (Not Palmer Amaranth)
  - Over 90% respondents say they Rotate Modes of Action or Rely on Retailers to Make Decisions
- Survey at 2019 Field Day- Kahoot





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0 = Susceptible 100 = 100% Resistant

Weed Populations from plants suspected of resistance by farmer

Field Trials

Outreach

- 8 media articles
- Handouts & brochure
- Speaking events
- 3 field days highlighting herbicide program comparisons in corn and soybean plots
- Video summary
- Website www.protectiowacrops.org

2018 Field Day Video

- https://www.ipm.iastate.edu/protectiowacrops

What should we do?

- Opinions of the Group