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Heterosis in Simmental Angus Rotational-Cross Calves

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Summary

Heterosis estimates were determined for gestation length, birth weight, and yearling weight using a two-breed rotational crossbreeding system with Angus and Simmental cattle. Heterosis for gestation length was -.3%; birth weight, 8.31%; weaning weight 5.05%, and yearling weight, 5.39%. Angus-sired calves from Simmental dams were significantly heavier at weaning and as yearlings than the reciprocal cross.

Introduction

Systematic crossbreeding of beef cattle is a useful tool for commercial cattlemen, resulting in an efficient, autonomous breeding program with a minimal loss in heterosis.

It has been well documented that heterosis can be utilized well by the cow-calf producer, since the greatest amounts of heterosis are expressed in pre-weaning traits. The established cow herd should be crossed with a different bull breed. This first cross allows for maximum heterosis. However, if there is no breeding system, large losses in heterosis can occur after crossbred replacement heifers are placed into the herd.

Some type of crossbreeding system should be used to produce maximum obtainable heterosis in the offspring. Rotational crossbreeding is such a system. In a rotational system, all replacement heifers are produced and only purebred sires need to be purchased. The rotational system should be developed to match the management of the operation.

A two-breed, rotational crossbreeding system was initiated in southeast Kansas utilizing Angus and Simmental cattle. Reproductive, pre-weaning, postweaning, and carcass data were collected and heterosis values determined for gestation length, birth weight, weaning weight, and yearling weight.

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Procedures

Data were collected on 425 cows and their progeny at the Southeast Kansas Agricultural Experiment Station, Parsons, from 1979 to 1985. Hereford cows, present at the station in 1979, were gradually eliminated and replaced with Simmental and Angus straightbred and crossbred cows. A two-breed, rotational crossbreeding system was initiated in 1980. Twenty females each were maintained in purebred Simmental and purebred Angus herd to use as comparisons. Forty cows were maintained in a two-breed, rotational crossbreeding herd. The existing cows were divided into three groups; two were housed at Parsons and one approximately 15 miles southwest at Mound Valley. Average cow weights were 1054.82 ± 83.24 lbs for purebred Simmental, 986.83 ± 101.58 lbs for purebred Angus, and 1008.81 ± 92.43 lbs for the crossbred cows. The cows were pastured primarily on fescue and native grass and supplemented with hay and concentrate when needed during the winter months.

From 1979 to 1983, two groups calved in the fall and one group in the spring. Fall-calving cows began calving in late August or early September and continued through November. Spring calves were born in late February through May. All groups were synchronized and bred AI with Angus and Simmental bulls. Angus and Simmental bulls also were used as cleanup bulls.

The breeding season lasted 60 to 90 days. In 1984, the spring-calving herd was eliminated and switched to fall calving. Calves were weaned at approximately 205 days of age. Replacement heifers were selected from offspring or bought from producers, and steer calves were placed in the feedlot or sold. First calf heifers were bred to Angus bulls and then placed into the rotation. All calves received creep feed, except in 1979 when spring-born calves and half of Parsons, fall-born calves did not receive creep feed.

Data were collected on calving ease, gestation length, birth weight, weaning weight, and yearling weight. All records that were used in developing models for gestation length, birth weight, weaning weight, and yearling weight also were used in calculating heterosis values. From 1980 on, steers were placed in a feedlot and carcass data were collected. Traits measured included days on feed, average daily gain, final weight, carcass weight, quality grade, yield grade, ribeye area, and backfat thickness.

Heterosis was calculated using least squares means for gestation length, birth weight, weaning weight, and yearling weight (Table 25.1). Only 82 observations were used in calculating heterosis estimates, since other observations included Hereford blood, and a base Hereford population was not maintained after 1979.

Reciprocal cross means were also calculated. Sire and dam breeds were taken into account in calculating least squares means and standard errors for birth weight, weaning weight, and yearling weight. Least squares means for dam breeds were an indication of maternal heterosis.

Results and Discussion

Simmental calves were sired by Abricot, Eagle, Mr. PR, Alpine Polled Proto, Cezon, Bar 5 Fantastic, Formula 10, CPS, Lightning, AR Extra 8J, and sons of these bulls. The 8 purebred calves comprising the basis for comparison had an average gestation length of 292 ± 2.1 days and birth weight of 77.4 ± 5.8 lb. Adjusted weaning weight average was 538.2 ± 26.9 lb and average for yearling weight was 683.1 ± 35.6 lb.

Forty-one Angus calves sired by PS Power Play, Dalebanks Rito 9144, Dalebanks Barometer 0829, Dalebanks Skynere 9238, Benchmark 0505, Thomas Chaps, and Ken Caryl Mr. Angus characterized the purebred Angus population. Average gestation length for purebred Angus was 284 ± 2.95 days, with an average birth weight of 70.34 ± 2.95 lb. Average adjusted weaning weight was 537.5 ± 15.41 lb and yearling weight was 672.97 ± 19.82 lb.

The crossbred population was sired by bulls used in the purebred Simmental and Angus populations. The results are based primarily on the F_1 generation. Six F_2 calves have been produced thus far in the study. Twenty-six 50% Simmental, 50% Angus calves were born. Of the 26 F_1 calves, 15 were sired by Simmental bulls and 11 were sired by Angus bulls.

Average gestation length was 287 ± 2.69 days and birth weight average was 80.0 ± 4.21 lb for the 50% Angus, 50% Simmental calves. Weaning weight average was 565.1 ± 18.37 lb and yearling weight average was 714.4 ± 47.65 lb.

Table 25.2 gives heterosis for birth weight, gestation length, weaning, weight and yearling weight by percentage of breeding in the calves. The most reliable heterosis values are associated with 50% Angus-50% Simmental calves, which included most of the calves in the heterosis analysis. All heterosis values in that group are very similar to previously published reports.

The reciprocal F_1 crosses favor the Angus-sired calves raised by Simmental dams. Those calves were 4.76 lbs heavier at birth, 72.63 lbs heavier at weaning, and 52.23 lbs heavier as yearlings compared to the reciprocal. In the parent populations, purebred Simmental calves outweighed purebred Angus calves at birth, weaning, and as yearlings. The differences between the reciprocal cross calves cannot be totally explained by differences in milk production between the two dam breeds.

Studies of rotational crossbreeding systems indicate that high levels of heterosis are sustained in successive generations. The F_1 crosses produced thus far should express maximum individual heterosis. As F_1 females are retained in the herds, subsequent generations in the two-breed, rotational crossbreeding system should show decreased individual and maternal heterosis.

Previous studies have shown that both individual and maternal heterosis will stabilize to two-thirds of the maximum heterosis in seven generations using a two-breed, rotational crossbreeding system.

Table 25.1. Least Squares Means and Standard Errors by Trait and Percentage of Angus and Simmental in Calves Used to Calculate Heterosis Values

% breeding of calf		No. born	Trait			
Simmental	Angus		Birth weight (kg)	Gestation length (d)	Weaning weight (kg)	Yearling weight (kg)
0	1	41	31.9 (1.34) ¹	283.9 (2.52)	243.8 (6.99)	305.2 (8.99)
1/8	7/8	2	37.8 (4.65)	293.0 (3.48)	270.7 (16.54)	338.5 (23.31)
1/4	3/4	2	30.9 (4.81)	-	222.0 (18.85)	286.8 (26.71)
1/2	1/2	27	36.3 (1.91)	287.0 (2.69)	256.3 (8.33)	324.0 (12.61)
5/8	3/8	2	39.0 (4.72)	303.7 (4.53)	280.8 (22.54)	364.3 (31.26)
1	0	8	35.1 (2.60)	292.1 (2.07)	244.1 (12.18)	309.8 (16.58)

¹Standard errors are in parentheses.

Table 25.2. Percent Heterosis for Birth Weight, Weaning Weight, Yearling Weight, and Gestation Length

Simmental % in Calf	Heterosis (%) ¹			
	Birth Wt.	Weaning Wt.	Yearling Wt.	Gestation Length
1/2	8.31 (27) ²	5.05 (26)	5.39 (13)	- .30 (10)

¹Heterosis = ((Crossbred Avg. - Weighted Purebred Avg.) / Weighted Purebred Avg.) * 100. Weighted purebred average = (Angus mean * % Angus in calf) + (Simmental mean * % Simmental in calf).

²Numbers in parentheses indicate number of observations.