

Weed Control in Sugarbeet

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Presentation Outline

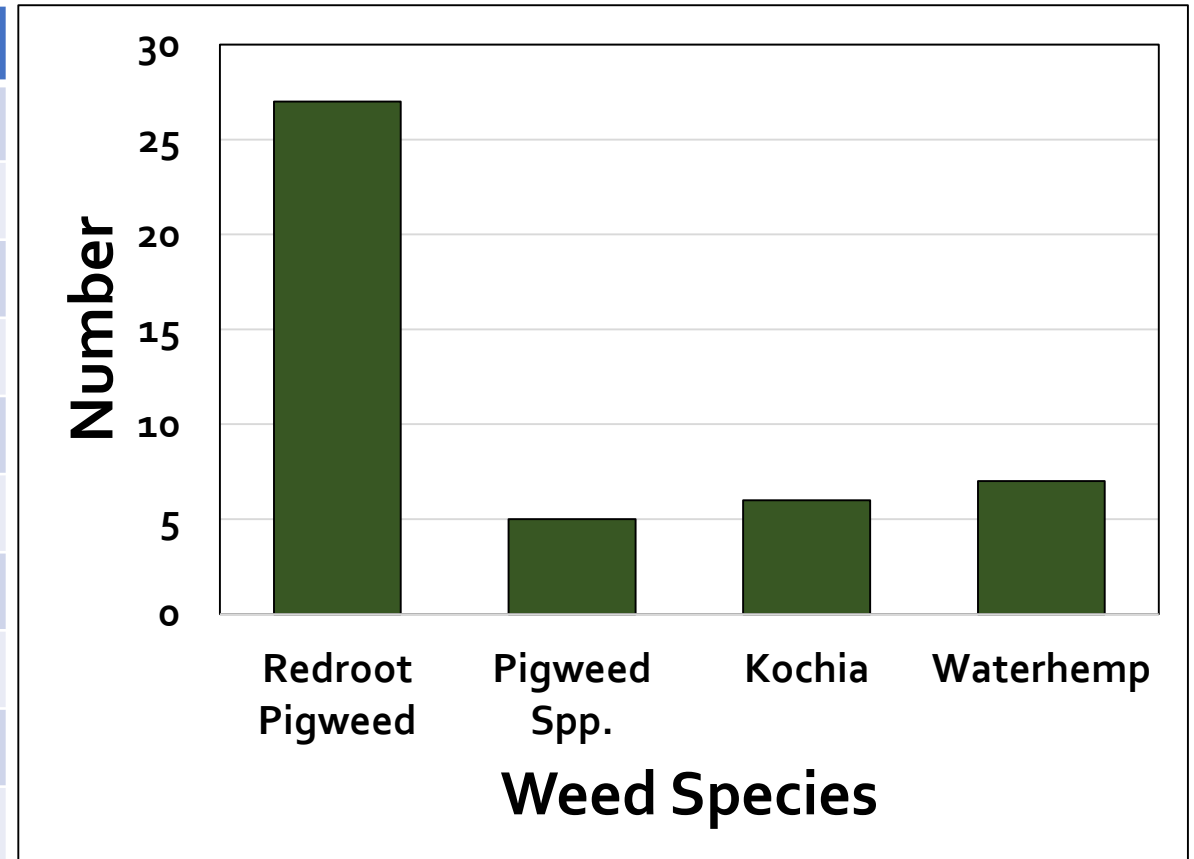
- ① Waterhemp control in dry season
- ② Complex mixtures
- ③ Controlling waterhemp escapes
- ④ Common ragweed control and labels update
- ⑤ Palmer amaranth update

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



^aAnnual 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



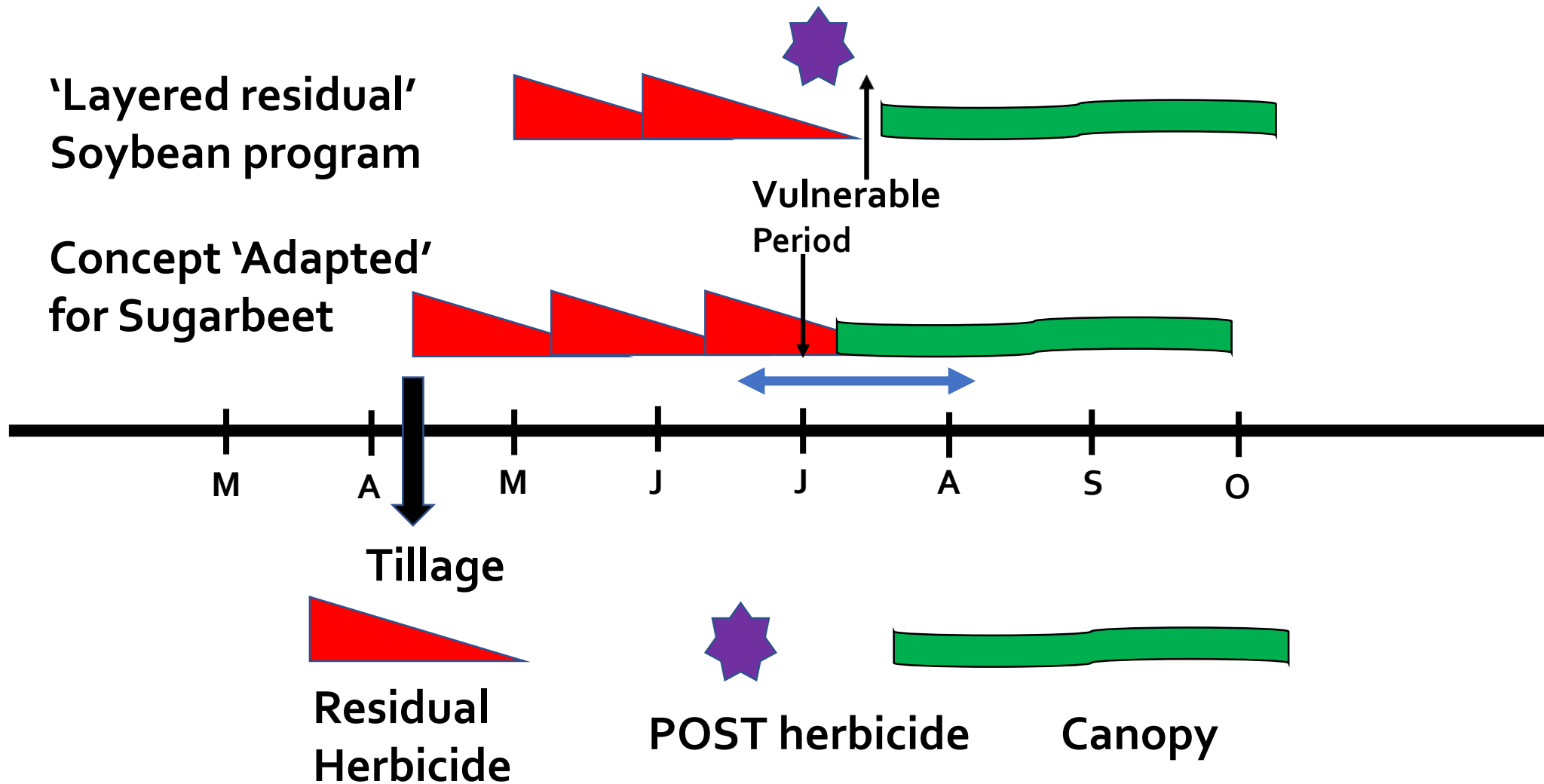
Image credit: Bruce Ackley, The Ohio State University, Bugwood.org

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

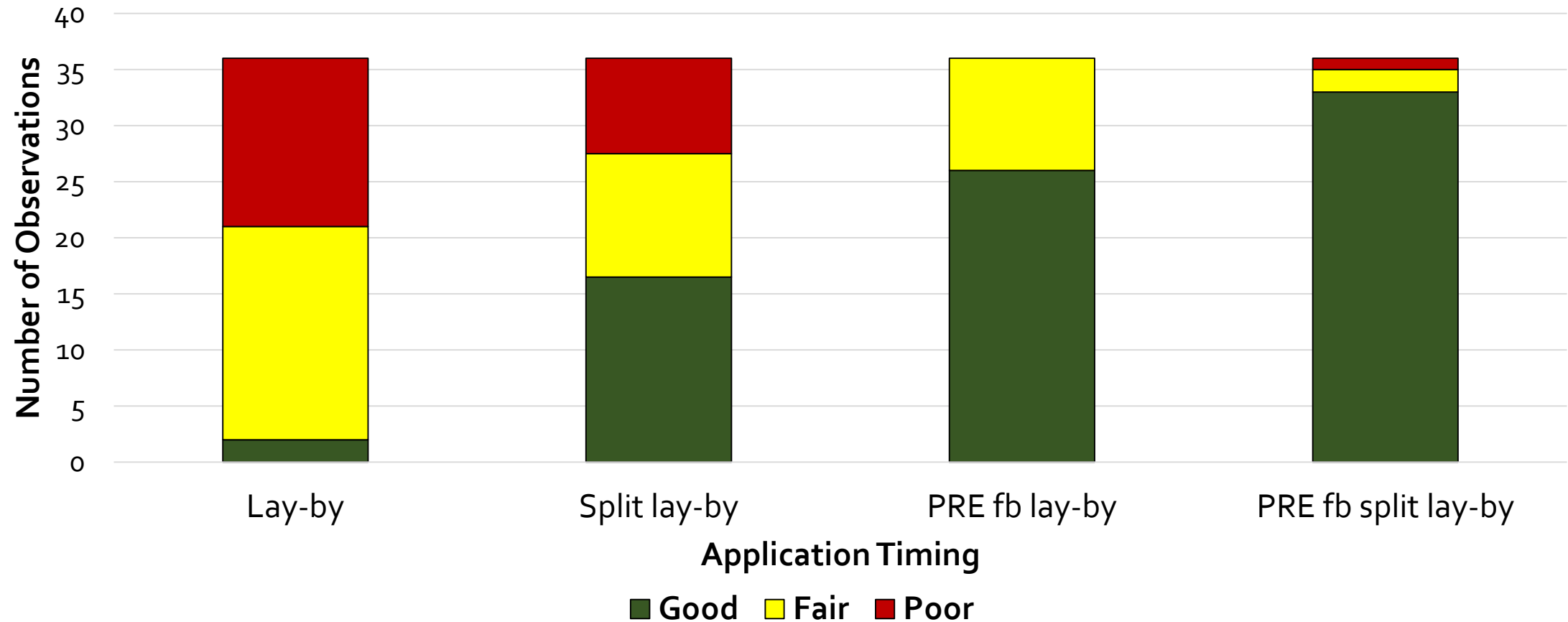
Layered Residual Herbicides

Objective: Prolong PRE activity until canopy fills



Adapted from a slide created by B Hartzler, ISU

Waterhemp control (good, > than 85%), fair (65% to 84%), and poor (< than 64%) in response to treatment and timing summed across evaluations, locations, and years.



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

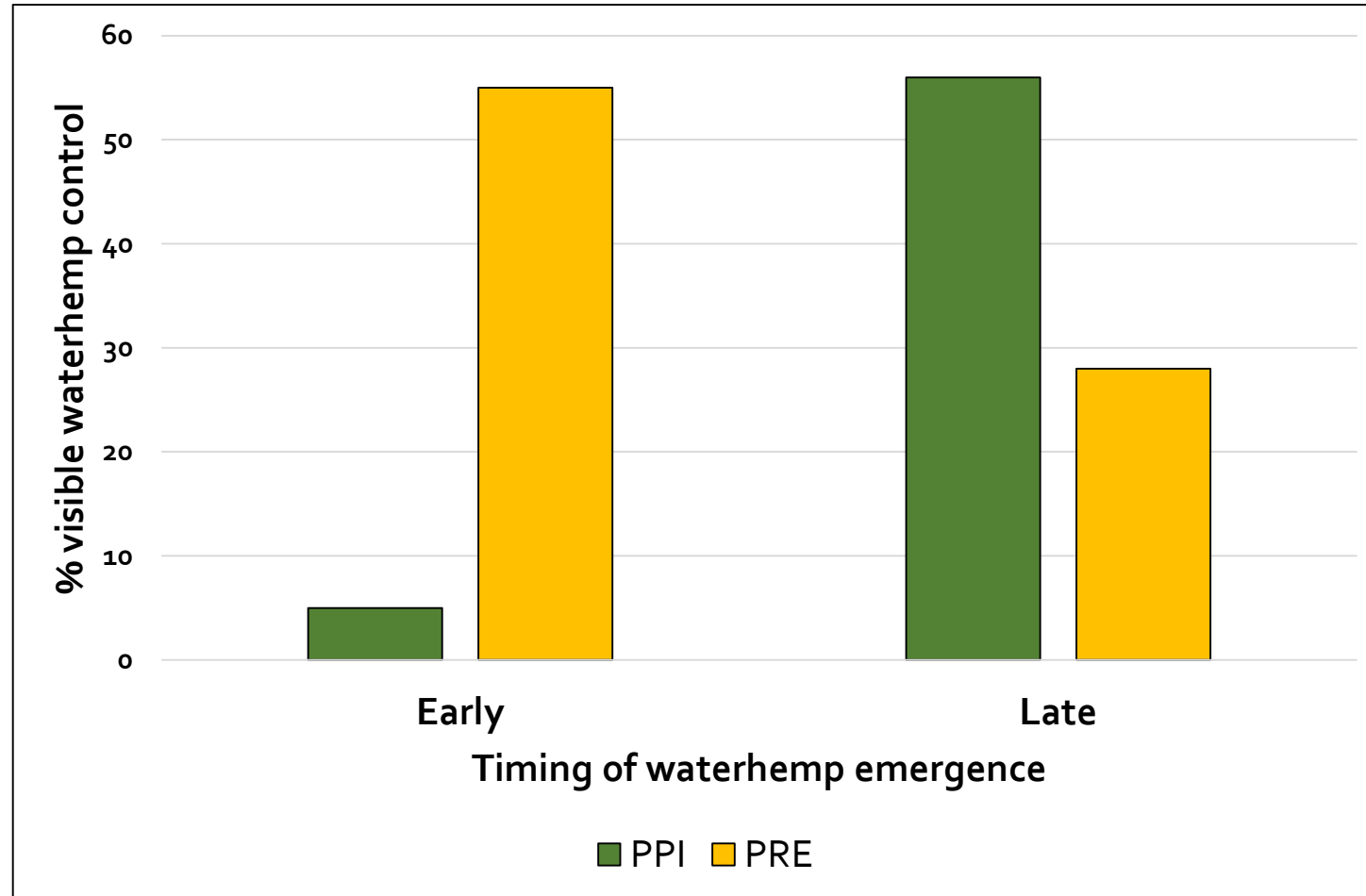


Control of EARLY and LATE emerging waterhemp with ethofumesate at various rates, July 9, Fargo 2021

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



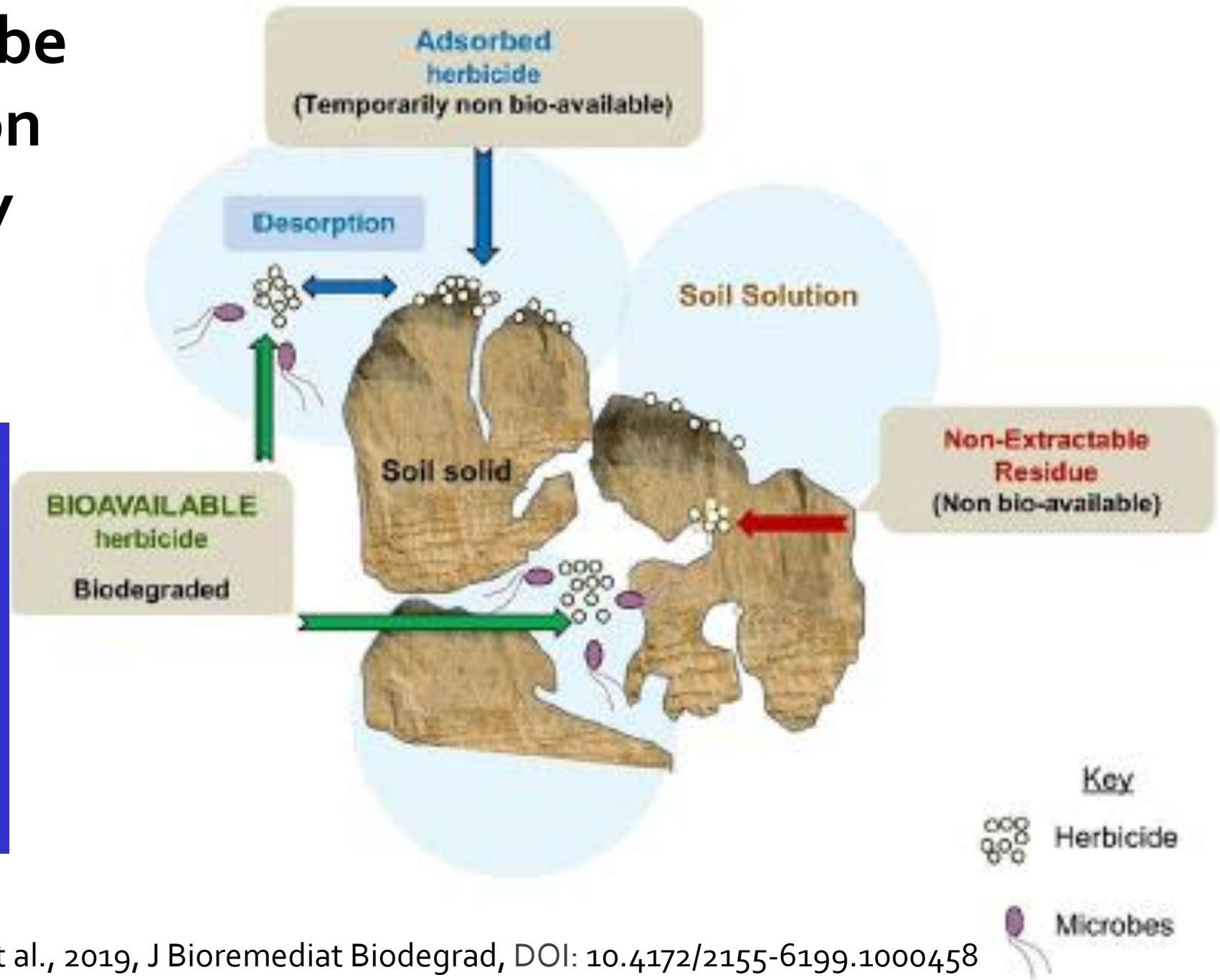
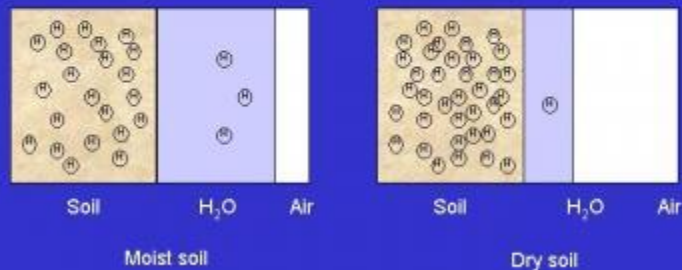
Soil residual herbicides kill weeds as seed or seedlings imbibe water

- 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
	K_{OC}	(ppm)	(days)
Warrant	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

Figure 2. Soil moisture effect on herbicide availability.



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

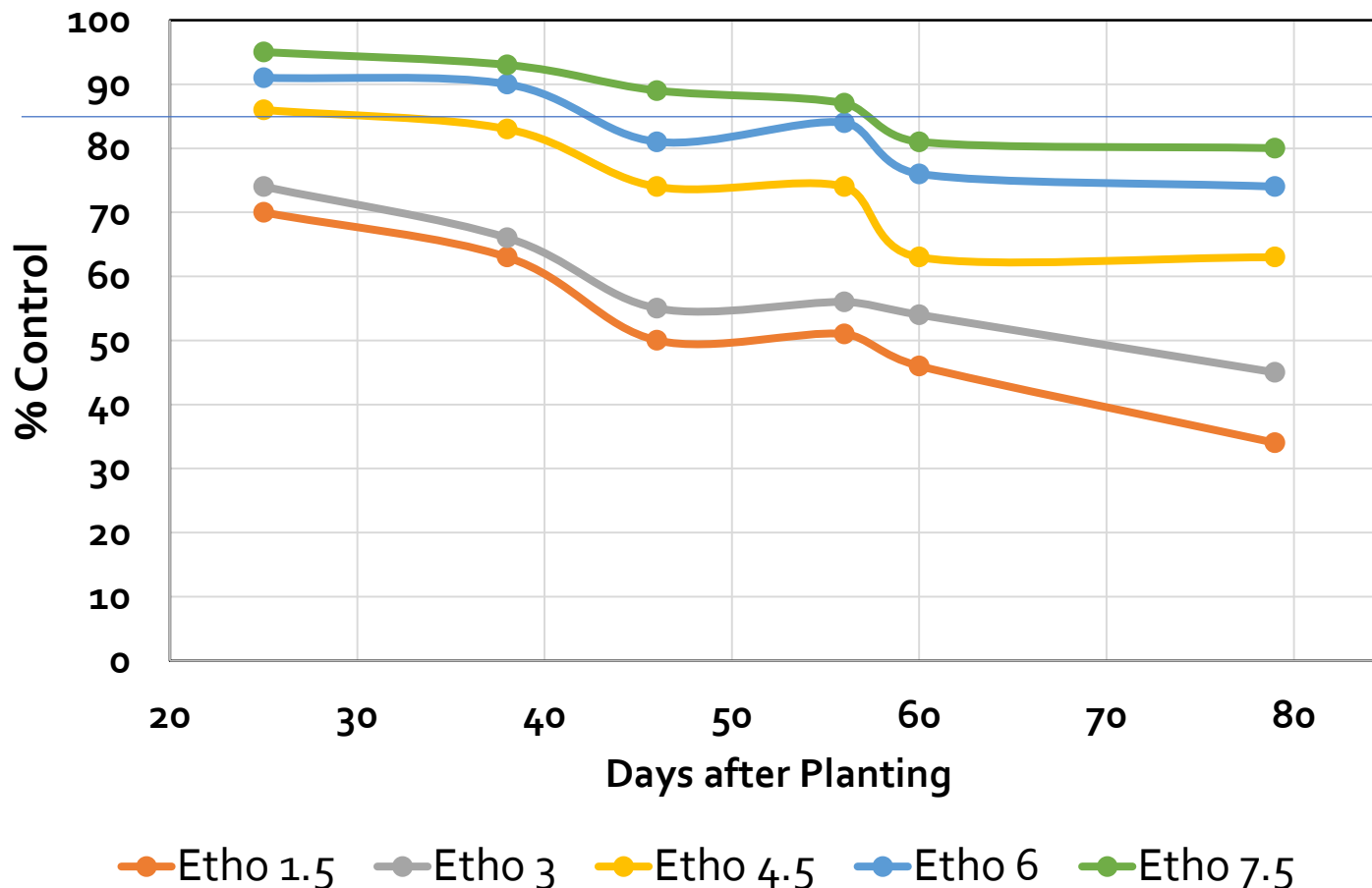
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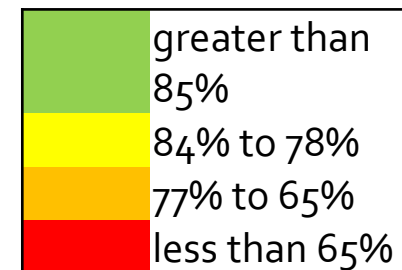
- PPI etho was adsorbed to colloids and diluted by incorporation, not available for waterhemp control
- PRE partially incorporated into soil and available after the May 10th rain
- PPI etho in the soil solution and available for late emerging waterhemp following June rains
- PRE etho likely degraded/lost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



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

A ₁ B ₁	A ₂ B ₁
A ₁ B ₂	A ₂ B ₂

Rainfall events, Blomkest and Moorhead, MN, 2021

Moorhead, MN

Blomkest, MN

May 27, 0.2-in

Jun 7, 0.7-in

Jun 10, 1.4-in

Jun 20, 0.9-in

Jun 27, 0.6-in

Jun 28, 0.8-in

Jul 9, 0.8-in

Aug 6, 1.9-in

Aug 20, 1.3-in

Aug 23, 1.3-in

Aug 26, 0.6-in

Aug 28, 1.2-in

March

April

May

June

July

August

September



Soil residual herbicides improved waterhemp control at Moorhead, MN, 2021




Treatment	Rate	46 days	66 days	76 days
None		89 B	76 B	67 B
Etho + Dual Magnum	2 pt + 8	93 A	84 A	78 A
Etho	6 pt	95 A	87 A	79 A




Treatment	Rate	26 days	47 days	57 days
Gly + etho / gly + etho	28+6 / 28+6	76 c	63 c	31 d
+ Outlook / + Outlook	12 /12	96 a	91 a	84 ab
+ Warrant / + Warrant	3pt / 3 pt	94 ab	91 a	81 b
+ Outlook / + Warrant	12 / 3 pt	95 ab	93 a	87 ab

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.

Glyphosate, etho, Outlook at 10 oz plus Asana at 6 oz



Glyphosate, etho, and Outlook at 10 oz



- EC formulations (Outlook and S-metolachlor) speckle sugarbeet
- Asana may be “synergizing” the speckled phenotype
- Speckle is related to a surfactant system “spreading” the droplet

Visual sugarbeet injury and fresh weight reduction, averaged across two greenhouse runs, 2020 to 2021.

Herbicide treatment	Rate	Growth Reduction 7 DAT ²	Growth Reduction 14 DAT	Fresh Weight Reduction
	--fl oz/A--	-----%-----		%
Base ²		4 d ³	9 c	--
Base + Outlook	21	16 c	20 b	7.6
Base + Outlook and Lorsban	21 + 16	28 b	21 b	8.0
Base + Outlook, Lorsban and Stinger	21 + 16 + 6	43 a	35 a	10.5

¹DAT=Days after POST treatment.

²Base= Roundup PowerMax at 32 fl oz/A + Ethofumesate 4SC at 12 fl oz/A + N-Pak Liquid AMS at 2.5% v/v.

³Means within a main effect not sharing any letter are significantly different by the LSD at the 10% level of significance.

Sugarbeet injury in response to herbicide treatments, averaged across PRE herbicide, greenhouse, 2020.

Herbicide treatment ¹	Necrosis ²	Malformation	Growth Reduction
	-----%-----		
Base ³	1 c ⁴	4 c	3 b
Base + Stinger	1 c	16 b	3 b
Base + Stinger + Dual Magnum	3 c	11 bc	2 b
Base + Stinger + Dual Magnum + Betamix	11 b	28 a	17 a
Base + Stinger + Dual Magnum + Betamix + Lorsban	18 a	26 a	18 a

¹All POST entries included Destiny HC (HSMOC) + N-Pak Liquid AMS at 1.5 pt/A + 2.5% v/v.

²Necrosis, malformation and growth reduction averaged across evaluations.

³Base = Roundup PowerMax at 32 fl oz/A + Ethofumesate 4SC at 12 fl oz/A.

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July	Electric Discharge Systems (WeedZapper™)
August / September	Hand remove waterhemp

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:

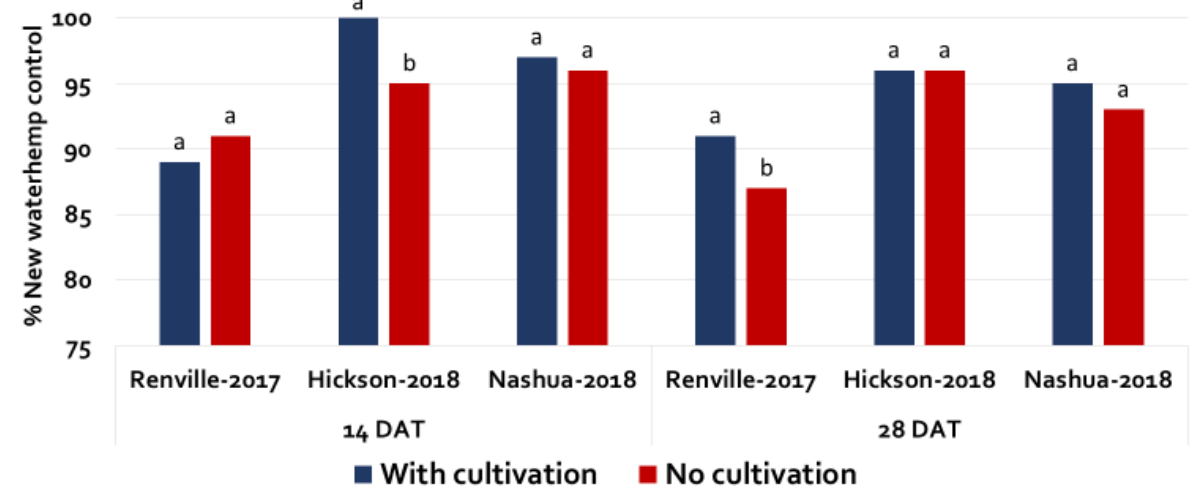
- The WeedZapper™, Sedalia, MO
- Developed in 2018
- 200,000 watts
- 40-44 ft front-end mounted boom
- PTO driven generator
- Requires a 275 PTO HP tractor
- 2 to 6 mph
- Advanced safety improvements



Hooded sprayer designed by Willmar Fabrication



Early cultivation generally had no effect on new waterhemp emergence control



Common ragweed control and label changes

We have observed some ragweed biotypes more difficult to control

- Common ragweed seed collected from sugarbeet fields with escapes
- Control, PowerMax at 32 and 64 fl oz and Stinger at 3 and 6 fl oz/A
- Visual control weekly
- Table is visual control 50 DAT

Stinger Rate	Control	ACS-1	ACS-2	ACS-3	Minn-Dak
fl oz/A	%	%	%	%	%
3	85	60	50	90	70
6	90	70	60	95	85

Control is a 'university standard', likely susceptible



Stinger HL 'Higher Load' is approved for corn, cereals, canola, and sugarbeet in MN and ND.

Product	Loading	Labeled rate	Sugarbeet rate
Stinger	3 lb/gal	4 – 10.7 fl oz/A	2 – 6 fl oz/A
Stinger HL	5 lb/gal	2.4 – 6.4 fl oz/A	1.2 – 3.6 fl oz/A

	Converting Stinger rate to Stinger HL rate			
	fl oz/A	fl oz/A	fl oz/A	fl oz/A
Stinger	2	3	4	6
Stinger HL	1.2	1.8	2.4	3.6

Roundup PowerMax 3 Herbicide

Nonselective foliar control of both grass and broadleaf weeds

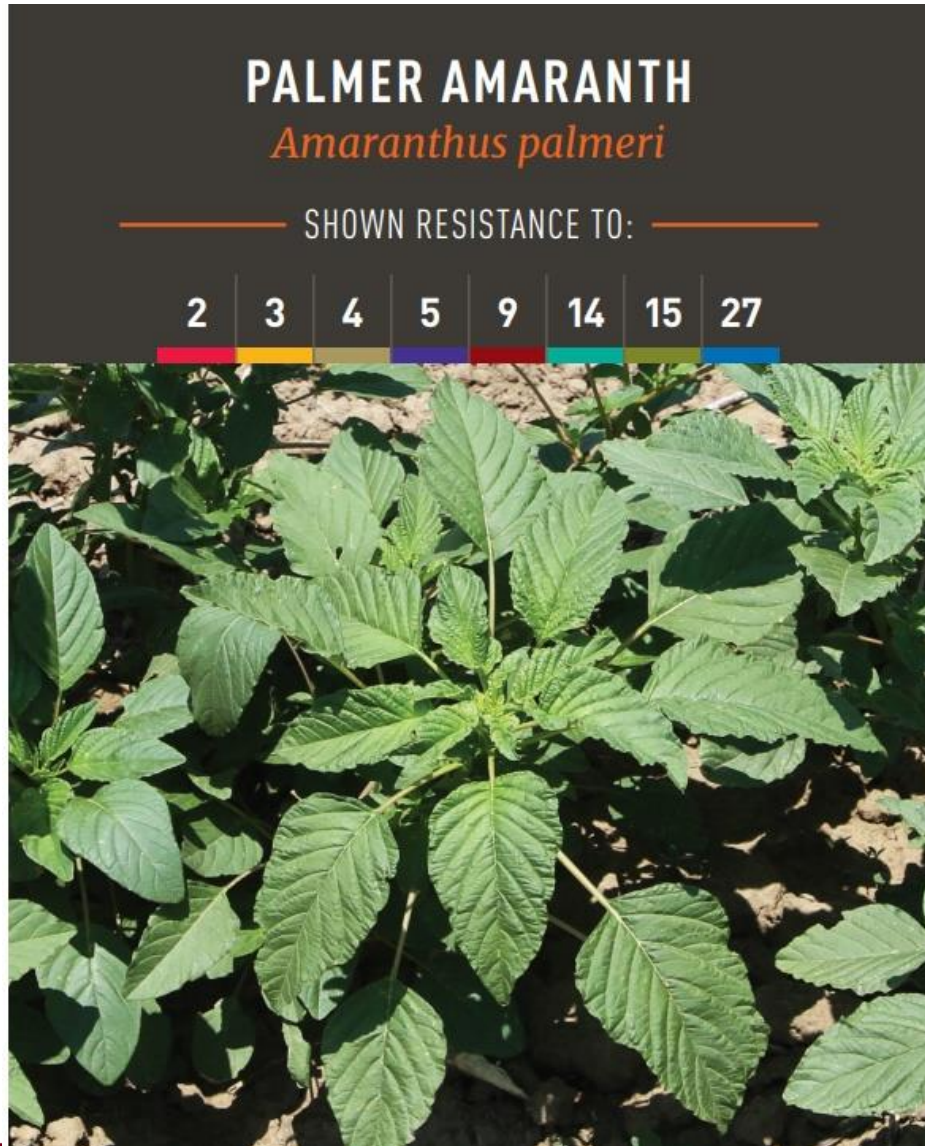
Active Ingredient and Site of action

- 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

Palmer amaranth update



Why the big deal?

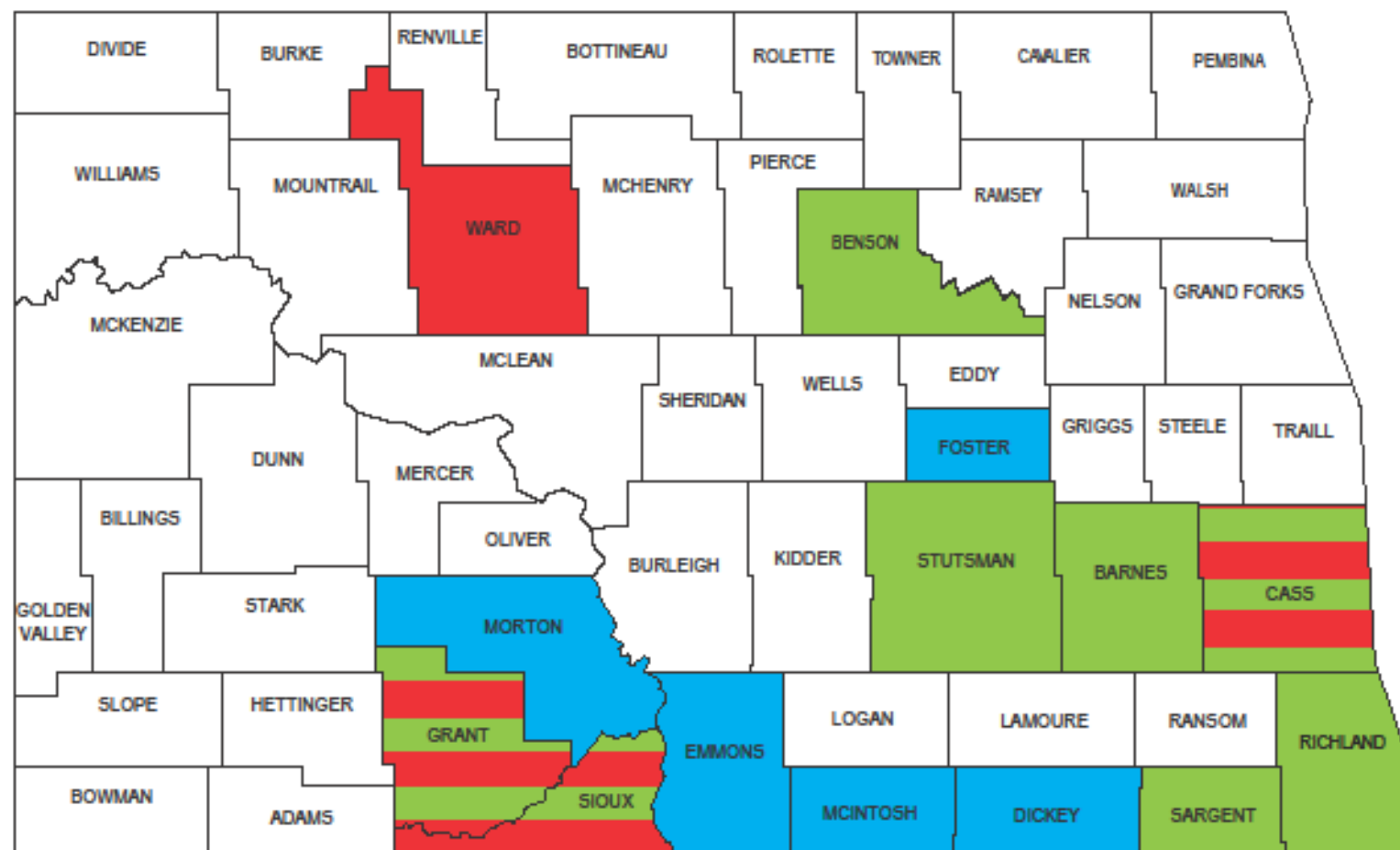
- Fast growing (up to 2-3 inches/day)
- Prolific seed producer
 - Potential 500,000+ seeds/plant
- Can cause severe yield losses
 - Up to 91% in corn & 79% in soybean
- Herbicide resistance concerns
 - R to multiple SOAs common

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® H ₂ O, Trellan®	2,4-D, Clarity®, quinclorac	atrazine, metribuzin, Linex®	Roundup® (glyphosate)	Flexstar®, Cobra®	Dual®, Harness®	Callisto®, Laudis®



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

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.



We appreciate your trust

- The Sugarbeet Research and Education Committee for supporting our field research program.
- To Vipond Grain Farms, Norcross; M & L Ness, Comstock; and Vince Ulstad, Hickson for providing us with the opportunity to conduct our experiments on their fields.
- Minn-Dak Farmers Coop Research Team for planting and harvesting
- North Dakota State and Univ of Minnesota Experiment Stations

Thank you for your continued support

Tom Peters

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