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INTRODUCTION

- Infection with *Mycobacterium avium* ssp. *paratuberculosis* (Johne's disease) has been estimated to cost dairy producers between \$200 million and \$1.5 billion per year.
- A 2007 survey by the USDA National Animal Health Monitoring System showed that 2/3 of dairy operations are infected with Johne's Disease (JD), yet currently no effective vaccine or treatment exists.
- Enzyme-linked immuno sorbant assay (ELISA) tests measure JD infection and are analyzed from milk samples collected by 13 DHIA laboratories and AntelBio.

OBJECTIVE

- To determine what environmental and genetic factors affect ELISA milk scores for JD.

DATA & METHODS

- ELISA milk test results for JD were available for 200,880 samples.
- In order to assign effect categories, ELISA scores were matched with lactation data from the AIPL national dairy database resulting in 101,849 tests.
- Additional edits restricted data to Holstein cows with complete records, leaving 97,490 tests from 538 herds in 14 states for the years 2002-2008.
- SAS GLM was used to examine effects for:
 - Year of test
 - Herd
 - Parity group (1, 2, 3, and ≥4)
 - Stage of lactation at test (60 d groups (1-60, 61-120, ... ≥361)
 - Season of test (Jan.-Mar., Apr.-Jun., etc.)
 - Season of cow's birth (Jan.-Mar., Apr.-Jun., etc.)

METHODS (cont.)

- Variance Estimation:
 - Subset of Holstein sire-identified records used in AIREMLF90 to calculate variance components.
 - Heritability estimated as:

$$4\sigma^2_{\text{sire}} / (\sigma^2_{\text{sire}} + \sigma^2_{\text{cow}} + \sigma^2_{\text{residual}})$$
 - Repeatability estimated as:

$$(\sigma^2_{\text{sire}} + \sigma^2_{\text{cow}}) / (\sigma^2_{\text{sire}} + \sigma^2_{\text{cow}} + \sigma^2_{\text{residual}})$$
- BLUP90IOD used to calculate estimated breeding values (EBV) for individual animals.
- Data used in variance estimation included 74,812 tests from 49,711 cows in 1,197 herd-years, representing 7,125 sires.
- Data used in calculating EBV included 97,490 tests from 66,595 cows in 1,305 herd-years, representing 7,126 sires.
- Model:
 - ELISA score = Herd-year of test
 - + Parity group (4 groups)
 - + Stage of lactation at test (7 groups)
 - + Season of test (4 groups)
 - + Parity x stage interaction (28 groups)
 - + Sire
 - + Cow
 - + Residual

(Sire, cow and residual effects were random, all others fixed)

RESULTS

- Variance estimates for ELISA score gave a heritability of 3.8% and a repeatability of 26%.



RESULTS (cont.)

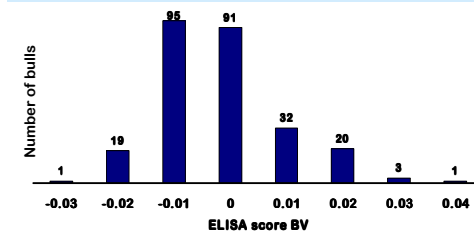
- Distribution, mean, standard deviation, and least squares difference of ELISA score

Effect	Percent of data	Mean	Std Dev	Least Squares Difference
Parity				
1	45.3	0.02	0.15	-0.021
2	26.0	0.04	0.20	-0.002
3	14.6	0.05	0.21	0.009
≥4	14.2	0.04	0.18	0.000
Test stage (dim)				
1-60	12.2	0.03	0.15	-0.017
61-120	8.2	0.02	0.13	-0.026
121-180	7.7	0.02	0.15	-0.024
181-240	10.9	0.03	0.16	-0.021
241-300	22.8	0.03	0.17	-0.020
301-360	18.3	0.04	0.19	-0.014
≥361	20.0	0.06	0.22	0.000
Test year				
2002	3.8	0.00	0.13	-0.039
2003	8.5	0.01	0.15	-0.027
2004	12.3	0.03	0.12	-0.015
2005	14.1	0.04	0.13	-0.003
2006	20.4	0.05	0.19	0.007
2007	24.8	0.04	0.20	-0.008
2008	16.2	0.04	0.20	0.000
Season of test				
Jan.-Mar.	25.9	0.03	0.17	-0.003
Apr.-Jun.	25.2	0.04	0.18	-0.001
Jul.-Sep.	24.7	0.04	0.18	-0.003
Oct.-Dec.	24.2	0.03	0.17	0.000
Season of cow birth				
Jan.-Mar.	22.8	0.03	0.17	0.000
Apr.-Jun.	24.9	0.04	0.19	0.001
Jul.-Sep.	27.2	0.04	0.17	0.001
Oct.-Dec.	25.1	0.04	0.18	0.000

- Mean and standard deviation for ELISA score was lowest in parity 1. Parity effect was significant ($P < 0.001$).
- Mean ELISA score was lowest near peak lactation time (61-120 DIM) and highest after 360 d ($P < 0.001$).
- Year effect (generally) showed a small increase ($P < 0.001$) but had limited data in early years.
- Season of sampling and season of cow's birth were both evenly distributed and showed little effect on ELISA score (non-significant).

RESULTS (cont.)

- Distribution of JD ELISA EBV for Holstein AI bulls with at least 50 ELISA daughter tests



- Estimated breeding values for 262 bulls with at least 50 ELISA daughter tests ranged from -0.03 to 0.04.
- Mean and standard deviation of JD ELISA EBV were 0.00 and 0.011, respectively.

- Correlation of trait PTAs with JD ELISA EBV for Holstein AI bulls (with ≥50 or ≥100 tests)

PTA	Correlation		PTA	Correlation	
	≥50 recs	≥100 recs		≥50 recs	≥100 recs
Milk	0.08	0.05	Prod. Life (PL)	-0.20	-0.23
Fat	-0.07	-0.09	Dau. Preg. Rate (DPR)	-0.12	-0.16
Protein	0.03	0.04	Net Merit (NM)	-0.14	-0.16
SCS	-0.07	-0.06			
			No. of bulls	262	152

- PTA for DPR, PL, and NM showed low (negative) correlations with JD ELISA EBV, indicating as these improve, ELISA score for JD should decline.
- PTA of all other traits showed very small relationships with JD ELISA EBV (-0.09 to 0.08).

CONCLUSIONS

- The variation in JD ELISA EBV (0.07) indicates progress can be achieved with genetic selection.
- More widespread and routine testing with ELISA through the DHI system could offer the opportunity to reduce JD.