

Forages and Livestock to Diversify wheat-based Cropping System



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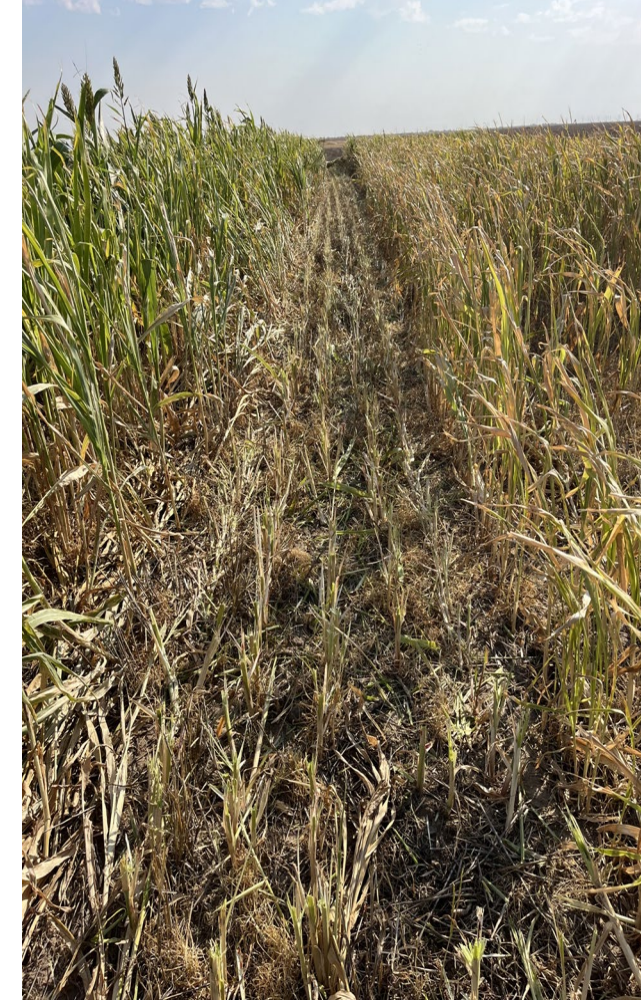
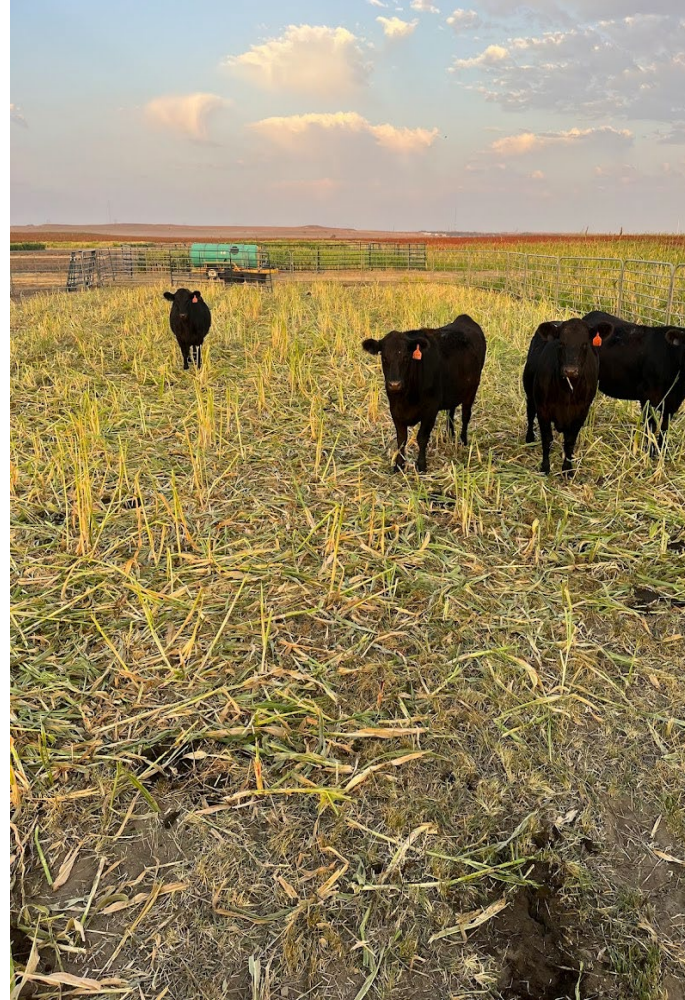
- Current rotations within the central Great Plains (CGP) are water inefficient, and highly erodible due to long fallow periods that leaves the soil exposed and only retains 20-35% of fallow precipitation.
- Rotations in the CGP have the potential to be intensified, but there is producer hesitancy because of limited precipitation and the effect cropping intensification may have on subsequent grain crop yield.
- Intensifying systems with annual forages while integrating grazing could provide soil health benefits, additional income, therefore negating economic impacts to grain yield. (Holman et al., 2023)

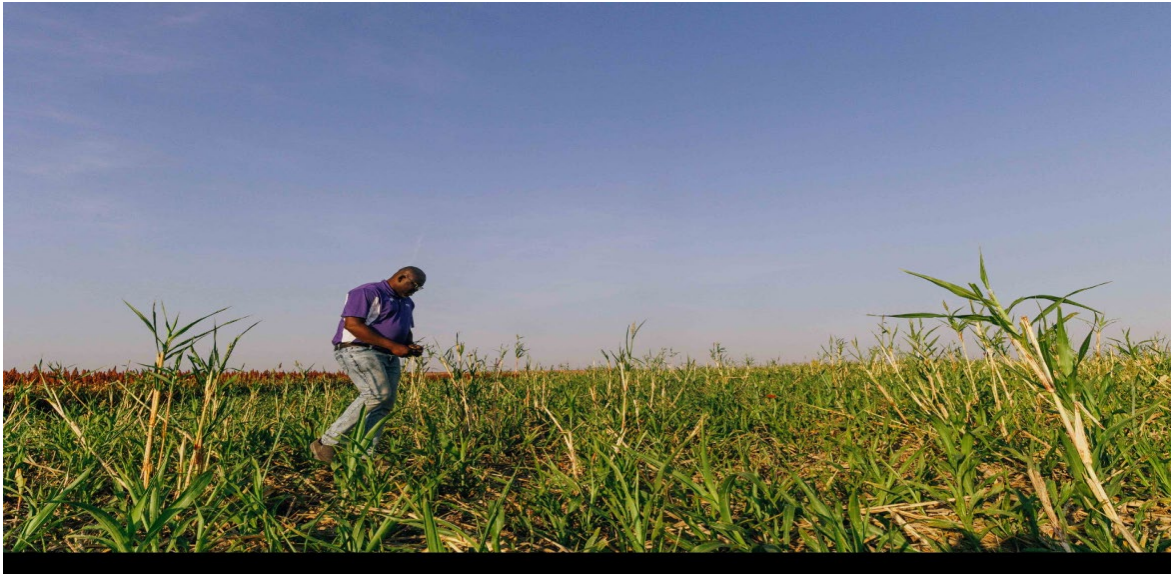
- Hypothesis
 - Intensifying the W-GS-F rotation with annual forages will increase precipitation use efficiency, improve soil health, and system profitability
 - Grazing will be more profitable and have limited effect on soil properties compared to haying
- Objectives
 - Assess how grazed and hayed annual forages and sorghum stalks affect soil properties when integrated into a W-GS-F rotation
 - Monitor grain crop yield response and profitability to integrating annual forages and ruminant livestock



- Initiated in 2021 at the Agricultural Research Center-Hays near Hays, KS
- Average annual precipitation 22 inches
- Compared winter wheat (*Triticum aestivum L.*)-grain sorghum (*Sorghum bicolor (L.) Moench*)-fallow rotation (W-GS-F) with grazing of the GS stalks, grazing or haying of forage sorghum (FS) grown in place of GS and immediately after wheat planting
- Study design was a RCB with four replications
- Treatments:
 1. Winter wheat-grain sorghum-fallow (W-GS-F)
 2. Winter wheat-grain sorghum (grazed stalks)-fallow (W-GSG-F)
 3. Winter wheat/forage sorghum (grazed)-forage sorghum (grazed)-fallow (W/FSG-FSG-F)
 4. Winter wheat/forage sorghum (hayed)-forage sorghum (hayed)-fallow (W/FSH-FSH-F)
- Individual plot size was 60 or 90 ft by 120 ft for grazed treatments (or 30 by 120 ft for non-grazed treatments)

- Forage harvesting and grazing occurred at or near heading
- Before and after grazing, biomass determined using two 2ft x 3ft quadrats per plot.
- Stocking rate ranged from 3 to 5 AUM/acre depending on available forage (approx. 50% of biomass removed)
- Before Haying biomass was determined using the same quadrants, then harvested using a Carter forage harvester
- Grazing sorghum stalks occurred in November each year

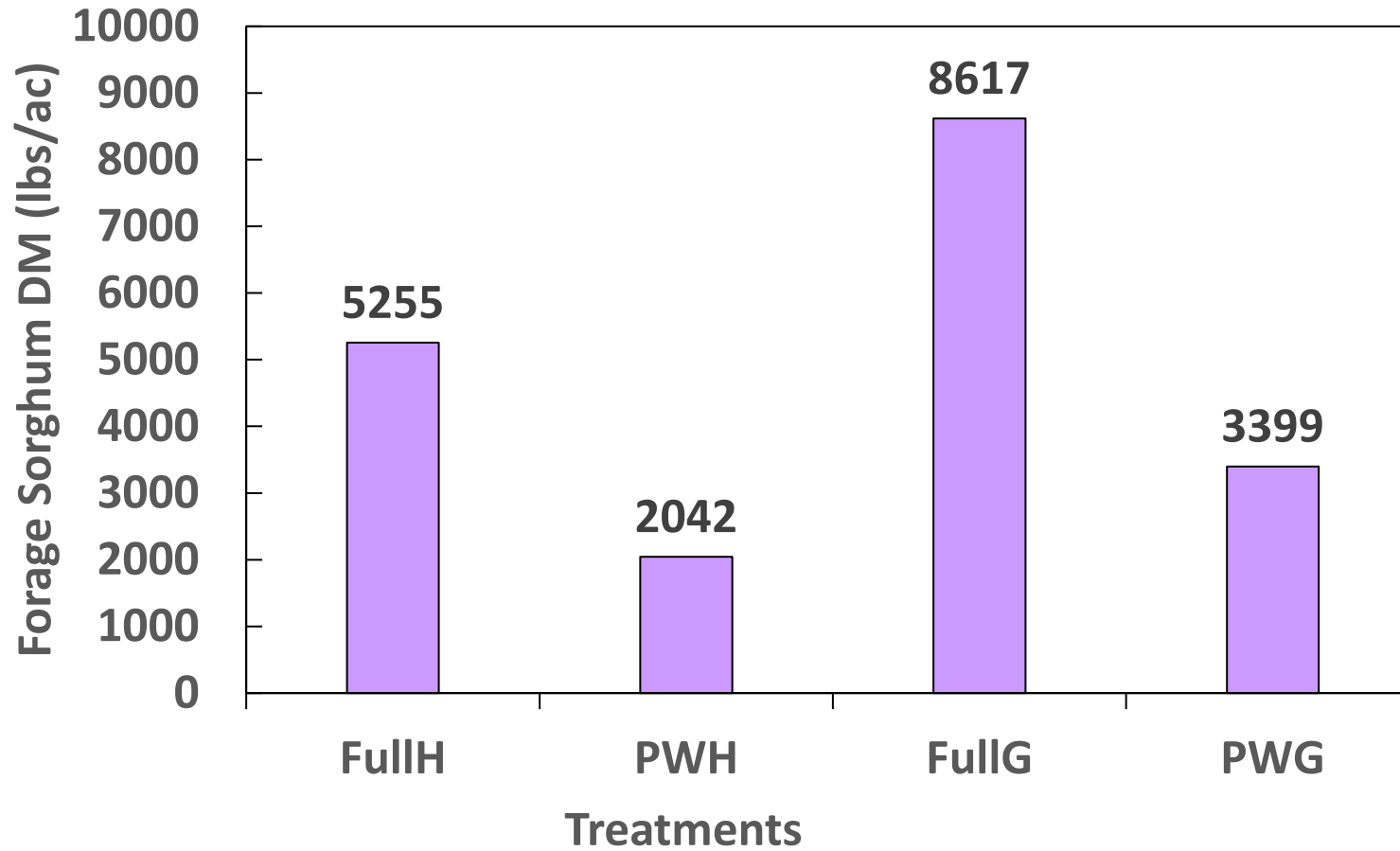




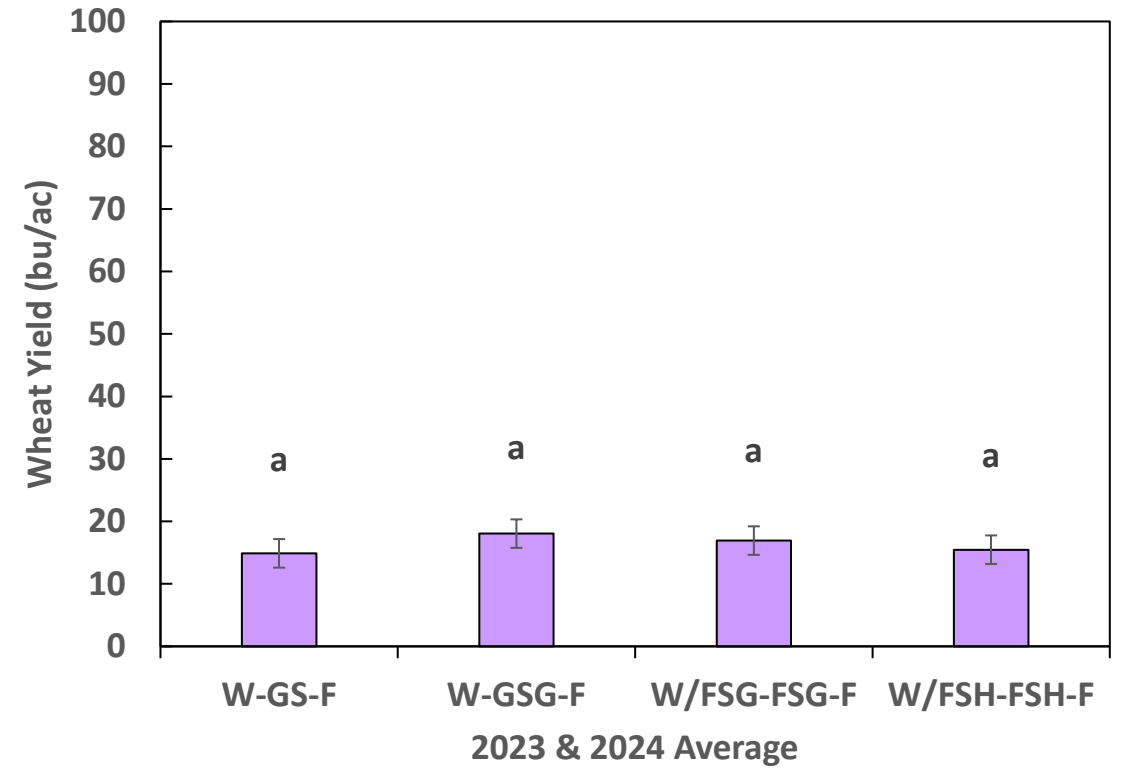
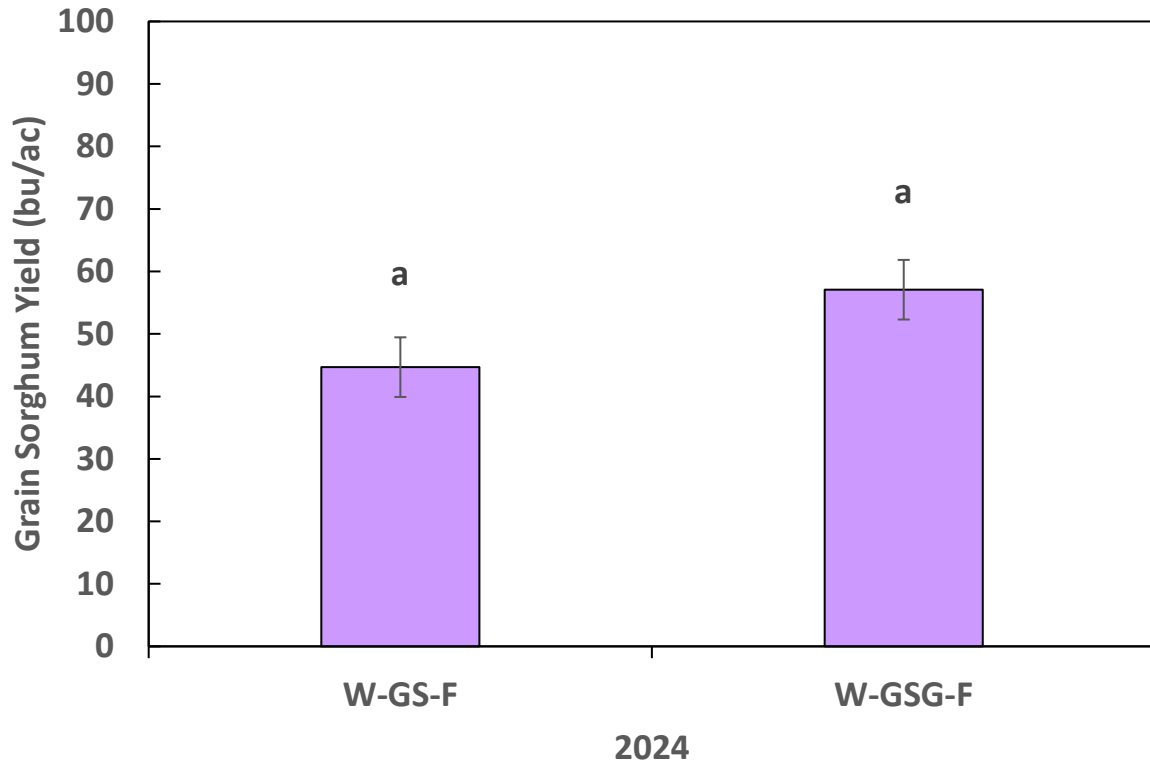
- Wheat and GS harvested in 2023 & 2024 after the complete three-year rotation was made
- Soil sampling occurred at 0-2 in and 2-6in in August of 2023 in the fallow phase of the third year
- Physical
 - Bulk Density
 - Penetration Resistance
 - Aggregate stability (0-2in)
- Chemical
 - N and P
 - SOC
 - POM
 - Aggregate associated carbon (0-2in)
 - Soil pH



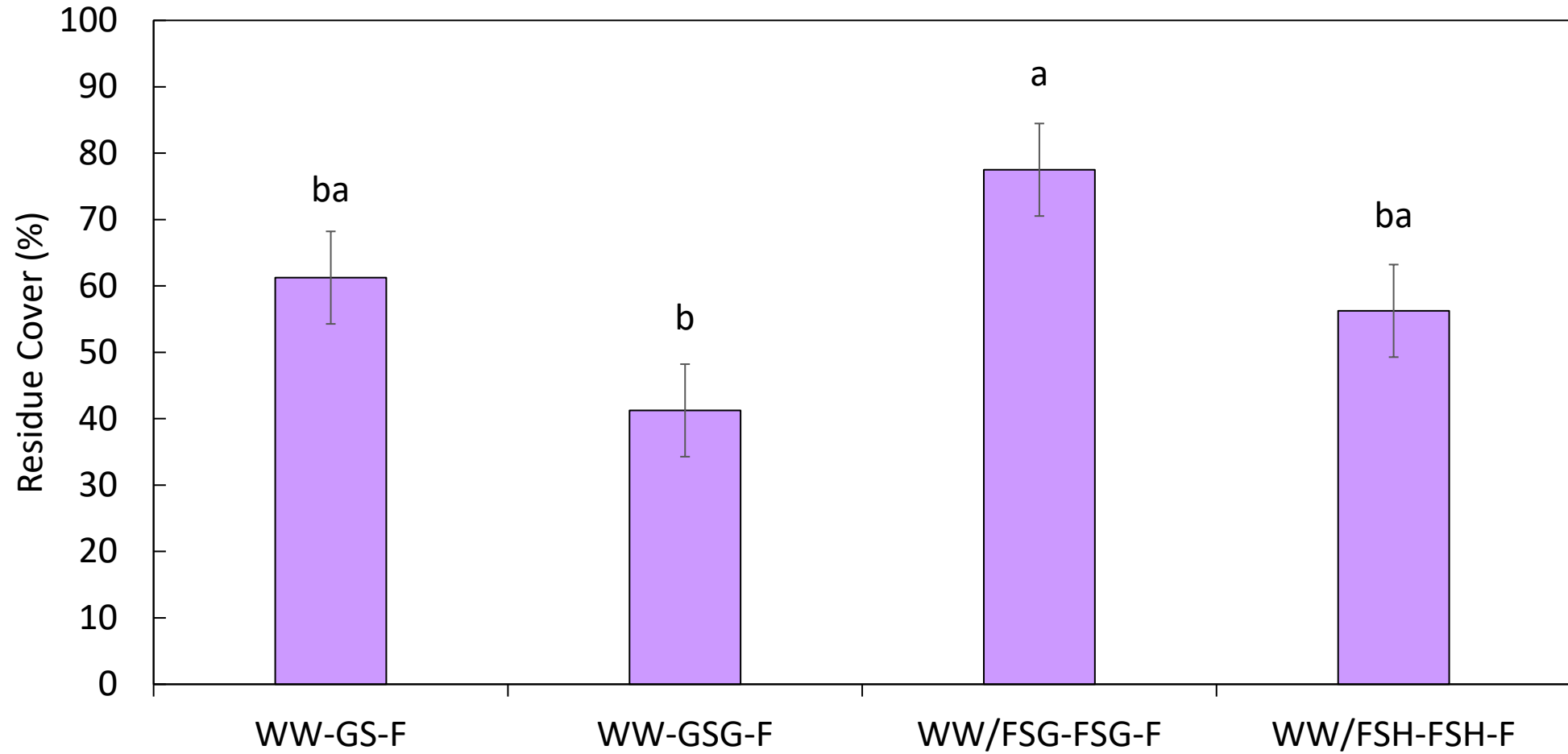
FORAGE YIELD (2021 to 2024)



GRAIN YIELDS



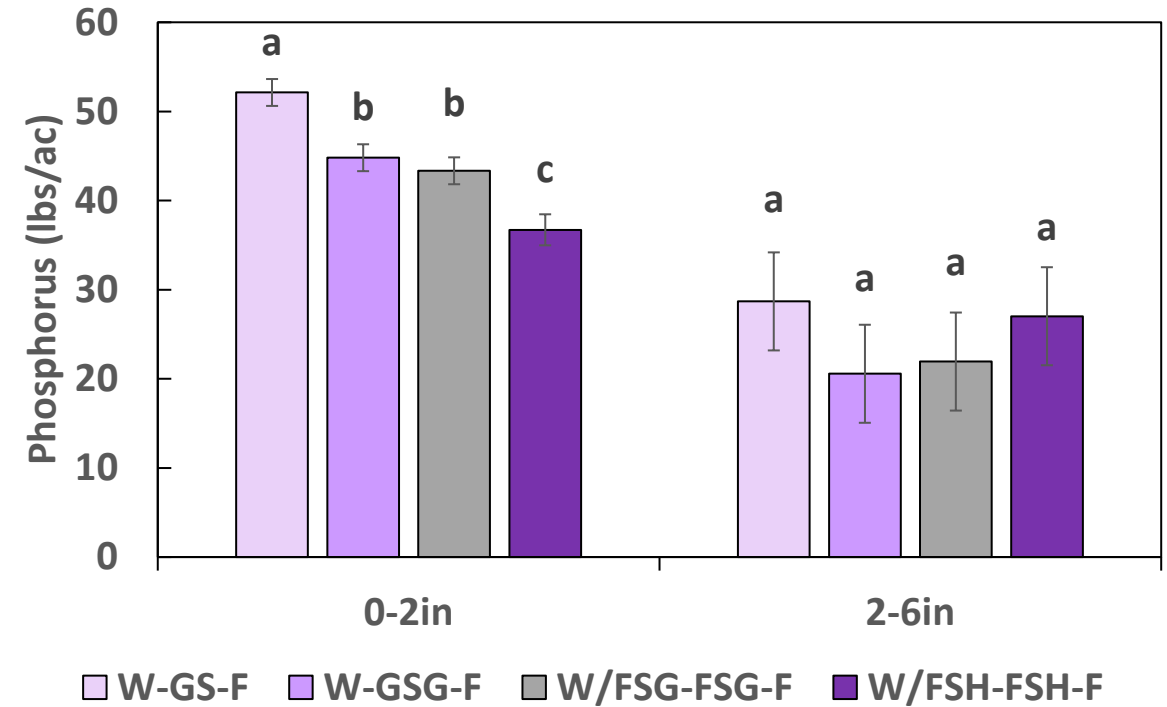
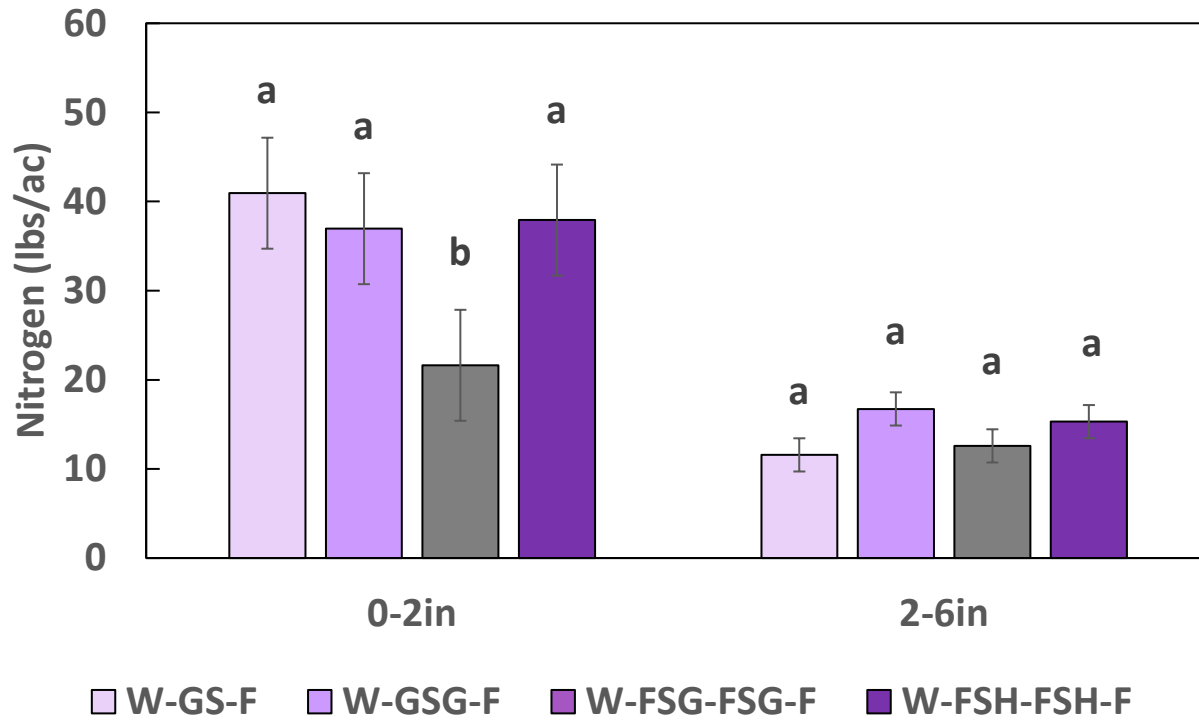
RESIDUE COVER in 2023



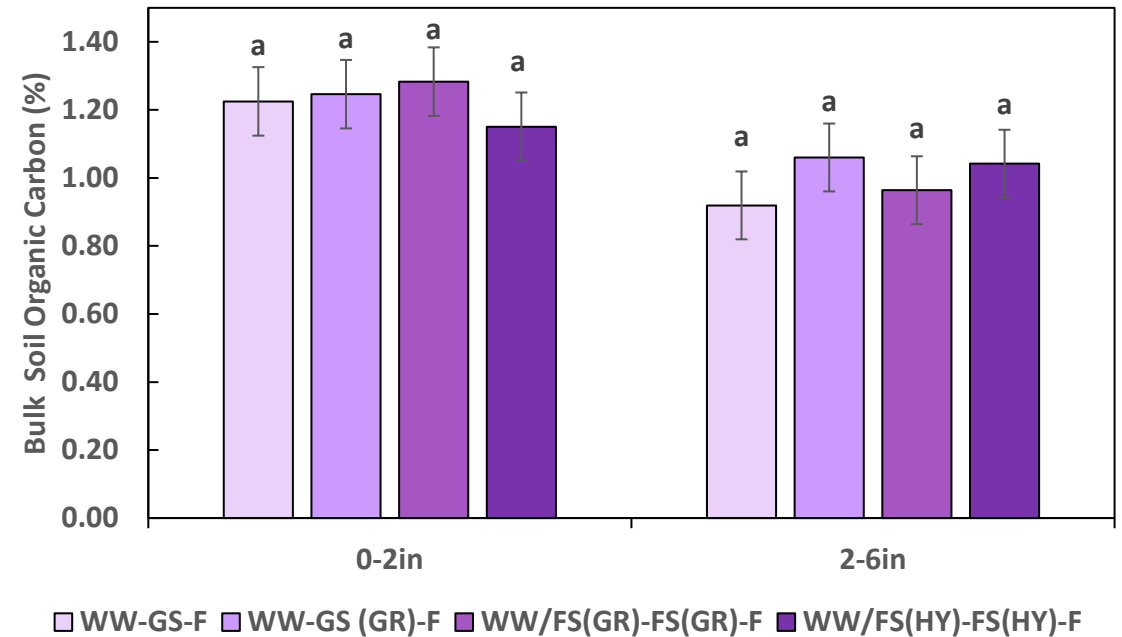
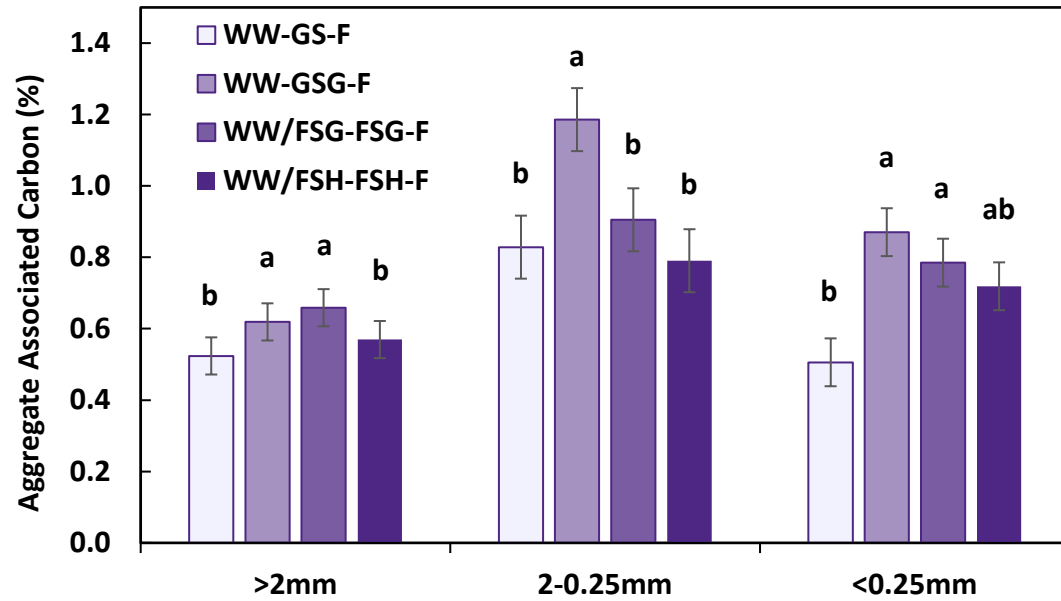
SOIL PHYSICAL PROPERTIES

Depth	Treatment	PR	BD	MWD	WEF
		MPa	g/cm ⁻³	mm	%
0-2in	W-GS-F	0.5a	1.1a	0.9a	25.3a
	W-GSG-F	0.5a	1.2a	1.1a	28.2a
	W/FSG-FSG-F	0.5a	1.2a	1.1a	23.5a
	W/FSH-FSH-F	0.5a	1.1a	1.2a	32.1a
2-6in	W-GS-F	0.8a	1.4a	-	-
	W-GSG-F	0.9a	1.5a	-	-
	W/FSG-FSG-F	0.7a	1.5a	-	-
	W/FSH-FSH-F	0.9a	1.4a	-	-

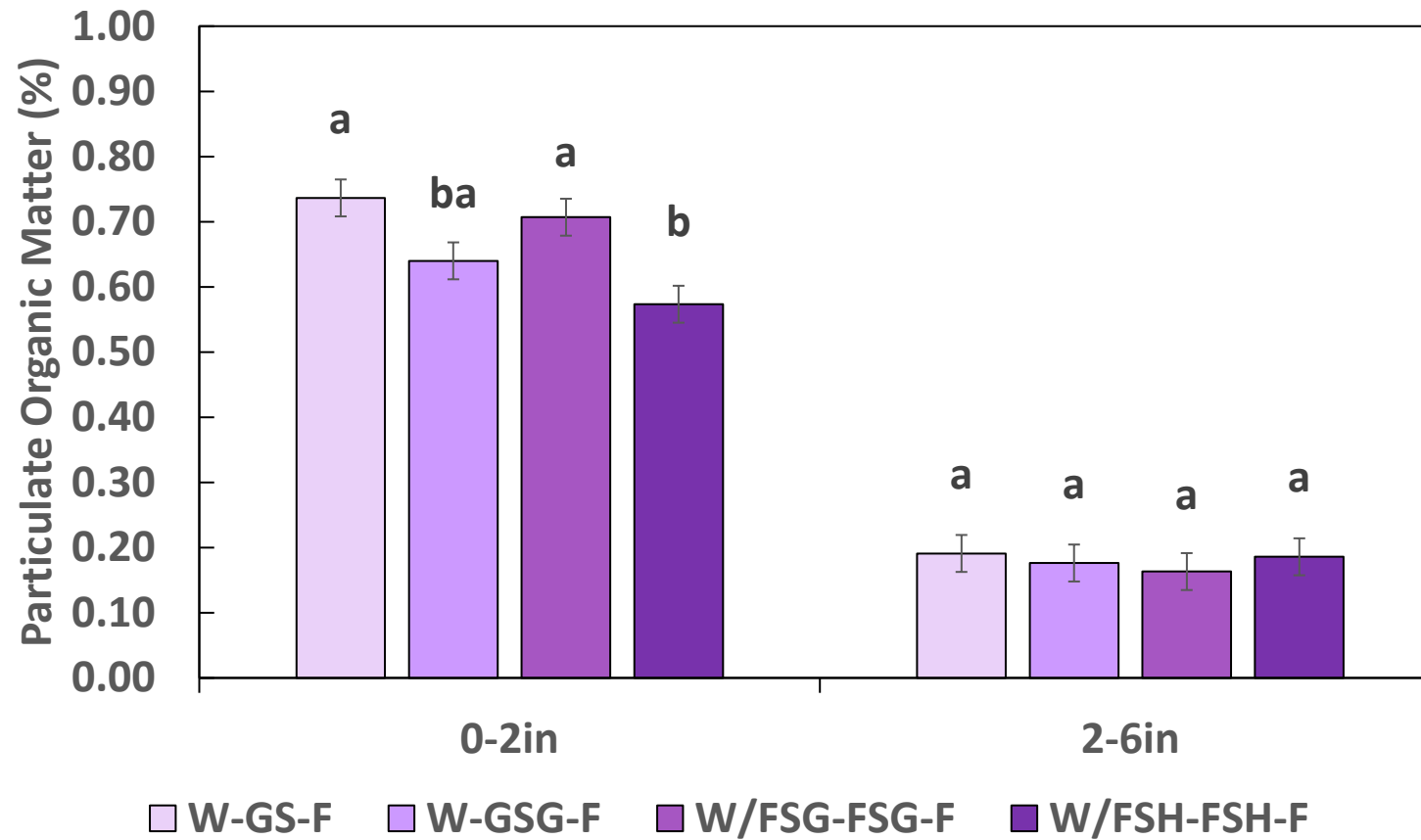
NITROGEN AND PHOSPHORUS



Soil Organic Carbon



Particulate Organic Matter



CONCLUSION

- Intensifying the W-GS-F rotation with livestock integration increased residue cover, and aggregate associated carbon in the 0-2 in depth
- integrating livestock reduced P and N concentrations in the 0–2-inch depth.
- Haying reduced POM and P concentrations compared to grazing. Grazing FS reduced N compared to all other treatments.
- The addition of annual forages and livestock had no effect on bulk density, penetration resistance, bulk SOC, or aggregate stability at the 0-2in to 2-6in depths. Phosphorus and N showed no difference among treatments at the 2-6in depth. Grain yields were not significantly different among any of the treatments.
- Therefore, adding forage for haying or grazing in the W-GS-F rotation may potentially add another revenue source, and have a neutral or positive impact on grain yield and soil properties.

- Significant droughts and other environmental factors have limited wheat, grain sorghum, and post-wheat forage sorghum production.
- An economic analysis will be conducted to examine the profitability of each cropping system.
- Longer-term studies are needed to evaluate effects of grazing and haying annual forages on crop yields and soil properties
- More data on grazing sorghum stalks and inventory as forage resource

Funding and Contact Info



Contact information

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Hays