A COMPARISON OF SEMEN QUALITY IN BRAHMAN CROSS AND AFRICANDER CROSS BULLS

H.R. CHRISTENSEN* and G.W. SEIFERT**

Summary

Semen collected from Brahman cross and Africander cross (Belmont Red) bulls in Central Queensland was examined to assess the proportion of live sperm and the proportions of abnormal sperm. Brahman cross bulls produced a lower proportion of live sperm than Africander cross bulls although individual Brahman cross bulls were equal to the best of the Africander cross bulls. Significant breed differences were found in the proportion of total minor abnormalities with AX bulls producing fewer than BX bulls. Proportionately more AX bulls than BX bulls produced semen with above minimum levels of per cent live and with fewer than maximum levels of some abnormalities. The implications of these findings when selecting bulls on semen quality are discussed.

I. INTRODUCTION

Substantial gains in production can be achieved by systematic utilization of crossbreeding in Northern Australia (Piper and Latter 1974). Zebu cattle have already gained popularity in that area, where in Central and Northern Queensland over 50% of breeding bulls in 1973 were Brahman or Brahman derived and 39 holdings carried some Africander breeding stock (Anon., 1973). Although zebu introductions in Australia have largely been used to create new breeds (Piper and Latter 1974), there is an increasing trend towards systematic crossbreeding (Rudder, pers. comm.).

Limited research has shown that the fertility of Brahman crosses is lower than that of Africander crosses in the F2 generation (Seifert and Kennedy 1972; Seebeck 1974) and part of the decline in fertility is attributable to the bull (Seifert, unpublished data).

Semen quality is a component of bull fertility and two measures used to assess semen quality are the proportion of live sperm and the proportion of morphologically abnormal sperm in the semen.

This paper records differences observed in these measures between two crossbreeds, Brahman cross (BX) and Africander cross (AX),

II. MATERIALS AND METHODS

Semen samples were collected from AX and BX bulls on the National Cattle Breeding Station, "Belmont", Rockhampton, during 1973, 1974 and 1975. The derivation of the crossbred bulls and the environment of the station were described by Kennedy and Turner (1959). The bulls used had been selected from the bull calf drops in 1971, 1972 and 1973 on the basis of their growth performance and tick resistance. At the time of

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semen collection the average age of the bulls was 24 months in 1973, 22 months in 1974, and 18 months in 1975.

The bulls were run together from birth and were sampled as they came up the crush. Semen was collected using manual massage of the ampullae per rectum after the method of Goodwin (1970) and Parsonson, Hall and Settergren (1971). The density of the semen sample collected was assessed visually and scored 1-5, very dense semen with visible motion being scored as 5. The percentage live sperm in each sample was assessed by counting 100 sperm cells on an eosin-nigrosin stained smear using stain prepared according to Swanson and Bearden (1951). The frequencies of sperm abnormalities were assessed by counting 100 sperm cells on India ink stained smears.

The proportion of live sperm, the proportion of each of 23 individual types of sperm abnormality, the proportions of major and minor groups of abnormalities as classified by Blom (1972), and density of the semen sample were recorded. The proportions were transformed to the angle \[ X_{ij} \arcsin(\text{proportion}) \] (Snedecor 1967) and were analysed by the least squares method (Harvey 1960) using the following model:

\[ X_{ij} = \mu + Y_i + B_j + (YB)_{ij} + e_{ij} \]

where

- \( X_{ij} \) = live sperm \((n=1)\); individual abnormalities \((n=2...25)\); density \((n=26)\); major abnormalities \((n=27)\); minor abnormalities \((n=28)\).
- \( \mu \) = overall means
- \( Y_i \) = year \((i=1,2,3)\)
- \( B_j \) = breed of bull \((j=1,2)\)
- \( (YB)_{ij} \) = the interaction of the \( i^{th} \) year by the \( j^{th} \) breed of bull
- \( e_{ij} \) = random error. Assumed NID \( (0,\sigma^2) \)

III. RESULTS AND DISCUSSION

Table 1 shows the analysis of variance for the angular transformations of proportion of live sperm and minor abnormalities.

**TABLE 1**

Analysis of variance for proportion live sperm and proportion minor abnormalities

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>D.F.</th>
<th>Love Sperm</th>
<th>Minor Abnormalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years ((Y))</td>
<td>2</td>
<td>10.778</td>
<td>886.889***</td>
</tr>
<tr>
<td>Breeds ((B))</td>
<td>1</td>
<td>753.185</td>
<td>300.075*</td>
</tr>
<tr>
<td>Y x B</td>
<td>2</td>
<td>267.410**</td>
<td>90.174</td>
</tr>
<tr>
<td>Error</td>
<td>118</td>
<td>55.133</td>
<td>61.080</td>
</tr>
</tbody>
</table>

* P < .05; ** P < .01; *** P < .001
(a) Proportion of live sperm

The BX bulls had fewer live sperm than the AX bulls, but one BX bull produced semen with a higher proportion live sperm than the best of its contemporary AX bulls. However, significantly more (X², P < 0.001) BX bulls produced semen with less than 70% live sperm than did AX bulls. A level of 60% live sperm has been suggested as the minimum acceptable level for normal bull semen (Galloway 1974) and more BX bulls than AX bulls (X², P < 0.1) produced semen with less than 60% live sperm.

In all years the BX had lower% live sperm than the AX (Table 2), but this difference was particularly large during 1973, causing a significant interaction. The reason for this large difference during 1973 has not been determined.

<table>
<thead>
<tr>
<th>Breeds</th>
<th>Years</th>
<th>1973</th>
<th>1974</th>
<th>1975</th>
<th>All years</th>
</tr>
</thead>
<tbody>
<tr>
<td>AX</td>
<td>Live sperm</td>
<td>63.2</td>
<td>78.0</td>
<td>75.3</td>
<td>78.9</td>
</tr>
<tr>
<td></td>
<td>Minor Abnorm</td>
<td>11.0</td>
<td>5.7</td>
<td>11.6</td>
<td>9.2</td>
</tr>
<tr>
<td>BX</td>
<td>Live sperm</td>
<td>65.3</td>
<td>73.7</td>
<td>73.3</td>
<td>70.9</td>
</tr>
<tr>
<td></td>
<td>Minor Abnorm</td>
<td>17.4</td>
<td>5.5</td>
<td>17.8</td>
<td>12.9</td>
</tr>
<tr>
<td>All breeds</td>
<td>Live sperm</td>
<td>74.8</td>
<td>75.9</td>
<td>74.4</td>
<td>75.0</td>
</tr>
<tr>
<td></td>
<td>Minor Abnorm</td>
<td>14.0</td>
<td>5.6</td>
<td>14.5</td>
<td>11.0</td>
</tr>
</tbody>
</table>

†Includes: elongated narrow, microcephalic, macrocephalic, double, and detached normal heads; distal droplets, bent tails and detached acrosome.

These results suggest that when selecting bulls on the basis of semen quality the acceptable proportion of live sperm may need to be lower for BX bulls than for AX bulls. Preferably it may be necessary to sample proportionately more BX bulls than AX bulls to obtain the required number with a common acceptable proportion of live sperm.

(b) Proportions of abnormal sperm

There were significant (P < 0.05) breed differences noted in the proportion of total minor abnormalities, AX bulls producing fewer abnormalities than the BX bulls (Table 2). Year effects were highly significant for many abnormalities indicating that environmental effects could be important sources of variation.

Although there was no significant breed difference for individual abnormalities in all samples, significantly fewer (X², P < 0.05) BX bulls than AX bulls produced semen with less than 10% bent tails; less than 15% tailless heads; and less than 4% proximal droplets. The levels examined are the maximum acceptable normal levels suggested by Galloway (1974). Thus, proportionately more BX bulls than AX bulls would be rejected if a common acceptable level of abnormalities was used.
These results support the work of Chenoweth and Osborne (1975) that Brahman cross bulls have a poorer reproductive function than Belmont Red bulls although some individuals of the BX genotype are equal to the best of the Belmont Red genotype.

IV. ACKNOWLEDGEMENTS

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REFERENCES