The rate of genetic gain for a specific trait is determined by generation interval and selection intensity. Theoretically, genetic gain increases as generation interval is reduced and selection intensity is increased. In practice, reduction in generation interval results in an increased requirement for replacement animals to maintain herd size, and this results in a reduction in selection intensity.

There is a lack of guidelines for managerial systems that result in compatibility between reducing generation interval and increasing selection intensity. This paper describes an approach which may be useful for developing managerial systems to rationalise this conflict.

METHODOLOGY

A series of herd models of equal adult equivalents was constructed using survival, reproductive and growth rates inferred from Central Queensland research (Anon. 1976, Rudder 1978, Corlis et al., 1980, Rudder et al., 1981). The basic characteristics of these models were:

(1) Weaning rates of 68 to 85 per 100 cows joined depending on age and lactation status at joining. These gave herd reproductive rates of 74 to 78 percent depending on age of cow at final joining.

(2) Mortality rates of one to two percent in non-lactating and one to four percent in lactating animals, depending on age. Overall mortality rates in the breeding cows were 2.2 to 2.8 percent, depending on age at final joining.

(3) Steers and heifers surplus to breeding herd requirements were sold at an average age of three years. Cows that were culled from the breeding herd for reproductive failure were fattened and sold during the following 12 months. Pregnant cows culled for age were allowed to rear the calf that followed and then fattened prior to sale.

(4) Heifers were joined initially to calve at two years of age with those failing to conceive being rejoined to calve at three years of age. Lactating two and three year old cows that failed to conceive were rejoined the following year, but all other age and lactation status groups were culled if they failed to produce a calf.

(5) Bulls were selected from the calf crop and were joined to produce their first calves at three years of age. The joining rate was four bulls per 100 breeding cows.
Differences in age at calving for the female parents were determined by generating six models with ages of cows at final joining of four, five, seven, nine, eleven and twelve years. The age of bulls when their progeny were born was varied by assuming that bulls were joined for one to seven seasons with appropriate replacement rates each year.

When bulls were used for two or more years, an annual wastage of 10 percent was assumed.

The various generation intervals and selection intensities generated by these models were evaluated by estimating potential genetic gain for two-year-old live weight. These estimates were based on a phenotypic variance of 25 kg and heritability of 0.50.

RESULTS AND DISCUSSION

Average ages of the cows at calving were 3.49, 3.91, 4.62, 5.19, 5.63 and 5.81 years for final joining ages of four, five, seven, nine, eleven and twelve years respectively. The proportion of the female calf crop required to maintain herd numbers was 75, 62, 50, 44, 41 and 40 percent in logical sequence.

Average ages of the bulls when their progeny were born were 3.00, 3.47, 3.93, 4.37, 4.79, 5.19 and 5.58 years. Proportions of the male calf crop required as sires varied from 2.1 to 11.5 percent, depending on the bull and cow management strategy.

Estimated genetic gain per year was calculated for each combination of cow and bull age at final joining. The key values are shown in Figure 1.

The most effective management for breeding cows was final joining at five years of age. Reduction in final joining age to four resulted in a reduced selection intensity that cancelled any benefit from reduced generation interval. Conversely, older cows at final joining increased generation interval and negated benefits of increased selection intensity.

There was little difference between using bulls for two or three seasons. Using bulls for seven seasons was the worst strategy. Joining bulls for three or four seasons was better than joining bulls for one season, while using bulls for six seasons was marginally better than the worst strategy. Similar comments to those made for the breeding cow strategies apply to the bull strategies.

There was no change in the number of cows joined or calves produced until the age of cows at final joining was reduced to seven years. When final joining was seven, five and four years of age, the number of calves produced declined one, two and two percent respectively. This was caused by reduced reproductive and survival rates due to increased proportions of young cows in the breeding herd as age at final joining declined. Therefore, reduction in generation interval by reducing cow age at final joining must be balanced against trends in productivity of the breeding herd.
The results obtained from this study show that estimated genetic gain in terms of live weight for age at two years is highest when bulls are used for only two seasons and the age of cows at final joining is five years. However, reducing age of cows at final joining had an adverse effect on herd productivity. Programs to effect genetic improvement should be designed in the context of the whole herd situation and not in isolation.

FIGURE 1: Effect of Age of Cows at Final Joining and Age of Bulls at Joining on Estimated Genetic Gain

REFERENCES


