

Weed Control in Sugarbeet

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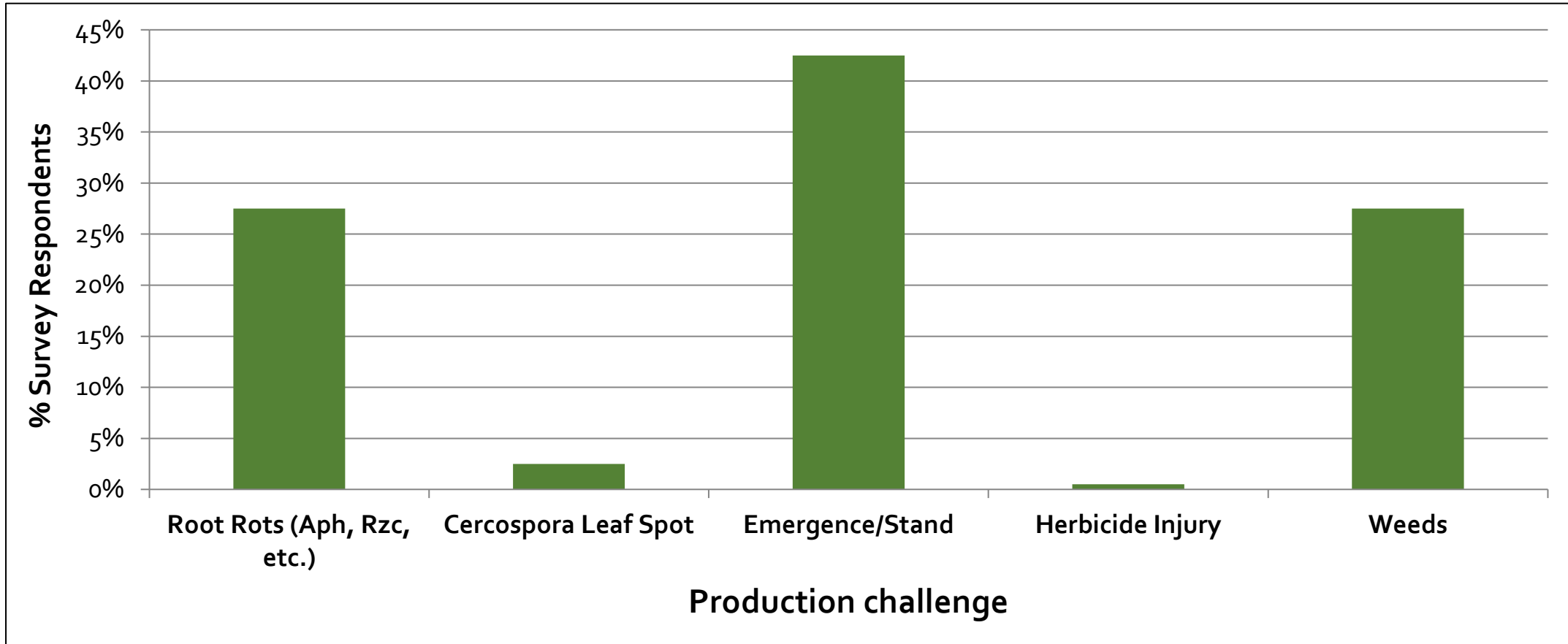
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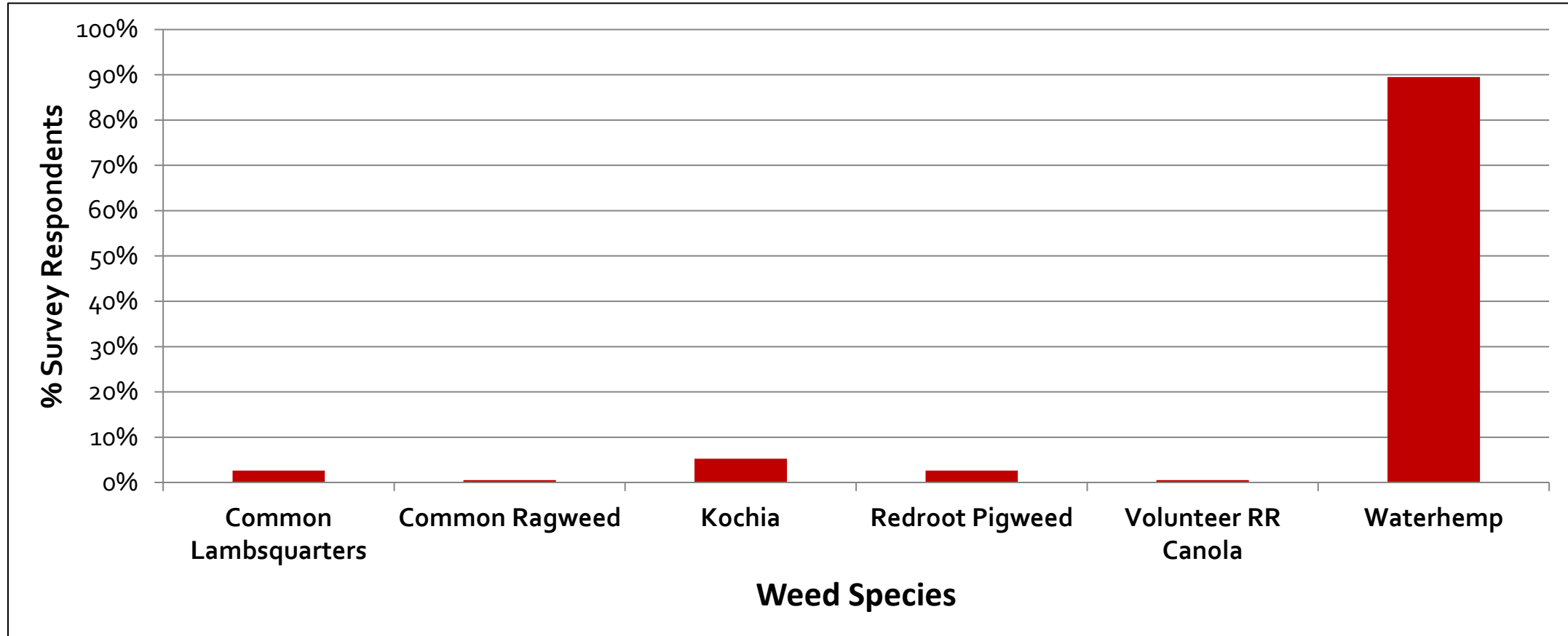
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What was your most important production problem in 2022?^a (Multiple Choice)



^aGrand Forks Growers Seminar, February 16, 2023

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



^aGrand Forks Growers Seminar, February 16, 2023

Outline

- Waterhemp control in sugarbeet
- Stinger HL for ragweed control
- Complex mixtures
- Spin-Aid for kochia control

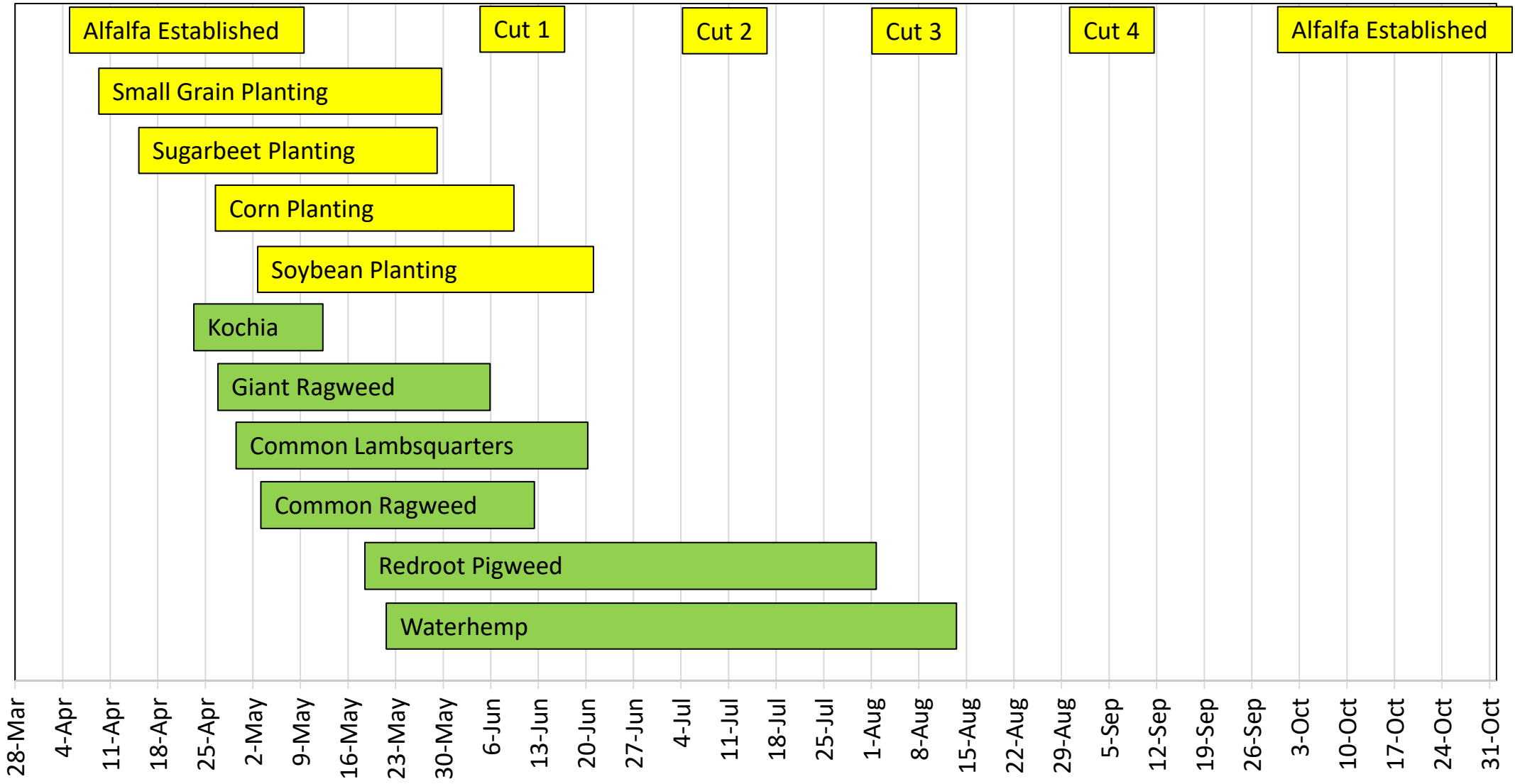


Key:

Emergence Period

Flowering Period

Crop Planting and Harvesting

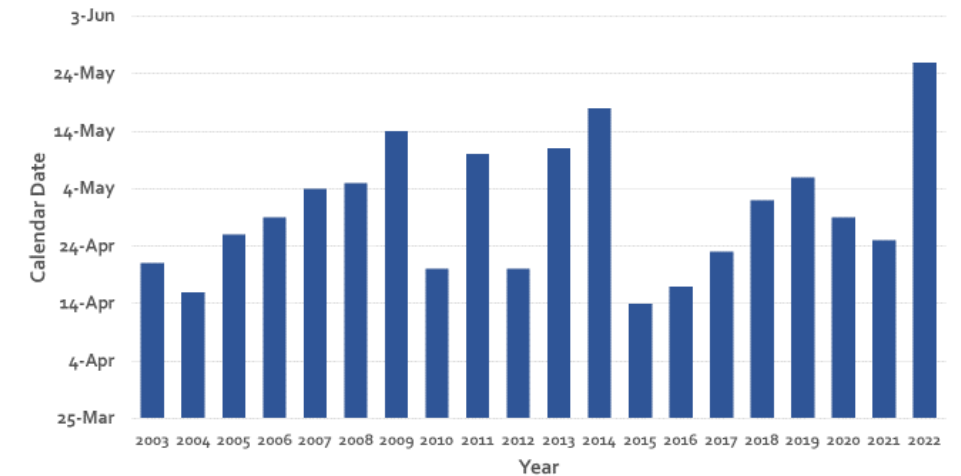


Adapted from Werle et al. 2014, Goplen et al. 2017, Weedometer 2008

Waterhemp control by the numbers

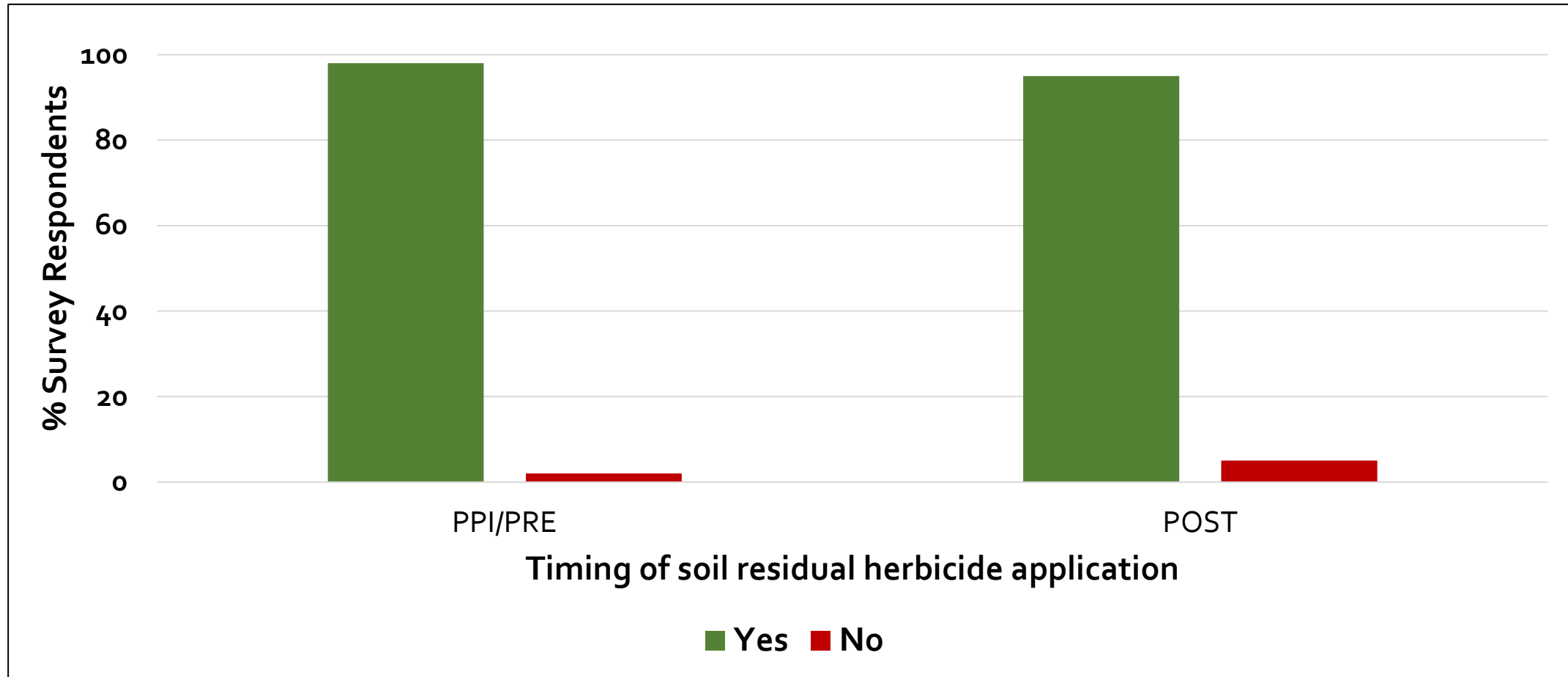
- When will waterhemp emerge? May 10
 - Date hasn't change much across years
- When will I plant sugarbeet?
 - April 14 to May 26, Minn-Dak, 2000-2022
- Time interval between first and second layby?
 - 13 to 17 days^a

Average sugarbeet plant date, MDFC, 2003 to 2022.



^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 POST in 2022?^a



^aGrand Forks Growers Seminar, February 7, 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)

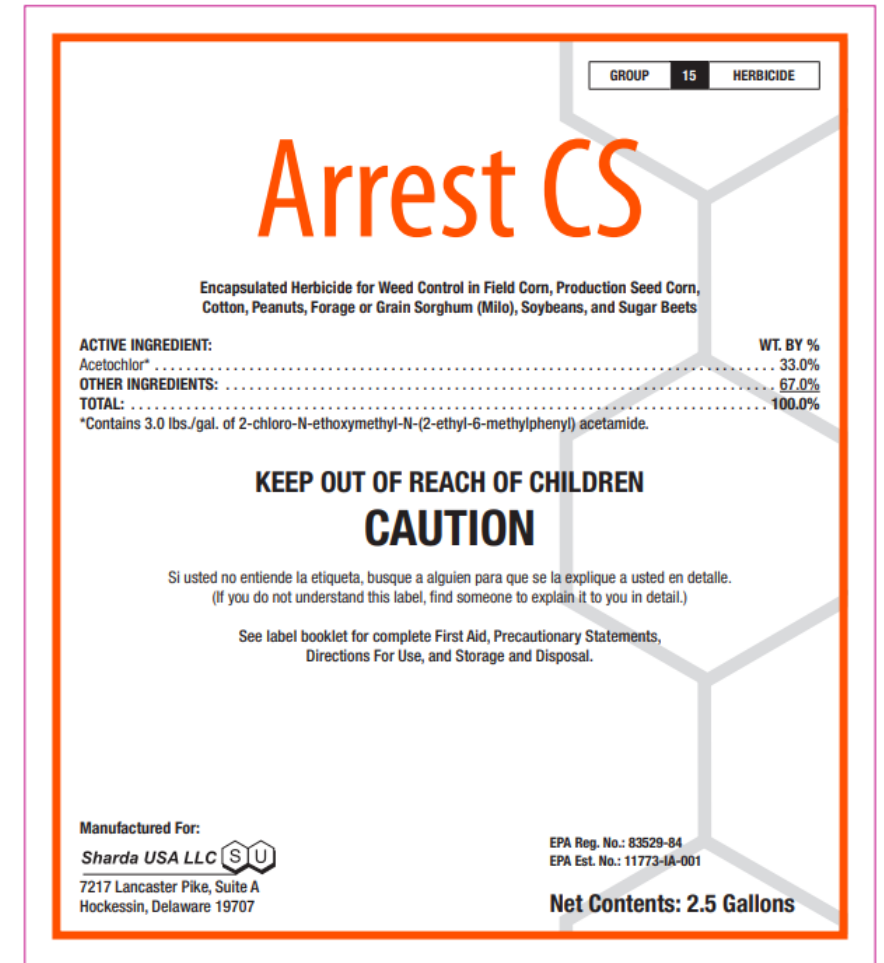
- Warrant, Bayer CropScience
- Enversa, Corteva agriscience
- Arrest CS, Sharda USA LLC

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

Best Management Practices for Stinger HL application and ragweed control

- Stinger HL at 1.8 fl oz/A must be our lowest rate; 2.4 fl oz is preferred.
- Stinger HL at 1.8 fl oz/A fb Stinger HL at 1.8 fl oz/A for repeat applications, especially on ragweed greater than 2-inch.
- Time Stinger HL application to ragweed size rather than sugarbeet stage.
- May need to separate glyphosate and Stinger HL application if your want to delay termination nurse crop to 4-lf sugarbeet.



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	1.8 – 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

Common ragweed control, Ada, MN, 2022

Ragweed less than 2-inch

Treatment	Rate	Common ragweed control	
		July 8 16 DAAC	July 26 34 DAAC
	fl oz/A	%	%
Stinger HL + PowerMax3	1.2 + 25	75 b	60 cd
Stinger HL + PowerMax3	1.8 + 25	91 a	80 b
Stinger HL + PowerMax3	2.4 + 25	91 a	88 a
Stinger HL + PM ₃ / Stinger HL + PM ₃	1.5 + 25 / 1.5 + 25	91 a	89 a
Stinger HL + PM ₃ / Stinger HL + PM ₃	1.8 + 25 / 1.8 + 25	95 a	94 a
LSD (0.05)		6	6

Common ragweed control, Ada, MN, 2022

Ragweed 2- to 4-inch

Treatment	Rate	Common ragweed control	
		July 8 11 DAAD	July 26 29 DAAD
	fl oz/A	%	%
Stinger HL + PowerMax3	1.2 + 25	65 c	54 d
Stinger HL + PowerMax3	1.8 + 25	68 c	63 c
Stinger HL + PowerMax3	2.4 + 25	71 bc	65 c
Stinger HL + PM3 / Stinger HL + PM3	1.5 + 25 / 1.5 + 25	69 c	77 b
Stinger HL + PM3 / Stinger HL + PM3	1.8 + 25 / 1.8 + 25	70 bc	79 b
LSD (0.05)		6	6

Sugarbeet injury, Ada, MN, 2022

Treatment	Rate	Common Ragweed	Sugarbeet	Growth Reduction	
				June 30 8 DAAC	July 16 24 DAAC
	fl oz/A	inch	lvs	%	%
Stinger HL + PowerMax3	1.2 + 25	<2	2	0 d	0
Stinger HL + PowerMax3	1.8 + 25	<2	2	0 d	0
Stinger HL + PowerMax3	2.4 + 25	<2	2	0 d	0
Stinger HL + PowerMax3	1.2 + 25	2-4	2-4	6 bcd	0
Stinger HL + PowerMax3	1.8 + 25	2-4	2-4	8 bc	0
Stinger HL + PowerMax3	2.4 + 25	2-4	2-4	11 ab	3
LSD (0.05)				7	NS

Other thoughts about Stinger HL

- 10.5 months **Rotation Interval** with soils greater than 2% organic matter AND rainfall more than 15 inches during 12 months following application
- 6-inch of rain in June, July and August
- Climate information is especially if Stinger HL rate is greater than 3.6 fl oz/A in a season
- Manage clopyralid products in the sequence with sugarbeet

Spring Wheat	Sugarbeet	Corn
WideMatch	Stinger HL	SureStart/II / TripleFlex/II
WideARmatch		Resicore / Resicore XL
Curtail		Maverick
PerfectMatch		Kyro

Why do you make pesticide mixtures?

- Improve weed control
- Broaden spectrum of control
- Save trips



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

Sugarbeet degrades herbicides by metabolizing herbicides

Challenging environmental conditions slow metabolism

- Cool temperatures
- Excessive moisture conditions
- Overcast days

Multiple herbicides means sugarbeet has to detoxify several active ingredients under stress conditions...at the same time



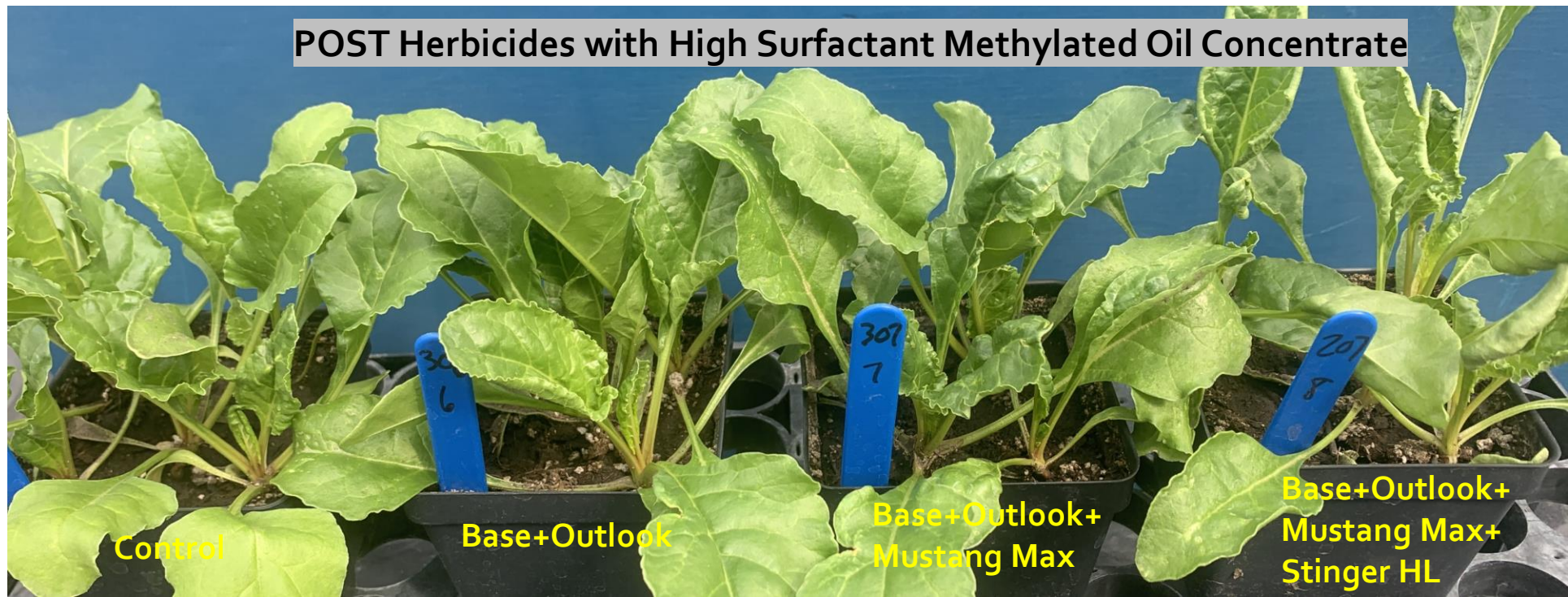
Etho + Dual Magnum (PRE) at 2 + 0.5 pt/A followed by RUPM₃ + etho + S-metolachlor + Stinger HL (2-lf) at 25 + 6 + 16 + 1.5 fl oz/A fb RPM₃₃ + etho + S-metolachlor + Stinger HL (6-lf) at 25 + 6 + 16 + 1.5 fl oz/A, Rothsay, MN, 2022.

Sugarbeet injury, greenhouse, March 2023

Treatment	Rate	GR, 10 DAT	GR, 14 DAT	GR, 17 DAT
	fl oz /A	-----%-----		
RUPM ₃ + ethofumesate (base)	30 + 12	10 c	4 c	3 c
Base + Outlook	21	27 b	12 b	9 c
Base + Outlook and Mustang Maxx	21 + 4	16 c	15 b	18 b
Base + Outlook, Mustang Maxx and Stinger HL	21 + 4 + 3.6	37 a	37 a	43 a
LSD (0.10)		10	9	10

- Injury from Mustang Maxx (or Asana) less than chlorpyrifos.
- Add adjuvant with RUPM, ethofumesate and Outlook. Leave it out with RUPM, ethofumesate, Outlook, insecticide and Stinger

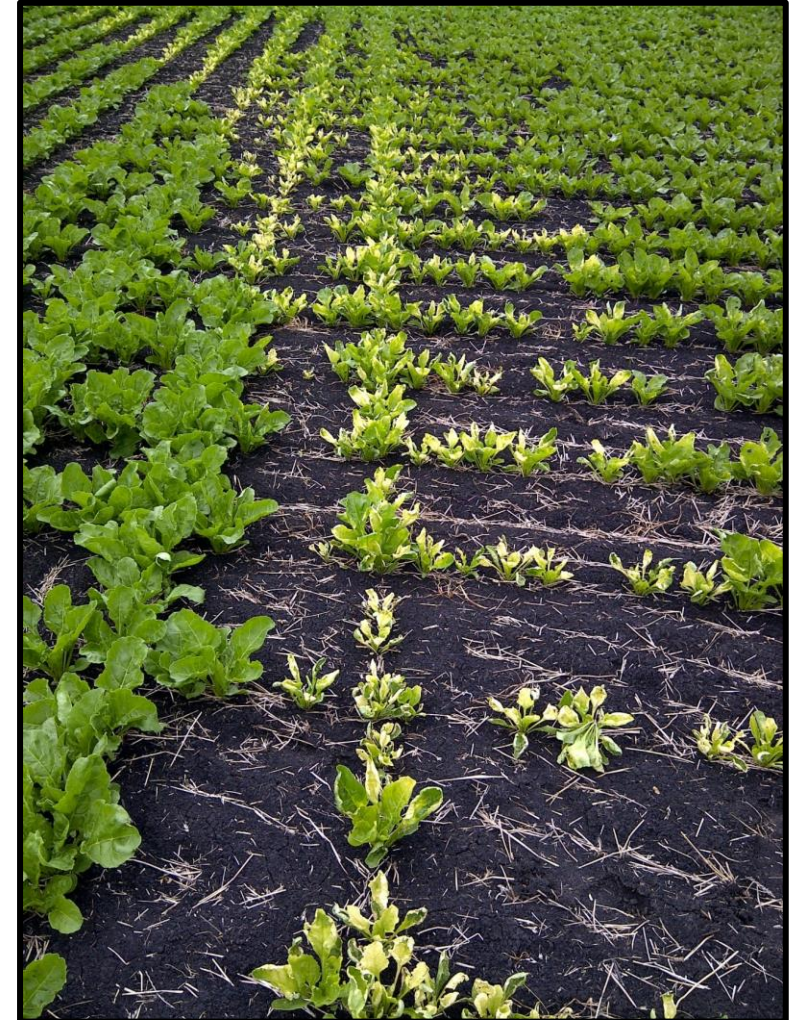
Run 2



Soil-borne fungicides with herbicides

- Quadris can be mixed with Roundup Power Max and/or Stinger
- Oil based formulations or adjuvants mixed with Quadris may cause necrosis and chlorosis injury to sugarbeet
- What about Excalia?

Quadris mixed with oil-based herbicides may cause bronzing or bleaching damage. Image probably at overlap rate. Photo courtesy of Mike Metzger, Minn-Dak Farmers Coop.



Sugarbeet injury in response to herbicide treatment, greenhouse, 2023

Herbicide treatment	Rate	Necrosis		Growth Reduction	
		4 DAT	14 DAT	4 DAT	14 DAT
	----fl oz/A----	%	-----%-----		
Non-Treated Control	-	0 c	3 c	3 d	
RUPM ₃ + etho + Outlook (base)	28+ 6+ 16	8 b	16 b	13 c	
Base + Excalia + Mustang Max + Stinger HL	2 + 4 + 2.4	0 c	19 b	21 b	
Base + Quadris + Mustang Max + Stinger HL	14.3 + 4 + 2.4	30 a	60 a	43 a	

- Can sugarbeet injury be explained by Excalia or Quadris formulation?
 - Excalia is a suspension concentrate formulation
 - Quadris is a flowable formulation

Pesticide mixtures with Excalia or Quadris, greenhouse, 2023

Images collected on May 1, 2023, 11 DAT



*Base = Roundup PowerMAX3 + Nortron + Outlook with Destiny HC and Amsol Liquid AMS

Sugarbeet injury in response to herbicide treatment, greenhouse, 2023

Herbicide treatment	Rate ----fl oz/A----	Necrosis	Growth Reduction	
		4 DAT	4 DAT	14 DAT
		%	-----%-----	
Non-Treated Control	-	0 b	3 b	3 b
RUPM ₃ + etho + Outlook (base)	25+ 12+ 21	8 a	16 a	13 a
Ecalia and Mustang Max	2 + 4	0 b	10 ab	0 b
Quadris and Mustang Max	14.3 + 4	0 b	11 ab	5 ab

Mustang Max mixed with Excalia or Quadris, greenhouse, 2023

Images collected on May 1, 2023, 11 DAT





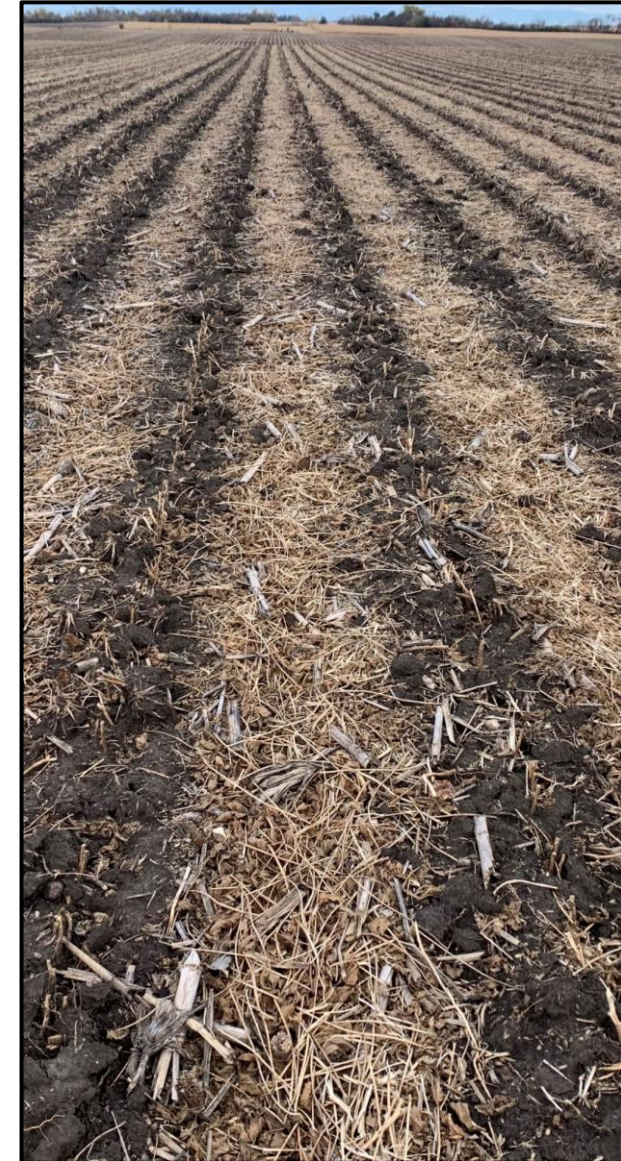


Kochia control in sugarbeet

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
- Roundup PowerMax3 + ethoxylate tallowamine adjuvants + AMS



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



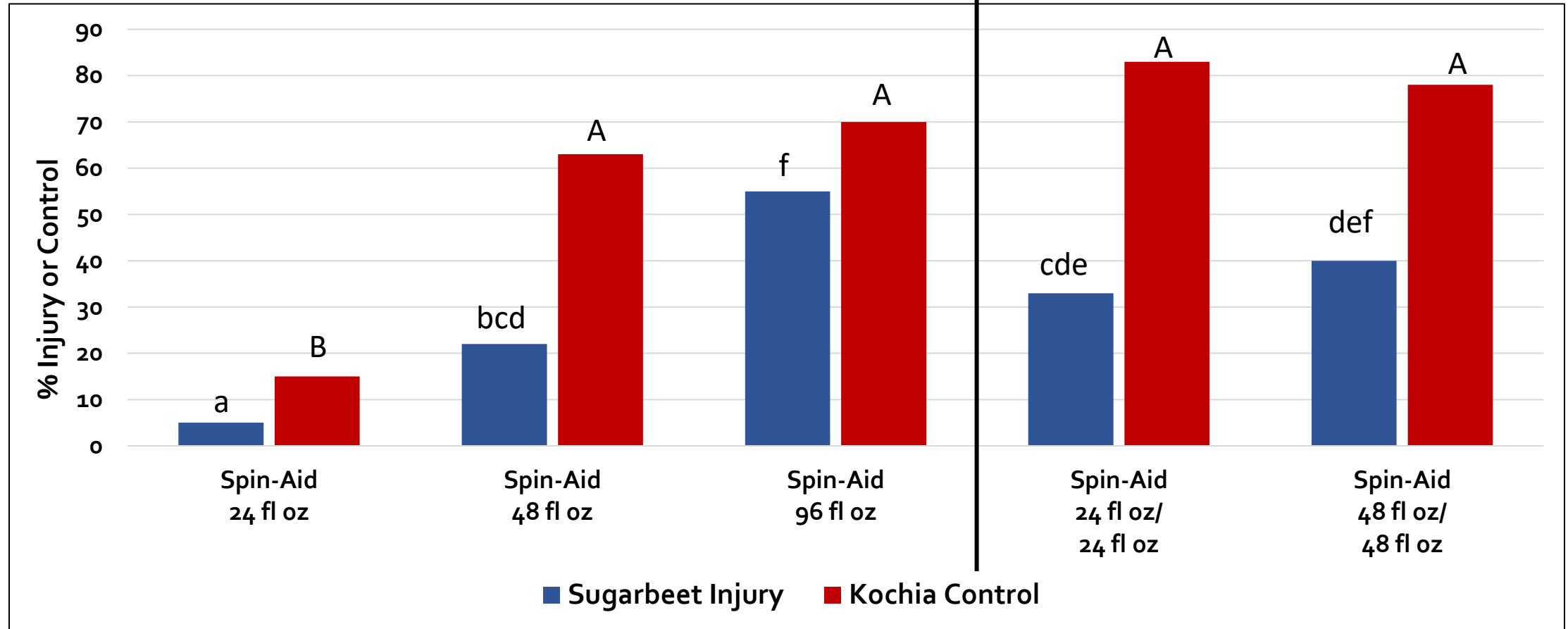
- too big
- Scout early next year

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



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

Spin-Aid as part of an integrated kochia control program

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

Sugarbeet stage	Alone	Following soil residual herbicide
(lf stage)	Spin-Aid + etho (fl oz)	Spin-Aid + etho (fl oz)
Cotyledon	16 + 4	12 + 4
2	24 + 4	16 + 4
4	32 + 4	24 + 4
6	40 + 4	32 + 4

Future Research and Activity

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



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	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
In-Season Use	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Traditional Broadcast Spray Application	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Targeted Spray Application*	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Single Tank	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Dual-Product Solution System/Split Tank	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

Image from the John Deere website

Thank you to our collaborators

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Thank you for your continued support

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