A photograph of a field where a dense carpet of green weeds, likely Palmer amaranth, has overtaken the crops. In the foreground, two young soybean plants with large, rounded leaves are visible, standing out from the sea of weeds. The background shows a flat landscape under a clear sky.

The War Against Weeds in Drought AKA: A Typical Year in ND

Dr. Joe Ikley

NDSU Extension Weed Specialist

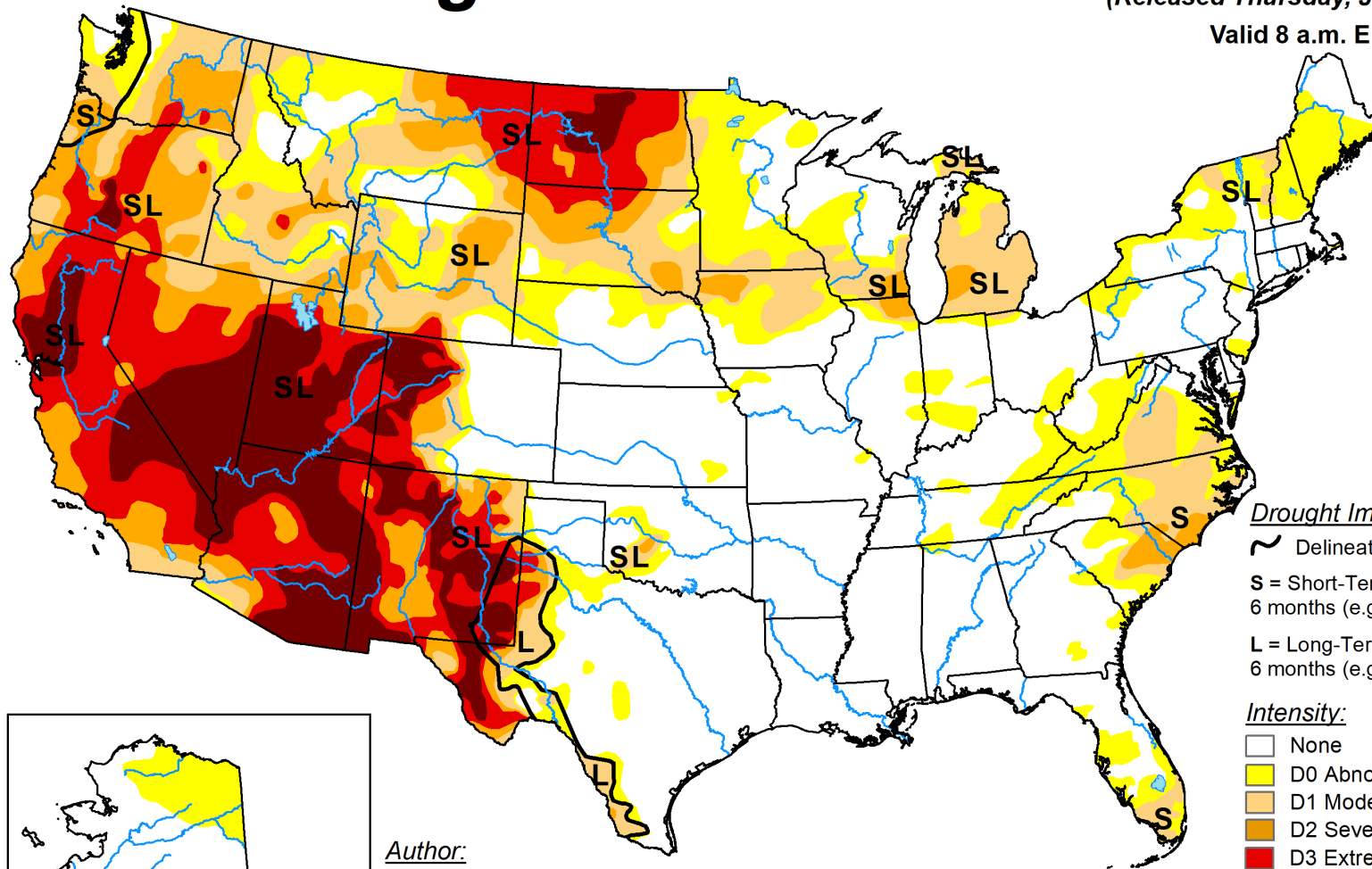
12/19/2023

U.S. Drought Monitor

June 1, 2021

(Released Thursday, Jun. 3, 2021)

Valid 8 a.m. EDT



Drought Impact Types:

~ Delineates dominant impacts

S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

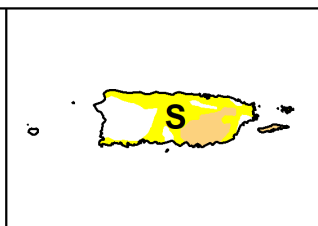
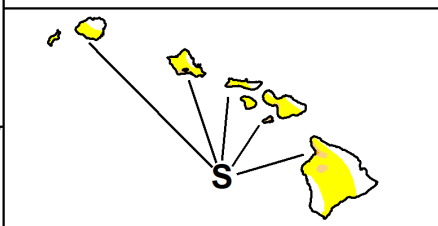
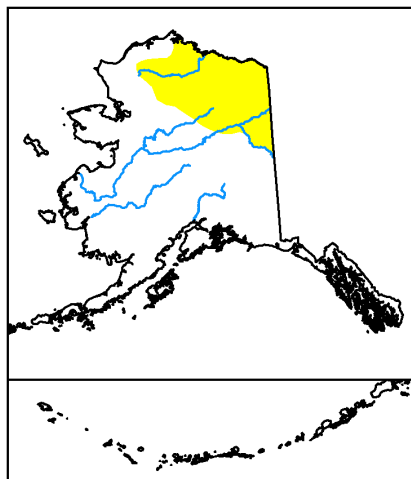
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

Author:

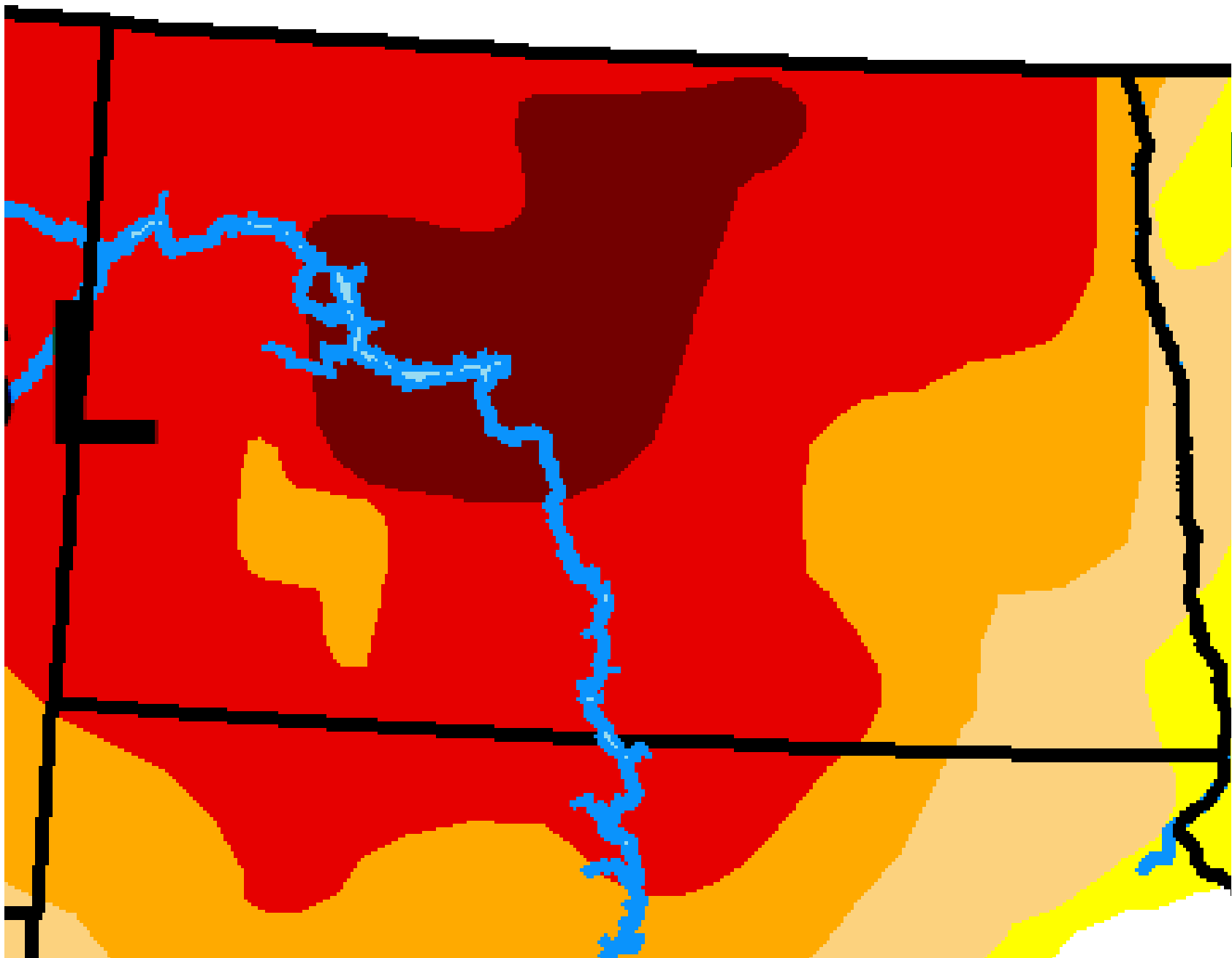
Brian Fuchs
National Drought Mitigation Center



The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>



droughtmonitor.unl.edu



Water



Common Ragweed



PRE Herbicides in Drought

- Typically recommend 1" within first week, 2" within first two
 - 0.5" in ND
- Water solubility affects incorporation of herbicides
 - Low – <10 mg/L
 - Medium – 10-1000 mg/L
 - High – >1000 mg/L
- Questions about UV loss abundant in drought years
- Root vs shoot uptake
 - Germination depth of weeds

Degradation of Soybean PRE Herbicides

Active ingredient	Trade name	Photosensitivity/UV Loss	Water Solubility (mg/L)	Primary degradation
Acetochlor	Harness, etc (Not Warrant/encapsulated)	Negligible losses	223	Microbial
Dicamba		Negligible	4500	Biological
Dimethenamid-P	Outlook	Little impact	1174	Microbial
Flumioxazin	Valor, etc	Not susceptible	1.79	Microbial
Metribuzin	Sencor, Tricor, etc	Insignificant	1100	Microbial
S-metolachlor	Dual Magnum, etc	Major contributor, particularly under prolonged lack of rainfall.	488	UV on surface, Microbial if incorporated
Pendimethalin	Prowl, etc	Minor	0.275	Anaerobic
Pyroxasulfone	Zidua, etc	Negligible losses	3.49	Microbial
Sulfentrazone	Authority/Spartan, etc	Not susceptible	110 @ pH 6 780 @ pH 7 1600 @ pH 7.5	Microbial
Trifluralin	Treflan, etc	Decomposes	0.3	

Degradation of Group 15 Herbicides

Active ingredient	Trade name	Photosensitivity/U V Loss	Water Solubility (mg/L)	Half-life (days)	Primary degradation
Acetochlor	Harness, etc (Not Warrant/encapsulat ed)	Negligible losses	223	10-20	Microbial
Dimethenamid-P	Outlook	Little impact	1174	20-38	Microbial
S-metolachlor	Dual Magnum, etc	Major contributor, particularly under prolonged lack of rainfall. Half-life of 8 days on soil surface	488	30-50 (if incorporated)	UV on surface, Microbial if incorporated
Pyroxasulfone	Zidua	Negligible losses	3.49	16-26	Microbial

Soybean Premix Herbicides

Fierce MTZ

Active ingredient	Trade name	Photosensitivity/UV Loss	Water Solubility (mg/L)	Half-life (days)	Primary degradation
Flumioxazin	Valor, etc	Not susceptible	1.79	11.9 to 17.5	Microbial
Metribuzin	Sencor, Tricor, etc	Insignificant	1100	30-60	Microbial
Pyroxasulfone	Zidua, etc	Negligible losses	3.49	16-26	Microbial

Boundary

Active ingredient	Trade name	Photosensitivity/UV Loss	Water Solubility (mg/L)	Half-life (days)	Primary degradation
Metribuzin	Sencor, Tricor, etc	Insignificant	1100	30-60	Microbial
S-metolachlor	Dual Magnum, etc	Major contributor, particularly under prolonged lack of rainfall.	488	30-50 if incorporated 8 on soil surface	UV on surface, Microbial if incorporated

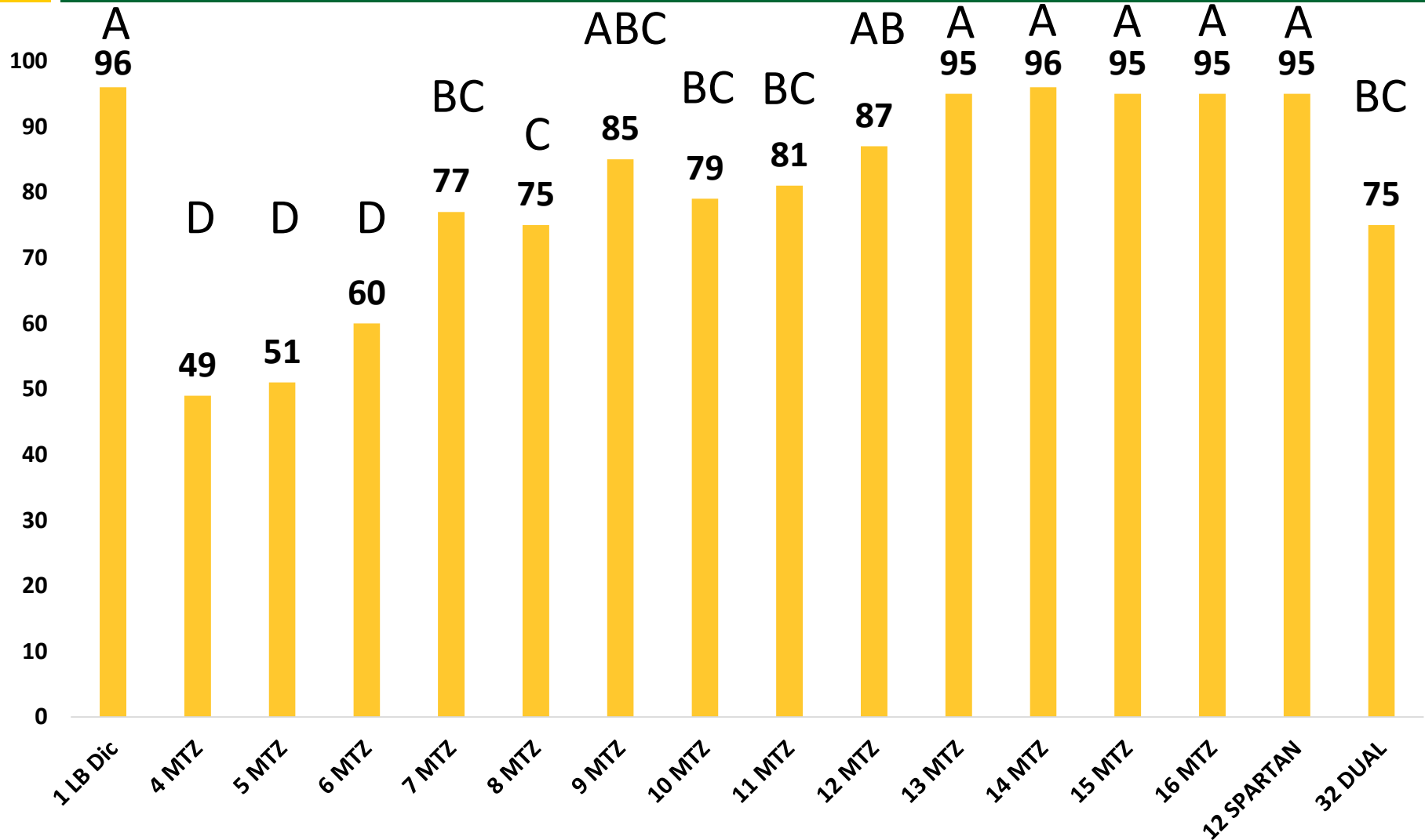
Pigweed Control with PRE Herbicides

- Less than 0.5" within 14 days of PRE
 - 2021-2023
 - First inch after 4 weeks and 10 events - 2023
- Rate titration of metribuzin
- Different PRE programs with metribuzin on waterhemp
- Benefit of dicamba added PRE

PRE Pigweed Control with Metribuzin

- Concept: We need more metribuzin
 - Many premixes are full rate of another herbicide, cut rate MTZ
- Rate titration from 4 to 16 ounces 75 DF
 - *No soybean injury observed
- Dicamba, sulfentrazone, S-metolachlor used as comparisons

Waterhemp Control 6 Weeks After Planting

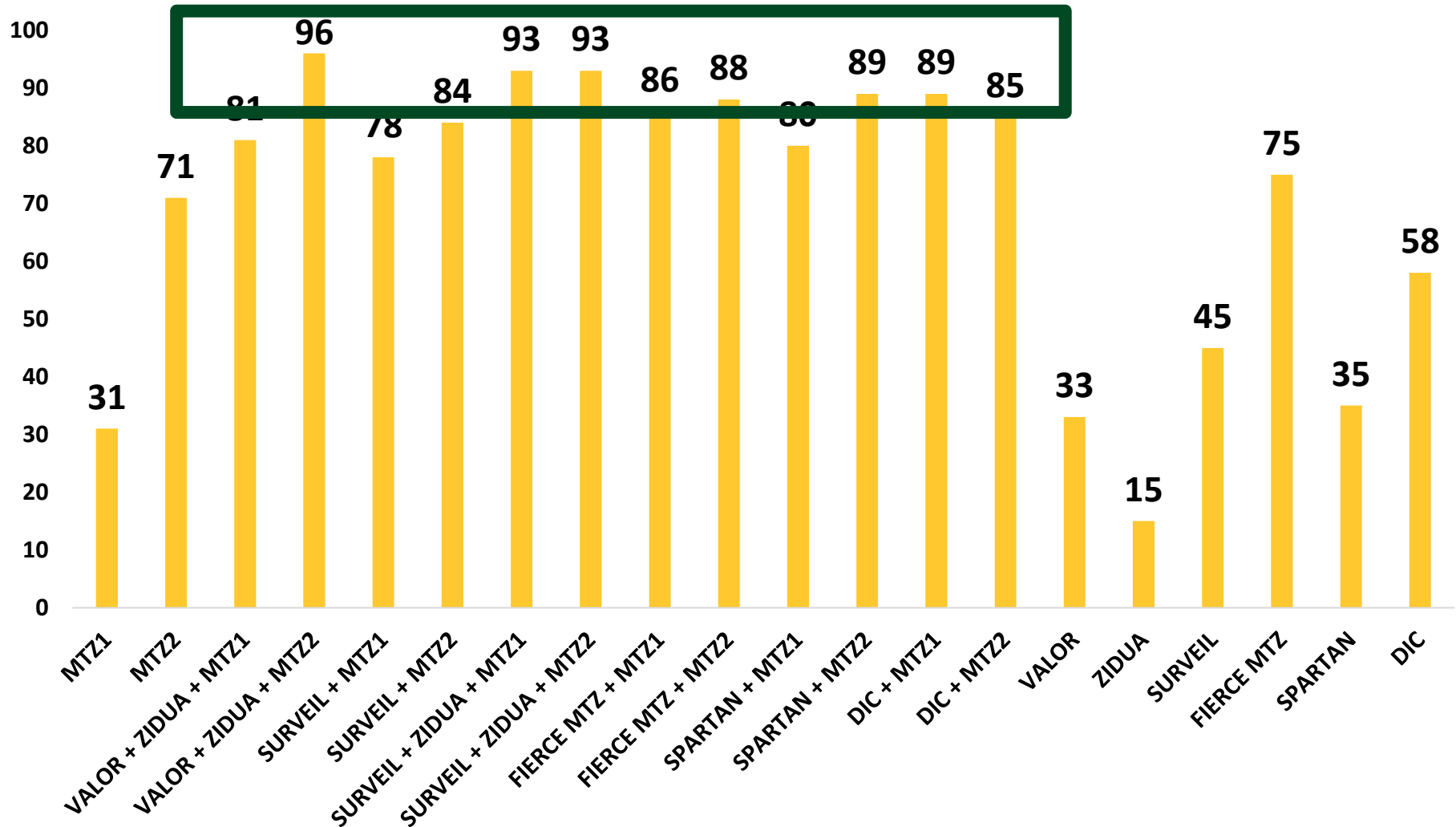


PRE Herbicides and Metribuzin Rates

- Evaluate 0.25 and 0.5 lb ai/A metribuzin with soybean herbicides

Product	Rate (per A)
Valor EZ + Zidua SC	2.5 fl oz + 3.5 fl oz
Surveil (Valor + Firstrate)	3.5 oz
Surveil + Zidua SC	3.5 oz + 3.5 fl oz
Fierce MTZ*	1.25 pt
Spartan	4 fl oz
Dicamba	0.5 lb ae

Waterhemp Control 6 Weeks After Planting



>83 = A

Valor



Zidua



Fierce MTZ

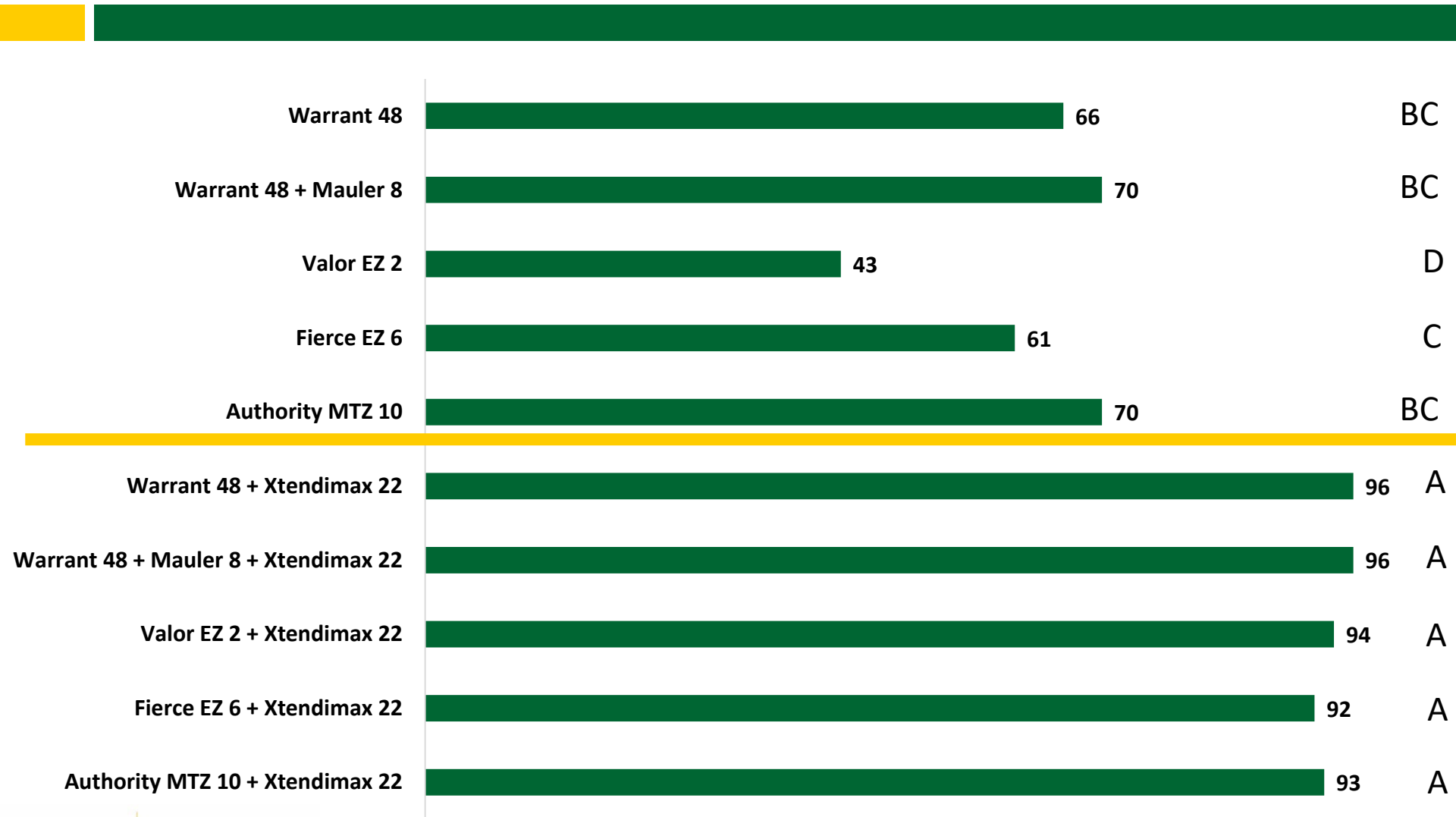


PRE Waterhemp Control with Dicamba

- Conducted at NW22 (Fargo) in 2021, 2022, and 2023
- PRE Herbicides applied with and without 0.5 lb dicamba
- All years had <0.5" rainfall within 14 days after application

Waterhemp Control – 2021-2023

35-42 DAP



PPI vs PRE on Waterhemp

- Two experiments in Fargo 2021/22
 - Planted 'ND Palomino'

- PPI and PRE experiment
 - Incorporation depth of 4"
 - Pre applied after tillage



Treatments – PPI

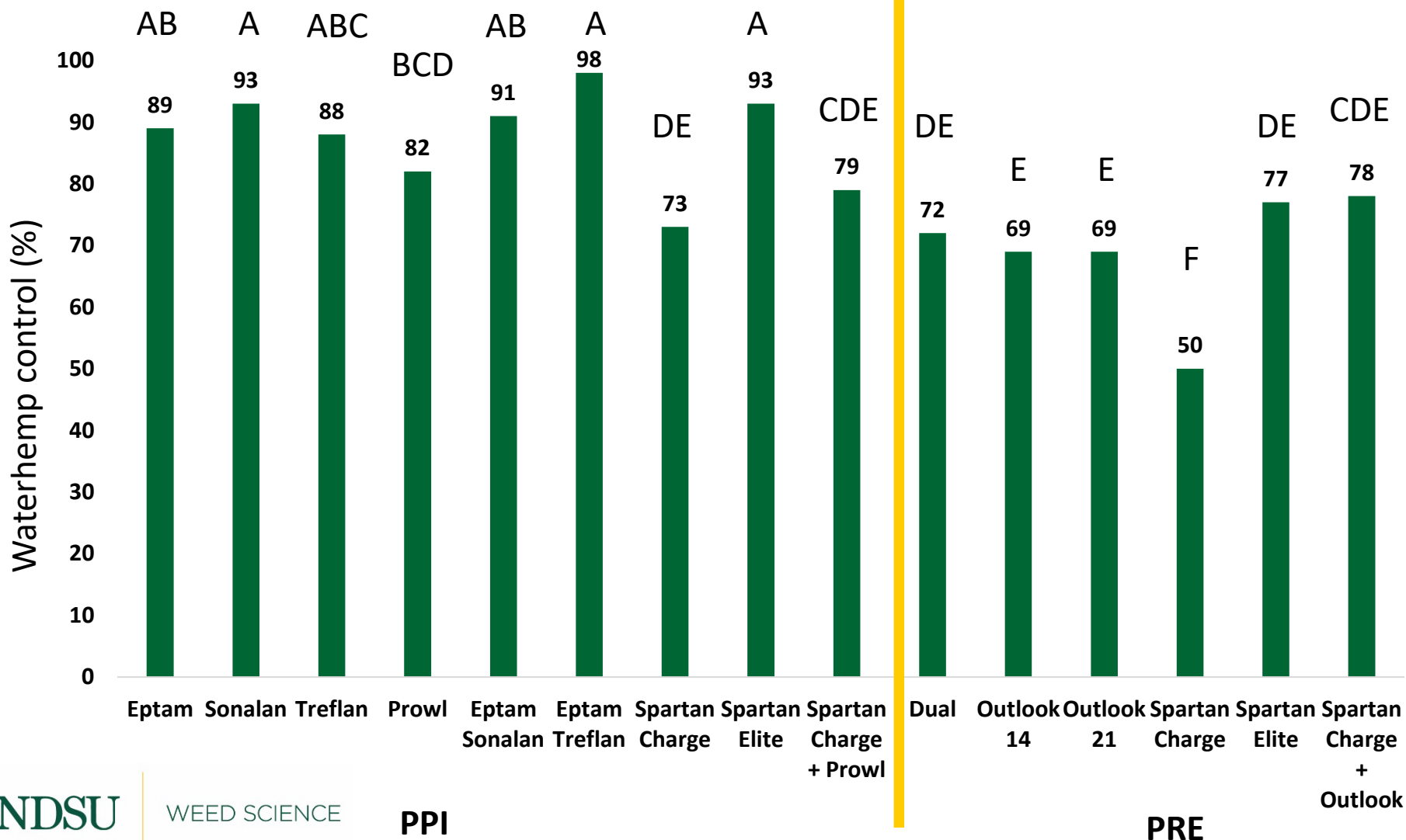
Product	Rate (Product /A)
Eptam 7E	4 pt
Sonalan HFP	3 pt
Treflan HFP	1.5 pt
Prowl H ₂ O	3 pt
Eptam 7E + Sonalan HFP	3 pt + 2 pt
Eptam 7E + Treflan HFP	3 pt + 1.5 pt
Spartan Charge	5 fl oz
Spartan Elite	25 fl oz
Spartan Charge + Prowl H ₂ O	4 fl oz + 1.5 pt

Treatments – PRE

Product	Rate (Product /A)
Dual II Magnum	2 pt
Outlook	14 fl oz
Outlook	21 fl oz
Spartan Charge	5 fl oz
Spartan Elite	25 fl oz
Spartan Charge + Outlook	4 fl oz + 14 fl oz

PPI/PRE Results – Waterhemp

8 Weeks After Planting



Summary of PRE Trials

- All years had <0.5" rainfall within 14 days after application
- Multiple modes of action best
 - Full rates!
- Results more variable than “wet” years
 - Dicamba improved consistency
- PRE still important

Minot ND – 2021

July 13



PRE: May 10

May 20: 0.17

May 21: 0.27

May 22: 0.12

May 23: 0.23

May 24: 0.15

June 11: 0.95

Drought Weed Control Plan



PHASE 1 PHASE 2 PHASE 3

**SKIP
THE PRE**

?

Profit



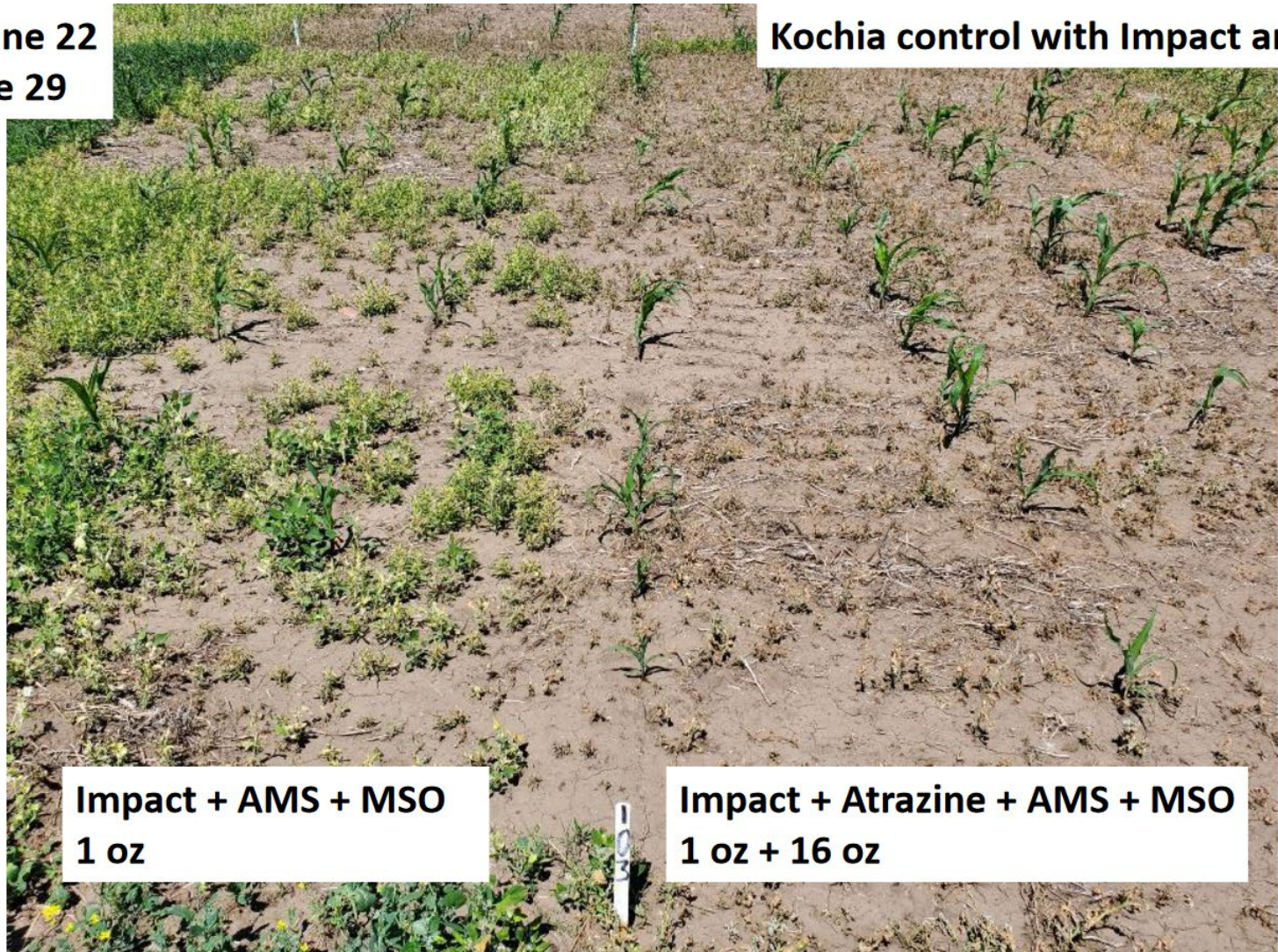
WHAT'S PHASE 2??



Minot ND – 2021

Applied: June 22
Photo: June 29

Kochia control with Impact and Atrazine



Impact + AMS + MSO
1 oz

Impact + Atrazine + AMS + MSO
1 oz + 16 oz

Plant Response to Drought

- Thicker cuticle
 - Waxy, oil based
 - Oil adjuvants – like dissolves like
- Altered leaf angle
 - Grasses rolled
 - Broadleaves drooped
 - Issues with adhesion – spray in morning
 - Deposition aids
- Slower growth
 - Systemic herbicides – most affected
 - Contact herbicides – less affected



Common lambsquarters under environmental stress, Bathgate, ND

Reduced green foxtail control may be due to drought stress

“Although drought-stressing green foxtail before and up to 1 d after herbicide application did not reduce control with fluazifop-P in growth chamber trials, extending the drought stress for 2 to 4 d after herbicide application reduced control of green foxtail with fluazifop-P by 40 and 57%, respectively.” (Boydston, Weed Sci.)

Low soil water content for 10 to 14 days before and 7 days after herbicide application reduced control of green foxtail with fenoxaprop, fluazifop-P, haloxyfop, and sethoxydim. Withholding irrigation for 10 to 14 days before herbicide application did not reduce control of green foxtail with normal use rates of herbicides if plots were irrigated at the time of application.” (Boydston, Weed Sci).

POST Rules of Thumb

- Temperature + Relative Humidity Rule – 140 (150)
 - Temp + RH exceeds 150 = better weed control, more crop injury
 - Temp + RH less than 150 = less weed control, less crop injury
 - Can drive adjuvant choice/rate (oil vs surfactant)
 - 90F + 50% humidity = 140
 - 90F + 70% humidity = 160

Temperature and Relative Humidity Effects

The following standard will help determine the optimum adjuvant rate to use. If the temperature and relative humidity exceed 150 (e.g. temperature of 85°F plus 70% relative humidity = 155), use the lower adjuvant rates.

- Evaporation Rates increase
 - Humectants?
 - Delta T
- Volatility increases

Delta T (ΔT): Another Tool for Application Decision Making

Imported from
Australia



Joe Ikley and Andrew Thostenson; Weed Scientist and Pesticide Specialist

Old School Sling Psychrometer

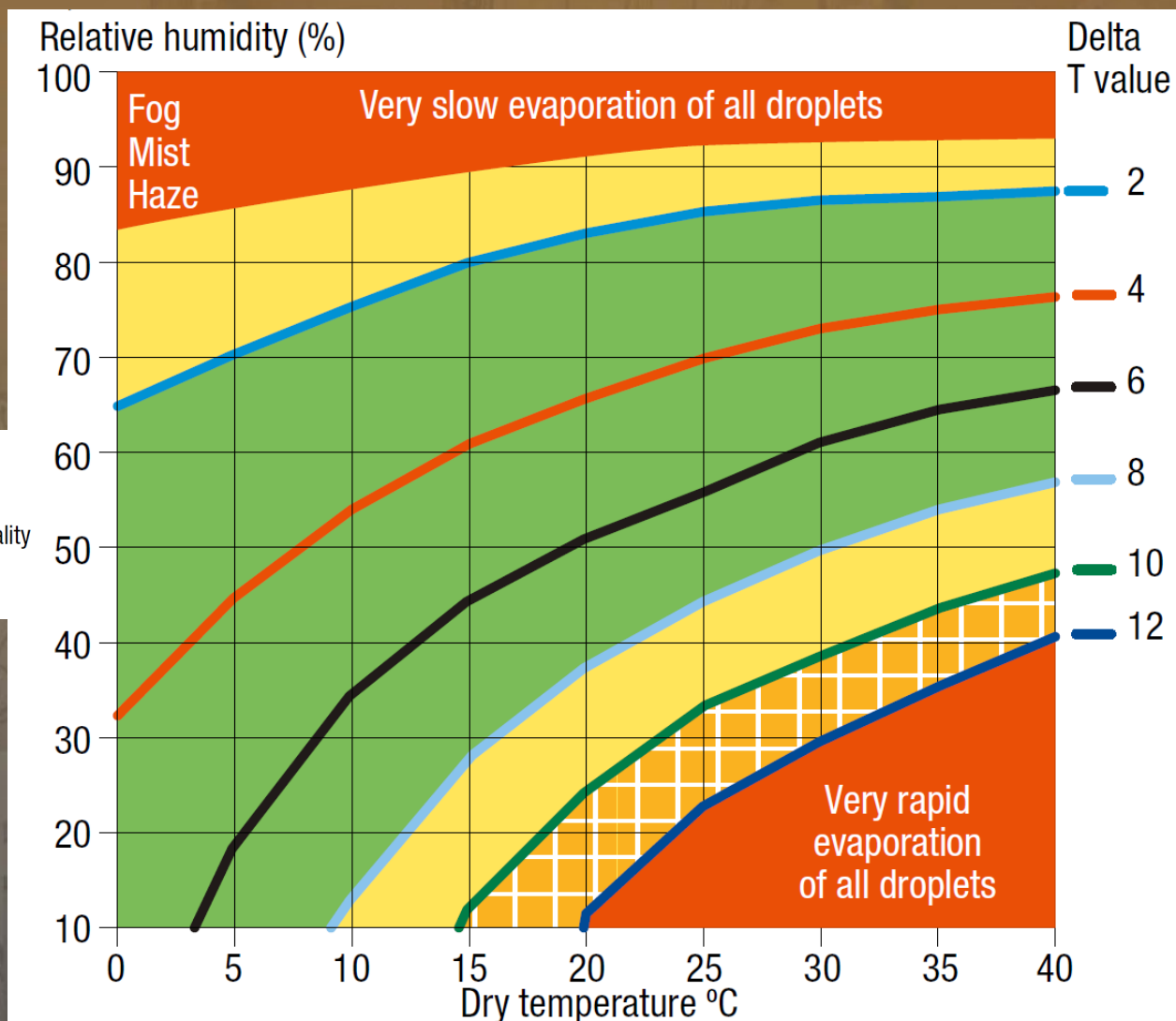


Temperature spread between
the two thermometers is
called the ΔT

Australia Nufarm Chart

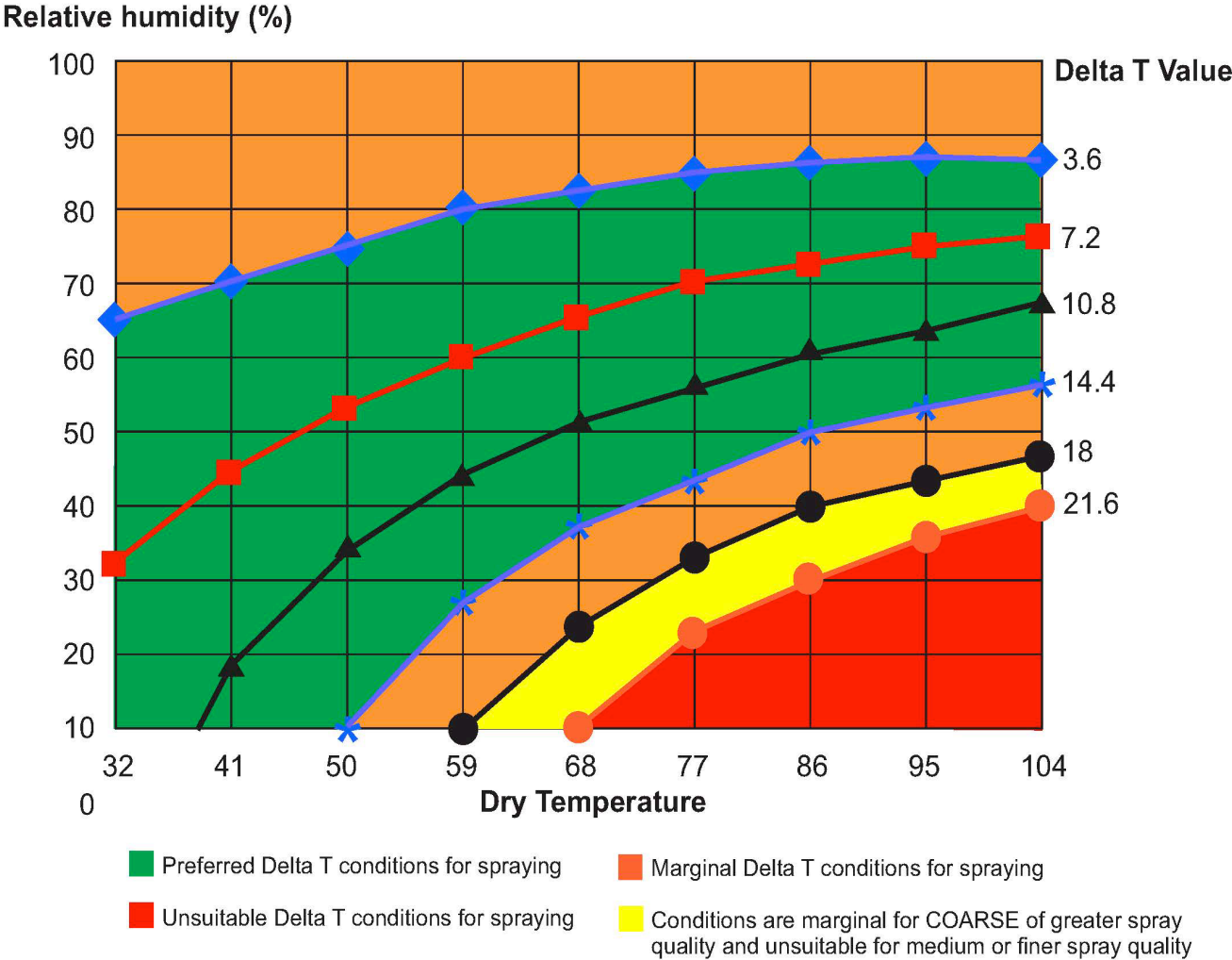
- Preferred Delta T conditions for spraying
- Marginal Delta T conditions for spraying
- Conditions are marginal for COARSE or greater spray quality and unsuitable for medium or finer spray quality
- Unsuitable Delta T conditions for spraying

SOURCE: ADAPTED BY GRAEME TEPPER (2012) ORIGINALLY SOURCED FROM NUFARM'S SPRAYWISE DECISIONS CHART (2012)



NDSU Developed Chart, Adapted from Australia

Posted on-line in
the NDSU Weed
Guide



ΔT values indicate evaporative potential.
High values can reduce spray droplet
survival in the air and at the target.



ΔT Impact on Spray Drop Evaporation

- Low Value = Slow Evap.
- Medium Value = Faster Evap.
- High Value = Rapid Evap.



Drought in 2021 raised
havoc for pesticide efficacy

Spray days in June and July
registered very high ΔT



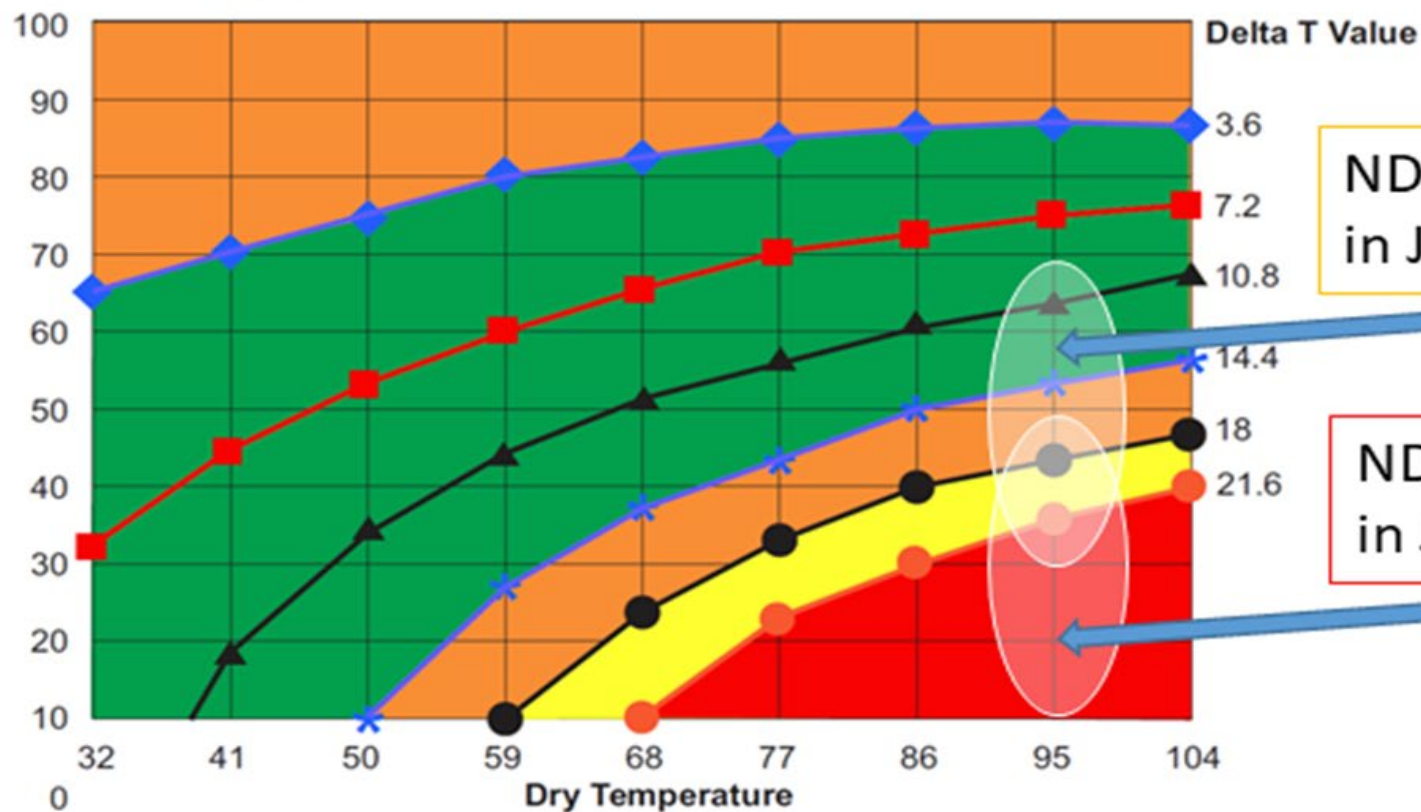
Photo 1. Soybean field showing turned over leaves because of drought stress.

Too often, pesticide applications were made in extremely hot and dry conditions

Temperatures above 90 degrees F with relative humidity at 20% or less



Relative humidity (%)



ND Delta T values
in June of 2022

ND Delta T values
in June of 2021

Preferred Delta T conditions for spraying

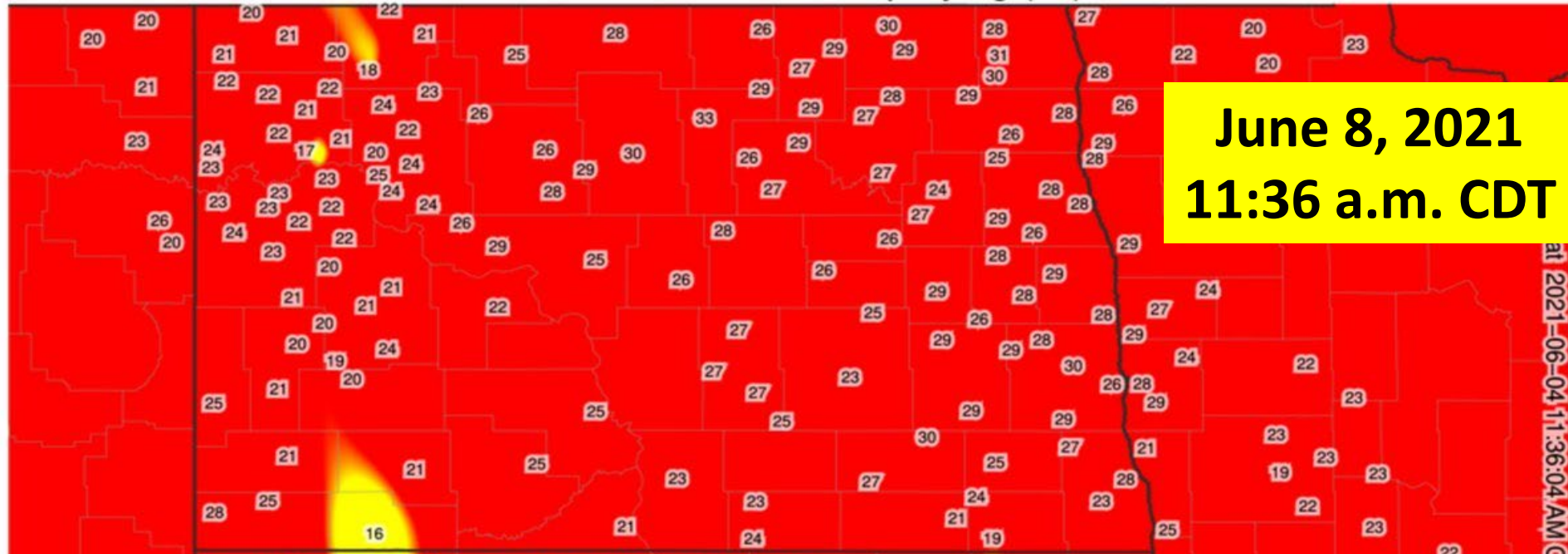
Marginal Delta T conditions for spraying

Unsuitable Delta T conditions for spraying

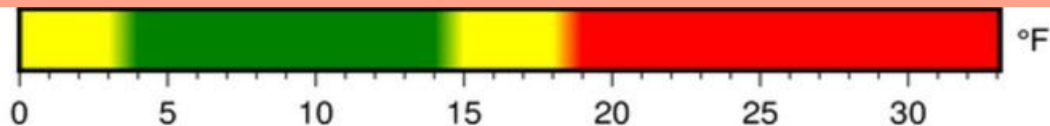
Conditions are marginal for COARSE of greater spray
quality and unsuitable for medium or finer spray quality

Estimated Delta T for Spraying (°F)

June 8, 2021
11:36 a.m. CDT

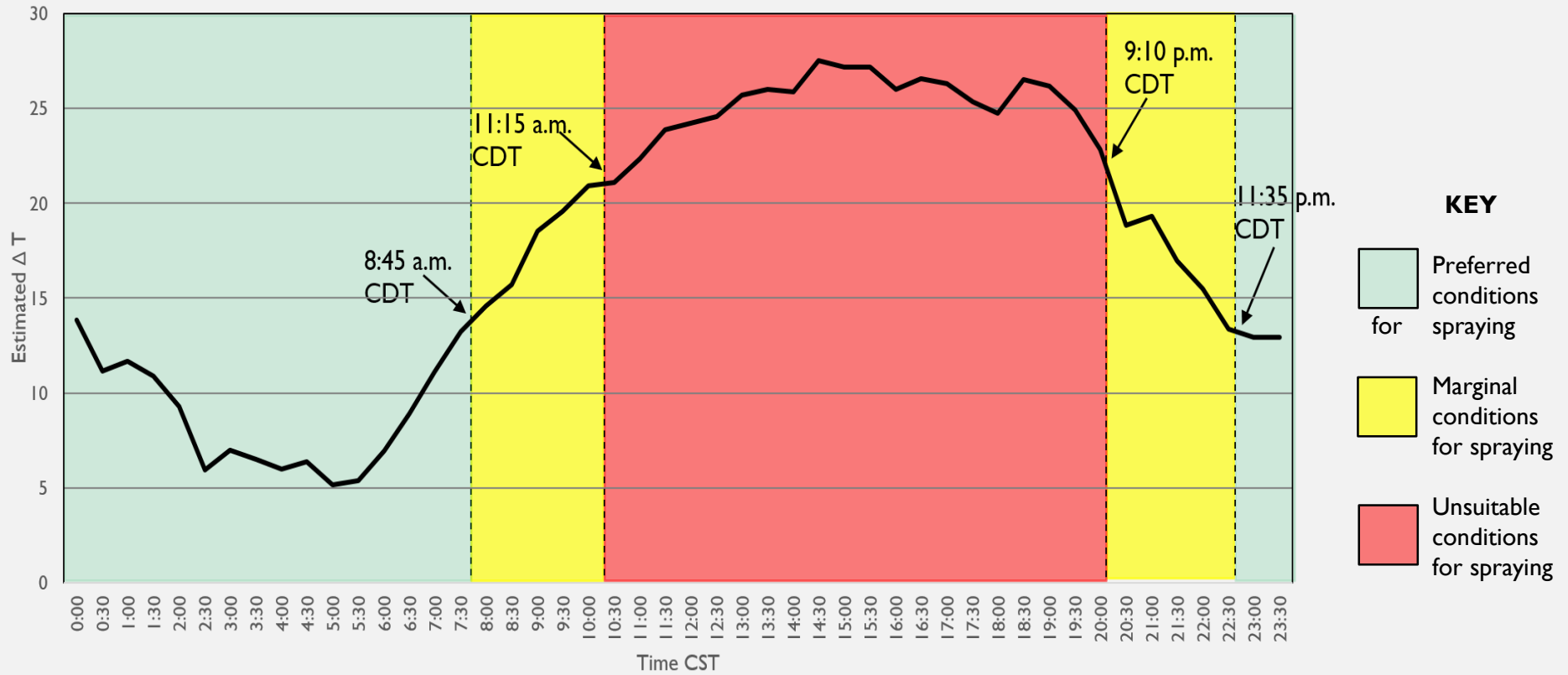


The interaction between heat, humidity, and droplet evaporation can be described in a **Delta T** value.



PROSPER, ND 6/17/2021

Estimated ΔT



Delta T Take Home

- Extreme heat and low humidity will impact efficacy
- Use higher water volumes, if possible
- Always use adjuvants that help maintain droplet integrity
- Avoid nozzles that produce fine spray drops, if possible
- Curtail operations during the heat of the day
- Following ΔT recommendations are NOT always practicable, but they can be helpful!

And now
for something
completely different...





Photo courtesy: Dr. Phil Stahlman,
KSU

2024 Weed of the Year!



**UTAH FILES CONSUMER PROTECTION
LAWSUIT AGAINST TIKTOK**



34°
6:25

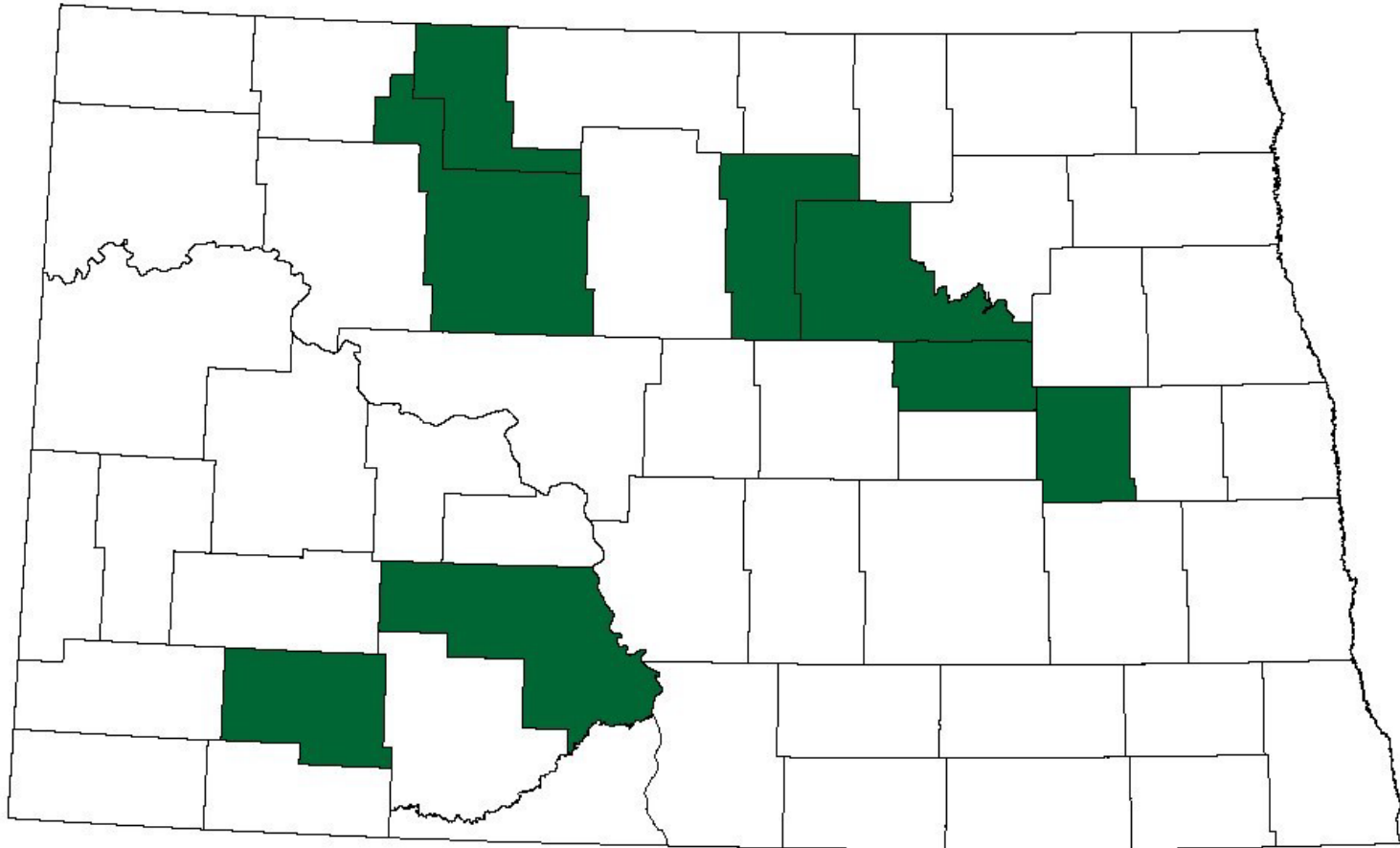


NDSU

WEED SCIENCE

Group 14-R Kochia

NORTH DAKOTA

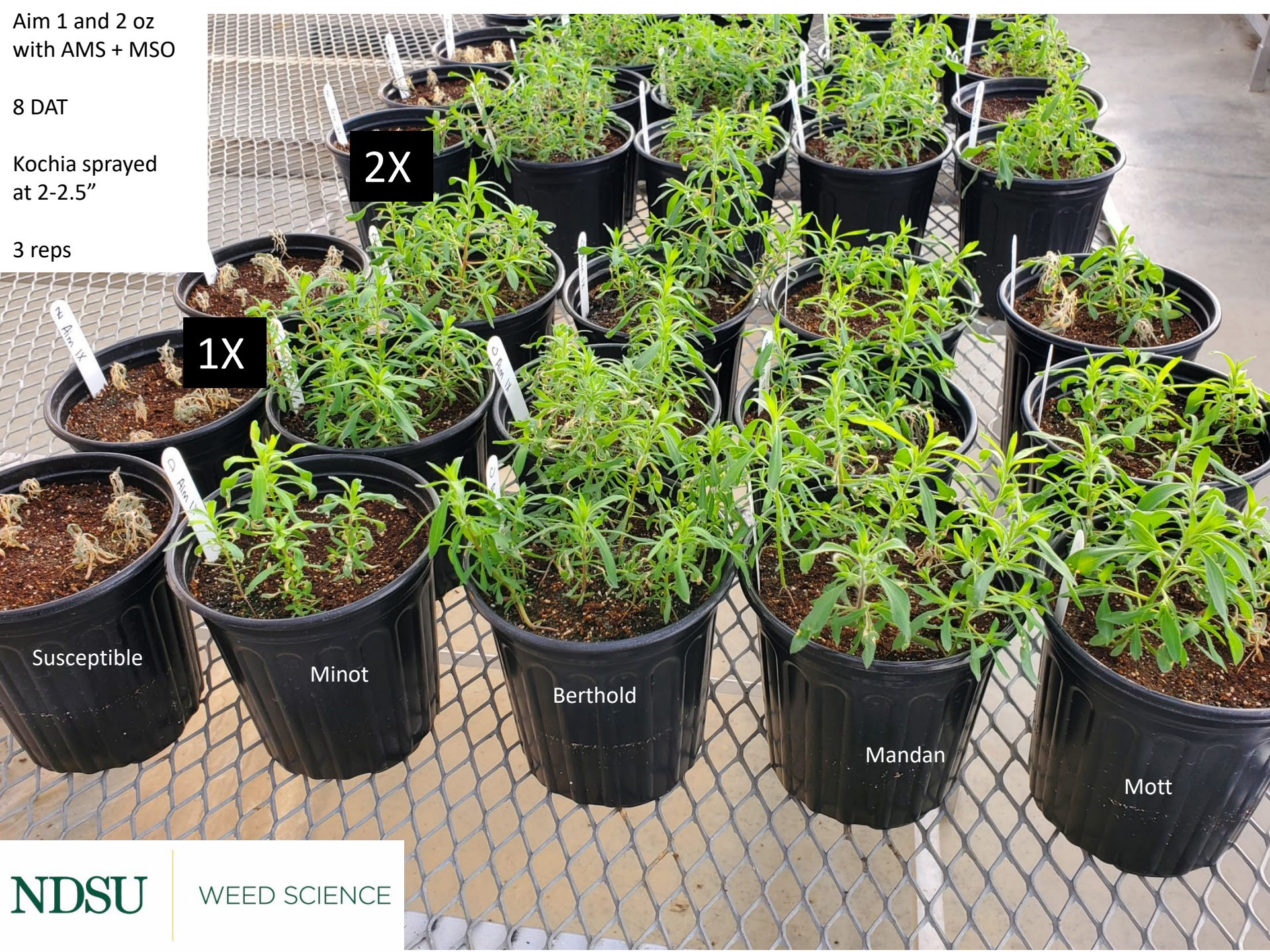


Aim 1 and 2 oz
with AMS + MSO

8 DAT

Kochia sprayed
at 2-2.5"

3 reps



2X

1X

Susceptible

Minot

Berthold

Mandan

Mott

Sharpen 1 & 2 oz
with AMS + MSO

8 DAT

Kochia sprayed
at 2-2.5"

3 reps



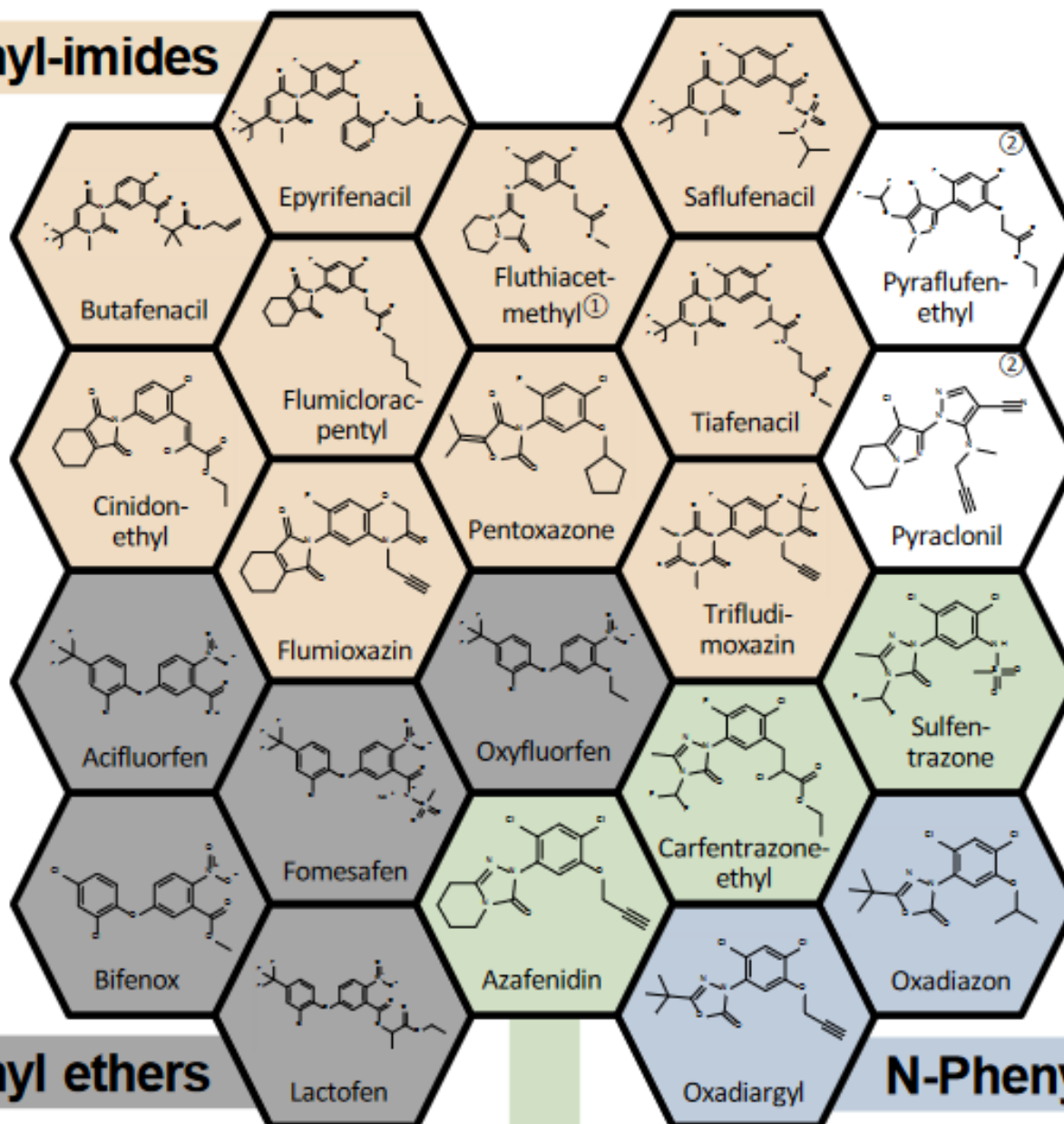
Kochia control with Aim 1 oz to 16 oz



Photo: 6 DAT



N-Phenyl-imides

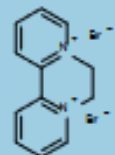


Diphenyl ethers

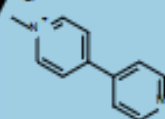
N-Phenyl-triazolinones

N-Phenyl-oxadiazolones

22



Diquat



Paraquat

UNT

Aim 1X

Aim 2X

Minot

Δ FLEXSTAR 1X

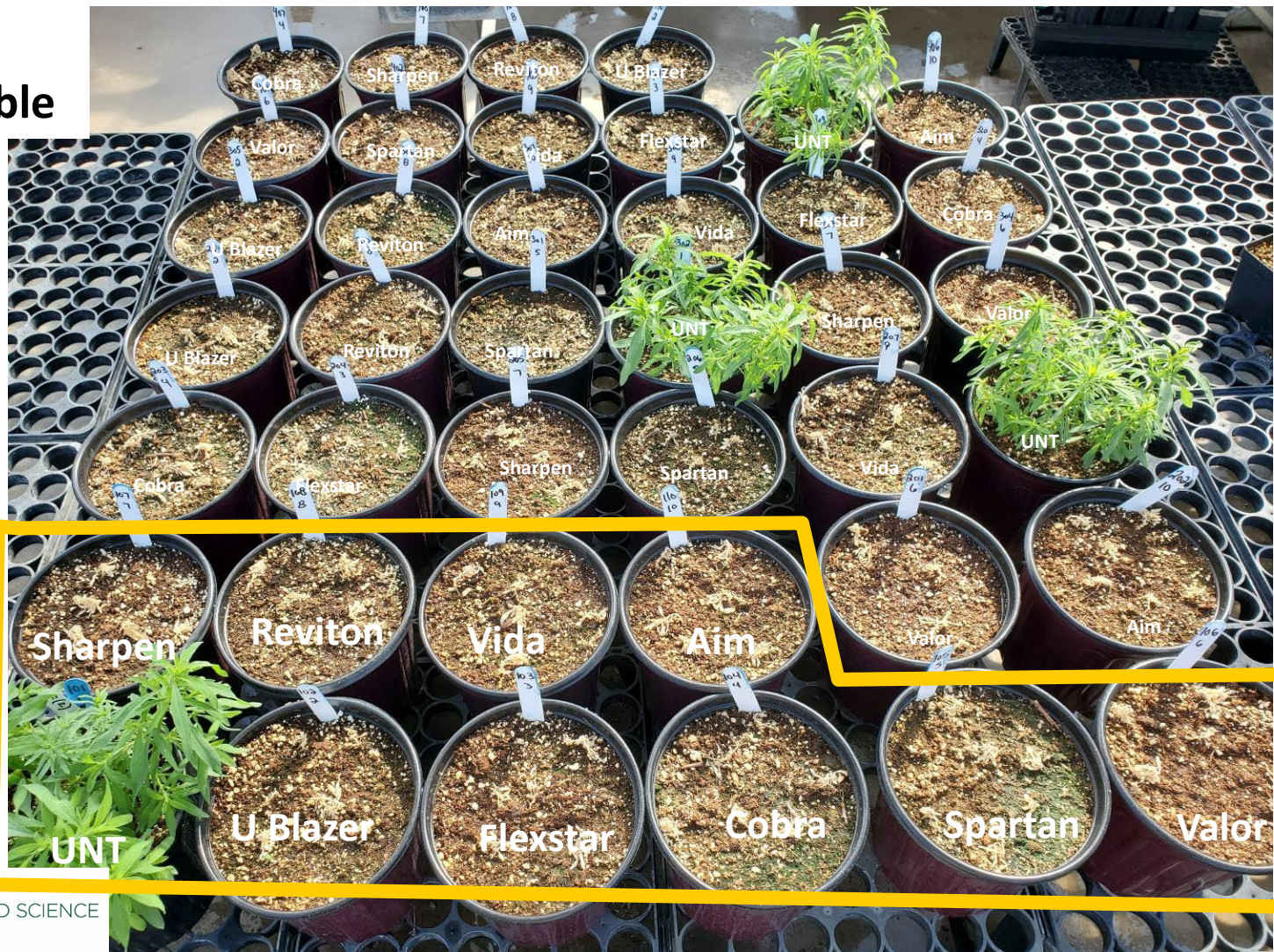
Δ FLEXSTAR 2X

Flexstar 1X

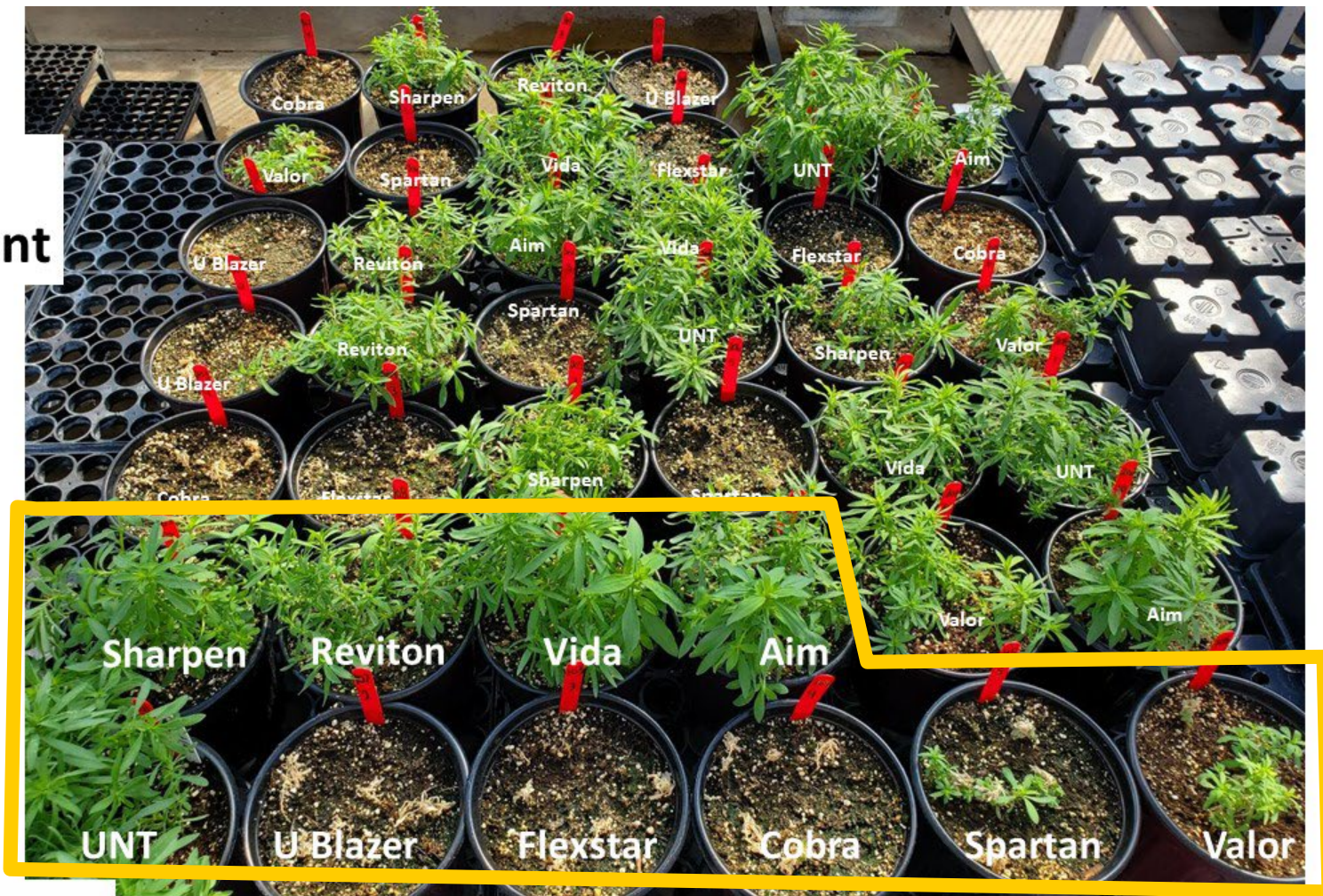
Flexstar 2X

Aim 1X = 1 oz
Flexstar 1X = 0.75 pt

Minot Susceptible



Minot Resistant



Minot
Susceptible



Mandan



Planted/Sprayed
Feb 22

Photo: 20 DAT

3 reps



1. Mott
2. Mandan
3. Berthold
4. Minot
5. Mohall-F
6. Mohall-I
7. Susceptible

Great Falls, Montana – October 2023

Courtesy: Darrin Schreder Photography and Design via Storyful



War Against Weeds Podcast



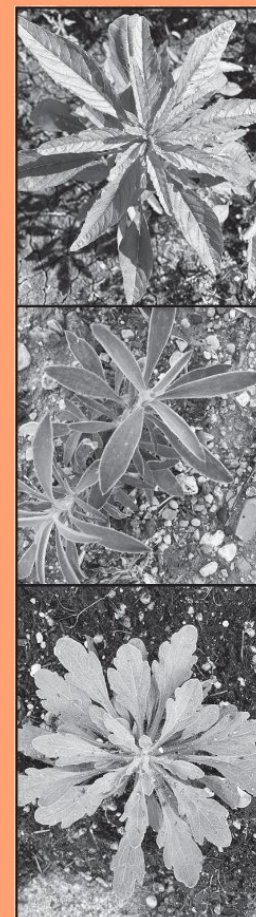
Contact

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 @NDSUWeeds



2023

North Dakota Weed Control Guide

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