CONTINUING DEVELOPMENT OF A TROPICAL DAIRY BREED

M.L. TIERNEY* AND G.K. REASON*

INTRODUCTION

The development of tick resistant, heat tolerant breeds of dairy cattle was commenced in the early 1960's by both CSIRO and the Queensland Department of Primary Industries. These breeds were developed principally with a view to having a tick resistant breed of dairy cattle available should there be a breakdown in the current available acaricides.

The Australian Milking Zebu (AMZ) was based on the Jersey, Sahiwal and Sindhi breeds (Hayman 1974). It was developed by CSIRO. The Australian Friesian Sahiwal (AFS) was developed by the Queensland Department of Primary Industries and was based on the Holstein-Friesian and Sahiwal breeds (Alexander et al. 1984a).

With the likelihood of a complete breakdown of available acaricides less likely now than it appeared in the early 1960's, the emphasis of both breeds is now more directed to filling an export role in developing countries where levels of nutrition and management impose severe constraints on productivity of Bos taurus animals.

This paper will discuss the production achieved by the AFS breed, which is basically 50% Holstein-Friesian and 50% Sahiwal, and the likely improvement in the breed in the future.

CURRENT PRODUCTION

Table 1 presents production data from the 1984-85 Queensland Herd Recording year for AFS and Holstein-Friesian cows.

Table 1 AFS and Holstein-Friesian production results from the 1984-85 Queensland Herd Recording year

<table>
<thead>
<tr>
<th>Age</th>
<th>No.</th>
<th>AFS Milk (L)</th>
<th>AFS Fat (kg)</th>
<th>Holstein-Friesian Milk (L)</th>
<th>Holstein-Friesian Fat (kg)</th>
<th>AFS as % of Holstein-Friesian Milk</th>
<th>AFS as % of Holstein-Friesian Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤3 years</td>
<td>95</td>
<td>2088</td>
<td>87</td>
<td>9950</td>
<td>3315</td>
<td>126</td>
<td>63.0</td>
</tr>
<tr>
<td>3 years</td>
<td>98</td>
<td>2604</td>
<td>110</td>
<td>7734</td>
<td>3698</td>
<td>143</td>
<td>70.4</td>
</tr>
<tr>
<td>&gt;4 years</td>
<td>150</td>
<td>3072</td>
<td>124</td>
<td>22590</td>
<td>4066</td>
<td>155</td>
<td>75.6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>440</td>
<td>2729</td>
<td>113</td>
<td>47351</td>
<td>3824</td>
<td>146</td>
<td>71.4</td>
</tr>
</tbody>
</table>

In Queensland, then, the AFS is currently producing approximately 71% of the milk produced by Holstein-Friesians and 77% of the fat.

These figures are not strictly comparable with those which have been reported previously (Tierney 1985) in which the AFS was reported in 1983-84 as producing 75% of the milk and 82% of the fat of the Holstein-Friesian breed.

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There has been a better editing of the data included in the 1984-85 analysis than in the 1983-84 analysis.

While the above figures show the production of the AFS relative to the Holstein-Friesian, which is by far the most popular breed of dairy cattle in Queensland, the performance of the AFS relative to the other breeds in Queensland is far more favourable. These figures are presented in Table 2.

Table 2 Average Production, by breed, from the 1984-85 Queensland Herd Recording year

<table>
<thead>
<tr>
<th>Breed</th>
<th>No. of Cows</th>
<th>Lactation Length (Days)</th>
<th>Milk (L)</th>
<th>Test (%)</th>
<th>Fat (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFS</td>
<td>440</td>
<td>266</td>
<td>2729</td>
<td>4.1</td>
<td>113</td>
</tr>
<tr>
<td>AME</td>
<td>163</td>
<td>280</td>
<td>2227</td>
<td>4.5</td>
<td>101</td>
</tr>
<tr>
<td>Ayrshire</td>
<td>971</td>
<td>276</td>
<td>3054</td>
<td>3.8</td>
<td>117</td>
</tr>
<tr>
<td>Guernsey</td>
<td>2527</td>
<td>277</td>
<td>2808</td>
<td>4.3</td>
<td>120</td>
</tr>
<tr>
<td>Holstein-Friesian</td>
<td>47351</td>
<td>281</td>
<td>3824</td>
<td>3.8</td>
<td>146</td>
</tr>
<tr>
<td>Illawarra</td>
<td>13950</td>
<td>271</td>
<td>3310</td>
<td>3.8</td>
<td>125</td>
</tr>
<tr>
<td>Jersey</td>
<td>7238</td>
<td>277</td>
<td>2748</td>
<td>4.7</td>
<td>130</td>
</tr>
</tbody>
</table>

In interpreting the relative productions reported above, it must be considered that during the 1984-85 production year, there were still a considerable number of F1 heifers being evaluated. As in past years, the rejection rate of F1's was of the order of 50% (Alexander et al. 1984a) with cows being rejected because of a failure to milk for 120 days. These cows are included in the AFS data bank while such cows would normally not appear in the other breeds. The relatively higher proportions of cows of young ages in the AFS than in the other breeds also tends to reduce the overall production of the AFS. In the current year, 66% of the AFS cows recorded were aged 4 years or less, while only 52% of the Holstein-Friesians were of a similar age.

The current production levels of the AFS have been achieved through the use of a bull proving programme which was begun in 1976. Under this programme, as with all dairy bull proving programmes, sires which are identified as superior are mated to elite cows to produce a team of young bulls for proving each year. Once bulls are proven to be genetically superior, they are available for general use through artificial insemination.

The first AFS bulls were not proven till 1982, so it is only since that time that proven AFS semen has been available. Progeny of proven sires are only now coming into semen production, and it is only in 1985 that the first sons of proven sires have been available for inclusion in proving teams.

In the 1985 listing of Australian Breeding Values (ABV’s) released by the Australian Dairy Herd Improvement Scheme, there are now five AFS bulls with ABV’s of +6 kg of fat or better and four bulls with ABV’s of +100 litres of milk or better. In total, there are now ten AFS bulls with positive ABV’s for fat and nine with positive ABV’s for milk.
FUTURE DEVELOPMENT OF THE BREED

While the average production of the AFS breed for 1984-85 was 2,729 litres of milk and 113 kg of fat, some 10% of AFS cows (45 cows) had productions of 4,000 litres of milk or better, while 19% (84 cows) had productions of 150 kg of fat or better.

These superior cows will be utilised to form a nucleus herd of elite cows in which a multiple ovulation and embryo transfer (MOET) programme will be carried out.

Nicholas and Smith (1983) have reported that in most progeny testing programmes, rates of genetic gain of less than 1% per year are being achieved. This would certainly be the case with the AFS breed, where numbers involved have been small, and up until three years ago, proven sires were not available to breed young bulls for inclusion in progeny test teams. In the same paper, they suggest that by using a MOET programme to breed bulls for use in AI, rates of gain of up to 2.3% per year can be reasonably expected.

The establishment of a MOET programme in the development of the AFS breed will greatly increase the rate of genetic gain that should be made in the future.

USE OF AFS BREED IN TROPICAL COUNTRIES

Lack of numbers, at this stage, of AFS cattle preclude the export of a ready-made tick resistant, heat tolerant breed of dairy cattle for use in tropical countries.

To overcome this lack of numbers of AFS cattle, large numbers of Sahiwal x Friesian cows are being exported to tropical countries from New Zealand. These F1 cattle have the same problems with failure to milk as were seen in the original F1 cattle in the development of the AFS breed (Alexander et al. 1984a).

McMillan and Pearce (1985) have suggested that a better approach would be to mate AFS sires to Bos taurus dams and then inseminate the resulting progeny with semen from unrelated AFS sires before they are exported. Alternatively, AFS semen could be used to inseminate Bos taurus cattle already in, or exported to, tropical countries, with the progeny again being inseminated with AFS semen. Continued use of AFS semen would eventually result in cattle of approximately 50% Sahiwal and 50% Holstein-Friesian genes.

The performance of AFS X Holstein-Friesian cattle in co-operators' herds in Queensland was measured as a percentage of the production of their Bos taurus herdmates in three dairying districts in Queensland in the early 1980's. These data are presented in Table 3.

In each of the geographical areas reported in this table, the AFS X Holstein-Friesian cattle performed better than their Bos taurus herdmates. This shows that such a mating system, as the first step in the production of basically 50% Sahiwal, 50% Holstein-Friesian cattle, has resulted in increased production in the AFS X Holstein-Friesian cattle.
Table 3 Production of AFS X Holstein-Friesian Cattle and their Bos taurus herdmates

<table>
<thead>
<tr>
<th>Location</th>
<th>Production of crossbred as a percentage of B. taurus herdmates</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Queensland (approximately 17°S)</td>
<td>117% 118%</td>
</tr>
<tr>
<td>Central Queensland (approximately 21°S)</td>
<td>110% 115%</td>
</tr>
<tr>
<td>South-east Queensland (approximately 27°S)</td>
<td>104% 110%</td>
</tr>
</tbody>
</table>

The MOET programme currently being developed with the AFS breed will also result in reasonable numbers of heifers, or embryos, of the AFS breed for export to tropical countries. These numbers will be relatively low still in the short term and the use of AFS semen would appear the best way of developing large numbers of tropically adapted, high production dairy cattle in the near future.

USE OF EMBRYO TRANSFER IN BOS INDICUS/BOS TAUROUS BREED DEVELOPMENT

T.V. SCHMIDT*

INTRODUCTION

Use of Follicle Stimulating Hormone (FSH) in super-ovulation of Australian Friesian Sahiwal (AFS) cows is discussed. This tick resistant dairy breed has been developed to fill a need for a dairying animal for the tropics. It is a 50% Bos indicus, 50% Bos taurus cross that has been selected for tick resistance and milking ability. The variability in milk production amongst cows of this cross makes it desirable that the breed be expanded from the top 25% of the AFS herd. Hence the use of super-ovulation and embryo transfer to increase the number of calves born per year to the higher producing AFS cows will significantly improve the rate of genetic gain in the breed.

The development of a capacity to freeze embryos will allow the export of the AFS breed in a more convenient and less costly manner than the current live export of mature animals. Another advantage of embryos being transported to South East Asia and implanted in native female cattle to complete their gestation is the immunity that the calves will obtain from their surrogate mothers. This immunity will provide some protection against diseases specific to that area. Animals imported into these areas face a period of exposure and risk to these diseases before immunity develops.

Follicle Stimulating Hormone is the current drug of choice in super-ovulation of cows. Opinions vary as to the most effective method of administration and the most effective dose rates. Lauria et al. (1983) concluded that low total dosage (31 mg FSH) induced in lactating dairy cows a highly variable response, whilst 62 mg FSH produced a satisfactory response. These above dose rates were administered in descending levels i.e. 5 mg, in each of two injections 12 hours apart on day 1 of the programme, 4 mg in each of two injections on day 2 and subsequently decreasing down to 1 mg in two injections on day 5 of the programme.

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Donaldson (1984) however, concluded that the total embryos produced declines from 14.9 with total dose levels of 28 mg to 6.8 with 50 mg. He also concluded that a descending dose of FSH produced significantly more embryos than a level dose but that the number transferable was the same. Heath (1984) recommends a descending dose level with total dose rates of between 25 mg and 50 mg FSH depending on the individual cow.

MATERIALS AND METHODS

Nineteen Australian Friesian Sahiwal (AFS) cows were super-ovulated between June 1984 and June 1985. Three of these were treated on two occasions and two were treated on three occasions, giving a total of 26 flushings in all. Two treatment regimes of FSH were used. Eleven cows were given FSH at a rate of 5 mg twice daily until standing heat (usually a total dose of 45 mg to 50 mg). Fifteen cows were treated with reducing doses of FSH until standing heat (usually a total dose of 32 mg). In both cases heat was induced by the injection of Prostaglandin on day 3 of treatment.

RESULTS AND DISCUSSION

Embryos were collected non-surgically. The 26 flushings produced a total of 167 embryos. Those that received a constant dose of FSH produced 80 embryos with a mean of 7.6. Those that received the descending dose of FSH produced a total of 77 embryos with a mean per flush of 5.35. The two treatments do not appear to induce different levels of embryo production, and differences in embryo production between animals appears to be due to individual responses to FSH rather than the dose rate or method of administration. Predicting individual cow’s responses by the use of serum hormone levels (FSH, luteinizing hormone, progesterone, oestradiol-17 or human chorionic gonadotrophin) would therefore be of obvious benefit.

Although not statistically significant, there did appear to be a reduction in embryos recovered per treatment when cows were flushed on more than one occasion.

Table 1  Effect of repeated super-ovulation treatment in AFS cows

<table>
<thead>
<tr>
<th>Cow No.</th>
<th>1st Flush (embryos)</th>
<th>2nd Flush (embryos)</th>
<th>3rd Flush (embryos)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KD01</td>
<td>21 (15/11/84)</td>
<td>15 (14/2/85)</td>
<td>3 (12/4/85)</td>
</tr>
<tr>
<td>S2931</td>
<td>8 (15/11/84)</td>
<td>8 (14/2/85)</td>
<td>U (24/3/85)</td>
</tr>
<tr>
<td>z717</td>
<td>12 (7/ 2/84)</td>
<td>2 (13/ 3/05)</td>
<td></td>
</tr>
<tr>
<td>V977</td>
<td>2 (31/ 1/85)</td>
<td>8 (13/ 3/85)</td>
<td></td>
</tr>
<tr>
<td>A5</td>
<td>9 (13/ 3/85)</td>
<td>5 (10/ 4/85)</td>
<td></td>
</tr>
</tbody>
</table>

Elsden and Siedel (1982) at the Colorado State University indicated that an immunological response to repeated injections of gonadotrophins may limit the number of times a donor may be super-ovulated. The antigenicity of FSH (and pregnant mare serum gonadotrophin) may stimulate the production of antigenadotrophins which may reduce subsequent response.
Our data, reported in Table 1, are insufficient to establish a trend in Bos indicus cross animals but we feel that there could be a seasonal component in the apparent decrease in embryo production with repeat super-ovulation. Cows undergoing a single-super-ovulation in the period January to June produced less embryos than cows super-ovulated in the period July to December.
CONCLUSION

G.I. ALEXANDER*

The papers presented here outlined the development of the AFS breed to date, and the potential, through embryo transfer, to use the best cows currently available in the breed to make rapid genetic gains in the future.

While the production of the AFS breed, relative to the Holstein-Friesian, under grazing conditions in Queensland is of the order of 70–75% of the Holstein-Friesian, limited data from the Northern Territory (Alexander et al. 1984b) suggest that under wet tropical conditions the AFS will outperform European breeds of dairy cattle both in terms of lactation performance and reproductive performance. The AFS breed therefore should be ideally suited to meet the problems faced in the development of a dairy industry in ASEAN countries.

These problems are not only involved with methods of actually introducing new genetic material into developing countries. Such methods are well discussed here and involve the initial use of AFS semen with subsequent importation of live animals or the development of technology necessary to allow the use of procedures such as embryo transfer.

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Other major problems are the lack of knowledge regarding the management of dairy cattle and problems related to storage and marketing.

The Queensland Department of Primary Industries has a history of providing assistance through training courses in conjunction with the Australian Development Assistance Bureau (ADAB). Such training could be an integral part of the development of a dairy industry in ASEAN countries.

The Department has also been involved in joint projects under the auspices of the Australian Centre for International Agricultural Research (ACIAR). Specific further work required in an overall development programme could be undertaken under this or similar funding arrangements.

While the discussion in this group of papers has been centered on the ASEAN countries in general and Sabah, Malaysia, in particular, the implications of such programmes are not restricted to this region.

The development of self-sufficient dairying industries is currently being pursued also by countries on the Indian sub-continent and in Central and South America. As an example, it has been suggested that Ecuador could well be involved in the establishment of a dairy industry for its coastal region over the next few years. Such a development could eventually involve over 50,000 dairy cattle.

The ability of Australia to be able to assist in the development of dairy industries in such countries will necessitate not only the provision of cattle of suitable genetic make-up, but also the provision of technology packages to support such development and the provision of training where necessary.

REFERENCES