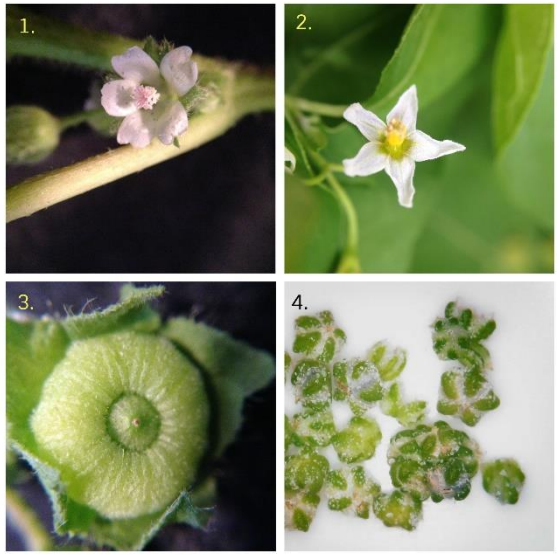
NDSU Non-Chemical Weed Management

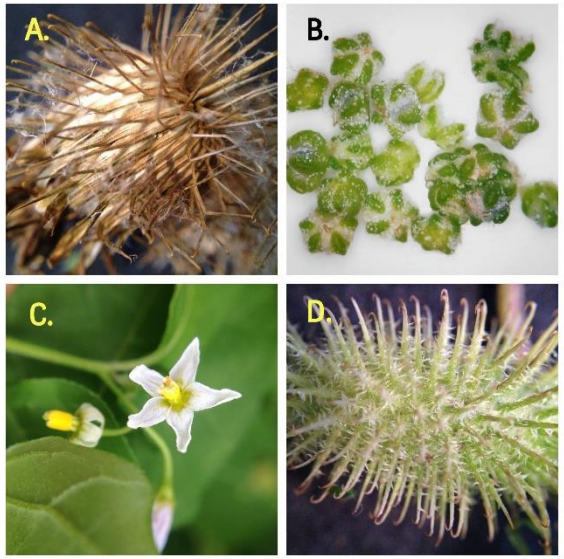


Wild World of Weeds Workshop

January 17, 2023

Research Update

Dr. Greta Gramig



Current Projects

- '**Creep-Stop**' *Organic Research and Extension Initiative*, USDA
  - In partnership with Montana State and Washington State
  - Comprehensive study of creeping perennial weeds in NGP organic small grains
- '**Perennial Flax**' *Sustainable Agriculture Research and Education*, USDA
  - Working with Burton Johnson (NDSU) and Brent Hulke (USDA-ARS, Fargo)
  - First steps to develop native Lewis flax as a perennial crop
- '**H_2O Mulch**' *Organic Research and Extension Initiative*, USDA
  - In partnership with USDA-ARS, Morris, MSU, WSA, OSU
  - Working to develop alternatives to plastic mulch for organic horticulture
- '**Biodegradable mulches for environmentally responsible pest management in fruit and vegetable crops**' *USDA/ND Specialty Crop Block Grant Program*
  - In partnership with Dr. Deirdre Prischmann-Voldseth, NDSU Entomology
  - Evaluating hydromulch impacts on weeds and crop/insect interactions

Table 1. Three crop sequences compared across four years for their weed suppressive ability.

	Year			
Treatment	2019	2020	2021	2022
ALF	Forage barley and alfalfa. Awnless barley planted as a nurse crop with alfalfa.	Alfalfa	Alfalfa	Hard red spring wheat (HRSW)
LENCL	Lentil for grain harvested in August	HRSW + yellow sweet clover	Yellow sweet clover or pea¥. Tilled under in May. Tilled at 21-28-day intervals subsequently.	HRSW
CCPLY	Nine species cool season polyculture	HRSW	Nine species mixed season polyculture	HRSW

¥ Pea was planted instead of sweet clover at the Turtle Lake, ND site as minimal clover reemerged after winter.

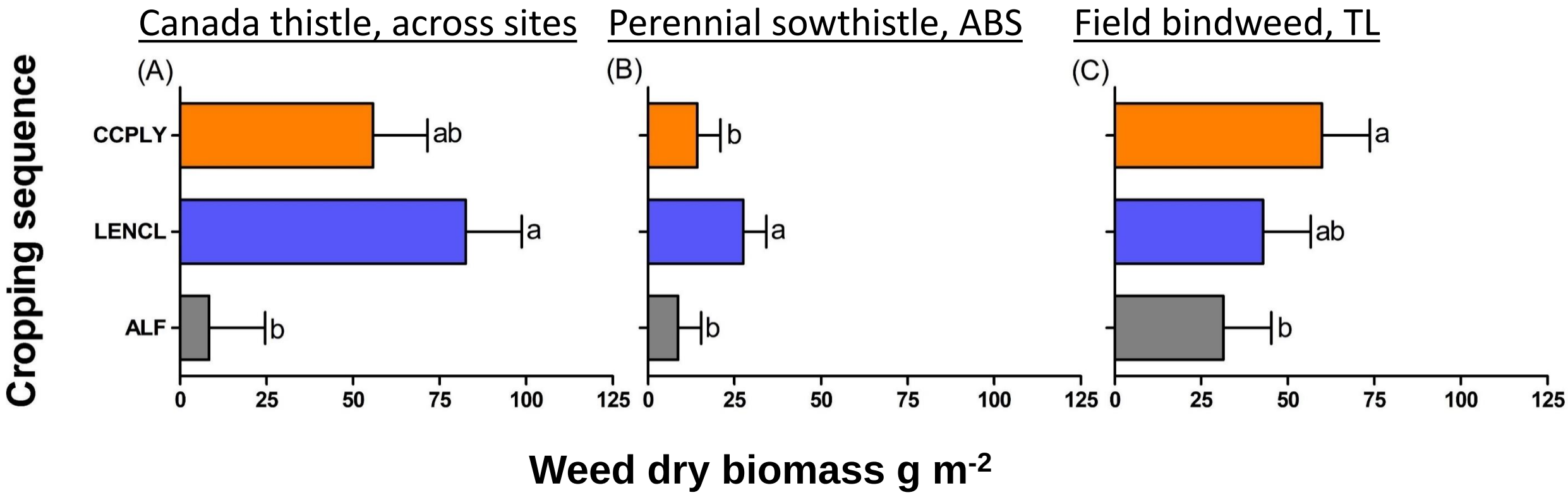


Figure 3. Mean plus standard error average biomass (grams m^{-2}) of (A) Canada thistle (pooled across sites); (B) perennial sow thistle; and (C) field bindweed. Canada thistle was measured at both the Absaraka and Turtle Lake, ND sites. Perennial sow thistle was only measured at Absaraka, ND; field bindweed was only measured at Turtle Lake, ND. Lower case letters denote differing means within a species among cropping sequence treatments according to Tukey's Honest Significant Difference test at α=0.05.

Results in summary

- ALF performed best
- Field bindweed biomass in CCPLY – tillage/competition?
- Difficulties with CCPLY, LENCL
- Tillage impacts
  - Perennial sow thistle ⬇
  - Field bindweed ⬆

Seed size range for cover crop polyculture

Why perennial flax?

- Ecosystem services
  - Carbon sequestration
  - Soil protection
  - Pollination
- Resiliency
  - Social and environmental
- Oil quality
  - Omega-3 fatty acids
  - Marketability

Linum lewisii, a perennial native to North America

Challenges

Weed management

- Weakly competitive
- Non-chemical approach
- Little information

Agronomic unknowns

- Seeding rate, row spacing, planting date, harvest timing
- No published recommendations

Adaptive Management Approach

2020 → **2021** → **2022**

Field Flaming Results

2022: Cultivation, Harvest, Intercropping w/Winter Wheat

- Comstock, MN site only
- Field cultivator, wide sweeps
- Managing stand for yield
- Yielded **60 kg ha^{-1}**
  - Conventional annual flax yields around **1200 kg ha^{-1}**
  - Potential for two cuttings?

MulcH_2O: Biodegradable Composite Hydromulches for Sustainable Organic Horticulture

- Two sites: ND and WA
- RCBD, 4 reps, 6 treatments
  - Paper only, 2% psyllium husk, 2% guar gum, 6% psyllium husk, 6% guar gum, polyethylene mulch
- WA – mulches applied 6/1 (three passes), ‘Albion’ day-neutral strawberries planted 6/8
- ND – mulches applied 6/28 and 6/29 (two passes), ‘Albion’ day-neutral strawberries planted 6/29
- Application rate ~ 4500 kg DM/ha

Research funded by USDA Organic Research and Extension Initiative

Field Sites and Application Equipment ND (left) & WA (right)

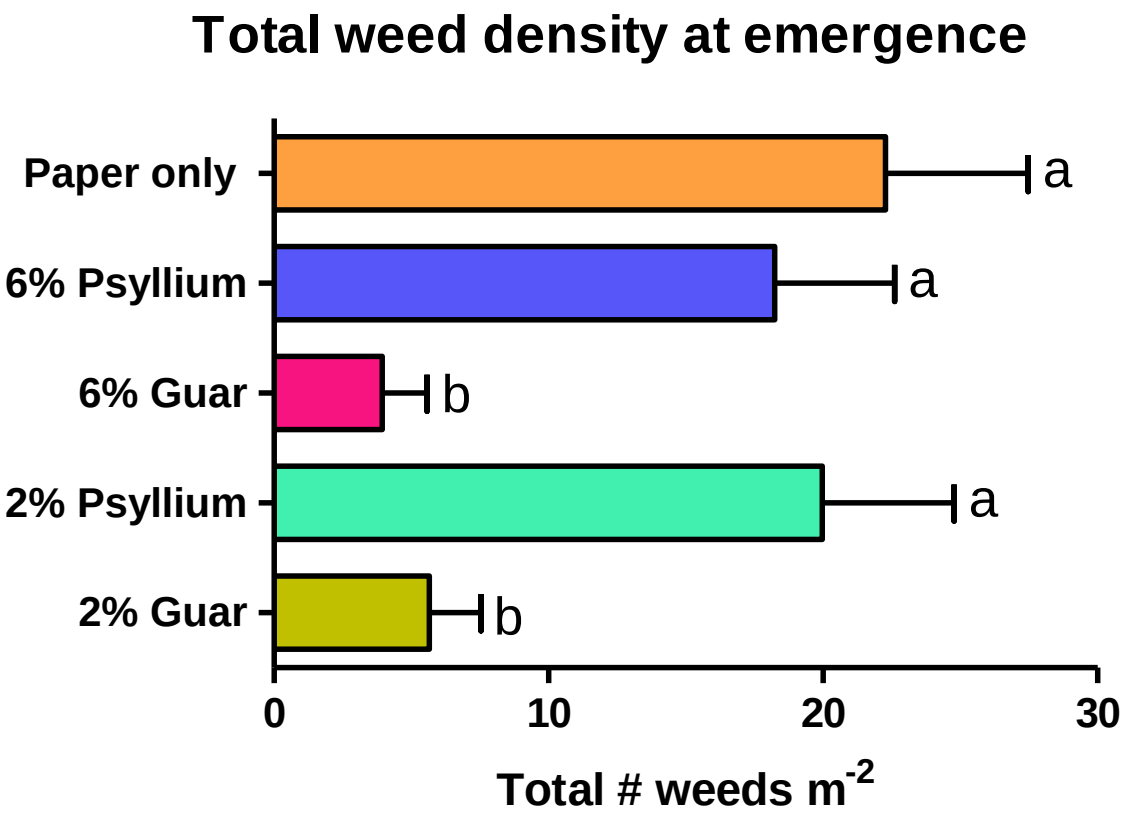
Hydromulch application videos WA & ND

Washington

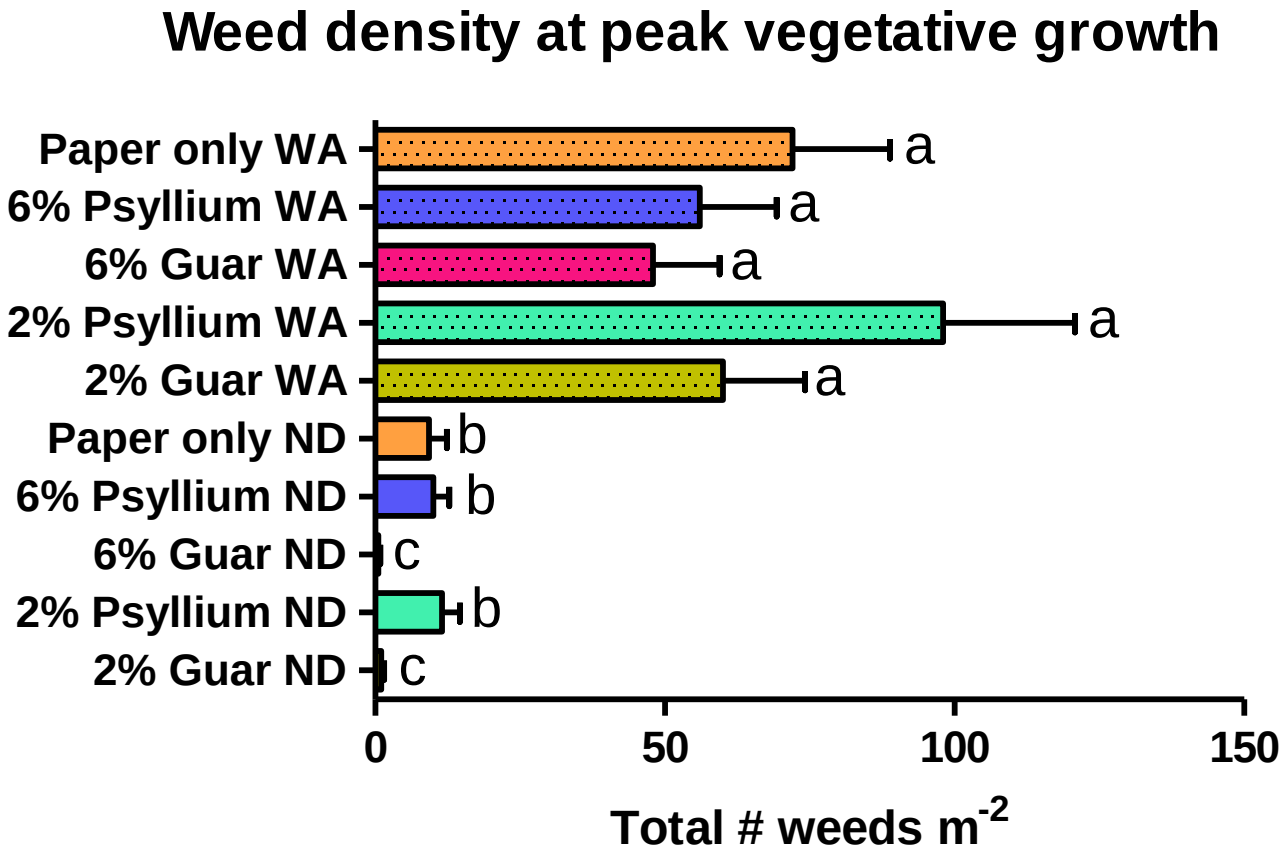
North Dakota

Results – Weed Density

Note that PE had zero weeds at both sites, so this treatment was not included in tests of weed responses.

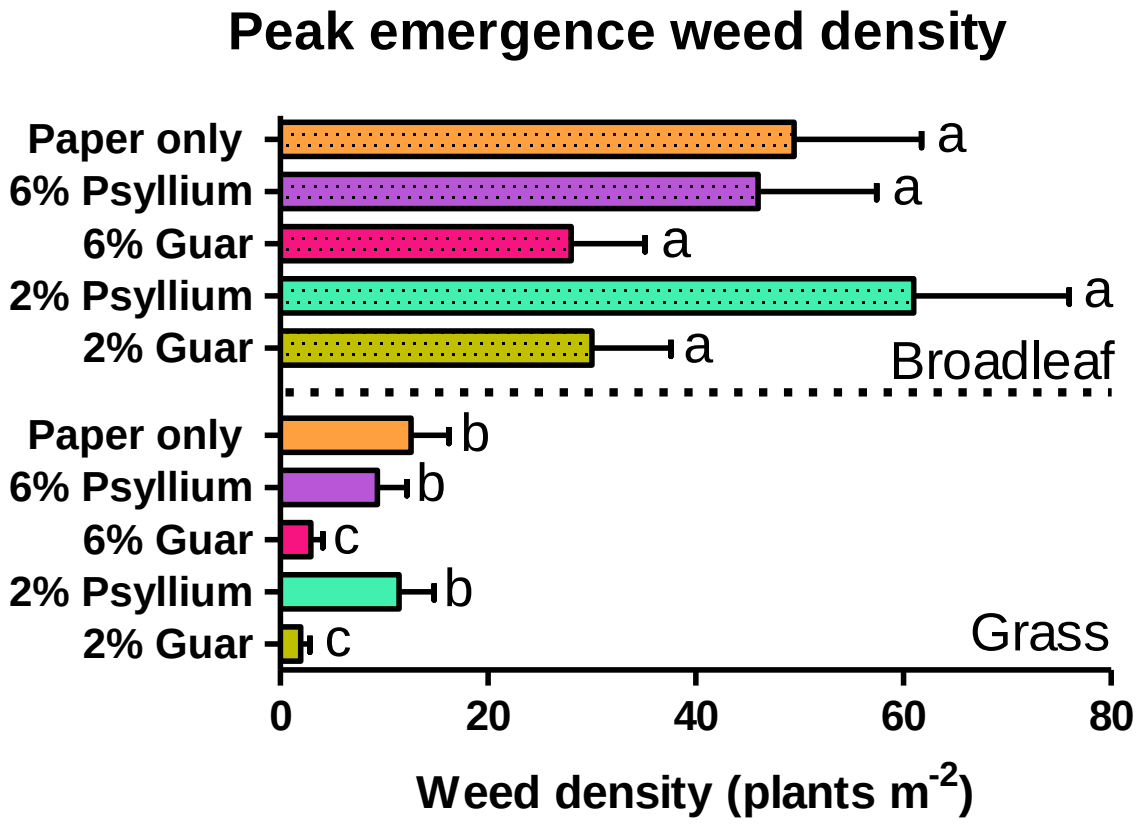


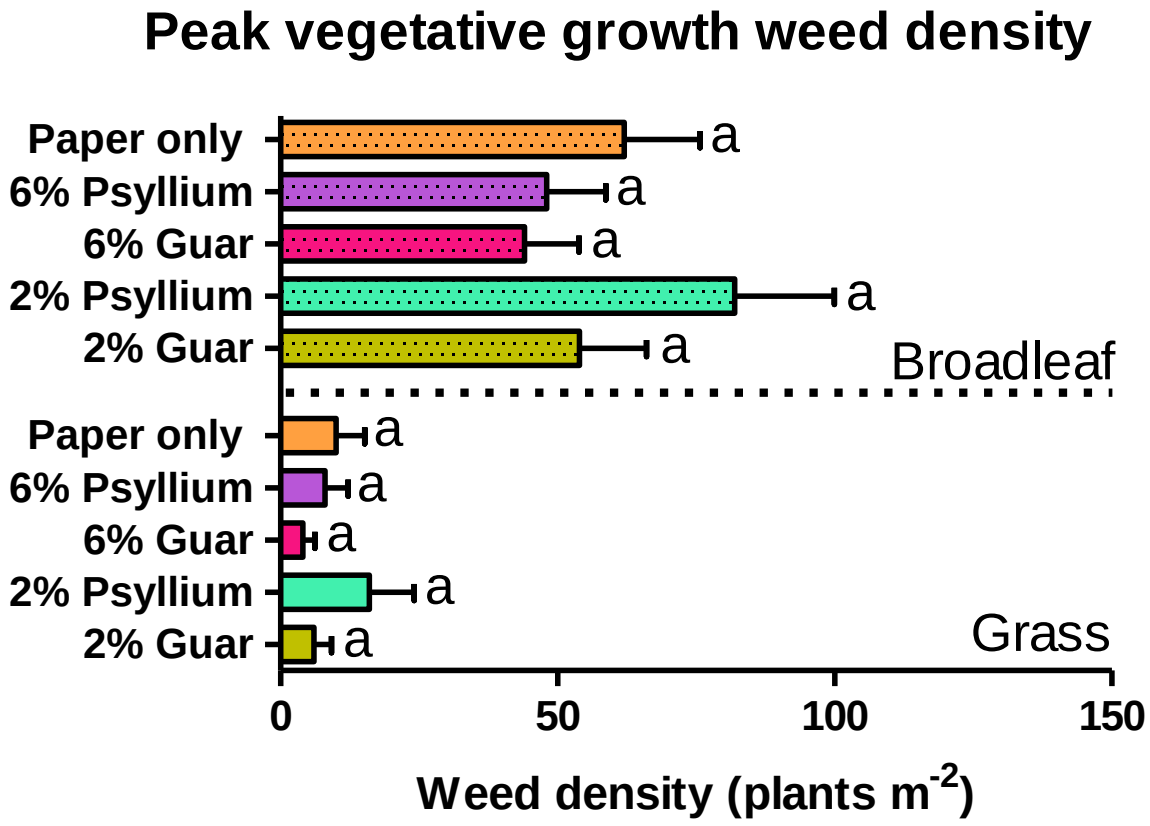
No treatment X site interaction, results across sites



Sites separated due to treatment X site interaction

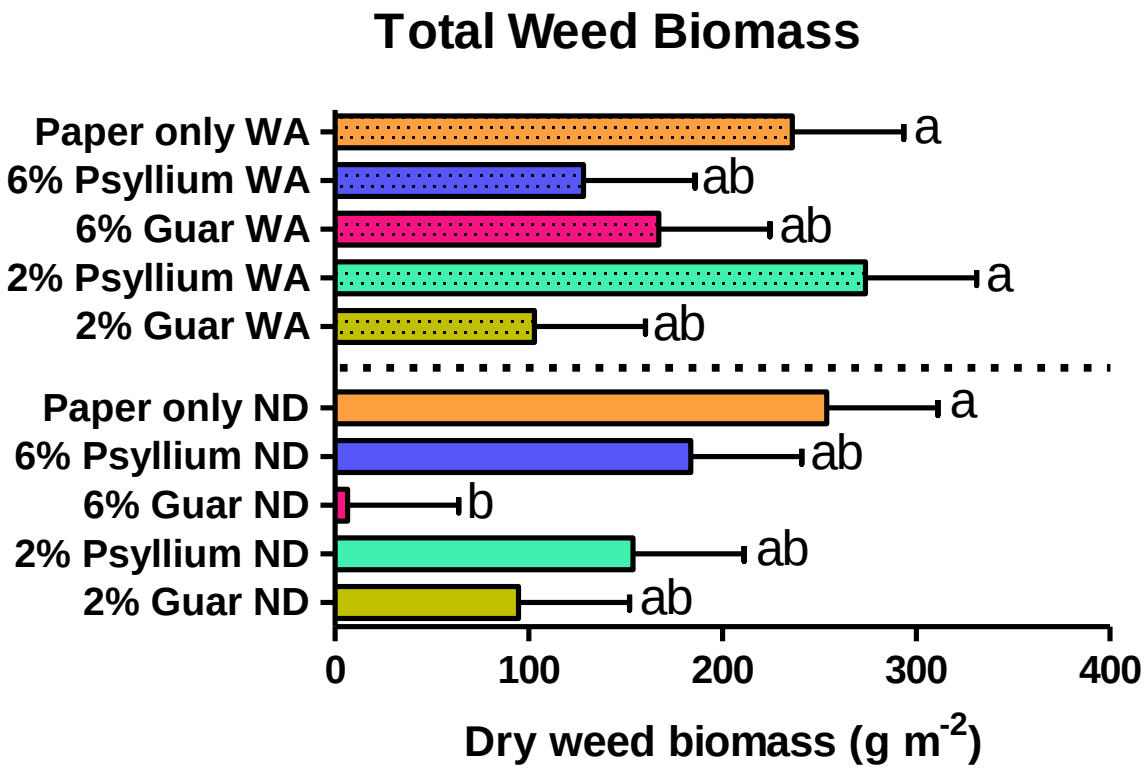
WA: Suppression of broadleaf vs. grass weeds (*No grass weeds at ND for this comparison*)





Note: Broadleaf and grass results are from separate analyses.

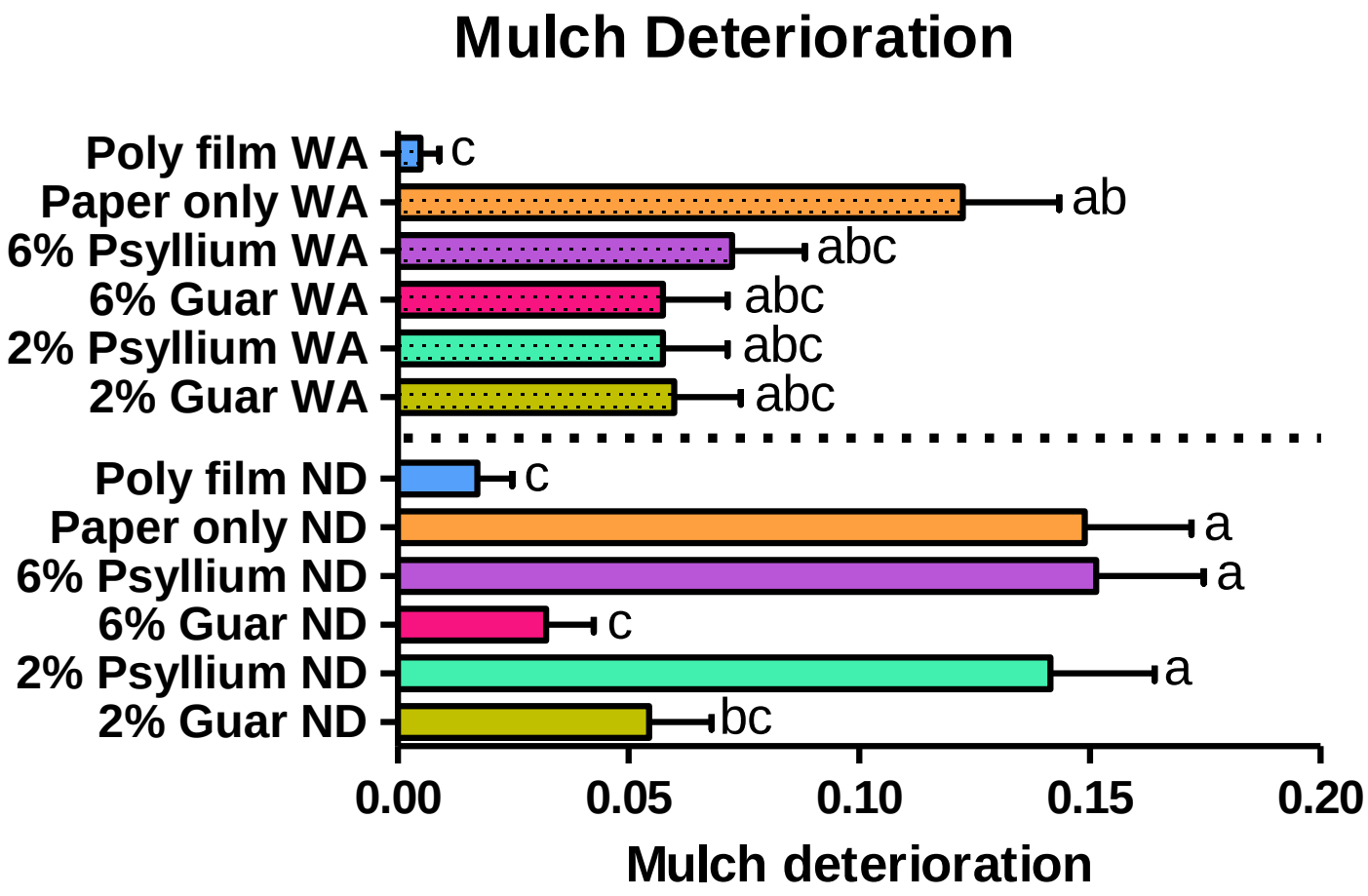
Total weed (broadleaves and grasses combined) biomass sampled 8/12 (WA) and 8/29 (ND)



6% Guar Gum at North Dakota Site

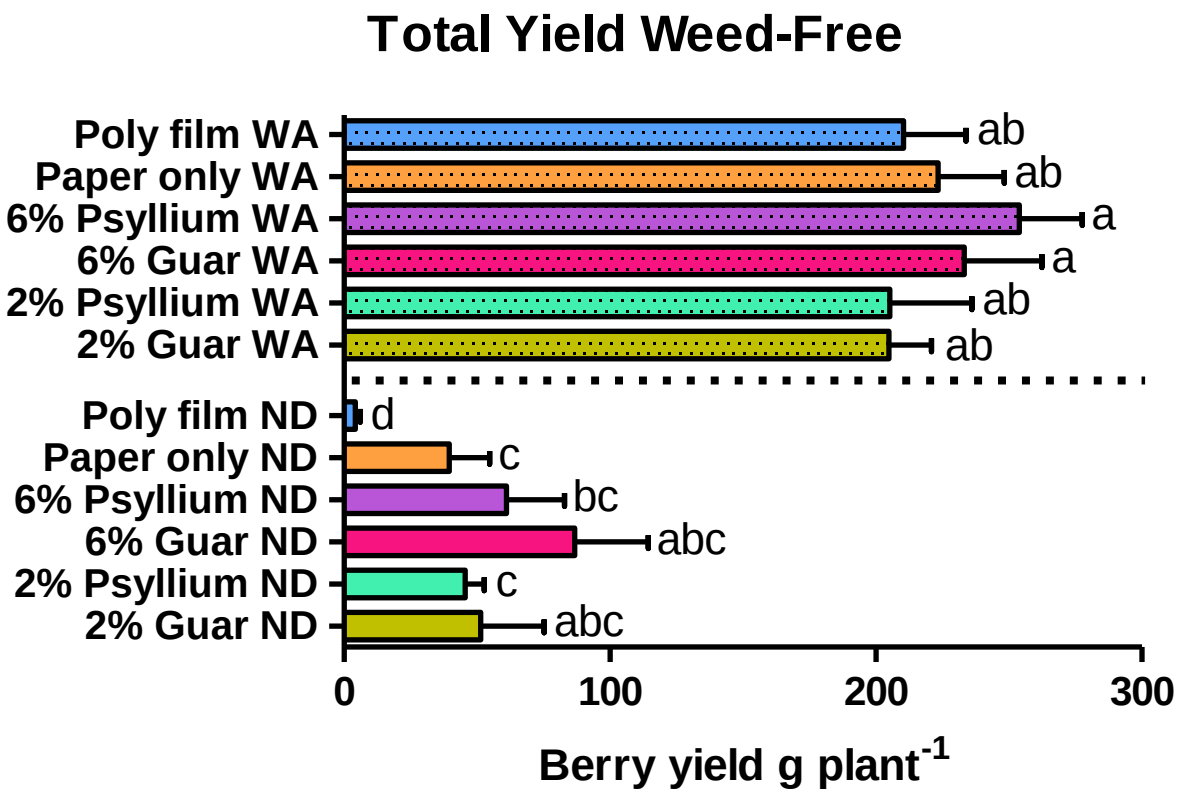
Washington site = more weeds

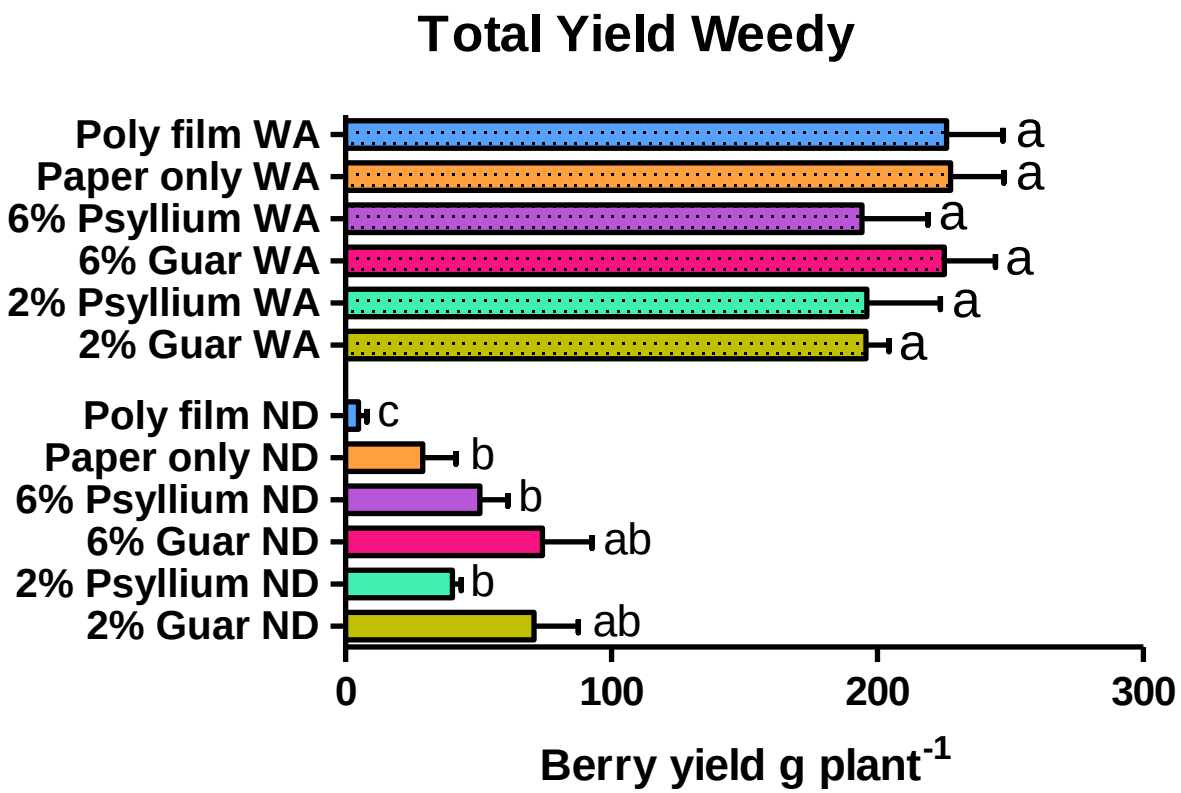
Percentage Mulch Deterioration
Visual estimates, end of season



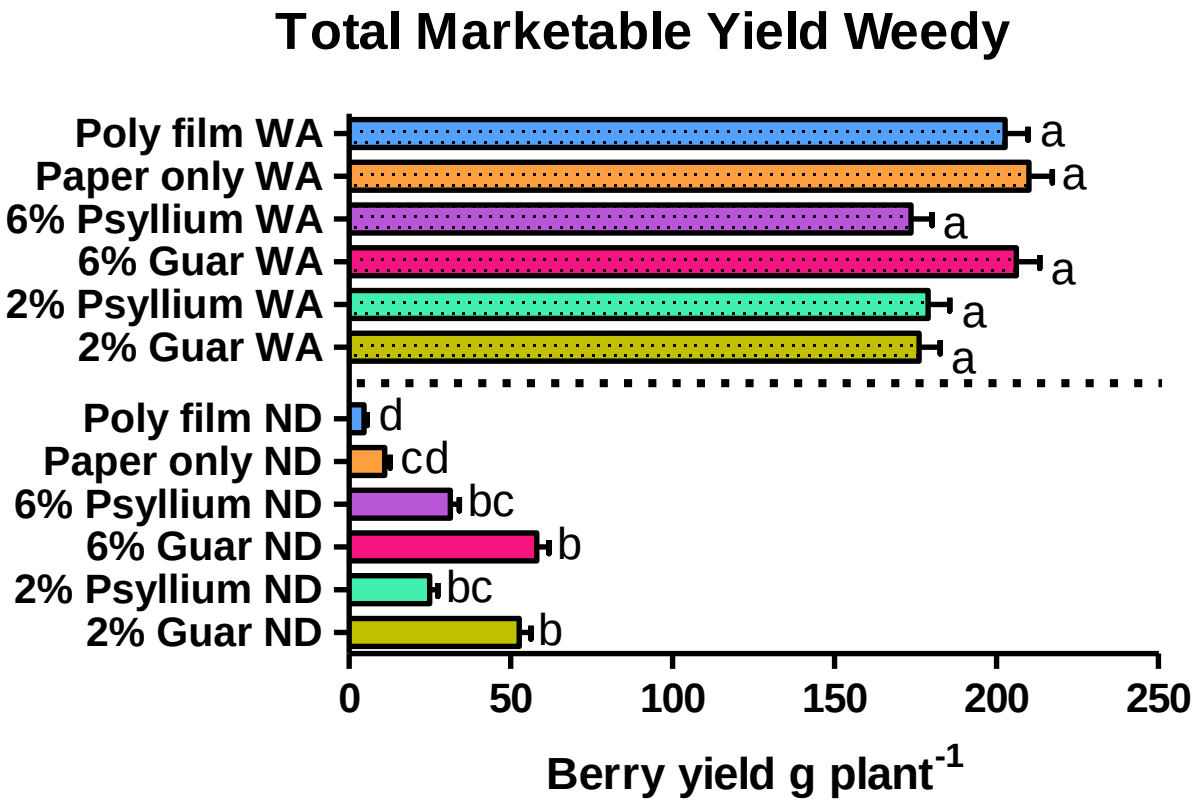
Paper-only hydromulch, showing deterioration mainly along the drip tape line and plot edges

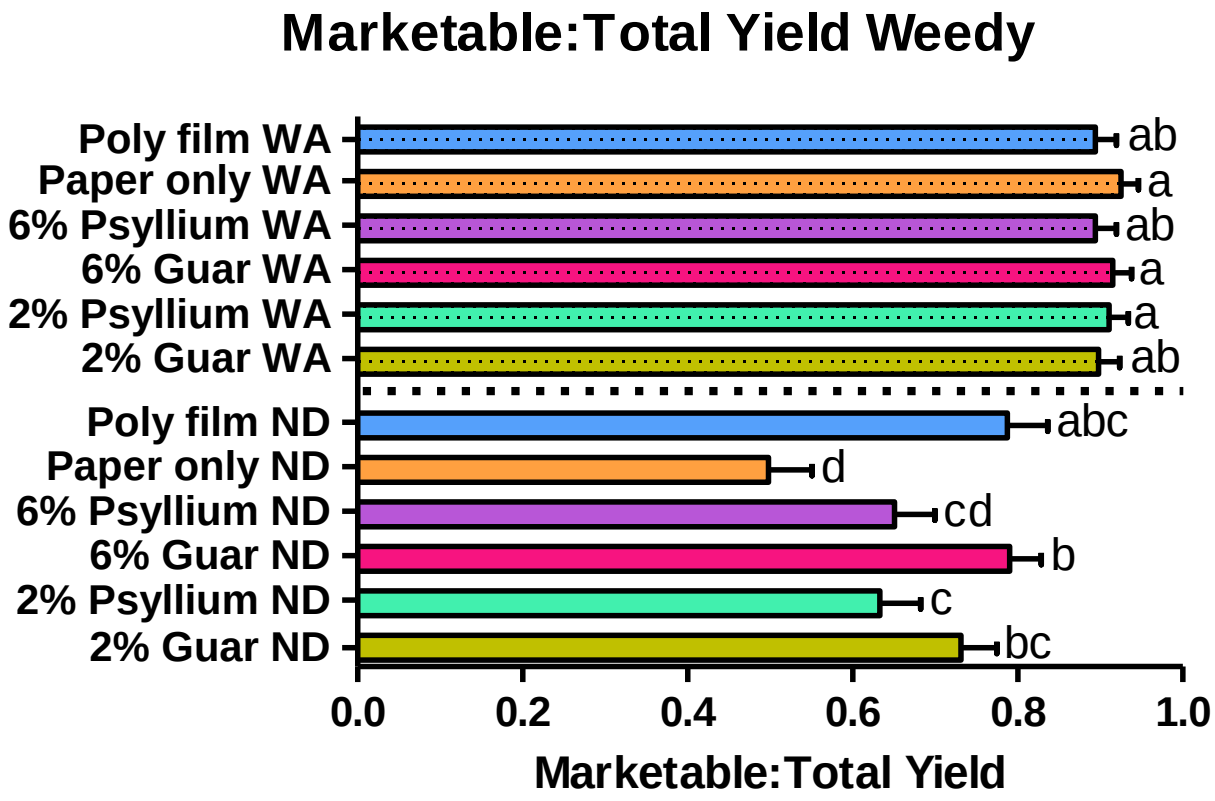
Total Berry Yield Weed-Free and Weedy





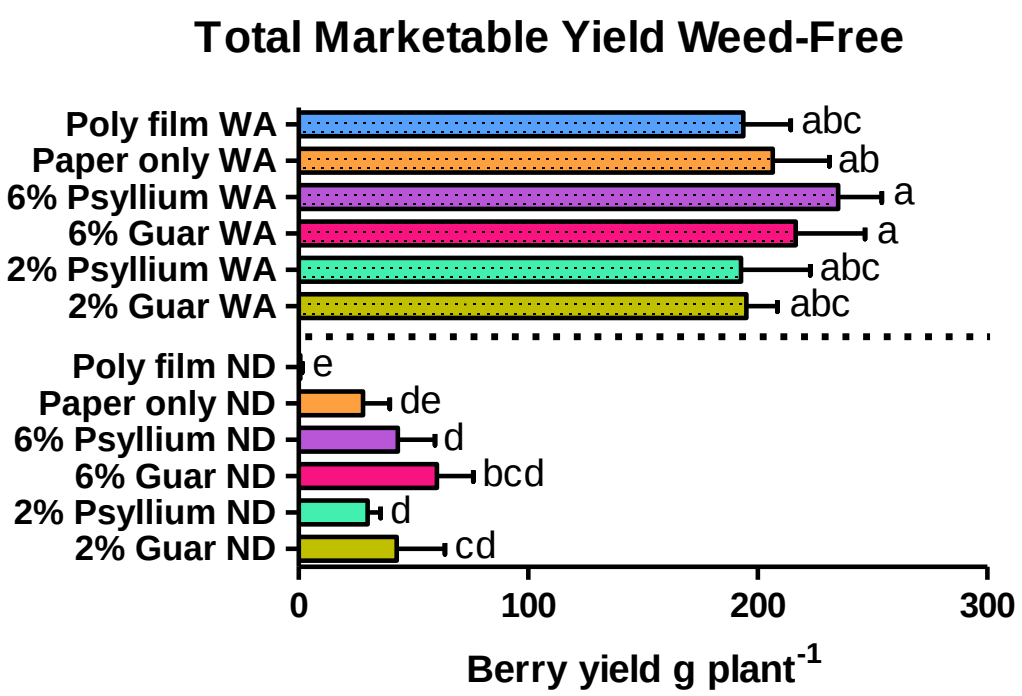
Marketable Berry Yield Weedy

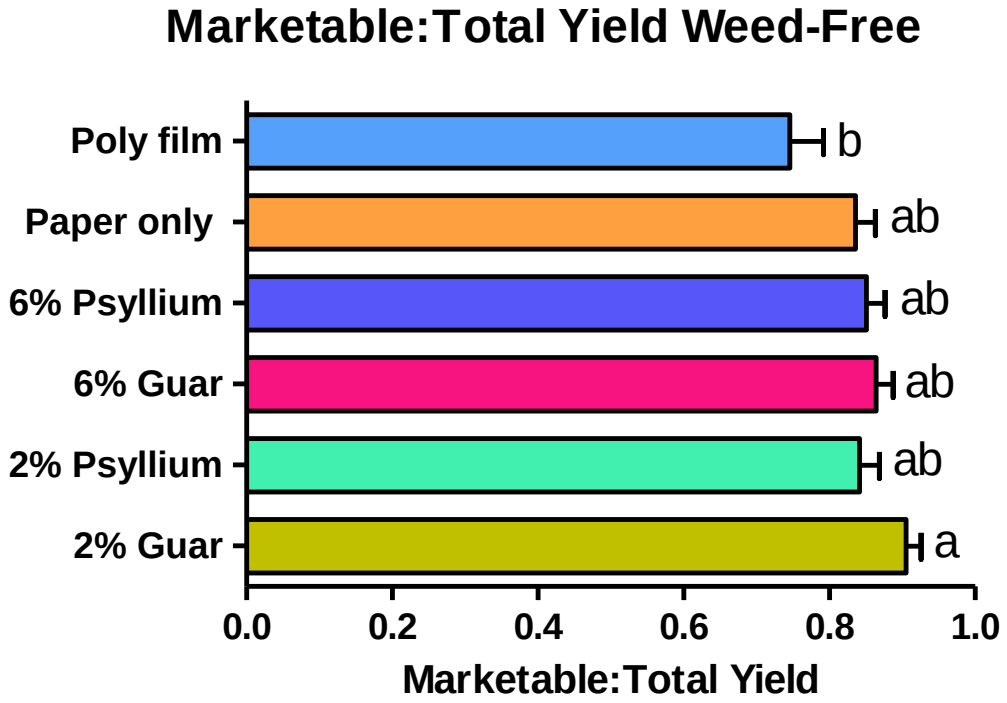




Note: Yield is expressed per-plant because plots had differing numbers of plants and this plant loss was **not** associated with mulch treatment.

Marketable Berry Yield Weed-Free





Note: Yield is expressed per-plant because plots had differing numbers of plants and this plant loss was **not** associated with mulch treatment.

The proportion of marketable yield was greater for WA than for ND ($p < 0.0001$, 93 vs. 69%, respectively.

Acknowledgments for Hydromulch Project

- Co-PIs:
  - Lisa DeVetter, Washington State U
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  - Suzette Galinato, Washington State U
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  - Sharon Weyers, USDA-ARS, Morris MN
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  - Ross and Amber Lockhart, Heart and Soil Farm, ND
- Graduate Students:
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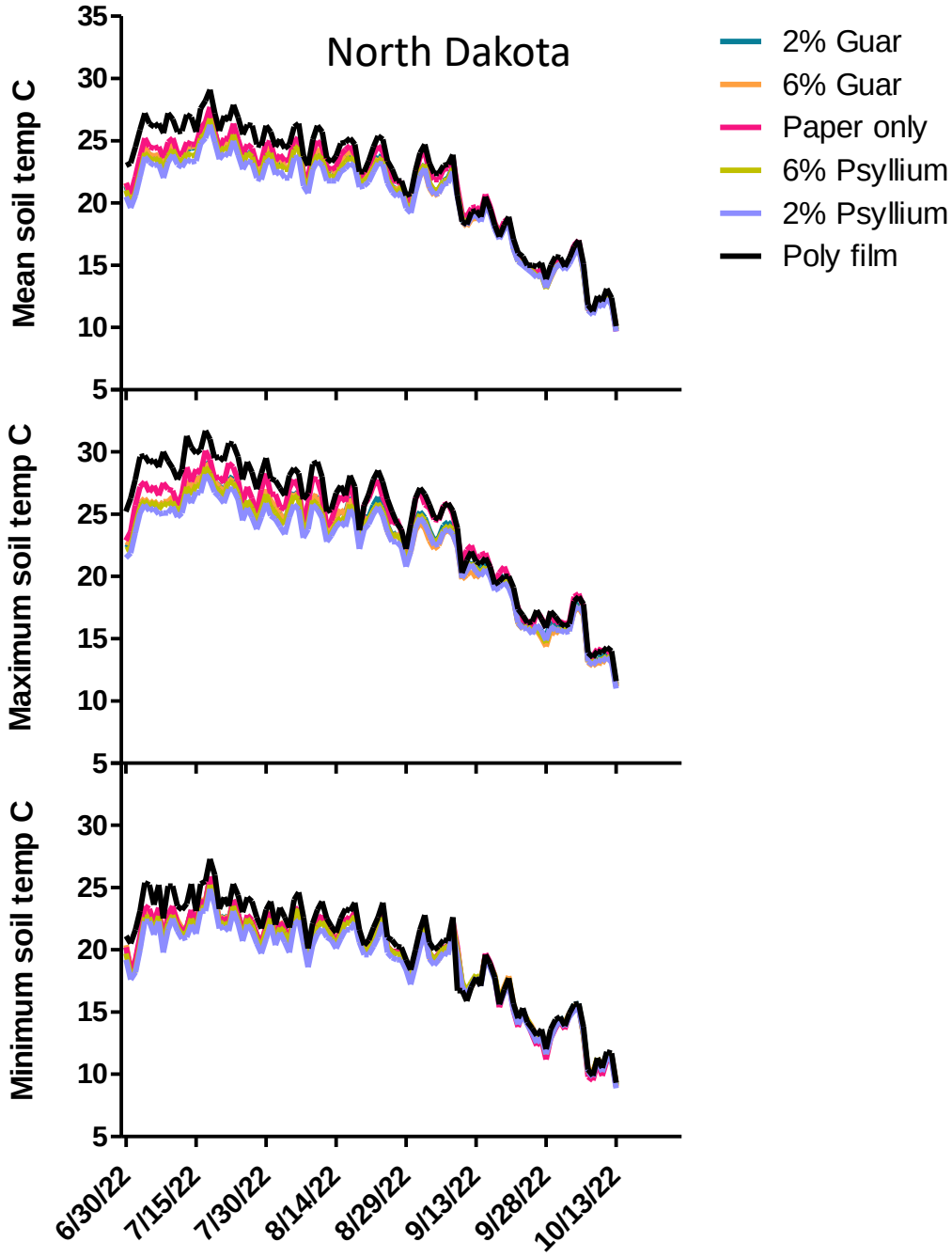
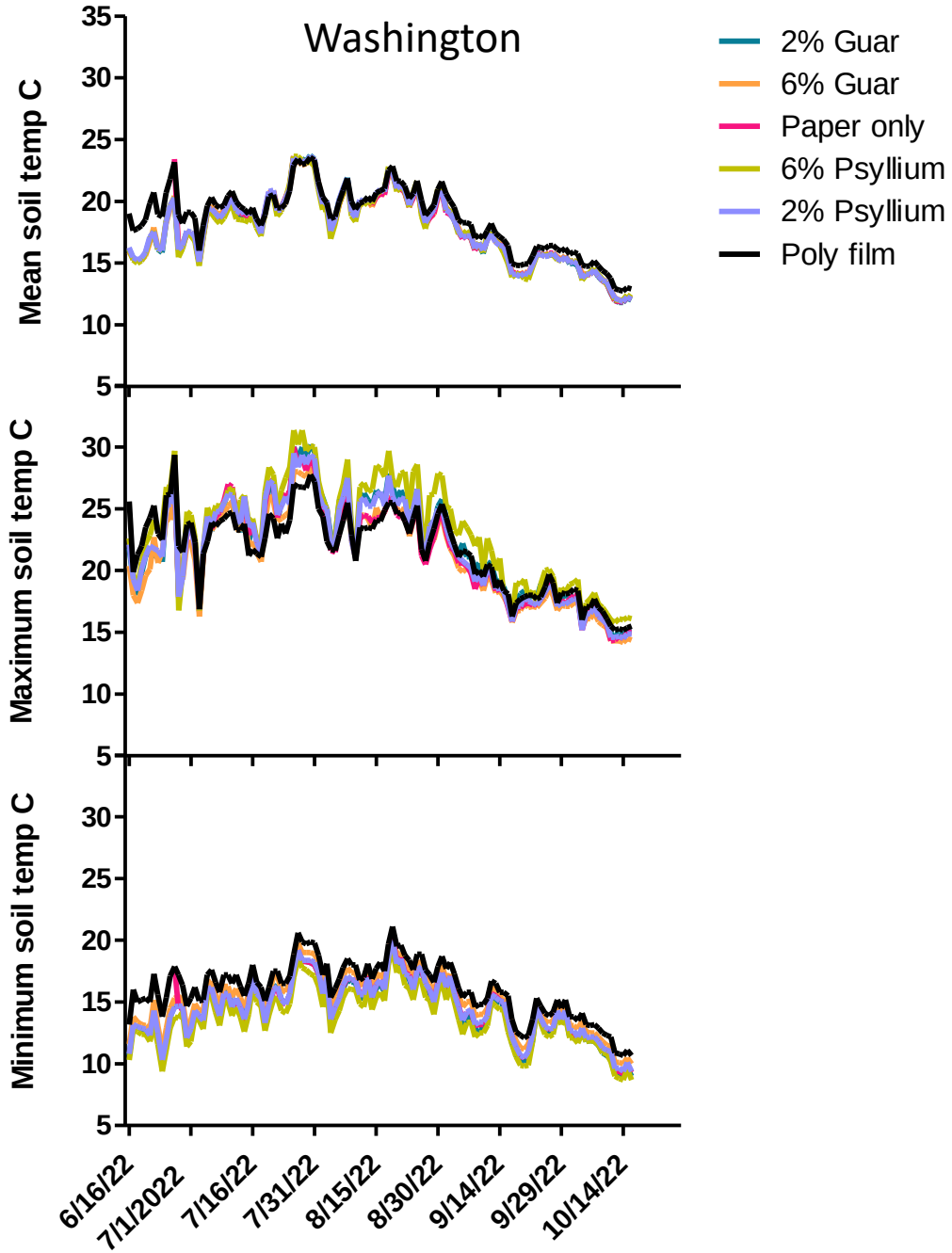
- Technical Support:
  - Pete Gregoire and Keith Biggers (NDSU)
  - Brian Maupin (WSU)


North Dakota
Mean soil temp C
Maximum soil temp C
Minimum soil temp C
35
30
25
20
15
10
5
6/30/22
7/15/22
7/30/22
8/14/22
8/29/22
9/13/22
9/28/22
10/13/22
2% Guar
6% Guar
Paper only
6% Psyllium
2% Psyllium
Poly film


Washington
Mean soil temp C
Maximum soil temp C
Minimum soil temp C
35
30
25
20
15
10
5
6/16/22
7/1/2022
7/16/22
7/31/22
8/15/22
8/30/22
9/14/22
9/29/22
10/14/22
2% Guar
6% Guar
Paper only
6% Psyllium
2% Psyllium
Poly film

Soil moisture content