Waterhemp Control in Sugarbeets The Battle Continues

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NDSU EXTENSION SERVICE

UNIVERSITY OF MINNESOTA EXTENSION

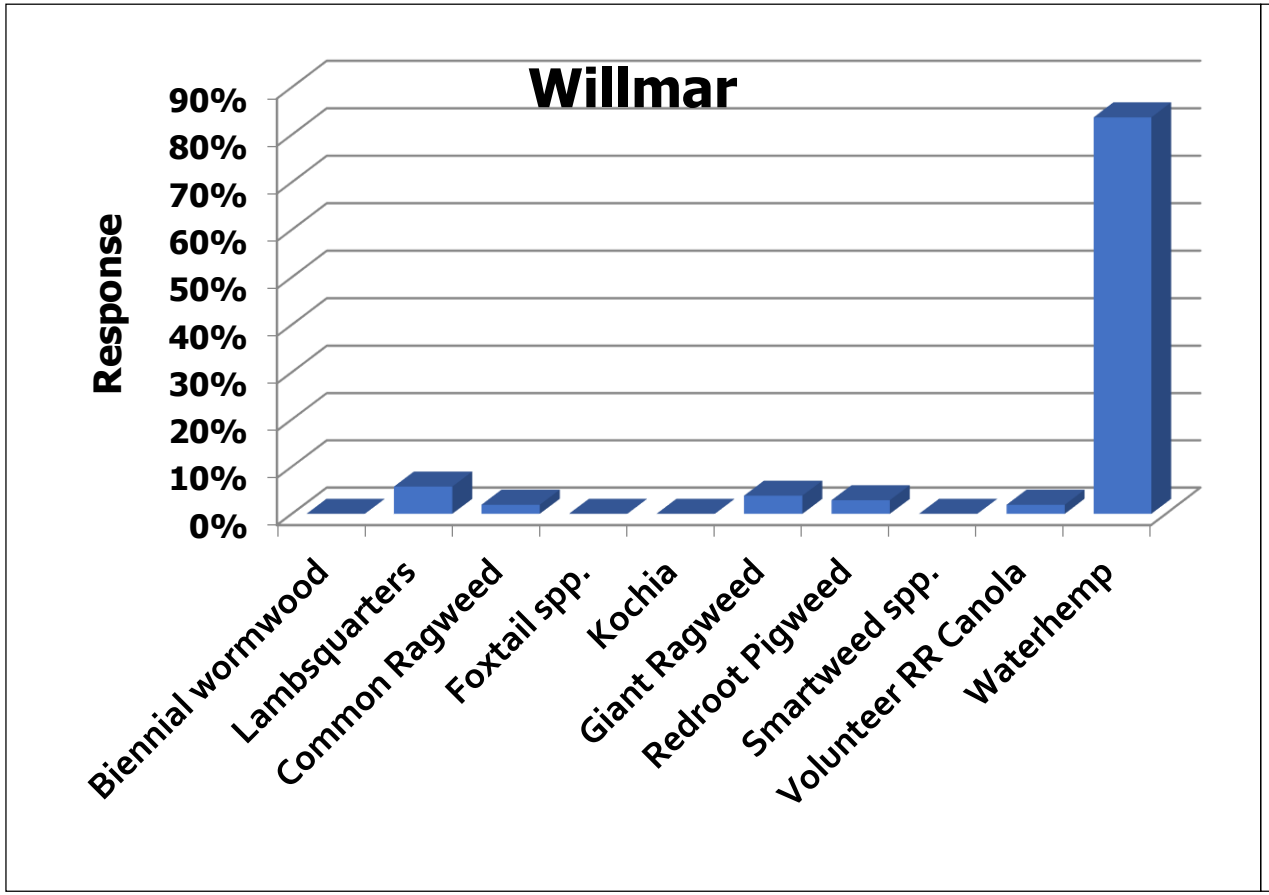
North Central United States Region, Weeds in Broadleaf Crops, 2016[1]

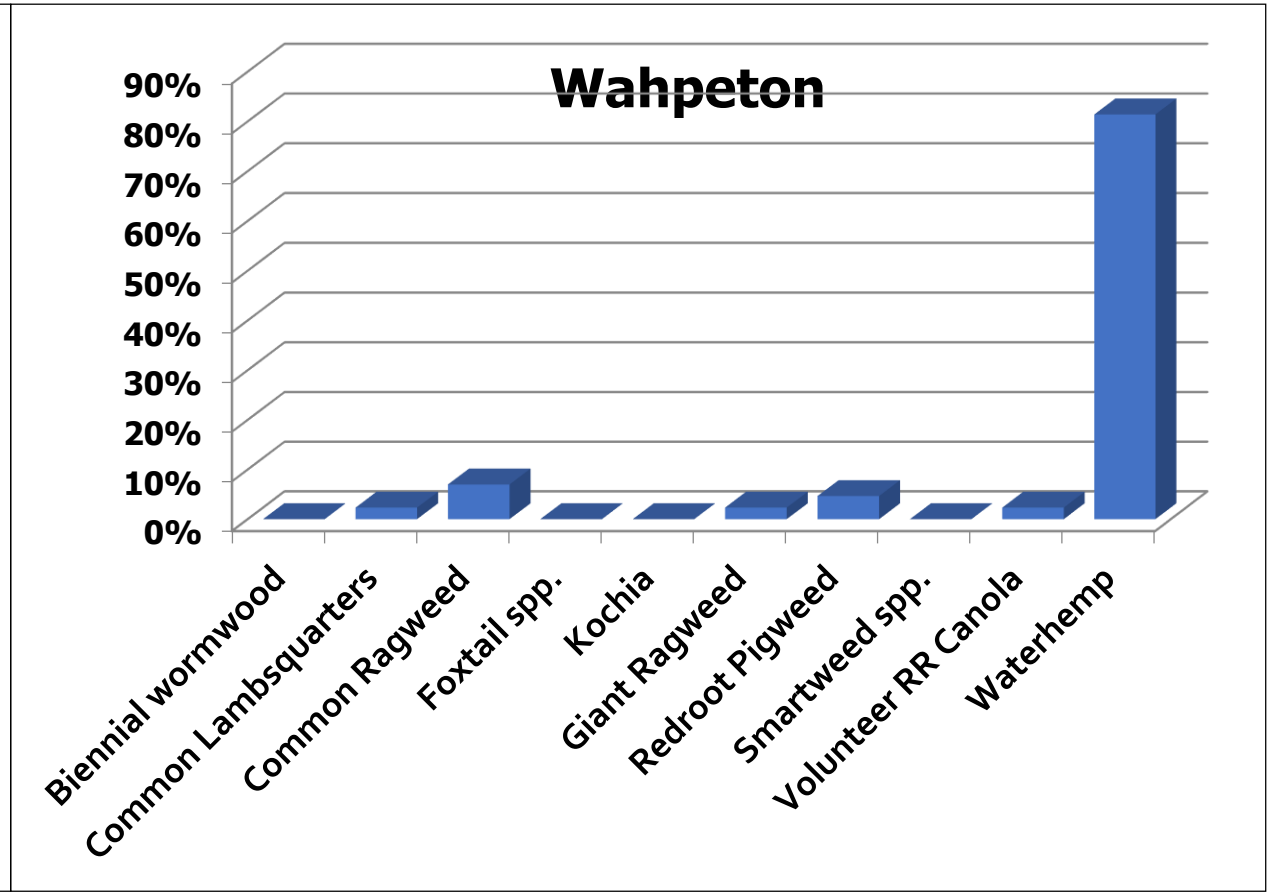
	Most Common[2]	Most Troublesome[2]
1	Foxtail spp.	Waterhemp
2	Lambsquarters	Lambsquarters
3	Waterhemp	Horseweed
4	Redroot pigweed	Giant ragweed
5	Velvetleaf	Palmer amaranth
6	Horseweed	Common ragweed
7	Common ragweed	Kochia
8	Kochia	Nightshade spp.
9	Palmer amaranth	Velvetleaf
10	Giant Ragweed	Redroot pigweed

[1]Survey respondents are members of national and regional weed science societies

[2]Common weeds refer to weeds most frequently observed; troublesome weeds are most difficult to control (but may not be widespread)

What was your worst weed problem in 2016 in sugarbeet?[1]





[1]Results from Turning Point Survey conducted at 2017 Grower Seminar

Waterhemp: The "Devil's" Weed

Glyphosate alone, glyphosate in tank-mixes[1]

	Central Minnesota	RR Valley South	RR Valley Central	RR Valley North
	----------% of survey respondents----------			
Glyphosate	22	17	30	**84**
Glyphosate + soil residual herbicide applied POST	44	56	26	0
Glyphosate + POST broadleaf herbicide	19	22	37	16
Glyphosate + POST grass herbicide	15	5	7	0
Broadleaf Tank-mix	63	78	63	16

[1]Turning Point Survey of Growers; conducted at the 2017 Sugarbeet Grower Meetings

Waterhemp emerged, image, May 22

Percent visual waterhemp control from repeat applications of glyphosate[1]

	Herman 2014	Herman 2015	Moorhead 2015	Lake Lillian 2015
	----------% Preharvest control[2]----------			
Experiment 1	33	48	60	48
Experiment 2	35	56	34	-
Experiment 3	36	58	66	60
Experiment 4	-	48	39	-

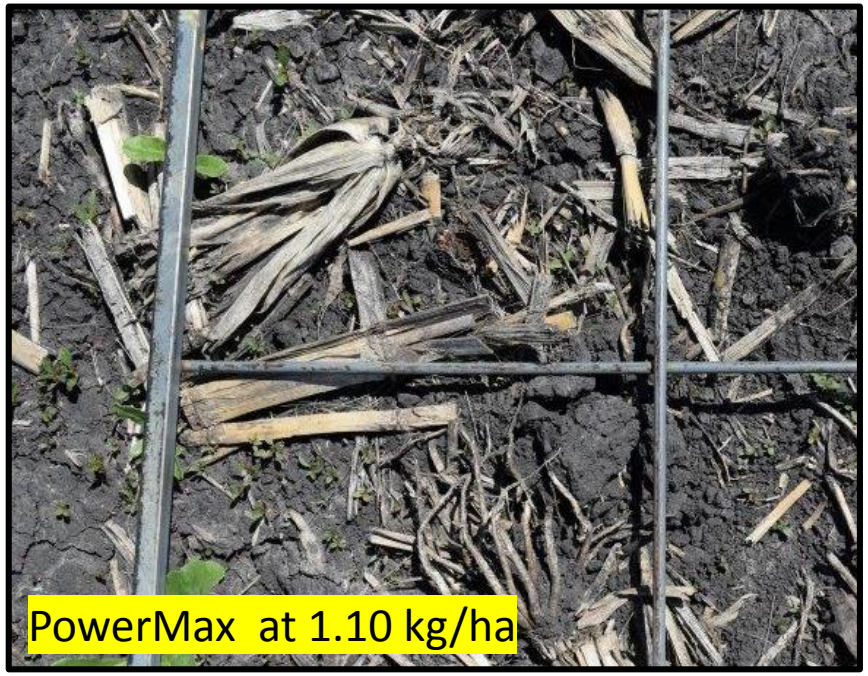
[1]Roundup Power Max at 28/28/22 fl oz/A plus Prefer 90 NIS at 0.25% v/v and N-Pak AMS at 2.5% v/v

[2]Visual percent waterhemp control at preharvest evaluation

Does PowerMax control waterhemp in Grant and Kandiyohi Counties, MN?

Treatment	Rate	Herman, 2014	Lake Lillian, 2017	Lake Lillian, 2017
	fl oz/A	----------Count/m2----------		
Roundup PowerMax	28	101	192	116
Control	0	432	727	792


Control plot, Jun 6

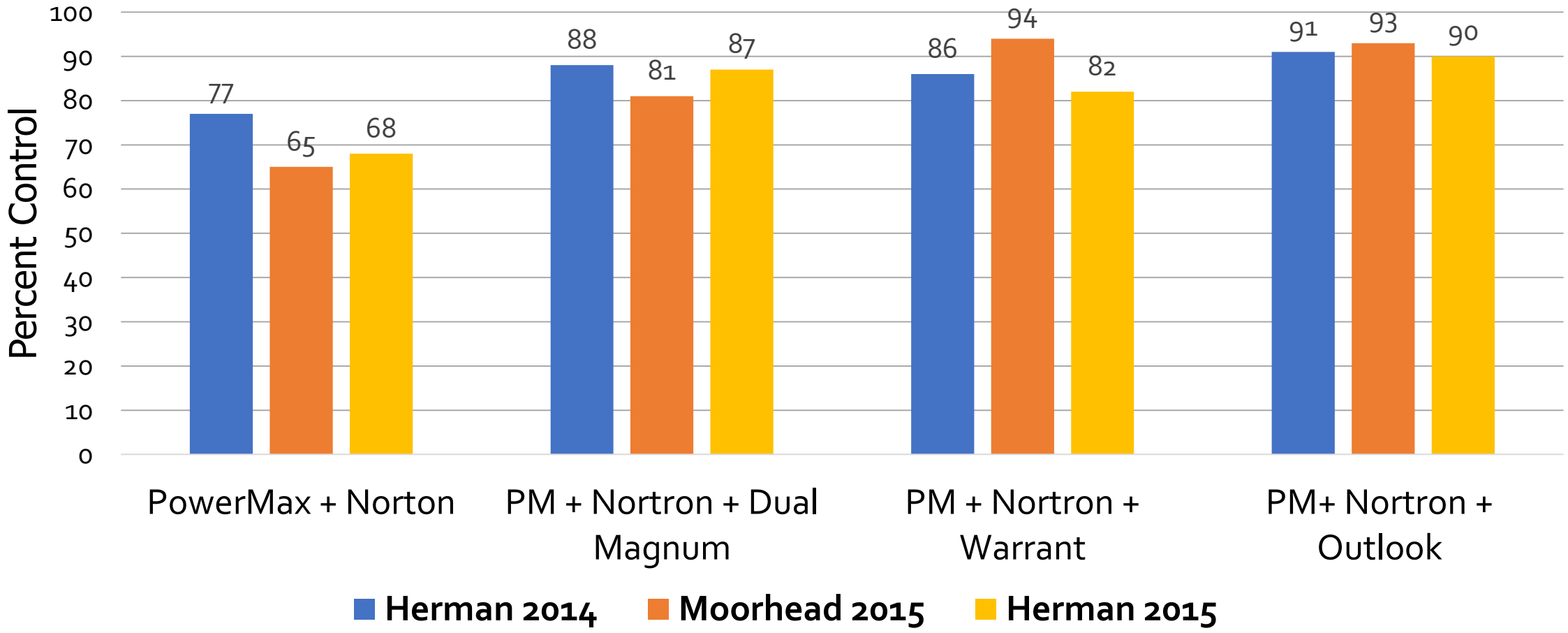

PowerMax at 1.10 kg/ha

Number of waterhemp per meter square, June 6, 2017, Lake Lillian, MN

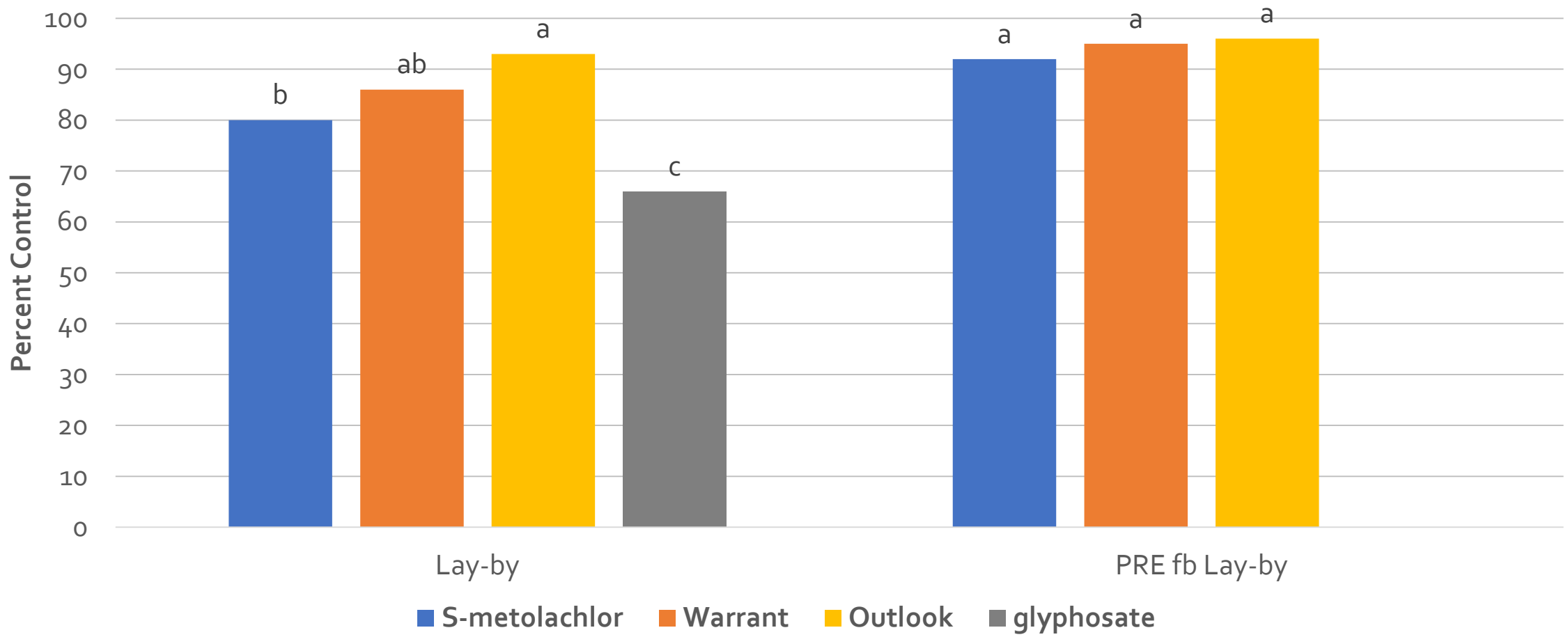
YES. 77% control at Herman and 76% control at Lake Lillian

Increasing the rate or repeat applications does not improve control

Waterhemp control from postemergence herbicides, across locations and years



Waterhemp control from soil-applied herbicides lay-by or S-metolachlor at 0.5 pt/A fb lay-by, across locations, 2015

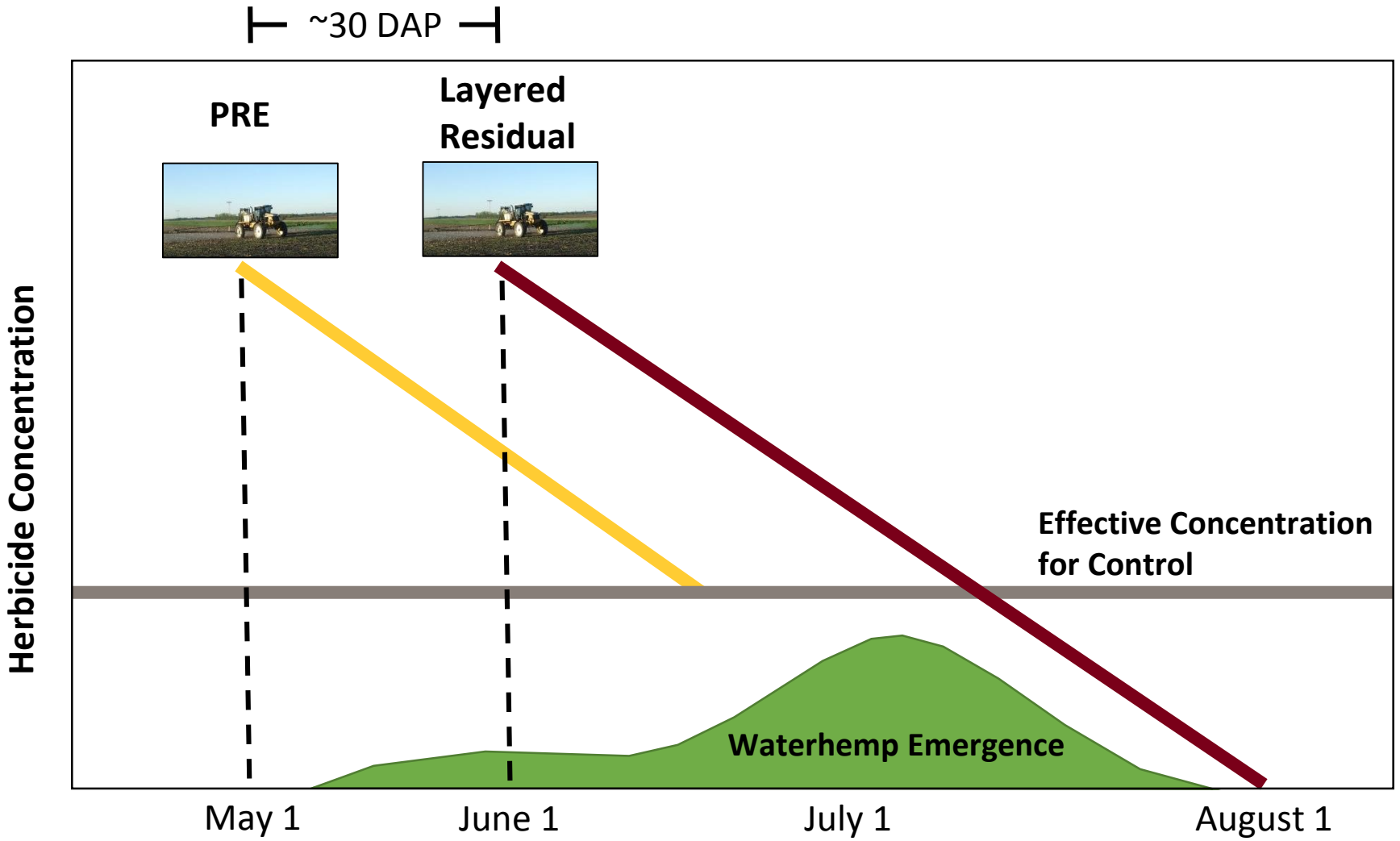


Early Planting (Moorhead) and late planting (Herman)

Precipitation followed application in 2014 and 2015

- 0 to 7 days after application
- Greater than 0.5 inch
- Emerged broadleaves less than 2-inch
- Glyphosate at 28 fl oz/A + ethofumesate at 4 fl oz/A
- Canopy rapidly followed chloroacetamides

LAYERED HERBICIDE CONCEPT

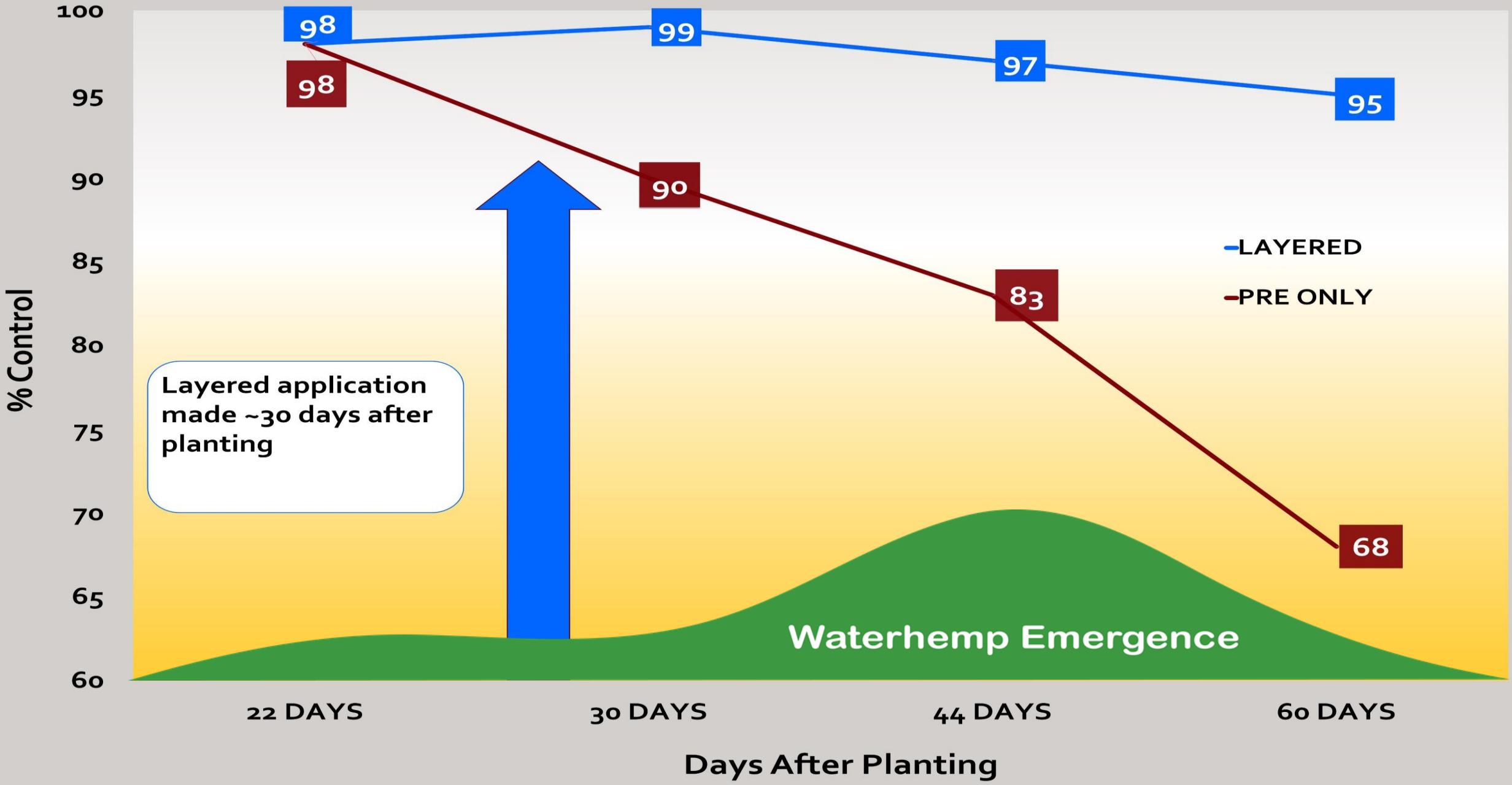


Soybean injury and waterhemp control from preemergence and postemergence herbicides, near Renville, MN in 2016

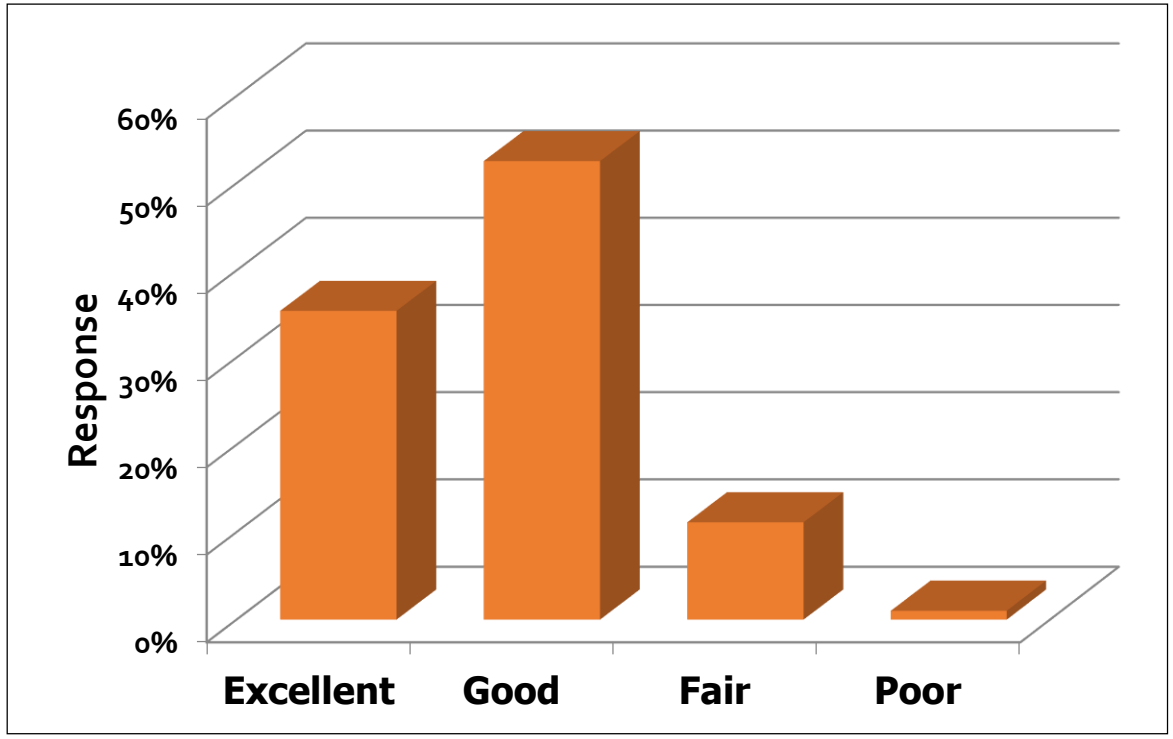
			Sbn Injry	Waterhemp Control		
Treatment[1]	Rate oz/A* or fl oz/A	Code	June 22	June 8	June 22	Aug 8
			----------%----------			
PowerMax	32	POST	1	41	55	48
Authority MTZ / PowerMax	12* / 32	PRE	3	90	83	68
Warrant + PowerMax	24 + 32	POST	6	21	74	48
Authority MTZ / Warrant + PowerMax	12* / 24 + 32	PRE / POST	8	97	99	95
LSD (0.05)			12	19	18	21

[1]Tank-mixes with PowerMax with Destiny HC at 1.5 pt/A plus N-Pak AMS at 2.5% v/v. PowerMax alone with Prefer 90 NIS at 0.25% v/v plus N-Pak AMS at 2.5% v/v.

Layered residual herbicide for waterhemp control in soybean, Renville, MN



How effective was waterhemp control from lay-by application in 2016?[1]

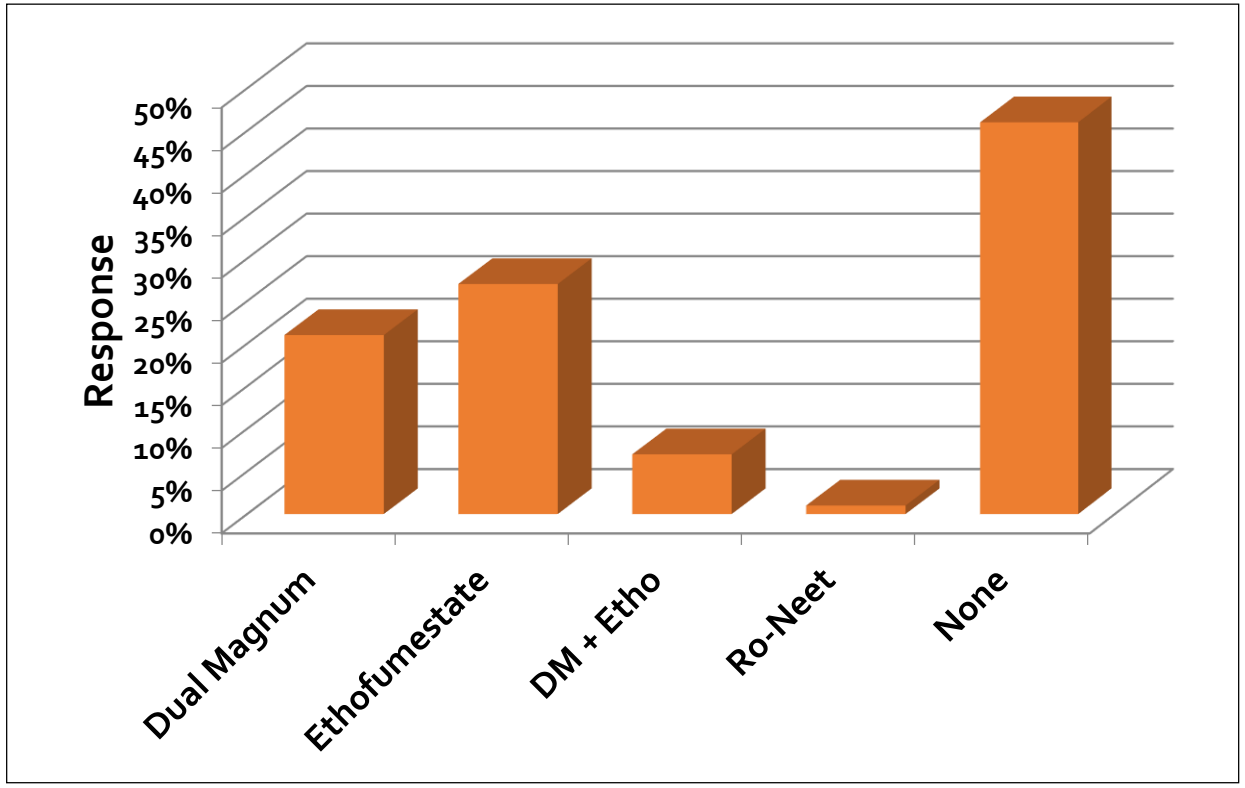


Willmar Meeting

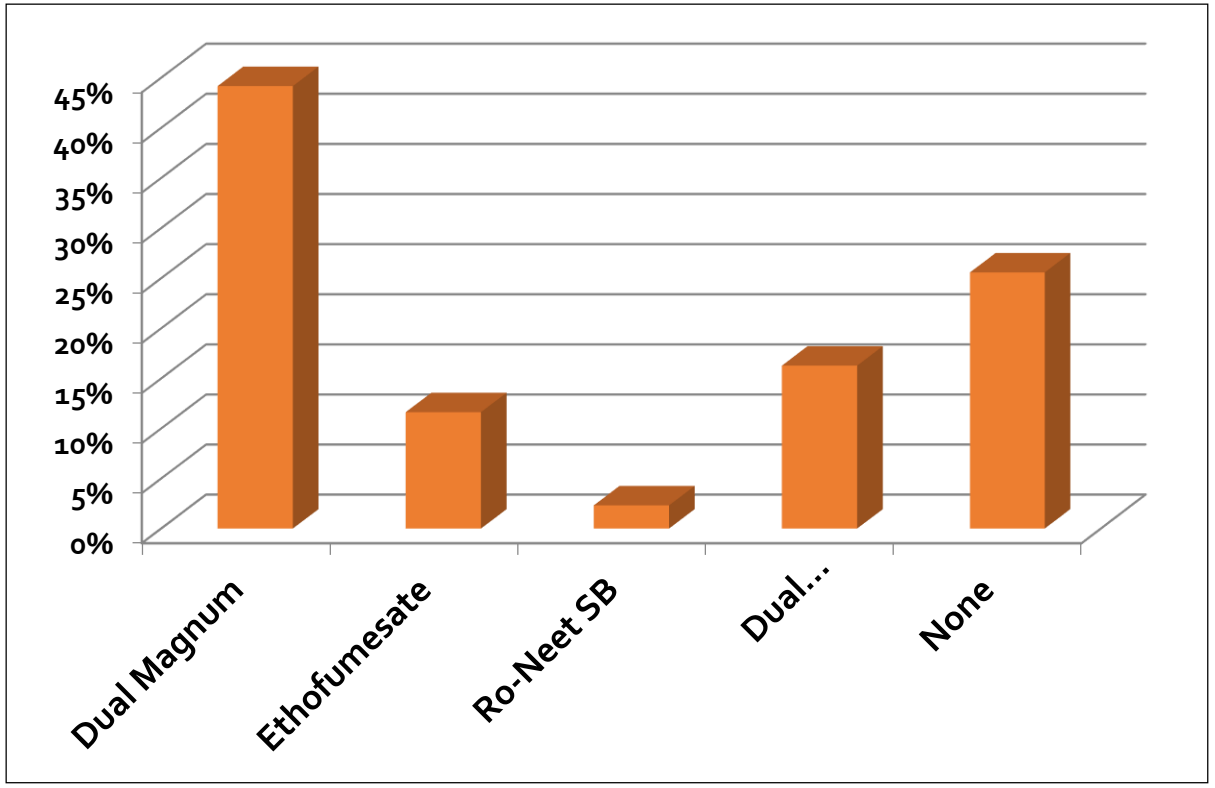
Wahpeton Meeting

[1]Results from Turning Point Survey conducted at 2017 Grower Seminar

What PRE herbicide(s) did you use in 2016?[1]



Willmar Meeting



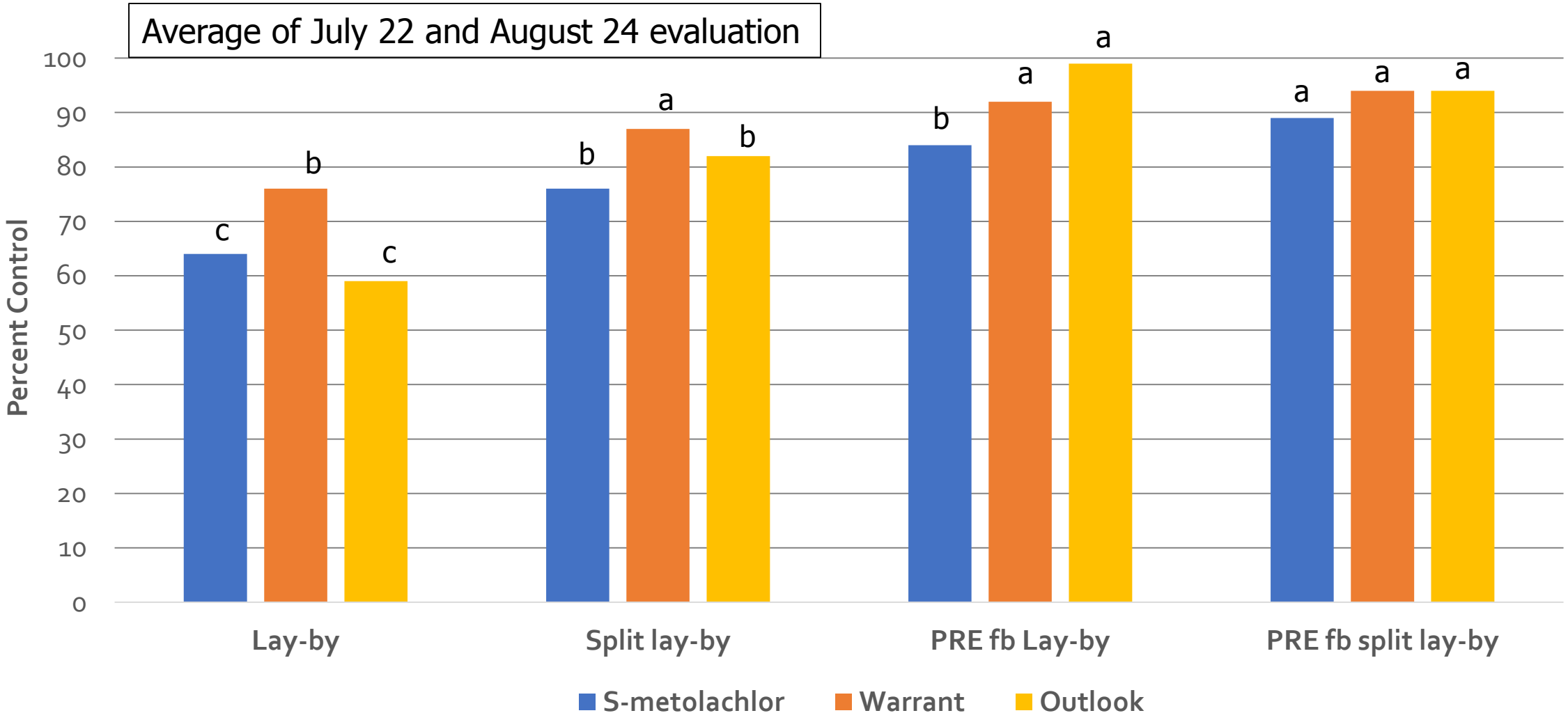
Wahpeton Meeting

[1]Results from Turning Point Survey conducted at 2017 Grower Seminar

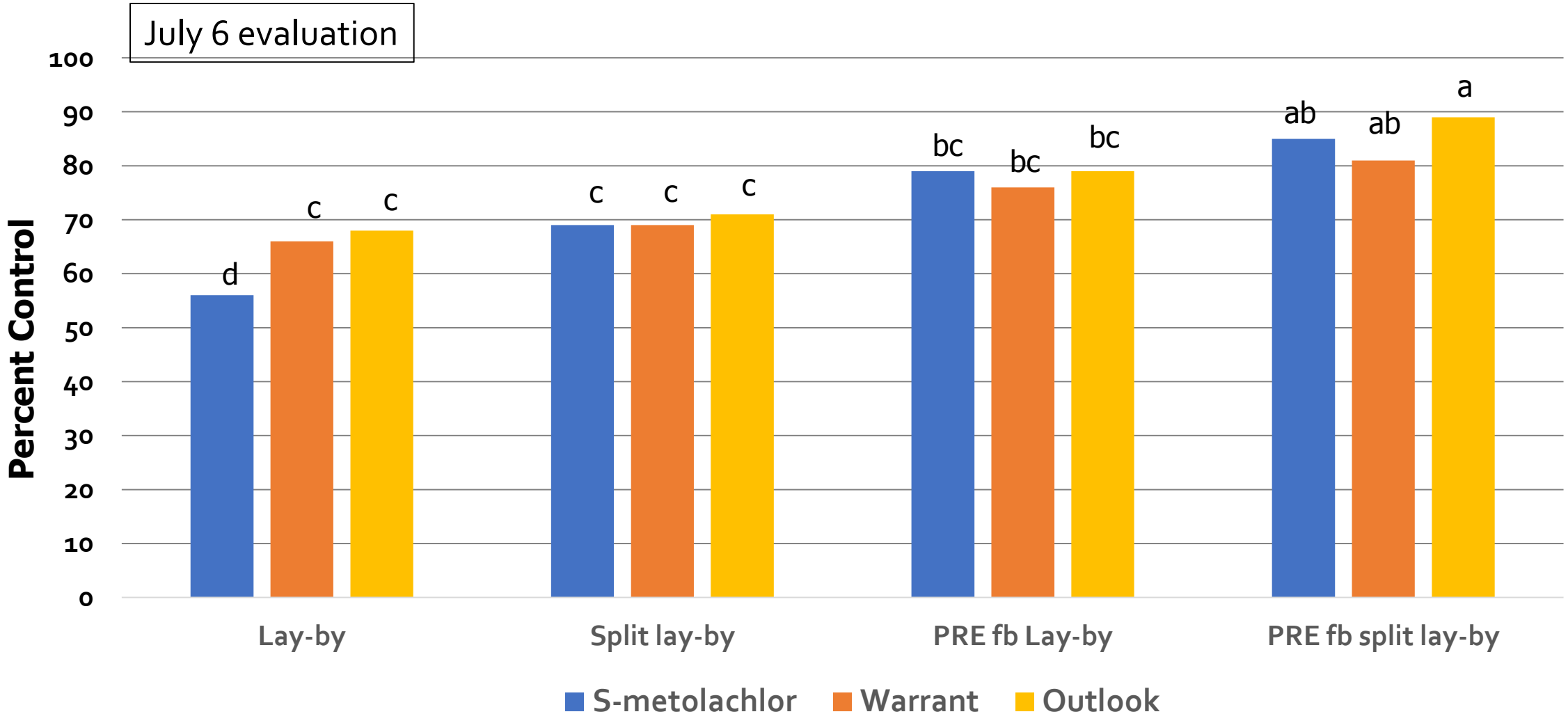
2016 and 2017 weather conditions were different from 2014 and 2015

- 2016 was an early spring
- Spotty spring precipitation created stand problems in 2016
- EPOST application delayed due to variation in stand
- Precipitation was limiting after EPOST application
- Some planted early in 2017
- Precipitation / delay in planting
- Prolonged period of dry conditions followed by spotty precipitation

Waterhemp control from soil residual herbicides lay-by or S-metolachlor at 0.5 pt/A fb lay-by, Moorhead, 2016



Waterhemp control from soil residual herbicides lay-by or S-metolachlor at 0.5 pt/A fb lay-by, L Lillian, 2017



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

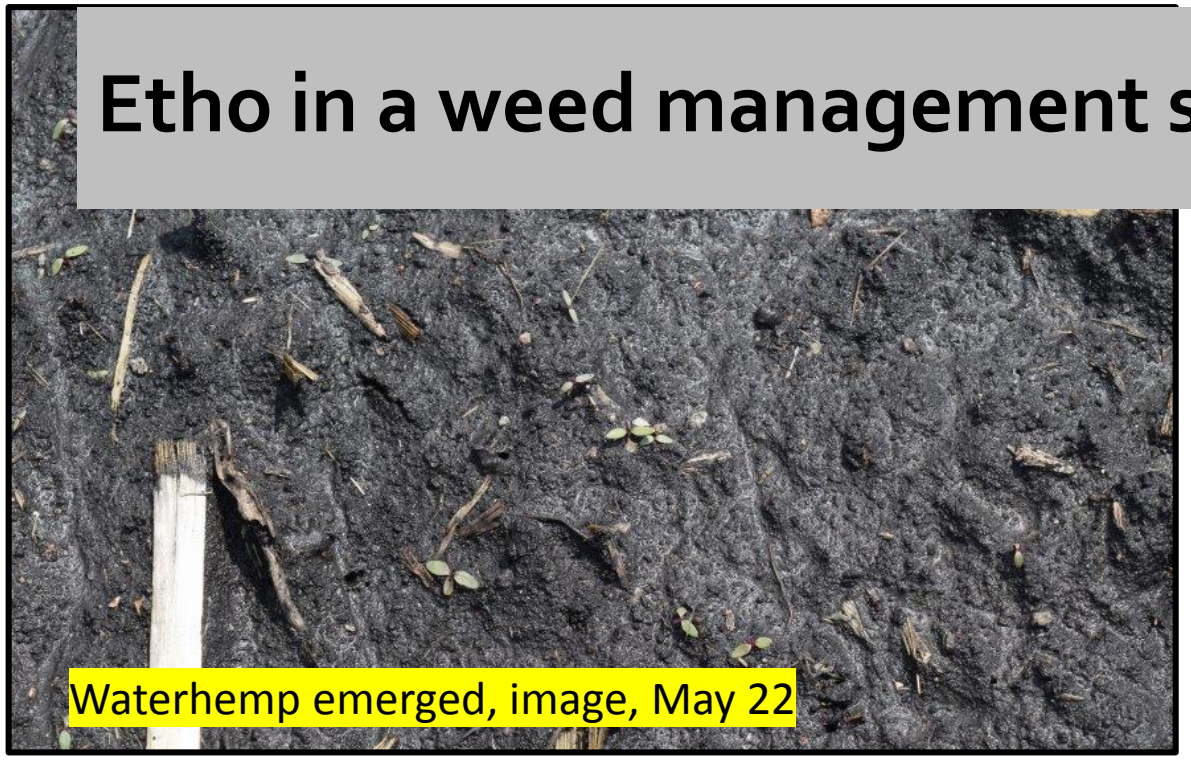
Waterhemp control costs[1], by product concept

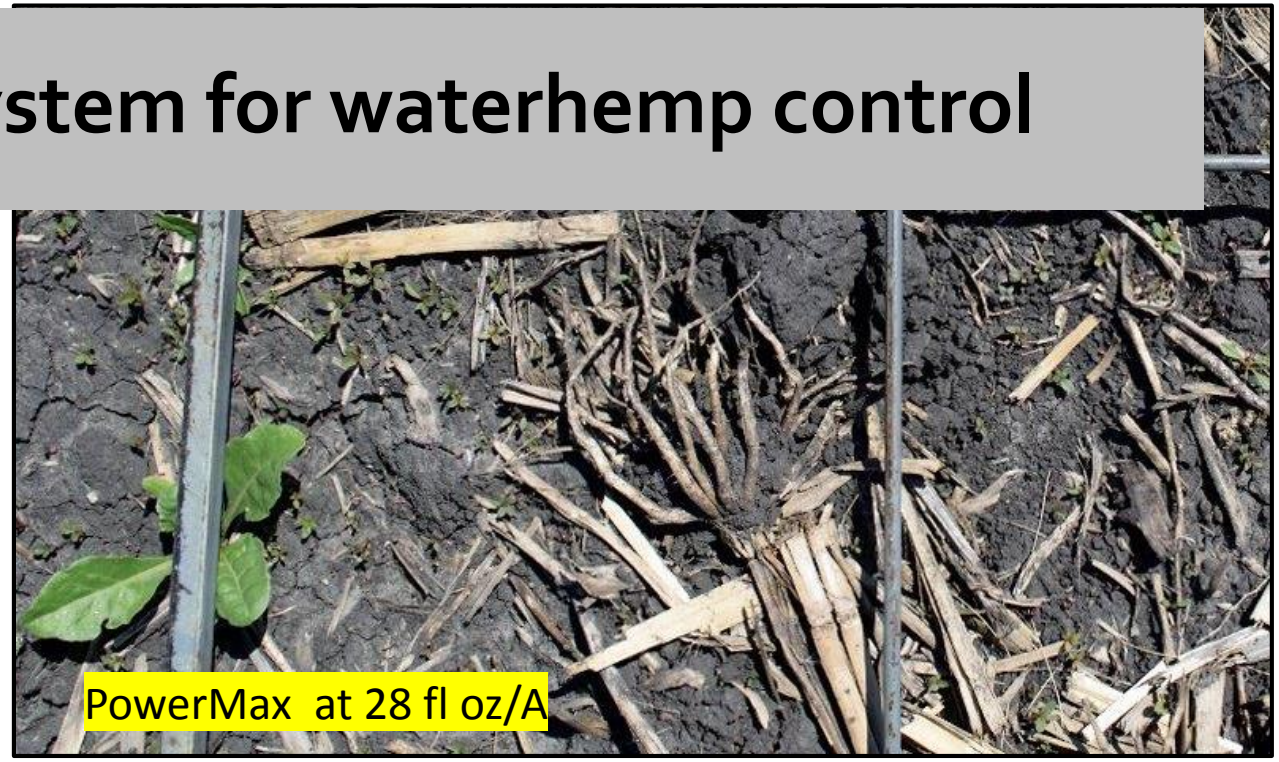
	Lay-by	Split lay-by	Pre fb Lay-by	Pre fb Split Lay-by
	----------($$)----------			
Warrant	$16	$23	$24	$31
Outlook	$21	$28	$29	$36
Dual Magnum	$19	$30	$27	$38
Average	$19	$27	$27	$35

Two applications - Roundup PowerMax + ethofumesate + HSMOC + AMS = $32

[1]According to the 2018 North Dakota Weed Control Guide

Etho in a weed management system for waterhemp control



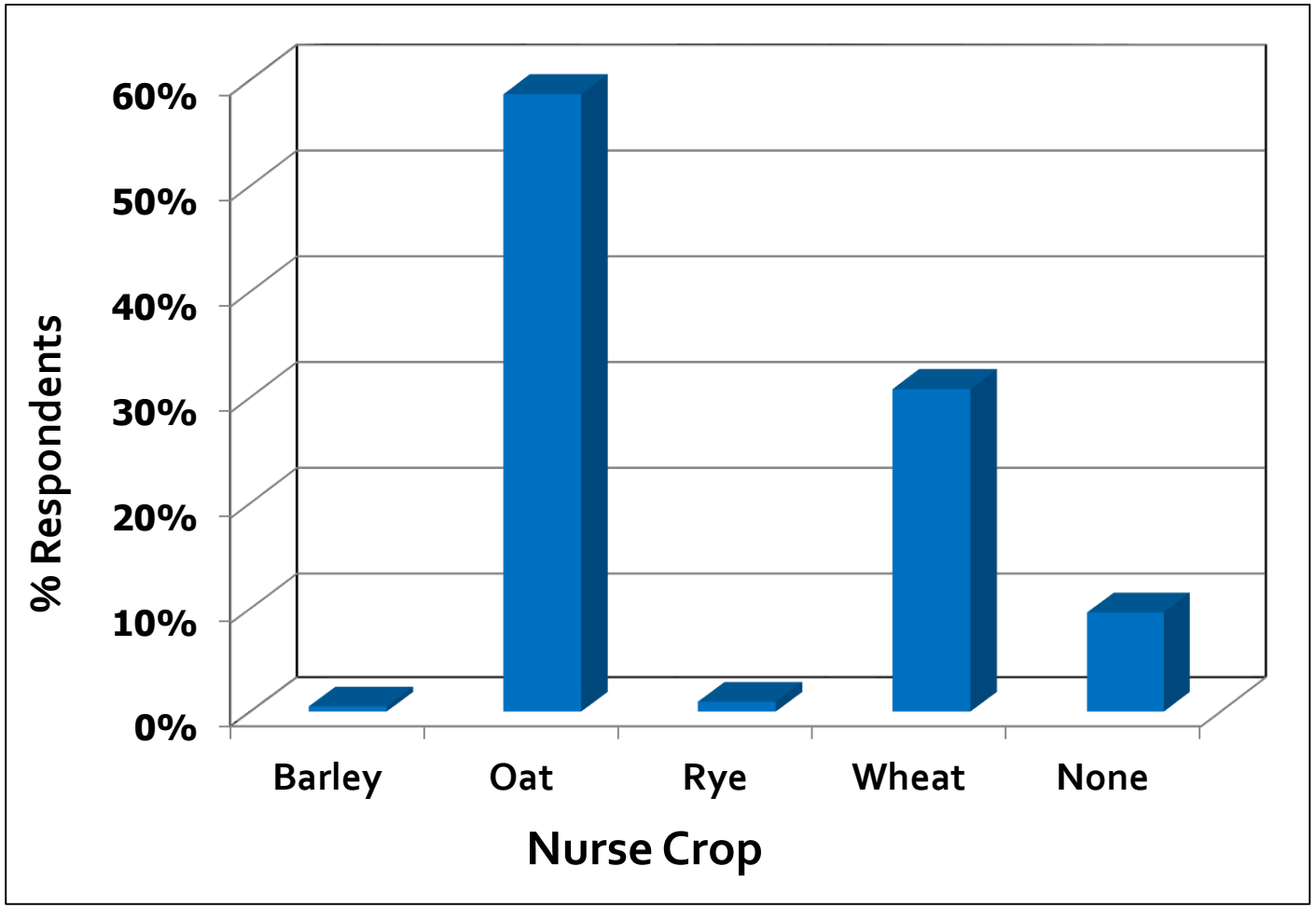


Waterhemp (count per meter square) or as a percent of control , June 6, 2017, Lake Lillian, MN

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

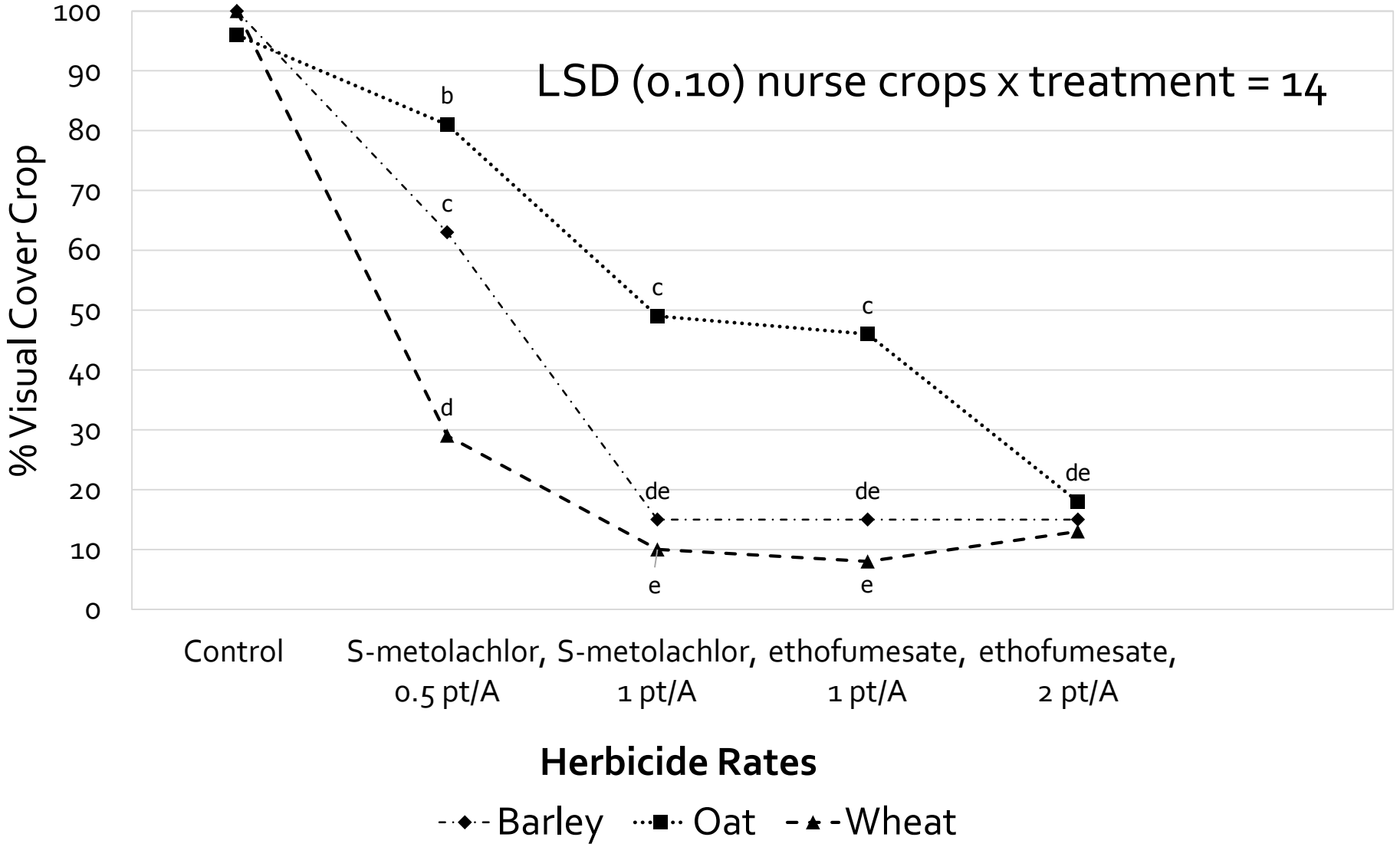
Herbicide	Rate	Application	Count	Visual Control
	pt/A		Num/m²	%
Ethofumesate	2	PRE	53bc	93
Ethofumesate	3	PRE	20cd	97
Ethofumesate	4	PRE	07d	99
PowerMax	1.75	EPOST	116b	85
Control			792a	

Nurse crop seeded as a companion crop with sugarbeet, SMBSC[1]



[1]Results from Turning Point Survey conducted at 2017 Grower Seminar

Effect of soil-residual herbicide on barley, oat, and wheat ground cover 35 days after planting, Foxhome, MN, 2015



Discussion
Selectivity or Placement?

- Water solubility and sorption may partially explain herbicide response
  - S-metolachlor is more water soluble than ethofumesate
  - S-metolachlor is taken up by cereals through the shoot, just above the seed
  - Precipitation moves S-metolachlor past the shoots of developing cereals
  - Ethofumesate requires more precipitation to move it from the seeding zone
  - Ethofumesate is taken up by both cereal roots and shoots, thus, increasing its potential for injury
- Herbicides are more easily activated in course textured soils

We must control waterhemp PRE or EPOST with residual herbicides

We are in trouble when we rely on POST rescue, especially on waterhemp greater than 4 inches

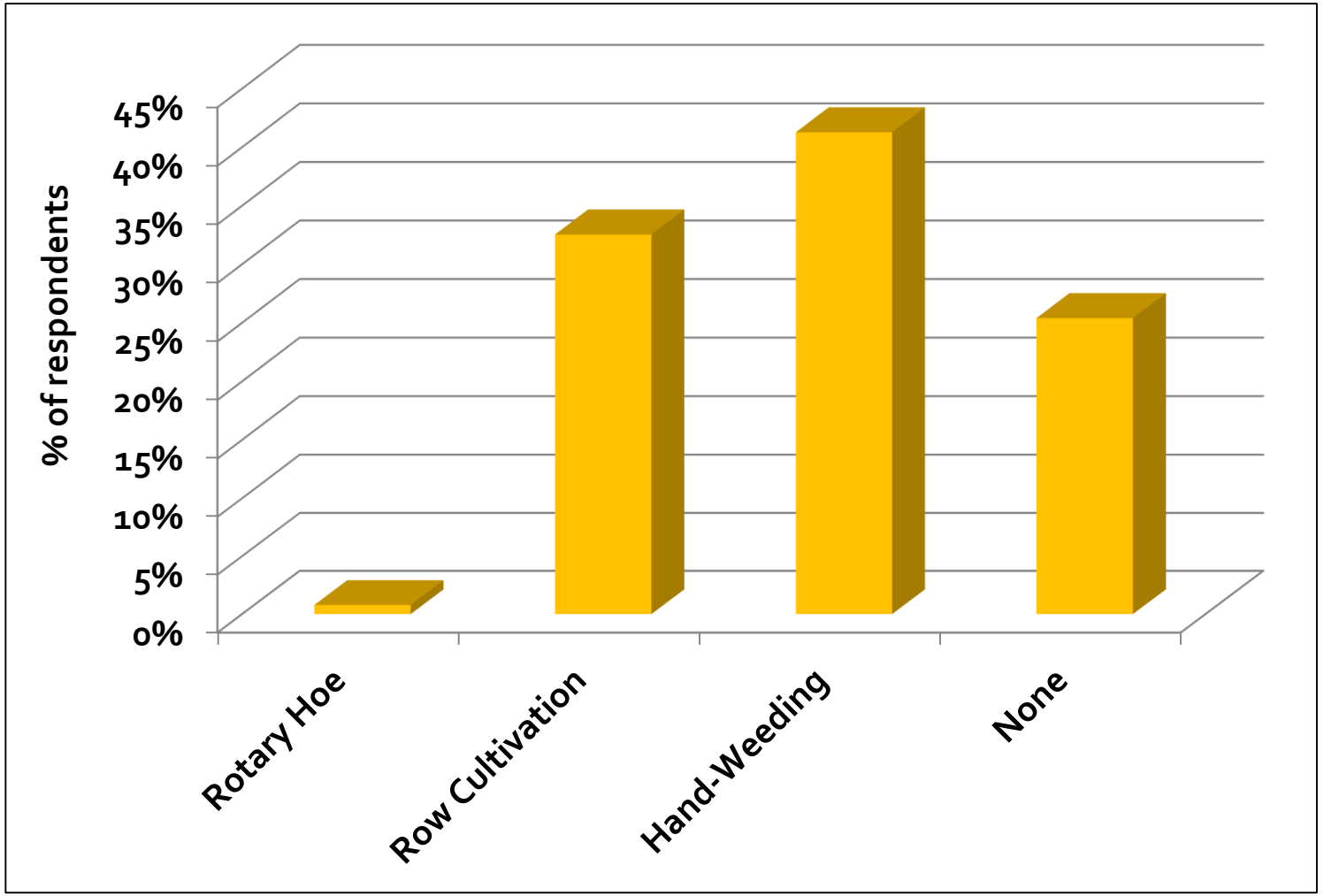
Waterhemp and common lambsquarters control from rescue herbicides at Lake Lillian, MN in 2017

Treatment	Rate/A	Appl[1]	June 26 Waterhemp	July 6 Waterhemp	July 6 Lambsquarters
			----------% control----------		
UpBeet + MSO	1 oz + 1.5 pt	POST	3	18	0
Ethofumesate 4SC + MSO	12 fl oz + 1.5 pt	POST	8	25	8
UpBeet + Ethofumesate 4SC + MSO	1 oz + 12 fl oz + 1.5 pt	POST	3	20	10
Roundup PowerMax fb Roundup PowerMax+ Ethofumesate + N-Pak AMS + Destiny HC	28 fl oz fb 28 fl oz + 6 fl oz + 2.5 % v/v + 1.5 pt	EPOST POST	63	50	100
LSD (0.05)			**11**	**15**	**4**

[1]EPOST was waterhemp and lambsquarters 4-inch; POST was waterhemp and lambsquarters 6-inch

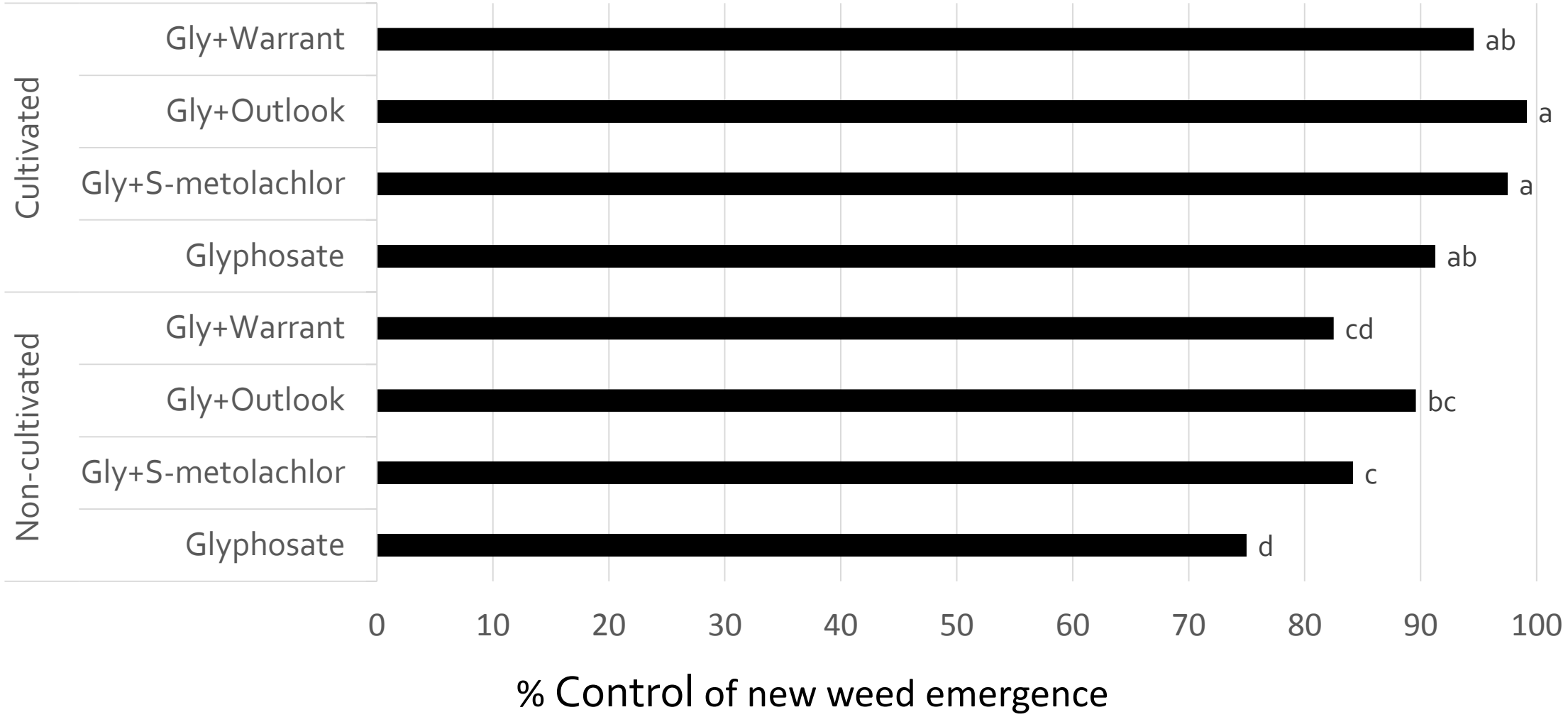
ALS (SOA2) resistant waterhemp

Mechanical tillage to control weeds at SMBSC[1]



[1]Results from Turning Point Survey conducted at 2017 Grower Seminar

Cultivated plots tended to have less weed emergence 14 DAT, across locations, July 24, 2017



Cultivation appears to be a valid rescue treatment

- Cultivator was effective in removing 65% of emerged weeds
- Cultivation did not stimulate emergence of new weeds
  - Herbicide was not affected
- Cultivation results in overall better control

2018 Waterhemp Control Recommendations

Planting Date	Recommendation
Plant Sugarbeet in April	Split lay-by application (early postemergence / postemergence) of chloroacetamide herbicides applied at 2-lf sugarbeet fb 4 to 6-lf sugarbeet
	Dual Magnum and/or ethofumesate PRE followed by a split lay-by application at 2 to 4-lf stage fb 4 to 6-lf stage
	Single lay-by application when sugarbeet is at the 2-lf stage or greater
Plant Sugarbeet in May	Dual Magnum and/or ethofumesate PRE followed by a split lay-by
Either	Continue to scout fields for late germinating waterhemp in late June and July
Either	Be prepared to rescue with Betamix + ethofumesate, UpBeet+ ethofumesate or Betamix + UpBeet (be aware of resistant biotypes)

Residual Herbicides applied EPOST and POST

What herbicides and rates?

- Warrant, Outlook, S-metolachlor (Dual Magnum, Cinch, Brawl, Charger Basic, Moccasin)

How should I use them; what rates?

- Split lay-by - Outlook at 12 fl oz fb 12 fl oz/A; metolachlor at 1 pt fb 1 pt and Warrant at 2.25 pt fb 2.25 pt/A
- Lay-by - Outlook, 18 fl oz/A; metolachlor, 1.25 pt/A; Warrant, 3.25 pt/A
- Pre fb split lay-by – Dual Magnum at 0.5-0.75 pt/A and/or ethofumesate at 2 pt/A fb Outlook at 12/12 fl oz/A, metolachlor at 1/1 pt/A, or Warrant at 2.25/2.25 pt/A

Ethofumesate

http://www.willowoodusa.com/products/herbicides/willowood-usa-ethofumesate/


201

Ethofumesate is applied PPI, PRE, or POST in sugarbeet

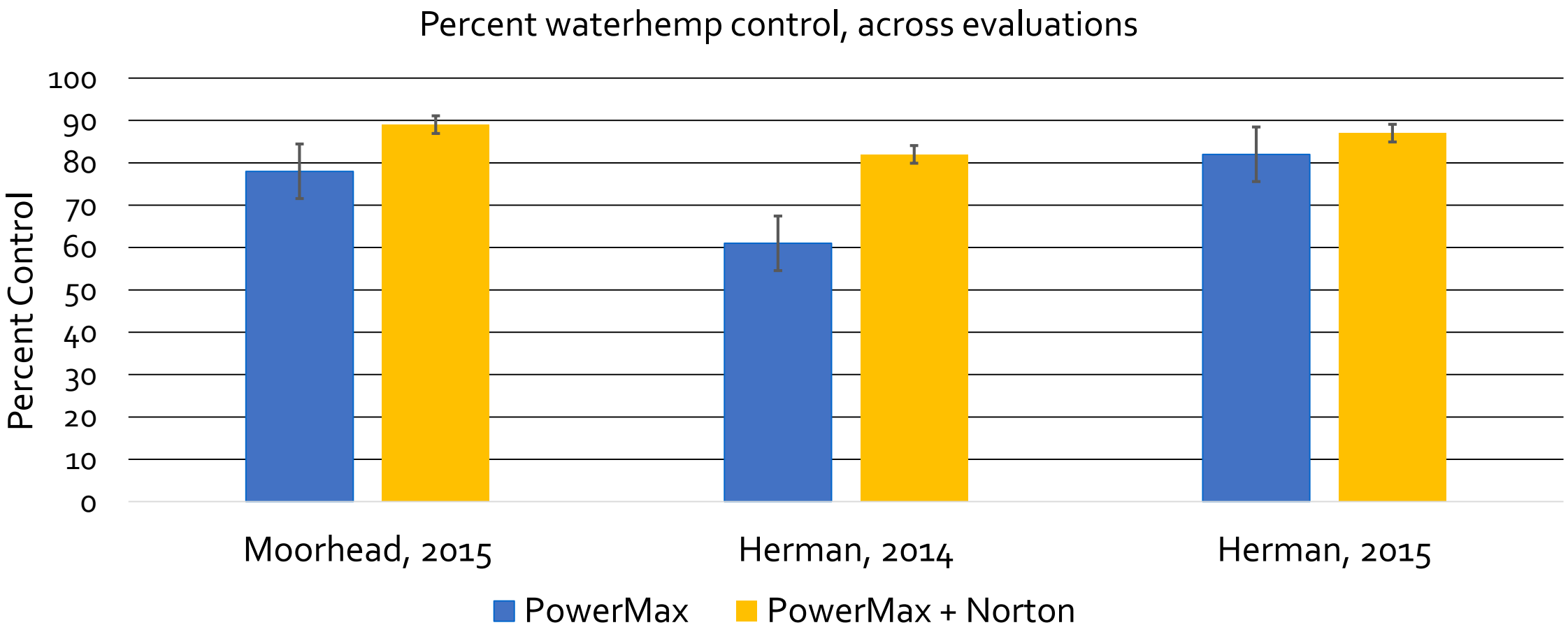
- Annual grass and broadleaf control (Sullivan and Fagala, 1970)
- Nortron (Fisons) first reference in annual survey of weed control practices (Dexter, Sgbt Res and Ext Rept, 1977)
- Absorbed by root and shoot and translocated to foliage (Eshel et al., 1978)
- Sugarbeet tolerance and weed efficacy related to soil characteristics and herbicide rate (Schweizer, 1975, Schweizer, 1979)
- Up to 10 weeks residual control (Ekins and Cronin, 1972)
- Sugarbeet tolerate POST applied ethofumesate (Eshel et al., 1976)

Waterhemp control from postemergence

Herbicides[1]	Herman 2014	Moorhead 2015	Herman 2015	Lake Lillian 2015	Average
	----------% visual control[2]----------				
glyphosate	36	66	20	61	46
glyphosate + ethofumesate	58	81	40	66	61

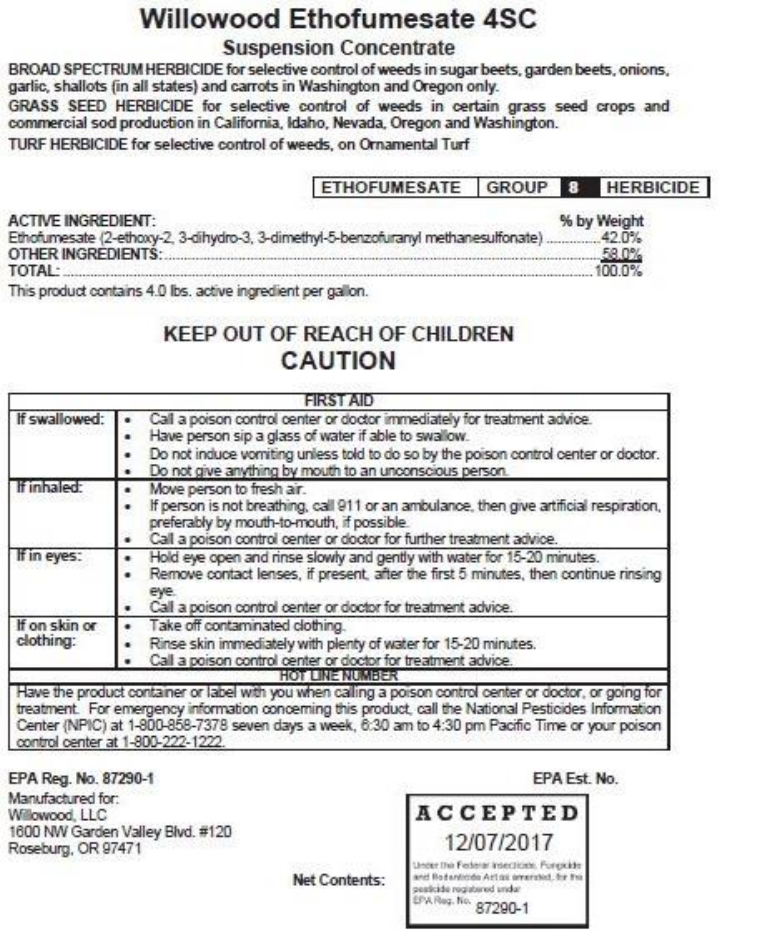
[1]Roundup alone with Prefer 90 NIS at 0.25% v/v and N-Pak AMS at 2.5% v/v. Roundup tank-mixes with Destiny HC at 1.5 pt/A and N-Pak AMS at 2.5% v/v.
[2]Visual percent waterhemp control at preharvest evaluation

Waterhemp control from glyphosate or glyphosate + ethofumesate, averaged across lay-by herbicides, 2014 and 2015



Regulatory approval for supplemental label on December 7, 2017

- POST rate up to 128 fl oz/A
  - Willowood Ethofumesate 4SC + glyphosate
  - Greater than 2-lf sugarbeet
  - Single or multiple applications
  - 10 day intervals between POST applications
  - 45 day Pre Harvest Interval (PHI)



Willowood Ethofumesate 4SC

Suspension Concentrate

BROAD SPECTRUM HERBICIDE for selective control of weeds in sugar beets, garden beets, onions, garlic, shallots (in all states) and carrots in Washington and Oregon only.

GRASS SEED HERBICIDE for selective control of weeds in certain grass seed crops and commercial sod production in California, Idaho, Nevada, Oregon and Washington.

TURF HERBICIDE for selective control of weeds, on Ornamental Turf

ETHOFUMESATE	GROUP 8	HERBICIDE

ACTIVE INGREDIENT:	% by Weight
Ethofumesate (2-ethoxy-2, 3-dihydro-3, 3-dimethyl-5-benzofuranyl methanesulfonate)	42.0%
OTHER INGREDIENTS:	58.0%
TOTAL:	100.0%

This product contains 4.0 lbs. active ingredient per gallon.

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID	
If swallowed:	• Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by the poison control center or doctor. • Do not give anything by mouth to an unconscious person.
If inhaled:	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. • Call a poison control center or doctor for further treatment advice.
If in eyes:	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
If on skin or clothing:	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.
HOT LINE NUMBER	
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. For emergency information concerning this product, call the National Pesticides Information Center (NPIC) at 1-800-858-7378 seven days a week, 6:30 am to 4:30 pm Pacific Time or your poison control center at 1-800-222-1222.	

EPA Reg. No. 87290-1

EPA Est. No.

Manufactured for:
Willowood, LLC
1600 NW Garden Valley Blvd. #120
Roseburg, OR 97471

Net Contents:

ACCEPTED
12/07/2017
Under the Federal Insecticide, Fungicide and Rodenticide Act as amended, for the pesticide registered under EPA Reg. No. 87290-1

Three questions about ethofumesate applied postemergence in sugarbeet

- Is ethofumesate safe to sugarbeet?

- Does ethofumesate control weeds?

- Does ethofumesate carryover to rotation crops after sugarbeet?
  - Corn
  - Soybean
  - Wheat

Sugarbeet injury[1] from ethofumesate or ethofumesate plus glyphosate, across rate and location

	Ethofumesate			Ethofumesate plus Glyphosate		
Rate	Prosper, ND	Minto, ND	Oslo, MN	Prosper, ND	Minto, ND	Oslo, MN
fl oz/A	---% growth reduction---			---% growth reduction---		
12	0	0	5	0	3	3
32	0	5	3	0	5	2
64	10	0	8	8	3	10
LSD (0.05)	NS	NS	NS	NS	NS	NS

[1]Visual growth reduction comparing sprayed rows to the adjacent untreated check

Sugarbeet injury[1] from ethofumesate at 128 fl oz/A at various application timing, Crookston, Foxhome and Lake Lillian

Location	Ethofumesate[2]	Yield	% Sugar	Recov Sugar
	fl oz/A	Ton/A	%	lb per acre
Crookston	0	27.7	18.5	9772
Crookston	128	28	18.5	9786
Foxhome	0	23	14.4	5619
Foxhome	128	22.5	14.7	5605
Lake Lillian	0	35.2	16.8	10092
Lake Lillian	128	35.3	16.7	10183

[1]No statistical difference between treatments within locations, $\alpha = 0.05$

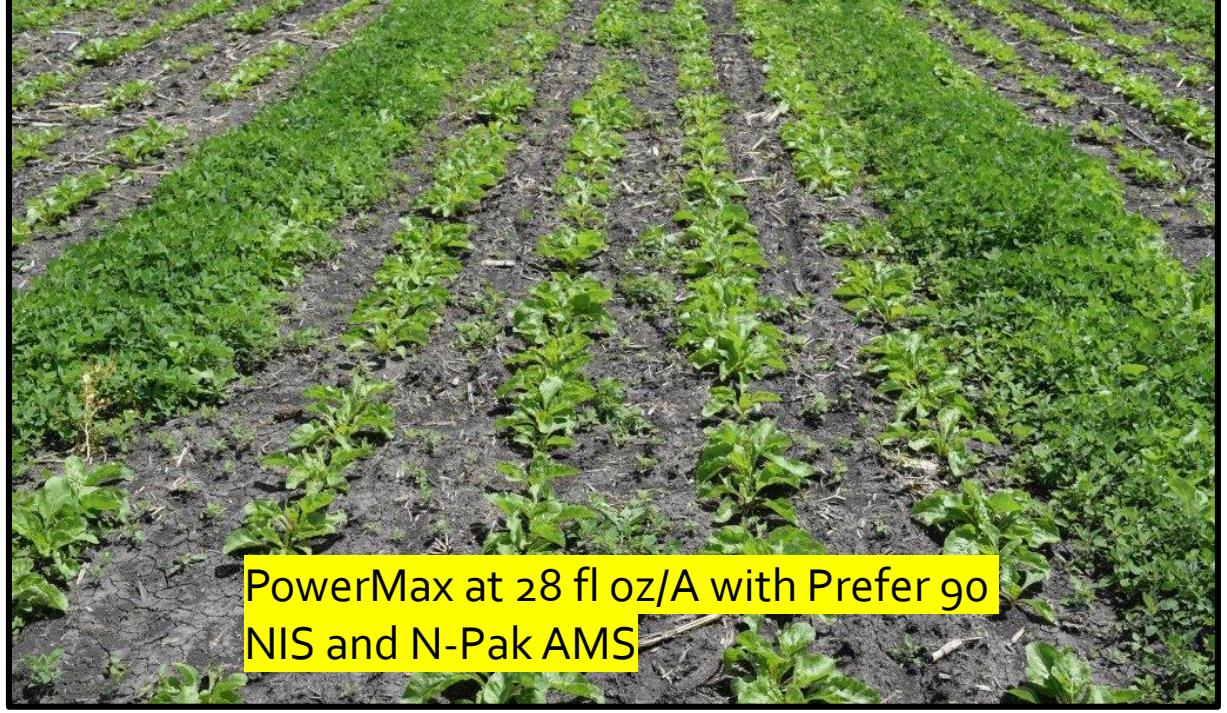
[2]Ethofumeate at 128 fl oz/A averaged across application timing

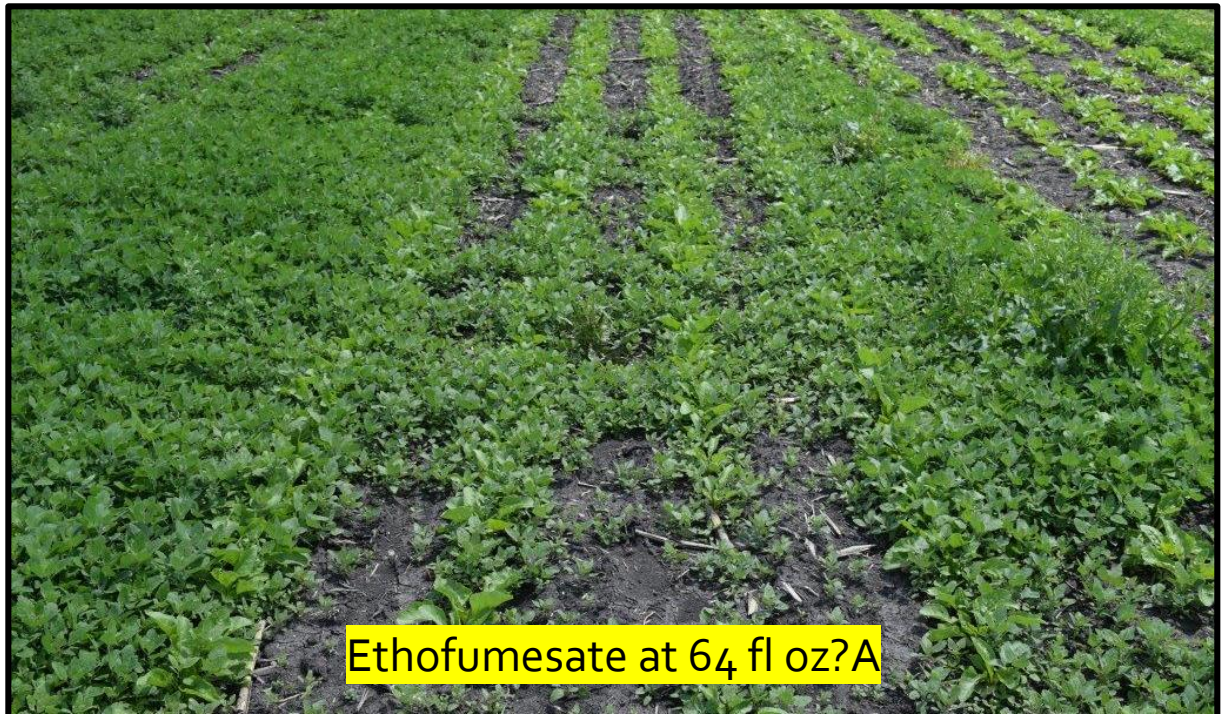
Lambsquarters control from ethofumesate over 2- and 6-lf sugarbeet, locations sorted by precipitation[1]

Etho-fumesate	Grand Forks, ND	Minto, ND	Oslo, MN	Moorhead, MN	Prosper, ND
(fl oz/A)	----------% visual control----------				
12 / 12	28 c	40 b	35 b	28 b	15 b
24 / 24	43 b	60 a	40 b	35 b	33 a
32 / 32	53 b	55 a	40 b	50 a	35 a
64 / 64	78 a	63 a	58 a	53 a	33 a

[1]Locations receiving 0.75-inch accumulated precipitation, up to 7 DAT; locations receiving 0.75-inch accumulated precipitation up to 14 DAT


Ethofumesate at 24 fl oz/A


PowerMax at 28 fl oz/A with Prefer 90
NIS and N-Pak AMS


Ethofumesate at 64 fl oz?A


Ethofumesate at 24 fl oz/A plus PowerMax at
28 fl oz/A with Prefer 90 NIS and N-Pak AMS

Pigweed[1] control from ethofumesate over 2- and 6-lf sugarbeet, locations sorted by precipitation[2]

Etho-fumesate	Minto, ND	Oslo, MN	Prosper, ND	Moorhead, MN
(fl oz/A)	----------% visual control----------			
12 / 12	15 c	35 b	28 c	95 a
24 / 24	20 bc	28 b	40 bc	98 a
32 / 32	25 b	33 b	45 b	100 a
64 / 64	40 a	50 a	75 a	99 a

[1]Redroot pigweed at Minto, Oslo, and Prosper; waterhemp at Moorhead

[2]Locations receiving 0.75-inch accumulated precipitation, up to 7 DAT; locations receiving 0.75-inch accumulated precipitation up to 14 DAT; locations receiving 0.75-inch precipitation > 14 DAT

Rotational crop yield (control – treatment) from ethofumesate at 128 fl oz/A applied at various calendar dates[1]

	Corn	Soybean	Wheat
	----------bu/A----------		
Repeat application[1]	(18)	(3)	1
June 15	(14)	(2)	(1)
August 15	(16)	(3)	(2)

[1]Sugarbeet planted in 2013; rotation crops planted in 2014 at Prosper, ND

[2]Ethofumesate at 32 fl oz/A applied at the 2-lf sugarbeet stage and at 14 day intervals (128 fl oz/A total)

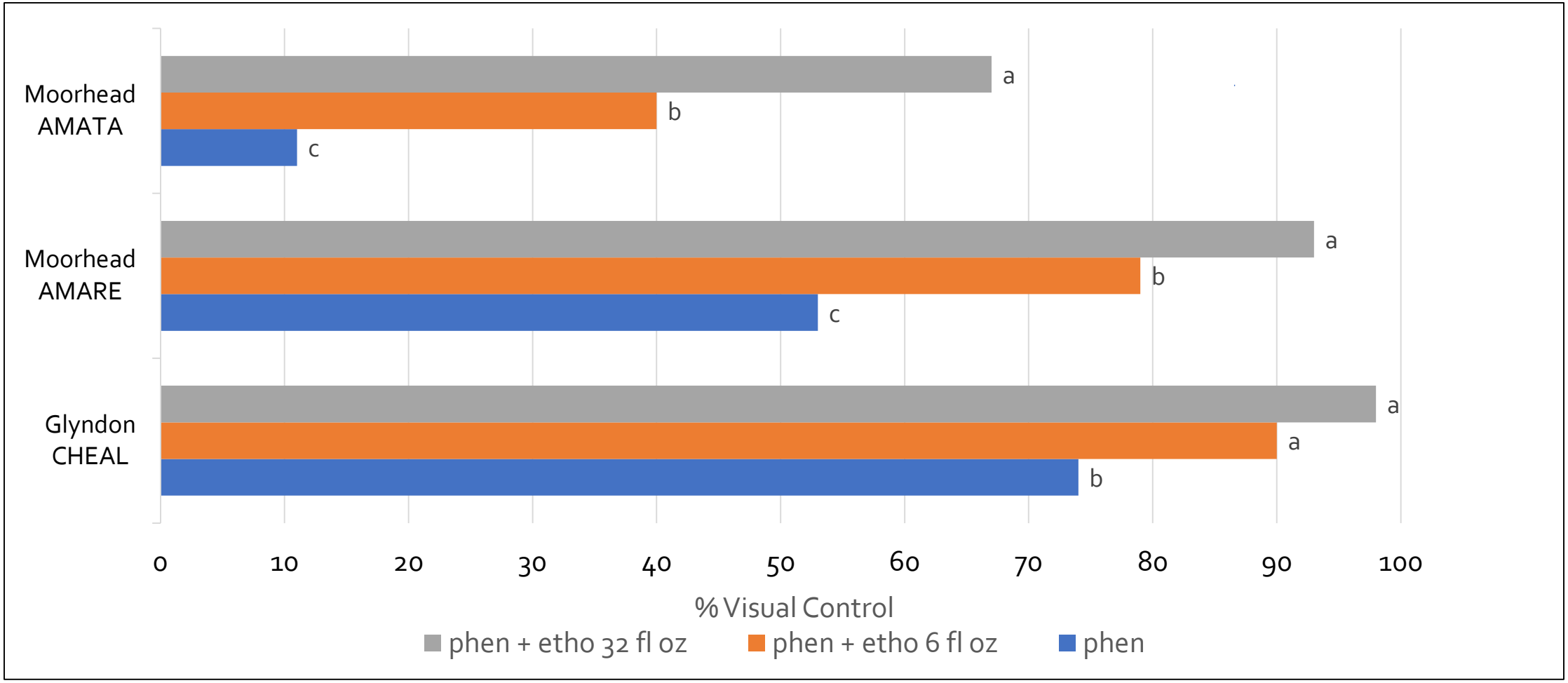
2018 Recommendations; 2018 Experiments

We need to proceed with caution

- Ethofumesate POST
  - Etho at 12 fl oz/A plus glyphosate
  - Up to 3 applications; 10 day interval between application
  - 45 day PHI
- Ethofumesate in a weed management system
  - Etho PRE (up to 2 pt) fb Etho EPOST (2-3 pt)
    - Us a chloracetamide for the second lay-by
  - Etho plus phenmedipham

We need to better understand crop rotation restrictions

Lambsquarters, redroot pigweed, and waterhemp control, Glyndon and Moorhead, MN, 2016



Does ethofumesate applied post rescue decapitate flowers?

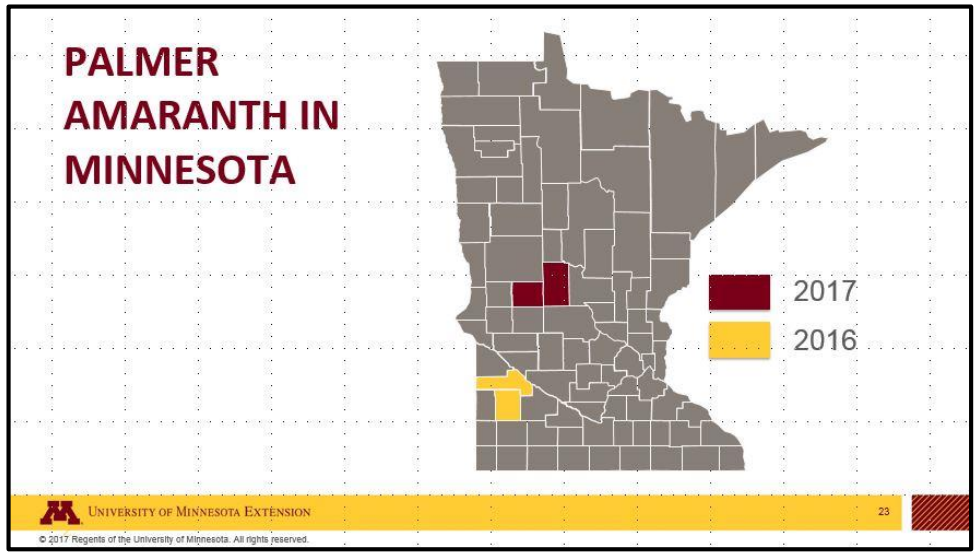
Summary

- Ethofumesate or ethofumesate plus glyphosate is safe to sugarbeet
- Ethofumesate alone does not control weeds postemergence
- We need to complete rotational crop experiments to determine safety to corn, soybean or wheat planted in sequence with sugarbeet

Palmer Amaranth in Minnesota Update

Research proposal to study PA in collaboration with Univ. of NE

- Experiment at multiple locations
- Indigenous palmer amaranth
- Soils similar to MN and ND
- Treatments including PRE fb EPOST (lay-by) programs
- Visual control; stand counts
- No yield data



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Thank you for your Support

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