

Weed Control in Sugarbeet

Thomas Peters, Alexa Lystad, and Adam Aberle

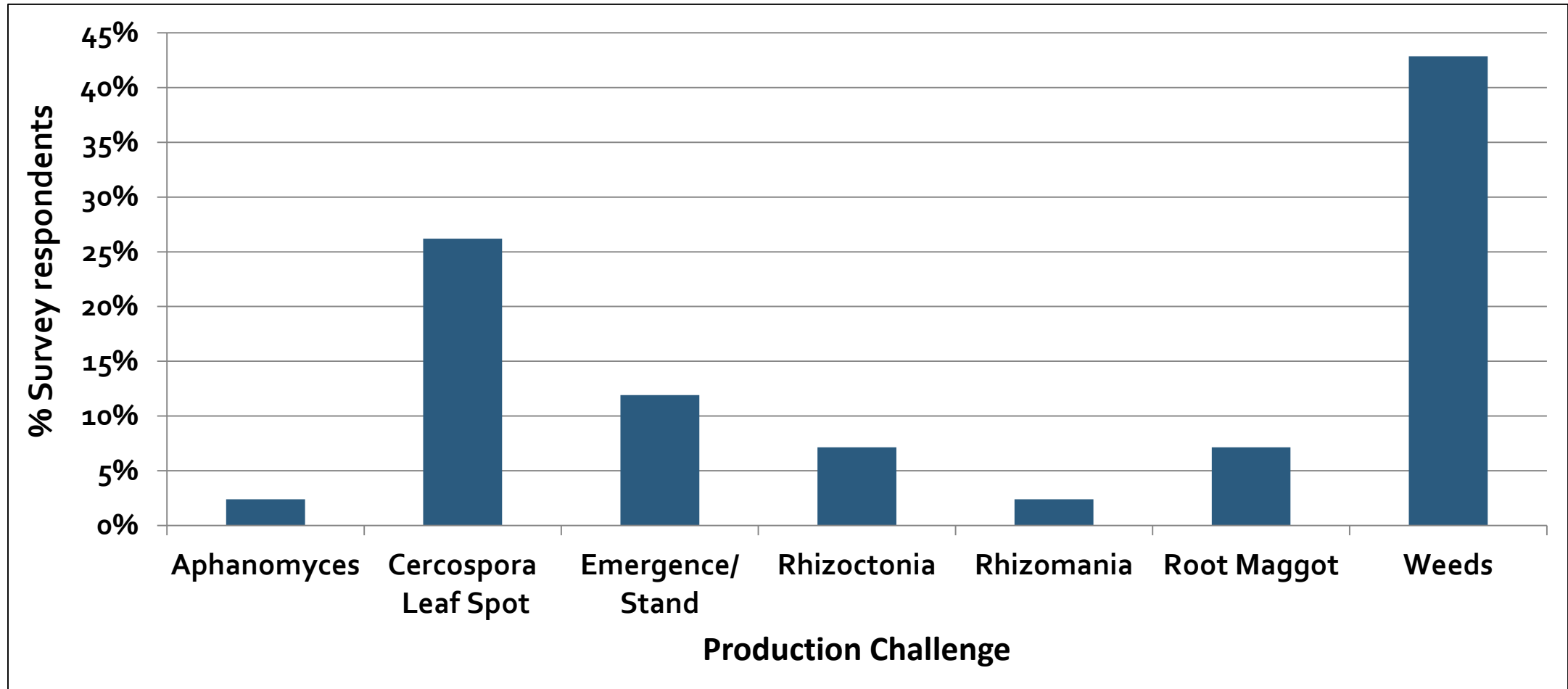
**North Dakota State University and
University of Minnesota**

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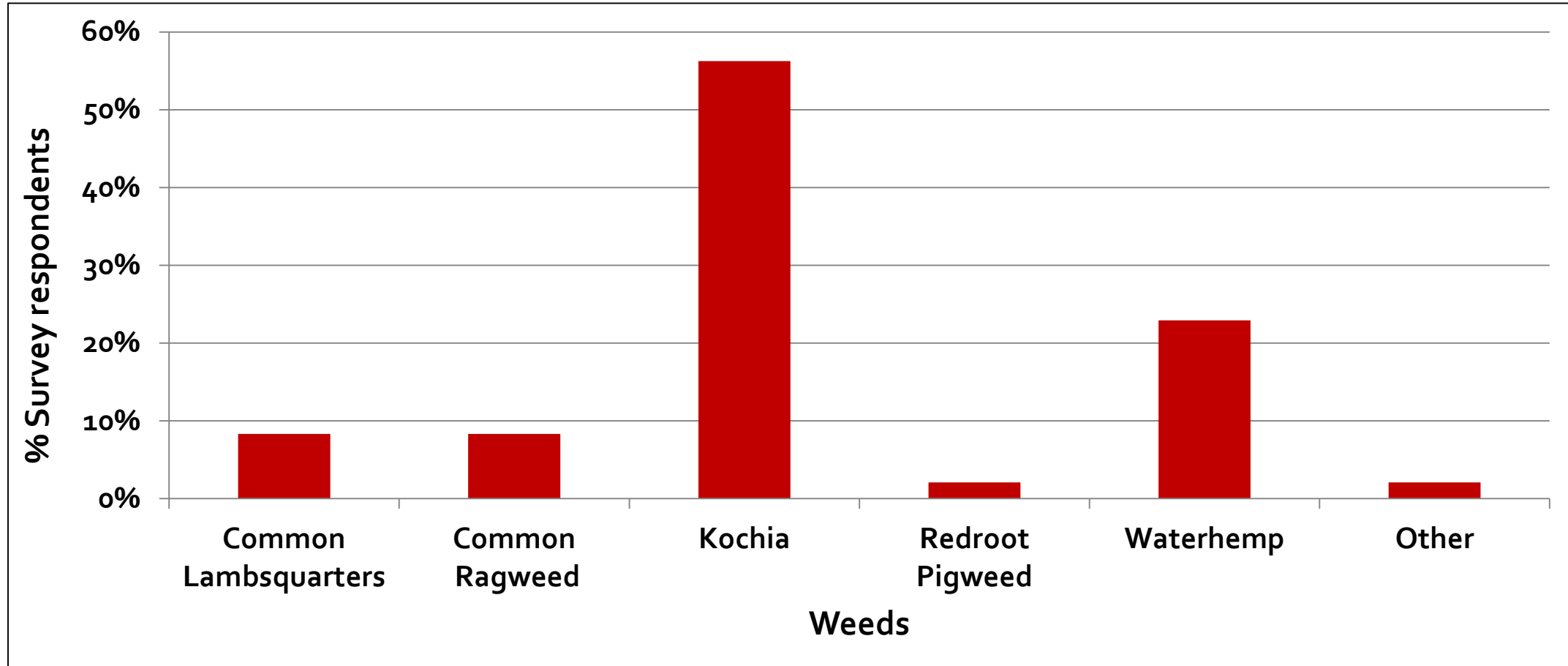
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EXTENSION

What was your most important production problem in 2022?^a (Multiple Choice)



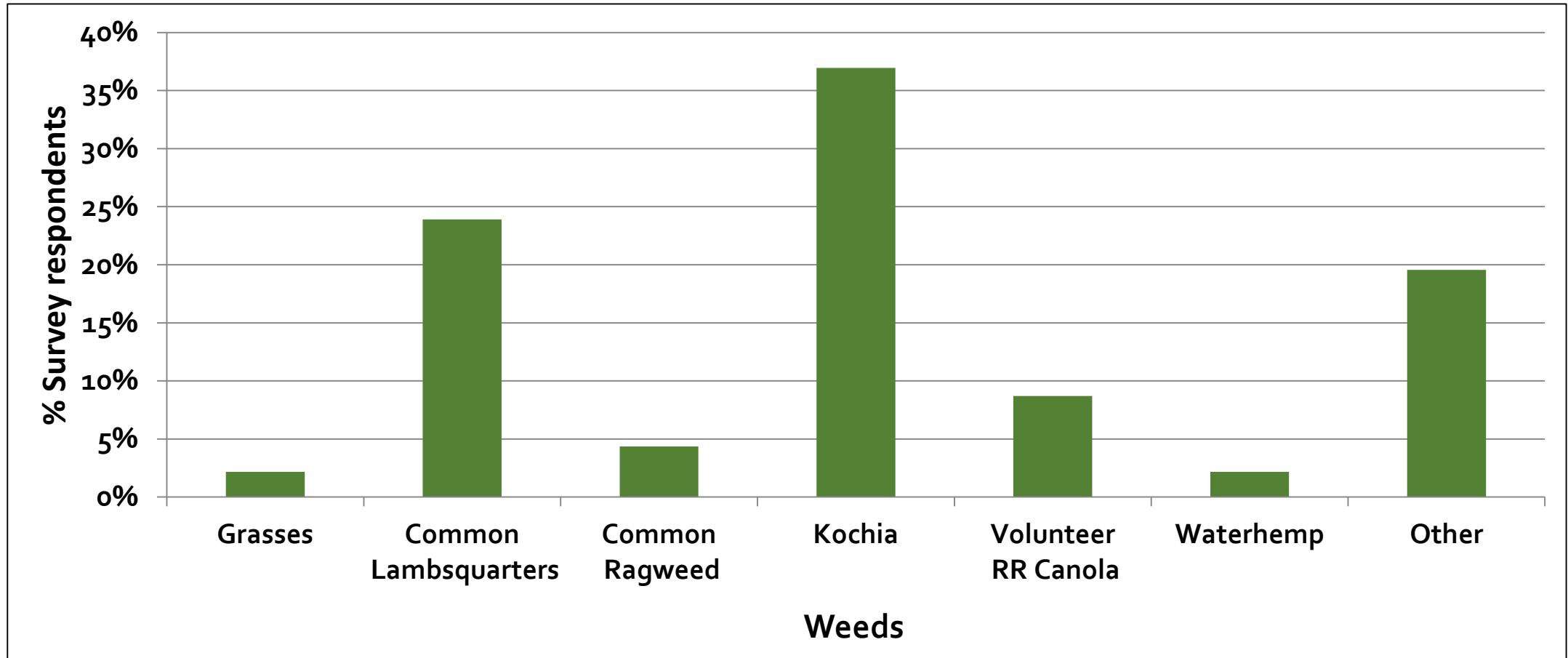
^aGrafton Growers Seminar, February 9, 2023

What was your most troublesome weed control challenge in 2022?^a



^aGrand Forks Growers Seminar, February 9, 2023

What was your second most troublesome weed control challenge in 2022?^a



^aGrand Forks Growers Seminar, February 9, 2023

Outline

- Kochia control
- Spin-Aid for kochia control
- Waterhemp control in sugarbeet



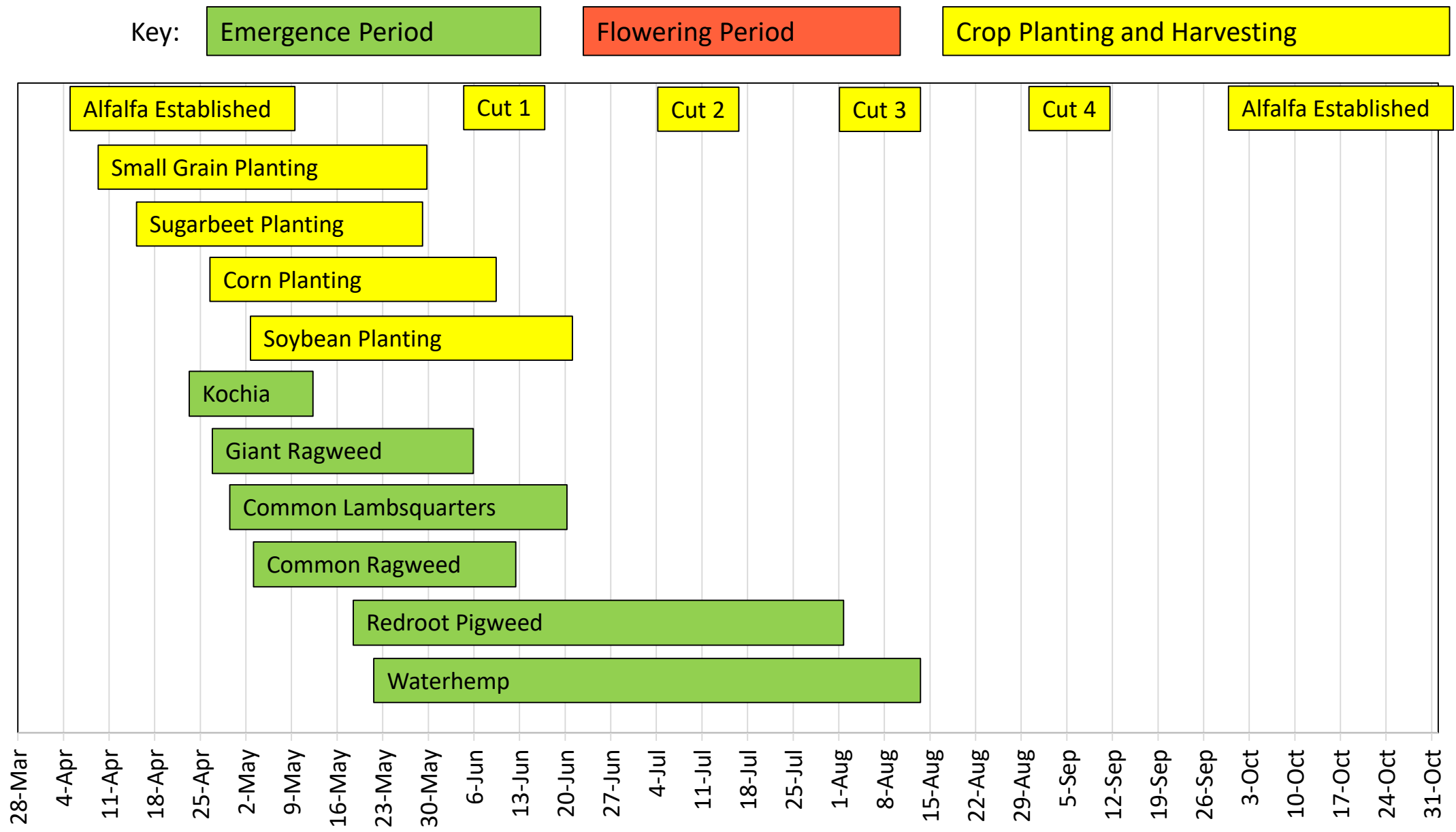
Kochia

- Life cycle, summer annual
 - One of the first weeds to emerge in spring
- Seed production, 15,000 seeds per plant
- Biology, very deep rooted, tolerate saline soils
- Biology, extremely competitive; a few plants will reduce yield
- Seed viability, 1 to 2 years
- Many document examples of herbicide resistance
 - ALS (SOA 2)
 - 2,4-D, dicamba, and fluroxypyr (SOA 4)
 - Triazines (5)
 - Glyphosate (SOA 9)
 - PPOs (SOA 14)
 - Multiple resistance in ND, 2+4 + 9, 2+4+9+14





March 26th. The surface 1-inch was thawed and below that it was frozen.
Photo credit, Lee Briese



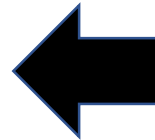
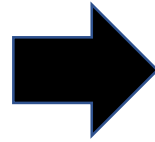
Adapted from Werle et al. 2014, Goplen et al. 2017, Weedometer 2008

Kochia

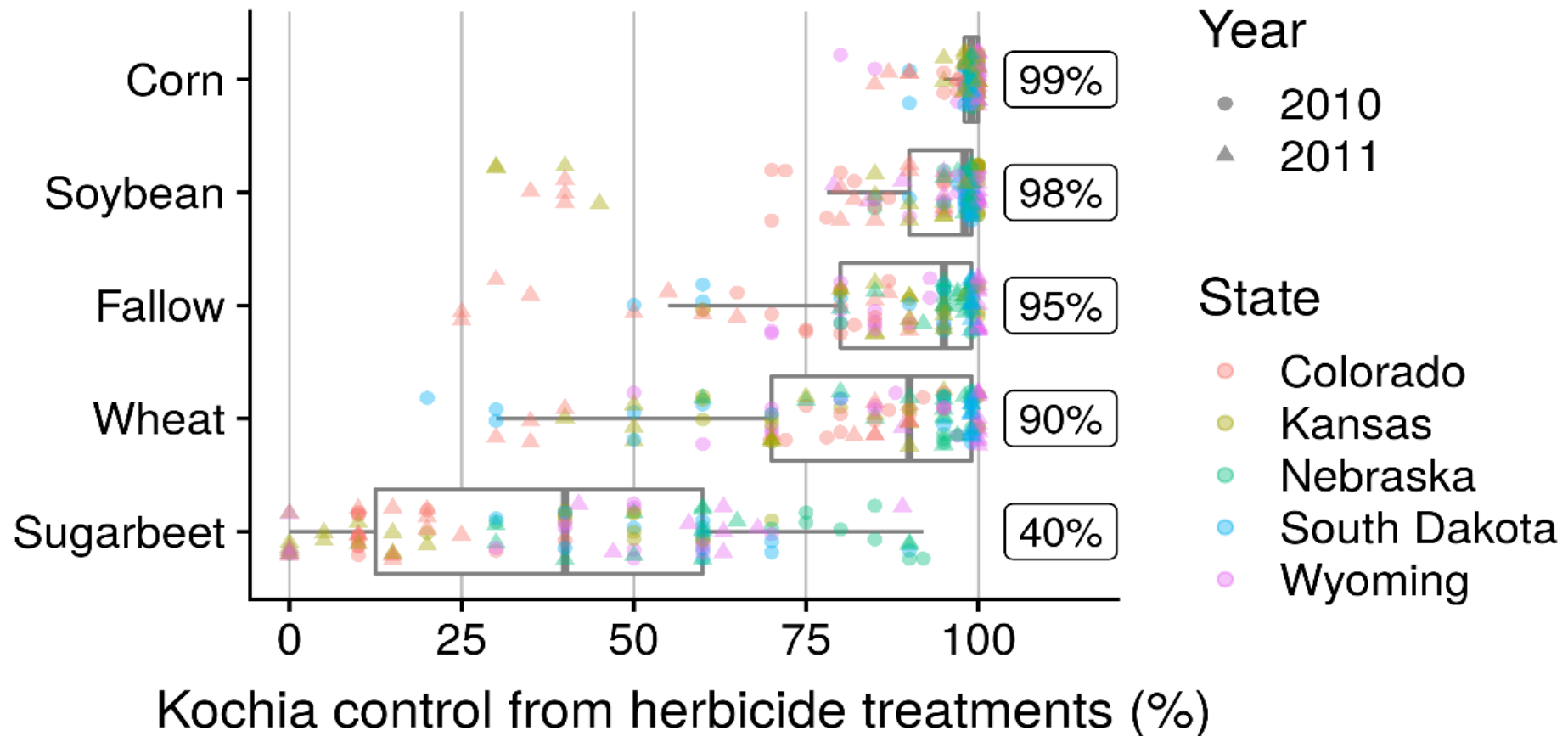
- Life cycle, summer annual
 - One of the first weeds to emerge in spring
- Biology, very deep rooted, tolerate saline soils
- Biology, extremely competitive; a few plants will reduce yield
- Seed production, 20,000 to 30,000 seeds per plant
- Seed viability, 1 to 2 years
- Many document examples of herbicide resistance
 - ALS (SOA 2)
 - 2,4-D, dicamba, and fluroxypyr (SOA 4)
 - Triazines (5)
 - Glyphosate (SOA 9)
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The Crop Sequence in the Red River Valley



Kochia control, 30 days after final application of herbicide treatment

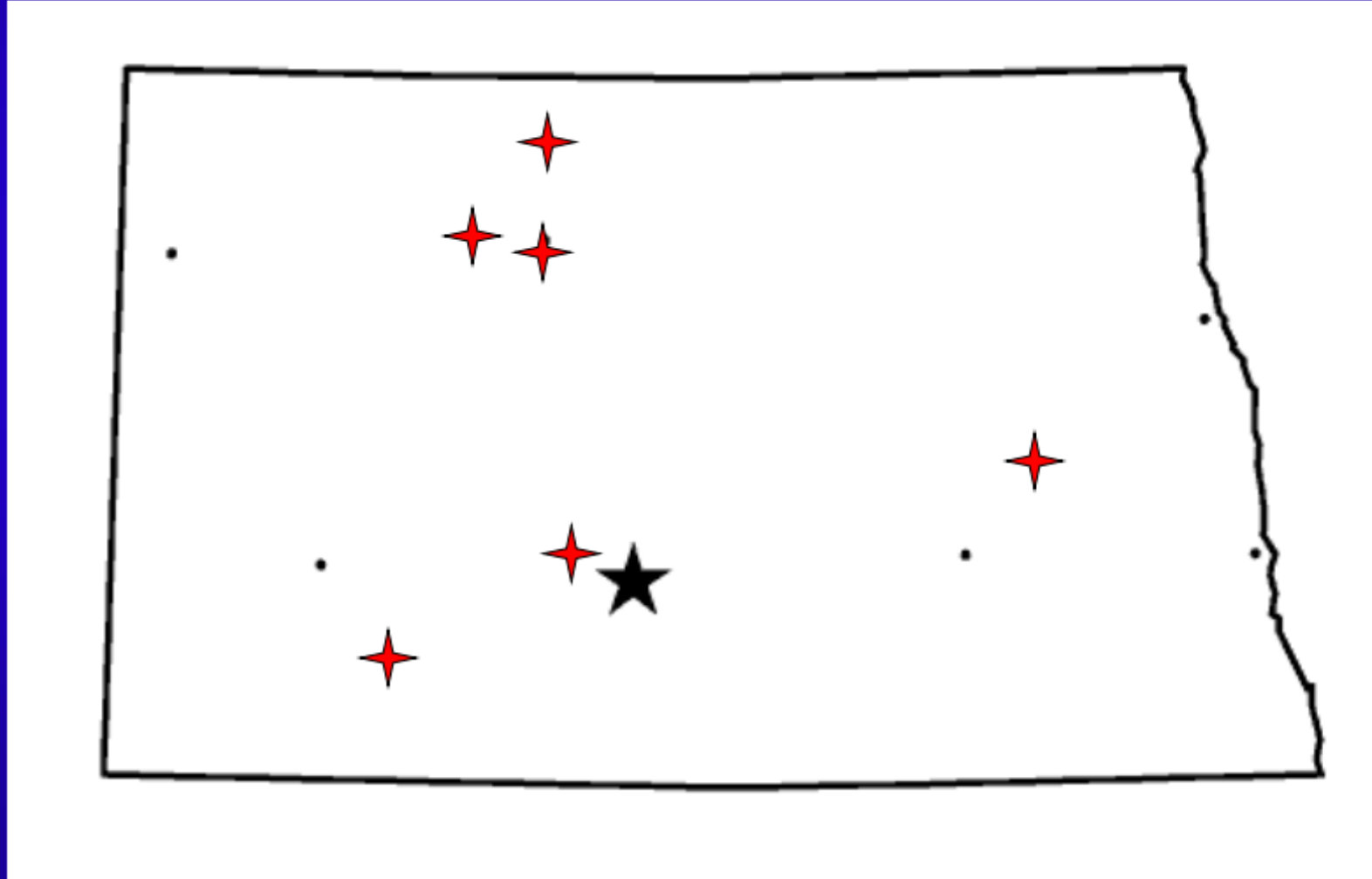


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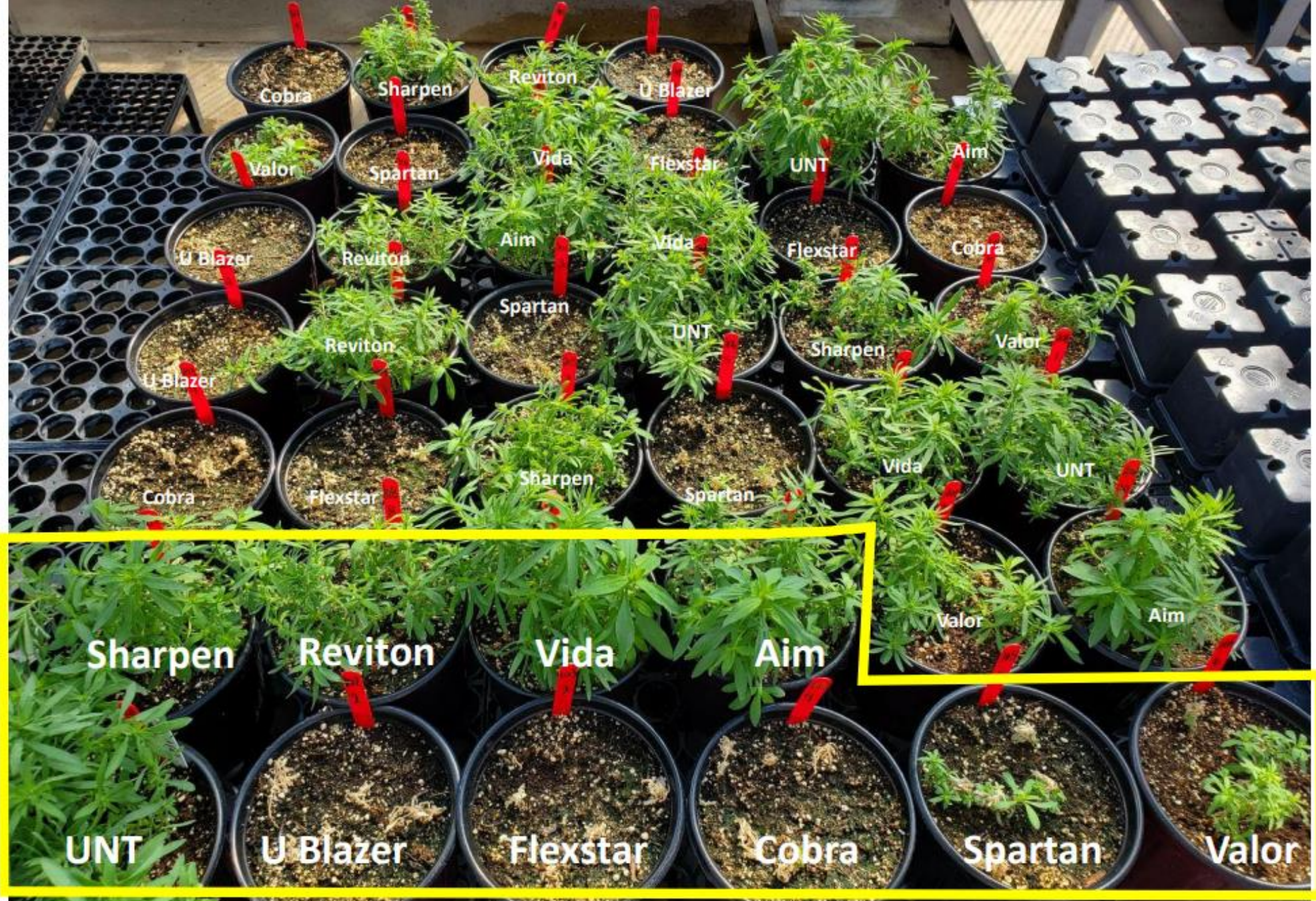


Kochia is now a Survivor of PPO Herbicides



Slide courtesy of
Kirk Howatt, NDSU

Minot



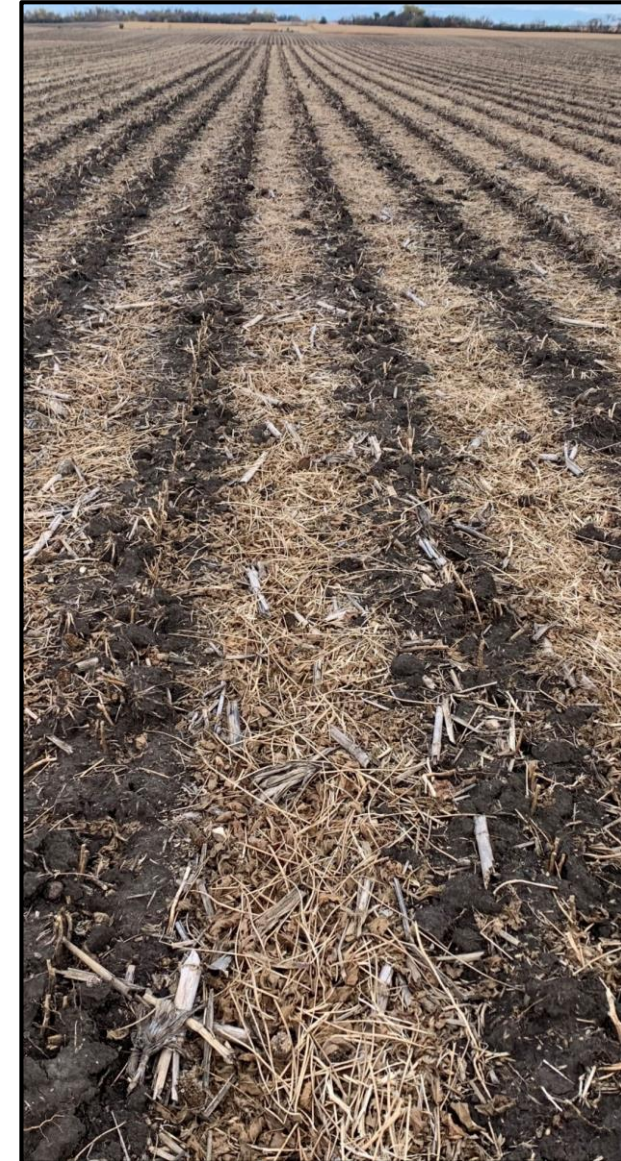


Kochia control in sugarbeet

Three options

All options begin with ethofumesate, soil applied

- Paraquat before sugarbeet emerges
 - Use rate depending on vegetation; 1.3 to 2 pt/A (max rate is 2.7 pt/A).
 - Gramoxone alone or in tank mixtures are permitted by ground and by air; a minimum of 10 gal/A by ground and 5 gal/A for aerial application.
 - Use spray nozzles that will produce medium to coarse droplets are recommended.
 - Use an adjuvant, Nonionic-Surfactant (preferred) at 0.25% v/v (2 pt/100 gal). Crop Oil Concentrate or Methylated Seed Oil at 1.0% v/v (1 gal/100 gal).
 - 24 hr re-entry.



Kochia control in sugarbeet

Three options

All options begin with
ethofumesate, soil applied

- Glyphosate sensitive kochia (fence-line kochia)
- Roundup PowerMax3 (full rates) mixed with a high quality adjuvant and ammonium sulfate
- Kochia up to 3-inch tall
- Use AMS; AMS is a water conditioner
- Shop for the best adjuvant you can find.
 - ethoxylate tallowamine adjuvant



Kochia control in sugarbeet

Three options

All options begin with ethofumesate, soil applied

- Redevelopment of phenmedipham combines historical field and recent greenhouse and field experiments
- Spin-Aid, Betanal, 'Blue Can'
 - Kochia, common lambsquarters and common ragweed control
 - Spin-Aid + ethofumesate; Spin-Aid + ethofumesate + RUMP3
 - Small kochia



- dime-size
- 4-leaves



- quarter-size
- 6- to 9-leaves



- too big
- Scout early next year

Response of weeds to Spin-Aid® alone or mixtures with ethofumesate

Weeds	Spin-Aid	Spin-Aid + etho
Common lambsquarters	G	G-E
Kochia	G	G-E
Redroot pigweed	P	P
Common ragweed	F	F-G
Wild mustard	G	G-E

E= Excellent (90-99%); G = Good (80-90%); F=Fair (65-80%); P=Poor (40-65%)

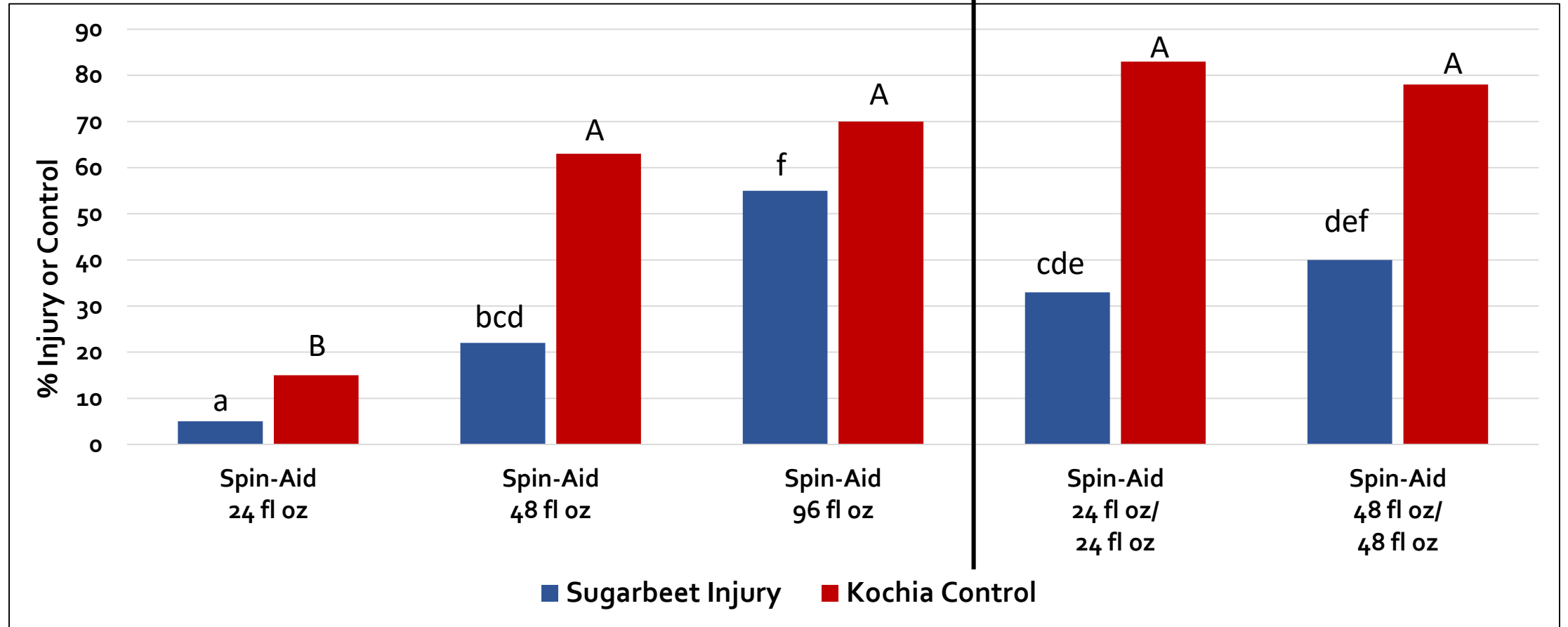
(ND Weed Control Guide, 1980)

What have we learned about Spin-Aid

- Sugarbeet rapidly metabolize Spin-Aid to less toxic compounds (Hendrick et al. 1974)
- Spin-Aid should be applied over small weeds; rate dependent on sugarbeet growth stage
- Environmental conditions influences PSII inhibitors efficacy
 - Weed control is less with cool temps and low light as compared with direct sunlight conditions (Abbaspoor and Streibig 2007)
 - Risk of injury increases at temperatures greater than 80F and sudden changes from a cool, cloudy environment to a hot, sunny environment (Betamix BMPs).



Injury or control from Spin-Aid, across locations, 2023.^{ab}



^aTreatments included ethofumesate at 4 to 12 fl oz/A plus Noble (MSO) at 1.5 pt/A.

^bMeans within a rating timing that do not share any letter are significantly different by the LSD at the 5% level of significance.

Kochia control from Spin-Aid, 21 DAT, greenhouse, December/January 2023/24



Sugarbeet tolerance from Spin-Aid, January

Treatment	Rate	Early, 10 to 16 DAB	Late, 23 to 29 DAB
	fl oz /A	%	%
Control		6	3
Spin-Aid + etho	24 + 4	28	6
Spin-Aid + etho/ Spin-Aid + etho	24 + 4 / 36 + 4	36	8
Spin-Aid + etho/ Spin-Aid + etho/ Spin-Aid + etho	24 + 4 / 36 + 4 / 48 + 4	44	20



Spin-Aid as part of an integrated kochia control program

- Spin-Aid rate is dependent on sugarbeet size
- Repeat Spin-aid applications on 5 day intervals for GR kochia control
- Roundup PowerMax3 mixed with Spin-Aid and etho on 10 day intervals
- Temperature at application and the following day will dictate rate
- Evaluating mixtures with Spin-Aid in the greenhouse

Sugarbeet stage	Alone	Following soil residual herbicide
(lf stage)	Spin-Aid + etho (fl oz)	Spin-Aid + etho (fl oz)
Cotyledon	Up to 16 + 4	12 + 4
2	Up to 24 + 4	16 + 4
4	Up to 32 + 4	20 + 4
6	32 + 4	24 + 4

2-inch LQ control in response to Spin-Aid applied Jan 29 and Feb 2, Greenhouse.^a



^aglyphosate tolerant source

Control of 2-inch common lambsquarters with Spin-Aid, greenhouse, 2024

Treatment ^a	Rate	Control, 4 DAAA	Control, 10 DAAA	Control, 14 DAAA
	fl oz/A	%	%	%
Control		0 b	0 c	0 c
Spin-Aid + etho	16 + 4	48 a	82 b	79 b
Spin-Aid + etho fb Spin-Aid + etho	16 + 4 / 24 + 4	62 a	93 a	94 a
Spin-Aid + etho fb Spin-Aid + etho	16 + 4 / 32 + 4	68 a	96 a	95 a
LSD (0.10)		21	6	7

^aNoble Methylated Seed Oil, 1 pt/A, Winfield United

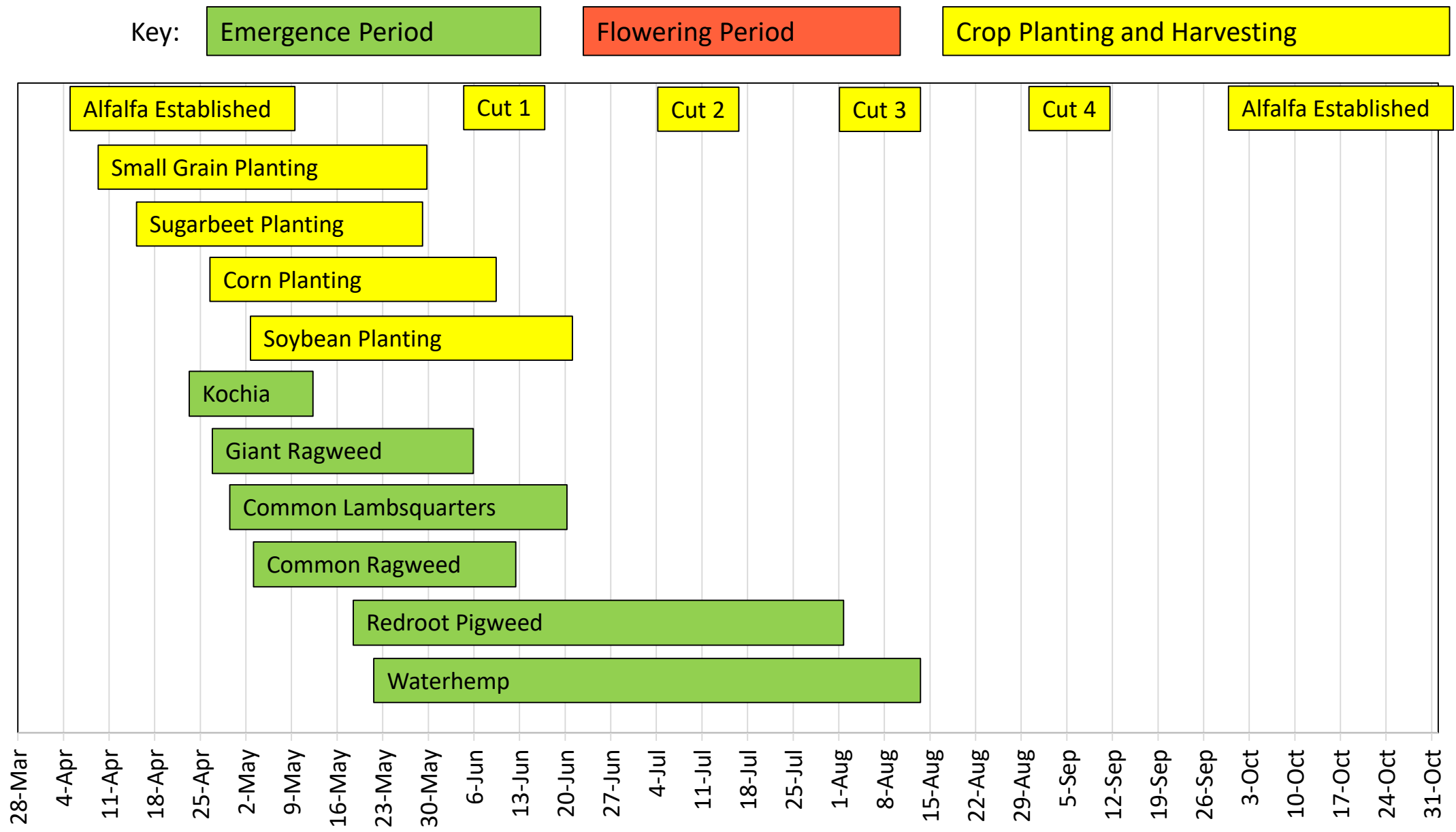
Future Research and Activity

- Spin-Aid alone and mixes with Stinger HL for common ragweed control
- Tallowamine adjuvants with glyphosate for kochia control
- Update 24(c) local needs label, cotyledon to 6-If sugarbeet, tank-mixes with group 4 and group 15 herbicides, adjuvants



I have three wishes every spring: 1) plant sugarbeet in April; 2) 1-inch of rain after PRE application; and 3) complete and uniform sugarbeet stands

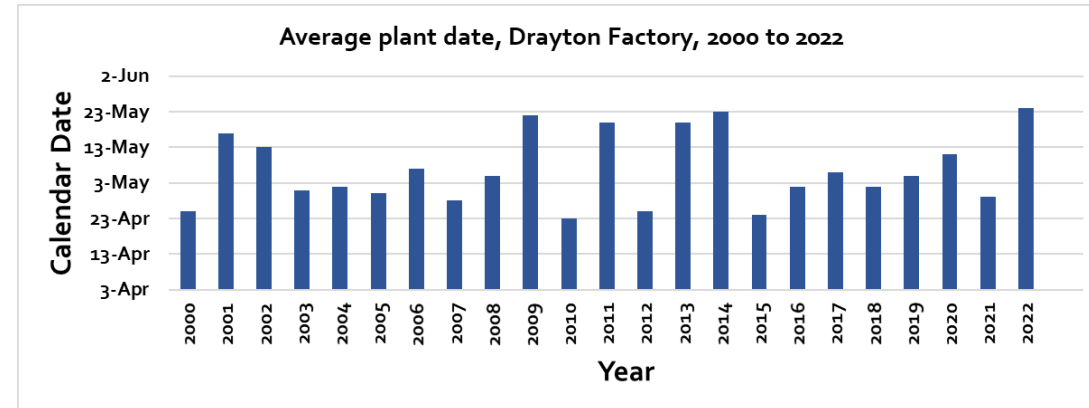




Adapted from Werle et al. 2014, Goplen et al. 2017, Weedometer 2008

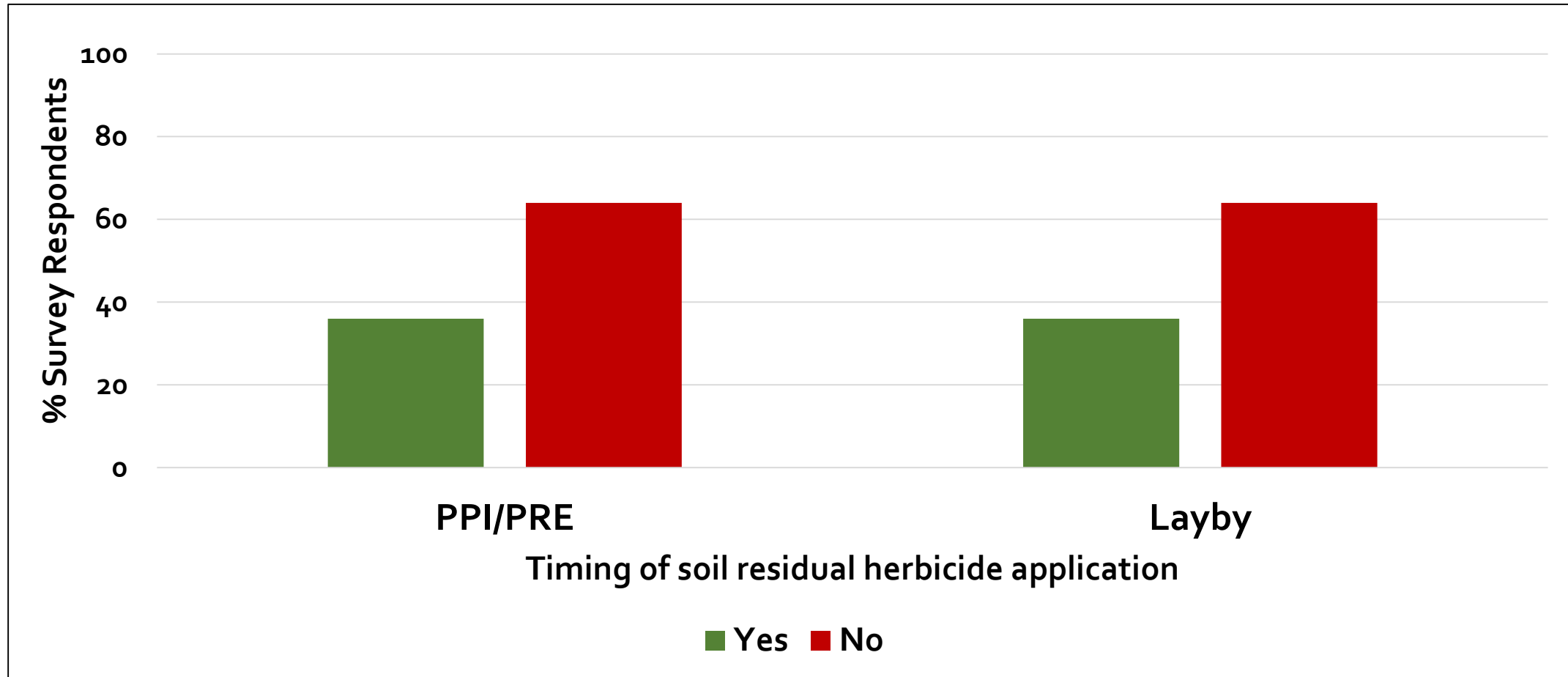
Waterhemp control by the numbers

- When will waterhemp emerge? May 15
 - Date hasn't change much across years
- When will I plant sugarbeet?
 - April 23 to May 24, Drayton, 2000-2022
- Time interval between first and second layby?
 - 13 to 17 days^a



^aHolen CA (1998) Effect of environment on sugarbeet injury from desmedipham and a growing degree equation for predicting sugarbeet leaf stages. Ph.D dissertation. Fargo, ND: North Dakota State University. 74 p

Did you use a soil residual herbicide PPI/PRE or layby herbicide in 2022?^a



^aGrafton Growers Seminar, February 9, 2023

Waterhemp Control Program in Sugarbeet

Planting Date	Recommendation
Sugarbeet plant in April or May	Dual Magnum at 0.5 to 1.0 pt/A, ethofumesate at 3 to 7.5 pt/A or Dual Magnum at 0.5 to 0.75 pt/A plus ethofumesate at 2 to 3 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 18ee), Liberty with the Redball™ 915 hooded sprayer (24c), or inter-row cultivation
July	Electric Discharge Systems (WeedZapper™)
August / September	Hand remove waterhemp

Ethofumesate in 2024

Group 15

Ethofumesate products for sugarbeet production

- Nortron, Bayer CropScience
- Ethotron, UPL NA Inc.
- Ethofumesate 4SC, Farm Business Network
- Nektron, Atticus, AG
- Maxtron 4SC (3.78 lb/G), ALBAUGH, LLC

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Chloroacetamides in 2024

Group 15

Dimethenamid

- Outlook, BASF

Acetochlor (encapsulated)

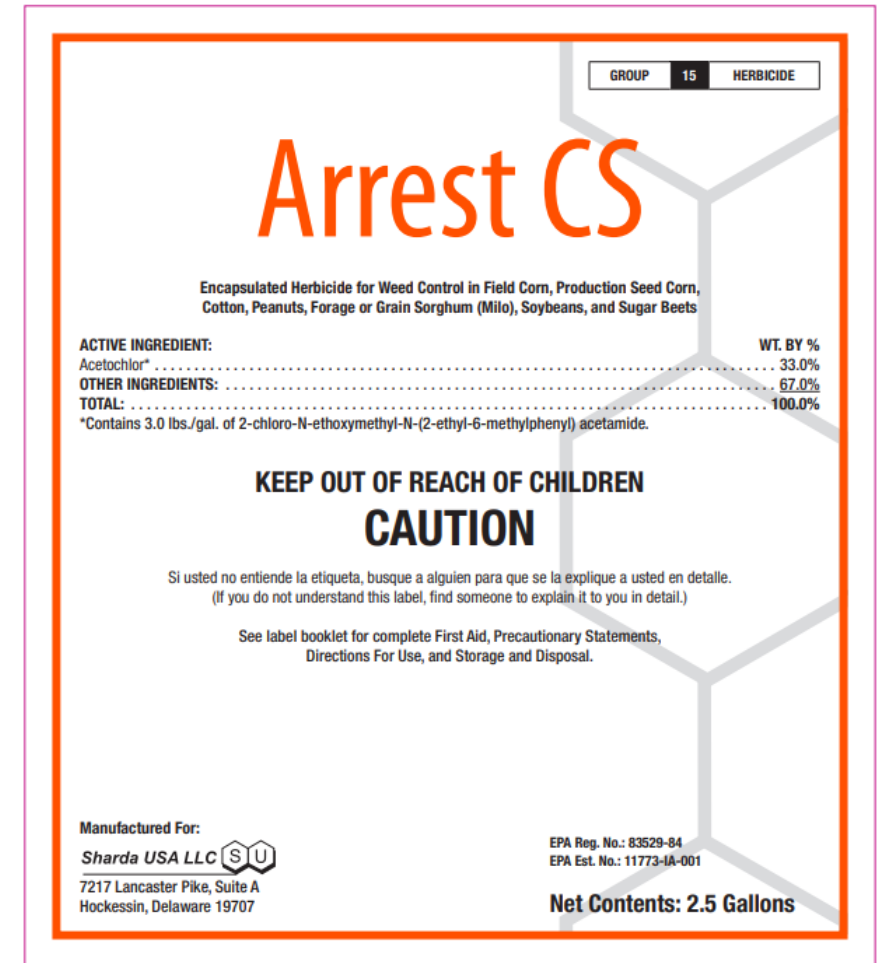
- Warrant, Bayer CropScience
- Enversa, Corteva agriscience
- Arrest CS, Sharda USA LLC

S-metolachlor

- Dual Magnum, Syngenta Crop Protection, LLC
- EverpreX, Corteva agriscience
- Medal, Syngenta Crop Protection, LLC
- Brawl, TENKOZ, Inc.
- Moccasin, UPL NA Inc.
- Charger Basic, WinField United

Arrest CS

- Warrant is encapsulated acetochlor. I believe encapsulation offers safety with sugarbeet
- Arrest CS is also an encapsulated formulation
- Warrant is labeled for application POST in sugarbeet
- Arrest CS has labeled applications of pre-plant, at-planting, preemergence, and POST applications in sugarbeet
- **DON'T apply this product before, at, or immediately after planting**



How long do soil residual herbicides last?

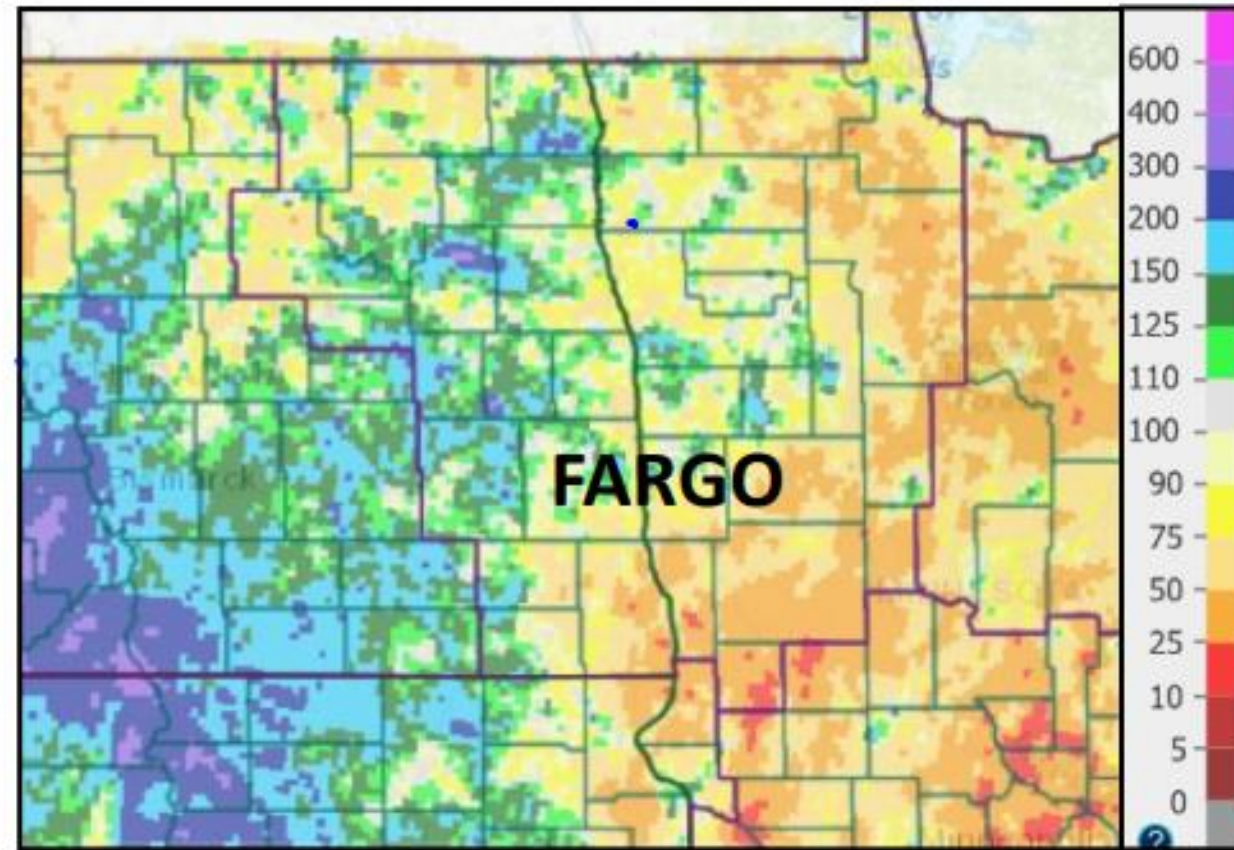
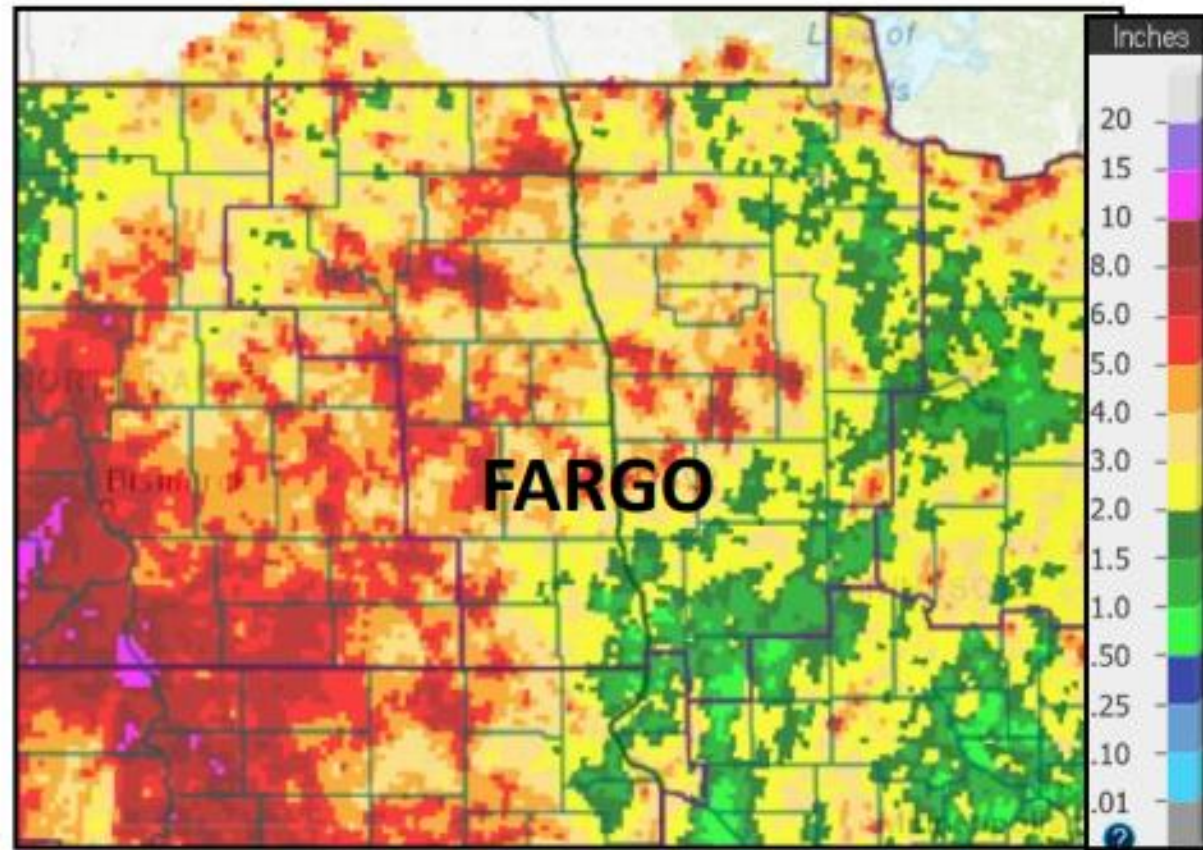
Product	Application in sugarbeet	ND Weed Control ^b	TJP / Label
		Num of Weeks	
Ethofumesate 5-7.5 pt	PPI/PRE	6 to 12	4-8
Ethofumesate 2-3 pt	PRE	-	3
Dual Magnum	PRE	0-2 / 2-6	2

Residual weed activity ^b	Num of Weeds
Short	0 to 2
Medium	2 to 6
Long	6 to 12
Very Long	Greater than 12

Product	Application in sugarbeet ^a	ND Weed Control ^b	TJP / Label
		Num of Weeks	
Outlook	POST	0-2 / 2-6	2
S-metolachlor	POST	0-2 / 2-6	3
Warrant	POST	0-2 / 2-6	4

^aPOST to sugarbeet; PRE to waterhemp

June 2023 Rainfall



June precipitation (left) for eastern North Dakota and northwest Minnesota.
June percent of normal precipitation (right).

Outlook, S-metolachlor or Warrant applied at the 2- If stage

- The Section 3 label states Warrant, S-metolachlor products and Outlook application at the 2-If sugarbeet.
- Growers frequently ask about timing Outlook, especially when rain is in the forecast.
- My question is “Do you have a full stand?”
- I have always wondered about Outlook impact on stand.

Sugarbeet stands in response to treatment, Drayton ND, 2023

Treatment PRE ¹	Treatment POST	Rate	Sugarbeet Stand ²
		(fl oz/A)	(Num per 100 ft row)
No	Outlook/ Outlook	12 / 12	80 b
No	Dual Magnum / Dual Magnum	18 / 18	140 a
No	Dual Magnum / Outlook	18 / 12	143 a
No	RUPM ₃ +etho / Ultra Blazer	25 + 6 / 16	135 a
Yes	Outlook/ Outlook	12 / 12	100 ab
Yes	Dual Magnum / Dual Magnum	18 / 18	122 ab
Yes	Dual Magnum / Outlook	18 / 12	135 a
Yes	RUPM ₃ +etho / Ultra Blazer	25 + 6 / 16	144 a

¹ Ethofumesate + Dual Magnum, PRE

²Stands collected on 4- to 6-lf sugarbeet

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See & Spray™ technology

- Camera system recognizes 'plant' is different from sugarbeet
- Artificial intelligence vs. Machine Learning
- AI is computer software that mimics human cognition to perform complex tasks.
- ML is an application of AI that uses algorithms trained on data to perform a task
- I hear possible field evaluation in sugarbeet in 2024 and commercially available in sugarbeet in 2026
- What is our goal in sugarbeet?
- What herbicides make sense to use in sugarbeet?



	SEE & SPRAY SELECT	SEE & SPRAY ULTIMATE	SEE & SPRAY PREMIUM
Fallow Use			
In-Season Use			
Traditional Broadcast Spray Application			
Targeted Spray Application*			
Single Tank			
Dual-Product Solution System/Split Tank			



Image from the John Deere website

Thank you to our collaborators

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- David Mettler and SMBSC research team; Emma Burt and the Minn-Dak research team
- Our grower cooperators
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 - Minn-Dak Farmers Coop: Tony Hought, Matt Moxness, Vince Ulstad
 - Southern Minnesota Beet Sugar Coop: Steve and Nick Frank, Petersen Farms, Youngkrantz Family Farm

Thank you for your continued support

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