

What It Takes to Improve Weed Management

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And

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How many of you play golf?

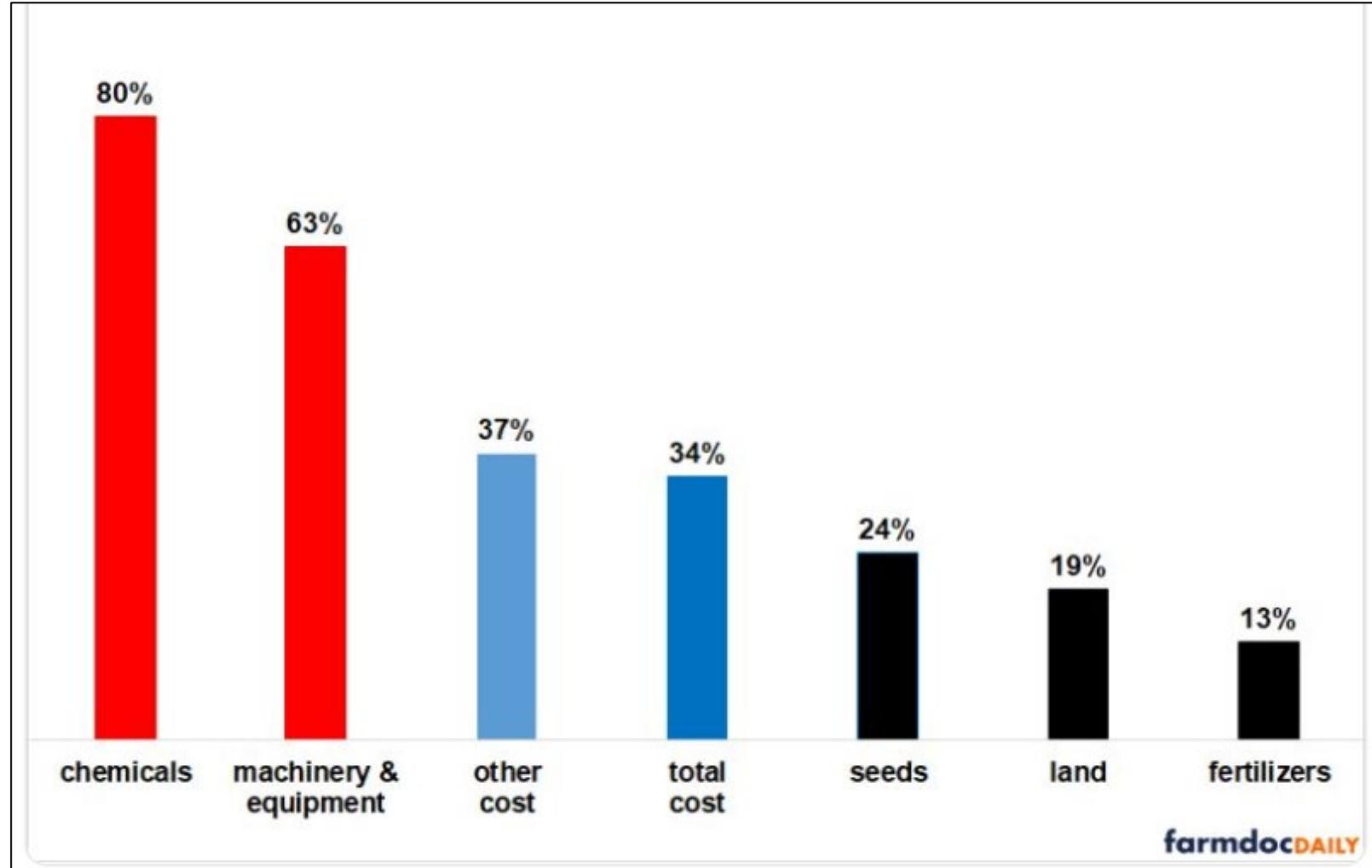
According to Gemini:

- Use the 7/10 rule (don't take chances)
- Aim for the center
- Choose the safe alternative
- Accept mistakes; move on to the next one; don't let it/them cloud your judgement



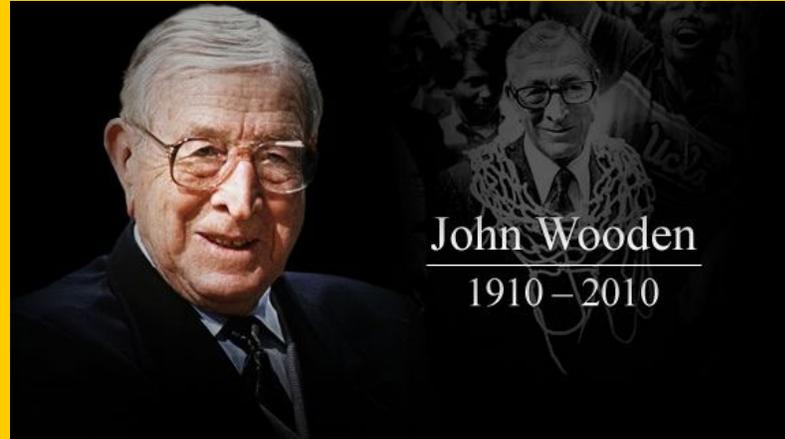
Playing golf and farming might be the same in 2026

- FarmDoc Daily is a data-driven online publication from the University of Illinois, Department of Agricultural and Consumer Economics.
- It provides daily, research-based articles on farm economics, management, policy, and marketing.



Crop production costs combined, 2023-2024 vs. 2012-2013

**"It's the little details that are vital.
Little things make big things happen,"**



"It's the little weed management details that are vital. Little things make weed-free crop fields", Stachler's Weed Science rendition of John Wooden's quote.

NDSU

EXTENSION

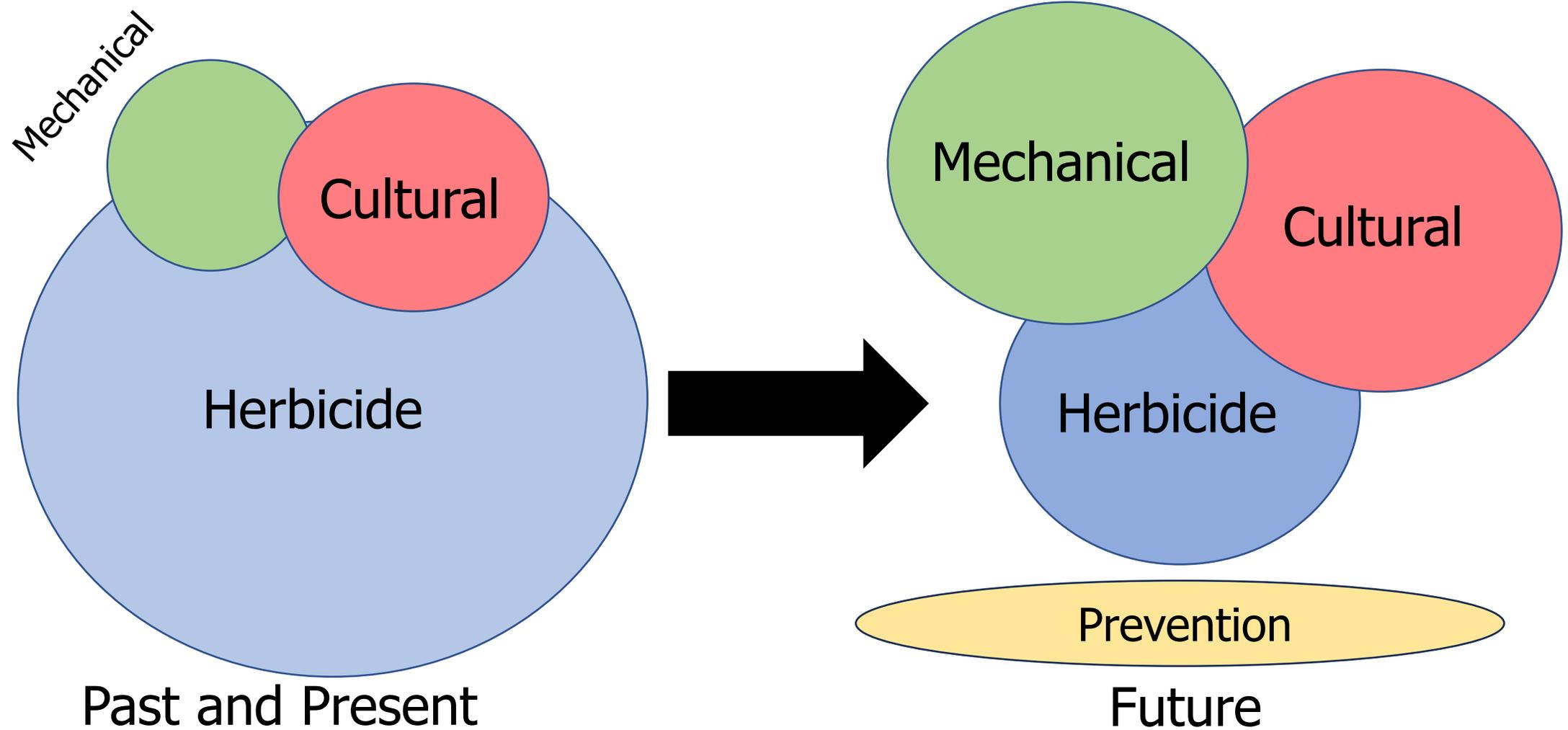


Weed-free soybean field!





Integrated Weed Management



Spend time this winter learning about getting back to weed management basics

1. Weeds present in 2025 crops at harvest
2. Manage weeds for each field, not the farm
3. Get back to herbicide basics; select the right product(s)
 - Preparation
 - Create the best herbicide trait/herbicide program for the crops grown on your farm
 - Learn about herbicide premixtures, effective herbicides and crop rotation restrictions
4. Adjuvants
5. Scouting and timing of second POST application
6. Sprayer management



Spend time this winter learning about getting back to weed management basics

7. Spray nozzle selection
8. How tillage effects weed management
9. Crop canopy suppresses weeds
10. Weather conditions and time of day
11. Post-harvest weed control
12. Manage weeds inside and outside field border/perimeter
13. Fall-applied herbicides
14. Cover crops
15. Water source and temperature
16. Apply herbicides at proper time of day
17. Mix herbicides in proper order

These last 5 weed management basics are **ALSO IMPORTANT!** However, we won't have enough time to cover these today.

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Were weeds present at time of crop harvest?

1. If kochia, waterhemp, common ragweed, wild oat, and green foxtail were present in your crop at harvest time consider them most likely resistant to herbicides.
2. Herbicide sites of actions ND weeds are most likely resistant to:
A. Groups 1, 2, 4, 5, 9, 14, and 27
3. Be honest about why weeds are present at harvest.

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Why manage weeds in each field and not the entire farm?

1. Each field has a unique weed management and cropping history.
2. Weeds in nearby fields may get into your fields.
 - A. Water
 - B. Wind
 - C. Equipment
3. Due to the types of herbicide-resistant weed biotypes this is the only way to manage weeds consistently effectively today.
4. Problems:
 - A. Takes more management.
 - B. Choosing many different effective herbicides across the farm may keep you from earning herbicide manufacturer rebates.

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 - ***Preparation***
 - ***Create the best herbicide trait/herbicide program for the crops grown on your farm***
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Get back to herbicide basics GROW, <https://growiwm.org>

- Know the most troublesome weeds in your fields.
- Are you going to use a PREMIX?
- What herbicides are in the PREMIX?
- What site-of-action groups?
- Are the herbicides effective (> 95% control) against all of the weeds in your field.
- Use your tools

A. 2026 North Dakota Weed Control Guide

B. <https://www.cdms.net/>

C. <https://www.greenbook.net/>

D. <https://www.agrian.com/labelcenter/results.cfm>

NDSU EXTENSION
EXTENDING KNOWLEDGE) CHANGING LIVES

W1947 (Revised January 2026)

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 and Herbicide

Site of Action Group	Mode of Action	Number of Resistant Weed Species in U.S.	Chemical Family	Active Ingredient	Product Examples / Trade Name(s)			
1	ACCase Inhibitors (aryl-GA carboxylase)	16	Aryloxyphenoxy propionate	oxadiazole-propargyl, benzoxypyr-ethyl, fluroxypyr-butyl, quizalofop-ethyl	Discover M0, Fusaria, others, Fusilab 2X, Assure II, Targa, others			
			Cytohexasedione	carfentrazone	Select Max, Arrow, others			
			Phenylpyrazolin	proflaquin	Axial XL			
2	ALS Inhibitors (acetolactate synthase)	21	imidazolinone	imazethalapyridine, imazapic, imazapyr	Beyond 2000, Plateau, Pursult			
			Sulfonylurea	halosulfuron-methyl, mesosulfuron-methyl, nicosulfuron, thiflufuron, sulfosulfuron, thifensulfuron-methyl, tribenuron-methyl, trifluralin	Pursult, Sandia, others, Olegny, Ally, Escort, others, Accent Q, Matrix, Resolve, others, Outlier, Harnsey, others, Express, others			
			Triazolopyrimidine - type 1 "SPG"	clorasulfuron-methyl, trarastrol, fomesafen	FirstRate, component of several			
			Triazolopyrimidine - type 2 "SPG"	pyrasulfuron	PowerFlex HL			
			Triazinone	sulfacetamide-Na, propoxycarbazone-Na, thifencarbazone-methyl	Everest 2.0, others			
			9	SPSP Synthase Inhibitor (5-enolpyruvyl-shikimate 3-phosphate)	18	glyphosate	Roundup, others	
						Synthetic Auxins (TRT, AFR1-6, and Unknown auxin receptor)	dicamba, 2,4-D, MCPA	Barvel, Clarity, others, 2,4-D, Elixir One, others, MCPA, others
			4	Auxin Mimics (Growth Regulators)	11	benzoxazole	dicamba	Barvel, Clarity, others
						Phenoxy-carboxylate	2,4-D, MCPA	2,4-D, Elixir One, others, MCPA, others
						6-Chloropyridazine	clpyralid	Stinger, others
6-Arylpicolinate	haloxifen-methyl	Elevere						
19	Auxin Inhibitor	9	Aryl-carboxylate	dicamba	component of Status			
			Pyridyl-pyrazolopyrimidine	fluroxypyr	Starane, others			
5	Photosystem II Inhibitors (D1 Site/264 binders and non-Histidine 275 binders)	28	Phenyl-carbamate	fluroxypyr	Starane, others			
			Triazine	atrazine	AATraz, others			
			Triazinone	metribuzin	Metribuzin, others			
6	Photosystem II Inhibitors (D1 Histidine 275 binders)	1	benzothiazole	terbufos	Beagran, others			
			Nitro	百草枯	Maestro, others			

Premix	Trade Name(s)	Active Ingredient	Site of Action Group
Acaron	AATraz, Caribata	atrazine, meclofenox	27
Acaron Flex	Dual II Magnum, Cytoprene	S-metolachlor, bicyclopyrone	27
Acaron GT	Caribata, Dual II Magnum, Roundup	S-metolachlor, glyphosate	27
Afforia	Express, Vastar	thifensulfuron, sulfentrazone-ethyl	2
Arthon Flex	Zidua	pyrasulfuron	13
Arthon Pro	Outlook, Arthon	dimethenamid-P, isoproturon	27
Authority Assist	Pursult	imazethalapyridine	2
Authority First or Sonic	FirstRate	clorasulfuron	2
Authority Supreme or Authority Edge	Spartan	sulfentrazone	13
Axial Bold	Axial XL	proflaquin	1
Axial Star	Tacoma, Starane	fluroxypyr-ethyl, fluroxypyr	2
Batalan Arigid	Starane	fluroxypyr	2
Boundary	Dual Magnum	S-metolachlor	13
BoundKey XC	Dual Magnum	S-metolachlor	13
Bronze	Maestro, Pursult	benzoxypyr, imazethalapyridine	2
Capreno	Vario	thifencarbazone	2
Cartivo	MCPA, Starane	MCPA, fluroxypyr	2
Colt + Salvo	Maestro, Accent Q	benzoxypyr, 2,4-D	2
Colt + Sward	MCPA, Starane	MCPA, fluroxypyr	2
Corvus	Vario, Starane Flex	thifencarbazone, dicamba	2
DFlax Duo	DFlax	dicamba	2
Fierce E2	Vastar	sulfentrazone	13
Fierce MTZ or Pio	Vastar, Klyde	sulfentrazone, metribuzin	13
Flestar GT	Roundup, Flestar	glyphosate, fomesafen	2
Hales GT	Roundup, Dual II Magnum, Caribata	glyphosate, S-metolachlor, meclofenox	27
Harnsey Max	Harnsey, Caribata	acetic acid, meclofenox	13
Huskie	Maestro	benzoxypyr	2
Huskie Complete	Vario, Maestro	thifencarbazone, benzoxypyr	2
Huskie FE	Starane, Maestro	fluroxypyr, benzoxypyr	2
Impact CORE	Harnsey	acetic acid	2
ImpactZ	Impact	isoproturon	27
Inogate	Everest	sulfacetamide	2
Katagon	Accent Q, Shandis	nicosulfuron, topraloate	2
KeyStone NXT or KeyStone LA NXT	Surpass NXT, AATraz	acetic acid, atrazine	2
Kochlavo	2,4-D	2,4-D	2
Kyo	Surpass NXT, Impact	acetic acid, isoproturon	27
Maverick	Caribata	pyrasulfuron	13
OpenSky	PowerFlex, Starane	pyrasulfuron, fluroxypyr	2
Pandora	Harmony	thifensulfuron	2
Perkure	PowerFlex	pyrasulfuron	2
Perkure	Stinger	clpyralid	2



Need 2-4 effective active ingredients in each herbicide application and for a season-long program. POST when annual weeds are less than 3-inches. PRE mandatory for time management constraints and reduced weed density and plant height.

	Wheat	Sugarbeet	Corn	Soybean
PRE	(14)	(15)	(15) (27)	(3) (4) (5) (14) (15)
POST/PRE	(15)	(15)	(15)	(15)
POST	(27) (6) (4)		(4) (5) (27)	(4) (10)

- Lots of 15's
- Not many options for waterhemp control in sugarbeet
- Lots of options PRE, but not POST in soybean

RESTRICTED USE PESTICIDE

(GROUND AND SURFACE WATER CONCERNS)

FOR RETAIL SALE TO AND USE ONLY BY CERTIFIED APPLICATORS OR PERSONS UNDER THEIR DIRECT SUPERVISION, AND ONLY FOR THOSE USES COVERED BY THE CERTIFIED APPLICATOR'S CERTIFICATION.

THIS PRODUCT IS A RESTRICTED-USE HERBICIDE DUE TO GROUND AND SURFACE WATER CONCERNS. USERS MUST READ AND FOLLOW ALL PRECAUTIONARY STATEMENTS AND INSTRUCTIONS FOR USE IN ORDER TO MINIMIZE POTENTIAL FOR ATRAZINE TO REACH GROUND AND SURFACE WATER.

Sale, use and distribution of this product in Nassau and Suffolk Counties in the State of New York is prohibited.

ATRAZINE	GROUP 5	HERBICIDE	MESOTRIONE	GROUP 27	HERBICIDE
BICYCLOPYRONE	GROUP 27	HERBICIDE	S-METOLACHLOR	GROUP 15	HERBICIDE



Escanee QR para Español




A Herbicide for Control of Annual Grass and Broadleaf Weeds in Field Corn, Seed Corn, Silage Corn, Sweet Corn and Yellow Popcorn

Active Ingredients:

S-Metolachlor: (CAS No. 87392-12-9)	23.40%
Atrazine*: (CAS No. 1912-24-9)	10.93%
Mesotrione: (CAS No. 104206-82-8)	2.60%
Bicyclopyrone: (CAS No. 352010-68-5)	0.65%

Other Ingredients: 62.42%

Total: 100.00%

Acuron® Herbicide is a ZC formulation containing 1.0 pound Atrazine, 0.06 pound Bicyclopyrone, 0.24 pound Mesotrione, and 2.14 pounds S-metolachlor per gallon.

*Atrazine with a maximum of 0.45% related triazines.

KEEP OUT OF REACH OF CHILDREN.

CAUTION

See additional precautionary statements and directions for use on label.

EPA Reg. No. 100-1466

EPA Est. 100-LA-001

SCP 1466A-L1F 1121
4230207

2.5 gallons
Net Contents

Positives

- PPI, PRE, or EPOST
- Rate changes with OM
- Controls numerous important MN and ND weeds including waterhemp and kochia
- Reliable

Negative

- Carryover to other crops

Case-study, Acuron Herbicide

PREMIX	Active Ingredient	Trade Name	SOA	Effective Waterhemp /	Effective kochia?
Acuron	bicyclopyrone	Optogen	27	✓	✓
	mesotrione	Callisto	27	✓	✓
	atrazine	Aatrex	5	✓	✓
	S-metolachlor	Dual II Magnum	15	✓	NO

What is the use rate for my Amenia, ND Farm?

4% organic matter, 3 qt per acre

Always include Group 5 herbicide with a Group 27 herbicide due to synergy.

What is the herbicide rate in each component in the PREMIX?
Is the herbicide rate effective for waterhemp and kochia control?

Active Ingredient	Trade Name	Rate (lb ai/A at 3 qt/A)	Rate for effective control	Effective Waterhemp	Effective kochia?	Comment
bicyclopyrone	Optogen	0.045	0.045	✓	✓	partial control
mesotrione	Callisto	0.188	0.188-0.240	✓	✓	control
atrazine	Aatrex	0.75	2	✓?	✓?	partial control
S-metolachlor	Dual II Mag	1.59	1.53	✓	NO	partial / poor control

Case-study, TripleFlex II Herbicide

- PPI, PRE, or EPOST
- Rate changes with OM and soil texture
- Controls numerous important MN and ND weeds including waterhemp, but not kochia
- One effective waterhemp control herbicide and none for kochia
- 26 MONTH ROTATIONAL RESTRICTION TO SUGARBEET



PREMIX	Active Ingredient	Trade Name	SO A	Effective Waterhemp	Effective kochia
TripleFlex	acetochlor	Harness	15	✓	NO
	flumetsulam	Python	2	NO	NO
	clopyralid	Stinger HL	4	NO	NO

Case-study, Huskie FX Herbicide



Huskie[®]FX

HERBICIDE

PYRASULFOTOLE	GROUP	27	HERBICIDE
BROMOXYNIL	GROUP	6	HERBICIDE
FLUROXYPYR	GROUP	4	HERBICIDE

For control of broadleaf weeds in barley, rye, triticale, wheat, grain and forage sorghum, grasses grown for seed, forage or hay, and on Conservation Reserve Program (CRP) acres.

ACTIVE INGREDIENT(S):	
Pyrasulfotole	2.70%
Bromoxynil Octanoate.....	11.02%
Bromoxynil Heptanoate.....	10.66%
Fluroxypyr.....	9.02%
OTHER INGREDIENTS:	66.60%
TOTAL:	100.00%

Contains petroleum distillate.
Contains 0.26 pound Pyrasulfotole, 1.44 pounds Bromoxynil and 0.6 pound Fluroxypyr acid equivalent per gallon.

EPA Reg. No. 264-1208

KEEP OUT OF REACH OF CHILDREN WARNING AVISO

*Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle.
(If you do not understand the label, find someone to explain it to you in detail.)*

For **MEDICAL** and **TRANSPORTATION** Emergencies **ONLY**

Call 24 Hours A Day 1-800-334-7577

For **PRODUCT USE** Information Call 1-866-99BAYER (1-866-992-2937)

Please refer to booklet for additional precautionary statements and directions for use.

- POST
- Apply maximum rate of 18 fl oz/A
- Controls numerous important MN and ND weeds including waterhemp and kochia (< 2")
- Starane Ultra label says to apply 0.4 pt/A if dicamba-resistant kochia is present, which is likely present in most ND and MN fields.

Case-study, Huskie FX Herbicide

PREMIX	Active Ingredient	Trade Name	SOA	Effective Waterhemp	Effective Kochia
Huskie FX	pyrasulfotole	N/A	27	?	?
	bromoxynil	Moxy	6	?	?
	fluroxypyr	Starane Ultra	4	NO	?

None of these herbicides by themselves will control all waterhemp and kochia!

Always include Group 6 herbicide with pyrasulfotole, a Group 27 herbicide, due to synergy.

What rate of Starane Ultra should be added to reach 0.14 lb ai/A of fluroxypyr?
 $0.14 \text{ lb ai/A} - 0.084 \text{ lb ai/A} = 0.056 \text{ lb ai/A}$
 $0.056 \text{ lb ai/A} / 2.8 \text{ lb ai/gal} \times 128 \text{ fl oz/gal} = 2.6 \text{ fl oz/A of Starane Ultra}$

What is the herbicide rate in each component in the PREMIX?
 Is the herbicide rate effective for waterhemp and kochia control?

Active Ingredient	Trade Name	Rate (lb ai/A at 18 fl oz/A)	Rate for effective waterhemp/kochia ctrl	Effective Waterhemp	Effective Kochia	Comment (waterhemp / kochia)
pyrasulfotole	N/A	0.037	?	?	?	partial control ?
bromoxynil	Moxy	0.203	0.5 lb ai/A (?)	NO	NO	No control
fluroxypyr	Starane Ultra	0.084	NO / 0.14 lb ai/A (?)	NO	?	No control / partial control?

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- 4. *Adjuvants***
5. Scouting and timing of second POST application
6. Sprayer management

Use **PROPER** adjuvants and rates as recommended by herbicide label

1. Use full recommended rates of spray grade AMS especially for glyphosate and glufosinate.
2. AMS replacements are usually **LESS** effective for glyphosate and glufosinate and some other herbicides.
3. Not all adjuvants are created equal, including adjuvants in generic herbicide formulations. Use the best adjuvant, not the cheapest adjuvant.

Use **PROPER** adjuvants and rates as recommended by herbicide label

4. Best type of adjuvant to add to glufosinate is an anionic surfactant.
5. Apply minimum rate of 1.5 pt/A of an oil adjuvant with several herbicides needing 2.0 pt/A.
6. When oil-loving herbicides are mixed with glyphosate use HSMOC or HSPOC, depending upon the non-glyphosate herbicide.
7. Apply minimum rate of 1.5 pt/A of an HSMOC or HSPOC.
A. Is this the recommended rate and is it affordable?

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Scout every field before and after each herbicide application and apply 2nd POST timely.

1. Scout 5 to 10 days after **each** herbicide application.
2. This includes burndown and PRE herbicide applications.
3. Apply 2nd POST herbicide application 7 to 14 days after 1st POST application.
 - A. In dry bean apply Basagran plus Reflex (1/2 rate) 7 days after the 1st POST application.
4. Don't wait for weeds to come up through the crop canopy!

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Sprayer operation

1. Boom height should be adjusted to obtain 100% flat fan nozzle overlap, NOT 33%! Boom height usually 20 to 25 inches above target. Spray angle impacts height.
2. Placement of every other nozzle forward and backward maximizes plant coverage with contact herbicides??
3. Calibrate sprayer frequently.

Sprayer operation

4. Check each nozzle multiple times during the growing season and replace worn nozzles.
5. Only use nozzles designed for use with Pulse Width Modulation (PWM) sprayers.

Sprayer travel speed



1. Slower sprayer travel speeds (< 8 mph) are critical for tall weeds and dense weed populations, field borders, and contact herbicides.

Liberty Ultra (29 fl oz/A)
plus AMS (3 lb/A)

20 GPA with Wilger nozzle

Tall = 10 to 18 inch
Short = < 5 inch

Sprayer travel speed (mph)	Visual Control (%)	
	Tall Powell Amaranth	Short Powell Amaranth
6	69 AB	88 AB
8	74 A	78 B
10	63 AB	65 C
11.5	57 B	63 C

LSD (0.1)



Spend time this winter learning about getting back to weed management basics

7. *Spray nozzle selection*

8. How tillage effects weed management

9. Crop canopy suppresses weeds

10. Weather conditions and time of day

11. Post-harvest weed control

12. Manage weeds inside and outside field border/perimeter

The “Nozzle Compromise”: Select the nozzle producing the correct droplet size for herbicide and weed

- Are you applying a contact or translocating herbicide?
- Obtain best spray coverage.
- Are you trying to reduce spray drift?
- Follow label directions!



Nozzle Droplet Size Classification

Color Codes for Droplet Size

Category	Symbol	Color Code	Approx. VMD Range (microns)
Extremely Fine	XF	Purple	<60
Very Fine	VF	Red	60-145
Fine	F	Orange	145-225
Medium	M	Yellow	226-325
Coarse	C	Blue	326-400
Very Coarse	VC	Green	401-500
Extremely Coarse	XC	White	501-650
Ultra Coarse	UC	Black	>650

Size Comparison:

Diameter of Common Items (approximate) in Microns

- 2,000 μm #2 pencil "lead"
- 850 μm paper clip
- 420 μm staple
- 300 μm toothbrush bristle
- 150 μm sewing thread
- 100 μm human hair

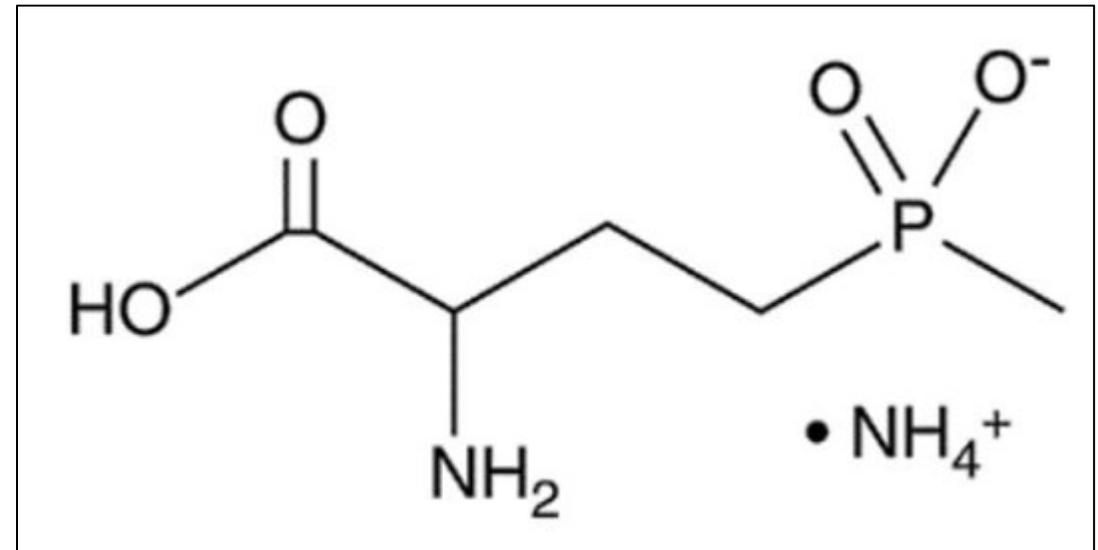


Based on ASABE 572.1 Standards and referenced in nozzle charts, American Society of Agricultural and Biological Engineers

I'm using the Winfield United version of glufosinate called Total[®] SL

WINFIELD
UNITED

- Limited translocation within the plant
- Control is best when weeds are actively growing
- Complete spray coverage; contact activity
- Small weed sizes (less than 3-inch)
- Target medium-size droplets (250-350 microns).
- 20 gallons/A spray volume





UNIVERSAL APPLICATION RATE CHART FOR 15" TIP SPACING

TIP CAPACITY	LIQUID PRESSURE IN PSI	CAPACITY ONE TIP IN GPM	CAPACITY ONE TIP IN OZ/MIN	GALLONS PER ACRE – 15" SPRAY TIP SPACING											
				4 MPH	5 MPH	6 MPH	7 MPH	8 MPH	10 MPH	12 MPH	14 MPH	16 MPH	18 MPH	20 MPH	22 MPH
04	75	0.46	61	40	38	34	27	27	23.8	19.8	15.8	11.9	10.8	9.5	8.0
	90	0.53	68	52	42	35	30	26	21	17.5	15.0	13.1	11.7	10.5	9.5
	15	0.24	31	24	19.0	15.8	13.6	11.9	9.5	7.9	6.8	5.9	5.3	4.8	4.3
	20	0.28	36	28	22	18.5	15.8	13.9	11.1	9.2	7.9	6.9	6.2	5.5	5.0
	30	0.35	45	35	28	23	19.8	17.3	13.9	11.6	9.9	8.7	7.7	6.9	6.3
	40	0.40	51	40	32	26	23	19.8	15.8	13.2	11.3	9.9	8.8	7.9	7.2
	50	0.45	58	45	36	30	25	22	17.8	14.9	12.7	11.1	9.9	8.9	8.1
	60	0.49	63	49	39	32	28	24	19.4	16.2	13.9	12.1	10.8	9.7	8.8
	75	0.55	70	54	44	36	31	27	22	18.2	15.6	13.6	12.1	10.9	9.9
	90	0.60	77	59	48	40	34	30	24	19.8	17.0	14.9	13.2	11.9	10.8
15	0.31	40	31	25	20	17.5	15.3	12.3	10.3	8.8	7.7	6.8	6.1	5.6	
20	0.35	45	35	28	23	19.8	17.3	13.9	11.6	9.9	8.7	7.7	6.9	6.3	

- Nozzle orifice size determined by ground speed and spray pressure
- Pick your favorite (??) nozzle manufacturer and nozzle type
- I selected a Spraying System Co., Turbo TeeJet nozzle
- Need to choose nozzles more wisely!!

Herbicide Mode of Action Group	Example Active Ingredients	Water Volume (US gpa)	Spray Quality
1	clodinafop, pinoxaden, clethodim, fenoxaprop	7 - 10	Medium - Coarse
2 (broadleaf)	thifensulfuron, tribenuron, florasulam	6 - 10	Coarse – Very Coarse
2 (grass)	pyroxsulam, flucarbazone-sodium, thiencazone, imazamox	7 - 10	Medium - Coarse
4	2,4-D, MCPA, dicamba, clopyralid, fluroxypyr	6 - 10	Coarse – Very Coarse
9	glyphosate	3 - 5	Coarse – Very Coarse
6	bromoxynil	7 - 10	Medium - Coarse
10	glufosinate	10 - 12	Medium - Coarse
14	carfentrazone (Aim) saflufenacil (Heat)	8 - 10	Medium - Coarse
22	diquat	10 - 15	Medium - Coarse
27	pyrasulfotole (Infinity, Velocity M3)	7 - 10	Medium - Coarse

- I have come to appreciate the work by Tom Wolfe and Jason Deveau
- Sprayers 101
- <https://sprayers101.com/>

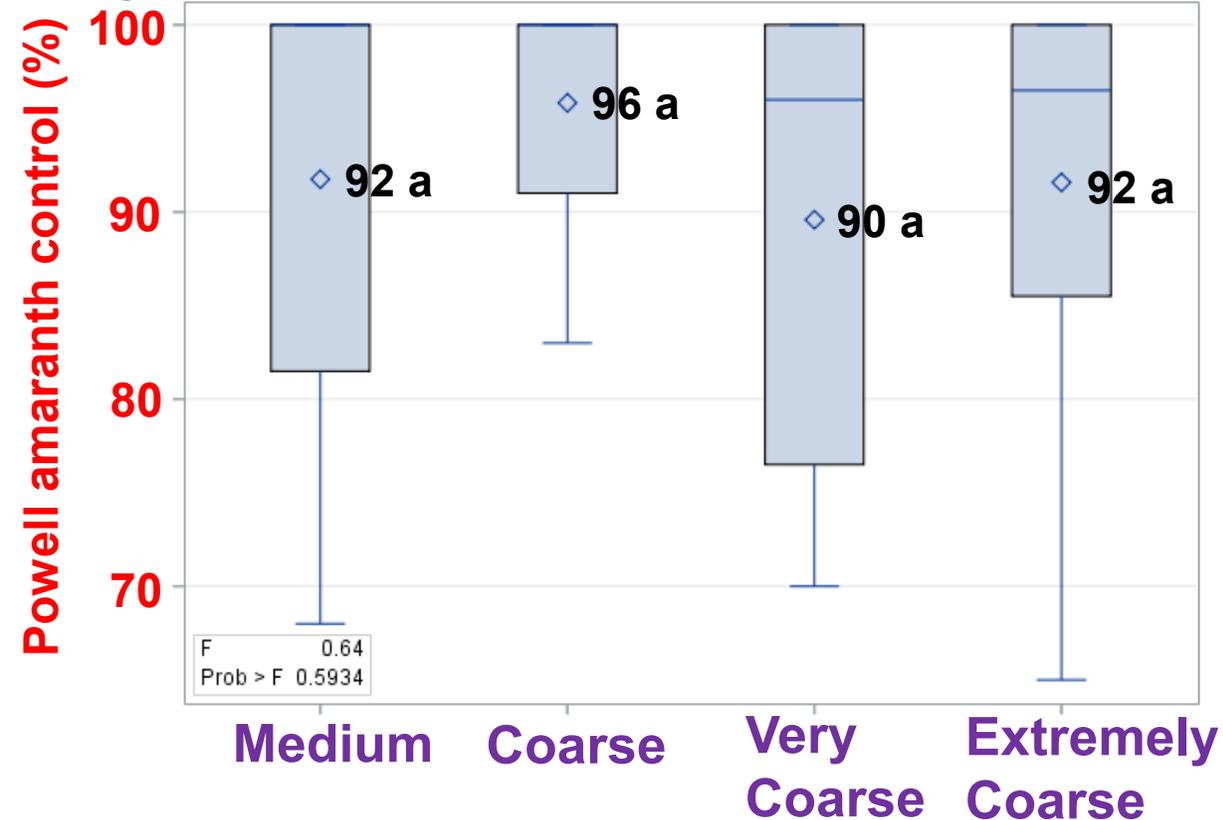
Droplet size and nozzle manufacturer



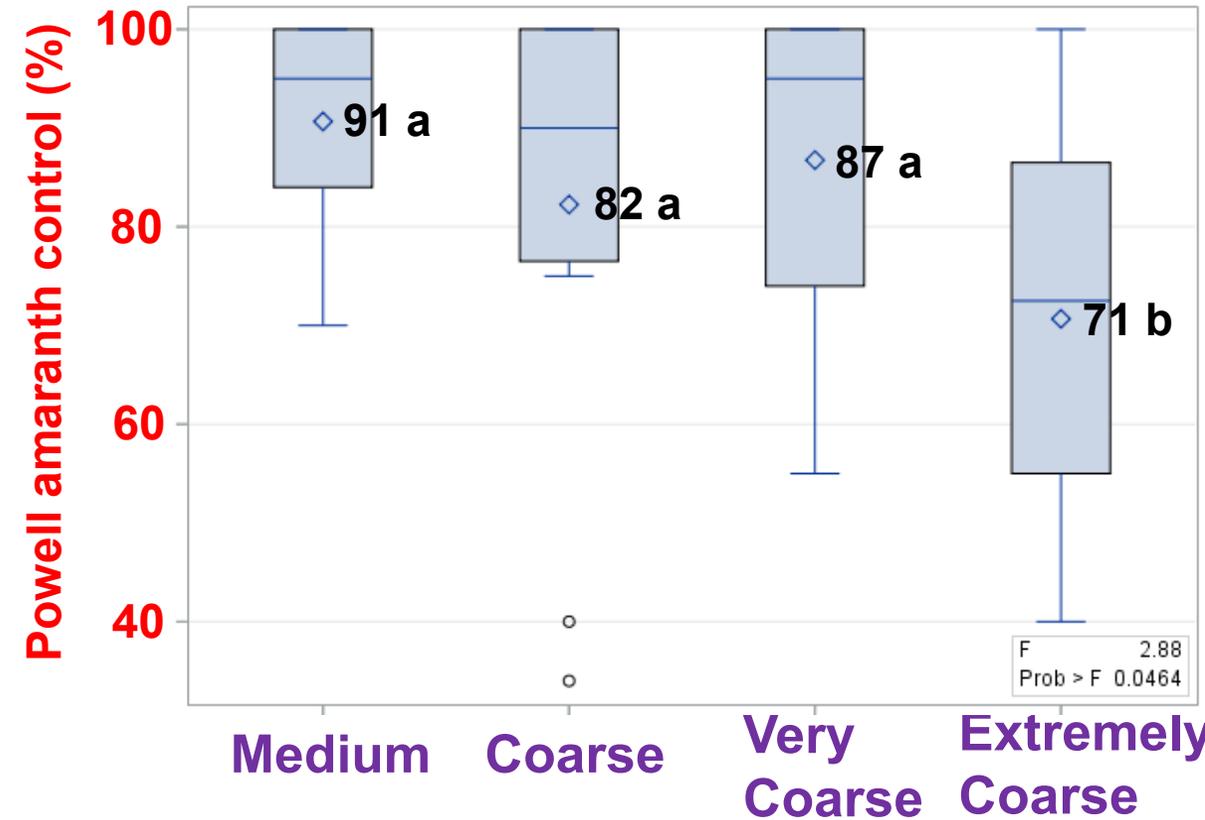
- Drexel MSO (2 pt/A)
- AMS (3 lbs/A)
- Anti-Foam (2 oz/100 gal)
- 10 mph

Herbicide(s)	Powell amaranth Control (%)	
	Wilger	Teejet
Liberty Ultra (29 fl oz/A)	88 b	72 b
Liberty Ultra + Enlist One (32 fl oz/A)	97 a	88 a

Wilger (all 60 psi)



TeeJet (30 to 60 psi)





Spend time this winter learning about getting back to weed management basics

7. Spray nozzle selection

8. How tillage effects weed management

9. Crop canopy suppresses weeds

10. Weather conditions and time of day

11. Post-harvest weed control

12. Manage weeds inside and outside field border/perimeter

Why are you conducting tillage? Are you using the right equipment to accomplish your objective?



Vertical tillage vs. field cultivator

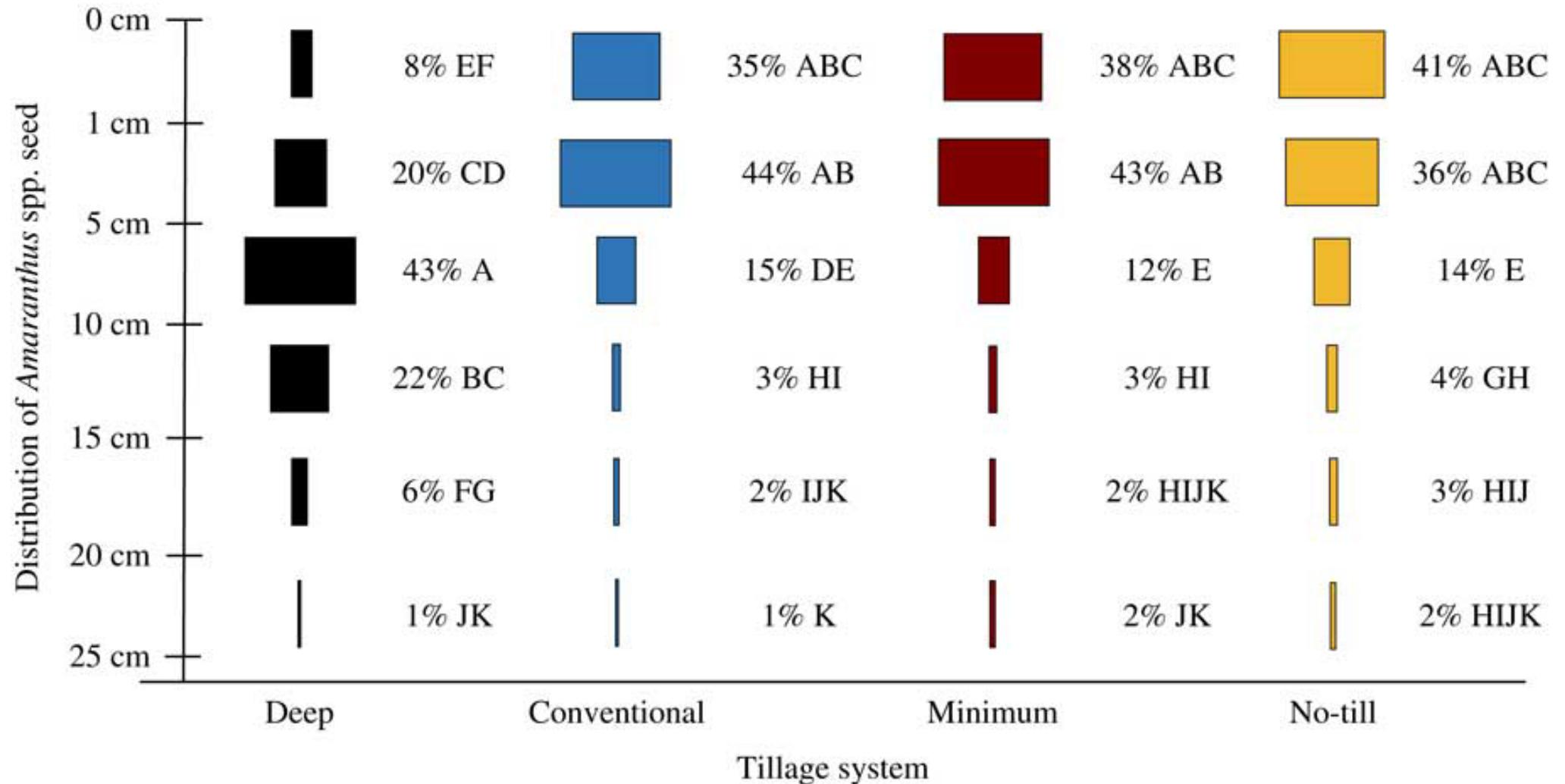
Vertical Tillage

- manage residue and prepare seedbed
- causes less disturbance than shanks since the blades roll through the soil as they cut
- little residue buried
- operated in fall and spring
- destroys soil structure
- Moves perennial weeds a few feet and doesn't control them
- **"doesn't control all emerged weeds at time of tillage"**
- **"surviving weeds more difficult to control with POST herbicides"**

Field Cultivator

- slice through the soil on a horizontal plane providing weed control and producing a level seedbed
- runs at a deeper depth than vertical tillage
- controls most small emerging annual weeds
- spreads perennial weeds farther into field
- **designed to lift the soil and undercut to eliminate weeds**

Tillage effects and pigweed seeds





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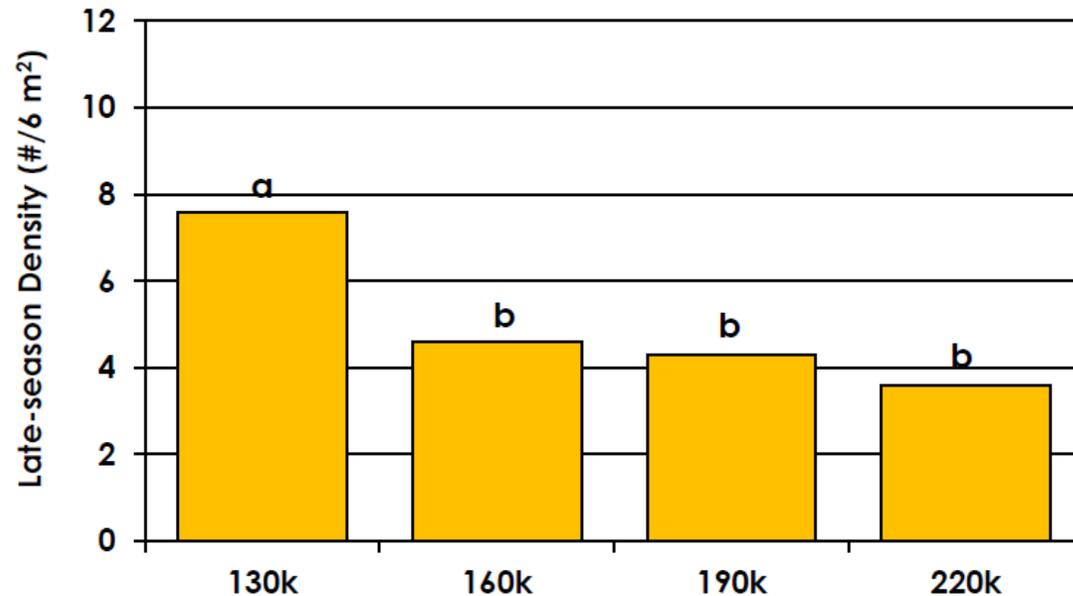
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**Petersen Farms &
Louriston Dairy
Murdock, MN**

Use your crop to your weed control advantage to eliminate late germinators

What effect does soybean planting population have on pigweed control?

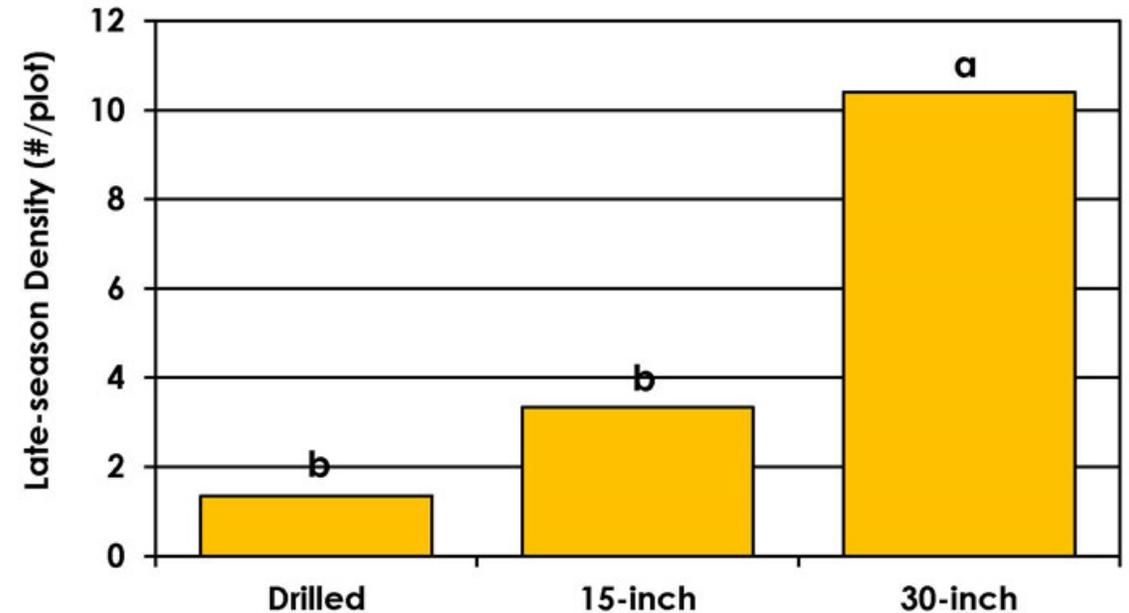


*Results summarized across herbicide programs, tillage types, and row spacings.

**Means followed by the same letter are not different, $P \leq 0.05$

© Dr. Kevin Bradley, University of Missouri

What effect does soybean row spacing have on pigweed control?



*Results summarized across herbicide programs, tillage types, and planting populations.

**Means followed by the same letter are not different, $P \leq 0.05$

© Dr. Kevin Bradley, University of Missouri

Do certain soybean varieties emerge quicker and / or have rapid early season development?

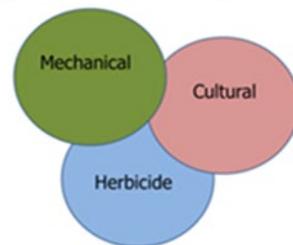
NO.

- There has been renewed interest among some public breeders to look for varieties that are more competitive with living cover crops (such as oilseeds like camelina or pennycress)
- Dr. Jim Orf, UMN Soybean Breeder, selected for soybean more competitive with weeds - specifically for organic systems



Light interception or canopy closure for four seeding rates (seeds/acre) planted in 20 inch rows. A. 25,000, B. 125,000, C. 225,000, D. 275,000.

Integrated Weed Management



Herfiter, Iowa State University

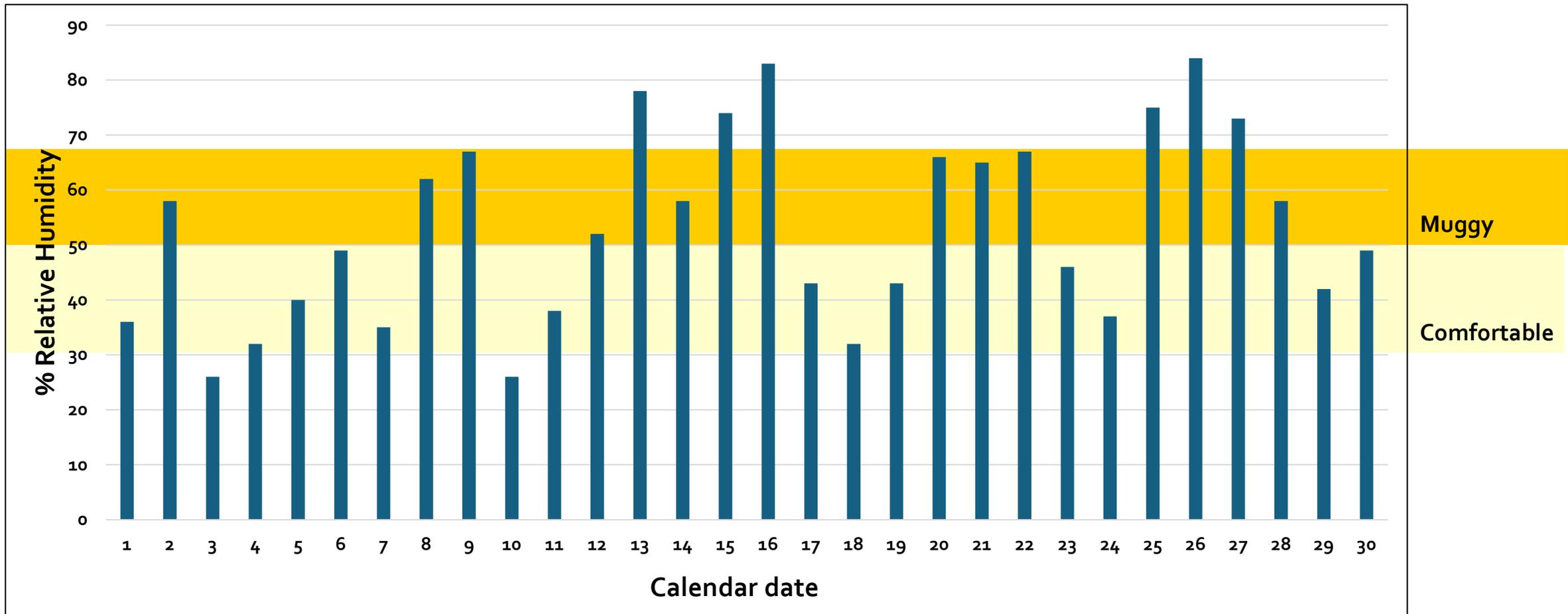




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Relative humidity June 2025, 12:00 noon to 6:00PM, Hillsboro, ND





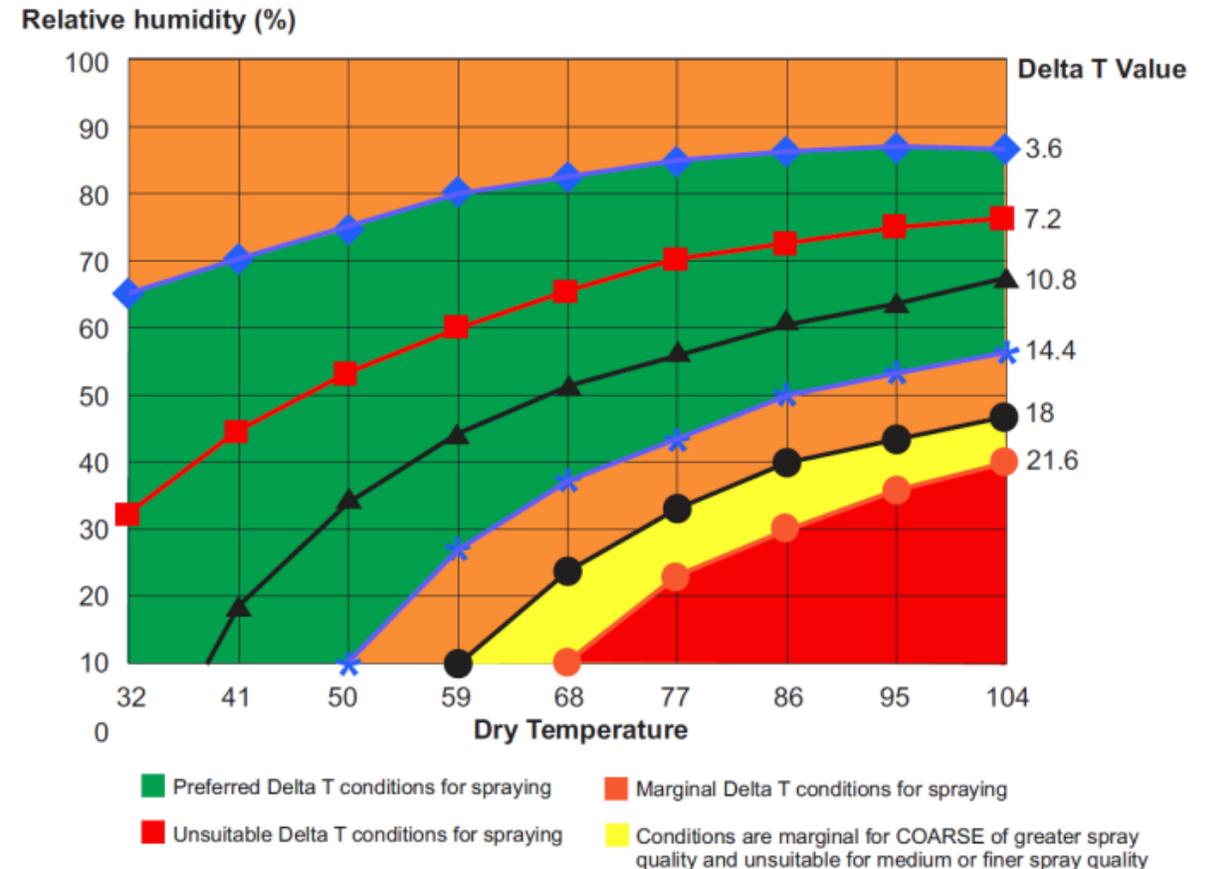
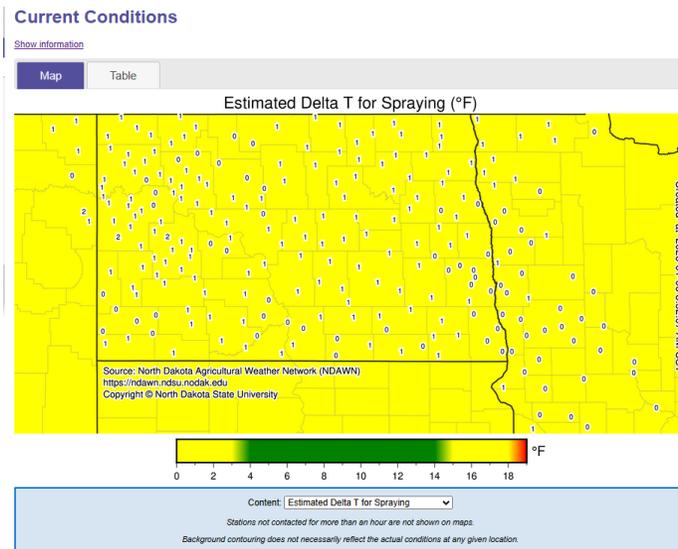
Question: Would anyone delay making a Total[®] SL application because of low humidity?

- Remember, Peters (and Ikley) say that waterhemp can grow 2-inch per day in June
- Probably not, but knowledge of how environmental conditions impact herbicides is important
- The appropriate rate, spray quality, and adjuvant system will improve outcomes in challenging environments

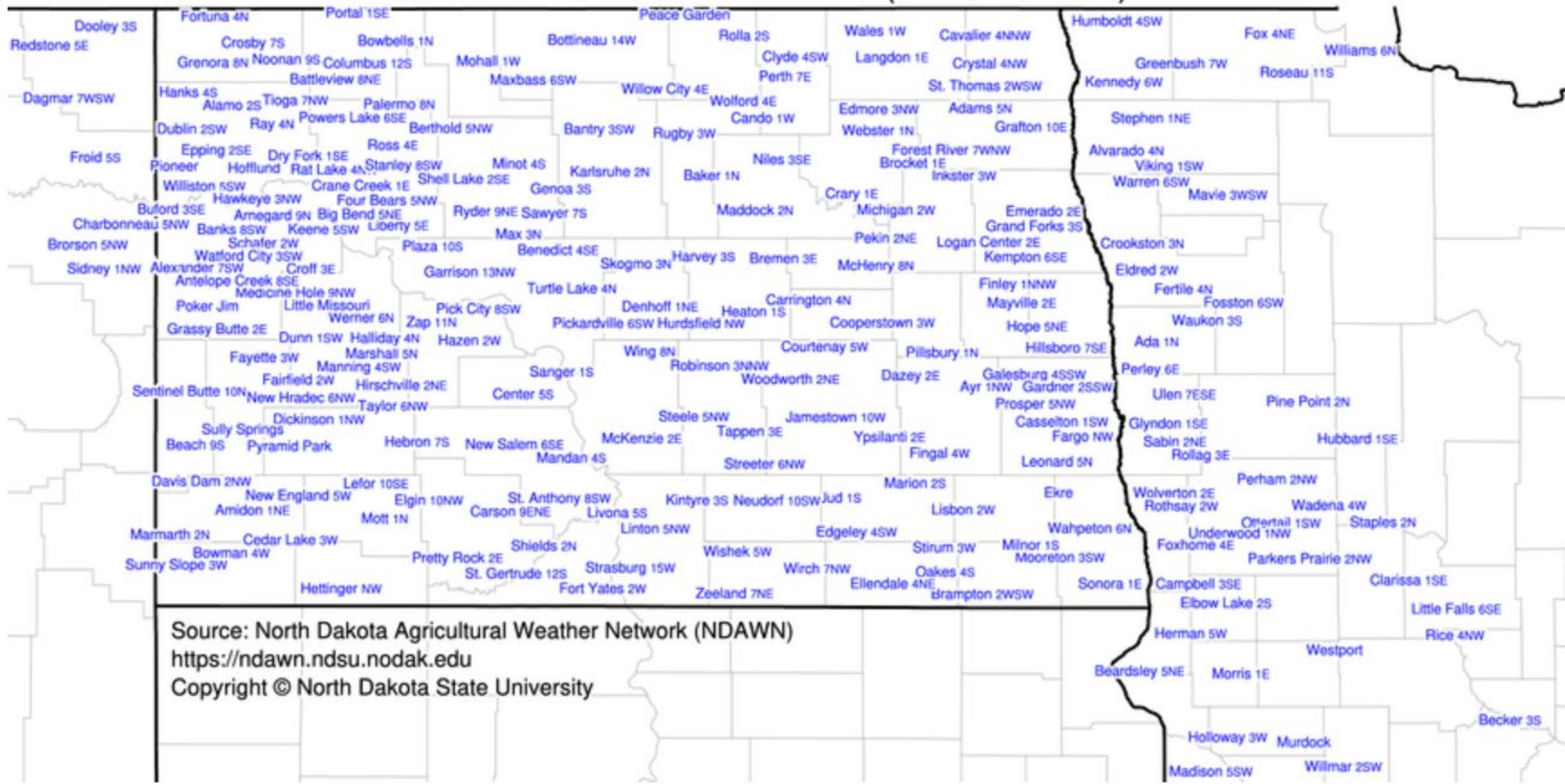
Liberty Ultra prefers humidity conditions

Delta T chart

- Impact of humidity and temperature on droplet evaporation
- Low humidity creates droplets that rapidly evaporate



NDAWN Station Locations (2026-01-02)



NDAWN in Minnesota is called MAWN, Minnesota Ag Weather Network

→ ↻ 🏠 mda.state.mn.us/minnesota-ag-weather-network

📺 YouTube 📺 CNN - Breaking Ne... 📺 ESPN: Serving sport... 📺 StarTribune.com: Ne... 📺 NDSU - North Dako... 📺 GopherIllustrated.c... 📺 My Meetings - Zoom 📺 Home - North Ce

MINNESOTA AG WEATHER NETWORK

[Home](#) > Minnesota Ag Weather Network

The MDA and local partners operate 40 weather stations in the Minnesota Ag Weather Network (MAWN). Another 24 stations in the state are owned and operated by the North Dakota Ag Weather Network (NDAWN), a vital partner in the project.

Providing accurate and detailed local weather data within 20 miles of ag areas across the state is a goal of the project. Up to 80 total stations may be necessary to achieve this goal.



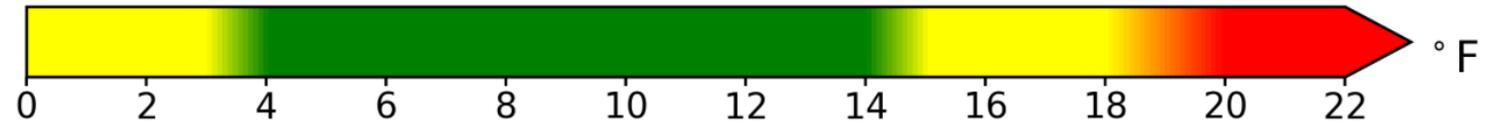
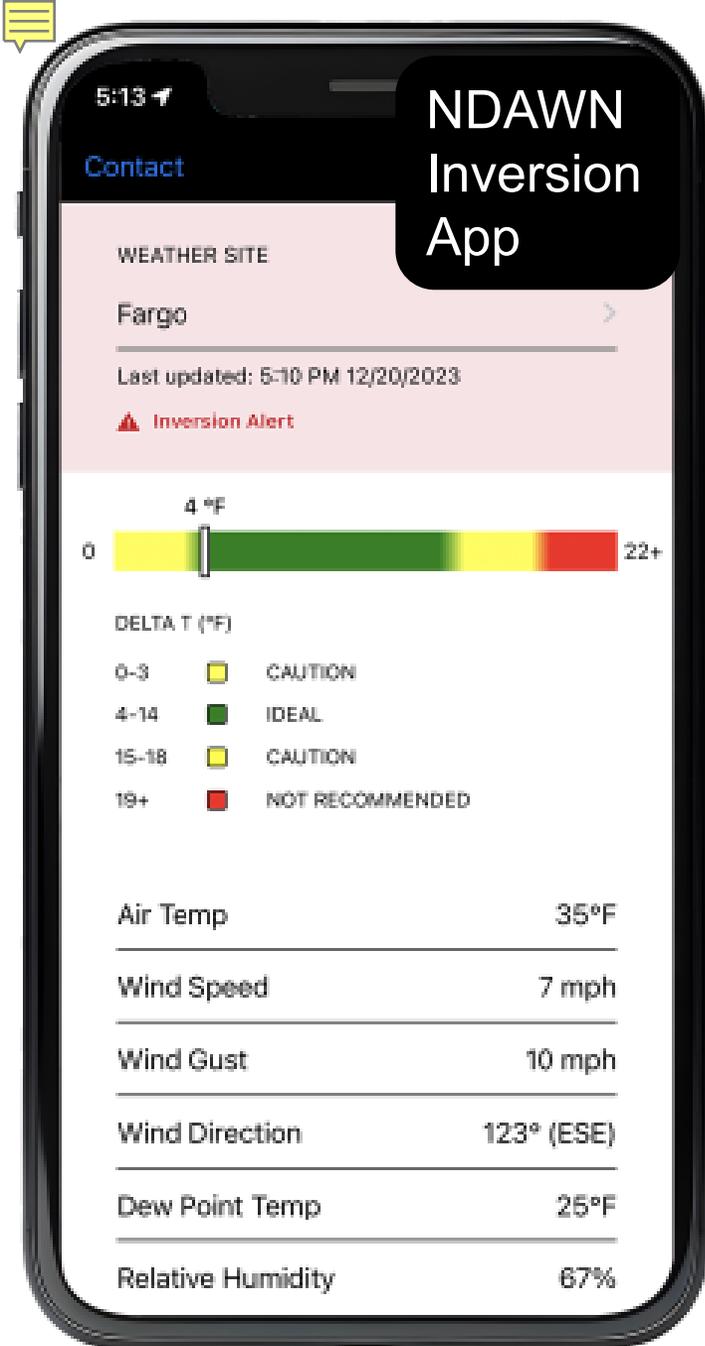
FORMS + RESOURCES

- > [Runoff Risk Advisory Forecast](#)
- > [Minnesota Ag Weather Station Host Application](#)

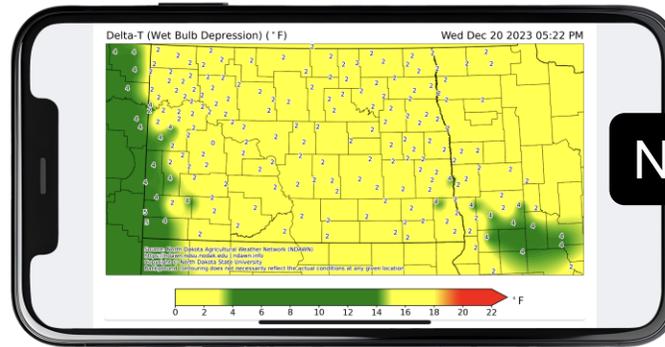
CONTACT US

[Stefan Bischof](#)
Pesticide & Fertilizer Management /
Fergus Falls
218-396-0720
✉ Stefan.Bischof@state.mn.us

- MAWN is similar to ND
- Minnesota station data is available at: ndawn.ndsu.nodak.edu
- In MN, 64 stations operated by MAWN AND NDAWN
- MAWN has the same algorithms and download capability



The warmer and sunnier the better (65F+), but watch Delta T.



NDSU EXTENSION **ND Delta T** Home Next 6 Days Past 7 Days Archive About

ATTENTION. The 2025 growing season has concluded and daily updates of this site have been disabled. This is a static website view as of October 31, 2025.

Managed by Rob Proulx, NDSU Extension Technology Specialist

▲ Check the NDAWN Inversion App

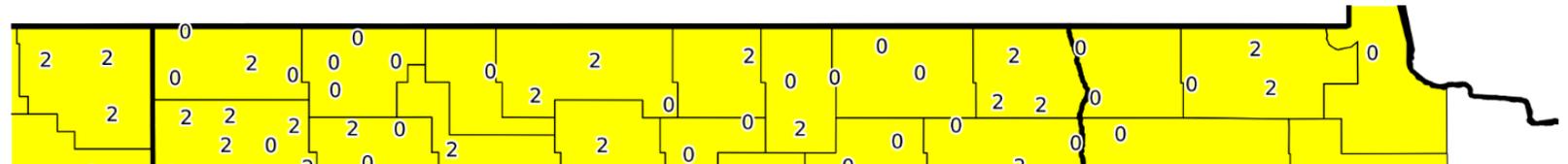
Delta T is just one weather variable to consider before spraying. Check the [NDAWN Inversion](https://raproulx.github.io/nddeltat/about.html) app for the latest temperature, wind conditions, Delta T, and inversion alert for your location.

<https://raproulx.github.io/nddeltat/about.html>

Current Conditions

Delta-T (Wet Bulb Depression) (°F)

Jan 27 2026 12:01 AM





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Visited with Kirk Howatt, NDSU Small Grains Weed Control Research....

- Delayed PRE of Zidua beneficial as long as it rains
 - Zidua runs out as the canopy begins to senescence even if it rains
 - Preharvest options? Postharvest options?
 - Don't forget about 75% of the wheat is rotated to sugarbeet
-
- 4 inch waterhemp found in wheat stubble in Sept/Oct
 - Joe counted approximately 88 seeds per plant
 - Roughly 7 plant per foot squared
 - Half the plants are female
 - 13.5M seeds/A = 90 plants/A at 150,000 seeds/plant
 - 5.4M if 40% germinate and emerge the following spring



Image credit : Joe Ikley, NDSU Weed Science

Wheat suppresses pigweed... until harvest^a

Treatment	Rate	6 DAT	22 DAT
	fl oz/A	%	%
PowerMax	32	26 c	28 d
PowerMax/PowerMax	32/32	33 c	50 c
2,4-D amine+PowerMax	64+32	64 b	88 ab
Sharpen+PowerMax ^b	1+32	90 a	98 a
Sharpen+Valor+PowerMax ^c	1+1+32	99 a	98 a
P-value		0.0001	0.0001

^aHickson, ND, 2020

^b4-month rotation restriction to sugarbeet (unfrozen ground)

^c4-month rotation restriction and tillage to sugarbeet

^{bc}Sharpen with MSO at 1 pt/A



Prior to treatment



**Sharpen (1 fl oz/A) +
Roundup PowerMax 3 (30 fl oz/A)
+ MSO (1 pt/A)**

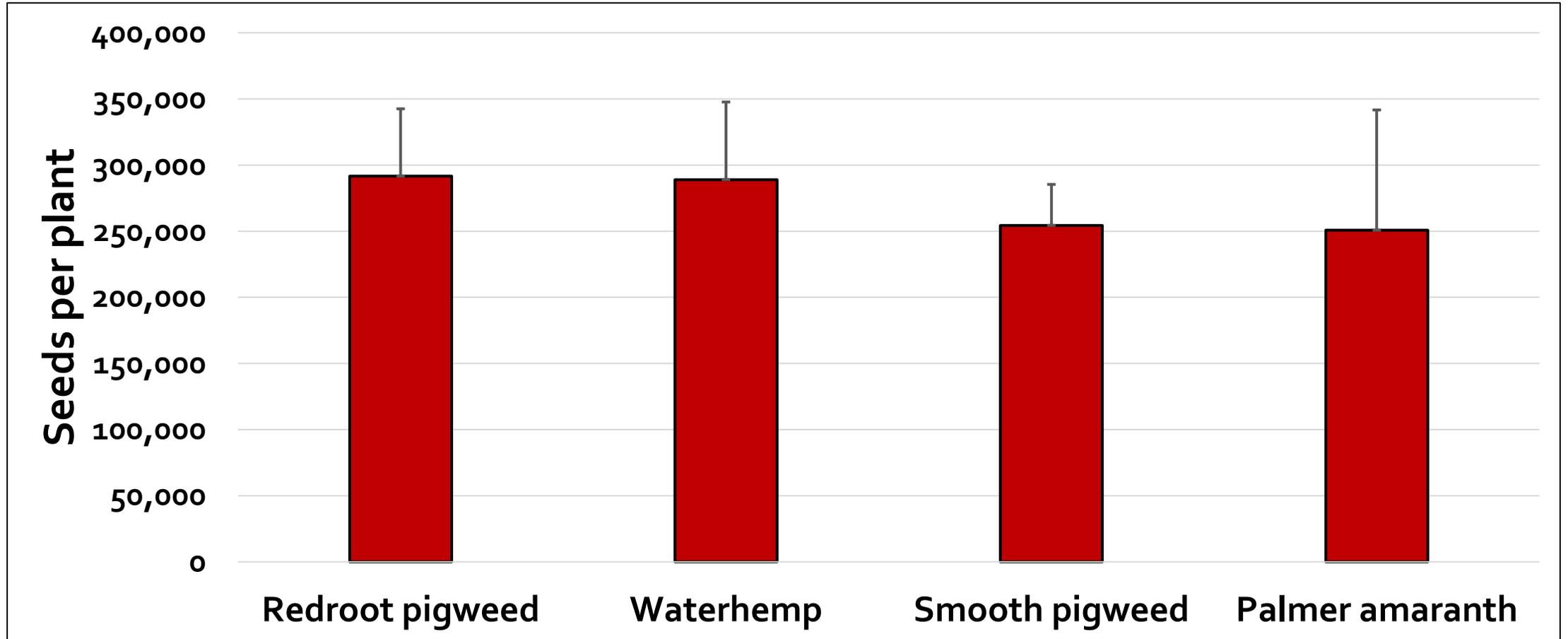




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Pigweed species make a lot of seed

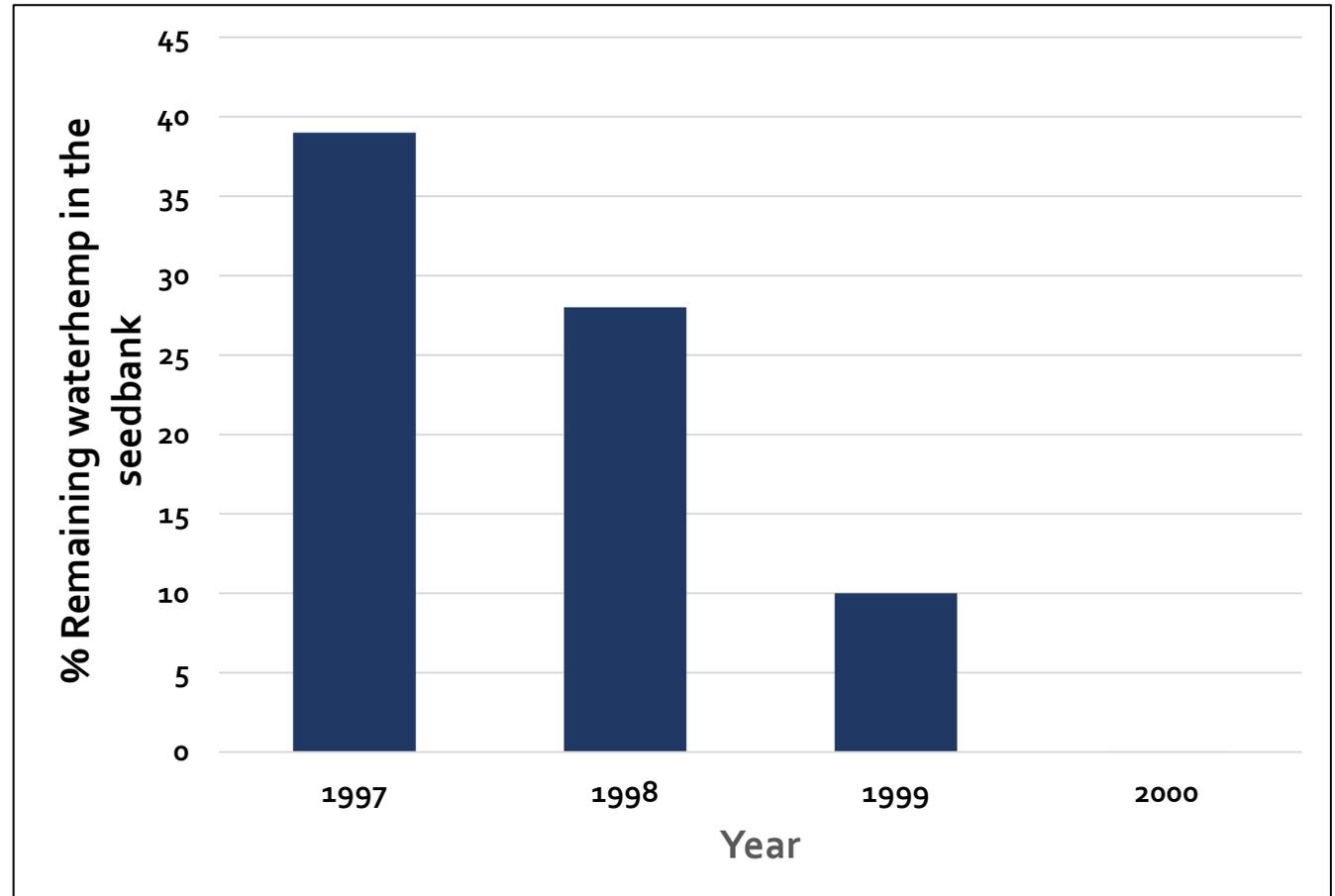


**Waterhemp seed is viable 7 to 14 days after flowering.
Carry pigweed from the field if you go through the
trouble of pulling weeds**



PREVENTION: The best way to get rid of waterhemp is not to allow new seed production

- Steckel et al., Weed Science 2007, 55: 235-239
- Soybean field allowed to make seed in 1996
- Field not allowed to go to seed after 1996
- Percent of the original common waterhemp seed bank remaining in 1997, 1998, 1999 and 2000



Poorly managed outside field borders and between fields



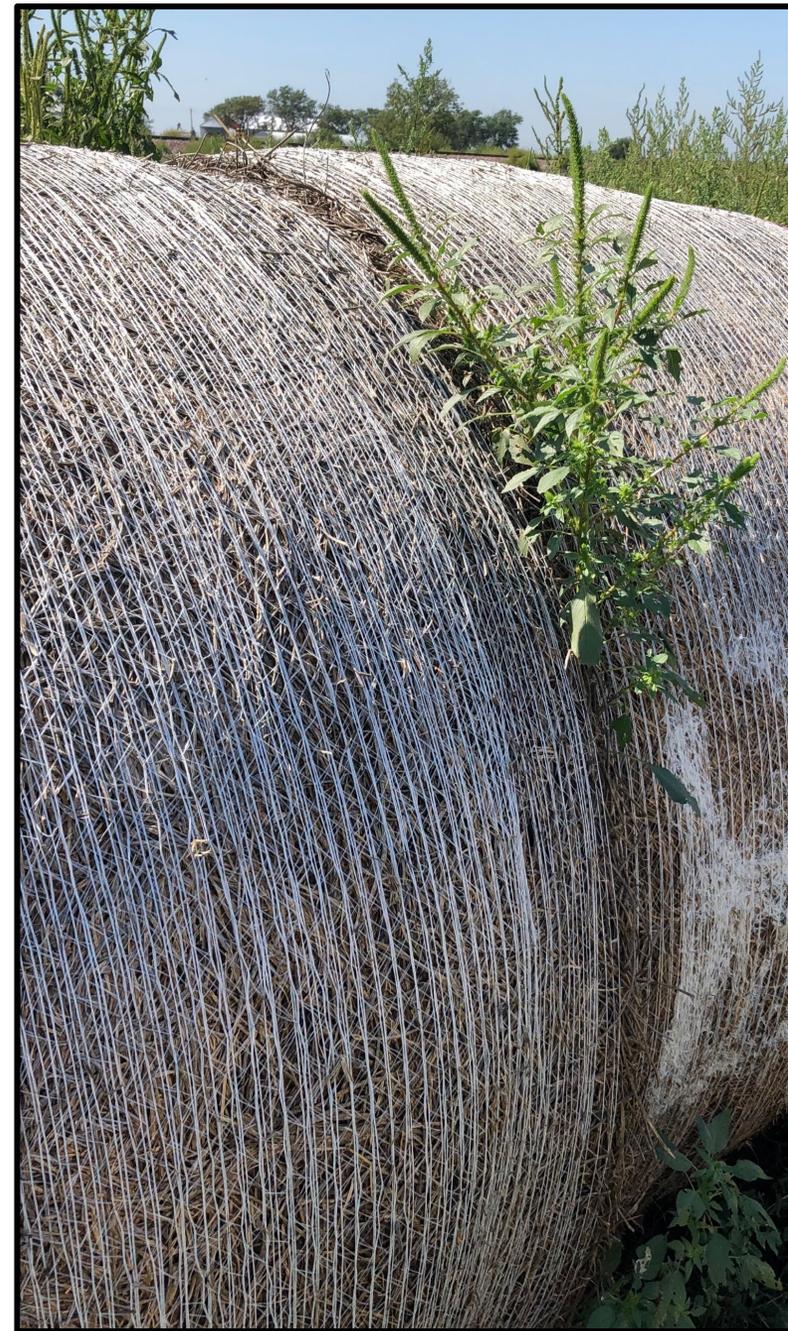
Properly managed outside field borders





Manage weeds on inside of field border

1. Apply the highest rate of PRE herbicides and/or more herbicides on the inside border.
2. Spray the inside border days ahead of the rest of the field to match the size of weeds since they are usually taller in the border.
3. Apply the maximum herbicide rates on the outside border.
4. Adjust spray boom to proper height on inside border, don't put it low to reduce drift causing poor spray coverage of weeds.
5. Apply a second application 14 days later regardless along with additional Group 15 herbicide.
6. Pull surviving weeds on inside border.





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11. Post-harvest weed control
12. Manage weeds inside and outside field border/perimeter
13. Fall-applied herbicides
14. Cover crops
15. Water source and temperature
16. Apply herbicides at proper time of day
17. Mix herbicides in proper order

These last 5 weed management basics are just AS IMPORTANT as the last 12!

Summary

- Making good judgements is critical in 2026
- Use winter technical meetings to re-learn the basics
- Develop multiple season-long strategies for each field - need backup plans!
- Use university recommendations – Read through the handouts
- Don't make poor short term decisions causing future weed management problems!



"It's the little weed management details that are vital. Little things make weed-free crop fields"

NDSU

EXTENSION



Thank you for your continued support

Tom Peters

- Extension Sugarbeet Agronomist and Weed Control Specialist

- thomas.j.peters@ndsu.edu

  BeetWeedControl @tompeters8131

- 701-231-8131 (office)

- 218-790-8131 (mobile)



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Thank You! Questions?

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701-541-0043

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