

# LONG-TERM CROPPING SYSTEMS WITH COVER CROP & GRAZING ON-FARM RESEARCH

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**Nuckolls and Webster Counties**

**Non-irrigated**

**3 Treatments:**

**Ungrazed Wheat Stubble**

**Grazed Cover Crop**

**Ungrazed Cover Crop**

**Data Collected:**

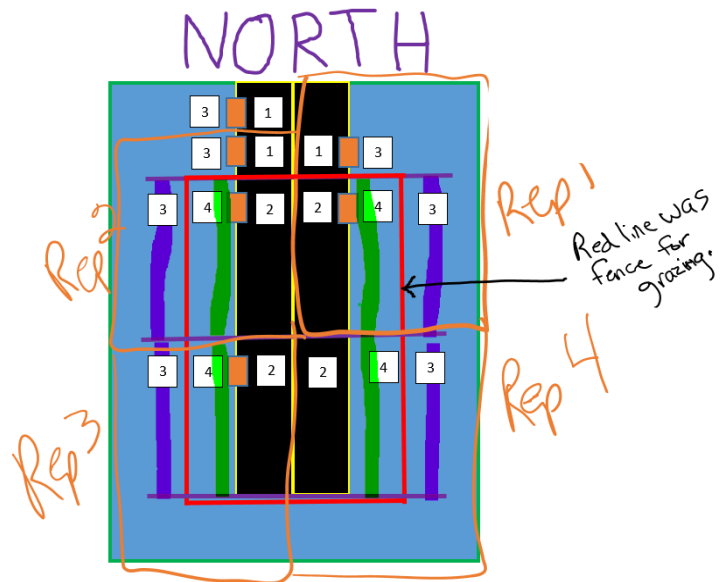
**Soil properties**

**Value of grazing  
(animal unit months)**

**Succeeding crop yields**

**Soil moisture**

**Cover crop Biomass**



- This is a three-year, non-irrigated, no-till crop rotation:
  - Wheat
  - Corn
  - Soybeanwith cover crops planted in the cover crop treatments following the wheat crop only.
- Grazing of cover crops and corn residue in the ‘Grazed Cover Crop’ treatment only
- WATERMARK™ soil moisture sensors were installed to determine treatment impacts for each growing season.



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## Location Crop Rotation

Year	Nuckolls Co.	Webster Co.
2016	<b>Cool-season cover crop</b> planted into wheat stubble & GCC* treatment grazed. (winter terminated)	
2017	<b>Corn.</b> Corn residue grazed in GCC treatment.	
2018	<b>Soybean.</b> Wheat planted in the fall.	<b>Warm-season cover crop</b> planted into wheat stubble (CSP program) and GCC treatment grazed. (winter terminated)
2019	<b>Wheat</b> harvested. <b>Cool-season cover crop</b> planted into wheat stubble and GCC treatment grazed. (chemical terminated)	<b>Corn.</b> Corn residue grazed in GCC treatment.
2020	<b>Corn.</b> Corn residue grazed in GCC treatment.	<b>Soybean.</b> Wheat not planted. End study.
2021	<b>Soybean.</b> <b>Wheat</b> planted in the fall.	
2022	<b>Wheat</b> harvested.	

\*GCC = Grazed Cover Crop treatment

## 2016 Nuckolls County Cool-Season Cover Crop

Planted on August 14, 2016, following wheat harvest and consisted of a mix of winter peas, spring triticale, oats, collards, and purple top turnip.

Cover crop biomass measured on October 19, 2016, was 3,401 lb/ac and consisted mainly of grass and turnip

November 2016, 28 (1,100 lb) first-calf heifers grazed 9.6 acres for 22 days, resulting in the cover crop carrying 2.4 animal unit months (AUM)/ac. Post-grazing, 2177 lb/ac biomass still present.



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## 2019 Nuckolls County Cool-Season Cover Crop

Planted on 9/3/19. Cover crop contained 10 lb/ac winter peas, 25 lb/ac winter triticale, 25 lb/ac black oats, 1.3 lb/ac collards, and 1.3 lb/ac turnip.

Cattle grazed the cover crop and only 8.66 AUM (vs. 19.03 AUM in 2016) were achieved due to the wet fall, late planting, and minimal growth.

Cover crop was 8" at time of termination by 32 oz Roundup, 8 oz/ac Dicamba, 0.5 lb/ac Atrazine, and 4 oz/ac Balance Flexx on 3/20/20.



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## 2<sup>nd</sup> Field (Webster Co.) – Cover Crop Fall 2018 (Post-grazing)

- Planted July 15, 2018 with 6 lb/ac cowpea, 7 lb/ac BMR sorghum sudan, 4 lb/ac pearl millet, 2 lb/ac radish, 1.5 lb/ac turnip.
- 8,405 lb/ac biomass pre-grazing (88% grass).



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**2<sup>nd</sup> Field-Webster County-Year 1 (2019 cover crop)**

- The grazed area contained 52.3 acres.
- October 21, 2018, 35 head of first-calf heifers weighing 1,100 lbs grazed for 91 days.
- A great deal of forage remained in the grazed area when cattle were removed according to the cooperating producer.
- Post-grazing biomass samples were not able to be collected.



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**Three-year follow up soil analysis taken prior to cover crop planting July 12, 2019.**

-----0 to 8 inches-----						
	Soil pH	OM %	Nitrate-N ppm	Nitrogen lb N/A		
Cover Crop – Non-grazed	5.7 A*	3.3 A	6.6 A	16.0 A		
Cover Crop/Stubble – Grazed	5.5 AB	3.2 A	6.3 A	15.0 A		
Stubble – Non-grazed	5.5 B	3.1 A	6.0 A	14.5 A		
P-Value	0.090	0.105	0.395	0.390		
-----0 to 4 inches-----						
	Solvita CO2-C (ppm)	Total Biomass (ng/g)	Total Bacteria Biomass (ng/g)	Total Fungi Biomass (ng/g)	Diversity Index	Soil Health Calculation
Cover Crop – Non-grazed	59	2860	1073	183	1.06	10.00
Cover Crop/Stubble – Grazed	44	3498	1524	298	1.44	7.87
Stubble – Non-grazed	63	2760	1287	198	1.30	9.69
P-Value						
-----4 to 8 inches-----						
	Solvita CO2-C (ppm)	Total Biomass (ng/g)	Total Bacteria Biomass (ng/g)	Total Fungi Biomass (ng/g)	Diversity Index	Soil Health Calculation
Cover Crop – Non-grazed	31	906	353	4	0.94	5.89
Cover Crop/Stubble – Grazed	29	1526	569	53	1.22	5.53
Stubble – Non-grazed	21	977	354	12	1.06	4.65
P-Value						

### 3 Year Soil Physical Properties Changes

- Sampling for soil physical properties including bulk density was completed on August 5, 2019.
- Neither cover crops nor grazing had a significant effect on soil bulk density in the top 2 inches.
- The average bulk density:
  - Grazed cover crops was 1.08 g/cm<sup>3</sup>
  - Ungrazed cover crops was 1.09 g/cm<sup>3</sup>
  - Ungrazed wheat stubble was 1.06 g/cm<sup>3</sup>.

**There was no effect of grazing or cover crop in the 2-4" depth of soil.**



## Economic Analysis-Nuckolls County (2016 Cover Crop – 2020 Corn Crop)

	2016 Cover	2017 Corn	2018 Soy	2019 Wheat	3-Year Total
Cover Crop—Non-grazed	-\$46.64	\$211.35	\$54.18	\$59.56	<b>\$278.45</b>
Cover Crop/Stubble—Grazed	\$22.86	\$210.05	-\$19.82	\$59.56	<b>\$272.65</b>
Stubble—Non-grazed	-\$18.00	\$227.10	\$68.98	\$55.91	<b>\$333.99</b>

	2019 Cover	2020 Corn	2021 Soy	2022 Wheat	6-Year Total
Cover Crop—Non-grazed	-\$49.42	\$304.23	TBD	TBD	<i>\$533.26</i>
Cover Crop/Stubble—Grazed	\$20.80	\$311.13	TBD	TBD	<i>\$604.58</i>
Stubble—Non-grazed	-\$18.00	\$342.99	TBD	TBD	<i>\$658.98</i>

- Used closest UNL Budget each year so anyone could compare costs.
- Cost of cover crop includes: seeding and cover crop seed. Fence/labor for grazing and hauling water added cost to grazed cover crop treatment. Value of Animal Unit Months grazed added value to the grazed cover crop (GCC) treatment.
- Cost of \$18/ac assessed to chemical burndown of weeds in wheat stubble.
- Value of \$5/ac rental rate (common for area) added to grazing the corn residue in GCC treatment.
- Value of each harvested crop based on yield and market year average price used for all on-farm research studies that year.

2016 Cover Crop: Cost for spraying wheat stubble was \$18/ac. Costs for the non-grazed cover crop treatments were \$46.64/ac (\$28.64/ac for seed and \$18/ac for drilling). Costs for grazed cover crop treatments were \$61.94/ac (\$46.64/ac for the cover crop seed and planting, \$5/ac for fencing, and \$10.30/ac for water). Water cost was calculated assuming hauling water (1,000 gal) 15 miles every two days at \$2 per loaded mile and \$6 per \$1,000 gal. Costs for the grazed cover crop treatments equaled 128 | 2020 Nebraska On-Farm Research Network \$30.97/AUM (animal unit months). Value of the forage is estimated to be \$84.80/ac (based on rental rates of \$53/pair/month [1.25 AUMs] or \$42.40 AUM). 2017 Corn: The economic analysis had no input differences for any of the treatments for corn production. UNL Corn Budget 21 (EC872, 2017 Nebraska Crop Budgets, revised Nov. 2016) was the closest that fit this operation, so a total cost/ac of \$459.60/ac and a market year average price of \$3.15/bu was used. In the previously established grazed cover crop treatment, cattle grazed on the corn stalks. A \$5/ac cornstalk rental rate value was assessed to this 9.6 acre area. This rate assumes water, fencing, and the care of the animals. 2018 Soybean: The inputs were the same for the soybeans planted into all the previous treatments. UNL Budget 56 (EC872, 2018 Nebraska Crop Budgets, revised Nov. 2017) was used, which stated a \$315.82/ac total cost. A market year average price of \$7.40/bu was used. 2019 Wheat: The inputs were the same for the wheat planted into all the previous treatments. UNL Budget 70 (EC872, 2019 Nebraska Crop Budgets, revised Nov. 2018) was used which stated a \$247.04/ac total cost. A market year average price of \$3.65/bu was

used. 2019 Cover Crop: Cost for spraying the wheat stubble was \$18 (\$9/ac application and \$9/ac herbicide cost). Costs for the non-grazed cover crop treatments were \$49.42/ac (\$31.42/ac for seed and \$18/ac for drilling). Costs for grazed cover crop treatments were \$64.00/ac (\$49.42/ac for the cover crop seed and planting, \$5/ac for fencing, and \$9.58/ac for water). Water cost was calculated based on hauling water (5.75 water trips at \$16/trip which included cost of water). Costs for the grazed cover crop treatments equaled \$54.78/AUM ( $49.42 * 9.6 = 474.43 / 8.66 \text{AUM}$  from what was grazed = 54.78). Value of the forage is estimated to be \$84.80/ac (based on rental rates of \$53/pair/month (1.25 AUMs) or \$42.40 AUM). Forage production was limited in fall of 2019 compared to 2016 due to wet summer that delayed wheat harvest which delayed cover crop planting. Cool fall led to less growth. Only 8.66 AUM was achieved with the 2019 cover crop compared to 19.03 AUM with the 2016 cover crop. 2020 Corn: The economic analysis had no input differences for any of the treatments for corn production. UNL Corn Budget 23 (EC872, 2020 Nebraska Crop Budgets, revised Nov. 2019) was the closest that fit this operation, so a total cost/ac of \$452.10 and a market year average price of \$3.51 was used. In the previously established grazed cover crop treatment, cattle grazed on the corn stalks. A \$5/ac cornstalk rental rate value was assessed to this 9.6 acre area. This rate assumes water, fencing, and the care of the animals.

## Economic Summary-Webster County (final) (2018 Cover Crop-2020 Soybean Crop)

Marginal net return (\$/ac) economic analysis of this study for two crop years.

	2018 Cover	2019 Corn	2020 Soy	2-Year Total
<b>Cover Crop—Non-grazed</b>	<b>(-\$41.82)</b>	<b>\$285.79</b>	<b>\$190.16</b>	<b>\$434.13</b>
<b>Cover Crop/Stubble—Grazed</b>	<b>\$74.06</b>	<b>\$298.45</b>	<b>\$202.28</b>	<b>\$554.79</b>
<b>Stubble—Non-grazed</b>	<b>(-\$18.00)</b>	<b>\$278.13</b>	<b>\$183.51</b>	<b>\$443.64</b>

- Used closest UNL Budget each year so anyone could compare costs.
- Cost of cover crop includes: seeding and cover crop seed. Fence/labor for grazing and hauling water added cost to grazed cover crop treatment. Value of Animal Unit Months grazed added value to the grazed cover crop (GCC) treatment.
- Cost of \$18/ac assessed to chemical burndown of weeds in wheat stubble.
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## Take Home Points

- After three years: grazed cover crop treatments had higher total microbial biomass and fungal biomass than other treatments.
- After three years: No difference in soil physical properties amongst treatments.
- Economical returns for cover crops in a system need to include:
  - Seeding & seed cost -Fence/labor, hauling water, animal care, grazing value (when grazing cover crops)
  - In the future: benefits to the soil (need better information on how to calculate)
- Cover crop biomass dependent upon planting timing and environmental conditions.
- Cool-season cover crop produced less biomass and was more variable over years than warm-season cover crop.
- Ungrazed wheat stubble was the most economical treatment with the cool-season cover crop when water had to be hauled for cattle grazing.
- Grazed cover crop was the most economical treatment with warm-season cover crop when water didn't have to be hauled for cattle grazing.



<https://cropwatch.unl.edu/nebraska-farm-research-network-results-update-meetings-2021>

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## Nebraska On-Farm Research Network Results Update Meetings 2021

**FEBRUARY 25 AND 26, 2021**

RELIABLE, RESEARCH BASED INFORMATION FOR YOUR FARM

# Questions?

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