

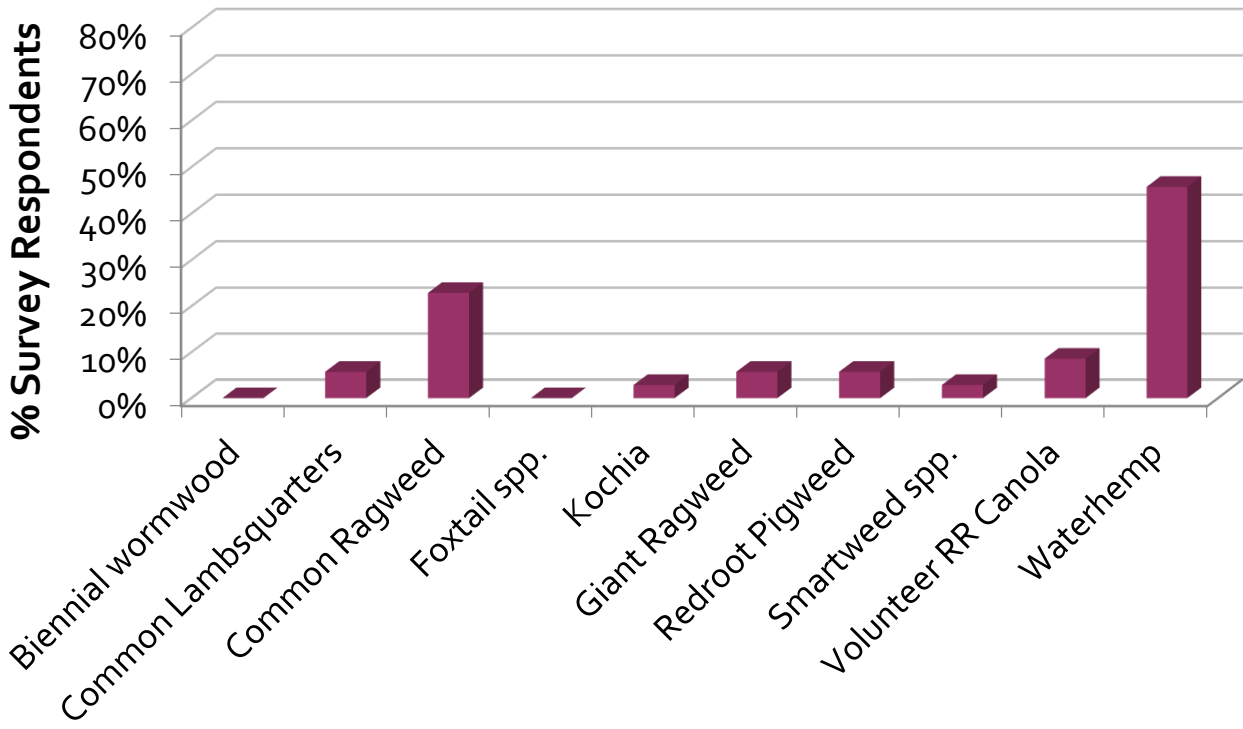
Weed Control in Sugarbeet

Tom Peters

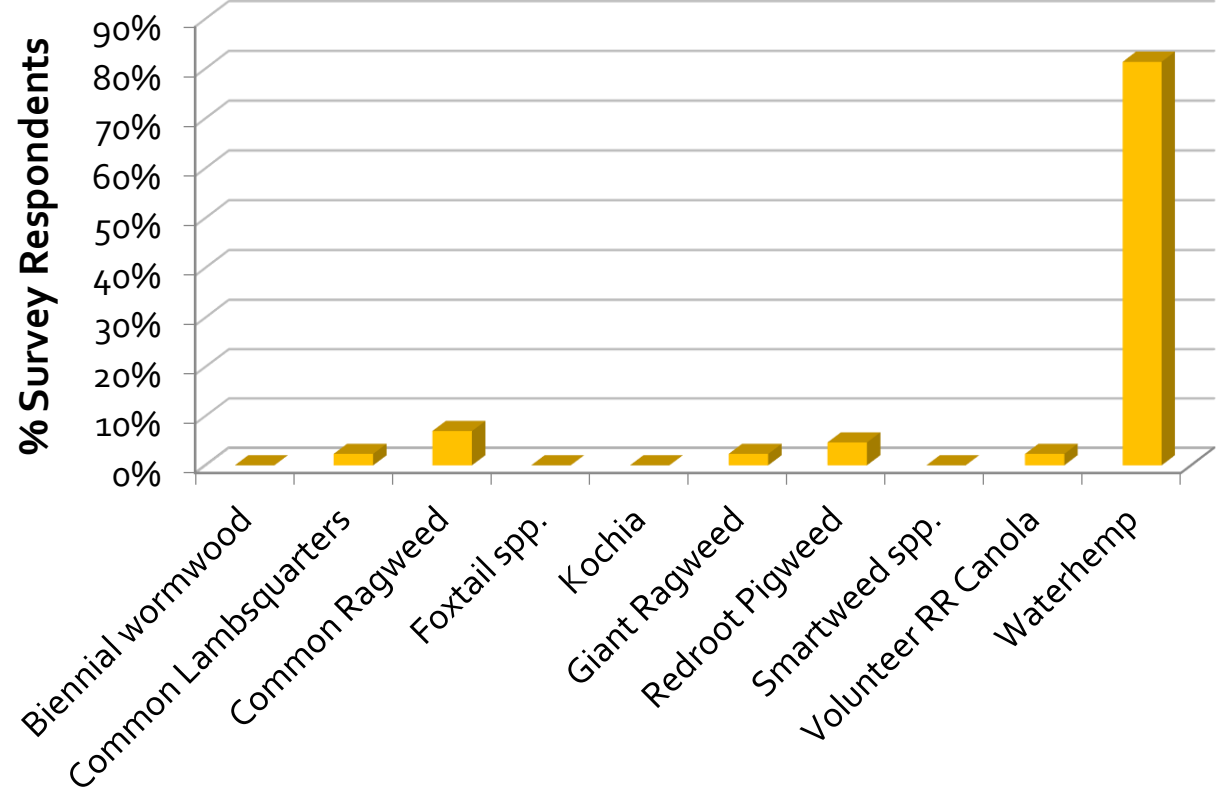
**Extension Sugarbeet Agronomist and
Weed Control Specialist**

What was your worst weed problem in 2017¹?

Fargo, ND



Wahpeton, ND



¹Turning Point Survey of Growers; conducted at the 2017 Sugarbeet Growers Seminar, Fargo and Wahpeton

Glyphosate alone, glyphosate in tank-mixes¹

| | 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 |

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

Glyphosate products are different formulations and adjuvant loading

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

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

Regulatory approval for ethofumesate supplemental label, December 7, 2017

- POST rate up to 128 fl oz/A
 - Willowood Ethofumesate 4SC + glyphosate
 - 2-lf sugarbeet or greater
 - 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: | <ul style="list-style-type: none"> • 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: | <ul style="list-style-type: none"> • 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: | <ul style="list-style-type: none"> • 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: | <ul style="list-style-type: none"> • 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, 8:30 am to 4:30 pm Pacific Time or your poison control center at 1-800-222-1222. | |

EPA Reg. No. 87290-1
 Manufactured for:
 Willowood, LLC
 1800 NW Garden Valley Blvd. #120
 Roseburg, OR 97471

EPA Est. No.



Net Contents:

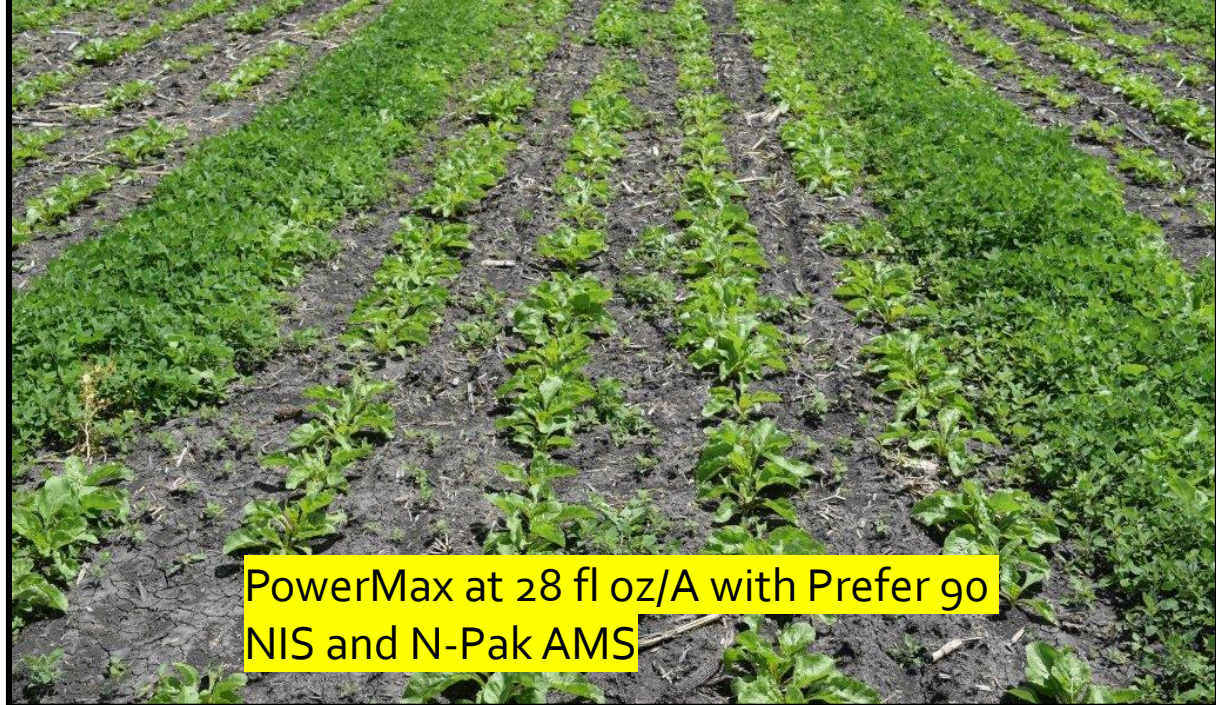
Lambsquarters control from ethofumesate at 2- and 6-lf sugarbeet, locations sorted by precipitation¹

| 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 |

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



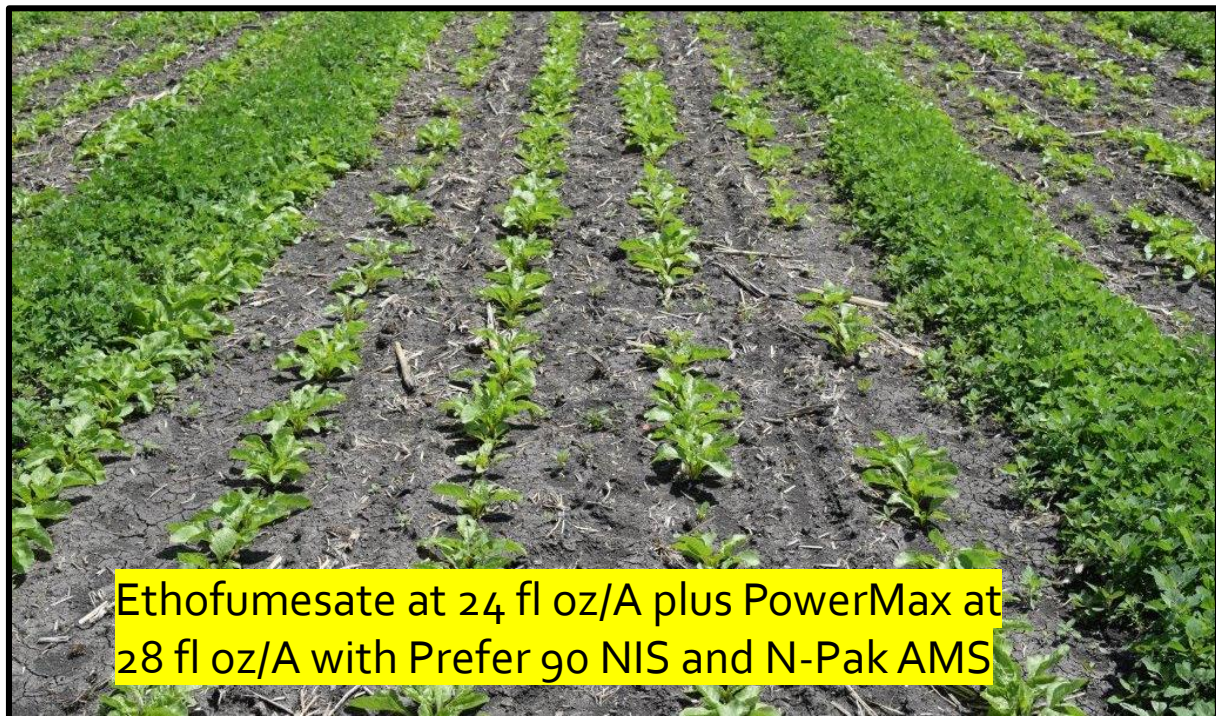
Ethofumesate at 24 fl oz/A



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

Lambsquarters control from etho + glyphosate, at 28 fl oz/A, locations sorted by precipitation¹

| Etho-fumesate | Grand Forks, ND | Minto, ND | Oslo, MN | Moorhead, MN | Prosper, ND |
|---------------|----------------------------|-----------|----------|--------------|-------------|
| (fl oz/A) | -----% visual control----- | | | | |
| 12 / 12 | 100 a | 98 a | 90 a | 78 ab | 100 a |
| 24 / 24 | 100 a | 100 a | 94 a | 78 ab | 100 a |
| 32 / 32 | 100 a | 100 a | 100 a | 78 ab | 100 a |
| glyphosate | 100 a | 98 a | 99 a | 70 b | 95 a |

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

²Applied at 2- and 6-leaf sugarbeet stage

Lambsquarters control at Barney, ND, 2016

| Herbicide ¹ | Rate | Lambsquarters Jun 22 | Lambsquarters Sept 7 |
|---|-----------------------------|-------------------------|-------------------------|
| | pt or fl oz/A | -----(% control)----- | |
| PowerMax/PowerMax/PowerMax ² | 28/28/22 | 70 | 78 |
| PMax+etho/PMax+etho/PMax+etho | 28+4/28+4/22+4 | 70 | 80 |
| Etho+PMax/etho+PMax/PMax | 2p+28/2p+28/22 | 85 | 89 |
| etho+PMax+phen/etho+PMax+phen/ PMax+phen | 2p+28+12/2p+28+20/ 22+28 | 89 | 100 |
| LSD (0.05) | | 9 | 7 |

¹PMax = PowerMax, etho = ethofumesate, Bmix = Betamix, phen = phenmedipham

²PowerMax at 28/28 fl oz/A plus Prefer 90 NIS at 0.25% v/v and N-Pak AMS at 2.5% v/v. All other treatments contained HSMOC at 1.5 pt/A and N-Pak AMS at 2.5% v/v

2018 Recommendations; 2018 Experiments

Valley North

Ethofumesate in a weed management system

- Ethofumesate + glyphosate
 - Tough broadleaf weeds or demanding environments
 - Etho at 12 to 24 fl oz/A plus glyphosate
 - Up to 3 applications; 10 day interval between application
 - 45 day PHI
- Improved broadleaf control
 - Etho + glyphosate + broadleaf herbicide
 - Kochia and Lambsquarters

We need to better understand crop rotation restrictions

2018 Recommendations; 2018 Experiments

SMBSC

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

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

Up to one inch common ragweed

| Herbicide Treatment ¹ | Rate | July 7 sgbt inj | July 7 cora cntl | July 14 cora cntl | July 25 cora cntl | Cost |
|---------------------------------------|------------------|-----------------------|------------------------|-------------------------|-------------------------|------|
| | fl oz/A | ------(%)----- | | | | \$\$ |
| PMax / PMax / PMax | 28 / 28 / 22 | 1 | 74 | 74 | 76 | \$31 |
| PMax+Stinger / PMax+Stinger / PMax | 28+2 / 28+2 / 22 | 3 | 89 | 88 | 92 | \$46 |
| PMax+Stinger / PMax+Stinger / PMax | 28+4 / 28+4 / 22 | 9 | 95 | 95 | 95 | \$61 |
| 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 Mayville

Greater than

weed,



Herbicide Treat

PMax / PMax /

PMax+Stinger

PMax+Stinger

LSD (0.05)

¹All treatments

²PMax is Round

4 July 25
cora
cntl

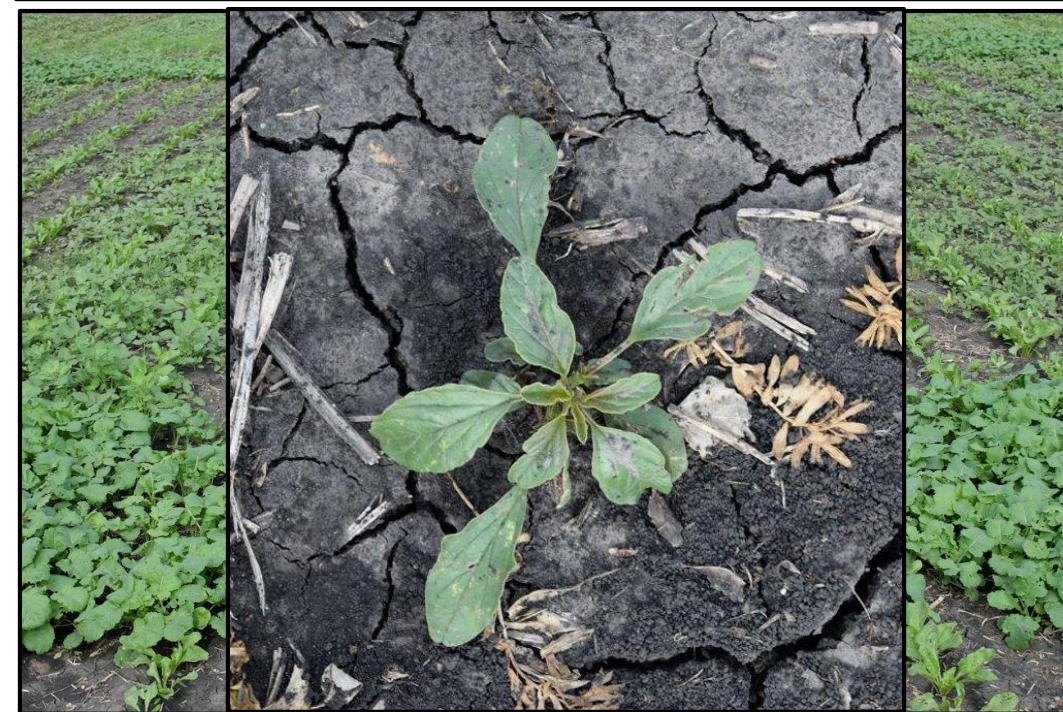
| |
|-------|
| ----- |
| 82 |
| 84 |
| 91 |
| 10 |



Stinger controls weeds in four families; composite, legume, nightshade, and smartweed

| Herbicide | Rate | Day after treatment | Lambsquarters | Pigweed |
|-----------|---------|---------------------|---------------|---------|
| | fl oz/A | | % | % |
| Stinger | 2 | 7 | 4 | 15 |
| Stinger | 2 | 7 | 23 | 3 |
| Stinger | 4 | 13 | 17 | 30 |
| Stinger | 4 | 13 | 20 | 3 |

KayJay Ag Services, Inc., Horace, ND, 2017



Percent visual waterhemp control from repeat applications of glyphosate¹

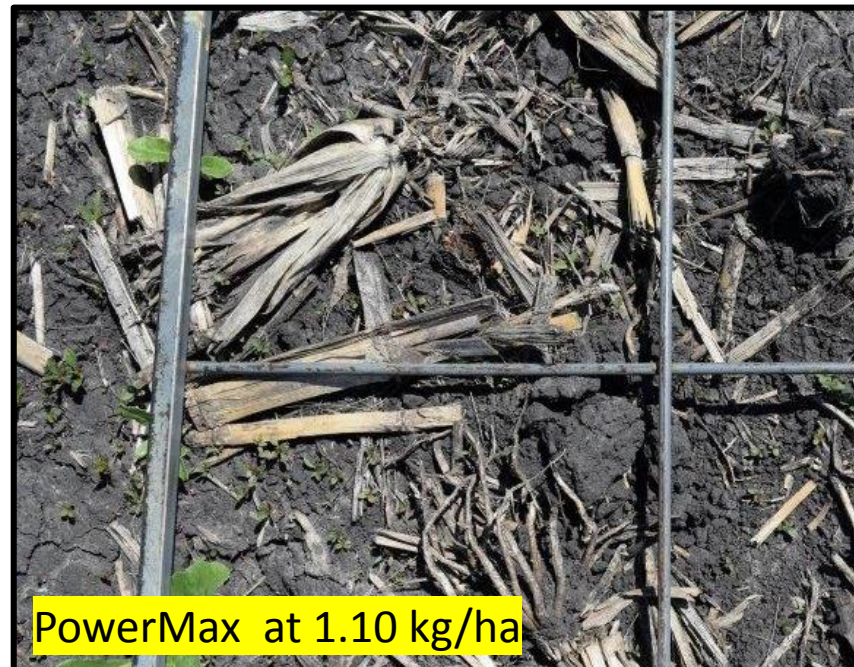
| | Herman 2014 | Herman 2015 | Moorhead 2015 | Lake Lillian 2015 |
|--------------|--|----------------|------------------|----------------------|
| | -----% Preharvest control ² ----- | | | |
| Experiment 1 | 33 | 48 | 60 | 48 |
| Experiment 2 | 35 | 56 | 34 | - |
| Experiment 3 | 36 | 58 | 66 | 60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

¹Roundup 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

²Visual 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 |

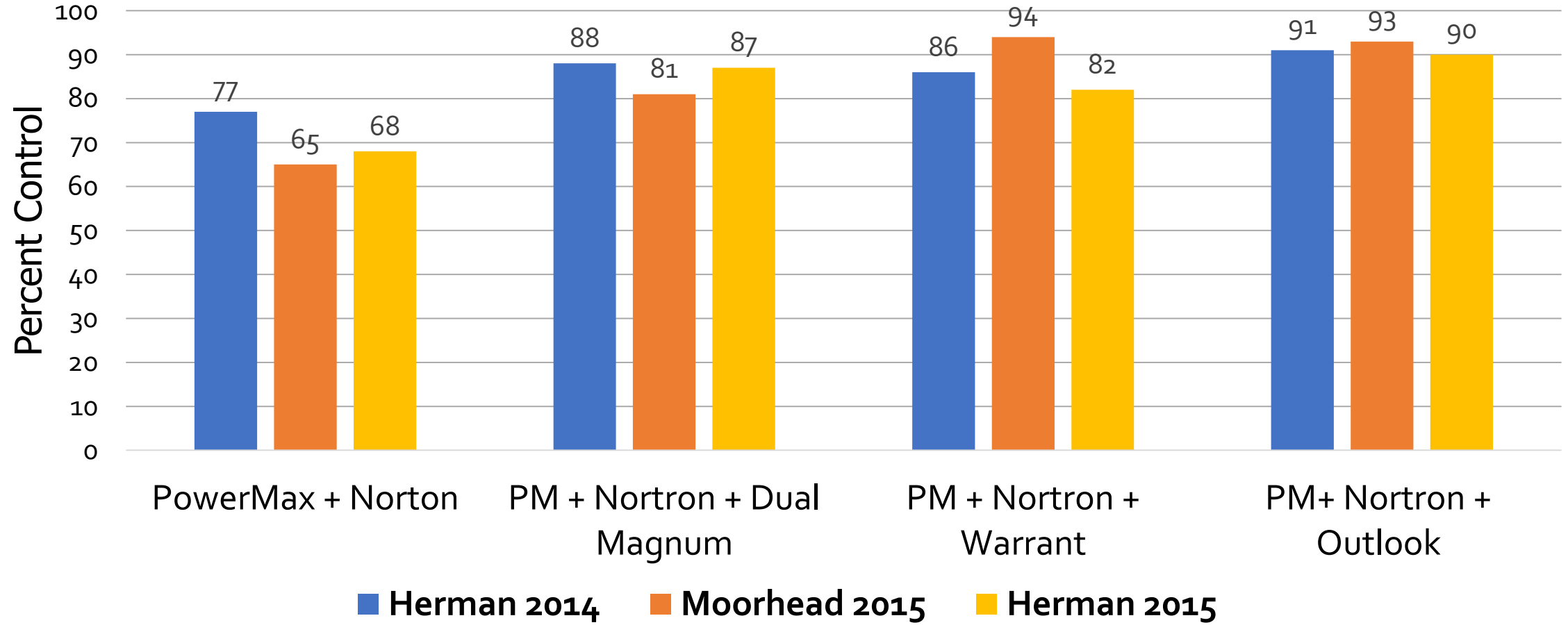


Number of waterhemp per meter square, June 6, 2017, Lake Lillian, MN

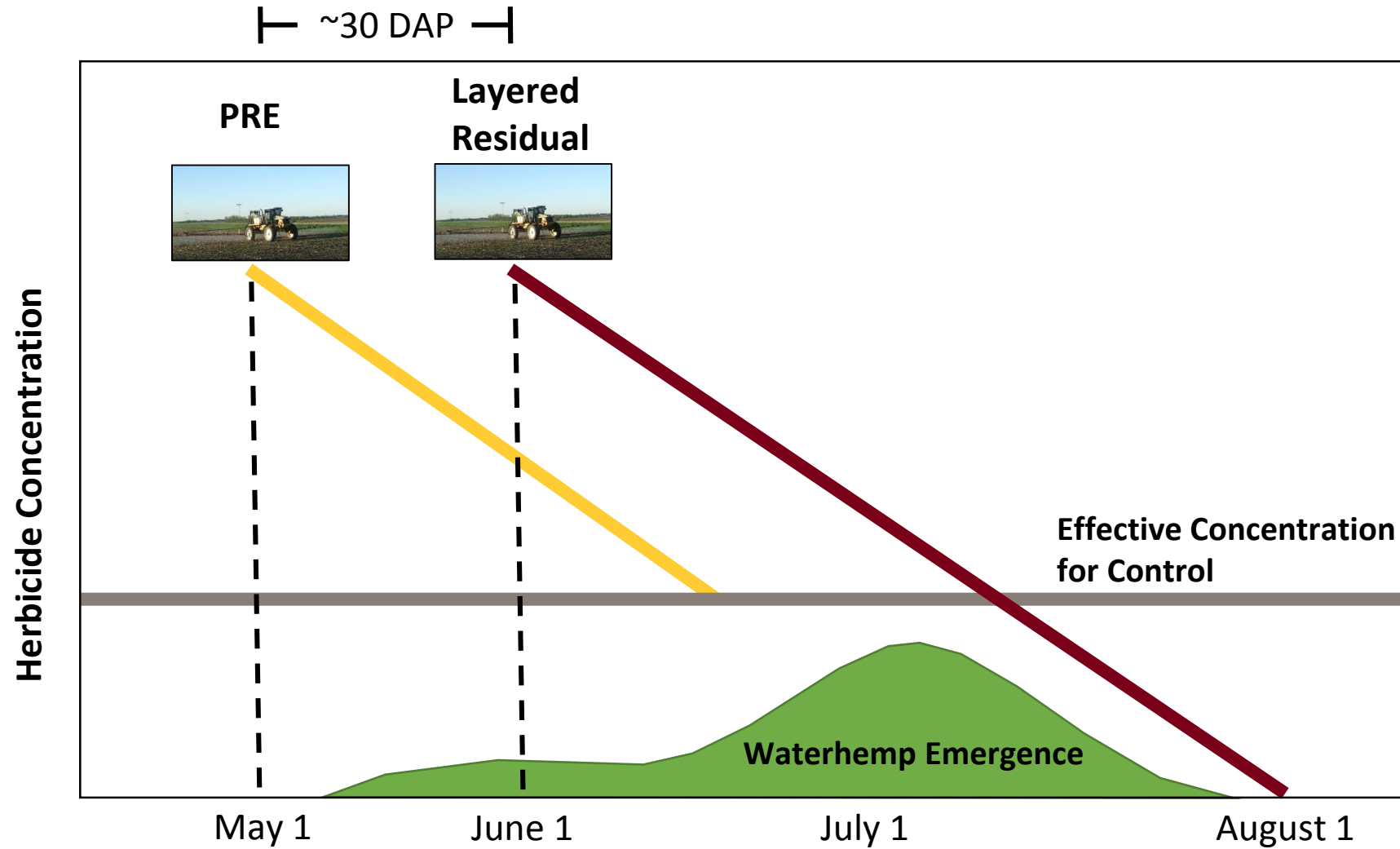
YES. 77% control at Herman and 76% control at Lake Lillian

Increasing the rate or repeat applications does not improve control

Waterhemp control from postemergence herbicides, across locations and years



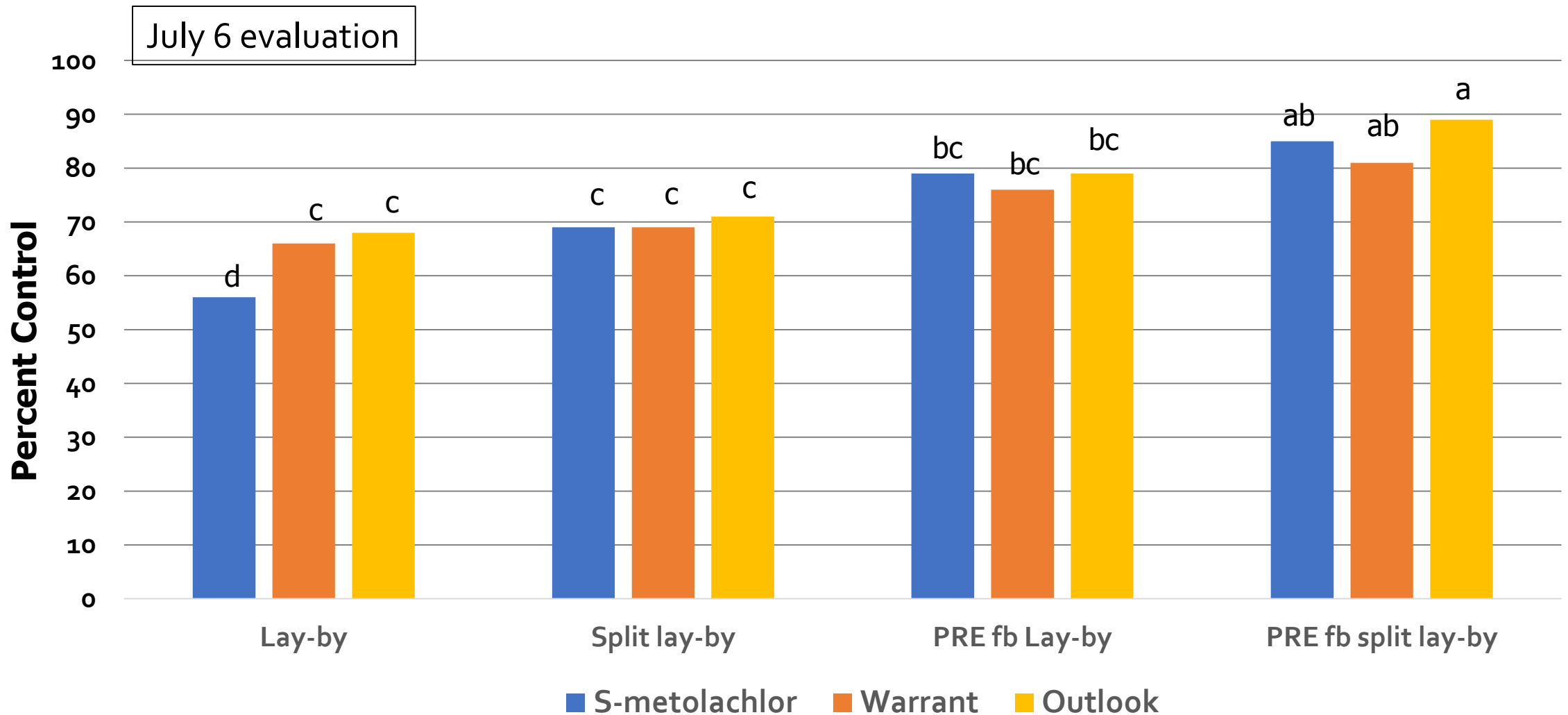
Layered Herbicide Concept



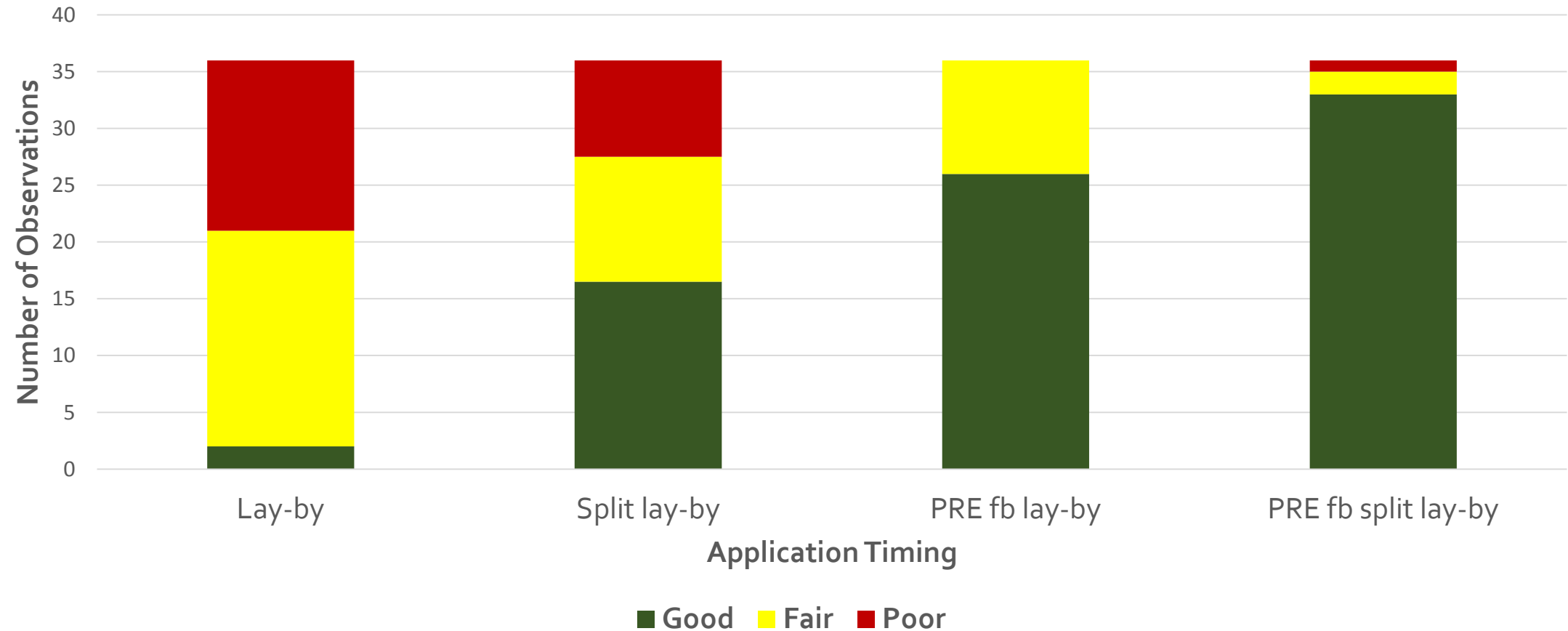


Waterhemp emerged, image, May 22

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 costs¹, 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

¹According to the 2018 North Dakota Weed Control Guide

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/m ² | % |
| Dual Magnum | 8 | PRE | 25b | 97 |
| PowerMax | 28 | EPOST | 192c | 74 |
| Control | | | 727a | |

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

How do I decide between ethofumesate or Dual Magnum PRE?

Ethofumesate (Nortron, Ethotron, Ethofumesate 4SC)

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

Dual Magnum

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

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 | 28 fl oz fb | EPOST | | | |
| Roundup PowerMax+ Ethofumesate + N-Pak AMS + Destiny HC | 28 fl oz + 6 fl oz + 2.5 % v/v + 1.5 pt | POST | 63 | 50 | 100 |
| LSD (0.05) | | | 11 | 15 | 4 |

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

A photograph showing a vast field of dense, green waterhemp plants. The plants are growing in rows, and the field extends to the horizon. In the foreground, a clipboard with a white sheet of paper is visible, held by a black binder. The paper has some text on it, including "Adj= MSO" and "1.5 pt".

ALS (SOA2) resistant waterhemp

Adj= MSO

1.5 pt

Herbicide risk of developing weed resistance

- Chloroacetamides, SOA₁₅, S-metolachlor, Outlook Warrant
- Lipid Synthesis Inhibitors, SOA₉, Ro-Neet, ethofumesate
- Photosystem I Inhibitors, SOA₅, Betamix
- ACC-ase Inhibitors, SOA₁, Assure, Poast, SelectMax
- Glyphosate, SOA₉
- ALS Inhibitors, SOA₂, UpBeet

Least
Likely



Most
Likely

Heap, I. The International Survey of Herbicide Resistant Weeds. Online. Internet.
Thursday, February 15, 2018

Dicamba



North Dakota-specific protocols announced for Dicamba



The North Dakota-specific use protocols on the Dicamba formulations of XtendiMax, Engenia, and FeXapan are as follows and are in addition to the federal requirements:

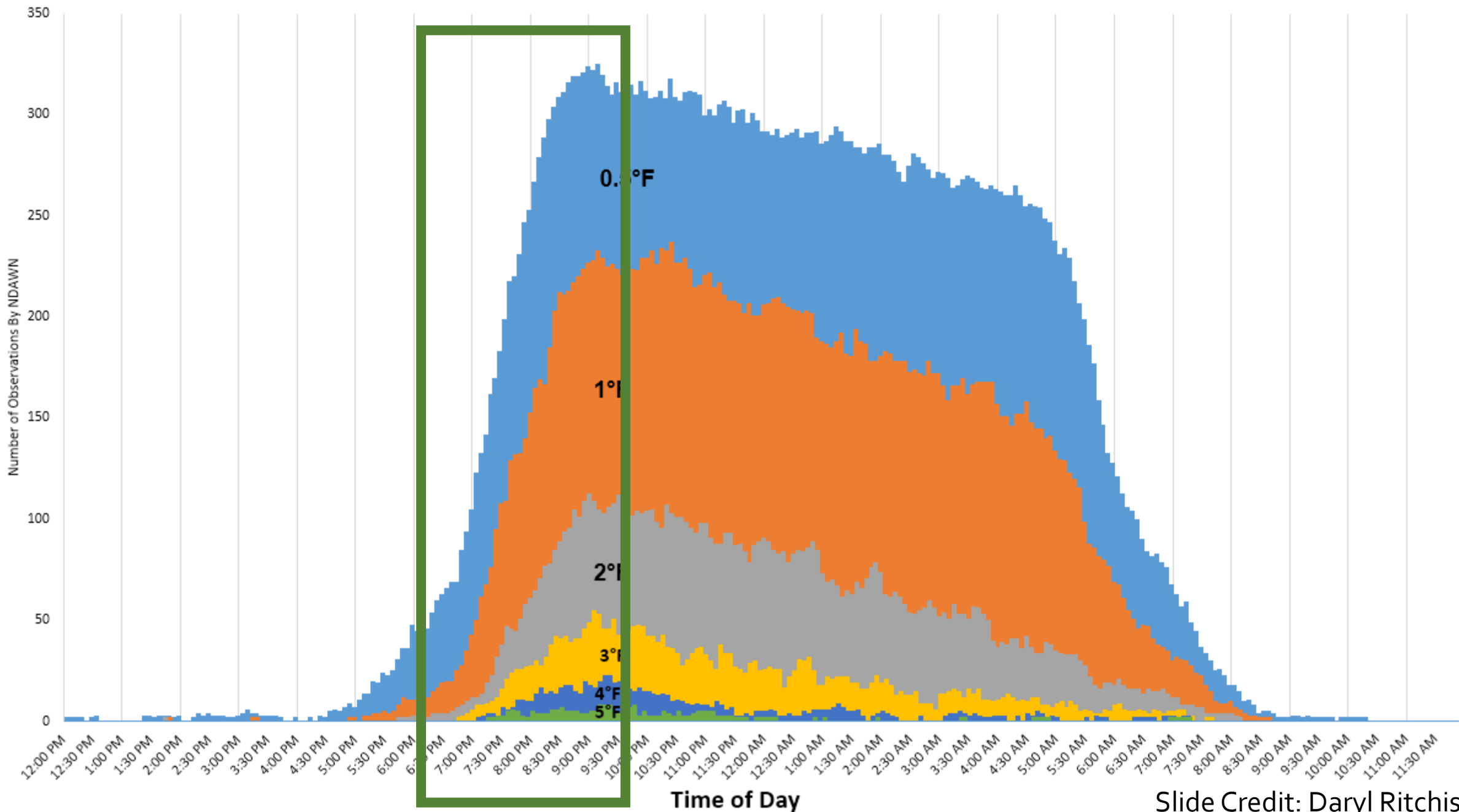
- **No applications may be made after June 30** or after the first bloom (R₁ growth phase), whichever comes first.
- **No applications may be made if air temperature of the field at the time of application is over 85 degrees** Fahrenheit or if the forecasted National Weather Service high temperature for the day exceeds 85 degrees Fahrenheit.
- Applications of the product may only be made **from one hour after sunrise to one hour before sunset.**

STATE RESTRICTIONS - MN 24(c)

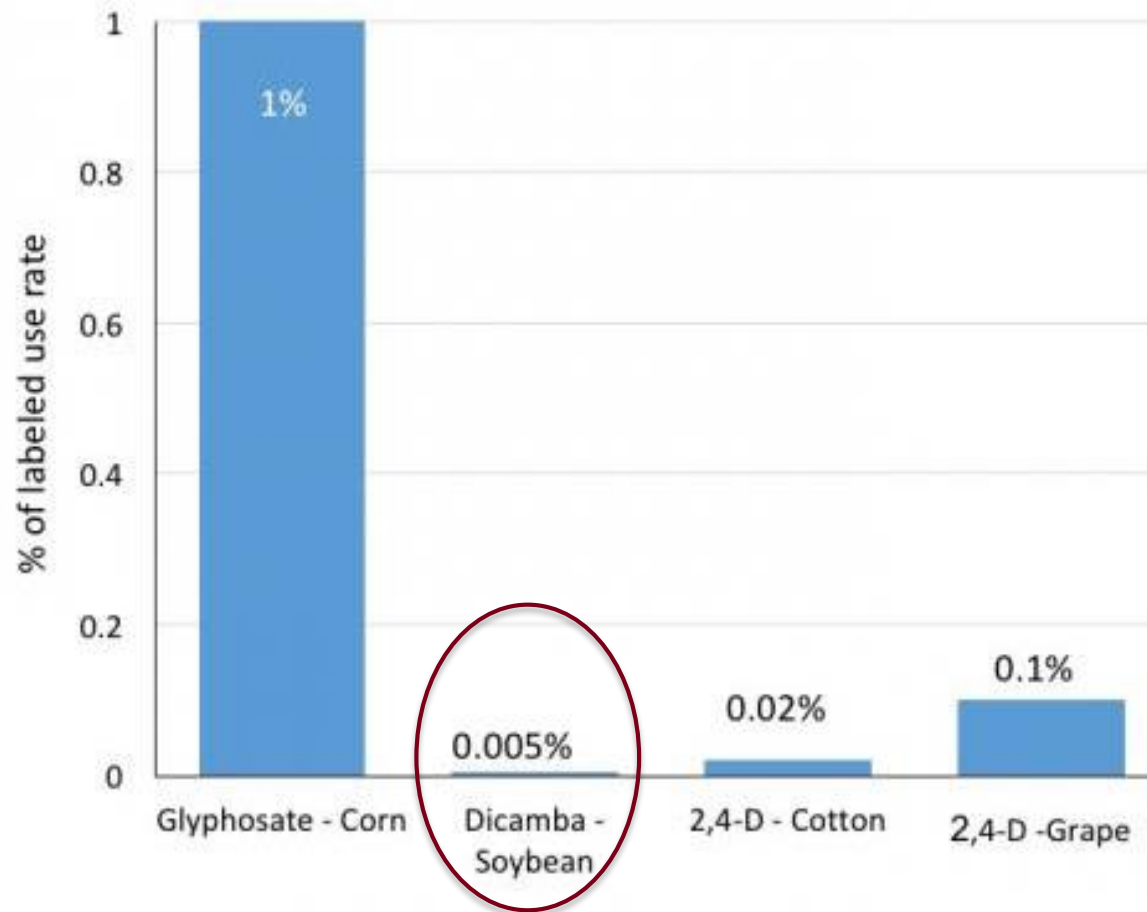
EXPIRES ON 10/1/2018

- **No application shall be made after June 20, 2018**
- **No application shall be made if the air temperature of the field at the time of application is over 85 degrees Fahrenheit OR if the National Weather Service's forecasted high temperature for the nearest available location for the day exceeds 85 degrees Fahrenheit.**
 - ✓ Local National Weather Service forecasts are available at <https://www.weather.gov/phi/localclimate>
- **Retail sale to and use ONLY by Certified Applicators**
- **Registrants are responsible for dicamba-specific training**
 - ✓ ~90 minute, in-person session that is free of charge
 - ✓ Attendance records maintained by registrants
 - ✓ One training session satisfies requirements for any of the three dicamba products
 - ✓ MCPR will maintain training session calendar at:
 - ✓ <https://mcpr-cca.org/dicamba-information-trainings/>

Inversion Frequency During Time of Day (June - July -August)



Lowest Observable Dose Causing Significant Visual Crop Response



Sugarbeet malformation injury from Xtendimax, 7 to 10 DAT (early) and 17 to 35 DAT (late) at Prosper, ND

XtendiMaxx at 3.3 fl oz/A (1/10th the labeled rate), applied June 19, image 3 DAT



Photo Credit: Mike Metzger, Minn-Dak Farmers Coop



Removing Herbicide Residues from Agricultural Application Equipment



*How Proper Cleaning
Helps Prevent Crop
Damage and Improves
Performance*

[PDF] Removing Herbicide Residues from Agricultural Application Equipment

<https://ppp.purdue.edu/wp-content/uploads/2016/08/PPP-108.pdf> ▼

Kevin Leigh Smith, Editor, **Purdue** Agricultural Communication. 2. How Proper of the Spray Droplet (**Purdue** Extension publication PPP-107), available from Tank **Cleanout** : Turning a Lot Into a Little. The procedure for removing herbicide residue from the inside of a **sprayer** tank is no different than the procedure.

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

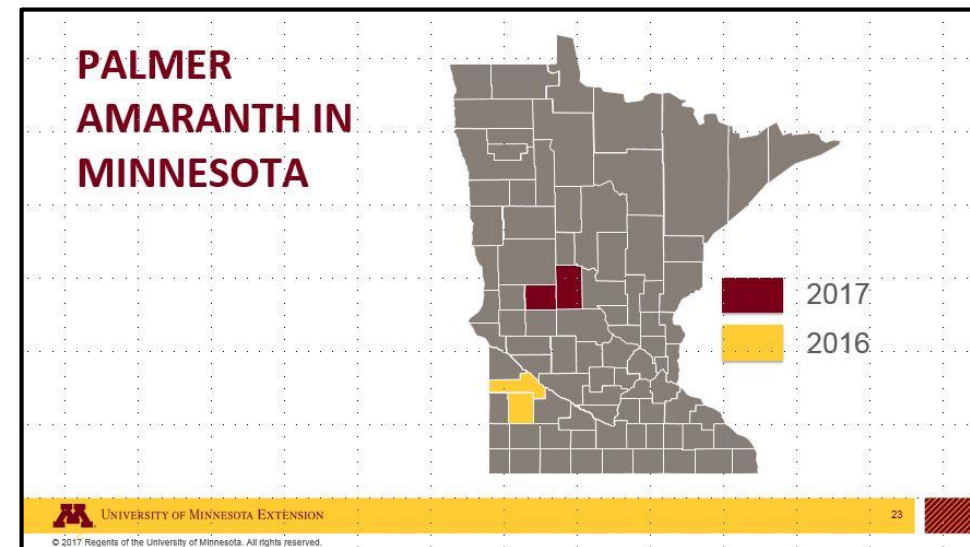




Image Credit: Bob Hartzler, ISU

K. George Beck and James Sebastian,
Colorado State University, Bugwood.org

Acknowledgements

- Sugarbeet Research and Education Board for funding these research
- Minn-Dak Farmers Cooperative Research Team including Mike, Brad, and Emma
- Our cooperators: **Tim and Michael Backman (Herman)**, James Bergman (Oslo), Glenn and Danny Brandt (Ada), Andy and Brent Levos, Frank Mataczjek (Grand Forks), Pinta Brothers (Minto), American Crystal Sugar (Moorhead), Chris and Brian Schlegel (Lake Lillian), Jeff Schmoll (Lake Lillian), **Brent Torkleson (Foxhome)**, **Larry Wold (Galchutt)**

Thank you for your Support

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