

Impact of Grazed versus Non-Grazed Cover Crops on Subsequent Crop Yield and Soil Quality Indicators, NRCS Demo Farm

Study ID: 0719107202001

County: Knox

Soil Type: Trent silt loam 0-2% slope; Nora silt loam 2-6% slopes; Moody loam 2-6% slopes

Planting Date: 5/7/20

Harvest Date: 9/29/20

Seeding Rate: 27,000

Row Spacing (in): 30

Hybrid: Golden Harvest® E116K4-GH and Pioneer® P0506AM

Reps: 10

Previous Crop: Prevented Plant - Cover Crops

Tillage: No-Till

Herbicides: **Pre:** 32 oz/ac Roundup®, 1.6 oz/ac Outlook®, 5 oz/ac Verdict®, and 16.3 oz/ac atrazine on 5/15/20 **Post:** 0.10 gal/ac Brazen™ on 6/16/20; 0.15 oz/ac Cadet®, 3 oz/ac Callisto®, and 32 oz/ac Roundup® on 6/25/20

Seed Treatment: None

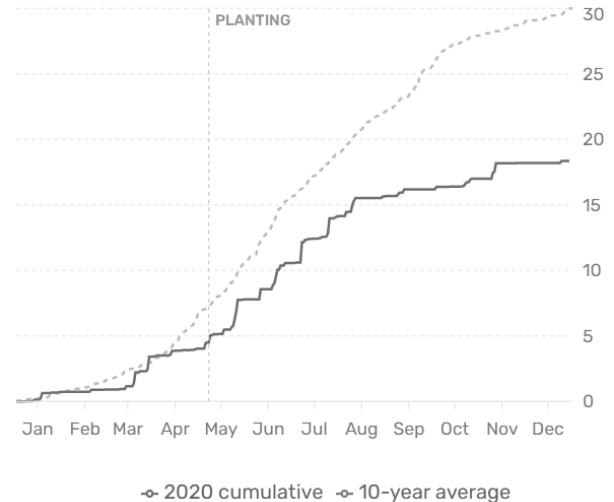
Foliar Insecticides: None

Foliar Fungicides: None

Fertilizer: 117 lb/ac 12-0-0, 97 lb/ac 10-34-0, 0.26 gal/ac 2-0-0, and 0.15 gal/ac zinc applied with planter on 5/7/20; 168 lb/ac N as 32% UAN with herbicide on 5/15/20; 204 lb/ac 46-0-0, and 133 lb/ac 21-0-0-24 sidedress on 6/16/20

Irrigation: None

Rainfall (in):



Introduction: This study is being conducted on a soil health demonstration farm as part of the Nebraska USDA/Natural Resources Conservation Service's (NRCS) Soil Health Initiative, and involves the farmer, the Nebraska On-Farm Research Network, and the USDA/NRCS. Two treatments are being evaluated in this five-year study: grazed cover crop/forage and non-grazed cover crop. The field was divided into plots approximately 2 acres in size that were assigned as grazed or non-grazed. These plots will be maintained throughout the project (2016-2020). This is the fourth and last year of this study. In July 2018, prevented plant cover crops were drilled and grazed during fall 2018 in the grazing plots. Corn was then planted on May 7, 2020, and harvested on September 29, 2020. Baseline and soil health measures were collected in 2016, 2017, 2018, 2019, and 2020 (Tables 1 and 2).

Results:

Table 1. Soil physical, chemical, and biological properties for non-grazed and grazed cover crop treatments.

Treatment	Infiltration (in/hr)	Soil moisture (%)	Bulk density (g/cm ³)	Soil temp. (F)	Soil respiration ¹	Total soil health score ²
2016 (1 sample per treatment replication, n=4 per treatment; samples collected on Oct. 20, 2016)						
Non-grazed	7.8 A*	30.8 A	1.24 A	50.3 A	-	19.6 A
Grazed	29.2 A	27.7 A	1.21 A	51.2 A	-	19.8 A
P-value	0.206	0.424	0.659	0.168	-	0.834
2019 (1 sample per treatment replication, n=4 per treatment; samples collected on Nov. 8, 2019)						
Non-grazed	45.0 A	29.2 A	1.11 A	34.3 A	4.62 A	21.8 A
Grazed	22.1 A	33.5 A	1.14 A	33.6 A	4.38 A	21.5 A
P-Value	0.138	0.259	0.831	0.299	0.6042	0.1817

Table 1 Continued

Treatment	Infiltration (in/hr)	Soil moisture (%)	Bulk density (g/cm ³)	Soil temp. (F)	Soil respiration ¹	Total soil health score ²
2020 (1 sample per treatment replication, n=4 per treatment; samples collected on Oct. 14, 2020)						
Non-grazed	26.4 A	10.4 A	1.22 A	50.2 A	3.88 A	22.6 A
Grazed	23.6 A	10.6 A	1.33 A	49.5 A	4.25 A	22.0 A
P-Value	0.869	0.943	0.412	0.587	0.391	0.391

¹Soil respiration (Solvita® burst).

²Score based on field assessment. The overall indicator score is based on the sum of 8 indicators (1=degraded, 2=in transition, 3=healthy): soil structure, structure type, surface condition, soil management, soil pores, earthworms, biological activity, and smell. Soil assessment was not completed in 2017 and 2018 as it was originally planned for every other year interval.

*Values with the same letter are not significantly different at a 90% confidence level.

Table 2. Haney soil health test from 2016, 2017, 2018, and 2019 for non-grazed and grazed cover crop treatments at 0-6 in depth.

Treatment ¹	OM (%)	Solvita CO ₂ Burst (ppm)	Total N (ppm)	Org. N (ppm)	Total Org. C (ppm)	Nitrate (ppm)	Ammonium (ppm)	Inorg. N (ppm)	Org. C:N	Org. N Release (ppm)	Soil Health Score ²
2016 Non-grazed	3	90.2	23.7	15.2	185	7.8	0.5	8.3	12.2	15.2	10.8
2016 Grazed	2.9	41.5	22.5	14.5	178	7.3	1.2	8.5	12.3	9.5	6.6
2017 Non-grazed	3.7	24	29.6	14.5	142	13.6	0.4	14	9.8	9.9	6.7
2017 Grazed	3.7	41	27.8	13.3	137	12.6	0.6	13.2	10.3	13.3	8.2
2018 Non-grazed	3.5	60	12.8	9.3	130	3	2.1	5.1	13.9	9.3	9.5
2018 Grazed	3.4	81.8	12.5	9	117	2.5	2.6	5.1	13	9	11.4
2019 Non-grazed	4.1 A*	70.1 A	19.4 A	9.45 A	113 A	7.17 A	4.9 A	12.05 A	12.1 B	9.45 A	10.21A
2019 Grazed	3.92 A	55 A	13.8 B	7.4 B	102 A	4.95 A	2.8 A	7.72 A	13.8 A	7.4 B	8.27 A
P-value	0.523	0.22	0.0568	0.0455	0.33	0.283	0.291	0.165	0.0392	0.0455	0.176

¹A representative sample was taken from each treatment for Haney soil tests in 2016-2018 and in 2019 one sample was taken per treatment replication (n=4 per treatment), which allowed statistical analysis on treatment effects.

²Calculated using the amount of CO₂-C release in 24 h along with a separate procedure from the H3A extract to measure soil concentrations of water-extractable organic C (WEOC) and water-extractable organic N (WEON). SH score = CO₂/10 + WEOC/100 + WEON/10 (Roper et al., 2017).

*Values with the same letter are not significantly different at a 90% confidence level.

Table 3. 2020 cover crop biomass for grazed and non-grazed treatments. Cover crop biomass measured on May 6, 2020.

Biomass (lb/ac)	
Non-grazed	3632 A*
Grazed	2423 B
P-Value	0.0518

*Values with the same letter are not significantly different at a 90% confidence level.

Table 4. 2020 corn moisture and yield, for grazed and non-grazed cover crop treatments.

	Moisture (%)	Corn Yield (bu/ac)†
Non-grazed	22.3 A	156 A
Grazed	23.6 A	161 A
P-Value	0.356	0.615

*Values with the same letter are not significantly different at a 90% confidence level.

†Bushels per acre corrected to 15.5% moisture.

‡Marginal net return based on \$3.51/bu corn.

Summary:

- There were no differences in most of the soil health parameters between the treatments in 2017, 2019, and 2020 (Table 1). Total and organic N and organic N release (N being released through microbial activity from the organic N pool) was higher for non-grazed (Table 2).
- There were no differences in corn moisture and yield between the treatments. The middle part of the field was wet at planting and the seeds ended up damping off. The southern half of the field was harvested as earlage so no yield map is available. Therefore, yield results are from the northern half of the field. Results from previous years follow.

Summary of Previous Years

YEAR ONE | In year one, cover crops were drilled on October 15, 2016, following corn harvest, and the grazed treatments had 100 head of cows grazing for 1 week in April 2017. Field peas were then planted on April 20, 2017, and harvested on July 26, 2017. Cover crops were again planted July 30, 2017 and 180 head of cows grazed from October 20, 2017, through October 28, 2017, in the grazed treatments. Dry forage production was 9,380 lb/ac.

YEAR TWO | In year two, winter wheat was planted on November 4, 2017, at a rate of 2 bu/ac. Wheat was harvested July 27, 2018. Winter wheat yield was evaluated for grazed versus non-grazed cover crop treatments. A 30' buffer was applied to the treatments to adjust for GPS drift when laying out fences and recording yield data. In 2018, there was no wheat yield difference for the grazed versus non-grazed treatment.

Table 5. 2018 wheat yield for grazed and non-grazed cover crop treatments.

	Wheat Yield† (bu/ac)
Non-grazed	46 A
Grazed	47 A
P-Value	0.220

*Values with same letters are not significantly different at 90% confidence level.

†Yield values are from cleaned yield monitor data.

YEAR THREE | In year three, a prevented plant cover crop was drilled on July 8, 2019. Mix was composed of 2.5 lbs/ac pearl millet, 5 lbs/ac Japanese millet, 10 lbs/ac spring oats, 10 lbs/ac winter triticale, and 10 lbs/ac non-GMO soybeans. No yield measurements were made for the non-grazed and grazed cover crop strips.

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