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# A Comparison of Various Selection Plans for Sheep Improvement

A. L. RAE, Massey Agricultural College, Palmerston North.

## SUMMARY.

In a flock of sheep where adequate records of pedigree and performance are kept, there are a number of different ways of using the available information in selecting those animals which are to be retained for breeding. Given reasonably accurate estimates of heritability, reproductive rates and selection differentials, various selection plans may be compared on the basis of the rate of genetic gain per year which they produce in a flock.

The computations of annual genetic gain were based on a flock of 1000 ewes with a lambing percentage such that for every 100 ewes, 100 two-tooth sheep are available at the time of selection. Each year, 60 per cent. of the two-tooth ewes available must be selected to enter the flock to maintain flock numbers. In all selection plans, the selection of these ewes is on individual merit for the character or index concerned. Each ram is mated to 50 ewes. Two values of heritability are taken: 0.10 and 0.40.

The following plans were compared:—

(1) Six two-tooth rams are selected from the 500 available, selection being on individual merit. The generation interval in this case is 3.75 years.

(2) Each year, 20 two-tooth rams are selected on individual merit from the 500 available and are used for only one year. The generation interval is then two years.

(3) The flock is divided into two parts: the "Testing" flock and the "Nucleus" flock, the latter consisting of the best ewes selected on phenotype. Rams are selected only from the "Nucleus" and are then tested in the "Testing" flock. The best rams on the basis of their progeny test are used in the "Nucleus" in subsequent years. It is assumed that 20 ewes are used to test each ram. Two variations of this plan are considered: (a) Information on the progeny of the sires being tested is available at weaning age. (b) Information on the progeny is not available till they are yearlings.

(4) The selection of sires is based on the optimum combination of information on their own phenotype and the averages of the half-sib families to which they belong.

The results show that, at both levels of heritability, plan 1, which represents the rate of genetic gain per year from selection as it is normally carried out in stud flocks, is the least satisfactory. Reducing the generation interval of the sires to two years, as in plan 2, increases the rate of gain per year by about 15 per cent. over plan 1. In plans 3 (a) and 3 (b), under the assumed conditions, the greatest rate of gain per year is achieved when about 70 per cent. of the ewe flock is used for testing purposes. When heritability is 0.40, there is no advantage in progeny testing (3a and 3b) over the use of individual selection (plan 2). When heritability is 0.10, progeny testing is about 10-15 per cent. better than plan 2 in yearly rate of gain. Plan 4 is almost as efficient as progeny testing since it does not involve an increase in the generation interval through having to wait for the information on the progeny of the sires being tested. Again, as with progeny testing, the advantage of plan 4 over individual selection is greater when heritability is low.

## Discussion

Mr. Carter: These plans are concerned solely with selection within a flock. What modification would be necessary to take care of heredity-environment interaction where selection is between flocks?

Dr. Rae: To extend these plans to take into account inter-flock selection would require information on such aspects as the mean differences between flocks and the extent to which these differences are caused by genetic effects, environmental effects and interactions between heredity and environment. If heredity-environment interactions are important, then the tendency is to breed a type of sheep for each set of environmental conditions, a process which would tend to reduce the amount of inter-flock selection.

Mr. Hancock: In the initial selection of rams and ewes, is it necessary to keep the progeny up to the hogget stage?

Dr. Rae: Results to date indicate that the correlations between weaning records and hogget records in the Romney are very much lower than those found by Terrill and his co-workers at the Western Sheep Breeding Laboratory. In these circumstances, it does seem better to evaluate the progeny at the hogget stage.

Dr. Filmer: Would Dr. Rae comment on work already done along these lines? Terrill's work at Idaho indicated that the results achieved did not come up to the calculated results.

Dr. Rae: Little work has been done with sheep in checking actual gain from selection against the expected results computed from knowledge of heritabilities and selection differentials. Work of this nature is greatly needed. Terrill, at Dubois, has compared expected annual genetic progress from selection with actual progress as shown by the regression coefficients of the traits on years. In some cases, the actual gain was lower than expected. The information does not seem to be available to explain these differences. It is to be noted, however, that the regression of a trait on years may be, as indicated by Terrill's results, influenced by any trend or non-randomness in the yearly environmental conditions.

Dr. Wallace: Do you consider the practical difficulties in putting the later plans into practice as compared with the earlier ones? Would economic losses render them unsatisfactory? Mating individual rams with groups of ewes gives rise to serious losses if the rams prove infertile. The nucleus might therefore need to be larger than 30 per cent.

Dr. Rae: The plans have been compared only on the basis of the annual genetic gain which they produce. A full operational approach to the problem would require taking into account the costs in collecting the extra data, practical difficulties such as those you have mentioned and would be likely to change the optimum structure of the flock.