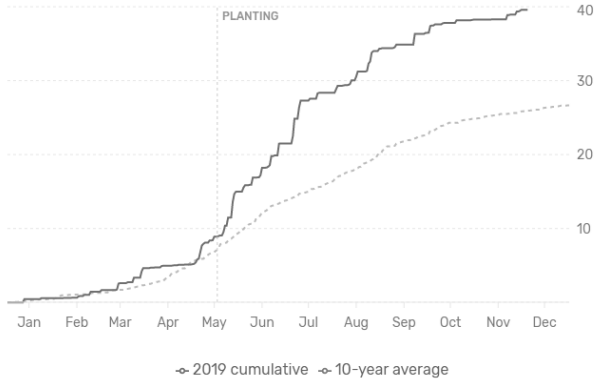
EXTENSION
On-Farm Research

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

Study ID: 0721181201901
County: Webster
Soil Type: Holdrege silt loam 0-1% slope
Planting Date: 5/17/19
Harvest Date: 11/1/19
Seeding Rate: 25,000
Row Spacing (in): 30
Variety: Pioneer® P1498
Reps: 4
Previous Crop: Wheat
Tillage: No-Till
Herbicides: ***Pre:*** atrazine, Balance® Flexx, Roundup® ***Post:*** DiFlexx® Duo (safened dicamba), Roundup®

Fertilizer: 200 lb N/ac preplant; 6 gal/ac 10-34-0 starter
Irrigation: None
Rainfall (in):



Introduction

This is the first 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 (July 10, 2018 Table 1). Initial infiltration rates 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.

Table 1. Beginning soil analysis prior to cover crop planting 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 CO2-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 sudan, 4 lb/ac pearl millet, 2 lb/ac radish, and 1.5 lb/ac turnip. Cover

crops were terminated by freeze and sorghum sudan was 4-5' tall when terminated. Cover crop biomass was measured on November 6, 2018 following frost termination. 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. 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 endrows. 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).

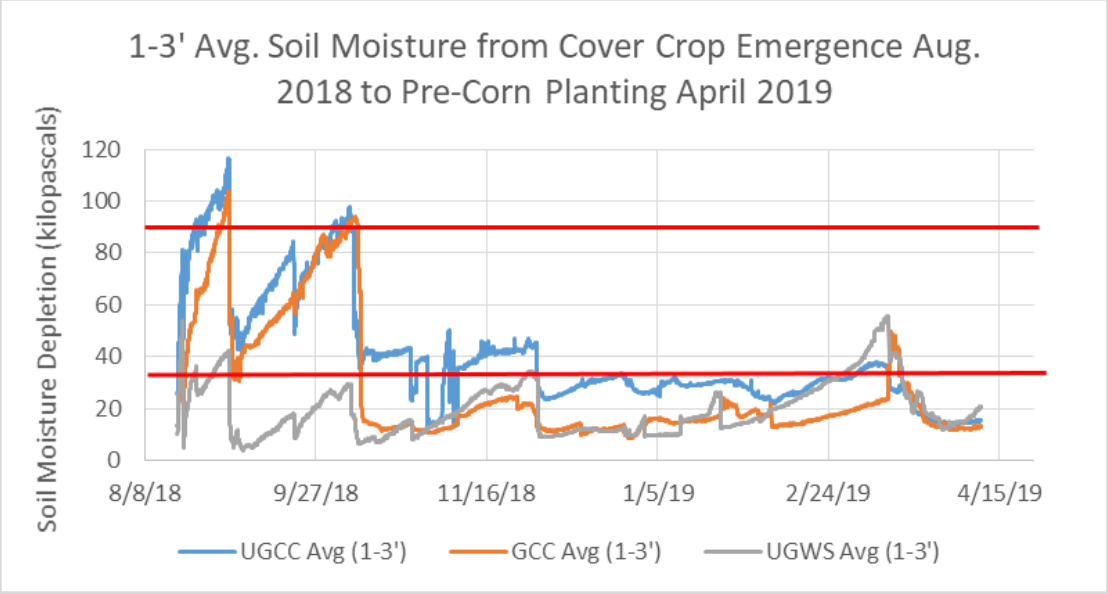


Figure 1. Soil moisture data for three feet depth from September 2018 to April 2019 for the three treatments. UGWS = Ungrazed Wheat Stubble, UGCC = Ungrazed Cover Crop, GCC = Grazed Cover Crop. Lines for field capacity (30 kPa) and 35% depletion (90 kPa) for silt loam soils are shown for reference. While 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 endrows (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.

Economic Summary (preliminary)

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 $6370 (using a value of $2.00/head/day) for the 52.3 acres grazed. The resulting net benefit is $74.06/acre. Costs in Table 3 will be updated each year to determine the final 3-year total.

Table 3. Marginal net return ($/ac) economic analysis of this study for three crop years.

	2018 Cover	2019 Corn	2020 Soy	2021 Wheat	3-Year Total
Cover Crop—Non-grazed	(-$41.82)	$285.79	TBD	TBD	*$243.97*
Cover Crop/Stubble—Grazed	$74.06	$298.45	TBD	TBD	*$372.51*
Stubble—Non-grazed	(-$18.00)	$278.13	TBD	TBD	*$260.13*

The study will continue in 2020, with the cash crop rotating to soybeans.

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