

Weeds Management in Sugarbeet Grafton Growers Meeting

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NDSU EXTENSION
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Sugarbeet Weed Control Team

- Aaron Carlson
 - Farm background from Central MN dairy country
 - Crop and Weed major at NDSU from 2000 to 2004
 - MS Weed Science 2006 under Dr. Alan Dexter
 - Research Specialist in Extension Sugarbeet Program
 - Enjoys hunting, sports and spending time with wife, Katie, and 3 boys, Austin, Ben and Cody



Weeds management in sugarbeet requires a 'systems' approach

- Diversity in crops planted in the sequence
- Consideration to herbicides and herbicide families
- Cover crops suppress weeds germination
- Set an expectation for near perfect weed control
 - In sugarbeet
 - In all crops planted in the field in the sequence
- No new seed entering the weed seed bank

Use at least two and preferably three crops in the sequence; rotate to a different crop each year

Crops in the sequence...

- Have different planting and harvest dates
- Are planted at different row spacing and at different densities
- Have unique tillage needs; depth and timing of tillage
- Plant residue is managed differently
- Use a perennial sod crop if it fits your enterprise

Discuss with landlords and bankers about the necessity for implementing special practices or rotating into other crops

➤ Think strategy. Pick fields or a percent (i.e., 10%) of the operation to be targeted for special treatment



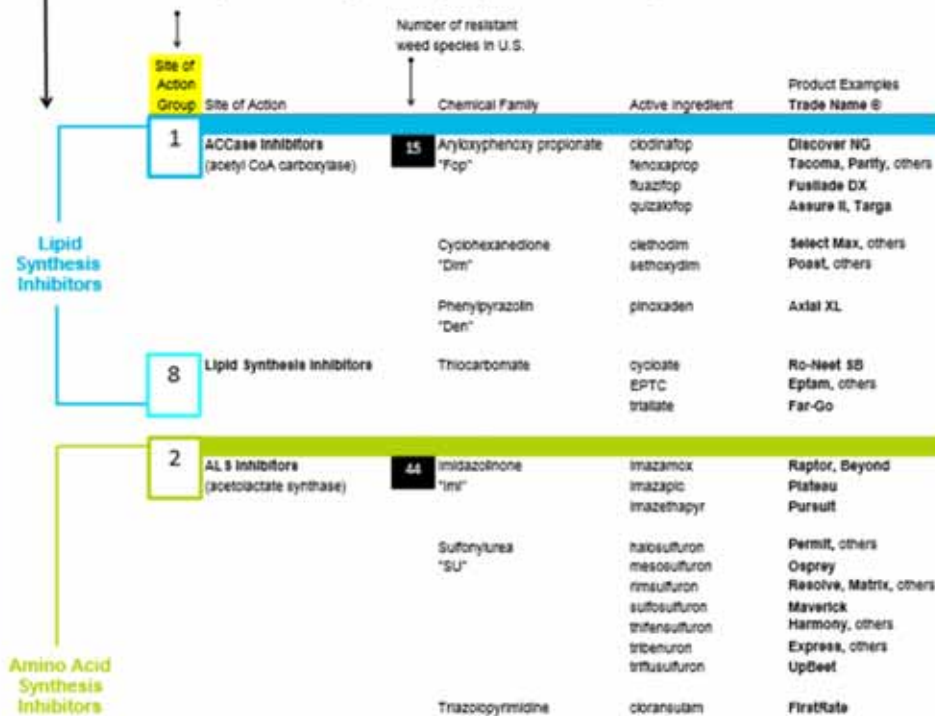
North Dakota Herbicide Chart

Repeated use of herbicides with the same site of action alone can result in the development of herbicide-resistant weed populations.

By Mode of Action (effect on plant growth)

This chart groups herbicides by their modes of action to assist you in selecting 1) to maintain greater diversity in herbicide use and 2) to rotate among herbicides with different sites of action to delay the development of herbicide resistance.

The Site of Action Group is a classification system developed by the Weed Science Society of America.



This chart lists premix herbicides alphabetically by their trade names so you can identify the premix's component herbicides and their respective site of action groups. Refer to the Mode of Action chart on the left for more information.

Premix Trade Name @	Trade Name @	Active Ingredient	Site of Action Group
Affinity Broad Spec	Harmony :1	trifluralin	2
	Express :1	trifluralin	2
Affinity TankMtx	Harmony :4	trifluralin	2
	Express :1	trifluralin	2
Anthem *	Zidua*	pyroxasulfone	15
	Cadet	futhiacet-ethyl	14
Audit	Harmony :3	trifluralin	2
	Express :1	trifluralin	2
Authority Assist	Spartan	sulfentrazone	14
	Pursult	imazethapyr	2
Authority First - or Sonic	Spartan	sulfentrazone	14
	FirRate	chloransulam	2
Authority MTZ	Spartan	sulfentrazone	14
	Metribuzin	metribuzin	5
Axial Star	Starane	fluroxypyr	4
	Axial XL	pinoxaden	1
Betamix	—	desmedipham	5
	—	phenmedipham	5
Boundary	Dual Magnum	s-metolachlor	15
	Metribuzin	metribuzin	5
BroadAxe	Dual Magnum	s-metolachlor	15
	Spartan	sulfentrazone	14
Bronate (generic)	Buctril	bromoxynil	6
	MCPA	MCPA	4
Callisto Xtra	Callisto	mesotrione	27
	Atrazine	atrazine	5
Capreno	—	thiencarbazon	2
	Laudis	tembotrione	27
Corvus	—	thiencarbazon	2
	Balance Flexx	isoxaflutole	27
Curtail	Stinger	cycopyrid	4
	2,4-D	2,4-D	4
Curtail M	Stinger	cycopyrid	4
	MCPA	MCPA	4

Use herbicides from multiple herbicide families across the sequence

<u>Ragweed</u>	<u>Waterhemp</u>	<u>Kochia</u>
-	- DNA (yellow)	-
- Sharpen	- Sharpen	- Sharpen
-	- Spartan	- Spartan
-	- Valor	- Valor (S)
- metribuzin	- metribuzin	- metribuzin
-	- Zidua	- Zidua (S)
-	- Basagran	- Basagran
- Cobra	- Cobra	-
- Flexstar	- Flexstar	- Flexstar
- Liberty	- Liberty	- Liberty
- cold hard steel	- cold hard steel	- cold hard steel

Toooooooo much PPO inhibitor herbicides!

Slide courtesy of Alicia Harstad, Stutsman County Agent

Perimeter Weed Management



Weed control summary, 2014 growers survey

	Number of in-season glyphosate applications	Glyphosate applied (lb/A)	Ave. glyphosate use rate (lb/A)
2014	2.3	2.19	0.97
2013	2.2	2.11	0.96
2012	2.0	2.32	1.16
2011	2.4	2.21	0.92
2010	2.4	2.09	0.87
2009	2.2	1.85	0.84

- Sugarbeet farmers made between 2 and 3 sequential glyphosate applications
- Total pounds of glyphosate active are trending greater
- Average glyphosate use rate is increasing

Satisfaction to RR Sugarbeet system, 2014 growers survey

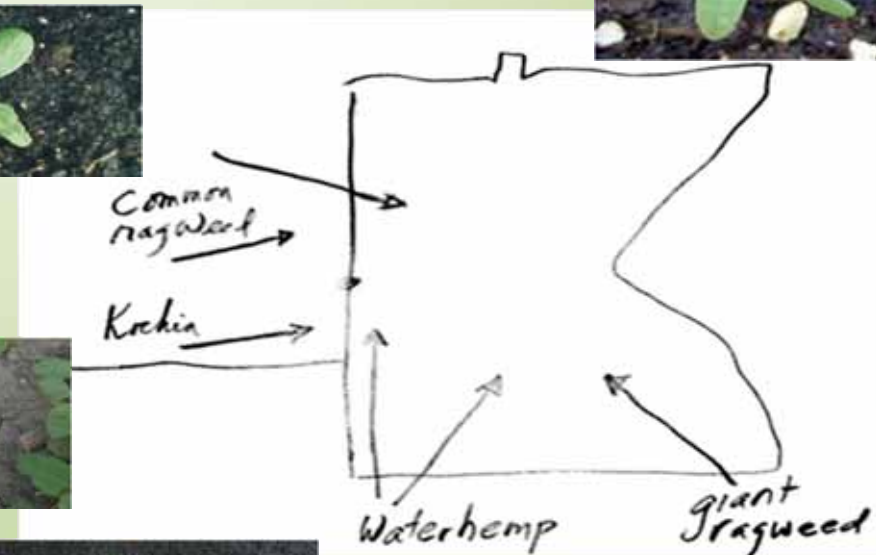
	No Response	Excellent	Good	Fair	Poor
2014	7	59	29	4	1
2013	6	70	22	2	1
2012	23	59	12	6	0
2011	9	74	11	2	4
2010	9	72	14	3	2
2009	10	78	10	0	1

- Growers are reporting excellent results with the RR Sugarbeet system
- Percent growers reporting good results is increasing. Why?

There are tough-to-control weeds in sugarbeet

Depending on where you farm...

- Common ragweed
- Kochia
- Waterhemp
- Giant ragweed
- Lambsquarters



Sugarbeet injury and control of common ragweed, Mayville, ND, 2014

Up to one inch common ragweed

Herbicide Treatment ¹	Rate	July 7 sgbt inj			
	fl oz/A	-----			
PMax / PMax / PMax	28 / 28 /22	1			
PMax+Stinger / PMax+Stinger / PMax	28+2 / 28+2 / 22	3	89	88	92
PMax+Stinger / PMax+Stinger / PMax	28+4 / 28+4 / 22	9	95	95	95
LSD (0.05)		10	14	11	10



¹All treatments were applied with N-Pak AMS at 2.5% v/v and Prefer 90 NIS at 0.25% v/v

²PMax is Roundup PowerMax

Sugarbeet injury and control of common ragweed, Mayville, ND, 2014

Up to two inch common ragweed

Herbicide Treatment ¹	Rate	July 7 sgbt inj	July 7 cora cntl	July 14 cora cntl	July 25 cora cntl
	fl oz/A	------(%)-----			
PMax / PMax / PMax	28 / 28 / 22	11	81	76	75
PMax+Stinger / PMax+Stinger / PMax	28+2 / 28+2 / 22	14	84	83	89
PMax+Stinger / PMax+Stinger / PMax	28+4 / 28+4 / 22	10	84	84	93
LSD (0.05)		10	14	11	10

¹All treatments were applied with N-Pak AMS at 2.5% v/v and Prefer 90 NIS at 0.25% v/v

²PMax is Roundup PowerMax



Sugarbeet injury and control of common ragweed, Mayville, ND, 2014

Greater than two inch common ragweed

Herbicide Treatment ¹	Rate	July 7 sgbt inj	July 7 cora cntl	July 14 cora cntl	July 25 cora cntl
	fl oz/A	------(%)-----			
PMax / PMax / PMax	28 / 28 / 22	-	64	68	82
PMax+Stinger / PMax+Stinger / PMax	28+2 / 28+2 / 22	-	59	72	84
PMax+Stinger / PMax+Stinger / PMax	28+4 / 28+4 / 22	-	63	76	91
LSD (0.05)		-	14	11	10

¹All treatments were applied with N-Pak AMS at 2.5% v/v and Prefer 90 NIS at 0.25% v/v

²PMax is Roundup PowerMax



Control of common ragweed, one inch or less

PowerMax plus Stinger, 28 fl oz + 2 fl oz fb
PowerMax plus Stinger, 28 fl oz + 2 fl oz fb
PowerMax, 22 fl oz



PowerMax, 28 fl oz fb PowerMax, 28 fl oz fb
PowerMax, 22 fl oz



Control of common ragweed, two inches or less

PowerMax plus Stinger, 28 fl oz + 4 fl oz fb
PowerMax plus Stinger, 28 fl oz + 4 fl oz fb
PowerMax, 22 fl oz

PowerMax, 28 fl oz fb PowerMax, 28 fl oz fb
PowerMax, 22 fl oz



Recommendations for common ragweed control

- For common ragweed control less than one-inch tall
 - Roundup PowerMax at 28 fl oz/A plus Stinger at 2 fl oz/A
 - Make a repeat application approximately 14 days following the first application.
- For common ragweed control less than two-inches tall
 - Roundup PowerMax at 28 fl oz/A plus Stinger at 3 fl oz/A
 - Make a repeat application approximately 14 days following the first application.
- For common ragweed control in fields that are up to four-inches tall
 - Roundup PowerMax at 28 fl oz/A plus Stinger at 4 fl oz/A or
 - Roundup PowerMax at 28 fl oz/A plus Stinger at 2 fl oz/A plus either ethofumesate at 4 fl oz/A, UpBeet at 0.5 oz/A or Betamix at 12 fl oz/A
 - Make a repeat application approximately 14 days following the first application.

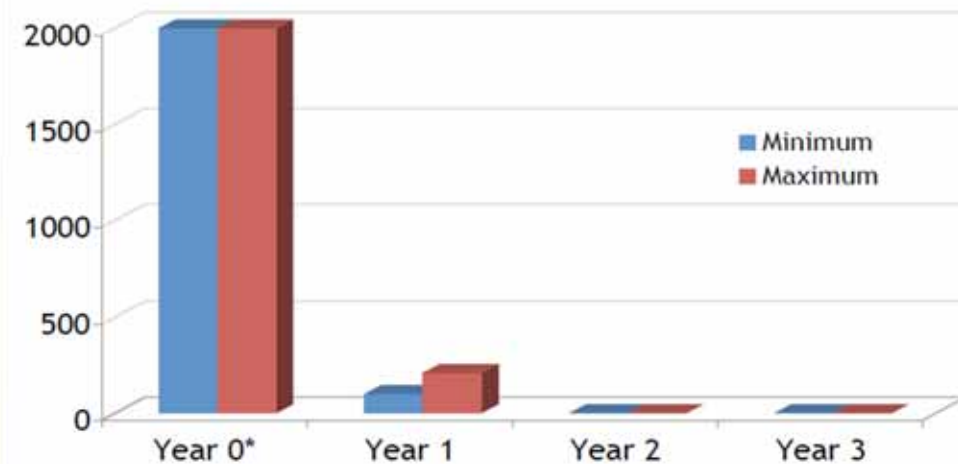
**Use AMS at 8.5-17 lb per 100 gallon and NIS surfactant at 0.25% v/v; use HSMOC at 1.5 pt/A with ethofumesate or Betamix

Control of volunteer RR canola in sugarbeet

- Canola can survive in soil for up to four years
- Number of canola volunteers is dependent on several factors including weather and time of harvest
- Gulden et al. found that the major of volunteer canola germinate and emerge in the first year following crop
- Volunteers can be managed in crop sequence with herbicides
- Small canola is easier to control than large canola



Figure 1. Volunteer canola emergence over time.



*Year 0 is the starting seedbank with 2000 viable seeds/m²

Source: Gulden et al. 2003.

Control of volunteer RR canola in sugarbeet

- Canola control from UpBeet at 0.25 oz/A at cotyledon to 2-leaf canola and twice sequentially provided greater than 95% control
- Increasing the UpBeet rate to 0.5 oz/A and applying twice sequentially gave near complete canola control
- ethofumesate soil applied followed by Roundup PowerMax gave inadequate canola control
- Sugarbeet injury from UpBeet at 0.25 or 0.5 oz/A plus Betamix was greater than UpBeet alone with RoundupMax



Kochia

- Extremely competitive weed; a few plants can cause yield reduction
- Many document examples of herbicide resistance
 - 2,4-D and MCPA
 - ALS
 - glyphosate
- The power of the crop sequence, herbicides in small grains
- Spray weeds postemergence when they are small
- Kochia seeds loose viability after one year
- Equipment cleanout; a hygienics approach



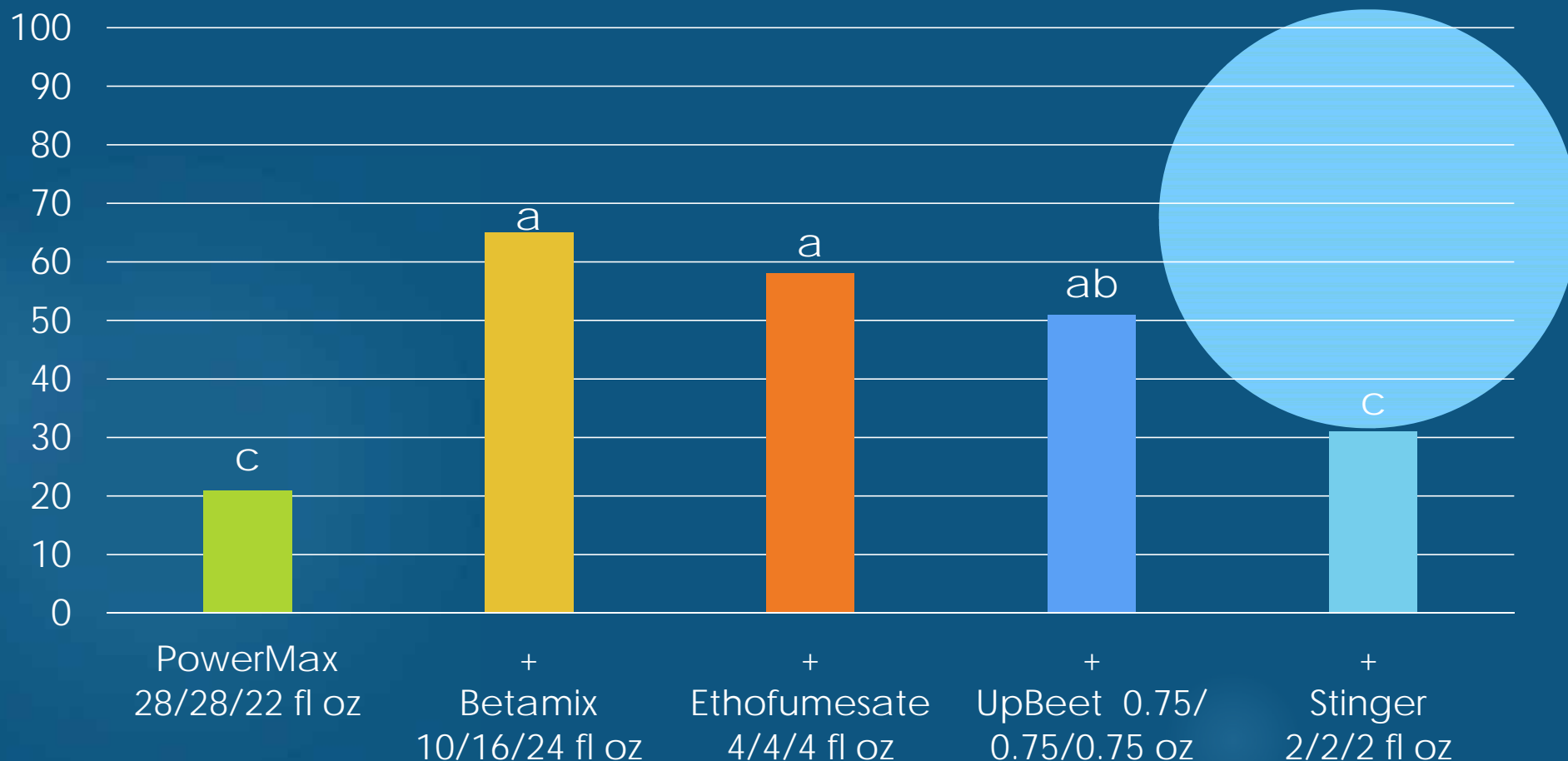
Kochia control in sugarbeet



1. Light to moderate infestations of kochia; glyphosate susceptible kochia
 - Roundup PowerMax at 28 fl oz/A plus ethofumesate at 4 fl oz/A and AMS plus HSMOC
 - Make a repeat application approximately 14 days following the first application
2. Moderate infestations of kochia, glyphosate resistant kochia
 - Roundup PowerMax at 28 fl oz/A + ethofumesate at 4 fl oz/A + Betamix at 8 fl oz to 32 fl oz/A depending on infestation and sugarbeet growth stage
 - Apply with AMS plus HSMOC
 - Make a repeat application approximately 14 days following the first application.
3. Moderate to heavy kochia
 - Ethofumesate applied preemergence at 6 to 7.5 pt/A followed by PowerMax at 28 fl oz/A plus ethofumesate at 4 fl oz/A
 - Scout and determine if Betamix should be added to the tank-mix
 - Apply with AMS plus HSMOC
 - Make a repeat application approximately 14 days following the first application

RESULTS - Postemergence

Waterhemp Control - Aug. 27, 2014



Roundup PM + NIS + AMS applied sequentially at 28 to 32oz/A, Herman MN



Roundup PM + NIS + AMS applied sequentially at 28 to 32oz/A at Herman MN



Roundup PM + NIS + AMS applied sequentially at 28 to 32oz/A at Herman MN



What is going on?

- Biotypes are genetically the same
- Biotypes may have the same appearance (but not always)
- Biological traits in some plants that are not common to the population as a whole



- Weed shifts occur when glyphosate controls some biotypes but not all
- Over time, the resistant biotypes become the predominant waterhemp in the field

What can one learn about the biology of the weed that will impact control strategy

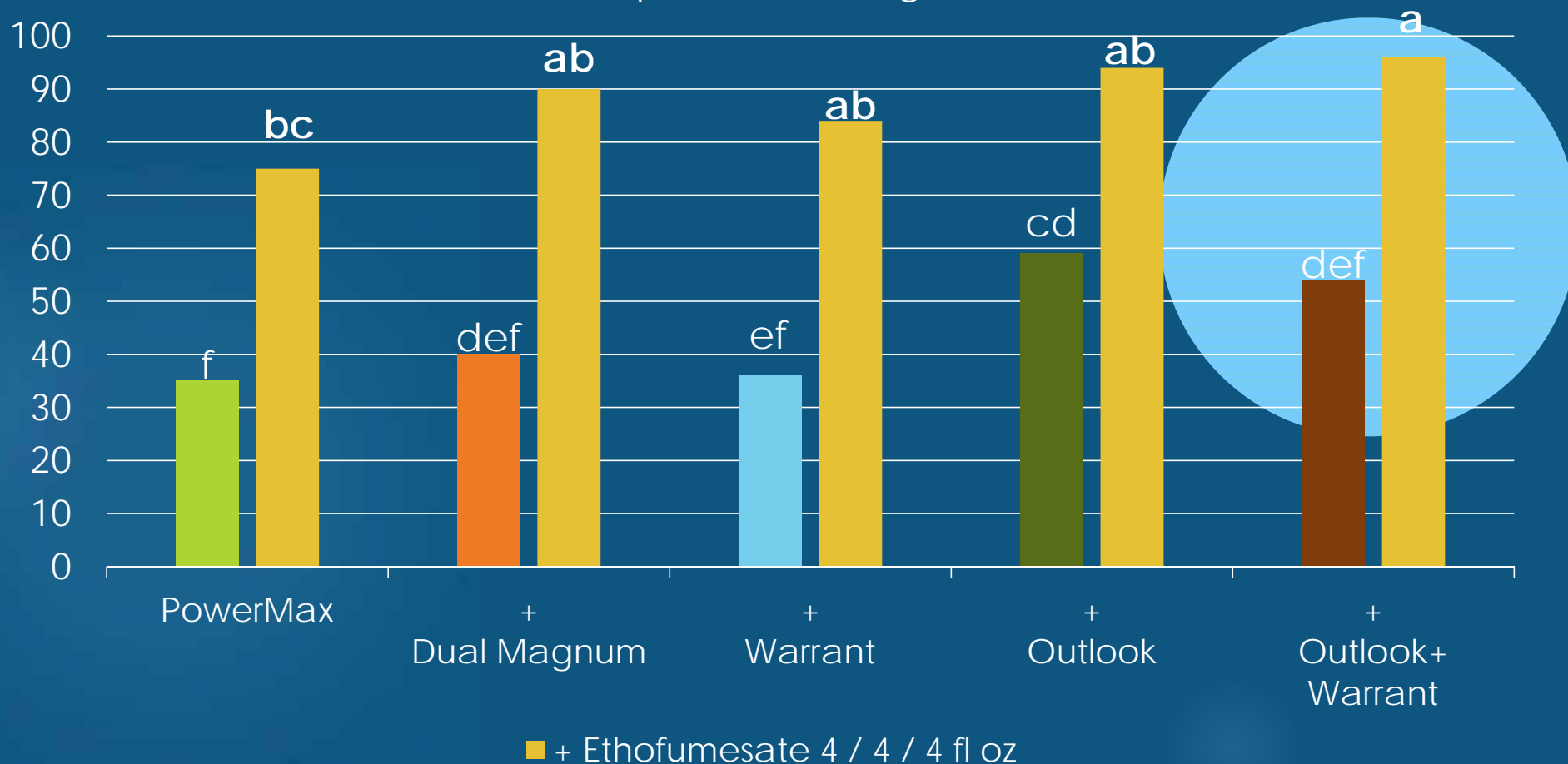
Think like a weed

- ▶ Understand its life cycle, summer annual
- ▶ Growth habit, 4-5 feet tall
- ▶ Reproductive habit, dioecious, male and female flowers on separate plants
- ▶ Longevity in soil, 6 years
- ▶ When does it germinate, Early June through July
- ▶ How did it respond to tillage, light and temperature responsible for germination /dormancy
- ▶ Shallow or deep, at our near the soil surface
- ▶ Seed production, prolific, 142,000



RESULTS – Lay-by

Waterhemp Control – Aug. 27, 2014



PowerMax - 48 dat



PowerMax +
Ethofumesate - 48 dat



PowerMax +
Outlook - 48 dat

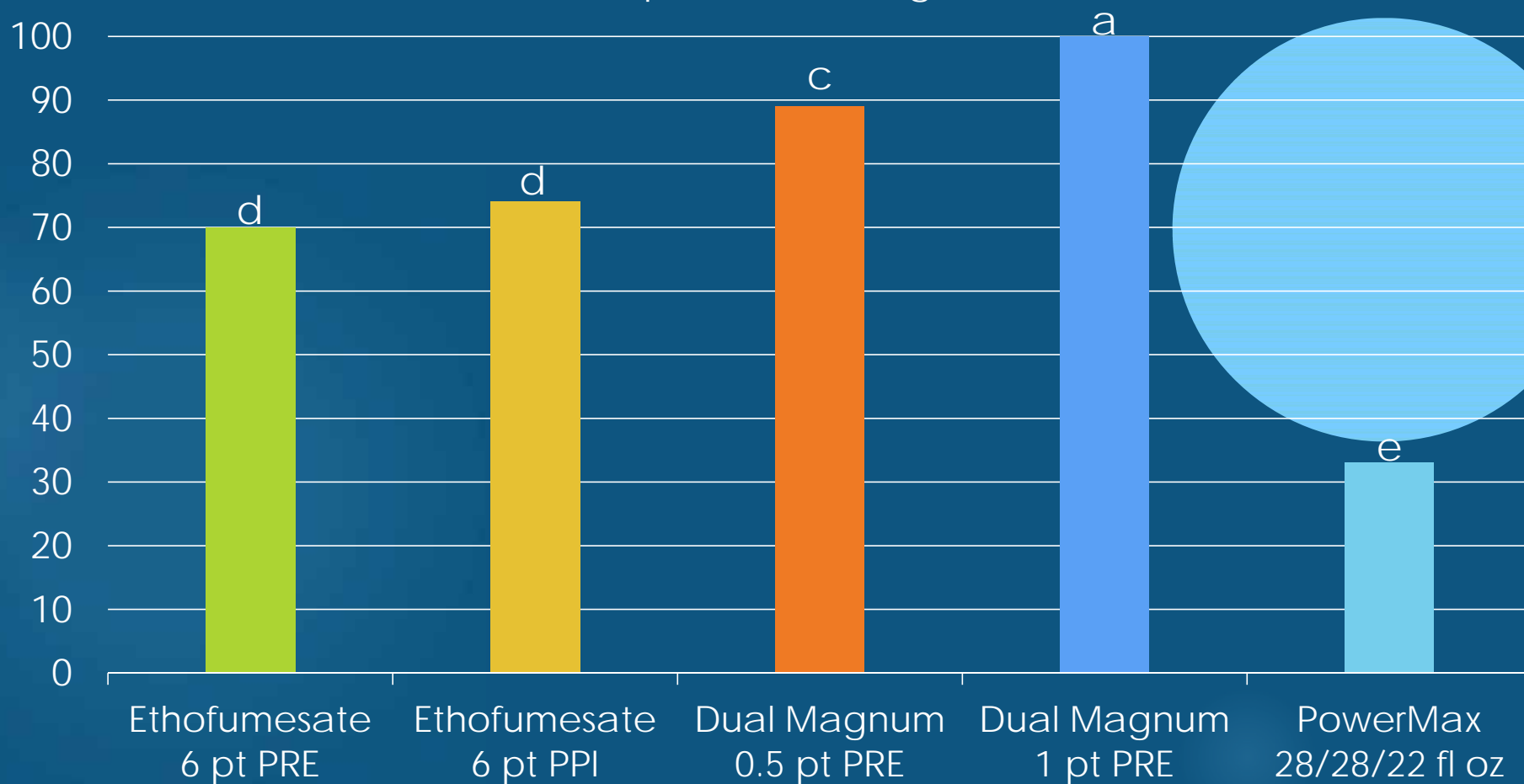


PowerMax +
Outlook +
Ethofumesate - 48 dat



RESULTS – PRE & PPI

Waterhemp Control – Aug. 27, 2014



Spring-seeded cereal cover crops offer several purposes to sugarbeet growers

- Reduce stand loss from wind and blowing soil
- Phosphorus credits in exchanging for operating the factory at SMBSC
- Suppress weeds
- Improve soil health



Weed Control with Cover Crop

- Cover crops used on 35 – 40% of ND & MN beet acres in 2013
- Conflict between maintaining cover crop and controlling weeds with soil herbicides



Weed Control with Cover Crop

Treatment ¹ & Rate	1 bu/a Oat Stand 6/5/13	3 bu/a Oat Stand 6/5/13	Herman Wahe cntl 9/5/13	
	<u>#/ ¼ m²</u>	<u>#/ ¼ m²</u>	<u>1 bu/a</u>	<u>3 bu/a</u>
No Soil Herbicide	28	81	83	87
Dual Magnum 1 pt/a	31	81	100	99
Ethofumesate 4SC 3 pt/a	22 -20%	48 -40%	99	99
Ethofumesate 4SC 7 pt/a	12 -55%	23 -70%	100	100
LSD 5%	12	12	6	6

¹All treatments received PowerMax 32 / 24 / 22 fl oz/a + AMS 8.5 lb/100 gal + NIS 0.25% v/v

Ground cover as a percent of counts in untreated control, across locations and cereals species, 19 to 27 DAP



		Foxhome	Crookston	Herman	Lake Lillian
	Rate (pt/A)	% Barley Cover	% Wheat Cover	% Wheat Cover	% Oat Cover
Dual Magnum	0.5	86	79	79	80
Dual Magnum	1	58	71	61	85
ethofumesate	2	32	33	28	68
ethofumesate	3	32	26	26	74
LSD (0.05)		14	19	13	NS

Herbicide treatments applied over wheat and barley at Crookston and Foxhome, 2014



Dual Magnum, 0.5 pt/A



ethofumesate, 2 pt/A



Sugarbeet as a percent of stand counts, across locations, 19 to 27 DAP



		Foxhome	Crookston	Herman*	Lake Lillian
	Rate (pt/A)	-----% Sugarbeet Stand-----			
Dual Magnum	0.5	96	102	100	105
Dual Magnum	1	105	101	100	97
Ethofumesate	2	69	108	100	101
ethofumesate	3	80	98	100	100
LSD (0.05)		NS	NS	NS	NS

* Visual assessment due to variation from excessive rainfall

Questions, Future Trial Considerations

1. Can spring seeded cover crops consistently suppress weeds?
2. Why did spring seeded cover crops respond differently to herbicides?
3. What is the impact of timing of soil-applied herbicide application?
4. What if Dual Magnum, Outlook or Warrant are applied lay-by over cover crops?
5. Is the timing correct for when cover crops are stopped?



Manage the seed bank...it's a "Numbers Game"

Minimize "Deposits" and
Maximize "Withdrawals"



Photo from J Bond, Mississippi State Univ



Single waterhemp plant in 2011 (Clay County, MN)
estimate of the actual seed number per plant = 142,000

The Weed Seedbank

- Germination – 3-40% of first year seed that enter into the seedbank germinates
- Rapid turnover – approximately 2/3 of seedbank lost annually
- Seedbank can be depleted by 25% per year of good weed management in cultivated soils (data from Nebraska)
- Seedbank can be replenished with a single year of bad control (Burnside et al., 1986)



Weeds are prolific producers of seeds

Weeds produce tens or hundreds of thousand seed per plant while crop plants only produce several hundred seeds per plant

- Giant foxtail -10,000
- Common ragweed – 30,000
- Purslane -52,000
- Lambsquarters – 72,000
- Redroot pigweed -117,000
- Waterhemp – 142,000
- Palmer amaranth – 460,000



Common predators of weed seeds....

- Seeds are a source for energy for insects and rodents
- Greater than 5% per day loss when on soil surface
- Total losses range from 20 to 90%
- Tillage after harvest can greatly reduce predation since predators don't dig for seed



Research targets for 2015

- Tough weeds
 - Additional experiments to improve our understanding of control of tough weeds in sugarbeet
 - Waterhemp, giant ragweed, kochia and volunteer RR canola
- Yield trials to better understand crop safety from Dual alone or with ethofumesate
- Soil-applied herbicides impacts on cover crops
- A weeds management strategy in fields planted to sugarbeet
 - Corn, soybean and cereals
- Update, Herbicide Mode of Action and Sugarbeet Injury Symptoms



Weed control contribution to the 2014 Sugarbeet Research and Extension Reports?

- Annual Growers survey
- Common ragweed control in sugarbeet
- Waterhemp control in sugarbeet
- Weeds management in the crop sequence – contribution to weed control in sugarbeet
- Impact of soil-applied herbicides on spring-seeded cereal cover crops in sugarbeet

Thank You

- We thank the Sugarbeet Research & Education Board for funding our program in 2014
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