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**Genetic correlations between
susceptibility to *Mycobacterium bovis* infection
and performance
in Irish Holstein Friesian dairy cows**

**M.L. Bermingham, S.J. More, M. Good,
A.R. Cromie, I. M. Higgins and D.P. Berry**



Introduction



Bovine tuberculosis (bTB)

- **Infectious respiratory disease**
- **wide range of animals**
- **including man**
- **tubercles (*granuloma*)**



Mycobacteria bovis

- **The primary agent of bTB**

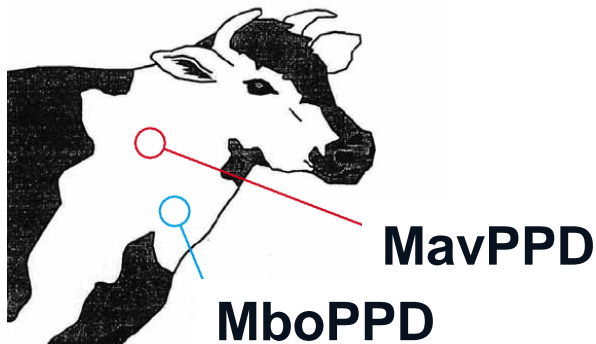


Introduction



Active surveillance

- **Single intradermal comparative tuberculin test (SICTT)**
- Annually in Republic of Ireland (ROI)

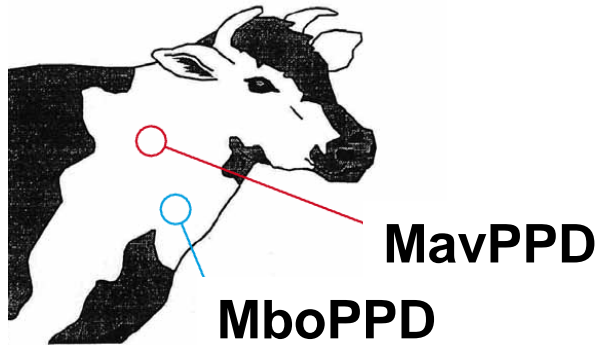


M. bovis purified protein derivative - MboPPD
***M. avium* purified protein derivative - MavPPD**

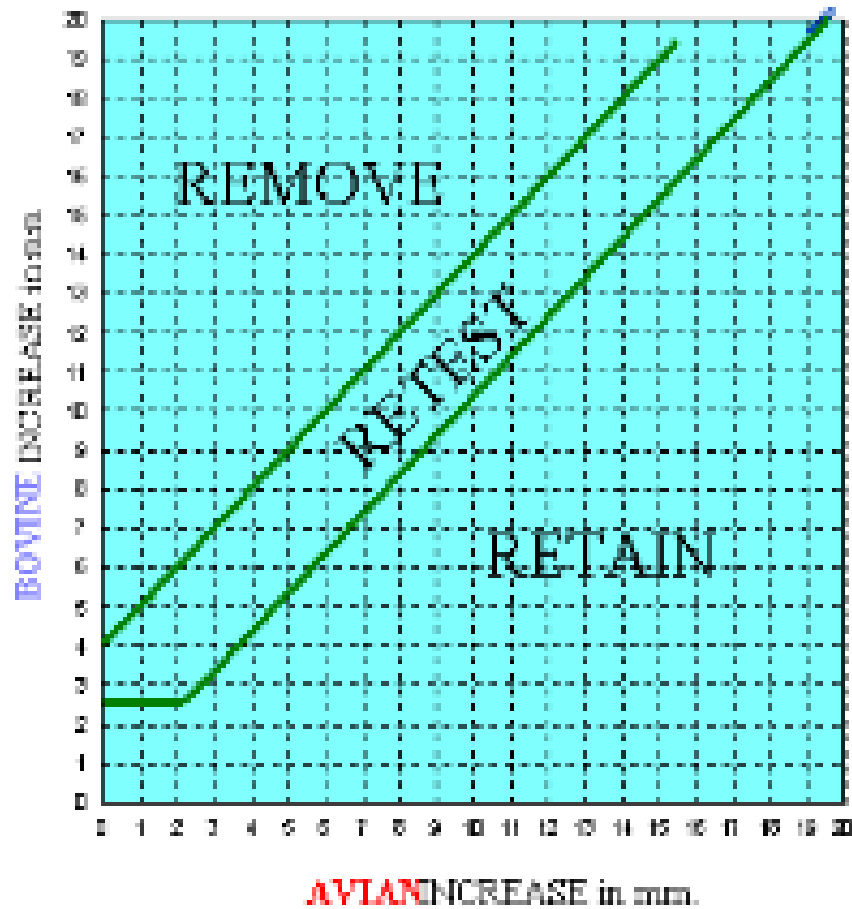
Introduction



SICTT Interpretation



Standard Interpretation



Introduction



Non bTB-free status

- **Ireland/other countries**
- **Transmission**
 - **wildlife-to-cattle**
 - **cattle-to-cattle**



Introduction



Genetic selection

- ↑ resistance to bTB in cattle
- complement eradication efforts

Two recent studies

- Exploitable variation exists among GB and ROI HF dairy cows for resistance to tuberculosis

Heritabilities:

Responsiveness to the SICTT

Abattoir-confirmed *M. bovis* infection

GB data

ROI data

0.16 (0.012)	0.14 (0.025)
0.18 (0.044)	0.18 (0.041)

Brotherstone et al. 2010

Bermingham et al. 2009



Genetic correlation ~1.0

- ROI dairy cows
- ↑ resistance to confirmed *M. bovis* infection
- via SICTT data



Introduction



Genetic correlations

- **-ve: susceptibility to confirmed *M. bovis* infection vs. milk yield (UK)**
- **antagonistic: risk of clinical mastitis vs. milk yield**
- **inconsistent: susceptibility to other diseases vs. *performance***

Impact of selection of economically important traits

- **Genetic resistance to *M. bovis* infection**
- **ROI dairy cattle needs to be determined**



Objective



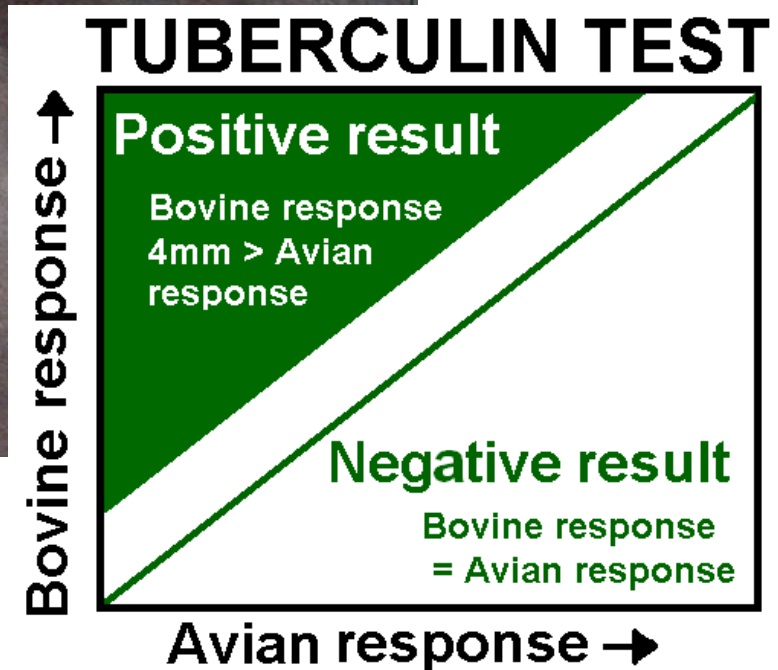
- **To estimate the genetic correlations between susceptibility to *M. bovis* infection and economically important traits**



Materials and Methods



Measure of bovine susceptibility *M. bovis* infection



Eight performance traits

- **Milk yield**
- **Fat yield**
- **Protein yield**
- **Somatic cell score**
- **Calving interval**
- **Survival**
- **Body condition score**

SICTT responsiveness



Data

- 108,000 SICTT herd summary records
- 2,000,000 SICTT results
- November 2000 to December 2007

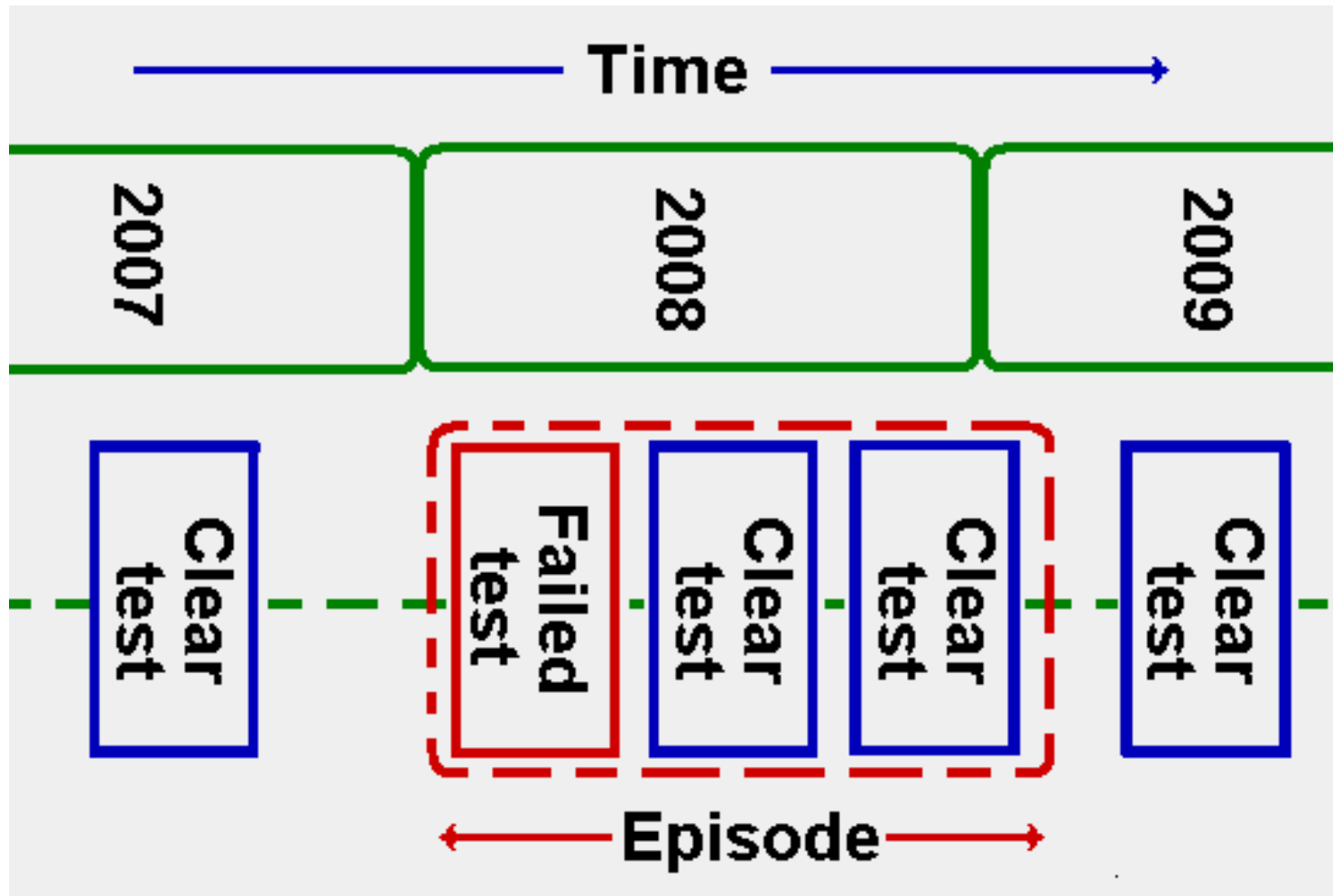
Data Edits

- Episodes
 - High likelihood of exposure to *M. bovis*
 - SICTT herd summary records
 - divide data

SICTT responsiveness



Episode



SICTT responsiveness



Data Edits

- **Deleted animals**
 - No known pedigree data
 - Outside the normal age for a given parity
 - Inconclusive SICTT results
 - Moved into the herd - 6 weeks of SICTT
- **Retained episodes**
 - 1 standard reactor
 - 10 or more animals

Data records

- **17,178 SICTT responsiveness**
- **598 episodes**



Performance traits



Data

- 3,600,000 305-day milk, fat & protein yield & SCC
- 6,500,000 calving date and calving interval (CI)
- 86,000 1st parity body condition score (BCS)
 - Irish cattle breeding federation database
 - calvings January 1985 to December 2007

Data Edits

- Cow survival lactation 1-2, 2-3 & 3-4
- Deleted Cows
 - CIs < 300 > 800 days
 - Unknown parity
 - <15 months of age
 - Outside the normal age for a given parity
 - <75% Holstein-Friesian
 - No known sire



Performance traits



Data records

- **105,064 production**
 - 2,185 *M. bovis* infection records
- **112,337 CI**
 - 2,389 *M. bovis* infection records
- **104,044 survival**
 - 2,895 *M. bovis* infection records
- **57,250 BCS**
 - 354 *M. bovis* infection records



Analysis



Genetic & residual (co) variance components

- **Responsiveness to the SICTT vs. performance**
 - bivariate linear-linear sire model
 - bivariate threshold-linear sire models
- **Statistical package ASREML**
- **Significance: Likelihood ratio test**



Results



Trait	Responsiveness to the SICTT		
	Parity 1	Parity 2	Parity 3
Milk	0.23 (0.14)	0.24 (0.14)	0.13 (0.16)
Fat	0.32 (0.14)	0.39 (0.13)	0.23 (0.15)
Protein	0.16 (0.15)	0.32 (0.14)	0.06 (0.16)
SCS	-0.34 (0.14)	0.11 (0.15)	-0.14 (0.17)
CI	-0.07 (0.18)	0.00 (0.22)	-0.18 (0.29)
Survival	-0.08 (0.22)	-0.17 (0.23)	-0.62 (0.22)
BCS	0.36 (0.14)		

Significance of the difference from zero; $P < 0.05$

Results



Trait	Responsiveness to the SICTT	
	LLM	TLM
Fat	0.39 (0.13)	0.37 (0.13)
SCS	-0.34 (0.14)	-0.29 (0.14)
Survival	-0.62 (0.22)	-0.67 (0.21)
BCS	0.36 (0.14)	0.35 (0.13)

The test of significance: t-test; $P > 0.05$



Discussion



- **Results from this study**
 - **Based on**
 - large datasets
 - alternative statistical approaches
 - **Selection for**
 - ↑ survival may indirectly ↓
 - ↓ SCS & ↑ fat production & BCS
 - ↑ susceptibility to *M. bovis* infection
 - ROI Holstein Friesian dairy herd



Acknowledgements



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