



FACT SHEET
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CHOOSING THE RIGHT FORAGE FOR GRAZING: LEGUMES, GRASSES, AND MIXTURES COMPARED IN WESTERN CANADA

ANNUAL OR PERENNIAL FORAGES FOR GRAZING IN WESTERN CANADA? WHAT WORKS BEST FOR BEEF, PROFIT, AND THE ENVIRONMENT

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Introduction

Forages are the main feed source for beef cattle in western Canada, and choosing the right forage system can greatly affect farm profitability and sustainability. Traditional pasture systems often use mixtures of grasses and legumes because they provide good forage quality and can reduce fertilizer requirements through natural nitrogen fixation (Peprah et al., 2021). Recently, producers have shown growing interest in annual polycrop mixtures containing several plant species, which may improve forage production, biodiversity, soil health, and nutrient cycling. However, limited information is available on how these systems compare with established perennial forage mixtures under grazing conditions.

This study compared annual and perennial forage systems for forage production, feed quality, cattle performance, methane emissions, and economic returns.

Site and Forage System Management

The study was conducted at the Livestock and Forage Centre of Excellence Cow-Calf Teaching Unit near Clavet, Saskatchewan over six years. Four forage systems were evaluated, including two annual systems: (1) **BR-PE-BRS**: CDC Austenson barley + 4010 pea + Winfred forage brassica + Gorilla forage brassica; (2) **FR-CLOV**: AC Hazlet fall rye + Frosty berseem clover; and two perennial systems: (3) **HBG-ALF**: AC Success hybrid brome grass + PS3006 alfalfa; (4) **MBG-SF**: AC Armada meadow brome grass + AAC Mountainview sainfoin. Perennial forages were established in 2018 and remained productive over multiple years, while annual forage mixtures were reseeded each spring from 2019 onward. Fertilizer and inoculants were applied according to soil test recommendations to support forage



growth and nitrogen fixation (Government of Saskatchewan, 2021). Annual and perennial forage treatment paddocks were seeded using recommended seeding rates for the region.

Forage Yield, Composition, and Quality

Forage yield and botanical composition were measured before and after grazing. Samples were collected, dried, and analyzed for quality.

Grazing Management

In each of 5-yr (2019-2023), crossbred steers were allocated to forage systems for an average grazing period of 54 days. Grazing started when forage plants reached at least 10 cm in height and were still actively growing. Steers grazed continuously within each forage (paddock) until forage was reduced to about 5-7 cm in height.

Steer Performance and Dry Matter Intake

Steer weight (**BW**) gain (**ADG**), body condition (**BCS**), and grazing days were measured. Dry matter intake (**DMI**) and total beef production per acre were estimated.

Methane Emissions Measurement

Cattle methane emissions were measured using an automated system that records gases when animals visit to consume small amounts of feed.

System Cost Analysis

Table 1. Effect of forage system on forage yield (DM basis), composition and utilization					
Item	Forage System ¹				
	Annual			Perennial	
	BR-PE-BRAS	FR-CLOV		HBG-ALF	MBG-SF
Yield, lb/ ac	2518	989		2344	1444
Grass, %	64.9	69.6		57.0	92.9
Legume, %	9.6	0		40.4	4.8
Brassica, %	8.1	–		–	–
Other, %	16.0	29.5		1.2	0.9
Chemical composition, % DM ²					
CP	9.8	13.7		7.4	6.2
ADF	31.1	29.4		44.0	43.0
TDN	63.7	61.4		52.8	54.4



The economic performance of annual and perennial forage systems was evaluated by calculating all production costs and returns per acre. Costs included seed, fertilizer, herbicide, labour, equipment, and land rent. Perennial systems had high initial establishment costs that were spread over several years, while annual systems required new input costs each year but produced yearly returns.

Utilization, %	46.6	65.0	54.1	49.0
¹ BR-PE-BRS = barley + peas + brassicas, FR-CLOV = fall rye + berseem clover, HBG-ALF = hybrid brome grass + alfalfa, MBG-SF = meadow brome grass + sainfoin. ² CP = Crude protein; ADF = Acid detergent fibre; TDN = Total digestible nutrients.				

Results and Discussion

Forage Yield and Composition

The highest dry matter yields were found in the barley-pea-brassica system (BR-PE-BRS) and the hybrid brome grass-alfalfa system (HBG-ALF). In contrast, the meadow brome grass-sainfoin (MBG-SF) and fall rye-clover (FR-CLOV) systems produced lower yields (**Table 1**).

Botanical composition varied widely among systems. Annual forage mixtures were dominated by grasses, particularly barley or fall rye, had very low legume presence. Perennial systems showed a more balanced mix of grasses and legumes, especially in HBG-ALF mixture. However, both annual systems contained more “other” plants, including naturally occurring weeds and volunteer species.

Annual systems had higher crude protein (averaged 11.8%) and greater total digestible nutrients (averaged 62.6%), indicating better feed value for animal growth. Among all treatments, the fall rye-clover system had the highest crude protein content (13.7%) (**Table 1**).

Overall, annual forage mixtures provided higher-quality, but more grass-dominated forage, while perennial systems offered more balanced plant mixtures, but lower feed quality.

Animal Performance

Table 2. Steer performance and grazing capacity of forage systems

Item	Forage System ¹			
	Annual		Perennial	
	BR-PE-BRAS	FR-CLOV	HBG-ALF	MBG-SF
BW, lb				
Initial	870	875	837	838
Final	922	937	952	909
ADG, lb	1.4	2.4	1.6	0.8
Rib fat, mm				
Initial	3.38	3.17	3.16	3.24



Animal performance was generally similar across all forage systems (**Table 2**). However, steers grazing the fall rye-clover (FR-CLOV) system showed slightly greater weight gains, while those grazing meadow brome-grass-sainfoin (MBG-SF) had the lowest.

Final	2.91	3.10	2.77	3.13
Change	-0.46	0.00	-0.28	0.20
DMI ² , lb/d	23.0	25.5	23.5	21.8
Animal grazing days, d/ac	42.1	24.7	44.7	31.9
Total beef production, lb/ac	51.3	62.8	69.2	36.1
¹ BR-PE-BRS = barley + peas + brassicas, FR-CLOV = fall rye + berseem clover, HBG-ALF = hybrid brome-grass + alfalfa, MBG-SF = meadow brome-grass + sainfoin.				

Forage intake also did not differ much, but steers on FR-CLOV tended to eat more than those on MBG-SF. This is likely to reflect the higher quality and easier digestibility of the FR-CLOV forage, compared with the more fibrous perennial forages. Lower protein in MBG-SF may have also limited intake.

Although FR-CLOV supported the greatest daily gains, its low forage yield reduced grazing duration. Overall, the hybrid brome-grass-alfalfa (HBG-ALF) system produced the highest total beef output per acre because it combined steady animal performance with greater forage availability and longer grazing time.

Methane Emissions

Steers grazing perennial forage systems produced more methane per unit of feed eaten and per unit of animal output than those grazing annual systems. Overall, annual forages resulted in lower methane emissions and better emission efficiency (for details see Wasden et al., 2026). Higher-quality, more digestible forages (typical of annual systems) supported more efficient digestion and lower methane production per unit of feed. In contrast, perennial forages contained more fibre (**Table 1**), which increases methane formation during digestion.

System Cost

Overall, perennial forage systems were more profitable than annual systems (**Table 3**). Hybrid brome-grass-alfalfa (HBG-ALF) system consistently produced the best economic returns. It was the only system that remained profitable across multiple valuation approaches, mainly due to its strong forage yield and lower establishment costs spread over time. Meadow brome-grass-sainfoin (MBG-SF)



showed moderate but generally marginal returns. In contrast, the annual systems, especially, fall rye-clover, had the lowest profitability. Their higher seed and establishment costs, combined with lower forage yield under drought conditions, reduced net returns. If forage yields had been higher under normal growing conditions, profitability of annual systems would have improved substantially.

Implications

Perennial forage systems were generally more profitable and productive over time, mainly due to higher forage yield and more grazing days. Annual forages improved animal gains and reduced methane emissions per unit of forage, but were less economical. Overall, hybrid bromegrass-alfalfa was the most balanced and sustainable grazing option.

References

- Government of Saskatchewan. 2021. Forage Crop Production Guide. [Online] Available: <https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/crops-and-irrigation/forage-production-annual-native-perennial/forage-crop-production>
- Wasden, M. I., J. Sammons, D. Damiran, B. Biligetu, K. Larson, and H. A. Lardner. 2026. Comparing annual and perennial forage systems: impacts on yield, quality, steer performance, emissions, and profitability. *Appl. Anim. Sci.* 42 (4).
- Peprah, S., E. Darambazar, B. Biligetu, A. D. Iwaasa, K. Larson, D. Damiran, and H. A. Lardner. 2021. Harvest date effect on forage yield, botanical composition, and nutritive value of novel legume-grass mixtures. *Agron.* 11:2184, <https://doi.org/10.3390/agronomy11112184>

Table 3. Average annual cost, revenue, and net return for three different valuation methods (\$/ac)

Item	Forage System ¹			
	Annual		Perennial	
	BR-PE-BRS	FR-CLOV	HBG-ALF	MBG-SF
Cost ² , \$/ac	191.46	244.63	108.96	116.28
Revenue estimated by				
Steer gain ³	36.01	39.94	49.45	34.37
DM yield ⁴	218.65	111.60	233.78	140.38
Grazing days ⁵	194.56	99.92	195.00	126.21
Net return (\$) estimated by				
Steer gain	-305.70	-402.54	-117.03	-161.08
DM yield	-157.86	-369.48	19.51	-88.28
Grazing days	-181.94	-381.15	-19.27	-102.45

¹BR-PE-BRS = barley + peas + brassicas, FR-CLOV = fall rye + berseem clover, HBG-ALF = hybrid bromegrass + alfalfa, MBG-SF = meadow bromegrass + sainfoin. ²Costs based on seeding costs plus land rent (opportunity cost) for each treatment. ³Steer gain as revenue - weight gain per acre × \$0.40/lb. ⁴DM yield as revenue source - Pre-Graze DM Yield lb/ac × price of standing hay (\$0.03/lb 2019-2020; \$0.06/lb 2021-2023). ⁵Grazing days as revenue source - Pre-Graze DM Yield lb/ac divided by 26.5 lb × \$1.00 per day. In 2018, all treatments had the same revenue (Greenfeed hay).