Weed Control in Sugarbeet

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Presentation Outline

① Waterhemp control in dry conditions, control escapes

② Ultra Blazer sugarbeet tolerance and waterhemp control

③ Kochia and Common ragweed control; Label changes

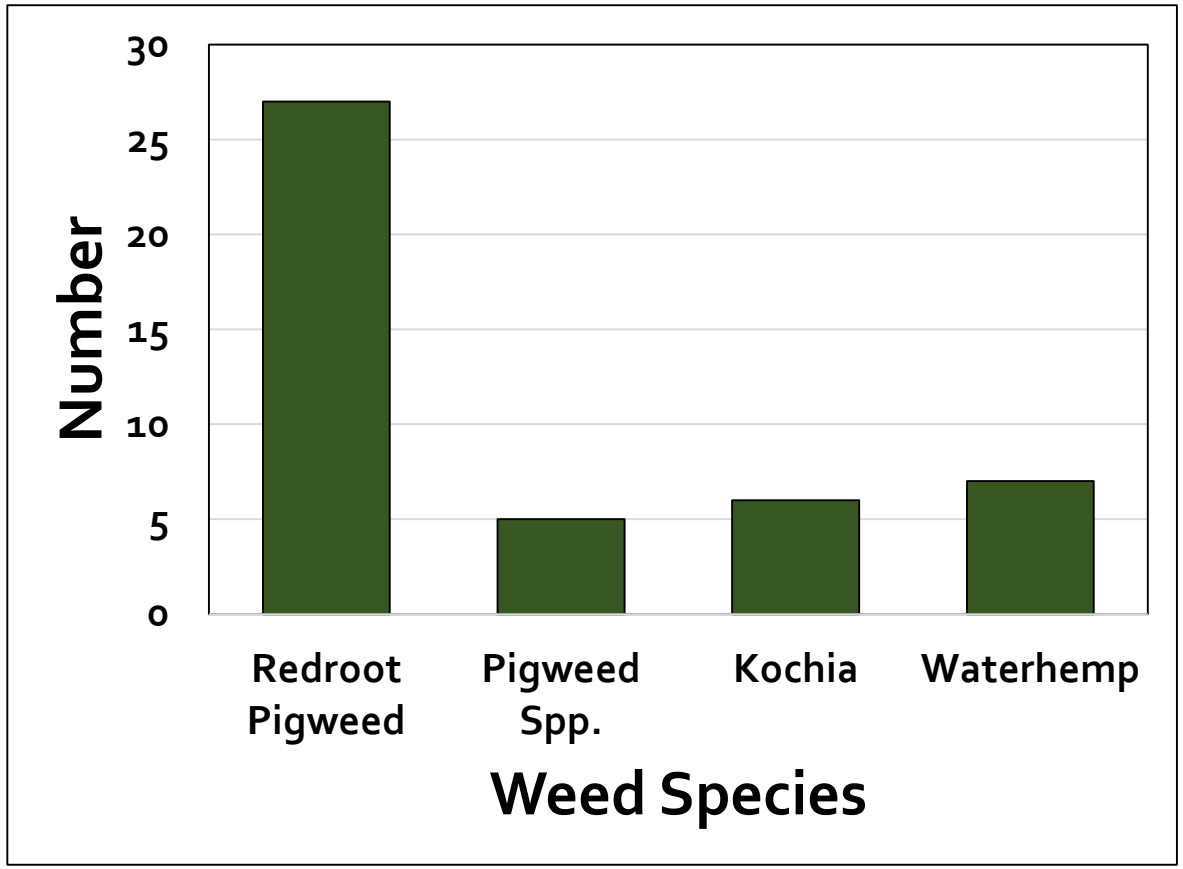
④ Herbicide carryover, when does it occur?

⑤ Palmer amaranth update

Waterhemp emergence, May 2, 2020, Mapleton, ND Greg Krause, Minn-Dak Farmers Coop

Most important weed problem in sugarbeet, 1975 to 2020, annual survey.[a]

Year	Most important weed
1975	Redroot pigweed
1980	Redroot pigweed
1985	Redroot pigweed
1990	Redroot pigweed
1995	Redroot pigweed
2000	Kochia
2005	Pigweed spp.
2010	Kochia
2015	Waterhemp
2020	Waterhemp



[a]Annual herbicide use survey was mailed to sugarbeet producers (farm units) in eastern ND and MN from 1968 to 2016. Survey has been conducted at Grower Seminars since 2017.

Why were *Pigweed* Spp. frequently named most important weed?

- Sugarbeet is a member of the Betoidae subfamily within amaranthaceae and includes approximately 2,500 species
- *Amaranthus* Spp. are both common and troublesome weeds in MN and ND
- Germinate and emerge in response to moisture and light (cultivation)
- Germination and emergence from May through August
- Prolific seed producers
- Seed is viable up to six years

Waterhemp

Image credit: Cody Walstrom, Minn-Dak Farms Coop

Redroot pigweed

Image credit: Bruce Ackley, The Ohio State University, Bugwood.org

Waterhemp Control Program in Sugarbeet

Planting Date	Recommendation
Sugarbeet plant in April or May	PRE. Dual Magnum at 0.5 to 0.75 pt/A, ethofumesate at 2 to 5 pt/A or Dual Magnum at 0.5 pt/A plus ethofumesate at 2 pt/A
	Split lay-by application (early postemergence / postemergence). Chloroacetamide herbicides applied at 2-lf sugarbeet fb 6 to 8-lf sugarbeet
June	Continue to scout fields for waterhemp. Control escapes with Ultra Blazer (Section 18), Liberty with the Redball™ 915 hooded sprayer (24c), or inter-row cultivation
July	Electric Discharge Systems (WeedZapper™)
August / September	Hand remove waterhemp

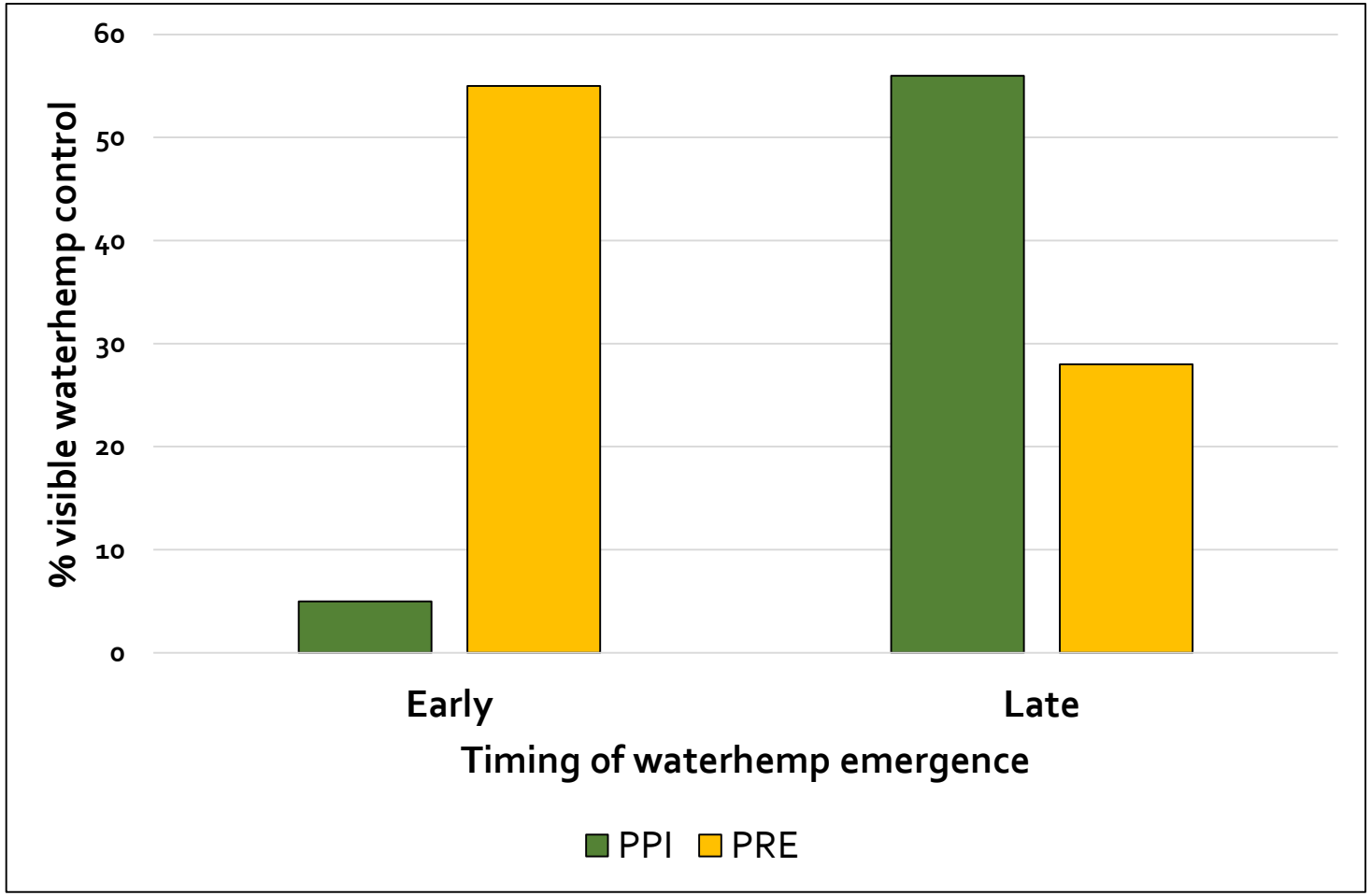
Waterhemp control in response to ethofumate PPI and PRE, Fargo airport, 2021

Control of EARLY and LATE emerging waterhemp with ethofumesate at various rates, July 9, Fargo 2021

Herbicide	PPI Application		Preemergence Application	
(pt/A)	(Early)	(Late)	(Early)	(Late)
2	0	15	5	10
4	0	50	45	20
6	10	65	63	15
8	20	65	65	45
10	10	63	75	43
12	10	75	78	40

- May 10 plant (bone dry), 0.4-inch on May 20, 1.0- and 1.1-inch on June 7 and June 10

Early and late emerging waterhemp control in response to ethofumesate PPI or PRE, 2021

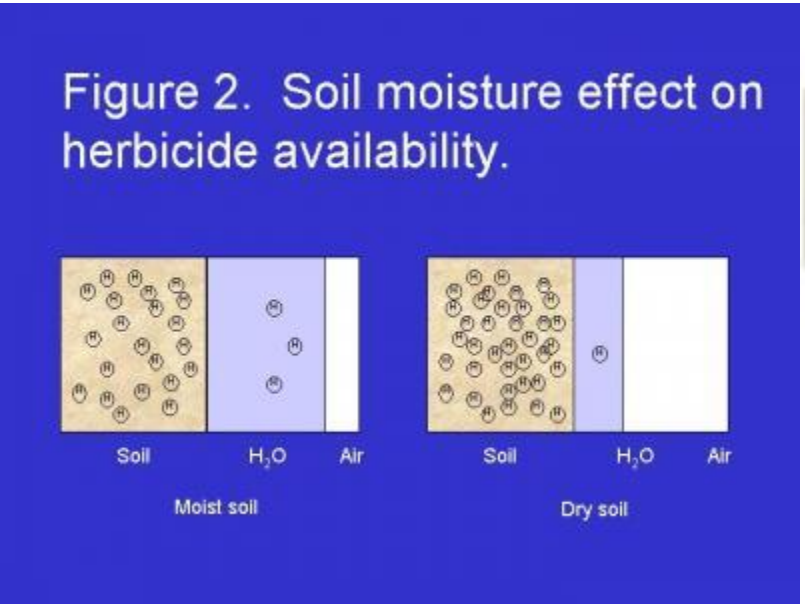


Soil residual herbicides kill weeds as seed or seedlings imbibe water

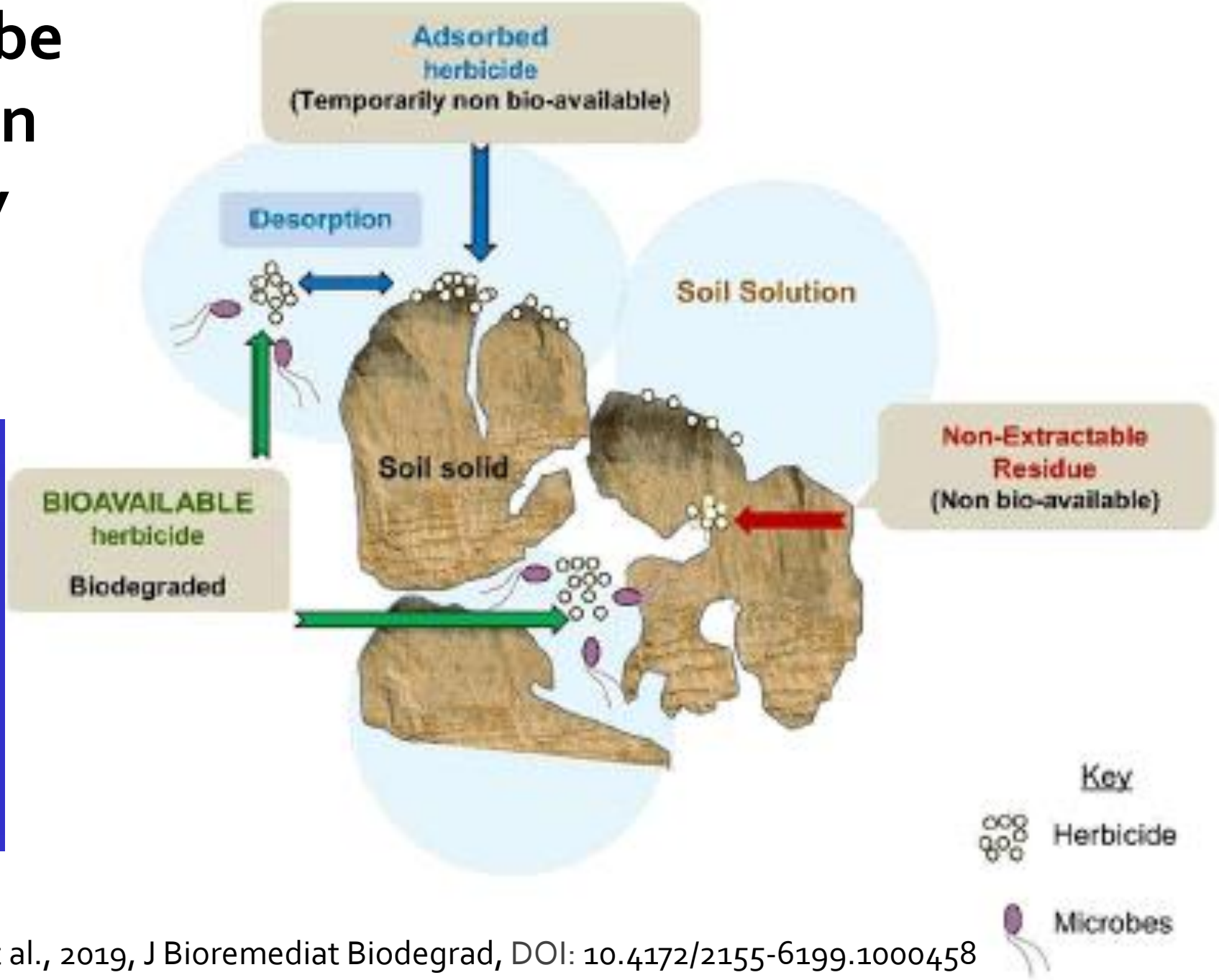
- Herbicide must be localized in the upper inch of soil or zone where small seeded broadleaves germinate.
- Efficacy may be reduced when there is limited rain in the weeks following application even if a herbicide is activated in a timely fashion.
- Soil residual herbicides move from soil water to adsorption sites on soil colloids as soil dries, reducing herbicide available to germinating weed seeds.
- Absorptive (K_{OC}) is the ratio of herbicide bound to soil colloids versus herbicide in the soil solution.

Herbicide	Absorptivity	Water Solubility	Half-life
	[a]K_{OC}	(ppm)	(days)
Acetochlor	200	233	NA
Outlook	155	1,174	20
Ethofumesate	340	110	98

Herbicides must be in the soil solution to be taken up by seeds, roots, or shoots



Hartzler, Professor Emeritus, ISU



Kanissery, et al., 2019, J Bioremediat Biodegrad, DOI: 10.4172/2155-6199.1000458

Control of EARLY and LATE emerging waterhemp with ethofumesate at various rates, Fargo 2021

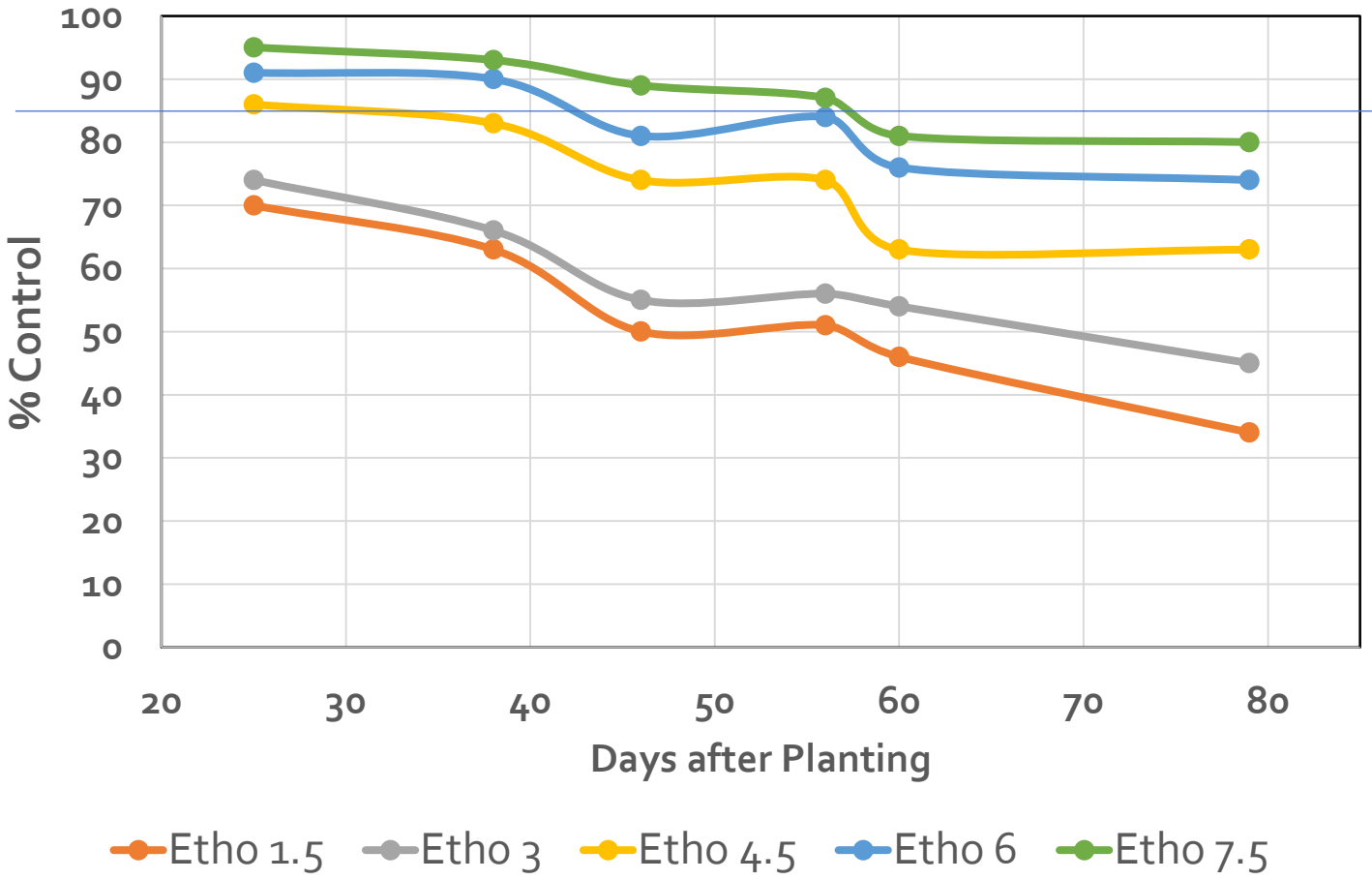
Herbicide	PPI Application		Preemergence Application	
(pt/A)	(Early)	(Late)	(Early)	(Late)
2	0	15	5	10
4	0	50	45	20
6	10	65	63	15
8	20	65	65	45
10	10	63	75	43
12	10	75	78	40

- May 10 plant (bone dry), 0.4-inch on May 20, 1- and 1.1-inch on June 7 and June 10

- PPI etho was adsorbed to colloids and diluted by incorporation, not available for waterhemp control
- PRE partially incorporated into soil and available after the May 10th rain
- PPI etho in the soil solution and available for late emerging watehemp following June rains
- PRE etho likely degraded/lost for late emerging waterhemp

Waterhemp control in response to ethofumesate PRE, Blomkest MN, 2020

Sublethal rates: full control for less time or less than full control?



	Days after planting					
	25	38	46	56	60	79
Etho 1.5	70	63	50	51	46	34
Etho 3	74	66	55	56	54	45
Etho 4.5	86	83	74	74	63	63
Etho 6	91	90	81	84	76	74
Etho 7.5	95	93	89	87	81	80

	greater than 85%
	84% to 78%
	77% to 65%
	less than 65%

Waterhemp control with soil residual herbicides
Materials and Methods

- RCBD and 4 replications
- Three locations: Blomkest and Moorhead, MN and Fargo, ND
- Factorial Treatment arrangement:
  - Factor A is PRE treatment (3 treatments)
  - Factor B is POST Treatment (4 treatments)
- Percent visible waterhemp control, 0 to 100% scale

Factor A, 2 levels
Factor B, 2 levels

A1B1	A2B1
A1B2	A2B2

Soil residual herbicides improved waterhemp control in a dry environment, Blomkest, MN, 2021

Treatment	Rate	31 days	44 days	56 days
None		89 B	85 B	83 B
Etho + Dual Magnum	2 pt + 8	93 A	91 A	89 A
Etho	6 pt	92 A	94 A	91 A

Treatment	Rate	18 days	31 days	43 days
Gly + etho / gly + etho	28+6 / 28+6	85 d	85 c	79 c
+ Outlook / + Outlook	12 /12	95 ab	92 ab	88 ab
+ Warrant / + Warrant	3pt / 3 pt	86 d	89 bc	88 ab
+ Outlook / + Warrant	12 / 3 pt	92 bcd	90 abc	89 ab

Summary

ethofumesate, S-metolachlor, Outlook, and Warrant

- Soil residual herbicides are our best strategy for waterhemp control in sugarbeet.
- Follow the program and do not try to time to rainfall events (same story your financial advisor says about investing money).
- Shallow incorporate ethofumesate; tillage is to incorporate herbicide into the soil and not to prepare seedbed.
  - Consider incorporation if greater than 3 pt; 4 or 5 pt preferred
- McAuliffe and Appleby (Weed Sci) reported ethofumesate adsorption to colloids and degradation in ultra dry soils.
- Waterhemp germinates and emerges from surface to 1-inch in soil.

Waterhemp Control Program in Sugarbeet

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Controlling escape waterhemp
Materials and Methods

- RCBD and 4 replications
- Two locations: Blomkest, MN and Hickson, ND
- Ethofumesate banded and low rates of the lay-by program to create weed escapes
- Percent visible waterhemp control, 0 to 100% scale

Nortron PRE in a band / S-metolachlor split layby / cultivation

Waterhemp control from escape treatments, Blomkest, 2021

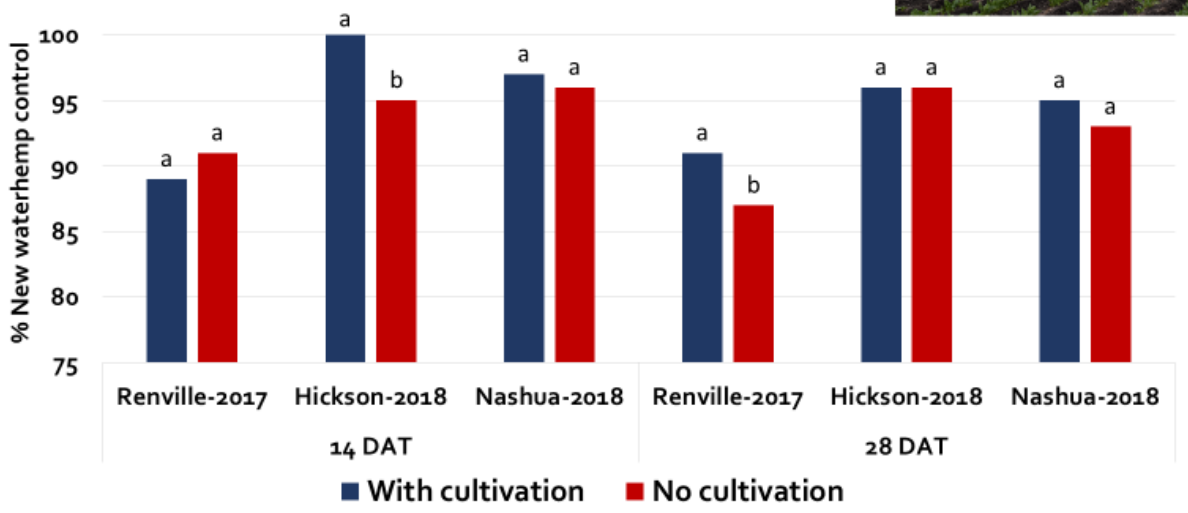
Treatment	40 DAP	Treatment	2 DAT	24 DAT
	%		%	%
Etho (broadcast) /PM+etho	94	PM+etho	79 bc	78 bc
Etho (band) /PM+etho / PM+etho	79	PM+etho	73 c	70 c
Etho (band) / *S*-meto+PM+etho / *S*-meto+PM+etho	75	Liberty w/ Redball™ 915 hooded sprayer	75 c	86 ab
Etho (band) / *S*-meto+PM+etho / *S*-meto+PM+etho	79	Gramoxone w/ Redball™ 915 hooded sprayer	90 ab	87 ab
Etho (band) / S-meto+PM+etho / S-meto+PM+etho	78	Inter-row cultivation	96 a	93 a
Etho (band) / S-meto+PM+etho / S-meto+PM+etho	85	Ultra Blazer+ PM + NIS + AMS	81 bc	90 ab
LSD (0.10)	NS		14	13

EDS, generation II, 2020:

- The WeedZapper™, Sedalia, MO
- Developed in 2018
- 200,000 watts
- 40-44 ft front-end mounted boom
- PTO driven generator
- Requires a 275 PTO HP tractor
- 2 to 6 mph
- Advanced safety improvements

Hooded sprayer designed by Willmar Fabrication

Early cultivation generally had no effect on new waterhemp emergence control



Sugarbeet tolerance from Ultra Blazer and waterhemp control

EPA approved Ultra Blazer for waterhemp control in sugarbeet on June 1, 2021

- Use UPL Ultra Blazer only
- Apply at 16 fl oz/A alone or with glyphosate
- One Ultra Blazer application can be made per season
- Can only be applied by ground equipment. Aerial application is prohibited.
- Target waterhemp less than 4" tall, control is reduced as waterhemp becomes larger
- Pre-Harvest Interval (PHI) = 45 days
- Do not apply Ultra Blazer after August 1st

NORTH DAKOTA DEPARTMENT OF AGRICULTURE

June 2, 2021
For immediate release

EPA approves herbicide for resistant waterhemp in sugarbeets

BISMARCK – The Environmental Protection Agency (EPA) has approved a request for a Section 18 emergency exemption for Ultra Blazer®, enabling North Dakota growers a new tool to combat glyphosate-resistant waterhemp in sugarbeets.

"With the discontinuance of Betamix, there are currently no registered postemergence products available to control waterhemp that survives preemergence treatments," Agriculture Commissioner Doug Goehring said. "This exemption gives growers a new product when early treatments are ineffective."

The exemption allows application of Ultra Blazer on sugarbeet fields in Barnes, Cass, Cavalier, Grand Forks, Pembina, Ransom, Richland, Sargent, Steele, Traill and Walsh counties. Ultra Blazer is to be applied one time at 16 fluid ounces per acre per year.

Users must follow all applicable directions, restrictions and precautions on the container label, as well as the Section 18 use directions.

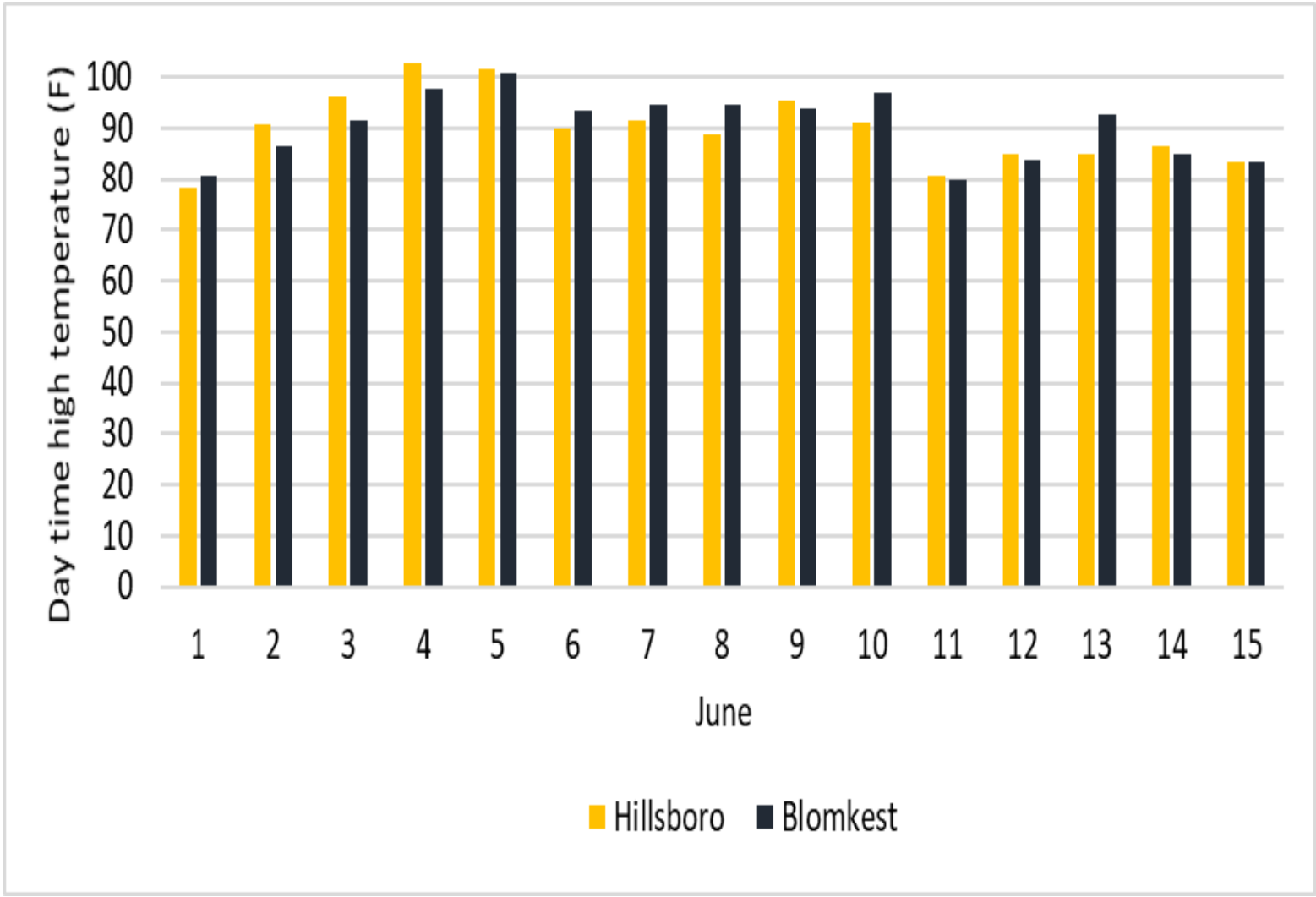
A Section 18 exemption under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) authorizes EPA to allow an unregistered use of a pesticide for a limited time if EPA determines that an emergency condition exists.

MEDIA: For more information, please contact Michelle Mielke at (701) 328-2233 or mmielke@nd.gov.

Michelle Mielke
Public Information Specialist
ND Department of Agriculture
P: 701.328.2233
www.nd.gov/ndda

Ultra Blazer Section 18 was approved on June 1, 2021

- 32,005 acres or 4,001 gallon Ultra Blazer
  - Minnesota, 28,711 acres
  - North Dakota, 3,294 acres
- Air temperatures 90F or greater, 8 consecutive days after approval
- Sugarbeet growth stage ranging from cotyledon to 8-lvs complicated application timing



Recommendation was based on Producer and Agriculturalist tolerance to sugarbeet injury

Trt Num	Treatment	Rate (fl oz or pt /A)
1	Ultra Blazer	16
2	Ultra Blazer + Prefer 90 NIS	16 + 0.125%
3	Ultra Blazer + Prefer 90 NIS	16 + 0.25%
4	Roundup PowerMax + Ultra Blazer + + Amsol Liquid AMS	28 + 16 + 2.5% v/v
5	Roundup PowerMax + Ultra Blazer + Prefer 90 NIS + Amsol Liquid AMS	28 + 16 +0.25% + 2.5% v/v

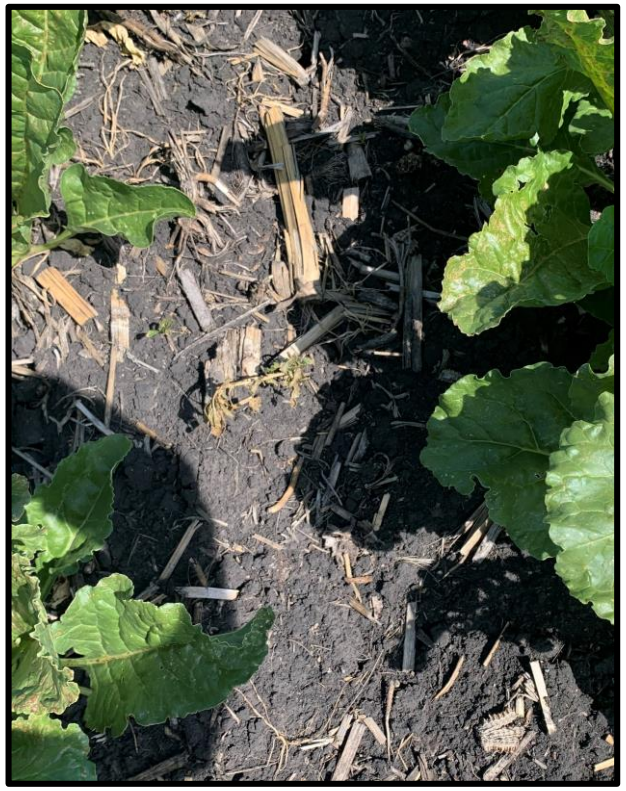
- We conducted demonstration plots at Benson, Crookston, MN, Hendrum, and Foxhome, MN and Casselton, ND.
- We collected yield parameters from the Hendrum, MN experiment.

Percent visual sugarbeet injury, 3 to 16 days following Ultra Blazer application, 2021.[a]

Treatment	Rate	Casselton	Crookston	Foxhome	Hendrum	Benson[b]
	pt/100 G	%	%	%	%	%
Ultra Blazer (UB)	-	9 d	9 c	10 c	8 d	-
UB + Prefer 90	1	14 c	10 bc	11 bc	10 cd	-
UB + Prefer 90	2	15 bc	15 ab	18 b	15 c	-
UB + Prefer 90 + Amsol liquid AMS	2 + 20 (2.5 G)	-	-	-	-	35 a
PM + UB + Amsol liquid AMS	20	19 b	20 a	25 a	21 b	-
PM + UB + Prefer 90 + Amsol liquid AMS	2 + 20	28 a	-	26 a	30 a	40 a

[a]Means followed by the same letter are not statistically different at alpha 0.1.

[b]Air temperature was 95F at application



Other Ultra Blazer Section 18 Emergency Exemption gleanings

- Ninety-five percent of respondents indicated the emergency exemption was beneficial for sugarbeet producers in Minnesota and North Dakota and contributed to overall weed management in 2021
- Ninety-two percent of respondents indicated they willingly would support application for a 2022 emergency exemption in sugarbeet in 2022.
- Spray volume and waterhemp size influenced control and regrowth.
- Some fields were bronzed more than others and for longer duration of time. Speed of recovery was dictated by soil moisture conditions.
- Some tried to correlate bronzing from Ultra Blazer to CLS. Heard both; less and more CLS following Ultra Blazer

Roundup PowerMax 3 Herbicide

Nonselective foliar control of both grass and broadleaf weeds

Active Ingredient and Site of action

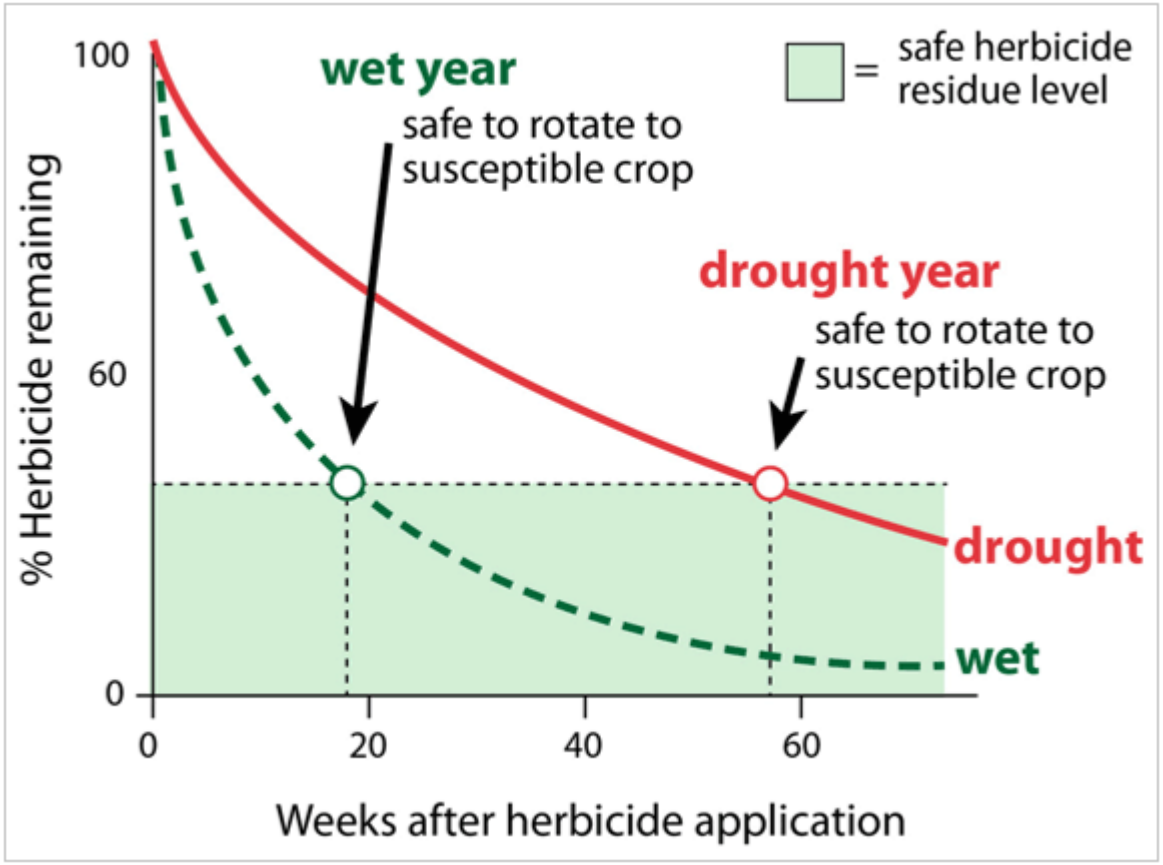
- Glyphosate in the form of the Potassium (K) salt
  - 4.80 lb ae/gal
  - 5.88 lb ai/gal

Equivalent Application Rates (fl oz/A)

lb ae/A	Roundup PowerMax 3 Herbicide	Roundup PowerMax Herbicide
0.75	20	22
1.125	30	32
1.5	40	44
2.25	60	64

Herbicide carryover, when does it occur?

Herbicides may persist longer in dry vs. wet soils



- Pesticide labels provide guidance for crop rotation restrictions
- Environmental conditions, especially rainfall will ultimately determine persistence of herbicides

Colquhoun, J. 2006. Herbicide persistence and carryover. University of Wisconsin Extension publication A3819.

Factors affecting herbicide carryover

- **Herbicide itself**
  - The chemical structure of a herbicide affects absorptivity (binding to soil) and water solubility.
  - Herbicides highly bound to soil particles are often less likely to be available for microbial degradation.
- **Moisture**
  - Moisture enables herbicide to be in the soil solution
  - Soil microbes are most active under moist but not saturated condition
  - Herbicide adsorption (binding) is greater under dry conditions
- **Temperature**
  - Optimum soil microbial activity occurs in June, July and August when temperatures range from 70F to 85F.
  - Less breakdown before June or after August or when soil temps are less than 50F
- **Soils**
  - CEC, especially organic matter
  - Soil pH

Carryover risk. Risk might be greater in drought conditions.

MOA/ Family	Trade Name	Common Name	Primary Dissipation Mode	Risk of Carryover Injury season following application to:		
				Corn	Soybean	Sugarbeet
Auxin	Stinger	clopyralid	Microbial	-	Moderate	-
ALS	Pursuit	imazethapyr	Microbial	Moderate	-	High
HPPD	Callisto	mesotrione	Microbial	-	Very low	High
HPPD	Laudis	tembotrione	Microbial	-	Low	High
PPO	Authority	sulfentrazone	Microbial	Low	-	High
PPO	FlexStar	fomesafen	Microbial	Moderate	-	High
PPO	Sharpen	saflufenacil	Microbial	-	Low	Low
PPO	Valor	flumioxazin	Microbial	Low	-	Moderate
PSII	Aatrex	atrazine	Microbial	-	High	High
PSII	Sencor	metribuzin	Microbial	Low	-	High

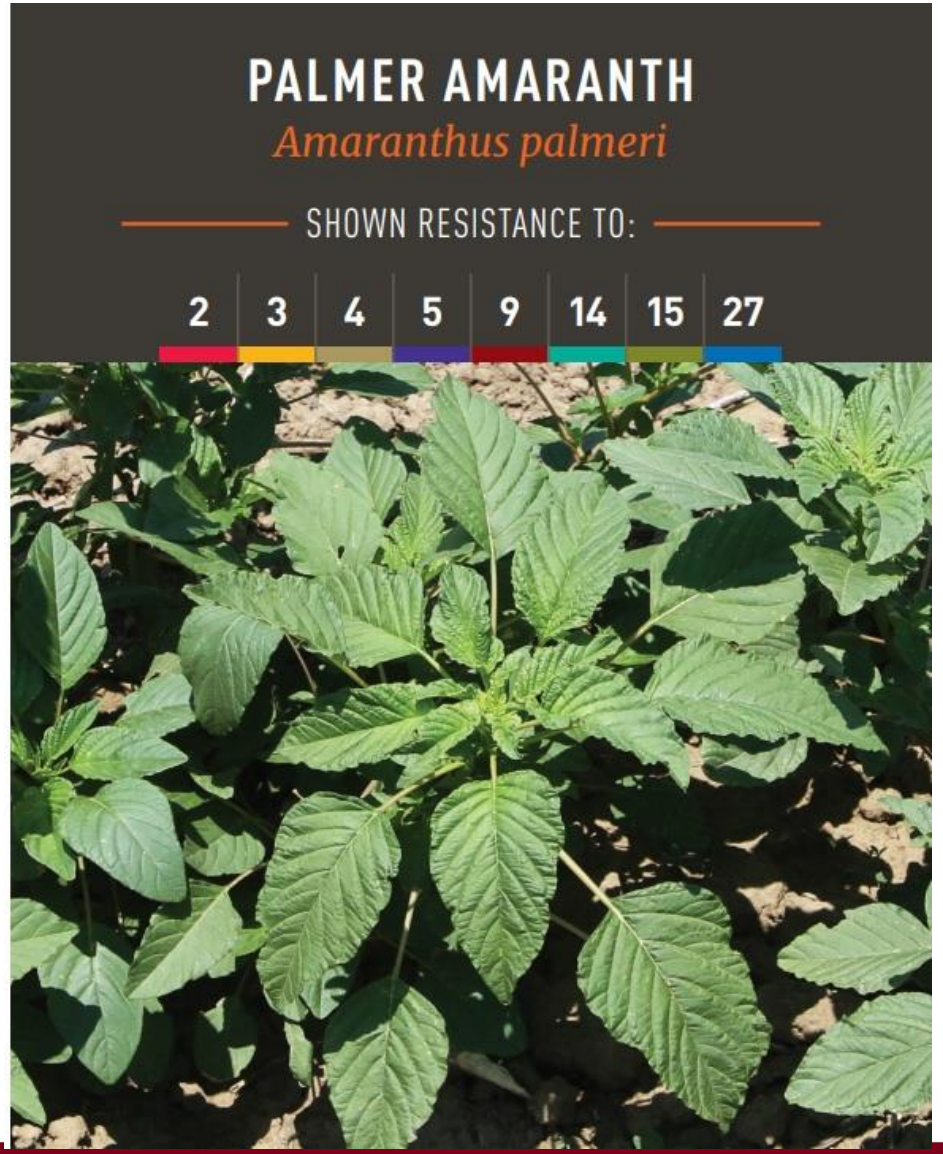
Group 4 herbicides and carryover to soybean

- Products in small grains, corn, and sugarbeet contain clopyralid (Stinger in sugarbeet).
- Stinger degradation is by microbes; application rate, soil texture, moisture and temperature affect rate of Stinger degradation/carryover.
- Stunting and stacked soybean nodes
- Soybean injury is erratic in fields; plant to plant variation or pockets of heavy damage
- Soil residues of Stinger do not cause the uniform distortion of leaves associated with drift of 2,4-D or dicamba.

Stinger carryover to soybean

Stinger carryover to soybean

Palmer amaranth update

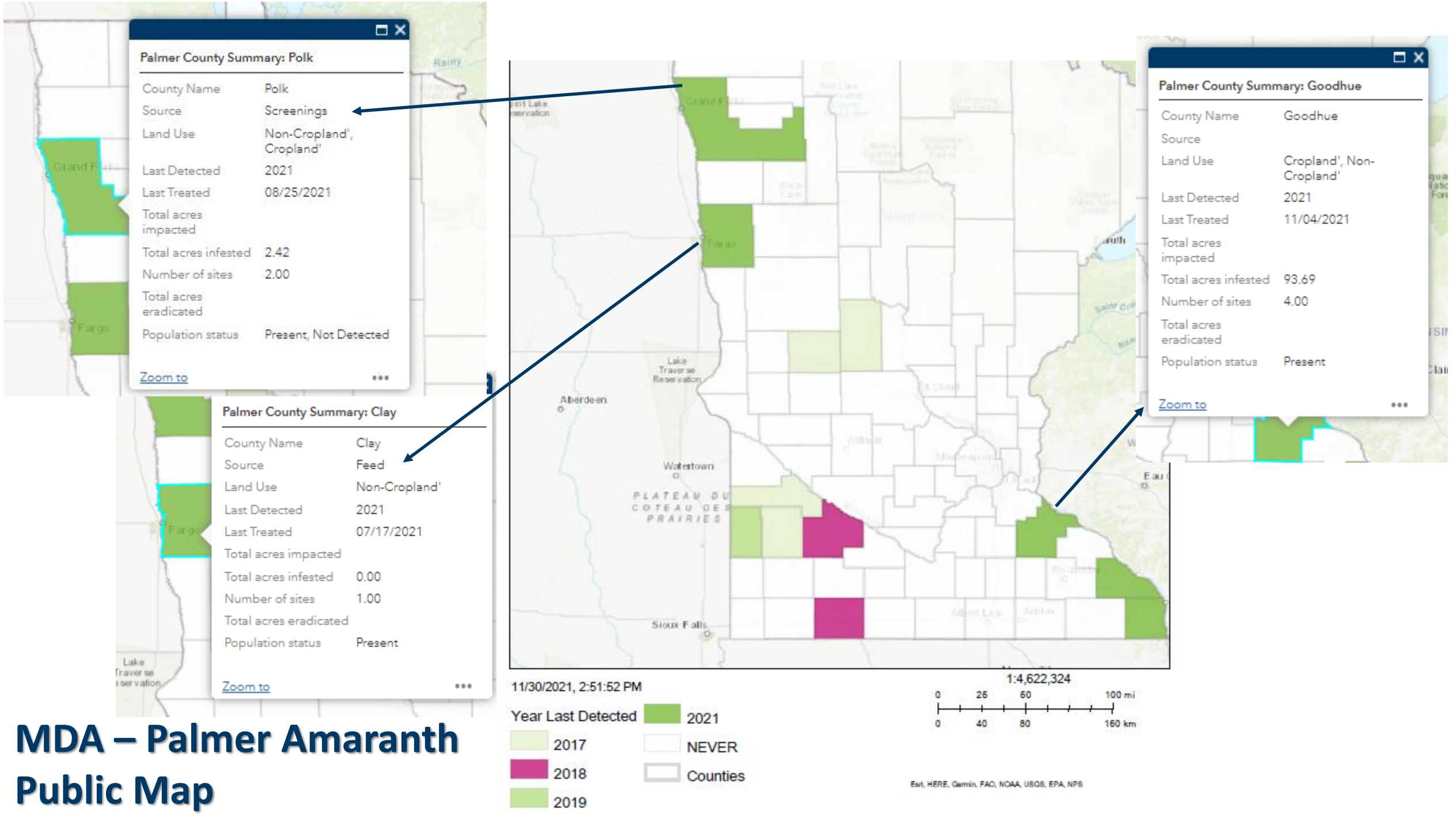


Why the big deal?

- Fast growing (up to 2-3 inches/day)
- Prolific seed producer
  - Potential 500,000+ seeds/plant
- Can cause severe yield losses
  - Up to 91% in corn & 79% in soybean
- Herbicide resistance concerns
  - R to multiple SOAs common

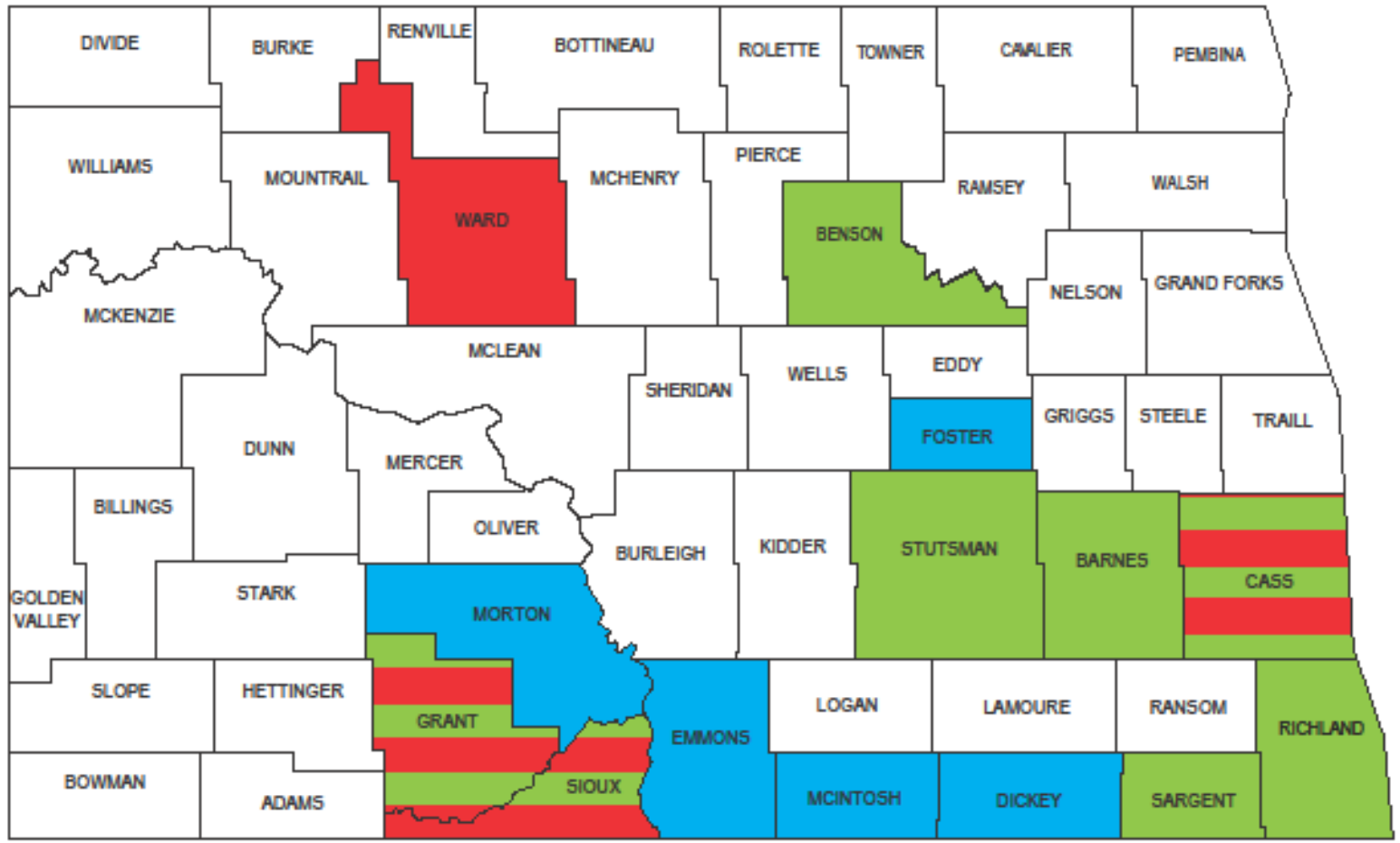
2	3	4	5	9	14	15	27
ALS INHIBITORS	MICROTUBULE INHIBITORS	SYNTHETIC AUXINS	PHOTOSYSTEM II INHIBITORS	EPSP SYNTHASE INHIBITOR	PPO INHIBITORS	LONG-CHAIN FATTY ACID INHIBITORS	HPPD INHIBITORS
Classic®, Pursuit®	*Prowl® H2O, Treflan®*	*2,4-D, Clarity®, quinclorac*	*atrazine. metribuzin, Linex®*	*Roundup® (glyphosate)*	*Flexstar®, Cobra®*	*Dual®, Harness®*	*Callisto®, Laudis®*

TakeACTION Herbicide-Resistance Management



MDA – Palmer Amaranth Public Map

North Dakota Department of Agriculture
Palmer Amaranth Distribution



Previously found but no longer detected
Previously found and still detected, under management
Population found in current year (2021)

As of 11/2/2021

If you suspect Palmer amaranth…..

1) Take Photos and record location

ARREST THE PEST
Contact to report sightings
arrest.the.pest@state.mn.us
888-545-6684

2) Immediately call

- TOM PETERS, local U of M Extension Educator or IPM Specialist, crop consultant, county agricultural inspector and/or MDA's **Arrest the Pest at 888-545-6684** to report locations

3) SAVE the plant(s) for positive ID!

- Leave in the field if you can until the MDA can verify the plant and collect sample for genetic confirmation
- If hand-pulled, collect at least 5 leaves from each plant, place in Ziploc bag and refrigerate until you contact the MDA
- Dead and dry plant material should be placed in a paper bag and stored at room temperature.

DEPARTMENT OF AGRICULTURE

We appreciate your trust

- The Sugarbeet Research and Education Committee for supporting our field research program.
- To Glenn and Danny Brandt, Fred and Spencer Kuehl, Neil Rockstad, Schatzke Farms, and Vince Ulstad for providing us with the opportunity to conduct our experiments on their fields.
- American Crystal Sugar, especially Greg Richards (my landlord at Moorhead)
- North Dakota State and Univ of Minnesota Experiment Stations

Thank you for your continued support

Tom Peters

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