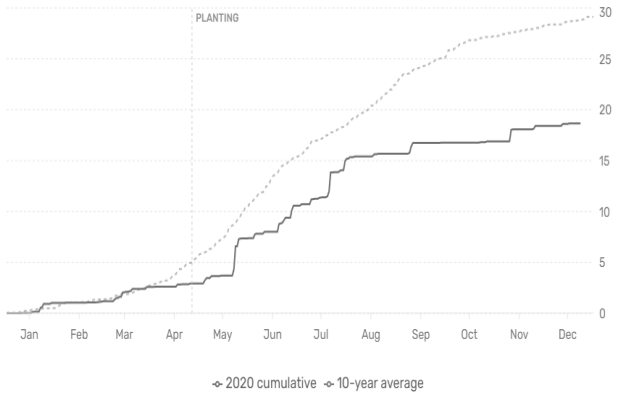
Effects of Grazing Cover Crops in a Three-Year Non-irrigated Rotation

Study ID: 0721181202001
County: Webster
Soil Type: Hastings silt loam 0-1% slope
Planting Date: 4/26/20
Harvest Date: 9/18/20
Seeding Rate: 160,000
Row Spacing (in): 15”
Variety: Pioneer® P31A22
Reps: 4
Previous Crop: Corn
Tillage: No-Till
Herbicides: ***Pre:*** 22 oz/ac XtendiMax®, 22 oz/ac Roundup®, 4 oz/ac Fierce® XLT on 4/15/20
Post: 22 oz/ac XtendiMax®, 22 oz/ac Roundup® on 5/25/20

Fertilizer: 60 lb/ac actual P on 3/21/20
Irrigation: None
Rainfall (in):



Introduction

This is the second year of a study evaluating crop rotation and cover crop impacts. In rainfed systems, adding cover crops into the rotation has the potential to decrease yields when precipitation is limited; however, the use of cover crops for forage may offset the costs while retaining soil benefits. This study evaluated three treatments: grazed cover crop (or stubble only depending on year of crop rotation), non-grazed cover crop, and non-grazed stubble.

Year 1 (2019 crop)

Following wheat harvest in 2018, beginning soil nutrient and health samples were taken on July 10, 2018 (Table 1). Initial infiltration tests were also conducted. This is the amount of time for 70 mL of water to enter the soil. Four replications were taken with values (minutes:seconds) of: 4:00, 4:05, 1:25, and 1:30. The longer infiltration times correspond to the two replications in heavier clay soils.

Table 1. Beginning soil analysis prior to cover crop planting on July 10, 2018. The lab didn’t specify treatments for the nutrient levels in its report, so 12 reps each are represented in the 0-4” and 4-8” beginning nutrient depths.

	0 to 8 inches			
	Soil pH	**OM %**	**Nitrate-N ppm**	**Nitrogen lb N/A**
0-4”	5.2	2.7	9.9	12
4-8”	5.7	2.5	6.3	7.5

	0 to 4 inches				
	Solvita CO_2-C (ppm)	**Total Biomass (ng/g)**	**Total Bacteria Biomass (ng/g)**	**Total Fungi Biomass (ng/g)**	**Diversity Index**
Cover Crop – Non-grazed	58 A*	2054 A	594 AB	93 B	1.34 B
Cover Crop/Stubble – Grazed	67 A	2095 A	808 A	187 A	1.58 A
Stubble – Non-grazed	57 A	1556 A	491 B	62 B	1.27 B
P-Value	0.304	0.184	0.049	0.004	0.002

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

Cover crops were planted in the cover crop treatments on July 15, 2018. The cover crop mix included 6 lb/ac cowpea, 7 lb/ac BMR sorghum-sudangrass, 4 lb/ac pearl millet, 2 lb/ac radish, and 1.5 lb/ac turnip. Cover crops frost-killed and sorghum-sudangrass was 4-5' tall at that time. Cover crop biomass was

measured on November 6, 2018, following frost-kill. These samples were taken from the ungrazed cover crop treatments as cattle were currently grazing the grazed treatment. Total average pounds of grass and brassica biomass was 8,405 lb/ac. The cover crop contained 12.3% turnip/radishes and 87.7% grass species. The grazed area contained 52.3 acres. Starting 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.

Watermark™ Soil Moisture Sensors were installed in the treatments after cover crop emergence. The wet fall of 2018 and wet spring of 2019 resulted in no differences in soil moisture amongst treatments prior to corn planting (Figure 1). Heavy rains washed the wheat residue into piles toward the field end rows; no washing was present in the portion of the field with cover crops, regardless of cover crop grazing. This left bare ground in that portion of the field compared to the ungrazed and grazed treatment areas (Figure 2). The lack of cover in the ungrazed wheat stubble was visible via aerial imagery in this field (Figure 3).

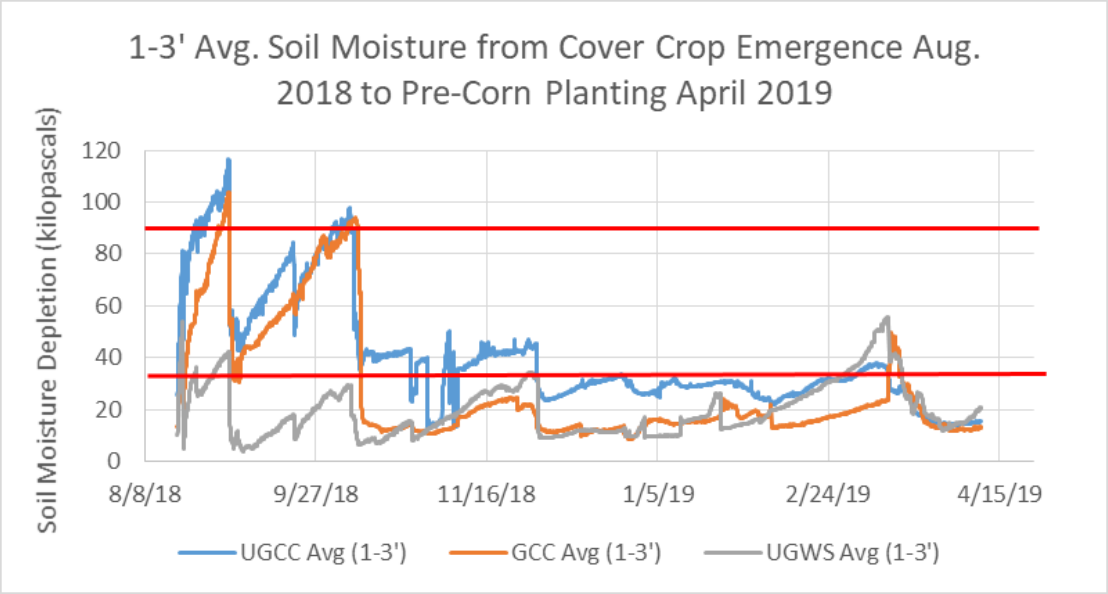


Figure 1. Soil moisture data for three feet depth from September 2018 to April 2019 for the three treatments. UGWS = Ungrazed Wheat Stubble, UGCC = Ungrazed Cover Crop, GCC = Grazed Cover Crop. Lines for field capacity (30 kPa) and 35% depletion (90 kPa) for silt loam soils are shown for reference. While this is a non-irrigated field, 35% depletion is the suggested irrigation trigger for silt loam soils in Nebraska. The data shows that all treatments had a full soil moisture profile going into the corn growing season of 2019.

Figures 2 and 3. Heavy spring rains dislodged and washed the ungrazed wheat stubble in the field leaving residue piles in the end rows (left). The lack of residue cover in the ungrazed wheat stubble treatments could be seen throughout the growing season via aerial imagery (shown via June 20, 2019, true color image photo as dark colored strips in center of field in the photo on the right).

Corn was planted on May 17, 2019. Stand counts, stalk rot, grain moisture, test weight, and yield were evaluated for the corn crop (Table 2). Soil moisture via Watermark™ sensors was also evaluated for all treatments for the duration of the growing season (not shown in this report).

Table 2. Corn yield data for 2019.

	Stand Count (plants/ac)	Stalk Rot (%)	Test Weight (lb/bu)	Moisture (%)	Corn Yield (bu/ac)†
Cover Crop – Non-grazed	24,333 A*	3.33 A	61 AB	15.0 A	189 A
Cover Crop – Grazed	24,833 A	1.00 A	61 B	14.6 B	191 A
Wheat Stubble – Non-grazed	23,167 A	0.83 A	62 A	14.2 B	187 A
P-Value	0.409	0.474	0.067	0.009	0.233

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 15.5% moisture.

The addition of cover crops and grazing did not impact beginning soil moisture for the 2019 corn crop due to a wet fall in 2018 and wet spring in 2019. Corn stand count, stalk rot, and yield were not impacted by the cover crop and grazing treatments. Corn test weight for the ungrazed wheat stubble treatment was higher than for the grazed cover crop treatment. Grain moisture was higher for the ungrazed cover crop treatment than the grazed cover crop treatment and ungrazed wheat stubble treatment.

Year 2 (2020 crop)

Soybeans were planted on April 26, 2020. Additional background information for the 2020 soybean crop is listed at the top of this report. Stand counts, grain moisture, test weight, and yield were evaluated (Table 3). Soil moisture via WATERMARK™ sensors was also evaluated for all treatments for the duration of the growing season.

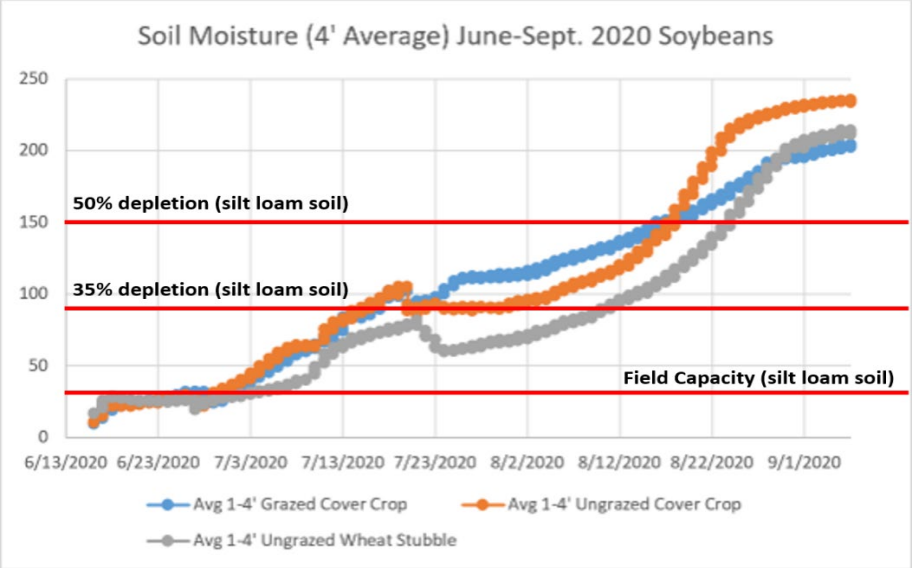


Figure 4. Soil moisture data for four feet depth from June 2020 to September 2020 for the three treatments. UGWS = Ungrazed Wheat Stubble, UGCC = Ungrazed Cover Crop, GCC = Grazed Cover Crop. Lines for field capacity (30 kPa) and 35% depletion (90 kPa) for silt loam soils are shown for reference. While this is a non-irrigated field, 35% depletion is the suggested irrigation trigger for silt loam soils in Nebraska. The data shows that all treatments had a full soil moisture profile going into the soybean growing season of 2020. The cover crop treatments were above 50% depletion by mid-August, whereas the wheat stubble treatment reached 50% depletion toward the end of August.

Table 3. Soybean yield data for 2020.

	Stand Count (plants/ac)	Test Weight (lb/bu)	Moisture (%)	Soybean Yield (bu/ac)†
Cover Crop – Non-grazed	88,500 A*	55.55 B	11.73 A	61 A
Cover Crop – Grazed	84,250 A	56.13 A	11.97 A	63 A
Wheat Stubble – Non-grazed	87,000 A	55.5 B	11.7 A	61 A
P-Value	0.851	0.03	0.128	0.685

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre adjusted to 13.0% moisture.

There were no impacts on beginning soil moisture amongst treatments. The cover crop treatments reached 50% soil moisture depletion sooner than the ungrazed wheat stubble treatment; however, no yield differences were observed. There were no differences in soybean stand count and moisture amongst the treatments. Soybean test weight for the grazed cover crop treatment was higher than for the ungrazed cover crop and ungrazed wheat stubble treatments.

Economic Summary (Final)

2018 Cover Crop: Costs to spray the wheat stubble for weed control were $18/ac. Costs for the non-grazed cover crop treatments were $41.82/ac for cover crop seed and drilling. Costs for the grazed cover crop treatments were $47.74 ($41.82/ac for cover crop seed and drilling, $5/ac for fencing, and $0.92/ac water). Grazing benefit is $6,370 (using a value of $2.00/head/day) for the 52.3 acres grazed. The resulting net benefit is $74.06/acre.

2019 Corn: The economic analysis had no input differences for any of the treatments for corn production. UNL Corn Budget 23 (EC872, 2019 Nebraska Crop Budgets, revised Nov. 2018) was the closest that fit this operation, so a total cost/ac of $438.08/ac and a market year average price of $3.83/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 52.3 acre area. This rate assumes water, fencing, and the care of the animals.

2020 Soybean: The economic analysis had no input differences for any of the treatments for soybean production. UNL Soybean Budget 58 (EC872, 2020 Nebraska Crop Budgets, revised Nov. 2019) was used, which states a $392.90/ac total cost. A market year average price of $9.50 was used.

Table 4. Marginal net return ($/ac) economic analysis of this study for two crop years.

	2018 Cover	2019 Corn	2020 Soy	2-Year Total
Cover Crop—Non-grazed	(-$41.82)	$285.79	$190.16	***$434.13***
Cover Crop/Stubble—Grazed	$74.06	$298.45	$202.28	***$574.79***
Stubble—Non-grazed	(-$18.00)	$278.13	$183.51	***$443.64***

This study is now concluded as the landowner did not desire wheat to be planted in the fall of 2020. The grazed cover crop treatment was the most profitable for the 2018-2020 time-frame in this field. One factor that led to this increased profitability included the use of a warm-season cover crop that allowed greater biomass and more grazing days. Another factor is that water was not hauled to this location. These are important considerations when determining the overall economics of cover crop studies. Ending soil health samples have not been collected for this field yet.

Sponsored by: University of Nebraska Lincoln **In Partnership with:** Nebraska Corn Board, Nebraska Soybean Checkoff, Nebraska Corn Growers Association, Nebraska Dry Bean Commission