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Development of a performance test for the selection of rams having facial eczema-tolerant progeny

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ABSTRACT

A practical performance test identifying rams siring progeny with greater than average tolerance to sporidesmin-induced liver damage (facial eczema) has been developed. The performance test, which can be conducted under field conditions using toxic pasture as the challenge, depends on measuring elevations in plasma gamma glutamyltransferase levels as a nondestructive way of assessing sporidesmin-induced liver damage. Selection for tolerance to facial eczema in commercial flocks is now feasible. Trial results indicate rapid responses to selection can be expected.

Keywords Facial eczema; heritable tolerance; performance testing

INTRODUCTION

Campbell and his colleagues first reported in 1975 (Campbell *et al.*, 1975) that tolerance to the facial eczema toxin sporidesmin, is highly heritable and on the basis of their work with 1455 progeny of 160 Romney rams have since estimated the heritability (h^2) to be 0.42 ± 0.09 (Campbell *et al.*, 1981). Such a high heritability offers the possibility of rapid progress in breeding more tolerant stock. But tantalisingly this potential has not been realised because the techniques used in this research have not been suitable for adoption by the breeding industry. Their work has depended on a progeny test requiring controlled dosing of the test animals with known amounts of toxin and their subsequent slaughter for liver grading. Progeny testing requiring the dosing and slaughter of 10 or so lambs per sire screened is clearly impractical in the field, and furthermore the isolated sporidesmin is not available in the quantities required for any widespread screening of potential sires.

The application of these research findings is thus dependent on the development of a sire selection procedure based on:

- (i) performance testing of potential sires — to allow the widest possible screening;
- (ii) exposure to naturally toxic pasture as a source of sporidesmin;
- (iii) a method of assessing liver damage not requiring the slaughter of the animals — an obvious necessity for performance testing but also important in reducing costs of progeny testing if it should be required.

Such a test has been available since Towers and Stratton (1978) showed that the increased levels of the liver enzyme gamma glutamyltransferase (GGT) found in the blood following sporidesmin intoxication are highly correlated with the liver-damage scores assigned after the animals slaughter. This blood test for liver damage is now widely used for assessing liver damage in facial eczema. As a stable, readily assayed enzyme that remains elevated for several weeks, GGT is well suited to field use.

It remained then to demonstrate that rams that themselves perform well when challenged with sporidesmin leave progeny that also perform well, i.e., show a greater than average tolerance to the toxin and that the performance test (and for that matter progeny testing) could be conducted under field conditions using pasture with high spore counts as the toxic challenge.

Data on the relationship between the performance of a sire and that of his progeny after exposure to the toxin have now been collected for a total of 75 sires tested at Ruakura. Further information has been collected in co-operation with private breeders during a check of the feasibility of performance testing under field conditions using toxic pasture to provide the challenge.

METHODS, RESULTS AND DISCUSSION

In the Ruakura trials sires born in 1978, 1979 and 1980 were subjected to a serial sporidesmin dosing programme designed to identify both the most sensitive and most resistant rams. The rams were first

challenged with a low dose of sporidesmin (a total of 0.05 to 0.06 mg/kg live weight in 3 equal doses given on consecutive days) and blood samples for GGT analysis collected 10, 14 and 21 days later. Animals whose GGT levels increased more than 2-fold over their pre dosing level were drafted off, all other animals were then redosed with twice the initial dose rate (i.e., 0.1 to 0.12 mg/kg) and resampled for GGT analysis. Again animals showing a more than 2-fold increase in the baseline GGT levels were drafted off and the non-reactors redosed with 0.2 to 0.24 mg sporidesmin/kg.

Within each group the rams were ranked on the GGT levels reached and the time of the elevation in GGT levels. Animals with the least and the last increases in plasma GGT levels being deemed to have the greatest tolerance to sporidesmin.

In each year the 5 most susceptible and 5 most tolerant rams (denoted S rams and T rams) were identified. Progeny from these rams were identified as S progeny or T progeny respectively.

Subsequently the progeny of all sires were subjected to a single sporidesmin challenge (a total of 0.23 to 0.28 mg sporidesmin/kg given in 3 equal doses) and slaughtered for liver grading 5 to 6 weeks later.

TABLE 1 Performance of progeny of selected tolerant and susceptible sires — Ruakura trials.

Born	n	T progeny	All	S progeny
			Percent clinical	
1978	19	23	34	38
1979	30	12	17	20
1980	26	13	16	28
			Mean	
			liver-damage score	
1978	19	0.88	1.26	1.89
1979	30	1.03	1.34	1.38
1980	26	1.04	1.36	1.78

Table 1 compares the performance of the T and S progeny with the average for all lambs tested. In each year the T progeny had a lower than average incidence of clinical cases and a lower than average liver-damage score. In contrast the S progeny suffered greater than average damage in all years. These data confirm that the performance of the ram is a predictor of his progeny's performance and indicate that selection for tolerance should result in a relatively rapid reduction in the adverse effects of this disease. Table 2 presents the expected reduction per generation in several indices measuring susceptibility to facial eczema assuming a ram selection rate of 25%. In addition the number of generations necessary to achieve a 50% reduction in these indices, assuming a similar rate of gain per generation, is shown.

TABLE 2 Expected rate of gain per generation assuming a 25% ram selection rate.

	Percent reduction	Generations to 50% reduction
Liver damage		
incidence	11	6
severity	19	4
Clinical cases	24	2 to 3
Deaths	34	2

The feasibility of performance testing under field conditions was investigated in co-operation with a group of private breeders, who submitted ram lambs chosen as potential flock sires to a central site where they grazed toxic pasture for several weeks. The animals were bled at 10 to 14 day intervals for GGT testing and the most tolerant and most susceptible ram from each breeder identified. These were then each mated as ram lambs to about 50 ewes on their home properties to generate offspring for progeny testing. All rams successfully served their ewes, even those susceptible rams suffering moderately severe clinical eczema. The following autumn 12 lambs from each sire were brought to the central testing site and exposed to toxic pasture for 4 weeks prior to slaughter for liver grading.

During the closely monitored performance test, serum GGT analysis indicated a 66% incidence of detectable liver damage (elevated GGT levels) but no deaths and only a very low incidence of clinical eczema was recorded. Rams from 6 of the 8 sources showed a wide variation in their response to grazing toxic pasture. Rams from the remaining 2 properties (breeders 7 and 8) were either all sensitive (4 tested) or all resistant (6 tested) to the challenge received. The progeny of these rams have been classed as all S progeny or all T progeny.

The progeny test was conducted on toxic pasture during the severe facial eczema outbreaks of 1981 and the high spore counts prevalent on the test site are reflected in the high mean liver-damage scores and the relatively high incidence of both clinical cases and deaths recorded. Similar incidences for clinical cases and deaths were recorded in the farmers' ewe flocks. Table 3 lists the results for individual breeders. Overall the progeny of T sires identified as tolerant to facial eczema (T progeny) have performed substantially better than the progeny of S sires identified as susceptible during the performance test (S progeny). This was particularly apparent in the overall incidence of clinical cases (15% among T progeny as against 52% among S progeny) and deaths (11% in T progeny against 36% in S progeny).

Experience in this trial and in subsequent perform-

TABLE 3 Performance and progeny test results for tolerant and sensitive rams selected under field conditions.

Breeder	Sire's GGT	T progeny			S progeny			
		Liver score	Clinicals %	Deaths %	Sire's GGT	Liver score	Clinicals %	Deaths %
1	71	1.91	17	8	1155	2.83	33	25
2	90	2.20	18	18	263	2.70	40	10
3	79	2.45	9	9	551	3.42	25	17
4	66	2.5	0	0	517	3.33	50	33
5	71	1.83	25	17	821	3.38	66	66
6	85	1.82	17	17	329	2.55	18	18
7	73	2.82	26	18	526	3.00	55	36
					200	3.36	73	64
8	60	1.58	0	0	650	3.82	100	50
	99	1.75	8	8				

Normal range for GGT 37 to 67 IU/l at 37°, mean 52 IU/l.

ance tests conducted by this group of breeders and also by a private veterinarian indicate that performance testing can be successfully conducted under field conditions using toxic pasture as the challenge with sufficient control to enable the resistant animals to be identified without causing undue distress to susceptible animals. The necessary expertise in blood collection and GGT analysis is available commercially to the breeder. Thus the way is now open for breeders in districts where facial eczema occurs to begin selecting for increased tolerance to the disease with the expectation of making rapid progress in reducing the incidence of clinical cases and deaths.

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