Facial eczema action group workshop notes

Ruakura conference 27 October 2015

Convened by Robert Carter, steering group lead

with funding support from Beef and Lamb New Zealand

To engage with the FE Action group or learn about progress since the October 2015 workshop contact:

Robert Carter
phone: +64 7 896 7020
email: unca.rokit@xtra.co.nz

Workshop and report facilitated by Groundwork Associates

Any questions about the workshop facilitation or the recommendations in the report can be directed to:

Annie Perkins
phone: +64 7 855 7163
email: annie.perkins@groundworkassociates.co.nz
web: www.groundworkassociates.co.nz

Table of Contents

1. Introduction

These collaborative workshop notes were produced by Groundwork Associates with significant contributions by Robert Carter, the FE Action group, and the attendees of the workshop listed below.

Beef and Lamb provided cash funding for the workshop facilitation and catering. Time was provided in kind by those who attended, the steering group, and Groundwork Associates - who donated time to support the farmers and scientists in putting this document together.

Purpose

FE Action group is a mid-northern North Island Farmer Council initiative. Our aim is to achieve a collaborative, farmer driven, prioritised research and development needs analysis of facial eczema in the sheep, beef + dairy industry.

Aims

1. To answer to the question: where should we focus our efforts and funding in the future?

2. To look at facial eczema from a few different angles: vets, industry representatives, scientists, and farmers all bring different insights.

Who

43 representatives (full list at the end of this document) attended to discuss the state of facial eczema in New Zealand, and actions going forward to improve the situation. Participants came from all over New Zealand, including a few representatives from the South Island, but the North half of the North Island was the most strongly represented. The veterinary, industry, and research sectors were each represented by between 5 and 10 participants and the rest of the group was made up of farmers (approximately 20 participants).

Attendees

Name	Phone	Email
Annie Perkins (facilitator), Lara Heppenstall and Jody Joblin	07 855 7163	Annie.perkins@groundworkassociates.co.nz lara.heppenstall@groundworkassociates.co.nz
Keith Abbott	0274 639 859	keithabb@xtra.co.nz
Craig Alexander	07 888 1703	calexander@xtra.co.nz

Ross Alexander	07 883 4780 027 222 0247	Rossco628@gmail.com
Neville Amyes	07 838 5421	Neville.amyes@agresearch.co.nz
David Arvidson	09 296 0597	arvidsonz@gmail.com
Kate Broadbent	09 233 3230	Broadbent.ka@gmail.com
Robert & Suzanne Carter (Convenor)	07 896 7020	Unca.rokit@xtra.co.nz
Simon Carthew	027 226 2262	simon@carthewgenetics.co.nz
Cathryn Christie	027 223 4745	Cathryn.c@vetora.nz
Trevor Cook	027 446 3616	Trevor.cook@totallyvets.co.nz
Neil Cullen	07 838 5414	Neil.cullen@agresearch.co.nz
Cliff Deery	021 073 1620	Jcd@xtra.co.nz
Edward Dinger	07 827 8784	edward@ceresfarm.co.nz
Jo & Andrew Gaston	07 877 8411	gastonjam@xtra.co.nz
Cam Heggie	027 501 8182	camheggie@pggwrightson.co.nz
Tim Hale		tim.hale@agresearch.co.nz
Mark Illston	06 388 7804	mark@mindahills.co.nz
Rachel Jukes		Rachel.jukes@beeflambnz.com
Sharl Liebergreen	021 522 999	Sharl.Liebergreen@zoetis.com
Chris Logan	027 604 8450	chris.logan@lincoln.ac.nz
Julia McCracken	029 770 4597	Julia@piopiovets.co.nz
John McIntyre	021 747 455	John.mcintyre@focusgenetics.com
Kathryn McRae	022 632 9577	Kathryn.mcrae@agresearch.co.nz
John Marchant	09 232 5613	Dimmock Road, Pokeno, RD 1
Anna Martyn	021 247 2278	anna@piopiovets.co.nz
Greg Mirams	027 435 8245	greg@techiongroup.co.nz
John Morrison	06 327 7359	ardofarm@farmside.co.nz
Claire Nicholson	021 332 733	Sirona Animal Health

Bruce Orr	027 592 2121	bruceorr@xtra.co.nz
Claire Phyn	021 055 1090	Claire.phyn@dairynz.co.nz
Tony Pleasants	07 855 6889	Tony.pleasants@agresearch.co.nz
Russell Proffit	027 355 2927	rnmwproffit@xtra.co.nz
Ross Richards	07 895 7144	romani@farmside.co.nz
Geoff Ridley	027 422 4102	Geoff.ridley@beeflambnz.com
Jo Scott	021 917 024	Johanna.scott@zoetis.com
Allan Sheppard	027 522 6477	a.sheppard@auckland.ac.nz
Bob Steed	09 433 2616	Kereru_station@xtra.co.nz
Neale Towers	07 856 4701	neale.towers@ihug.co.nz
Kara Watson	027 663 3315	kwatson@fvs.co.nz
John Wilkie	021 267 4425	jdw@waione.co.nz
Robyn Williamson	07 871 0809	Williamson.robynw@gmail.com
Boyd Young	06 756 9197	BW.KA.Young@farmside.co.nz
Mark Young		Mark.young@beeflambgenetics.com

Key Terms

BVs - breeding values

DPX - term used in SIL (Sheep Improvement Ltd) data outputs to describe the tolerance to Eczema estimated breeding value (EBV)

EBVs - Estimated Breeding Values

FE (Facial Eczema) - a disease in livestock (primarily sheep but also including beef and dairy bovine animals) caused by the spores of a fungus (Pithomyces chartarum). When swallowed the spores release the toxin sporidesmin in the GI tract of the animal. Can cause severe injury to the liver and bile ducts.

FEBV - same as DPX, also used in some outputs from bureau's facilitating data outputs

GGT - a marker of liver damage in the blood (most tolerant animals have a low GGT level following a challenge with sporidesmin; blood GGT levels increase with the amount of facial eczema damage each animal suffers post challenge)
(Gamma glutamyl transferase)

Pithomyces chartarum - the fungus whose spores produce the toxin (sporidesmin)

Ramguard (Ramguard FE Tolerance Testing Service) - a tool used by ram breeders to identify FE tolerant rams

Sheep 5K - a genomic selection tool. It uses 5 000 DNA markers (SNPs - see definition below) to derive breeding values. Breeding values derived from a genomic tool are called molecular breeding values (mBVs).

Sheep 50K - same as above but has 50000 SNPs assessed, more accurate than Sheep 5k but also more costly.

SIL (Sheep Improvement Ltd) - the national performance recording and genetic evaluation service for the sheep industry

SNP or snip (Single Neucleotide Polymorphism) - single site change on the DNA responsible for triggering or controlling a function in an animal.

Sporidesmin - the toxin released by the fungus.(Pithomyces chartarum) It can cause severe injury to the liver and bile ducts of sheep and cattle. Used in controlled circumstances for performance testing in animals. (Sheep and cattle)

2. The situation around facial eczema depicted by group pictures

Directions: “Draw a picture of what the situation around facial eczema looks like now. Try to use images - what does it look like?”

Some common themes that emerged consistently across the eight pictures produced by the different groups were:

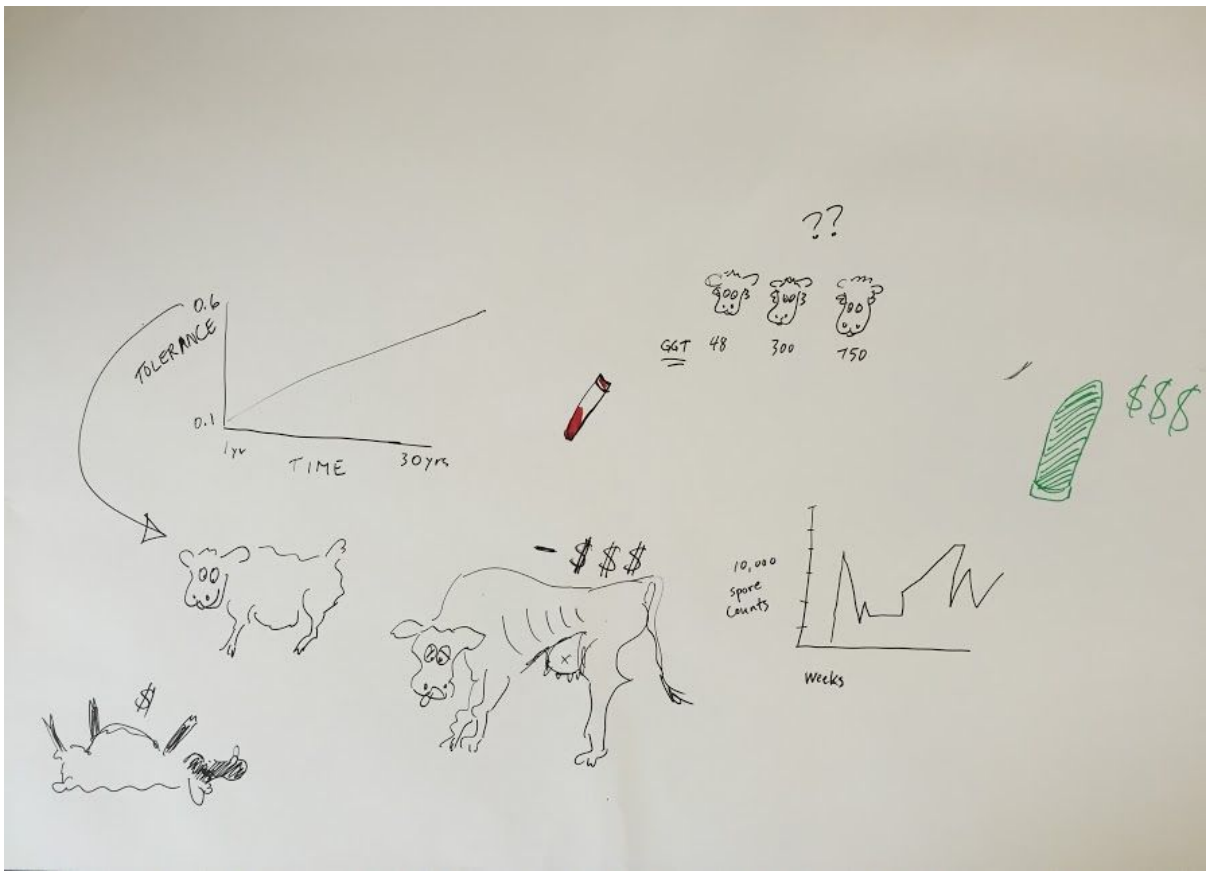
- sick animals (subclinical majority vs. clinical minority)
- the effect of FE on animal welfare
- the high cost of all the treatments and preventative measures ($$)
- the stressed/worried farmer
- the effect of climate/weather/temperature.

Some striking smaller images came up on many of the posters. The committee may want to crop out some of these striking sub-images from the pictures of the posters and get a graphic designer to re-work them for use in publications/promotional purposes. Some sub-images that give an overall portrayal of the FE situation are the “tip of the iceberg” analogy for the visible vs. invisible effects of FE, the teeter totter that appeared on another poster, the idea (not drawn) of a farmer with their head in the sand, and the map of New Zealand showing the regions most affected. Some other powerful images were the drawing of liver damage, the worried farmers, and the image of the spore as a grenade.

Posters by group

Poster by a group of farmers (link to video)

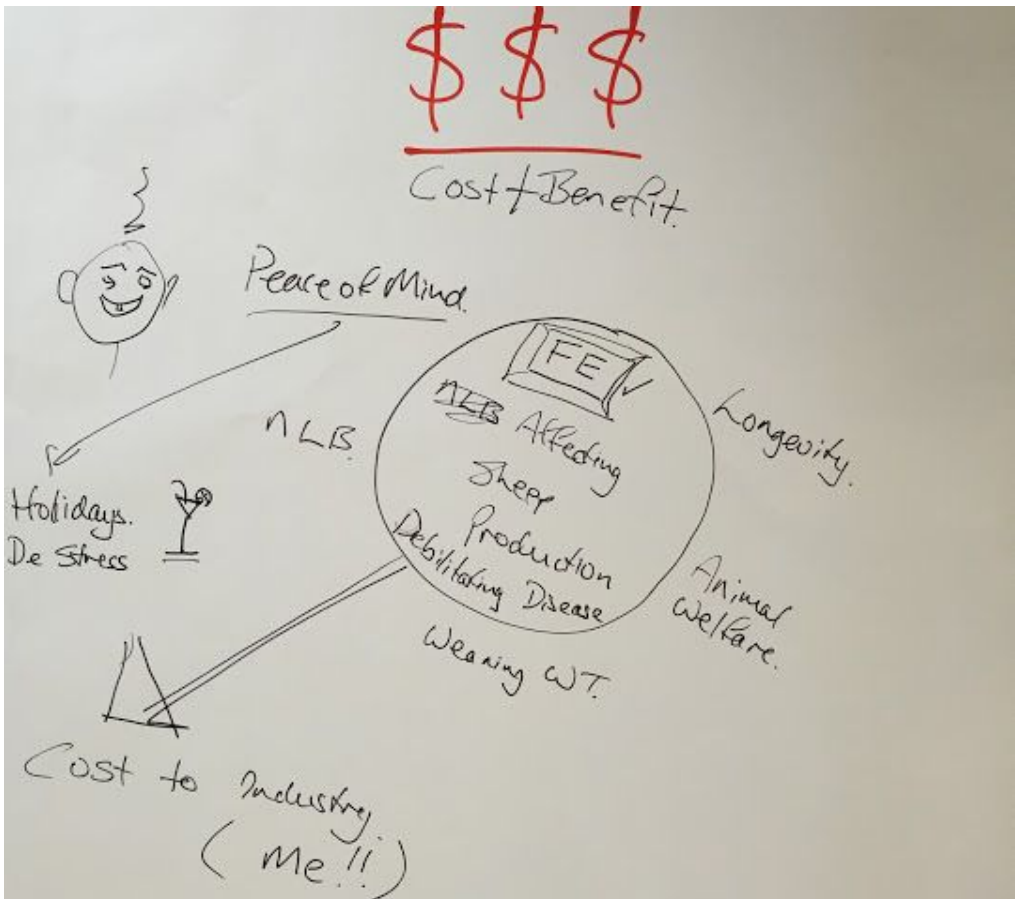
- $ showing the cost of dead and non-productive animals
- Graph shows tolerance increasing over time, based on dose rate. Goes up to 30 years, showing it takes a long time but results in animals having high tolerance at 0.6.
- Blood sampling for GGT analysis is the current selection tool. This comes at a high cost but without that tool we don't know which animals to cull, and more importantly, which ones to breed from to increase tolerance across the flock.
- Zinc capsules also come at a high cost!
- Spore counts highly volatile, hard to control and unknown which have extended periods of exposure.
- Spore counts can vary greatly across the topography of a farm and paddock by paddock depending on a number of factors such as microclimate and feed type, pasture length/density, species, quality etc.



Poster by a group of farmers (link to video)

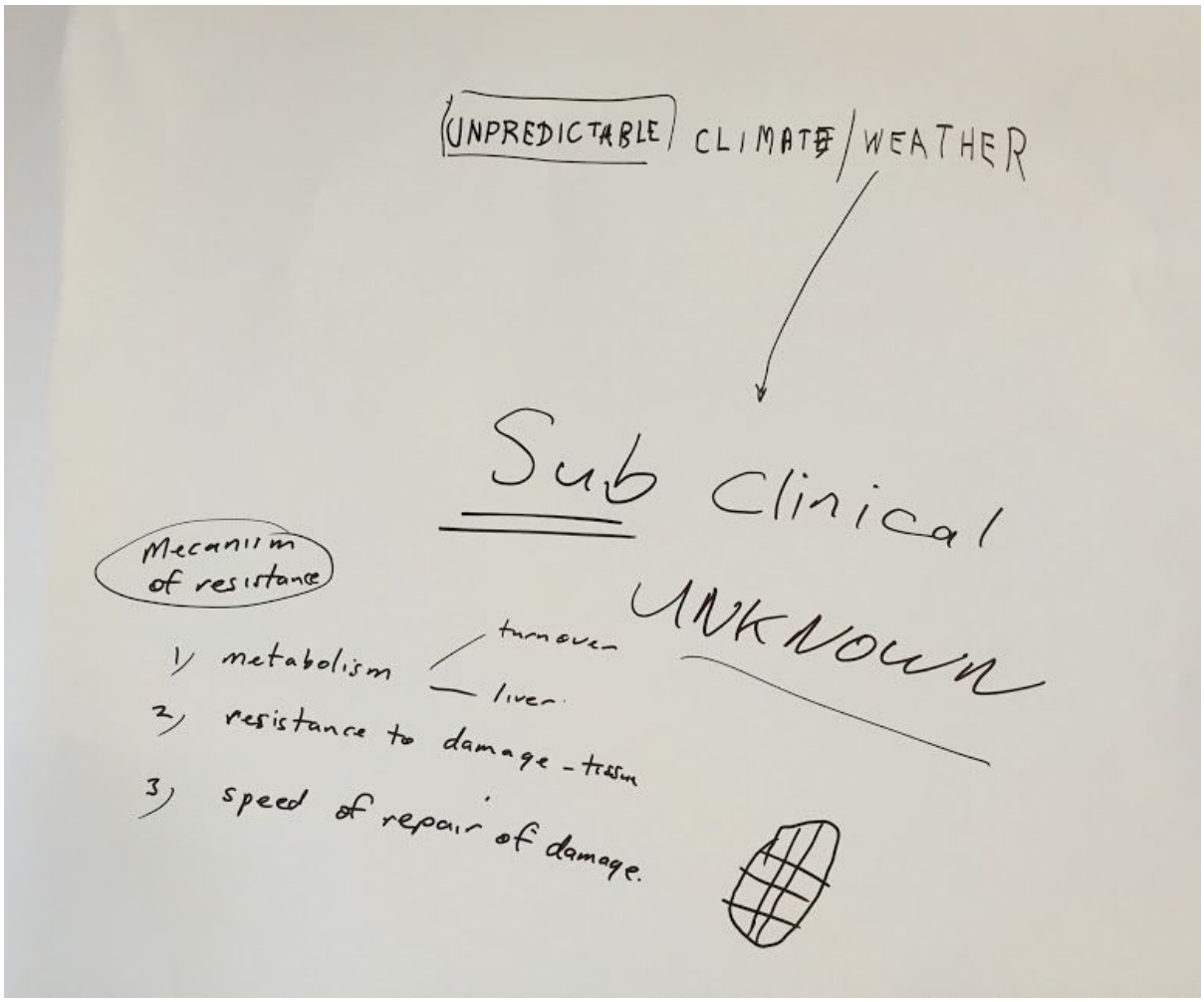
- FE is the heart of everything if you are farming in the North Island, and it’s going into the South Island as well.
- NLB is affected, weaning weight, animal welfare all affected
- Huge overall cost to industry, most farmers only think about “ME” not the industry

- Gives you peace of mind if you have an eczema tolerant flock, and come February holidays, you have a happy wife. If you can do all this you can make money!



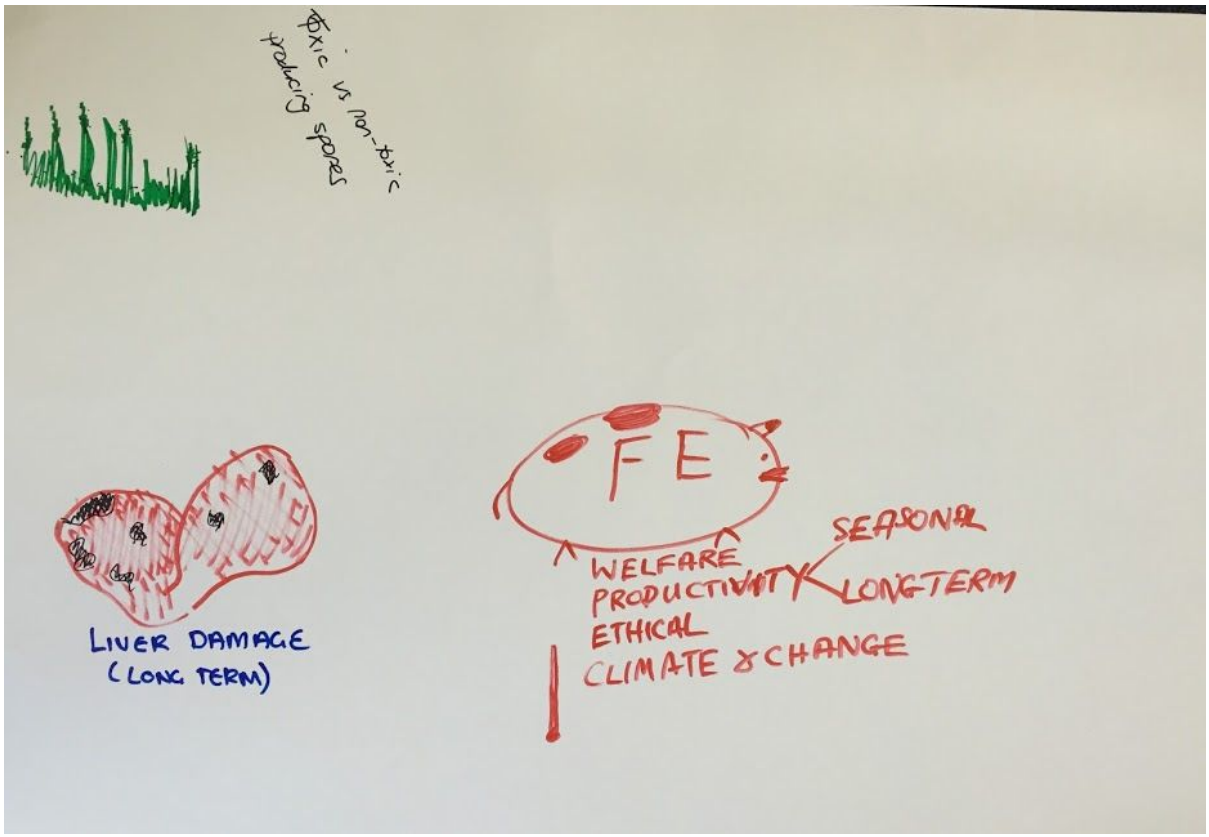
Poster by a group of scientists (link to video)

- Depicted the spore as a grenade, which is what the spore actually looks like under a microscope.
- Sub-clinicals are the biggest unknown and we don't know what damage is being done from them.
- Unpredictable climate and weather (more variable further South), which presents an issue.
- Mechanism of resistance, metabolic side / liver damage, we don't know what resistance to damage in the tissue and what is the speed of repair.



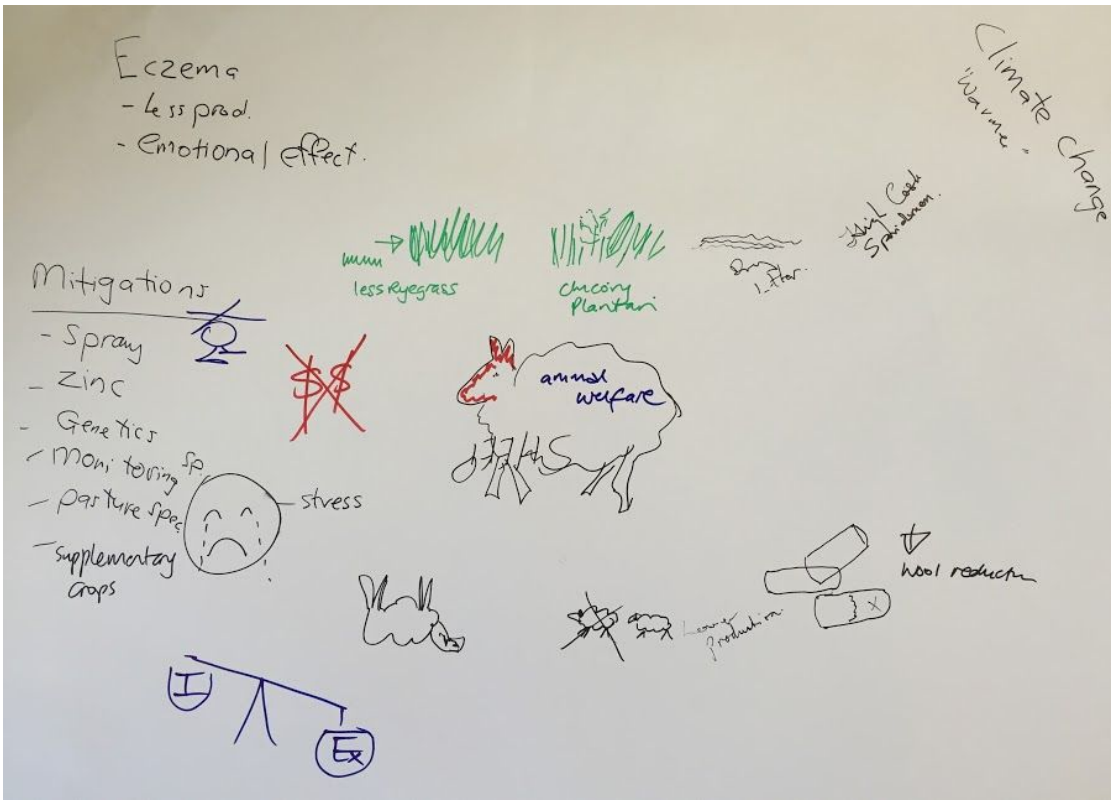
Poster by a group of scientists (link to video)

- Skin damage and effect on animal welfare which the industry is not addressing
- Seasonal and long term productivity of animals
- Ethical issues of dosing animals with sporidesmin
- Climate change moving FE into South island
- Context of pasture and spore population, there are toxic and non-toxic strains of Pithomyces chartarum
- Liver damage effects can be long / short term



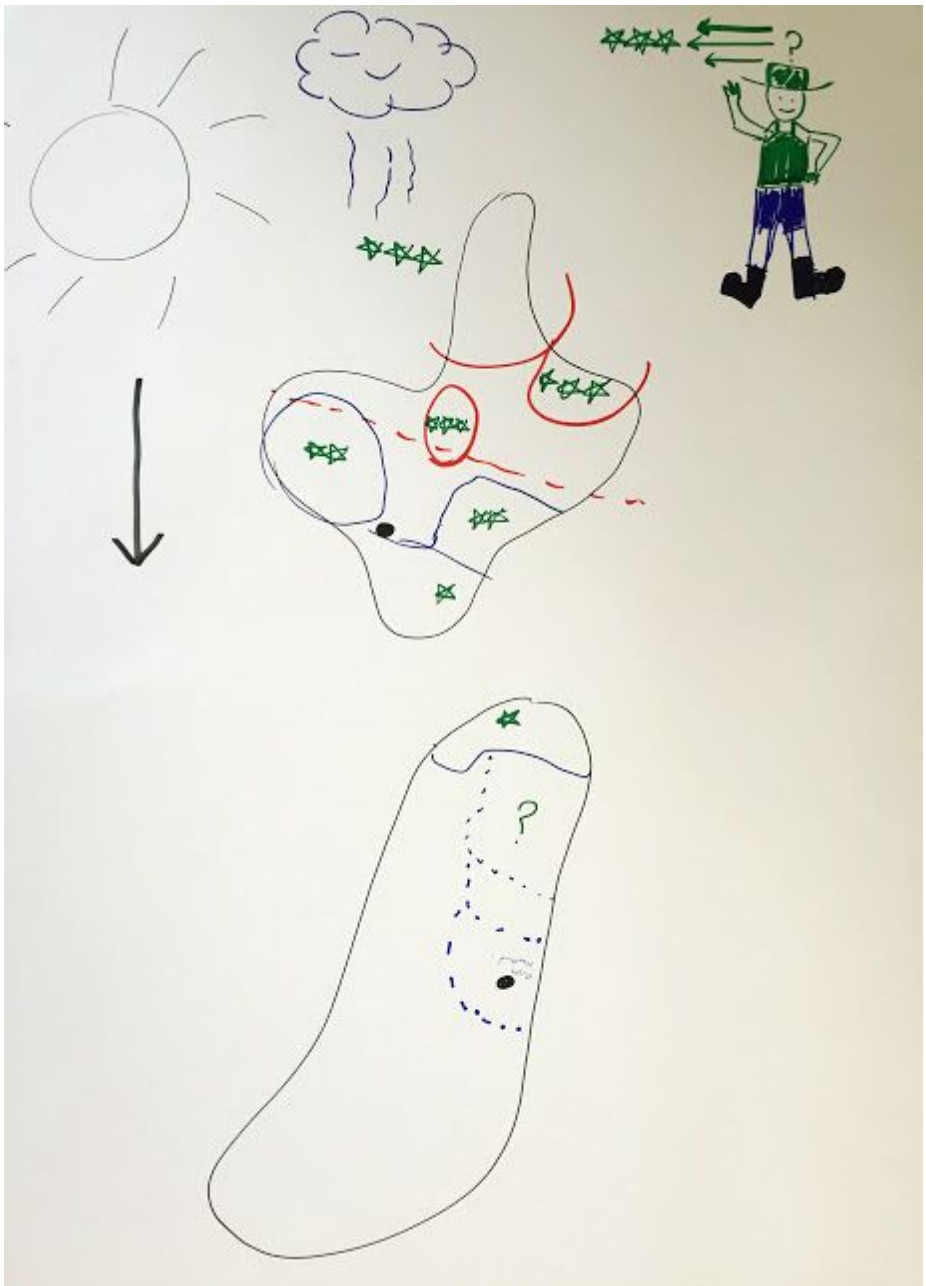
Poster by a group of farmers [(link to video)]

- Affects animal welfare and loss of production
- Emotional stress on farmer
- High cost of sporidesmin and thus of the Ramguard FE tolerance test.
- Mitigating factors, fungicide spraying, zinc dosing all cost money
- Climate is out of our hands



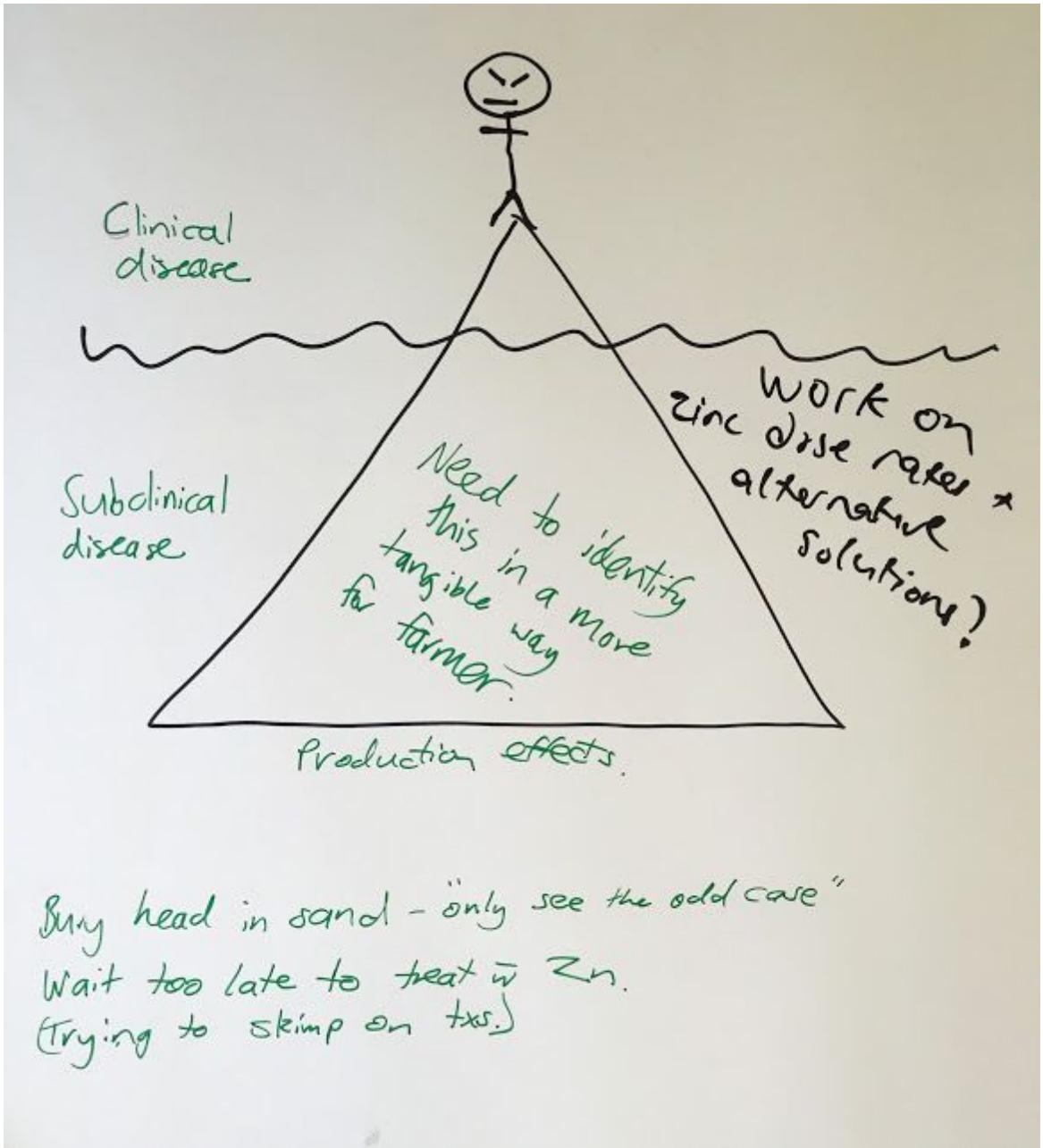
Poster by a group from industry (link to video)

- Majority of knowledge is in the hub of the central north island
- Climate change is and will be influential
- Farmers have high levels of knowledge
- First adopters will likely to be farmers within this local area



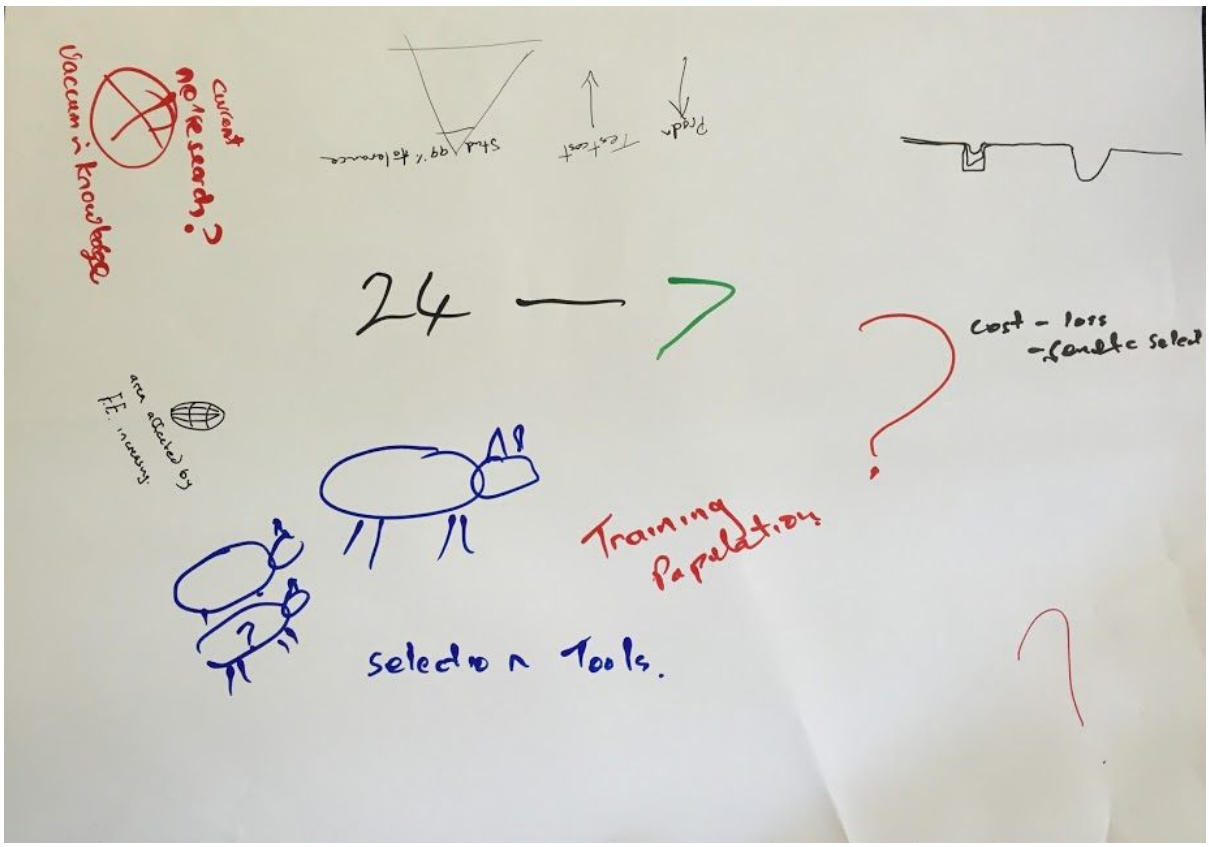
Poster by a group of vets [(link to video)]

- Believe the monitoring and treatment tools are available, but most farmers don't make use of these items already.
- Why is it that farmers don't do anything?



Poster by a group of farmers [(link to video)]

- How much does it cost us? (must be huge).
- Biggest concern is cost, which is non quantifiable. More realisation of this may help colleagues/ farmers to realise that progress can be made.
- Selection tools could be more economical and provide more incentive to do more about it.



3. Seasonal timeline for facial eczema management

Directions: “make a bit of a seasonal timeline, so draw a line down the middle of your poster and label the months of the year, so roughly try to get the twelve months of the year across that timeline. Once you’ve got that, what do you do? There are a lot of things you do on your farm or in your industry now. Where are the pressure points? Where is the action? This is about what we do across the year to manage facial eczema? Roughly what time of the year do you do what?”

Overview

The main facial eczema season in New Zealand is from January to June, but there is something that needs to be done to manage the effects of FE every month of the year. During the January to June season farmers should be spore counting regularly to give a picture of spore trends, including faecal spore counts if possible, and checking the livers of any dead animals. Management practices to minimise effects of FE that will be ongoing from January to June include spraying of pastures, use of zinc prophylaxis, treatment of those showing clinical signs, stock shift, hot block avoidance, and the use of fodder crops/grass.

During the off-season from July to December farmers will be assessing the damage done by the previous FE season and preparing for the next season. The proactive farmer will never have a month where he/she isn’t thinking about facial eczema.

Group responses

Link to video of the group of vets discussing of their timeline
Videos of the whole committee discussing the seasonal timeline:
Link to video 1/5
Link to video 2/5
Link to video 3/5
Link to video 4/5
Link to video 5/5

January/ February	• spray pastures (needs to be early - January time, before spore counts begin to rise) • maintain pasture quality to avoid dead matter, no mechanical topping as that creates the dead and dying litter that the spores develop in.

	● bolus depending on spore counts (don't miss the boat by bolusing too late) + liaise with vets [ongoing from Feb-June] ● begin prophylaxis (Zinc) as required [ongoing Feb-May] ● Do blood tests to monitor natural exposures [ongoing Feb-May] ● Test dose young rams with Ramguard testing procedure. ● do your main flock cull ● make purchase decisions in terms of ewes and new hoggets ● ewe management ● test ram lambs, start lamb sales ● scan cows ● do genomic tests (sheep, rams, young rams, specifically for FE) ● test bloods for GGT if you have sick animals during this period ● continue to maintain pasture quality ● school holiday time (beach time but also extra workers)
March	● monitoring phase (do spore counts) ● feed supplements to cattle, sheep (to limit exposure to Pithomyces spores) ● put rams out (mating), locking in decisions around that (genetics) ● bolus depending on spore counts (don't miss the boat by bolusing too late) ● test bloods for GGT if you have sick animals during this period ● start to see clinical signs ● Usage of Ramguard FE progeny/new flock sires testing service [ongoing March - August/September]
April/May	● breed stock [ongoing April-May] ● start to see clinicals if you've done nothing (depression) ● keep an eye on spore counts ● consider shifting lambing timing, depending on climate (humidity, rain) ● bolus depending on spore counts ● start to think about semen orders in dairy industry ● test bloods for GGT if you have sick animals during this period
May	● do Ramguard testing [ongoing May - August], assess ram/ewe hoggets for GGT levels from natural challenge for later controlled sporidesmin test challenge (Ramguard) ● breed stock ● april activities ongoing ● bolus depending on spore counts
June	● check copper levels if zinc used ● ill-thrift in ill hoggets ● test for brucellosis ● start to see FE effects in sheep/cattle/dairy

	● do ewe scanning, more selection ● do DNA testing for ram hoggets (for breeders) ● national Field days ● bolus depending on spore counts
July	● lambing/calving [ongoing July - Sept] ● do FE resistance testing [ongoing July - October] ● test for brucellosis ● check the livers of any dead ones (sheep, cattle) ● transition period into milking in dairy industry ● post-partum issues with those infected with FE ● start to dose with sporidesmin (produced all year round) [ongoing July-Nov]
August/ September	● read Heartland sheep (Country Wide magazine) ● research breeders selecting for FE tolerance ● select FE tolerant breeder ● make selection choices ● Ramguard - test rams, selection of FE tolerant rams ● final ewe hogget selection ● put in crops that are FE safe ● there will be positive and negative marketing, heaps of advertising (about what rams they have) ● make sure buying decisions are based on good testing decisions ● test for brucellosis, check out the rams you've already got
October/ November	● do your lambing ● commercial ram selection for FE tolerant rams ● ram sales, who's selling what [ongoing Oct - December] ● decide what ram to buy ● plan FE and grazing management for upcoming season ● monitor previous years' outcomes, and treatment. Review previous season's outcomes ● figure out losses from previous season (ewes that have been affected) ● put FE safe crops in ● pasture management (minimise dead litter) ● identify some areas on the farm that are less affected by FE (south facing slopes) ● identify alternative pasture you can graze when spore numbers are high
December	● check the water, start zinc early - water intake can be extremely variable dose accuracy essential to be of any use at all. Controlled access to water, ie troughs only. Taste/flavour/ all issues. ● start spore counts for next season

	● think about your pasture quality ● think about feed quality ● decide control [plan] and purchase materials

4. Significant events in the history of facial eczema

Directions: “What are some of the significant events in the history of tackling facial eczema (FE)?”

(Click to view video of presentation)

1918	Sheep deaths unexplained; Gus Urquhart wrote home to England explaining about mystery disease killing sheep in South Auckland area, Karaka and Papakura
1938	FE outbreak, serious in the Waikato.
1939	Ruakura established as research centre to address FE
1950s	Spores identified; identifying fungi responsible; toxins as the cause (associated with Autumn & rye grass)
1961	Identifying sporidesmin (developed test for toxicity and isolated toxin. The first mycotoxin known to cause animal disease was sporidesmin.
1960s	Spore counting, pasture spore counting (commentary: developed wash count method, taught a lot of farmers how to do it, created quite a network of home spore counting through Waikato)
late 1960’s	fungicide protection (commentary: fungicide protection (Manutuke research station in Gisborne) - used fungicides such as Thiabendazole, a sheep oral drench based on Benzimidazole, an anthelmintic. A lot of work was done showing how to use it, quite widely used particularly in dairy industry. However lost ground because of having to make decision regarding spraying programmes. (eg. if you sprayed too late it just didn’t work)
	farmer/breeder drivers in place to find solution
1970s	Colin Southey encouraged farmers to be brought into the information loop to assist with information transfer between farmers and scientists At this time Ruakura hosted a Farmers' Conference annually over 3 days when up to 1000 farmers and advisors listened to talks on the latest research
1974	Genetic connection (this was when the breakthroughs came, always was obvious that you had some clinicals, was an agronomist who first decided to do work on whether that was genetically linked)
mid-1970	Breakthrough time when the connection was made between increases in blood serum GGT and the severity of the liver damage
1975	serum GGT testing for liver damage (tried several assays including GGT, found

	out that there was a good relationship between the elevation in serum GGT and severity of liver damage, now had a blood test)
	Zinc protection, zinc as preventative treatment, zinc drench
	Gladys Reid - Zinc prophylaxis discovery (that zinc was protective was first demonstrated in a trial in rats ran mainly to show whether it would speed healing. Giving zinc before sporidesmin gave very high levels of connection. Gladys Reid's only contribution was to interest us [Ruakura] in the idea of zinc as protection because she initially thought she had "zinc deficiency" in her animals the signs of which were said to disappear after zinc supplements were given. This led to quite a lot of work on dose rates. The first recommendations for use or zinc prophylaxis would have been in early 1980s.)
1978	Field testing of the idea that selection for FE tolerance could be based on on a performance test measuring increases in serum GGT after a sporidesmin challenge
	start of ram test for FE tolerance using toxic pasture [high spore counts] as the sporidesmin challenge
1980s	Colin Southey encouraged breeders to select for tolerance using toxic pasture [high spore counts] as the sporidesmin challenge
1982	Stock Safeti (first commercial company to start making sporidesmin for use in FE tolerance testing) established using techniques developed at Ruakura formed by Colin Southey and several ram breeders
Mid 1980s	MAF bought Stock Safeti back (1986), renamed as RamGuard
	"Hot" pasture impact test found to be difficult to manage.
	Farmers buy in to dosing with sporidesmin.
	heritability estimates - h2 = 0.4 in other words, heritability of FE tolerance in sheep is 40%.
	faecal spore counting
	Zinc boluses "The Time Capsule" developed
	Genetic selection ongoing
1989	FE outbreak very severe.
1995	EBV's further work. Dr Chris Morris, AGR scientist (Chris Morris developed an estimated breeding values for eczema) Transferred to SIL
2000	Ovita formation intended to help drive ongoing research. (Ovita was formed to develop genomic tools out of research that was funded by both the Wool Board

	and Meat NZ Ltd. Both organisations went through a metamorphosis and Ovita was a 3 way partnership to carry the R&D forward. Genomic tools such as the 5k SNP are the result, as well as parentage tests and others that Zoetis takes to market.) Now BLNZ genetics in conjunction with Zoetis.
2011 to 2015	Parrotts - farm trial, Beef + Lamb, Kara Watson Franklin vets
2010	50k SNP test using historic bloods (50k SNP chips were first brought in for gene identification)
2013	Sheep 5k (once there was enough data used then 5k was able to use some of the main markers in its analysis and this was also able to use information from animals with 50k)
2010	Testing dairy bulls

5. Key tools we already have for managing facial eczema

Directions: “What do we have in our toolkit right now?”

Table of Contents

Breeding (genetics)

Dr Neil Cullen’s (AGR Scientist) comments

“Genetics is the solution” i.e, using tolerance bred into flocks through selection is our best bet, since zinc and fungicides are pretty nasty, and the alternative is prevention/protection by throwing out ryegrass. It does take time, breeders are finally starting to get a good return on their investment. The dairy industry has never seriously taken FE genetics on.”

Responses

- We can use breeding values
- can use within flock BVs
- Accuracies will increase with greater numbers tested
- can use phenotypes for FE breeding values
- can make use of farmer/breeder experience (who has good genetics)
- can select reliable breeders
- can use 5k/50k information when making selections
- we have gene testing (DNA)
- DNA parentage
- genetic selection
- genetics (Dairy semen)
- can select tolerant rams
- can select sires based on dosing and DNA
- can do SIL- based selection of breeding stock
- there is genetic merit for FE tolerance
- can use raw RamGuard data such as GGT levels vs. F.E EBVs

- RamGuard testing of rams

Testing

Neil's comments

"Testing is just an extension on genetics, you scan the top producing animals, then it feeds back into the flock. The tools are well documented, the limiting factor is just getting people to use them."

Responses

- BCS (Body Condition Scoring) selection with LW change
- ewe hogget selection based on GGT levels during a measured (spore counts) natural challenge period on farm.
- GGT tested hoggets at end of month, related to above.
- blanket GGT testing (screening) as above.
- ewe hogget selection GGT commercials too.
- takes time for genetics to come through, 5 years for a useful level of tolerance in a ewe flock once tolerant sires are introduced.
- Blood testing to monitor natural exposure, testing serum for GGT and Zinc
- production testing SIL

Education/Information/Knowledge

Neil's comments

"The knowledge is there, it's just a matter of filtering it out."

Responses

Industry

- can use SIL indexes to identify the most productive animals
- encourage farmers to get advice on how to interpret figures (when selecting rams)
- advisors educate farmers on choosing FE tolerant sires
- there is sharing info between industries (dairy, beef, sheep)
- there is access to education materials
- FE Ramguard certificate
- there is professional support for vets

Farmers

- knowledge of $ loss tells us control of FE needed
- can make use of existing networks
- there is information sharing between farmers
- education of ram purchasers

- climate monitoring
- relevant information
- review past year before start of new
- keen people and passionate breeders
- knowledge + awareness
- live information on the web, independent and accurate.

Spores

Neil's comments

"Spore counts can be used. A more user friendly fecal spore count system has been developed."

Pasture counts are predictive, faecal counts are retrospective. (Neale Towers)

Responses

- spore counts
    - get an early start
    - monitor trends
    - monitor weekly
    - farm-specific faecal and grass/pasture counts
    - pasture-specific
    - vet liaison
- what is sporidesmin testing best practice? What feeding levels should rams have post dose? Protocol is needed.

Planning

Neil's comments

"It's all about timing, there's no point in putting a zinc bolus in an animal 2 weeks after a high spore count, also have to make sure you have the stuff on hand when you need it."

Responses

- Proactive planning (so you're not too late)
- We need to plan monitoring, treatments and management actions and feed rotations
- feedback
- action
- $$$ (planning for FE related expenditures)
- $$$ help (where can you get $ from?)

Zinc

Neil's comments

"Seems like most of our results have showed zinc in water troughs is a waste of time unless dose rate and intake per animal is accurate". No recommendation for sheep.

Responses

- zinc bolus use must be timely - protection + monitoring start early!
- zinc dosing effectiveness depends upon method

Animal health

Neil's comments

"Here we're talking about the monitoring of animals, culling animals, and some of the treatments to help affected animals."

Responses

- We know that animal health issues can be from natural exposure or inflicted (testing)
- Can control FE by culling ewes, rigorous culling in general
- Identify affected animals and extent of disease through blood testing, and checking GGT levels post-FE exposure
- high dose B12 may help animals who are affected
- works liver monitoring and feedback to producers, similar to Sheep measles reports.
- connecting with science
- Manderson's mix - a drench that may help animals suffering from stress (comment from scientist Neale Towers: "the idea that drenching with various oils might help FE affected animals has been around for 50 years - with absolutely no evidence of efficacy."

Crops/pasture

Neil's comments

"This is an interesting one. Ryegrass is the nasty one - there's some kind of symbiotic relationship or something that provides suitable environment for fungus to survive under."
 Neale Towers: Endophytes don't contribute to FE - but there is an interaction between tolerance to FE and tolerance to ryegrass staggers. FE tolerant animals are more tolerant to RGS

Responses

- Can spray pastures with fungicides such as Mycotak to try to reduce fungal growth
- Existing crops + plant research
- Managing FE through grazing
- Management through pasture selection by avoiding hot paddocks and using crops and safe cool paddocks in danger periods

Wrapup: is there anything that Neil missed?

-What about the use of lime? There's very little evidence to show an effect.
-What about the blood testing that we do on the sheep, is that relevant in the cattle?
(GGT normal range is 30-70 sheep, 0-60 in cattle)

6. Identifying gaps

What tools are we missing?

[Link to video introducing the gaps in our FE toolbox]

Table of contents

Science funding and research

"Where to allocate research dollars is something we'll deal with once we get all this information in some form of order. The research priorities will fall out of this discussion." (Robert Carter, farmer and forum convenor)

Sporidesmin production and the affordable testing of tolerance

What are the gaps?

- Issue: the upper limit is unclear in the protocol for sporidesmin testing (need to set an upper limit as 0.6mg/kg has been exceeded by some flocks and is unclear as to whether there is any benefit to raising dose rate)
- Want new diagnostic testing systems and more diagnostic tools
- Need to determine what is the best practice to identify the most tolerant animals.
- We need cheaper testing for tolerance and cheaper sporidesmin and/or cheaper alternatives to sporidesmin
- Need cheaper screening for females
  Kate Broadbent: "GGT testing to natural challenge is relatively inexpensive. Education about this option may be necessary."
- How can we make the DNA or the sporidesmin test cheaper ? - cost/reliability/ accuracy is limiting the use of it
- Need to determine how we can simplify the test procedure for identifying tolerant animals
- The elephant in the room is this; We need more data from progeny testing with sporidesmin to underpin the validation of the genomic tools thus increasing their accuracy, problem is that sporidesmin testing is very expensive limiting the number of tests. So we want better tools for identifying tolerant animals

- Need to establish whether other fungi also cause effects/ multiply of same? What else is there? Stress, shearing/changed feed environment for example.

Why is this important?

- Sporidesmin is difficult to make more cheaply, maybe a synthetic is an option? Is there an alternative to sporidesmin?
- Could economy of scale (more production per/g) lower the cost of production? (Per gram or per dose)
- Need to establish the upper limit of RamGuard. The limit has to balance ethics, economics, and animal welfare, currently 0.65 mg (spdn) per kg lw. If there is no reaction at 0.6 then the limit may well be moved upwards.
- Could be linkages to other diseases / genetic traits. Correlation to other disease traits - what are they?
  Neale Towers: Selection for FE tolerance increases tolerance to ryegrass staggers and vice versa. Probably a result of increase ability to detoxify/excrete foreign chemicals/toxins in general.
- GGT screening used to measure response to natural exposure, could this be used for genetic selection? This would require development of a protocol.
  John Wilkie: “For a group of people who would all claim to be farming in an FE environment, the scepticism toward the concept of natural exposure measurement is unbelieveable. Back to basics: spores are most toxic when the fungi is sporulating, under ideal conditions counts can double in 24 hours, the very low early season counts, (<1000), can raise blood GGT levels in 3 days warm drizzle, or 2 or more potentiation events over a couple of weeks.”
  Neale Towers: “Before Stock Safeti was formed instructions for performing a tolerance test using toxic pasture were published. However difficulties in matching occurrence of toxic pasture and testing facilities, and absence of toxic pasture in some years, greatly limited progress.”

Recommendations

- Identify if a saliva “ Carla” type test can be developed for response to sporidesmin. This maybe could be a potential genetic tool.
- Get expert input into relevance of other mycotoxins. What’s the breeding relationship to FE tolerance?
- Review the production of Sporidesmin.
- Seek to understand the difference between the effect of a cumulative dose vs. a one-off high dose (at the same total dose rate, see publication by Barry Smith)
- Develop new technology: can faecal spore counts be matched to GGT? What would be the protocol? What’s the potential benefit to breeders?

Notes from presentation + discussion

Link to video of presentation

- Need for a review of sporidesmin production. The cost is high so we don't do as much performance testing as we should, which undermines the accuracy of the genomic tools we've got. See previous comment above.
- What are the effects of other fungi on liver function?
- Need protocol for sporidesmin testing
- There are lot of questions around genetics – hinges on the production of less costly sporidesmin. Sporidesmin is very difficult to make, so it's not an easy thing to do. There was a synthetic option proposed.
- Economies of scale: could more production lower the cost? If you take a warehouse concept, could we make it cheaper on a per-gram or per-dose level?
- What's the upper limit for Ramguard? Agreed that it has to be a balance between ethics, economies of doing things, and welfare.
- Alternatives to sporidesmin in terms of a breeding tool, what else could we use?
    - There's potential for more analysis in linkage between facial eczema and other disease traits. If so, what are they? Can we get those correlations narrowed down?
    - Can we, again, look more closely at natural exposure with GGT screening for genetic selection. General feel that there aren't enough protocols on that.
- We're looking for a middle ground, a softer ground, between doing nothing and doing Ramguard.
- Find an accurate reference range for faecal spore counts.
- **I have a vested interest - what tools do we have that are new? (Greg Mirams, techion group)**
- Two fundamental tests (pasture spore counting, fecal spore counting). Both are hard to run outside of the lab.
- **We're working on a way of digitising samples in the field, getting them from the field to the internet. Removing the microscope, simple sample preparation, results beamed from the field to the internet. The linkages become really powerful once the data is online, can slice and dice the data.**
- **We have a prototype of a facial eczema system which we'll be trialling this season.** Pithomyces spores are small, under 20 microns, but the initial stuff is promising, we think we can image these little beasts. **It can do both fecal and pastural spore counts, easily done by a farmer, once it's online can be overlaid on maps and all kinds of clever things.** Then you're getting easy data from the farmer into the system.
- Other part of that, could that device play a role in genetics? Can we use it for a more sophisticated tools between natural infection and GGT?
- The role of our business (the ones who developed this tool) is to build platforms for industry to use as we see fit. It's not us collecting the data, it's providing an infrastructure.

Accuracy of the DNA testing tools

Gaps

- Want to determine the genetic trends in FE tolerance, and want a better understanding of what makes animals more or less susceptible to FE.
- Need to identify what is the lowest level of GGT reaction needed to identify tolerant and susceptible animals.
- Need to extend the phenotype database and make it better.
- For beef bulls there's no existing system to assess genetic merit, so for dairy/beef we need to get more phenotypic data, need a training set for genomic evaluation, and need to look into dairy cattle and beef genetics for resistance to FE.
- Need more training populations in general
- Need accurate genetic information
- Want to increase percentage accuracy for DNA
- Need DNA selection that is accurate
- Need a genetic test that is accurate, simple, and cost effective.
- Costs are currently limiting the use of DNA
- Increasing the use of currently available DNA tools/diagnostics
- What is the national level of FE challenge right across the country? Anecdotally the SI is relatively free but suspect that there is more subclinical than previously thought.

Why is it important?

- $400 approx per [Ramguard] test (how can we lower this cost? privatise?)
- Continuing support of Ramguard testing service.
- Increase the accuracy of FE Estimated Breeding Values. (DPX on SIL)
- Use 5K for screening because it's cheaper?
- Add dose rate to evaluation (better evaluation)
- Progeny testing is not standardised
- Grow the training population- more species/breeds
- Educate to "normalise" the use of BVs by farmers
- Increase the price of sires so there's more money for progeny testing (*price differential)

Recommendations

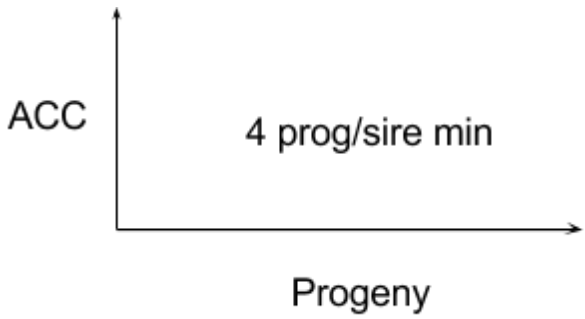
- Farmers are still in denial about effects of FE - we need to look at livers (inform commercial farmers with information on kill sheets)
- Recommend creating a district kill sheet report (this could be a powerful tool.
- That all processors report liver damage from FE.
- Gribbles spore counts and correlations with liver damage noted at the works).
- Farmers need to understand the subclinical economic effects.
- Educate commercial farmers about facial eczema testing, dose rate, heritability etc.

- Research different forages, which ones are the most beneficial and “animal friendly.” (Reg Keogh has published work in this area) Anecdotal evidence indicates areas to examine, such as plantains, chicory etc

Notes from presentation + discussion (genomic tools)

link to video of presentation

- Need more progeny testing to underpin the validation we require to make tools better and more accurate
- Need a better understanding of what makes animals susceptible to FE (can see crossovers all the time between categories)
- The desire to have higher accuracy breeding values, and the impact progeny testing has on that (Sharl Liebergreen mentioned that this came out of Ovita programmes).
- Need to be testing many more progeny per sire (the problem is expense).
- Question about the desire to have higher accuracy breeding values and what is the impact progeny testing has on that?
    - we drew up a chart, really need to be testing many more progeny per sire.



    - cost of test is approximately $400 a pop, so probably the number of progeny tested isn’t going to increase
    - want many more progeny tested sires contributing to EBVs and GBVs
    - Protocol is 4 progeny per sire, desire to stabilise breeding accuracy on a young ram, different feeding regimes, dose rates, etc. all can have an effect on BV’s
    - Want a better evaluation with more data points.
    - Considering the cost of Ramguard, maybe should be using Sheep 5k or genomic tools to screen many more animals that you otherwise wouldn’t, would come down to brand new sires.
    - Issue around progeny testing not being standardised.
- We started with the science, moved down to breeding layer, then market + commercial farmers.
- Educating farmer on breeding values, making it more normal for them.
- Creating a price differential between breeders who are doing a good job, those who aren’t
- **We think we should investigate having liver biopsies/scores on all kill sheets on the north Island, suddenly farmers will be aware of problems on the farm, might realise there’s an investment to be made in tolerant rams/bulls.**

- Different forages - noticed that kikuyu (a semi-tropical plant) is now prevalent in the Waikato, growing on the road, with climate change we just said let it come south.

Extension and learning

Key gaps to work on:

- Need linked networks and expert linkages
- Need media coverage to raise awareness
- Showing economic effects of eczema.
- Simplifying the messages to farm operators
- Want to increase knowledge, understanding, and uptake adoption through education
- Need opportunities to upskill for farmers, and stock agents
- Don't have a central info portal.
- Need to get the right messages to farmers, information not bullshit.
- Want liver testing at slaughter: if we had routine assessment in meat plants
    - Pathology info
- Need better understanding of why farmers are not using the tools
    - Social science knowledge might help us with this.
    - Who can use genomic tools? (can we only use them for some breeds?)Related to the progeny test issue raised above.
    - **John Wilkie:** "Use of feed crops as a dry summer protection strategy has indirectly assisted young stock past the critical first exposure to FE. They are subsequently better able to tolerate exposure later in life. Therefore farmers are less concerned about FE, (not using tools)."
- Want quality control on information and to clear up grey zones of knowledge and understanding

Why is this important?

- Independent evaluation of 'solutions/problems' is important to ensure true "industry good" and to ensure integrity and independence from commercial imperatives.
- There's a percentage of farmers who don't engage or uptake information, why?
    - we need to put it into dollars and cents for them
    - they don't know where to go for information
    - there's conflicting information in the public domain.
- If knowledge isn't spread from scientists to farmers and then used, then there is no point. Need to convince farmers of value.
- Extension: to educate and encourage farmers to prevent the occurrence of FE
- Need a portal for ALL validated information

Recommendations

- Develop a central **Information Portal** that will include spore count information (provide more of spore count info to farmers earlier in the season). The portal will ensure consistent messaging and filter the bullshit (will have a 'Technical advisory team' to do this who are experts in the area).

- Portal will get a key message out to the industry - the basics of FE (nutrition, pastures, genetics)
- Have a sections on the website called “mythbusters”; “Questions to ask your ram breeder”; “Economic effects (putting it into dollars and cents)”
- Involve industry bodies like DairyNZ, Beef+Lamb, MPI Sustainable farming fund, Meat processors, MIA and have links to their websites.
- Get the word out by making use of social media, having an 0800 number for more information, taking out an advertisement in FW, having a flyer, and mobile friendly apps, holding workshops and discussion groups
- In order to make sure we’re educating the next generation, make sure we have links to University and Industry Training Organisation (ITO), and training providers: Taratahi, Smedley, Waipoa, Telford (ITO)

Notes from presentation + discussion

Link to video of presentation

- **liver testing at slaughter - using this pathology information**
- group of us put together a booklet - Facing up to Facial Eczema (if everyone read it in 1996 when we put it together the problem would be over)
- Need to understand the fungi - spreading because of climate change, and what other evolutionary things are happening to these fungi over time?
- social science stuff (why the hell are farmers still aren’t using the tools we have? We’d love to know the answer)
- Why aren’t people using the tools we have? Complex answer - farmers have different reasons.
- One reason we thought of was around communication - that farmers need to hear it from a few different sources before we take up the information and that just isn’t happening
- **Solution: Online information portal** (with links to other organisations, let vet practices, meat companies, Dairy NZ)
- Technical advisory team: will come up with the key priorities to help direct the people organising the information. We’d need a group of independent, unbiased technical people to ensure uniformity of message.
- Target audience for portal: farmers – sheep + beef farmers, dairy farmers
- Central place linking to industry bodies (partners) so that you reach out to people in their databases (to get the farmers who don’t give a rat’s ass) also to ensure a consistent message
- Once we’ve decided what information needs to be on there we’d need to get someone involved (PhD student?) to get the thing set up
- Needs to be a simple format so it’s easy to use
- Literature review.

Nutrition

- Can we develop an environmentally-safe toxin neutraliser to give animals before they ingest the spores?
- What's the extent of liver recovery post-challenge?
- What are FE disease interactions with wintering crops (i.e. swedes are commonly used in the South Island and are known to have anti-nutritional features, that may be an issue in the future)
- What interventions do we have to reverse the adverse FE effects?
- What are the effects of stress on animal fighting FE? Changing feed? Changing environment? Nutritional stress?
- What are the anti-nutritional effects of wintering crops and their interactions with FE?
- How does Zinc actually protect against FE? What's the mechanism? (see publications by Rex Munday)
- What's the interaction between Copper + Zinc? Is copper deficiency through FE season protective against FE?
- Why does high copper reserves in the liver allegedly accelerate liver damage?
- Is there a nutrient status that predisposes animals to FE?
- How can we allow feed production without FE risk?
- Different pasture mixtures and the effects on FE spore populations
- Does liming help?
- Want a longer acting Zinc capsule
- Pasture spore counting tools need to be easier and more accurate
- What's the effect of releasing Zinc into the environment? Could be be looking at a possible Zinc ban anytime in the future?
- Can we GM *pithomyces* to produce non-toxic spores? Cross-breeding programme with varieties from elsewhere?

Why are these topics important?

- Because there is confusion regarding trace minerals and FE
- Nutrition is vital to animal health and FE occurs in times of nutritional stress. What happens if animals are well fed?
- Because feeding and nutrition are important strategies to be used in addition to selecting for FE resistance (i.e. genetics)
- We don't have a clear picture on how animal development or nutritional history affect our ability to assess innate tolerance.
- Is our current sporidesmin production system the most efficient it can be?
- Does animal development affect its ability to exhibit tolerance to FE?
- Do we know how environmental conditions (e.g. high/low nutrition) influence response to sporidesmin challenge? We need to make the most efficient use of methodology.

Recommendations

- Literature review: we should dig out all the previous research. (on the interaction of nutrition and FE, and trace minerals and FE. Should include the effect of Zinc and

Copper on FE in order to discover trends (treatment frequency, when given? what method? form organic/inorganic)?

Notes on presentation + discussion

link to video of presentation 1/4
link to video of presentation 2/4
link to video of presentation 3/4
link to video of presentation 4/4

- Need to know effect of nutritional stress on FE, and effect of copper deficiency on FE
- Question of if you're testing pre-dose + post-dose, do they have the same feeding regime at those times?
- We did sporidesmin dosing trials on FE susceptible cows at two different times. A response to sporidesmin was obtained in the May trial but there was no response to the same dose in the trial conducted in spring. What was the difference? Nutrition. They were fully fed in May but there was a feed pinch in November.
- Previous research - what's already been done, questions around trace minerals? (not much research done, could be something worth doing)
- **We proposed organising a big 5 year national survey (led by veterinarians across the Dairy, Sheep + Beef industry that knew the farmers) looking at all aspects of FE (management methods, treatment methods, incidence of FE, fertilisers used, nutritional levels, organic or biodynamic methods using less chemical fertilisers to see if that had an effect on microbes in soil,….)**
- **(All fertilisers are chemical, underpinning biological processes are chemical processes. Comment from RC)**

Fungi: both natural and as produced and used in test.

Gaps

- Need understanding of high vs. low toxin production by fungi
- Review of sporidesmin production. GM approach? Is there any other way to produce the toxin?
- Need to better understand the fungus ecology and how the fungus is evolving
- What's the effect of sporidesmin on the GI tract?
- What about microbes in the gut?
- There are fundamental knowledge gaps in terms of ecological, physiological, and evolutionary understanding
- There's a lack of funding and capability to research plant fungus/toxins. Many issues have been touched on but not pursued due to lack of funding

Recommendations

- Production of sporidesmin important to investigate
- All of the above identified in the "Gaps".

Epigenetics; A farmer's perspective, John Wilkie

Gaps

- Need a definition of resistance - what's the resistance/tolerance mechanism? (knowing resistance is the basis for selection)
- In a ram breeding flock:
    - Every March we need to get GGT21 for all incoming 2th ewes (+ 10% culling margin), GGT21 all MA rams, GGT21 any clinicals, and use the best DPX sire every year
    - **John Wilkie:** "Given what I reported about sub-clinical FE affecting conception rates, for a commercial flock in an FE environment, conventional wisdoms assume more importance, ie, cull dries, and select replacement ewe lambs from the twin-scanned mob, plus GGT blood test all flock sires annually, (can be done same time as Brucellosis blood test)."

Why is it important?

- Genomics isn't everything - so what's missing?
- 40% of resistance to FE in a ram breeding flock is due to heritability (h2) - so where's the other 60% coming from?
- There's another layer of biological coping mechanisms: epigenetics controls/regulates the genomic response
- Animals must have a mechanism to cope with a variable challenge
- Molecular profiling at epigenetic level shows strong relationships to phenotype
- Genomics looks at genes and their variations and mutations, whereas epigenetics looks at so-called non-coding DNA and its influence on gene expression and regulation
- Explains how a changing environment can influence phenotypic outcome
- Epigenetic markers may identify susceptible individuals and ability to detox conversely

Recommendations

Refer to Allan Shepherd's discussion (link to video) and slides

- In terms of epigenetic markers: we need to look for correlation to phenotype to validate markers, and need flocks to test across the spectrum of tolerance
- Recognising that some basic science is a necessary prerequisite and the basic early science may not provide immediate answers

Notes on presentation + discussion

- This is centered around research being done/has been done in the last few years
- Biologists looking at organisms struggling to survive in a changing environment, and at the discord between phenotype and genotype
- There's a general understanding that genomics can't answer everything so we also need think about it from a phenotypical and biological perspective, taking into account ecology, environmental influence, disease stress

- **We’re trying to get to mechanisms and useful outcomes: we want to get biomarkers that tell us which animals are the better candidates for breeding, and we want to understand mechanisms of action, which will give us better way of dealing with issues when they come up.**

7. Guest presentations

Epigenetics presentation - Allan Sheppard

Click to view associated powerpoint presentation
Click to view the video of Allan's presentation

Selected notes

- Let's go through some biological examples of adaptive physiology (when the detection of a signal from a predator activates a change in offspring)
- I asked the questions: how heritable is this change? How reversible?
    - we don't quite know - but in this case it reverted back in one generation
- Interesting genes being turned on/off in the presence of sporidesmin, genes that are to do with detoxifying (this makes sense)
    - ABCG2 gene (controls a liver protein that shunts out toxins from the liver to the bloodstream)
    - We have biomarkers for each of these pathways

Question: Is this going to become a tool in the future?
Answer: would love to use epigenetic biomarkers for breeding choices, also to prime animals so they respond better (nutrition intervention)

Question: So what if you try to make the change in the fungus instead of the sheep? Is this possible?
Answer: If they are under epigenetic control, then theoretically yes.

Overall message: There is hope. The basic science has been done, now we need to show it can be translated to farms.

Question: What do you need from us today?
Answer: Would like to go in and measure natural exposures. Would love to set up trials on-farm to trail biomarkers.

My story - John Wilkie

Click to view associated powerpoint presentation
Click to view the video of John's presentation