BARLEY-CLOVER RELAY CROPPING TRIAL

Stubble grazing is currently an established practice in central Alberta, enabling livestock producers to utilize alternative forage resources such as cereal crop stubble (Alberta Agriculture and Forestry, 2019) during the fall period prior to winter feeding practices (corn, swath, or bale grazing). Most stubble grazing scenarios involve cattle feeding on a mixture of straw, chaff, grain left over from the combine, and weeds. As a result, feed quality can vary considerably. In general, straw and chaff contain low levels of protein, energy, calcium, and magnesium. Wheat straw, for example, contains approximately 0.40 Mcal/lb of net energy, 3.6% crude protein, 0.19% calcium, and 0.09% phosphorus.

According to the Cowbytes program, a 1300 lb mature pregnant cow in her second trimester (mid-gestation) requires approximately 15.3 lb/day of total digestible nutrients (TDN), 12.4 Mcal/day of net energy, 1.6 lb/day of crude protein, 30 g/day of calcium, and 17 g/day of phosphorus (Beef Cattle Research Council 2024). Most stubble grazing occurs prior to weaning, when cows still have relatively high energy and protein requirements due to lactation. After weaning, energy and protein requirements may decline by up to 35%. Therefore, access to higher-quality feed prior to weaning remains important (Alberta Agriculture and Forestry 2019; Yaremcio 2023; Beef Cattle Research Council 2024).

Introducing a relay crop that can be grazed after cereal harvest may offer a practical solution to this challenge. Legume relay crops could improve forage quality for livestock producers while also contributing potentially mineralizable nitrogen (N) for subsequent crops. Suitable relay crops must be low-growing to avoid interfering with grain combining, capable of establishing during the growing season without competing excessively with the cereal crop for soil water and nutrients, and easy to terminate the following spring.

Subterranean clover (Trifolium subterraneum) is a cool-season, low-growing annual legume with high palatability and good drought tolerance. White clover (Trifolium repens) is another cool-season legume commonly included in pasture mixtures in North America. It has good shade tolerance and can overwinter during mild winters with adequate snow cover in Alberta. Unlike subterranean clover, white clover also tolerates cool and wet conditions well (Bergkvist 2003; Kintl et al. 2018; Hill et al. 2021). In terms of nutrient content, white clover contains approximately 25% crude protein (more than six times higher than straw). Total digestible nutrients (TDN) are also relatively high at approximately 80%. Calcium content is estimated at 1.5% (nearly ten times higher than straw) (Caradus et al. 2023), while phosphorus content is approximately 0.4% (almost four times higher than straw). White clover can fix between 100 and 150 lb N/acre from the atmosphere, although some nitrogen will be removed through grazing of above-ground biomass (Caradus et al. 2023). The price for urea (46-0-0) was approximately $730/MT, equivalent to $0.72/lb of N (direct communication with a local fertilizer retailer, November 19, 2024). Based on this value, the nitrogen credit from white clover could range from $72 to $108/acre annually. Subterranean clover can supply approximately 80–130 lb N/acre, corresponding to $58–$94/acre per year. Although not all fixed nitrogen becomes available to the following crop due to immobilization, denitrification, and potential leaching losses, producers using a clover relay system may still realize fertilizer savings of approximately $14/acre annually. This is particularly relevant for grain and livestock producers seeking to reduce fertilizer input costs for subsequent crops.

This project is evaluating the introduction of white clover and subterranean clover as relay crops in feed barley. Following the completion of the first year of field work, the study continues to examine several factors that may influence the success of this system. Specifically, the project is assessing the effects of clover species on weed suppression at both harvest timings and evaluating their influence on soil available nitrogen for the subsequent crop. The study will also determine whether significant interactions exist among clover species, soil available nitrogen, and harvest timing.

This report presents data from the first year of the study and includes only results from the Gateway Research Organization (GRO site). The findings should be interpreted with caution.

Agronomic Information:
Seeded: June 6, 2025
Seed Depth: ¾ inch
Soil Temp: 20 °C
Seeding Rates: Barley: 242 seeds/m2; White Clover: 5 lbs/ac; Subterranean Clover: 10 lbs/ac
Rainfall recorded (seeded to harvest): Silage Harvest: 149.2 mm; Grain:156.9 mm; Stubble: 162.4 mm
Fertilizer:
Side Banded: 28.29-5.78-15.42-1.93 @ 311.28 lbs/ac
88 lbs/ac Actual N; 18 lbs/ac Actual P; 48 lbs/ac Actual K; 6 lbs/ac Actual S
Pre-emergence: Glyphosate @ 280 g ae/ac on June 10, 2025
Silage Harvest: August 20, 2025; Grain Harvest: September 12, 2025; Stubble Regrowth: October 06, 2025

BARLEY-CLOVER RELAY CROPPING TRIAL CONTINUED

BARLEY-CLOVER RELAY CROPPING TRIAL - GRO, WESTLOCK - 2025

Trt No.	Treatment Name	Plot Type	Barley (plants/m2)		Clover (plants/		Barley Height (cm)		Barley Flowering (# of days)		Silage Yield (kg/ha) Adjusted		Grain Yield (kg/ha) Adjusted		Leftover Stubble (kg/ha) Adjusted	
1	Barley + White Clover	Silage	138.3	a	52.0	a	64.0	a	54.8	a	7776.3	a	-	-	1648.3	a
3	Barley + Subterranean Clover	Silage	150.0	a	44.3	a	60.3	a	54.8	a	7629.8	a	-	-	1328.8	a
5	Barley Only	Silage	145.5	a	0.0	b	64.8	a	55.3	a	7103.8	a	-	-	1634.0	a
2	Barley + White Clover	Grain	134.0	a	59.0	a	63.3	a	55.0	a	-	-	4909.3	a	2044.3	a
4	Barley + Subterranean Clover	Grain	142.5	a	57.5	a	60.0	a	54.8	a	-	-	4602.0	b	1737.8	a
6	Barley Only	Grain	156.5	a	0.0	b	59.0	a	54.8	a	-	-	4500.5	c	1919.8	a
	LSD P=.05 (% mean diff)		33.22 (23%)		29.83 (84%)		9.89 (16%)		0.67 (2%)		544.35 (8%)		84.98 (2%)		842.56 (49%)	
	Standard Deviation		22.04		19.79		6.56		0.44		314.61		49.11		559.04	
	CV		15.26		55.82		10.6		0.81		4.19		1.05		32.53	

Means followed by same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).

Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

RESULTS AND DISCUSSION:

No significant treatment effects were observed on barley establishment, plant height, flowering time, or residual stubble biomass. For silage production, yields ranged from 7,103 to 7,776 kg/ha. Although the differences among treatments were not statistically significant at the conventional $\alpha = 0.05$ level, the analyzed p-value (0.0517) was very close to the significance threshold, suggesting a marginal or near-significant treatment effect and indicating a possible trend that might become clearer with greater replication or under different environmental conditions.

In the grain system, however, clear treatment effects were observed. Barley grown with white clover produced the highest grain yield (4,909 kg/ha), followed by barley intercropped with subterranean clover (4,602 kg/ha), while barley grown alone yielded the least (4,501 kg/ha); all three treatments were significantly different from one another.

It is important to note that after the silage harvest, the site received only 7.7 mm of precipitation over a 22-day period, resulting in very limited regrowth. Consequently, the biomass of grain stubbles was greater than that observed in the silage regrowth plots.

Overall, these results suggest that intercropping barley with clover can maintain and potentially improve both silage and grain production, particularly when barley is grown with white clover, without negatively affecting barley growth or development.

Based on the feed analysis results (see next page) of the barley-clover relay cropping trial, there were no statistically significant differences ($P \leq 0.05$) among the three treatments: Barley + White Clover, Barley + Subterranean Clover, and Barley Only, for any of the measured nutritional parameters. All treatments shared the same significance grouping ("a"), indicating that the inclusion of clover in relay cropping did not significantly change silage quality compared with barley grown alone.

The barley–clover relay cropping trial revealed clear differences in stubble feed quality (see next page) depending on the clover species and harvest type. In the silage plots, barley + white clover and barley only treatments produced regrowth with higher crude protein (9.63–9.85%), lower fiber content (ADF 19–22%, NDF 40.1–42.4%), and higher total digestible nutrients (65.10–66.03%) compared to barley + subterranean clover, which had lower protein (6.15%), higher fiber (ADF 36.5%, NDF 61.4%), and lower TDN (54.84%). Relative Feed Value (RFV) was also higher in barley + white clover and barley only (142.96–153.87%) than in barley + subterranean clover (83.21%), indicating that silage regrowth from barley + white clover or barley only provide superior nutritive value and digestibility for livestock.

In the grain plots, the pattern was reversed. Barley + subterranean clover produced stubbles with higher crude protein (9.35%), lower fiber (ADF 21.7%, NDF 39.7%), and higher TDN (66.06%) than barley + white clover and barley only, which had lower protein (5.95–6.28%), higher fiber (ADF 37–37.5%, NDF 62.1–62.5%), and lower TDN (54.10–54.32%). RFV was also highest for barley + subterranean clover (155.32%), compared to 80.63–81.39% in the other treatments. These results indicate that barley + subterranean clover provides the most nutritious stubble in grain-harvested plots, offering better protein, energy, and digestibility for livestock feed.

Overall, the trial shows that the choice of clover species has a meaningful effect on the quality of leftover feed, whether after a silage harvest or a grain harvest, although the impact depends on the type of harvest. For silage regrowth, barley with white clover or barley alone performs best, while barley with subterranean clover is more effective for grain stubbles. This gives producers the flexibility to enhance forage quality according to their harvest strategy.

BARLEY-CLOVER RELAY CROPPING TRIAL CONTINUED

BARLEY-CLOVER RELAY CROPPING TRIAL - SILAGE -FEED ANALYSIS

Trt No.	Treatment Name	Crude Protein %		ADF %		NDF %		TDN %		Calcium %		Phosph-orus %		Potas-sium %		Magnes-ium %		Sodium %		RFV	
1	Barley + White Clover	10.18	a	19.62	a	36.71	a	67.53	a	0.34	a	0.16	a	1.31	a	0.13	a	0.09	a	173.05	a
3	Barley + Subterranean Clover	10.05	a	18.51	a	35.57	a	68.50	a	0.31	a	0.16	a	1.25	a	0.13	a	0.08	a	179.54	a
5	Barley Only	10.45	a	19.16	a	36.42	a	68.96	a	0.31	a	0.15	a	1.33	a	0.12	a	0.07	a	176.35	a
LSD P=.05 (% mean diff)		0.85 (9%)		4.04 (22%)		3.92 (11%)		3.48 (6%)		0.05(15%)		0.02 (14%)		0.23 (18%)		0.01 (12%)		0.02 (30%)		26.64 (16%)	
Standard Deviation		0.49		2.34		2.27		2.01		0.03		0.01		0.13		0.01		0.01		15.40	
CV		4.79		12.24		6.26		2.94		8.27		7.87		10.04		6.45		16.88		8.73	

Means followed by same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).

Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

BARLEY-CLOVER RELAY CROPPING TRIAL - STUBBLE -FEED ANALYSIS

Trt No.	Treatment Name	Plot Type	Crude Protein %		ADF %		NDF %		TDN %		Calcium %		Phosph-orus %		Potas-sium %		Magnes-ium %		RFV	
1	Barley + White Clover	Silage	9.85	a	23.02	b		b	65.10	a	0.37	ab	0.10	ab	1.23	b	0.11	bc	142.96	a
3	Barley + Subterranean Clover	Silage	6.15	b	36.49	a	61.43	a	54.84	b	0.41	a	0.06	c	1.53	a	0.12	abc	83.21	b
5	Barley Only	Silage	9.63	a	21.95	b		b	66.03	a	0.34	b	0.11	a	1.16	b	0.11	bc	153.87	a
2	Barley + White Clover	Grain	5.95	b	37.04	a	62.12	a	54.32	b	0.41	a	0.06	c	1.48	a	0.14	a	81.39	b
4	Barley + Subterranean Clover	Grain	9.35	a	21.67	b		b	66.06	a	0.33	b	0.09	b	1.15	b	0.09	c	155.32	a
6	Barley Only	Grain	6.28	b	37.45	a		a	54.10	b	0.41	a	0.06	c	1.54	a	0.13	ab	80.63	b
LSD P=.05 (% mean diff)			0.94 (12%)		1.90 (7%)		3.46 (7%)		1.46 (3%)		0.05 (13%)		0.01 (13%)		0.17 (13%)		0.02 (20%)		13.68 (12%)	
Standard Deviation			0.63		1.26		2.29		0.97		0.03		0.01		0.12		0.01		9.08	
CV			7.94		4.27		4.46		1.61		8.13		8.42		8.56		12.75		7.81	

Means followed by same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).

Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

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