



## Iowa Pest Resistance Management Program

### WHAT IS THE IOWA PEST RESISTANCE MANAGEMENT PROGRAM?

The Iowa Pest Resistance Management Program is an effort involving all members of Iowa's agricultural sector to slow the development of resistance to management practices in weeds, insects, and pathogens. Pest adaptation to chemical, genetic, and agronomic management practices is occurring at a much faster rate than new technologies are being developed. By slowing the development of resistance, valuable pest management technologies can be preserved, helping to protect long-term farm profitability.

### HOW DOES THE IOWA PEST RESISTANCE MANAGEMENT PROGRAM WORK?

Iowa farmers play a leading role in stewardship of pest management technologies through the management decisions they make. In addition, working with agronomists, crop advisers, ag retailers, and other agricultural professionals will be key for the successful, widespread adoption of pest resistance management (PRM) practices.

Pilot projects demonstrating active, successful pest resistance management are being developed across the state. These projects will be focused on utilizing the latest pest resistance management tools and also examine approaches to encourage successful, voluntary PRM adoption. Farmers and agricultural professionals play a vital role in setting direction, developing, and implementing these projects. 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).

### COMMUNITY LED PILOT PROJECTS

We encourage farmers, crop advisers, agronomists, and other agricultural professionals to participate in the development and implementation of pilot projects addressing a variety of resistance issues:



Herbicide resistant  
waterhemp, Central Iowa



Western corn rootworm  
resistance to Bt traits,  
NC and NE Iowa



Palmer amaranth,  
Harrison County



Pyrethroid resistance in  
soybean aphid,  
NW Iowa

### HELP SLOW RESISTANCE DEVELOPMENT!

Collaboration between farmers, agronomists, seed and chemical dealers, landowners, and other agricultural professionals is crucial to slow the development of pest resistance. Are you interested in joining a project near you? Are you having issues with these pests in a different location in Iowa? If so, contact us with the information below.

### FOR MORE INFORMATION

Contact Evan Sivesind at  
515-294-7990 or [sivesind@iastate.edu](mailto:sivesind@iastate.edu)

# Harrison County Pest Resistance Management Pilot Project

## HARRISON COUNTY PILOT GOALS

The overall intent of this project is to change the mindset of the entire agricultural community—including farmers, landowners, agronomists, crop advisors, bankers, seed companies, chemical companies, and research institutions—to include pest resistance management as an integral part of cropping-related decisions. Advance planning, rotation of practices and modes of action will help preserve the effectiveness of current and future management tools. The Harrison County Pilot will also provide essential support and feedback for the state-wide Iowa Pest Resistance Management Program, which seeks to address pest issues while avoiding resistance (see other side).



**Marestail**



**Waterhemp**

**Palmer amaranth**



**Giant ragweed**

## TARGET WEEDS

The Harrison County pilot project will focus on Palmer amaranth as well as waterhemp, marestail, and giant ragweed. Palmer amaranth was first discovered in Iowa in the late summer of 2013 in southwestern Harrison County, and its presence offers a unique opportunity to test management options and effectiveness in Iowa. Waterhemp, marestail, and giant ragweed are included in management trials because these weeds are already creating control problems for farmers in the county.

## LOCATION

The Harrison County pilot project will identify two locations per weed (one in the Loess Hills and one in the Missouri River Valley). Since farming practices and strategies differ between these two landscapes, it is expected that weed management techniques will also vary between the two.

## WHO IS INVOLVED?

Larry Buss, a local farmer is the Harrison Pilot lead  
Todd Cohrs, Ag Lender, FCSA Financial Officer  
Greg Christiansen, Ag Lender, Midstates Bank, NA  
Mike Dickinson, Harrison County Farm Bureau Vice President  
Matt Handbury, Heartland COOP Agronomist  
Carter Oliver, Harrison County Program Coordinator, ISU Extension and Outreach  
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, BASF  
Mike Witt, Iowa State Field Agronomist

## LEARN MORE

Contact Larry Buss at  
712-269-2989 or  
l-buss@windstream.net



# Harrison County Herbicide Resistance Project Corn Field Day

PRE Reps			Treatment	Rate / Ac	Herbicide Group	POST Reps			Treatment	Rate / Ac	Herbicide Group
101	204	304	Atrazine	32 oz	5	101	204	304	glyphosate	22 oz	9
			glyphosate	22 oz	9				AMS	5%	
102	205	301	Acuron	48 oz	27,27,5,15	102	205	301	glyphosate	22 oz	9
			glyphosate	22 oz	9				Atrazine	16 oz	5
									AMS	5%	
103	201	303	Corvus	3 oz	2,27	103	201	303	glyphosate	22 oz	9
			glyphosate	22 oz	9				Atrazine	16 oz	5
									AMS	5%	
104	203	305	Resicore	20 oz	4,15,27	104	203	305	glyphosate	22 oz	9
			glyphosate	22 oz	9				Atrazine	16 oz	5
									AMS	5%	
105	202	302	Verdict	13 oz	14,15	105	202	302	glyphosate	22 oz	9
			glyphosate	22 oz	9				Atrazine	16 oz	5
									AMS	5%	
106	209	310	Harness Xtra	48 oz	15	106	209	310	glyphosate	22 oz	9
			glyphosate	22 oz	5				Atrazine	16 oz	5
									AMS	5%	
									Status	3 oz	4,19
									HSCOC	8 oz	
107	208	308	Acuron	48 oz	27,27,5,15	107	208		HalexGT	57.6 oz	15,27,9
			glyphosate	22 oz	9				Atrazine	16 oz	5
									AMS	5%	
									NIS	0.25%	
108	210	309	Corvus	3 oz	2,27	108	210	309	glyphosate	22 oz	9
			glyphosate	22 oz	9				Atrazine	16 oz	5
									AMS	5%	
									Laudis	3 oz	27
									NIS	0.25%	



PRE Reps			Treatment	Rate / Ac	Herbicide Group	POST Reps			Treatment	Rate / Ac	Herbicide Group
109	206	307	Resicore	20 oz	4,15,27	109	206	307	glyphosate	22 oz	9
			glyphosate	22 oz					Atrazine	16 oz	5
									AMS	5%	
									Realm Q	4 oz	2,27
									NIS	0.25%	
110	207	306	Verdict	13 oz	14,15	110	207	306	glyphosate	22 oz	9
			glyphosate	22 oz	9				Atrazine	16 oz	5
									AMS	5%	
									Armezon PRO	16 oz	27,15
									NIS	0.25%	

COMPONENT			SITE-OF-ACTION GROUP	
PREMIX	ACTIVE INGREDIENT	TRADE NAME®		
ACURON	bicyclopyrone	-----	27	
	mesotrione	Callisto	27	
	atrazine	AAtrex	5	
	s-metolachlor	Dual II Magnum	15	
CORVUS	thiencarbazone	Varro	2	
	isoxaflutole	Balance Flexx	27	
RESICORE	clopyralid	Stinger	4	
	acetochlor	Surpass NXT	15	
	mesotrione	Callisto	27	
VERDICT	saflufenacil	Sharpen	14	
	dimethenamid-P	Outlook	15	
HARNESS XTRA	acetochlor	Harness	15	
	atrazine	AAtrex	5	

COMPONENT			SITE-OF-ACTION GROUP	
PREMIX	ACTIVE INGREDIENT	TRADE NAME®		
STATUS	diflufenzopyr	-----	19	
	dicamba	Clarity	4	
HALEX GT	s-metolachlor	Dual Magnum	15	
	mesotrione	Callisto	27	
	glyphosate	glyphosate	9	
REALM Q	rimsulfuron	Resolve	2	
	mesotrione	Callisto	27	
ARMEZON PRO	topramezone	Armezon	27	
	dimethenamid-P	Outlook	15	

COMPONENT			SITE-OF-ACTION GROUP	
	ACTIVE INGREDIENT	TRADE NAME®		
	atrazine	AAtrex	5	
	glyphosate	glyphosate	9	
	tembotrione	Laudis	27	



## Who is Involved?

Larry Buss, Farmer, Harrison Project Lead,  
President of Harrison/Crawford County  
Corn Growers Association  
Greg Christiansen, Ag Lender, Midstates  
Bank, NA  
David Cooper, Farmer, Harrison County  
Extension Council  
Todd Cohrs, Ag Lender, FCSA Financial Officer  
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John Swalwell, Asgrow/Dekalb Agronomist  
Brent Wiersma, Business Representative,  
BASF  
Mike Witt, Iowa State Field Agronomist

## Managing Resistance

To reduce the spread and development of herbicide resistance, the use of diverse weed management programs are essential, including timely applications of herbicide mixtures containing multiple, effective mechanisms of action in addition to cultural and mechanical techniques where feasible. Due to high seed production in many weed species, all efforts to reduce and prevent seed production by resistant individuals will be highly beneficial.

## Resistance Screening

Waterhemp, giant ragweed, and Palmer amaranth populations from Harrison County fields were collected and screened for resistance to commonly used herbicides. All 9 populations tested were resistant to Roundup (glyphosate), while 6 of 9 waterhemp populations were resistant to Cobra (lactofen). Of two Palmer amaranth populations tested, two were resistant to Roundup and one was resistant to Callisto (mesotrione). All three giant ragweed populations were resistant to Roundup, with one population resistant to Callisto. These results clearly show that herbicide resistant weeds are common in Harrison County and will continue to spread.



Weed seeds were grown in a greenhouse and treated with common herbicides to identify resistant populations.

## Iowa Pest Resistance Management Program

The Iowa Pest Resistance Management Program (IPRMP) is an effort involving all members of Iowa's agricultural sector to slow the development of resistance to management practices in weeds, insects, and pathogens. Pest adaptation to chemical, genetic, and agronomic management practices is occurring at a much faster rate than new technologies are being developed. By slowing the development of resistance, valuable pest management technologies can be preserved, helping to protect long-term farm profitability.



### LEARN MORE

Contact Larry Buss at  
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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.

## Harrison County Pest Resistance Management Project



[ProtectIowaCrops.org](https://ProtectIowaCrops.org)



About the Project

The Harrison County Pest Resistance Management Project is an effort to address the growing challenge posed by resistant pests. Since pests spread easily by wind, water, wildlife and equipment, resistance management is the responsibility of everyone involved in agriculture. A team of farmers, agronomists, crop advisers, researchers, bankers, agribusiness professionals, seed and herbicide company professionals and landowners is working to increase collaboration, spread awareness, and find solutions to resistance issues to ensure that pest resistance management is an integral part of all agricultural business decisions. While the project began with a focus on waterhemp, marestail, giant ragweed, and palmer amaranth, the team decided to expand and address disease resistance as well. This project is one of several resistance management projects being implemented across Iowa as part of the Iowa Pest Resistance Management Program.

Field Trials

Field trials were conducted in 2018 to allow side-by-side comparisons of 10 comprehensive weed management programs in four cooperator’s fields. Trials were conducted in 3 soybean fields (two no-till, one with tillage) and one cornfield. Herbicide programs were designed to demonstrate “Good,” “Better,” and “Best” herbicide programs in terms of managing weeds and resistance. All programs involved two passes, and ranged from tillage followed by Liberty (glufosinate), to a pre-mix consisting of three herbicides modes of action (MOAs) followed by Liberty plus Outlook (dimethenamid), for a total of four unique MOAs for the season. Visit [protectiowacrops.org](https://protectiowacrops.org) for more detail.

	Herbicide Resistance
Waterhemp	Roundup, Cobra
Palmer Amaranth	Roundup, Callisto
Giant Ragweed	Roundup, Callisto
Note: Populations deemed resistant through DNA screening or if <80% controlled in greenhouse screening. Note: Marestail screening was attempted but did not grow.	



Harrison County 2018 Field Day

Field Days

Two field days were hosted in 2018: one in June and one in July. A corn weed management field day took place June 18th southwest of Modale. Participants had the opportunity to observe the progress of field trials. They could also learn how to identify Palmer amaranth, as this site was the first case of Palmer amaranth in Iowa. The July field day was held at a no-till soybean field southwest of Logan, again featuring ten weed management programs. These replicated treatments allowed attendees to compare differences in weed management between treatments containing residual preemergence herbicides vs. no residual, and the effects of post-emergence residual applications. A video of the field day can be viewed at [protectiowacrops.org](https://protectiowacrops.org).

On August 2nd, a group of researchers and representatives from the United States Environmental Protection Agency (EPA) and the United States Department of Agriculture (USDA) heard from the Harrison County Pest Resistance Management Project Team regarding its efforts to share information on local weed resistance in the county. The team hosted the EPA and USDA personnel on a tour of the no-till soybean field. The Harrison County team recognizes that the EPA and USDA are also part of the overall agricultural community that must be engaged to fully deal with pest resistance management.

Field infested with giant ragweed and waterhemp





## **2019 Science Policy Experience: Collaborative Approach to Resistance Management**

Welcome to the 2019 Science Policy Experience program sponsored by the Entomological Society of America (ESA) and the Weed Science Society of America (WSSA). The two societies have joined efforts to provide a unique opportunity to explore collaborative approaches to pest resistance management. We have attempted to engage the key stakeholder groups that have a vested interest in improving the adoption of best management practices to control these pests in a sustainable manner. **Our goal is that you will leave this experience with a new perspective and tools that assist each of you individually, and as members of your organizations, to engage broader stakeholder groups in the development and implementation of local, voluntary, community-based resistance management.**

Many attendees have studied or participated in successful community-based programs from both a weed science and entomology perspective. Many attendees will also share challenges they have experienced in attempting to establish such community-based approaches. The aim of this experience is to learn lessons from the past so that improvements can be made in the future. We have decades of science and experience to inform pathways to the adoption of effective integrated resistance management that will help the achievement of sustainable agriculture systems. It is our hope that your experience during the next couple of days will lead all of us toward creating the possibility of those promising future outcomes.

When we conclude this experience, we expect each of you to personally commit to applying what you learn during the next couple days. Take advantage of this network and utilize the tools you've acquired to help you and your organizations attempt to advance initiatives that will enable the formation of community-based approaches. We have entered an era of socially responsible pest management. We must take advantage of new paradigms in communication, social networks, digital tools, and agricultural technology. The steering team and colleagues who helped develop this event aspire to create a dialogue that extends well beyond the next couple of days. We will be following up with each represented stakeholder group to determine how we can assist your efforts in advancing this cause. We sincerely appreciate each and everyone of you taking the time to attend this program!

**Special thank you to the Iowa Pest Resistance Management Plan Project (IPRMP) and Harrison County!!**



<https://www.ipm.iastate.edu/protectionwacrops>

<https://www.regulations.gov/document?D=EPA-HQ-OPP-2014-0805-0094>

<https://www.epa.gov/sites/production/files/2017-09/documents/prn-2017-2-herbicide-resistance-management.pdf>

[http://www.entsoc.org/sites/default/files/files/EntSocAmerica\\_PolicyStatement\\_InsecticideResistanceMgt.pdf](http://www.entsoc.org/sites/default/files/files/EntSocAmerica_PolicyStatement_InsecticideResistanceMgt.pdf)

[http://www.entsoc.org/sites/default/files/files/EntSocAmerica\\_PolicyStatement\\_IRMGeneticallyModifiedCrops.pdf](http://www.entsoc.org/sites/default/files/files/EntSocAmerica_PolicyStatement_IRMGeneticallyModifiedCrops.pdf)

<http://wssa.net/wssa/weed/resistance/>

Ervin DE, Frisvold GB. 2016. Community-based approaches to herbicide-resistant weed management: lessons from science and practice. *Weed Sci* 64 (Special Issue): 609-626

Hurley, T. M. 2016. "Shock and Awe Pest Management: Time for Change." *Choices*. Quarter 4

Miranowski & Lacy 2016. When do Resistance Management Practices Pay for the Farmer and Society? The Case of Western Corn Rootworm. *AgBioForum*. 19(2): 173-183

Shaw, D. 2016. The Wicked Nature of the Herbicide Resistance Problem. *Weed Sci* 64 (Special Issue): 552-558

Nosworthy et al. 2012. Reducing the Risks of Herbicide Resistance: Best Management Practices and Recommendations. *Weed Science* Special Issue: 31-62.

Onstad, D. 2014. Insect Resistance Management. 2nd Edition. Biology, Economics, & Prediction. Academic Press. 560 pages.

Ervin, D. and G.B. Frisvold. 2016. "Are Community-Based Approaches to Manage Herbicide Resistance Wisdom or Folly?" *Choices*. Quarter 4. Available online:

<http://www.choicesmagazine.org/choices-magazine/theme-articles/herbicide/are-community-based-approaches-to-manage-herbicide-resistance-wisdom-or-folly>.

Miranowski, J. 2016. Intervention to Manage Pest Resistance: Community-Based or Government Regulation. *Choices* Quarter 4. Available online: <http://www.choicesmagazine.org/choices-magazine/theme-articles/herbicide/intervention-to-manage-pest-resistance-community-based-or-government-regulation>

Lasley, P. "The Model for Community Change". Iowa State University.

Shaw et al. 2018. "Next Steps in Combating Herbicide Resistance...our view". *Weed Science*. [www.cambridge.org/wsc](http://www.cambridge.org/wsc)

## Pest Resistance Management Agenda – 2019 Final

### Overarching Goal:

Learn how to increase the likelihood that more voluntary, community-based pest resistance management projects will form

Attendees should plan to arrive in Omaha, NE on the afternoon/evening of August 5<sup>th</sup>. A block of rooms has been reserved at the Courtyard Marriott. Please enjoy the Old Market area, downtown Omaha and plan to have dinner on your own.

#### 1) Day 1 (August 6<sup>th</sup>) - **Local Community Learnings**

- a. 7:45am – Load bus and travel to Logan, IA Community Center
- b. 9:15am – Harrison County Iowa Pest Resistance Management Pilot Project
  - i. **Larry Buss and Team**
- c. 10:30am – Break
- d. 10:45am – Audience learning (Addressing key questions)
- e. 12:00pm – Lunch at Community Center
  - i. Special Guest Speaker – **Dave Much** (People's Company)  
**"Socially Responsible Pest Management"**
- f. 12:45pm – Load bus to head to field tour
- g. 2:45pm – Break and load bus back to Community Center
- h. 3:00pm – Community role playing – Teams receive issue to address
- i. 4:45pm – Load bus to go to Larry Buss farm for dinner (Social Hour)
- j. 6:00pm - Dinner
  - i. Special guest – **Mike Naig (Secretary of Ag for Iowa)**
- k. ~8:00pm – Load bus to travel to Ankeny, Iowa
- l. ~10:00pm – Arrive at Hampton Inn and Holiday Inn Express

#### 2) Day 2 (August 7<sup>th</sup>) – **Tools to Enable Community Formation**

- a. 7:30am – Load bus to travel to Des Moines Area Community College
- b. 8:00am - ESA and WSSA Resistance Policy Positions
- c. 8:20am – **Case studies (weeds and insects) (30 minute talks)**
  - i. Weed Science: **Ian Burke** (Pacific NW)
  - ii. Entomology: **George Frisvold** (Arizona)
  - iii. Weed Science: **Jeff Gonsolus** (Univ of MN)
- d. 9:50am - Break
- e. 10:05am: Entomology: **Tim Woelfel** (Ag Retailer, MN)
- f. 10:30 – 11:00am – **Social Science and Key Learnings - Iowa**
  - i. **Dr. Paul Lasley**
- g. 11:00am – **"Tools to develop local communities"**
  - i. **Roxi Beck (Center for Food Integrity)**
- h. 12:00pm – Lunch
- i. 12:45pm – Break back into assigned community teams
- j. 2:30pm – Break
- k. 2:45pm - Group leaders from community sessions discuss key learnings

- l. 3:30pm – Next Steps – Participant dialogue on actionable next steps
- m. ~4:00pm – Adjourn – Bus transports attendees to Des Moines airport
- n. Dinner on own

Final goals of tour:

- Action plans at all levels that will support and sustain local community-based solutions
- Participants leave feeling empowered with a clear identification of their roles in leading action plans all levels.





## Iowa Pest Resistance Management Program

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### HOW DOES THE IOWA PEST RESISTANCE MANAGEMENT PROGRAM WORK?

Iowa farmers play a leading role in stewardship of pest management technologies through the management decisions they make. In addition, working with agronomists, crop advisers, ag retailers, and other agricultural professionals will be key for the successful, widespread adoption of pest resistance management (PRM) practices.

Pilot projects demonstrating active, successful pest resistance management are being developed across the state. These projects will be focused on utilizing the latest pest resistance management tools and also examine approaches to encourage successful, voluntary PRM adoption. Farmers and agricultural professionals play a vital role in setting direction, developing, and implementing these projects. 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).

### COMMUNITY LED PILOT PROJECTS

We encourage farmers, crop advisers, agronomists, and other agricultural professionals to participate in the development and implementation of pilot projects addressing a variety of resistance issues:



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Palmer amaranth,  
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Pyrethroid resistance in  
soybean aphid,  
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### HELP SLOW RESISTANCE DEVELOPMENT!

Collaboration between farmers, agronomists, seed and chemical dealers, landowners, and other agricultural professionals is crucial to slow the development of pest resistance. Are you interested in joining a project near you? Are you having issues with these pests in a different location in Iowa? If so, contact us with the information below.

### FOR MORE INFORMATION

Contact Evan Sivesind at  
515-294-7990 or [sivesind@iastate.edu](mailto:sivesind@iastate.edu)

## **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 as 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.

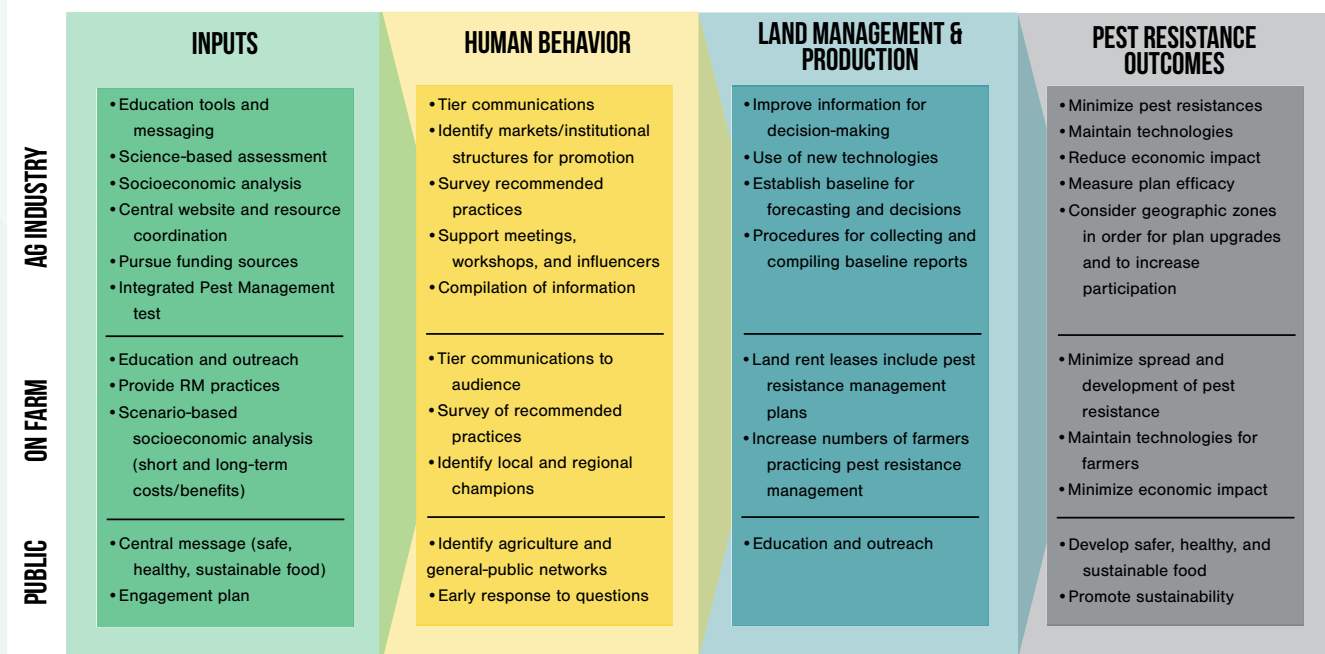
Finally, pilot projects of active PRM will be established. These projects will be focused on utilizing the latest pest resistance management tools and also examine approaches to encourage successful, voluntary PRM adoption. The pilot projects will identify key stakeholders within a defined "community" 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.

The logic model shows how the IPRMP will build success by combining knowledge from all groups to change the way pests are managed to achieve sustainable productivity.

## IOWA PEST RESISTANCE MANAGEMENT PLAN LOGIC MODEL



## NEXT STEPS

March 2017: Review of pilot-project proposals

April 2017: Pilot projects selected

May 2017: Pilot projects launch

Once the pilot projects launch, there will be periodic on-farm sessions to share progress, learnings, and innovations. Year three of the pilots projects will be key for sharing tested accomplishments. Once results are compiled, adjustments will be made to the plan and to pilots to continue improving management efforts.



US Herbicide Resistance Action Committee  
US Insecticide Resistance Action Committee  
US Fungicide Resistance Action Committee



# Harrison County Herbicide Resistance Project

Come see side-by-side comparison of 10 herbicide programs

## Corn Field Day

Monday, June 18

9:30 to 11:00 am

## Location

Larry Meyer Farm

¾ mile west of Austin Avenue (K45) on 280th St  
southwest of Modale

## Agenda

Project Intro

Herbicide Trials

Resistance Screening Results

Palmer amaranth ID



## Rain or Shine

In the event of rain, program will  
take place at Jason Buss Farm,  
800 South Main St, Modale, Iowa  
Call Harrison Extension Office to  
confirm details: (712) 644-2105

**Refreshments will be provided!**



## Rain or Shine

In the event of rain, program will take  
place at the Logan Community Center,  
108 W 4th St, Logan, IA  
Call Harrison Extension Office  
to confirm details: (712) 644-2105

**Cattlemen's grilling; lunch is provided!**



## Soybean Field Day

Friday, July 13

10 am to 1:30 pm

## Location

Larry Buss Farm  
Approximately 300 feet west  
of the intersection of US highway 30  
and Niagara Trail South about 2 miles  
southwest of Logan

## Agenda

Project Intro

Herbicide Trials

Resistance Screening Results

Palmer amaranth ID

*your choice. your yield. our future.*  
**PROTECTIONIOWACROPS.ORG**



## Who is Involved?

Larry Buss, Farmer, Harrison Project Lead,  
President of Harrison/Crawford County  
Corn Growers Association  
Greg Christiansen, Ag Lender, Midstates  
Bank, NA  
David Cooper, Farmer, Harrison County  
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## Managing Resistance

To reduce the spread and development of herbicide resistance, the use of diverse weed management programs are essential, including timely applications of herbicide mixtures containing multiple, effective mechanisms of action in addition to cultural and mechanical techniques where feasible. Due to high seed production in many weed species, all efforts to reduce and prevent seed production by resistant individuals will be highly beneficial.

## Resistance Screening

Waterhemp, giant ragweed, and Palmer amaranth populations from Harrison County fields were collected and screened for resistance to commonly used herbicides. All 9 populations tested were resistant to Roundup (glyphosate), while 6 of 9 waterhemp populations were resistant to Cobra (lactofen). Of two Palmer amaranth populations tested, two were resistant to Roundup and one was resistant to Callisto (mesotrione). All three giant ragweed populations were resistant to Roundup, with one population resistant to Callisto. These results clearly show that herbicide resistant weeds are common in Harrison County and will continue to spread.



Weed seeds were grown in a greenhouse and treated with common herbicides to identify resistant populations.

## Iowa Pest Resistance Management Program

The Iowa Pest Resistance Management Program (IPRMP) is an effort involving all members of Iowa's agricultural sector to slow the development of resistance to management practices in weeds, insects, and pathogens. Pest adaptation to chemical, genetic, and agronomic management practices is occurring at a much faster rate than new technologies are being developed. By slowing the development of resistance, valuable pest management technologies can be preserved, helping to protect long-term farm profitability.



[ProtectIowaCrops.org](https://ProtectIowaCrops.org)

### LEARN MORE

Contact Larry Buss at  
712-269-2989 or  
[l-bbuss@windstream.net](mailto:l-bbuss@windstream.net)

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.

## Harrison County Pest Resistance Management Project





About the Project

The Harrison County Pest Resistance Management Project is an effort to address the growing challenge posed by resistant pests. Since pests spread easily by wind, water, wildlife and equipment, resistance management is the responsibility of everyone involved in agriculture. A team of farmers, agronomists, crop advisers, researchers, bankers, agribusiness professionals, seed and herbicide company professionals and landowners is working to increase collaboration, spread awareness, and find solutions to resistance issues to ensure that pest resistance management is an integral part of all agricultural business decisions. While the project began with a focus on waterhemp, marestail, giant ragweed, and palmer amaranth, the team decided to expand and address disease resistance as well. This project is one of several resistance management projects being implemented across Iowa as part of the Iowa Pest Resistance Management Program.

Field Trials

Field trials were conducted in 2018 to allow side-by-side comparisons of 10 comprehensive weed management programs in four cooperator’s fields. Trials were conducted in 3 soybean fields (two no-till, one with tillage) and one cornfield. Herbicide programs were designed to demonstrate “Good,” “Better,” and “Best” herbicide programs in terms of managing weeds and resistance. All programs involved two passes, and ranged from tillage followed by Liberty (glufosinate), to a pre-mix consisting of three herbicides modes of action (MOAs) followed by Liberty plus Outlook (dimethenamid), for a total of four unique MOAs for the season. Visit [protectiowacrops.org](http://protectiowacrops.org) for more detail.

	Herbicide Resistance
Waterhemp	Roundup, Cobra
Palmer Amaranth	Roundup, Callisto
Giant Ragweed	Roundup, Callisto
Note: Populations deemed resistant through DNA screening or if <80% controlled in greenhouse screening. Note: Marestail screening was attempted but did not grow.	



Harrison County 2018 Field Day

Field Days

Three field days have been held: one in June 2018, one in July 2018 and one in July 2019. A corn weed management field day took place south-west of Modale. Participants had the opportunity to observe the progress of field trials. They could also learn how to identify Palmer amaranth, as this site was the first case of Palmer amaranth in Iowa. The second field day was held at a no-till soybean field southwest of Logan, again featuring ten weed management programs. These replicated treatments allowed attendees to compare differences in weed management between treatments containing residual preemergence herbicides vs. no residual, and the effects of post-emergence residual applications. The 2019 field day included a new

herbicide trial comparison, and fungicide trials are also being observed. A video of the 2018 field day can be viewed at [protectiowacrops.org](http://protectiowacrops.org). On August 2, 2018, a group of researchers and representatives from the United States Environmental Protection Agency (EPA) and the United States Department of Agriculture (USDA) heard from the Harrison County Pest Resistance Management Project Team regarding its efforts to share information on local weed resistance in the county. The team hosted the EPA and USDA personnel on a tour of the no-till soybean field. The Harrison County team recognizes that the EPA and USDA are also part of the overall agricultural community that must be engaged to fully deal with pest resistance management.

Field infested with giant ragweed and waterhemp





## Field Day: Harrison County Pest Resistance Management Project



**Tuesday, July 9**  
**10:00 am - 1:00 pm**

### Location

**Immediately northeast of the intersection of Niagara Trail and 262nd Street, which is about 1.5 to 2 miles southwest of downtown Logan.**

### Rain or Shine

**In the event of rain, program will take place at the Logan Community Center, 108 W 4th St, Logan, IA  
Call Harrison Extension Office to confirm details: (712) 644-2105**

### Agenda

**Project Intro  
Herbicide Trials  
Fungicide Trials**



**Cattlemen's grilling; lunch is provided!**

*your choice. your yield. our future.*  
**PROTECTIONIOWACROPS.ORG**

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# Harrison County Pest Resistance Management Project

## 2019 Field Day Plot Sheets



Sites of Action on Display

SITE-OF-ACTION GROUP	NUMBER OF RESISTANT WEED SPECIES IN U.S.	CHEMICAL FAMILY	ACTIVE INGREDIENT	PRODUCT EXAMPLES (TRADE NAME®)
SITE OF ACTION				
<b>1</b> ACCASE INHIBITORS (acetyl CoA carboxylase)	15	Aryloxyphenoxypropionate (fops)	clodinafop cyhalofop fenoxaprop fluzafop quizalofop	Discover NG Clincher RiceStar, others Fusilade DX Assure II, Targa
		Cyclohexanedione (dims)	clethodim sethoxydim	Select Max, others Poast, Poast Plus
		Phenylpyrazolin	pinoxaden	Axial XL
<b>3</b> MICROTUBULE INHIBITORS	6	Benzamide	pronamide	Kerb
			ethalfluralin	Sonalan
		Dinitroaniline	pendimethalin trifluralin	Prowl H <sub>2</sub> O, others Treflan, others
<b>4</b> SYNTHETIC AUXINS (TIR1, AFB5, and unknown auxin receptors)	8	Arylpicolinate	halauxifen	Elevore
		Benzoic acid	dicamba	Banvel, Clarity, DiFlexx, Engenia, FeXapan, XtendiMax, others
		Carboxylic acid	aminopyralid clopyralid fluroxypyr quinclorac triclopyr	Milestone Stinger Starane Ultra Facet Garlon, Remedy Ultra
		Phenoxy	2,4-D MCPA	2,4-D, Enlist One, others MCPA, others
<b>9</b> EPSP SYNTHASE INHIBITOR (5-enolpyruvyl-shikimate-3-phosphate)	17	Organophosphorus	glyphosate	Roundup, several others
<b>10</b> NITROGEN METABOLISM INHIBITOR				
GLUTAMINE SYNTHETASE INHIBITOR	1	Organophosphorus	glufosinate	Liberty, Rely, others
<b>15</b> LONG-CHAIN FATTY ACID INHIBITORS	3	Amide	dithiopyr napropamide	Dimension Devrinol
		Chloroacetamide	acetochlor dimethenamid-P s-metolachlor	Harness, Surpass, Topnotch, Warrant, others Outlook Dual Magnum, others
		Oxyacetamide	flufenacet	Define
		Pyrazole	pyroxasulfone	Zidua

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COMPONENT			SITE-OF-ACTION GROUP
PREMIX	ACTIVE INGREDIENT	TRADE NAME®	
BOUNDARY	s-metolachlor	Dual Magnum	15
	metribuzin	Metribuzin	5
SONIC	sulfentrazone	Spartan	14
	cloransulam	FirstRate	2
ZIDUA PRO	imazethypyr	Pursuit	2
	saflufenacil	Sharpen	14
	pyroxasulfone	Zidua	15

### PHOTOSYNTHESIS INHIBITORS

PHOTOSYSTEM II INHIBITORS (different binding than 6 & 7)

### CELL MEMBRANE DISRUPTORS

PPO INHIBITORS

# Tillage Treatments

PRE Reps	Treatment	Herbicide Group	Rate / Ac	POST Reps	Treatment	Herbicide Group	Rate / Ac	
101	Outlook	15	12 oz	101	Liberty	10	32 oz	
					AMS		3 lbs / 112 oz liq	\$28.71 ac
					Clethodim	1	6 oz	
102	Boundary	15,5	24 oz	102	Liberty	10	32 oz	
					AMS		3 lbs / 112 oz liq	\$31.06 ac
					Clethodim	1	6 oz	
103	Sonic	14,2	3 oz	103	Liberty	10	32 oz	
					AMS		3 lbs / 112 oz liq	\$27.87 ac
					Clethodim	1	6 oz	
104	Sonic	14,2	3 oz	104	Liberty	10	32 oz	
	Prowl H2O	3	2 pts		AMS		3 lbs / 112 oz liq	\$38.57 ac
					Clethodim	1	6 oz	
105	Zidua PRO	15,14,2	6 oz	105	Liberty	10	32 oz	
					AMS		3 lbs / 112 oz liq	\$37.78 ac
					Clethodim	1	6 oz	
106	Outlook	15	12 oz	106	Xtendimax	4	22 oz	
					glyphosate	9	22 oz	\$31.52 ac
					Clethodim	1	6 oz	
					DT Adjuvant & DRA		0.5%	
107	Boundary	15,5	24 oz	107	Xtendimax	4	22 oz	
					glyphosate	9	22 oz	\$33.87 ac
					Clethodim	1	6 oz	
					DT Adjuvant & DRA		0.5%	
108	Sonic	14,2	3 oz	108	Xtendimax	4	22 oz	
					Warrant	15	32 oz	\$37.31 ac
					glyphosate	9	22 oz	
					Clethodim	1	6 oz	
					DT Adjuvant & DRA		0.5%	
109	Sonic	14,2	3 oz	109	Xtendimax	5	22 oz	
	Prowl H2O	3	2 pts		Warrant	15	32 oz	\$48.01 ac
					glyphosate	9	22 oz	
					Clethodim	1	6 oz	
					DT Adjuvant & DRA		0.5%	
110	Zidua PRO	15,14,2	6 oz	110	Xtendimax	4	22 oz	
					Warrant	15	32 oz	\$47.22 ac
					glyphosate	9	22 oz	
					Clethodim	1	6 oz	
					DT Adjuvant & DRA		0.5%	

Cost per acre represent chemical costs ONLY. Prices may vary due to payment dates, marketing programs, application, etc.

# No-Till Treatments

PRE Reps	Treatment	Herbicide Group	Rate / Ac	POST Reps	Treatment	Herbicide Group	Rate / Ac	
111	Outlook	15	12 oz	111	Liberty	10	32 oz	
	2,4-d LV4	4	16 oz		AMS		3 lbs / 112 oz liq	\$48.59 ac
	glyphosate	9	22 oz		Outlook	15	10 oz	
	AMS		5%		Clethodim	1	6 oz	
	HSMSO		8 oz					
112	Boundary	15, 5	24 oz	112	Liberty	10	32 oz	
	2,4-d LV4	4	16 oz		AMS		3 lbs / 112 oz liq	\$48.07 ac
	glyphosate	9	22 oz		Dual	15	16 oz	
	AMS		5%		Clethodim	1	6 oz	
	HSMSO		8 oz					
113	Sonic	14, 2	3 oz	113	Liberty	10	32 oz	
	2,4-d LV4	4	16 oz		AMS		3 lbs / 112 oz liq	\$47.75 ac
	glyphosate	9	22 oz		Outlook	15	10 oz	
	AMS		5%		Clethodim	1	6 oz	
	HSMSO		8 oz					
114	Sonic	14, 2	3 oz	114	Liberty	10	32 oz	
	Prowl H2O	3	2 pts		AMS		3 lbs / 112 oz liq	\$58.45 ac
	2,4-d LV4	4	16 oz		Outlook	15	10 oz	
	glyphosate	9	22 oz		Clethodim	1	6 oz	
	AMS		5%					
	HSMSO		8 oz					
115	Zidua PRO	15,14,2	6 oz	115	Liberty	10	32 oz	
	2,4-d LV4	4	16 oz		AMS		3 lbs / 112 oz liq	\$57.66 ac
	glyphosate	9	22 oz		Outlook	15	10 oz	
	AMS		5%		Clethodim	1	6 oz	
	MSO		16 oz					
116	2,4-d LV4	4	16 oz	116	glyphosate	9	22 oz	
	glyphosate	9	22 oz		AMS		5%	\$15.13 ac
	AMS		5%		Clethodim	1	6 oz	
					HSMSO		8 oz	
117	Xtendimax	4	22 oz	117	Xtendimax	4	22 oz	
	glyphosate	9	22 oz		glyphosate	9	22 oz	
	DT Adjuvant & DRA		0.50%		Warrant	15	32 oz	\$42.96 ac
					Clethodim	1	6 oz	
					DT Adjuvant & DRA		0.5%	

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# No-Till Treatments

PRE Reps	Treatment	Herbicide Group	Rate / Ac	POST Reps	Treatment	Herbicide Group	Rate / Ac	
118	2,4-d LV4	4	16 oz	118	Xtendimax	4	22 oz	\$32.50 ac
	Warrant	15	32 oz		glyphosate	9	22 oz	
	glyphosate	9	22 oz		Clethodim	1	6 oz	
	AMS		5%		DT Adjuvant & DRA		0.5%	
119	Xtendimax	4	22 oz	119	Xtendimax	4	22 oz	\$42.96 ac
	glyphosate	9	22 oz		glyphosate	9	22 oz	
	Warrant	15	32 oz		Clethodim	1	6 oz	
	DT Adjuvant & DRA		0.50%		DT Adjuvant & DRA		0.5%	
120	Xtendimax	4	22 oz	120	Xtendimax	4	22 oz	\$50.58 ac
	glyphosate	9	22 oz		glyphosate	9	22 oz	
	Boundary	15	24 oz		Clethodim	1	6 oz	
	DT Adjuvant & DRA		0.50%		DT Adjuvant & DRA		0.5%	
121	Xtendimax	4	22 oz	121	Xtendimax	4	22 oz	\$54.02 ac
	Sonic	14,2	3 oz		Warrant	15	32 oz	
	glyphosate	9	22 oz		glyphosate	9	22 oz	
	DT Adjuvant & DRA		0.50%		Clethodim	1	6 oz	
					DT Adjuvant & DRA		0.5%	
122	Xtendimax	4	22 oz	122	Xtendimax	4	22 oz	\$64.72 ac
	Sonic	14,2	3 oz		Warrant	15	32 oz	
	Prowl H2O	3	2 pts		glyphosate	9	22 oz	
	glyphosate	9	22 oz		Clethodim	1	6 oz	
	DT Adjuvant & DRA		0.50%		DT Adjuvant & DRA		0.5%	
123	Xtendimax	4	22 oz	123	Xtendimax	4	22 oz	\$65.93 ac
	Zidua PRO	15,14,2	6 oz		Warrant	15	32 oz	
	glyphosate	9	22 oz		glyphosate	9	22 oz	
	MSO		16 oz		Clethodim	1	6 oz	
	DT Adjuvant & DRA		0.50%		DT Adjuvant & DRA		0.5%	
124	2,4-d LV4	4	16 oz	124 A	Xtendimax	4	22 oz	\$22.96 ac
	glyphosate	9	22 oz		glyphosate	9	22 oz	
	AMS		5%		DT Adjuvant & DRA		0.5%	
				124 B	Liberty	10	32 oz	\$23.41 ac
					Clethodim	1	6 oz	
					AMS		5%	
125	2,4-d LV4	4	16 oz	125 A	Xtendimax	4	22 oz	\$22.96 ac
	glyphosate	9	22 oz		glyphosate	9	22 oz	
	AMS		5%		DT Adjuvant & DRA		0.5%	
				125 B	Liberty	10	32 oz	\$33.33 ac
					Clethodim	1	6 oz	
					Outlook	15	10 oz	
					AMS		5%	

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