Tropical cattle are well adapted to the environmental conditions prevailing in the tropics, but their dairy potential is poorly developed. Selective breeding offers good prospects for improving their milk yields.

Tropical cattle are late maturing, have low milk yields, and usually do not let down milk unless they are stimulated by the sucking of the calf. A widely used strategy to improve the dairy potential of tropical cattle is the introduction of genetic material from European dairy breeds, either by importing stock of both sexes in large numbers, or by acquiring bulls (or semen) for crossbreeding with indigenous females. Both approaches have been tried and the results have been varied. Importation of animals of temperate breeds has, in general, been successful only where heat stress is moderate, good feeding and management have been provided, and veterinary services are easily available. Crossbreeding has in most cases led to a dramatic increase in productivity in the first crossbred generation, but subsequent generations have often performed below expectation.

Introduction of genetic material from temperate countries is one of the main reasons for erosion of the of the genetic resources of tropical cattle. These cattle possess genetic properties that are essential for survival and reproduction in the tropics. It is important to preserve these properties for future use.

The alternative to importation of genetic material is improvement by selection (i.e. the best individuals are chosen to parent the next generation). The impressive results achieved by selection in many temperate breeds suggest that there are good prospects for improving the dairy potential of tropical cattle by the same method.

Factors affecting genetic change from selection

The genetic change in one generation brought about by selection is determined by:

a) The genetic variability (i.e. how much the individuals vary with respect to their genetic make-up),

b) The intensity of selection, which is determined by the proportion of individuals needed for breeding (depending on reproductive rate and viability).

c) The accuracy of selection, i.e. how accurately the individuals with the best breeding value can be identified.

The change per unit of time (e.g. per year) depends also on the time interval between successive generations (i.e. the average age of the parents when their progenies are born).

Strategies for genetic improvement in a closed herd

The extensive milk recording schemes which form the basis of dairy cattle breeding programmes in many temperate countries do not exist in the tropics, and cannot easily be established. In addition, artificial insemination often does not function properly. It might therefore be necessary to start an improvement programme with a single herd (or a group of cooperating herds). The following is a prediction of genetic gain for milk yield in a closed (nucleus) herd when the main aim is to maximize progress in this trait. Two alternative strategies for selection of bulls were examined:

a) Progeny testing (performance of daughters)

b) Pedigree selection (performance of female ancestors and their close relatives)

In both alternatives it was assumed that females were selected on the basis of pedigree combined with individual performance. All viable female calves were reared, bred and kept for one lactation. Culling of cows took part at the end of their first lactation, and all
cows not needed in order to maintain herd size were culled. The computations were carried out for a herd of 500 cows.

**Predicted improvement**

a) Progeny testing of bulls

The intensity of selection depends on the number of bulls tested per year, and the accuracy of selection on the number of daughters per bull. It was found that the optimum number of daughters per bull would be about 12, which means that about 10 bulls can be tested per year. We will assume that the best one of the tested bulls is selected each year and used for breeding to cows nominated to be dams to the next generation of bulls (about 10% of the cows in the herd). All other females are mated to young bulls, in order to produce daughters for progeny testing. The genetic progress from this scheme was predicted at 194 kg of milk per generation. With an interval of 6.8 years between successive generations this gives a gain of 28.6 kg per year.

b) Pedigree selection

The following ancestors of the bull calf (the “candidate”) were considered: Dam, granddams, and paternal half sister of dam and of sire (see Figure 1). Genetic gain was now predicted at 163 kg of milk per generation or 36.3 kg per year (generation interval = 4.5 years).

**Conclusions**

In a single herd a genetic gain of 30 to 40 kg of milk per year can be achieved simply by selecting young bulls on the basis of their pedigree and cows on the basis of pedigree and first lactation performance. For a herd of 500 cows a scheme based on progeny testing of bulls was predicted to give somewhat lower genetic gain. Progeny testing schemes are competitive only in units comprising several thousand recorded cows.

In the absence of facilities for freezing and storing frozen semen progeny testing schemes require that the bulls are kept alive until their daughters have completed their first lactation. The costs and practical problems involved in feeding and housing a large number of mature bulls are considerable. Additionally, the genetic benefits from progeny testing are not realized until after about ten years.

The genetic gain achieved in a closed herd can be disseminated to a much larger population by distribution of bulls. If all bulls with above average pedigrees are considered acceptable, a nucleus herd can provide about 15 bulls per 100 cows in the herd per year. The gain achieved in the nucleus herd will be transmitted to outside herds with a time lag of about two generations (nine to ten years).

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