# NEMESIS IN ACTION - BREEDING FOR WORM RESISTANCE

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## SUMMARY

The implementation of a practical selection program for worm resistance in a ram breeding flock is described including the timing of faecal sampling, sample collection and counting. The relationship between faecal egg count (FEC) and dag score was examined and an association was found between these two traits ($r=-0.18$, $P<0.01$). The relationships between FEC and a production index including adult clean fleece weight, fibre diameter, body weight and number of lambs weaned was found to be not significantly different from zero. If genetic correlations between FEC and production traits were assumed to be zero, including FEC in the breeding objective was predicted to reduce gains in component traits by 13% and 29% respectively when 50% or 70% of the possible selection emphasis for FEC was used. The realised reduction was less than this, being 9% and 19.7% respectively. This may be the result of favorable rather than neutral correlations between FEC and production traits or it may be due to chance. Incorporation of worm resistance into sire selection procedures and sale information for ram buyers is discussed.

## INTRODUCTION

In 1988 drench resistance was found at "Panlatinga", Keith, in the south-east of South Australia. White (benzimidazole) and clear (levamisole) drenches were found to be ineffective, while a combination (benzimidazole/levamisole) drench and ivermectin gave effective worm control. Since then the combination and ivermectin drenches have been alternated but in 1993 the combination drench was measured to be only 83% effective. Regular challenge by Barbers' Pole worm (Haemonchus contortus) is controlled by the use of closantel. "Panlatinga" is predominantly a ram breeding enterprise and so carries all male and female hoggets until at least their 16 month shearing. Consequently the proportion of young sheep on the property is high and until recently there were no wethers or cattle to assist in worm control by alternate grazing. The flock structure makes it difficult to use management options, such as spelling paddocks or grazing with worm resistant stock, to assist in the control of worm infections. Effective drenches have played an important role in the worm control program which makes the program vulnerable to the further development of drench resistance.

With this background, breeding for worm resistance was attractive for the following reasons. It offers management advantages in the flock of less dags, lower drench costs and better production, similar benefits to clients and fits in with an easy care philosophy for sheep. This paper reports the results of the first year's measurements of faecal egg count (FEC) and examines the effect of including FEC on other production traits in the stud's breeding objective.

## MATERIALS AND METHODS

FEC measurements of 1993 drop rams were recorded. These rams (approx. 1000) were born in August 1993, weaned in November 1993 and first shorn in May 1994. Clean fleece weight, fibre diameter and body weight were measured at this shearing. The top 400 rams were selected on a combination of their production figures and subjective appraisal and run together until a second shearing in February 1995. Clean fleece weight, fibre diameter and liveweight were measured again for each ram. In October 1994 the sheep were monitored for internal parasites. Fifteen faecal samples were collected from the mob which had been previously drenched in February 1994. FECs from the samples ranged from 600 - 5300 epg, with a mean of 1770 epg. This level of infection met the criteria thought to maximise the likelihood of detecting genetic differences - that is, the mean was in excess of 1000 epg and there were no zero counts. On the basis of the monitor count a decision was made to sample the whole group.

The rams were brought in from the paddock and put straight down the race. The 398 sheep were sampled in 3 hours with 2 people faecal sampling and 2 people labelling and packing the samples into small plastic bags. This procedure was carried out by the manager and staff at "Panlatinga". The samples were sent to the Central Veterinary Laboratory in Adelaide and FECs were done at a cost to the stud of $2.00 per test. The infection was a mixture of worm genera comprising 85% Black Scour worm (Trichostrongylus spp.), 17% Barbers' Pole worm (Haemonchus contortus) and 3% Brown Stomach worm (Ostertagia spp.). At faecal sampling the sheep were scored for dags on a scale of 1-5, with 1 being no dags and 5 being heavily soiled. FEC was cube root transformed and then standardised to a mean of zero and standard deviation of 1 for analysis. Estimated breeding values (EBVs) are expressed in standardised units. Least squares analysis of variance was used to test differences in mean $FEC^{0.33}$ for dag score classes.

Breeding values were estimated for FEC by CSIRO using the software package PEST (Groeneveld 1990) and were based on the individuals measurement only. Using half-sib information where available, breeding values for adult clean fleece weight, fibre diameter, body weight and number of lambs weaned were estimated by a private breeding consultant using standard selection index procedures (Falconer 1989). The wool and body weight breeding values were combined in a selection index (INDEX1) designed to increase clean fleece weight (adult CFW), decrease fibre diameter (adult FD), maintain body weight (adult BW) and keep slight positive pressure on increasing the number of lambs weaned (NLW). The indices which include FEC in addition to the production traits were described by Woolaston (1994) and use 50% (WORM50) and 70% (WORM70) of the possible selection emphasis for FEC.

## RESULTS

The average FEC was 1180 epg with a range from 50 - 4600 epg. The average dag score was 1.82 and the distribution is given in Table 1. Birth rank had no significant effect on FEC or dag score. There was a significant ($P<0.01$) phenotypic correlation of -0.18 between untransformed egg count and dag score. The average FEC and $FEC^{0.33}$ for sheep in each dag score class is given in Table 1.

Table 1. Mean faecal egg count for sheep in each dag score class.

| Dag Score | Number of sheep | FEC (epg) | $FEC^{0.33}$(se) |
|---|---|---|---|
| 1 | 212 | 1291 | $10.42^{a}$ (0.15) |
| 2 | 75 | 1171 | $9.98^{ab}$ (0.26) |
| 3 | 44 | 941 | $9.35^{bc}$ (0.33) |
| 4 | 34 | 785 | $8.74^{c}$ (0.38) |
| 5 | 10 | 1342 | $10.44^{a}$ (0.70) |

Means with different superscripts differ significantly ($P<0.05$).

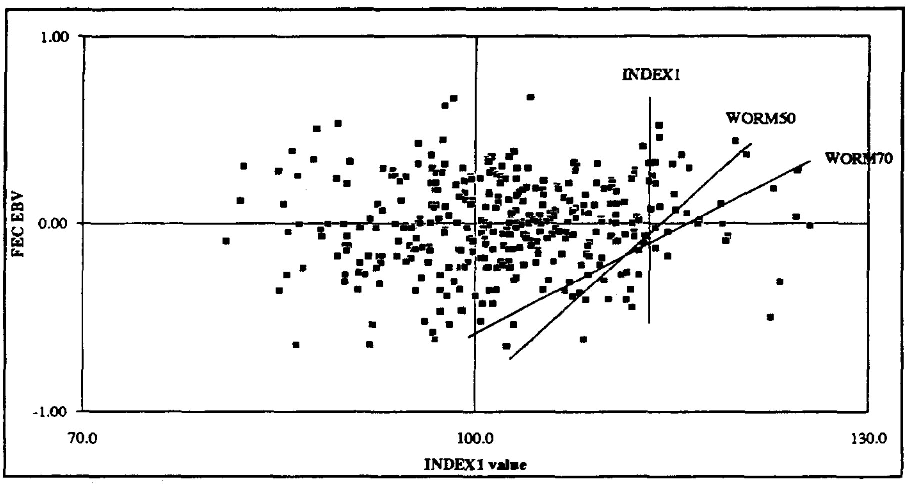
Predictions of individual trait responses for adult CFW, adult FD, adult BW and NLW using INDEX1 were 0.156 kg, -0.40 •, 0.79 kg and 0.005 lambs, respectively, per standard deviation of the index. Using WORM50 there was a predicted reduction in production traits of 13% while achieving 50% of the possible response in FEC. Using WORM70 the predicted responses were reduced by 29% while achieving 70% of the possible response in FEC. The realised effects on mean EBV for each trait of selecting the best 30 rams with each of the three indices are shown in Table 2.

Table 2 Mean INDEX1 values and EBVs for adult CFW, adult FD, adult BW, NLW and FEC for the highest ranked 30 rams using INDEX1, WORM50 and WORM70 and % change in EBVs.

| Trait | Mean INDEX1 value and EBVs for best 30 rams selected by each index | | | | |
|---|---|---|---|---|---|
| | INDEX1 | WORM50 | % Change | WORM70 | % Change |
| INDEX1 value | 117.8 | 116.2 | 9.0 | 114.3 | 19.7 |
| Adult CFW (kg) | 0.533 | 0.453 | 15.0 | 0.422 | 20.8 |
| Adult FD (•) | -0.345 | -0.360 | -4.3 | -0.310 | 10.1 |
| Adult BW (kg) | 6.867 | 6.661 | 3.0 | 5.044 | 26.5 |
| NLW (lambs) | 0.022 | 0.025 | -13.6 | 0.023 | -4.5 |
| FEC (sd units) | 0.106 | -0.145 | | -0.243 | |

The FEC breeding value for each ram is plotted against the ram's INDEX1 value in Figure 1. The correlation between FEC breeding value and INDEX1 (r=0.09) was not significantly different from zero. When WORM50 is used 18/30 animals selected on INDEX1 are also selected. When WORM70 is used 13/30 are the same.

Figure 1. FEC EBV and INDEX1 value for 1993 drop rams at Panlatinga. Points to the right of each line show best 30 animals selected by each index.



## DISCUSSION

The dag scores of the rams appeared to be related to their FEC in some manner but it was not the commonly assumed relationship of increasing worm numbers with increasing dag score. For dag scores from 1 to 4, it appeared that increasing dags were associated with declining FEC. This relationship, however, did not hold for the highest dag score (5), which was associated with the highest mean FEC. In previous studies with Merino sheep in the south-west of Victoria dag score and FEC have been unrelated (Larsen et al. 1994). However, there has been some evidence from research with Romney sheep in New Zealand that dag score could be inversely related to FEC (Baker et al. 1991) but results from different studies have varied. This is an area of research that needs to be pursued so that breeders in southern Australia have a better understanding of how breeding for low FEC may affect dagginess in their sheep.

The lack of a relationship between FEC EBV and the production traits in INDEX1 was encouraging. The distribution of data points in Figure 1 was very close to random, indicating no strong association between INDEX1 and the FEC breeding value for each ram. This result is not necessarily consistent with the assumption that there are zero genetic correlations between FEC and production, as in this case the FEC EBVs are equivalent to the phenotypic measurement of FEC. The predicted responses in the component traits of each index will be sensitive to the genetic correlations used in the analysis and may change considerably if the genetic correlations are significantly different from zero. The realised reduction in INDEX1 values by selecting animals on WORM50 or WORM70 (9% and 19.7% respectively, Table 2) were lower than the predicted values of 13% and 29%. This may be the result of favorable rather than neutral correlations between FEC and production traits or it may be due to chance.

There were a number of rams with high INDEX1 values which also appeared to be worm resistant (Figure 1). Thirty rams are required as replacement sires and for the first year of selection the best 30 animals will be ranked on each index (INDEX1, WORM50, WORM70). The results show that a significant proportion of the same animals will be selected regardless of the index used. The impact of including worm resistance on the mean breeding values for the production traits in this selected group can be seen in Table 2. With the aid of these figures and a subjective appraisal of the sheep, a decision will be made as to how much pressure will be put on worm resistance; that is, whether the WORM50, WORM70 or some index either side of each of these will be adopted for long term use.

Ram buyers will be provided with FEC EBVs for each animal. For all other traits phenotypic deviations are currently provided. To assist clients to interpret the FEC EBVs an explanation will be available in the sale catalogue. Because of the range of clients buying rams from "Panlatinga", even rams with high FEC EBVs will suit someone, especially buyers from drier areas. Clients from wormy areas have expressed a keen interest in purchasing rams that will offer some improvement in the worm resistance of their flocks.

## ACKNOWLEDGMENTS

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**REFERENCES**

BAKER, R.L., WATSON, T.G., BISSET, S.A., VLASSOFF, A. and DOUCH, P.G.C. (1991). In "Breeding for Disease Resistance in Sheep". pp 19, Ed. G.D. Gray and R.R. Woolaston, (Melbourne:Australian Wool Corporation).
FALCONER, D.S. (1989). Introduction to Quantitative Genetics. (Longman Scientific and Technical: Harlow).
GROENEVELD, E. (1990). PEST User's Manual. (University of Illinois: Illinois).
LARSEN, J.W.A., ANDERSON, N., VIZARD, A.L., ANDERSON, G.A. and HOSTE, H. (1994). *Aust. Vet. J.* **71**:365.
WOOLASTON, R.R. (1994). *Proc. 5th WCGALP* **20**:281.