Weed Control in Sugarbeet
Fargo

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North Dakota State University / Univ of Minnesota

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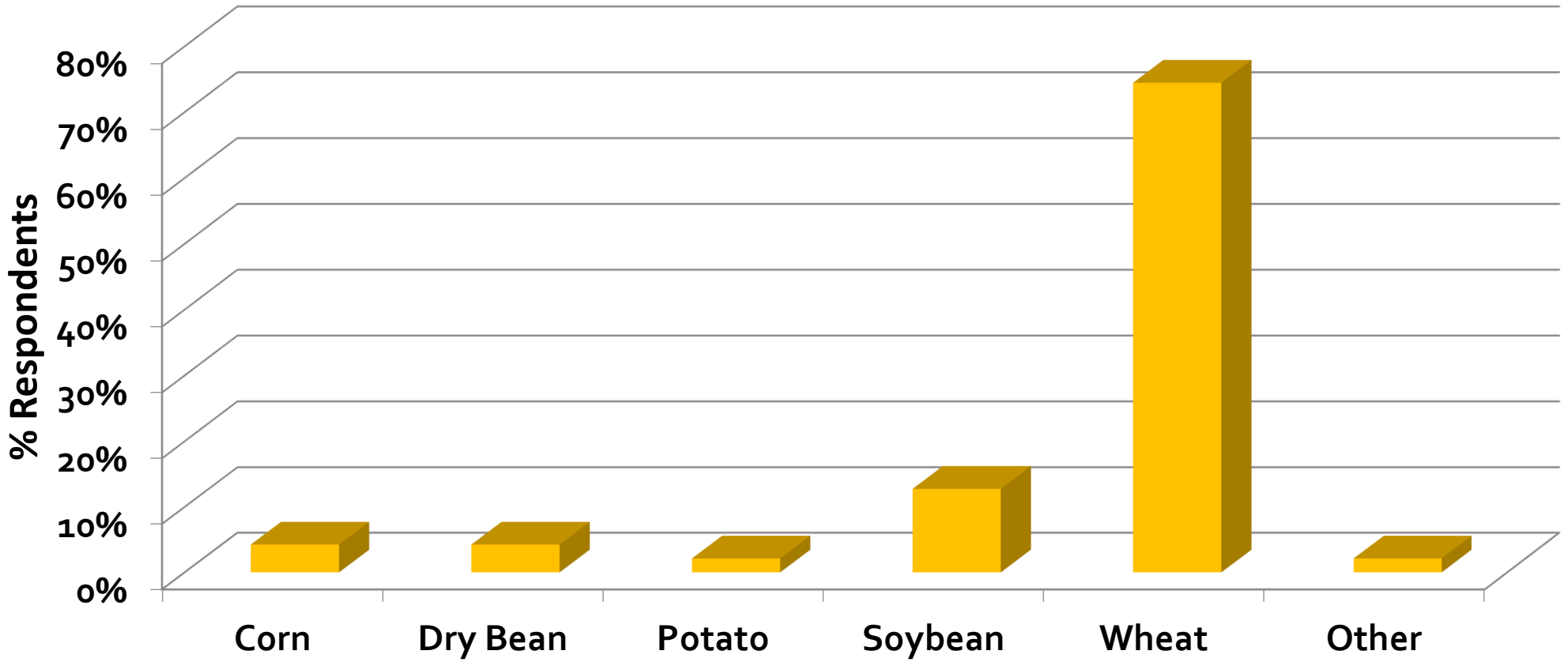
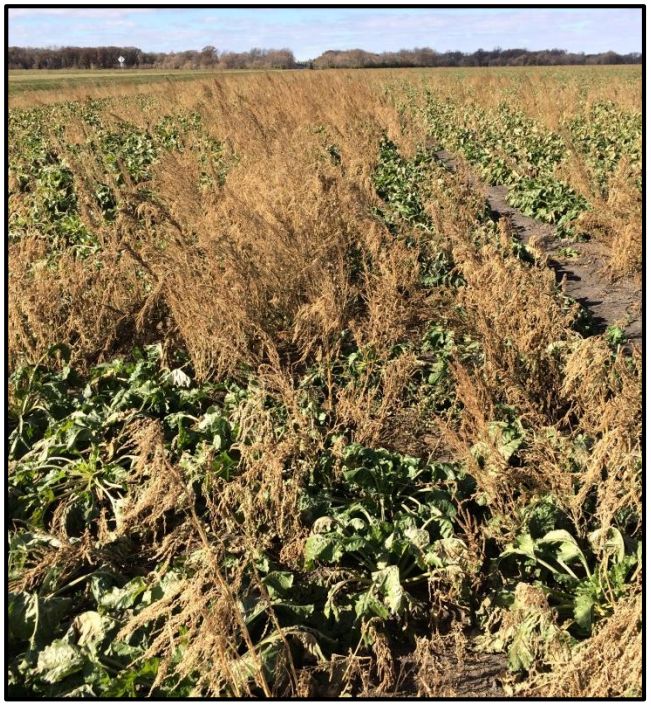
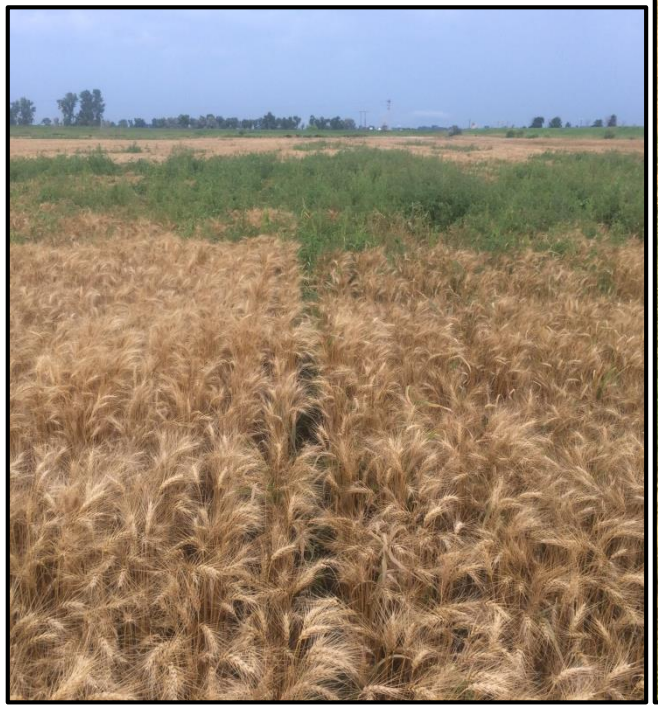
What crop preceded most of your sugarbeet acres in 2017[1]?

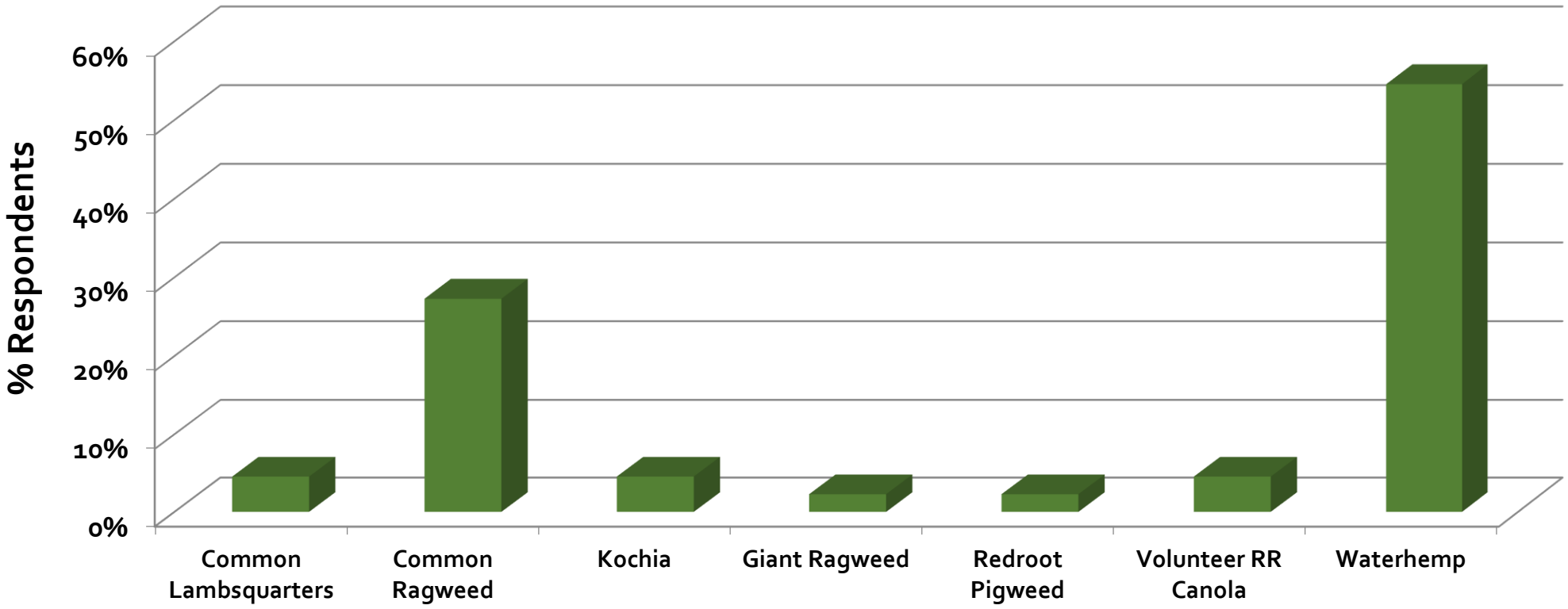


[1]Turning Point Survey of Growers; conducted at the 2018 Sugarbeet Growers Seminar, Fargo





What was your worst weed problem in 2017[1]?



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Common Ragweed

- Life cycle: summer annual broadleaf
- Growth habit: fibrous root system, grows 2 to 4 feet high
- Germination: soil temperature triggers germination,
  - between 50 and 80 F
  - returns to dormancy when temperatures get hot in June and July
- Reproductive habit: male and female flowers are in separate flower heads on the same plant (monoecious)

- Seed production: 30,000 to 60,000 seeds per plant
- Longevity: 25 to 35 years
- Resistant biotypes to multiple classes of herbicides
  - ALS (SOA 2)
  - PPO inhibitor (SOA 14)
  - Glyphosate (9)

Sugarbeet injury and control of common ragweed, Doran ND, 2018

Three inch common ragweed

Herbicide Treatment[1]	Rate	June 21 sgbt inj	June 28 cora cntl	July 11 cora cntl
	fl oz/A	----------(%)----------		
PowerMax [2]	28	8	55	58
PowerMax+ethofumesate	28+4	18	55	53
PowerMax+Stinger	28+2	5	85	73
PMax+Stinger	28+4	8	94	93
PowerMax+Stinger/ PowerMax+Stinger	28+2/ 28+2	10	98	99
PowerMax+Stinger/ PowerMax+Stinger	28+4/ 28+4	8	100	100
LSD (0.1)		14	5	8

[1]PowerMax alone and PowerMax+Stinger treatments were applied with N-Pak AMS at 2.5% v/v and Prefer 90 NIS at 0.25% v/v.

[2]Application May 31 and June 13

Sugarbeet injury and control of common ragweed, Doran ND, 2018

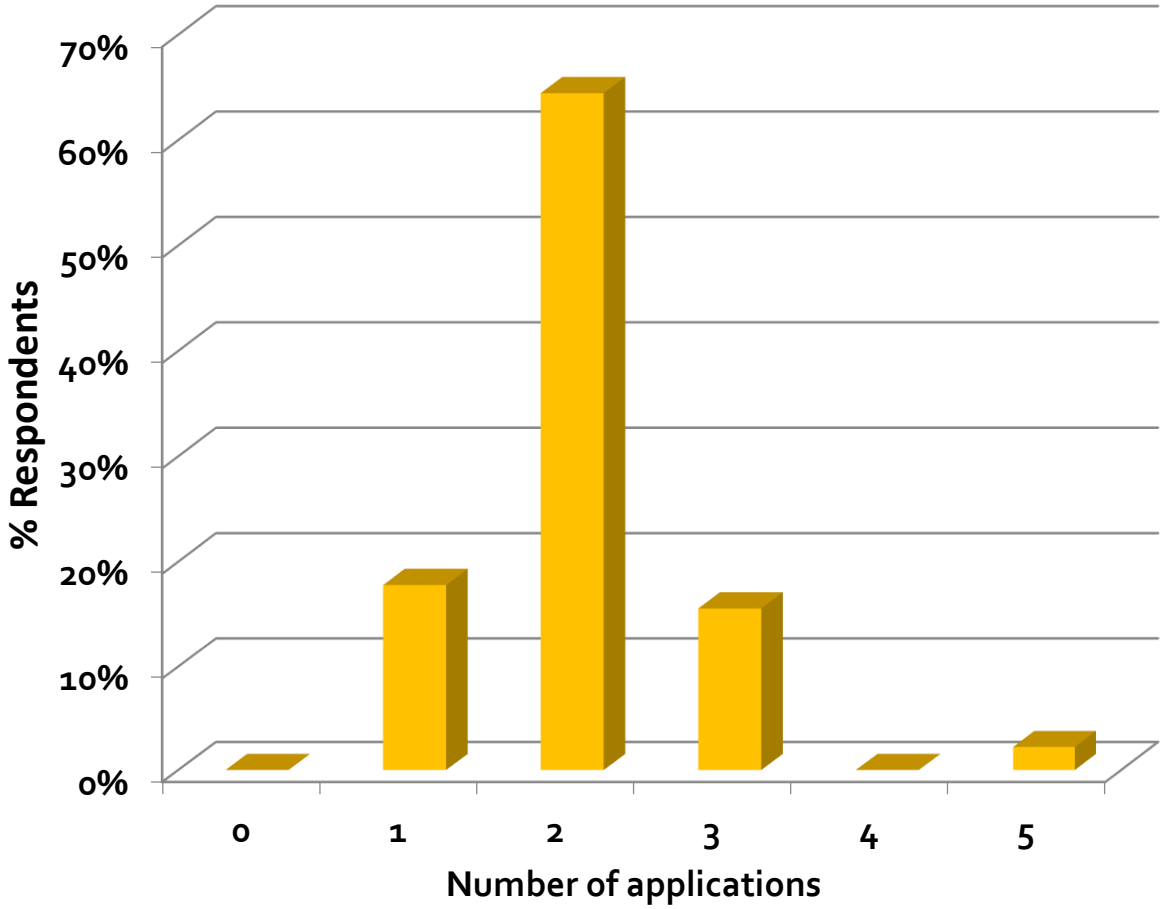
Six inch common ragweed

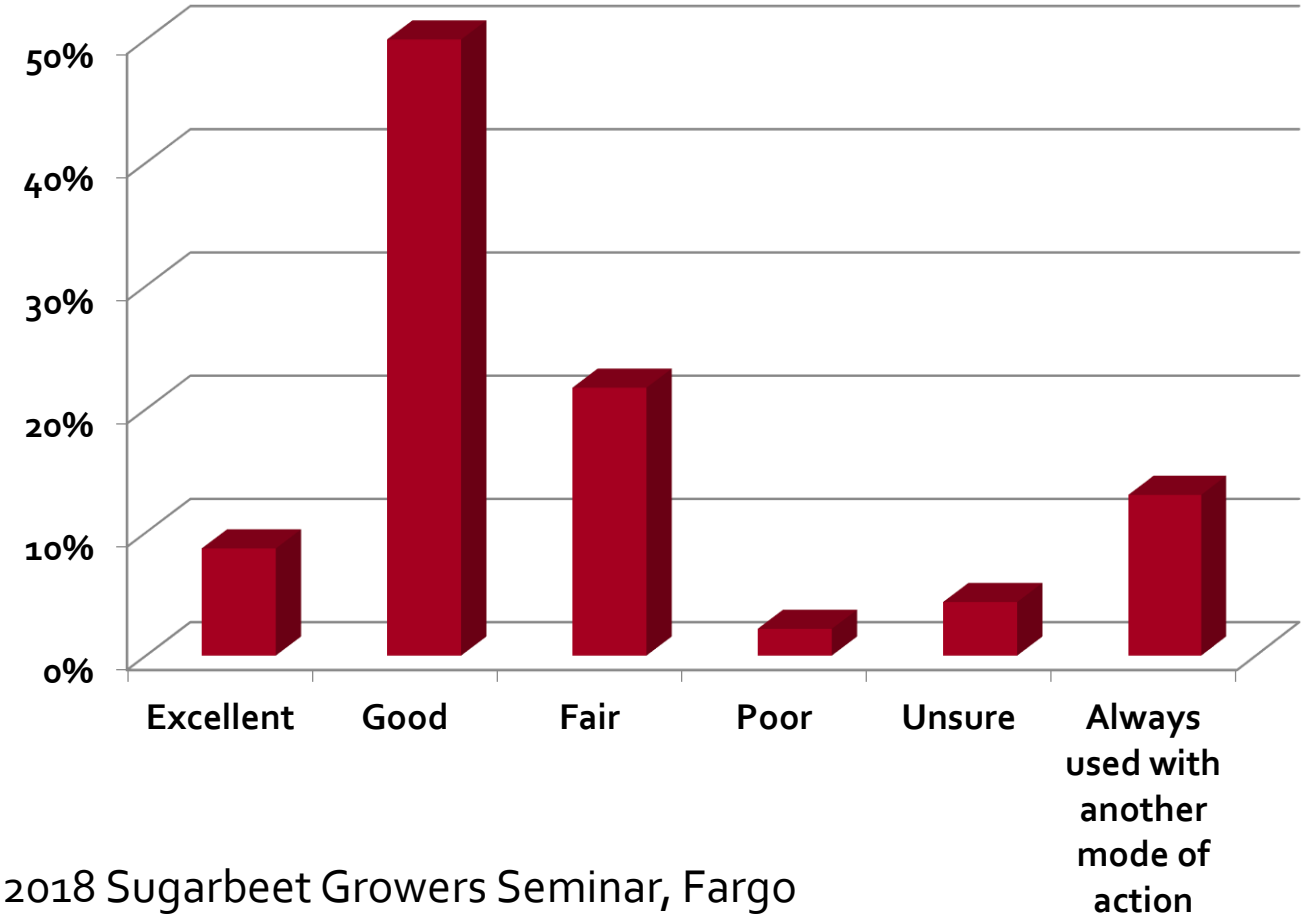
Herbicide Treatment[1]	Rate	June 21 sgbt inj	June 28 cora cntl	July 11 cora cntl
	fl oz/A	----------(%)----------		
PowerMax [2]	28	5	78	66
PowerMax+ethofumesate	28+4	18	71	65
PowerMax+Stinger	28+2	13	76	72
PMax+Stinger	28+4	23	75	73
PowerMax+Stinger/ PowerMax+Stinger	28+2/ 28+2	15	81	82
PowerMax+Stinger/ PowerMax+Stinger	28+4/ 28+4	28	76	91
LSD (0.1)		8	13	16

[1]PowerMax alone and PowerMax+Stinger treatments were applied with N-Pak AMS at 2.5% v/v and Prefer 90 NIS at 0.25% v/v.

[2]Application May 31 and June 13

How many glyphosate applications did you use in 2017? How did it work[1]?





[1]Turning Point Survey of Growers; conducted at the 2018 Sugarbeet Growers Seminar, Fargo

Glyphosate alone, glyphosate in tank-mixes[1]

	Central Minnesota	RR Valley South	RR Valley Central	RR Valley North
	----------% of survey respondents----------			
Glyphosate	9	23	34	**79**
Glyphosate + soil residual herbicide applied POST	77	47	11	0
Glyphosate + POST broadleaf herbicide	9	23	53	17
Glyphosate + POST grass herbicide	5	7	2	4
Broadleaf Tank-mix	86	70	64	17

[1]Turning Point Survey of Growers; conducted at the 2018 Sugarbeet Grower Seminars

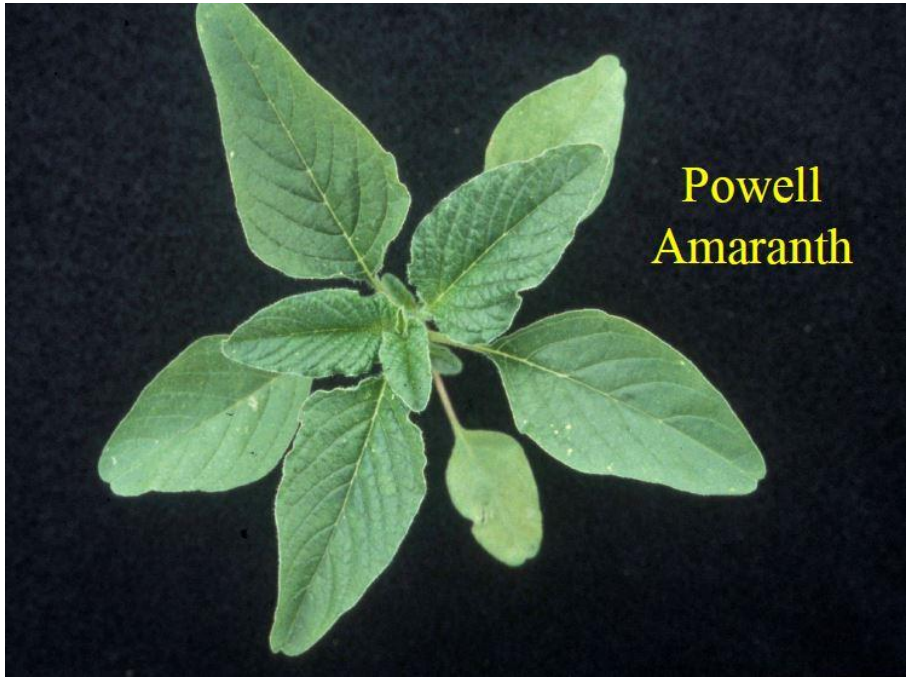
Glyphosate products are different formulations and adjuvant loading

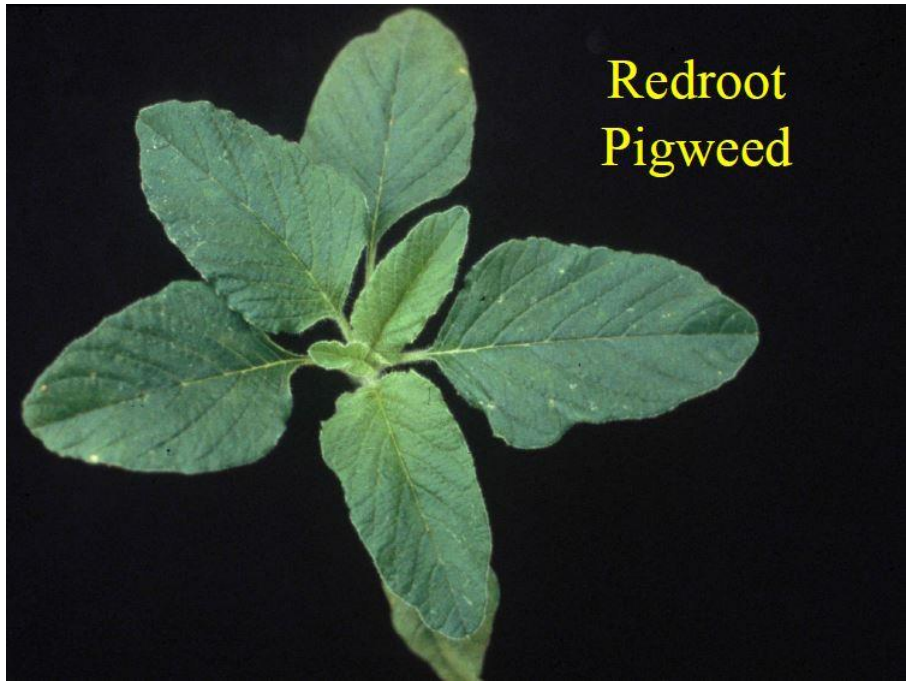
Trade Name	Manufacturer	Glyphosate Salt	lb ae/gal	lb ai/gal	Adjuvant Load*	Rate to get 0.98 lb ae /A
PowerMax	Monsanto	K	4.5	5.5	Full	28
Roundup Original	Monsanto	Ipa	3	3	Full	42
Buccaneer	Tenkoz	Ipa	3	4	Partial	42
Buccaneer Plus	Tenkoz	Ipa	3	4	Full	42
Cornerstone 5 Plus	Winfield United	Ipa	4	5.5	Full	31
Credit / 41	NuFarm	Ipa	3	4	Partial	42
Glyfos	Cheminova	Ipa	3	4	Partial	42
Gly Star Gold	Albaugh	Ipa	3	4	Full	42
Imitator Plus	Drexel	Ipa	3	4	Full	42
Mad Dog	Loveland	Ipa	3	4	Partial	42
Showdown	Helena	Ipa + NH_4	2.7+0.3	3.64	Full	42

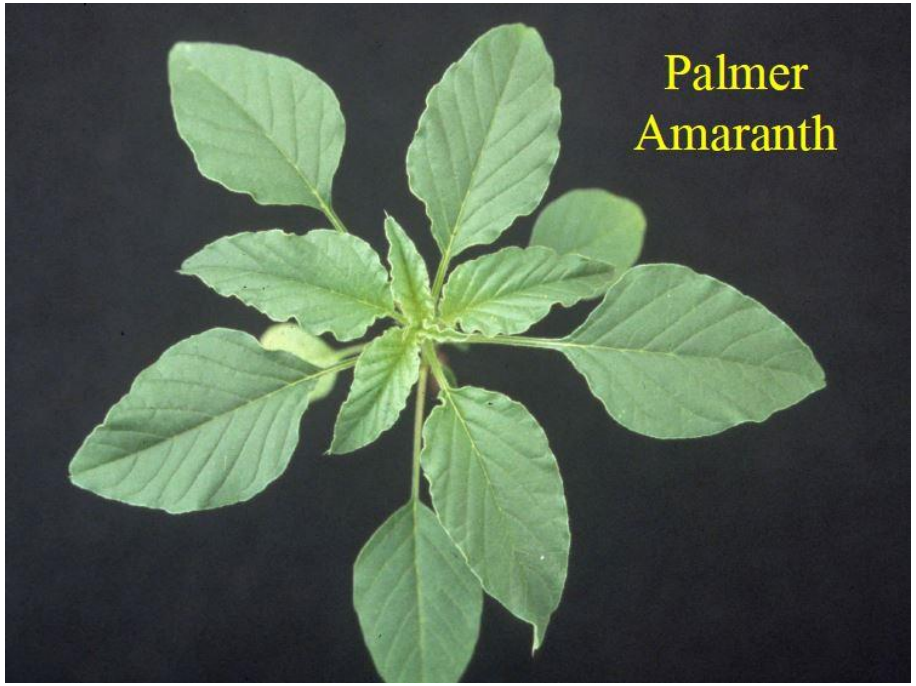
*Add NIS to glyphosate unless prohibited by the label; Full, add 1 qt/100 gal water, Partial, add 1-2 qt/100 gal water

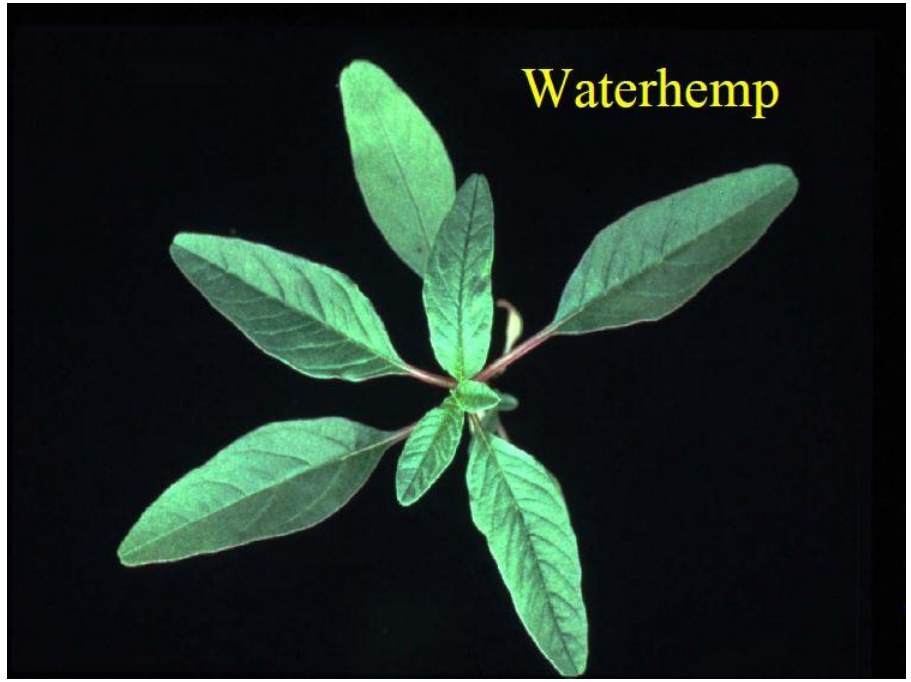

Redwood County MN 2018
Grant County MN 2014

Palmer amaranth


Powell
Amaranth


Redroot
Pigweed


Palmer
Amaranth


Waterhemp

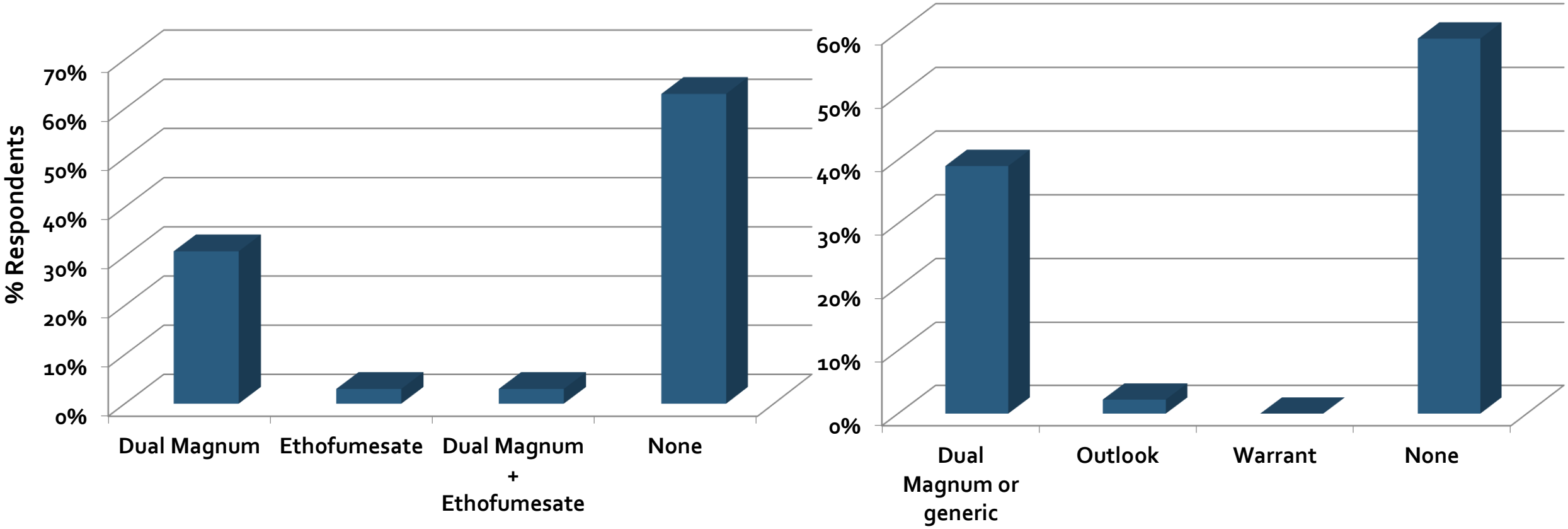
Sugarbeet injury and waterhemp control from glyphosate or glyphosate mixtures, 4-, 6- to 8- and 10- to 12-sugarbeet leaf stage, across environments, 2014 and 2015[a].

Treatment[b]	Rate	Sugarbeet 9-16 DAT	Waterhemp mid-season	Waterhemp pre-harvest
	oz or fl oz/A	%	%	%
PowerMax/PMax/PMax	28/28/22	1	63 d[e]	48 e
PowerMax+etho/PMax+etho/ PMax+etho/	28+4/28+4/ 22+4	2	76 c	67 cd
PowerMax+UpBeet/PMax+UpB/ PMax+UpBeet	28+0.75/28+0.75/ 22+0.75	3	84 abc	73 abc
PMax+Betamix/PMax+Betamix/ PMax+Betamix	28+12/28+16/ 28+24	5	81 abc	67 cd
PMax+Stinger/PMax+Stinger/ PMax+Stinger	28+2/28+2/ 22+2	5	66 d	59 d
p-value (0.05)		0.0877	<.0001	<.0001

[a]Herman MN 2014, Herman MN 2015, and Moorhead MN 2015

[b]PowerMax with Prefer 90 non-ionic surfactant at 0.25% v/v plus N-Pak ammonium sulfate at 2.5% v/v. PowerMax tank-mixes with Destiny HC at 1.5 pt/A plus N-Pak ammonium sulfate at 2.5% v/v.

Which soil-applied (PPI or PRE and lay-by) herbicide did you use in 2017[1]?



[1]Turning Point Survey of Growers; conducted at the 2018 Sugarbeet Growers Seminar, Fargo

Waterhemp emerged, image, May 22

PRE/POST vs. POST

Advantages

- Product layer buffers against delayed POST; activation of POST
- Our most efficacious program
- Reduces the likelihood of waterhemp POST escapes

Disadvantages

- Takes time and manpower; grower needs to plant and spray
- There is injury under certain environments
- Concerns with nurse crop

Precipitation during three applications timings, Mooreton, ND and Campbell, MN, 2014 to 2018

Treatment[1]	2014	2015	2016	2017	2018	Average
Mooreton, ND	----------precipitation (inches)----------					
PRE	**0.12**	**0.35**	0.94	1.63	**0.02**	0.61
EPOST	1.15	3.4	**0.11**	1.19	**0**	1.17
LPOST	0.86	2.10	0.54	**0.05**	1.49	1.01
Campbell, MN						
PRE	-	-	1.00	1.95	**0.03**	0.99
EPOST	-	-	**0.27**	0.93	**0.02**	0.41
LPOST	-	2.20	0.88	**0**	1.62	1.13

[1]PRE, April 10 to April 20; EPOST, May 10 to May 20; LPOST, May 27 to June 6

How do I decide between ethofumesate or Dual Magnum PRE?

Ethofumesate (Nortron, Ethotron, Ethofumesate 4SC

- Needs 0.75 in precipitation to activate
- History of safe use on sugarbeet PRE and POST
- $25 per acre

Dual Magnum

- Needs 0.5 inch precipitation to active
- Apply at 0.5 pt/A; safety greatest OM>3% or medium and fine texture
- Indemnified label
- $7.50/acre

Waterhemp (count per meter square) or as a percent of control , June 6, 2017, Lake Lillian, MN

Herbicide	Rate	Application	Count	Visual Control
	fl oz/A		Num/m²	%
Dual Magnum	8	PRE	25b	97
PowerMax	28	EPOST	192c	74
Control			727a	

Herbicide	Rate	Application	Count	Visual Control
	pt/A		Num/m²	%
Ethofumesate	2	PRE	53bc	93
Ethofumesate	3	PRE	20cd	97
Ethofumesate	4	PRE	07d	99
PowerMax	1.75	EPOST	116b	85
Control			792a	

Etho in a weed management system for waterhemp control


Waterhemp emerged, image, May 22

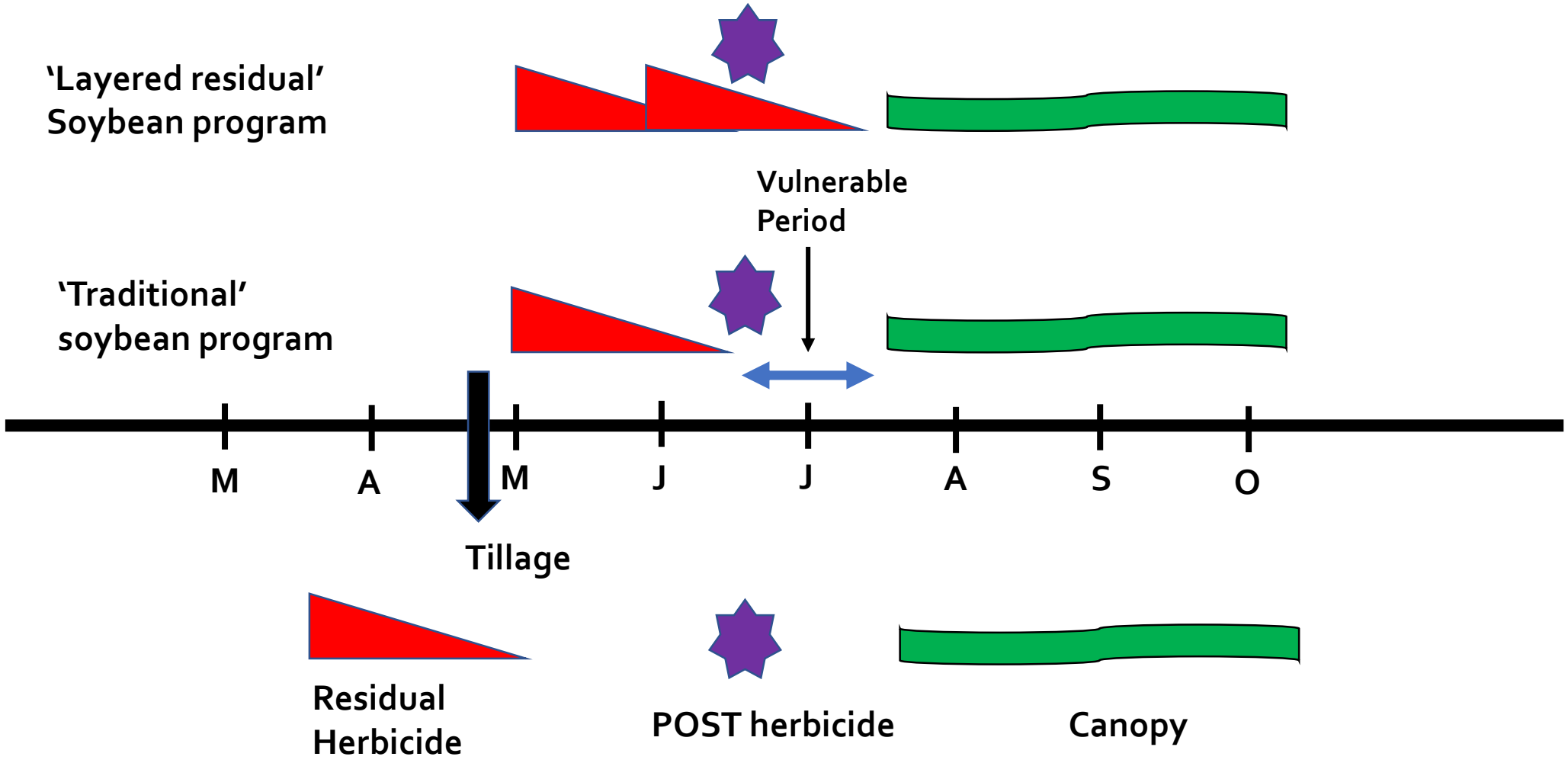

PowerMax at 28 fl oz/A


Control plot, Jun 6


Ethofumesate

Number of good, fair, and poor estimates of waterhemp control across herbicides and application timing, summed across evaluations, locations, and years

Layered Residual Herbicides
Objective: Prolong PRE activity until canopy fills



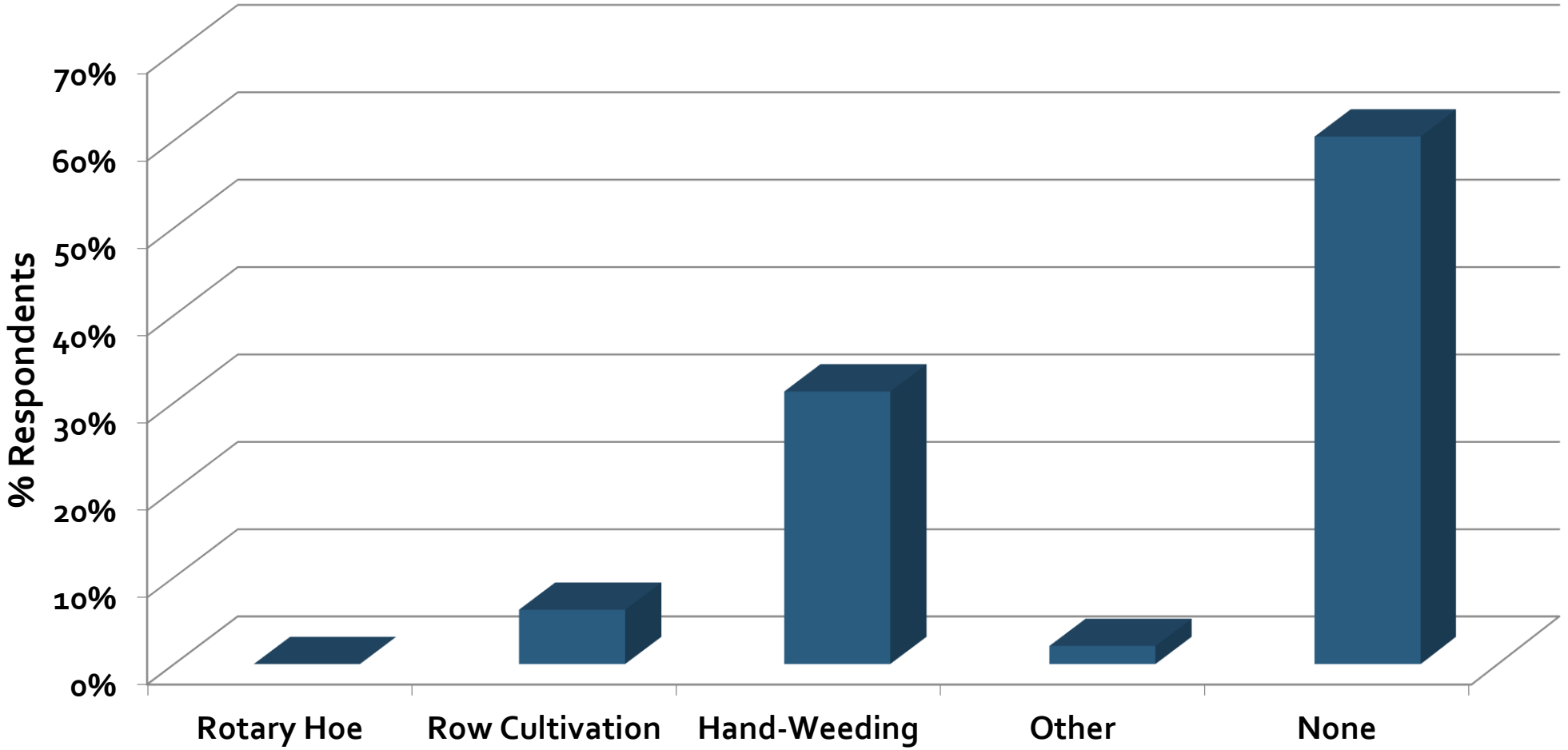
Adapted from a slide created by B Hartzler, ISU

How do you decide what POST (lay-by) product to use?

Risk management

- Replanting, select Dual Magnum
- Activation early, select Outlook
- Sugarbeet safety, Dual Magnum or Warrant
- Length of control, Warrant
- Spectrum, Warrant
- Relationship with industry, ?

What other POST weed control methods did you use in 2017[1]?



[1]Turning Point Survey of Growers; conducted at the 2018 Sugarbeet Growers Seminar, Fargo

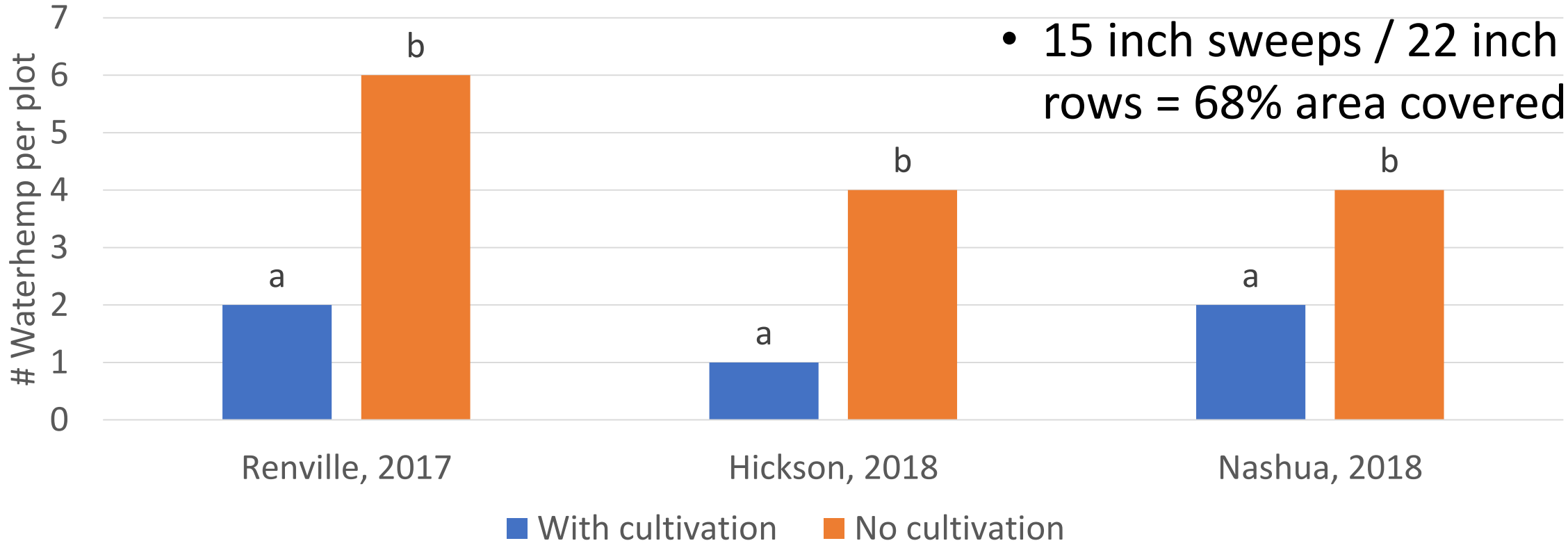
Summary of Cultivation Research in Sugarbeet

Nathan Haugrud and Tom Peters, NDSU

Technical questions

- Cultivation to remove herbicide-resistant weeds?
  - Effects on weed emergence?
- Interactions with residual herbicide?
  - Incorporation and activation
  - Damage to an established herbicide barrier?
- Negative effects on sugarbeet yield and quality?

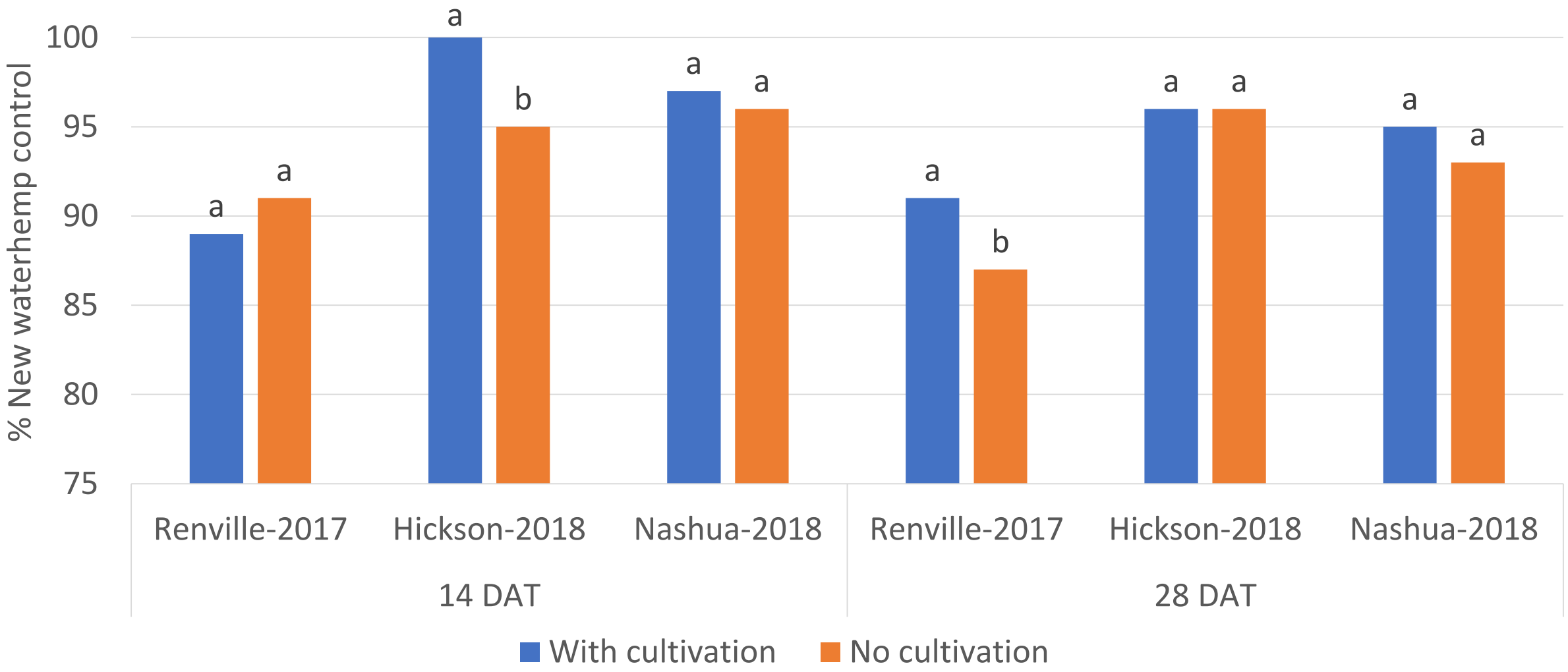
Cultivation immediately after herbicide resulted in 50-75% less waterhemp, 14 DAT



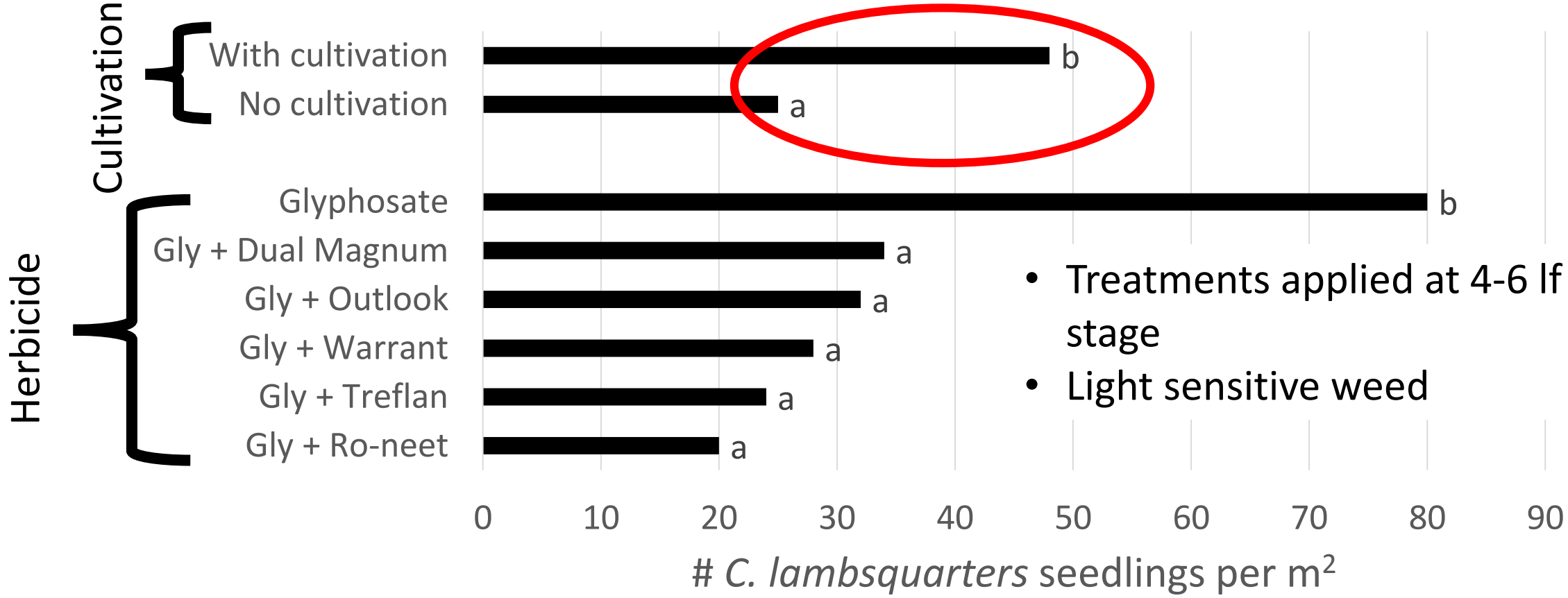
- 15 inch sweeps / 22 inch rows = 68% area covered

ANOVA	Cultivation			Herbicide	C X H Interaction
	Renville, 2017	Hickson, 2018	Nashua, 2018	All environments	
P-value	0.009	0.002	0.019	NS	NS

Early cultivation generally had no effect on new waterhemp emergence control



Early cultivation increased common lambsquarters emergence, Galchutt-2018, 28 DAT



- Treatments applied at 4-6 lf stage
- Light sensitive weed

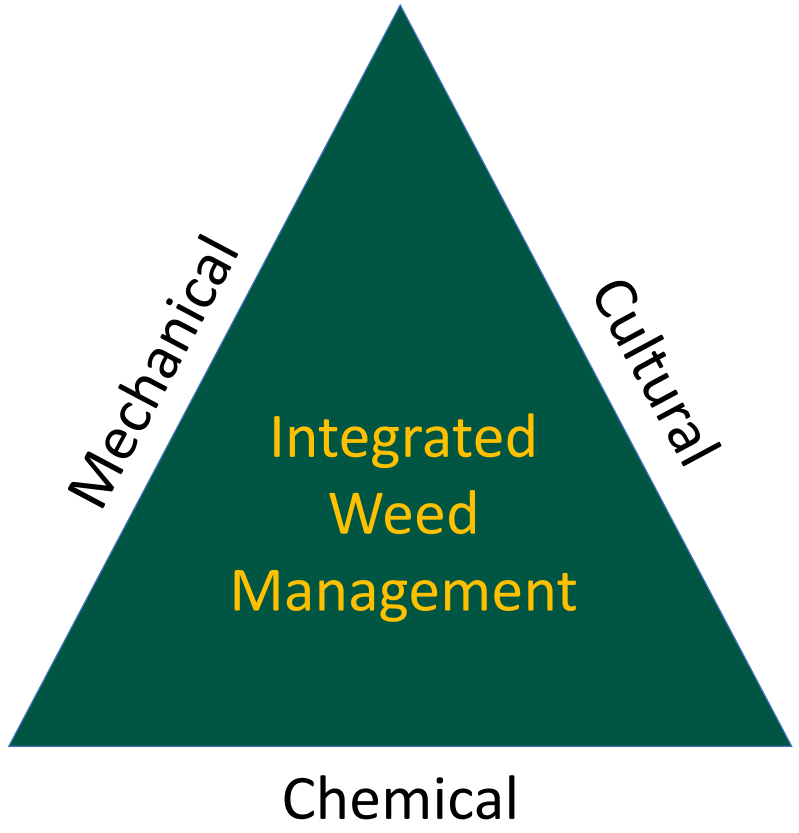
ANOVA	Cultivation	Herbicide	C X H Interaction
P-value	0.018	< 0.001	NS

Cultivation timing had no effect on sugarbeet yield across all environments in 2018

	Yield Components		
Cultivation timing	Root yield	Sucrose content	RSA
	Tons/acre	%	Lbs/acre
Control	24.3	15.0	6,817
June 21	24.1	14.8	6,773
July 5	24.7	14.9	6,934
July 19	23.5	14.9	6,563
August 2	25.4	14.7	6,899
August 16	24.4	14.5	6,529
June 21 + July 19	24.3	14.5	6,679
July 5 + Aug 2	24.7	14.6	6,698
July 19 + Aug 16	23.5	14.8	6,472
June 21 + July 19 + Aug 16	23.5	14.8	6,540
ANOVA	----------*p value*----------		
Treatment	0.944	0.062	0.947

The Future of Cultivation: 2019 and Beyond

- Valuable tool to removal weeds that herbicide did not/will not control
- Timing is key: cultivate near crop canopy closure
  - No effects on weed emergence if shade is present
- No effect on yield in 2018, but repeats in future years are needed



These steps are general for all sprayers, but…

- Know your sprayer
  - Where can residues hide? Where are my valves? Screens? Hoses?
  - Consult your operators manual
- Develop a checklist
- Know the physical properties of the chemical you're applying
  - Dry vs. EC vs. solution
  - Jar mix to test incompatability

Seven steps of sprayer cleanout

1. Spray out booms every night (or when herbicides demand it)
2. First rinse is in the field
3. Remove and clean all screens
4. Remove and clean boom end caps
5. Second rinse with water
6. Add tank cleaner
7. Final rinse and flush

Cleanout process focuses on three objectives:

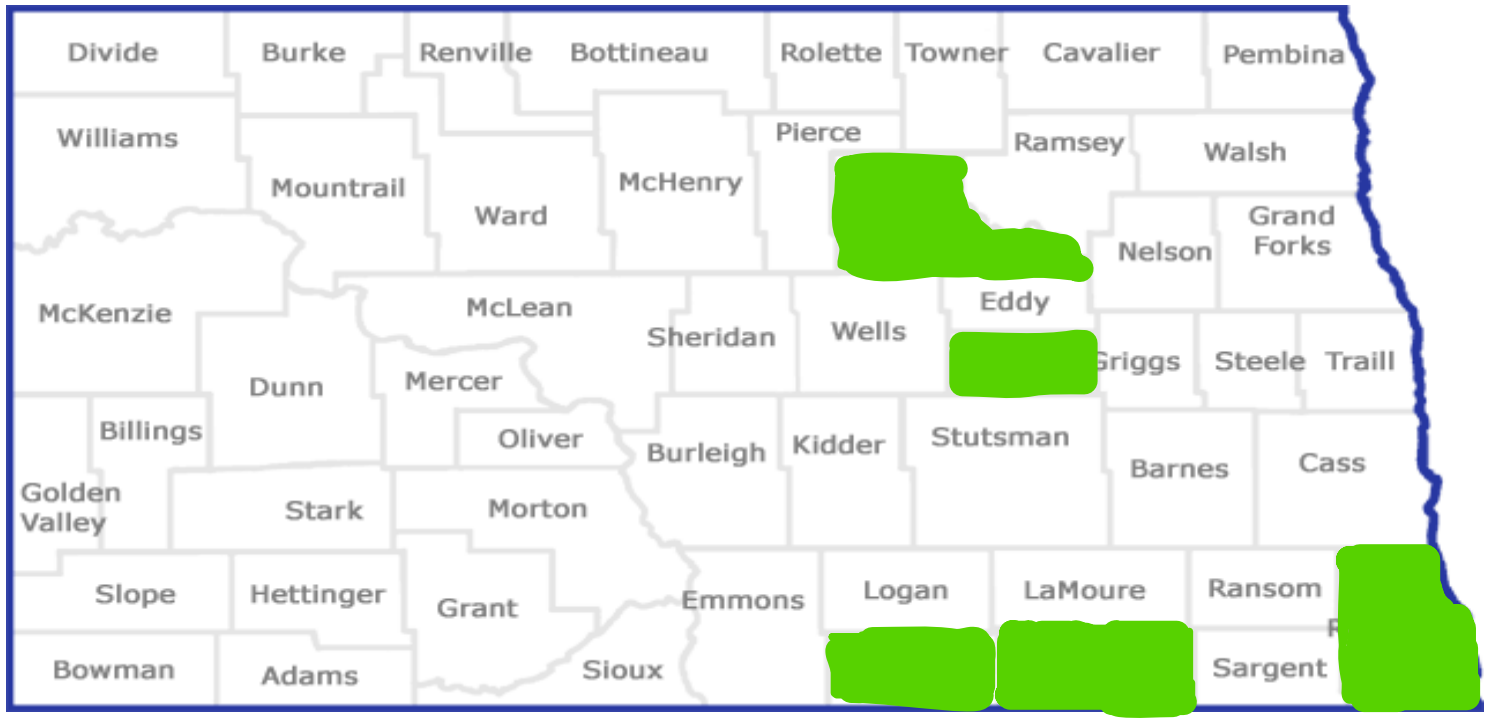
- Remove as much of the remnant mixture as possible
- Dilute the remainder as much as possible and use it to clean the boom plumbing.
- Ensure anything that came in contact with spray mix has been cleaned.

Ammonia, bleach, detergents and tank-cleaners

- Ammonia - increases the pH of the solution which increases the herbicide solubility, ex. SU and weak acid herbicides
  - is effective at penetrating and loosening deposits and residues
  - 1 gallon ammonia in 100G water
- Bleach - lowers the pH of the solution which speeds the degradation of some herbicides.
- Detergents – cleaners, designed to remove oil-soluble herbicides
- Commercial tank cleaners – usually contain ammonia and a detergent
  - Commercial tank cleaners usually perform better than household detergents

Palmer amaranth (left) and waterhemp (right) 35 days after planting

Palmer amaranth was confirmed in five North Dakota Counties in August and September



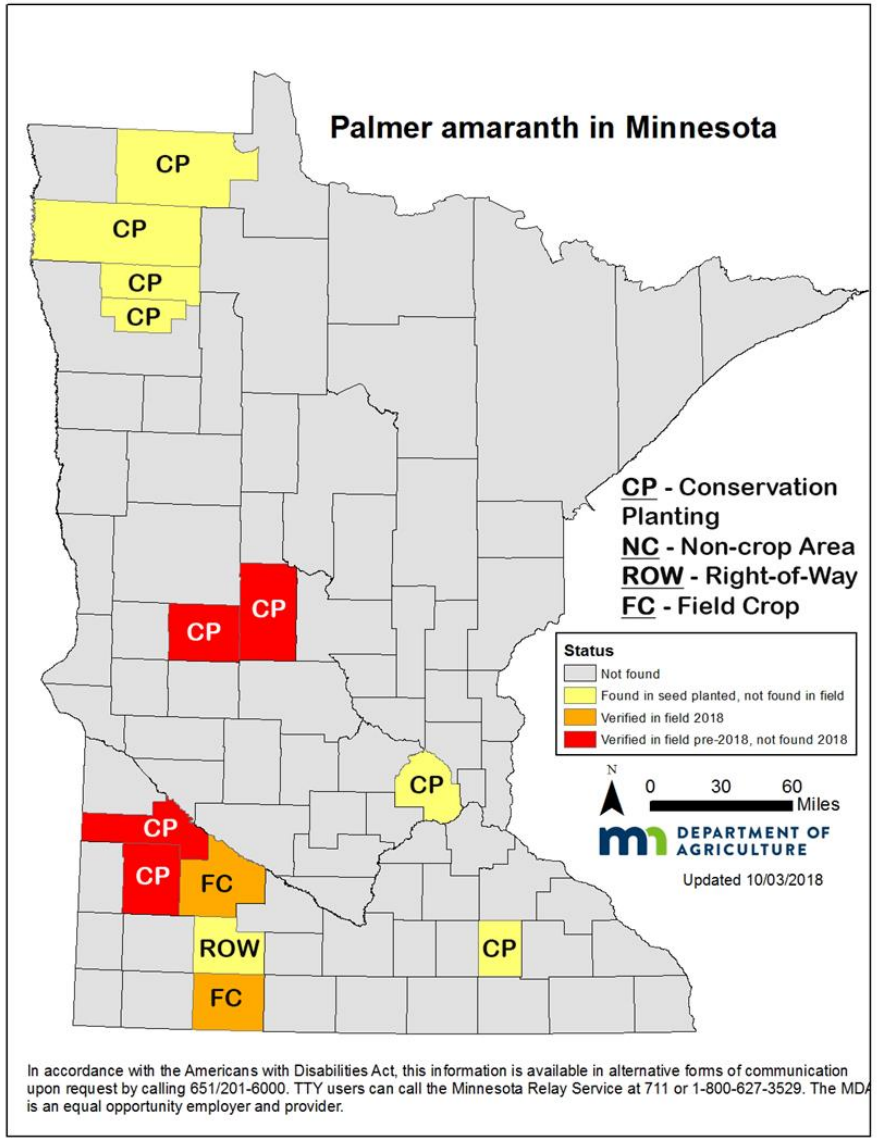
County	Possible source
McIntosh	Migratory birds
Dickey	Purchase of used combine out-of-state
Foster	Custom combining
Benson	Railroad car cleanout
Richland	Alternative sources for cattle feed

Current Status in Minnesota

- STATEWIDE SUMMARY
  - 18 landowners in Six Counties With Confirmed Palmer plants since 2016
    - 42 CRP plantings in 4 Counties (2016 – 2017)
      - **NO PALMER discovered in Lyon, Yellow Medicine, Todd or Douglas counties in Fall 2018 on these plantings**
    - 2 Soybean fields - 1 Jackson & 1 Redwood County – Fall 2018
      - Plants hand-pulled and destroyed; no seed produced
      - **No other Palmer plants found within a 5-mile radius MDA field survey**

* 2017 – Summer – seed lot tested positive for Palmer
- Sold to MNDOT for seeding a ROW in SW MN
- ***MDA Found No Palmer On This Site In 2017 or 2018***

** 2018 – Spring - seed lot tested positive for Palmer
- Sold to 8 Landowners, planted at 14 locations in 4 counties potentially impacting 1,400 acres
- ***MDA Found No Palmer On These Acres In 2018***



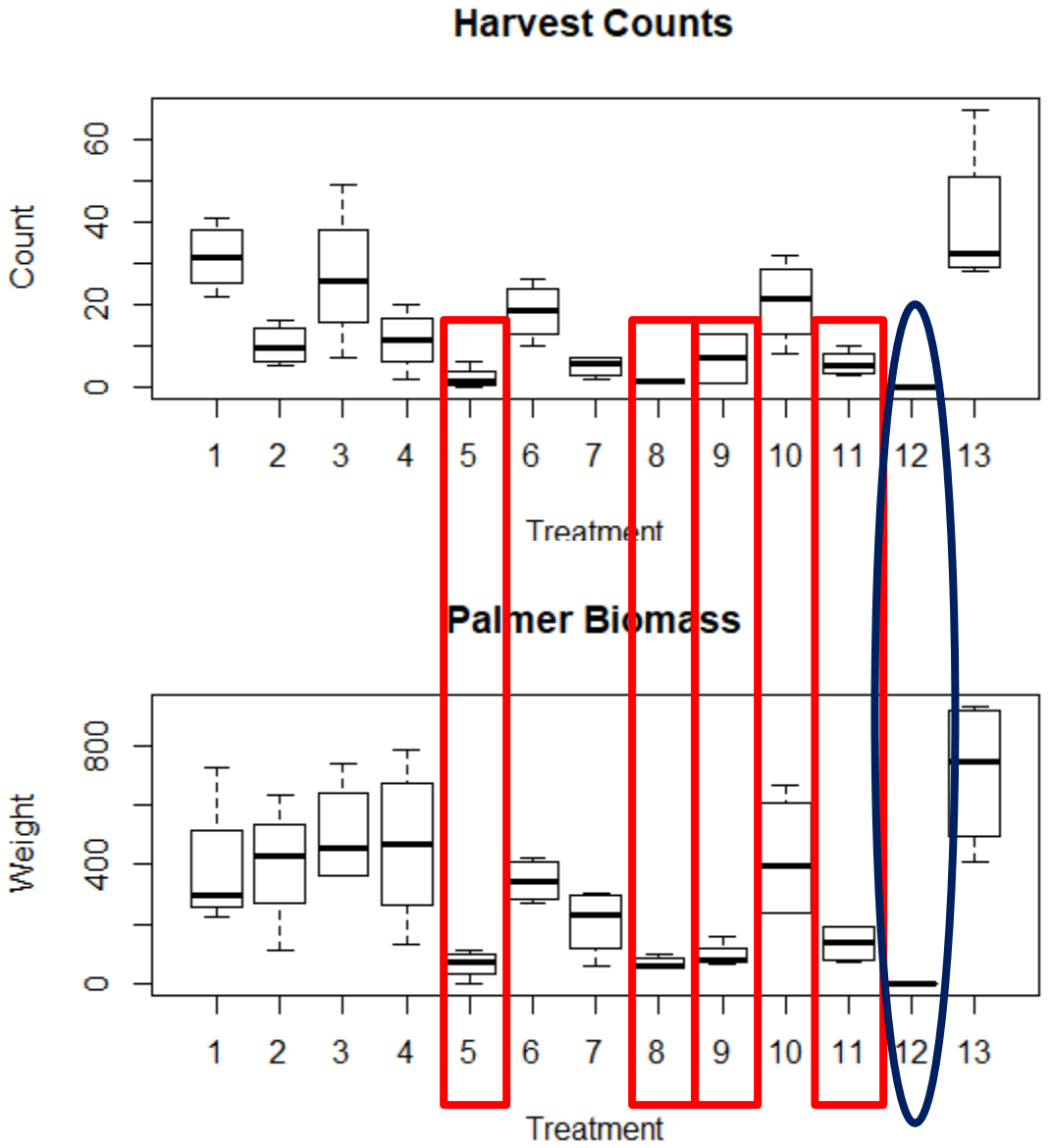
Palmer Amaranth control in greenhouse, 2017

Herbicide treatment	Height (inch)	Control 5 DAT	Control 24 DAT
		---------(%)---------	
Betamix+ethofumesate+UpBeet (3 pt + 12 fl oz + 1 oz)	2	99 a	99 a
Betamix+ethofumesate+UpBeet (3 pt + 12 fl oz + 1 oz)	4	56 b	57 b
Betamix+ethofumesate+UpBeet (3 pt + 12 fl oz + 1 oz)	8	34 c	24 c

Herbicide treatment	Height (inch)	Control 20 DAT	Control 28 DAT
		---------(%)---------	
Betamix+ethofumesate+UpBeet (3 pt + 12 fl oz + 1 oz)	2	70 a	23
Betamix+ethofumesate+UpBeet (3 pt + 12 fl oz + 1 oz)	4	43 b	17
Betamix+ethofumesate+UpBeet (3 pt + 12 fl oz + 1 oz)	8	38 b	13

Palmer amaranth number and weight m^{-2}, Scottsbluff NE in 2018

Num	Treatment
1	**Etho/PM/PM, PRE/2/6 TL**
2	+ Warrant, 2TL
3	+ Etho, 2TL
4	+ Warr+etho, 2TL
5	+ Warrant, 6TL
6	+ Etho, 6TL
7	+ Warr+Etho, 6TL
8	+ Warr/Warr, 2/6 TL
9	+ Etho/Warr, 2/6 TL
10	+ Etho, 2 TL
11	+ Warr+Etho/Warr+ Etho
12	Weed Free Check
13	Weedy Check



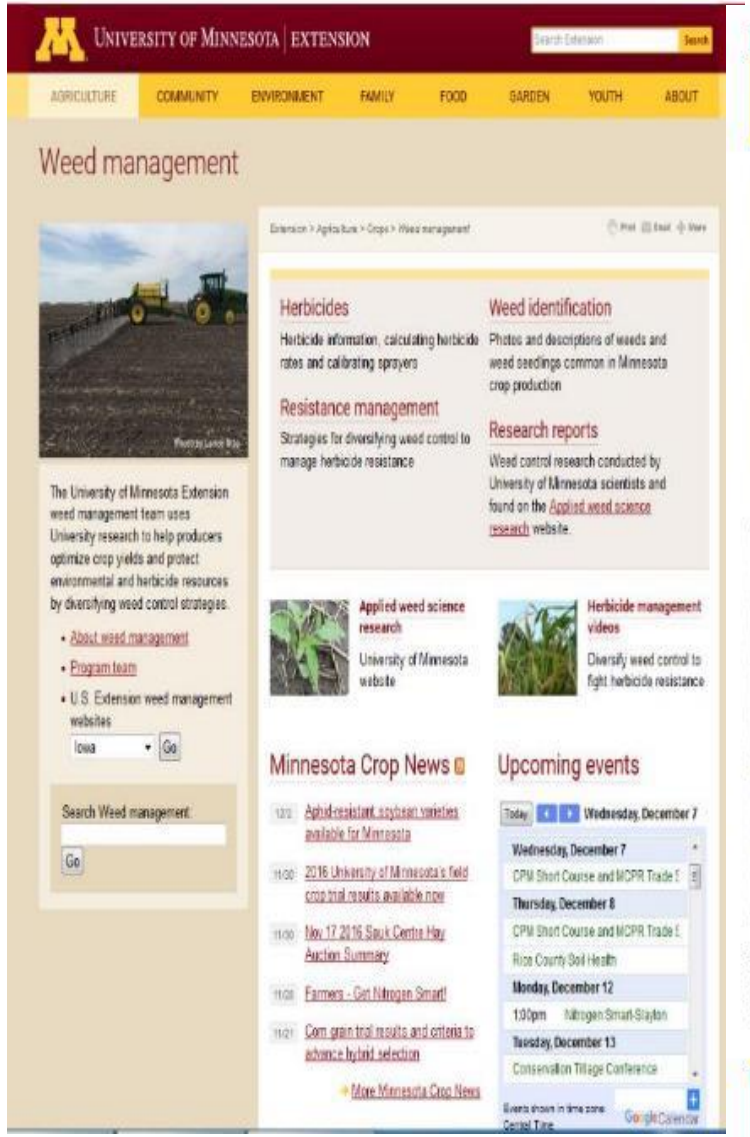
Waterhemp control and sugarbeet tolerance, Moorhead and Lake Lillian MN and Amenia ND, 2018

Trt	Treatment	Rate (pt or fl oz/A)	Sugarbeet stage (Num leaves)	AMATA Mrhd Jun 27	AMATA L Lilli Jul 22	Visible Gro Red Amenia	Recov sugar Amenia
				%	%	%	lb/A
1	Etho/PM + Etho/ PM + Etho	3p / 28 + 4 /28 + 4	PRE / 2-4 /6-8	88 a	89 a	2 a	11,015
5	Etho / PM + Etho / Warrant + PM + Etho	3p / 28 + 4 / 3p +28 + 4 /	PRE / 2-4 / 6-8	96 a	98 a	7 a	11,037
8	Etho / Warrant + PM + Etho / Warrant + PM + Etho	3p / 3p +28 + 4 / 3p + 28 + 4	PRE / 2-4 / 6-8	100 a	100 a	26 b	10,845
9	Etho / Etho + PM / Warrant + PM + Etho	3p / 3p + 28 / 3p + 28 + 4	PRE / 2-4 / 6-8	93 a	95 a	30 bc	11,851
11	Etho / Etho + Warrant + PM / Etho + Warrant + PM	3p / 2p + 1.5p + 28 / 2p +1.5p + 28	PRE / 2-4 / 6-8	94 a	100 a	35 c	10,497

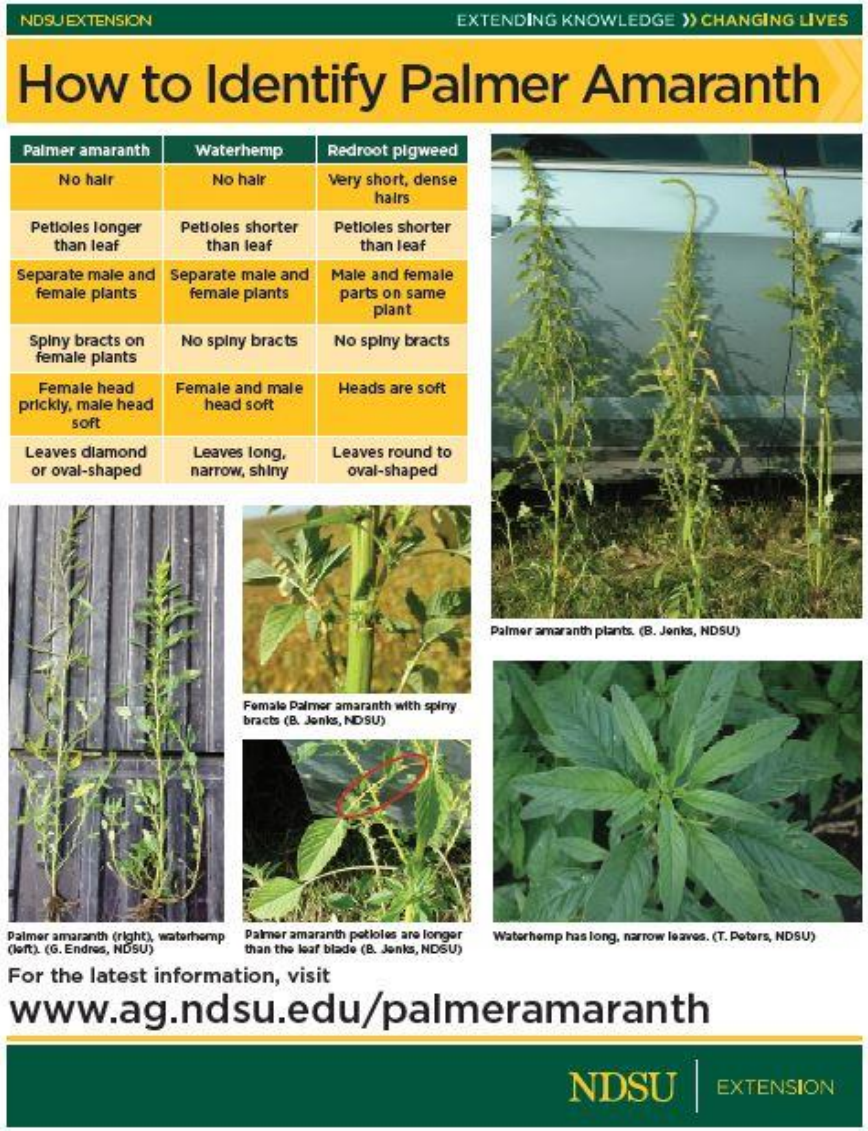
- Treatments provided greater than 90% waterhemp control at Moorhead and Lake Lillian in 2018
- Growth reduction was observed with repeat applications of Warrant or Warrant + Ethofumesate
- No differences in root yield, sucrose content or recoverable sucrose per acre at Amenia, ND

Online Resources

www.mda.state.mn.us/weedcontrol



http://z.umn.edu/palmerID



Acknowledgements

- The Sugarbeet Research and Education Board for funding this research
- American Crystal Sugar Company and Greg Richards for use of the Moorhead factory field location
- North Dakota State University Experiment Station for the use of land near Amenia, ND

Thank you for your Support

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