



# Summer legumes an alternative protein source for the Ogallala Aquifer Region

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# Background Information

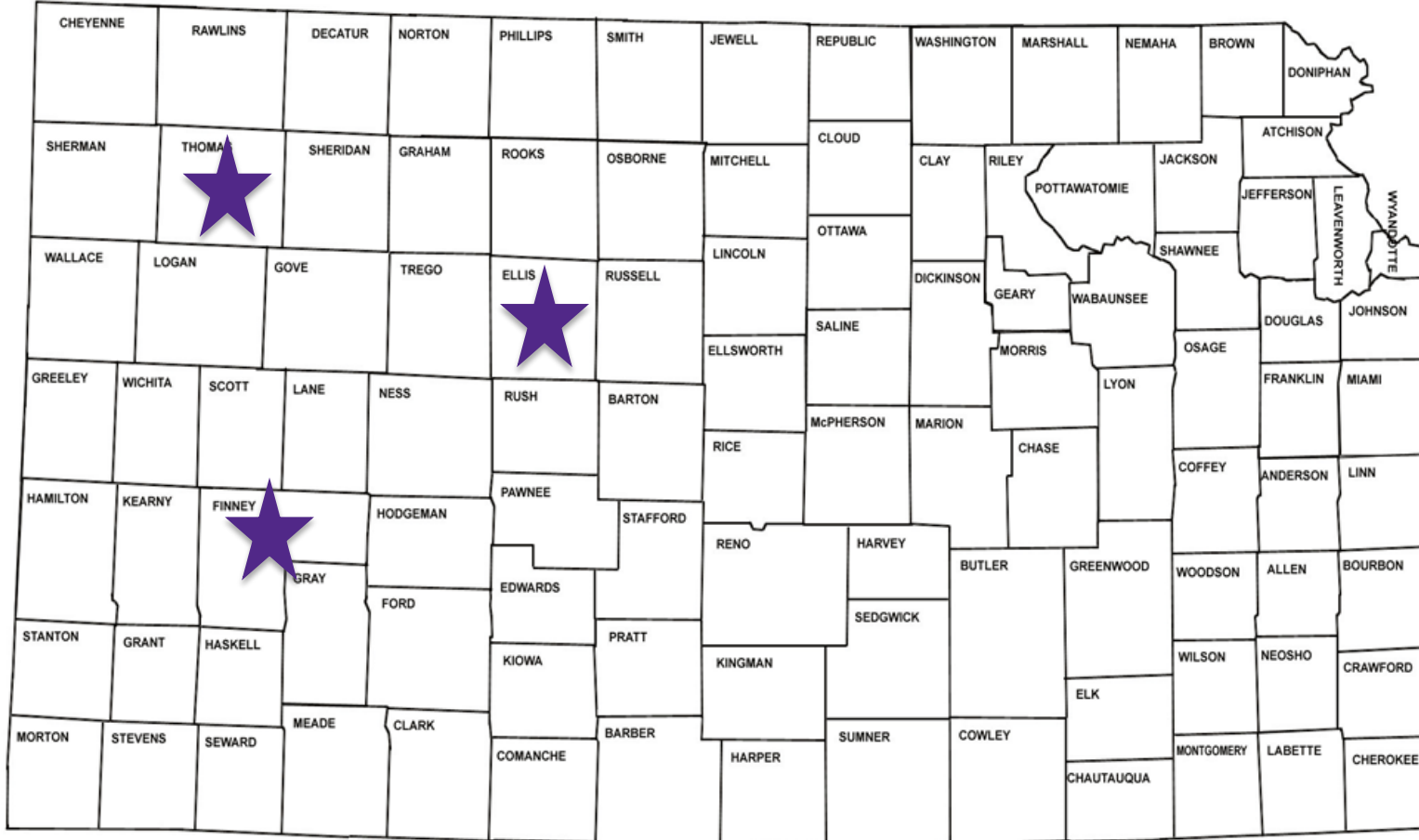


- Great regional demand for high protein forage
  - Growing & lactating cattle require higher quality forage
- Summer annual grass produce high biomass but lower quality
- Alfalfa requires irrigation (<24” rainfall)
  - 15-24” irrigation required to reach maximum yield potential
  - <10” irrigation to maintain irrigation capacity
- Summer annual forage legumes for the region?

# Objective

- Determine forage yield, nutritive value, and water-use efficiency of six warm-season annual forage species (four legume species and two grass species)

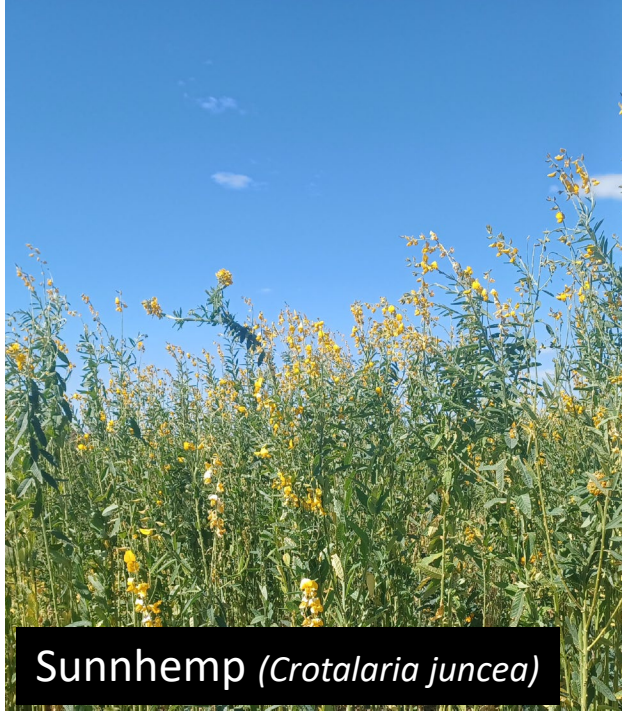
# Materials and Methods



- Garden City
  - ❖ Irrigated
- Colby
  - ❖ Dryland
- Hays
  - ❖ Dryland



Forage Soybean (*Glycine max*)



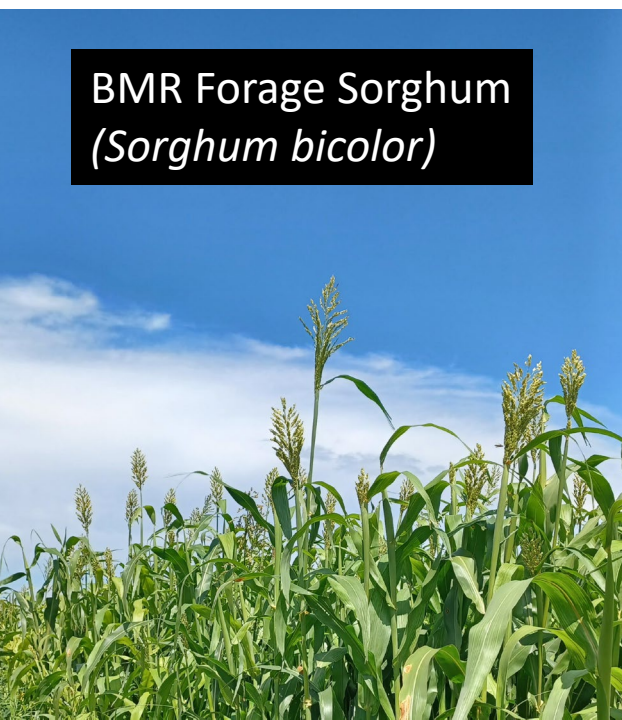
Sunnhemp (*Crotalaria juncea*)



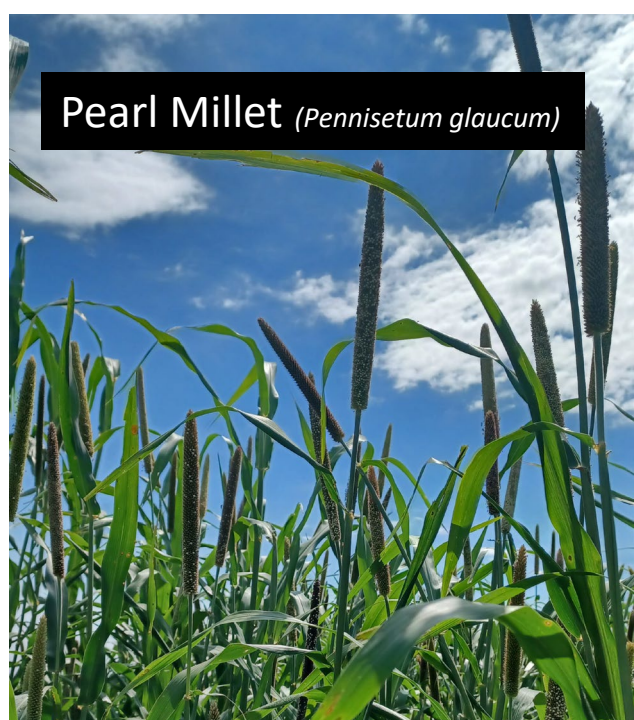
Lablab (*Lablab purpureus*)



Cowpea (*Vigna unguiculata*)



BMR Forage Sorghum  
(*Sorghum bicolor*)

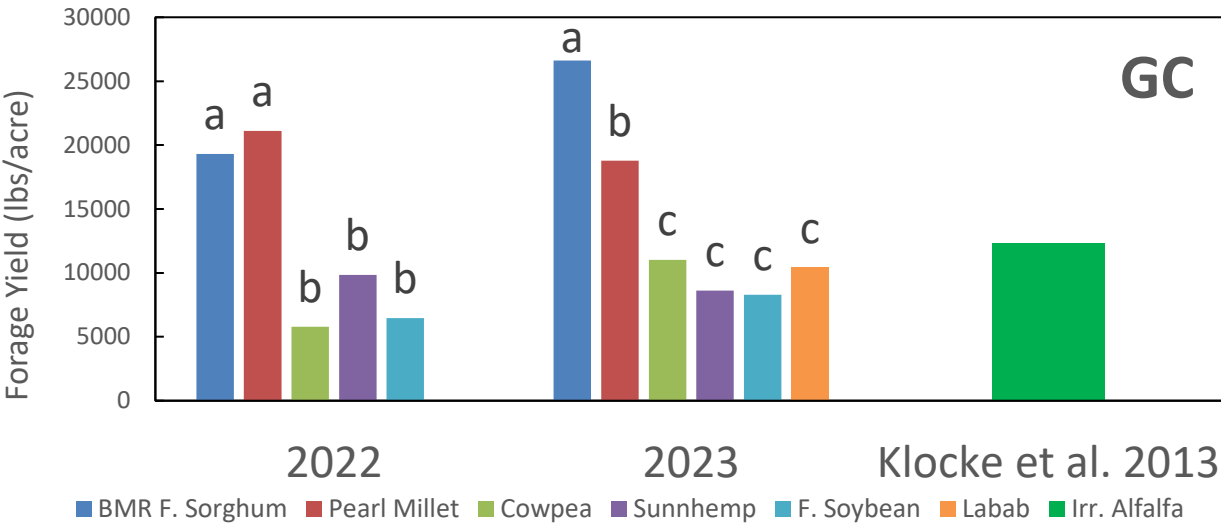
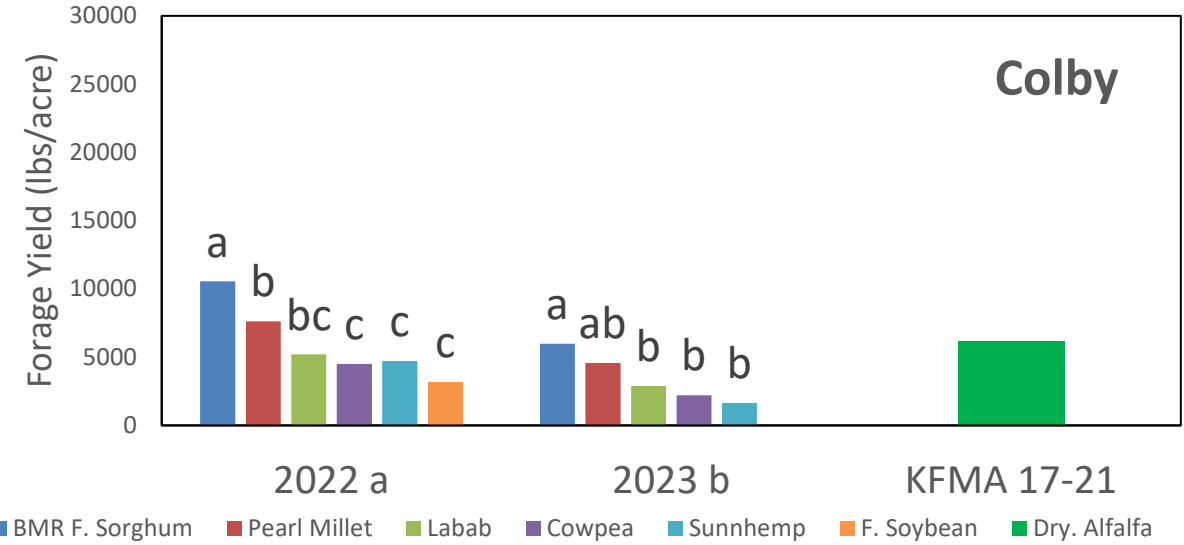
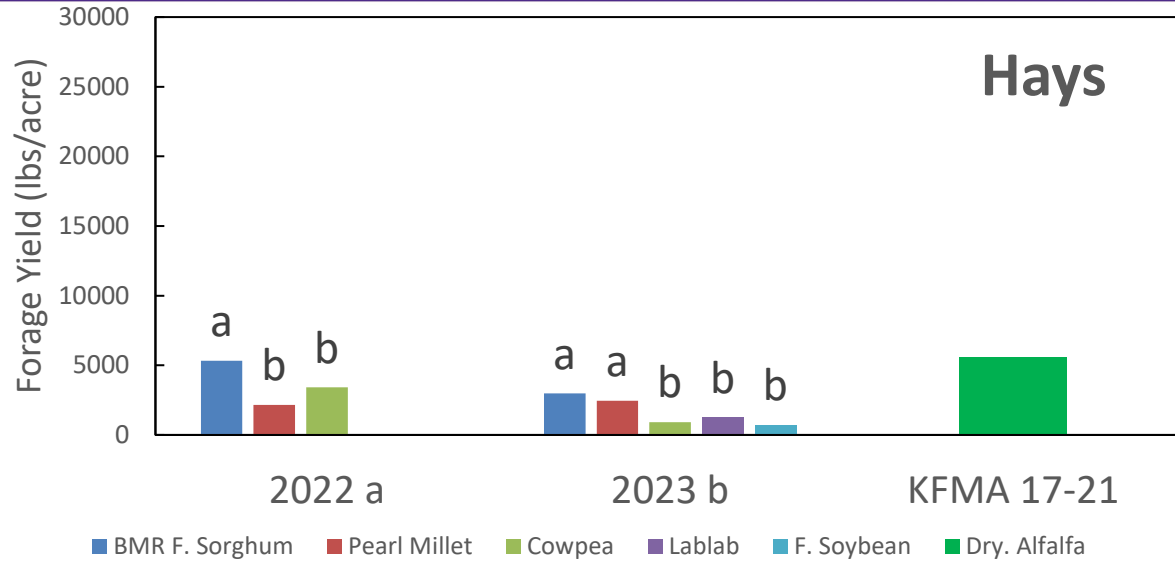


Pearl Millet (*Pennisetum glaucum*)

## Materials and Methods

- Garden City, each species harvested multiple times
- Colby and Hays, crops harvested at end of growing season
- Grasses – Boot, Anthesis, Soft Dough, and Kernel Hard
- Forage Soybean and Cowpea – Begin Flowering, Beginning Pod Formation, Beginning Seed Fill, and Beginning Maturity
- Sunnhemp – Beginning Flowering and End of Season (never formed pods)
- Lablab – End of Season (never entered reproductive stage)

# Yield x Location



## Agronomic challenges:

- Weed control and herbicide drift
- Feeding damage (sunhemp)
- Hays: 2022 and 2023 dry years
- Colby: 2023 planted very late
- Lablab grown all sites 2023

# Water Use and Water Use Efficiency

- Water use similar across species
- Water use efficiency greater for grass than legumes
  - More E required to synthesis plant protein than carbon



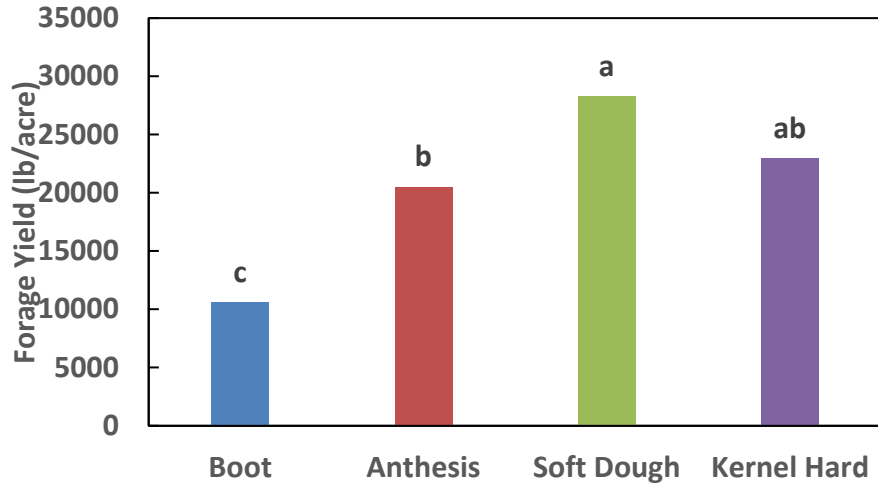
## Garden City

# Cutting Stage Impact on Forage Sorghum and Cowpea: Yield, Water Use, WUE, and Quality

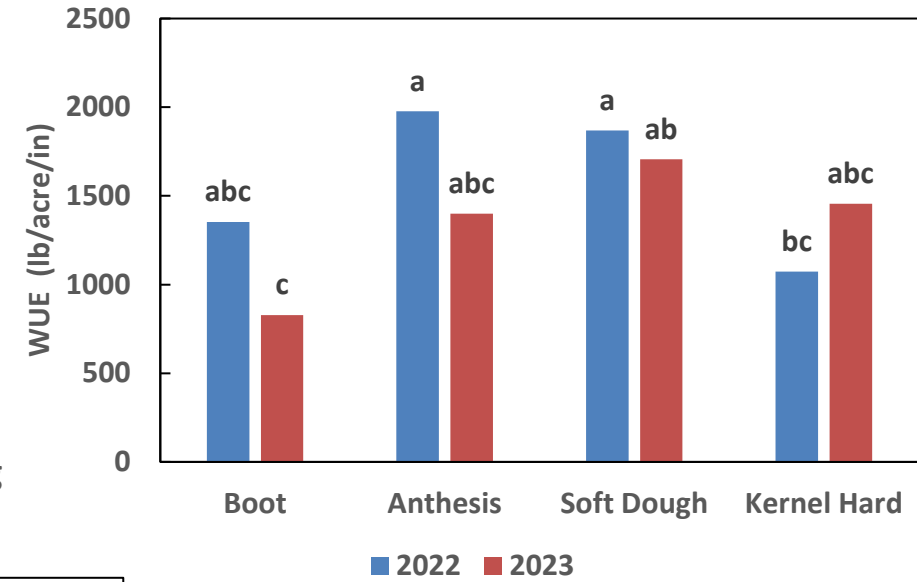


# BMR Forage Sorghum

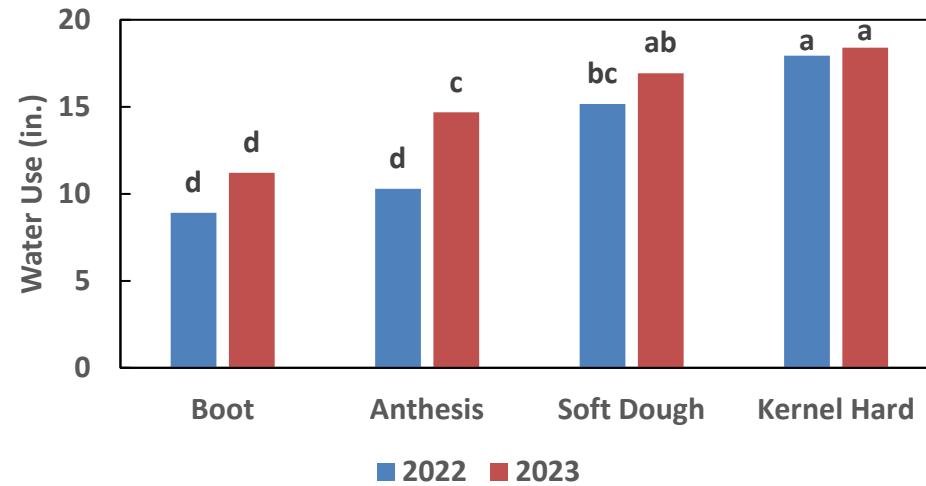
BMR Forage Sorghum Yield by Cutting Stage Across Years



BMR Forage Sorghum WUE by Cutting Stage

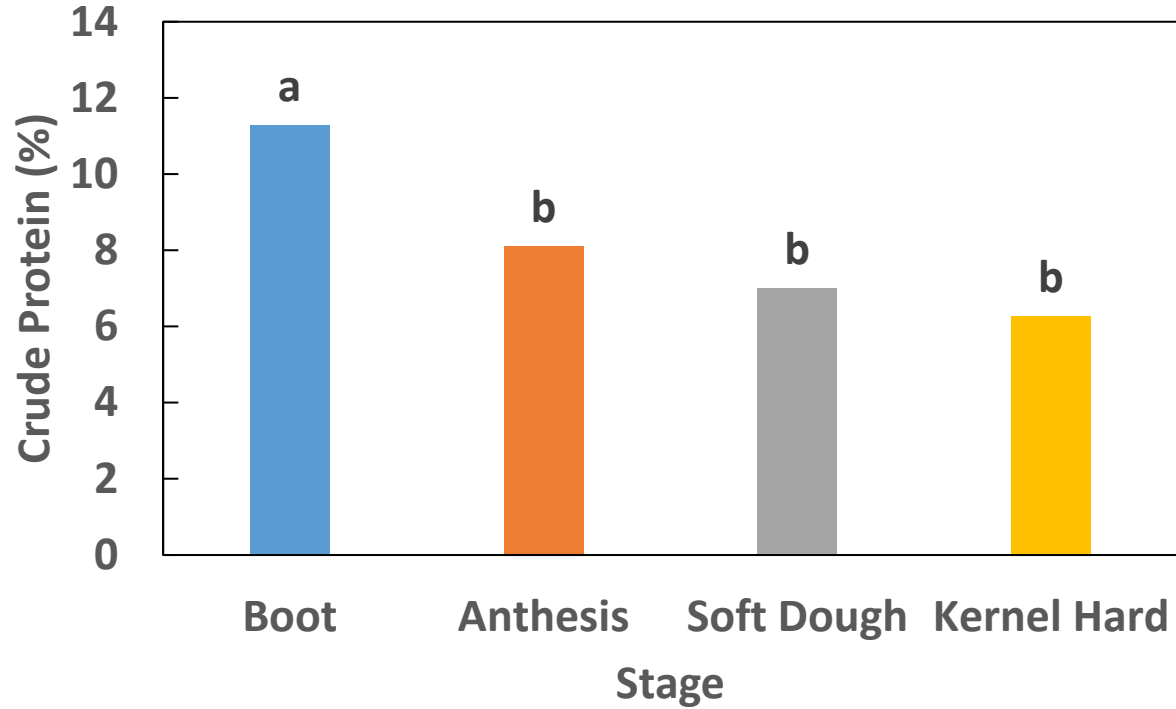


BMR Forage Sorghum Water Use by Cutting Stage

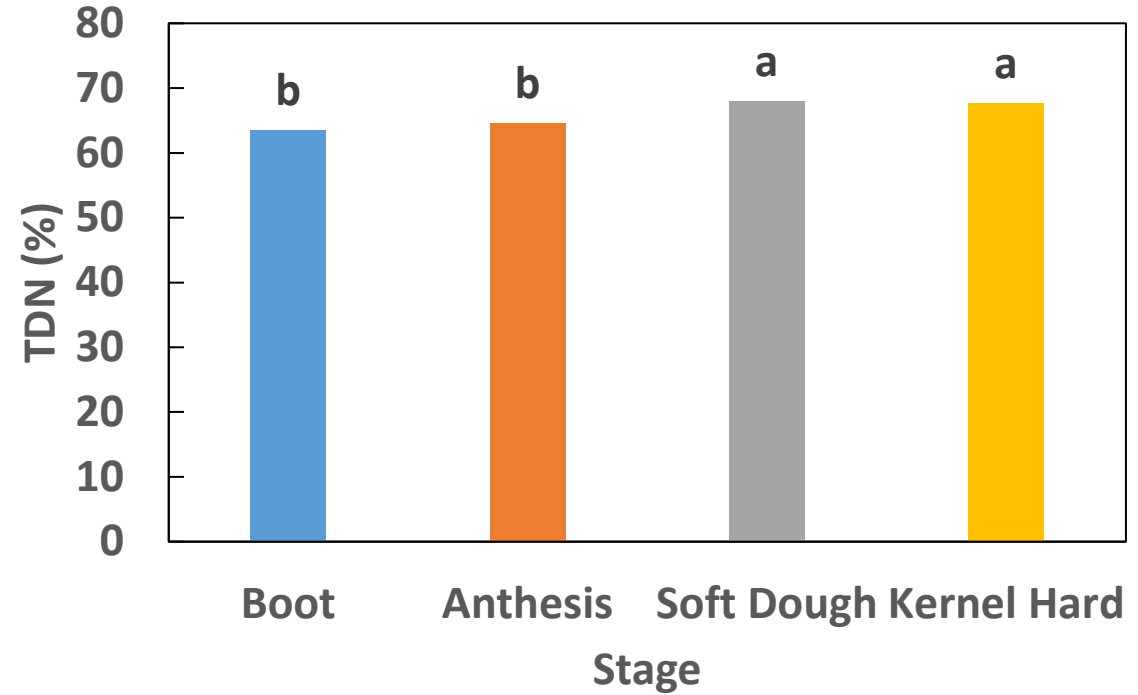


# BMR Forage Sorghum

## BMR F. Sorghum Crude Protein by Stage



## BMR F. Sorghum TDN by Stage



# Cowpea (*Variety: Iron and Clay*)



Stage	2022	2023
Planting	6/17	5/30
Flowering	9/14	10/4
Podding	10/6	
Seeding	10/11	
Maturity	10/14	



- Cowpea on 10/13/22
- Cowpea did not reach R3 in Colby or Hays either year

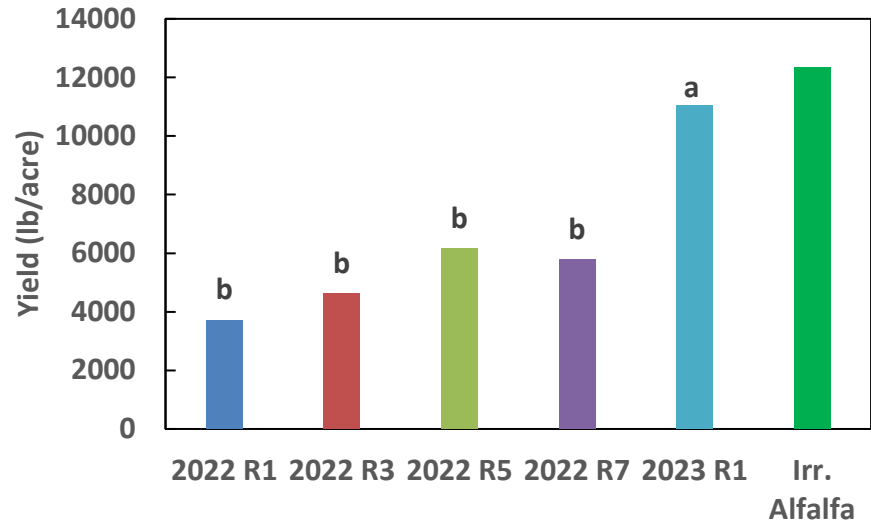


- Cowpea on 10/4/23
- Did not progress past R1 before first freeze

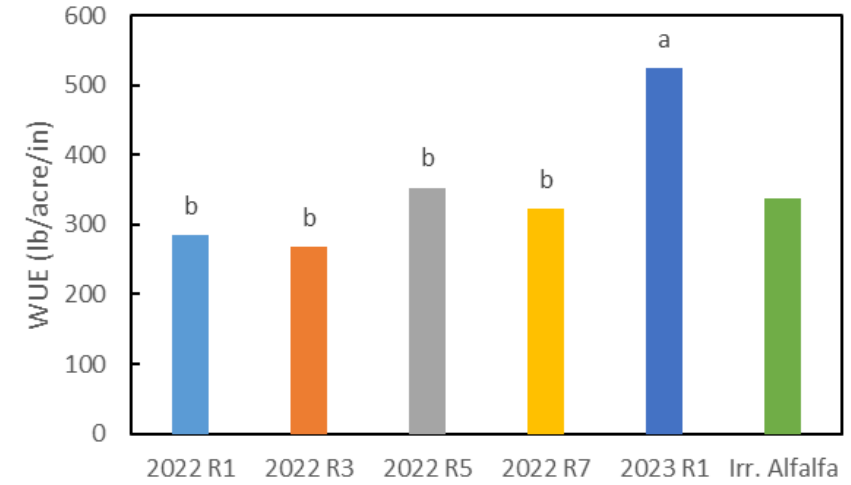
# Cowpea



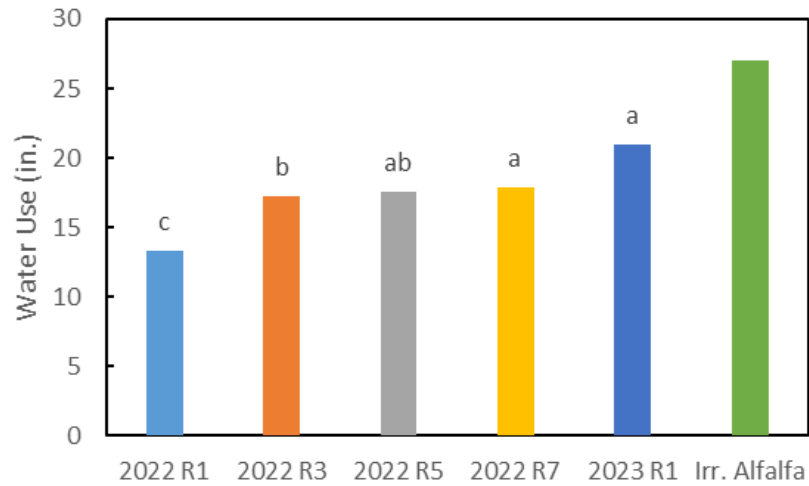
### Cowpea Yield by Stage



### Cowpea WUE by Cutting Stage



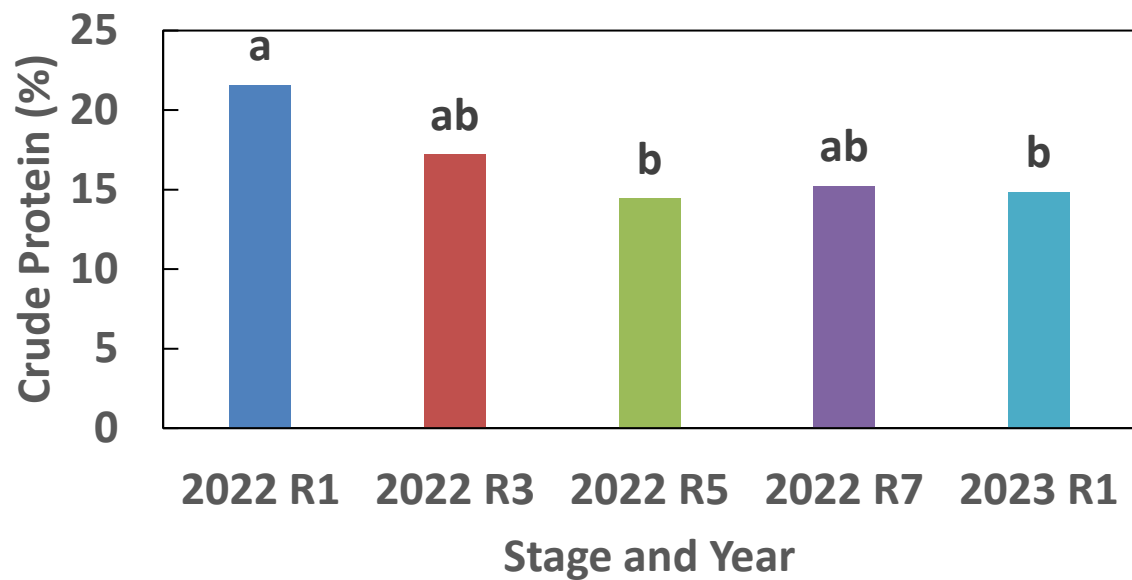
### Cowpea Water Use by Stage



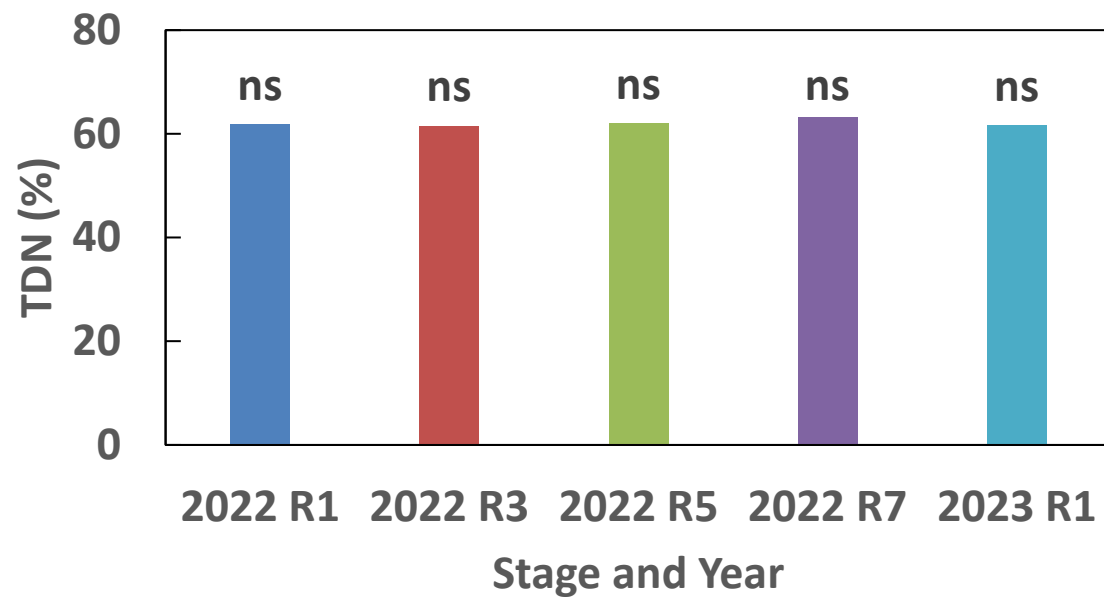
# Cowpea



### Cowpea Crude Protein by Stage and Year

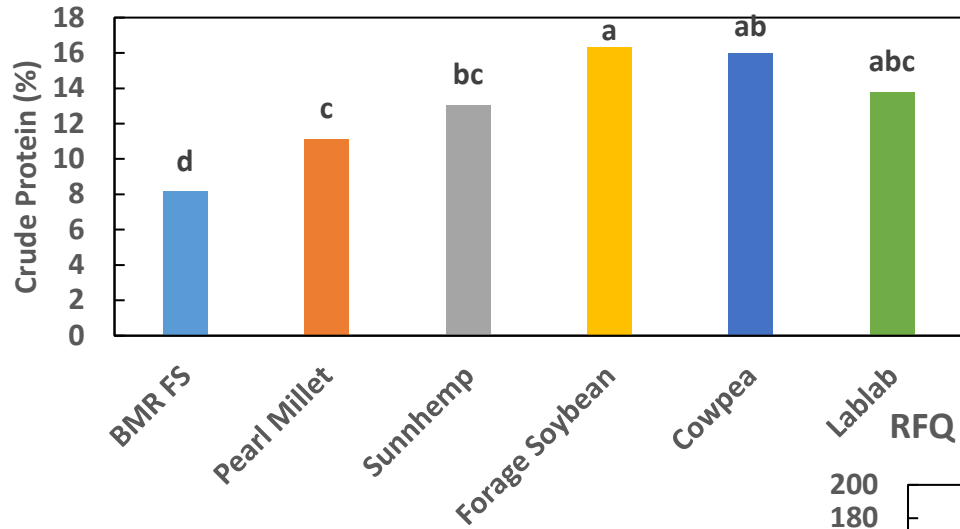


### Cowpea TDN by Stage and Year

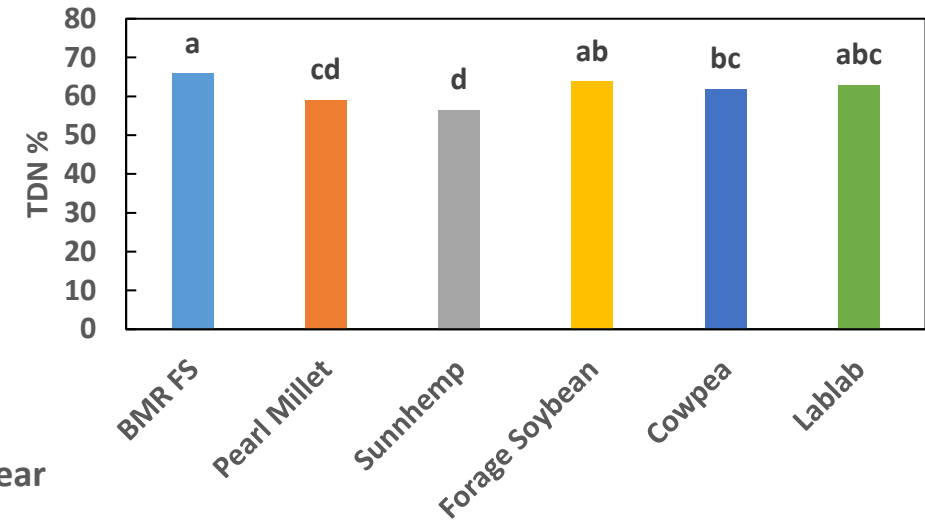


# Comparing Average Quality Measures By Species

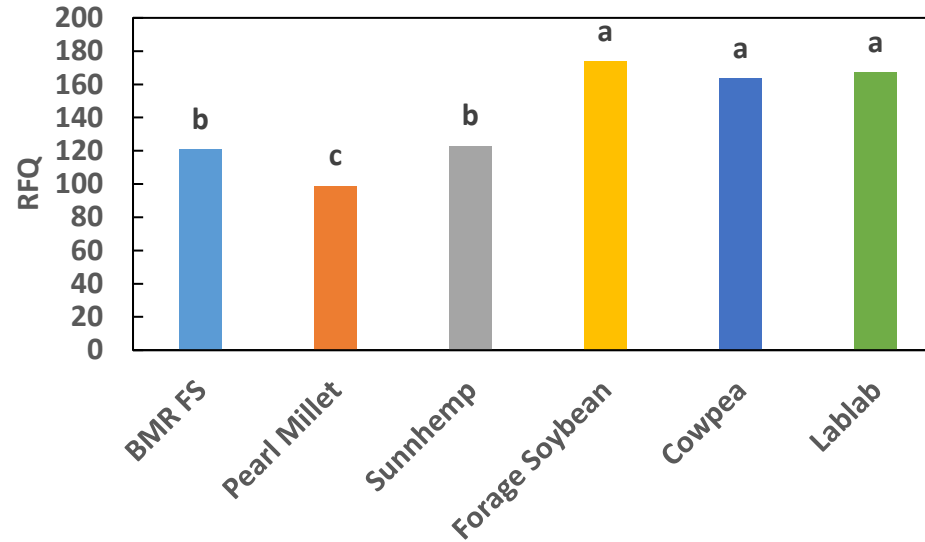
### Crude Protein Content by Species Across Cutting Stage and Year



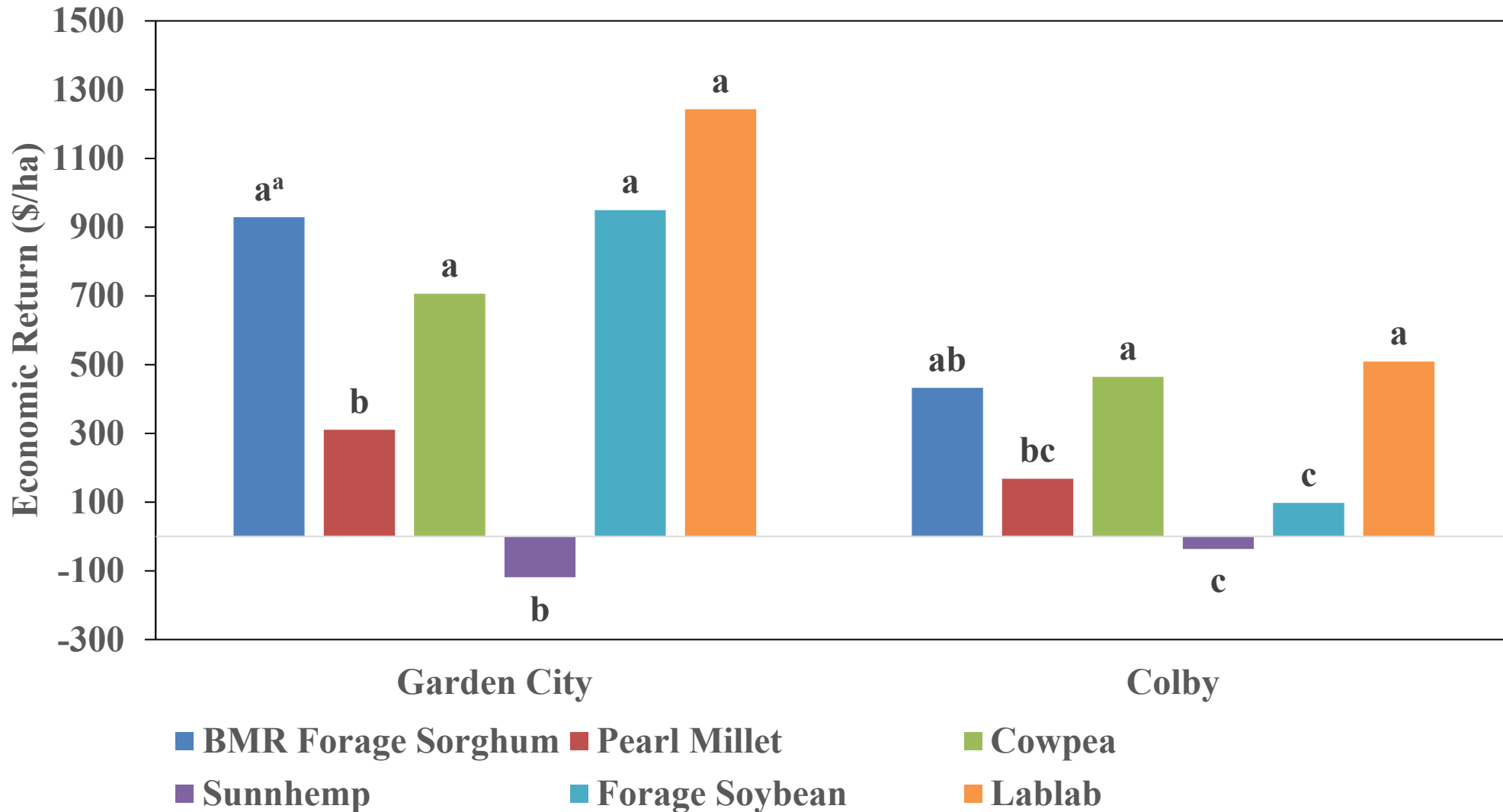
### TDN by Species Across Cutting Stage and Year



### RFQ by Species Across Cutting Stage and Year



# Economic Returns



# Conclusions

- Yield:
  - Forage sorghum > Pearl millet > Legumes
- Quality:
  - Legumes > Pearl millet = Forage sorghum
- Maturity:
  - Trade off between yield and quality
  - Water use efficiency greatest:
    - Grass: anthesis – soft dough
    - Legumes: little difference (cowpea 2023)



# Conclusions

- Legumes: Lablab and Cowpea
  - Only legumes that established at every site when planted
  - Appear to be the most stress tolerant
  - Comparable to alfalfa yield, water use, and WUE in both dryland and irrigated environments



# Further Research/Analysis



- Investigate cowpea varieties for forage & black-eye pea grain market
- Investigate cowpea and lablab planting date, varieties, and harvest frequency
- Direct comparison between alfalfa, cowpea and lablab under low irrigation and dryland

Tribune Experiment Station Variety Trials, 1925



Cowpeas, 100-280 lb/a

Soybean, 400-1170 lb/a



## Questions?

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References: Klocke, N. L., Currie, R. S., & Holman, J. D. (2013). Alfalfa response to irrigation from limited water supplies. *Transactions of the ASABE*, 56(5), 1759-1768.