The Performance Of Two-Year-Old Hereford, Hereford X Holstein And Holstein Females As Influenced By Level Of Winter Supplement Under Range Conditions

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Story in Brief

The productivity of 2-year-old Hereford, Hereford x Holstein and Holstein females calving during November, December and January were compared under tallgrass range conditions. Two levels of supplemention (Moderate and High) were imposed on groups within each breed at calving and extended through the wintering period. One additional level of supplementation (Very High) was fed only to one group of Holstein females.

The amount of cow weight lost during the winter decreased as level of supplementation increased. The females which lost more weight during winter tended to gain more weight in the summer; the exception being the Holstein females. Condition scores closely followed the trends of winter weight losses and summer weight gains. The Holstein females produced heavier calves at birth than the other females. The 240-day sex-corrected weaning weights for the Angus x Hereford, Angus x Hereford x Holstein and Angus x Holstein calves were 504. 557 and 620 pounds, respectively. Average daily milk yield for the Hereford, Hereford x Holstein and Holstein females was 12.4, 18.3 and 24.3 pounds/day, respectively.

A definite trend existed for increased milk yields during the wintering period as level of supplementation increased within breed. The number of days from calving to first observed estrus and number of days from calving to apparent conception tended to decrease as level of supplementation increased. Poor reproductive performance was noted for the Moderate and High Holstein females. The Moderate Hereford females had the greatest dollar return above land and supplement costs. A level of supplement high enough to allow good rebreeding performance of Hol-

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steins resulted in a lower dollar return than noted for Hereford and Hereford x Holstein females.

Introduction

The milk production of beef cows is being increased in order to increase weaning weights of their calves. Selection on the basis of weaning weight results in selection for higher milk production, but milk production potential can be increased most rapidly by infusing genes for high milk production from animals of dairy breeding. Research has shown a strong correlation between level of milk production of beef cows and weaning weight of their calves.

The conversion of milk to calf gain is very efficient process. Within the limits of milk produced by beef cows, each additional 10 pounds of milk produces approximately an additional pound of calf gain. Research has indicated that conversion at high levels of milk production may not be as efficient. While it may be possible to greatly increase the level of milk production of range beef cows, the feed intake of the cow may be a limiting factor for greatly increasing total productivity. The purpose of this study was to determine the influence of varying levels of winter supplementation on actual milk yield, calf performance and reproductive efficiency of range brood cows differing widely in milk production potential.

Experimental Procedure

A groups of Hereford, Hereford x Holstein and Holstein heifers approximately one-year-old were assembled at the Fort Reno Livestock Research Station in the fall of 1969. A minimum of three herds were represented in the origin of each breed group. The heifers originated primarily from Oklahoma; however, some of the Holstein heifers originated in Wisconsin and some of the Hereford x Holstein heifers originated in Texas. For the ensuing year all heifers were maintained on tallgrass native range. The range on the Fort Reno station, classified in excellent condition, is little bluestem (Andropogon scerparus) predominantly and has a carrying capacity of approximately seven acres per cow-calf unit on a yearlong basis. The range forage is normally dormant from early November (first frost) to late April. Ample forage was available at all times.

All heifers received 2.0 pounds soybean meal (44 percent crude protein) per head daily from October 25, 1969 to April 30, 1970. The Holstein heifers received an additional 3.3 pounds ground milo per head daily to achieve a degree of body condition comparable to the Hereford and Hereford x Holstein heifers which received 2.0 pounds ground milo per head daily. All heifers were synchronized with CAP and bred artificially to a single Angus bull from February 15 to April 2, 1970 at which time they were pasture mated to three Angus bulls rotated bi-weekly among the three breeds until May 15, 1970. All heifers diagnosed open by pregnancy check in August, 1970 were sold and replaced with similar females from herds in Oklahoma. At calving (November 2, 1970 to January 26, 1971) each female was assigned to a level of winter supplementation on the basis of a preassigned calving order to equalize calving date within breed. The general design of the experiment is presented in Table 1.

The females within each breed were subjected to either two (Hereford and Hereford x Holstein) or three levels (Holstein) of winter supplementation designated as Moderate, High and Very High. The Moderate level consisted of that amount of supplemental feed deemed necessary to allow good rebreeding performance in the Hereford females. Previous experience at the Fort Reno Livestock Research Station suggested a winter weight loss (including weight loss at calving) from fall to spring of 10 to 15 percent would allow good rebreeding performance. The same level of supplement was fed to a group of Holstein females and to a group of Hereford x Holstein females. The High level was established by the Hereford x Holstein females and consisted of that amount of supplement estimated necessary to maintain their body condition and physiological activity comparable to that of the Moderate Herefords; this same level was fed to a group of Hereford females and to a group of Holstein females. The Very High level was established by the Holstein females and consisted of that amount of supplement estimated necessary to maintain their body condition comparable to Moderate Herefords and High Hereford x Holstein crossbreds; this level was fed only to Holsteins.

Table 1. Calving and Weaning Data

	Hereford		Hereford X Holstein		Holstein			
Item	Moderate	High	Moderate	High	Moderate	High	Very High	SE[1]
No. of calves	12	12	13	13	11	11	11	
Male	5	6	6	6	4	4	9	
Female	7	6	7	7	7	7	2	
Avg. calving date[2]	364[a]	364[a]	364[a]	353[a]	356[a]	358[a]	354[a]	6.4
Avg. birth wt., lb.	63.9[b]	64.2[b]	68.8[b]	64.2[b]	79.6[a]	81.8[a]	81.6[a]	2.4
Avg. adj. weaning wt., lb.	507[c]	500[c]	550[b]	563[b]	604[a]	621[a]	634[a]	14.5

[1] Approximate standard error, n = 12.
[2] Day of year, January 1, 1970 = 001.
a, b, c Means on the same line with differing superscripts differ significantly ($P < .05$).

The base breed-treatment groups were the Moderate Hereford, High Hereford x Holstein and Very High Holstein females which were fed an average of 2.6, 5.5 and 7.7 pounds/head/day post-calving of a 30 percent crude protein range supplement, respectively. Within each nutritional treatment, the quantity of supplement fed each female was adjusted for differences in body size on the basis of metabolic weight ($W^{.75}$). For example, an average weight Moderate Hereford and any Hereford x Holstein or Holstein female of the same weight on the Moderate level of supplementation was fed the same amount of supplement, but a lighter female received less and a heavier female received more (regardless of breed) in recognition of the fact that maintenance requirements are influenced by cow size.

The average daily supplement fed pre- and post-calving to each breed-treatment group is presented in Table 2. All females were individually fed the supplement five times per week (daily allowance x 7 ÷ 5) for a 172-day period from November 9, 1970 to April 30, 1971. Each breed-treatment group was maintained separately after cross-nursing was noted. Rotation among separate pastures was practiced at monthly intervals to minimize pasture effects on performance.

Individual cow weights were taken monthly from November, 1970 to November, 1971. Cow condition scores were taken just prior to initiation, just after termination and just before reinitiation of the supplemental feeding period. The condition scores were based on a scale of 1 (very thin) to 9 (very fat).

All calves were weighed and identified by ear tag within 24 hours after birth. The calves remained with their dams on native pasture until weaning and did not receive creep-feed. Calf weights were obtained after a six-hour shrink at monthly intervals during the lactation. All calves were weaned at 240 ± 7 days of age and weights were adjusted to 240

Table 2. Supplement Intake

Item	Hereford		Hereford X Holstein		Holstein		
	Moderate	High	Moderate	High	Moderate	High	Very High
Supplement[1], lb.							
Total winter [2]	434.5	731.1	514.8	881.8	594.7	944.9	1203.2
Average daily, winter	2.5	4.3	3.0	5.1	3.5	5.5	7.0
Average daily, pre-calving	1.4	1.4	2.1	2.1	2.9	2.9	2.9
Average daily, post-calving	2.6	4.8	3.1	5.5	3.3	5.7	7.7

[1] Soybean meal (44%), 60.1%; milo, ground, 30.3%; dehydrated alfalfa meal, 5.0%; dicalcium phosphate, 2.9%; Masonex, 1.3%; salt, 0.5%; plus vitamin A added at 10,000 I.U./lb. of supplement.
[2] November 9, 1970 - April 30, 1971, 172 days.

days by interpolation (for calves weaned after 240 days of age) or extrapolation from past rate of gain (for calves weaned under 240 days of age). The age-corrected weaning weights of the heifer calves were corrected to a steer equivalent by multiplying by 1.05.

The estimated 24-hour milk production of the females was determined by the calf-suckle technique. The first estimate was made in late December, 1970 with subsequent estimates taken at approximately monthly intervals until seven estimates had been made for each female. The calves were weighed to the nearest 0.1 pound immediately before and after nursing; the difference in calf weight represented the estimated milk yield for a six-hour period. Four six-hour estimates were combined to give a 24-hour estimate of milk yield.

All females observed in estrus were artificially inseminated to one Charolais bull for 23 days beginning February 17, 1971, then hand mated for 22 days and pasture exposed for 45 days to three half-sib Charolais bulls. Rebreeding performance was evaluated on the basis of date of first observed estrus, date of apparent conception and pregnancy determined by rectal palpation approximately 90 days after the breeding season terminated.

Results and Discussion

Cow Weight and Condition.

A significant ($P < .01$) treatment effect was noted for winter weight loss; the amount of weight loss decreased as level of supplementation increased (Table 3). Hereford females which lost more weight in the winter tended to gain more weight during the summer; a trend in agreement with previous results with spring calving Herefords at the Fort Reno Station. It is interesting to note that this trend was not observed with the Hereford x Holstein females and particularly with the Holstein females. In fact, the Moderate Hereford x Holstein and Moderate Holstein females only regained their winter weight loss and consequently did not increase in weight as normally observed between 2 and 3 years of age.

Condition scores closely followed the trends of winter weight losses and summer weight gains with the mid-lactation condition scores decreasing as level of supplementation decreased. The Moderate treatment showed a compensating effect (larger increases than the High or Very High treatments) when adequate nutrition was available during the summer grazing season. A significant ($P < .01$) treatment effect for spring condition scores existed with the High females exhibiting more external fatness than the Moderate females.

The cow weights by period, including pre-partum, lactation and post-lactation are presented graphically in Figure 1. All breed-treatment

Table 3. Weight, Weight Change and Condition Data

Item	Hereford		Hereford X Holstein		Holstein			
	Moderate	High	Moderate	High	Moderate	High	Very High	SE[1]
Weight, lb.								
Fall, 1970 (pre-calving)	885^{c}	904^{c}	988^{b}	995^{b}	1151^{a}	1090^{a}	1116^{a}	26
Spring, 1971 (mid-lactation)	753^{c}	788^{c}	813^{bc}	882^{ab}	946^{a}	917^{a}	954^{a}	26
Fall, 1971 (post-lactation)	985^{b}	983^{b}	993^{b}	1055^{b}	1152^{a}	1156^{a}	1200^{a}	28
Weight change, lb.								
Winter	-132^{ab}	-116^{a}	-175^{cd}	-113^{a}	-205^{d}	-173^{cd}	-162^{bc}	13
Summer	232^{ab}	195^{c}	180^{c}	173^{c}	206^{bc}	239^{ab}	246^{a}	13
Year[3]	100^{a}	79^{a}	5^{b}	60^{a}	1^{b}	66^{a}	84^{a}	
Wt. change (%)								
Winter	-15	-13	-18	-11	-18	-16	-15	
Summer	31	25	22	20	22	26	26	
Year	11	9	0	6	0	5	7	
Condition score[2]								
Fall, 1970 (pre-calving)	6.17^{a}	6.33^{a}	5.00^{b}	5.08^{b}	4.27^{c}	3.55^{c}	4.27^{c}	0.25
Spring, 1971 (mid-lactation)	4.83^{b}	5.58^{a}	3.85^{c}	4.77^{b}	2.09^{e}	2.09^{e}	3.09^{d}	0.27
Fall, 1971 (post-lactation)	5.25^{a}	5.58^{a}	4.38^{b}	4.69^{b}	3.36^{d}	3.00^{d}	3.73^{c}	0.20

[1] Approximate standard error, n = 12.
[2] Condition score: very thin = 1, ... , very fat = 9.
[3] Significant treatment effect ($P < .01$).
a, b, c, d, e Means on the same line with differing superscripts differ significantly ($P < .05$).

groups tended to increase in body weight until calving and then showed a drastic reduction in weight associated with calving loss. All cattle continued to lose weight during the wintering period and reached their lowest weight during the fifth or sixth periods (third or fourth months of lactation, March to April on the average) after which a steady increase in weight until weaning was noted. There was a trend for the weight curves of the three breed groups to remain separate throughout the year. There were no significant differences in weight between treatments within a breed for any period during the year.

Calf Weight.

The mean birth weights and 240-day sex-corrected weaning weights are presented in Table 1. The Angus x Holstein calves were significantly heavier ($P < .001$) at birth than the Angus x Hereford x Holstein and Angus x Hereford calves. Since all females were bred to common Angus

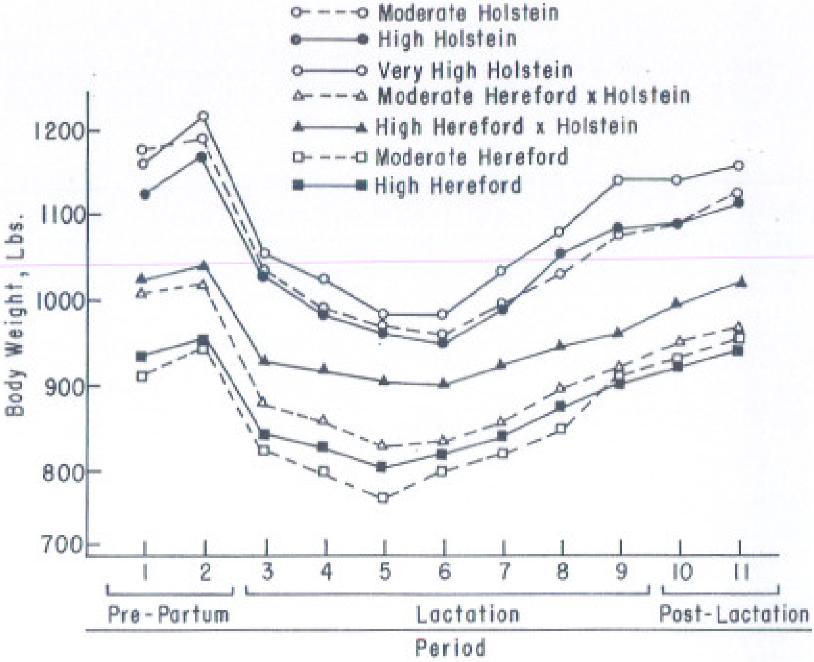

Figure 1. Average body weight curves.

bulls, these differences in birth weight were probably due to the larger body size of the Holstein females which weighed significantly ($P < .01$) more than the Hereford x Holstein and Hereford females. At weaning, the Angus x Holstein, Angus x Hereford x Holstein and Angus x Hereford calves weighed 620, 557 and 504 pounds, respectively. All differences in weaning weight among the three breed groups were highly significant ($P < .01$), but there were no significant treatment differences within breed.

Milk Yield.

The Holstein females produced the greatest entire lactation milk yield, followed by the Hereford x Holstein and Hereford females (Table 4). All differences in milk yield among breeds were highly significant ($P < .001$). Lactation curves for the three breed groups remained separate throughout lactation; this indicated that three different milk production potentials had indeed been established by the three breeds of females used in this experiment. For the Holstein females, no level of supplement appeared to be superior or inferior to the other levels except for periods 3

Table 4. Milk Production Data

Item	Hereford		Hereford X Holstein		Holstein			SE[1]
	Moderate	High	Moderate	High	Moderate	High	Very High	
Total lactation yield, lb.	2880	3096	4152	4632	5640	5880	5952	
Daily yield, lb.[2]	12.0[d]	12.9[d]	17.3[c]	19.3[b]	23.5[a]	24.5[a]	24.8[a]	0.74

[1] Approximate standard error, n = 12.
[2] Significant treatment effect ($P < .05$).
a, b, c, d Means on the same line with differing superscripts differ significantly ($P < .05$).

and 4 during which the Moderate Holsteins produced significantly less ($P < .01$) milk than the Very High Holsteins. The treatment lactation curves for both the Hereford x Holstein and Hereford females tended to remain separate with the High females producing somewhat higher levels of milk; however, these differences were nonsignificant ($P > .05$).

The lactation curves observed in this experiment were much flatter than many previously reported, possibly due to the availability of spring grass at the time when milk yields normally decline as well as the generally excellent grass conditions throughout the summer 1971 grazing

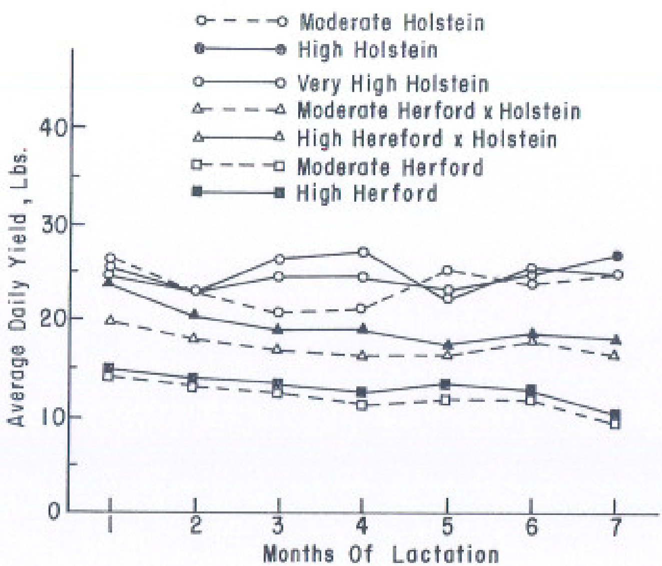

Figure 2. Average daily milk yield.

season. The Holsteins actually produced as much milk during late lactation as during early lactation, perhaps caused by the limited capacity of the calf for milk in early lactation.

The milk production of all breed-treatment groups was influenced by the imposed nutritional treatments as well as the seasonal quality of the forage. There was a definite trend for increased milk yields during the wintering period as level of supplementation increased within breed. A significant ($P < .01$) treatment effect for milk yield was noted during periods 3 and 4 (March and April) when the forage was extremely mature, weathered and of lowest quality and level of supplementation should have had its greatest effect. Reduced protein and/or energy intake have been shown to result in reduced milk yields for several months after termination of winter supplementation; however, in this experiment females wintered at the lower levels generally showed a slightly greater increase in milk yield when spring grass became available.

Reproductive Performance.

There were no significant differences among breeds for days to first observed estrus or days to apparent conception (Table 5). There was a definite trend for the number of days to first observed estrus and the number of days to apparent conception to decrease as level of winter supplementation increased. All Hereford, Hereford x Holstein and Very High Holstein females rebred. Only 8 out of 11 Moderate Holstein fe-

Table 5. Reproductive Performance Data

	Hereford		Hereford X Holstein		Holstein			
Item	Moderate	High	Moderate	High	Moderate	High	Very High	SE[1]
No. of females	12	12	13	13	11	11	11	
No. of females exhibiting estrus	12	12	13	13	8	9	11	
Days post-partum to first observed estrus[2]	71[a]	62[a]	82[b]	68[a]	83[a]	71[a]	65[a]	8.1
Days post-partum to apparent conception[3]	78[ab]	75[a]	100[b]	94[ab]	89[ab]	90[ab]	77[ab]	8.1
No. of females bred	12	12	13	13	8	9	11	

[1] Approximate standard error, n = 12.
[2] Based only on those females which exhibited estrus.
[3] Based only on those females that conceived.
[a,b] Means on the same line with differing superscripts differ significantly ($P < .05$).

males and 9 out of 11 High Holstein females rebreed during the 90-day breeding season. These females were never observed in estrus; therefore, the Moderate and, possibly, High levels of supplementation appeared to be too low to support maximum reproductive performance in 2-year-old Holsteins under range conditions even when ample forage was available at all times.

Economic Analysis.

The results of any economic analysis depends on the prices which are assumed. Different prices can be substituted by anyone at any time.

An economic analysis of returns above land and supplement costs is presented in Table 6, based on assumptions which will be described. Cost of the native range was estimated to be $50.00 per year per female for the Moderate Herefords. A drylot trial involving the same breed-treatment groups as this experiment was conducted concurrently. Individual roughage intakes were determined in the drylot trial and served as the basis for estimation of forage consumption of the range cows. The percent of forage consumed by each breed-treatment group in drylot compared to that of the Moderate Herefords was multiplied by $50.00 to estimate the land cost of each group. The cost of the supplement was estimated at $85.00/ton.

The calves from the Hereford, Hereford x Holstein and Holstein females were estimated to be worth $41.00, $39.00 and $37.00/cwt for steers and $36.00, $34.00 and $32.00/cwt for heifers, respectively. Estimated calf value was calculated by multiplying the actual weaning weight of the steer and heifer calves by their respective price/cwt. and then calculating an unweighted steer-heifer average.

Table 6. Economic Analysis

	Hereford		Hereford X Holstein		Holstein		
Item	Moderate	High	Moderate	High	Moderate	High	Very High
Land requirement, %[1]	100	102	118	112	147	146	136
Land cost per female, $	50.00	51.00	59.00	56.00	73.50	73.00	68.00
Supplement cost per female, $	18.47	31.07	21.88	37.48	25.27	40.16	51.14
Total land and supplement cost, $	68.47	82.07	80.88	93.48	98.77	113.16	119.14
Average value of calf, $	190.72	188.27	196.14	198.51	203.52	210.12	209.47
Return above land and supplement cost, $	122.25	106.20	115.26	105.03	104.75	96.96	90.33

[1] Expressed as % of Moderate Herefords as determined by forage intake in a drylot trial.

The Moderate Hereford females returned the most profit above land and supplement costs ($122.25), followed by Moderate Hereford x Holsteins ($115.26). Feeding the High level of supplementation to either Herefords or Hereford x Holsteins decreased profits by $16.05 and $10.23, respectively. The Holstein females returned the lowest profit and will show an additional loss in the next calf crop due to a failure of some females to rebreed in the Moderate and High groups. All Very High Holsteins rebred, but the high cost of supplementation in this group decreased profit; however, it may represent the level of supplementation necessary for 2-year-old Holsteins under range conditions.

Summary

Results of this study indicate that 2-year-old Hereford x Holstein females are capable of producing more milk and weaning heavier calves with comparable reproductive performance on the same level of supplement as Hereford females when ample forage is available, but due to their larger body size require more forage (acres) per cow-calf unit. The Holstein females were superior to the other breeds in this study in milk yield and calf weaning weights, but were at some disadvantage due to increased forage (acreage) requirement per cow-calf unit, poor reproductive performance at low levels of supplementation and high supplement costs at the highest level of supplementation.