Renegerative Agriculture

Improving relative forage quality during stubble grazing with low-growing clovers as relay crops

Collaborators:

Lakeland Agricultural Research Association (lead)
Lakeland College
Gateway Research Association

Background:

Stubble grazing is currently a widespread practice in central Alberta, which enables livestock producers to make use of alternative forage resources (i.e. cereal crop stubble) in the fall and prior to winter feeding practices (corn, swath, or bale grazing). Most stubble grazing scenarios involve cattle feeding on a mixture of straw, chaff, grains (left over from combine), and weeds. As such, the quality of the feed can vary considerably. In general, straw and chaff contain low amounts of protein, energy, calcium and magnesium. Additionally, most stubble grazing scenarios occur prior to weaning, where cows still have high energy and protein requirements as they are still lactating. Thus, there is a need to improve forage quality in this timeframe.

This project aims to introduce white clover, subterranean clover as a relay crop in feed barley. The study will consider a few factors that will promote successful outcomes. The first factor will be to investigate the impact of clover species on weed suppression (at both harvest timings). The second factor will be to investigate the impact of clover species on soil available nitrogen to the following crop. The study will measure if there are significant interactions between such factors (clover species, soil available nitrogen, and harvest timing).

Objectives:

i. Evaluate the impact of feed barley+ clover species (white or subterranean clover) on silage yield and quality.
ii. Evaluate the impact of feed barley+ clover species (white or subterranean clover) on grain yield and quality.
iii. Determine cereal+clover intercrop combination(s) that will improve forage yield and quality during the stubble grazing period.
iv. Produce a reliable estimate of the potentially mineralizable N (nitrogen credit) derived from cereal+clover relay crop systems.
v. Determine which relay crop system (cereal+clover combination(s) and harvest timing) will bring the highest economic return to grain and livestock producers.

Materials & Methods:

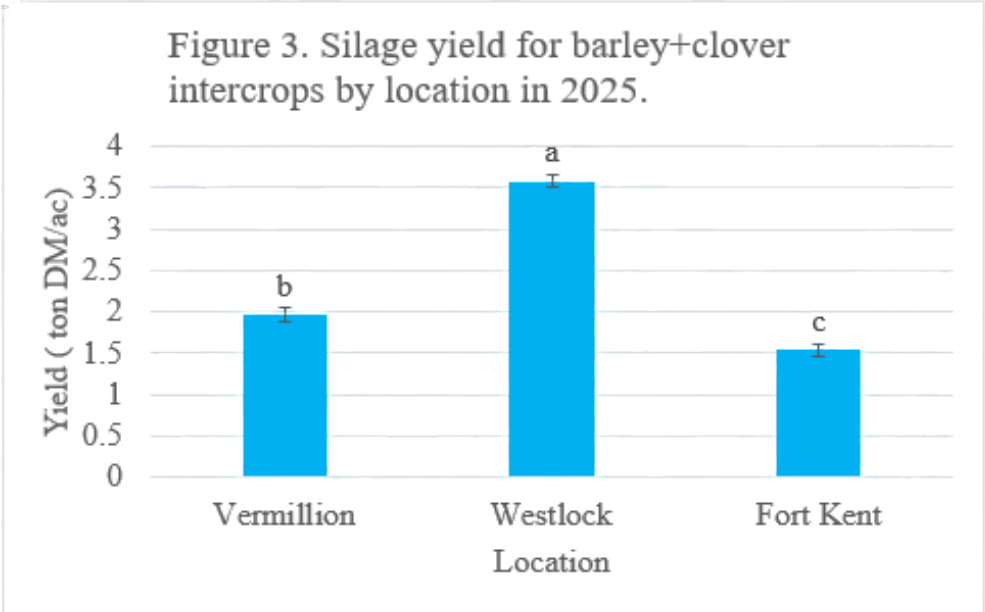
1. Feed barley underseeded with white clover (harvested at silage timing)
2. Feed barley underseeded with white clover (harvested at grain timing)
3. Feed barley underseeded with subterranean clover (harvested at silage timing)
4. Feed barley underseeded with subterranean clover (harvested at grain timing)
5. Feed barley (harvested at silage timing)
6. Feed barley (harvested at grain timing)

Figure 1: Subterranean clover intercropped with feed barley.
Photo taken July 10th, 2025.

Figure 2: Subterranean clover intercropped with feed barley. Silage harvest. Photo taken August 8th, 2025.

Results and Discussion

Silage yield



Barley silage yields were significantly different by location (Figure 3; $p<0.0001$). Westlock had the highest silage yields at 3.58-ton DM/ac, followed by Vermillion (1.97-ton DM/ac) and Fort-Kent (1.54-ton DM/ac). The addition of clovers did not significantly increase silage yields ($p=0.8510$). Silage yield differences were likely due to environmental conditions, where Westlock received more early season rain than Vermillion and Fort-Kent.

Silage quality

		Vermillion		Westlock		Fort Kent		Pr(>F)
CP	%	10.4	b	10.2	b	11.8	a	5.809e-08***
TDN	%	74.3	a	68.3	c	72.2	b	7.268e-10***
NEG	%	1.14	a	1.04	b	1	b	1.071e-07***
NEM	%	1.87	a	1.71	b	1.72	b	5.571e-09***
Calcium	%	0.201	c	0.323	a	0.242	b	3.207e-11***
Phosphorus	%	0.121	c	0.163	b	0.196	a	8.37e-14***
RFV		190	a	176	a	133	b	6.519e-10***
Potassium	ppm	1.13	b	1.29	a	1.28	a	0.007489**
Magnesium	%	0.145	b	0.127	c	0.191	a	8.99e-12***

Stubble yield (above-ground biomass) was not significantly different with the addition of clovers (p=0.2865), nor across different locations (p=0.0869)(Figure 5). Additionally, whether you removed the biomass during silage, or kept it for grain, it did not influence the total amount of stubble harvested (p=0.5598). It did, however, influence the quality of that stubble, with the silage plots displaying higher quality stubble in September.

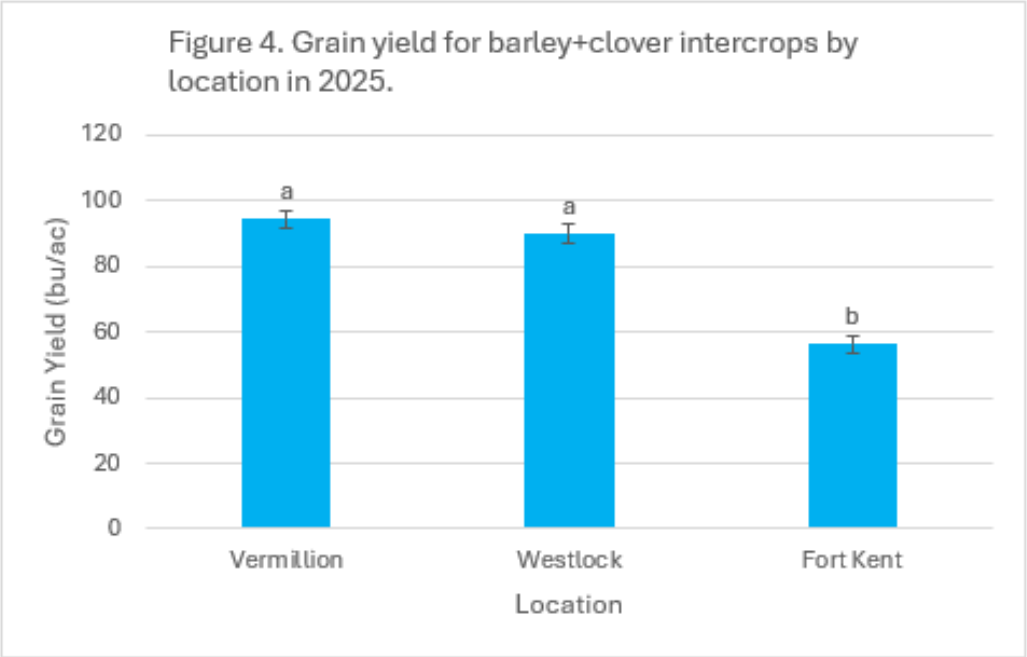
Stubble quality (by biomass removal)

		Silage Kept		Silage Removed		Pr (>F)
%CP	%	6.65	b	9.04	a	0.0008102***
%TDN	%	52.6	b	58.2	a	6.052e-15***
NEG	%	0.54	b	0.7	a	7.875e-15***
NEM	%	1.25	b	1.41	a	8.698e-15***
Phosphorus	%	0.0539	b	0.0861	a	<2.2e-16***
RFV		73.9	b	103.7	a	<2e-16***

Feed test results from the stubble/regrowth in 2025 demonstrated that the stubble quality improved when the barley was silaged and left to regrow. That was true for crude protein, TDN, NEG, NEM, phosphorus and RFV. However, there was no significant effect on calcium, magnesium, copper, and zinc. This effect may have been heightened because of the early season drought conditions followed by the arrival of late season moisture (mid-August). This likely improved regrowth and stubble quality in August. Under similar conditions, the recommendation would be that it is better to silage the barley crop, and to graze the regrowth+stubble in September. These results were consistent across all three site locations.

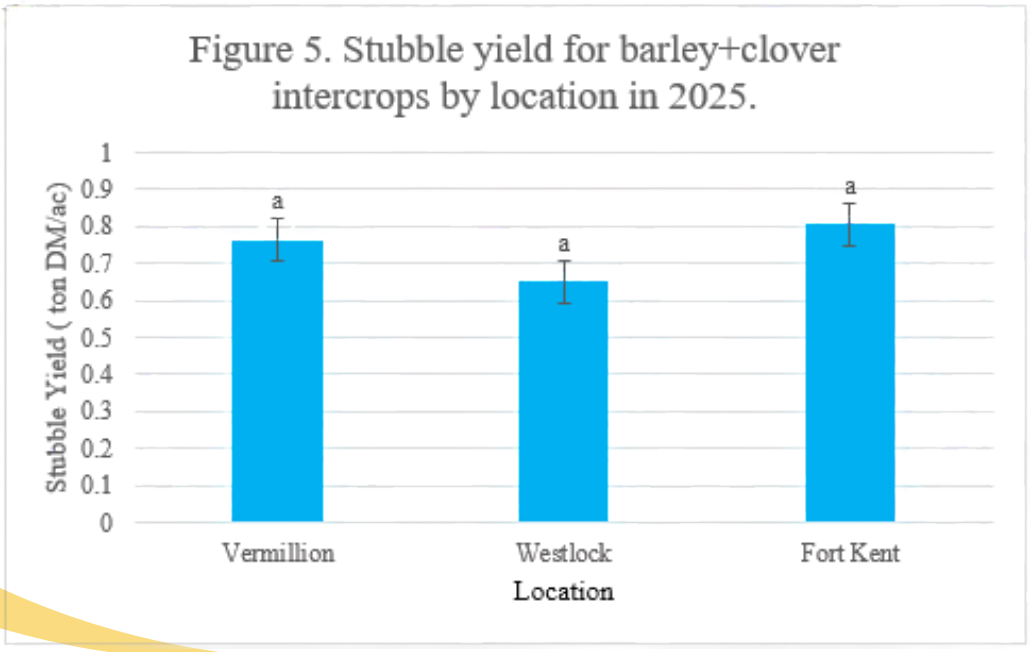
Silage feed test results indicated that all tested nutrients were significant by location ($p<0.05$). Crude protein, potassium, magnesium, and phosphorus content were highest in Fort-Kent. Total digestible nutrients, net energy gain and net energy maintenance were highest in Vermillion. Relative feed value was highest in Vermillion and Westlock. The addition of clovers did not influence nutrient content in silage. This was likely owing to the drought, but also the staging of the clovers at silage timing.

Grain yield



Barley grain yields were significantly different by location ($p<0.0001$). Vermillion had the highest grain yields at 94±2.7 bu/ac, followed by Westlock (90±2.7 bu/ac) and Fort-Kent (56±2.7) (Figure 4). The addition of clovers did not significantly impact silage yields ($p=0.1203$) in 2025. On a positive note, despite the drought conditions, clovers did not decrease barley grain yield in 2025. Thousand kernel weights and test weights followed the same trends.

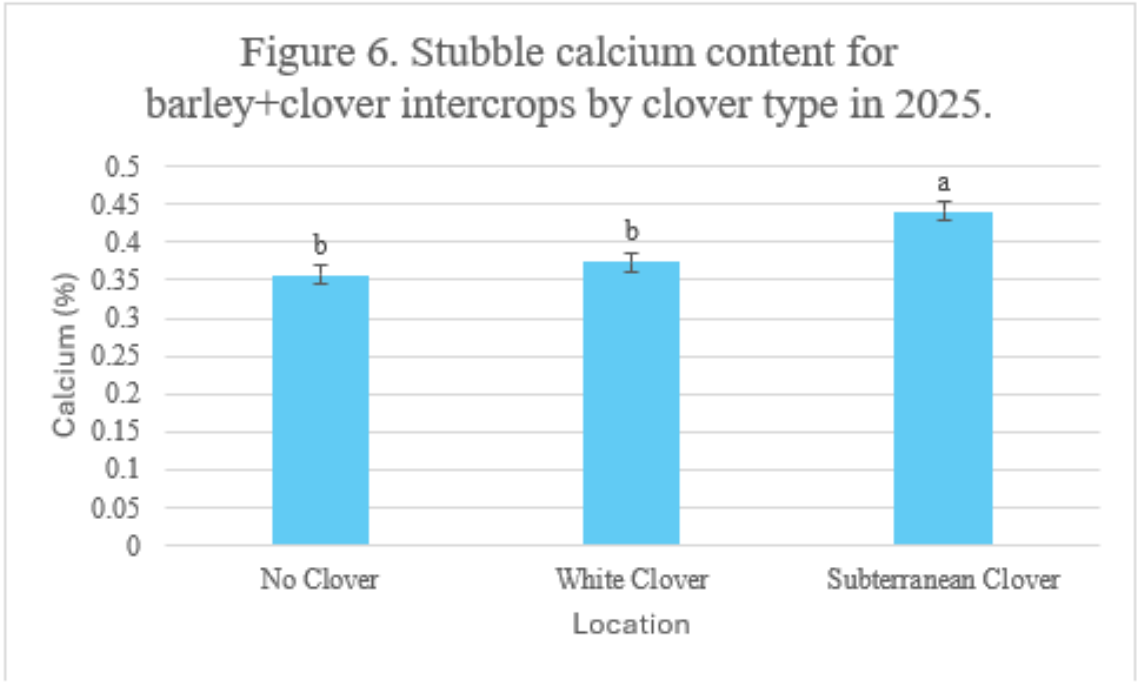
Stubble yield



Stubble quality (by location)

		Vermillion		Westlock		Fort Kent		Pr(>F)
%CP	%	5.89	c	7.87	b	9.78	a	4.444e-13***
%TDN	%	52.8	b	60.1	a	53.3	b	<2.2e-16***
NEG	%	0.522	b	0.8	a	0.537	b	<2.2e-16***
NEM	%	1.24	b	1.48	a	1.26	b	<2.2e-16***
Phosphorus	%	0.0546	b	0.0792	a	0.0762	a	4.676e-13***
Magnesium	%	0.167	b	0.115	c	0.237	a	<2.2e-16***
Copper	ppm	3.67	c	5.46	b	7.28	a	3.04e-09***
Zinc	ppm	16.4	b	18	b	27.5	a	5.076e-11***
RFV		69.8	c	116.2	a	80.3	b	<2e-16***

Stubble quality



In 2025, apart from calcium, the addition of clovers did not improve stubble quality. Subterranean clover significantly improved calcium content in the stubble ($p<0.0001$, Figure 6). The effect was most observed in the Vermillion and Ft-Kent locations (western locations). White clover, on the other hand, did not show such promise. This was likely owing to poor emergence during drought conditions. Subterranean clover is better adapted to drought conditions compared to white clover. We hypothesized that clovers would improve crude protein content in the stubble. Our results showed that this was not the case in the 2025 growing season ($p=0.2498$). Again, this was likely due to persistent drought conditions.

Conclusion

This was year 1 of the project. We are scheduled to run the same experiment for three more years. The main take-aways from Year 1, was that if the silage was removed, the stubble was of higher quality. That is what we expected out of a dry year, but we were surprised to see that it was true for all nutrients tested.

Based on one year of data, on a dry year, the recommendation is to silage, and to graze the regrowth in the fall. The addition of subterranean clover did not improve silage or stubble yield. However it did improve calcium content in the stubble, which is very important for pregnant cows.

We will need to adjust the seeding rate on the white clover. It is not known to do well in dry conditions such as what we had in 2025, but we do want to increase the seeding rate, and see if we get a better establishment in future years.

Proudly funded by:

RDAR Results Driven Agriculture Research

Municipal District Bonnyville No. 87

Alberta

County 19 St. Paul

Sustainable Canadian Agricultural Partnership
Competitive. Innovative. Resilient.

Canada