Genetic Correlations among Protein, Productive Life, and Type Traits from the United States and Diseases Other than Mastitis from Denmark and Sweden

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Introduction

Genetic relationships among diseases, production, productive life (PL), and type traits need to be known before the most effective breeding strategies can be developed.

The objectives of this paper are to estimate genetic relationships among protein yield (PY), PL, and type traits from the United States (US) and diseases other than mastitis from Denmark (DK) and Sweden (SW).

Materials and Methods

Official sire evaluations from the US (July 1995) for production traits, PL, and type traits (from USDA and Holstein Association) and official sire evaluations from SW for diseases other than mastitis (July 1995) were used in estimating the genetic correlations. Genetic evaluations from SW include all diseases other than mastitis in first lactation (0/1 trait); the evaluations are calculated from a single trait sire model with relationships and a heritability of .02 (1). Sire evaluations for diseases other than mastitis from DK were also used in the analyses. Details of the multiple trait sire model used in the calculation of the DK genetic evaluations can be found in (3). Diseases in separate lactations (lactations 1, 2, and 3) were treated as separate traits and heritabilities were all around .02. Sire evaluations (from separate analyses) were available for all diseases other than mastitis, for reproductive diseases, for digestive and metabolic diseases, and for feet and leg diseases.

Procedures used in (2) were also used in this study. Edits were made to include only sires with 50 daughter equivalents in DK or SW and reliability for PL from the US of .60 or greater or, in the case of matches with type, reliability for linear type of .70 or greater. Edits were also made at 125 daughter equivalents in DK or SW and results were similar to those reported in this paper. Correlations with DK sire evaluations for other diseases in third lactation are also not reported because they were all almost identical to the correlations with sire evaluations from other diseases in second lactation.

Results and Discussion

Means, standard deviations, and descriptions for the sire evaluations used in the study are in Table 1. For the Danish and Swedish traits, higher sire evaluations are more desirable. Mean reliabilities for the US traits were all .95 or above. Mean reliabilities for the Danish traits were from .49 to .56 depending on the lactation number, trait and data subset (match with US production data or type data). Mean reliability for the Swedish trait was .51.

Genetic correlations among PY, PL, and selected type traits from the US and diseases other than mastitis from DK and SW are in Table 2. Genetic correlations between PY and diseases other than mastitis were all unfavorable and ranged from -.19 to -.62. Correlations with milk and fat yield are not reported but were similar to the correlations with PY. Genetic correlations between PL and diseases other than mastitis were favorable (range .08 to .39). Residual correlations, after adjustment for milk yield, between PL and diseases other than mastitis were, in general, much larger than the product moment correlations (genetic correlations from .29 to

.52 when residual correlations are used). Of the 104 and 84 bulls in the US-DK and US-SW data files (US production subsets), only 39 were common to both the US-DK and US-SW files. Note that PL evaluations from the US had very high reliabilities (mean >.95) so essentially all the information in the PL evaluations would have been direct information on daughter productive life.

Genetic correlations among the selected type traits and diseases other than mastitis were small and negligible with a few exceptions. The most notable exception is the large negative correlations (-.34 to -.73) between dairy form and diseases other than mastitis. These correlations were sometimes larger in magnitude than the correlations between PY and the corresponding disease trait. Selection for cows that look like they have high milk production (for high dairy form scores) may substantially increase diseases other than mastitis in dairy cattle.

Note that the correlations among foot angle and rear legs and the various measures of diseases other than mastitis were all low and near 0. Rump angle had a moderate correlation with diseases of feet and legs (more slope from hooks to pins was desirable). In addition, the traits body depth, strength, and stature, in general, tended to have unfavorable correlations with the various measures of diseases (especially with feet and leg diseases and reproductive diseases).

Conclusions

A substantial antagonistic genetic relationship exists between PY and diseases other than mastitis. A desirable genetic correlation exists between PL and diseases other than mastitis (especially if the effect of milk yield on PL and disease is removed). Results from this study indicate that the genetic correlations between most type traits (exceptions include dairy form and rump angle) and diseases other than mastitis are small.

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Table 1. Means, standard deviations, and descriptions for US, Danish, and Swedish sire genetic evaluations[1]

	Means	SD	Higher values for the trait correspond to:
US traits			
Protein	3.63	22.9	higher yield
Productive life	.497	1.32	longer life
Final score	.397	.834	higher final score
Rear legs side view	-.135	1.27	more leg set
Foot angle	.302	1.38	steeper angle
Rump angle	-.244	1.19	lower pin setting
Rump width	.235	1.33	wider rump
Dairy form	.441	1.08	more angularity
Body depth	.289	1.32	more depth
Strength	.184	1.33	more strength
Stature	.252	1.24	more height
Danish traits			
All diseases other than mastitis in first lactation	-.600	.394	less disease
All diseases other than mastitis in second lactation	-.594	.370	less disease
Reproductive diseases in first lactation	-.202	.168	less disease
Reproductive diseases in second lactation	-.201	.186	less disease
Foot and leg diseases in first lactation	-.088	.112	less disease
Foot and leg diseases in second lactation	-.066	.080	less disease
Digestive diseases in first lactation	-.255	.195	less disease
Digestive diseases in second lactation	-.271	.200	less disease
Swedish traits			
All diseases other than mastitis in first lactation	94.8	4.68	less disease

[1] Data on US protein, productive life, and Danish disease evaluations are from 104 sires, data on US type are from 88 sires, and data on Swedish disease evaluations are from 84 sires.

Table 2. Genetic correlations among (correlations among sire genetic evaluations adjusted for reliabilities) productive life, protein yield and selected type traits from the US and diseases other than mastitis from Denmark and Sweden[1]

US trait	DOTH1[2]	DOTH2	SOTH1	DREP1	DREP2	DFL1	DFL2	DDD1	DDD2
Protein	-.62	-.60	-.19	-.52	-.62	-.47	-.46	-.43	-.30
Productive life	.16	.23	.39	.08	.12	.19	.18	.17	.24
Final score	-.20	-.06	.06	-.21	-.16	-.09	-.02	-.06	.06
Rear legs side view	-.15	-.04	-.04	-.14	-.07	-.07	-.02	-.11	-.08
Foot angle	.05	.09	.09	-.02	-.06	-.01	-.05	.11	.12
Rump angle	.20	.05	-.14	.08	-.08	.39	.40	.16	.09
Rump width	-.18	-.06	.20	-.08	-.13	-.20	-.05	-.13	.02
Dairy form	-.73	-.60	-.46	-.64	-.61	-.50	-.38	-.55	-.34
Body depth	-.25	.00	.03	-.19	-.13	-.28	-.12	-.11	.13
Strength	-.14	.06	.13	-.09	-.04	-.20	-.08	-.05	.12
Stature	-.13	.09	.15	-.09	-.04	-.13	-.02	-.02	.19

[1] Correlations between US protein and productive life and Danish traits are based on 104 bulls. Correlations between US type traits and Danish traits are based on 88 bulls. Correlations between US protein and productive life and the Swedish trait are based on 84 bulls. Correlations between US type traits and the Swedish trait are based on 83 bulls. Edits were made to include only bulls with a minimum of 50 daughter equivalents in the genetic evaluations for diseases and reliabilities for US productive life of .60 or greater or reliabilities for US linear type of .70 or greater.

[2] DOTH1 = All diseases other than mastitis recorded in first lactation from Denmark; DOTH2 = All diseases other than mastitis recorded in second lactation from Denmark; SOTH1 = All diseases other than mastitis recorded in first lactation from Sweden; DREP1 = reproductive diseases in first lactation; DREP2 = reproductive diseases in second lactation; DFL1 = foot and leg diseases in first lactation; DFL2 = foot and leg diseases in second lactation; DDD1 = digestive and metabolic diseases in first lactation; DDD2 = digestive and metabolic diseases in second lactation.