Iowa Nutrient Research Center • Final Report
Fall Grant

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Introduction

As cover crop integration into row crop systems has increased, so has the interest in the potential additional forage resource cover crops could provide. While several research and demonstration projects have focused on spring grazing of overwintering cover crops, less work has been done focusing on fall grazing of cover crops. Therefore, the objective of this project was to evaluate the effectiveness of fall-grazing a cereal rye and oat cover crop mix by beef cattle to promote a sustainable crop and livestock system increasing farming efficiency while improving water quality and other agronomic benefits.

Specifically, the project focused on evaluating forage quality and yield as well as grazing days and cattle performance when grazing cover crops in the fall as well as to determine if cover crops can still maintain agronomic benefits such as reducing soil compaction and building soil organic matter when grazed.

Research findings

Cover crop forage quality and quantity varies greatly based on weather patterns, location in the state, seeding dates, and competition from the cash crop when interseeded. Table 1 and Figures 1, 2, and 3 demonstrate the variability in nutrient quality of various cover crop samples taken from the outlying farms in the fall of 2018 and 2019. The average number of fall grazing days in 2018 was 8 days, where only one field was grazed for 7 days in the fall of 2019. Despite the limited availability of fall grazing days, the nutritional value of the cover crops makes it a high-quality feedstuff and contributes to feed savings for the Iowa beef producer. Thus, the forage availability creating further incentive for cover crops adoption across the state and aid in more efficient use of resources further improving both cattle and crop enterprise profitability.

While the amount of fall grazing was limited in this two-year study, fall grazing does not appear to have negate the agronomic benefits cover crops are known to provide, such as reducing soil compaction (Table 3) or building soil organic matter (Table 4). However, since many of the agronomic benefits take more than just two years of using cover crops to really start to see a difference or impact, a longer assessment is needed to continue to evaluate how grazing can impact the known agronomic benefits cover crops can provide.

Publications created
**Specific to the project alone:*
Grazing Fall-Seeded Cover Crops with Fall-Calving Cow-Calf Pairs (RFR-A18120)
Grazing Fall-Seeded Cover Crops with Stocker Cattle (RFR-A1953)

**Joint publications that include project data:*
Best Management Practices for Fall Grazing Cover Crops infographic
Grazing Cover Crops to Avoid Soil Compaction
Herbicide Use May Restrict Grazing Options for Cover Crops (CROP 3082)
Managing Cattle Health Issues When Grazing Cover Crops (IBC 129)
A Field Guide to Winter Cereal Rye Forage Quality (ASL R3309)
Nitrate and Sulfur in Fall Grazed Cover Crops (ASL R3312)
Farmers Experiences with Fall Grazing Cover Crops (IBC 142; in progress)
Cover Crop Integration in Iowa (an extension programming evaluation summary; in progress)

Additional Research Findings
Cover crop forage quality and quantity varies greatly based on weather patterns, location in the state, seeding dates, and competition from the cash crop when interseeded either aerially or via high-clearance seeder into the crop. For yield checks, 1 forage sample was taken for approximately every 5 acres. Those samples were then condensed into a composite sample representing 10 – 15 acres which was submitted for nutrient analysis. Table 1 and Figures 1, 2, and 3 demonstrate the variability in nutrient quality of forage samples taken from the outlying farms in fall of 2018 and 2019. Variation within a field and from field to field ranged greatly, likely due to weather influence, location within the state, the presence of the previous cash crop and emergence competition when cover crops were interseeded, and cover crop stage of production when sampled (Table 2).

In 2018, the average number of fall grazing days was approximately 8 days, ranging from 0 – 12 days depending on the field (Table 2). Only one field was not grazed due to limited establishment success from weed pressure within the field (Field C). Fields B and D were grazed by fall-calving, cow-calf pairs. While not measured, it was noted that forage yield appeared to be greater prior to harvesting of the cash crop, so it is believed that the cover crop was too fragile to handle the traffic of machinery during the cash crop harvest, especially with soybeans as the combine head would have removed some forage as well. In 2019, only one of the five fields had adequate forage to allow for 7 days of grazing. Cover crop growth on the other fields were limited, and therefore not sampled, due to an early killing frost in October, which occurred before the cash crop was even harvested.

The nutritional value of the cover crops (Table 1) demonstrates the value of the high-quality forage. While even the minimum protein and energy values are near adequate or above the requirements of stocker calf or lactating cow, the high moisture content of the forage despite grazing after a killing frost is a concern for forage intake by the ruminant. The average dry matter (DM) of the cover crop mix in this study was 21.1%. For comparison, the average DM of vegetative pastures in Iowa in the spring is typically 30-35%. Therefore, additional supplementation is recommended to ensure increased utilization of cover crops when grazing.

High stocking rates and forage yield were the limiting factors to gaining additional grazing days in this study.

Due to the short timeframe of fall grazing in the study, cattle performance is not reported, but stocker cattle maintained weight while grazing. Despite the limited availability of grazing days, fall-grazing of cover crops by beef cattle can contribute to a feed savings by extending the grazing season, thus creating further incentive for cover crops adoption across the state and aid in more efficient use of resources further improving both cattle and crop enterprise profitability.

From an agronomic perspective, it does not appear to negate the agronomic benefits cover crops are known to provide such as reducing soil compaction or building soil organic matter although fall grazing was limited in this two-year study. Soil bulk density measurements were collected to measure compaction (Table 3). Looking at the bulk density results and considering the soil test of the fields included in the study, the bulk density results still fall within the range of bulk densities considered ideal (less than 1.40 g/cm^3) for plant growth, according to the Natural Resource Conservation Services general relationships with soil texture (silty loam or silty clay loam) and bulk densities. Bulk densities that negatively affect plant root growth would be 1.55 g/cm^3 or greater.

Soil moisture is another aspect that can affect compaction. Soil moisture data was gathered from the weather stations located on the farms during the time of grazing. In 2018, during the time of fall grazing soil moisture at all three farms was at or below field capacity at the 12-inch depth. In 2019, soil moisture at Western Research Farm, which was the only field grazed, was below field capacity at the 12-inch depth.

Organic matter samples were collected in study, but they are also being used as additional timepoints in a longer-term assessment to evaluate the impact grazing cover crops has on organic matter levels (Table 4). No differences were detected in the organic matter between 2018 and 2019 with the different treatments, which was not surprising given this was just a two-year study. A lot of the agronomic benefits of cover crops are more long-term benefits, so additional work is needed to further evaluate if agronomic benefits like reduced compaction and increased organic matter levels are maintained with fall grazing of cover crops.

Acknowledgements
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Table 1. Summary of forage quality of fall-seeded cereal rye and oat cover crop mix sampled in Fall 2018 and 2019

Item, %	Average	Minimum	Maximum	Standard Deviation
Dry matter	21.1	14.6	27.1	4.96
Crude protein	24.3	20.3	30.0	3.07
Acid detergent fiber	20.7	13.8	30.1	6.21
Neutral detergent fiber	31.3	23.0	36.4	5.79
Total digestible nutrients	69.8	53.9	78.2	7.60
Relative feed value	227	143	316	68.3
Calcium	0.57	0.47	0.64	0.063
Phosphorus	0.48	0.31	0.61	0.105
Magnesium	0.24	0.18	0.29	0.044
Potassium	3.17	1.92	4.20	0.858
Sulfur	0.31	0.24	0.37	0.048

Table 2. Summary of forage and cattle management of fall-seeded cereal rye and oat cover crop mix sampled in Fall 2018 and 2019

Field[1]	Forage Yield[2]	Average Stocker Weight[3]	Stocking Rate, AU/Ac[4]	Cattle Turnout Date[5]	Cattle Removal Date[6]	Previous Cash Crop	Cover Crop Seeding Date	Cover Crop Seeding Method
2018								
A	342	896	1.3	11/13	11/26	Corn	8/29	Aerial
B[7]	1,675	-	2.3	10/29	11/05	Corn silage	8/22	Drill
C[8]	98	-	-	-	-	Corn	8/24	Aerial
D[7]	728	-	1.7	11/08	11/16	Soybeans	8/24	Aerial
E	343	895	1.8	11/16	11/28	Corn	8/25	Interseed
2019								
A[8]	-	-	-	-	-	Soybeans	9/13	Aerial
B[8]	-	-	-	-	-	Soybeans	9/17	Aerial
C[8]	-	-	-	-	-	Soybeans	9/17	Aerial
D[8]	-	-	-	-	-	Corn Silage	10/17	Drill
E	228	693	1.9	11/06	11/13	Soybeans	9/10	Aerial

[1]A = Allee Research Farm; B, C, D = McNay Research Farm; E = Western Research Farm
[2]Pounds of forage per acre on a dry matter basis.
[3]Weight of stocker cattle in pounds at grazing initiation.
[4]Number of 1,000 pound animal units (AU) per acre (Ac).
[5]Date of grazing of covers was initiated.
[6]Date of grazing of covers was completed.
[7]Grazed by fall-calving, cow-calf pairs.
[8]Not grazed due to limited forage growth.

Table 3. Summary of soil bulk density measurements in g/cm^3 taken at the 0-6" sampling depth and soil moisture levels during the time of fall grazing.

Field[1]	Fall baseline/ Pre-grazing[2]	Post fall grazing	Cover crop not grazed	No cover crop	Soil Moisture Levels in relation to field capacity at the 12" depth[3]
2018					
A	1.46	1.27	1.23	1.25	Below
B	1.39	1.33	1.44	1.37	At or below
C	1.38	1.34	1.35	1.24	At or below
D	1.35	1.33	1.34	1.22	At or below
E	1.30	1.36	1.34	1.35	Below
2019					
E	1.35	1.35	1.35	1.43	Below

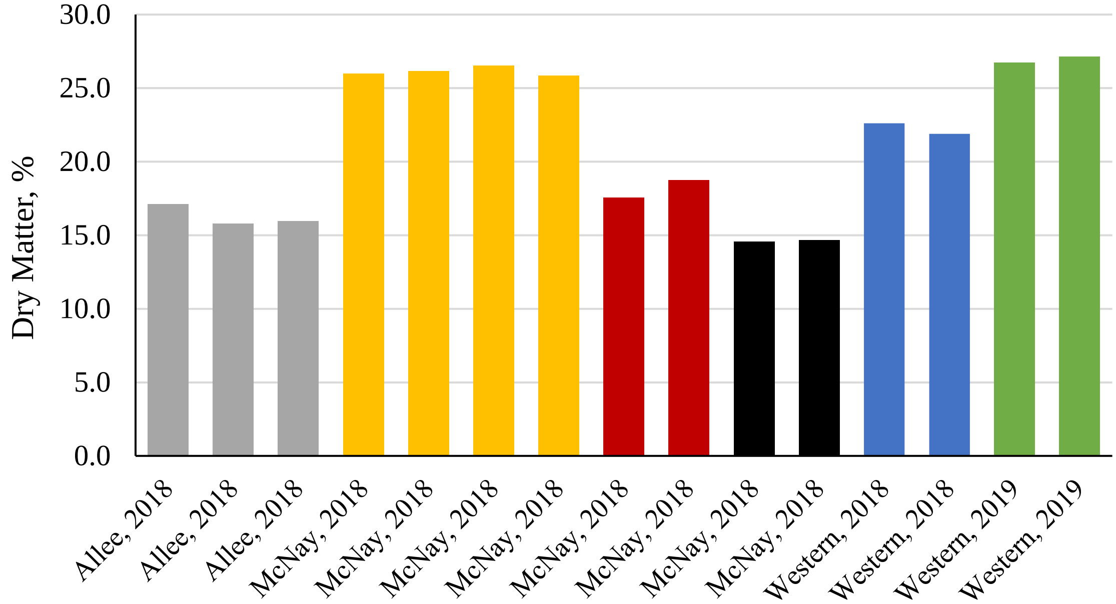
[1]A = Allee Research Farm; B, C, D = McNay Research Farm; E = Western Research Farm
[2]Pre-grazing is a baseline field average bulk density.
[3]Bulk density samples were collected in 2019, but data from the Western Research Farm is only presented since the other farms were not grazed due to limited forage growth.

Table 4. Summary of organic matter levels, reported as %[3].

Field[1]	Grazed cover crop	Cover crop not grazed	No cover crop
2016[2]			
A	7.6	7.4	6.3
B	4.3	4.6	4.1
C	4.0	4.8	5.2
D	5.0	4.7	4.1
E	3.6	3.5	3.8
2018			
A	4.7	4.4	4.4
B	4.6	4.6	4.5
C	4.4	5.3	5.4
D	5.3	4.7	4.7
E	2.9	3.0	3.0
2019			
E	3.7	3.7	3.9

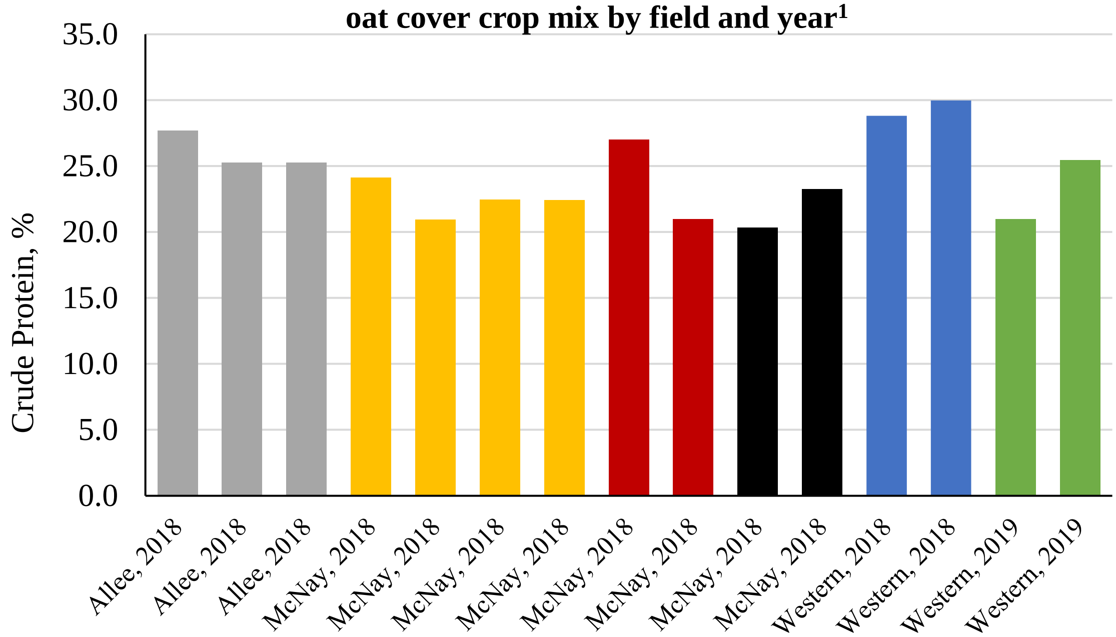
[1]A = Allee Research Farm; B, C, D = McNay Research Farm; E = Western Research Farm
[2]Baseline organic matter samples as part of a longer-term grazing cover crop study being conducted in these same fields.
[3]2016 organic matter samples were ran at the ISU Soil Testing Lab, which closed shortly after. 2018 and 2019 samples were ran by Ward Laboratories. Some of the differences above may be contributed to differences in the lab and a delay in the Allee and Western Research Farm samples in being sent to the lab for analysis.

Figure 1. Variability in dry matter of fall-seeded cereal rye and oat cover crop mix by field and year[1]



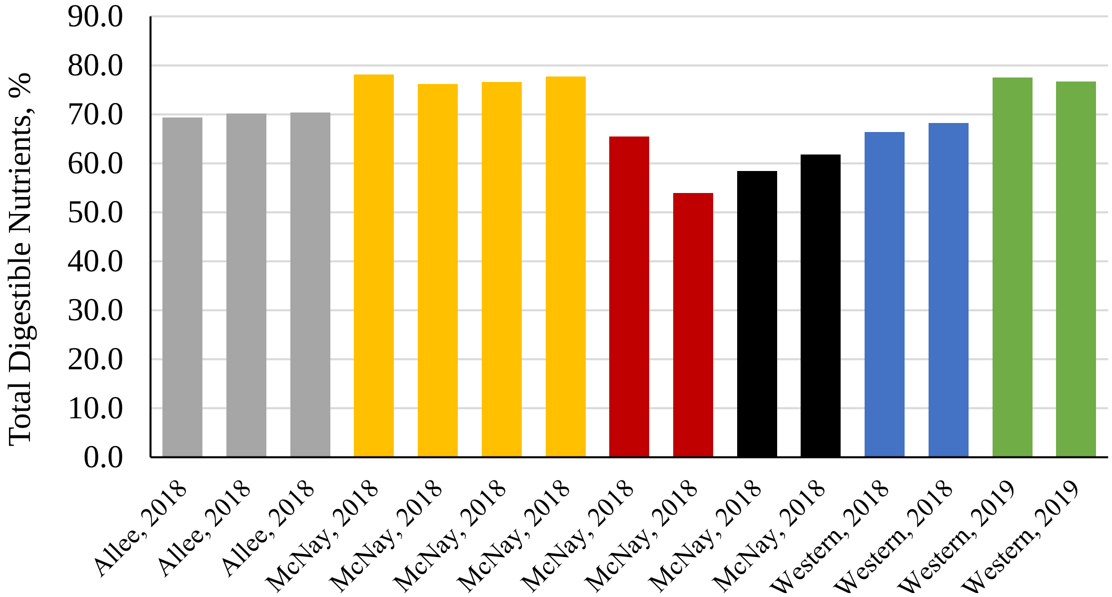
[1]Bars of the same color originated from the same field. Allee = Field A, sampled 10/30/18; McNay = Fields B, C, and D, sampled 11/8/18; Western = Field E, sampled 11/16/18 and 11/6/2019.

Figure 2. Variability in crude protein of fall-seeded cereal rye and oat cover crop mix by field and year[1]



[1]Bars of the same color originated from the same field. Allee = Field A, sampled 10/30/18; McNay = Fields B, C, and D, sampled 11/8/18; Western = Field E, sampled 11/16/18 and 11/6/2019.

Figure 3. Variability in total digestible nutrients (energy) of fall-seeded cereal rye and oat cover crop mix by field and year[1]



[1]Bars of the same color originated from the same field. Allee = Field A, sampled 10/30/18; McNay = Fields B, C, and D, sampled 11/8/18; Western = Field E, sampled 11/16/18 and 11/6/2019.