Evaluating The Role Of Grazing Strategies On Plant Production And Soil Health Across A Decade Timescale

Merilynn Hirsch-Schantz | USDA-ARS Grassland Soil and Water Research Station
Douglas R. Smith | USDA-ARS Grassland Soil and Water Research Station
Javier Osorio Leyton | Texas A&M AgriLife Research Station
Kabindra Adhikari | USDA-ARS Grassland Soil and Water Research Station
Jeff Goodwin | Center for Grazing land Studies, Texas A&M University
Douglas R. Tolleson | Texas A&M AgriLife Research Station
Kelly Thorp | USDA-ARS Grassland Soil and Water Research Station
(Robert) Daren Harmel | Center for Agricultural Resources Research

USDA
U.S. DEPARTMENT OF AGRICULTURE

ltar
Long-Term Agroecosystem Research

Texas is cattle country

Grazing is a common land use across the state

There is an ongoing debate between rotational and continuous grazing

Weather related disturbances are increasing in frequency

- Droughts
- Flooding
- Erosion

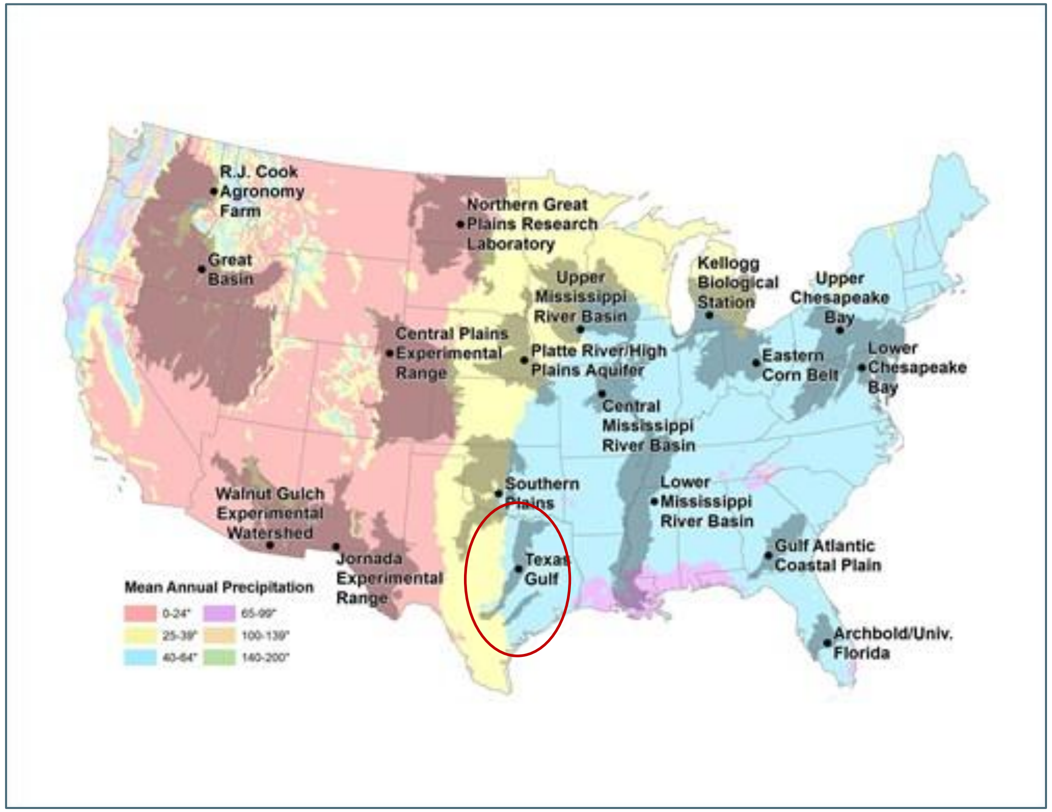
- Alternative grazing management strategies may increase the resistance and resilience to weather-related disturbances.

- There is potential to sell carbon credits but little information on the sequestration of pasturelands

LONG-TERM AGROECOSYSTEM RESEARCH

- The Long-Term Agroecosystem Research Network | LTAR
    - Common grazing land studies
- Accounting for differences in grazing on plant production and soil health
- Relevant studies must be long-term and spatially realistic

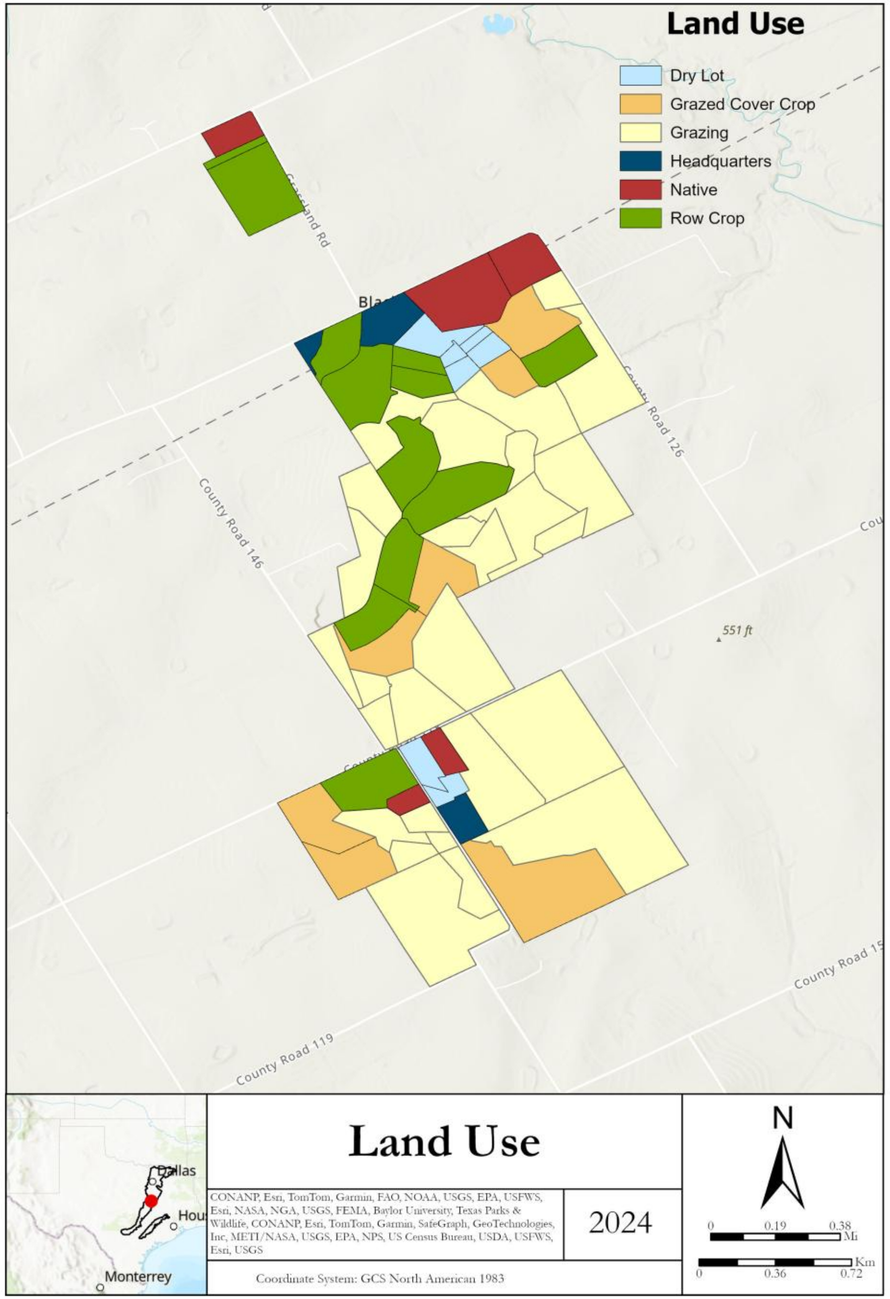
ltar
Long-Term
Agroecosystem
Research



Objective

Compare alternative adaptive grazing land management treatments of rotational grazing supplemented with cover crops to prevailing grazing strategies of continuous use supplemented with forage oats

STUDY SITE



Land Use
Dry Lot
Grazed Cover Crop
Grazing
Headquarters
Native
Row Crop
County Road 126
County Road 146
County Road 119
551 ft
Dallas
Monterrey
Land Use
CONANP, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, USFWS, Esri, NASA, NGA, USGS, FEMA, Baylor University, Texas Parks & Wildlife, CONANP, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, USFWS, Esri, USGS
2024
Coordinate System: GCS North American 1983
N
0 0.19 0.38 Mi
0 0.36 0.72 Km

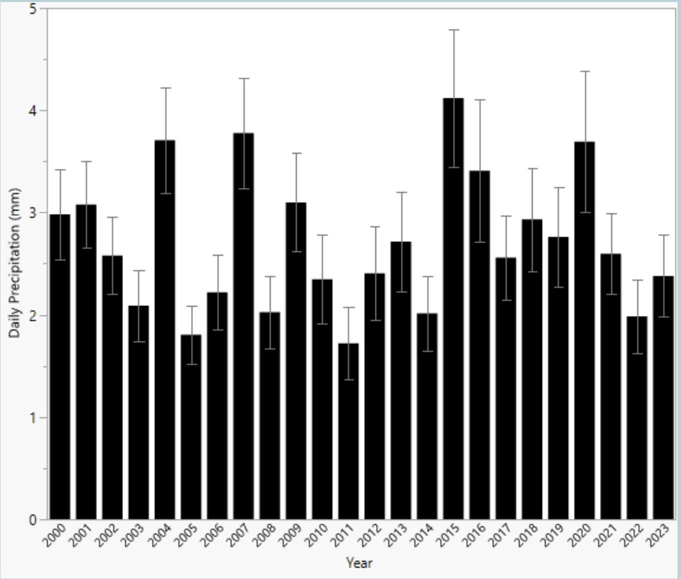
CLIMATE

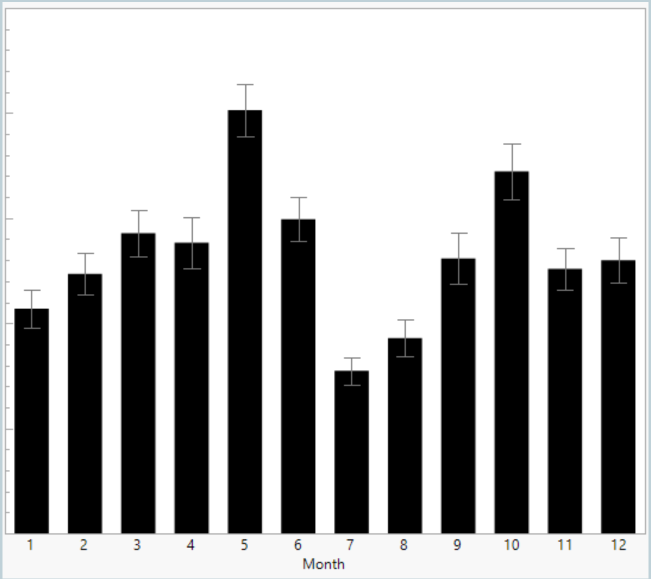
Precipitation:

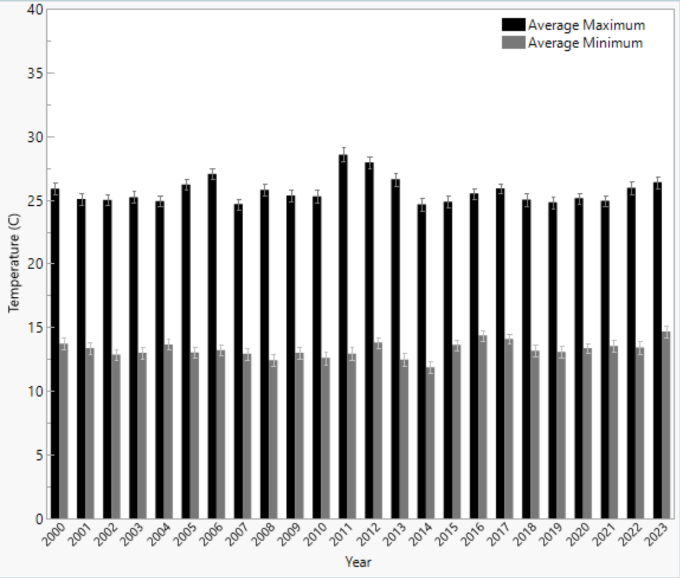
- Yearly:
    - Dynamic across years
- Monthly:
    - Bimodal

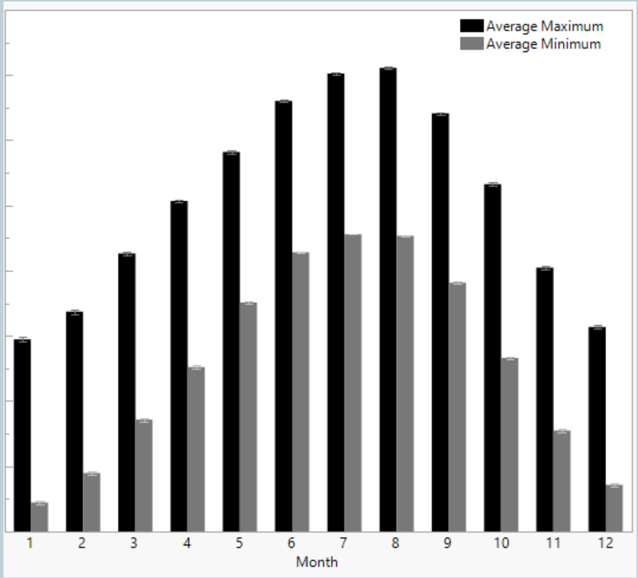
Temperature:

- Yearly
    - Constant
- Monthly
    - Unimodal





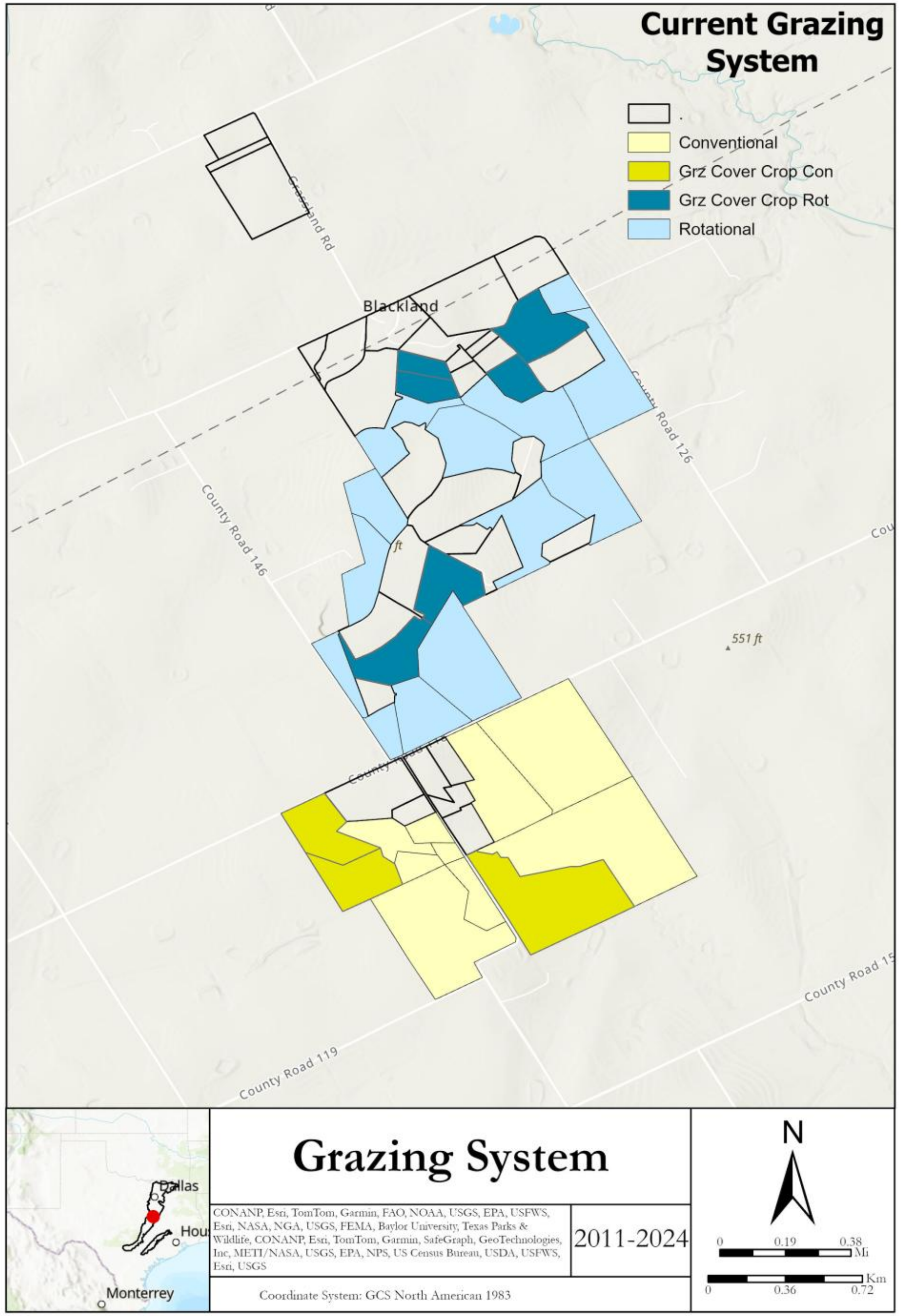




STUDY DESIGN

- Alternative-North Ranch
  - Rest-Rotational grazing (220 ac)
    - 11-month rotation
  - Grazed cover crops (summer and winter) (61 ac)
  - Adaptable stocking rate (~1.5-2.5 AUM)
  - No fertilization

- Prevailing- South Ranch
  - Continuous grazing (211 ac)
  - Grazed forage oats (winter) (71 ac)
  - Set stocking rate (2 AUM)
  - Manure added at recommended rates 2011-16

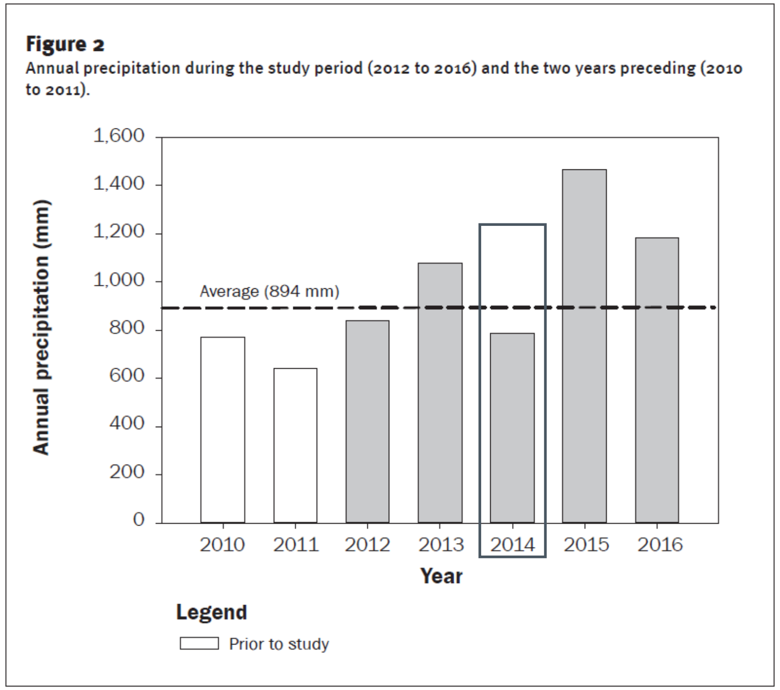


Harmel et al., 2021

METHODS

- Plant Production Sampling
  - Peak plant production (July) 2014-17
  - Year-round grazed-clipped sampling 2018-24
    - Exclosures used to account for grazing
- Fecal animal nutrition (monthly)
  - Crude protein (CP)
  - Digestible organic matter (DOM)
- Soil Sampling
  - Biannual sampling (June and November)
    - 0-15 cm taken randomly throughout pastures
  - Soil sampling
    - Deionized (DI) water extractions
      - Nitrate (NO_3), Ammonium (NH_4), Phosphate (PO_4), Total Carbon (TC), Total Organic Carbon (TOC), Total Nitrogen (TN)
    - H3A and M3 extractions
      - Phosphorus (H3A P, M3 P) and Potassium (H3A K, M3 K)

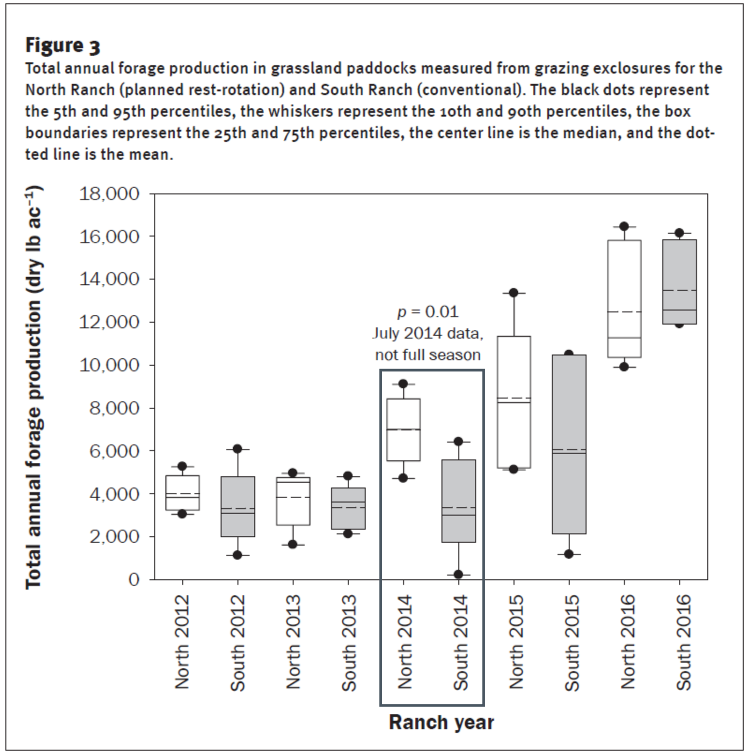
INITIAL RESULTS



Dynamic precipitation (Fig. 2)

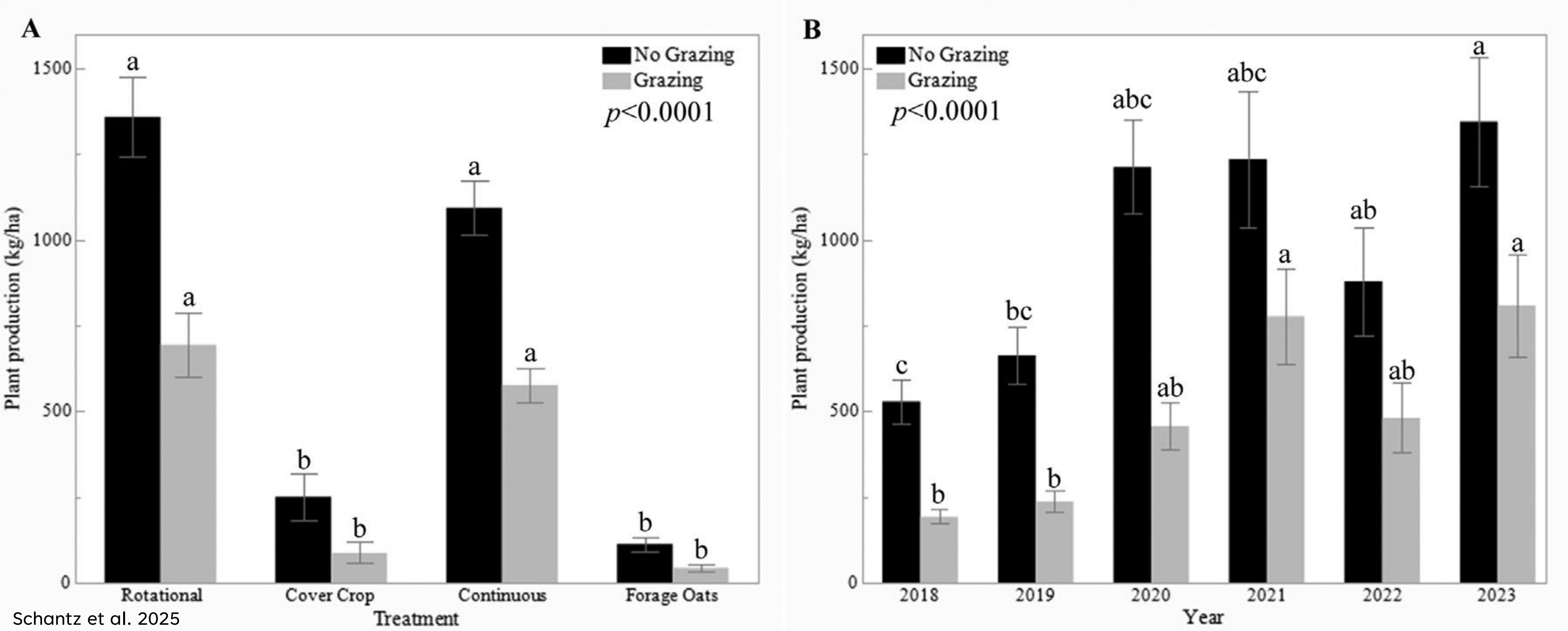
Non-significant differences in grazing strategies especially during drought (Fig. 3)

Higher production in rotationally grazed treatment (North)



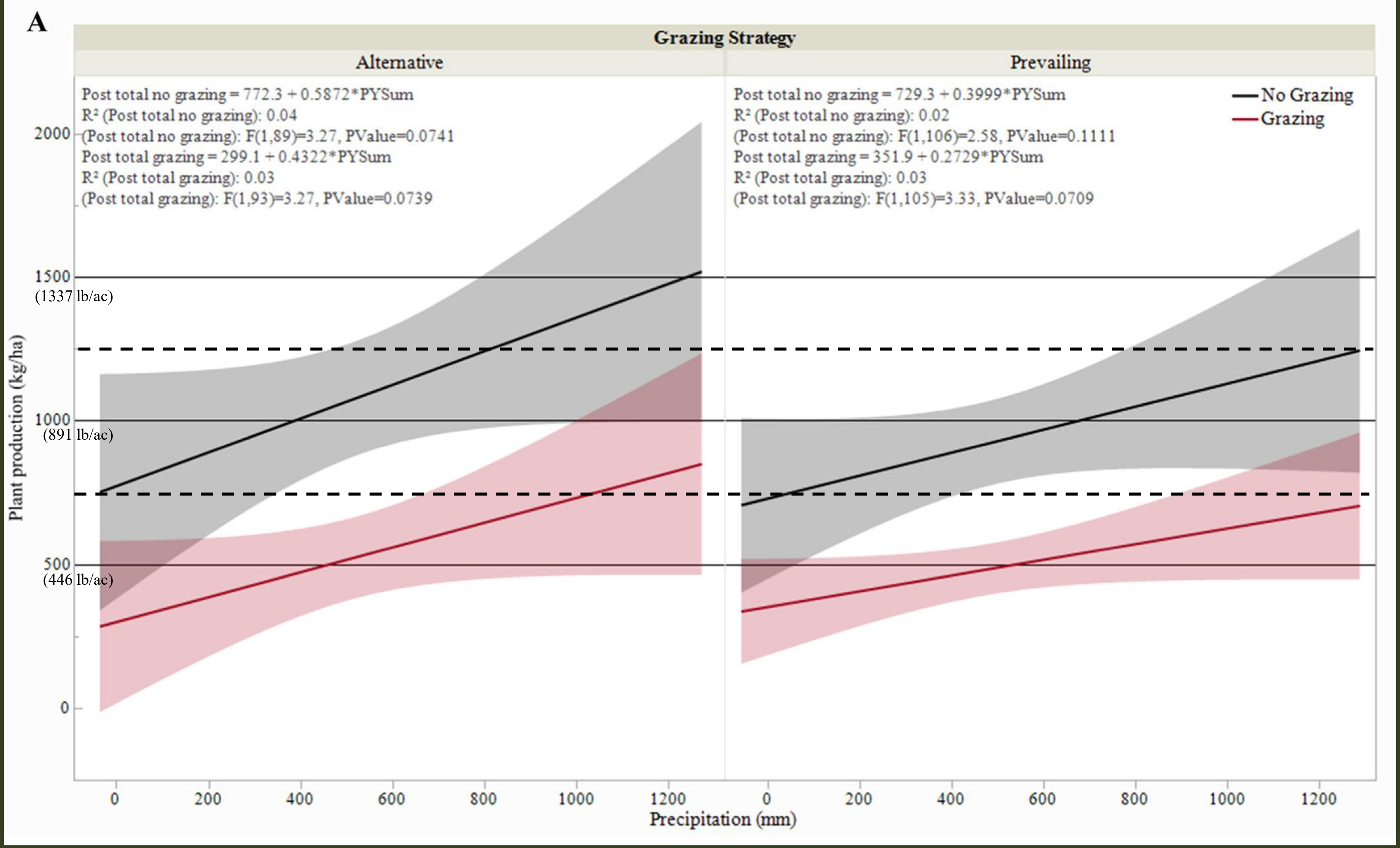
Harmel et al., 2021

PLANT PRODUCTION BY GRAZING TREATMENT



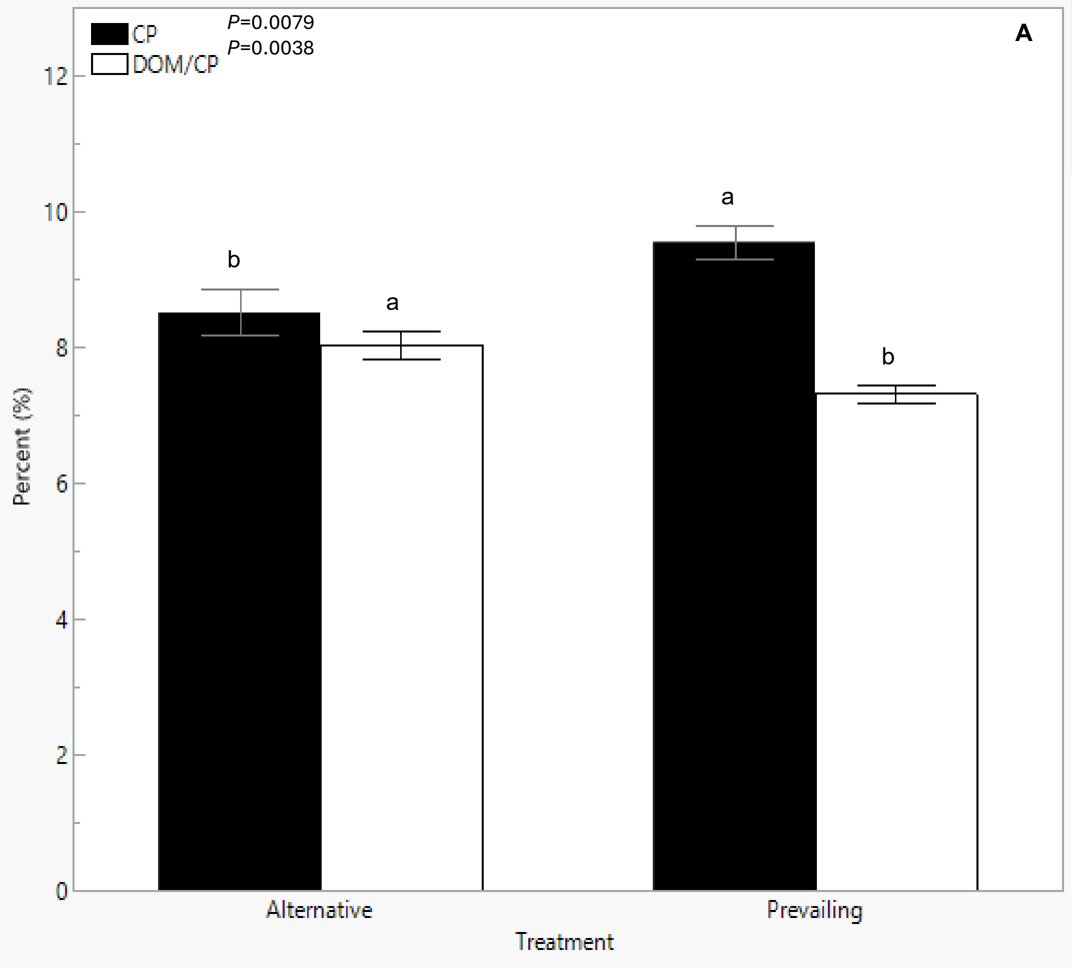
Schantz et al. 2025

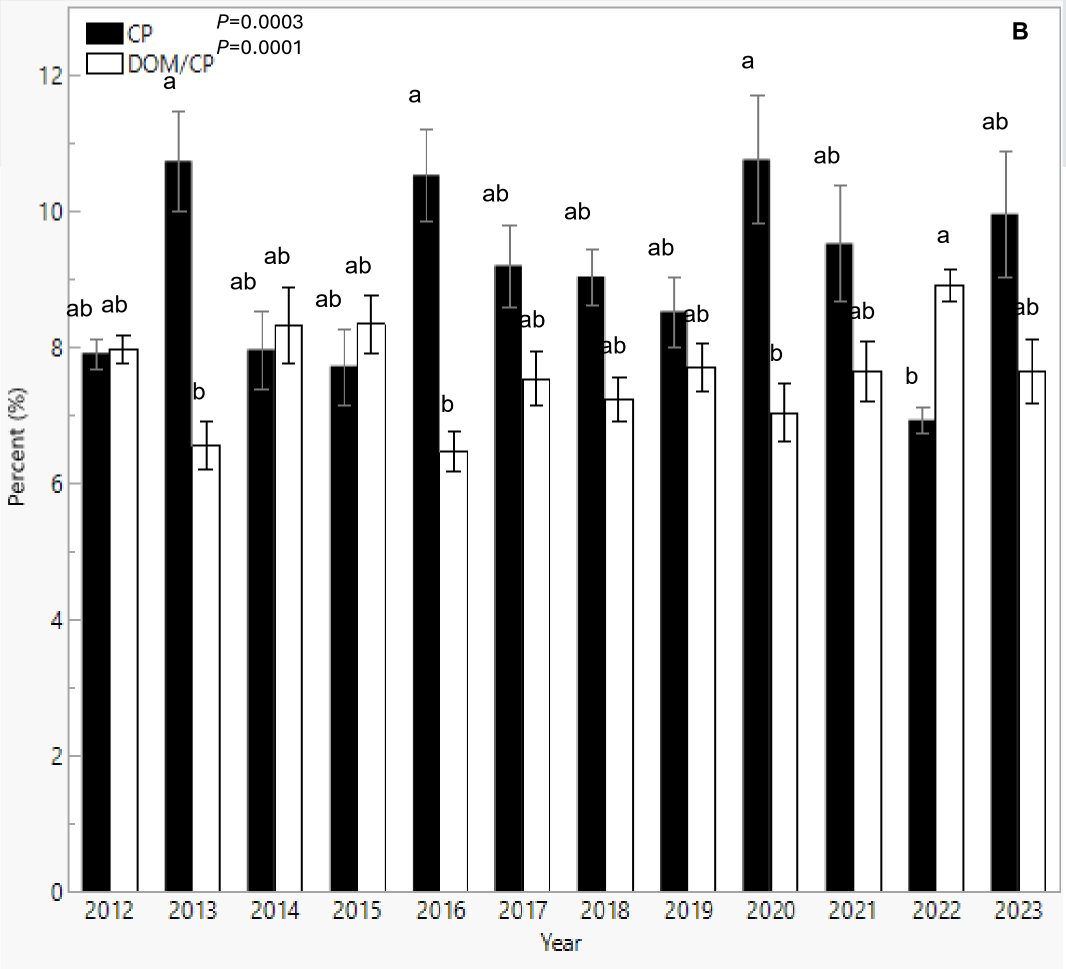
Plant production by YTD Precipitation Abundance



Schantz et al. 2025 Journal of Rangeland Ecology and Management

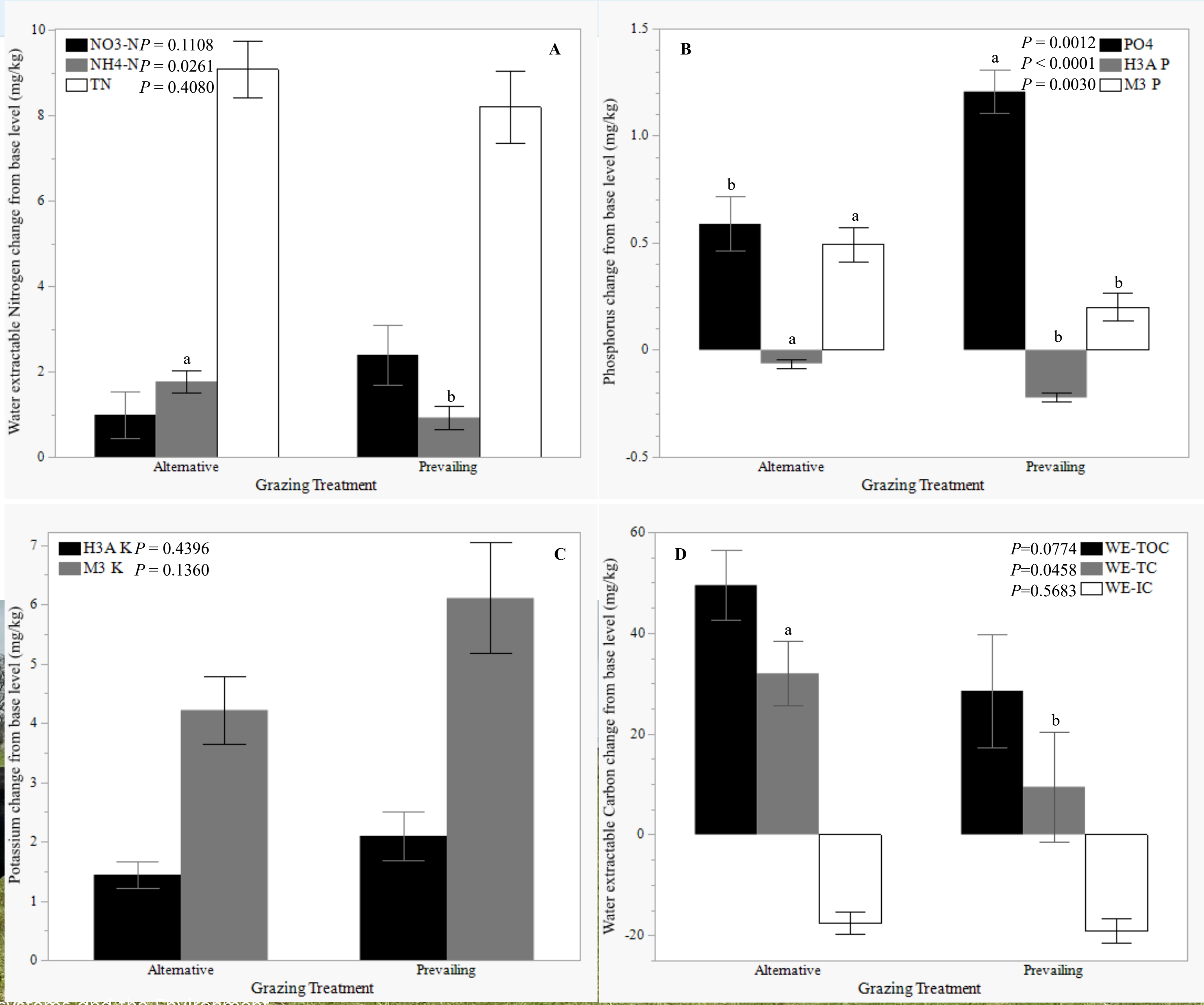
ANIMAL NUTRITION





Schantz et al. 2025 Journal of Rangeland Ecology and Management

SOIL NUTRIENT DYNAMICS

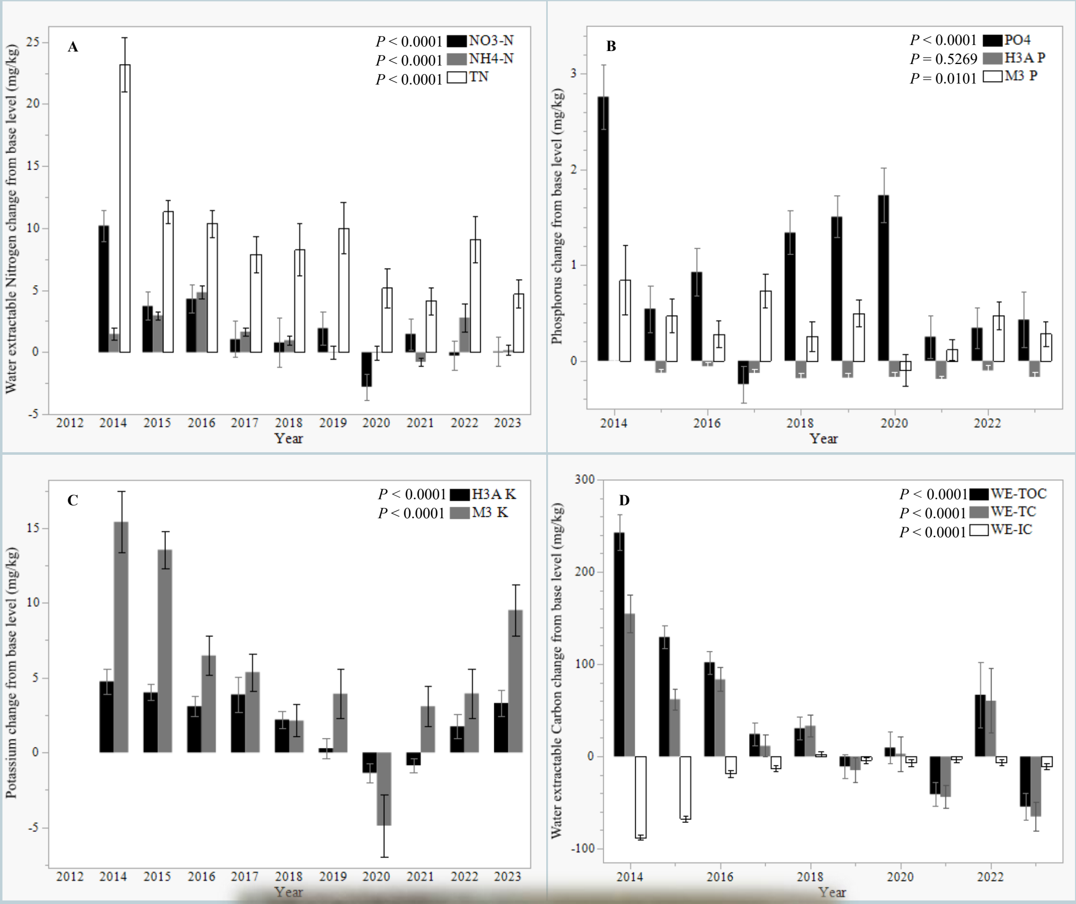


Schantz et al. 2025 Journal of Agriculture, Ecosystems and the Environment

Photo by C.J.P. Grisham

SOIL NUTRIENT AVAILABILITY

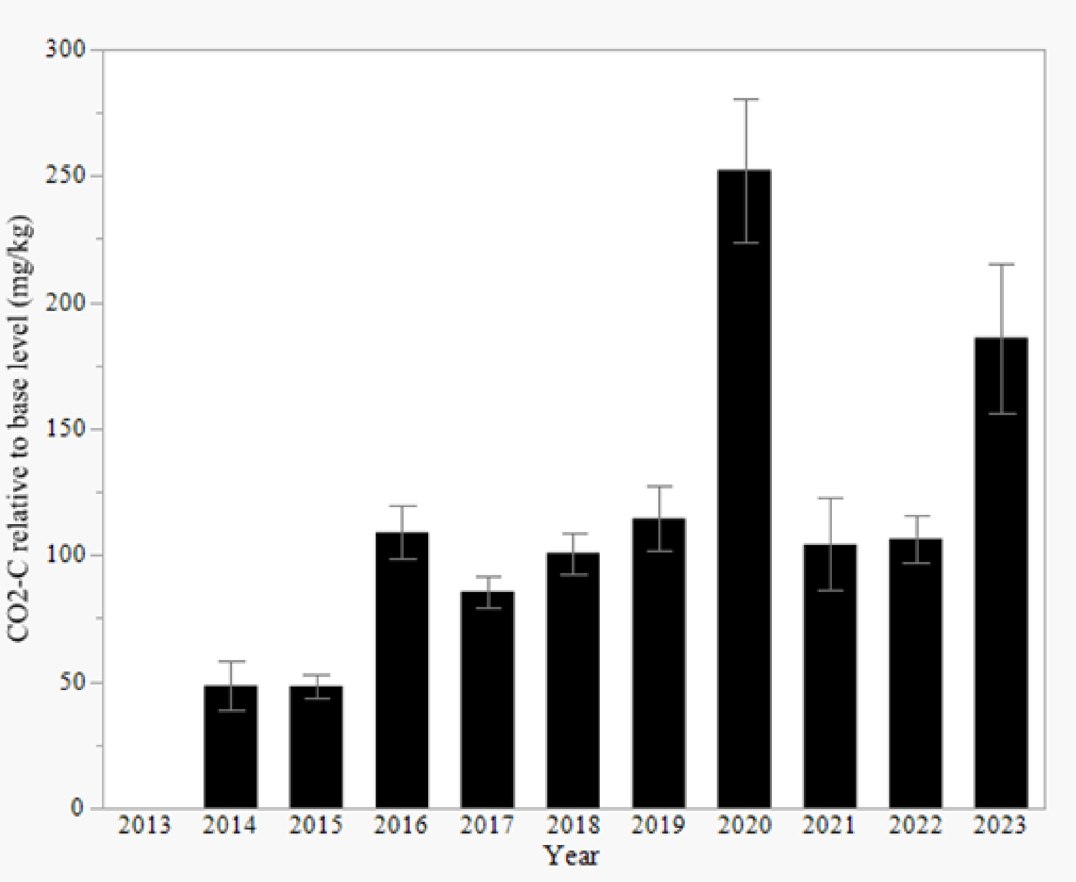
- Decreasing Nutrient Abundance through time
  - Greater efficiency/plant use?
  - Precipitation availability?
  - Microbial activity?



Schantz et al. 2025 Journal of Agriculture, Ecosystems and the Environment

TOTAL CARBON CHANGE

Greater CO_2-C i.e., microbial abundance through time.



Schantz et al. 2025 Journal of Agriculture, Ecosystems and the Environment

CONCLUSIONS

- **Biomass: Improved**
  - Alternative grazing yields greater biomass compared to prevailing grazing treatments
  - Differences may not detectable until drought and after more than a decade of grazing – legacy effects?
  - Can lead to an addition $0.50 per acre in C sequestration credits in the carbon market
- **Animal Nutrition: Inconclusive**
  - CP was higher when grazing prevailing treatments, but DOM/CP is higher in alternative treatments.
- **Soil Health: Improved**
  - Phosphate abundance is lower in alternative grazing treatments (substantial $ savings)
  - Soil NO_3 and NH_4 are dynamic largely depending on grazing treatment and precipitation
  - C and N decrease through time
    - Tied to climate cycles (i.e., drought)
    - Microbial activity


QUESTIONS
Acknowledgements:
Texas State NRCS | Dr. Wayne Polley | Dr. Rick Haney | Lynn Grote | Steve Grote | Kyle Tiner | Edward Timms | Katherine Jones | Chris Kolodziejczyk | John Sorensen | Chris Grisham | David Rowley | Eliza Ranly

NEXT STEPS


Photo by C.J.P. Grisham

NRCS-CEAP Pastureland Project

Texas A&M AgriLife

Texas State NRCS

- Virtual Fencing
- APEX-Modeling
- Rapid Assessment Tools