RANKING OF SIRE PROOFS FOR FEMALE FERTILITY OF DAIRY CATTLE, USING DIFFERENT TRAITS, MODELS, AND DATA SETS

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1. Introduction

Selection of sires is mainly based on fat yield in the FRG. With raising production level and high usage of proved bulls, reliable sire proofs for so called secondary traits such as female fertility become necessary.

Female fertility is a summarising expression for a series of different traits, describing lifetime performance, calving performance, or reproduction.

Traits describing reproductive performance of cows such as NON-Return (NR) or NUMBER of INSEMINATIONS per PREGNANCY (NI) are recorded routinely by the AI industry and by this available without extra costs for estimating breeding values.

Heritability estimates for female fertility traits usually are in a range of h^2 = o.o1 to o.1o . This leads to a high number of daughters (app. 2oo) , if sire proofs for female fertility should have same repeatability as for milk traits. Test of young sires is based on app. 1oo daughter records in the FRG . This situation rises the question, wether selection of sires for female fertility may be based on proofs with rather low repeatability.

The paper analyses ranking of sire proofs between different traits, models, and data sets.

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2. Data and Method

4200 cow records have been extracted from a total data set of app. 150.000 records. Cows selected are daughters from 21 sires, all having positive proofs for fat yield (av. : 24.3 kg). Each sire was represented by 200 daughters, devided into two batches - first 100 and first two hundred daughters. AI records after first calving were used only, because these cows all are mated to test sires, so that direct sire effects are reduced to a minimum. Each record had information on sire identification, date of first calving, NON RETURN (checked by gestation length), NUMBER of INSEMINATIONS, milk yield during first 100 days, and Non return of the HERD. Non return of the herd was precalculated as moving average of two years, using total data set.

Sire proofs are calculated using three approaches :

P(P) $Y_{ij} = \mu + s_i + e_{ij}$ (sires s_i fix)

P(C) $Y_{ijkl} = \mu + m_i + h_j + s_{ijk} + e_{ijkl}$

m_i = milk yield class (i=1to3)
h_j = herd non return class (j=1to3)
s_{ijk} = sires within m_i and h_j
all effects fix

P(B) $Y_{ijkl} = \mu + (mh)_i + k_j + s_{ik} + e_{ijkl}$

$(mh)_i$ = m by h - class (see P(C))
k_j = month of calving
s_{ik} = sire within $(mh)_i$ as random effect
BLUP solution to s_{ik} with h^2=0.02

The approaches are different with respect to the model and mathematical solution. P(P) is the most simple procedure using nothing else but daughter averages (μ has scale effect only). P(C) may be classified as a Contemporary Comparison, whereas P(B) may be regarded to be a modern approach for sire evaluation.

Comparisons between traits, models (approaches) and data sets are based on PEARSON and SPEARMAN correlation coefficients resp.

Table 1 contains subclass means milk yield by herd non return for both female traits regarded - NR and NI.

TABLE 1 : Female fertility within milk yield and herd fertility classes

Herd fertility (NR%) Limits	100 days lactation yield (kg) 1175 - 1790	1791 - 2058	2059 - 3370	Herd class av.
0 - 49	49.90[1]	41.80	41.90	44.30
	1.70[2]	1.83	1.91	1.83
50 - 63	64.00	62.70	50.20	59.50
	1.51	1.51	1.76	1.58
64 - 100	74.90	71.00	66.[illegible]0	71.20
	1.33	1.40	1.45	1.59
Yield class av.	63.00	60.10	52.40	59.00
	1.50	1.56	1.72	1.59

[1] NON-RETURN (NR%) [2] NUMBER OF INSEMINATIONS/PREGN (NI)

3. Results

Table 2 shows 21 sire proofs for two traits (NR and NI) based on 200 daughter records per sire. Both traits lead to a comparable ranking. Using P(C) proofs, linear correlation comes out with r = 0.91, rank correlation is close to that with r = 0.90.

TABLE 2 : Sire proofs based on 200 dauhgter records, estimated by different approaches

Approach	P(P)	P(C)	P(B)	P(P)	P(C)	P(B)
Trait	NR	NR	NR	NI	NI	NI
Sire code						
H	-11.5	- 9.7	- 8.8	- 0.30	- 0.27	- 0.20
K	- 7.0	- 5.5	- 5.9	- 0.15	- 0.14	- 0.09
I	- 4.5	- 6.1	- 6.6	- 0.01	- 0.05	- 0.04
J	- 4.5	- 3.6	- 3.8	- 0.13	- 0.12	- 0.11
B	- 4.0	- 3.8	- 4.4	- 0.12	- 0.14	- 0.14
O	- 3.0	- 1.0	- 0.8	- 0.03	- 0.01	- 0.04
A	- 2.0	- 2.0	- 1.6	- 0.01	- 0.03	- 0.04
F	- 0.5	- 0.2	0.0	- 0.06	- 0.08	- 0.08
M	- 0.5	- 1.0	- 3.5	0.00	- 0.02	0.00
Q	0.0	- 2.4	- 1.3	0.03	- 0.02	0.00
N	0.5	- 0.4	- 1.6	0.02	0.00	0.05
T	1.0	4.4	2.1	0.01	0.07	0.12
C	1.5	1.3	0.8	0.01	- 0.03	- 0.09
P	1.5	0.8	0.1	0.04	0.02	0.07
U	2.0	2.0	1.5	0.09	0.09	0.11
L	2.5	2.8	3.1	0.03	0.02	0.05
D	5.0	4.4	6.4	0.16	0.12	0.09
G	5.5	3.6	4.1	0.07	0.03	0.04
E	6.0	5.4	6.9	0.12	0.08	0.04
S	6.0	6.6	7.3	0.10	0.10	0.07
R	6.5	4.2	5.1	0.13	0.08	0.15
$s_{b.v.}$	4.67	4.23	4.53	0.108	0.096	0.093

Irrespectively of the model used, all proofs are distributed close to normality (Table 3). Ranking of sire proofs within models shows very similar results (Table 4). This is in particular true for those bulls with extreme negative proofs (ranks 1 to 4). Correlation coefficients are in a range from o.82 to o.97.

If selection of test sires is based on app. 1oo daughters, rank correlation of proofs for female fertility between 1oo and 2oo daughters becoms important. Table 5 shows the results for NR. In some cases different ranking occurs, but in general a fairly good agreement exists. This again is especially true for extremely negative sires. Correlation coefficients are rather low with r = o.71 to o.82 .

TABLE 3 : Distribution of sire proofs (number of sires)

Approach / Trait	expected	P(P) NR	P(C) NR	P(B) NR	P(P) NI	P(C) NI	P(B) NI
Range							
<- 1.51 $s_{b.v.}$	1	1	1	1	1	1	2
- o.51 to - 1.5o	5	5	5	5	4	5	4
- o.5o to + o.5o	9	9	8	9	1o	9	7
+ o.51 to + 1.5o	5	6	6	4	6	6	7
>+ 1.51 $s_{b.v.}$	1	o	1	2	o	o	1

TABLE 4 : Ranking of sires within different approaches (2oo daughters / sire)

Rank	1	2	3	4	5	6	7	8	~	14	15	16	17	18	19	2o	21
Approach (Trait)																	
P(P) (NR)	H	K	I	J	B	O	A	F		P	U	L	D	G	E	S	R
P(C) (NR)	H	I	K	B	J	Q	A	O		U	L	G	R	T	D	E	S
P(B) (NR)	H	I	K	B	J	M	A	N		U	T	L	G	R	D	E	S
P(P) (NI)	H	K	J	B	F	O	I	A		L	P	G	U	S	E	R	D
P(C) (NI)	H	K	B	J	F	I	A	C		P	G	T	E	R	U	S	D
P(B) (NI)	H	B	J	K	C	F	I	A		N	L	P	S	D	U	T	R

Combination	Trait	Correlation coefficients PEARSON	Correlation coefficients SPEARMAN
P(P) - P(C)	NR	o.95	o.93
P(P) - P(B)	NR	o.95	o.95
P(C) - P(B)	NR	o.97	o.97
P(P) - P(C)	NI	o.97	o.93
P(P) - P(B)	NI	o.86	o.82
p(C) - P(B)	NI	o.93	o.92

TABLE 5 : Ranking of sires within different approaches and data sets (trait : NR)

Rank		1	2	3	4	5	6	7	8 ~	14	15	16	17	18	19	2o	21
Approach (Daughters)																	
P(P)	(1oo)	H	K	B	J	M	Q	F	O	T	A	G	U	I	S	D	E
P(P)	(2oo)	H	K	I	J	B	O	A	F	P	U	L	D	G	E	S	R
P(C)	(1oo)	H	K	Q	B	J	M	N	F	G	C	U	A	S	T	D	E
P(C)	(2oo)	H	I	K	B	J	Q	A	O	U	L	G	R	T	D	E	S
P(B)	(1oo)	H	K	J	B	M	N	Q	F	I	R	U	A	T	S	D	E
P(B)	(2oo)	H	I	K	B	J	M	A	N	U	T	L	G	R	D	E	S

Combination	Correlation coefficients PEARSON	SPEARMAN
P(P) (1oo/2oo)	o.8o	o.71
P(C) (1oo/2oo)	o.8o	o.81
P(B) (1oo/2oo)	o.82	o.76

4. Discussion and Conclusion

Near identical results gained for the two traits used are not very much surprising, because app. 6o % of all cows need one insemination and app. 85 % of all cows need one or two inseminations. That means both traits have two categories - 0/1 for NR and 1/2 for NI. Selection could therefore be limited to one trait.

Under economic consideration selection potential for female fertility is limited compared to that of fat yield, giving no room for expensive sire proofs. The own results have shown that all approaches used resulted into very similar ranking. This observation may be typical for categorically scored traits. VAN VLECK and KARNER (198o) for example analysed sire evalualtion by BLUP for type score traits. By inspection of the unadjusted daughter frequencies only slight differences to BLUP proofs are to be find in their data set.

The comparison of sire ranking using sires' first hundred and first two hundred daughters came out with rather low correlation coefficients. Considering again the limited selection potential for female fertility, sire proof ranking based on 1oo daughters may justify to withdraw sires with extremely negative proofs.

SUMMARY

Due to low h^2 of female fertility traits such as NON-RETURN (NR) or NUMBER of INSEMINATIONS / PREGNANCY (Ni), sire proofs for female fertility need app. 2oo daughters to have a reliability comparable to proofs for milk traits. Test of young sires however is based on 1oo daughter record at maximum in the FRG.

The present paper analyses ranking of 21 sire proofs between two traits (NR 9o days, Ni), 3 models (deviation from μ_{pop}, CC, BLUP), and 2 data sets (first hundred and two hundred daughters).

Rank correlation between models are above o.95, between traits app. o.9o, and between data sets app. o.8o.

It is concluded that proofs of young sires based on 1oo daughters may be calculated by a simple model.

It is justified to withdraw young sires with extremely negatively proofs for female fertility.

R E S U M E N

Debido a la baja h^2 de ~~la fertilidad de~~ los caracteres femeninos de la fertilidad, tales como el "no-retorno" (NR) ó el "número de inseminaciones/gestación" (Ni), se llevaron a efecto pruebas con los sementales en relación con la fertilidad de las hembras en aproximadamente 200 hijas para poséer unos datos de confianza con destino a los controles lecheros. No obstante, la prueba de los novillos se basó sobre 100 hijas como registro máximo en la República Federal Alemana. El presente trabajo analiza la oscilación en 21 pruebas de sementales entre dos caracteres (NR 90 días, Ni), 3 modelos (desviación de pop´CC´BLUP) y 2 lotes (primer centenar y segundo centenar de hijas). La correlación entre los modelos fué de más de 0,95, entre los caracteres de aproximadamente 0,90 y entre los datos aproximadamente 0,80. Se deduce que las pruebas de los sementales jóvenes basadas en 100 hijas pueden calcularse por un modelo sencillo. Está justificado eliminar todos los jóvenes que demuestran caracteres extramadamente negativos para la fertilidad femenina.

Literature cited :

Van Vleck, L.D. and Karner, P.J. 198o : J.Dairy Sci 63 , 1328-1333