

Technical Series

ONLINE

Are your cows well protected against FE this summer?

Emma Cuttance, VetEnt

Key Points

- *Sub-clinical facial eczema (FE) is currently a problem on at least a third of dairy farms in the North Island.*
- *Spore counting is good for detecting trends but counts are highly variable. To be most relevant, the same paddocks need to be tested each week on your own farm.*
- *Chicory and plantain are protective against facial eczema in pure swards; tall fescue may have some protective effect.*
- *Lime has no effect on spore counts.*
- *In a 2014 trial, only 31% of cows that received a form of zinc supplementation had serum zinc concentrations in the range thought to be protective against facial eczema.*
- *Farmers need to assess the effectiveness of their chosen management program by testing a selection of cattle for zinc concentration in the blood and liver damage.*



Cause of FE

Facial Eczema (FE) is caused by the saprophytic fungus *Pithomyces chartarum* which lives on dead and decaying litter at the base of pastures. When weather conditions are warm and humid the fungus produces spores filled with a toxin (Sporidesmin) that, when eaten, causes damage to the liver and bile ducts. The damaged liver is unable to rid the body of wastes, causing a breakdown product of chlorophyll to accumulate in the blood which results in the clinical symptoms of facial eczema, namely photosensitivity. Clinically affected cattle will seek shade but, if exposed to direct sunlight, the skin quickly becomes inflamed and may peel away, particularly on the light coloured areas of the body.

The problems

Images of badly affected stock are highly emotive, hence it is not uncommon for such photos to be used in public releases from animal welfare groups. Clinical symptoms of FE, therefore, present significant risk to New Zealand's 'clean green image' and reputation for sustaining a high level of animal welfare in farmed livestock.

Costs associated with FE arise from deaths, condemnation of carcasses and underperformance in live weight gain, poor reproductive performance and decreased milk production. Production losses due to FE in New Zealand, adjusting for inflation, have been estimated to range up to \$215 million NZD per year for sheep and beef cattle alone¹.

FE can cause significant production loss for dairy farmers. Towers and Smith² observed a drop in milk volume of up to 25% when cows were artificially dosed with sporidesmin, while Smith and Embling³ found a reduction of 10% milk volume when cows were naturally exposed to long periods of low spore counts (0-90,000 spores/g) on pasture.

The subclinical effect on milk production is also of considerable concern. 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, while a much greater proportion have significant liver damage without any obvious clinical symptoms⁴. Morris et al.⁵ found that survivability of jersey heifers was 6-10% lower in herds that were naturally challenged by an FE outbreak (as measured by serum gamma-glutamyltransferase; GGT).

¹ Calculated using the calculator at www.rbnz.govt.nz/statistics/0135595.html, (accessed 30/06/2015)

Recent work on FE

In 2014, a study of 106 North Island dairy herds from 9 different facial eczema prone regions was completed. The aims of this study were to document current practices used to manage and prevent FE, and determine the effectiveness of each practice. From each farm, 10 cows were blood sampled to test for liver damage, four paddocks were sampled to measure spore counts, and a 23 page questionnaire was completed detailing the management practices and farmer attitudes to facial eczema.

Results of this study indicated that 32% of farms had sub-clinical facial eczema damage. If this figure reflects an average incidence in FE prone areas, the cost to the industry would equate to \$78M in lost production. Therefore, prevention of this disease is vital for both production and welfare.

The fungus and its spores in pasture

The majority of the fungal spores are found below the mid height of the sward but they can also be found on green growing leaves⁶ as they will blow in the wind, especially when the ground is disturbed, and can adhere to growing grass and clover⁷.

Optimal growth of the fungus is considered to occur at 24°C and sporulation (spore production) at 100% humidity; under these conditions germination of the fungus can occur within 30 minutes⁸ and sporulation within 2 days⁹. Spores can be found in the pasture all year round but only in low numbers when conditions are not suitable.

Spore counting is currently the most widely used method to assess the potential intake of toxic spores by grazing animals; and thus their risk of facial eczema.

Counting spores is not a direct measure of pasture toxicity, but in vitro studies have demonstrated that the amount of toxin produced is proportional to the number of spores in the culture^{10, 11}. The direct measurement of sporidesmin (toxin) concentrations is currently not feasible in a timely manner and in a general veterinary practice or a farm setting, and so counting spores is both a valid and feasible alternative.

The spore counting technique recommended by Oldman and Di Menna¹² is the method currently used by the majority of farmers, veterinarians, laboratories and researchers. For this method, 200g of pasture is collected by walking diagonally across a paddock and stopping at 10 points along the diagonal and cutting pasture at the base. A 60 g sample of pasture is then randomly selected from the total pasture collected and added to 600 mL of water, then shaken vigorously for 3 minutes. The pasture is removed, leaving the 'wash water'. An eye dropper is used to collect a sample of the solution (water aliquot) to read under a microscope at 100x magnification. Depending on the depth of the grids the total pasture spore counts/g pasture are estimated by multiplying the number of observed spores by 5,000 or 10,000.

In 2013, this method was closely examined by analysing 12,784 spore counts from four farms. Each farm had one paddock with 40 pegs evenly placed. Each peg site had 30 spore counts analysed using grass cuts from a 1m radius around the peg every week.

Throughout the sampling period, there was a large variation between farms (0-490,000 spores/gram pasture and a large amount of variability between individual pegs in the paddock.

To increase the accuracy of spore counts, repeat sampling of the wash water is needed. Table 1 shows that we increase our confidence in the true number of spores as we increase the number of samples we count from the wash-water.

Total count	Predicted count		
	One sample	Two samples	Three samples
10	0-21	2-19	3-16
20	2-35	7-32	10-29
30	5-49	12-45	17-42
40	7-63	18-47	26-54
50	10-76	23-70	30-66

Table 3: 95% limits of agreement for predicted counts from one to three samples for total counts from 10 samples from the same wash water from an individual grass sample. For example, a grass sample where the total spore count from 10 samples was 20, the predicted spore counts from individual samples will, 95% of the time, be between 2 and 35, whereas for three samples 95% of the time the predicted count will be between 10 and 29.

What this means in practice is that spore counts need to be taken from multiple paddocks and at regular intervals on the farm of interest. If decisions for managing FE risk are based on the spore count then at least three aliquots from wash water for a single sample should be read and an average calculated. In addition, due to the amount of variability expected from a spore count reading, it is recommended that spore count trends are used for management decisions rather than single one-off counts.

Control options

Avoiding toxic pasture

The role of pasture species in the control of facial eczema was initially researched on multiple paddocks in Northland, Waikato and Palmerston North from 1997-2000. Chicory (*Cichorium intybus*), clovers (*Trifolium pratense* and *Trifolium repens*) and tall fescue (*Festuca arundinacea*) based pastures were first compared to ryegrass dominant pastures (*Lolium perenne*) by assessing faecal spore counts in animals grazing paddocks made up of different pasture mixes e.g. tall fescue, white clover and chicory in comparison to ryegrass and white clover. Other pasture species were also compared by harvesting leaves of ryegrass, cocksfoot (*Dactylis glomerata*), browntop (*Agrostis tenuis*), Yorkshire fog (*Holcus lanatus*), chicory, red clover, white clover, lotus (*Lotus pedunculatus*) and tall fescue¹³.

Results from this study suggested species supporting low levels of *P. chartarum* were chicory, red and white clover, lotus and tall fescue, while the species supporting high levels of *P. chartarum* were ryegrass, cocksfoot, browntop, and Yorkshire fog¹³. The study had some methodological deficiencies but is the best data we have to provide guidance.

A trial completed on a DairyNZ farm in 2012 using weekly spore counts to assess facial eczema risk on different pastures showed that mixed pastures that incorporated tall fescue, chicory, plantain and lotus had similar spore counts to ryegrass pastures. This indicates that just inclusion of species known to be "FE safe" into pasture is not enough to decrease paddock spore counts indicating that they are only an effective control measure when grown in pure swards.

Reducing toxin production

Fungicides act on mitosis and cell division in susceptible fungi and therefore slow down the development and spore production of the fungus. Benzimidazole fungicides were successful in reducing *P. chartarum* spore numbers in an in vitro (laboratory) study¹⁴.

Fungicide sprays must be absorbed into the plant material to work. It is therefore important that fungicides are used on green and growing plant material. To be effective, spraying needs to be accurate and completely cover the entire paddock which includes fence lines, under shelter belts, around troughs and under trees. As the spray prevents the fungus from developing, if spore counts are high prior to spraying the fungicide will not perform to expectation.

The 2014 study showed that the use of fungicide sprays were the least common method of protection against FE.

Protecting animals against ingested toxins

Oral zinc dosing has been known to be an effective way of managing facial eczema since the early 1970's. The protective effect of zinc is related to its ability to bind to sporidesmin (toxin) and inhibit the generation of the superoxide radical formed by the unstable sporidesmin molecule¹⁵ and so prevent damage to the liver and bile ducts.

The most common methods of zinc treatment used by farmers are trough treatment, feed treatment and drenching.

There have been a number of studies evaluating the effectiveness of zinc sulphate (ZnSO₄). Smith and Embling³ used ZnSO₄ at dose rates of 0.35g Zn/d as zinc heptahydrate for 36 days, and found this gave sufficient protection against FE as shown by absence of liver damage. Trough treatment, however, may not guarantee all cows are protected, given individual cow variation in the amount of water consumed and climatic conditions (cooler weather and rainfall) that can reduce water requirements.

Drenching provides confidence that all cows have received their daily dose, though there has been very little research on the effectiveness of zinc drenching. In 2009, Morris and Hickey¹⁶ compared the serum (blood) zinc levels of 10 cows supplemented with zinc sulphate in the trough to 10 cows supplemented with a zinc oxide drench. Both treatments resulted in sufficiently elevated serum Zn levels for protection against FE, though serum Zn increased more rapidly for the drenched group.

There is no published literature the author is aware of on the efficacy of zinc oxide in feed.

Although all methods of zinc administration can be effective, all methods equally can fail. As a general rule, the more control a farmer has on the amount of zinc a cow receives (drenching, capsules) the more likely it is that the cows are receiving the correct amount of daily zinc.

Reasons for breakdown in control

Despite the widespread use of management methods for controlling facial eczema, there are still many breakdowns in control shown by clinical outbreaks or unseen subclinical damage.

The 2014 study looked for possible reasons for these breakdowns.

The key findings were:

- From blood sampling of 10 cows per farm, it was found that 32% of these herds had experienced a facial eczema challenge (liver damage).
- Pasture spore counting was significantly under-utilised as a management tool for FE management. Only 33% of herd managers reported that they measured spore counts on their own farm. 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 decisions about how FE would be managed, 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.
- Only 31% (95% CI 28 to 34%) of cows that received zinc supplementation had serum zinc concentrations in the range thought to be protective against FE because the majority of farmers are unintentionally under-dosing cows.
- Zinc in drinking water is the most common method used but the least effective at achieving adequate blood zinc levels.
- Key point: ***It is possible for all zinc treatments to work, but all methods can fail if the dosage is incorrect. The method is more likely to fail if a cow has control over her intake of zinc (water, feed)***
- All FE management strategies had obvious opportunities for error to occur and were likely reasons why blood zinc levels were so low. The main problems identified included: (a) unknown and wide variation in cattle weights within the same herd, and (b) failure to monitor blood zinc levels and liver damage in cattle which would allow management protocols to be adjusted, if necessary.

DairyNZ now has a protocol for farmers to follow to give the best chances of protecting against facial eczema damage (<http://www.dairynz.co.nz/animal/health-conditions/facial-eczema/>).

In future, protection against FE will be improved by the selective breeding of dairy cattle for tolerance to sporidesmin (see July 2014 Technical Series). Semen from 'FE tolerant' bulls is already available on the market. However, increasing protection via breeding programmes is a slow process, so zinc treatment will remain the best FE protection tool for some time yet.

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