The use of genetics in enhancing farm resistance to bTB

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Abstract

The aspiration of eradicating TB may seem far-fetched given the lengthy eradication programme and dwindling progress in recent years. However, until recently, the genetic makeup of cattle had never been considered as part of the solution.

Research undertaken in Ireland at Teagasc Moorepark, in conjunction with ICBF, has revealed that certain family lines of cattle are more prone to becoming TB reactors. In the same way that genetics influences milk production and weight gain, animal health is also under genetic control.

Following years of research, ICBF has made breeding values for resistance to TB freely available for AI bulls. Farmers can use the breeding values to identify how likely bulls are to produce offspring that will become TB reactors.

The number of TB reactors in herds undergoing a TB-breakdown is, on average, 26% higher in cattle with the worst breeding values for TB resistance compared to cattle with the best breeding values for TB resistance.

As cattle with more favourable breeding values for TB resistance are less likely to become TB reactors, herds that have many cattle that are genetically more resistant to TB are also likely to incur fewer TB-breakdowns.

Prevention of just one TB infection in a 100-cow herd could avert up to 5 secondary TB infections arising from cattle-to-cattle transmission.

ICBF has made breeding values for resistance to TB available to herd-owners for their individual animals & included breeding for TB resistance a part of national dairy and beef breeding goals.

For farmers looking to avoid TB-outbreaks, breeding cattle more resistant to TB is a free, easy, and complementary tool provided by ICBF.

Introduction

Bovine TB is a global problem. It causes significant economic losses to livestock farmers and of poses a threat to the health of humans.

In Ireland, we have seen a 44% increase in the number of TB reactor animals in 2024 compared to the previous year – resulting in over 41k TB reactors affecting 6% of herds.

All cattle herds in Ireland are tested annually for TB. When a herd tests positive for TB is restricted from trading animal in or out of the herd for a set period.

Studying the link between TB outcomes and animal ancestry

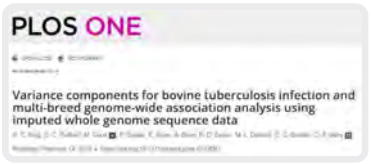
Dr. Siobhan Ring and fellow researchers looked at the genetics of TB resistance.

Using TB test results from the Dept of Agriculture testing program and the ancestry data held on the national database, they looked at the link between probability of animals susceptibility to TB and their ancestry.

They created a binary phenotype based on animal in herd having a positive TB test and the other animals present in the herd that did not have a TB reaction

Exposure definition took into account management groups and as was defined as shown below:

Phenotype & Exposure Definitions



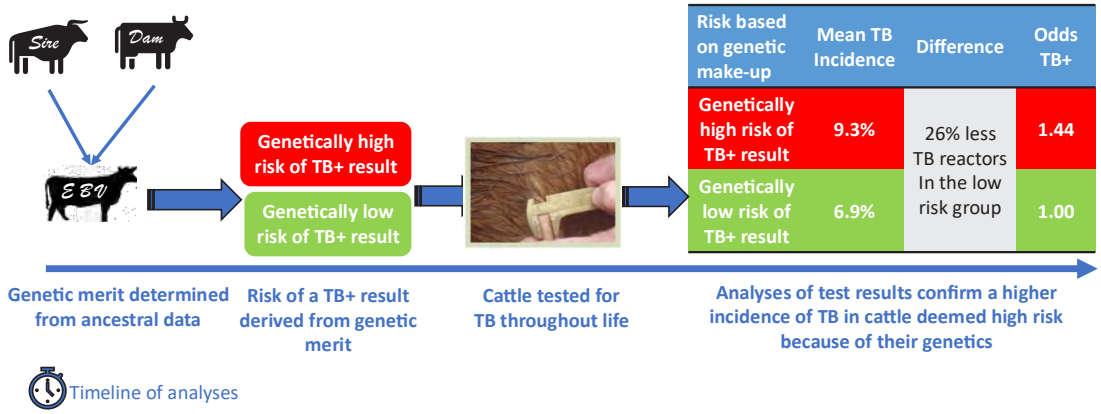
- **Binary Phenotype**
  - 1 — *bTB reactor or slaughterhouse case*
  - 0 — *Other animals present in herd*
- **Exposure (within bTB-breakdown & management group)**
  - *≥1 bTB reactor with lesions observed, or*
  - *≥1 slaughterhouse case, or*
  - *≥2 bTB reactors, irrespective of lesions*
  - *1.6m animals in evaluations*

Breeding values (BVs) were estimated for 150,000 newborn calves, using only ancestral data and TB records from their ancestors.

These calves were then categorized into low, medium, or high genetic risk groups based on their TB resistance BVs. The TB status of these calves was followed throughout their lifetimes to evaluate the predictive accuracy of the BVs.

They then validated this categorization with the actual TB test results and found that for a herd with a TB outbreak, the mean incidence of TB in animals in the high category was 9.3% while those in the low risk category was 6.9%. This means that there were 26% less TB reactors in the low risk group.

Genetic Analysis



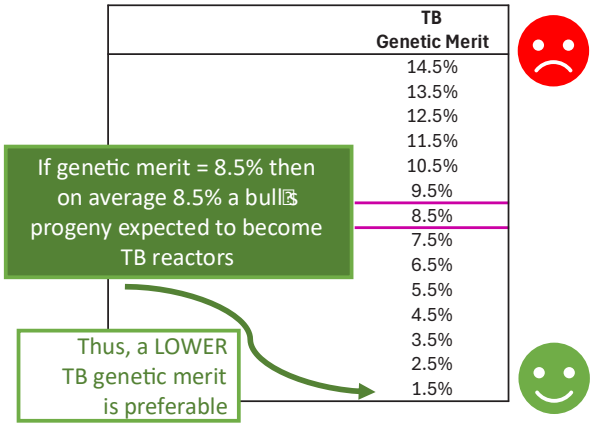
Risk based on genetic make-up	Mean TB Incidence	Difference	Odds TB+
Genetically high risk of TB+ result	9.3%	26% less TB reactors In the low risk group	1.44
Genetically low risk of TB+ result	6.9%		1.00

This type of validation has been repeated across various levels of TB infection intensity, and the results consistently show that genetically high-risk animals are diagnosed with more TB—regardless of the level of infection intensity in the herd.

Potential gains for breeding for TB resistance

The study showed that Genetic resistance to TB typically ranges from 1% to 15%, with an average of 8.5%. This means that, on average, 8.5% of a bull's offspring could become TB reactors if exposed to the bovine TB bacterium.

Potential Gains for Breeding for TB Resistance



If we look at the year just past in Ireland, there were 41k TB reactors, with an estimated 490,000 cattle exposed to TB (based on a median breeding value for TB of ~8.5%).

What would happen if genetic merit deteriorates?

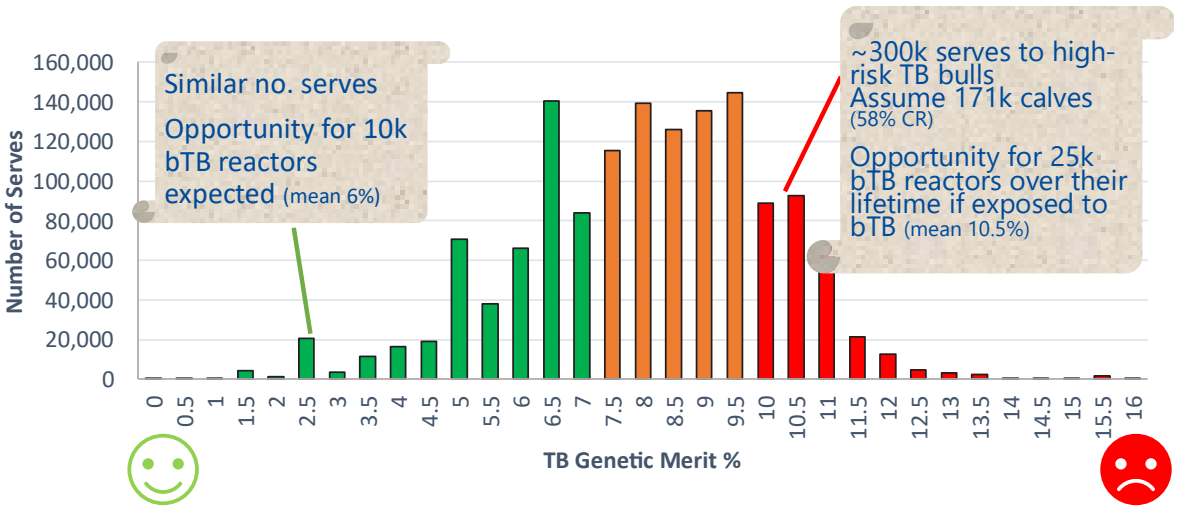
If the median TB breeding value increases to 12.5% (a 4-percentage-unit decline in genetic resistance) the number of reactors would have risen to 61k—1.5 times the number of reactors in 2024.

What happens if genetic merit improves?

If the median TB breeding value had been better, e.g. 4.5% (a 4-percentage-unit increase in genetic resistance), the number of reactors would have expected to be to 22k—almost half the number of reactors in 2024.

The diagram below shows another way of looking at the figures and the potential of choosing to breed from high-risk or low risk bulls.

Potential Impact of 2024 Bull Usage



In the high-risk TB bulls

If there were 300,000 serves in 2024 □ we expect on average 171,000 calves born.

Of these, an estimated 25,000 calves may become TB reactors.

In the Low-Risk TB bulls

Again there were 300,000 serves in 2024 □ we expect on average 171,000 calves born.

Of these, an estimated 10,000 calves may become TB reactors.

A simple selection decision between a high-risk or low-risk TB bull can result in a 15,000-calve difference in the number of potential TB reactors—without any additional cost.

Interpreting the genetic merit for farmers

To make selection easier, ICBF has introduced a traffic light system for TB resistance in the dashboards that are available to farmers when making breeding decisions

- Red: Bottom 33% (low TB resistance)
- Orange: Middle 33% (average TB resistance)
- Green: Top 33% (high TB resistance)

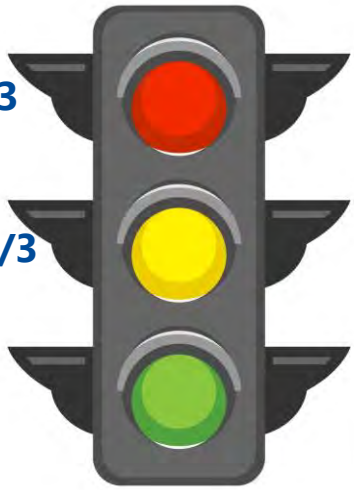
This is available to all farmers using the ICBF animal search.

They can go to the website or the app and look up the health subindex for a given bull and see whether it is a high, medium or low risk for TB

It Is also available to all farmers is the Active Bull List.

Interpreting the Health Sub-Index Traits

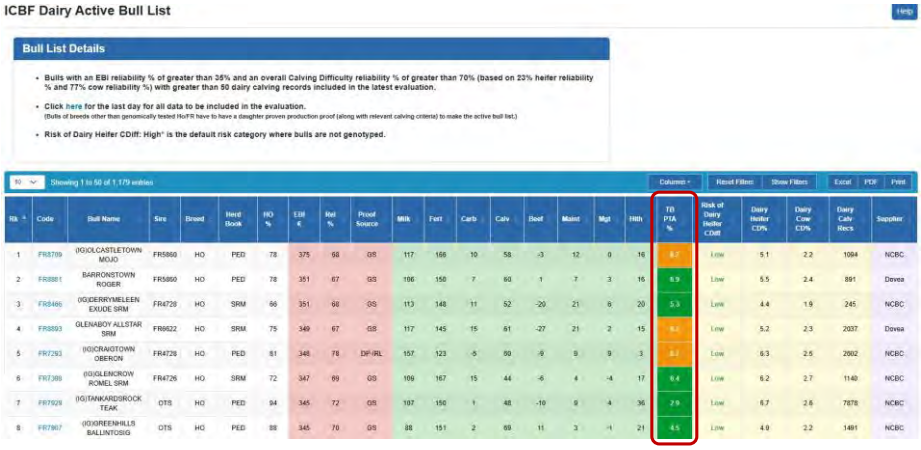
- **Worst 1/3**
- **Middle 1/3**
- **Best 1/3**



The ICBF Dairy Active Bull List is a tool for dairy farmers to select AI sires (bulls) based on their genetic merit, specifically their EBI (Economic Breeding Index) and other relevant traits. It helps identify bulls with high EBI values, which indicate their potential to improve herd profitability.

This year ICBF added the TB genetic merit to the list to make it easier for farmers to see which bulls haver higher risk of producing calves that are more susceptible to a TB infection

Visibility of TB Trait – ICBF Active Bull List



Furthermore, the farmer can view the genetics dashboard for the animals in his own herd.

ICBF has added a TB component to the overall national breeding indices

The EBI, which is the main dairy breeding index and the Replacement, Dairy-Beef and Terminal index for beef farmers

Inclusion of bTB into breeding goals

When we look at the impact of using the TB genetic merit on the overall dairy index – we see that the farmer does not need to sacrifice genetic gain by select based on good TB genetic merit.

The can still select a high EBI bull with a good TB ranking.

Summary

- We need to use all the tools available in combatting bTB
- Enhancing genetic resistance to bTB can significantly reduce the number of reactors, minimize herd disruptions, and lower costs
- Breeding for bTB resistance is a PROACTIVE not reactive solution
- Genetics is cumulative and permanent