greater than the length slope between Periods 3 and 4. From this one may postulate that a decline in bone growth might be noted in the early "feedlot" phase of this study.

Literature Cited

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Performance Of Three-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 winter-calving, 3-year-old Hereford, Hereford x Holstein and Holstein females under tallgrass range condition was compared. Two levels of supplementation (Moderate and High) were imposed on groups within each breed at calving and extended through the rest of the winter. An additional level of supplementation (Very High) was fed to a group of Holstein females.

As level of supplementation increased, winter weight loss decreased except for the Herefords. Cows in each group regained their winter weight loss the following summer except the Moderate Holsteins. Condition scores followed trends similar to winter weight losses and summer gains. Daily milk yield for the Hereford, Hereford x Holstein and Holsteins females was 14.0, 21.7 and 28.8 lb/day, respectively. Birth weights

In cooperation with USDA, Agricultural Research Service, Southern Region.

were 85, 86 and 96 lb., respectively; and weaning weights were 597, 645 and 730 lb., respectively.

As level of supplementation increased, cows tended to exhibit estrus and conceive sooner. The moderate Hereford x Holstein female had the greatest dollar return above land and supplement costs per productive cow, but their poor rebreeding performance as three-year-olds decreased their net efficiency so that the most economical producers of weaned beef were the Herefords.

Introduction

Weaning weight is one of the most important economic factors in beef production. Selection for weaning weight automatically results in selection for milk production because of the high correlation between level of milk production of beef cows and weaning weight of their calves. Milk production potential can be increased most rapidly by infusing genes for high milk production from dairy animals.

The conversion of milk to calf gain is a rather efficient process within the limits of milk production of the beef cow. Within this range, the conversion is approximately 10 lb of milk per pound of gain. This conversion may not be as efficient at high levels of milk production. Although it is possible to increase the level of milk production of range beef cows, the increased feed requirements of the cow may decrease the efficiency of beef production. 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.

Methods and Materials

Groups of Hereford, Hereford x Holstein and Holstein females have been continuously maintained under tallgrass native range conditions at the Fort Reno Livestock Research Station since they were one year old. At first calving, they were assigned to a level of winter supplementation on the basis of a pre-assigned calving order to equalize calving date within breed. The Design of the experiment is presented in Table 1.

Within each breed, the females were subjected to two levels of winter supplementation designated as Moderate and 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 loss (including weight loss at calving) from fall to spring of 10 percent for yearling heifers bred to calve at 2 years of age and 15 percent for 2-

Table 1. Calving and Weaning Data

Item	Hereford		Hereford x Holstein		Holstein		
	Moderate	High	Moderate	High	Moderate	High	Very High
No. of calves weaned	12	8	9	12	3	8	8
Male	7	7	1	4	1	3	5
Female	5	1	8	8	2	5	3
Avg. calving date[1]	369	373	359	366	363	370	364
Avg. birth wt., lb.	84	85	86	86	100	92	96
Avg. adj. weaning wt., lb.	601	592	645	641	723	736	730

[1] Day of year, January 1, 1971 = 001

year-old females, rebred to calve at 3 years of age. The same level was fed to a group of Hereford x Holstein females and to a group of Holstein females.

The High level was established by the Hereford x Holstein females and consisted of that amount of supplement estimated necessary to maintain a 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. Also, a Very High level was fed to a group of Holstein females. This level was established by the Holstein females and consisted of that amount of supplement estimated necessary to maintain a body condition similar to the Moderate Herefords and High Hereford x Holstein crossbreds; this level was fed only to Holsteins.

The base breed-treatment groups were the Moderate Hereford, High Hereford x Holstein and Very High Holstein females which were fed, as 2-year-olds, an average of 2.6, 5.5 and 7.7 lb./head/day post-calving of a 30 percent crude protein supplement, respectively. As 3-year-olds they were fed 3.1, 6.3 and 9.2 lb./head/day, respectively. Within each nutritional treatment, the quantity of supplement fed each female was adjusted for differences in body sizes. Supplement intake by treatment and breed is summarized in Table 2.

The females were bred as yearlings to Angus bulls; their performance as 2-year-olds was summarized by Kropp et al., 1972. As 2-year-olds they were bred to Charolais bulls; this report summarizes their performance as 3-year-olds. The females were artificially inseminated to one Charolais bull for 23 days, then hand mated for 22 days and pasture exposed for 45 days to three half-sib Charolais bulls.

Table 2. Supplement Intake

Item	Hereford		Hereford x Holstein		Holstein		
	Moderate	High	Moderate	High	Moderate	High	Very High
Supplement, lb.[1]							
Total winter[2]	353	691	343	763	390	780	1189
Avg. daily, winter	2.24	4.40	2.19	4.86	2.49	4.97	7.57
Avg. daily, pre-calving	0.82	1.53	0.84	2.02	0.97	2.24	3.90
Avg. daily, post-calving	3.05	6.09	2.86	6.33	3.30	6.40	9.16

[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 IU/lb of supplement.
[2] November 9, 1971 to April 15, 1972.

Monthly individual cow weights (after a 6-hour shrink) were taken from November, 1971 to November, 1972. Cow winter weight losses were calculated from November, 1971 to the lowest weight after calving (March). Cow conditions scores were taken prior to initiation, after termination and before re-initiation of the supplemental feeding period. The scale for condition score was from 1 (very thin) to 9 (very fat).

All calves were weighed within 24 hours after birth and remained with their dams on native pasture until weaning; no creepfeed was fed. During lactation, monthly calf weights (after a six-hour shrink) were adjusted to 240 days by interpolation or extrapolation. The age-corrected weaning weights of the heifer calves were adjusted to a steer equivalent by multiplying by a factor of 1.05.

The 24-hour milk production was estimated by the calf suckle technique. The first estimate was taken when the calves were four to six weeks of age and then monthly until seven estimates had been taken.

Results and Discussion

Cow Weight and Condition

The amount of winter weight loss decreased as level of supplementation increased except for the Herefords (Table 3). The High Herefords lost more weight during winter (28 lb.) than the Moderate Herefords. Apparently the Moderate level provided adequate supplementation for Herefords, and increasing supplementation to the High level resulted in a decrease in forage intake; the High Herefords also produced more milk

[1] Oklahoma Agricultural Experiment Station Miscellaneous Publication 87, pp. 26-36.

Table 3. Weight, Weight Change and Condition Data

Item	Hereford		Hereford x Holstein		Holstein		
	Mod-erate	High	Mod-erate	High	Mod-erate	High	Very High
Weight, lb.							
Fall, 1971 (Pre-calving)	1012	1022	995	1070	1187	1172	1210
Spring, 1972 (Mid-lactation)	850	832	812	897	912	955	1011
Fall, 1972 (Post-lactation)	1035	1046	1011	1092	1168	1172	1240
Weight change, lb.							
Winter	—162	—190	—183	—173	—275	—217	—199
Summer	+185	+214	+199	+200	+256	+217	+229
Year	+ 23	+ 24	+ 16	+ 27	— 19	0	+ 30
Weight change, %							
Winter	—16.00	—18.59	—18.39	—16.17	—23.17	—18.52	—16.45
Summer	+21.76	+25.72	+24.51	+22.30	+28.07	+22.72	+22.65
Year	+ 2.27	+ 2.35	+ 1.61	+ 2.52	— 1.60	0	+ 2.48
Condition score[1]							
Fall, 1971 (Pre-calving)	5.69	6.10	4.27	4.85	3.33	3.00	3.75
Spring, 1972 (Mid-lactation)	4.46	4.40	2.27	3.23	1.33	1.78	2.38
Fall, 1972 (Post-lactation)	6.58	6.40	4.90	4.92	3.00	4.00	4.50

[1] Condition score; very thin = 1, . . . , very fat = 9.

than the Moderate Herefords. Similar to the previous year (when they were 2-year-olds), the 3-year-old Hereford females that lost more weight in the winter gained more weight in the summer. This trend was not as apparent for the Holsteins and Hereford x Holstein females although the Moderate Holsteins gained more than the other Holstein treatments. The Moderate and High Holsteins did not increase in weight during the year as is normally observed between 3 and 4 years of age.

Generally, condition scores followed the trends of winter weight losses and summer weight gains. The High Herefords lost more condition than the Moderate females but they were much fatter than the Moderates in the fall before calving. As 2-year-olds a trend existed for the groups that lost the most condition during the winter to compensate by gaining more in the summer. As 3-year-olds, however, the trend was not as distinct. Moderate Holsteins and Moderate Hereford x Holstein crossbreds lost the most condition in the winter (2.00 units each); the Moderate crossbreds compensated by gaining 2.63 units of condition in the summer but the Moderate Holsteins only gained 1.67 units of condition, probably due to a higher level of milk production.

The cow weights during pre-partum, lactation and post-lactation periods are presented graphically in Figure 1. The loss in weight between the first and second month is primarily due to weight loss at calving. All breed-treatment groups tended to continue to lose weight until the fourth month (third month of lactation) after which a steady increase in weight until weaning was noted. The Holsteins remained heavier throughout the trial than the Herefords and crossbreds. Weight of the two Hereford groups was very similar throughout the year, again indicating that the Moderate level of supplementation was adequate. However, Moderate Hereford x Holstein crossbreds and Holsteins were considerably lighter in weight than their higher supplemented breed mates during the peak months of lactation; the Moderate crossbreds remained lighter to weaning time.

Calf Weight

Birth weights and 240-day sex-corrected weaning weights are presented in Table 1. Calves out of Holstein cows were heavier than those out of Hereford x Holstein cows. Since all females were bred to common Charolais bulls, the differences in birth weight were probably due to the larger body size of the Holstein females. At weaning calves out of Hereford, Hereford x Holstein and Holstein cows weighted 597, 643

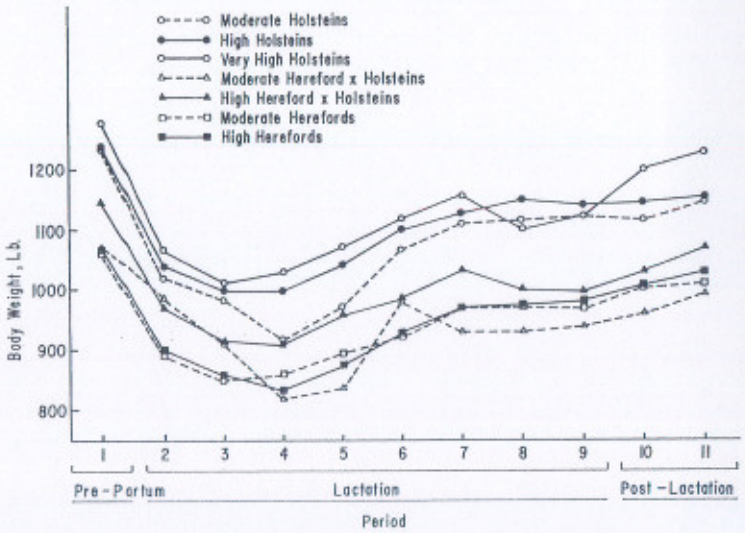

Figure 1. Average body weight of cows.

and 730 lb., respectively. Level of winter supplement within breed had little influence on weaning weight, as was true the previous year.

Milk Yield

The greatest difference in total milk yield was between breeds with the Herefords, Hereford x Holsteins averaging 3348, 5208 and 6920 pounds compared to 2988, 4392 and 5824, respectively, when they were 2-year-olds. Cows on the higher levels of supplementation tended to produce slightly more milk within each breed (Table 4), but this was not reflected in differences in weaning weight. Lactation curves for the three breed groups remained separate (Figure 2) with the previously mentioned trend for the groups receiving higher levels of supplementation to consistently produce more milk.

The lactation curves were remarkably flat and were similar to those of the same females as 2-year-olds, in contrast to earlier reported lactation curves, probably due to the availability of spring grass when milk yield normally declines. The Holsteins actually increased in milk production through the fifth month of lactation, probably because of the increased capacity of the calf at the time of lush grass in the spring during periods 4 and 5 (March and April). Spring grass seemed to increase milk production for the females fed lower levels of winter supplement relatively more than that of females on higher levels.

Reproductive Performance

A definite trend existed 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, especially in the Holsteins (Table 5). More cows were used to calculate reproductive performance (Table 5) than weaning data (Table 1) because some cows whose calves had died raised a foster calf. Their reproductive data was valid but their calving and weaning data was not. As 2-year-olds, all Herefords, Hereford x Holstein and Very High Holstein females rebred. A possible accumulative effect on reproduction occurred for the Moderate crossbreds since

Table 4. Milk Production Data

See Corrected Table p. 285

Item	Hereford		Hereford x Holstein		Holstein		
	Moderate	High	Moderate	High	Moderate	High	Very High
Total lactation yield, lb.	3120	3576	5040	5376	6552	6912	7296
Daily yield, lb.	13.0	14.9	21.0	22.4	27.3	28.8	30.4

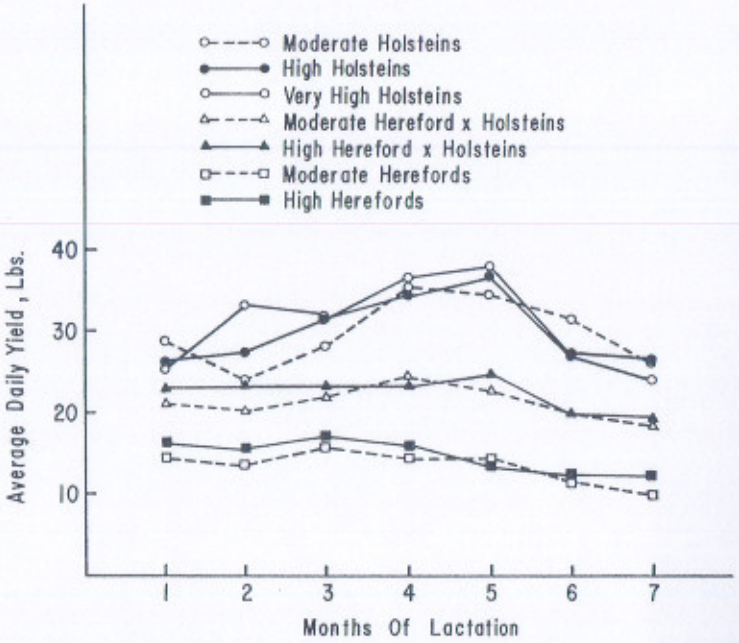

Figure 2. Average daily milk yield.

only 8 of 11 rebred as 3-year-olds. Only one Holstein (a High level female) was open, but it is difficult to appraise the reproductive performance of the Holsteins because of the disproportionate number of females which raised calves as 2-year-olds. This disproportionality was due to the poor reproductive performance the previous year (as 2-year-olds), especially for the Moderate Holsteins. The High Hereford female that was open was probably due to chance; this was the only open Hereford in two productive years.

Economic Analysis

The economic analysis shown in Table 6 is based on Oklahoma 1972 prices. Different prices can be substituted as appropriate.

The assumptions for the economic analysis presented in Table 6 will be described. Cost of the native range was estimated to be $65.00 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

Table 5. Reproductive Performance Data

Item	Hereford		Hereford x Holstein		Holstein		
	Moderate	High	Moderate	High	Moderate	High	Very High
No. of females	12	10	11	13	4	9	8
No. of females exhibiting estrus	12	10	9	13	4	8	8
Days post-partum to first observed estrus[1]	72.7	68.3	79.3	66.2	126.7	78.5	57.7
No. of females bred	12	9	8	12	4	8	8
Days post-partum to apparent conception[2]	94.0	90.4	94.0	89.8	140.0	93.9	85.1

[1] Based on those females which exhibited estrus.
[2] Based on those females that conceived.

Table 6. Economic Analysis

Item	Hereford		Hereford x Holstein		Holstein		
	Moderate	High	Moderate	High	Moderate	High	Very High
Land requirement, %[1]	100	92	104	107	131	126	128
Land cost per female, $	65.00	59.65	67.69	69.54	84.87	82.02	83.17
Supplement cost per female, $	15.93	31.14	15.48	34.38	17.55	35.10	53.55
Total land and supplement cost, $	80.93	90.75	83.17	103.92	102.42	117.12	136.72
Average value of calf	243.57	239.64	248.89	247.98	253.27	256.02	254.77
Return above land and supplement cost, $	162.64	148.89	165.72	144.06	150.85	138.90	118.05
Return adjusted for conception, $[2]	162.64	148.89	140.86	144.06	102.58	120.84	110.97

[1] Expressed as % of Moderate Herefords as determined by forage intake in drylot trial.
[2] Based on conception rate as 2-year-olds.

range cows. The percent of forage consumed by each breed-treatment group in drylot compared to that of the Moderate Herefords was multiplied by $65.00 to estimate the land cost of each group. The cost of the supplement was estimated at $90.00.

The calves from the Hereford, Hereford X Holstein and Holstein females was estimated to be worth $43.00, $42.00 and $40.00/cwt for steers and $38.00, $37.00 and $35.00/cwt for heifers, respectively, with a discount of $2.00/cwt for weights above 600 pounds. Estimated calf value was calculated by multiplying the 240-day weaning weight of the steer and heifer calves by their respective price/cwt and then calculating an unweighted steer-heifer average.

On the basis of those cows which weaned calves, the Moderate cross bred females returned the most profit above land and supplement costs ($166.89) followed closely by the Moderate Herefords ($162.73). Looking a year ahead, however, the Moderate Herefords will have an advantage because of better rebreeding performance. (Table 5.) Feeding the High level of supplementation to the Herefords and the Hereford x Holsteins decreased profits by $13.79 and $20.94, respectively. The Holsteins returned less profit than the comparable supplement groups in the other breeds, due to a higher feed requirement.

A more realistic financial return figure would be provided by adjusting for rebreeding performance. This was done by multiplying the return above feed cost per calf by the percent conception of the cows as 2-year-olds (Table 6). On this basis, Moderate Herefords were the most profitable.

Conclusion

Based on performance under range conditions through 3 years of age, Herefords have been most profitable. The additional feed necessary for good rebreeding performance of heavier milking cows weaning heavier calves (Hereford x Holstein crossbreds and Holsteins) has reduced profit.