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BRIEF COMMUNICATION: Reduced reproductive outcomes in ewes susceptible to facial eczema

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Introduction

There are both clinical and sub-clinical effects on grazing ruminants that ingest the toxin sporidesmin produced by the fungus *Pithomyces chartarum*, with the clinical effects of the toxin giving rise to the colloquial name of the disease "facial eczema". The sub-clinical effects of Facial Eczema (FE) have been documented and impact on most aspects of production from fertility through to growth. Data used to estimate the effects of the sporidesmin ingestion have ranged from natural exposure to high levels of sporidesmin in the outbreak in 1981 (Moore et al. 1990) through to differences in genetic selection lines and in trials where animals are artificially dosed with sporidesmin (Morris et al. 1991). Whilst the size of the impact does vary between studies, their overall conclusions are consistent, with decreased ewe fertility observed. In all studies, how the animal has tolerated (or not) the sporidesmin that it has been exposed to, is estimated through measuring serum gamma-glutamyl transferase (GGT) levels which have been shown to be a strong indicator of liver damage, the body organ most directly affected by the toxin (Towers & Stratton, 1978).

No studies have been reported using natural-challenge commercial data from the last two decades, a time in which, through a combination of improved management and genetic selection the average lambing percentage of the national flock has increased from 100% to 123% (Beef + Lamb New Zealand, 2013), and breeders have undertaken genetic selection, for sheep exhibiting increased tolerance to sporidesmin (Amyes & Hawkes, 2014).

The purpose of this study was to investigate the relationship between GGT levels and fertility, live weight and body condition in a recorded flock of Perendale and Romdale (Romney × Perendale) ewes that were exposed to a high levels of naturally occurring sporidesmin in the summer and autumn of 2016.

Materials and methods

The animals used in the study were part of a privately run stud-farming operation on a property in the South Waikato (latitude –38, longitude 175). The maternal breeds run within the stud are Perendales and Romdales (Romney × Perendale). The breeder has been genetically selecting for tolerance to FE using the RamGuard system under veterinary supervision since 1999 (Amyes & Hawkes, 2014).

In 2016, counts of *Pithomyces chartarum* spores remained elevated above the recommended treatment threshold 20,000 spores/g in the South Waikato from early February through April (AsureQuality, 2016). Blood samples were collected by the local veterinarian from a total of 1258 ewes from two age classes of the two breeds (six months old and 18 months old) in late March and blood serum GGT levels were measured. The different breeds within an age group co-grazed. The 18-month-old animals were joined with rams from mid-April, whilst the six-month-old animals were joined with rams from mid-May. The ewes were pregnancy scanned in early July and the number of foetuses a ewe was carrying (0, 1, 2 or 3) was recorded for each ewe. The 18-month-old ewes were weighed and condition scored at the time of the blood sample being taken, and were repeat weighed in late April and again at the time of scanning. The six-month-old animals were weighed at the time of blood sampling and again in late April.

The animals were categorised in to one of three groups to reflect the level of liver damage estimated by the GGT values. Low – GGT values less than 80 IU/L; Moderate – GGT values 80 to 300 IU/L; Severe – GGT values greater than 300 IU/L.

A series of REML mixed model analyses were conducted using Genstat (GenStat 18.1 VSN International LTD. 2015). The reproduction, live weight and body condition traits described above were fitted as the response variates. Breed (Perendale or Romdale) and GGT group (low, moderate or high) were fitted as fixed effects together with the interaction between breed and GGT group, with sire within breed fitted as a random effect in the model. The two age groups were analysed separately. The results for each age-breed-GGT group are reported.

Results and discussion

The overall average GGT levels (± SD) were 142 ± 213 (range 2-1187), 109 ± 188 (2-1289), 91 ± 140 (12-1279) and 82 ± 139 (14-1304) IU/L for the 18-month-old Perendale, 18-month-old Romdale, six-month-old Perendale and six-month-old Romdale, respectively. As indicated by the large range and standard deviations, there was large variability among the animals.

The number and proportion of animals within the low, moderate and severe GGT groups per breed is presented in Table 1. Despite the relatively large challenge that the

Table 1 Summary of results investigating the impact of level of blood gamma-glutamyl transferase (GGT), as an indicator of exposure to the sporidesmin toxin, and the impact of elevated levels on reproduction and body live weight traits. Low – GGT values less than 80 IU/L; Moderate –between and including 80 to 300 IU/L; Severe – greater than and including 300 IU/L.

	6-month old – GGT Group[1]				12-month old – GGT Group[1]			
	Low	Moderate	High	SED2	Low	Moderate	High	SED[2]
Number of observations								
Perendale	357	75	29		221	74	54	
Romdale	202	37	8		134	32	15	
Proportion of ewes within GGT group								
Perendale	0.77	0.16	0.06		0.65	0.20	0.15	
Romdale	0.82	0.15	0.03		0.74	0.18	0.08	
Proportion of ewes pregnant								
Perendale	0.70[a]	0.74[a]	0.48[b]	0.12	0.96[a]	0.98[a]	0.90[b]	0.04
Romdale	0.84[a]	0.82[ab]	0.62[b]	0.18	0.95[a]	0.96[a]	0.83[b]	0.08
Number of lambs scanned per pregnant ewe								
Perendale	1.24	1.14	1.11	0.14	1.70[a]	1.69[a]	1.53[b]	0.09
Romdale	1.20	1.19	1.33	0.24	1.75	1.77	1.71	0.16
Liveweight change March-April (kg)								
Perendale	1.2	1.4	0.9	0.37	4.1[a]	3.8[a]	2.8[b]	0.33
Romdale	0.8[a]	0.4[b]	0.4[ab]	0.69	3.8[a]	3.2[b]	2.1[c]	0.59
Liveweight change March-July (kg)								
Perendale					6.0[a]	5.4[b]	4.5[c]	0.53
Romdale					6.8[a]	5.8[ab]	5.3[b]	0.95
Body condition score change March-April								
Perendale					0.21[a]	0.15[b]	0.12[b]	0.05
Romdale					0.16[a]	0.09[a]	-0.04[b]	0.09
Body condition score change March-July								
Perendale					-0.26[a]	-0.38[a]	-0.42[b]	0.06
Romdale					-0.38	-0.44	-0.42	0.10

[1] Means within an age-breed with the same letter are not significantly different at $P<0.05$.

[2] SED for comparing Low vs High

animals were exposed to, the highest proportion of animals was in the low GGT groups. Whilst this information on its own would have suggested that the challenge had not been high, information simultaneously collected on ewes from terminal breeds that have not been genetically selected for FE tolerance, but were run with the Perendales and Romdales within the age groupings, had only between 19 and 37% of animals with low GGT values (data not presented). Thus, these results demonstrate the benefits of the genetic selection programme undertaken in this flock.

The reproductive, liveweight and body-condition performance of the animals per GGT group are presented in Table 1. These results show that, in both age groups, there was a significant difference for the majority of traits measured between animals that had high GGT levels vs low GGT levels. The exceptions being where, because of the natural-challenge nature of the data set, there were insufficient animals in the high GGT group that were pregnant to determine whether or not there was a statistically significant difference among the groups. The most comparable literature is that of Moore et al. (1990) who followed groups of animals that were exposed to a natural challenge in the Autumn of 1981, although the only comparable age group is the 6-month old data. In this current study, the difference in the proportion of 18-month old ewes that successfully held a pregnancy through to scanning was 6% and 12% lower for the high GGT group compared to the low GGT group for the Perendales and Romdales respectively, with the difference larger at 31% and 26% for the six-month-old ewes of the respective breeds. The size of the effect is similar to those reported by Moore et al. (1990), although the overall level of fertility is higher in this study to that of Moore et al. (1990) as in that study only 43% of the low GGT six-month-old ewe lambs became pregnant.

Of those ewes pregnant, the average number of lambs scanned was 10% lower for both age classes in the Perendales. The difference in number of lambs scanned could not be estimated in the Romdales due to insufficient numbers of animals with high GGT levels remaining, given those that did not get pregnant could not contribute to this particular analysis. This is in contrast to the findings of Moore et al. (1990) who did not observe any differences in the number of lambs ewes were carrying within the different GGT groups. However, in their study the overall number of lambs being carried by even their low GGT group was much lower than observed in this study, and may suggest that at lower levels of prolificacy the differences are not as evident.

Liveweight gain between the March and April was 32% and 45% lower for the high GGT compared to the low GGT group for the 18-month-old Perendales and Romdales, respectively. The differences were larger in the six-month-olds with differences of 23% and 57%, respectively. The difference in live weight from March through scanning was only available for the 18-month ewes, with the high GGT group gaining 25% and 23% less than the low GGT group for the Perendales and Romdales, respectively. There are no equivalent descriptors of liveweight change in the literature that could be found. Body condition score was only measured on the 18-month-old ewes. The change in body condition score between March and April saw the Perendale high GGT group gain 44% less body condition than the Perendale low GGT group, a difference of 122% for the Romdales, with the high Romdale GGT group actually loosing body condition during that time. When the change was considered from March through to scanning, all animals had lost body condition during this time, but the size of the loss in the high GGT groups was 62% and 9% greater than the low GGT groups for the Perendales and Romdales, respectively. There are no comparable measurements of changes in body condition score in the literature.

Other studies, such as those by Morris et al. (1991) and Smeaton et al. (1985), have also reported a negative relationship between GGT levels and the proportion of ewes that become pregnant and the number of lambs successfully pregnant ewes carry. Although as was similarly described for the Moore et al. (1990) study, the fertility structure of the flock currently studied was considerably different.

Considering a scenario where the entire flock consisted of all tolerant (low GGT) or all very susceptible (high GGT). Per 1000 ewes, taking in to account the differences in the number of ewes pregnant and the number of foetuses pregnant ewes are carrying, a flock of tolerant Perendale ewes would produce an extra 331 lambs as yearlings and 251 lambs as two-year-olds. With equivalent numbers of 229 and 117 extra lambs, respectively, for the Romdales. There is also the potential of further impacts on lamb survival and the subsequent milking ability of the ewes which could lead to differences in weaning weight, which will be investigated once further data is collected from the ewes measured in this study.

The results of this study, although generally consistent with the results of previous studies, do demonstrate the size of the effect at higher fertility levels than has previously been reported. The study also highlights the potential reduction possible in the proportion of ewes exhibiting high GGT levels (liver damage) through genetic selection.

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