THE EFFECT OF CULLING ON PRODUCTION IN DAIRY CATTLE.

I.R. Franklin*, R.W. Clarke+, and R.M. Morgan++

Summary

A large proportion of the Australian dairy population is herd recorded but not artificially bred, and hence individual farmer decisions, both in the choice of bulls and the culling of unproductive animals are a major component in genetic improvement. Production records from the herds of ten farmers co-operating with CSIRO in the AMZ breeding programme, together with records from other herds in the same area, have been used to measure culling rate and its relationship to age structure and average production. Changes in age structure can make an appreciable difference to rate of genetic improvement, but have little effect on average production per cow.

I. INTRODUCTION

Dairy herd improvement in Australia is fragmented and poorly implemented. In New South Wales the rate of genetic improvement through artificial breeding (A.B.) is estimated to be of the order of 0.5% per annum (K. Hammond, personal communication), and in a number of States there is no progeny testing programme at all. Even if an efficient herd improvement scheme was presently operating, a large proportion of the dairy population does not participate in A.B., and in these animals genetic improvement is largely under the control of the individual farmer.

Herd improvement at the farm level depends on age structure, the pattern of culling imposed by the farmer, and his access to herd recording information. Basically his choice is which cows he will use to breed replacement heifers, and which cows he will use to breed bulls. Rendel and Robertson (1950a) showed that in a closed herd with an average age structure the rate of genetic improvement could be at most one percent per annum, and in practice was likely to be half this. Even so, within-herd selection could allow genetic improvement equal to that currently available through some A.B. centres.

The farmer may increase the rate of genetic gain by increasing the number of heifers reared annually, which has the effect of increasing the selection differential (by increasing the number of cows that may be culled for low production), and by lowering the generation interval. He would be unlikely to adopt such a strategy if the cost of rearing heifers is uneconomic, as it presently is, and if the lowering of the mean age is such that the average milk production is substantially affected. In contrast, he may choose to rear a minimum number of heifers, namely the number required to

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replace those lost each year through injury, disease etc., and carry out little or no culling on production traits. For example if the average productive life of each cow were six years, the farmer would need to rear only one sixth of his herd as replacements. Such a procedure will lead to a slower rate of genetic improvement, but will minimize costs in rearing heifers. It is not obvious however how differences in age structure affect production. In a herd where a large proportion of heifers are reared annually, the inherently low production of heifers will be partly compensated by the lack of older cattle in the herds, and more importantly the opportunity for culling poor producers after the first lactation will result in a more highly selected, and hence more productive, adult herd.

We propose to examine these questions by comparing the age structure and culling rates in two groups of cattle in the North Coast dairying area of New South Wales. One group, consisting of ten herds, are participants in the A.M.Z. breeding programme, and are subsidised by CSIRO to rear 25-30% of their herds as heifers each year. The other group, the control herds, are a sample of nine farms (Jersey, Friesian, and AIS) which are recorded under the N.S.W. Department of Agriculture group herd recording scheme (D.H.I.P.) and presumably adopt a management practice which is typical of the area.

II. RESULTS

All herds are located near Lismore, in the Richmond Tweed region of the North Coast. While this region is usually considered a dairying area, there has been a dramatic swing towards beef production in the last ten years. During the period of this study, from 1965 to 1973, there has been a drop in the number of registered dairies from 4805 to 1139. Of the latter 1139 farms, 132 used A.B., 62 used D.H.I.P. and only 37 used both A.B. and D.H.I.P. The nine control herds are a sample from the 62 using D.H.I.P. In the ten A.M.Z. herds all cows are artificially bred and herd recorded.

Table 1 shows the age distribution at calving, the mean age, the age at first calf, and the percent heifers in these herds.

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>Age distribution at calving in AMZ and control herds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Age at 1st calf</td>
</tr>
<tr>
<td></td>
<td>Age (yr)</td>
</tr>
<tr>
<td>AMZ herds</td>
<td>.26</td>
</tr>
<tr>
<td>Control herds</td>
<td>.13</td>
</tr>
</tbody>
</table>

The difference in age structure is clear. The A.M.Z. herds are younger by 1.2 years, rear 1.6 times the number of heifers, and calve slightly earlier. It should be noted that while 17% of cows are in their first lactation in the control herds, only 13% calved at two years.

Table 2 shows the proportion of animals culled after each of the first six lactations. For example in the AMZ herds 67% of all first lactation heifers were retained to the second lactation, and 33% were culled. After the second lactation 30% of the survivors were culled,
leaving 47% of the original heifers. Table 3 shows the reasons for culling given to the herd recorder, and the proportion in each category.

### Table 2

**Proportion of cows culled at successive lactations.**

<table>
<thead>
<tr>
<th>Lactation number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMZ herds</td>
<td>0.33</td>
<td>0.30</td>
<td>0.21</td>
<td>0.34</td>
<td>0.25</td>
<td>0.27</td>
</tr>
<tr>
<td>Control herds</td>
<td>0.21</td>
<td>0.27</td>
<td>0.29</td>
<td>0.22</td>
<td>0.23</td>
<td>0.31</td>
</tr>
</tbody>
</table>

### Table 3

**Reasons given for culling.**

<table>
<thead>
<tr>
<th></th>
<th>Production</th>
<th>Fertility</th>
<th>Temperament</th>
<th>Mastitis</th>
<th>Age</th>
<th>Death/Injury</th>
<th>Surplus</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMZ herds</td>
<td>0.59</td>
<td>0.15</td>
<td>0.03</td>
<td>0.02</td>
<td>-</td>
<td>0.05</td>
<td>0.09</td>
<td>0.07</td>
</tr>
<tr>
<td>Control herds</td>
<td>0.54</td>
<td>0.08</td>
<td>0.03</td>
<td>0.11</td>
<td>0.07</td>
<td>0.10</td>
<td>-</td>
<td>0.07</td>
</tr>
</tbody>
</table>

There is little difference between the two groups of animals in the reasons for culling. Not surprisingly less cows died or were culled due to age in the AMZ herds, and slightly more were culled on production. The difference in culling for fertility is perhaps due to the Bos indicus ancestry of the AMZ. The primary difference between the two groups is in the timing of culling for production. Over 30% of AMZ cows were culled after the first lactation, and in 70% of these the reason given was low production. However, there were several co-operating farmers who tended to wait until after the second lactation to make a decision. This behaviour is even more striking in the control herds where peak culling is after the third lactation.

### III. Theory

The effect of age structure on production is a complicated topic. Rendel and Robertson (1950b) considered the subject in some detail, and their conclusions were identical to those reached in examination of these data. Hence, the argument will be only briefly outlined. The approach was to fit standard age corrections to the age distributions to assess the loss in production due to the younger and older age groups. Between the ages four to eleven years it makes little difference what proportion of cows are in each age group. A small number of heifers implies a low replacement rate, and hence a larger number of older cows which partially compensates for the lack of young animals. If a large number of heifers are reared, and culled early, the older cows will yield 5 to 10% more than if they were unselected, and this largely recoups the loss in production due to milking young cows. In the AMZ herds culling at early lactations has proven quite effective. The actual difference in production between all heifers, and those saved to the second lactation, was 176 kg, which is very close to the theoretical value.
In all, juggling the age structure through wide limits has a relatively small effect on production. The major consideration is the cost to the farmer of rearing heifers. On the North Coast the estimated total cost of rearing a heifer to two years is $86, and the return on selling a culled two year old is $25 to $30.

The rate of genetic improvement is greater in herds with the age structure of the AM2 cattle (0.7% per annum) compared with the control herds (approximately 0.5% per annum). The selection differential obtained by culling a large number of heifers from unselected dams, compared to replacing the herd with a small number of heifers from selected dams, is greater, but the effect is not large. The primary advantage of the former structure lies in the shorter generation interval.

IV. DISCUSSION & CONCLUSIONS

Despite the fact that it can be demonstrated that fairly large changes in age structure have little effect on average production per milking cow, and that younger mean ages result in greater genetic improvement, the present structure of the AM2 herds probably represents the limit to which a group of dairy farmers can be induced to go. The rates of genetic gain are small to the farmer, and clearly at the present time the cost of rearing calves in comparison to the return of culled animals militates against any lowering of the average age.

The proportion of heifers reared will be of central importance if a progeny testing programme is established in which sire testing herds are used, rather than spreading the testing over the entire herd recorded and artificially bred population. Here it is desirable that the number of progeny test heifers per herd is as large as possible. Between twenty and twenty five percent of the herd is probably a realistic upper limit on the proportion of heifers that can be expected, and even then inducements may have to be offered to persuade the farmer to rear extra heifers.

V. REFERENCES