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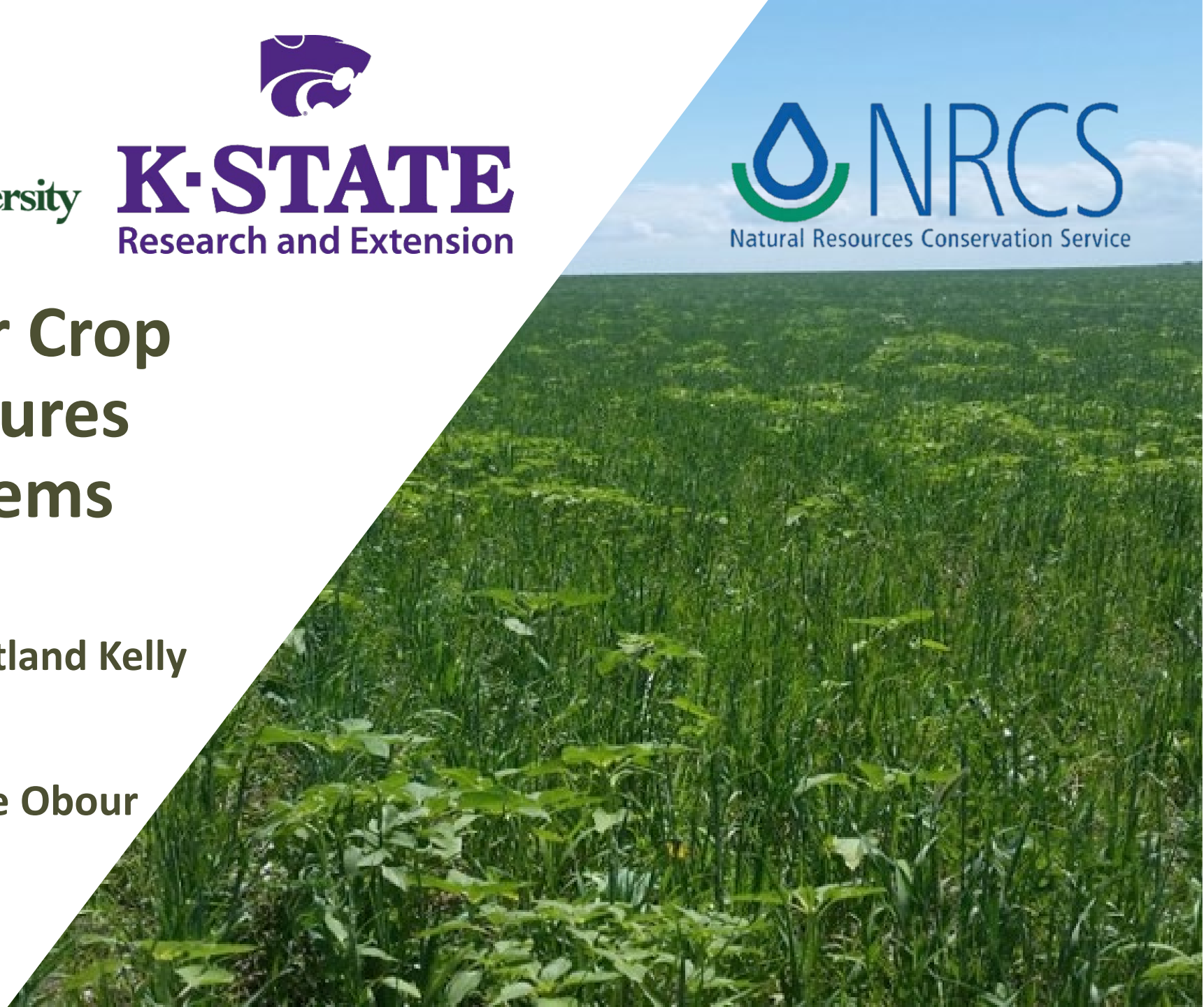
K-STATE
Research and Extension



Evaluating Cover Crop and Forage Mixtures for Dryland Systems

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Colorado State University

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Kansas State University



CIG Overview



- **Purpose—to stimulate the development and adoption of innovative conservation approaches and technologies on farms, ranches and forest lands.**
- **CIG projects are expected to lead to the transfer of conservation technologies, management systems, and innovative approaches (such as market-based systems) to agricultural producers, into NRCS technical manuals and guides, or to the private sector.**
- **CIG generally funds pilot projects, field demonstrations, and on-farm conservation research. On-farm conservation research is defined as an investigation conducted to answer a specific applied conservation question using a statistically valid design while employing farm-scale equipment on farms, ranches or private forest lands.**



Project Team

Research & extension team

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Curt Sayles, Seibert, CO
Troy Klassen, Vona, CO
Jeff Hurlburt, Idalia, CO
Matt Wilson, Bird City, KS

Overall Project Goal

Our long-term goal is to support producers in the High Plains (and beyond) to adopt management strategies that are profitable and build soil and ecosystem health.



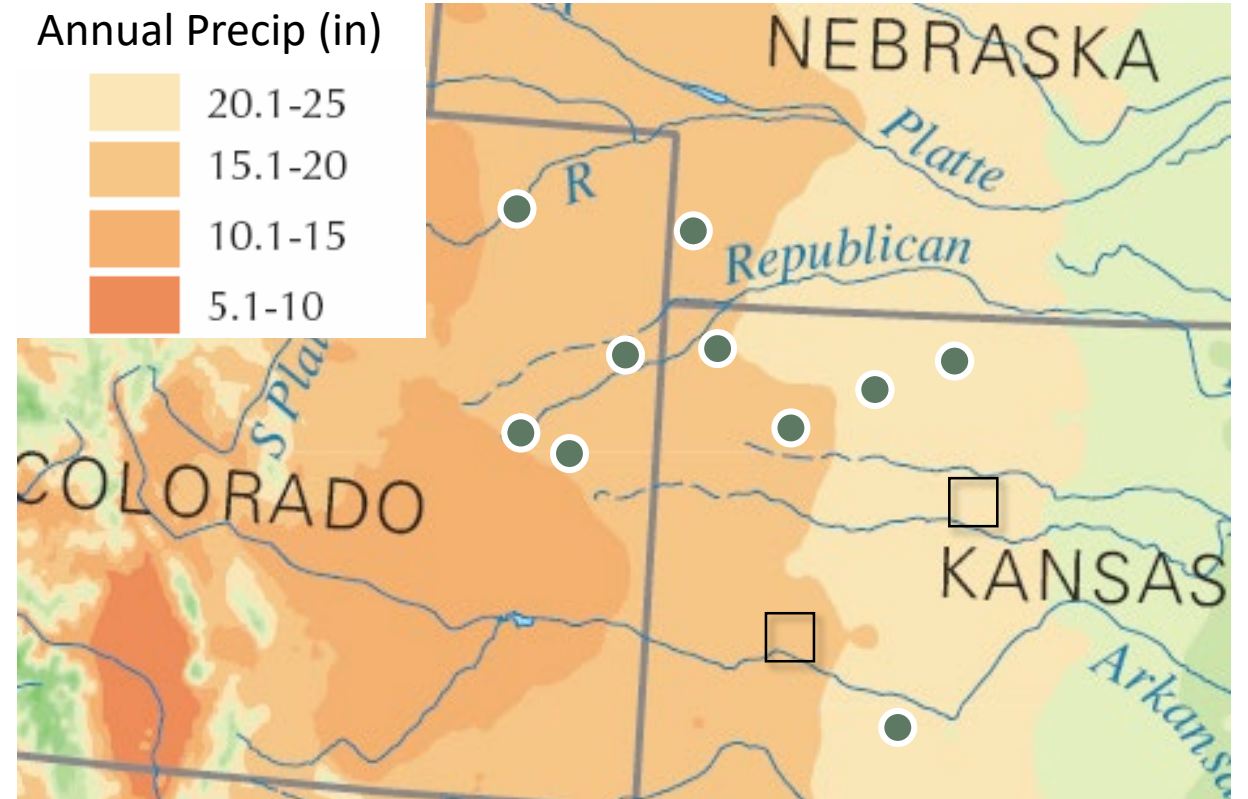
Study locations

On-Farm Research

- Cooperating producers

Research Station Trials

- KSU cropping systems experiments





On-farm research

Spring Planted Mixtures

2016 spring mix

5lbs spring peas

15lbs oats

15lbs forage barley

5lbs hay millet

2lbs rapeseed

1lbs flax

1lbs safflower

1lbs sunflower

Total: 45 lbs/acre, \$18/acre

2017 spring mix

5lbs spring peas

10lbs oats

10lbs forage barley

10lbs triticale

2lbs rapeseed

1lbs flax

1lbs safflower

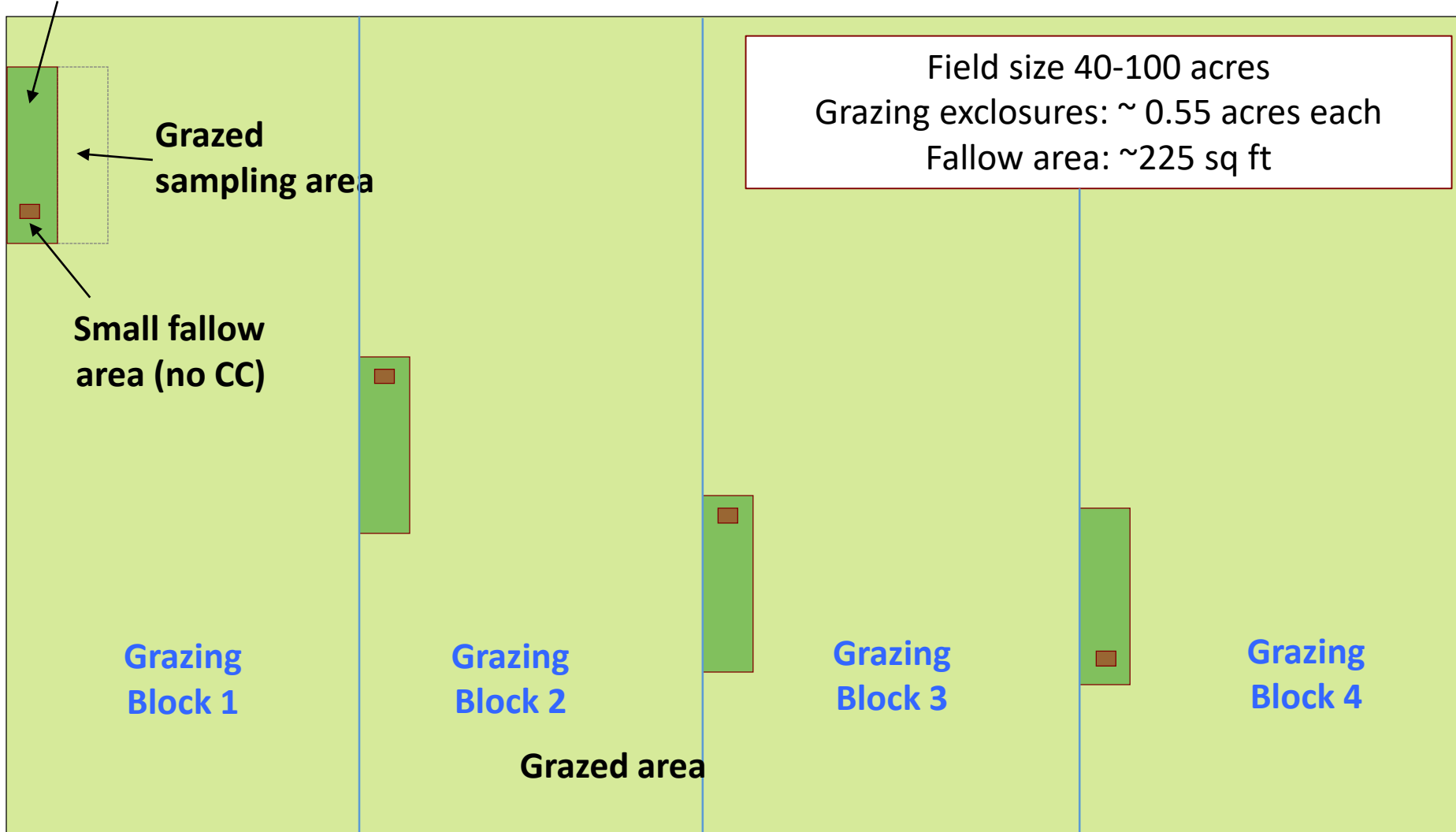
1lbs sunflower

1lbs purple top turnip

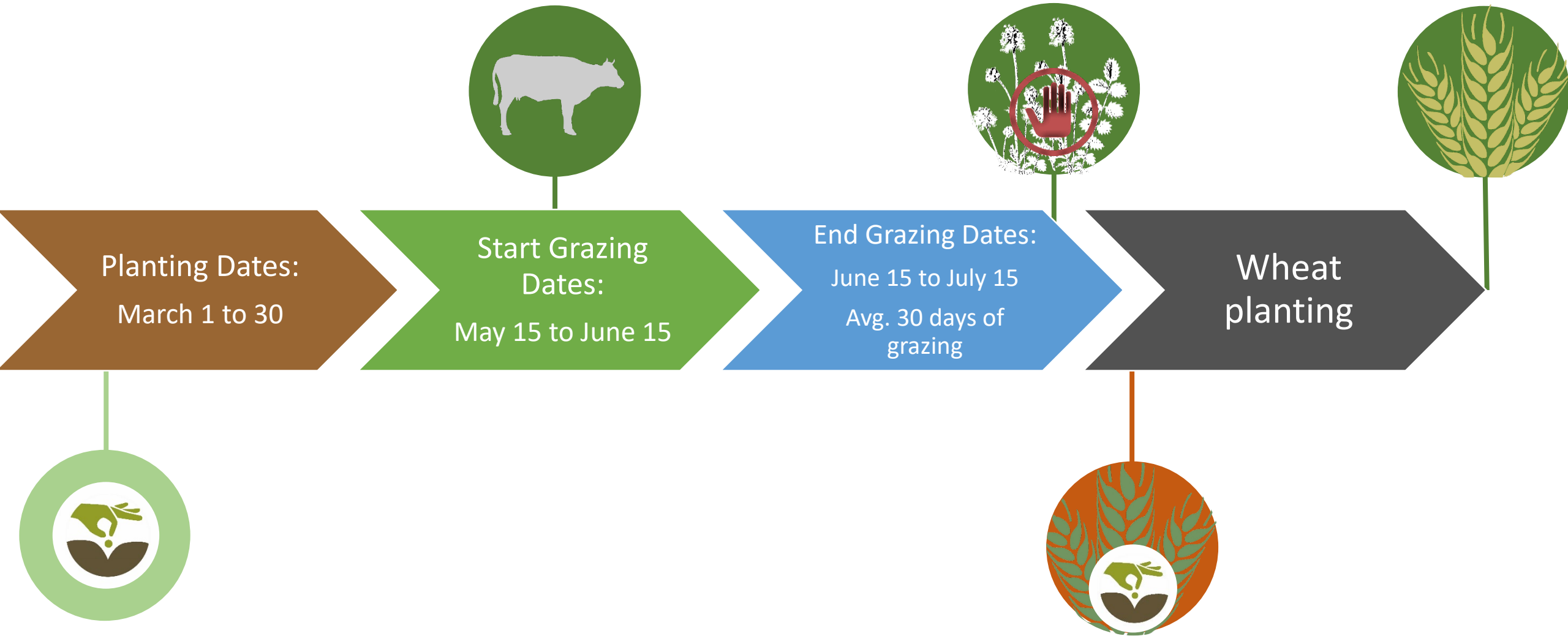
Total: 41 lbs/acre, \$18/acre

Field Layout

Ungrazed CC



Spring planted



Variables Measured

Soil quality

- **Bulk density**
- Residue quality
- **Aggregate stability**
- Soil C and N
- Active C (POXC + respiration)
- Potentially mineralizable N
- **Soil moisture dynamics**
- Haney test (sub-set)

Productivity and Profitability

- **Cover crop biomass production**
- Forage quality
- **Grain yields (in following season)**
- **Cattle weight gain**
- **Enterprise budgets**

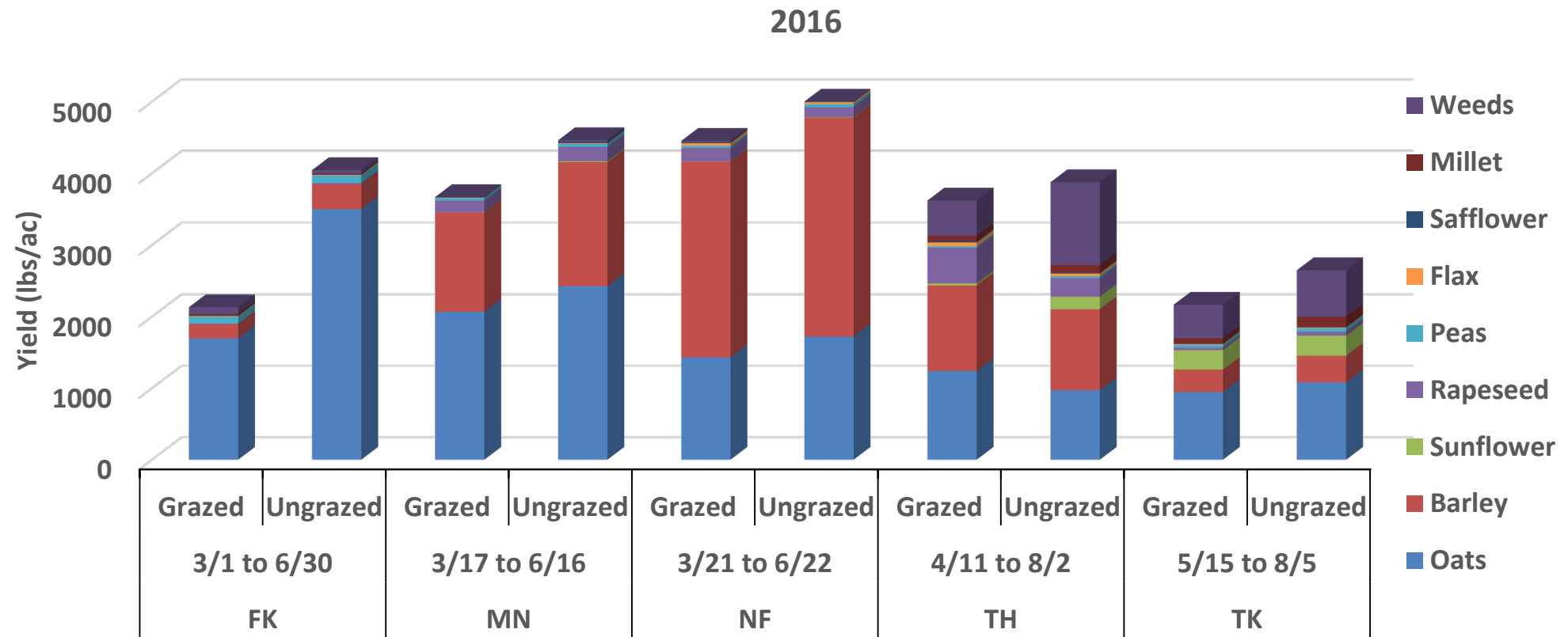
Weed Dynamics and Pollinators

- Weed community **and biomass**
- Pollinator abundance

A photograph of a field of grasses, likely a forage crop, showing a mix of green and yellowing stalks. A circular white overlay is positioned on the right side of the image, containing the text 'Forage Production' in a black, sans-serif font. Below the text is a short horizontal line.

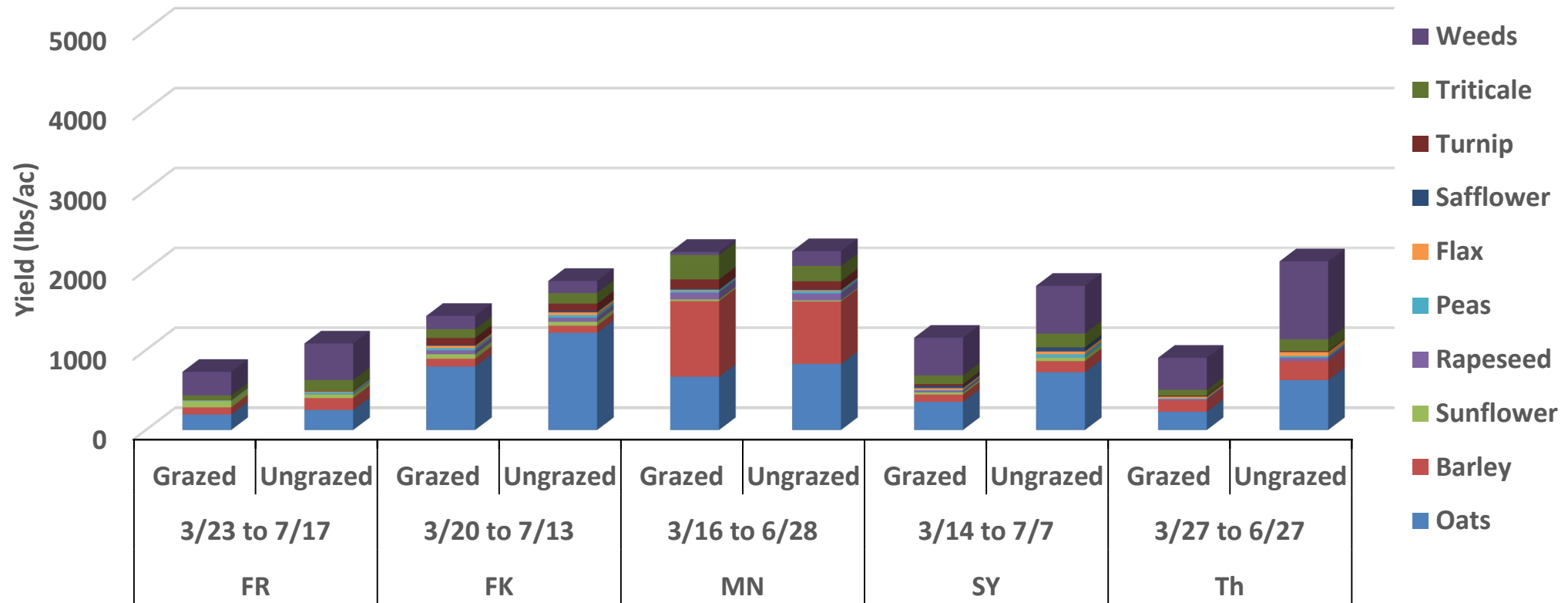
Forage
Production

Year 1 forage: ~2 tons/ac; little reduction in cover after grazing due to regrowth



Year 2 forage: <1 ton/acre; cooler conditions slowed growth & increased weed pressure

2017



5/18/16



6/16/16



Rep 1 Regrowth
6/16/16



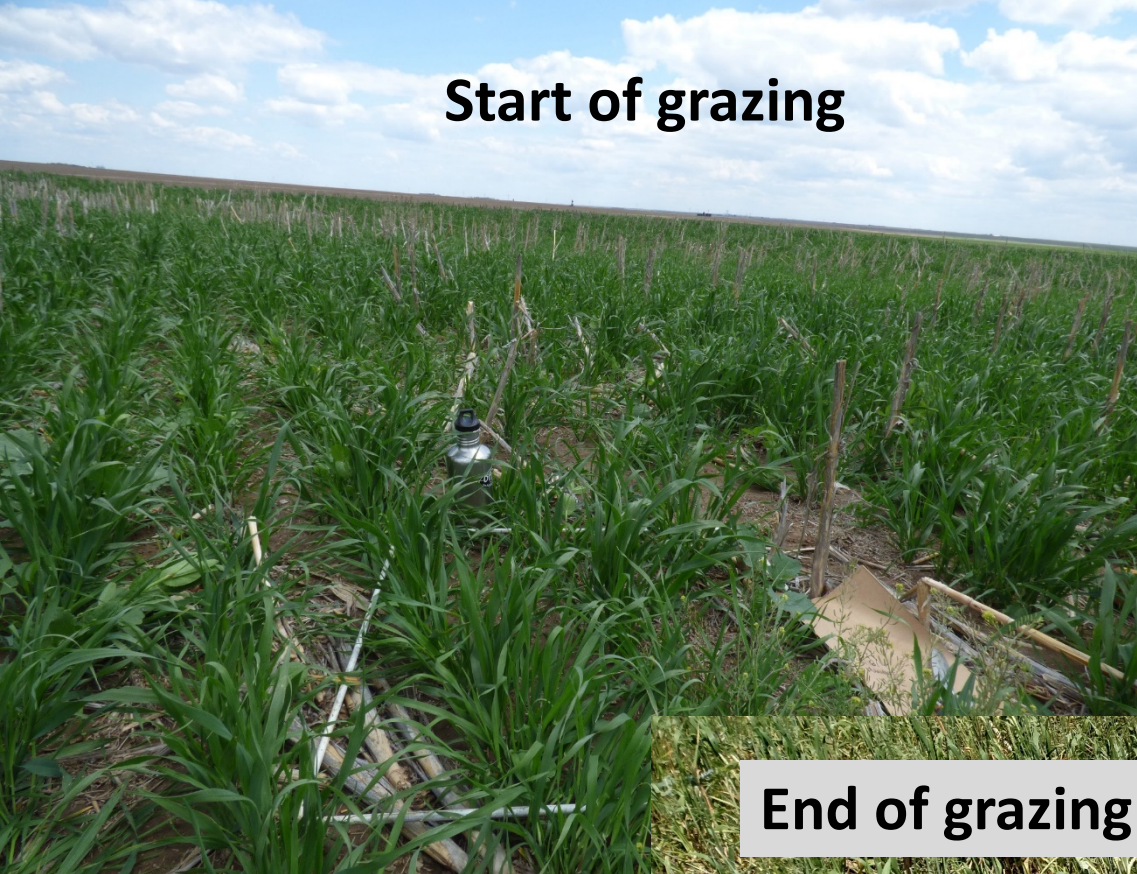


Animal
Performance

Forage supported ~4 wks of grazing with gains of ~2 lbs/day

	Planting Date	Growing days	Start graze	Days grazing	DM yield (lbs/ac)	ADG (lbs/d)	Stocking rate (lbs/ac)
FK '16	3/1	85	5/25	36	4044	pairs	281
FK '17	3/20	85	6/13	31	1863	pairs	380
MN '16	3/17	62	5/18	29	4461	3.37	912
MN '17	3/16	75	5/30	28	2235	2.19	531
SY '17	3/14	93	6/15	22	1802	3.59	542
NF '16	3/21	65	5/25	29	5020	2.48	346
TH '16	4/11	86	7/6	28	3875	2.34	475
TH '17	3/27	71	6/6	27	2108	1.30	358
FR '17	3/23	91	6/22	25	1081	0.69	424
TU '16	5/15	53	7/7	28	2684	1.39	1090
Average				28	2917	2.17	534

Start of grazing



Regrowth



End of grazing





End of grazing
planted May 15
start grazing June 7





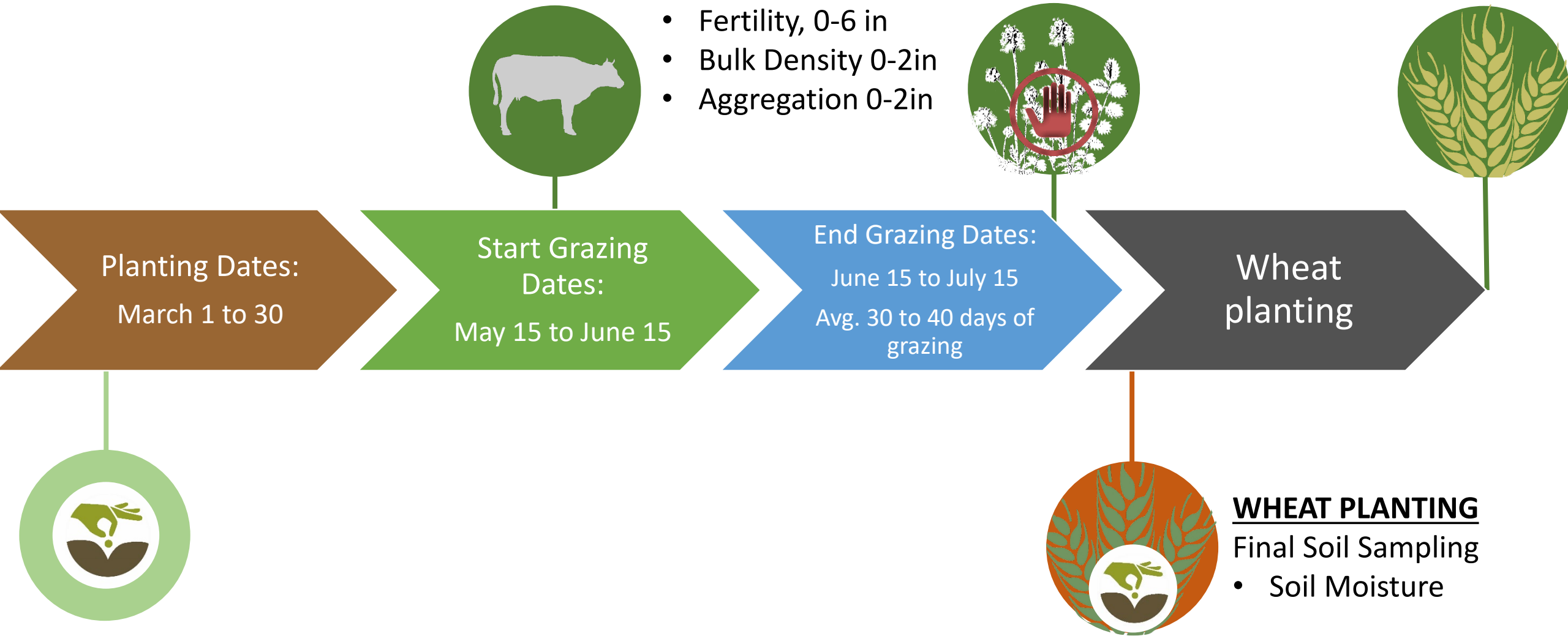
Soil Quality
Results

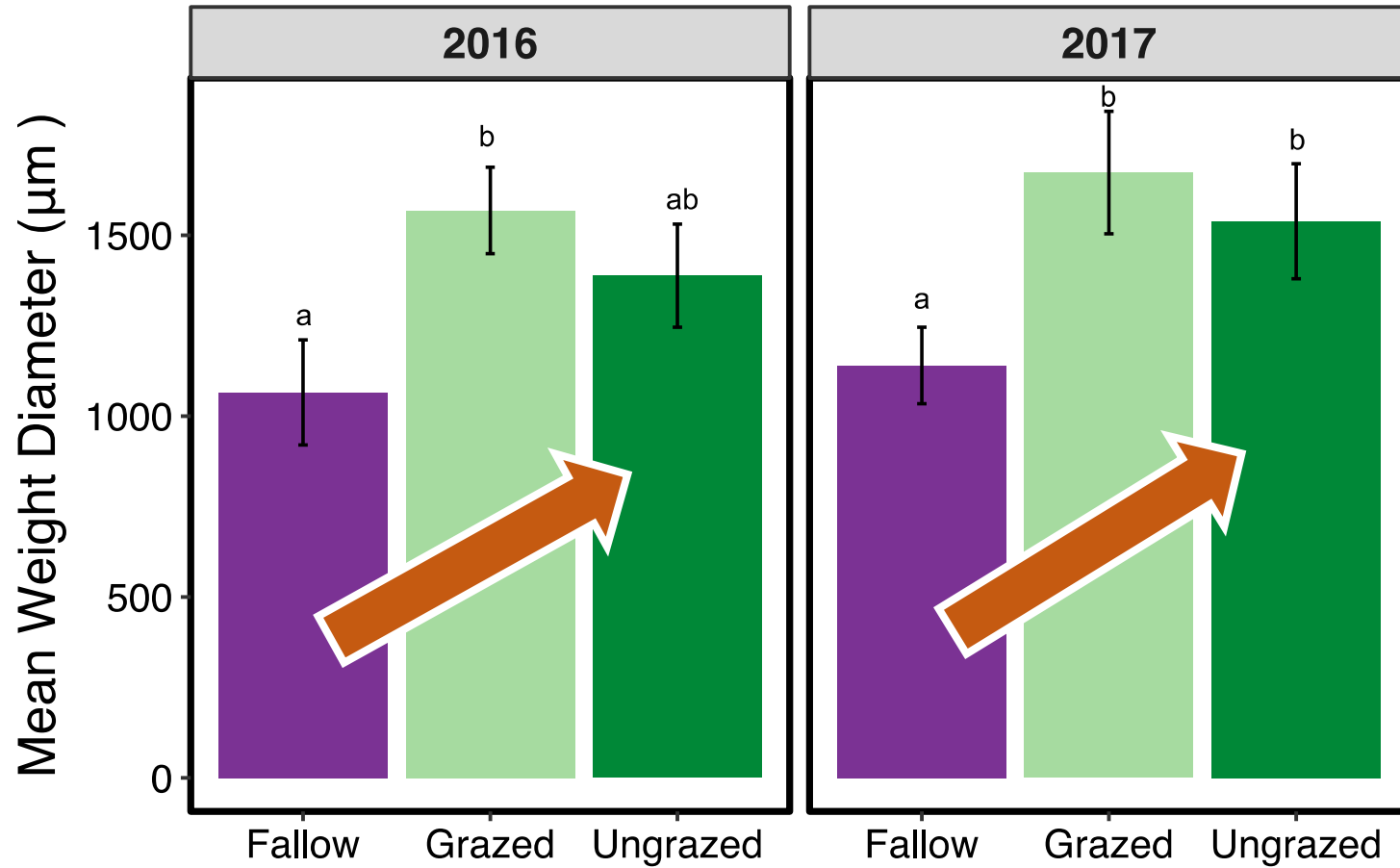
Sampling

TERMINATION:

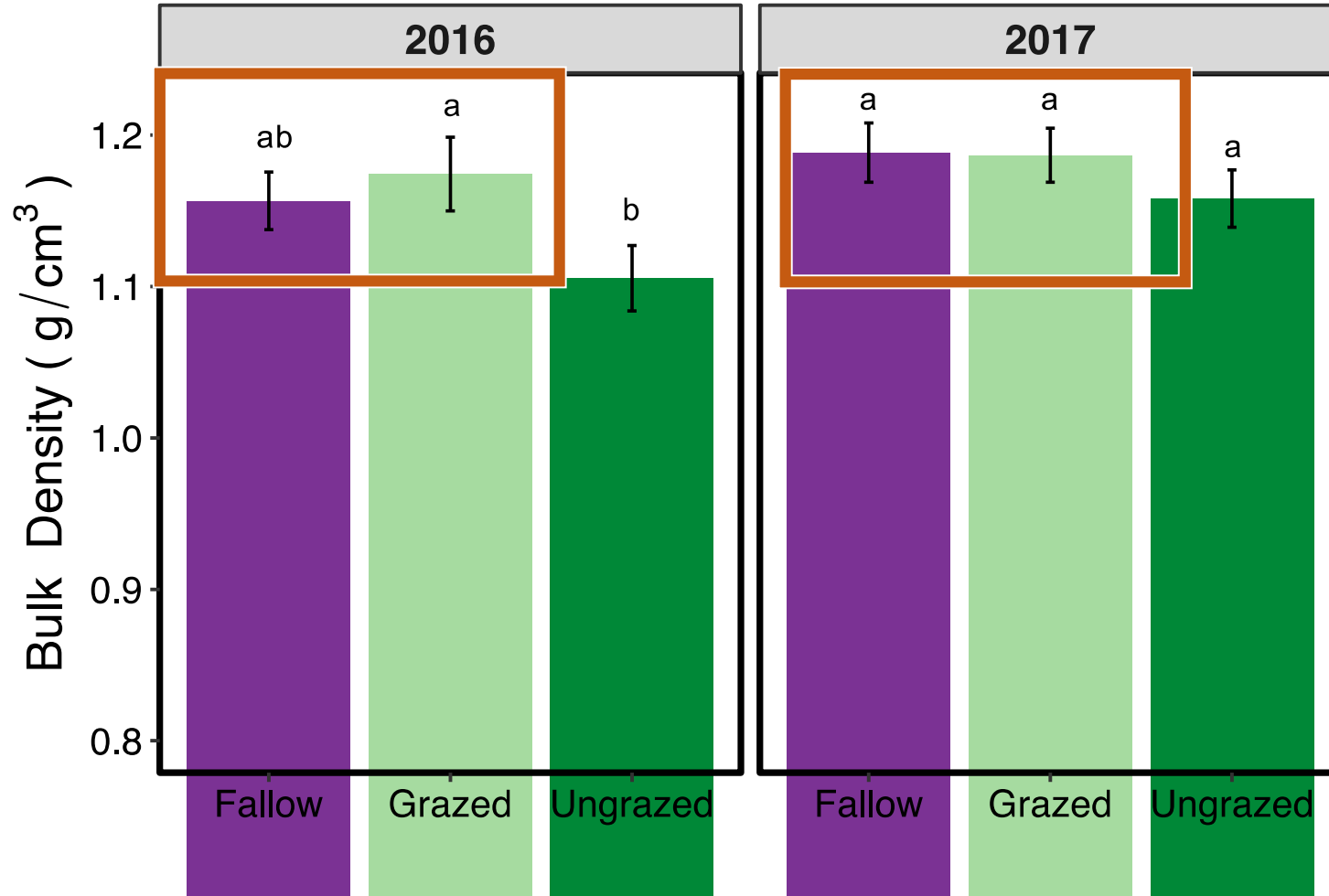
Main Sampling for Treatment Effects

- Soil Moisture
- Fertility, 0-6 in
- Bulk Density 0-2in
- Aggregation 0-2in

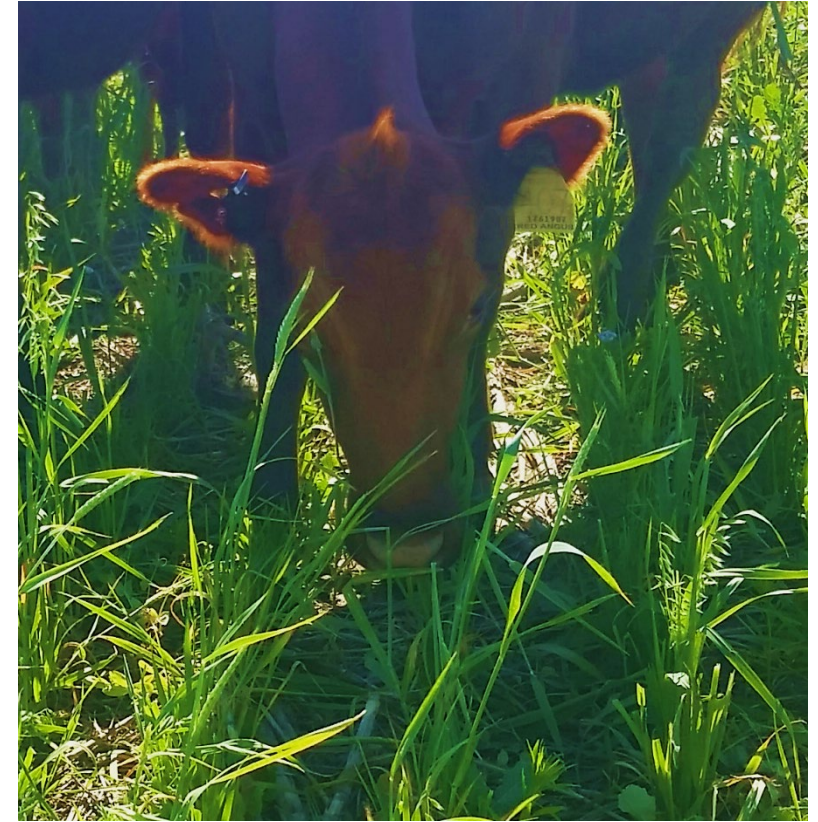
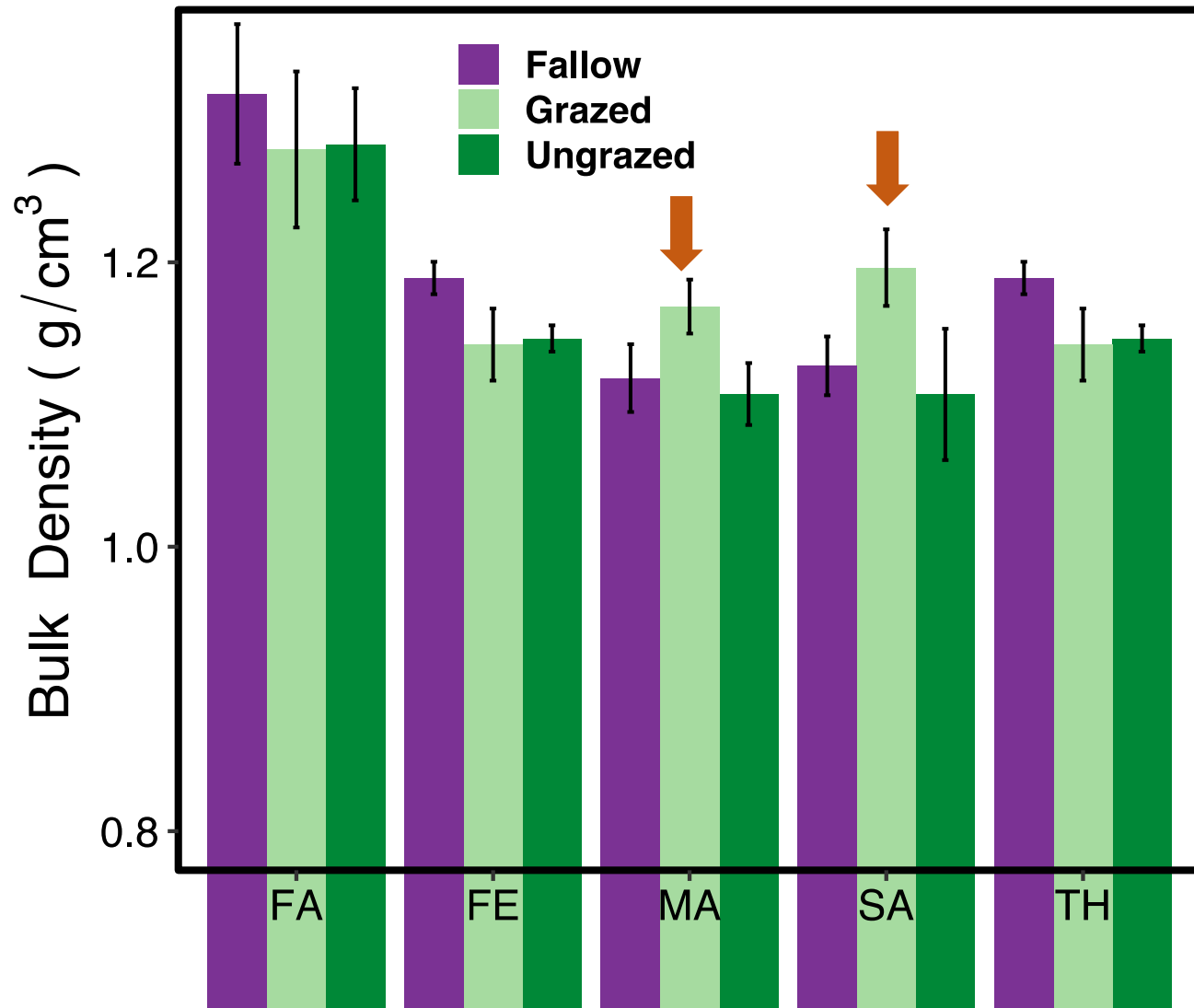




Surface aggregate stability increased with cover crops, especially with grazing

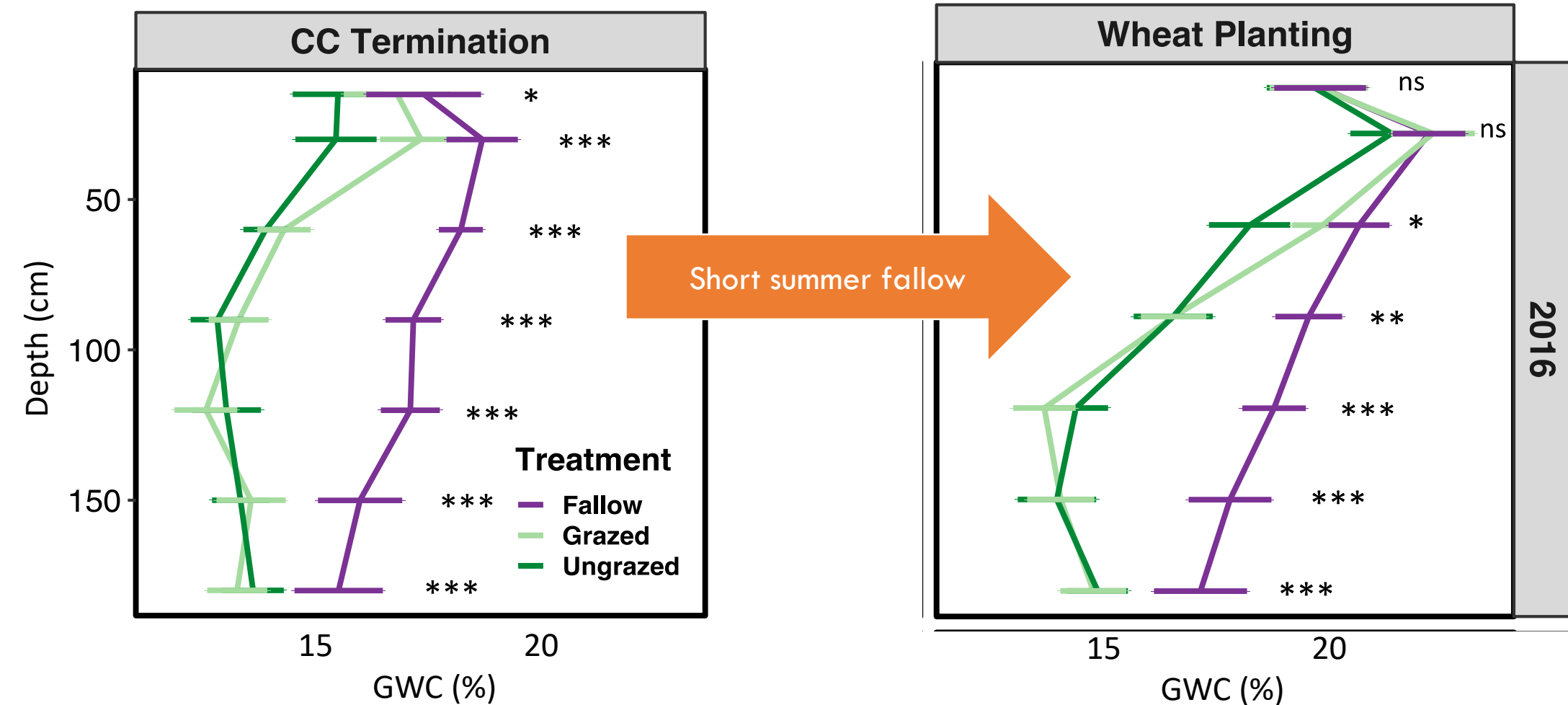


No noticeable increase in surface bulk density with grazing across all farms in both years



Slight increase in bulk density with stocking rates > 500 lb./acre

Fallow had more moisture below 2 ft.





Wheat Yields & Economics

Wheat yield

Treatment	Yield (bu/ac)
Fallow	52.2 a
Grazed	42.5 b
Ungrazed	41.3 b

Fallow plots had ~10 bu/ac greater yield

2016: 1 out of 4 fields with yield reduction

2017: 1 out of 3 fields with yield reduction

Economics

AUM = animal unit

Calves = .5

Steers = .75

Cows, heifers, and bull = 1.0

Range in average values across 2016 & 2017

		per AUM	per Acre
Increased returns		\$31.87-81.17	\$44.26-73.56
Reduced returns			\$8.00-40.00
Additional Costs:			
	Fence (materials)	\$2.77-6.85	\$1.18-7.20
	Labor (fence)	\$1.7-5.1	\$0.72-2.02
	Labor (livestock)	\$3.74-3.76	\$1.59-1.72
	Seed (\$18/ac)	\$11.15-24.53	\$10.44-18.00
	Fertilizer	\$6.75-16.25	\$6.91-9.10
	Herbicides	\$4.75-12.00	\$5.11-9.42
	Machinery Costs	\$12.19-12.94	\$5.19-22.88
	Other (e.g. water)	\$0.93-18.52	\$1.31-7.88
	Total Costs	\$52.23-91.70	\$39.02-71.65
Reduced Costs:			
	Herbicides		\$14.50
	Feed		\$11.25
	Pasture leases		\$20.00
	Total Reduced Costs		\$14.50-49.25
NET CHANGE IN INCOME:			\$16.77 to \$79.02



Cover Crop Research at K-State HB Ranch

**Augustine Obour and John Holman
Western Kansas Agricultural
Research Centers**

Research objectives

- Determine cover crop management options for dryland systems.
- Determine impacts of removing cover crops for forage on soil health.
- Evaluate flex-fallow as a strategy for sustainable integration of cover crops in semiarid environments.

Spring cover crop treatments

Treatment	Cover	Hay	Grazing
Fallow	--	--	--
Flex (oat/triticale)	X	X	X
Oat/triticale	X	X	X
Oat/triticale/peas	X	X	--
Spring oat	X	X	--
Spring triticale	X	X	--
Cocktail mix [†]	X	X	--
Spring pea for grain	--	--	--

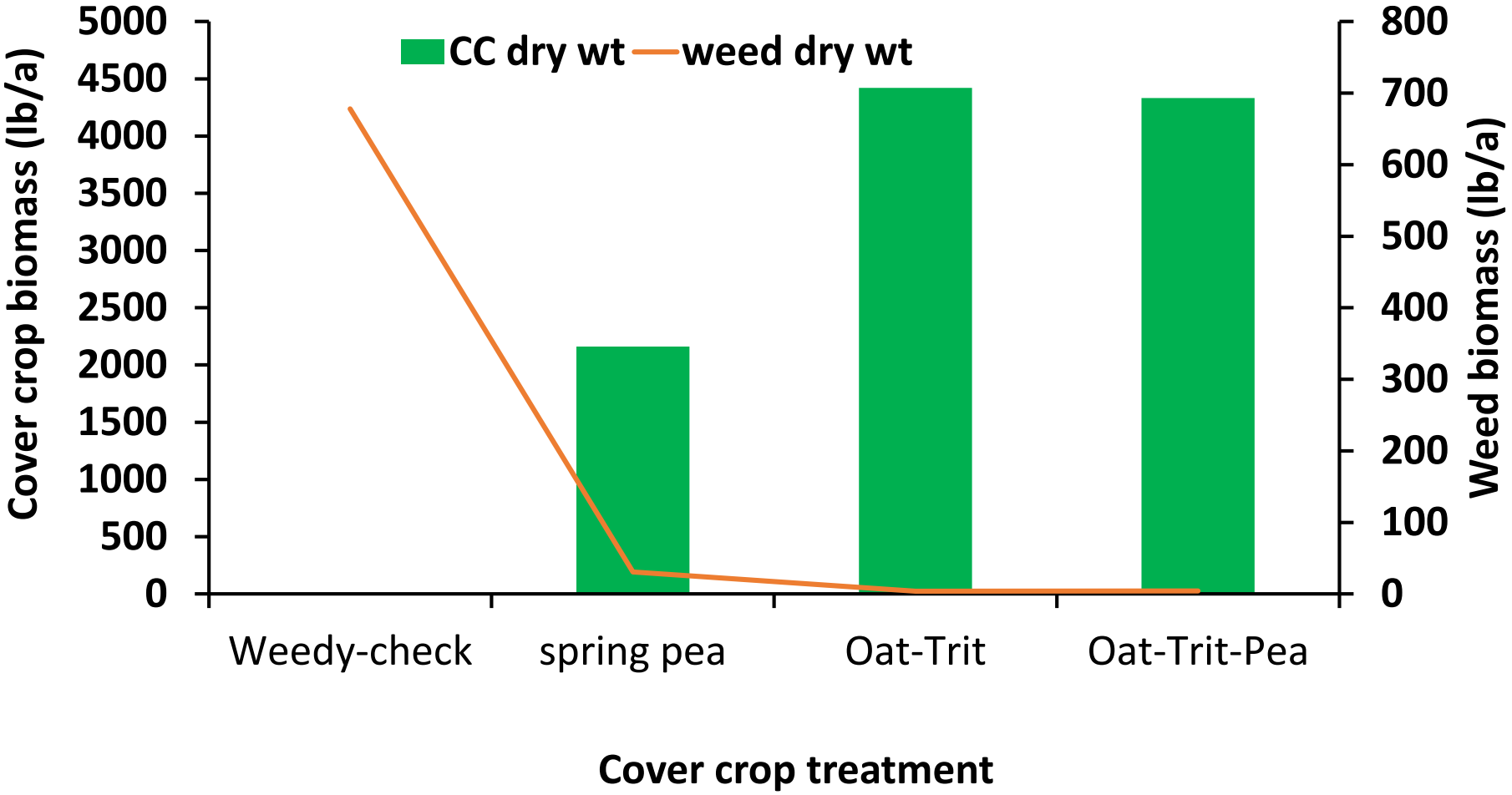
[†]Cocktail consists of oat/triticale/pea/buckwheat/turnip/radish mixture

Spring cover crop forage yield (3-yr average)

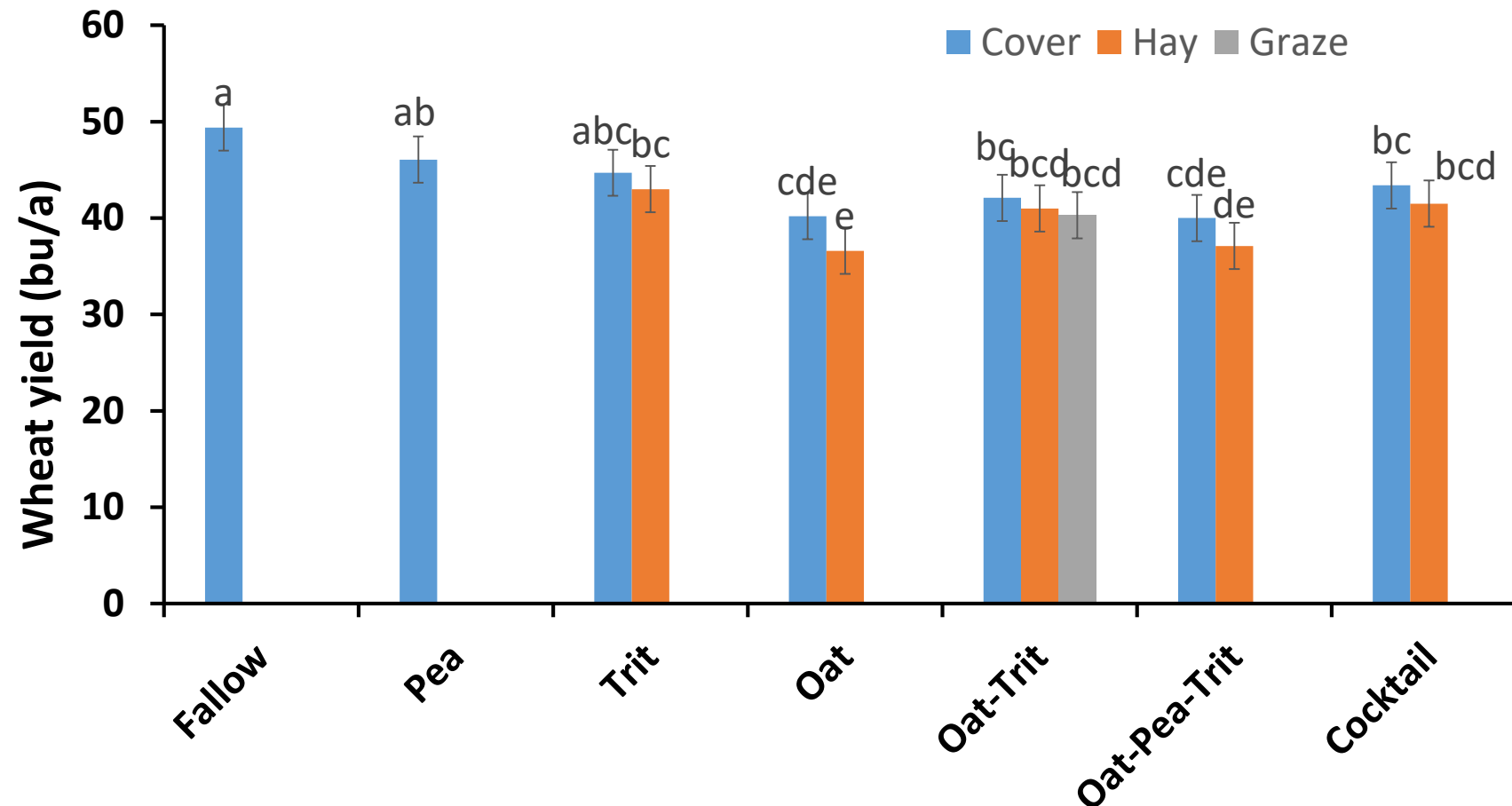
Treatment	Yield	CP	ADF	NDF	IVDMD
	lb/acre	%			
Oat/triticale (flex)	3014 a	11.6 c	37.1 b	62.9 bc	72.7 ab
Oat/triticale	3026 a	11.6 c	38.3 ab	64.8 ab	71.2 bc
Oat	2383 ab	11.9 bc	37.1 b	62.1 c	73.8 a
Triticale	2981 a	12.1 bc	38.8 a	65.3 a	69.7 c
Oat/triticale /pea	2440 ab	14.4 a	37.1 b	61.5 c	73.6 a
Cocktail	2225 b	13.0 ab	37.2 b	61.8 c	73.8 a

Flex treatment planted only when there was adequate moisture

Weed suppression by cover crops (2016-2017)



Wheat yield after spring cover crops (2016-2018)

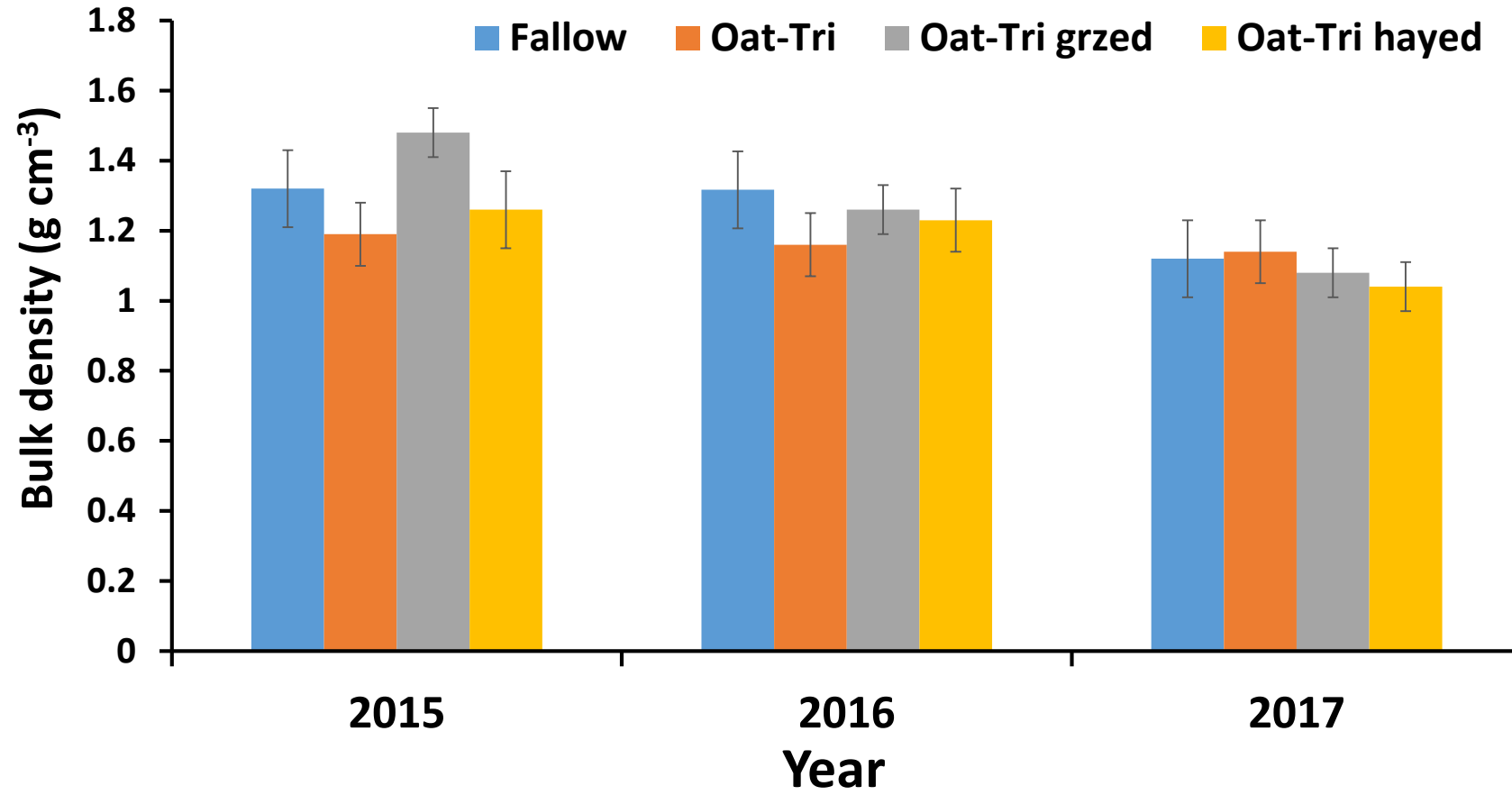


Grazing cover crops

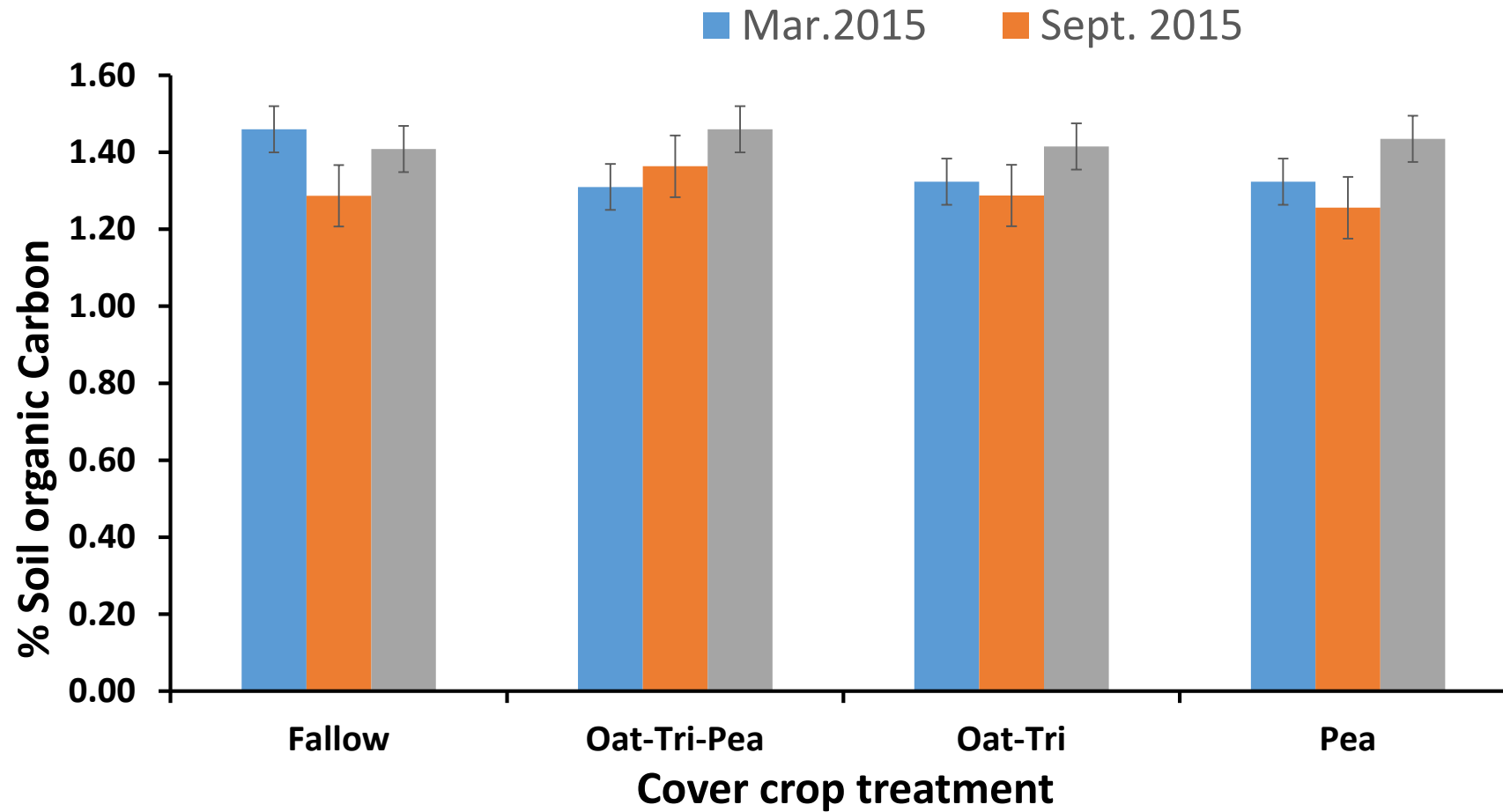


2015 grazing occurred from 5/19 to 5/22;
2016 grazing started from 6/14 to 6/21;
2017 grazing occurred from 5/30 to 6/3.
Stocking rate: 1.5 AUM/acre

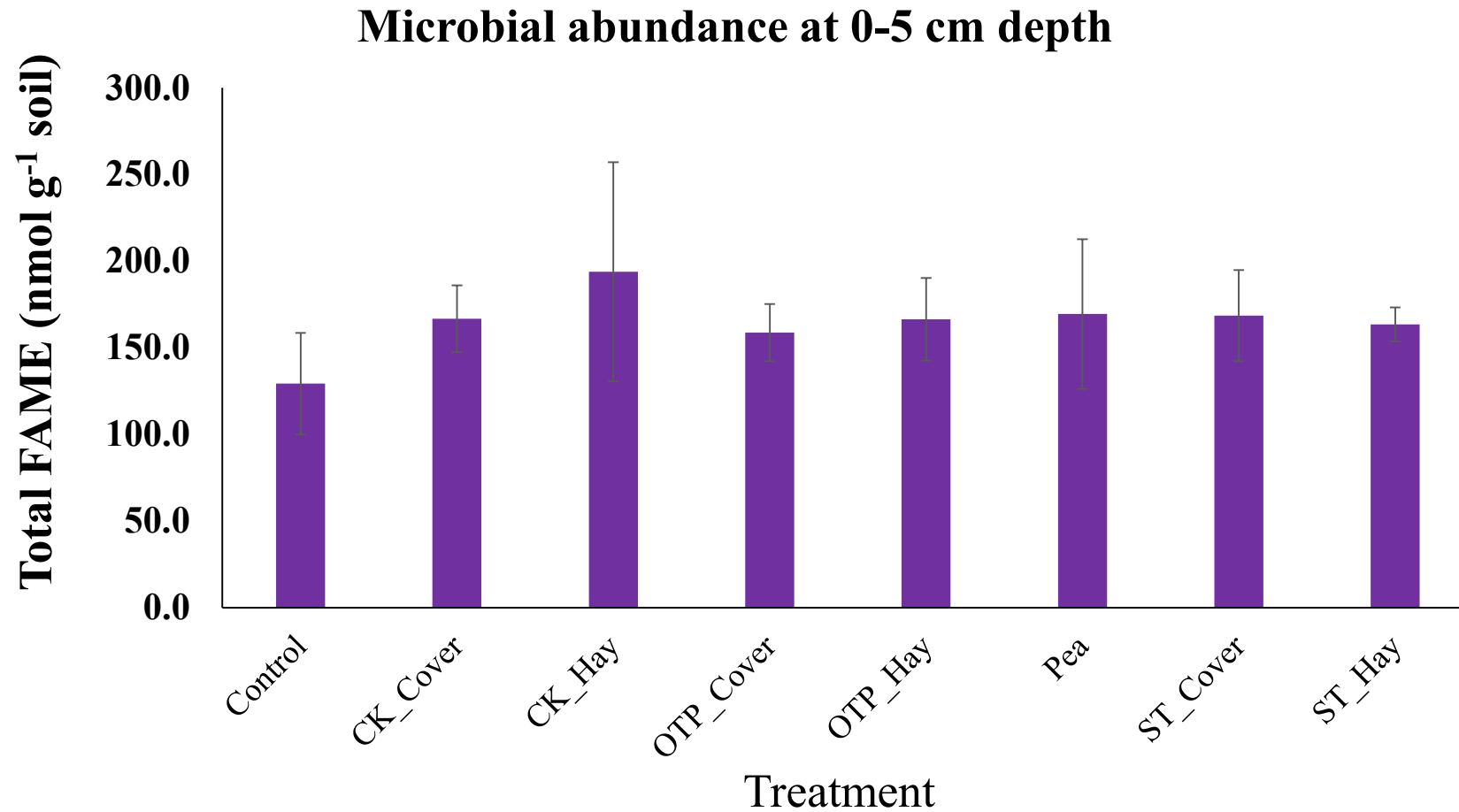
Grazing effects on bulk density (0 to 2 inches)



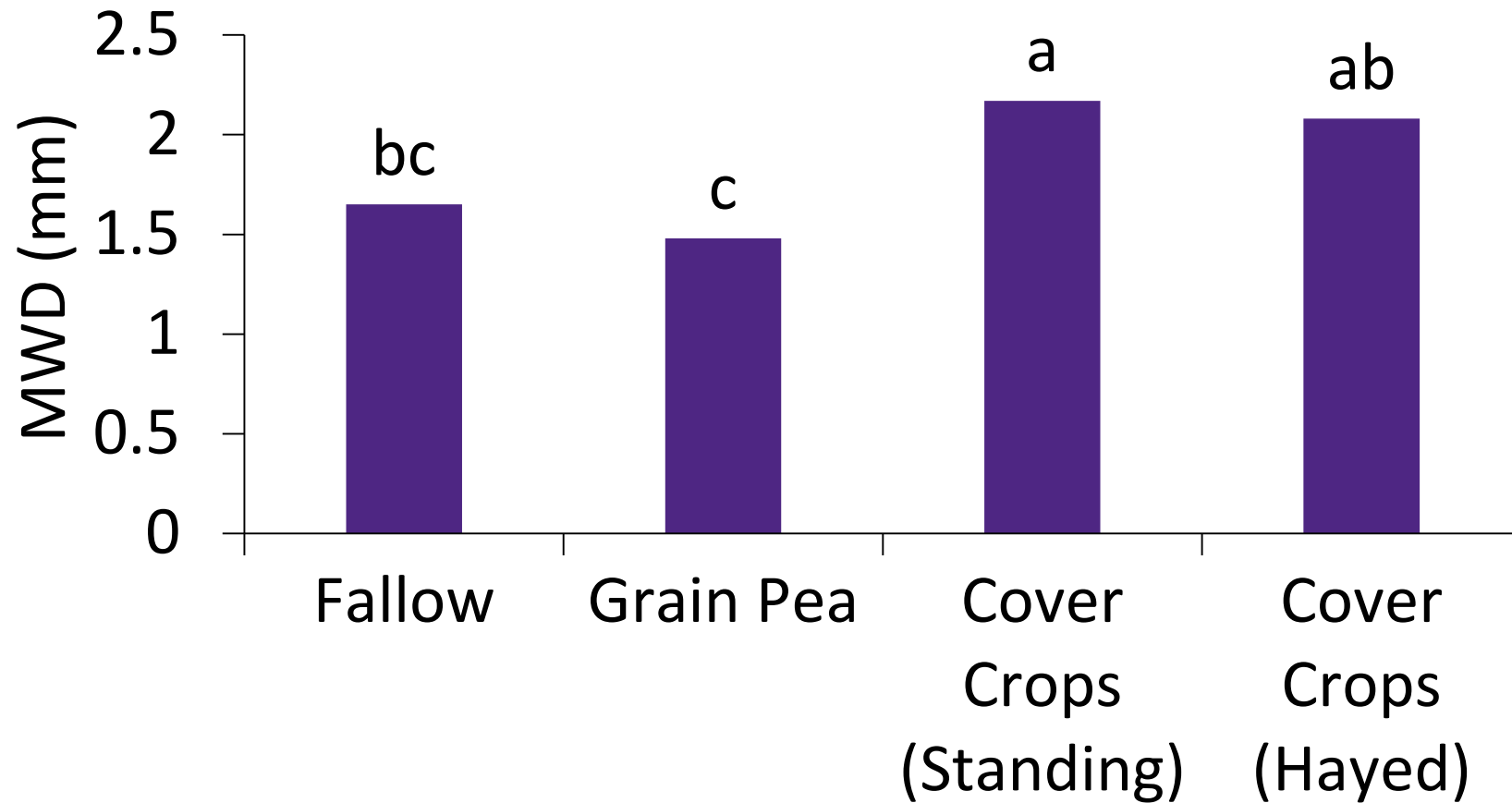
Soil organic carbon (0-6 inches)



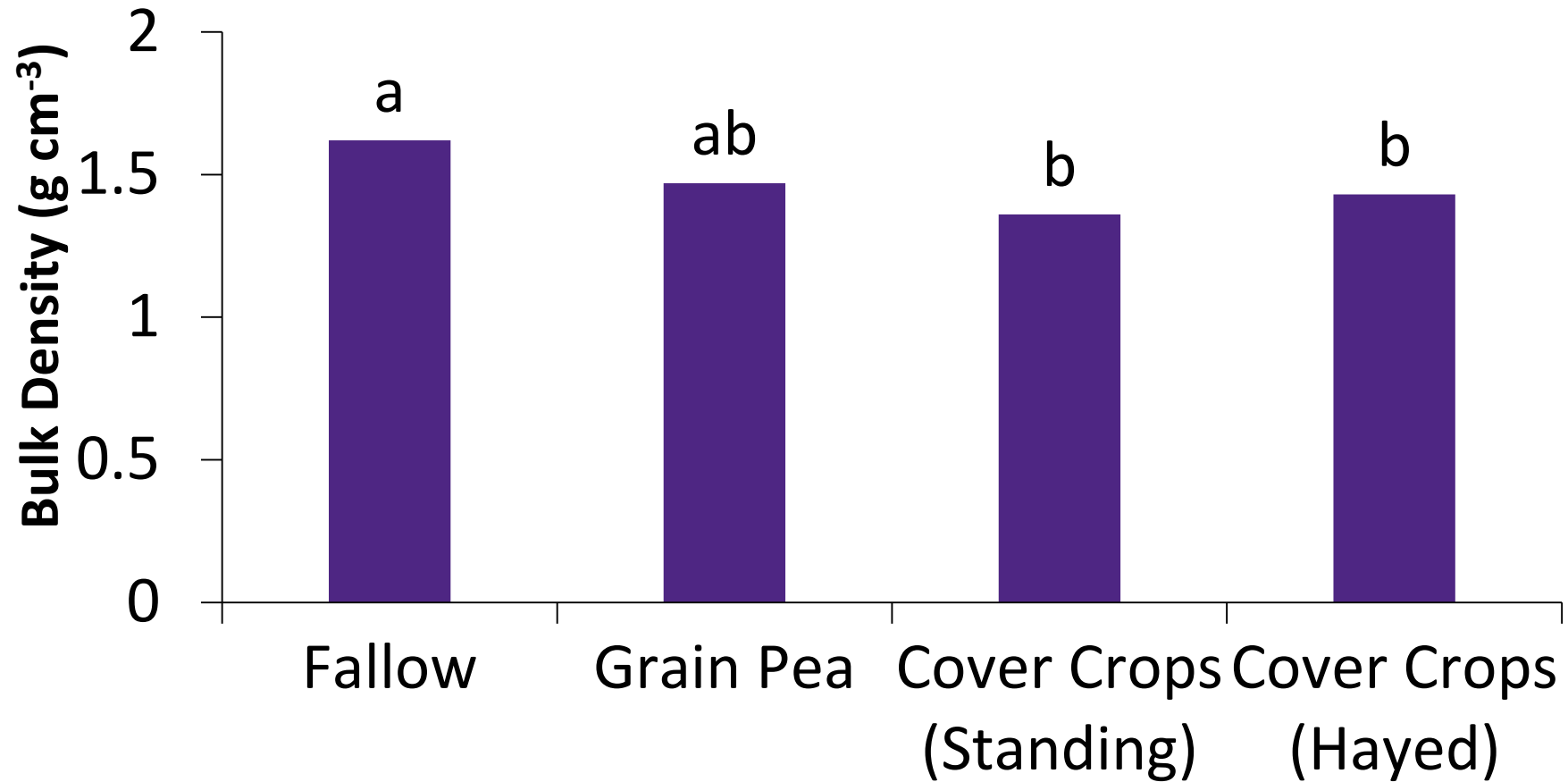
Soil microbial abundance 12-yr of cover crops



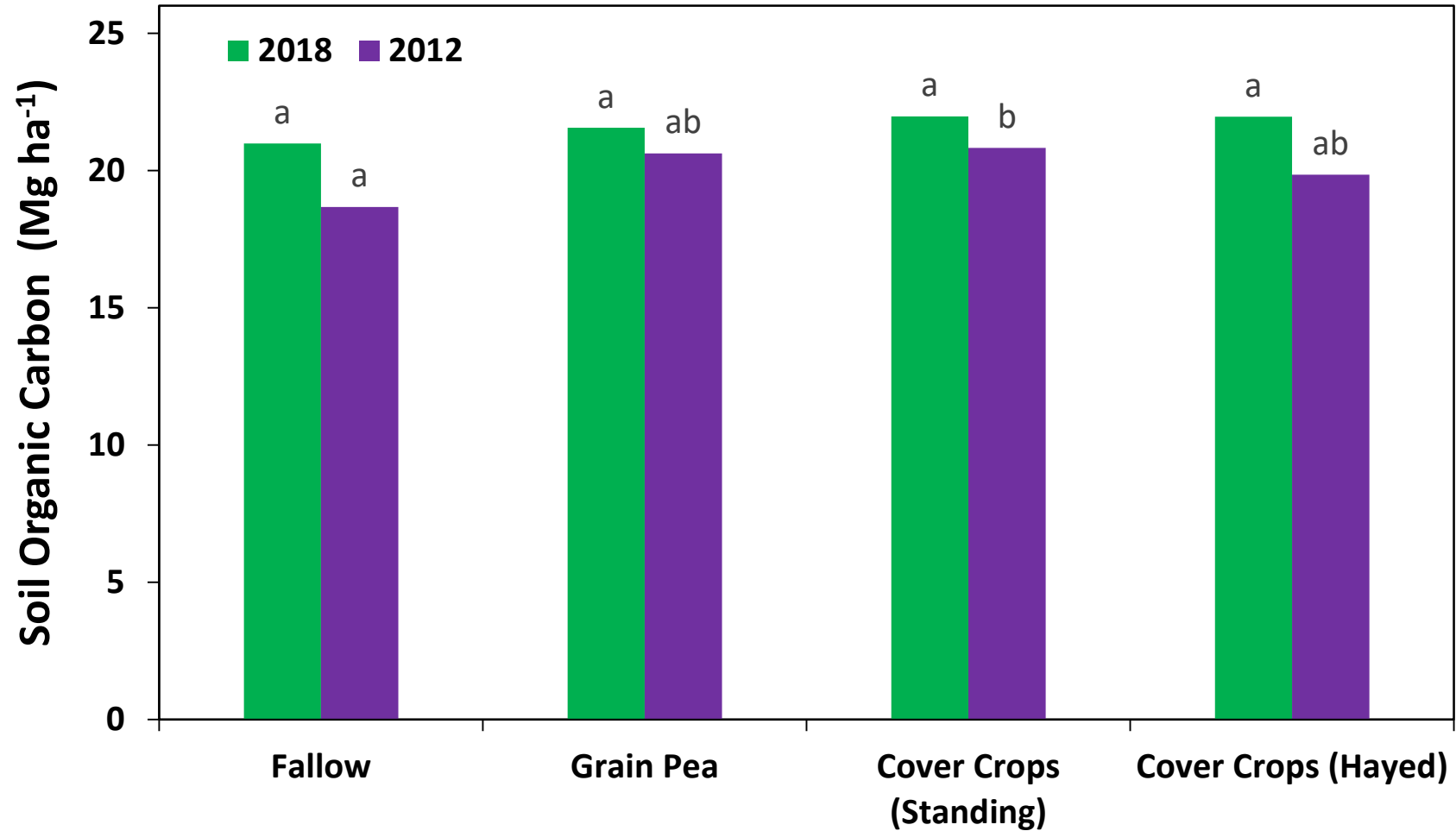
Wet aggregate stability 12-yr after cover crops



Bulk density 12-yr after cover crops



SOC 12-yr after spring cover crops

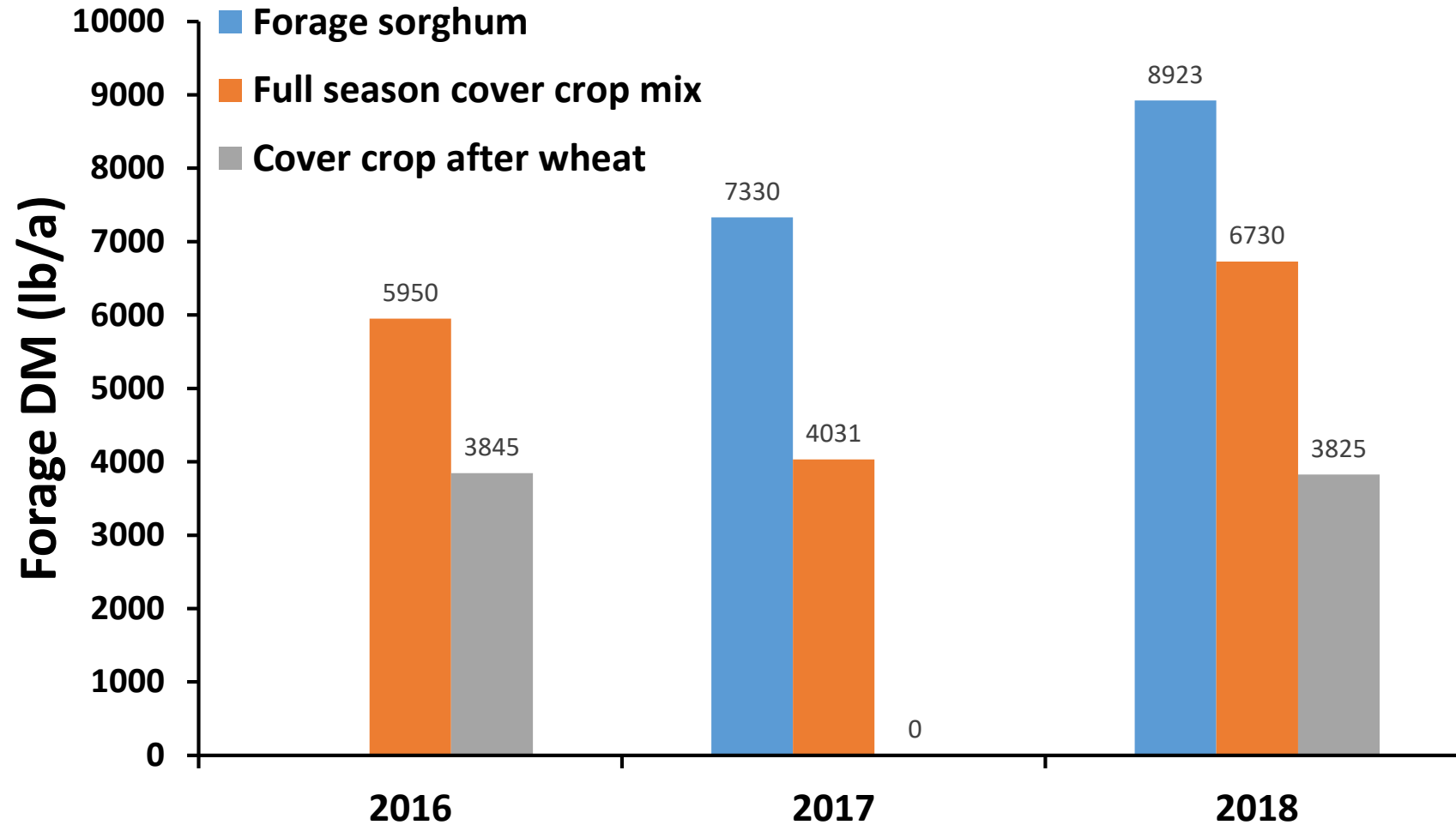


Post-wheat cover crop mixture

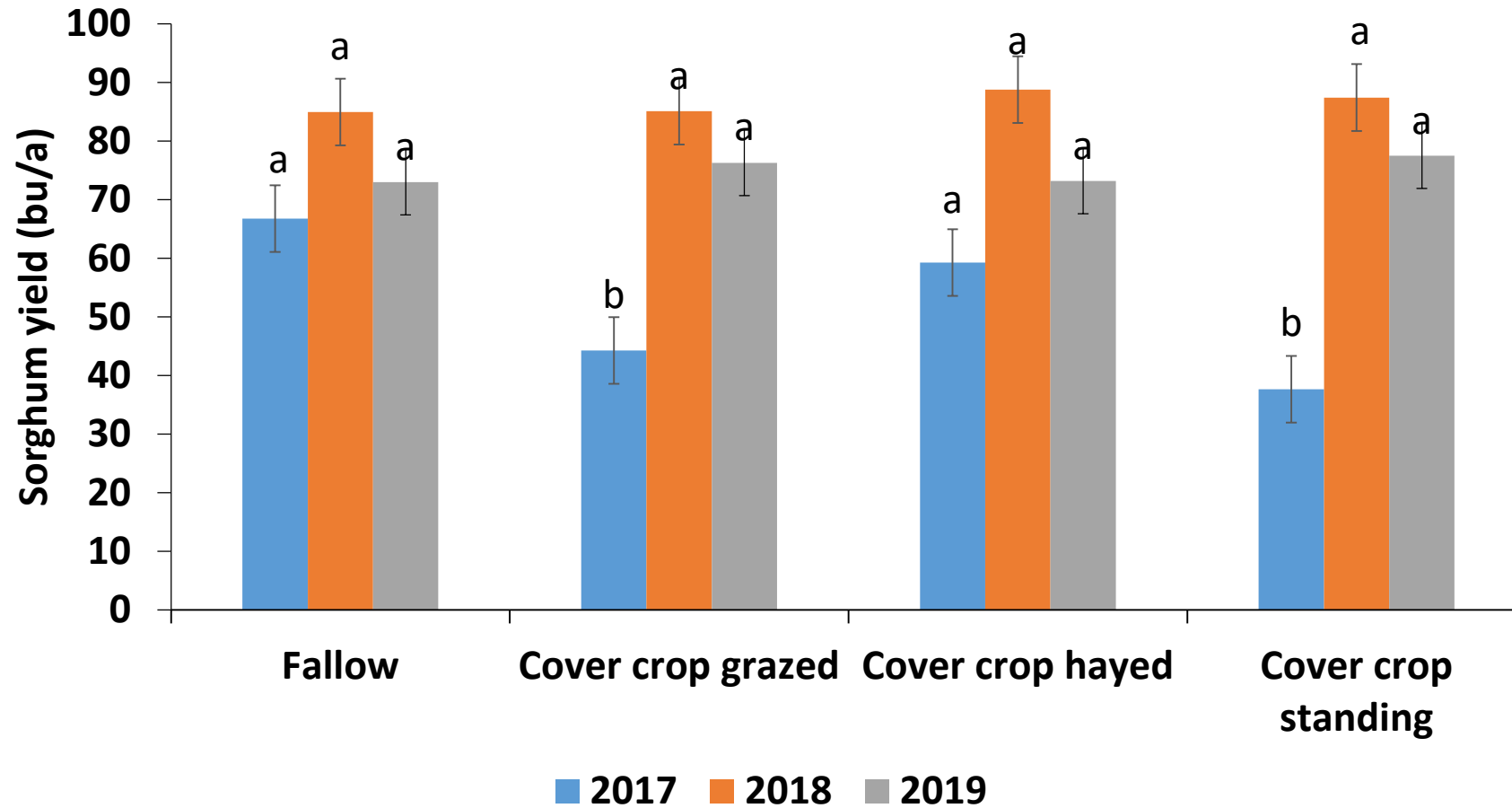


Planted on July 14, 2016. Consists of 10 # BMR sorghum-sudan, 5# pearl millet, 20# cowpea and 5 # Sun hemp

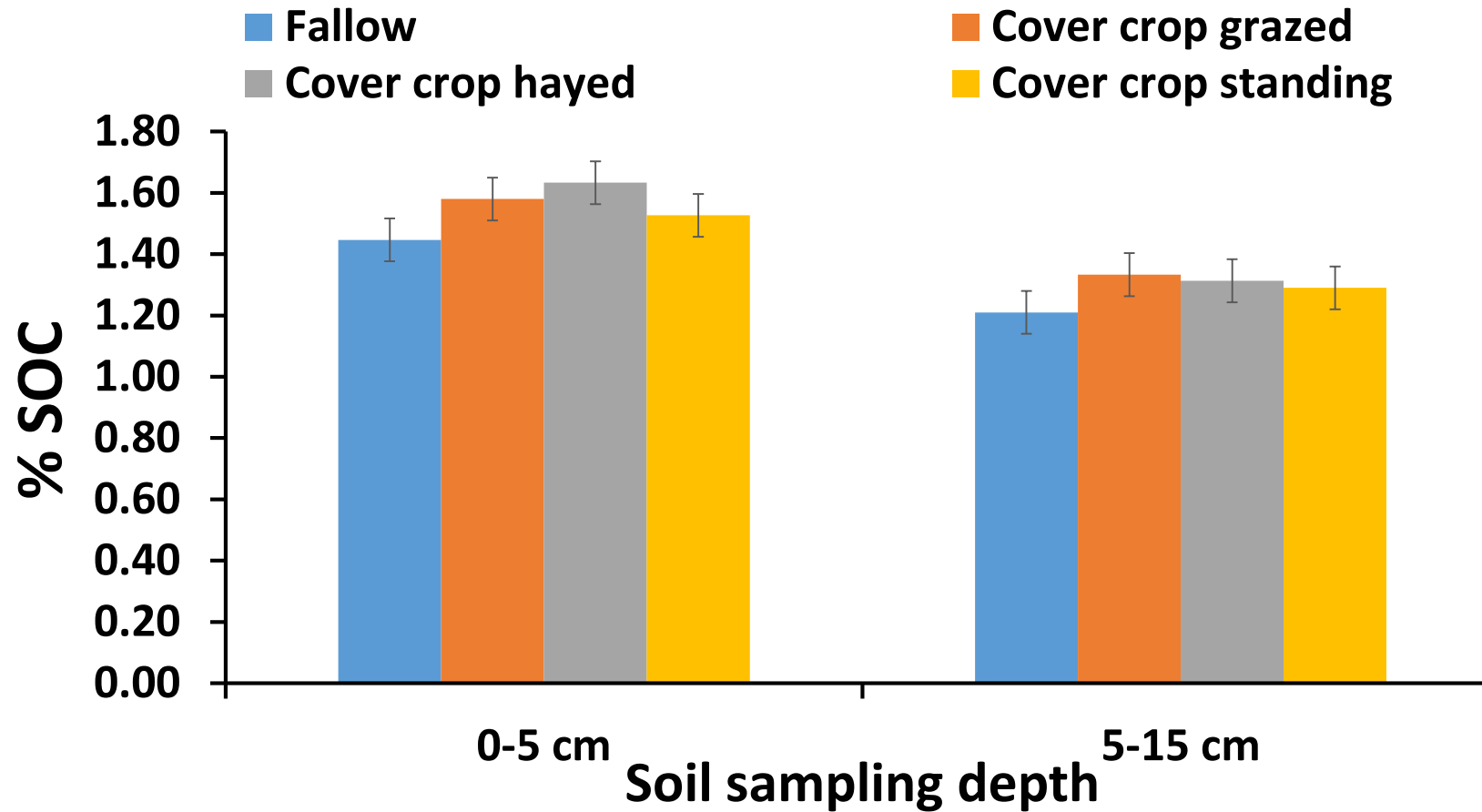
Summer cover crop forage yield



Post-wheat cover crop effects on sorghum yields



Post wheat cover crops effects on soil organic carbon





Summary

Can grazed cover crops be profitable and build soil and ecosystem health?

Spring planted

- Target planting date around March 15th
- Can maintain residue cover with regrowth
- High quality forage, but short window for grazing
- Good animal performance if grazed before maturity of forages
- Cool season grasses dominated mixtures
- Increased soil aggregation, Increased soil C over long term
- Grazing did not increase compaction in general
- Reduced soil moisture at deeper depths
- Variable effects on wheat yields , average yield reduction of ~10 bu/ac
- Reduced herbicide inputs/improved weed suppression
- Increased costs for labor, fencing, moving water
- Diversified income stream
- Variable, net positive income



Can grazed cover crops be profitable and build soil and ecosystem health?

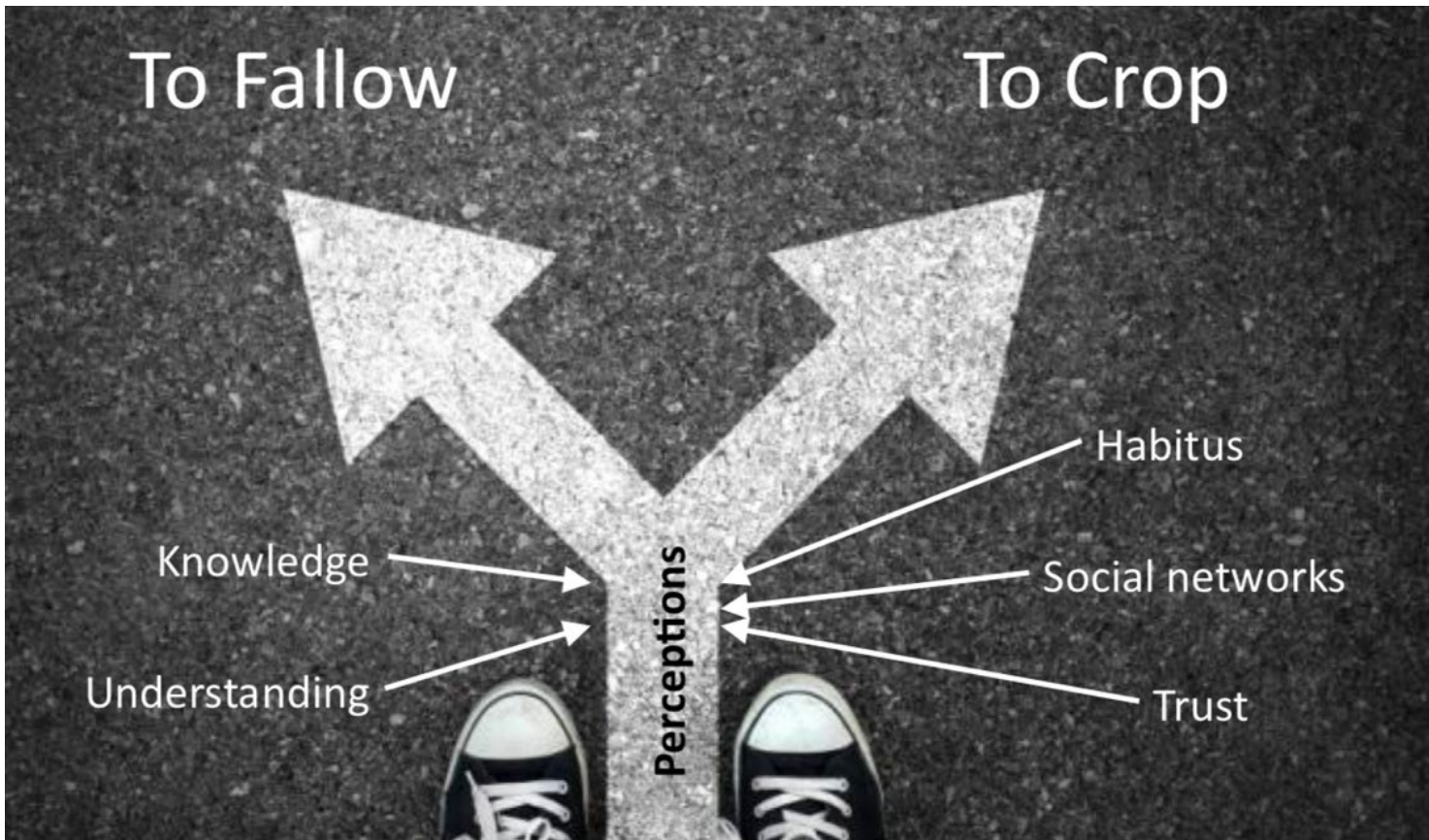
Post-wheat planted

- Can maintain residue cover despite little regrowth
- Variable animal performance due to high variability in data, generally lower than spring planted. Not that different from native range
- Increased soil aggregation, especially ungrazed
- Reduced soil moisture at deeper depths
- Can provide weed suppression if established earlier
- Higher risk of failure/insufficient growth for grazing
- Risk of disease transmission
- More flexibility on timing of grazing
 - Good for stockpiling
 - Sorghum provides biomass and lasting residue, but also toxicity concerns





Social and economic factors that influence producer decisions to fallow or not



Factors influencing crop rotation decisions

- Trusted sources of information
- Max yield vs. input reduction
- Perceptions or ability to manage risk
- Policy disincentives
- Markets for other crops

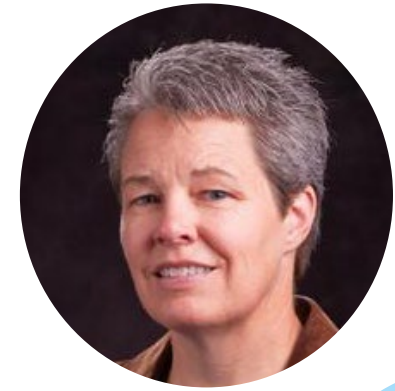
Rosenzweig et al. 2019

Rural Sociology

Thank you!



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