THE VALUE OF GENETIC IMPROVEMENT TO COMMERCIAL SHEEP PRODUCERS

K.M. NAPIER* and L.P. JONES*

Summary

In the Australian wool growing industry commercial sheep producers rely on studs to make genetic improvement which is then disseminated by the sale of rams. If a commercial producer buys rams of average genetic merit, his flock will lag two generations behind the stud. The paper examines the value of the genetic gain made by studs to commercial producers and the relative value of sale rams within the stud. This is achieved by calculating the extra value of wool produced and the year in which this accrues. The increases are discounted to their present value and the relative value of genetic gain and phenotypic merit calculated. It is concluded a significant premium can be paid for rams from a stud with a worthwhile selection program.

I. INTRODUCTION

The hierarchial structure and 'family group' organisation of the Merino industry has been described by Pattie (1973). At the top is a small number of closed 'parent' studs. These flocks pass rams to 'daughter' studs which in turn supply rams to general studs or commercial flocks. Commercial flocks may bypass the intermediary layers and buy rams direct from parent or daughter studs.

Bichard (1971) discussed the rate of dissemination of genetic improvement in such a structure and showed that there is a lag of approximately two generations between the layers of the hierarchy, when average males are sold to the next layer. The lag will be less or greater if better or worse than average males are transferred. In this paper we consider the value to a commercial producer of the improvement made by the stud from which he purchases rams. Only a two-tiered system will be discussed here. As a number of years elapse between the purchase'date of the ram and shearing of the progeny it is essential that the extra gains be discounted to a present value. The sum of the discounted returns over the years the progeny are shorn is termed the Net Present Value; the break-even premium a producer could pay for a ram above the value he could obtain with an unrecorded ram from his own flock.

Turner (1973) has assessed the value of performance recording by the extra wool produced from the offspring of selected parents. Thatcher and Napier (1976) have used discounting techniques to examine the profitability of selecting sheep for wool production. They showed the effect of different flock structures, lambing percentages, wool prices, costs and interest rates on the profitability of a selection programme. This paper considers the gains to the commercial producer from two sources;

(a) the genetic superiority of the stud from which he purchases ram, and
(b) the extra gains from the use of above average rams from the stud.

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* S.S. Cameron Laboratory, State Research Farm, Werribee, 3030.

II. BASIS FOR CALCULATION

The extra value of a purchased ram depends on:

(a) Value of extra wool produced per offspring.
(b) Number of offspring.
(c) Number of shearings of each offspring.
(d) Time between the purchase of the ram and the shearing of his offspring.
(e) Discount rate.

(a) Extra wool produced by progeny of a stud ram depends on the genetic superiority of the stud and the relative rating of the ram within the stud.

(i) -Gains due to genetic gains in the stud. Assuming that commercial flock lags two generations behind the stud, the superiority of progeny of the stud ram is equal to $2 \Delta G_S/2$

$= \Delta G_S = i\, h^2\, \delta p$ (see Table 1 for symbols used)

Using typical values ofl.5, 0.4 and 0.4 respectively = 0.24 kg.

(ii) Gain due to selection within the stud. Progeny of above average rams are $S\, h^2/2$ better than average i.e. 0.2 kg per kg of selection differential.

TABLE 1

Variables used in the analysis

d	: Discount rate.	Pl	: Proportion of flock retained for first adult shearing.
E_S	: Survival rate of adult ewes and wethers.	P_2	: Proportion of flock retained for second and subsequent shearings.
ΔG_S	: Genetic gain per generation of the stud.	δp	: Phenotypic standard deviation.
h^2	: Heritability.	R_S	: Probability of ram survival.
i	: Standardized selection differential.	S	: Selection differential.
M	: Number of seasons ram mated.	V	: Value of wool.
N	: Number of sheep produced ("two tooths").		

(b) Number of progeny depends on the mating ratio, weaning percentage, proportion shorn as "two tooths" and the number of matings the ram is used for.

(c) Number of shearings progeny are kept.

(d) Shearing of "two tooth" progeny occurs 2 years after ram purchase.

(e) Discount rate $d = \left(\frac{1}{1+r}\right)$ where r is the interest rate.

A discount factor d^t applies to shearings t years after purchase. The number of progeny shorn from the first mating of the ram is

$$N.R_S.P_1 + N.R_S.P_2E_S + N.R_S.P_2E_S^2 + \ldots\ldots$$

$$= N.R_S \{P_1 + P_2 \sum_{i=1}^{Y} E_S^i\}$$ where Y is the number of adult shearings.

The discounted value of the extra wool produced is

$$= V.N.R_S.d^2 \{P_1 + P_2 \sum_{i=1}^{Y} (E_S d)^i\}$$

The value of extra wool using a ram for several (M) seasons.

$$= V.N.d \sum_{j=1}^{M} (R_S.d)^j \{P_1 + P_2 \sum_{i=1}^{Y} (E_S.d)^i\}$$

III. PREDICTED VALUE OF A PURCHASED RAM

i) Value of genetic gain from stud.

The predicted value of a ram from a stud making genetic gain of ΔG_S = 0.24 kg/generation is given in Table 2. (Wool price 250 cents/kg clean, 47.5 "two tooths" produced per ram per year, 0.9 of these shorn).

TABLE 2

Value of genetic gain from the stud ($)

Matings	Adult shearings	P_2	Interest rate				
			0.0	0.10	0.15	0.20	0.25
3	4	0.9	268.9	171.8	140.5	116.5	97.7
		0.7	223.5	143.6	118.1	98.4	83.0
		0.5	175.8	115.5	95.7	80.4	68.3
3	5	0.9	314.9	193.4	155.8	127.4	105.7
4	5	0.9	399.6	236.0	187.0	150.7	123.3
4	6	0.9	455.0	258.9	202.1	160.9	130.4

ii) Relative value of a sale ram.

The predicted value of a purchased ram whose phenotype is 0.5 kg better than the mean of this stud is given in Table 3.

TABLE 3

Extra value of ram with fleeceweight 0.5 kg above the stud mean ($)

Matings	Adult shearings	P_2	Interest rate				
			0.0	0.10	0.15	0.20	0.25
3	4	0.9	112.0	71.6	58.5	48.5	40.7
		0.7	92.6	59.8	49.2	41.0	34.6
		0.5	73.2	48.1	39.9	33.5	28.4
3	5	0.9	131.2	80.6	64.9	53.1	44.0
4	5	0.9	166.5	98.3	77.9	62.8	51.4
4	6	0.9	189.6	107.8	84.2	67.1	54.3

IV. DISCUSSION

Commercial sheep farmers have generally relied on studs for genetic improvement. Thatcher and Napier (1976) have shown selection for wool production can be profitable (under certain circumstances), when increased wool production in the selected flock is considered. They did not assess the benefits of this genetic improvement being passed to commercial breeders by the sale of rams. This study shows commercial breeders can afford to pay a considerable premium for a ram from a stud with an effective improvement program. Thus studmasters with such a program are justified in asking a considerable premium for their rams: hence a selection program which may not be profitable in terms of extra wool produced in the stud may become profitable by the premium received for sale rams.

It is difficult to find out what genetic gains are being made by the stud industry at present. Turner (1973) has used official statistics to show that only a small increase (0.28% per head per year)

has occurred in fleece weight in one state (Western Australia) since 1950-51. This compares with an increase of 2.4% per annum in clean fleece weight in a CSIRO selection flock with fibre diameter maintained constant. In the present study we have considered a stud making approximately 1.5% per annum gain in clean fleece weight, a gain that should be able to be attained by a studmaster taking into account the other selection criteria that are considered in stud sheep selection.

The optimum flock structure of the commercial flock is determined by a number of factors such as the wool production and fertility of the ewes, the value of surplus sheep and the fertility of mated rams at older ages. The number of years a ram and his progeny are kept will be determined by these considerations. Examination of Table I and II show more can be paid for a ram when he is used for more years and his progeny are retained longer. However both these figures are predetermined by flock productivity factors and it should not be concluded that the longer sheep are retained the more valuable their improvement is. The longer they are retained the greater is the improvement lag behind the stud. The proportion of the flock retained influences a ram's value. If "two tooth" wethers and a proportion of cull ewes. are sold there will be no return from their extra wool production. It is doubtful if any premium will be realized in the market for surplus sheep, but this could be considered in some situations. The genetic influence of a ram is present long after his progeny have been culled. However these affects may be ignored as the contribution of a particular ram will halve each generation and at current interest rates the delay will reduce net present value of wool from granddaughters to a small amount. A small effect we have ignored in this analysis is the value of the rams fleece at subsequent shearings; this will mean he may be worth slightly more (several dollars) than the analysis shows.

Examination of the value of gains made by the stud and the relative merit of the ram show the former are relatively of more value than the latter. The selection program of studs is then the critical factor affecting genetic progress of the industry. As studs consist of only about 2% of the Merino sheep population, the small number of rams they use are of critical importance. Some authorities have suggested studs should cull all rams below the mean clean fleece weight. The recommendation can be disputed as even those 0.5 kg below the stud mean would still be relatively valuable to a commercial producer. This would mean his flock would lag 0.2 kg further behind if he purchased average rams from the stud but the flock would still have the same rate of gain as the stud. Conversely if a ram buyer buys better than average rams the lag between his flock and the stud will be reduced by a similar amount. Retaining more rams for sale in a stud means the cost of breeding rams can be spread over a wider number of sale rams.

Results of the present study clearly show that more effort could profitably be made to assist studs to make genetic improvement by such means as advisory services and computerized recording schemes. Genetically superior rams have a high value to the commercial producer which justifies the considerable costs of running a stud with an improvement program.

V. REFERENCES

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