Iowa State Beef Checkoff Research Program
Final Report

I. COVER PAGE

TITLE OF PROJECT: Early Life Impacts on Beef × Dairy Performance and Assessment of Challenges for Beef × Dairy in Iowa

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Project timeline:

Initiation: November 1, 2022
Live animal initiation: November 19, 2022
Live animal completion: October 31, 2024
Completion: December 31, 2024

Budget:

Awarded	$ 157,203
Spent	$ 133,203.54
Remaining funds	$ 23,999.46

II. NONTECHNICAL SUMMARY

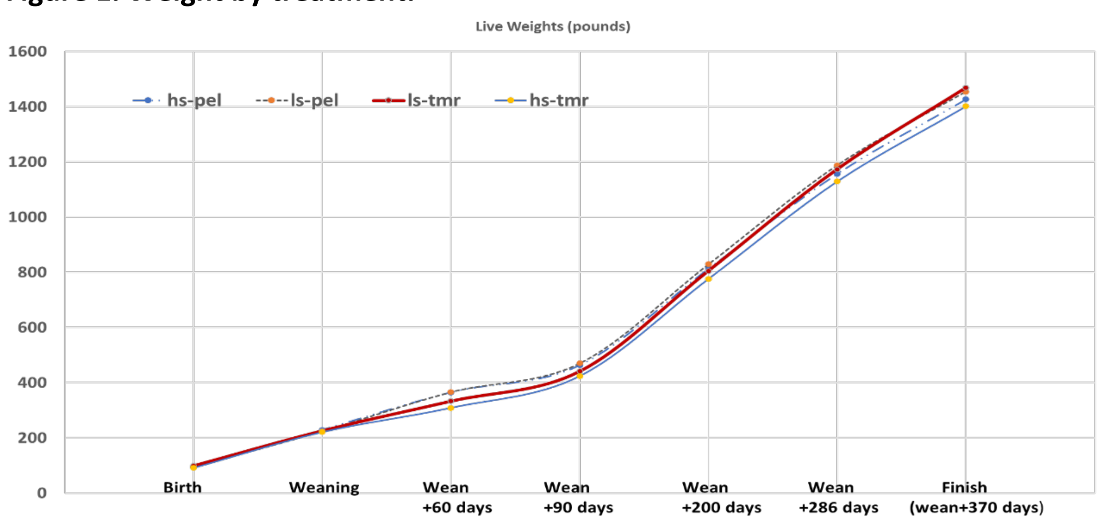
Beef from dairy herds contributes 20% or more of the beef supply in the United States. The beef supply from dairy farms is transitioning rapidly from straight-bred dairy to beef × dairy (BXD) crosses. Health concerns such as liver abscesses are more predominant in BXD cattle compared to straight-bred beef. The objectives of this project are to investigate the impact of early life nutrition and management on growth and performance of BXD crosses raised and finished at Iowa State.

Beef x dairy (BXD) calves were enrolled onto two different levels of starter starch before weaning. Each group was split in half at weaning and received either total mixed ration (TMR) or pellet at receiving for a total of four dietary treatments.

The level of starch in the nursery phase had no impact on performance, health and carcass measurement throughout life. In the receiving/grower stage, the pellet calves tended to eat more and grow faster in the first 60 days, but there was no difference for the full grower period. We suspect some of this may be behavioral due to the similar feed form vs the TMR calves that needed to learn to eat a different feed form.

Both TMR groups had numerically greater average daily gain (ADG) in the finishing phase than their pellet counterparts, though neither were statistically significant. The low starch-TMR group had increased finisher DMI, heavier ending weight, and a tendency for a greater economic return. They also had a different growth curve as seen in Figure 1. These calves were continuing to increase in body weight and likely could have been fed longer, while the other treatments were starting to slow in growth.

Figure 1. Weight by treatment.



There were no differences in carcass measurements, quality grade or yield grade based on starter or receiving diets. The low starch-TMR calves had significantly fewer liver abscesses and rumen condemnations.

The most obvious differences related to the health status of the calves. Calves that received one or more treatments or had a condemned organ had a significant difference for a 0.16 lb/d decrease in finishing ADG, a 49-lb lighter end weight and a 29-lb lighter carcass, and a tendency for a smaller ribeye area (REA), poorer yield grade (YG), a decreased grower ADG, decreased quality grade (QG), and a 10% decrease in Certified Angus Beef (CAB).

When combining the slight differences in feed intake, feed cost, feed efficiency and increased weights, the TMR group had a tendency for higher economic returns.

III. TECHNICAL REPORT

a. Impact

Results generated from this study will aid producers in making more informed decisions to improve calf health, performance, and increase profit potential of beef x dairy steers. Additionally, this data set will serve as a preliminary data to further investigate the impact of starch level and diet digestibility on nursery calf growth, the impact of early life nutrition on rumen health and liver abscesses and the impact of calf health on carcass value.

b. Methods

This study was comprised of three major components: an animal study comparing the impact of high starch (HS) vs low starch (LS) calf starter diets and the impact of pellet (PEL) vs a forage-based total mixed ration (TMR) receiving diet on lifetime growth, performance, health and carcass merit; a survey of producers; and a resource library of research on BXD cattle.

Table 1. Project timeline.

	Group 1	Group 2	Group 3
Calves born/enrolled	11/19/22-12/7/22	2/13/23-3/3/23	7/16/23-8/10/23
Starter Trial	11/19/22-2/8/23	2/13/23 – 5/2/23	7/16/23-10/10/23
Average Outside Temp on nursery trial	25°F ± 43, max of 33°F ± 43, and min of 15°F ± 43	40°F ± 44, max of 51°F ± 46, and min of 29°F ± 43	70°F ± 40, max of 82°F ± 40, and min of 59°F ± 41
Receiving Trial	2/8/22-4/10/23	5/2/23-7/3/23	10/10/23-12/8/23
Common grower diet at BNF	4/10/23-8/28/23	7/3/23-11/27/23	12/8/23-4/29/24
Common finisher diet at Armstrong	8/28/23- 3/12/24	11/28/23-5/28/24	4/29/24-10/30/24
Harvested	3/13/24	5/29/24	10/31/24

Nursery Stage

In the calf study, 120 Angus × Holstein bull calves were alternately assigned at enrollment to a high starch (HS: 26% starch, 20% protein, 7% fiber) or low starch (LS: 13% starch, 20% protein, 11% fiber) starter. All calves were housed in individual pens within a hoop shed with concrete flooring, a curtain on the north side with adjustable openings from the top or bottom, straw bales stacked on the south side and removed as the temperature increased, and ceiling fans. Individual pens were 6ft × 4ft, allowing 24ft^2 per calf. Before the calves arrived, lime was applied to the bottom of each pen, a bale of shavings was added on top of the lime, and straw topped the shavings. Additional straw bedding was added as needed. After each group, the concrete floor and all pen pieces were hot-water pressure washed and disinfected with chlorine dioxide.

Calves were sourced from the Iowa State University Dairy Research & Teaching Unit (ISU; n = 28), and two local dairies (LOC1; n = 80, LOC2; n=12), and initial body weights (BW) were recorded. Calves from LOC1 (≤24 hr of age) were delivered once per day and calves acquired from LOC2 (24-48 hr of age) were delivered upon availability. Blood samples were collected via jugular vein at 24-48 hr of age, and Transfer of Passive Immunity (TPI) was estimated using a Brix refractometer (Morrill and Tyler, 2012). All calves received the same milk replacer diet of 22% protein and 20% fat milk replacer (MR; Land O' Lakes Amplifier MAX, Land O' Lakes Animal Milk Solutions, Arden Hills, MN) via bottle. Calves were fed 3 quarts of milk 2x/d for the first five days, d 5-48 calves were fed 4 qt 2x/d, d 49-55 calves were fed 4 qt 1x/day, and wholly weaned on day 56. Calves were alternately assigned to either a high starch (HS) or low starch (LS) starter feed which was offered free choice beginning d 1; intake was measured daily. Water was offered free choice via bucket. Calves were weaned at d 57 following a 1-week step-down protocol but held at the dairy until the youngest calf in the group was weaned. BW was collected for all calves on Tuesdays and Fridays. Frame size measurements (body length (L), heart girth (HG), withers height (WH), hip height (HH), hip width (HW)) were taken before departure from the research farm; all calves aged between 63 and 81 d.

Table 2. Ingredient composition of starter diets fed (%, dry matter basis)

Ingredient	Low Starch Pellet	High Starch Pellet
Wheat midds	35.56	21.09
Dehulled Soymeal	22.96	29.93
Fine Ground Corn	11.39	33.90
Cottonseed Hulls	10.00	5.00
Sunflower meal 30-32	6.00	
Molasses	6.00	4.00
Soy Hulls	2.50	1.30
Supplement	5.55	4.72
@DECCOX 6%	0.05	0.05
Analyzed composition	*by Rock River Laboratory, Inc.*	
Crude Protein	23.08%	23.39%
ADF	13.18%	8.76%
aNDF	25.94%	17.82%
Starch	18.53%	28.65%
NEg, Mcal/ld	0.61	0.65
Nem, Mcal/lb	0.91	0.9+

Average daily gain (ADG) until weaning, weaning weight (WW), and frame size measurements were analyzed using PROC GLM (SAS 9.4) with the effects of source, starter, initial BW, serum protein level, age, and starter x age. Starter intake and BW were analyzed in PROC MIXED with the addition of repeated measures by calf. Period affected BW ($P = 0.01$), intake ($P < 0.01$), ADG ($P < 0.01$), and the frame measurements of L ($P = 0.01$), HG ($P = 0.01$), WH ($P < 0.01$), and HH ($P < 0.01$). Starter influenced daily intake ($P = 0.05$) but did not affect ADG ($P = 0.34$), BW ($P = 0.19$), or frame growth ($P > 0.05$). Although only 15 calves were classified as poor (< 8.1% on the Brix scale), TPI affected BW, starter intake, and HW ($P \leq 0.05$). Overall, pre-weaned calves showed limited response to starter starch content in this trial.

Table 3. Health Protocol.

Age	Treatment
Day 30 (ISU Dairy Farm)	castrated via bander
Day 42 (ISU Dairy Farm)	Vaccinated with intranasal BOVILUS® NASALGEN® (3-PMH, Merck Animal Health USA)
Day 60 transfer to Beef Nutrition Farm	Vaccinated with BOVILIS® NASALGEN® 3-PMH, BOVILIS® VISTA® 5 SQ, BOVILIS® VISION® 7(Merck Animal Health USA)
Day 160-170 (BNF)	Implanted with Synovex Choice® (Zoetis), and revaccinated with BOVILIS® VISTA® 5 SQ, BOVILIS® VISION® 7(Merck Animal Health USA)
Day 260-270 transported to Armstrong Research Farm	Reimplanted with Synovex® One Feedlot (Zoetis), dewormed with DECTOMAX® Injectable (Zoetis), and revaccinated with BOVILIS® VISTA® 5 SQ, BOVILIS® VISION® 7(Merck Animal Health USA)
Health events were assessed by Iowa State University College of Veterinary Medicine staff and treated accordingly.	*All dead animals were posted by ISU Veterinarian Field Services*

Health evaluations were done by the ISU dairy vets. Scour events were mainly treated with electrolyte therapy. Respiratory events were treated with Draxxin or Nuflor depending on severity or number of offenses. In all three groups, only 13 calves were treated for respiratory symptoms, an even spread with no real correlation to season.

Grow/Finish Stage

The second objective of the animal study was to evaluate the impact of a grain versus forage based receiving diet on receiving performance, finishing performance, health and carcass merit. The 117 weaned calves from the ISU Dairy were transported to the ISU Beef Nutrition Farm (BNF) to the Feed Intake Monitoring System (FIMS) pens and allocated to either a high starch grain diet or a low starch TMR forage/grain diet for 60 days. The FIMS pens were modified by building up a chute-type system to allow only one young calf to enter the feeder at a time and with a raised floor level so the small calves could reach into the bunks. Initially some calves were hesitant to enter the feeder so an additional bunk was utilized for about a week to teach the calves to eat and increase the feeding aggression of the calves. Individual daily feed intake was monitored throughout the feeding period.

Calves were weighed at day 0, 30, and 60 days on the receiving diet. All calves were then transferred to grower ration 1 and FIMS pens were opened so calves could move between pens. The grower ration 1 was fed for 30 days and all were transitioned to grower ration 2 at day 90. Cattle were allowed ad libitum intake.

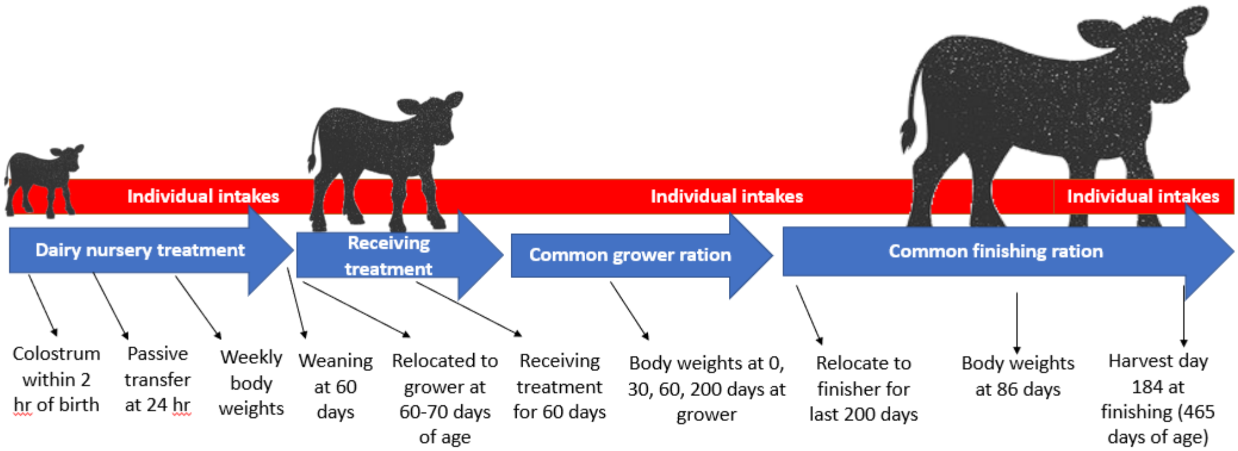
Table 4. Ingredient composition of receiving & finishing diets (%, dry matter basis).

% of ration DM	High Starch Pellet	Forage Based TMR Grower1	Forage Based TMR Grower2	Finisher
Wheat midds	46.6%			
HiPro SBM	13.0%			
Corn	20.0% (fine ground)	12.1%	26.3%	60.0%
Dry Distillers	10.0%	28.7%	11.3%	
Cotton seed hulls	4.0%			
Ryelage		32.0%	22.4%	
Corn Silage		30.6%	37.5%	
Alfalfa/grass hay				11.5%
Modified distillers				26.5%
Mineral/binder	3.8%	3.6%	2.6%	2.0%
Molasses	2.6%			
Calculated Analysis				
CP%	19.0%	18.9%	14.1%	12.3%
NFC%	42.0%	40.6%	53.1%	57.8%
NSC %	27.5%	24.4%	40.8%	47.1%
peNDF	1.0	9.2	8.2	5.0%
Fat%	4.6%	5.2%	4.8%	4.5%
NEg, Mcal/lb	0.56	0.61	0.62	0.61

On day 90 in the grower phase, calves were weighed, implanted, and revaccinated according to BQA guidelines (Figure 2). On day 200 in the grower phase, calves were shipped to the Armstrong Research Farm in southwest Iowa, weighed, reimplanted, dewormed, and revaccinated, beginning the finishing phase. They were fed for 200 days at the finisher in a single FIMS pen. Cattle were provided the same finishing ration.

Cattle were weighed on day 86 of finishing. They were harvested at day 184 of finishing (465 days of age) at Upper Iowa Beef in Lime Springs, IA. Harvest data collected included hot carcass weight, KPH, liver, lung and rumen scores. Camera data collected ribeye area, back fat, and marbling score/quality grade.

Figure 2. Protocol



To determine the economic returns on the grower and finisher stages, calves were valued at $7000/group from the nursery stage to the grower ($500 calf, $200 feed, labor, yardage for the 10 calves started). Feed cost was calculated using actual intakes of ingredients with the following prices: corn $200/t, ryelage $55/t, corn silage $55/t, DDG $230/t, pelleted feed $574/t, grower mineral $600/t, hay $180/t, modified distillers $90/t, finisher mineral $800/t. Yardage charged at $.70/hd/day. Processing charged at $12/hd at grower and $13/hd at finisher. Medical treatments charged at actual drug prices. Costs for cattle that died during a feeding phase were charged against the remaining animals in the group. The income value was calculated based on actual prices paid by Upper Iowa Beef: base price $299.85/cwt dressed carcass weight, CAB and PRIME premium $2 per cwt, no discounts on heavy or light carcasses, no discounts on Selects.

c. Results and Discussion

Starter Animal Performance

TPI and Health

According to the standards set by Lombard et al. (2020) for replacement heifers [10% poor (< 8.1), 20% fair (8.1-8.8), 30% good (8.9-9.3), and 40% excellent (> 9.4)], 12.5% (n=15) of calves fell into the poor category, exceeding the target of 10%; 25% (n=30) classified as fair, exceeding the target of 20%; 30.8% (n=37) classified as good, meeting the target of 30%; 31.7% (n=38) categorized as excellent, missing the target of 40%, (Table 5).

Table 5. TPI Classification for all Calves, percent of calves

Source	Poor (<8.1)	Fair (8.1-8.8)	Good (8.9-9.3)	Excellent (>9.4)
ISU	14.3	35.7	21.4	28.6
LOC1	13	24.7	33.8	28.6
LOC2	0	8.3	41.7	50
Total	12.5	25	30.8	31.7

This scale can indicate herd TPI and estimate a calf's future morbidity and mortality. However, despite colostrum provision, calf management can make a difference. TPI can be altered by quickness, quality, quantity, and cleanliness of the colostrum feeding, as well as calving difficulties and environmental stressors. However, as reflected in the health events, LOC1 calves received the most antibiotic treatments, ISU followed, and LOC2 calves had no health events. Health treatments were not statistically analyzed.

Table 6. Respiratory Event Distribution by Source and Period, percent treated

Source	Group 1	Group 2	Group 3
ISU	-	-	20%
LOC1	9%	9%	15%
LOC2	-	-	-
TOTAL	10%	10%	17%

Calves with minor diarrhea were treated with electrolyte therapy (Land O Lakes® Electrolyte Complete) twice daily. Respiratory incidences were treated with either DRAXXIN® (tulathromycin; Zoetis U.S.) or NUFLOR® (florfenicol; Merck Animal Health). There was a total of 11 respiratory events across all 3 periods. P1 had three events, P2 had three, and P3 had five. Out of the total events, three occurred in the ISU calves, all in P3. LOC1 calves recorded eight events, with three in P1, three in P2, and two in P3. LOC2 calves had zero events. Additionally, two calves from LOC1 were treated for navel infections during Group 2 (Table 6).

Milk and Grain Intake

BW was impacted by period ($P = 0.01$), initial weight ($P < 0.01$), TPI score ($P = 0.01$), and age ($P < 0.01$). Grain intake was influenced by treatment ($P = 0.05$), period ($P < 0.01$), TPI score ($P < 0.01$), age ($P < 0.01$), and treatment × age ($P < 0.01$). ADG was significant by period ($P < 0.01$) and initial weight ($P < 0.01$). Milk intake was not statistically significant amongst all experimental measurements.

Table 7. Summary of Nursery Results

	Treatment			*P*-Value
	HIGH	LOW	SE	Trt
Weaning weight (lbs)	179.8	177.7	0.61	0.19
Grain intake (lbs)	.99	.95	0.03	0.04
Average daily gain (lbs)	.90	.86	0.02	0.34

Growth

Frame measurements were not significant between treatments, L ($P = 0.37$), HG ($P = 0.06$), WH ($P = 0.48$), HH ($P = 0.26$), or HW ($P = 0.86$). Period was significant for L ($P = 0.01$), HG ($P = 0.01$), WH ($P < 0.01$), and HH ($P < 0.01$). Period was not significant for HW ($P = 0.86$). Initial weight was significant for HG ($P < 0.01$), WH ($P < 0.01$), and HH ($P < 0.01$) but was not significant for L ($P = 0.88$) or HW ($P = 0.97$). TPI score was only significant for HW ($P < 0.01$) but not significant for L ($P = 0.67$), HG ($P = 0.46$), WH ($P = 0.85$), and HH ($P = 0.11$). Lastly, age was only significant with HW ($P < 0.01$).

The average weaning weight for the HS calves was 179.8 lb and for the LS calves was 177.7 lb, and this was not significantly different ($P = 0.26$).
There was wide variation on grain intake between individual animals, but the HS calves consumed 0.99 lb per day and the LS calves consumed 0.95 lb per day (P = 0.04).

Figure 3. Average Daily Nursery Weight

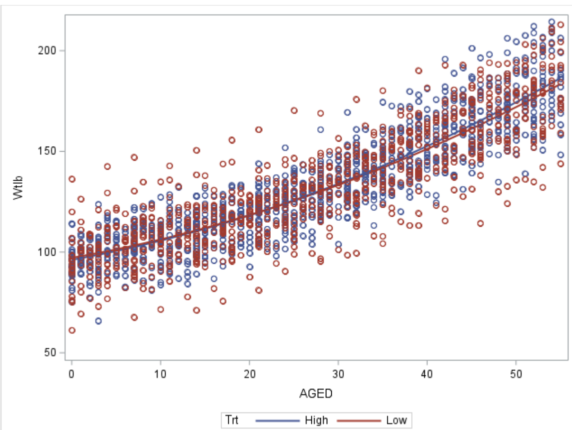
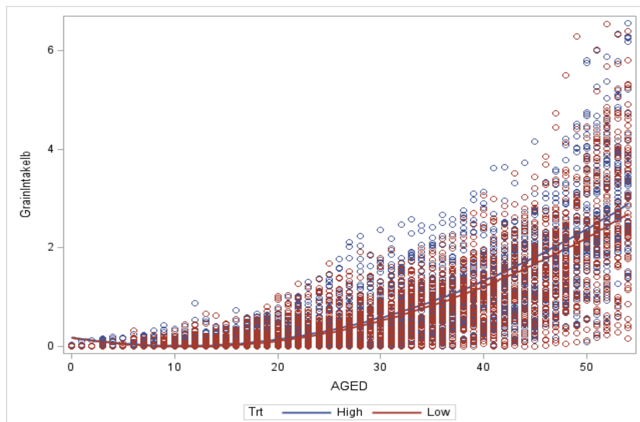


Figure 4. Daily Grain Intake



Grower Animal Performance

In the receiving/grower stage, the PEL calves ate significantly more and grew faster in the first 60 days but no difference for the full grower period. We suspect some of this may be behavioral due to the similar feed form versus the TMR calves that needed to learn to eat a different feed form, as well as learning to eat from the FIMS individual feeders. The difference at the end of the 60-day receiving trial was significant at $P < 0.01$ but was only a trend ($P = 0.09$) at the 90-day weight, and no difference at the end of the grower stage.

Finisher Animal Performance

The LS-TMR calves had numerically greater DMI and ADG in the finishing phase, though neither were statistically significant. The HS groups both were numerically lower in ending weight, DMI and ADG than the LS groups. The LS-TMR group had a tendency for a greater economic return. They also had a different growth curve as seen in Figure 1. These calves were continuing to increase in body weight and likely could have been fed longer, while the other treatments were starting to slow in growth.

There were no differences in carcass measurements, quality grade or yield grade based on starter or receiving diets. The LS-TMR calves had significantly fewer liver abscesses and rumen condemnations.

Table 8. Growth performance and characteristics of steers based on starter and receiving diets.

N started, hd/trt	30	30	30	30		
N finished, hd/trt	27	26	25	29		
	HS-PEL	**LS-PEL**	**LS-TMR**	**HS-TMR**	**SEM**	**Pr(>F)**
Birth Wt	94	95	99	91	1.20	0.17
Weaning Wt.(60 DOA)	229	224	226	221	2.78	0.81
End Receiving (120 DOA)	365	366	333	309	5.18	***<.01***
150 DOA	463	470	441	424	7.32	***0.09***
Ship to finisher(260 DOA)	813	829	805	776	9.46	0.22
346 DOA	1157	1188	1173	1129	11.78	0.32
Finished Wt (465 DOA)	1427	1455	1468	1401	12.98	0.26
	HS-PEL	**LS-PEL**	**LS-TMR**	**HS-TMR**	**SEM**	**Pr(>F)**
60-day Receiving ADG	2.32	2.39	1.75	1.50	.07	***<.01***
Total Grower ADG	2.89	2.98	2.84	2.74	0.04	0.18
Finisher ADG	3.21	3.27	3.33	3.26	0.06	0.92
60-day Receiving DMI	12.6	12.1	6.4	7.14	0.40	***<.01***
Total Grower DMI	14.25	13.28	12.38	13.11	0.34	0.31
Finisher DMI	26.43	26.29	27.08	25.17	0.58	0.7
Total Grower F:G	4.96	4.5	4.47	4.91	0.14	0.43
Finisher F:G	8.4	8.23	8.1	7.83	0.22	0.81
	HS-PEL	**LS-PEL**	**LS-TMR**	**HS-TMR**	**SEM**	**Pr(>F)**
Yield Grade	3.18	3.37	3.39	3.21	0.05	0.42
Carcass Wt	858	861	881	841	8.14	0.4
REA	12.3	12.1	12.4	12	0.11	0.5
BF	0.29	0.32	0.32	0.3	0.01	0.59
KPH	3.25	3.31	3.5	3.14	0.08	0.5
Quality Grade	8.9	8.8	8.7	8.6	0.08	0.67
% Prime	11.1	15.3	20	10.4	0.03	0.74
% CAB	77.8	65.6	56	65.5	0.08	0.43
% Select	3.7	3.7	8	0	0.02	0.51
Finished Wt= carcass adjusted final body weigh calculated utilizing hot carcass weight and standard 60% dressing percentage						

The most obvious differences related to the health status of the calves. Thirty-one head (29%) had some form of carcass condemnation, either rumen, liver, or lung. Fourteen of those cattle were treated for a respiratory issue during the feeding period, mostly in the grower phase. Treatment and organ condemnations were evaluated two ways, by animal and by treatment. Animals with any health issue (Table 10) count the number of animals with any treatments or condemnations, while Documented Health Issues counts each treatment or condemnation therefore resulting in greater than 100% when animals received multiple treatments or had multiple condemnations. Table 10 demonstrates that while HS-PEL had fewer multiple treatments, 63.3% of the animals had at least one respiratory treatment and most of those animals also had an organ condemned.

Animals that were treated once for a respiratory issue had a decreased value of $48 compared to non-treated animals. Animals receiving multiple treatments returned $91 less compared to non-treated animals. Calves that received one or more treatments or had a condemned organ had a significant difference of 0.16 lb/d decrease in finishing ADG, a 49-lb lighter end weight and a 29-lb lighter carcass, returned $74 less, and had a tendency for a smaller REA, poorer YG, a decreased grower ADG, decreased QG and a decrease in CAB.

Table 9. Health treatments and death loss percent by treatment and phase

	HS-PEL	LS-PEL	LS-TMR	HS-TMR
N started, hd/trt	30	30	30	30
N finished, hd/trt	27	26	25	29
Treatments by phase				
Nursery	10%	23%	10%	13%
Receiving	41%	36%	3%	37%
Grower	3%	4%	4%	0
Finisher	0	0	0	10%
MulTrt	10%	37%	17%	23%
Death loss based on number started				
Nursery	0	6.6%	3.3%	0
Receiving	6.6%	3.3%	10%	3.3%
Grower	0	3.3%	3.3%	0
Finisher	3.3%	0	0	0

Figure 5. Liver abscess by treatment

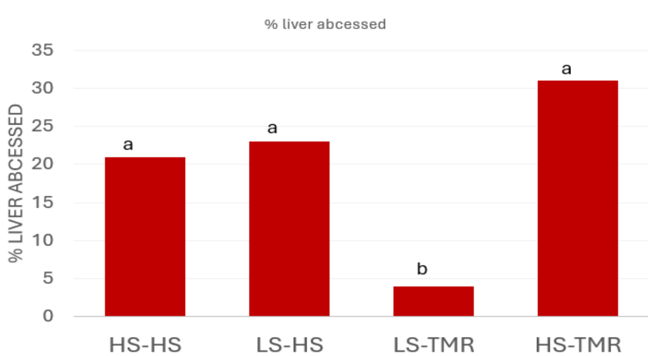


Table 10. Health Data, percent of animals harvested

%	hs-pel	ls-pel	ls-tmr	hs-tmr
Liver Abcess	21.4	23.1	4.2	31
Lungs Condemned	10.7	7.7	8.3	3.4
Rumens Condemned	17.9	11.5	4.2	6.9
Resp.Treats	63.3	43.3	43.3	60
Resp.Multitreats	3.3	13.3	10	20
Death Loss%	10	10	16.7	6.7
Animals with any Health Issue	66.7	40	53.3	56.7
Documented Health Issues	110	110	83.3	106.7

Table 11. Analysis of treatment for documented issues

		P(T<=t) one tail between treatments							
COMPARING		**Liver Abcess**	**Lungs Cond**	**Rumens Cond**	**Resp. Treats**	**Resp. Multi treats**	**Death Loss%**	**Animals with any Health Issue**	**Documented health Issues**
hs-pel	ls-pel	0.44	0.35	0.26	0.15	0.08	0.5	***0.02***	0.5
hs-pel	ls-tmr	***0.04***	0.39	0.06	0.14	0.15	0.23	0.15	0.12
hs-pel	hs-tmr	0.21	0.15	0.11	0.4	***0.02***	0.32	0.22	0.45
ls-pel	ls-tmr	***0.03***	0.47	0.17	0.5	0.35	0.23	0.15	0.19
ls-pel	hs-tmr	0.26	0.25	0.28	0.1	0.25	0.32	0.1	0.46
ls-tmr	hs-tmr	***<.01***	0.23	0.34	0.1	0.14	0.18	0.4	0.17
head included ***n***		107	107	107	120	120	120	120	120

Table 12. Correlation of health treatment to carcass (n=107 hd)

6%	respiratory treat to liver abscess
17%	respiratory treat to lung condemned
7%	respiratory treat to rumen condemned
14%	condemned lung and rumen
28%	condemned liver and rumen
38%	condemned lung and liver

Table 13. Health Status Effects on Feedlot Performance Across Treatments

Effect of:	1 or more Treatment or Condemned Tissues		Multiple Respiratory issues	
	Average Change from Mean	***Pr(>F)***	**Average Change from Mean**	***Pr(>F)***
Grower ADG (lbs)	-0.07	*0.08*	-0.04	0.68
Finisher ADG	-0.16	***<.01***	-0.36	***<.01***
Grower DMI (lbs.)	0.01	0.97	-0.43	0.6
Finisher DMI	-0.74	0.19	-1.4	0.33
Grower F:G	0.16	0.21	-0.01	0.97
Finisher F:G	0.16	0.43	-0.05	0.92
Wt at end of Grower (lbs)	-13	0.16	-13	0.57
Final Finished Wt (lbs)	-49	***<.01***	-73	***0.02***
Yield Grade	-0.09	***0.08***	-0.08	0.54
Carcass Wt (lbs)	-29	***<.01***	-36	***<.06***
REA (in2)	-0.24	***0.03***	-0.19	0.48
BF (inches)	-0.01	0.41	0.03	0.32
KPH %	-0.18	***0.03***	-0.13	0.52
Quality Grade *	-0.15	***0.06***	0.01	0.96
% Prime	-5%	0.1	-1%	0.88
% CAB	-10%	***0.02***	-7%	0.53
**10 = prime, 9 = high choice, 8 = choice, etc*				

Economic returns were calculated for both the grower and finisher phases and for the combination of the two. The nursery costs were calculated at $500 per calf purchase price plus $200 per calf for feed, labor, yardage for the 10 calves started, then divided by the actual number of calves weaned per group. Grower and finisher feed cost was calculated based on the actual amount of feed consumed per animal using the following prices: corn $200/t, ryelage $55/t, corn silage $55/t, DDG $230/t, pelleted feed $574/t, BNF min/vit $600/t, hay $180/t, modified distillers $90/t, Armstrong mineral $800/t. Yardage was charged at $.70/hd/day. Processing was charged at $12/hd for the grower phase and $13/hd for the finisher phase. Medical treatments were charged at actual drug prices. Costs for cattle that died during a feeding phase were charged against the remaining animals in the group. The income value was calculated based on actual prices paid by Upper Iowa Beef: base price $300/cwt dressed carcass weight, CAB and PRIME premium $2 per cwt, no discounts on heavy or light carcasses, no discounts on Selects.

Table 14. Economic Returns

Grower Phase Costs	HS-PEL	LS-PEL	LS-TMR	HS-TMR		
Cattle In	30	28	29	30		
Cost per Calf into grower phase	$750	$808	$840	$724		
Feed in grower phase	$392	$403	$280	$306		
Yardage $ per Calf in grower phase	$144	$147	$148	$143		
Processing $ per Calf in grower phase	$13	$13	$14	$12		
Treatment $ per Calf in grower phase	$8	$10	$9	$10		
Trucking to finisher ($700/group)	$19	$20	$21	$19		
Cattle Out	28	26	25	29		
Total Per Calf in grower phase	$1,326	$1,401	$1,312	$1,214		
Finisher Phase Costs	**HS-PEL**	**LS-PEL**	**LS-TMR**	**HS-TMR**		
Cattle In	28	26	25	29		
Feed at Armstrong	$634	$628	$647	$603		
Yardage $ per Calf in finisher phase	$135	$135	$135	$135		
Processing $ per Calf in finisher phase	$13	$13	$13	$13		
Treatment $ per Calf at Armstrong	$0	$0	$0	$4		
Trucking per calf to packer	$42	$42	$42	$42		
Cattle Out	27	26	25	29		
Total per Calf in finishing stage	$824	$818	$837	$797		
Total Cost $ per Calf Overall	$2,150	$2,219	$2,149	$2,011		
	HS-PEL	**LS-PEL**	**LS-TMR**	**HS-TMR**	**SEM**	**Pr(>F)**
Gross Carcass Value Paid	2554	2560	2616	2500	24.38	0.41
Net Carcass Return	404	342	467	489	42.00	0.14

When combining the slight differences in feed intake, feed efficiency and increased weights, the LS-TMR group had numerically higher carcass value and economic returns.

d. Conclusions

Our objective was to investigate the impact of early-life nutrition and management on the growth and performance of BXD crosses. Starch content in the nursery phase had limited impact on pre-weaning growth for BXD calves. Despite having half the amount of starch in their starter, the LS calves had similar frame and weight growth rates to their HS counterparts.

The transition from pelleted feed in the nursery to a TMR in the receiving trial had a negative impact on feed intake and ADG in the first 60 days, although the difference was less at 90 days and no difference for the total grower phase. More research is needed to determine a more ideal transition from nursery to grower phases.

There were no differences based on treatment for grower or finisher ADG, DMI or F:G, carcass weight or measurements, yield or quality grades, death loss or respiratory treatments. The LS-TMR treatment had significantly fewer liver abscesses and fewer multiple respiratory treatments, and a tendency toward greater economic returns.

Producer Survey

The third objective of the study was to assess the challenges experienced by commercial producers in Iowa and establish educational tools for beef and dairy producers raising BXD crosses.

A survey of commercial feedlot operators who feed out BXD crossbreds and dairy producers who raise crossbred calves was conducted in the spring of 2023. More than thirty contacts were made either by phone, mail or email to calf raisers in or near Iowa. Eleven producers who raise more than 21,000 dairy or BXD calves annually responded (3 by phone, 8 by mail) to evaluate their experiences raising BXD crossbred baby calves and to determine future research needs. At the same time roughly thirty producers who finish BXD calves were contacted, and 22 producers responded to the survey (8 by phone, 14 by mail) to evaluate their experiences raising BXD crossbred finishing calves. A complete summary of survey results is available at https://store.extension.iastate.edu/Product/16966 . An ISU Animal Industry Report was submitted in April and is in the review process.

Resource Library

The fourth objective of this study was to develop a resource library on care, management, and performance of the BXD crossbred. The resource library has been compiled and is posted on the IBC and ISU Dairy Team web sites. It can be found at https://www.iowabeefcenter.org/dairybeef.html . As of December 22, 2024, it had over 6600 views and more than 860 downloads of the Holstein Angus Beef Estimator. Announcement of the resource has been sent to media and has been well utilized by the industry. It has been published in the following publications:

- https://animalhealthdigest.com/new-beef-on-dairy-resources-available-from-iowa-beef-center/
- https://dairybusiness.com/beef-x-dairy-research-and-resources-from-iowa-state/

- https://www.beefmagazine.com/livestock-management/new-beef-on-dairy-resources-available-from-iowa-beef-center-
- https://www.morningagclips.com/new-beef-x-dairy-resource-available-on-iowa-beef-center-website/
- https://www.supportfarmers.com/news/through-the-gate-november-2023/
- https://www.nationalbeefwire.com/iowa-state-beef-x-dairy-research-project
- January 1, 2024 issue of Progressive Dairy.
- 11/22/23 ICA Pen Check email
- https://www.dairyherd.com/news/business/survey-beef-cross-calves-need-better-implant-breeding-strategies
- https://www.stgen.com/article/article.aspx?language=english&code=9794

e. Unexpected Problems or Outcomes

One initial problem was availability of bull calves. The ISU Dairy was not able to produce adequate numbers of bull calves so we purchased most from two local dairies who did not provide sire information. As a result, group configuration and animal flow differed from original plans. Three groups of forty calves each were fed instead of the planned 150 head. The modifications for the north barn at the Beef Nutrition Farm could not be modified in time to start this project so the FIMS barn was modified to handle the small calves by building up the floor and adding fencing to restrict access to the feeder to only one animal at a time. Cattle were then transported to the Armstrong farm for finishing to allow for the next group of weaned calves to move into the Beef Nutrition pens. This allowed for individual daily intakes throughout the entire feeding period.

If this project is repeated some modifications should be made to the nursery diets to include more highly digestible fiber sources since the current ration recommendations included a number of lowly digestible fiber sources, and the TMR group may benefit from a week or two transition from the pellets to the TMR in a group bunk feeding situation rather than transfer directly to the TMR in the individual feeder system.

Suggestions for additional research and future BXD projects include:

- Textured VS Pellet form in the nursery phase - Does feed form impact rumen development.
- Modify low-starch diet to include more digestible fiber sources compared to the high-starch diet.
- Transition from the individual pen nursery with pelleted feed to small group bunk-fed pens with a forage-based TMR, or transition from a pellet to a textured feed prior to the TMR
- Compare different bedding sources in the nursery and receiving phases to determine if bedding consumption was due to minor rumen acidosis.
- Track rumen pH during pre-weaning and receiving phases to determine when rumen acidosis starts developing and compare to liver abscesses at harvest.

f. Completed and Planned Publications, Presentations, and Outreach Media

Presentations:

Taylor Klipp, 2024 Feedlot Forum presentation, January 16, 2024, Impact of starter starch content on pre-weaning performance of beef × dairy calves, 112 attended from 3 states and 11 Iowa counties.

Garland Dahlke, 2024 Feedlot Webinar Series, February 29, 2024, Beef on Dairy Project, 29 live viewers, 167 YouTube views as of May 14, 2024.

Taylor Klipp, I-29 Moo University 2024 Dairy Webinar Series, March 5, 2024, Impact Of Starter Starch Content On Pre-weaning Performance Of Beef On Dairy Cross Calves, -- live viewers, -- YouTube views

Garland Dahlke, Multistate BXD working group presentation, May 2024

Taylor Klipp, Poster presentation, 2024 ADSA Annual meeting

Garland Dahlke, SW Iowa Cattle Feeders Day, December 2024, 12 attendees from 4 counties

Garland Dahlke, 2025 Feedlot Forum, January 2025

Denise Schwab, 2025 Driftless Region Beef Conference, January 2025 breakout session

Publications:

ISU Animal Industry Report, submitted April 2024

A Survey of Iowa Beef x Dairy Calf Raisers and Feedlot Operators to Further Describe Challenges Related to Finishing BXD Crossbreds. Submitted to ANR Communications for publication development in April 2024.

Field and Feedlot article – July 2023 (to subscribers in 17 NW Iowa counties)

Growing Beef article – July 2023 (to IBC subscribers)

Interview with Jaime Pullman-Beaulieu from Working Ranch for story on BXD for June 2024 issue.

Progressive Cattle article scheduled for February 2025

g. Personnel Support

Denise Schwab committed 0.02 FTE of her time on the project ($5322.76).

Garland Dahlke committed 0.01 FTE of his time on the project ($1899.87).

Beth Doran committed 0.005 FTE of his time on the project ($858.37).

h. Budget

	Budgeted	Spent	Remaining
Employee salary & benefits	$24,720	$15,838.54	$8881.46
Travel	$9925	$5502.19	$4422.81
Materials/Supplies	$3184	$687.04	$2496.96
Professional Services	$8400	$1981.63	$6418.37
ISU Research Farm user fees & farm modifications	$110,974	$109,194.14	$1779.86
Total	$157,203	$133,203.54	$23,999.46

i. Acknowledgements
All calves in this study were cared for following the guidelines approved by Iowa State University's Institutional Animal Care and Use Committee (protocol #22-220).

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