Summary of Cultivation Research in Sugarbeet

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Sugarbeet Weed Management in 2018

- Limited POST control options
  - Herbicide resistant pigweeds (waterhemp and Palmer amaranth)
  - Loss of historical herbicides (des+phenmedipham, "Betamix")
- Chloroacetamide herbicides soil applied (layby)
  - POST to sugarbeet, PRE to weeds (Peters et al. 2017)
- Renewed interest in cultivation

T. Peters (2018)

Inter-row Cultivation

Benefits:

- Non-selective mode of action
- No risk of resistance
- Incorporation of fertilizer and herbicide

Drawbacks:

- Limited area
- Potential yield damage (Dexter et al. 2000; Giles et al. 1990)
- Increased disease risk (Schneider et al. 1982)

Grove (2017)

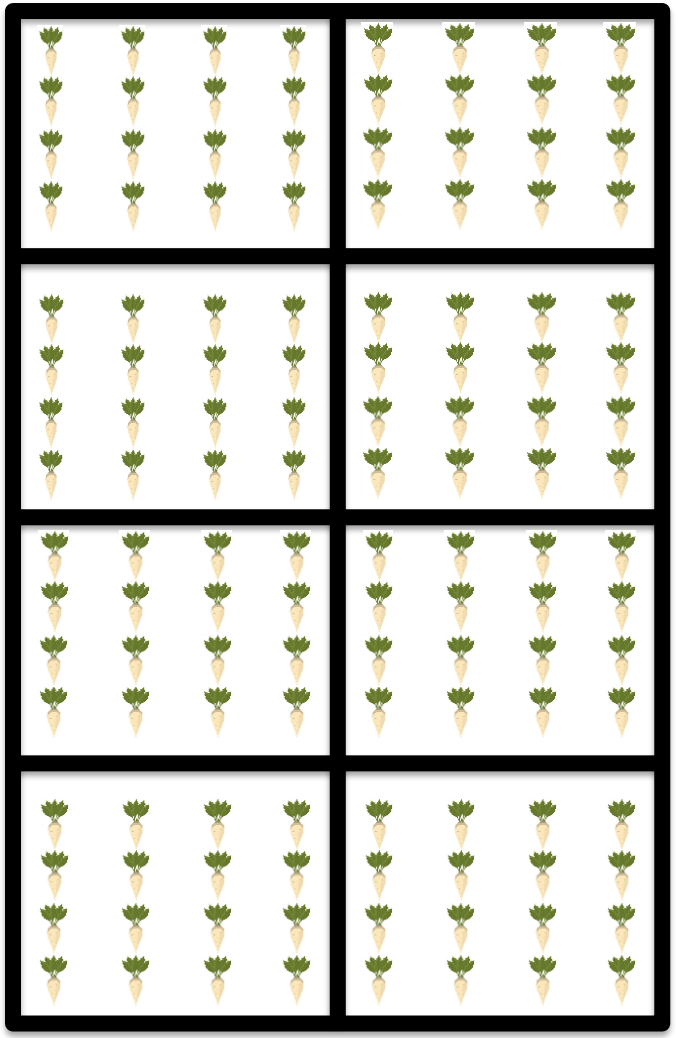
Cultivation Research Questions

- Cultivation to remove herbicide-resistant weeds?
- Effects on weed emergence?
- Interactions with residual herbicide?
  - Incorporation and activation
  - Damage to an established herbicide barrier?
- Negative effects on sugarbeet yield and quality?

NDSU Extension (2016)

Haugrud (2018)

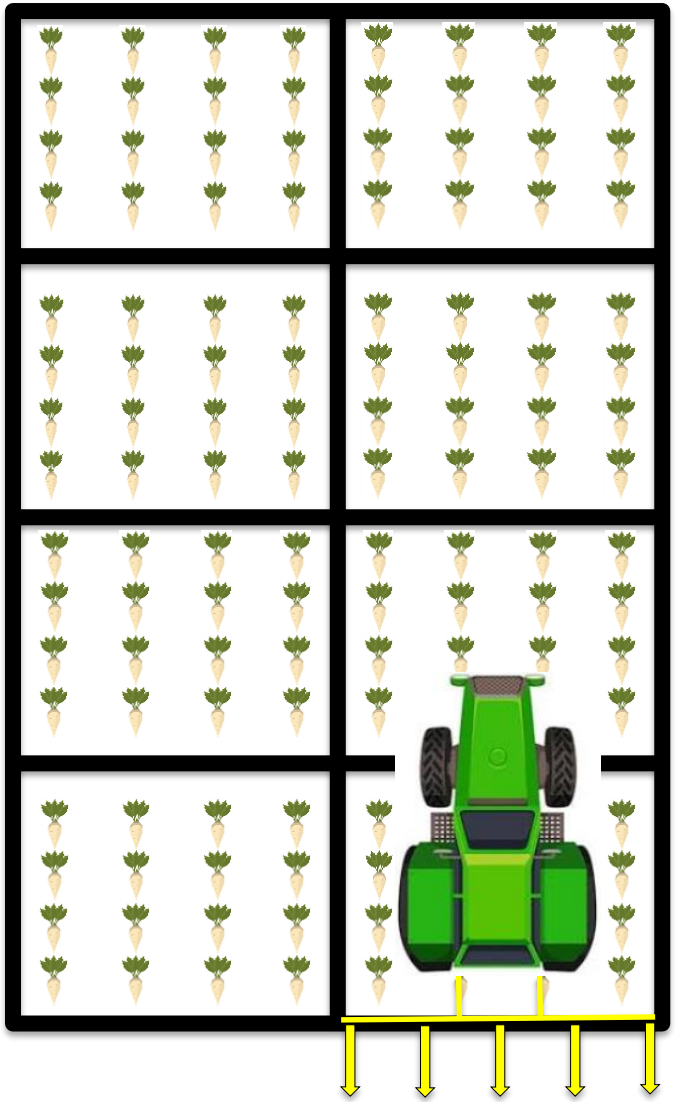
Herbicide applied at standard rates, volume, & pressure



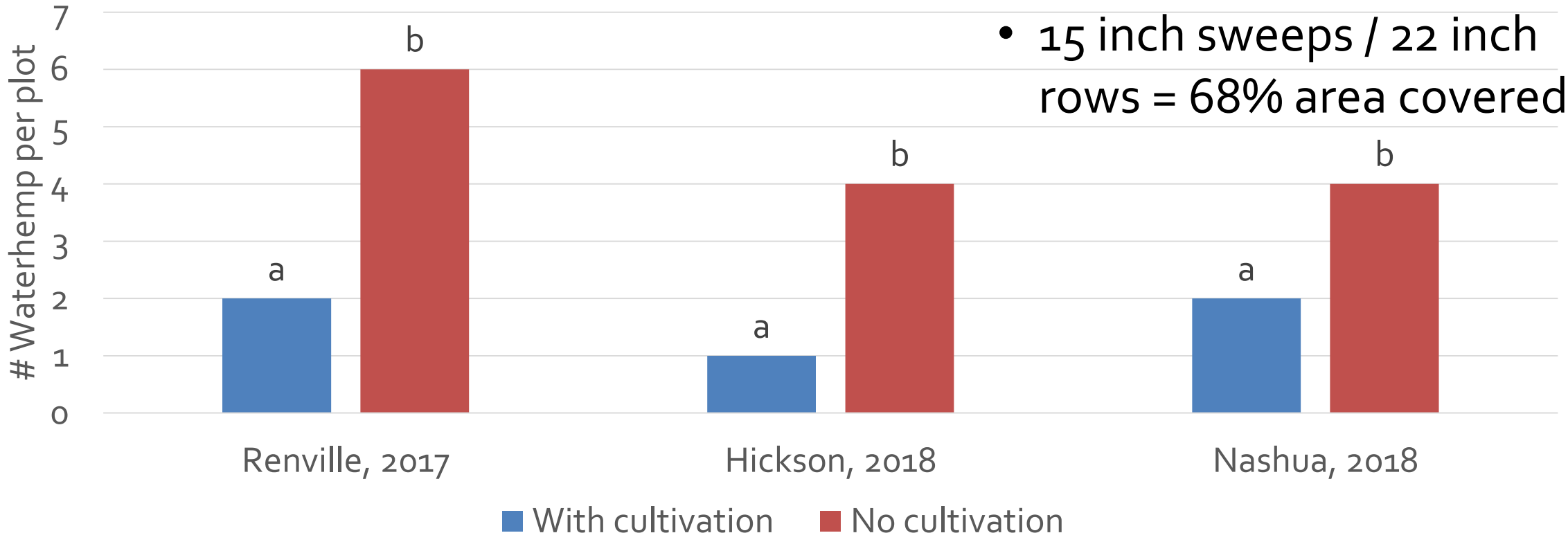
- Herbicide: Four/six levels
  - Glyphosate alone
  - Gly + Dual Magnum
  - Gly + Outlook
  - Gly + Warrant
  - Gly + Treflan
  - Gly + Ro-neet

Haugrud (2018)

Cultivation at 4 MPH and 1.5 - 2” depth



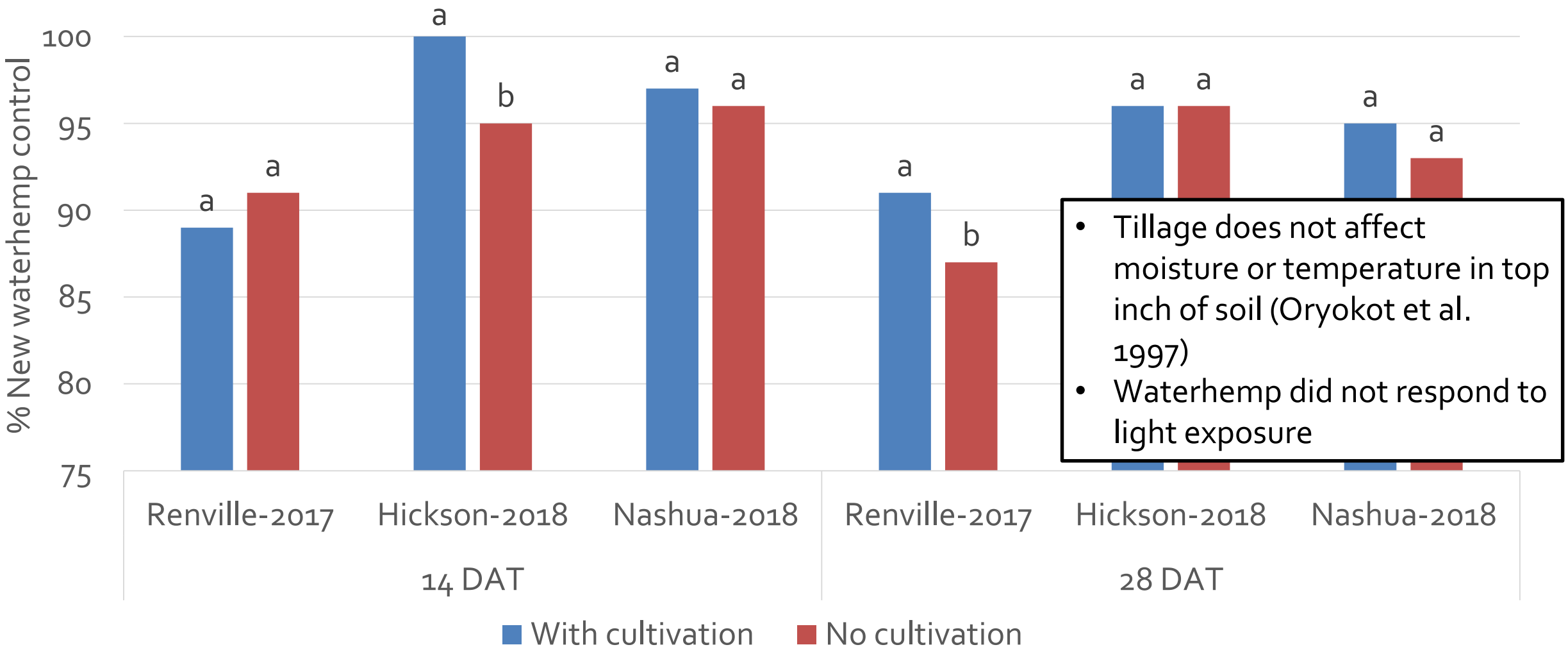
Cultivation immediately after herbicide resulted in 50-75% less waterhemp, 14 DAT



- 15 inch sweeps / 22 inch rows = 68% area covered

ANOVA	Cultivation			Herbicide	C X H Interaction
	Renville, 2017	Hickson, 2018	Nashua, 2018	All environments	
P-value	0.009	0.002	0.019	NS	NS

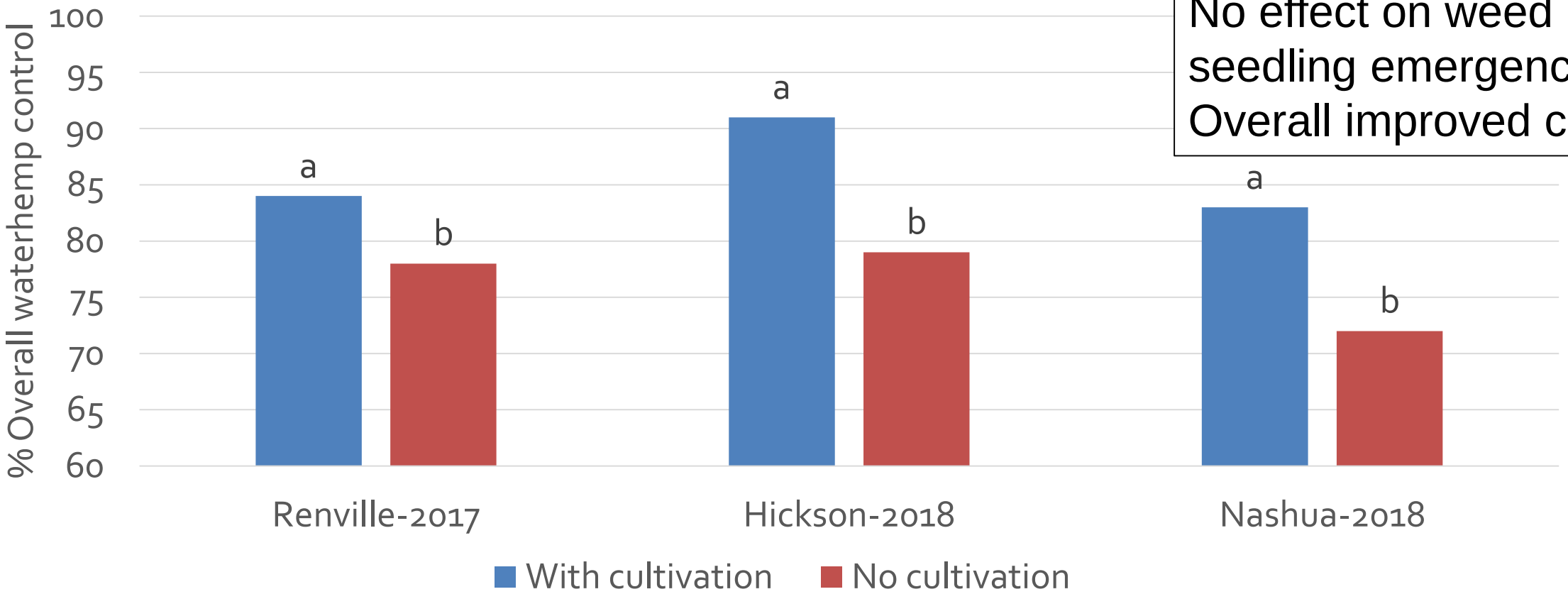
Early cultivation generally had no effect on new waterhemp emergence control



- Tillage does not affect moisture or temperature in top inch of soil (Oryokot et al. 1997)
- Waterhemp did not respond to light exposure

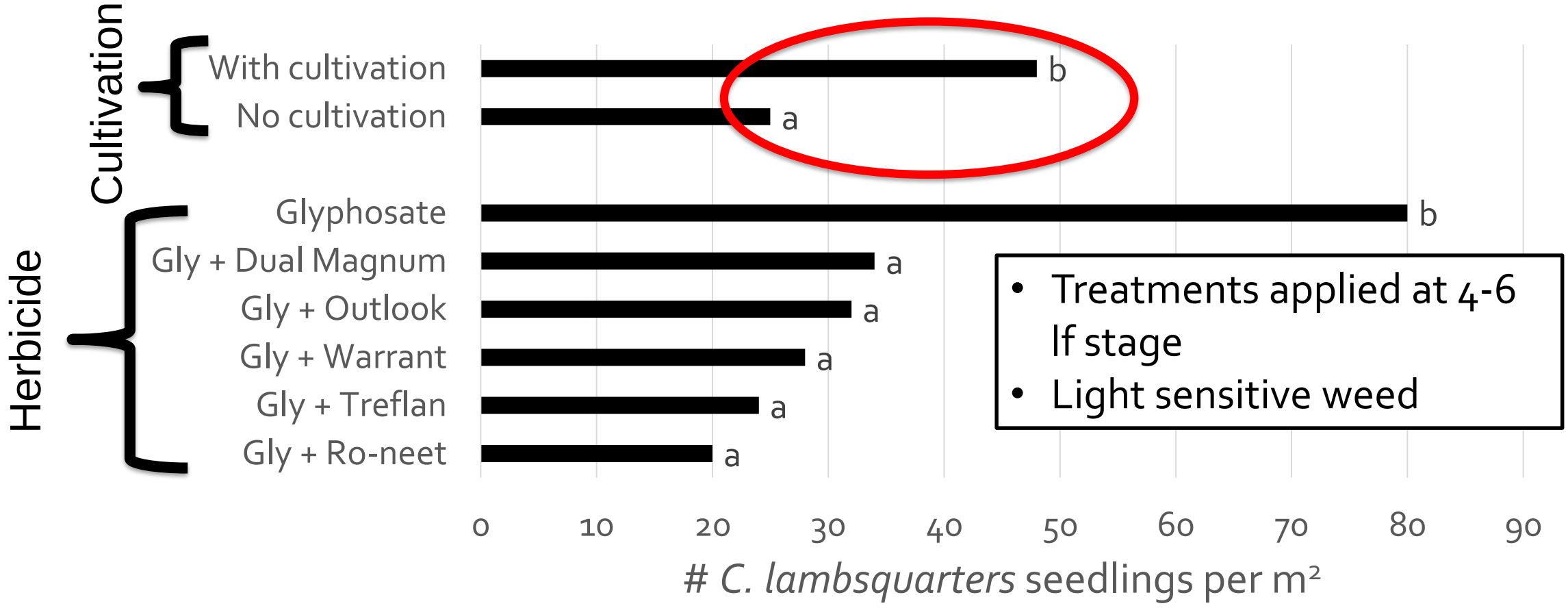
Early cultivation resulted in 6-11% improved overall control, 42 DAT

Initial removal of 65% of weeds + No effect on weed seedling emergence = Overall improved control



ANOVA	Cultivation			Herbicide	C X H Interaction
	Renville, 2017	Hickson, 2018	Nashua, 2018	All environments	
P-value	0.008	0.002	0.041	NS	NS

Early cultivation increased common lambsquarters emergence, Galchutt-2018, 28 DAT



ANOVA	Cultivation	Herbicide	C X H Interaction
P-value	0.018	< 0.001	NS

Cultivation Efficacy Summary

- Cultivation can remove about 2/3rds of weeds
- Generally no effect on waterhemp emergence
- Cultivation improved season-long waterhemp control by 6 to 19%
- No effect on lambquarters control, but risk for reduced seedling control if timed too early
- Take advantage of crop canopy by cultivating later

Cultivation Effect on Sugarbeet Yield

- Past research from 1980s and 1990s indicate yield loss from cultivation in certain environments
- Increased *Rhizoctonia solani* infection
  - Moving soil-borne pathogen nearer its host

Khan and Bolton 2016

Grove 2017

Cultivation Safety: Experimental Procedures

- Cultivation every 2 weeks from June 21 to August 16
- ‘Crystal 355’ planted early-May
- 4 MPH speed and 1.5-2 inches deep
- Quadris (azoxystrobin) for *Rhizoctonia* control

Cultivation timing had no effect on stand mortality or visual disease at any environment

Cultivation timing	Stand mortality [a]		
	Prosper	Hickson	Glyndon
	----------%----------		
Control	15	32	-14
June 21	20	37	-1
July 5	15	37	4
July 19	20	41	-10
August 2	11	32	-1
August 16	13	30	10
June 21 + July 19	13	31	-7
July 5 + Aug 2	19	36	4
July 19 + Aug 16	21	39	7
June 21 + July 19 + Aug 16	16	37	7
ANOVA	----------p value----------		
Treatment	0.082	0.435	0.848

[a] $\frac{\text{Pre treatment stand}}{\text{Harvest stand}} \text{ x } 100 = \%\ \text{Stand mortality}$

Cultivation timing had no effect on sugarbeet yield across all environments in 2018

	Yield Components		
Cultivation timing	Root yield	Sucrose content	RSA
	Tons/acre	%	Lbs/acre
Control	24.3	15.0	6,817
June 21	24.1	14.8	6,773
July 5	24.7	14.9	6,934
July 19	23.5	14.9	6,563
August 2	25.4	14.7	6,899
August 16	24.4	14.5	6,529
June 21 + July 19	24.3	14.5	6,679
July 5 + Aug 2	24.7	14.6	6,698
July 19 + Aug 16	23.5	14.8	6,472
June 21 + July 19 + Aug 16	23.5	14.8	6,540
ANOVA	----------*p value*----------		
Treatment	0.944	0.062	0.947

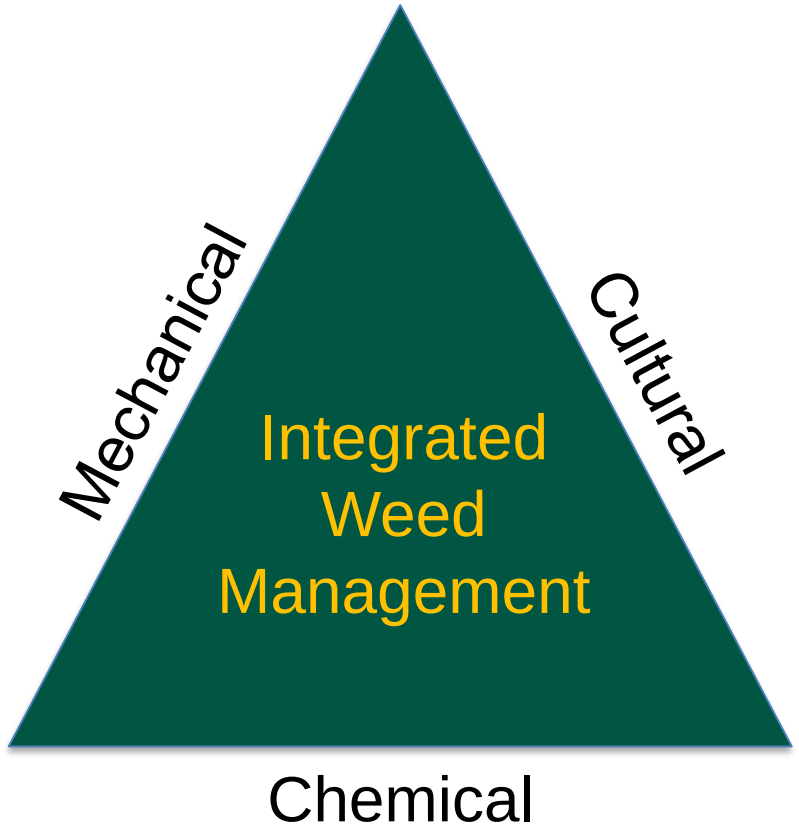
Conclusion: Cultivation timing had no effect on sugarbeet yield, stand density, or disease in 2018

- Differences between our experiments and previous research
  - Similar cultivation methods, but different timing and intervals
    - Dexter et al. (2000) and Giles et al. (1990) implemented weekly cultivation from mid-June to late-July

- Differences in production practices in 2018 vs the 1990s
  - Seed treatments and soil-applied Quadris (azoxystrobin)
  - 'Crystal 355', a diploid, is relatively resistant to *R. solani*

The Future of Cultivation: 2019 and Beyond

- Valuable tool to removal weeds that herbicide did not/will not control
- Timing is key: cultivate near crop canopy closure
  - No effects on weed emergence if shade is present
- Research on sugarbeet likely applicable to other row crops e.g. soybean



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