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# Value of DNA Marker Test for Facial Eczema Resistance in Dairy Cattle

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**Summary**

- The economic value of facial eczema (FE) has been estimated at about $3.91 per cow in Holstein Friesians, and $6.09 per cow in Jerseys, for each additional FE resistance marker copy carried. This has been calculated from the value of lost milksolids yields in FE-affected herds, in the lactation when the FE effects occurred.

- With improved FE genetics from both sire and dam selection, using AgResearch's *FE'nd*™ DNA marker test, the likely savings in an average 360-cow herd would ultimately reach between $302 and $5270 per year in the value of lost milksolids yields, depending on the severity of the FE season.

- The *FE'nd*™ DNA marker test is currently offered for heifers and cows only, and is able to assist with predicting the breeding value for FE resistance in Holstein Friesians and Jerseys, but not yet in crossbreds.

- DNA-testing replacement heifers, with the poorest 20% being culled each year on the *FE'nd*™ DNA marker test, will add to any savings from bull selection for FE resistance.

- As with all genetic gain in the dairy industry, greatest gains for FE resistance would be made by bull selection. Research is continuing at present to identify additional DNA markers closely linked to FE resistance, so that accurate bull selection decisions based on FE are feasible in the future.

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## A. Lost Production per Cow

Table 1 shows estimates of the loss in milksolids as a result of damage from facial eczema (FE), according to summaries recently completed for DairyNZ. Much of the toxin's effect on the cow cannot be seen, but the resulting liver damage reduces milksolids yield per lactation.

**Table 1. Relationship between GGT levels and lost milksolids production in the current lactation.**

| Range in Serum GGT (i.u./l) | Associated drop in MilkSolids per cow (kg/lactation) |
|---|---|
| 0-59 | 0 |
| 60-199 | 1.48 |
| 200-699 | 11.70 |
| 700+ | 38.33 |

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**B. Production Loss: Savings through Genetics**

Weighting over the various GGT levels per cow observed in an average NZ herd, the annual loss of production varies from an estimated 0.14 to 6.13 kg milksolids per cow per lactation, depending on seasonal weather conditions. Table 2 shows these costs in a herd of 360 cows, and the savings in milksolids by applying AgResearch's *FE'nd*™ DNA marker test.

**Table 2. Costs of lost milksolids from FE damage, without DNA selection applied and with *FE'nd*™ DNA selection applied, in 'good' and 'bad' seasons in a 360-cow herd (the season effects range from minimal FE damage to serious FE damage).**

| | | Good season (Minimal FE) | Bad season (Serious FE) |
|---|---|---|---|
| **Without DNA selection applied** | kg MS lost/cow | 0.14 | 6.13 |
| | kg MS lost/herd | 50.4 | 2206.8 |
| **With DNA selection applied** | kg MS lost/cow | 0.0 | 3.69 |
| | kg MS lost/herd | 0.0 | 1328.4 |
| **Savings** | Milksolids savings/cow | 0.14 | 2.44 |
| | Milksolids savings/herd | 50.4 | 878.4 |
| | **@$6.00 /kg MS** | **$302** | **$5270** |

- With improved FE genetics using the AgResearch *FE'nd*™ DNA marker test, the likely savings in an average herd are from $302 to $5270 per year, depending on the severity of the FE season. Taking an intermediate weather effect, an average of the two seasons above gives $2786 herd savings, equivalent to $7.74 per cow per year.

- These savings/cow are achieved by increasing the number of DNA marker copies for resistance from the present average of 2.02 to 4 in Holstein Friesians, and from 0.73 to 2 in Jerseys. As a result, the economic values for Holstein Friesians are $3.91 per cow ($1407 per 360-cow herd) and for Jerseys are $6.09 per cow ($2194 per herd), for an average additional resistance copy. These two values ($3.91 and $6.09), for an average additional resistance copy, are equivalent to $23.67 in Holstein Friesians and $36.86 in Jerseys *for a unit reduction in log GGT.*

**C. Testing Options**

At this early stage, the AgResearch DNA test for FE resistance is likely to be applied only to females. It is expected that AI bull selection opportunities will follow later.

For females, the selection and culling applied in the herd consists of:
a) Selection of heifer replacements, and/or b) Culling of cows.

a. *Heifer Replacements*
Having shown the net returns expected at the final endpoint (i.e. Section B above - when all animals carry resistant FE copies), we now demonstrate the net returns expected during the process of moving towards the endpoint. Up to 10-20% of potential heifer replacements could be culled on their *FE'nd*™ DNA marker result before entering the milking herd (depending on the time period over which AI was used, and how many heifer calves were reared from cows calving to AI pregnancies). For example, in a Jersey herd of 360 cows, culling back annual replacement heifer numbers from 90 to 72 based on *FE'nd*™ DNA marker results would involve:

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A testing cost of $450 (90 heifers x $5 for the marginal cost of FE-testing[1]), and;

A saving from reduced milksolids losses, yielding an expected return as follows:

Each year of DNA-testing heifer replacements for FE resistance (72 heifers per year retained; 18 culled out of an initial 90) would lead to an average 0.18 increase in the number of resistant alleles in the herd. This is from a base line of 0.73 marker copies associated with resistance in average Jerseys.

Repeated over a generation (5 years of selection), all cows in the herd would carry this small genetic advantage for FE.

Expected selection achieved (over a nil FE DNA-testing policy) = 0.18 extra resistance copies, with a value of 0.18 x $2194/5 from replacements per year (=$79), or $395 in the replacements' herd-life. At $6.00 per kg milksolids, this value is similar to the DNA testing cost, but would greatly exceed the testing cost when bull selection is included.

Net Return = Saved Costs less DNA-testing Cost = $434 - $450 in Year 1, a net loss of $16, and there are then cumulative benefits of the resistant animals over later lactations. Table 3 shows these cumulative net savings from heifer testing alone. Five years of testing should save $4260 in Jerseys (i.e. an average of $852 per year, in this example herd of 360 cows), as well as improving welfare.

**Table 3. Example of the first 5 years of heifer DNA-testing for FE resistance in Jerseys.**

| Years of testing | Generation | Proportion of herd DNA-tested for FE per generation | Return ($/yr) from the latest year's tests | Testing cost ($) | Gross return ($/yr) from cows in later lactations | Total per year ($) |
|---|---|---|---|---|---|---|
| 1 | 1 | 0.2 | 434 | 450 | 0 | -16 |
| 2 | 1 | 0.4 | 434 | 450 | 434 | 418 |
| 3 | 1 | 0.6 | 434 | 450 | 868 | 852 |
| 4 | 1 | 0.8 | 434 | 450 | 1302 | 1286 |
| 5 | 1 | 1 | 434 | 450 | 1736 | 1720 |
| **Cumulative net return** | | | | | | **$4260** |

Corresponding figures calculated for Holstein-Friesian heifer DNA testing are: an extra 0.31 resistance copies, with a value of 0.31 x $1407/5 from replacements per year (=$87), or $436 in the replacements' herd-life.

A satisfactory DNA test has not yet been devised for 'crossbreds' (between 13/16ths F and 13/16ths J).

*These estimates apply regardless of the practices of AI Centres in Generation 1, with respect to selecting bulls for FE resistance. In Generation 2 and onwards, sire selection would contribute a major part.*

*b. Culling Cows*

In contrast to the result for heifer replacements, the costs and benefits from FE-DNA-testing cows already in the herd (to achieve extra culling, and progress in the next generation) depend on the AI Centres. This is because the potential benefit comes from each cow's offspring, and only half of the calf's genes come from the dam. However, if the choice needs to be made between retaining one of two cows of similar Production Worth, then the one with the higher FE-resistance status from DNA tests is to be preferred.

[1] In addition to the standard parentage test charge per animal.