Integrated crop-livestock systems for cotton weed management.

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Background

- Rising costs and declining efficacy of seed technologies and herbicides
- Tillage is the main option for non-chemical weed control
- Conventional farmers seeking alternatives
- Organic farmers interested in no-till weed management options

Why sheep?

- Natural aversion to gossypol
- Many problematic weeds are palatable forages
- Prevalence in West Texas
- Potential revenue for farmers
- No discrimination between herbicide-resistant and susceptible weeds

Hypotheses

Relative grazing preference for weeds (vs. cotton) will increase with cotton maturity.

Sheep herbivory can be a viable method of weed management in cotton

Objectives

Characterize the grazing habits of sheep in cotton relative to cotton growth stage.

Evaluate the effects of sheep grazing initiation timing and intensity on ultimate cotton and weed biomass.

Methods - Design

- RCBD with 4 replications
- 3x3 factorial
  - 3 grazing initiation timings (4-leaf, 8-leaf, mid-bloom)
  - 3 grazing termination indicators (70%, 90%, 100% weed removal)
- Weed-free check (WFC)
- Weedy check (WC)

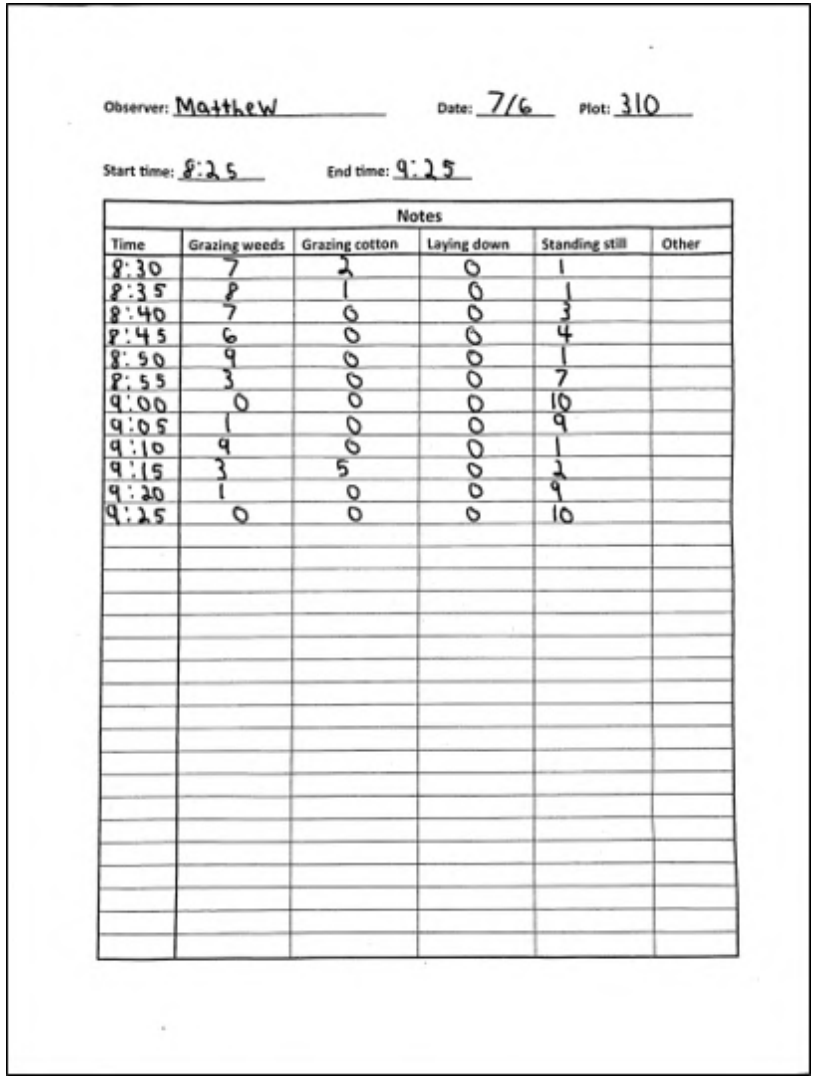
Methods - Plot management

- Location: San Angelo, TX
- Cotton variety: PHY 480 W3FE
- Row spacing: 102 cm (40”)
- Plot size: 12m x 26m (2022) or 8m x 13m (2023)
- Seeding rate: 92,000 seeds ha^{-1}
- Sheep per plot: 18 (2022) or 10 (2023)

Methods - Measurements

- Documented sheep behavior while in plots
  - Converted to sheep grazing hours per hectare (SGH)
- Cotton vs. weed canopy coverage via overhead imagery
- Final cotton and weed biomass

- Responses analyzed with mixed models in SAS 9.4
  - Fixed effects: Year | Initiation timing | Grazing intensity
  - Random effects: Block(Year)
  - Means separated with Fisher's LSD ($P < 0.1$)



Observer: Matthew Date: 7/6 Plot: 310

Start time: 8:25 End time: 9:25

Notes					
Time	Grazing weeds	Grazing cotton	Laying down	Standing still	Other
8:30	7	2	0	1	
8:35	8	1	0	1	
8:40	7	0	0	3	
8:45	6	0	0	4	
8:50	9	0	0	1	
8:55	3	0	0	7	
9:00	0	0	0	10	
9:05	1	0	0	9	
9:10	9	0	0	1	
9:15	3	5	0	2	
9:20	1	0	0	9	
9:25	0	0	0	10	

Non-grazed plot (left) vs. grazed plot (right)

Results (Simplified)

- Timing of grazing initiation and year had significant effects on sheep grazing behavior, as well as cotton and weed measurements.
- Ultimate outcomes were not significantly affected by grazing intensity.
- Very few interactions of consequence.

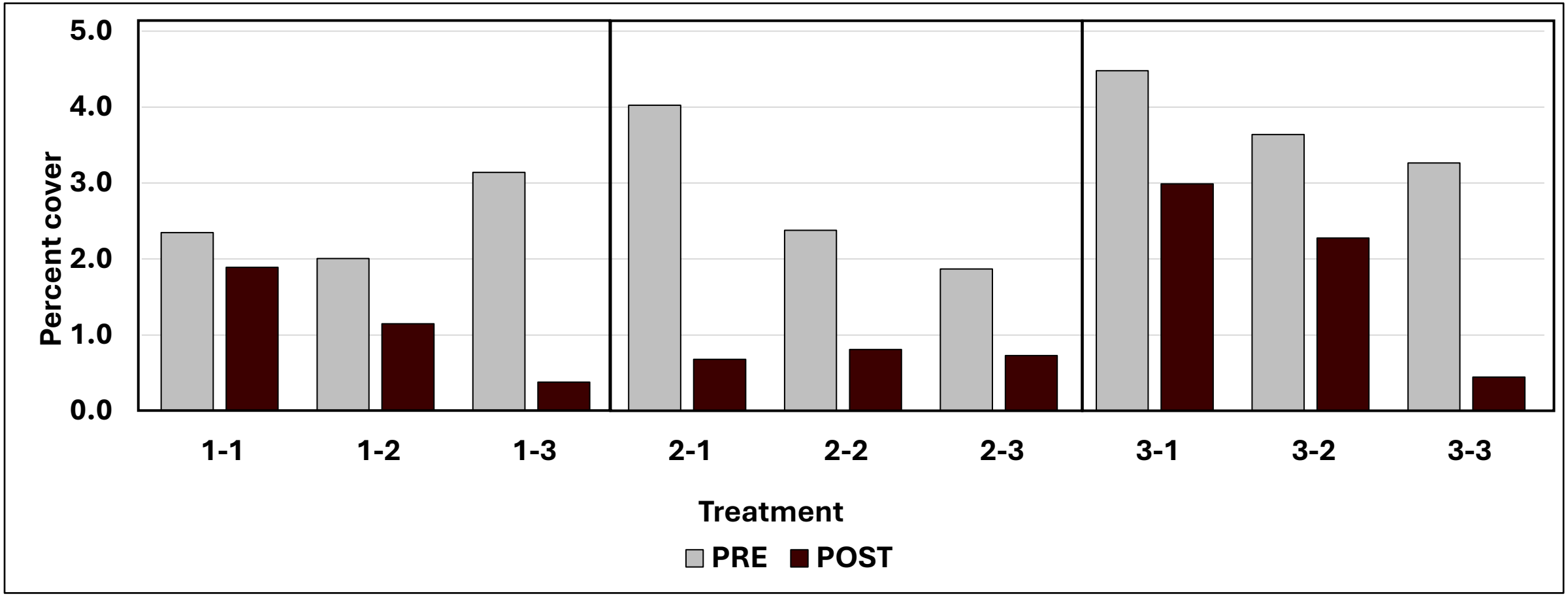
Year effects on sheep behavior

- 2023 had greater initial weed growth, which aligns with differences in weed SGH.

- Sheep came from the same herd in both years.
  - In the second year, **they immediately ate more cotton**.

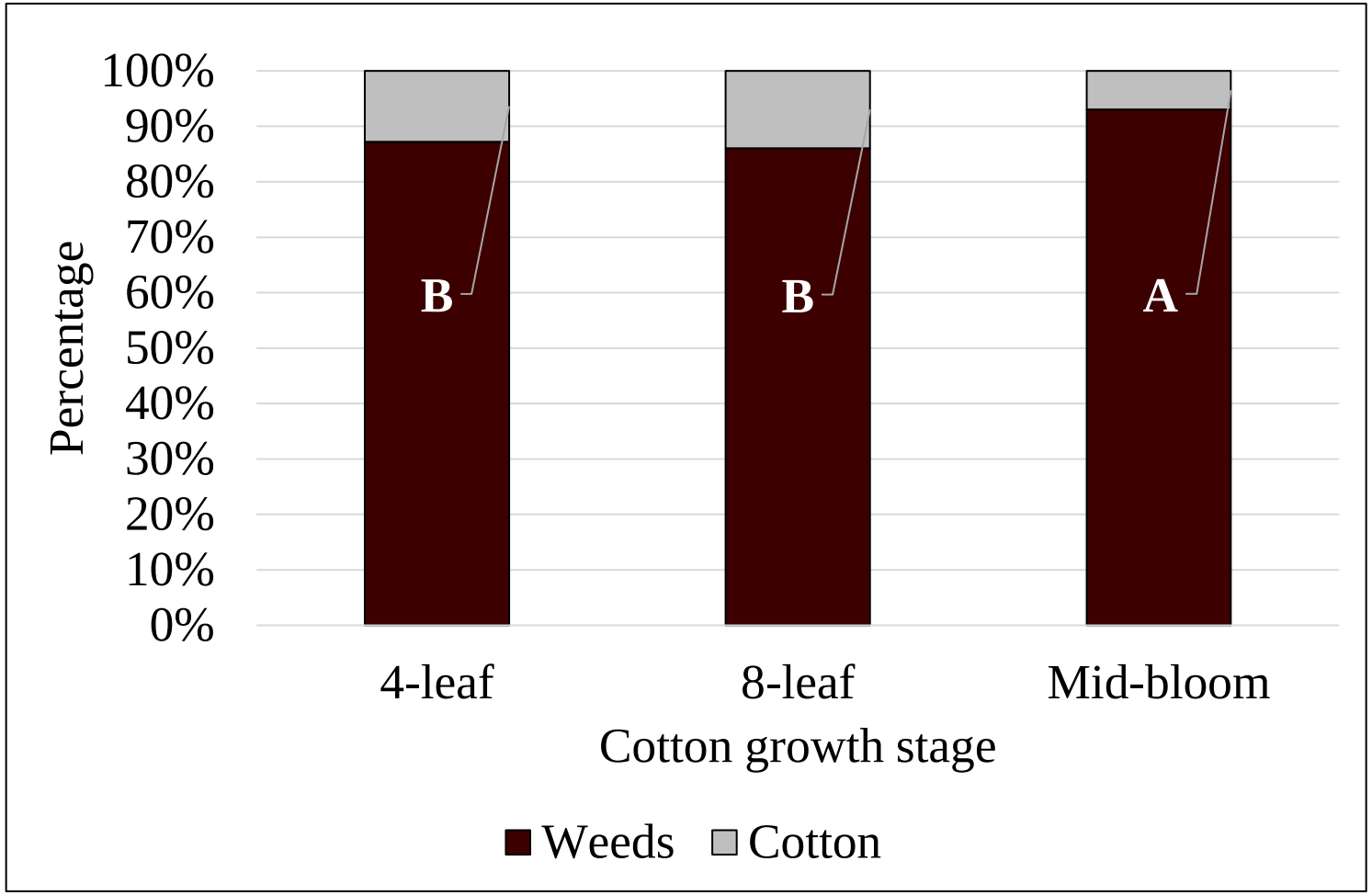
Year	Weed SGH		Cotton SGH	
	Initial	Season	Initial	Season
2022	186b	215b	10b	19b
2023	327a	329a	60a	78a

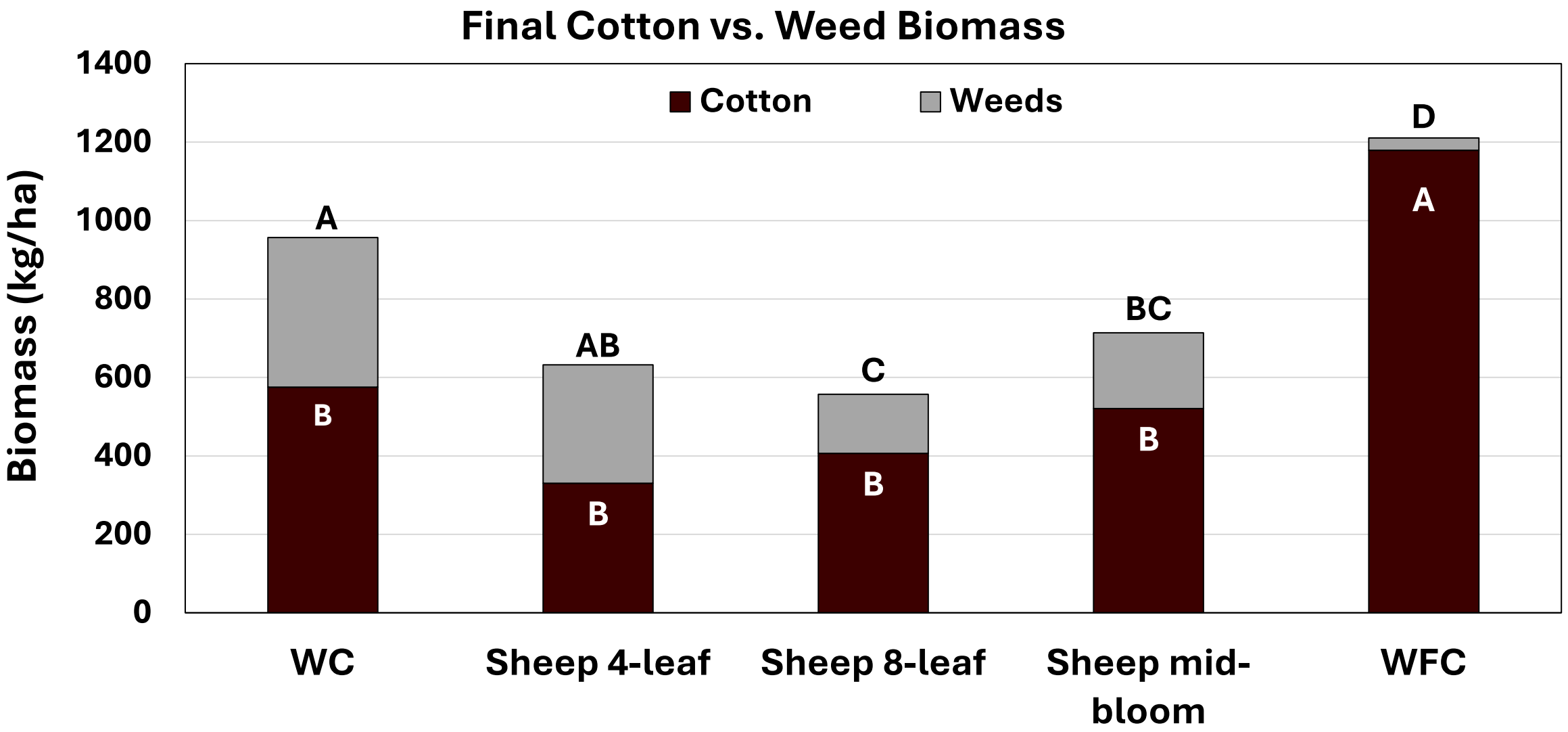
Weed canopy percentage before and after grazing (2022)



Grazing selectivity per cotton growth stage

- Sheep always ate more weeds than cotton.
- Cotton grazing declined with increasing maturity.
- Unfortunately, sheep grazing the crop 10 to 15% of the time can still be damaging.





- Sheep grazing reduced weed biomass but did not increase (or decrease) cotton biomass compared to the weedy check.

Conclusions

- Selectivity towards weeds increased with cotton maturity
- Sheep reduced weed biomass relative to weedy check
- Early-season grazing risks greater herbivory on the cotton
- Late-stage grazing initiation was likely too late in the season for weed management to improve crop growth
- Herbivory for weed management has merit, although successful in-crop grazing will likely be challenging to justify.

Thank you

- **Project funded by Southern SARE**
- Research performed in cooperation with Angelo State University
- San Angelo AgriLife Extension Agronomy team

Questions?