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Contract session: Facial eczema prevention

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Introduction

Facial eczema (FE) significantly impacts on the health and productivity of cattle (Towers & Smith 1978) and presents significant welfare concerns. The clinical manifestations of FE arise from damage to the liver. When spore count challenges are low to moderate and sustained, low-grade, chronic liver damage can then result in sub-clinical FE, a condition characterised by suboptimal productivity with little or no clinical signs. It is likely that sub-clinical FE goes un-noticed by many herd managers.

Whenever there is a significant FE challenge, farmers tend to recognise the presence of disease by identifying photosensitization in individual cows. It is possible for images of affected animals to be made public via animal welfare groups. This presents a risk to New Zealand's 'clean green image' and reputation for sustaining a high level of animal welfare in farmed livestock. However, photosensitisation represents only the tip of the iceberg of a herd-level FE problem. Research has shown that only a small proportion of cows within a herd affected by FE have photosensitisation, with a much greater proportion having significant liver damage without any obvious clinical signs (Di Menna et al. 2009). The causative agent of FE (a fungus, *Pithomyces chartarum*) was first identified in New Zealand in 1958. Since then protocols for management of the problem have been developed, mostly involving regular administration of zinc (Zn) salts to cattle by mouth. However, over the years a number of alternative management ideas for controlling facial eczema have also been tried and farmers have been discussing these methods with some conviction for years.

From 2012-2014 a body of research was undertaken to investigate a) the variability in spore counts between paddocks, within paddock, within grass samples and within water aliquot, b) the effect of pasture sward mix on pasture spore counts, c) the effect of lime on pasture spore counts, d) the effect of nitrogen on pasture spore counts and e) the effectiveness of different management methods from 105 farms around the North Island.

Within this paper we describe and briefly review the work undertaken within two of these areas: the variability of spore counts and, the effectiveness of different management methods from 105 farms around the North Island. For full details on these studies, see (Cuttance et al. 2016; 2017).

Study 1: Variability in pasture spore counts

Introduction

Spore counting is currently the most widely used method to assess the spore count load and potential risk of facial eczema from cattle grazing that pasture. The method of assessing spore counts to determine facial eczema risk has many sources of variability. The first point of variability is within farm and paddock grass samples. The second point of variability is within the testing method. Approximately 200 grams of pasture is collected, but only 60 g is used for analysis. It is possible there is variability within the 200 g sample. Approximately 0.5 mL is extracted out of 600mL of water. Such a small sample could also provide large variation.

Since the accepted protocol is to only do one count per grass sample, this potential unknown variability could alter many of the conclusions that are being made about the risk on a particular farm. The aims of this study were firstly, to quantify the variability within paddock, grass sample and sample aliquot to be taken to the counting chambers, and secondly, to find out if the variability within a paddock or grass sample could be attributed to the composition of those samples.

Methods

Managers of four commercial dairy herds in Te Awamutu, South Waikato, were recruited to take part in the study. A total of 40 sampling sites within the boundaries of each study paddock were defined. The paddock was paced out and 50 cm × 5 cm × 5 cm wooden pegs used to permanently identify each of the selected 40 sites.

Each farm was visited once weekly for 19 weeks starting on the 7th of January 2013. At each visit a grab sample of pasture of approximately 200 g was taken within a 1 metre radius of each sample site identifier peg. Pasture samples were then transported directly to the laboratory for processing. If there was limited pasture available then a single 60 g sample was taken from the paddock. If there was insufficient grass for sampling, the site was recorded as no sample for that week.

On arrival at the laboratory a 60 g sample of pasture was selected for a composition analysis. A qualitative estimate of pasture dry matter was made by squeezing the sample and estimating the moisture content. The sample was sorted into green grass, yellow grass, dead matter, green clover, yellow clover, and weeds. Each of the seven sorted categories was then weighed. If there was insufficient

organic material to register a weight, the component of the grass was recorded as less than 1 g. If there was no organic matter of a given category it was recorded as 0 g.

Spore counting consisted of mixing 60 g of pasture with 600 mL of tap water. Once water and pasture were combined, the sample was vigorously shaken for 3 min. Immediately after shaking, 1 mL of water was extracted and placed on a microscope slide followed by a cover slide with two counting chambers (of known volume). The total spore counts in the pasture were then estimated from the number of spores visible within the counting chambers, with one visible spore equivalent to 10,000 spores per gram of pasture.

For each 200 g pasture sample, there were three separate 60 g samples spore counted. For each 60 g pasture sample, 10 water aliquots were read. This meant that if a pasture sample of sufficient size was available, a total of 30 spore counts were done at a single peg site. On the same date, a paddock sample was taken by walking from one corner of the paddock to the other collecting 10 x 20 g samples at even intervals along the diagonal. The average of all the spore counts from all the pegs each week was compared with the paddock sample to determine if the current collection method is suitable for correctly estimating the paddock spore count.

Results and discussion

Throughout the sampling period, across all farms, spore counts ranged from 0 to 490,000 spores per gram of pasture. Figure 1 is a dot plot showing, for each farm, spore counts as a function of sampling date. For each of the farms there was a lot of variability between individual pegs for different sampling dates. As some spore counts were rising at individual pegs, others were falling, contributing to a large amount of variability within paddocks.

Table 1 Multivariable negative binomial regression model of the grass components affecting the geometric mean number of spores

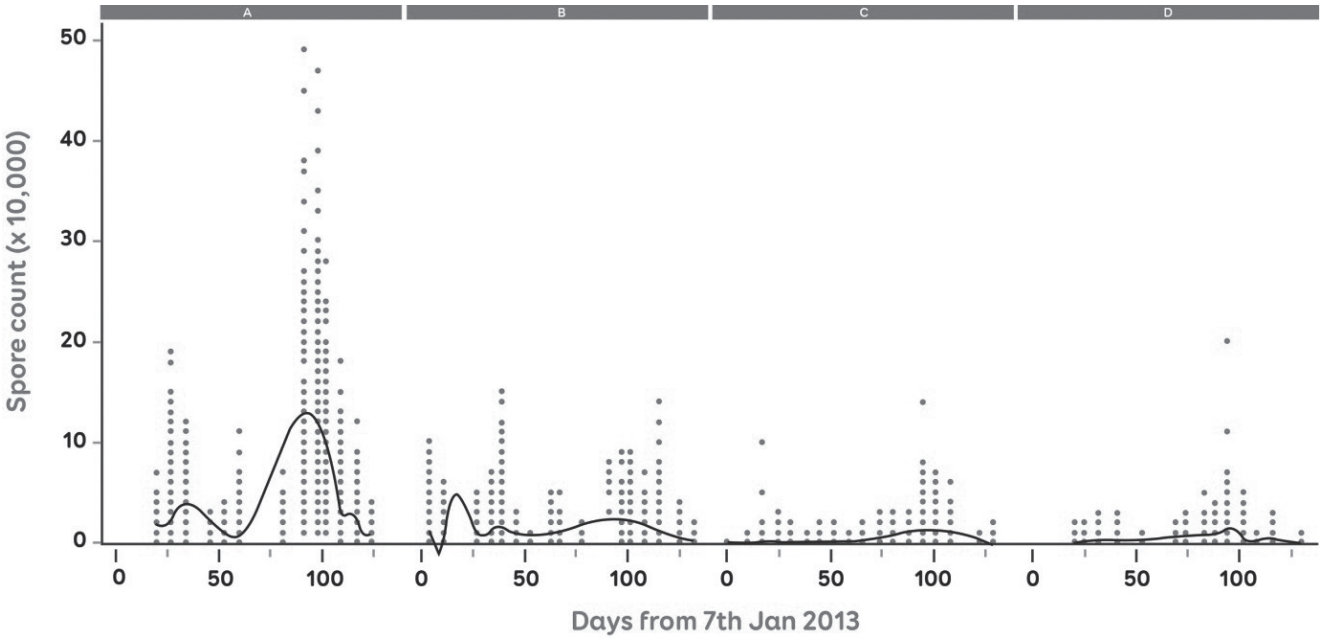
Coefficients	Estimate	95% CI	P
Intercept	-3.99	-1.87, -16.6	<0.001
Height <10cm	*Reference*		
Height 10-14cm	-0.73[a]	-2.62, -0.29	<0.001
Height >14cm	-1.60	-4.11, -0.63	<0.001
Grass Moisture (Wet)	*Reference*		
Grass Moisture (Medium)	1.18[b]	0.26, 2.54	0.005
Grass Moisture (Dry)	0.75	-0.26, 1.10	0.20

[a]Interpretation: In comparison to pasture with less than 10 cm in height, pasture between 10-14cm had 7,300 spores/gram pasture lower counts (95%CI=26,200-2,900 spores/g).
[b]Interpretation: In comparison to wet pasture, medium pasture had 11,800 more spores/gram of pasture (95%CI=2,600-24,500 spores/g pasture).

Composition analysis. The analysis showed that, when accounting for all measured factors, increased height of pasture and increased moisture of the pasture were associated with decreased spore counts. These findings are consistent with current knowledge of favourable conditions for the fungus to grow in (Table 1).

Aliquot variability. Measuring 3 aliquots per wash water sample significantly improved 95% limits of agreement (Figure 1). Variation in spore count between 60 g pasture samples selected from a 200 g paddock sample

Figure 1 Dot plot showing estimated spore count (× 10,000) per gram of pasture as a function of sampling date (expressed as the number of days from 7th January 2013), stratified by farm (labelled 'A' to 'D'). The line superimposed on each plot is a (non-parametric) smoothed line of best fit; the shaded areas on either side of the line indicate the uncertainty around the line of best fit.



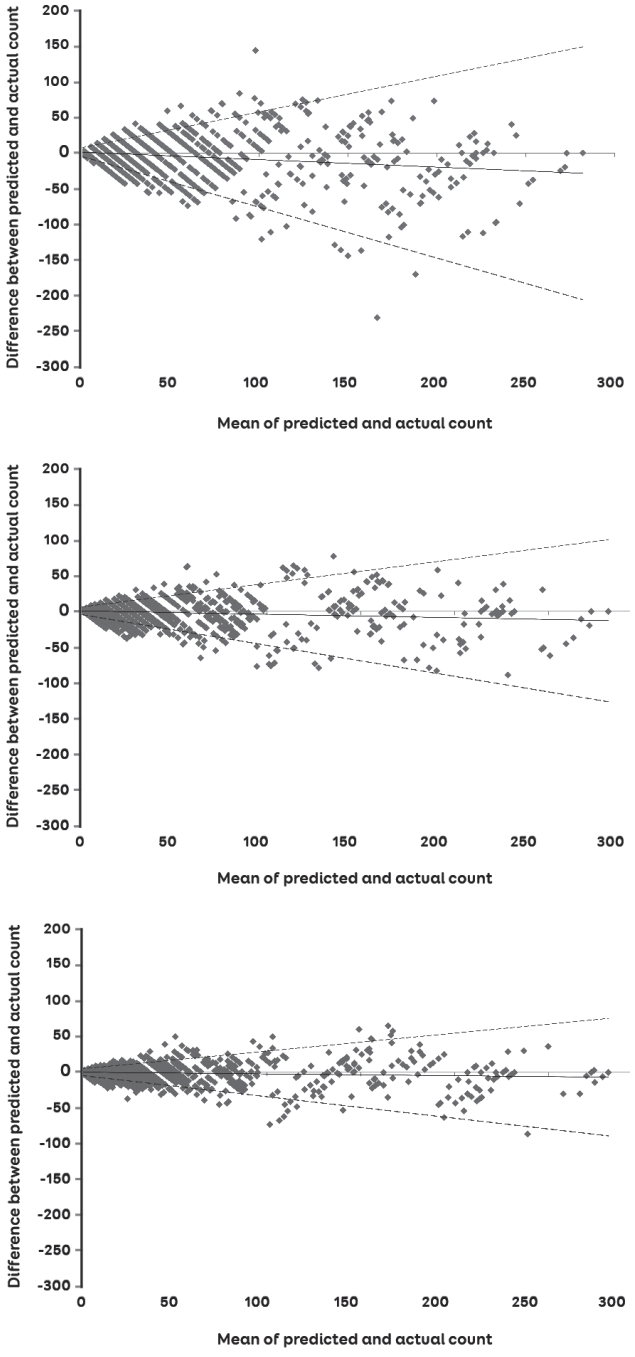
was as high as the variation between 1 and 10 aliquots of the same wash water. This should be used as the standard technique, particularly when determining whether to start or finish FE control programmes.

Study 2: Management of facial eczema survey

Introduction

Despite widespread use of zinc (Zn) salts and fungicides as a means for managing FE, outbreaks continue to occur in dairy herds throughout the North Island. This indicates that application of FE management protocols in herds are either not being applied correctly by herd managers or management protocols are being correctly applied and the delivery mechanisms are faulty. The aims of this study were to describe and evaluate the current practices used to manage and prevent FE in North Island dairy herds, and determine the prevalence of cows with elevated concentration of gamma glutamyl transferase (GGT), and concentrations of Zn in serum <18 μmol/L.

Figure 2 Bland-Altman plots showing the relationship between total spore counts determined from 6–10 individual aliquots of wash water from a 60 g pasture sample and predicted counts from (a) one, (b) two or (c) three individual aliquots of wash water from the same pasture sample. The solid line is the line of best fit and the dashed lines are 95% limits of agreement.



Method

This study was a survey of 106 dairy farms from the Northland, Auckland, Waikato, Bay of Plenty, Taranaki, and Manawatu-Wanganui regions between January–May 2014 (Cuttance *et al.* 2016). Veterinary clinics throughout the high FE risk regions of the North Island were invited to participate.

When regional spore counts were greater than 30,000 spores/g pasture in a given practice area, participating veterinarians randomly selected 10 or 20 farms (depending on the practice) from their practice client list. Herd managers from these farms were contacted and invited to participate in the survey.

Herd managers selected five cows that were up to and including four years of age and five cows that were greater than and equal to five years old. Selected cattle were drafted from the main milking herd and held for examination at approximately 10 a.m. on the day of which the questionnaire was administered to the attending herd manager.

The 10 cows were blood sampled and weighed. Blood samples were sent to NZVP for estimation of serum Zn and GGT within 12 hours of sampling. After the blood samples were collected, a survey on farm management practices relating to prevention of FE was administered to the herd manager.

Pasture samples were collected from four paddocks on each farm and submitted for spore count estimation. Pasture sampling and spore counting was carried out using standard protocols as explained in the previous section on variability in spore counting.

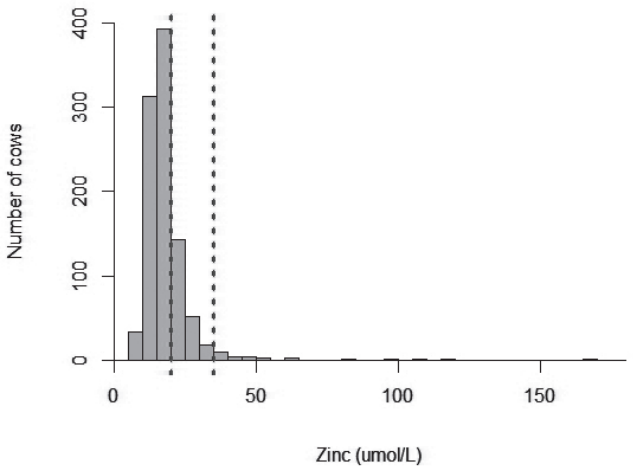
Results and discussion

Liver damage. Cows with GGT concentrations over 300 IU/L were assumed to have liver damage caused by FE. In total, 7% (95% CI 6 to 9%) of all cows that took part in the study had GGT concentrations greater than 300 IU/L.

A herd was classified as having evidence of a significant facial eczema challenge if one or more cows in the mob sampled had a GGT serum concentration greater than 300 IU/L. Of the farms in the study, 32% (95% CI 23 to 42%) showed evidence of a facial eczema challenge.

Pasture spore counts. Pasture spore counts were highly variable between paddocks, farms and regions and pasture spore counting was under-utilised as a management tool for FE management. Only 33% (95% CI 24 - 43%) of herd managers reported that they measured spore counts on their own farm.

Figure 3 Frequency histogram of serum zinc (Zn) concentrations in cattle on farms that used Zn to control FE (n = 921). The vertical dashed lines represent the lower and upper limits of the recommended range for FE protection (20 to 35 µmol/L; Munday *et al.*, 2001).



Common reasons for not monitoring their own pasture spore counts included being too busy, a belief that their own FE counts would not change their management decisions, a reliance on regional or spore counts measured on neighbouring properties, lack of familiarity with the technique and a belief that spore count results were too variable.

Zinc concentrations. The majority (93%) of herd managers reported that they had some form of management program in place for prevention of FE.

The normal range for serum Zn levels in cattle that are un-supplemented with any form of Zn is 11 to 20 µmol/L. Prophylactic Zn supplementation for the prevention of FE should raise serum Zn concentrations to 20 to 35 µmol/L (Smith 1987). Only 28.4% (95% CI 25.6 – 34.5) of cows receiving Zn supplementation had serum Zn concentrations within the protective range (Figure 3). A total of 2.4% (95% CI 1.5-3.6) of cows had serum Zn levels above the recommended range and the remaining 69.2% (95% CI 64.9-71.1) were below the recommended range. Out of the 34 herd managers who had evidence of FE damage in their herds, 20 of them thought their FE management program was effective.

Of the 72 herd managers who said their FE management program was effective 80% (95% CI 69 - 89%) based this conclusion on not seeing any cows with clinical signs. The reasons cited by the remaining herd managers included an absence of clinical cases of FE, that clinical cases had stopped appearing after starting their management program or that they had not experienced any FE-related deaths in their herd. Drenching, Zn in feed and a combination of Zn in feed plus water treatment were the only methods of administering Zn that resulted in cows having serum Zn levels in the recommended range for protection against FE.

All FE management strategies had obvious opportunities for error to occur. The main problems identified included: (a) wide variation in cattle weights within the same herd and a failure of herd managers to weigh cattle to determine an appropriate dose of Zn, and (b) failure to monitor responses which would allow management protocols to be adjusted, if necessary.

There were a large number of herds in this study where FE was not managed effectively. Cattle with liver damage (as indicated by elevated serum GGT concentrations) were present in 32% of the study herds. Only 29% of cows in herds with an FE management program using Zn had serum Zn concentrations within the recommended protective range.

Conclusions

The results presented within this review indicate that the majority of herd managers still think of FE simply as a clinical disease and are consequently making assumptions that because they don't see clinical signs of FE, their FE control efforts are working. There are many areas for potential improvement, primarily about utilising information to make decisions about FE management programs and their effectiveness.

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