Show Me the Weeds:

What might weed management look like in 2023 and beyond?

Dr. Kevin Bradley, University of Missouri

Some Thoughts on Weed Management in 2023 and Beyond

MORE COMPLEX herbicide labels, registrations, requirements, etc.

Get used to these kinds of labels in the future…

For land with **Hydrologic Soil Groups* A & B**: The land manager/applicator must effectively implement measures in the following tables to equal a **minimum of 4 credits**.

For land with **Hydrologic Soil Groups* C & D**: The land manager/applicator must effectively implement the measures in the following tables to equal a **minimum of 6 credits**.

Mitigation Measures			Credits
Reduce number of applications - Reduced number of applications of Enlist products per year. Applications may be made at any time during crop development but must maintain a minimum 12-day retreatment interval.		3 applications	0
		2 applications	2
		1 application	4
Residue Tillage Management: no till, strip-till, ridge-till and mulch-till			4
Vegetative Filter Strips	30 ft off-field vegetative buffer on down slope	HSG A or B	2
		HSG C or D	0
	100 ft off-field vegetative buffer on down slope	HSG A or B	4
		HSG C or D	1
Field border: border with dense vegetative stands with a minimum width of 30 ft.			2
Cover Crop			2
Vegetative Barrier: Permanent strips of dense vegetation along the contours of the field with a minimum width of 3 ft.			2
Contour Buffer Strips or Terrace			2
Grassed Waterway			2
Water and Sediment Basin			1
Contour Farming or Contour Strip Cropping			1

*Hydrologic Soil Group (HSG) definitions: A = Sand, loamy sand, or sandy loam; B = Sandy clay loam; C = Silt loam or loam; D = Clay loam, silty clay loam, sandy clay, silty clay or clay.

Applicators/Land Managers must meet minimum criteria described for each mitigation measure as outlined on Enlist.com/mitigationmeasures to receive credits.

POLITICS

EPA Proposes Five Changes to Atrazine Labels, Introduces "Picklist" Mitigation

EPA Atrazine 070122

EPA's Role in Herbicide Registration

1. **Must meet the standards of Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)**
   - ***"Reasonable certainty of no harm"***
   - ***"No unreasonable adverse effects"***

2. **Must also meet the standards of the Endangered Species Act (ESA). ESA requires EPA and other federal agencies to ensure that action they take *will not:***
   - **"Jeopardize the continued existence of *any* listed species", or**
   - **"Destroy or adversely modify *any* critical habitat for those species."**

What are we protecting?

- 1674 species in the U.S. currently (the list is growing)
- Missouri has 52 species (7 aquatic invertebrates; 3 birds; 20 fish; 2 insects; 4 mammals; 7 reptiles and amphibians; 9 plants)
- an updated decision will be released on the monarch butterfly in 2024


American Burying Beetle


Greater Prairie Chicken


Mead's Milkweed

Why should you care about ESA?

- **Has definitive language that does not allow for interpretation (i.e., who can say with certainty that there are ”no effects”?).**
- **Only considers risk to threated or endangered species. It does not consider the potential benefits of any pesticide use.**
- **Requires action if a SINGLE individual within a species may be affected.**
- **Has not had a major revision since 1973.**
- **As of January 2022, all new pesticide active ingredients will be assessed for their potential effects on threatened and endangered species. Why?/What’s different?**

Some Thoughts on Weed Management in 2023 and Beyond

M ORE COMPLEX herbicide labels, registrations, requirements, etc.

I NTEGRATED APPROACHES that don't just rely on herbicides alone will become more and more important.

Autonomous Weeding/Use of Robots

Bosch's Giant Robot Can Punch Weeds to Death

By Evan Ackerman
Posted 12 Nov 2015 | 20:00 GMT

Photo: Deepfield Robotics

At IROS last month, researchers from a Bosch startup called Deepfield Robotics presented a paper on "Vision-Based High-Speed Manipulation for Robotic Ultra-Precise Weed Control," which has like four distinct exciting-sounding phrases in it. We wanted to write about it immediately, but Deepfield asked us to hold off a bit until their fancy new website went live, which it now has. This means that we can show you video of their enormous agricultural robot that can autonomously detect and physically obliterate individual weeds in a tenth of a second.

Given the scale of farming today, treating weeds chemically is really the only practical way for humans to keep them under control, because you can use tractors or airplanes to cover large areas in a short amount of time. But all of those necessarily deadly (to weeds) chemicals then get on the plants we don't want to kill (because we want to eat them), as well as getting washed into the soil. The most organic and eco-friendly way of dealing with weeds is the old-fashioned way: physically removing them. "Physical removal" can mean

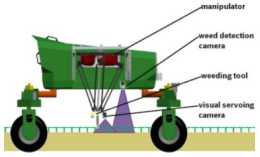


Image: Deepfield Robotics

FarmWise launches autonomous weeding robot

JANUARY 7, 2019 BY SAM FRANCIS

Deere is paying over $300 million for a start-up that makes 'see-and-spray' robots

- Blue River's robots affix to tractors and can precisely identify and spray herbicides, pesticides or fertilizers to plants in need.
- The start-up had raised about $31 million in venture funding.

Lora Kolodny | @lorakolodny
Published 8:08 PM ET Wed, 6 Sept 2017 | Updated 10:22 PM ET Wed, 6 Sept 2017

CNBC

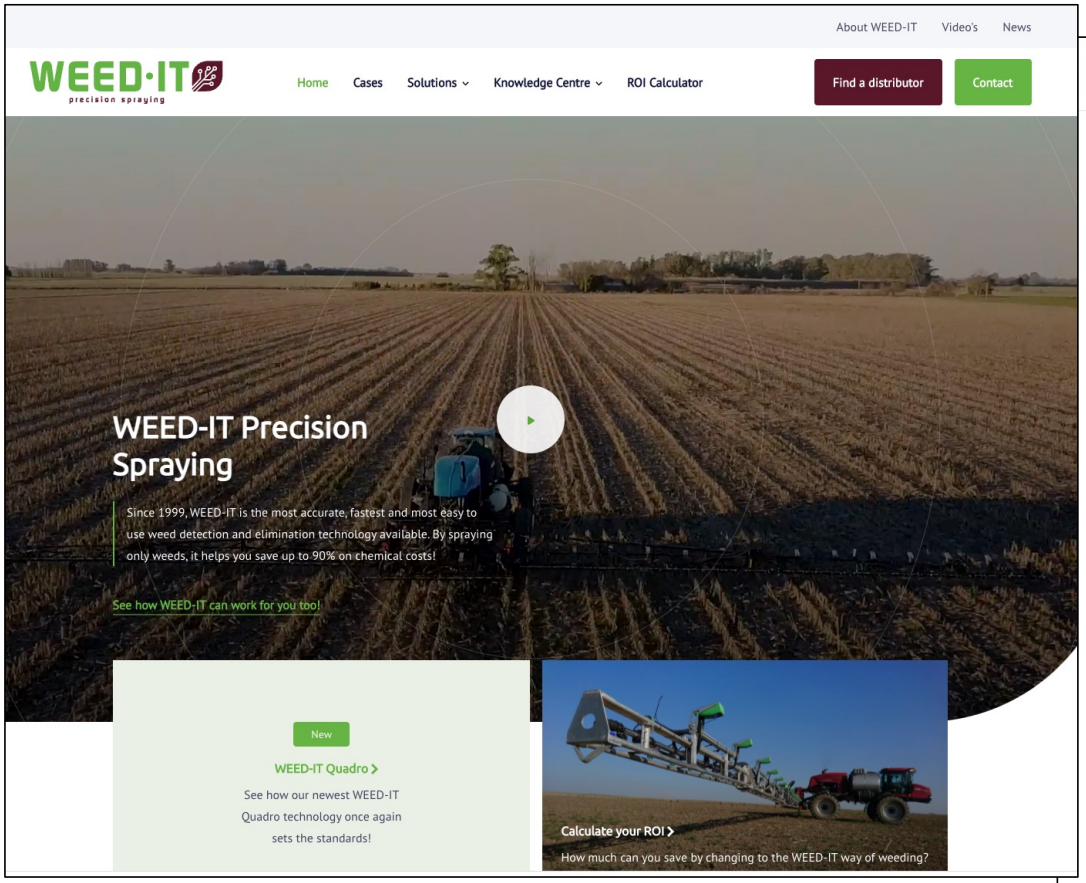
Michael Newberg | CNBC

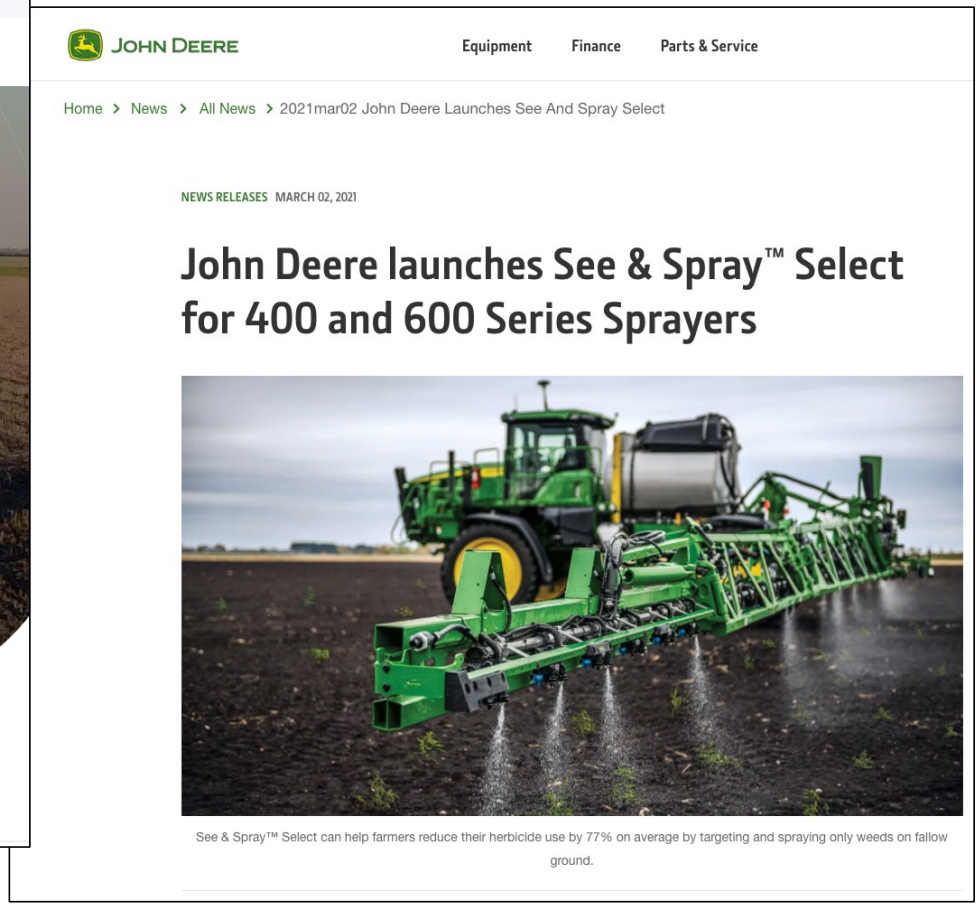
Sam Allen, CEO of John Deere at CONEXPO in Las Vegas on March 7. 2017.

Deere is bringing more robots to the farm.

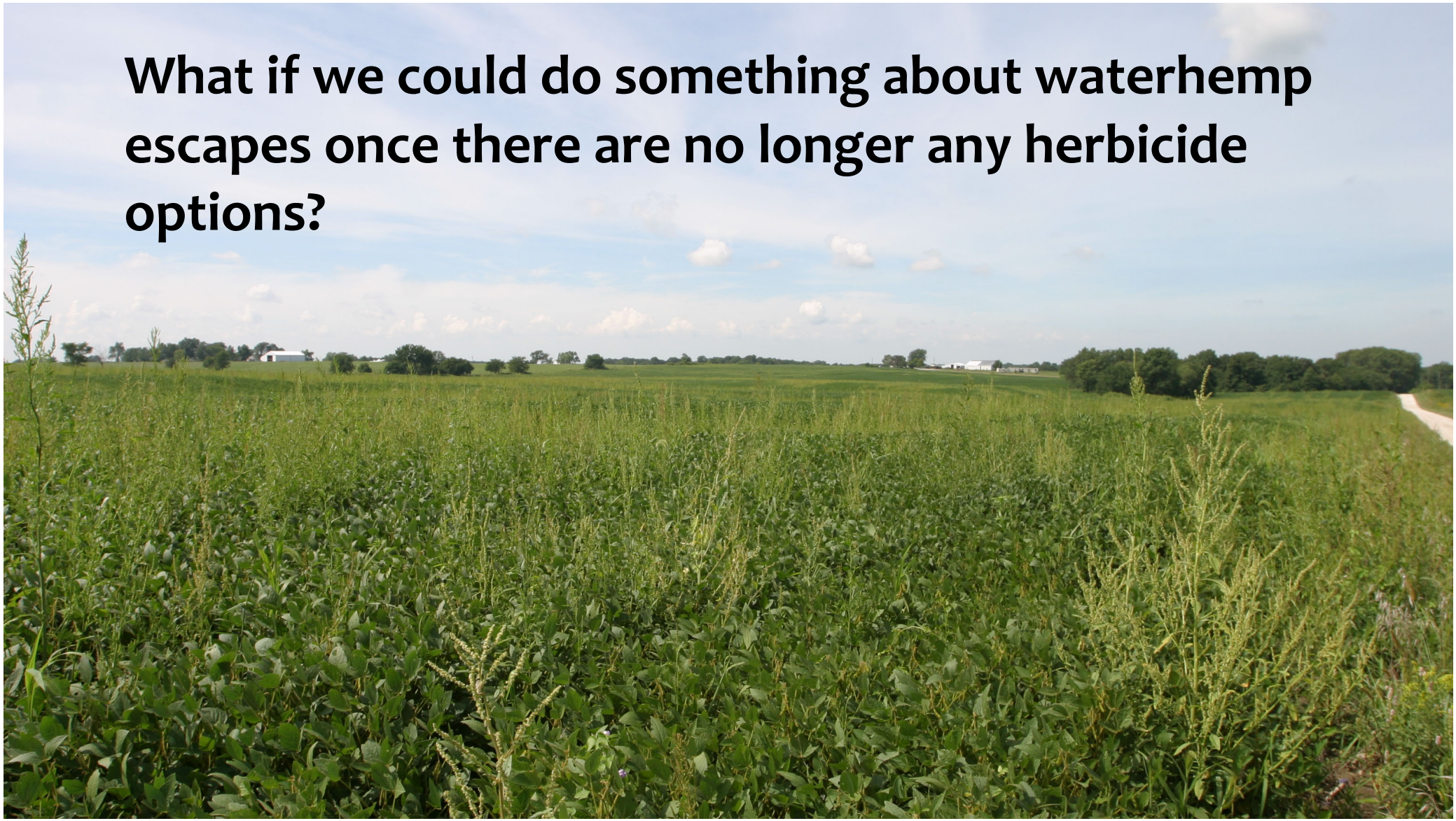
The maker of John Deere agricultural equipment said on Wednesday that it's acquiring robotics start-up Blue River Technology for $305 million. The deal is expected to close in September.

Precision Sprayers





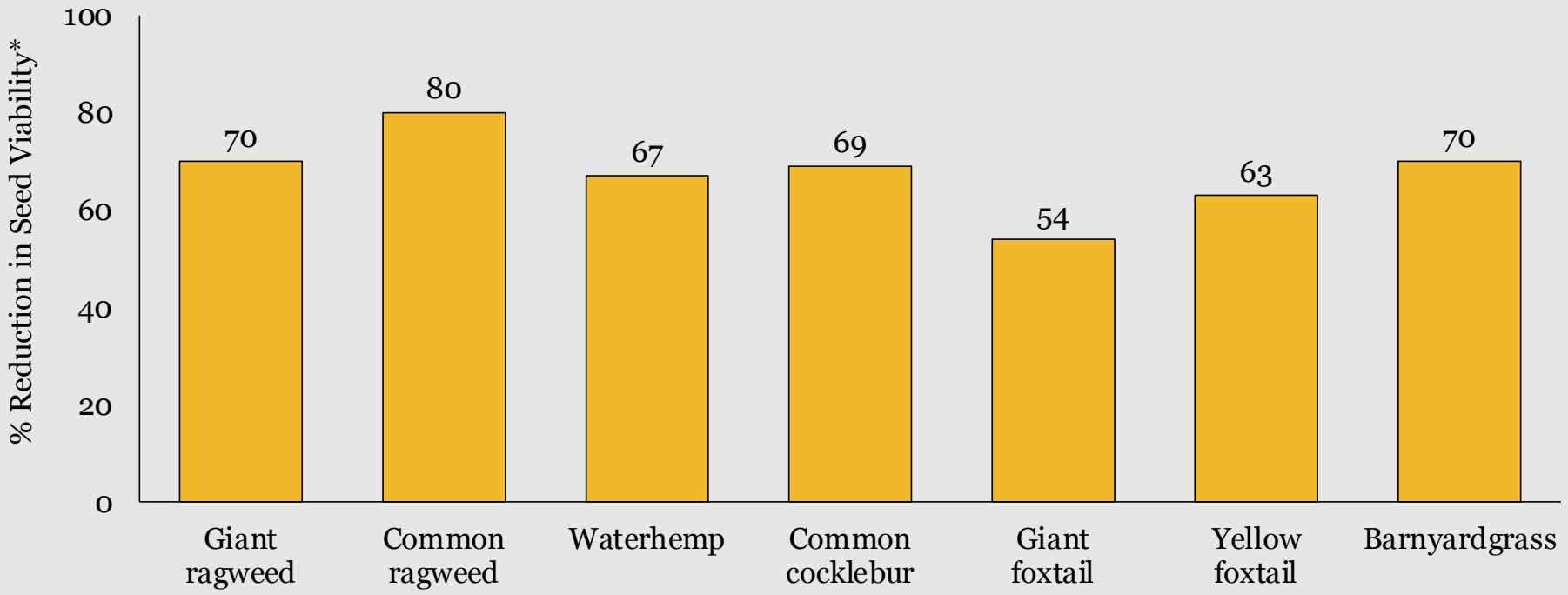

UAV Sprayers


What if we could do something about waterhemp escapes once there are no longer any herbicide options?

What we think we've learned so far…

- This is not a weed management tool. This is a weed rescue tool.
- Can be effective on some of our most problematic resistant weeds. Can also be variable on those same weeds but we're learning…
- Size, plant moisture, boom height all matter.
- Can substantially reduce weed seed viability.

Influence of Electrocution on Weed Seed Viability



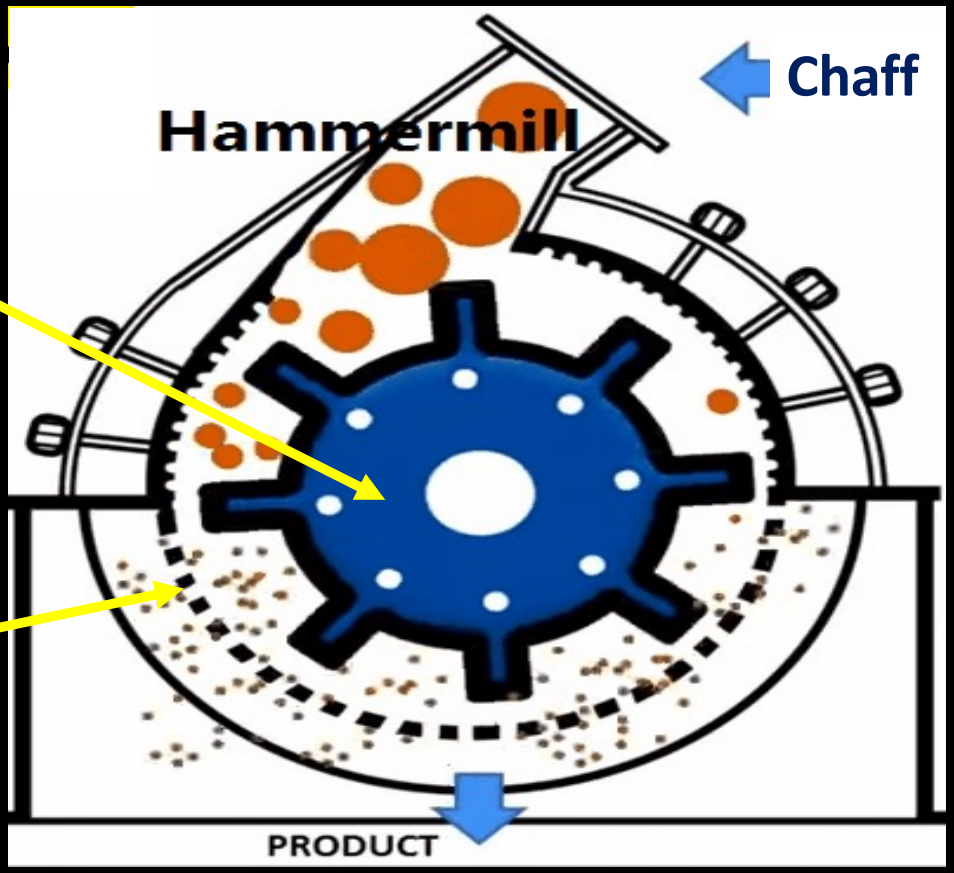
*Based on viability of non-treated seed of that species

Will On-combine Seed Destruction Devices Become “Standard” in the United States ?

Basic Hammer Mill/Cage Mill Concept

Rotating Bars

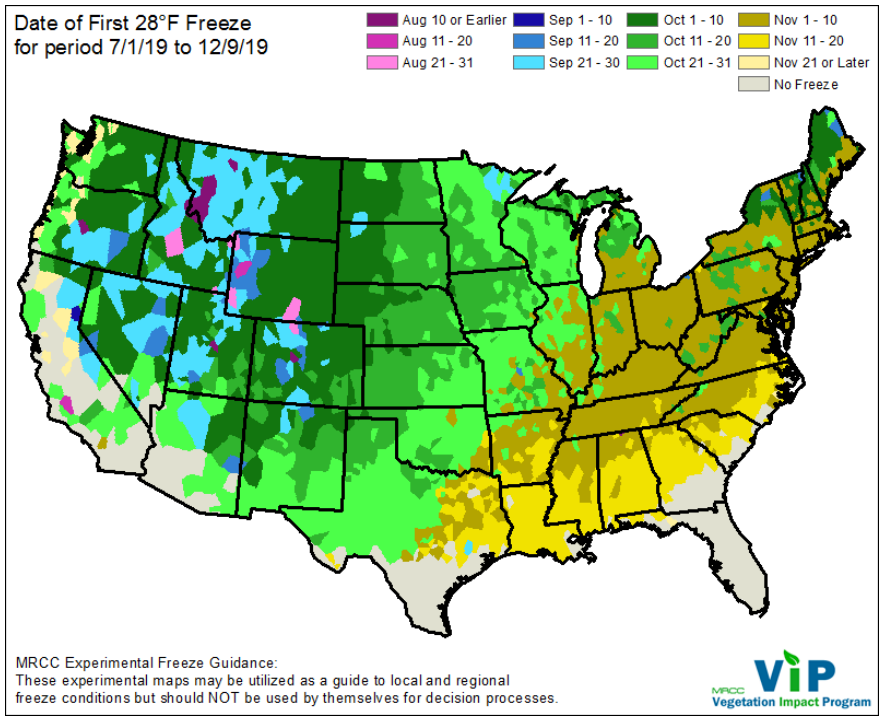
Stationary Bars



slide provided by Dr. Tom Barber, University of Arkansas

On-combine Impact Mills for use in U.S. Soybean

Date of First Freeze, 2019



1. The earlier the frost(s), the better. "Green" weeds with high moisture content have proven difficult.

On-combine Impact Mills for use in U.S. Soybean

2. Some degree of header loss of weed seed is likely to occur (~31% of available waterhemp seed in a field).

On-combine Impact Mills for use in U.S. Soybean

3. The majority of weed seed that enters the combine appears to make it into the seed terminator. Approximately 94% of waterhemp seed that comes out of the Seed Terminator are damaged (= non-viable).

On-combine Impact Mills for use in U.S. Soybean

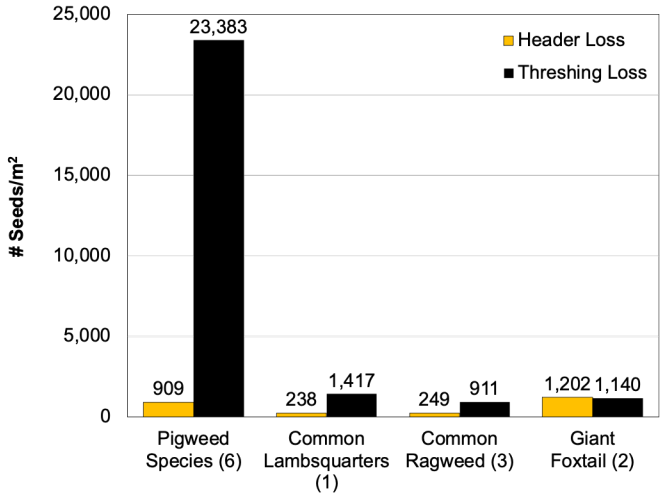


Figure 3. Average header and threshing loss of weed seeds when harvesting soybean. Numbers in parentheses indicate the number of locations that contained a given weed species.

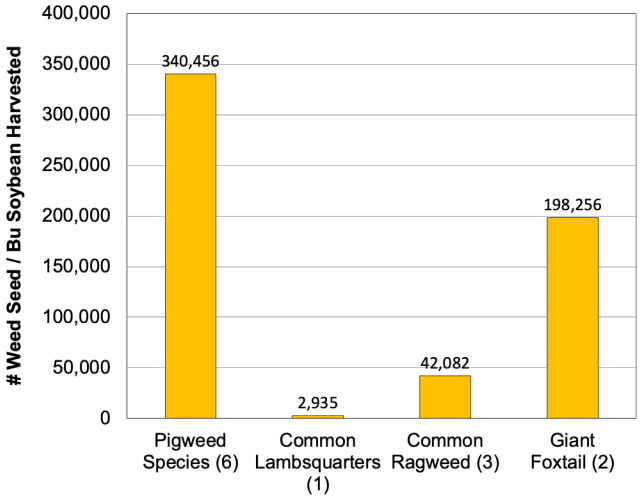
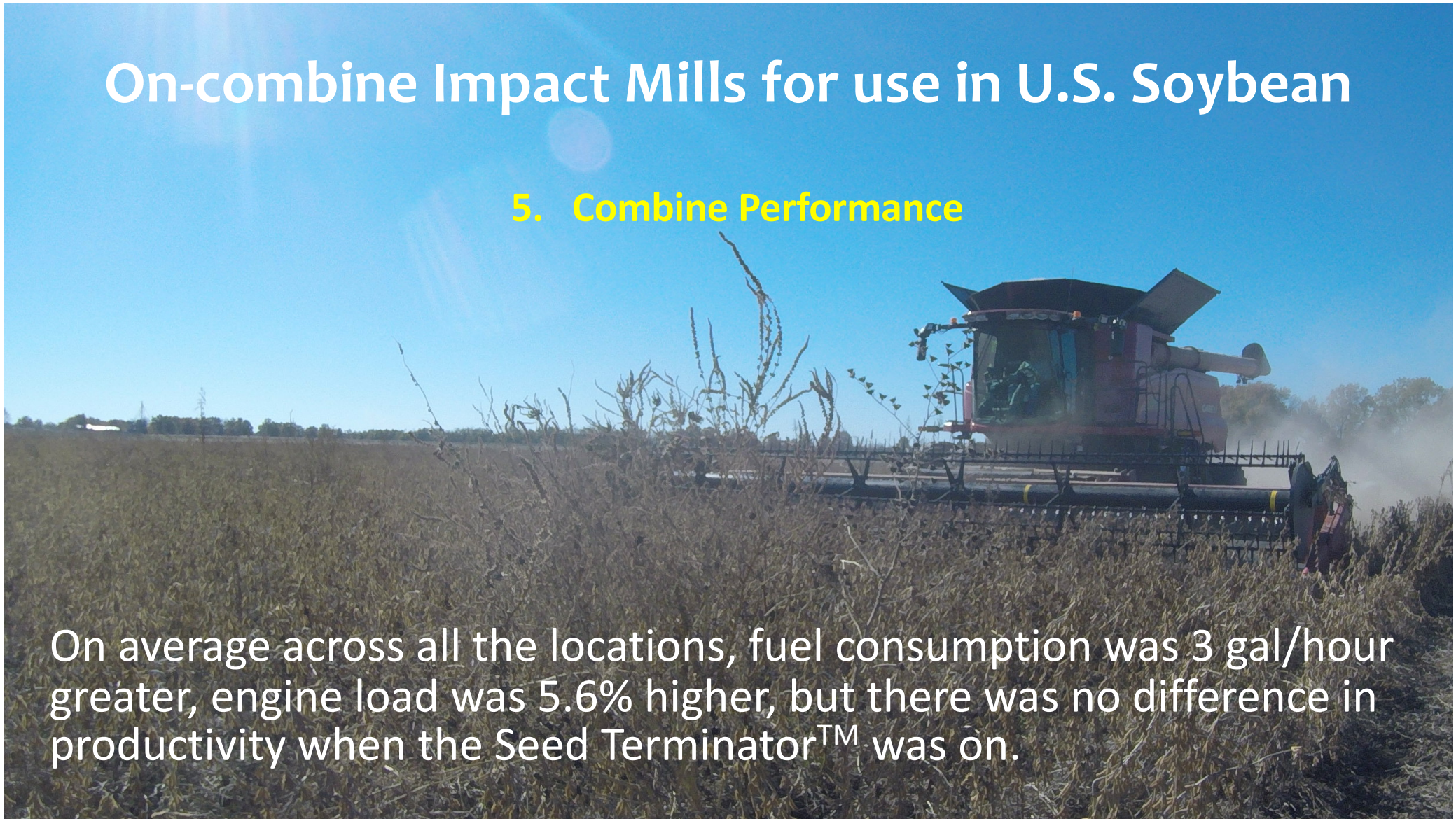


Figure 4. Average grain tank contamination of weed seed when harvesting soybean. Numbers in parentheses indicate the number of locations that contained a given weed species.

4. There is also a significant fraction of weed seed that is directed into the grain tank.

On-combine Impact Mills for use in U.S. Soybean

5. Combine Performance



On average across all the locations, fuel consumption was 3 gal/hour greater, engine load was 5.6% higher, but there was no difference in productivity when the Seed Terminator™ was on.

On-combine Impact Mills for use in U.S. Soybean

6. Significant reductions in the waterhemp seed bank were observed in 3 out of 5 locations.

On-combine Impact Mills for use in U.S. Soybean

7. Current costs of these implements are approximately $70-75k. We found operating costs to be ~$5/acre more than operating a conventional combine.

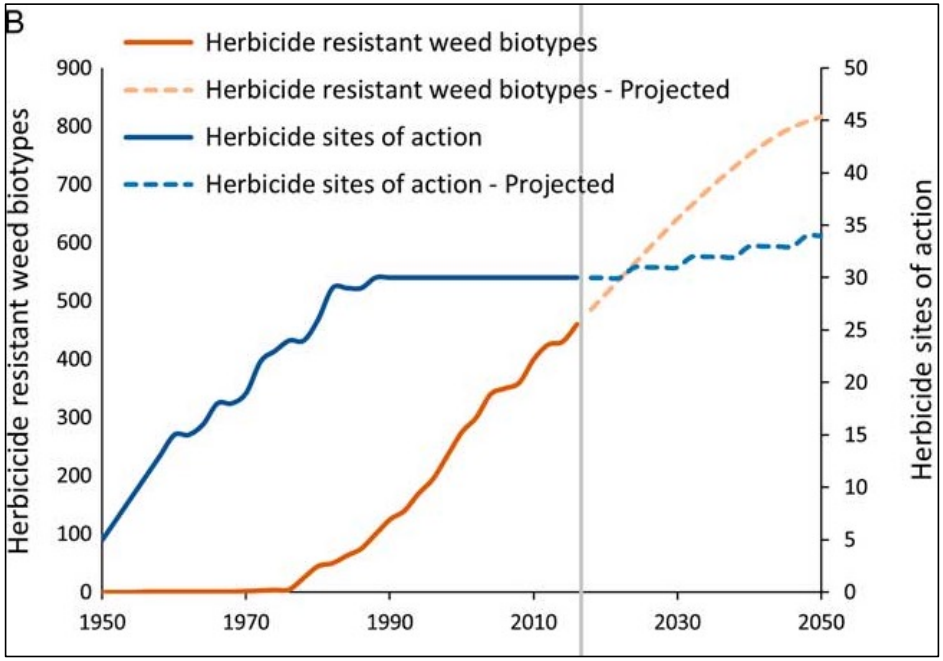
Some Thoughts on Weed Management in 2023 and Beyond

M ORE COMPLEX herbicide labels, registrations, requirements, etc.

I NTEGRATED APPROACHES that don't just rely on herbicides alone will become more and more important.

Z ERO TOLERANCE for resistant weeds. Because these "new" resistant weeds aren't like what mom used to make.

Where are we now?



Westwood et al. 2017

Progressive FARMER powered by DTN

Webinar: July WASDE Report — register today — DTN

MARKETS NEWS WEATHER LIVESTOCK CROPS EQUIPMENT MAGAZINE COLUMNS VIDEOS

HOME > CROPS > DICAMBA-RESISTANT PALMER AMARANTH CONFIRMED IN TENNESSEE

Dicamba-Resistant Pigweed

Dicamba-Resistant Palmer Amaranth Confirmed in Tennessee

7/28/2020 | 2:49 PM CDT

By Emily Unglesbee, DTN Staff Reporter
Connect with Emily: @Emily_Unglesbee

Some Palmer amaranth populations in Tennessee are resistant to dicamba and weed scientists are worried about the efficacy of 2,4-D and glufosinate, as well. (DTN photo by Emily Unglesbee)

ROCKVILLE, Md. (DTN) -- Weed scientists are officially confirming the presence of dicamba-resistant Palmer amaranth in Tennessee, where the dicamba-tolerant Xtend trait has dominated cotton and soybean acreage for several years.

Scientists at the University of Tennessee, the University of Arkansas and Texas Tech University have finished greenhouse trials and replicated field trials on Palmer amaranth populations collected from fields in several Tennessee counties, including Crockett, Gibson, Madison, Shelby and Warren.

"It's official," said University of Tennessee Extension weed scientist Larry Steckel. "We have resistance to dicamba, and some preliminary results suggest tolerance to 2,4-D is tagging along, too."

These findings aren't the first case of dicamba-resistant Palmer amaranth. That distinction belongs to a long-term

Recommended for You

Cash Market Moves
The White Combine: A Farmer's Worst Nightmare

Weed Control Minus Dicamba
Xtend Weed Control Options Without Dicamba

Progressive FARMER powered by DTN

Precise agronomic data for your fields — See how — DTN

MARKETS NEWS WEATHER LIVESTOCK CROPS EQUIPMENT MAGAZINE COLUMNS VIDEOS

HOME > CROPS > GLUFOSINATE-RESISTANT PALMER AMARANTH CONFIRMED IN ARKANSAS

Glufosinate-Resistant Pigweed

Glufosinate-Resistant Palmer Amaranth Confirmed in Arkansas

2/17/2021 | 4:31 PM CST

By Emily Unglesbee, DTN Staff Reporter
Connect with Emily: @Emily_Unglesbee

...und Palmer amaranth ...resistance to glufosinate (Liberty) ...nsas. (DTN photo by Pamela

ROCKVILLE, Md. (DTN) -- Scientists in Arkansas have confirmed the presence of glufosinate-resistant Palmer amaranth populations in two northeastern counties of the state.

The populations were collected from two fields in Mississippi County in 2020 and one field in Crittenden County in 2019, said Tom Barber, a University of Arkansas Extension weed scientist. The Crittenden County weeds were found to be 3.5 times more resistant to glufosinate than susceptible weeds, and the Mississippi County weeds appear at least 15 times more resistant than susceptible weeds, Barber explained in a university blog posted Wednesday.

The Arkansas scientists are testing the three pigweed populations for resistance to other modes of action, as well. For now, the glufosinate-resistant weeds do not seem widespread, Barber said.

"Currently, this problem does not appear to be widespread

Recommended for You

Aid Package Details for Agriculture
Ag Policy Blog

EPA: Politics Tainted Dicamba Decision
EPA Ignored Science in Past Dicamba Decision, New EPA Official Says

USDA Reports Summary

Waterhemp Scores Again

Illinois Scientists Find New Resistance in Waterhemp

2/8/2019 | 4:22 PM CST

By Pamela Smith, Crops Technology Editor
Connect with Pamela: @PamSmithDTN

Waterhemp is one tough weed. Now it has begun to outsmart a group of important residual herbicides. (DTN photo by Pamela Smith)

DECATUR, Ill. (DTN) -- Waterhemp has just thumbed its nose at another group of herbicides.

Waterhemp resistant to Group 15 herbicides (very long chain fatty acid inhibitors) has officially been found in Illinois research plots. It is the first dicot (broadleaf) weed in the world to outmaneuver herbicides within the Group 15 chemical family. While scientists aren't sure how widespread the issue is, University of Illinois weed scientist Aaron Hager said the discovery is yet another warning to change weed management behaviors now.

"Waterhemp has now shown the ability to resist seven different herbicide sites of action," Hager said. "Farmers have been leaning heavily on the Group 15 herbicides across all crops as they battle resistant weeds. This is another example of how important it is to diversify weed control approaches to keep the effectiveness of this tool," Hager said.

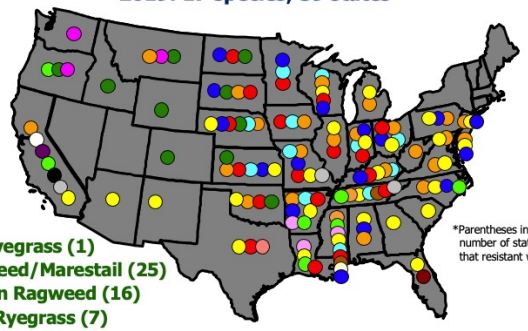
Syngenta has been collaborating with Illinois scientists on their findings and providing important background information, confirmed Dane Bowers, Syngenta's technical lead for herbicides, and Gordon Vail, Syngenta's technical product lead on S-metolachlor, one of the Group 15 herbicides.

S-metolachlor is the active ingredient commonly sold by Syngenta under the trade name Dual Magnum. It is also found as a component in many popular herbicide premixes.

"We feel it is important as a manufacturer to alert farmers to these findings and work alongside weed scientists to keep these herbicides effective as long as possible," said Vail. "The reality is not any one product or class of chemistry by itself is good enough. We need them all."

Glyphosate-resistant Weeds in the U.S.

2019: 17 species; 39 states



*Parentheses indicate the number of states in which that resistant weed occurs

- Rigid Ryegrass (1)
- Horseweed/Marestail (25)
- Common Ragweed (16)
- Italian Ryegrass (7)
- Giant Ragweed (12)
- Waterhemp (18)
- Palmer amaranth (28)
- Hairy Fleabane (1)
- Johnsongrass (3)
- Kochia (10)
- Junglerice (1)
- Ann. Bluegrass (3)
- Goosegrass (2)
- Spiny Amaranth (1)
- Russian Thistle (3)
- Ragwd Parthenium (1)
- Common Sunflower (1)

*Dr. Kevin Bradley, University of Missou

BROWNFIELD AG NEWS FOR AMERICA

SUBSCRIBE

HOME MARKETS SPECIAL EVENTS WEATHER PODCASTS & PROGRAMS ABOUT US AFFILIATE SUPPORT

TOPICS
TOP STORIES
NEWS
MARKET NEWS
CROPS
DAIRY
LIVESTOCK
USDA/GOVERNMENT
STATE LEGISLATURE
PRECISION AGRICULTURE
BIOTECHNOLOGY
SPECIALTY CROPS
WORLD AG NEWS/TRADE
EVENTS/ORGANIZATIONS
AG YOUTH

NEWS

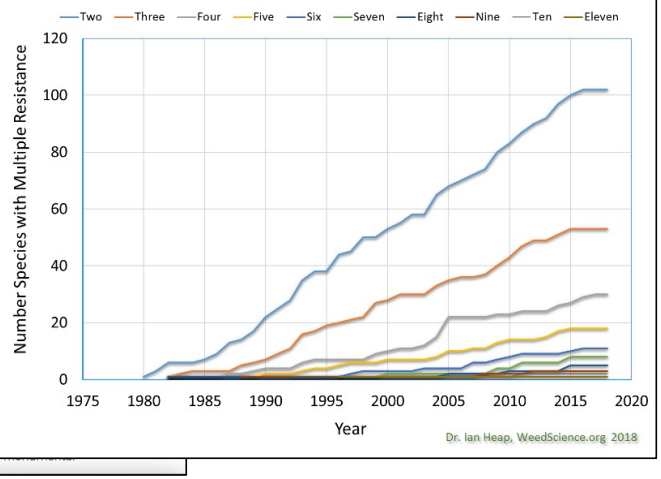
MU ON SIGNS OF POTENTIAL WATERHEMP RESISTANCE

July 9, 2021 By Julie Harker Filed Under: Crops, Missouri, News

There are signs of potential waterhemp herbicide resistance in Missouri.

University of Missouri weed scientist Kevin Bradley told participants at the MU Pest

Weed Species with Resistance to More than One Site of Action

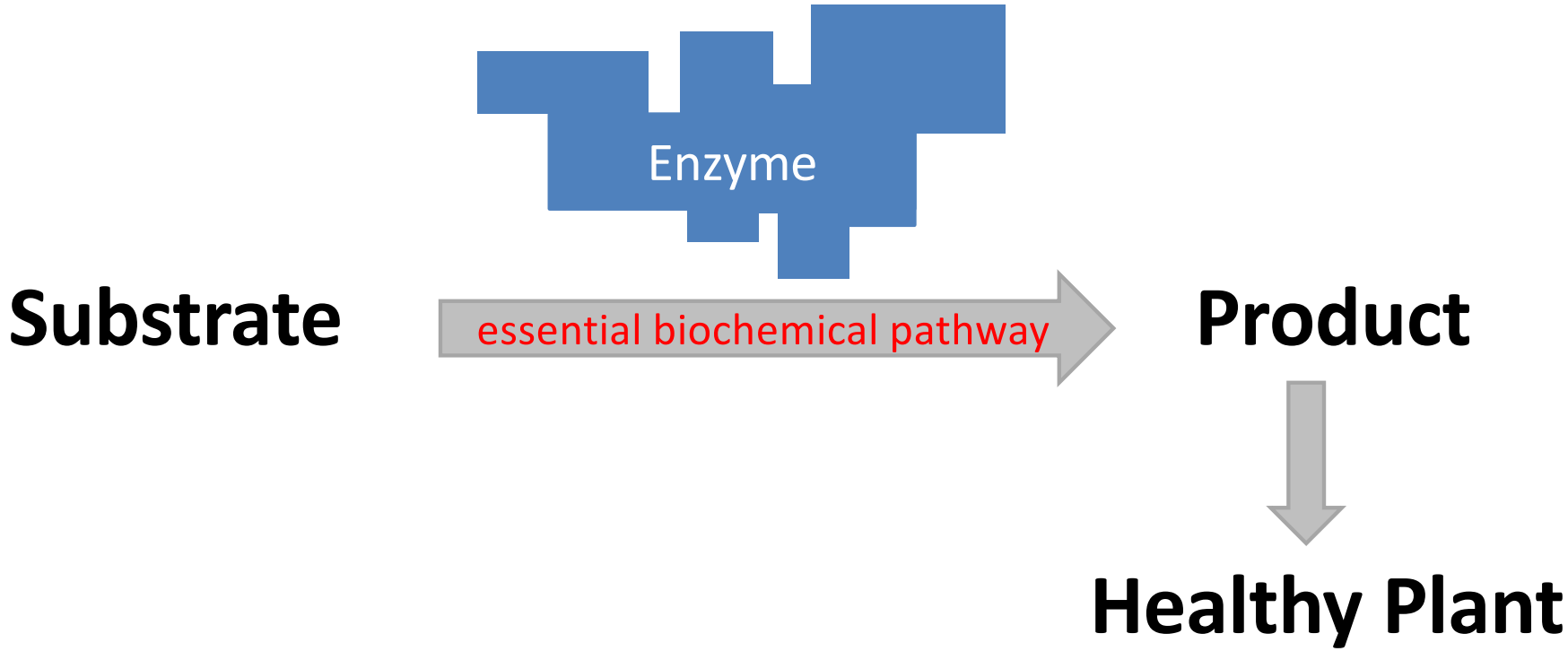


Dr. Ian Heap, WeedScience.org 2018

It's not just about more pigweeds with more resistance. It's the type of resistance mechanism(s) that are being found that is truly concerning.

"Old" Type of Resistance Mechanisms in Pigweeds:

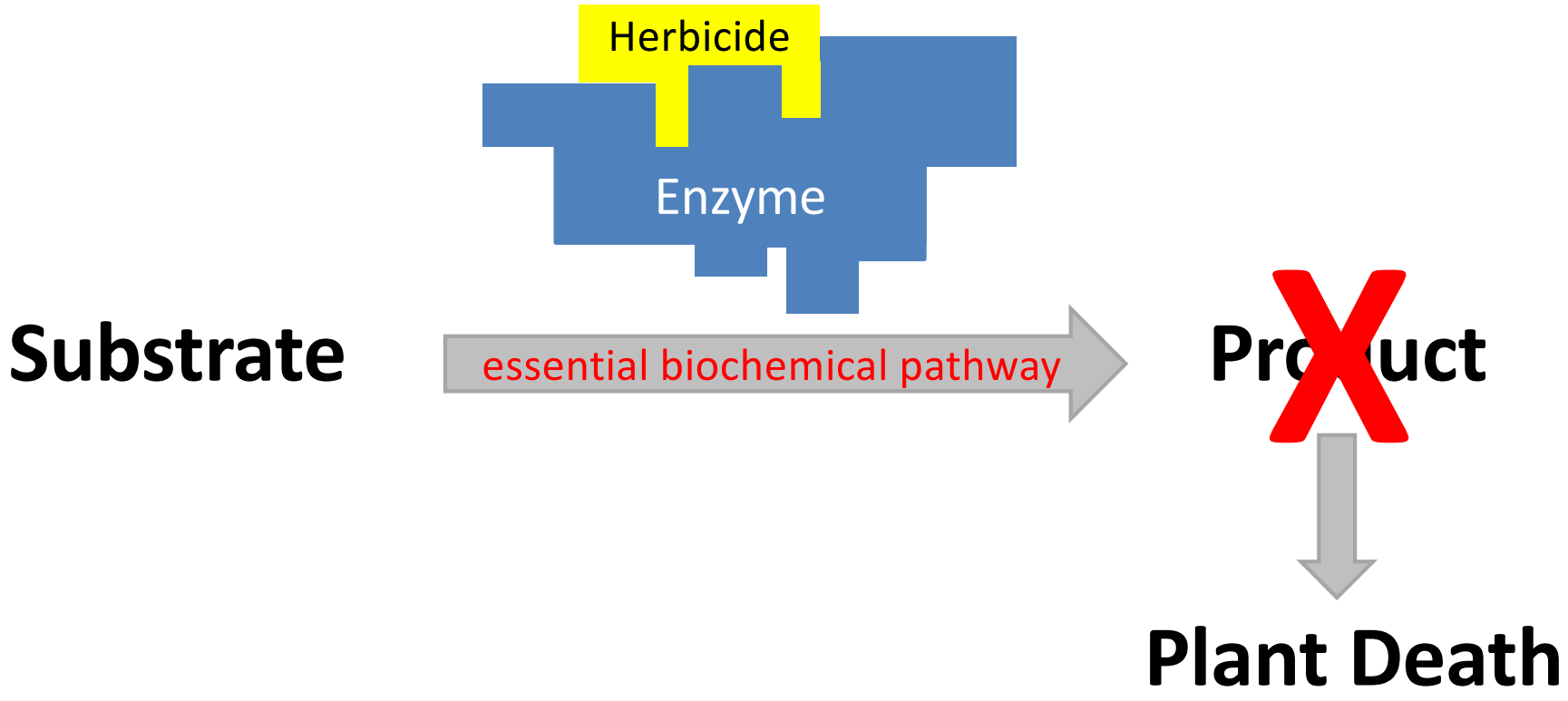
Target Site Resistance



For more info, see Dr. Pat Tranel's "Why Care About Metabolic Herbicide Resistance" video on YouTube

"Old" Type of Resistance Mechanisms in Pigweeds:

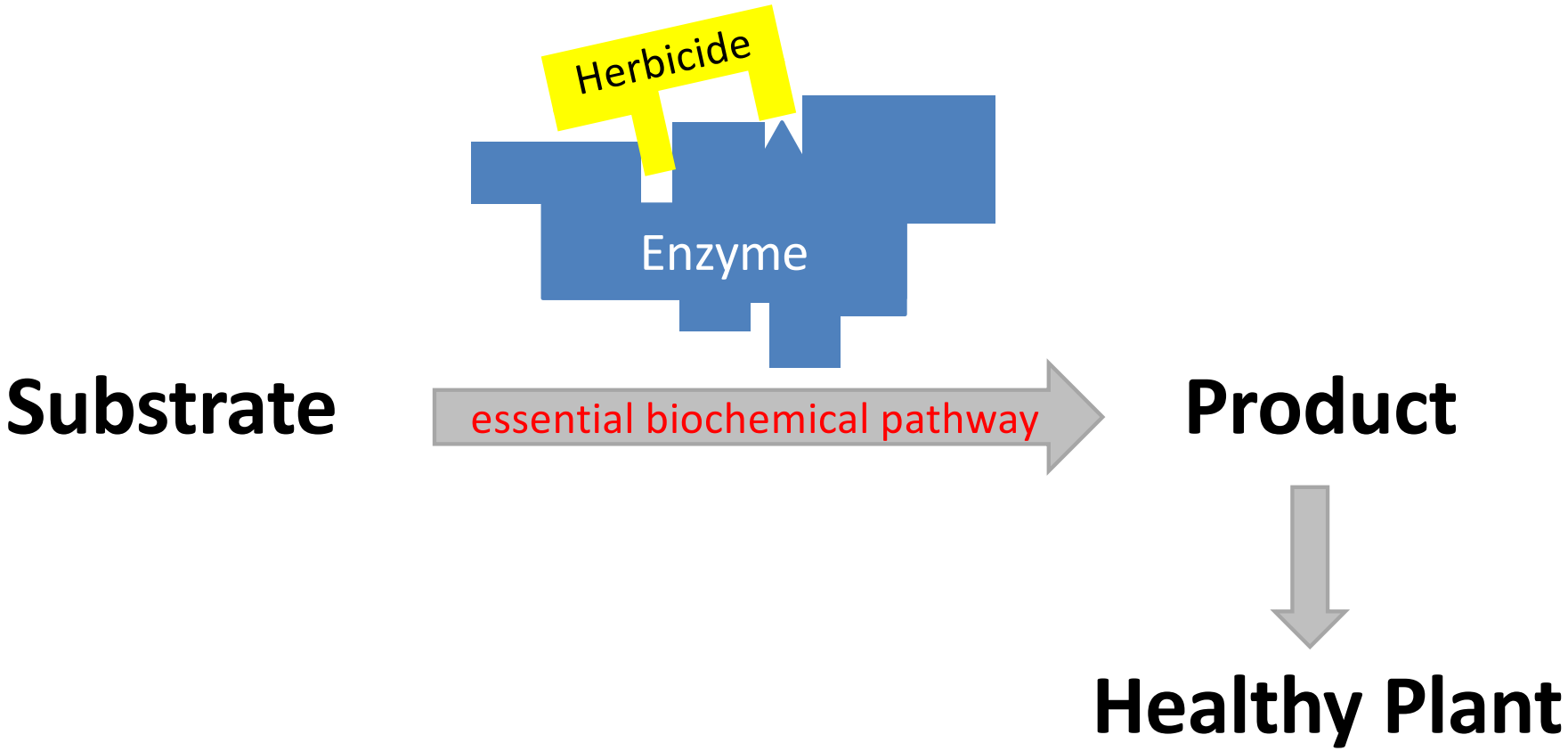
Target Site Resistance



For more info, see Dr. Pat Tranel's "Why Care About Metabolic Herbicide Resistance" video on YouTube

"Old" Type of Resistance Mechanisms in Pigweeds:

Target Site Resistance



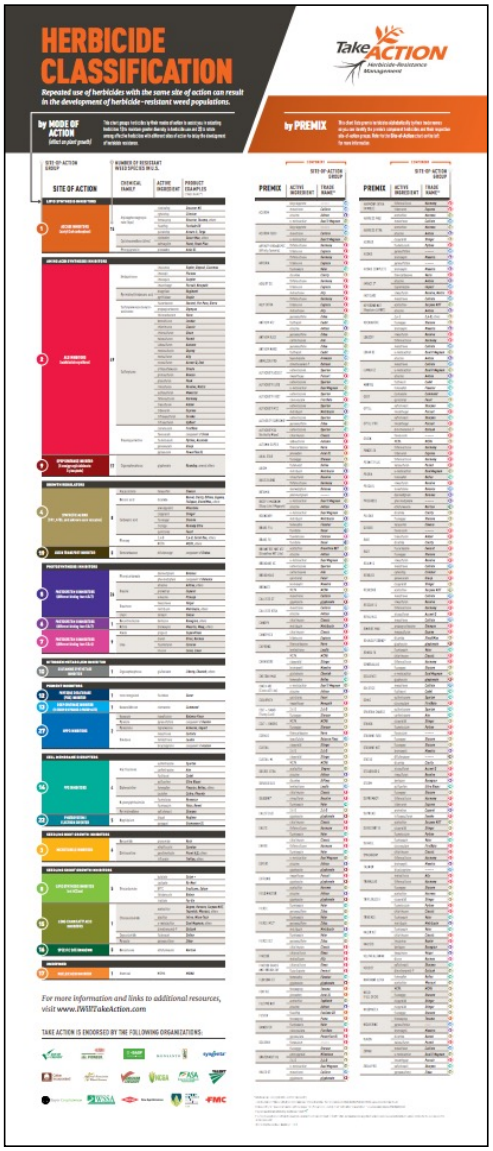
For more info, see Dr. Pat Tranel's "Why Care About Metabolic Herbicide Resistance" video on YouTube

"Old" Type of Resistance Mechanisms in Pigweeds:

Target Site Resistance

- Target enzyme is modified in some way, usually so that the herbicide can't bind
- Common with Group 2 (ALS), 5 (triazine), 14 (PPO), 9 (glyphosate)
- Can confer resistance to other herbicides within the same group but <u>never</u> to herbicides in other groups
- Common in 1990's and early 2000's

What has always been our recommendation for the control of these “old types” of resistant weeds?



HERBICIDE CLASSIFICATION

Repeated use of herbicides with the same site of action can result in the development of herbicide-resistant weed populations.

Take ACTION Herbicide-Resistance Management

by MODE OF ACTION (effect on plant growth)

by PREMIX

SITE-OF-ACTION GROUP | NUMBER OF RESISTANT WEED SPECIES IN U.S. | CHEMICAL FAMILY | ACTIVE INGREDIENT | PRODUCT EXAMPLES

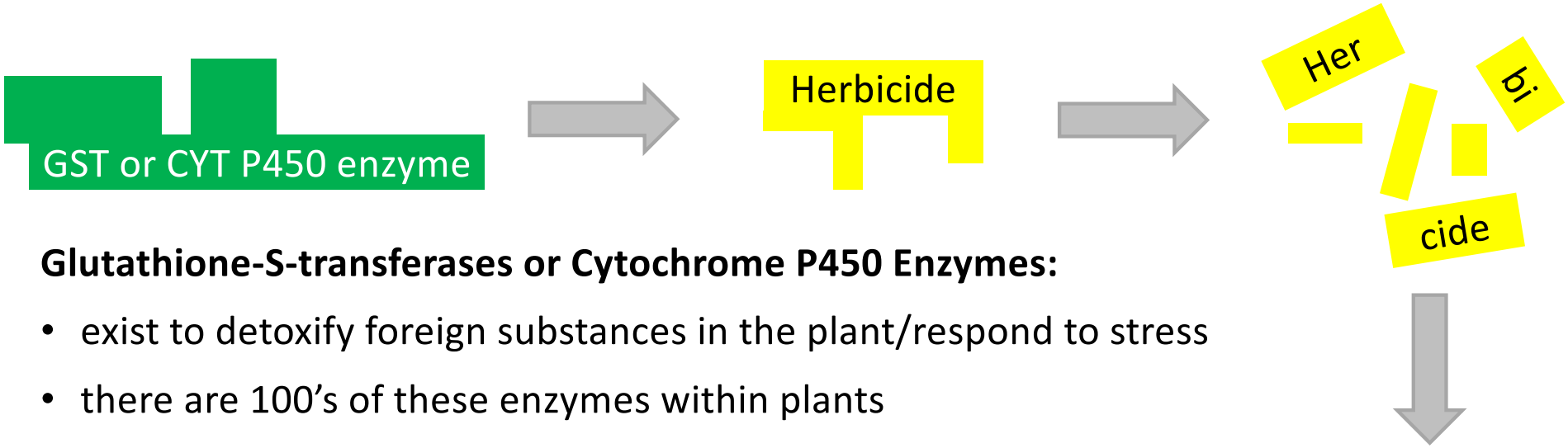
SITE OF ACTION

PREMIX | ACTIVE INGREDIENT | TRADE NAME*

For more information and links to additional resources, visit www.IWillTakeAction.com

TAKE ACTION IS ENDORSED BY THE FOLLOWING ORGANIZATIONS:

"New" Types of Resistance Mechanisms in Pigweeds:
Metabolic Resistance



Glutathione-S-transferases or Cytochrome P450 Enzymes:

- exist to detoxify foreign substances in the plant/respond to stress
- there are 100's of these enzymes within plants
- these enzymes are the reason we can use many herbicides without injury to the crop (e.g., atrazine and corn)
- metabolic resistance occurs when one of these enzymes become mutated or "overproduced"

For more info, see Dr. Pat Tranel's "Why Care About Metabolic Herbicide Resistance" video on YouTube

"New" Types of Resistance Mechanisms in Pigweeds:

Metabolic Resistance

- Plant is able to break down the herbicide at an increased rate
- Group 2 (ALS), 5 (triazine), 14 (PPO), 9 (glyphosate), 27 (HPPD), 15 (VLCFA), 4 (auxins)
- Can confer resistance to other herbicides within the same group and possibly to herbicides in other groups
- Common 2010 - today

What is our recommendation for the control of these "new types" of resistant weeds?

Some Thoughts on Weed Management in 2023 and Beyond

M ORE COMPLEX herbicide labels, registrations, requirements, etc.

I NTEGRATED APPROACHES that don't just rely on herbicides alone will become more and more important.

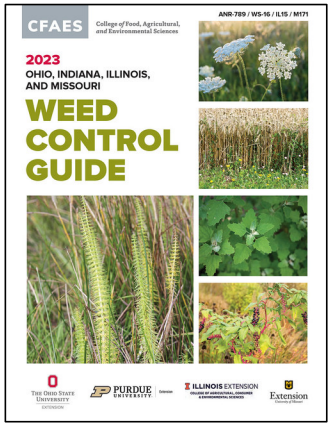
Z ERO TOLERANCE for resistant weeds. Because these "new" resistant weeds aren't like what mom used to make.

Mizzou® weed science

Email: bradleyke@missouri.edu

Phone: 573-882-4039

weedscience.missouri.edu



extensionpubs.osu.edu

id weeds

App: ID Weeds (free download)

facebook

Facebook: Mizzou Weed Science

twitter

Twitter: @ShowMeWeeds