WesternBeef DEVELOPMENT CENTRE

FACT SHEET #2017.02

EVALUATION OF LOW HEAT UNIT CORN HYBRIDS FOR BACKGROUNDING BEEF CALVES

By: Stephanie McMillan MSc, Dr. Gregory Penner, Dr. John McKinnon, Kathy Larson MSc, Federico Añez-Osuna MSc, Dr. Daalkhaijav Damiran, and Dr. Bart Lardner

Introduction

In western Canada, beef calves are typically weaned around 500 to 600 lb BW and are then backgrounded in a drylot for 100 to 150 d during winter until they reach 7-800 lb. Field-based backgrounding systems have lower costs (Kumar et al., 2012), but the type of forage must be carefully evaluated. Cool season annual forages such as barley are well suited to western Canada growing conditions and provide acceptable forage yield and quality, and animal performance (McCartney et al., 2008). Corn is a warm-season annual forage that is typically grown in western Canada for grain and silage production, however use of low-heat unit hybrids to be grazed standing is growing in popularity (Lardner et al., 2017; Divya et al., 2017). The objective of this study was to compare backgrounding with swathed whole plant barley and hybrid whole plant standing corn to a traditional drylot backgrounding system on the basis of forage characteristics, steer performance, and system cost.

Backgrounding Trial

Study Site and Crop Management

A 3-yr (2012-2014) beef steer backgrounding study was conducted at the Western Beef Development Centre's Termuende Research Ranch near Lanigan, Saskatchewan. In spring each year, an 8 acre field was seeded to corn (cv. Pioneer P7443R) at the rate of ~30,000 seeds/acre and 120 lb/acre of nitrogen fertilizer was applied. Also, in spring each year, a 10 acre field was seeded to barley (cv. AC Ranger; 2 bu/acre) along with 50 lb/acre of N fertilizer. Weed control in the corn crop was managed with one pre- and two post-seeding applications of 1 L/acre of glyphosate each year. The barley crop received an application (0.5 L/acre) tank mix of Refine® SG and AXIAL® BIA (pinoxaden) herbicide each year. Each year, 5 acre of barley crop was swathed in mid to late August at the soft dough stage and left in windrows for winter grazing, while the remaining 5 acre was baled as large round bales (~1450 lbs), transported to the yard site and fed as processed greenfeed in bunks in drylot pens. The corn crop was left standing for grazing. Subsequently, the swathed barley and corn fields were

each divided in two using portable electric fence to make two replicates for each grazing trial. The same field site was used for all 3-yr of the study.

Grazing Management

Over 3-yr, backgrounding trials were conducted from 12 December, 2012 to 19 February, 2013 (yr 1, 68 d), 17 October, 2013 to 21 February, 2014 (yr 2, 95 d), and 18 November to 30 December, 2014 (yr 3, 42 d). Each year, 120 spring-born fall-weaned Black Angus steers (BW = 551 lb; ~170 d of age) were stratified by BW and randomly allocated to 1 of 3 replicated (n=2) backgrounding systems: (i) grazing standing whole plant corn (**CG**) in field paddocks; (ii) grazing swathed whole plant barley (**BSG**) in field paddocks; or (iii) drylot pen feeding processed barley whole crop hay (**DL**). At the start of the trial, all calves were implanted and vaccinated for respiratory disease, *P. haemolytica* and *H. somnus*. The amount of forage allotted was adjusted on the basis of utilization and environmental conditions. The intent was to continue the trial until extreme winter conditions negatively affected accessibility to forages, resulting in animal gains below targeted rate (1.3 lb/d). The steers were limited to 3 to 4 d of standing corn and swathed barley using portable electric fence. For the DL system, barley greenfeed hay was processed through a 9.5 cm screen and fed *ad libitum* once daily. In addition, all calves were fed a range pellet (16% CP, 72% TDN) at 5.5 lb/hd/d. Free-choice access to a 2:1 mineral and cobalt iodized salt block were provided throughout the backgrounding phase. In extensive grazing systems (CG and BSG), the water was supplied daily in portable water troughs and 2 portable windbreaks (2.5 × 10 m) were provided for shelter to each replicate paddock group of calves. In DL feeding system, calves were housed in pens (50 × 120 m) surrounded by wood slat fences with 20% porosity and each pen contained an open-faced shed. Water was supplied to each DL pen in a heated water bowl. Steers BW, subcutaneous fat (**rib fat**, mm), and feed intake (**DMI**) were monitored during the study.

Weather

Growing season weather during the study had comparable temperatures but more precipitation relative to the long-term averages for the area. Successful growth of corn requires a minimum of 2000-2100 corn heat unites (**CHU**). The 3-yr average was 2570 CHU which was greater than 10-yr recorded average heat units (2227 CHU), indicating better than average growing seasons for corn during the study. The backgrounding trial of current study was conducted in an environment with colder temperatures but comparable precipitation relative to the long-term average. Year-to-year weather variation affected the length of backgrounding feeding phase. In yr 3 the experiment was terminated after 42 d, largely due to freezing rain and frozen and drifting snow limiting calves' access to swaths.

Backgrounding System Costs

Total production costs ($/head/d) were calculated as the sum of crop production costs, yardage costs, and bedding costs. Crop production costs were calculated using a combination of actual costs incurred, suggested retail prices and published custom rates from the Saskatchewan Ministry of Agriculture's Farm Machinery Custom and Rental Rate Guide (SMA, 2010). Land rental rate of $40/acre was built into the cost of the feed production. The feeding process was timed and used to determine equipment and labor costs. Labor was valued at $18/h and reported as $/head/d and costs for equipment used to feed are in line with suggested rates from the Saskatchewan Ministry of Agriculture's Farm Machinery Custom and Rental Rate Guide (Truck valued

at $30 per hour, Front-wheel assist tractor with front end loader $50 per hour and a bale processor at $13.12 per hour).

Finishing Trial

Following the backgrounding phase at WBDC, all steers were shipped to the University of Saskatchewan Beef Cattle Research Unit feedlot located in Saskatoon, Saskatchewan. Upon arrival all steers were vaccinated for blackleg, respiratory disease and *P. haemolytica* and *H. Somnus*. Tas-Vax 8, Express 5, and Somnu-Star PH following the feedlot processing protocol. The implant program for steers included administration of 36 mg Zeranol (RALGRO®) during processing and a second administration of 200 mg trenbolone acetate, 20 mg estradiol (Revalor 200) 60 d later. Steers from the 3 backgrounding systems (DL, BSG, and CG) were sorted by backgrounding treatment and randomly assigned to 1 of 12 pens with 10 steers per pen. Steers were provided 1 of 2 backgrounding diets with similar energy, consisting of 78% silage, 6% mineral pellet, and 16% grain supplied as either dry rolled barley grain or steam rolled corn grain for a targeted gain of 2.2 lb/head/d.

Once the calves reached approximately ~900 lb they were stepped up to 1 of 2 isocaloric finishing diets, consisting of 13% silage, 79.8% grain supplied as either dry rolled barley grain or steam rolled corn grain, 7% mineral pellet, and 0.2% limestone with a targeted final weight of 1360 lb. Finishing trial lasted 126, 140, and 96 d for yr 1, yr 2, and yr 3, respectively. Steers BW, subcutaneous fat (**rib fat**, mm), and feed intake (**DMI**) were monitored during the study. Carcass data was collected from the slaughter plant.

The feed was delivered *ad libitum*, once daily using a Farm Aid Mixer Wagon equipped with a digital scale. The barley grain was dry rolled to a processing index of 76% and bromegrass hay was ground in a tub grinder through a 9.5 cm screen. The corn grain was steam rolled.

Table 1. Nutrient profile (%, DM) of forages used on backgrounding systems[1]

Item	DL	BSG	CG
DM, %	81.5	58.1	57.2
CP, %	10.9	11.2	8.7
NDF, %	62.3	62.9	61.0
ADF, %	39.1	38.5	36.8
Crude fat, %	1.7	1.7	1.6
TDN, %	57.2	60.6	64.6
Ca, %	0.41	0.36	0.24
P, %	0.25	0.24	0.20

[1]DL = drylot pen feeding with barley greenfeed; BSG = Swathed whole barley for grazing; CG = Standing whole corn for grazing.

Results and Discussion

Backgrounding Trial

Forage Yield, Composition, Cow Utilization and Dry Matter Intake

Forage Yield and Nutritive Value

The forage yield of corn was 23% greater than that of barley (10,090 lb/acre vs. 8,930 lb/acre). The CP, P, and Ca content of barley forage in DL and BSG systems were greater than CG forage (**Table 1**). Corn forage energy content (TDN) was greater compared to barley greenfeed hay and slightly greater to swathed barley forage, respectively.

DMI, Nutrient Intake, and Nutrient Density

Effect of backgrounding feed strategy on calves feed, nutrient intake, and diet nutrient density over the 3-yr experiment is presented in **Table 2**. Utilization of the

forage in DL (or greenfeed) (83.6%) was numerically greater than CG (66.6%) and BSG (72.3%) systems. Forage intake (10.4 lb/d) and total diet DMI (14.8 lb/d) was not different for calves managed in the DL, CG, or BSG backgrounding systems. These results are close to those reported by Kumar et al. (2012) where calves grazing either swathed barley or pen fed processed barley hay plus supplement had total diet DMI of 17.2 and 16.5 lb/d, respectively. The observed DMI was within the recommendations suggested by NRC (2000) where backgrounding calves receiving a 60% TDN diet should consume 15.4 lb/d based on a targeted daily gain of 1.7 lb/day. Diet nutrient density of CP (12.2%) and TDN (68.5%) was similar among calf groups. However, TDN intake was greater for CG (9.9 lb/d) compared to BSG calves (8.6 lb/d) or DL calves (7.5 lb/d).

Table 2. Effect of backgrounding systems on DMI, consumed nutrient quantity, and density

	Backgrounding system[1]		
Item	**DL**	**BSG**	**CG**
DMI			
Forage utilization, %	83.6	72.3	66.6
Forage, lb/d	9.9	9.0	9.3
Supplement, lb/d	4.6	4.6	4.6
Total diet, lb/d	14.6	13.7	13.9
Nutrient Intake			
CP, lb/d	1.52	1.65	1.61
TDN, lb/d	7.5	2.0	2.0
Diet nutrient density			
CP, % DM	13.3	13.0	11.3
TDN, % DM	66.3	68.5	69.6

[1]DL = drylot pen feeding with barley greenfeed; BSG = swath grazing barley in field paddocks; CG = grazing standing corn in field paddocks.

Animal Performance

The effects of backgrounding system on calf performance are presented in **Table 3**. Steer initial BW and rib fat were not different between backgrounding systems. Likewise, final BW, ADG, as well as G:F did not much differ among calf groups. Differences were found between the 3 backgrounding systems for animal final rib fat thickness; BSG calves were greatest (3.05 mm), DL (2.45 mm) calves were lowest, and CG (2.74 mm) were intermediate. In general, as evidenced by the findings of the current study, steers fed with either swathed barley or whole plant corn will result in similar performance during backgrounding.

Table 3. Effect of backgrounding systems on beef calf performance

	Backgrounding system[1]		
Item	**DL**	**BSG**	**CG**
BW			
Initial, lb	552	550	552
Final, lb	655	653	649
ADG, lb/d	1.3	1.4	1.3
G:F, lb/lb	0.08	0.10	0.09
Rib fat, mm			
Initial	2.35	2.36	2.24
Final	2.45	3.05	2.74
Change	0.10	0.70	0.50

[1]DL = drylot pen feeding with barley greenfeed; BSG = swath grazing barley in field paddocks; CG = grazing standing corn in field paddocks.

Backgrounding System Cost

Total cost associated with each backgrounding system including crop (feed) production costs, feed costs, and cost of gain is presented in **Table 4**. Crop production expenses were greatest for the CG system, averaging $302/acre. The feed production costs for barley greenfeed bales and swath graze barley were not different, averaging $214 and $194/acre, respectively. The costs are higher for the

corn crop primarily because of seed costs and fertility requirements, but also because there is an extra spraying pass (3 herbicide applications for corn versus 2 for the barley crops) and additional pre-seeding field passes (e.g. harrowing and summers disk to break down corn stalk residue from previous crop yr). The high costs of growing corn is offset by higher yields and as a result on a cost per lb DM basis, the CG cost of $0.027/lb was intermediate to greenfeed bales ($0.033/lb) swathed barley ($0.025/lb). The lowest cost (calf/d) was for the CG, averaging $1.88 /calf/d over 3-yr, followed by BSG at $2.00/calf/d and DL at $2.82/calf/d.

The calculated cost of gain (**COG**) was lowest for CG ($1.34/lb), while DL was highest ($2.87/lb). Kumar et al. (2012) reported 31% lower COG for calves grazing swathed barley than feeding calves in a drylot system. In this study, the duration of winter grazing time averaged 68 d, which suggests that approximately 50% (or 78 of 150 d) of the backgrounding period feed requirement can be filled by grazing either swathed whole plant barley or standing whole plant corn at a reduced cost (~$60 and $70/calf for BSG and CG, respectively) over feeding hay in the drylot (DL).

Table 4. Economics of backgrounding steers on drylot greenfeed, swathed barley, and standing corn

	Backgrounding system[1]		
Item	**DL**	**BSG**	**CG**
Crop production expense, $/acre	214.27	193.41	302.02
Cost of forage, $ per lb of DM	0.033	0.025	0.027
Total production cost, $/calf per day	2.82	2.00	1.88
Cost of gain, $/lb	2.87	1.42	1.34
Net return, $/hd	-28.85	61.60	65.03

[1]DL = drylot pen feeding with barley greenfeed; BSG = swath grazing barley in field paddocks; CG = grazing standing corn in field paddocks.

Total system costs for extensively backgrounded steers on swathed whole plant barley or standing whole plant corn was 42 and 46% lower, respectively, than backgrounding in a drylot with barley greenfeed hay. Even though calves from extensive systems were slightly lighter following backgrounding, they still had greater net returns than the DL calves. This suggests that BSG and CG backgrounding systems can be more profitable than DL and are alternatives to background beef calves in an environmentally sustainable manner.

Finishing Trial

DMI, Nutrient Intake, and Nutrient Density
Ingredient make-up and nutrient composition of the finishing diet are presented in **Table 5**. The barley based diet was somewhat greater in CP (12.2 vs. 11.3%) than corn-based diet. Otherwise nutrient composition was similar in both diets.

Animal Performance and Carcass Characteristics
The effects of backgrounding and finishing treatment on finishing performance are presented in **Table 6**. The effects of backgrounding on finishing performance were minimal for the measured parameters of animal performance.

Initial BW, final BW, ADG, DMI, and G:F averaged 1616 lb, 1396 lb, 4.1 lb/d, 22.7 lb, and 0.18 lb/lb, respectively.

Carcass traits data are presented in **Table 7**. Extensive grazing systems had no negative effect on final steer performance and carcass composition. On average, HCW, DP, REA, grade fat was 833 lb, 59.9%, 78.0 cm2, 1.46 cm, respectively. Overall, the current study indicated that, i initial backgrounding system does not affect feedlot finishing performance (on either barley or corn based rations) nor carcass characteristics of beef steers.

Table 5. Composition and nutrient analysis of finishing diets (% DM basis)

	Diets[1]	
Item	**BAR**	**CORN**
Diet composition		
Barley silage	6.0	6.1
Bromegrass hay	14.6	15.6
Corn grain	-	66.5
Barley grain	67.6	-
Canola meal	6.7	6.7
Supplement	5.1	5.1
Diet nutrient composition		
CP	12.2	11.3
TDN	75.4	74.7

[1]BAR = barley based finishing diet; CORN = corn based finishing diet.

Table 6. Effect of backgrounding system on feedlot performance of beef calves

	Backgrounding[1]							
	DL			BSG			CG	
Item	**BAR[2]**	**CORN[2]**		**BAR**	**CORN**		**BAR**	**CORN**
Initial BW, lb	740	721		733	743		729	731
Final BW, lb	1399	1387		1398	1414		1377	1398
ADG, lb/d	4.0	4.2		4.2	4.2		4.0	4.2
DMI, lb/d	22.5	21.8		23.2	22.7		23.8	22.7
G:F	0.18	0.19		0.18	0.19		0.17	0.18

[1]Backgrounding: DL = drylot pen feeding with barley greenfeed; BSG = swath grazing barley in field paddocks; CG = grazing standing corn in field paddocks.
[2]Finishing: BAR = barley based finishing diet; CORN = corn based finishing diet.

Implications

The current study suggests that a viable alternative to drylot backgrounding is to offset approximately half (45%) to 80% of a 100 to 150 d backgrounding period with grazing swathed whole-plant barley or low heat unit standing corn. Extensively grazing backgrounders has reduced system costs (~50% less) relative to feeding hay in the drylot. Environmental conditions (i.e., snowfall, temperature, and wind speed) may limit accessibility of forage in field grazing systems. Careful animal management is a prime consideration when using an extensive grazing system as part of a winter backgrounding program.

Acknowledgements

This study was funded by the Saskatchewan Agriculture Development Fund, Alberta Livestock and Meat Agency, DuPont Pioneer and Western Beef Development Centre. The authors are extremely grateful to L. Pearce, G. Widdifield, and K. Savenkoff, Western Beef Development Centre, Lanigan, SK, and Beef Cattle Research Teaching Unit at University of Saskatchewan for assistance in the field and data management during this experiment.

Table 7. Effect of backgrounding system on carcass characteristics of calves

	Backgrounding[1]							
	DL			BSG			CG	
Item	**BAR[2]**	**CORN[2]**		**BAR**	**CORN**		**BAR**	**CORN**
Hot carcass weight, lb	835	837		829	848		814	838
Dressing percentage	59.5	60.4		59.3	59.6		59.0	59.9
Quality grade, %								
Canada AA	21.6	17.2		19.9	19.9		14.2	19.1
Canada AAA	78.4	81.1		80.1	76.4		85.8	79.3
Canada prime	-	1.7		-	3.8		-	1.7
Yield grade								
Canada 1	16.0	20.4		9.3	14.6		17.1	22.6
Canada 2	46.4	41.5		48.0	46.3		51.6	36.3
Canada 3	37.6	38.1		42.7	39.1		31.3	41.1

[1]Backgrounding: DL = drylot pen feeding with barley greenfeed; BSG = swath grazing barley in field paddocks; CG = grazing standing corn in field paddocks.
[2]Finishing: BAR = barley based finishing diet, CORN = corn based finishing diet.

References

Jose, D., D. Damiran, G. Penner, J. McKinnon, K. Larson, B. Lardner. 2017. Effect of winter grazing system on beef cow performance and system costs. WBDC Fact Sheet #2017–01. Western Beef Development Centre, Humboldt, Saskatchewan, Canada.

Kumar, R., H. A. Lardner, D. A. Christensen, J. J. McKinnon, D. Damiran, and K. Larson. 2012. Comparison of alternative backgrounding systems on beef calf performance, feedlot finishing performance, carcass traits and system cost of gain. Prof. Anim. Sci. 28:541–551.

Lardner, H. A., L. Pearce, and D. Damiran. 2017. Evaluation of low heat unit corn hybrids compared to barley for forage yield and quality on the Canadain Prairies. Sust. Agric. Res. 6(1).

McCartney, D., J. Fraser, and A. Ohama. 2008. Annual cool season crops for grazing by beef cattle: A Canadian Review. Can. J. Anim. Sci. 88:517–533.

NRC. 2000. Nutrient requirements of beef cattle. Update 2000. 7th rev. ed. Natl. Acad. Press, Washington, DC.

SMA (Saskatchewan Ministry of Agriculture). 2014. Farm machinery custom and rental rate guide. 2013–2014. Regina, SK, Canada.