Supplementary File

Genetic analysis of persistency indices of milk yield in Jersey crossbred cattle

Subrata Koloi[1] and Ajoy Mandal[2]*

Statistical analyses:

The following six animal models were fitted for the traits under study.

$$y = Xb + Z_a a + e, \quad (1)$$

$$y = Xb + Z_a a + Z_c c + e, \quad (2)$$

$$y = Xb + Z_a a + Z_m m + e \text{ with Cov } (a, m) = 0, \quad (3)$$

$$y = Xb + Z_a a + Z_m m + e \text{ with Cov } (a, m) = A\sigma_{am}, \quad (4)$$

$$y = Xb + Z_a a + Z_m m + Z_c c + e \text{ with Cov } (a, m) = 0, \quad (5)$$

$$y = Xb + Z_a a + Z_m m + Z_c c + e \text{ with Cov } (a, m) = A\sigma_{am} \quad (6)$$

where y is a n ×1 vector of observations for each trait; b, a, m, c and e are vectors of fixed effects (calving period/year, season of calving and parity of animal), direct additive genetic effects, maternal additive genetic effects, permanent environmental effects of dam and the residual effects, respectively; X, Z_a, Z_m, Z_c are the incidence matrices of fixed effects, direct additive genetic effects, maternal genetic effects and permanent environmental effect of the dam; A is the numerator relationship matrix between animals; and σ_{am} is the covariance between additive direct and maternal genetic effects. The (co)variance structure for the model was:

$V(a) = A\sigma_a^2$, $V(m) = A\sigma_m^2$, $V(c) = I_P\sigma_c^2$, $V(e) = I_R\sigma_e^2$ and Cov (a, m) = $A\sigma_{am}$

where I_P and I_R are identity matrices with orders equal to the number of dams and the number of lambs, respectively and σ_a^2, σ_m^2, σ_c^2, and σ_e^2 are direct additive genetic variance, maternal additive genetic variance, maternal permanent environmental variance, and residual variance, respectively. Estimates of heritability (h^2), maternal heritability (m^2) and permanent maternal environmental effects (c^2) were calculated as ratios of estimates of σ_a^2, σ_m^2 and σ_c^2, respectively, to the phenotypic variance (σ_p^2). The direct-maternal correlation (r_{am}) was computed as the ratio of the estimates of direct-maternal covariance (σ_{am}) to the product of the square roots of estimates of σ_a^2 and σ_m^2.

The most appropriate model for the trait was selected based on log likelihood ratio test (Meyer 1992). An effect was considered to have a significant influence when its inclusion caused a significant increase in log-likelihood, compared with a model in which it was ignored. Significance was tested at $P < 0.05$ by comparing differences in log-likelihoods to values for a chi-squared distribution with degrees of freedom equal to the difference in the number of (co)variance components fitted for the two models.

Results and Discussion

Table S1: Data structure for different persistency measures of Jersey crossbred cattle

Parameter/ Traits	P21	P31	P32	P4	P5
No. of records	1289	989	979	975	1297
No. of animals	540	510	508	507	548
No. of sires with progeny record	63	61	63	63	63
No. of dams with progeny record	246	226	228	229	251
Progeny per sire	20.35	16.08	15.44	15.38	20.48
Progeny per dam	5.19	4.30	4.23	4.20	5.12
Mean	0.77	0.60	0.77	4.69	1.28
Standard Deviation	0.17	0.17	0.16	0.76	0.25
CV (%)	22.08	28.33	20.78	16.21	19.53

Table S2 Estimates of (co) variance components and genetic parameters for lactation persistency index (P_{21}) of Jersey crossbred cattle

Parameters	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
$\boldsymbol{\sigma_a^2}$	0.0035	0.0020	0.0028	0.0045	0.0020	0.0036
$\boldsymbol{\sigma_m^2}$	-	-	0.0007	0.0025	0.0000	0.0014
$\boldsymbol{\sigma_{am}}$	-	-	-	-0.0031	-	-0.0023
$\boldsymbol{\sigma_c^2}$	-	0.0013	-	-	0.0013	0.0009
$\boldsymbol{\sigma_e^2}$	0.0198	0.0197	0.0198	0.0192	0.0197	0.0192
$\boldsymbol{\sigma_p^2}$	0.0232	0.0230	0.0232	0.0231	0.0230	0.0229
$\boldsymbol{h^2}$	0.15 (0.04)	0.09 (0.04)	0.12(0.05)	0.20	0.09	0.16
$\boldsymbol{m^2}$	-	-	0.03	0.11	0.00	0.06
$\boldsymbol{r_{am}}$	-	-	-	-0.94	-	-1.00
$\boldsymbol{c^2}$	-	0.06(0.03)	-	-	0.06	0.04
Log L	1714.69	1717.15	1715.09	1719.58	1717.15	1720.34

σ_a^2, direct additive genetic variance; σ_m^2, maternal additive genetic variance;σ_{am}, direct-maternal genetic covariance; σ_c^2, maternal permanent environmental variance; σ_e^2, residual variance; σ_p^2, phenotypic variance;h^2, direct heritability;m^2,maternal heritability; r_{am}, direct-maternal genetic correlation;c^2**:** σ_c^2/σ_p^2

Table S3 Estimates of (co)variance components and genetic parameters for lactation persistency index (P_{31}) of crossbred cattle

Parameters	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
$\boldsymbol{\sigma_a^2}$	0.0039	0.0021	0.0022	0.0028	0.0021	0.0024
$\boldsymbol{\sigma_m^2}$	-	-	0.0018	0.0025	0.0001	0.0005
$\boldsymbol{\sigma_{am}}$	-	-	-	-0.0011	-	-0.0005
$\boldsymbol{\sigma_c^2}$	-	0.0020	-	-	0.0020	0.0018
$\boldsymbol{\sigma_e^2}$	0.0197	0.0193	0.0196	0.0193	0.0193	0.0192
$\boldsymbol{\sigma_p^2}$	0.0236	0.0234	0.0236	0.0236	0.0234	0.0235
$\boldsymbol{h^2}$	0.17(0.03)	0.09(0.04)	0.09	0.12	0.09	0.10
$\boldsymbol{m^2}$	-	-	0.08	0.11	0.003	0.02
$\boldsymbol{r_{am}}$	-	-	-	-0.41	-	-0.40
$\boldsymbol{c^2}$	-	0.09(0.04)	-	-	0.08	0.08
Log L	1327.08	1330.15	1328.75	1329.30	1330.15	1330.26

Table S4. Estimates of (co)variance components and genetic parameters for lactation persistency index (P_{32}) of crossbred cattle

Parameters	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
σ_a^2	0.0011	0.0004	0.0003	0.0007	0.0002	0.0006
σ_m^2	-	-	0.0009	0.0017	0.0003	0.0011
σ_{am}	-	-	-	-0.0008	-	-0.0006
σ_c^2	-	0.0011	-	-	0.0008	0.0005
σ_e^2	0.0208	0.0204	0.0207	0.0204	0.0205	0.0203
σ_p^2	0.0219	0.0219	0.0219	0.0219	0.0219	0.0219
h^2	0.05 (0.03)	0.02	0.01	0.03	0.01	0.03
m^2	-	-	0.04	0.08	0.02	0.05
r_{am}	-	-	-	-0.74	-	-0.74
c^2	-	0.05(0.03)	-	-	0.04	0.02
Log L	1336.24	1337.70	1337.32	1337.91	1337.77	1338.03

Table S5. Estimates of (co)variance components and genetic parameters for lactation persistency index (P_4) of crossbred cattle

Parameters	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
σ_a^2	0.0750	0.0539	0.0427	0.0449	0.0422	0.0441
σ_m^2	-	-	0.0334	0.0349	0.0279	0.0293
σ_{am}	-	-	-	-0.0032	-	-0.0021
σ_c^2	-	0.0229	-	-	0.0629	0.0057
σ_e^2	0.4613	0.4570	0.4592	0.4584	0.4583	0.4577
σ_p^2	0.5363	0.5339	0.5352	0.5350	0.5347	0.5348
h^2	0.14(0.04)	0.10(0.05)	0.08(0.05)	0.08	0.08	0.08
m^2	-	-	0.06	0.07	0.05	0.06
r_{am}	-	-	-	-0.08	-	-0.06
c^2	-	0.04 (0.03)	-	-	0.01	0.01
Log L	-192.48	-191.46	-190.94	-190.93	-190.90	-190.90

Table S6. Estimates of (co)variance components and genetic parameters for lactation persistency index (P_5) of Jersey crossbred cattle

Parameters	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
$\boldsymbol{\sigma_a^2}$	0.0078	0.0067	0.0070	0.0099	0.0067	0.0097
$\boldsymbol{\sigma_m^2}$	-	-	0.0009	0.0029	0.0001	0.0245
$\boldsymbol{\sigma_{am}}$	-	-	-	-0.0042	-	-0.0041
$\boldsymbol{\sigma_c^2}$	-	0.0011	-	-	0.0011	0.0005
$\boldsymbol{\sigma_e^2}$	0.0495	0.0493	0.0495	0.0486	0.0493	0.0486
$\boldsymbol{\sigma_p^2}$	0.0573	0.0572	0.0573	0.0571	0.0572	0.0571
$\boldsymbol{h^2}$	0.14(0.04)	0.12(0.04)	0.12(0.04)	0.17	0.12	0.17
$\boldsymbol{m^2}$	-	-	0.02(0.02)	0.05	0.002	0.04
$\boldsymbol{r_{am}}$	-	-	-	-0.80	-	-0.84
$\boldsymbol{c^2}$	-	0.02(0.02)	-	-	0.02	0.008
Log L	1182.34	1182.71	1182.53	1184.49	1182.71	1184.52

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