Kochia (*Bassia scoparia* L.) control with Phenmedipham in sugarbeet

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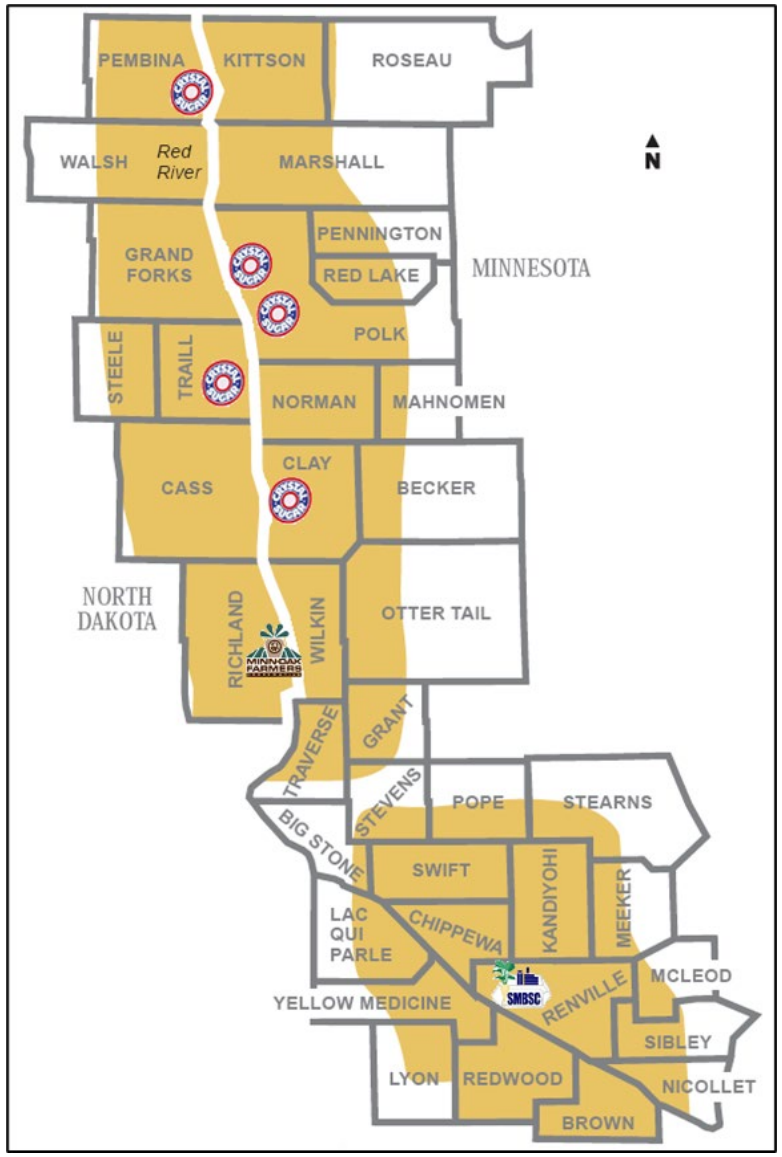
Impacts of glyphosate resistant (GR) weeds[a]

- Glyphosate resistant sugarbeet released in 2008 (Reddy and Nandula 2012)
- Repeated use and selection pressure have resulted in resistant biotypes
- GR kochia was 24% overall but 58% in Drayton factory district



[a]2023 survey of production practices conducted at the 2024 sugarbeet growers seminars.

Improving kochia control with mixtures at reduced rates

Emeritus Prof. Dr. Alan Dexter NDSU / UMN called micro-rate

- Combining contact, translocate, and residual herbicides
  - Phenmedipham (SOA 5) (Spin-Aid®)
  - Clopyralid (SOA 4) and/or glyphosate (SOA 9)
  - Ethofumesate (SOA 15)
- Two or three applications spaced five to seven days apart
- Control of multiple flushes of weeds
- Early treatment of small weeds reduces competition compared to later full-dose treatments
- Improved sugarbeet tolerance

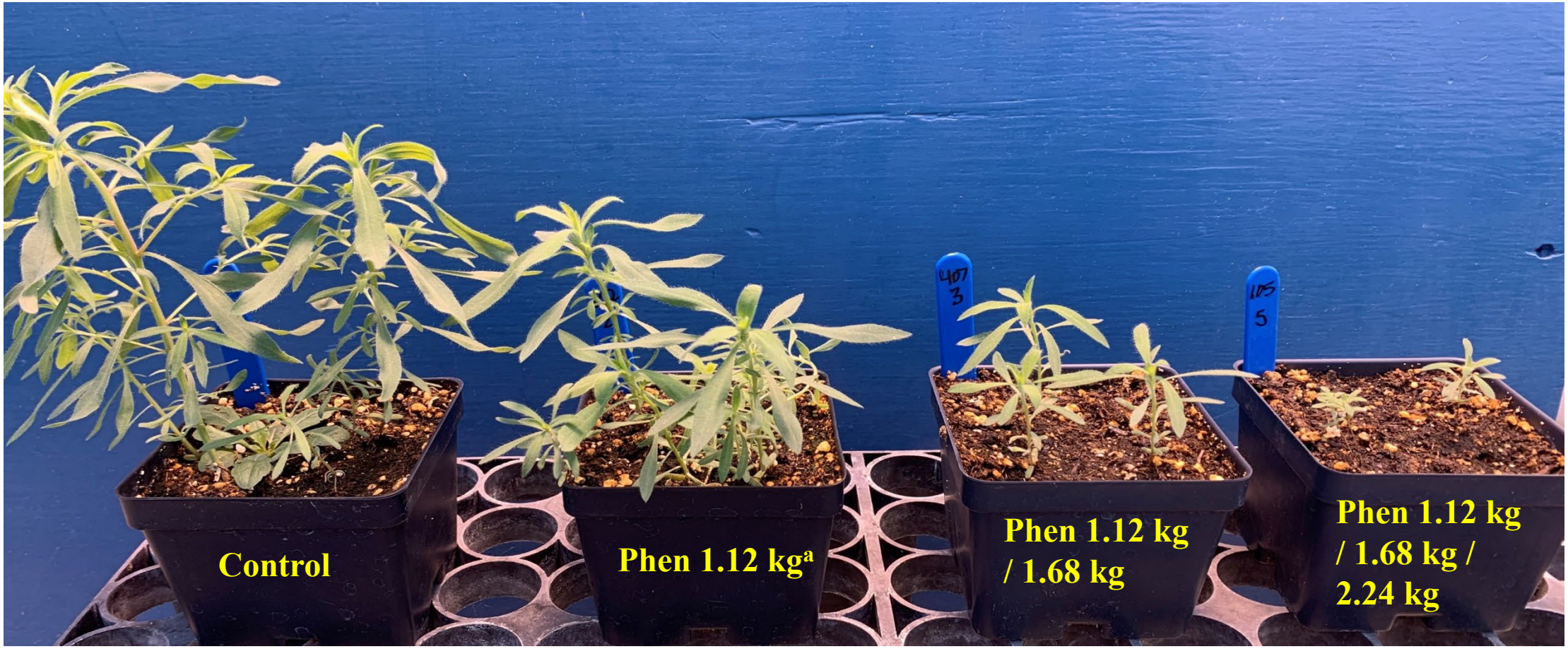
Phenmedipham (Spin-Aid®) , Belchim Ag Products USA

- **Sugarbeet rapidly metabolize phenmedipham** to less toxic compounds (Hendrick et al. 1974)
- Phenmedipham should be applied **2 – 3 times over small weeds**; **rate dependent on sugarbeet growth stage**
- **Mix with oils boosts efficacy (threat of injury in heat)**
- Environmental conditions influences **PSII inhibitors** efficacy
  - **Weed control** is **less** with **cool temps and low light** (Abbaspoor and Streibig 2007)
  - **Risk of injury increases** at maximum daily air temperatures **greater than 26.6C**, (Betamix BMPs).

Greenhouse experiments, December/January 2023/2024

- 80 – 90% kochia control was achieved when phenmedipham was applied at 1.12 / 1.68 / 2.24 kg ha^{-1} 14 days after last application (DAAC)
- >40% sugarbeet injury when temperatures exceeded 30C in the greenhouse
- Injury quickly reduced 21 DAAC
- Phenmedipham rates 0.84 / 1.12 / 1.68 kg ha^{-1} used in field program

Kochia control from phenmedipham, 21 DAAC, greenhouse, December/January 2023/2024



[a]Treatments included 280 g ha^{-1} ethofumesate and 1.68 L ha^{-1} methylated seed oil

Objectives

- Determine kochia control from one, two, and three phenmedipham applications
- Determine sugarbeet tolerance to phenmedipham

Efficacy materials and methods

- One, two, and three phenmedipham applications spaced five to seven days apart mixed with 0.28 kg ha^{-1} ethofumesate
  - Kochia: first application at dime-size and/or 5-leaf kochia, micro – mid-range rates depending on environment and size of sugarbeet
  - Common ragweed: first application at 5 cm
- Efficacy data collected as percent control; 0% no control and 100% plant death
- Statistical analysis: PROC GLIMMIX procedure in SAS (v. 9.4, SAS Institute, Cary, NC)

Tolerance materials and methods

- One, two, and three phenmedipham applications spaced five to seven days apart mixed with 0.28 kg ha^{-1} ethofumesate
- Crop injury data collected as percent sugarbeet growth reduction; 0% no crop injury and100% plant death
- Root yield data as tonnes per hectare, extractable sucrose per hectare, % sucrose, and sucrose loss to molasses
- Statistical analysis: PROC GLIMMIX procedure in SAS (v. 9.4, SAS Institute, Cary, NC)

Kochia Control 14 DAAD, Glyndon MN, 2024

Trt. Num.	Herbicide Treatment	Rate	Kochia Control[b]
		(kg ha^{-1})	----%----
1	Phenmedipham[a]	0.75	40 d
2	Phen / phen[c]	0.75 / 1.1	66 b
3	Phen / phen	0.75 / 1.66	55 c
4	Phen / phen / phen	0.75 / 1.1 / 1.66	74 ab
5	Phen / phen / phen	0.75 / 1.1 / 2.21	78 a
6	Phen / phen / phen	0.75 / 1.66 / 1.66	83 a
7	Phen / phen / phen	0.75 / 1.66 / 2.21	79 a
8	PRE / phen / phen	PRE / 0.75 / 1.1	75 ab
9	PRE / phen / phen / phen	PRE / 0.75 / 1.1 / 1.66	76 ab

[a]Phenmedipham mixed with 0.28 kg ha^{-1} ethofumesate. High surfactant methylated oil concentrate at 1.17 L ha^{-1} and AMS at 2.5% V/V.
[b]lsmeans with different letters significant at P=0.05
[c]Phenmedipham plus etho, glyphosate, HSMOC 0.28, 1.73, 1.1 kg ha^{-1} and 1.17 L ha^{-1}

Kochia Control 14 DAAD, Felton MN, 2024

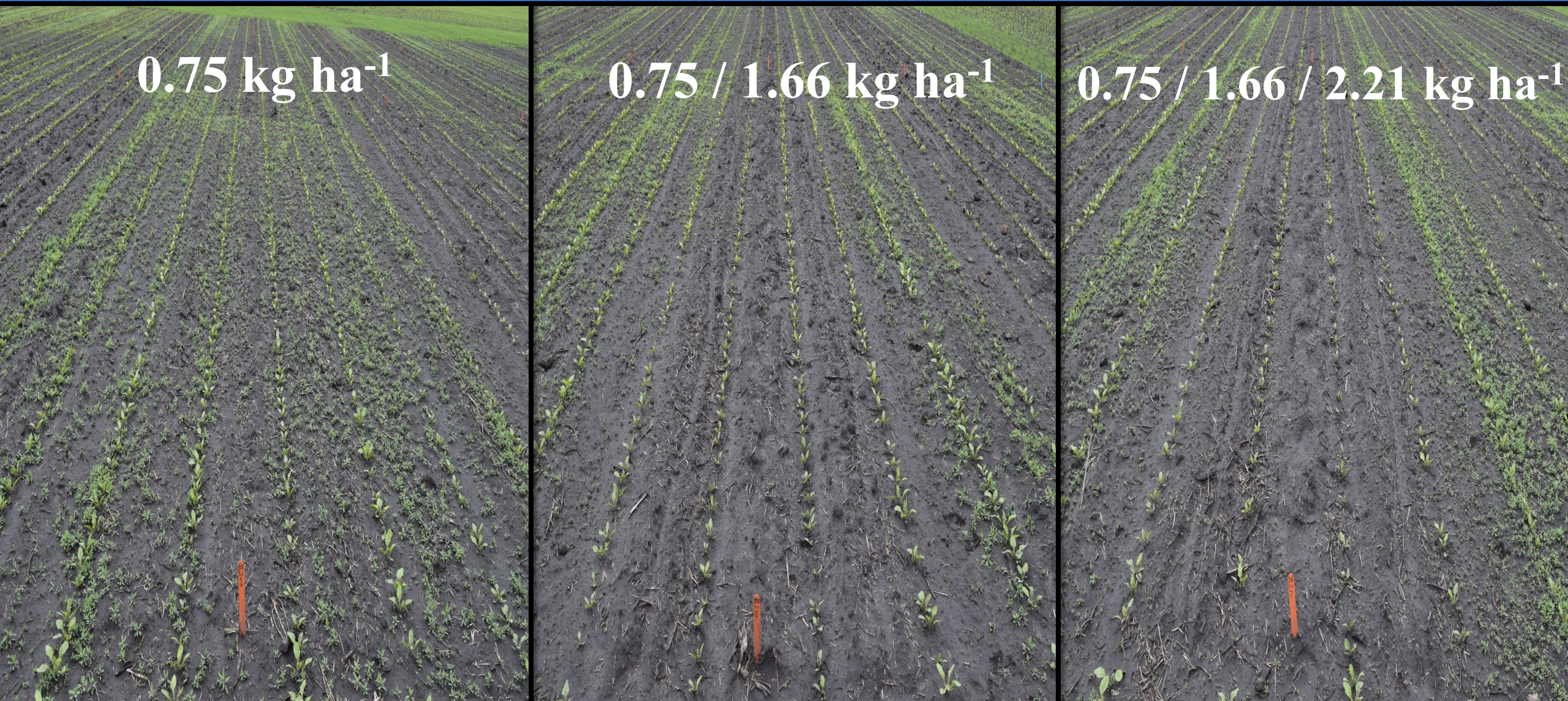
Trt. Num.	Herbicide Treatment	Rate	Kochia Control[b]
		(kg ha^{-1})	----%----
1	Phenmedipham[a]	0.75	50 e
2	Phen / phen[c]	0.75 / 1.1	66 d
3	Phen / phen	0.75 / 1.66	68 cd
4	Phen / phen / phen	0.75 / 1.1 / 1.66	80 ab
5	Phen / phen / phen	0.75 / 1.1 / 2.21	85 ab
6	Phen / phen / phen	0.75 / 1.66 / 1.66	79 ab
7	Phen / phen / phen	0.75 / 1.66 / 2.21	78 bc
8	PRE / phen / phen	PRE / 0.75 / 1.1	80 ab
9	PRE / phen / phen / phen	PRE / 0.75 / 1.1 / 1.66	89 a

[a]Phenmedipham mixed with 0.28 kg ha^{-1} ethofumesate. High surfactant methylated oil concentrate at 1.17 L ha^{-1} and AMS at 2.5% V/V

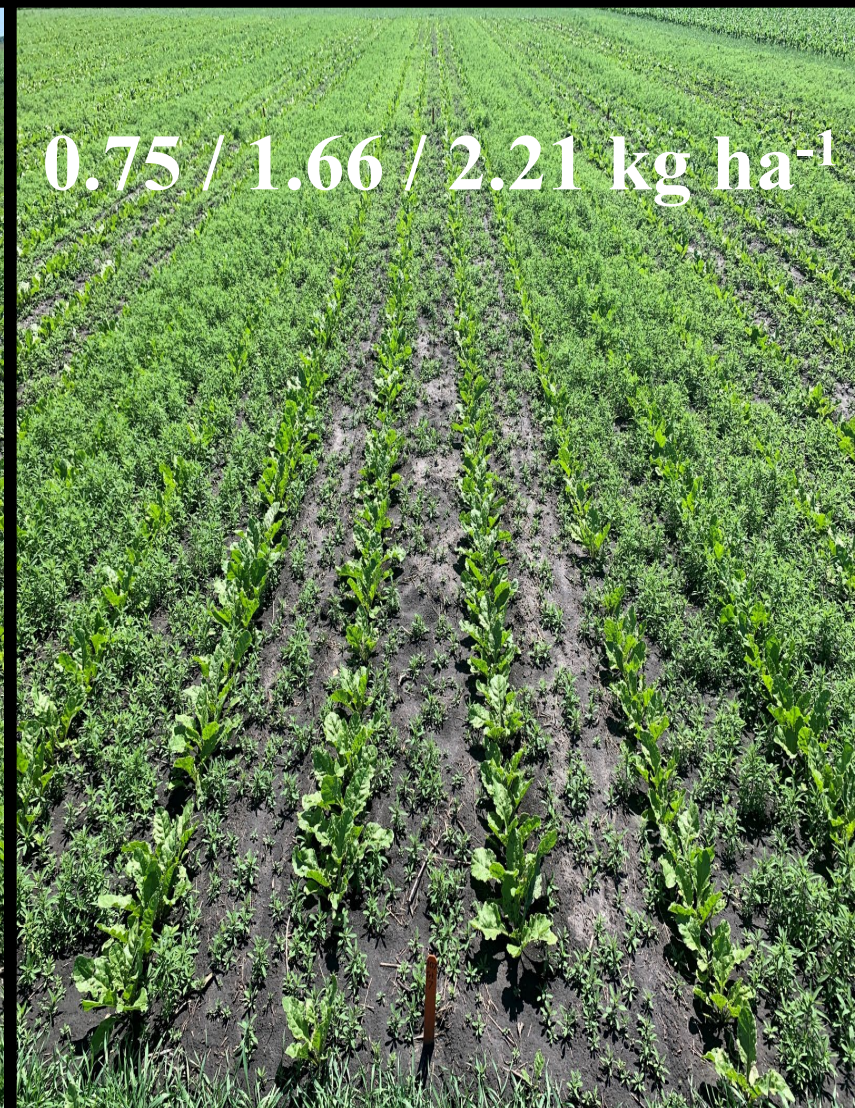
[b]lsmeans with different letters significant at P=0.05

[c]Phenmedipham plus etho, glyphosate, HSMOC 0.28, 1.73, 1.1 kg ha^{-1} and 1.17 L ha^{-1}

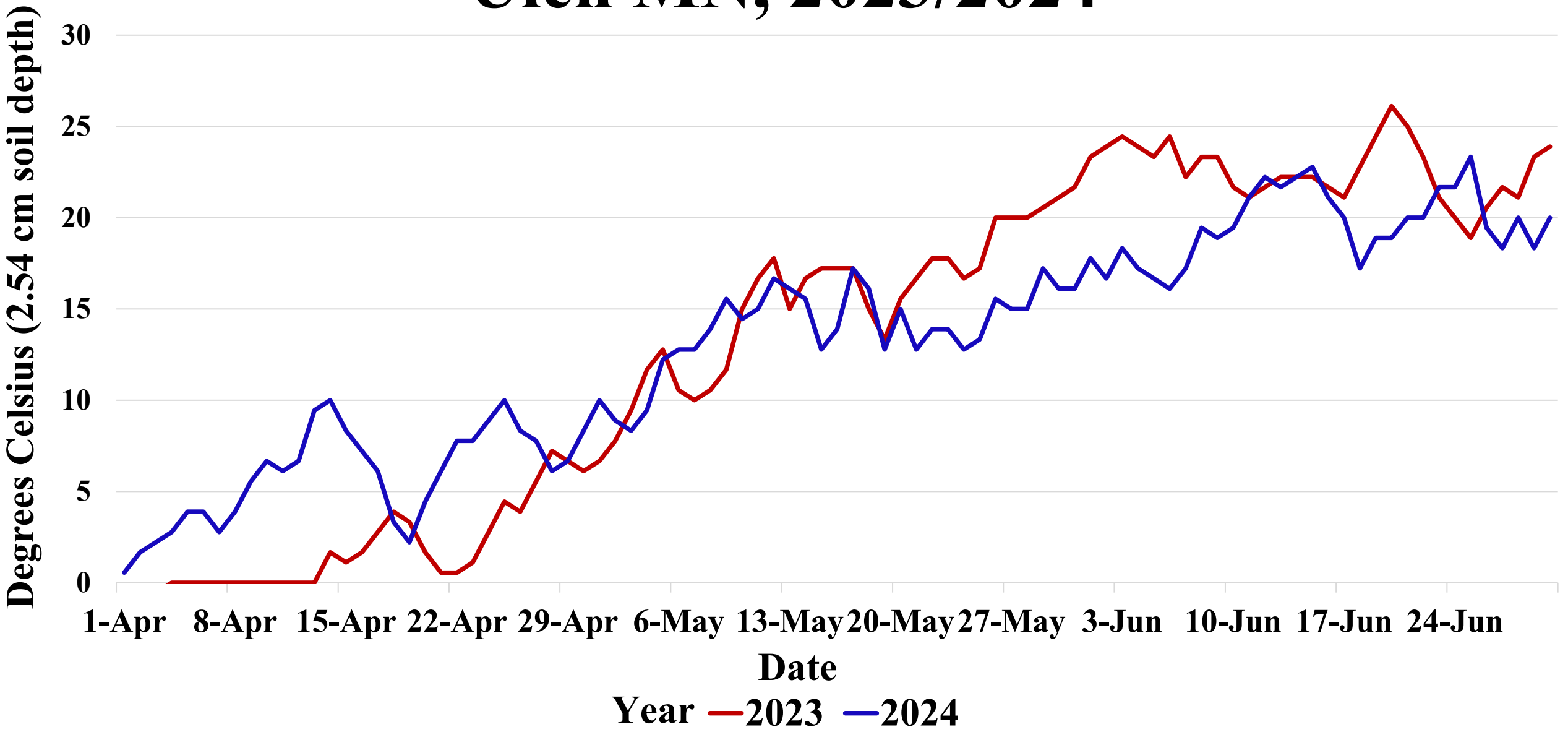
Kochia Control 14 DAAD, Felton MN, 2024



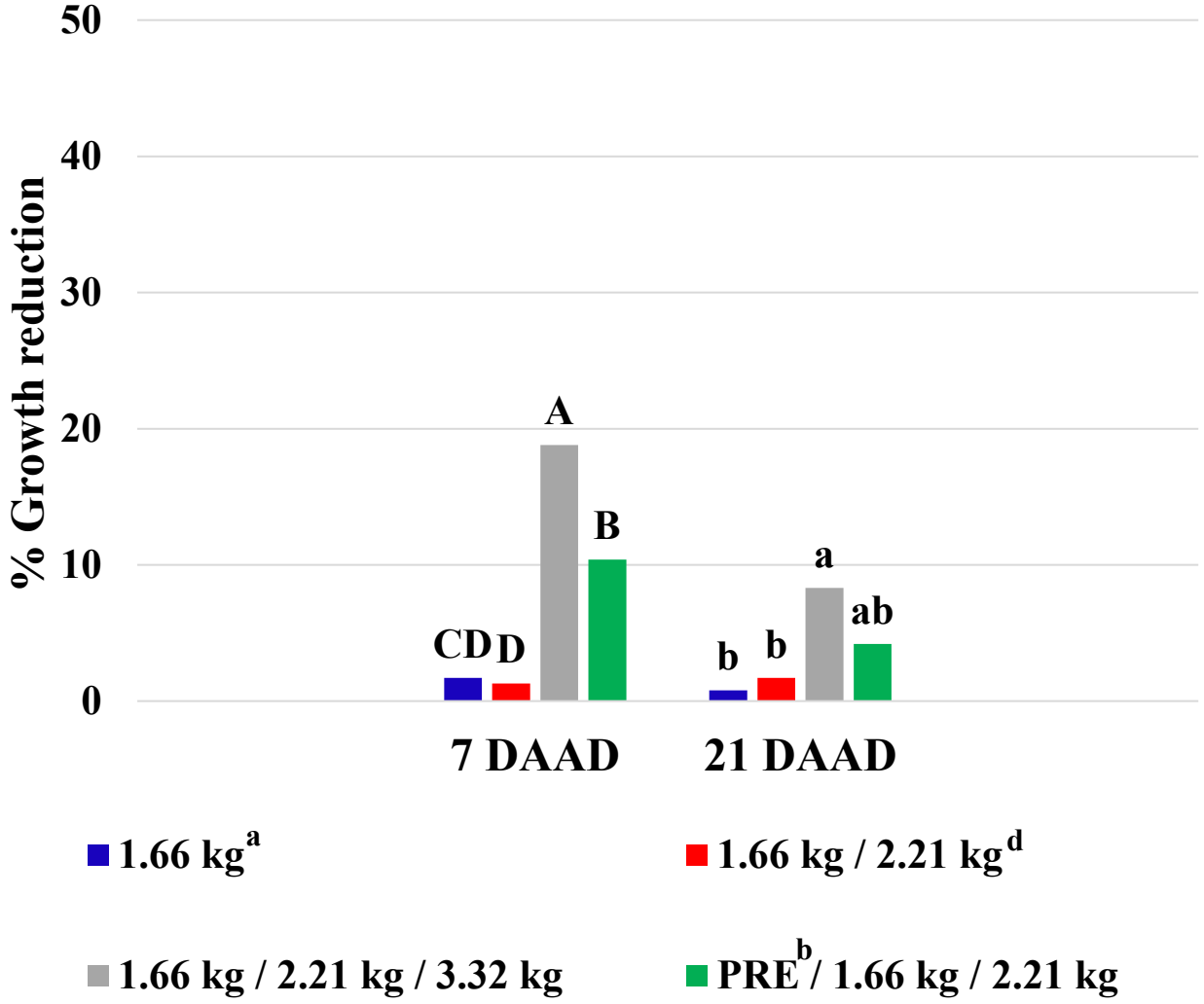
Kochia Control 28 DAAD, Felton MN, 2024



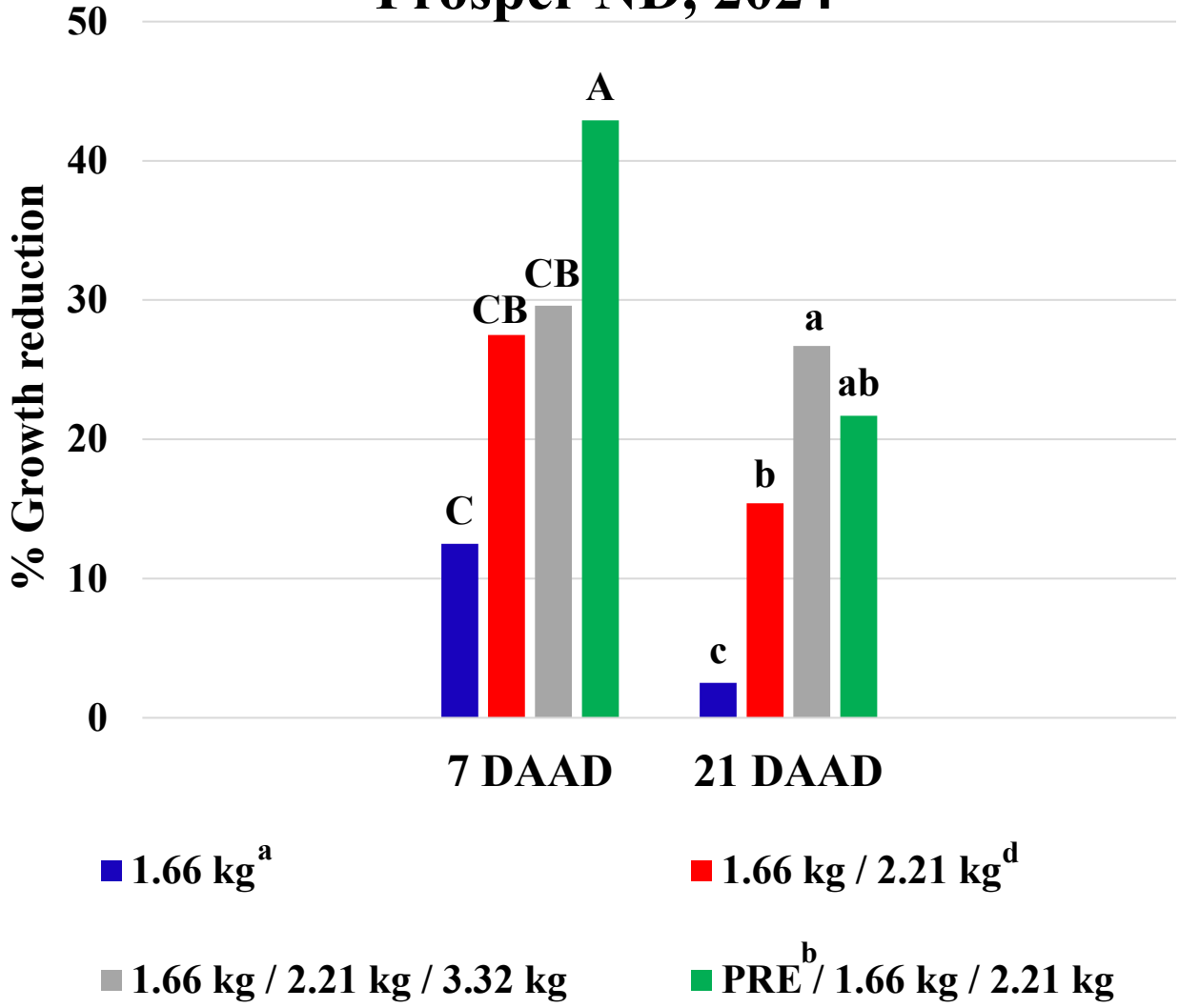
Soil Temperature April 1st – June 30th, Ulen MN, 2023/2024



Sugarbeet tolerance in response to phenmedipham at Crookston and Hendrum MN, 2024[c]

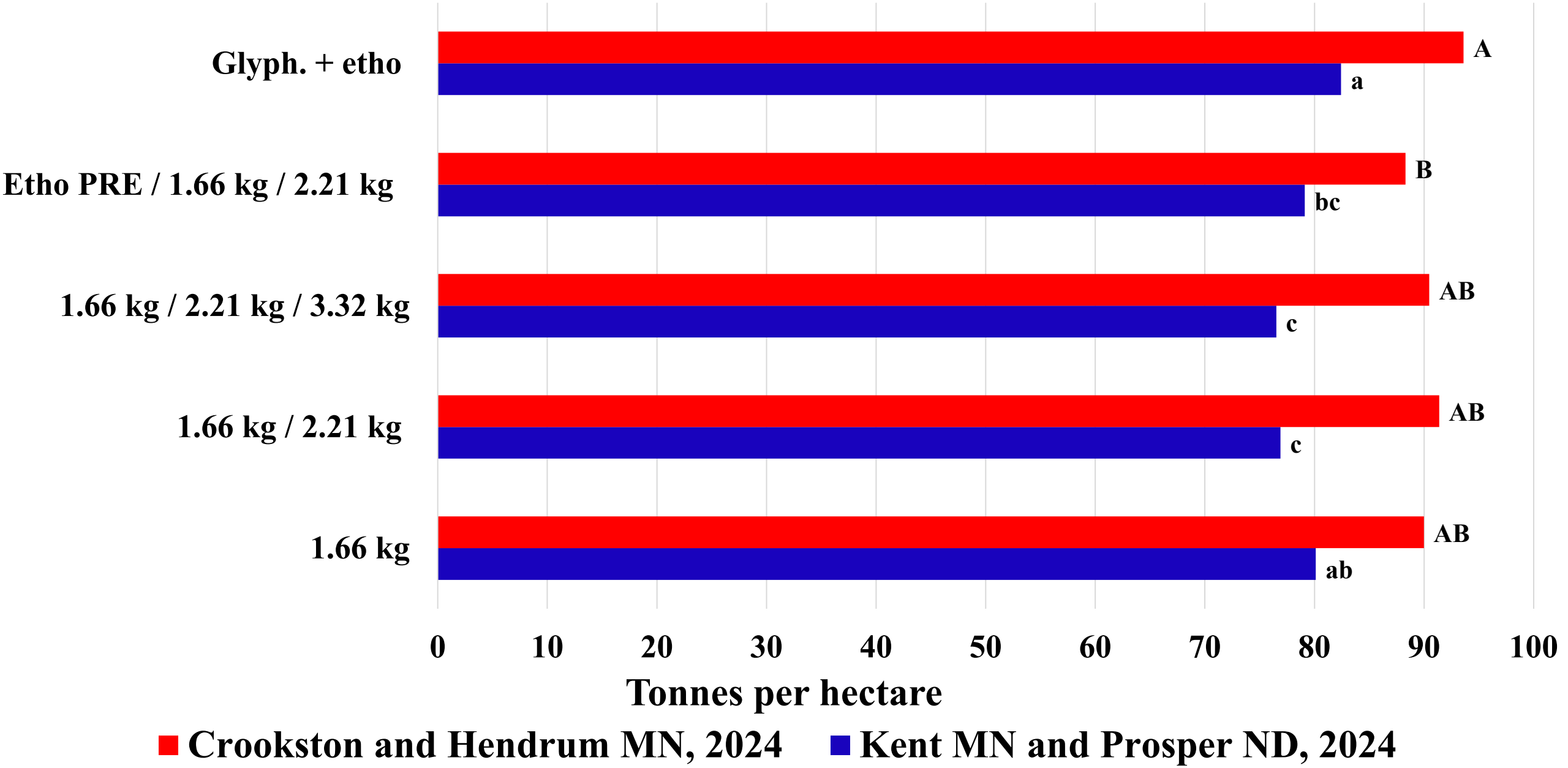


Sugarbeet tolerance in response to phenmedipham at Kent MN and Prosper ND, 2024[c]



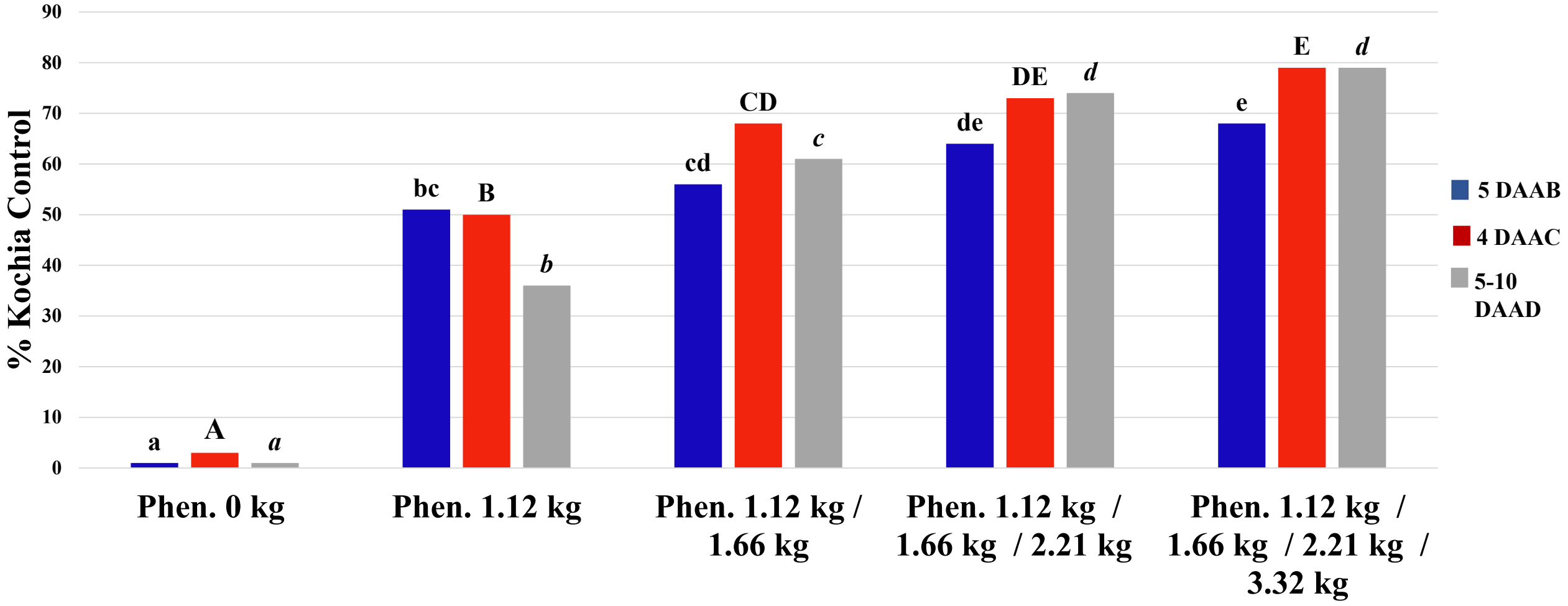
[a]Treatments included ethofumesate at 0.28 kg ha^{-1}
[b]Ethofumesate at 6.6 kg ha^{-1}
[c]lsmeans with different letters significant at P=0.05
[d]Phenmedipham plus etho, glyphosate, HSMOC 0.28, 1.73, 1.1 kg ha^{-1}

Sugarbeet root yield in response to phenmedipham[a]



[a]lsmeans with different letters significant at P=0.05

Kochia control from 1 - 4 phenmedipham (phen.) applications, across greenhouse runs, 2025[ab]



[a]Treatment includes ethofumesate at 4 fl oz/A plus MSO at 1 pt/A

[b]Means within a rating timing that do not share any letter are significantly different by the LSD at the 5% level of significance

Conclusion

- Rate is dependent on sugarbeet size and environment during application
- Three applications of phenmedipham may provide 80 – 90% control of kochia 14 days after final treatment
- Two and three phenmedipham applications did not reduce root yield in comparison to one application when treatments were made at ≤ 24C air temperature
- A fourth phenmedipham application improves kochia control although percent control does not differ from three applications

Working hypothesis

	Spin-Aid Rate[a]		
Sugarbeet Stage	Cold (<24C) at application	Warm (>24C) at application	Mixed with Stinger HL, etho and/or RUPM3[b]
(Lvs)	----------(kg ha^{-1})----------		
Cotyledon	1.12	0.84	0.84
Early 2-lf (horns)	1.40	1.12	1.12
2-4 lf	1.96	1.68	1.68
4 lf	2.24	1.96	1.96

[a]Spin-Aid will be applied on 5-7 day intervals when sugarbeet are actively growing and on 10 day intervals when sugarbeet are not growing.
[a]Spin-Aid mixed with ethofumesate at 0.28 kg ha^{-1} with MSO or HSMOC at 1.17 L ha^{-1}

Acknowledgements

- **Belchim Crop Protection USA**
- **Extension Sugarbeet cooperators**

  Efficacy trials: Keith Miller, Tyler Dahl, and David Arends

  Tolerance trials: Neil Rockstad, Pat Freese, Northwest Research and Outreach Center UMN, NDSU Experiment Station

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Thank you!