Weeds Management in Sugarbeet

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NDSU EXTENSION SERVICE

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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 - 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

Weed control summary according to the 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 make 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

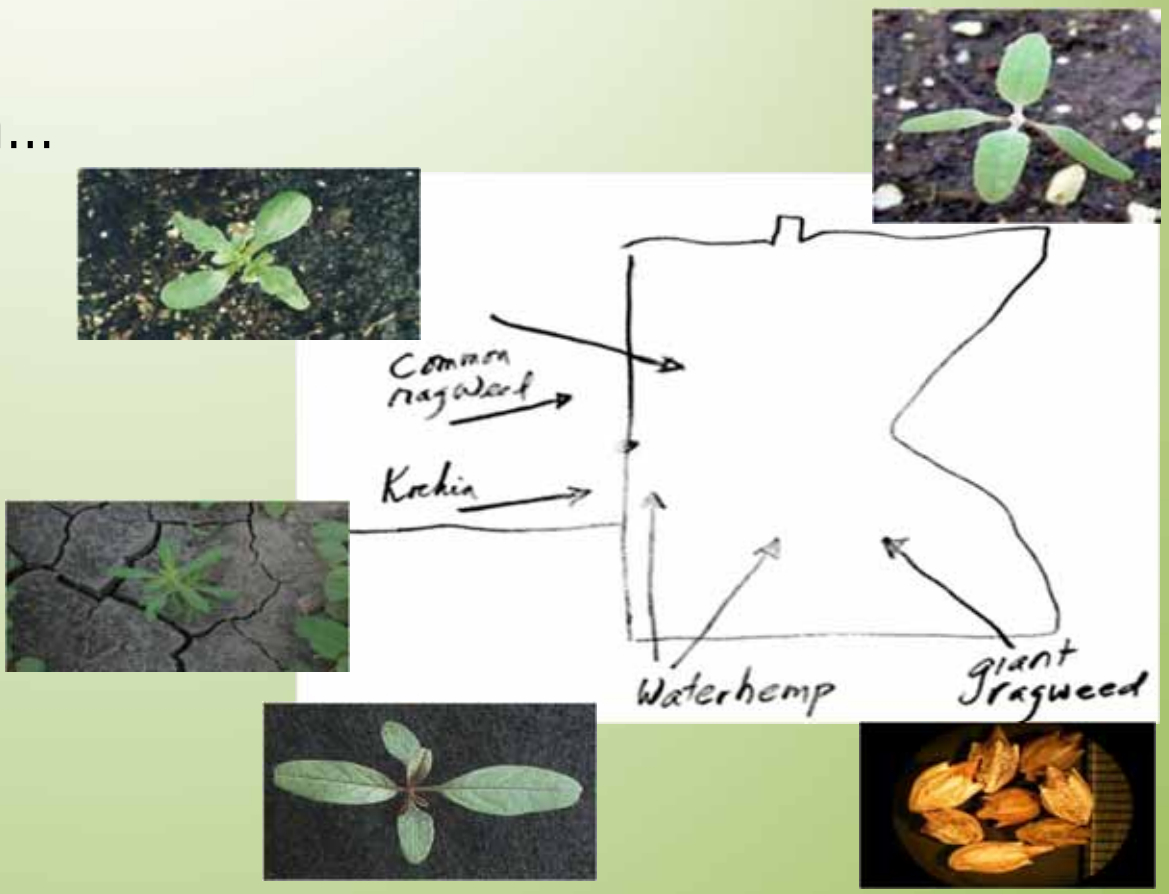
- Growers are reporting excellent results with the RR Sugarbeet system

- 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



INTRODUCTION – the problem

Waterhemp

- Amaranthus sp.
- Extended germination
- Rapid growth
- Tremendous seed production
- 13% of 2013 survey respondents' "worst weed"
- 44% in 2014

MATERIALS & METHODS

- Waterhemp control in sugarbeet
- Trials at 3 locations, Lake Lillian, Herman and Moorhead, MN
- Herman, MN – 3 experiments
  - Planted May 30, 2014
  - 'Crystal 981RR' in 22" rows
  - Treat center 4 rows of 6 row plots
  - 8002XR nozzles - 3 mph - 40 psi - 17 gpa
  - PPI treatments incorporated with rotary tiller
  - PRE treatments applied May 30
  - Three POST applications

POSTEMERGENCE

	Application 1	Application 2	Application 3
Date	June 23	July 2	July 10
Sugarbeet	4 – 6 lf	7 – 9 lf	10 – 12 lf
Waterhemp	2.5 inch	5 inch	11 inch

All treatments applied with adjuvants:

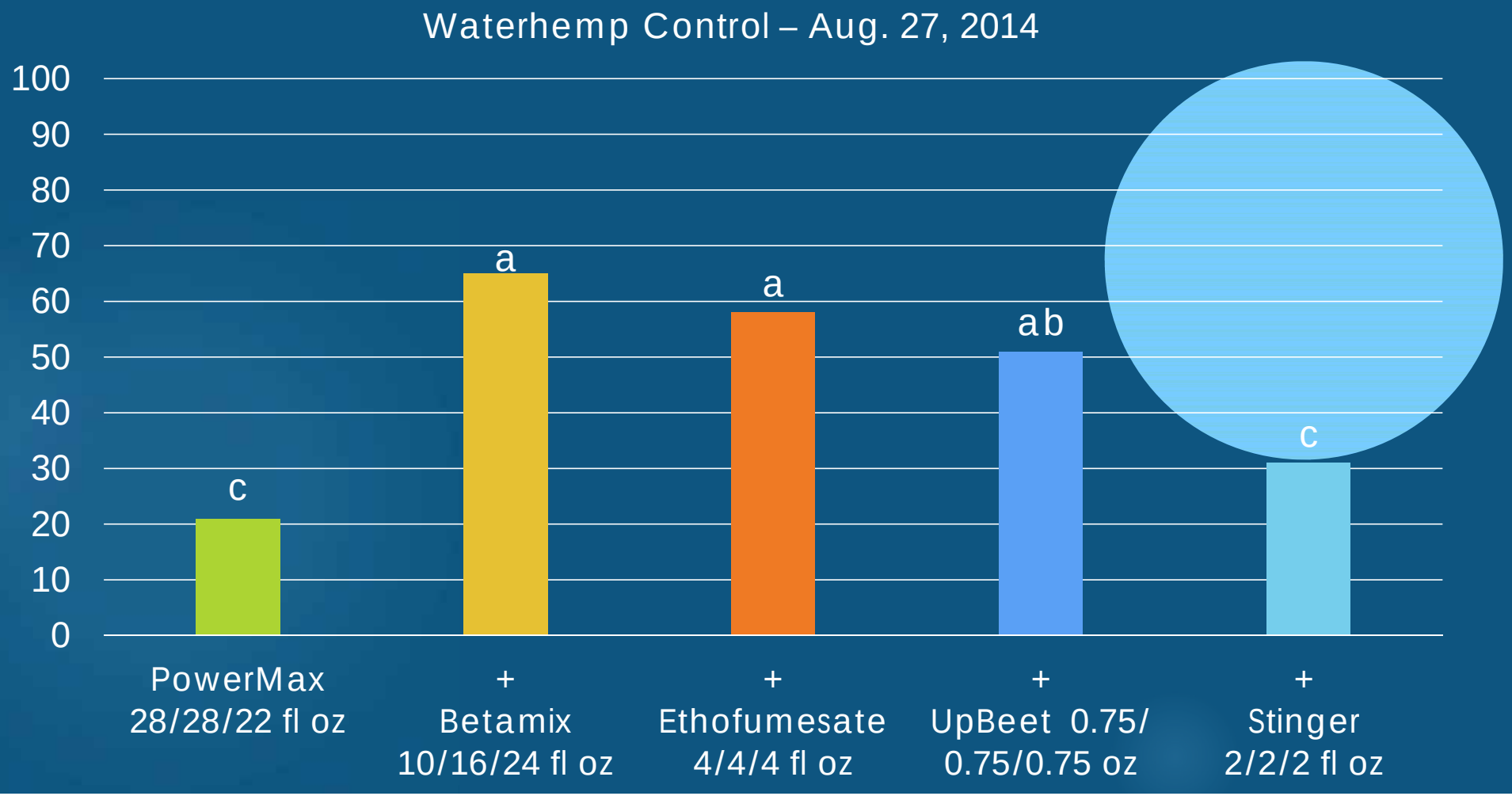
1. PowerMax + Ethofumesate or Betamix or UpBeet = AMS 8.5 lb/100gal + HSMOC 1.5 pt/A
2. PowerMax alone or + Stinger = AMS 8.5 lb/100gal + NIS 0.25%v/v

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

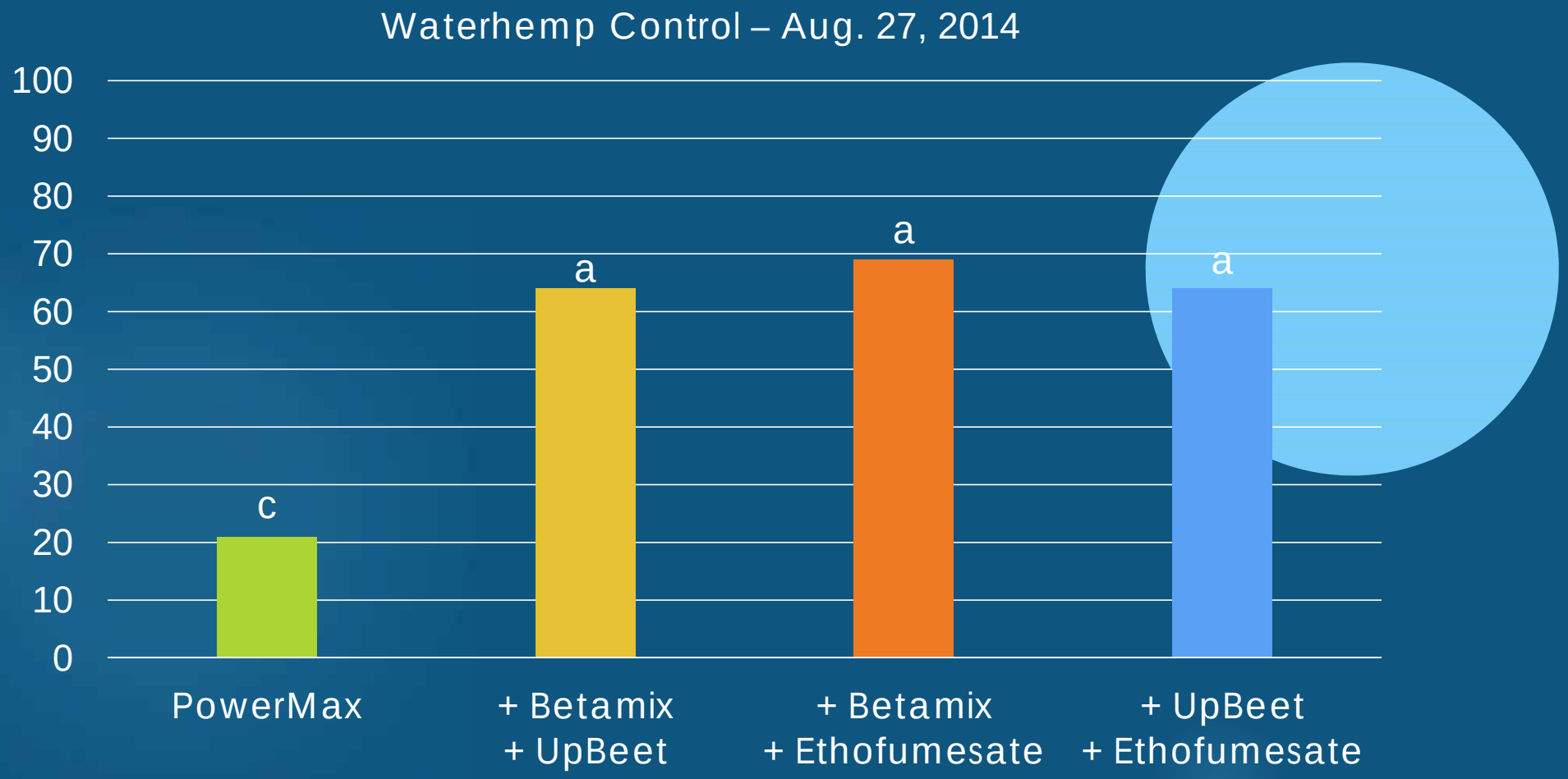
Roundup PM + NIS + AMS applied sequentially at 28 to 32oz/A at Herman MN

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

RESULTS - Postemergence



RESULTS - Postemergence



glyphosate - 14 dat

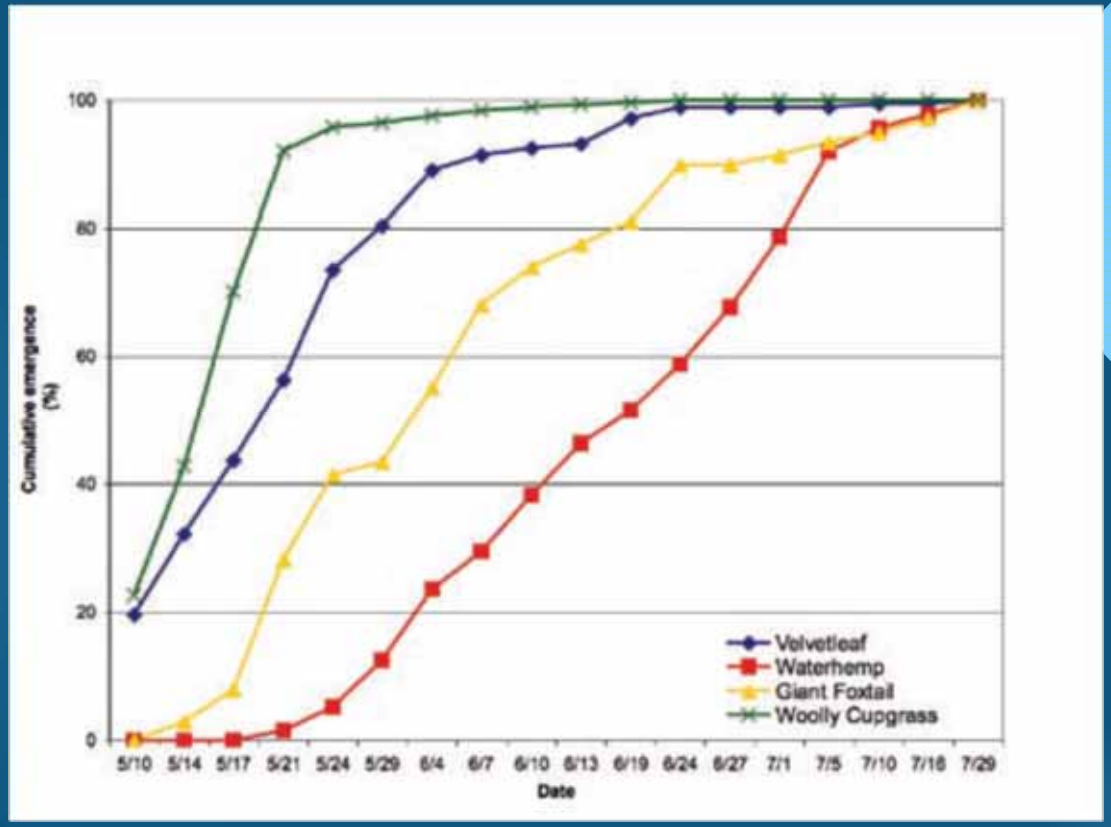
glyphosate +
ethofumesate - 14 dat

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

Emergence of four annual weed species. Adapted from Norby, Hartzler and Bradley, 2007



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

Weed seed survival in soil: Burnside et. al., Weed Sci: 44;74-85

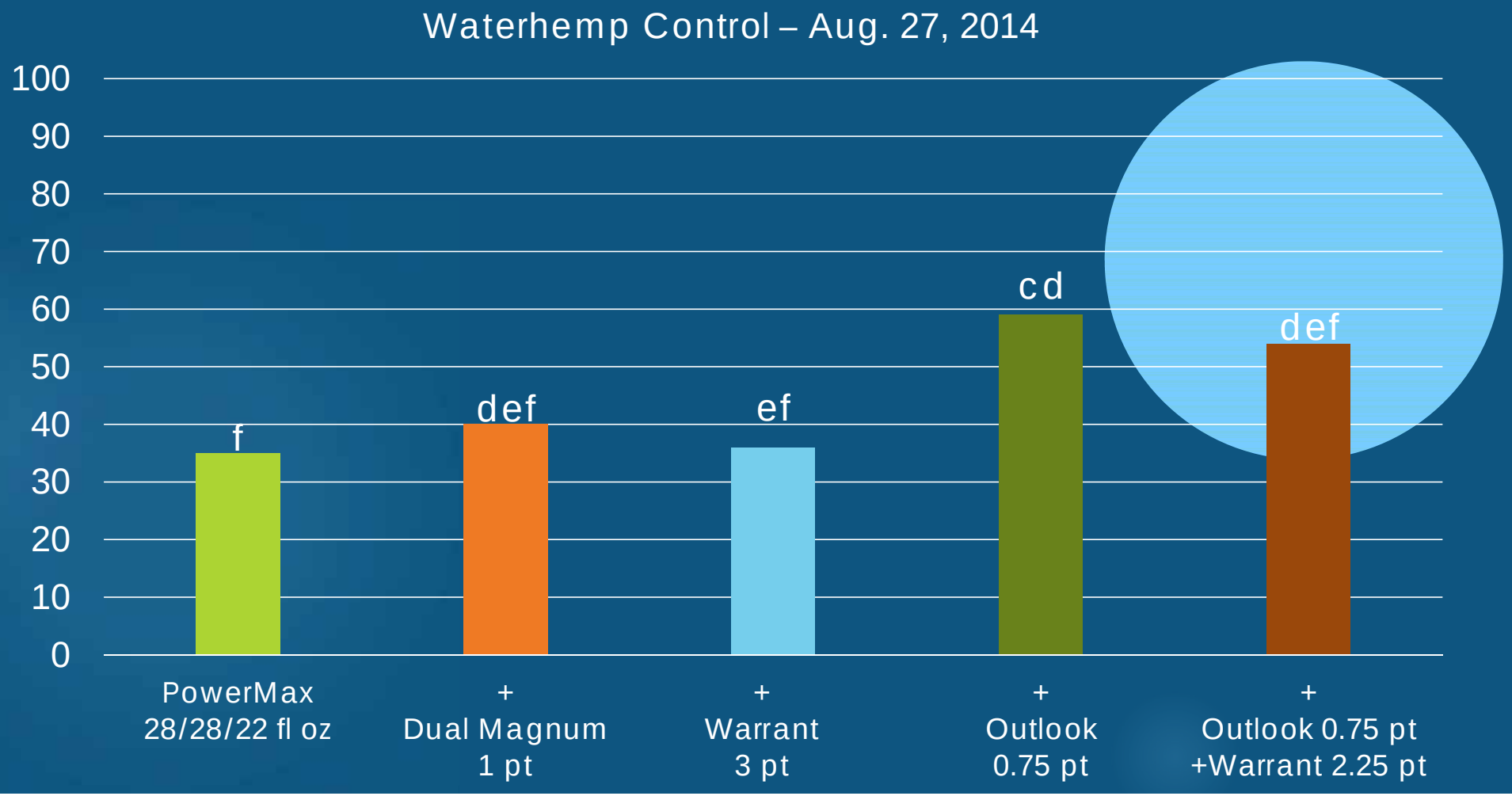
	Years of burial, Lincoln, NE					
Species	0	1	2	4	8	17
	% germination					
Green foxtail	99	2	0	0	0	0
Common lambsquarters	28	53	43	40	21	28
Kochia	100	0	2	1	1	1
Redroot pigweed	66	69	38	40	6	1
Waterhemp	40	42	39	24	9	1
Russian thistle	73	0	0	0	0	0

LAY-BY

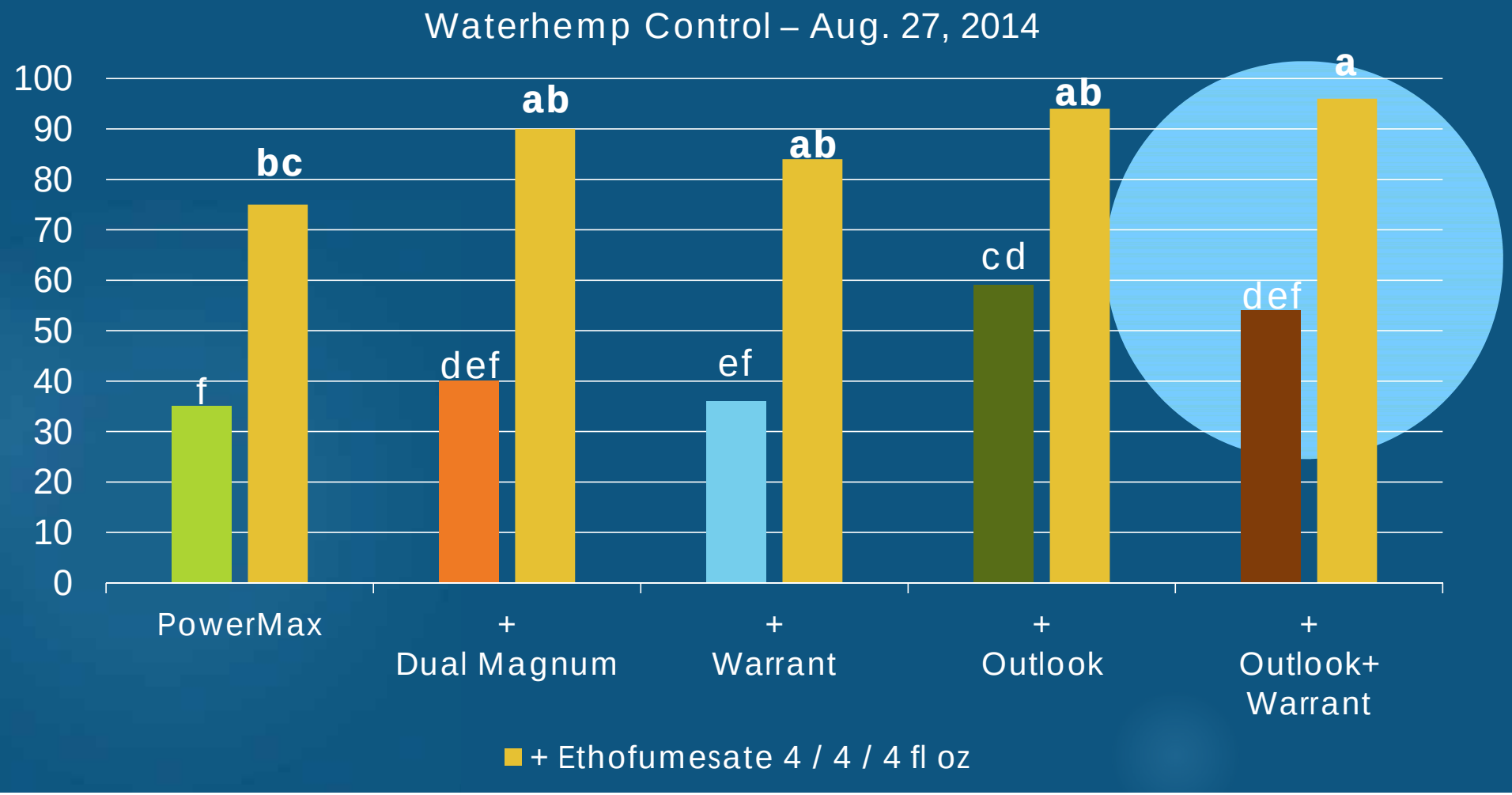
	Application 1	Application 2	Application 3
Date	**June 23**	**July 2**	**July 10**
Sugarbeet	**4 – 6 lf**	**7 – 9 lf**	**10 – 12 lf**
Waterhemp	**2.5 inch**	**5 inch**	**11 inch**

- All treatments applied with adjuvants:
  1. PowerMax + Ethofumesate = AMS 8.5 lb/100gal + HSMOC 1.5 pt/A
  2. PowerMax alone or + other herbicide = AMS 8.5 lb/100gal + NIS 0.25%v/v
- Lay-by herbicides applied in application 1

RESULTS – Lay-by



RESULTS – Lay-by



PowerMax - 48 dat

PowerMax + Ethofumesate - 48 dat

PowerMax +
Outlook - 48 dat

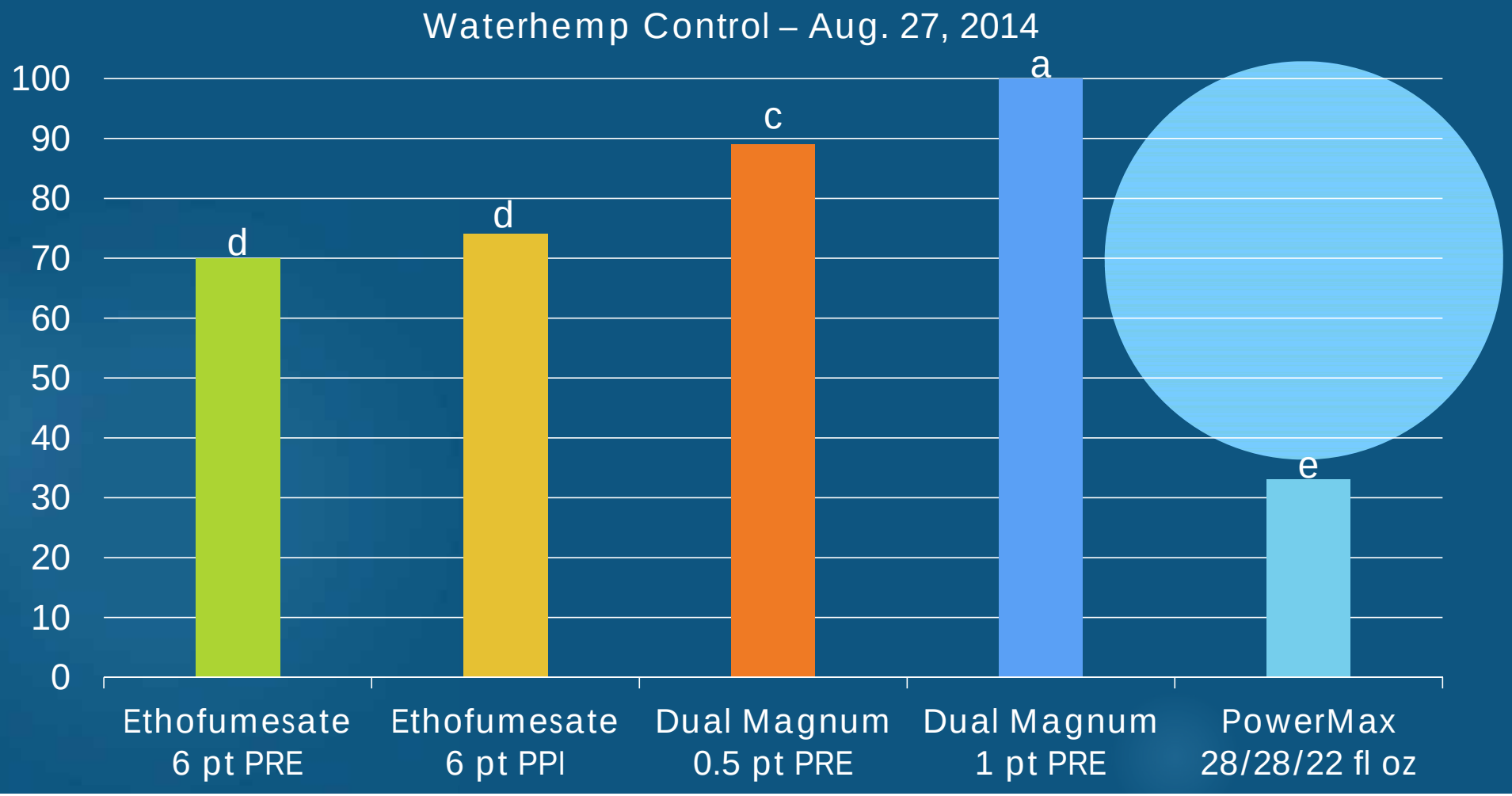
PowerMax +
Outlook +
Ethofumesate - 48 dat

PREPLANT INCORPORATED & PREEMERGENCE

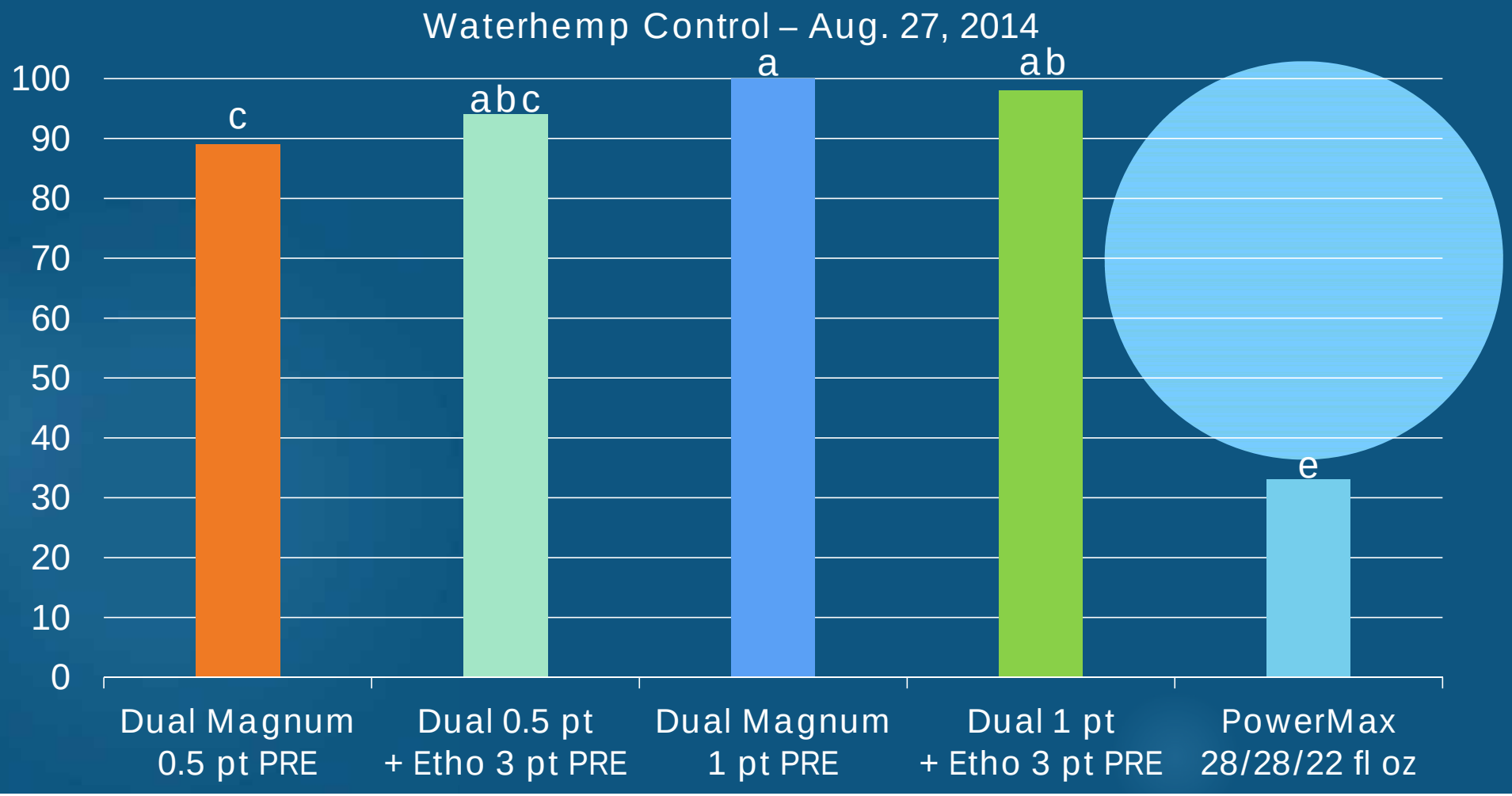
	PPI / PRE	glyphosate 1	glyphosate 2	glyphosate 3
Date	May 30	June 23	July 2	July 10
Sugarbeet	-	4 – 6 lf	7 – 9 lf	10 – 12 lf
Waterhemp	-	2.5 inch	5 inch	11 inch

- All POST PowerMax treatments applied with AMS at 8.5 lb/100gal + NIS at 0.25%v/v

RESULTS – PRE & PPI



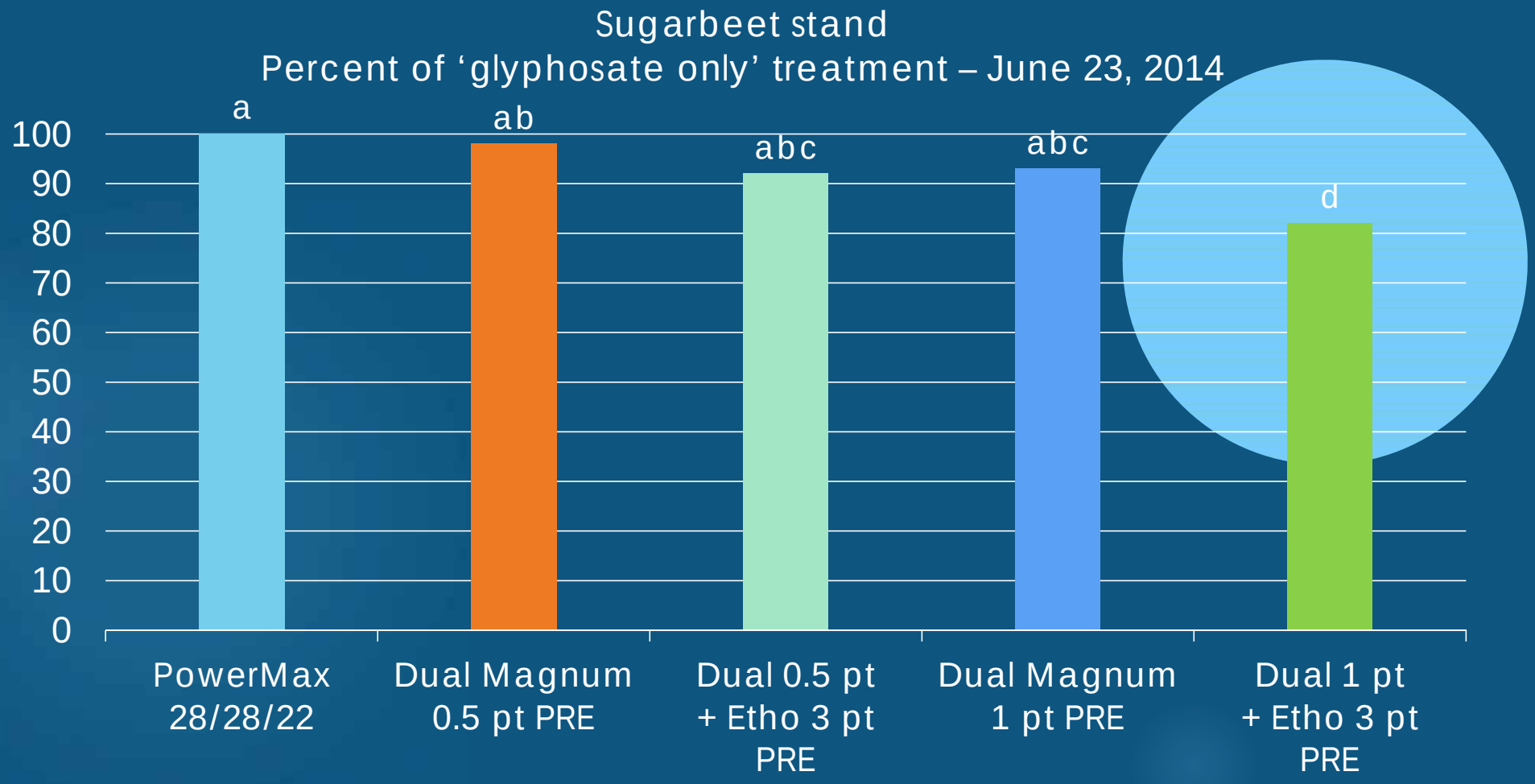
RESULTS – PRE & PPI



PowerMax - 48 dat

PRE Dual Magnum 0.5 pt
fb PowerMax - 48 dat

RESULTS – PRE & PPI



RECOMMENDATION TO GROWERS

1. Waterhemp as a minor weed
   a. glyphosate 0.98 / 0.98 / 0.77 (PowerMax 28/28/22 fl oz)** + ethofumesate 4 / 4 / 4 fl oz + AMS + HSMOC Known resistance, but low to moderate infestation
   b. glyphosate 0.98 / 0.98 / 0.77** + ethofumesate 4 / 4 / 4 fl oz + AMS + HSMOC + **lay-by herbicide (2 lf sgbt)**
2. Known resistance, moderate to heavy infestation
   a. PRE Dual Magnum 0.75 pt fb glyphosate 0.98 / 0.98 / 0.77** + ethofumesate 4 / 4 / 4 fl oz + AMS + HSMOC

**glyphosate at 1.125 lb/A (PowerMax 32 fl oz) if one application before V8 sugarbeet stage

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 suspectible 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

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

Up to one inch common ragweed

Herbicide Treatment[1]	Rate	July 7 sgbt inj	J		
	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

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

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

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

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	
	#/ ¼ m^2	#/ ¼ m^2	1 bu/a	3 bu/a
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

[1]All 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?

A Systems Approach to Weeds Management

Weeds Management Systems Approach

- Scout and identify weeds; map fields
- Learn about the biology of weeds
- Develop a strategy
  - crop sequences
  - Herbicides from herbicide families
- 100 percent weed control in crops in the sequence is paramount
- Manage the RR chip

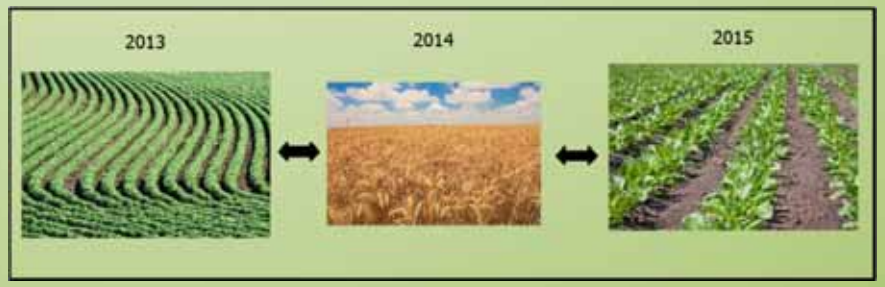
Use at least two and preferably three crops in the sequence; rotate to a different crop each year

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



Sugarbeet - a component of the cropping sequence in fields

- The 2014 sugarbeet growers survey indicates sugarbeet follow
  - wheat, 54%
  - corn, 22%
  - soybean / drybean, 12%
- Sugarbeet is planted in a crop sequence in fields every third and fourth and fifth year, opinion[1] vs. survey[2]
  - 3rd year, 60% 24%
  - 4th year, 30% 37%
  - 5th year, 10% 19%

[1]Derived from dinner conversation with T Grove, S Poindexter, C Halfmann and M Khan
[2]Results from ACS survey

Objective

Waterhemp control in fields planted to corn and soybean; fields that share the crop sequence with sugarbeet; a systems approach to weeds management

- provides greater than 90% visual waterhemp control; season-long control
- herbicides and herbicide families that compliment herbicides sugarbeet
- Herbicides with residues that do not extend into the next season
- Cost per acre including cost of the seed (profitability)

Weed control in corn, Herman, MN and Barney, ND, 2014

Herbicide treatment[1]	Appli	Herbicide rate (pt or fl oz/A)	19 Sep amata	14 Jul setvi	11 Jul cheal	11 Jul amare
			----------% control----------			
Harness + Sharpen	Pre	2 pt + 3 oz	98	100	94	100
Harness + Clarity/ Laudis + atrazine	Pre / Post	2 pt + 1 pt/ 3 oz + 12 oz	100	100	-[2]	-
Harness + atrazine / Status	Pre / Post	2 pt +12 oz / 7.5 oz	100	100	100	100
Sharpen / Status	Pre / Post	3 oz / 7.5 oz	96	95	100	100
Verdict / Status	Pre / Post	15 oz / 7.5 oz	100	99	100	100
Laudis + atrazine	Post	3 oz + 12 oz	99	100	100	100

[1]Laudis, atrazine and Status applied with MSO at 1.5 pt/A plus N-Pak AMS at 2.5% v/v
[2]no data

Harness+Banvel / Laudis+ atrazine

Haness+atrazine /status

Verdict / Status

Application timing, cost per acre[1], herbicide site of action[1], and crop rotational restrictions[1], corn herbicides

Herbicide treatment[1]	Appli	Herbicide rate (pt or fl oz / A)	Cost / A	SoA Families	Crop rotation[2]	
					sgbt	soyb
Harness + Sharpen	Pre	2 pt + 3 oz	$43.90	15, 14	NCS	NCS
Harness + Clarity/ Laudis + atrazine	Pre / Post	2 pt + 1 pt/ 3 oz + 12 oz	$54.00	15, 4 / 27, 5	10	12
Harness + atrazine / Status	Pre / Post	2 pt +12 oz / .5 oz	$56.00	15, 5 / 4, 19	NCS	12
Sharpen / Status	Pre / Post	3 oz / 7.5 oz	$43.65	14 / 4, 19	6	4
Verdict / Status	Pre / Post	15 oz / 7.5 oz	$53.75	14, 15 / 4, 19	NCS	4
Laudis + atrazine	Post	3 oz + 12 oz	$18.75	5, 27	10	12

[1]From 2015 North Dakota Weed Control Guide
[2]NCS = next crop season, number of months

Weed control in soybean, Herman, MN and Barney, ND, 2014

Herbicide treatment[1]	Appli	Herbicide rate (pt or fl oz/A)	14 Jul glymx	19 Sep amata	11 Jul cheal	11 Jul amare
			% inj	----------% control----------		
Dual + Valor / Liberty	Pre / Post	2 pt + 3 oz / 29 oz	4	96	98	100
Sharpen + Valor / Liberty	Pre / Post	1 oz + 3 oz / 29 oz	0	95	100	99
Verdict / Basagran / Basagran	Pre / Post / Post	5 oz / 1 pt / 1pt	0	84	76	95
Cobra / Cobra	Post / Post	10 oz / 10 oz	37	69	15	100
Basagran + Cadet / Basagran + Cadet	Post / Post	0.5 pt + 0.7 oz / 0.5 pt + 0.7 oz	29	61	63	91
Liberty / Liberty[2]	Post / Post	29 oz / 29 oz	2	81	97	100

[1]Liberty applied with N-Pak ammonium sulfate at 3 lb/A, Cadet, Basagran and Cobra applied with MSO at 1.5 pt/A.
[2]Experiment was planted to Liberty Tolerant soybean

Application timing, cost per acre[1], herbicide site of action[1], and crop rotational restrictions[1], corn herbicides

Herbicide treatment[1]	Appli	Herbicide rate (pt or fl oz / A)	Cost / A	SoA Families	Crop rotation[2]	
					sgbt	corn
Dual + Valor / Liberty	Pre/ Post	2 pt + 3 oz / 29 oz	$68.75	15, 14 / 10	5	1
Sharpen + Valor / Liberty	Pre / Post	1 oz + 3 oz / 29 oz	$44.25	14, 14 / 10	4	1
Verdict /Basagran / Basagran	Pre / Post / Post	5 oz / 1 pt / 1pt	$34.90	14, 15 / 6 / 6	NCS	1
Cobra / Cobra	Post / Post	10 oz / 10 oz	$31.26	14 / 14	0	0
Basagran + Cadet / Basagran + Cadet	Post / Post	0.5 pt + 0.7 oz / 0.5 pt + 0.7 oz	$29.46	6, 14 / 6, 14	0	0
Liberty / Liberty	Post / Post	29 oz / 29 oz	$38.50	10 / 10	0	0

[1]From 2015 North Dakota Weed Control Guide
[2]NCS = next crop season, number of months

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

There is a weed that.....

- Has a growth rate of greater than 2 inches/day
- Emerges in fields from May to August
- Produces more than 1 million seeds/plant
- Seed is viable after 6 years

We don't have it and we don't want it!

Palmer amaranth

Unbranched flowering structures

Thank You

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

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