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D.M. Marshall
South Dakota State University

W. Minqiang
South Dakota State University

B. A. Freking
South Dakota State University

RELATIONSHIP OF RELATIVE CALVING DATE OF BEEF HEIFERS TO PRODUCTION EFFICIENCY AND SUBSEQUENT REPRODUCTIVE PERFORMANCE

D. M. Marshall[1], W. Minqiang[2] and B. A. Freking[3]
Department of Animal and Range Sciences

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Summary

Relative date of first calving of beef heifers was studied in relation to production efficiency and subsequent reproductive performance. Crossbred heifers were managed in drylot for 1 year, providing for measurement of feed intake through weaning of the first calf. Production traits were evaluated by calving group (CG), where CG1 included records of heifers calving (and calves born) in the first 21 days of the calving season for a particular year, CG2 included those calving from 22 through 42 days and CG3 included those calving after 42 days. Calving groups did not differ significantly for preweaning calf average daily gain, while weaning age differences resulted in heavier weaning weights for CG1 compared to CG2 and CG3. Earlier relative calving date was associated with increased cumulative feed energy intake of heifers and their calves during the 1-year test period. In terms of production efficiency, the weaning weight advantage of earlier calving was only partly offset by increased feed energy intake of the dam-calf unit, resulting in .9 Mcal metabolizable energy (ME) less per lb calf weaning weight for CG1 vs CG2 and 2.9 Mcal ME less per lb calf weaning weight for CG1 vs CG3 for the 1-year period. Results suggested that within a limited calving season, earlier calving dams tended to be biologically and economically more efficient, apparently at least in part because a greater proportion of an annual production cycle consisted of a productive (lactating) mode, diluting maintenance costs as a fraction of all costs. Heifers in CG1 tended to calve earlier than CG3 heifers for the second calf. Calving interval was a biased measure under the management conditions of a limited breeding season and culling of open cows.

(Key Words: Beef Cattle, Calving Date, Production Efficiency, First Calf Heifers.)

Introduction

Efficiency of feed utilization and reproductive performance are among the most important factors that affect economic efficiency of commercial beef production. Because of the relatively low reproductive rate of cattle, a larger proportion of the total energy used for production goes to maintenance of the breeding herd for beef cattle than for other common meat-producing species. It is important to identify factors that might affect production efficiency and investigate the possible manipulation of such factors.

Use of a limited breeding season has been commonly recommended to make efficient use of labor resources, to match herd feed requirements to forage production and to improve calf uniformity. Calving interval, the time between successive calvings, has been recognized as an important characteristic of economic efficiency of the breeding herd but is more prone to be a biased measurement than is calving date in herds with fixed breeding seasons. Recent interest in incorporating cow reproductive measures in cattle genetic evaluation programs has been associated with investigation of genetic aspects of calving date. Since the feasibility of selecting for calving date depends on costs-benefits considerations, it is important to learn as much as possible about the relationship of relative calving date to other traits and to economic efficiency.

Previous research has evaluated the effect of relative calving date on calf weaning weight. However, to adequately assess the relationship of relative calving date to economic efficiency of production, it is also necessary to evaluate any potential increase in feed costs associated with earlier relative calving date. The objectives of this study were to evaluate the relationship of relative calving date to efficiency of feed

[1]Assistant Professor.
[2]Visiting Scholar.
[3]Former Graduate Research Assistant.

utilization for first calf production and subsequent reproductive performance.

Materials and Methods

The data used in this study were obtained from a comprehensive project designed to evaluate genetic aspects of feed utilization efficiency by beef cattle. The data were collected in a drylot management system which allowed measurement of feed intake along with the performance traits that are more commonly collected. The study included data from first-calf females and their calves for calf birth years 1981 through 1988. These females were born in the spring and weaned in October at the Antelope Range Livestock Station located in northwestern South Dakota.

After weaning, the heifers were transported to Brookings in late fall or late winter (all heifers born in the same year were handled alike) and were managed to calve at approximately 2 years of age. Pregnant heifers were placed in a drylot facility in October, 1 year following weaning, where feed intake was measured on each heifer for 1 year through weaning of her first calf the following October. Heifer breed types included crossbred Hereford-Angus, Hereford-Simmental, Hereford-Tarentaise and Hereford-Salers produced in rotational crossbreeding systems and straightbred Hereford. A combination of artificial insemination and natural mating was used to breed first-calf heifers, while 2-year-old cows were bred by artificial insemination only.

The breeding season for heifers and 2-year-old cows began in late May and was limited to approximately 55 days each year, resulting in an overall average calving date of March 30. Within each year, the date of the first birth was identified, and 21-day increment periods were computed for the calving season. Average performance was evaluated by calving group (CG), where CG1 included records of heifers calving (and calves born) in the first 21 days of the calving season for a particular year, CG2 included those calving from 22 through 42 days and CG3 included those calving after 42 days. The number of cow-calf pairs analyzed varied somewhat for different traits, with 419 records available for most traits. Of these, 260 were assigned to CG1, 101 were assigned to CG2 and 58 were assigned to CG3.

Under the drylot management system, the heifers were placed in individual feeding stalls twice daily and provided access to predetermined amounts of pelleted hay, chopped hay and grain. Feed not consumed by a heifer was periodically weighed and discarded. Feeding level was adjusted for each individual at 28-day intervals to provide gains that were assumed to be desirable for typical replacement heifer development and acceptable rebreeding performance. Daily feed metabolizable energy (ME) averaged 18.7, 18.8 and 18.8 Mcal for CG1, CG2 and CG3, respectively, from entry into the drylot up to calving. During lactation, daily feed ME for heifers averaged 27.3, 27.3 and 27.1 Mcal for CG1, CG2 and CG3, respectively. While daily feed levels for heifers were dictated by experimental protocol, cumulative feed energy intake of heifers (Table 1) depended on relative calving date. Calves were allowed to nurse their dams during the two daily periods when the dams were in the individual feeding stalls but were otherwise kept separate from dams to prevent cross-nursing. Calves were allowed access to individual creep feeders, which provided a high-roughage diet intended to replace forage which calves would have consumed from pasture under conventional management. Creep feed intake of calves is expressed as total ME from creep feed up to weaning.

Estimated milk production was evaluated by the calf weigh-suckle-weigh procedure and is expressed as milk yield after an overnight separation of calf and dam averaging about 14 hours. Calves were separated from their dams in the evening. The following morning, calves were weighed, allowed to nurse for approximately 15 minutes and then reweighed. Estimated milk production was computed as the difference between the two successive calf weights. This procedure did not create an especially unusual situation for the animals, since calves were separated overnight from their dams every day under the drylot management system. Estimated milk production was evaluated on four to six different dates each year and is presented as the average of those measurements.

Results and Discussion

On the average, calves in CG2 and CG3, respectively, were born 16.2 and 38.1 days later than calves in CG1 (Table 1). These same differences were reflected in calf age at weaning, since all calves within a year were weaned on the same day. Calving groups did not differ significantly for calf birth weight or average daily gain from birth to weaning. Weaning weights for CG1 calves averaged 23.5 and 69.6 lb heavier compared to CG2 and CG3 calves, respectively, reflecting weaning age differences. Earlier-born calves consumed more creep feed, with

TABLE 1. LEAST SQUARES MEANS AND STANDARD ERRORS FOR FIRST-CALF PRODUCTION TRAITS BY CALVING GROUP

Item	Calving group F-test	Calving group 1[a]	Calving group 2[b]	Calving group 3[c]
		Traits of the Calf		
Calf birth date, Julian	**	78.5 ± .65	94.7 ± .90	116.6 ± 1.41
Calf birth wt, lb	NS	75.0 ± .8	76.5 ± 1.2	76.9 ± 1.7
Calf preweaning ADG, lb/day	NS	1.73 ± .020	1.75 ± .029	1.68 ± .043
Calf age at weaning, day	**	220 ± .7	204 ± .9	182 ± 1.4
Calf weaning wt, lb	**	455.4 ± 4.8	431.9 ± 6.9	385.8 ± 10.1
Calf creep feed ME, Mcal	**	461 ± 6.9	402 ± 9.4	335 ± 14.4
		Traits of the Heifer		
Yearling wt, lb	NS	657 ± 5.2	653 ± 7.3	650 ± 9.8
Drylot on-test age, day	NS	572 ± 1.1	572 ± 1.6	573 ± 2.1
Drylot on-test wt, lb	NS	880 ± 5.2	873 ± 7.4	866 ± 10.0
Age at 1st calving, day	**	723 ± 1.2	743 ± 1.7	766 ± 2.2
Wt at 1st calving, lb	**	953 ± 7.2	982 ± 10.2	998 ± 13.6
Drylot off-test wt, lb	+	1,040 ± 5.7	1,059 ± 8.1	1,058 ± 10.9
Avg drylot test wt, lb	NS	970 ± 5.2	985 ± 7.3	986 ± 9.8
Overnight milk production, lb	NS	7.70 ± .134	7.49 ± .190	7.53 ± .255
Cumulative heifer feed ME, Mcal				
Beginning of test to calving	**	2,677 ± 17	3,072 ± 24	3,521 ± 32
Lactation	**	6,001 ± 30	5,475 ± 42	4,788 ± 57
Total 1-year drylot period	**	8,684 ± 36	8,554 ± 52	8,298 ± 69
		Production Efficiency		
Heifer and calf ME/calf weaning wt, Mcal/lb	**	20.2 ± .22	21.1 ± .31	23.1 ± .46

[a] Heifers calving in the first 21 days of the calving season.
[b] Heifers calving from day 22 through day 42.
[c] Heifers calving after day 42.
** P<.01.
[+] P<.10.
NS = nonsignificant (P>.10).

mean cumulative differences of 59 Mcal ME for CG1 vs CG2 and 126 Mcal ME for CG1 vs CG3.

Average yearling weight and age and weight of heifers when entering the drylot test were similar for the three calving groups. Earlier calving (CG1) heifers averaged 20 days younger at first calving than CG2 heifers and 43 days younger than CG3 heifers. Heifers in CG1 weighed less at first calving than heifers in the other groups, reflecting their younger age. Cumulative feed ME during the entire 1-year test period was significantly greater for earlier calving heifers with differences of 130 Mcal for CG1 vs CG2 and 386 Mcal for CG1 vs CG3. When the cumulative feed ME is subdivided and analyzed separately for lactation vs nonlactation, it is clearly evident that a larger proportion of the 1-year feed energy was utilized during lactation for earlier calving heifers. Although feed intake was not measured prior to the drylot test, a strong argument can be made for assuming that feed energy intakes were similar across calving groups prior to the drylot test. One point supporting such an argument is that means were very similar across calving groups for on-test age, yearling weight and on-test weight. Furthermore, even though earlier calving heifers would have been pregnant for a longer time period prior to the drylot test, pre-test differences in feed requirements due to differences in stage of pregnancy would be expected to be negligible that early in gestation.

The weaning weight advantage of earlier calving was only partly offset by increased feed energy intake of the dam-calf unit, resulting in significant differences between calving groups for the production efficiency ratio of total ME intake of the heifer and calf to calf weaning weight. Dam-calf pairs in CG1 were the most efficient, averaging .9 Mcal ME less per lb calf weaning weight compared to CG2 and 2.9 Mcal ME less per lb calf weaning weight compared to CG3. Earlier calving dams tended to be more efficient, apparently at least in part because a greater proportion of the 1-year production period was spent in a productive (lactating) mode, diluting the proportion of total feed energy utilized for maintenance, compared to later calving dams.

Results from a pooled intra-year-sire regression of selected traits on calving date are presented in Table 2. Interpretation of results based on regression analyses provides essentially the same interpretation as when based on calving group least squares means. Regression analyses suggest that, for each day that calving occurs earlier within a fixed season, weaning weight is increased 1.66 lb, cumulative calf creep feed ME increases by 2.63 Mcal and cumulative heifer feed ME for the 1-year period increases by 11.2 Mcal.

TABLE 2. REGRESSION OF VARIOUS PRODUCTION TRAITS ON CALVING DATE

Trait	Regression coefficient ± SE
Calf preweaning ADG	NS
Calf weaning wt, lb	-1.66 ± .238**
Cumulative calf creep ME, Mcal	-2.63 ± .39**
Cumulative total heifer feed ME, Mcal	-11.2 ± 2.54**
Heifer and calf ME/calf weaning wt, Mcal/lb	.061 ± .0109**

** P<.01.
NS = nonsignificant (P>.10).

To interpret results of this study from an economic perspective, one should consider possible differences between calving groups in costs and returns prior to, as well as during, the 1-year drylot test period. Assuming that differences between calving groups in costs prior to the drylot test period were negligible, based on reasons mentioned previously, the performance differences between calving groups during the drylot test period should be closely related to total economic differences through weaning of the first calf. Relative economic differences through weaning of the first calf were estimated, assuming base price coefficients of $.029 per Mcal of ME and $.718 per lb of calf weaning weight (based on average prices over the period 1981 through 1988), and utilizing calving group means for calf creep and heifer feed ME and calf weaning weight. No attempt was made to consider subsequent reproductive performance in economic analyses. Under the conditions of the present study, calving in CG1 resulted in an estimated average $14.81 per dam-calf pair more in feed costs to attain an extra 69.6 lb in calf weight weaned compared to CG3. Assuming equal price coefficients for CG1 and CG3 for calving weaning weight, the 69.6 lb difference in weaning weight amounts to $50.62. An assumed price premium of 4% for the lighter weight calves of CG3 would reduce the difference to $39.51. These figures reflect an average difference of 38 days for relative calving date. A larger difference in calving dates within a limited calving season would perhaps result in larger economic differences. These figures were based on production of the first calf sold at weaning, and no attempt was made to consider future performance from an economic standpoint. Other factors potentially affecting economic differences, including labor requirements and interest costs, were ignored.

Rebreeding performance is presented in Table 3. Cows that had calved in CG1 or CG2 for their first calf also tended to calve earlier than CG3 females for the second calf. Rebreeding pregnancy rates were similar for the three groups. Open cows were culled from the herd after weaning of their first calf. Therefore, among the 312 cows remaining in the herd for the second calf, late calving cows had shorter intervals between birth dates of their first and second calves. The late calvers either rebred relatively quickly or were open and culled.

Heavier weaning weights associated with earlier relative calving date more than offset increased cumulative feed energy intakes. Within a limited calving season, earlier calving dams tended to be more efficient, apparently at least in part because a greater proportion of an annual production cycle was spent in a productive (lactating) mode, diluting maintenance costs as a fraction of total costs. Calving interval was a biased measure under the management conditions of a limited breeding season with open cows culled. Results support the common suggestion that producers should attempt to have a high proportion of females calving early within a limited calving season, although the increase in calf weight associated with early calving was partly offset by increased feed costs.

TABLE 3. LEAST SQUARES MEANS AND STANDARD ERRORS FOR SUBSEQUENT REPRODUCTIVE PERFORMANCE BY INITIAL CALVING GROUP

Trait	Calving group F-test	Calving group		
		1[a]	2[b]	3[c]
Rebreeding pregnancy rate, %	NS	78.1 ± 2.9	72.7 ± 4.1	76.7 ± 5.6
Second calf birth date, Julian	**	80.8 ± 1.3	81.6 ± 1.9	90.3 ± 2.5
Calving interval, days	**	367 ± 1.3	348 ± 1.9	335 ± 2.5

[a] Heifers calving in the first 21 days of the calving season.
[b] Heifers calving from day 22 through day 42.
[c] Heifers calving after day 42.
** P<.01.
NS = nonsignificant (P>.10).