Slide 1

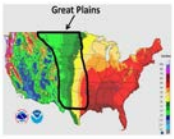
Grazing cover crops and annual forages to improve soil health in dryland cropping systems in the semi-arid Great Plains

Augustine K. Obour, PhD – Professor of Soil Science
Kansas State University Agricultural Research Center-Hays
Ona Highlight Webinar, October 24, 2023

Slide 2

Dryland crop production in the US Great Plains

- Water availability is critical for dryland farming
- East- west precipitation gradient affects crop production systems in the Great Plains
- Important grain production regions **(30% corn, 60% wheat production, 96% sorghum** in the USA)



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Semi-arid dryland cropping systems

- Highly dependent on soil water storage during fallow periods
- Fallow can increase the stability of crop yields year-to-year though **precipitation storage efficiency is very low (~20-30%)**
- Tillage during fallow decreases residue cover, increases wind and water erosion, and degrades soil health
- Even under NT, erosion risk increases when residue levels are too low to protect the soil

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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 limited subsequent crop yields**, especially in dry years

Holman et al., 2017

Slide 5

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

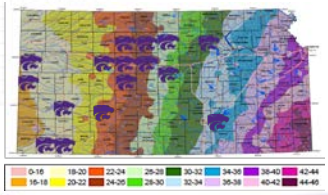
Slide 6

Cover Crop Research Efforts Across Western Kansas

- Determining forage production potential of cover crops in western Kansas environments and cropping systems
- Evaluating the impacts of grazing and haying cover crops on weed suppression, and crop yields
- Quantify the impacts of grazing cover crops on soil health and cropping system profitability

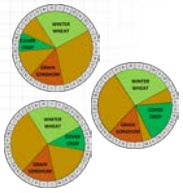
Slide 7

KSU WKREC Cover Crops/Soil Health Research Sites across Kansas



Slide 8

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

Slide 9

Dryland 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

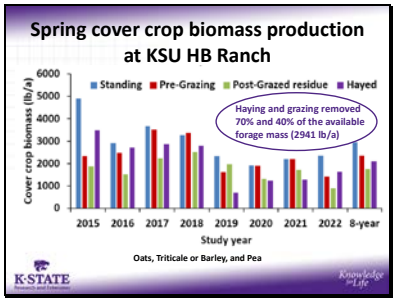
Hayed Cover Crops

- 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

Slide 10



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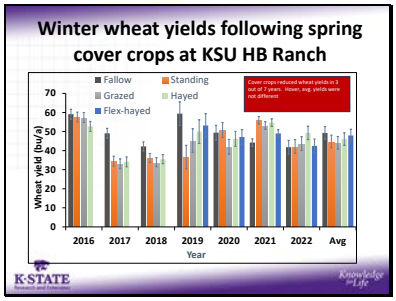

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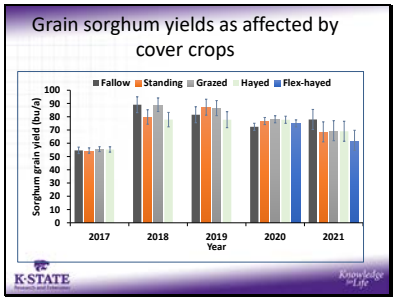

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Profitability of the cropping system

Description	Fallow	CC standing	Hayed CC	Grazed CC
Revenue				
Avg wheat yield (b/a)	2958	2688	2764	2646
Rev @ $0.05/lb	158.7	145.2	149.3	142.9
Avg. Sorghum yield	4206	4109	4006	4241
Rev @$0.089/lb	374.3	365.7	356.5	377.4
Avg. CC yield		2943	2090	2350
Rev of Hay @ $0.054/lb	0	0	123.3	0
Forage avail for grazing @50%				1175
Grazing days, 600 lb @ 18 lb/day				65.3
Weight gained, 45 days @ 2.48 lb/day				161.3
Rev, grazing lease @ $0.60 lb/lb				97.1
Total revenue $/a	533	511	629	677
Costs				
Wheat seed, $/a	33	33	33	33
Sorghum seed	12.6	12.6	12.6	12.6
Cover crop seed	0	20.3	20.3	20.3
Planting cost	31.9	47.9	47.9	47.9
Herbicide cost plus application	149.3	106.3	106.3	106.3
Fertilizer costs	129	129	129	129
Wheat & sorghum harvest	114	114	114	114
Haying operation costs	0	0	84	0
Total variable costs, $/a	470	463	547	462
Net revenue, $/a	64	48	82	164

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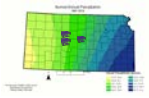
Grazing cover crops at Hays, Alexander, and Marquette, KS (2019 to 2021)

Treatments:

1. Non-grazed cover crop
2. Grazed cover crop



Cover crop species:

- Summer: Forage sorghum, German millet, sunflower, sunn hemp, and radish
- Spring: oat, triticale, barley, radish, sunflower, pea, rapeseed
- Winter: triticale, rapeseed, radish

Cover crop grazing:

- Cow-calf pairs at 575 to 1388 lb live weight per acre for 45 days at Hays
- Yearlings at 350 to 575 lb live weight per acre for 30 to 40 days at Alexander
- Yearlings at 550 to 575 lb live weight per acre for 45 to 60 days at Marquette

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Spring cover crop grazing in 2019 at Alexander

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

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Summer cover crop grazing in 2019 at Hays

06/28/2019 07/25/2019

Sunn hemp, Sunflower, Millet, Sudangrass, Radish, and Rapeseed

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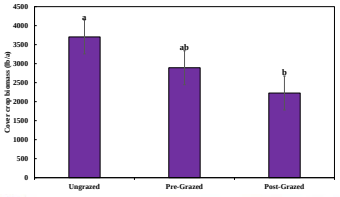
On-farm cover crop biomass



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Grazing days and animal performance

Location	Crude Protein %	Starting Date	Ending Date	Animal Class	Grazing Days	Average Daily Gains lb/day
Alexander, KS	26	5/14/19	6/14/19	calves	31	3.1
Marquette, KS	19	1/9/20	2/17/20	calves	39	1.2
Alexander, KS	20	8/05/20	09/18/20	heifers	41	1.5

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Soil Properties Evaluated

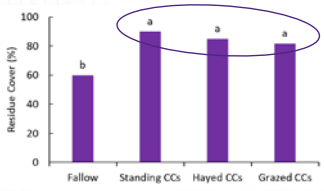
- Bulk Density
- Residue cover
- Penetration Resistance
- Soil Organic Carbon
- Soil Nutrients
- Water Stable Aggregates
- Dry Aggregate Stability
- Water Infiltration Rate

Slide 20

Residue after grazing at Marquette in 2019

Slide 21

Soil surface residue at HB Ranch in fall 2020



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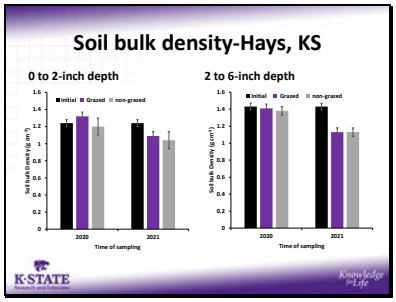

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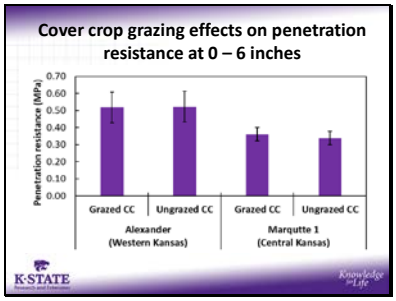

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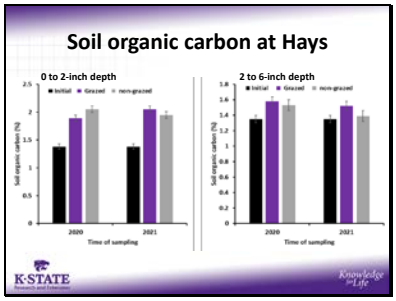

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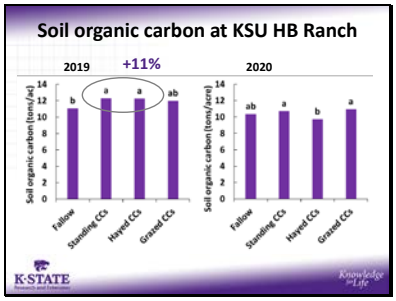

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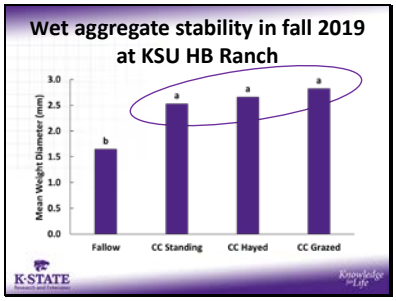

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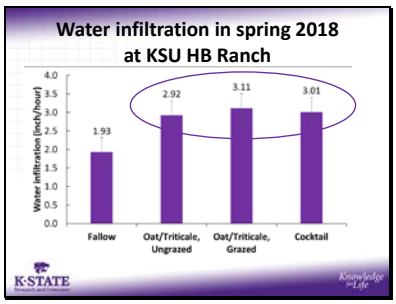

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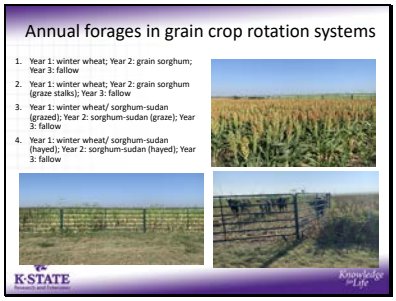

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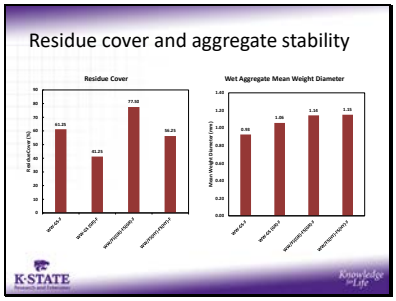

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Conclusions

- Cover crops may be productive in water-limited farming systems but there is substantial **year-to-year variation**
- Grazing cover crops had **no negative impact on soil bulk density or penetration resistance**
- Soil organic carbon/organic matter **increased** with most cover crops management strategies
- Cover crop **increased aggregate stability** compared to fallow

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Conclusions

- **Grazed or hayed** cover crops can provide similar soil health benefits compared to standing cover crops
- **Residue management** is critical to meeting soil health goals in water-limited farming systems
- **Grain crop yields** after cover crops were often similar or less than fallow
- Utilizing **cover crops for forage** improve soil health and farming system profitability

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Funding and Contact Info

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