Spring Cover Crop Research in the Semi-arid Drylands Systems in Ogallala Aquifer Region

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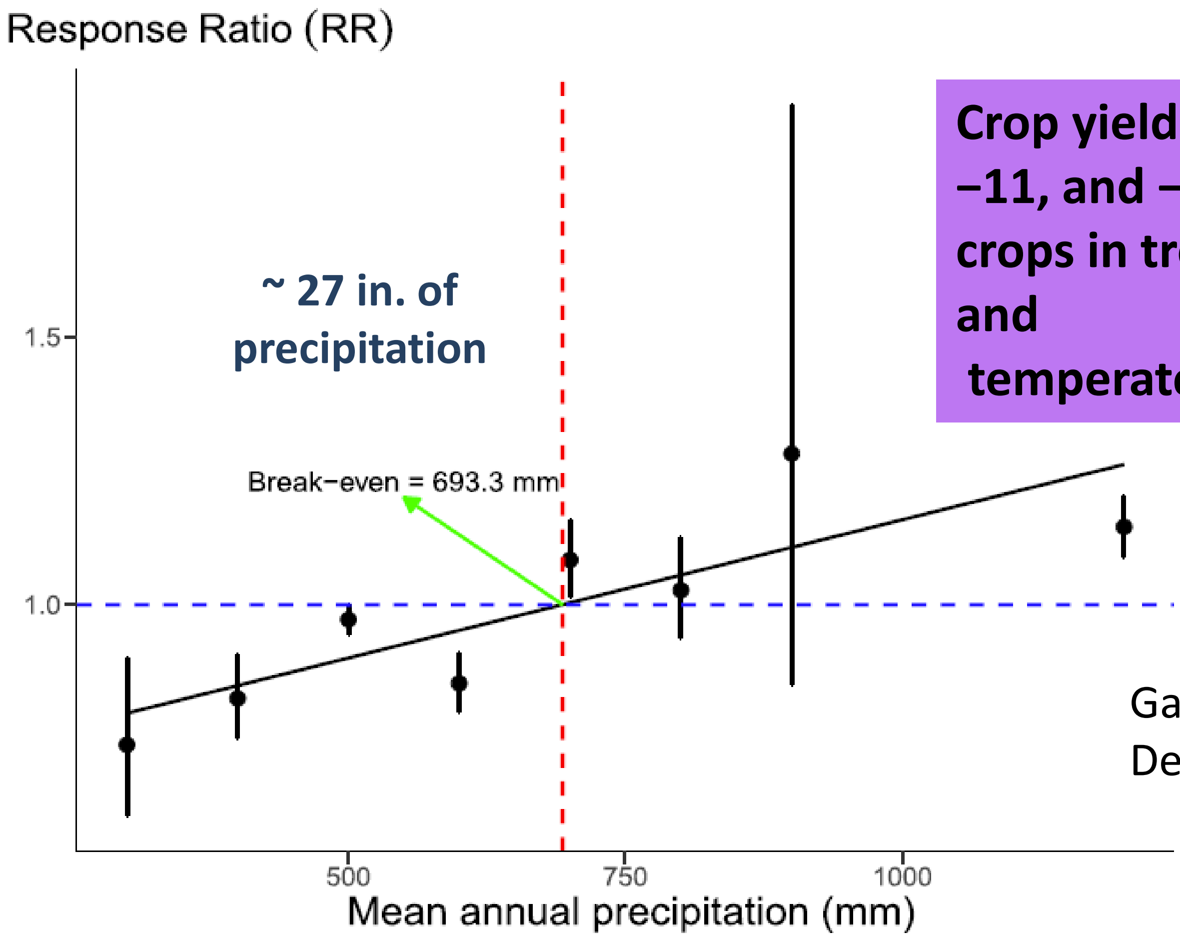
Replacing fallow with cover crops

- **Cover crops offer many benefits:**
  - Provide residue cover to protect the soil and reduce erosion
  - Increase soil organic matter and soil structure
  - Suppress herbicide resistant weeds
- Despite the benefits, **cover crops use soil water that may limit subsequent crop yields**, especially in dry years

Relationship of cash crop yields following CC and mean annual precipitation



Crop yields changed by +15, +4, −11, and −12% following cover crops in tropical, continental, dry, and temperate dryland climates.

Garba et al., 2022, Agron. Sust. Dev.

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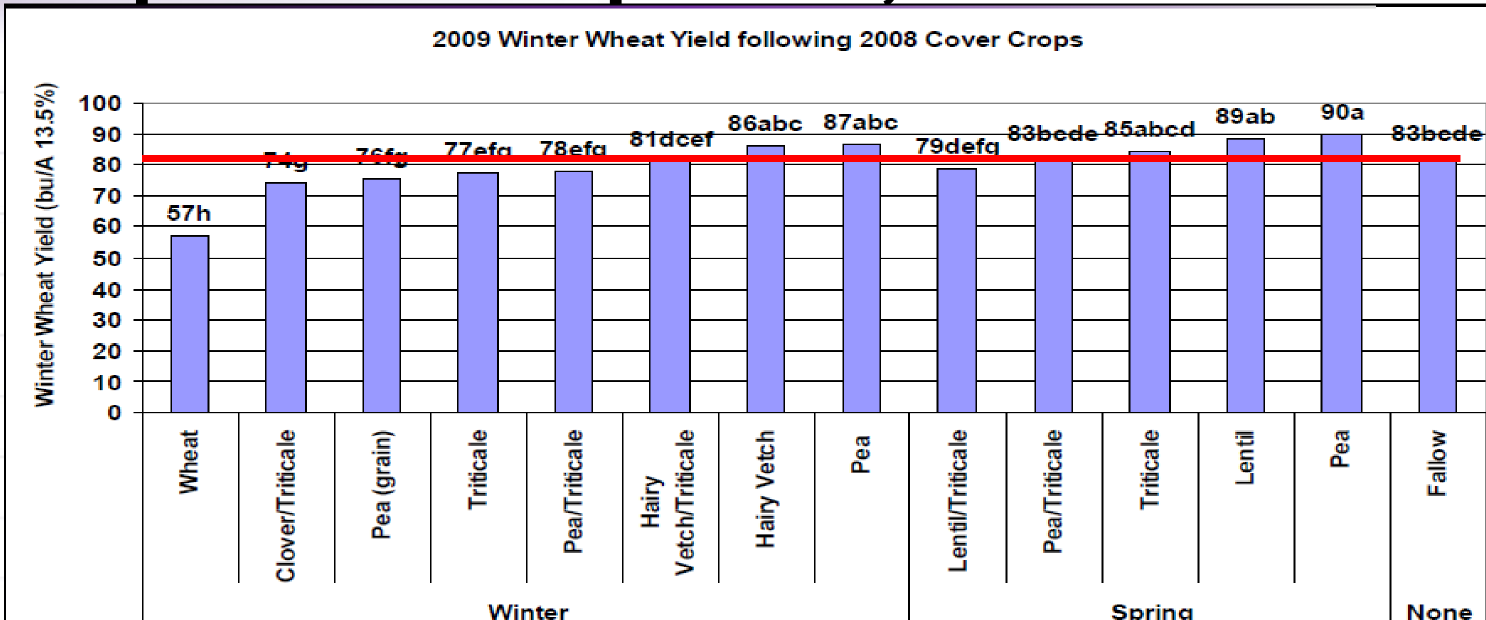
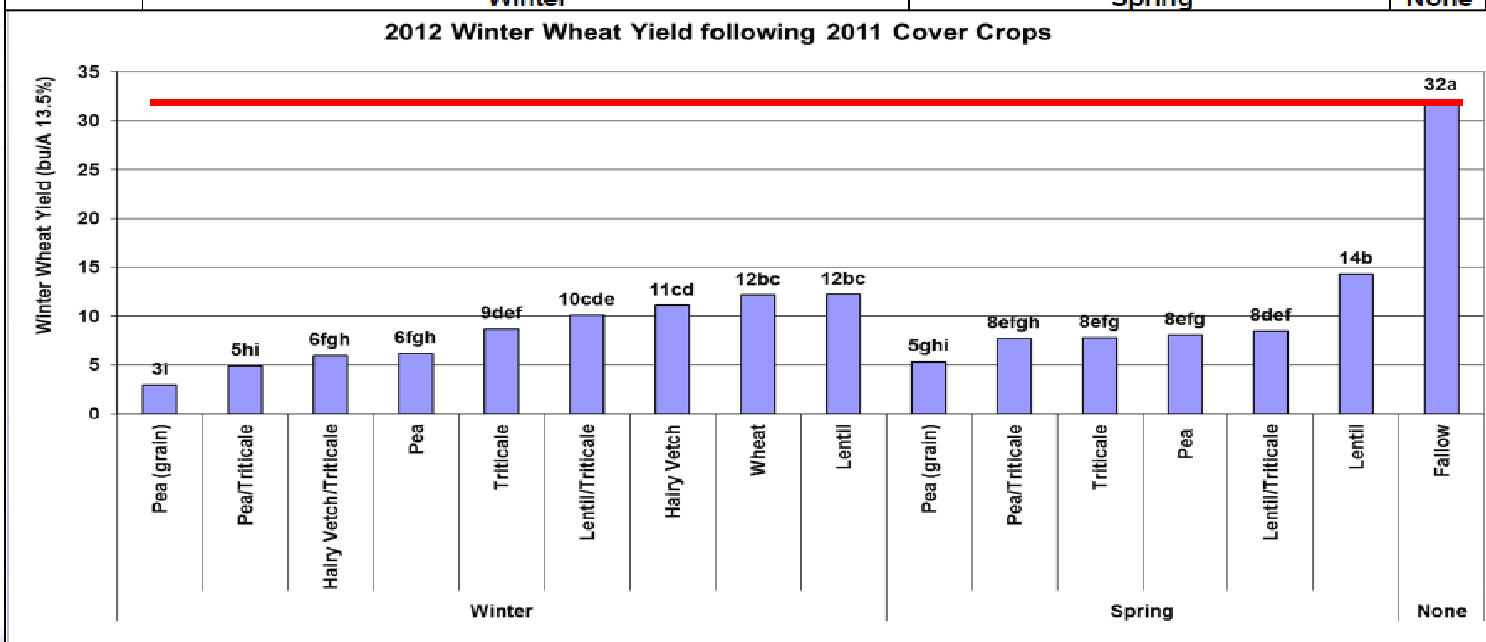
CC Impact on Crop Yield, SWREC

High Precipitation Year



Low Precipitation Year



Holman et al., 2019

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Residue 7/23/2014

- Planting CC destroys residue and without rain, produces no new residue

- Jan-Jun: 2” accumulative precipitation, average 7”

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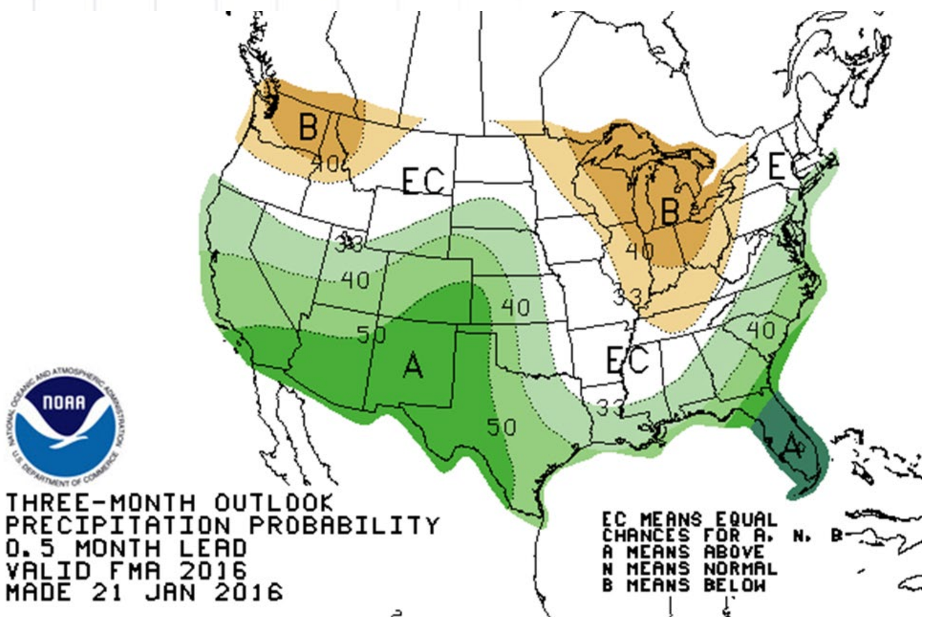
Flex-Fallow Concept

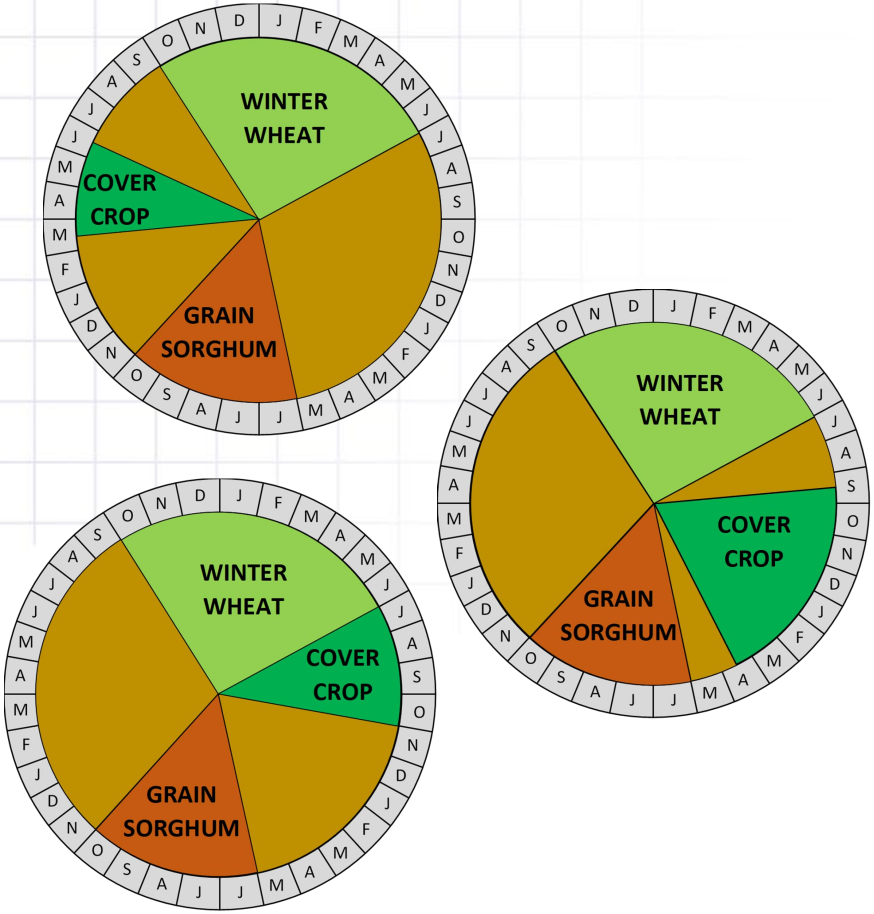
- At CC planting measure soil moisture with Paul Brown Probe
- Plant if >12” of soil moisture & Precipitation Outlook is neutral or favorable
- Otherwise implement fallow
- Trying to reduce losses and take advantage of wet years



Using cover crops as a forage resource

- Cover crops can provide immediate economic benefits in the form of high-quality forage
- **Drawbacks may include**:
  - Reduced residue cover and increased exposure to erosive winds and rain
  - Increased soil compaction and decreased water infiltration
  - Reduced soil organic carbon accumulation

Cover crops in wheat-corn/sorghum-fallow rotations



1. Cool-season cover crops planted in the spring into corn/sorghum stubble
2. Cool-season cover crops planted in the fall into wheat stubble
3. Warm-season cover crops planted immediately after wheat harvest

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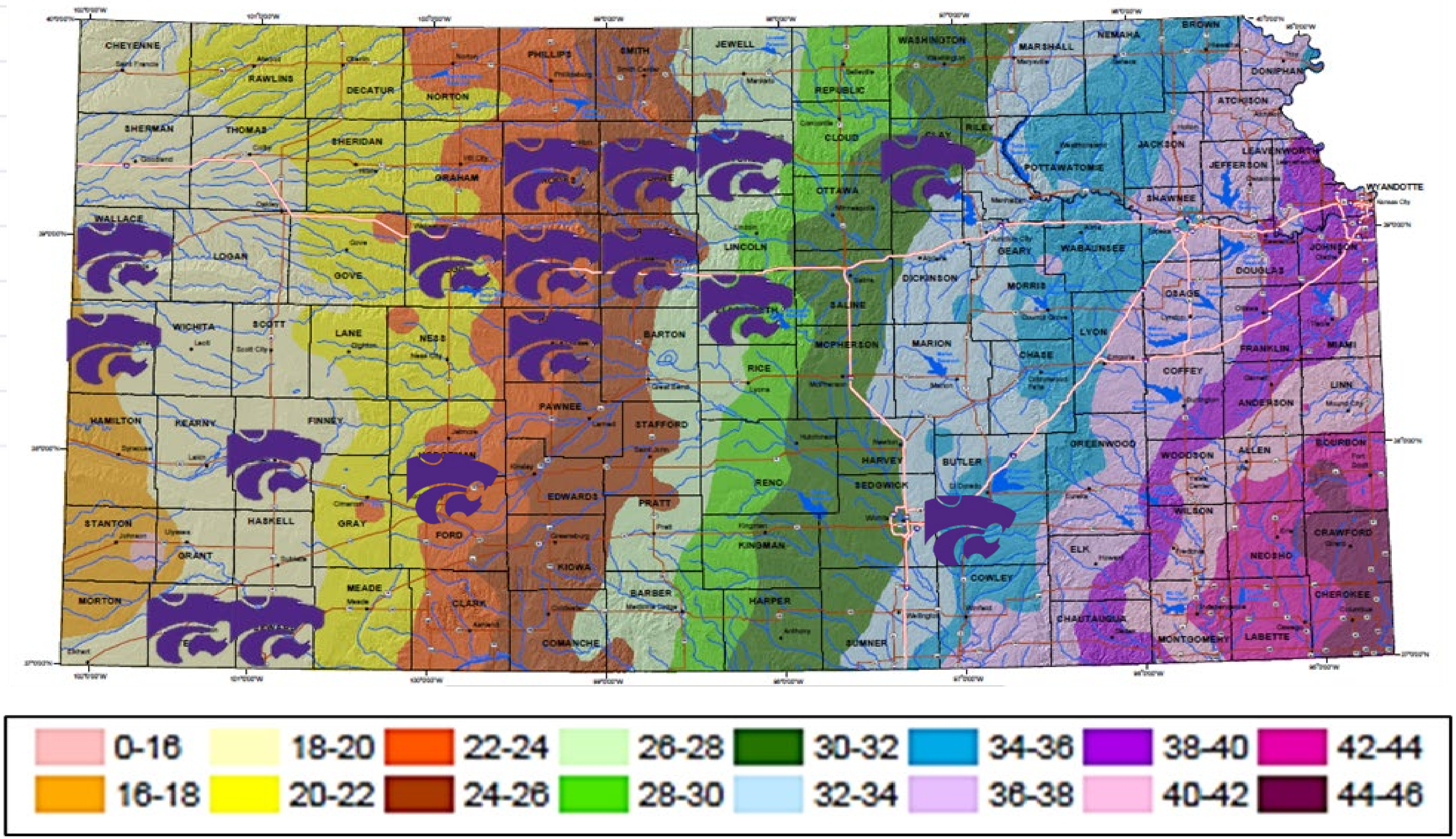
KSU WKREC Cover Crops/Soil Health Research Sites across Kansas



Dryland spring cover crop management studies at KSU HB Ranch (Trego County)

Planted in Wheat-Sorghum- Fallow rotation

Treatments

1. Chem-Fallow
2. Standing cover crop
3. Hayed cover crop
4. Grazed cover crop
5. Flex-hayed cover crop

Hayed Cover Crops

- At grass species heading stage
- 6 inches cutting height

Grazed Cover Crops

- Yearling heifers
- Generally, one week before haying takes place
- 1300 lb live weight per acre for four to seven days

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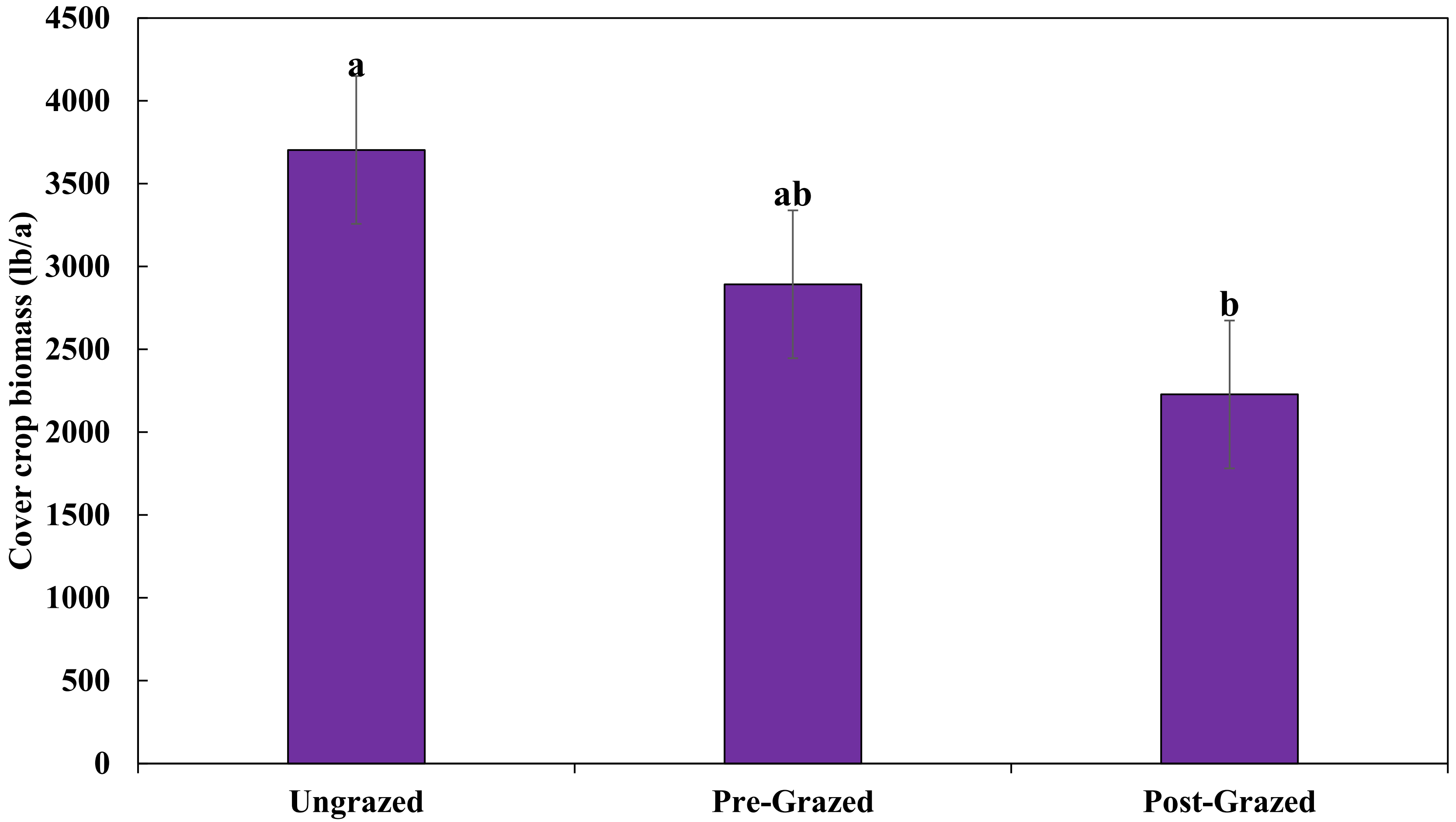
Spring cover crop grazing in 2019 at Alexander

Triticale, Oats, Barley, Pea, Sunflowers; Radish, and Rapeseed

On-farm cover crop biomass



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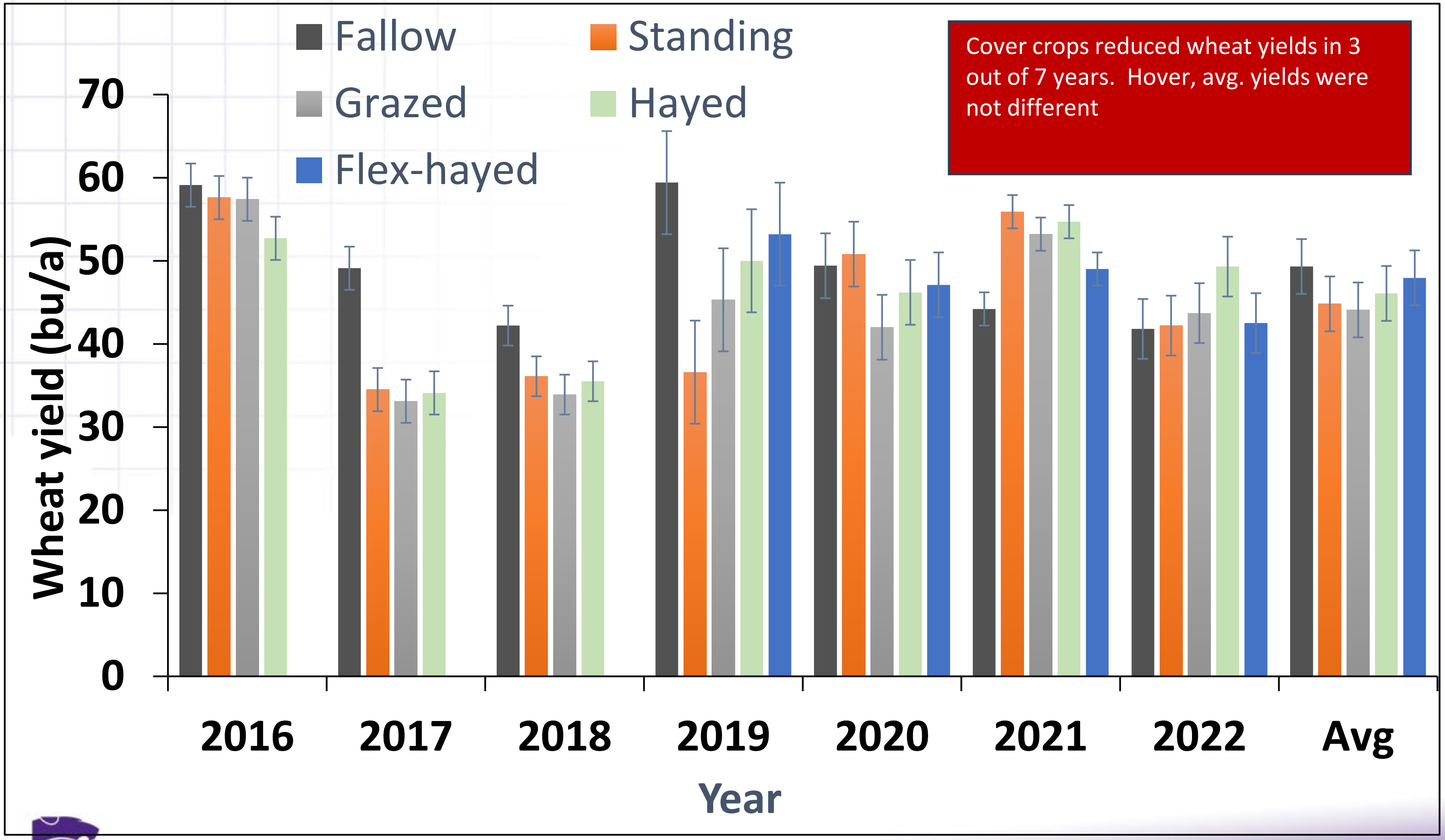
Winter wheat yields following spring cover crops at KSU HB Ranch



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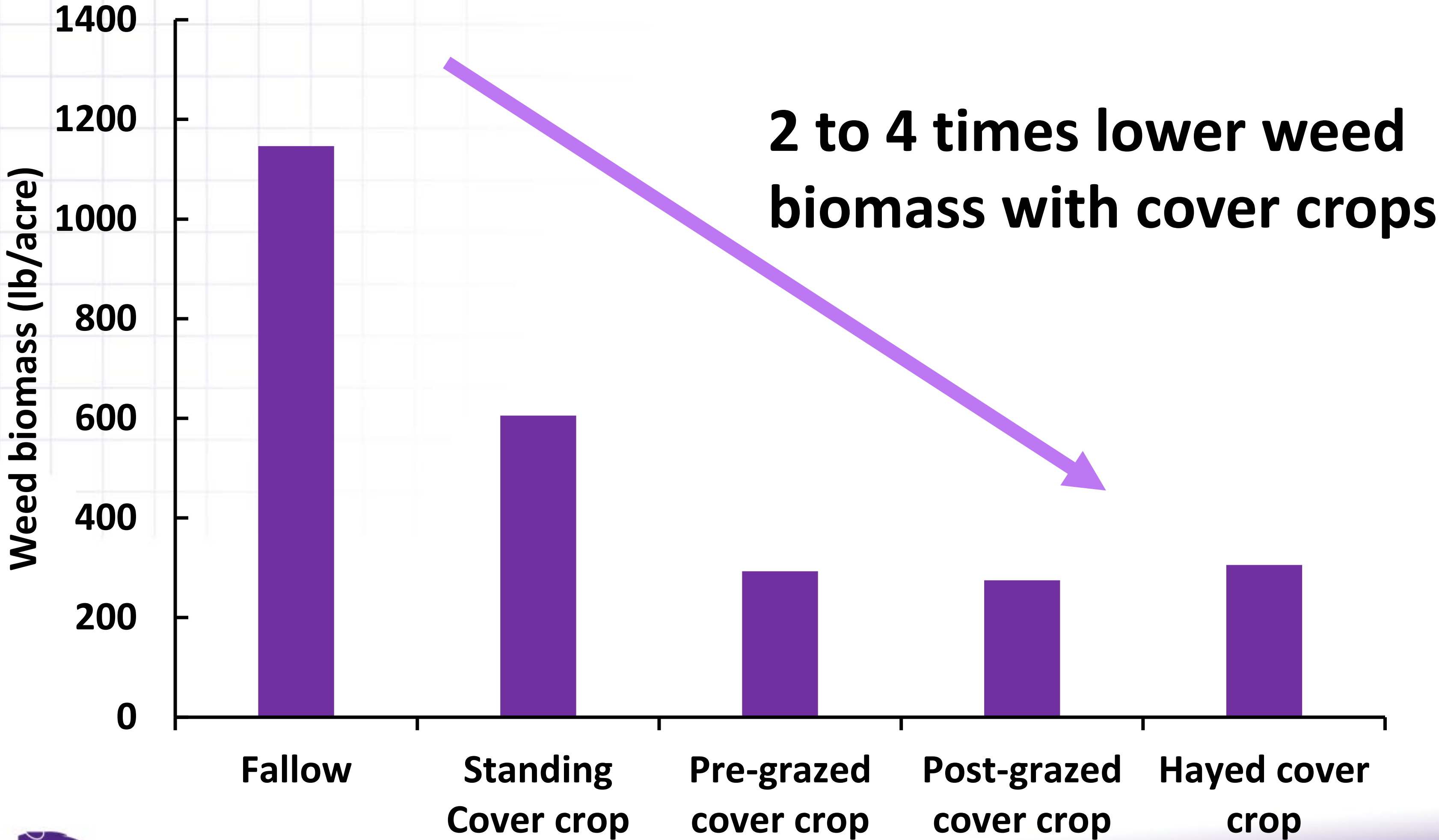
Weed biomass affected by spring cover crops



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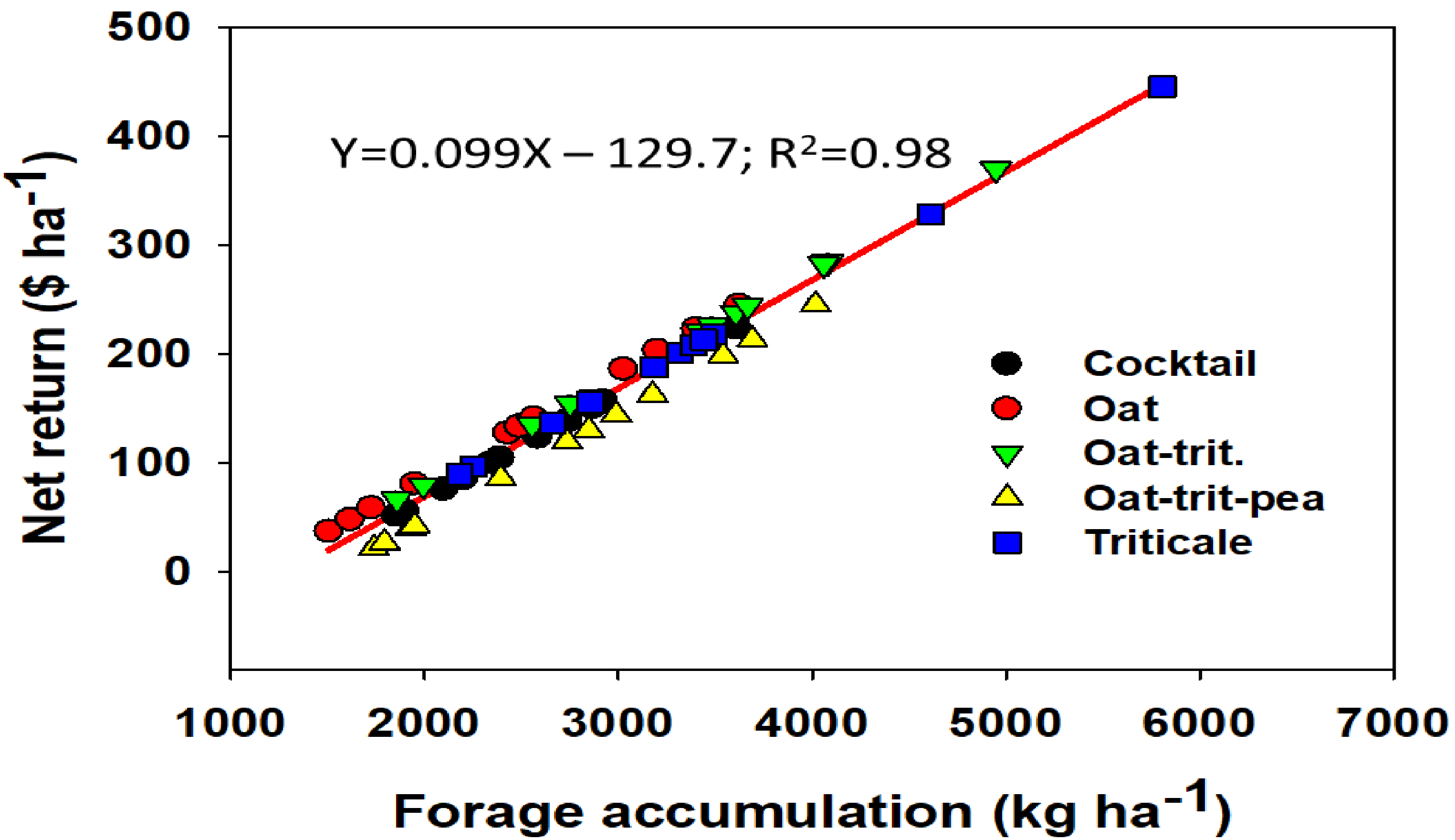
Cropping system net returns

Treatments	Net returns US$ ha^{-1}
Fallow management	
Fallow	***-53.97c***
Standing cover crops	***-118.03d***
Hayed cover crops	***88.23b***
Grazed cover crops	***161.45a***
Years	
2015-2016	243.05a
2016-2017	-0.24d
2017-2018	34.24cd
2018-2019	99.85b
2019-2020	54.67bcd
2020-2021	75.43bc
2021-2022	-6.56d
2022-2023	-345.08e

Oats, Triticale or Barley, and Pea

Profitability depends on CC productivity



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Soil Properties Evaluated

- Bulk Density
- Residue cover
- Penetration Resistance
- Soil Organic Carbon
- Soil Nutrients
- Water Stable Aggregates
- Dry Aggregate Stability
- Water Infiltration Rate

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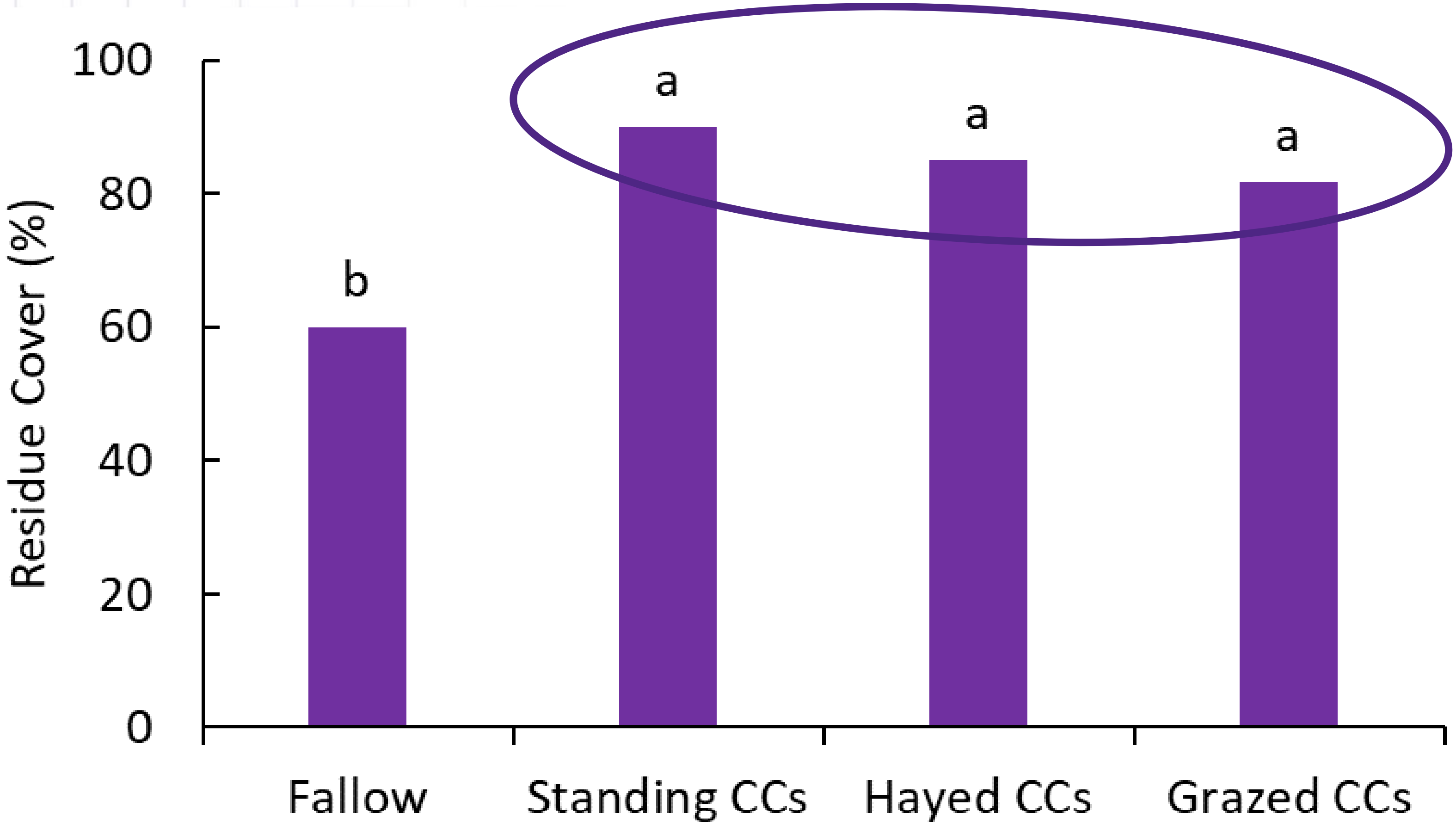
Soil surface residue at HB Ranch in fall 2020



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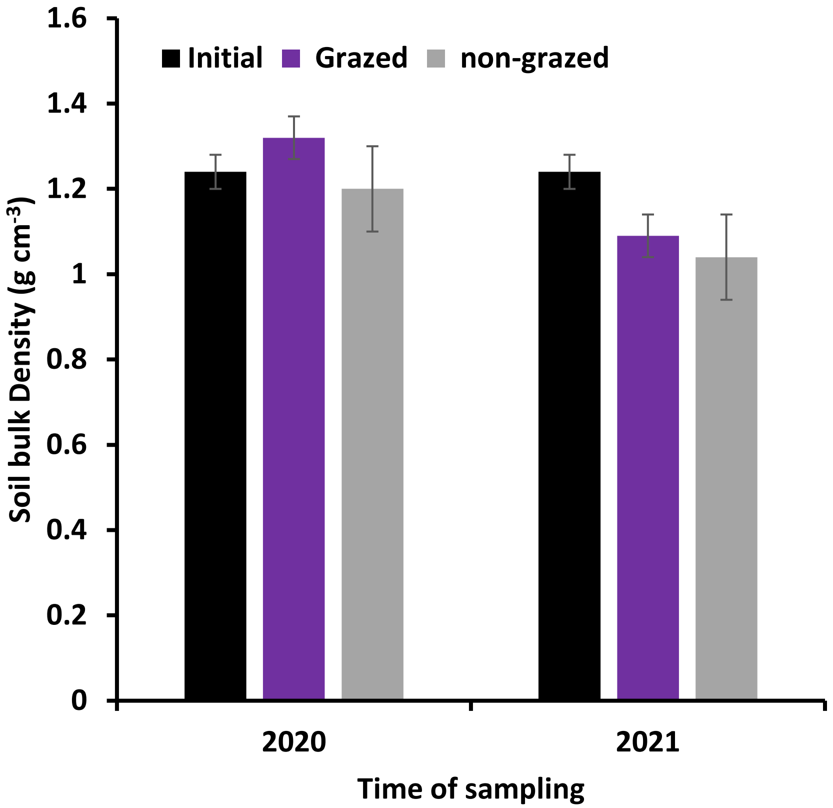
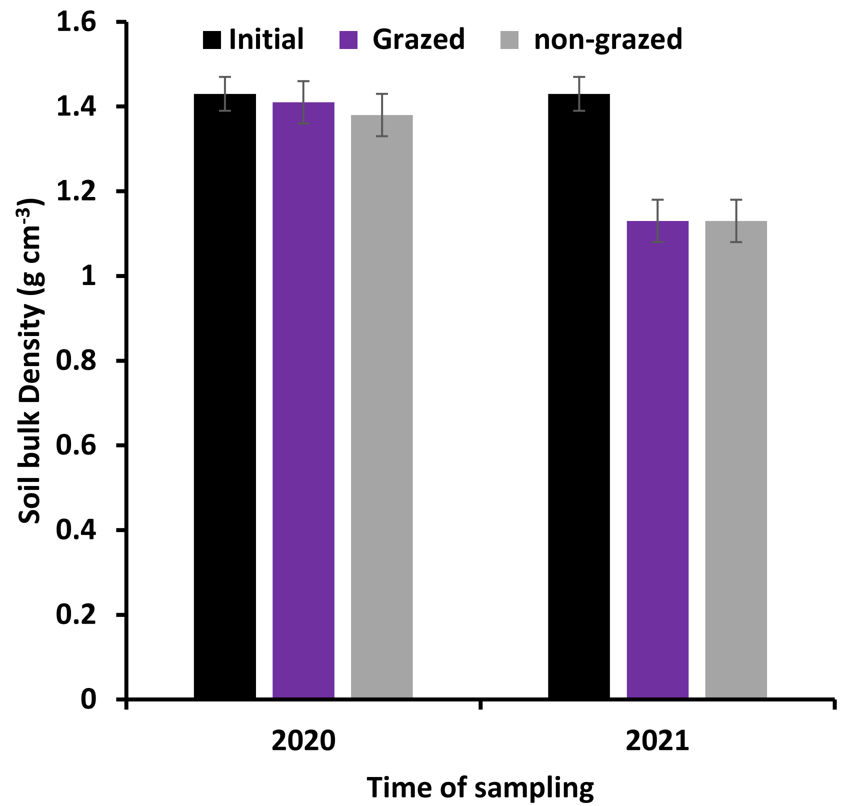
Residue after grazing at Marquette in 2019

Soil bulk density-Hays, KS

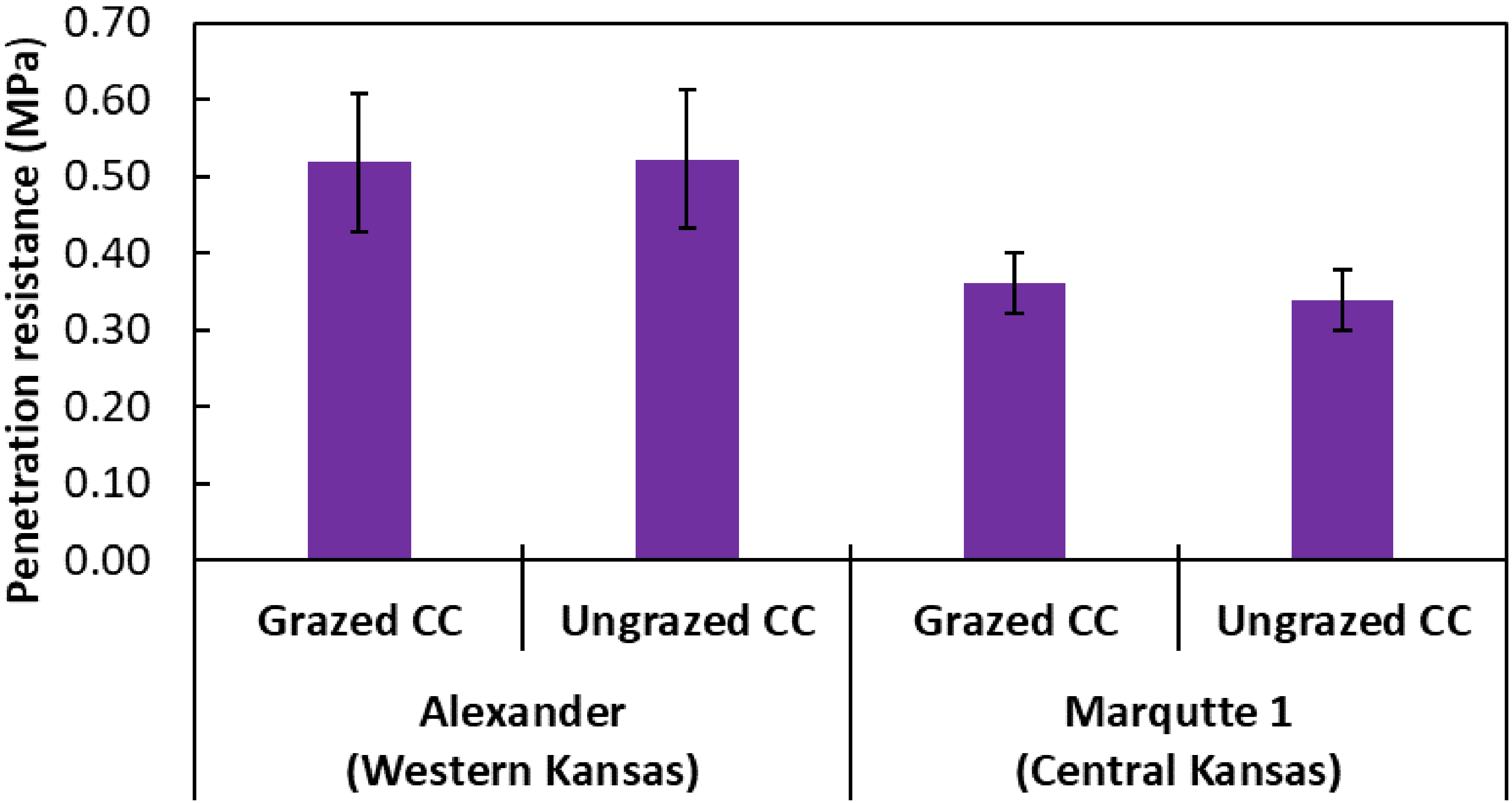
0 to 2-inch depth



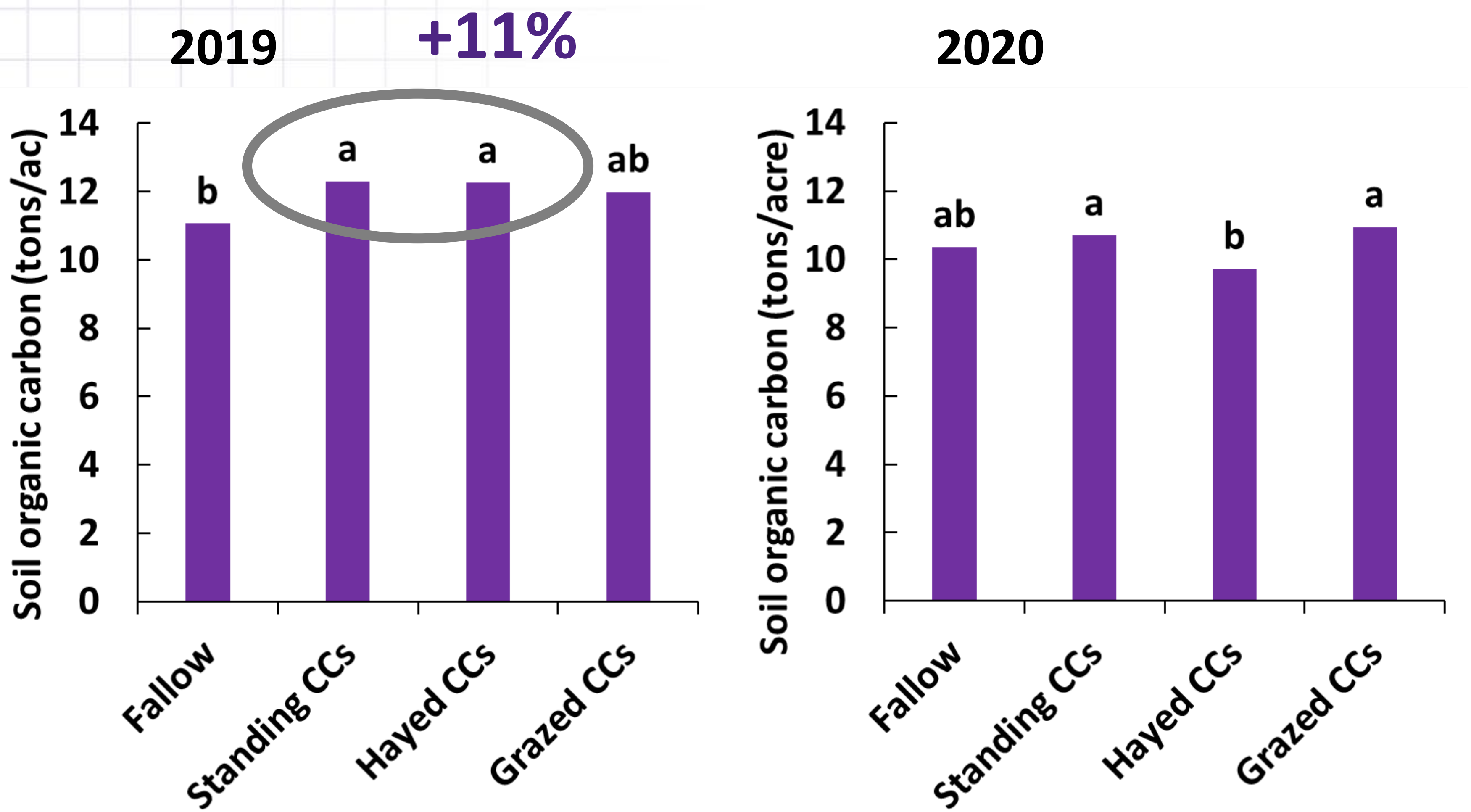
2 to 6-inch depth



Cover crop grazing effects on penetration resistance at 0 – 6 inches



Soil organic carbon at KSU HB Ranch



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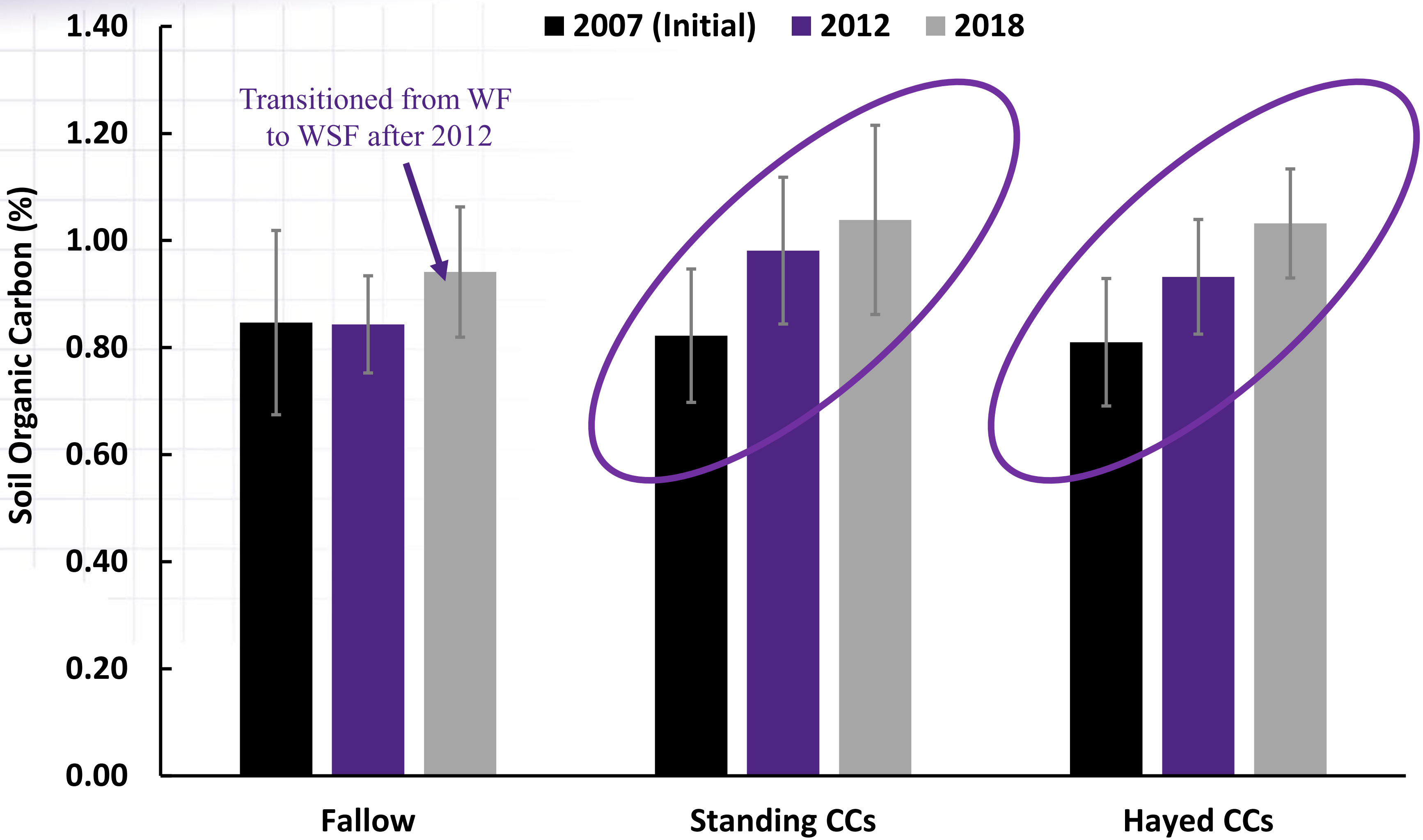
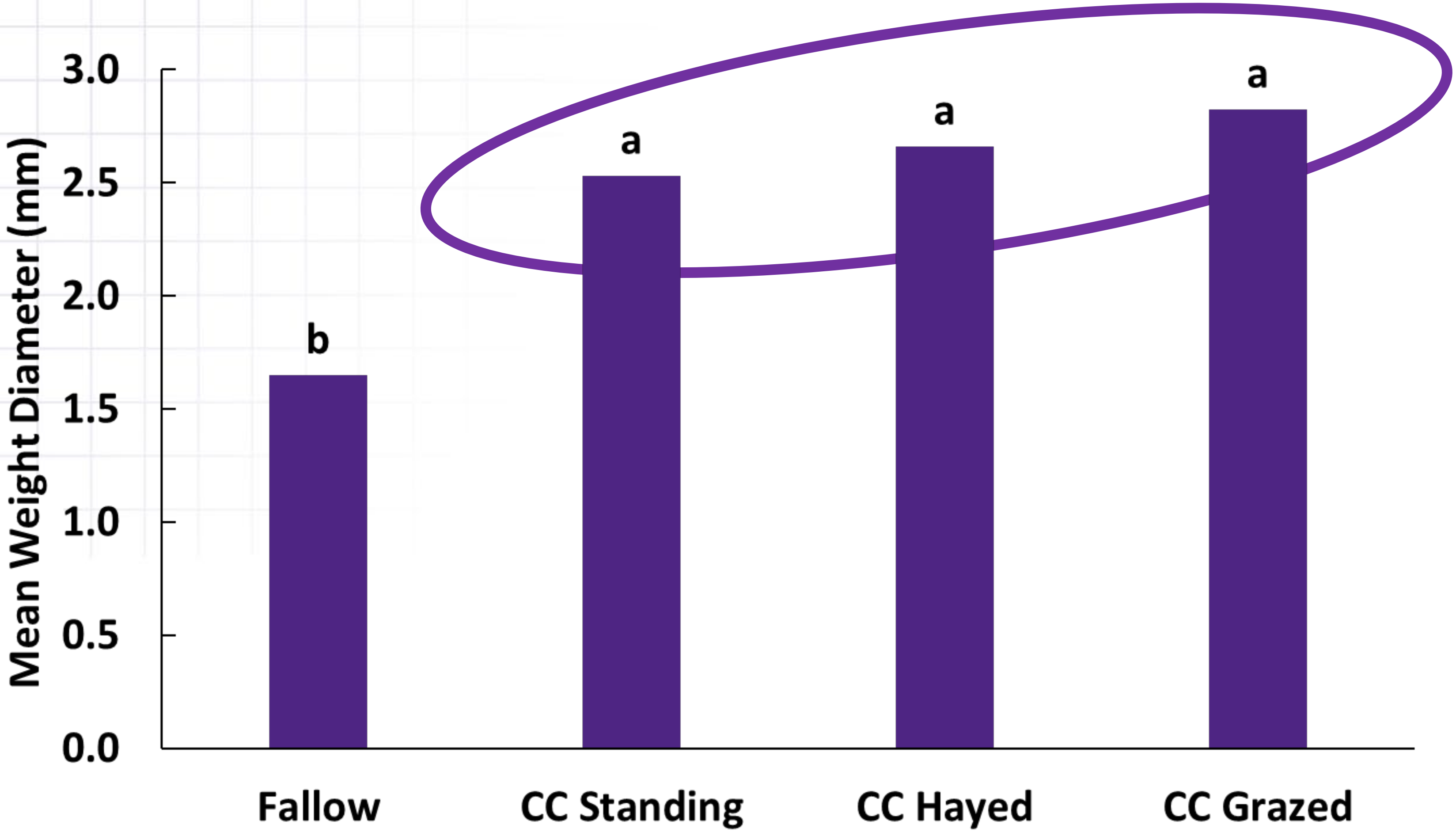
SOC (0-6 inch) GC



Cropping intensification with sorghum had significant impact on soil organic carbon

Wet aggregate stability in fall 2019 at KSU HB Ranch



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Conclusions

- CC productivity in water-limited environments is highly **variable**
- Grazing/haying cover crops had **no negative impact on soil bulk density or penetration resistance**
- Grazing/haying CC had **improved soil health** including SOC and aggregate stability
- Flex-fallow of CC to match environmental conditions

Conclusions

- **<u>Grazed or hayed</u>** cover crops can provide similar soil health benefits compared to standing cover crops
- **<u>Residue management</u>** is critical to meeting soil health goals in water-limited farming systems
- **<u>Grain crop yields</u>** after cover crops were often similar or less than fallow
- Utilizing **<u>cover crops for forage</u>** improve soil health and farming system profitability
- No advantage to CC mixture vs **<u>single species planting</u>**

Remaining Questions…

- ✓ Can flex-fallow minimize yield reductions and take advantage of wet years?
  - Poor seasonal weather prediction
  - Planted 2 of 10 years at GC, 8 of 10 years at HB
- ✓ Grazing CC
  - How much residue can be removed by grazing
- ✓ Reduced CC seeding rate
  - Can soil water use and yield loss be minimized?
- ✓ Continue to measure long-term soil changes
  - Compare standing, hayed, and grazed CC

Funding and Contact Info

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NRCS
Natural Resources Conservation Service

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