REPRODUCTIVE PERFORMANCE OF TWO- AND THREE-YEAR-OLD BULLS ASSIGNED TWENTY-FIVE OR FORTY COWS DURING THE BREEDING PERIOD

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Summary

Two- and 3-year-old beef bulls were exposed to 25 or 40 beef cows on pasture during a 90-day breeding period. Reproductive performance of bulls by age of bull and size of cow group was evaluated in terms of percentage calf crop. Results indicated that reproductive performance of 2-year-old bulls was higher, but not significantly different (P > .05), than that of 3-year-old bulls. The percentage calf crop from 40 vs 25 cows per bull was not different (P > .05). Differences among bulls (within age of bull and size of cow group) for percentage calf crop were significant for each of four intervals during the calving periods.

(Key Words: Reproductive Performance, Reproduction, Beef Bulls, Beef Cattle.)

Introduction

Using more bulls than are needed to breed cows within a specific time interval is an unnecessary expense in beef cattle production. The question arises as to how many cows can a bull breed without undue delay in conception during a 90-day breeding period? Research has not determined the answer to this question. Although an attempt was made to provide answers to this question in Kansas between 1946 and 1950 (Neumann and Snapp, 1969), details of the study are not available.

The purpose of this study was directed toward providing answers, at least in part, to the preceding question. The objectives of this study were to determine the effect of 2- vs 3-year-old bulls and 25- vs 40-cow breeding groups on percentage calf crop.

Materials and Methods

This 3-year study was conducted at the Georgia State Prison at Reidsville. Reidsville is in the upper coastal plain area. During the breeding period, the 3-year averages for average maximum, average minimum and average temperature were, respectively: April, 27.2 C, 12.2 C, 19.7 C; May 30.0 C, 17.2 C, 23.6 C; June 31.7 C, 19.4 C, 25.6 C. Average rainfall was 5.2 cm, 13.5 cm and 11.5 cm for April, May and June, respectively.

The cows were straightbreds and crosses of Angus, Polled Herefords and Santa Gertrudis as well as a small number of crossbreds sired by Charolais and Simmental x Polled Hereford (F 1 ) bulls. The Angus, Polled Hereford, Charolais and Simmental x Polled Hereford (F 1 ) bulls were from the Coastal Plain Station herds at Tifton and the Santa Gertrudis were from the University of Georgia herd at Athens. The bulls were considered a random sample among bulls whose weaning and post-weaning performance was in the upper half in the herds for the years in which they were raised. Bulls were not subjected to semen or fertility tests but were evaluated for physical soundness and were observed for breeding cows, especially during the early part of the breeding period. However, the 3-year-old bulls previously demonstrated the ability to breed cows as 2-year-olds.

Cows and bulls were wintered principally on average to low quality Coastal bermudagrass hay (IRN 1-00-703) and sorghum silage (IRN 3-04-321). During the remainder of the year, they were on Coastal bermudagrass pastures (IRN 2-00-717).

Each year, cows were allotted to 25-or 40-cow breeding groups with proportionate representation for the cow's breed composition, age, birth date of her calf and whether or not the cow was nursing a calf.

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animals included heifers first exposed to bulls as 2-year-olds and a few cows (not more than 5% in each breeding group) that failed to calve the previous year or whose calves were born dead or died soon after birth. It was assumed that all cows were cycling at the outset of the breeding period. Cows were weighed at the outset (April 1) and end (July 1) of the breeding period. Some of the cows were culled in the fall at the time the calves were weaned for reasons other than lack of pregnancy. Also, cows not producing or weaning calves 2 successive years were culled at the end of the calving period or at the usual time of culling in the fall. Cows were not palpated for pregnancy.

The breeding groups were rotated among pastures to minimize pasture differences. All pastures were open land, free of brush but with enough trees to provide adequate shade. The terrain among pastures was similar, varying from almost flat to gently rolling. All pastures were well sodded with Coastal bermudagrass; however, stocking rate varied from 3.7 to 5.0 cows per hectare. Differences in stocking rate was the primary reason for rotating breeding groups among pastures. Availability of grass was considered adequate in all pastures.

Two- and 3-year-old bulls were used the first and third years while 3-year-old bulls were used the second year. Five of the 2-year-old bulls used the first year were used the second year. Within age of bull, bulls of a particular breed or cross were assigned at random to either a 25- or 40-cow group. Each bull stayed continuously in the same pasture assigned to cows throughout the 90-day breeding period.

Records kept on cows calving included calves' birth date, sex, tattoo (same as ear tag) and identity of the calves' dams. At various intervals during the calving period (February 3,

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<td>90&lt;sup&gt;d&lt;/sup&gt;</td>
<td>97&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>A = Angus, PH = Polled Hereford, SG = Santa Gertrudis, C = Charolais, SX = Simmental X PH (F<sub>1</sub>).

<sup>b</sup>One cow in each of these 40-cow groups was culled when the calves were weaned in the fall. Since no cows were palpated for pregnancy, present calf crops of these groups were based on 39 cows present at calving.

<sup>c</sup>Average gain of cows during the breeding period from April 1, 1975 to July 1, 1975. The 25-cow groups gained an average of 31.7 kg (30.4 to 68.0 kg) while the 40-cow groups gained an average of 42.0 kg (30.8 to 54.9 kg).

<sup>d,e</sup>Vertical percentages within calving date, age of bull and cows per bull subset not having letters in common are significantly different (P<.05) as determined from estimated differences from least squares procedure.
February 16, March 3 and end of calving), cumulative percentage calf crop was determined for each of the cow groups.

Cows having calves at a particular interval were assigned a value of "1" (success) while those not having a calf at a particular interval were assigned a "0" (not a success). Analysis of variance, using the method of least squares (Barr and Goodnight, 1971), was used to analyze the values for individual cows to determine the statistical significance of factors affecting percentage calf crop. Two statistical models were used. The first model included percentage calf crop from 2- and 3-year-old bulls mated to groups of 25 or 40 cows the first and third years. Main effects were year, age of bull and size of cow group. Interactions were all two- and three-way interactions. Also included were effects due to bulls within year, age of bull and size of cow group. The residual was among cows within year, age of bull, size of cow group and bull. The residual was used as the error term for determining differences among bulls within year, age of bull and size of cow group. If significant, the latter was used as the error term for all main effects and interactions. The second model included percentage calf crop from 3-year-old bulls mated to groups of 25 to 40 cows the first, second and third years. This model and the procedure for determining statistical significance was the same as the first model except age of bull was deleted. Also, the two-way interaction of year x group, if found significant, was used in error term for main effects.

**Results**

The results of the first, second and third years are given in tables 1, 2 and 3. These tables also show cow gain during the breeding period. The average and range of cow gain for the 25- and 40-cow groups were similar each year. In general, the cows gained at an acceptable rate during the breeding period.

Means squares and least square means for the first and third years involving 2- and 3-year-old bulls are presented in table 4. Year difference

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**TABLE 2. REPRODUCTIVE PERFORMANCE OF 3-YEAR-OLD BULLS EXPOSED TO 25 OR 40 COWS DURING THE BREEDING PERIOD IN 1976**

<table>
<thead>
<tr>
<th>Bulls</th>
<th>Cows per bull, no.</th>
<th>Cow gain, kg</th>
<th>2-3-77</th>
<th>2-16-77</th>
<th>3-3-77</th>
<th>End of calving</th>
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<td>76d</td>
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<td>88de</td>
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<td>64d</td>
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<td>92de</td>
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<td>68d</td>
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<td>76d</td>
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<td>84de</td>
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<td>SX 360</td>
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<td>93</td>
<td>56de</td>
<td>64d</td>
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<td>71</td>
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<td>82de</td>
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</table>

A = Angus, PH = Polled Hereford, SG = Santa Gertrudix, SX = Simmental X PH (F1).

b One cow from each of these cow groups was culled when the calves were weaned in the fall. Since no cows were palpated for pregnancy, percent calf crops of these cow groups were based on the number of cows present at calving.

c Average gain of cows during the breeding period from April 1, 1976 to July 1, 1976. The 25-cow groups gained an average of 62.6 kg (42.6 to 93.4 kg) while the 40-cow groups gained an average of 59.3 kg (40.4 to 87.1 kg).

d,e,f Vertical percentages within calving date and cows per bull subset not having letters in common are significantly different (P<.05) as determined from estimated differences from least squares procedure.
### TABLE 3. REPRODUCTIVE PERFORMANCE OF BULLS EXPOSED TO 25 OR 40 COWS DURING THE BREEDING PERIOD IN 1977

<table>
<thead>
<tr>
<th>Bulls&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Cows per bull, no.</th>
<th>Cow gain&lt;sup&gt;c&lt;/sup&gt;, kg</th>
<th>2-3-78</th>
<th>2-16-78</th>
<th>3-3-78</th>
<th>End of calving</th>
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<sup>a</sup>A = Angus, PH = Polled Hereford, SG = Santa Gertrudis.

<sup>b</sup>One cow from each of these cow groups was culled when the calves were weaned in the fall. Since no cows were palpated for pregnancy, percent calf crops of these cow groups were based on the number of cows present at calving.

<sup>c</sup>Average gain of the cows during the breeding period from April 1, 1977 to July 1, 1977. The 25-cow groups gained an average of 67.7 kg (31.4 to 92.4 kg) while the 40-cow groups gained an average of 61.9 kg (40.0 to 94.0 kg).

<sup>d,e</sup>Vertical percentages within calving date, age of bull and cows per bull subset not having letters in common are significantly different (P<.05) as determined from estimated differences from least squares procedure.

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was not significant for any of the four calving dates. Although not significant, 2-year-old bulls had noticeably higher percentage calf crops during the first three calving dates which narrowed to 3.1% at the end of calving. The 40-cow groups had a small advantage over the 25-cow groups in calving percentage for each of the four calving dates. Of the interactions, year x group was the most important. For each of the calving dates, the 40-cow groups had a substantial advantage the first year but a slight disadvantage the third year compared with the 25-cow groups in calving percentage. Differences among bulls were significant for calving percentage in each of the calving periods.

Mean squares and least squares means for the 3-year-old bulls bred to 25 or 40 cows during the first, second and third years are presented in Table 5. Year differences in calving percentage were not significant for any of the calving periods. The comparatively larger mean squares for the first two calving periods were due to the higher calving percentages for the 25- and 40-cow groups the second compared with the other 2 years. The difference between the 25- and 40-cow groups was not significant for any of the calving periods. Year x group interaction was significant for the first calving period. This was primarily due to nonsignificant differences among bulls for the first period. For the 3-year-old bulls, calving percentage was higher for the 40-cow group for each calving period the first year, but the 25-cow group generally had higher calving percentages the last 2 years. However, at the end of calving, least square means indicated that calving percentage for these two cow groups was essentially the same.
TABLE 4. ANALYSES OF VARIANCE OF REPRODUCTIVE PERFORMANCE OF 2-AND 3-YEAR-OLD BULLS EXPOSED TO 25 OR 40 COWS DURING THE BREEDING PERIOD IN 1975 AND 1977

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Feb. 3</th>
<th>Feb. 16</th>
<th>March 3</th>
<th>End of calving</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mean squares</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year (Y)</td>
<td>1</td>
<td>1.093</td>
<td>.869</td>
<td>.136</td>
<td>.002</td>
</tr>
<tr>
<td>Age (A)</td>
<td>1</td>
<td>3.312</td>
<td>3.262</td>
<td>3.115</td>
<td>.203</td>
</tr>
<tr>
<td>Group (G)</td>
<td>1</td>
<td>.842</td>
<td>.132</td>
<td>.099</td>
<td>.546</td>
</tr>
<tr>
<td>Y X A</td>
<td>1</td>
<td>.354</td>
<td>1.086</td>
<td>1.217</td>
<td>.127</td>
</tr>
<tr>
<td>Y X G</td>
<td>1</td>
<td>1.946</td>
<td>2.794</td>
<td>1.082</td>
<td>1.007*</td>
</tr>
<tr>
<td>Y X A X G</td>
<td>1</td>
<td>.014</td>
<td>.024</td>
<td>.059</td>
<td>.124</td>
</tr>
<tr>
<td>Bulls (Y, A, G)</td>
<td>20</td>
<td>.826**</td>
<td>.892**</td>
<td>1.072**</td>
<td>.214**</td>
</tr>
<tr>
<td>Cows (Y, A, G, Bull)</td>
<td>875</td>
<td>.211</td>
<td>.222</td>
<td>.179</td>
<td>.103</td>
</tr>
</tbody>
</table>

**Least squares means of calving percentage**

<table>
<thead>
<tr>
<th>Year</th>
<th>1976</th>
<th>1977</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-year-old bulls</td>
<td>39.8</td>
<td>42.5</td>
</tr>
<tr>
<td>3-year-old bulls</td>
<td>32.6</td>
<td>29.9</td>
</tr>
</tbody>
</table>

Discussion

These data indicate that reproductive performance of 2-year-old bulls was slightly higher, but not significantly different than that of 3-year-old bulls. As judged by percentage calf crops at the various calving dates, there was an indication that 2-year-old bulls settled a higher percentage of their cows earlier in the breeding period than 3-year-old bulls. Settling cows early in the breeding period is of economic importance because these cows, compared with those that settle late in the breeding period, will have older and usually heavier calves at weaning. The data also indicated no significant difference in percentage calf crop from 40 vs 25 cows per bull during the 90-day breeding period. Further, these data showed that percentage calf crop at intervals during the calving period was influenced (P<.01) by differences among bulls. Thus, there were some bulls, whether they were 2- or 3-year-olds, that settled their cows earlier in the breeding period and (or) had a higher percentage of their cows settled by the end of the breeding period than other bulls. This is in agreement with results of Blockey (1978).

Survey results indicate that on the average one bull is used to breed 21.5 cows (Ensminger et al., 1955). Assuming that the current ratio is not greatly different from this ratio, more bulls are used for breeding purposes than are needed, especially under the conditions in which these data were obtained. Thus, the results of this study indicate that fewer bulls could reduce the bull cost per calf born.

The authors realize that the results of this study do not adequately answer the question of how many cows should be allotted per bull during the breeding period. Bulls of high serving capacity, as determined by Blockey (1978) or by some other determination prior to the breeding period, may satisfactorily settle more than 40 cows during a 90-day breeding period under certain conditions. Also, the number of cows per bull may vary due to differences in pasture area, climatic conditions, type of terrain, et cetera. It is expected that further studies will be forthcoming in this greatly needed area of research.
TABLE 5. ANALYSES OF VARIANCE OF REPRODUCTIVE PERFORMANCE OF 3-YEAR-OLD BULLS EXPOSED TO 25 OR 40 COWS DURING THE BREEDING PERIOD IN 1975, 1976 AND 1977

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Feb. 3</th>
<th>Feb. 16</th>
<th>March 3</th>
<th>End of calving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year (Y)</td>
<td>2</td>
<td>5.388</td>
<td>2.253</td>
<td>.568</td>
<td>.025</td>
</tr>
<tr>
<td>Group (G)</td>
<td>1</td>
<td>.008</td>
<td>.477</td>
<td>.153</td>
<td>.003</td>
</tr>
<tr>
<td>Y X G</td>
<td>2</td>
<td>.695*</td>
<td>.834</td>
<td>.532</td>
<td>.652</td>
</tr>
<tr>
<td>Bulls (Y, G)</td>
<td>20</td>
<td>.316</td>
<td>.720**</td>
<td>1.083**</td>
<td>.219*</td>
</tr>
<tr>
<td>Cows (Y, G, Bull)</td>
<td>811</td>
<td>.227</td>
<td>.228</td>
<td>.196</td>
<td>.120</td>
</tr>
</tbody>
</table>

Mean squares

<table>
<thead>
<tr>
<th>Year</th>
<th>Feb. 3</th>
<th>Feb. 16</th>
<th>March 3</th>
<th>End of calving</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976</td>
<td>31.5</td>
<td>49.5</td>
<td>62.9</td>
<td>84.7</td>
</tr>
<tr>
<td>1977</td>
<td>53.4</td>
<td>65.0</td>
<td>71.7</td>
<td>85.8</td>
</tr>
<tr>
<td>1978</td>
<td>28.4</td>
<td>50.3</td>
<td>68.0</td>
<td>86.9</td>
</tr>
</tbody>
</table>

Least square means of calving percentage

<table>
<thead>
<tr>
<th>Group</th>
<th>Feb. 3</th>
<th>Feb. 16</th>
<th>March 3</th>
<th>End of calving</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 cows per bull</td>
<td>37.4</td>
<td>57.5</td>
<td>69.0</td>
<td>86.0</td>
</tr>
<tr>
<td>40 cows per bull</td>
<td>38.1</td>
<td>52.4</td>
<td>66.1</td>
<td>85.8</td>
</tr>
</tbody>
</table>

*P<.05.
**P<.01.

**Literature Cited**