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Genetic evaluation of linear type traits for Swiss Braunvieh

L. Casanova
Herd Book Office
for Swiss Braunvieh
Chamerstr. 56
6300 Zug (Switzerland)

Introduction

In summer 1992 a linear type classification system was introduced in Switzerland for dairy and dual purpose cows (Swiss Braunvieh, Swiss Simmental and Swiss Holstein).
The system has so far been used for type classification of daughters of young bulls and for potential dams of the next bull generation. In this short paper, the classification method and genetic evaluation procedures used for the Swiss Braunvieh breed will be described.

Data

In this analysis only the data set of daughters of young bulls was used. For each unproven bull, about 50 randomly selected daughters in first lactation were classified. The conformation of 8 body, 7 feet and legs, 6 udder and 8 teat traits (see Appendix 1) are objectively scored from 1 to 9 where 1 and 9 are applied to the extremes of the traits. The conformation of 3 additional body traits is also measured. In the genetic analysis, all 32 traits were considered.
In addition to the traits mentioned, 35 conformation characteristics and general defects were scored on a present or absent basis. These traits were not investigated in this analysis. Appendix 1 shows the form used for the classification.

During the first year 4'137 first lactation cows, daughters of 79 unproven bulls, were classified.

Model for estimation of variance components and breeding values

A multiple trait sire model was used to estimate variance and covariance components as well as for solutions of sire effects. The model included the fixed effect of the individual classifier (data was collected from 8 different classifiers) and the fixed effect of a management group. Management groups were assigned according to calving year, calving season, geografical region and herd milk yield level. The herd milk yield level was computed by averaging lactation records minus one-half the breeding values for milk of the parents of cows. In addition, age at inspection, stage of lactation and proportion of US Brown-Swiss genes of the cow's dams were all fitted in the model as covariables. Relationships between sires were taken into account. The variance and covariance components were estimated by Restricted Maximum Likelihood (REML). The computer programm REMLPK of Meyer (1985, 1986) was used.

Body, feet and legs, udder and teat traits groups were analysed in separate data sets. Thus, covariance components were not obtained between all traits, but only within body traits or within udder traits and so on.

Results

Table 1 shows phenotypic means and standard deviations for all traits. The means in Table 1 are dependent on the definitions of scores. Under the assumption of normality and on a scale from 1 to 9, a standard deviation of 1.5 should result. Many traits listed in Table 1 show standard deviations less than the value intended, indicating a lack of scoring at the extreme ends of the range.

Heritabilities and standard errors are given on the diagonals of the Tables 2 to 5. Heritability estimates for all traits were consistent with previous analysis (for example Brotherstone at al., 1990) and ranged from 0.56 for height at withers to 0.09 for suspensory ligament.

Genetic and phenotypic correlations amongst the linear type traits are given in Table 2 to 5.

Publication of breeding values

In the genetic analysis 32 different type traits were considered. In the sire summaries for the breeders only 15 type traits are published. The published traits were chosen with respect to the variance of breeding values, heritability, genetic correlations with other traits and economical importance. Breeding values were transformed to a mean of 100 and a standard deviation of 10.

References

Brotherstone, S., C. M. Mc Manus and W.G. Hill (1990): Livestock Prod. Sci. 26: 177-192.
Meyer, K. (1985): Biometrics 41: 153.
Meyer, K. (1986): 3rd World Congr. on Genet. Appl. to Livest. Prod. 12: 454

Table 1

Phenotypic means and standard deviations (SD) for the linear type traits of 4'137 first lactation Braunvieh cows.

Trait	Abbreviation	Mean	SD
Height at withers (cm)	HAW	135.7	3.5
Height at rump (cm)	HAR	139.1	3.5
Circumference of chest (cm)	COC	190.1	6.7
Body			
Length	BOL	6.0	1.7
Rump length	RUL	5.9	1.6
Rump angle	RUA	4.8	1.1
Depth	BOD	5.7	1.5
Top line	TOL	5.4	1.0
Width	BOW	5.6	1.3
Muscling	MUS	5.6	1.3
Color	COL	5.2	0.9
Feet and legs			
Hock angle	HOA	5.5	1.1
Hock joint	HOJ	5.8	1.5
Strength	STR	5.4	0.9
Pastern	PAS	4.4	1.0
Hoof; Depth of heel	DOH	5.1	1.2
Hooves	HOO	6.5	1.1
Front feet	FFE	4.4	1.1
Udder			
Fore udder	FUD	5.2	1.6
Rear udder	RUD	5.1	1.5
Rear udder attachment	RUA	5.3	1.6
Strength of attachments	SOA	5.9	1.2
Veining	VEI	5.8	1.4
Suspensory ligament	SLI	5.2	1.1
Teats			
Shape	SHA	5.4	1.0
Length	LEN	6.2	1.2
Placement front	PLF	5.7	1.0
Placement rear	PLR	4.7	1.2
Placement side view	PLS	4.4	1.0
Teat angle; rear view	TAR	5.4	1.1
Teat angle - side view	TAS	4.2	1.0

Table 2

Heritability estimates (h^2 on diagonal) plus standard errors of h^2 for body traits; Genetic (below diagonal) and phenotypic (above diagonal) correlations amongst body traits.

	HAW	HAR	COC	BOL	RUL	RUA	BOD	TOL	BOW	MUS	COL
HAW	**0.56** *0.09*	0.88	0.51	0.74	0.59	0.04	0.29	0.07	0.25	0.01	0.02
HAR	0.97	**0.55** *0.09*	0.49	0.69	0.57	0.00	0.27	0.08	0.24	0.02	0.01
COC	0.49	0.44	**0.26** *0.05*	0.49	0.46	0.01	0.45	0.11	0.48	0.44	0.01
BOL	0.96	0.92	0.58	**0.43** *0.07*	0.77	0.08	0.43	0.06	0.35	0.11	0.00
RUL	0.93	0.91	0.57	0.96	**0.28** *0.05*	0.06	0.45	0.08	0.35	0.14	0.02
RUA	0.24	0.14	0.19	0.38	0.29	**0.17** *0.04*	0.02	-0.17	0.06	0.01	0.04
BOD	0.43	0.38	0.56	0.45	0.46	0.22	**0.21** *0.05*	0.05	0.38	0.25	0.04
TOL	-0.03	-0.01	0.19	-0.20	-0.11	-0.40	-0.28	**0.21** *0.04*	0.13	0.14	0.02
BOW	-0.04	-0.08	0.24	0.02	-0.03	0.18	0.06	0.33	**0.17** *0.04*	0.54	-0.01
MUS	-0.50	-0.52	0.26	-0.42	-0.43	-0.14	-0.12	0.33	0.65	**0.29** *0.06*	0.00
COL	0.01	-0.08	0.08	0.00	0.00	-0.01	-0.01	0.08	-0.15	-0.02	**0.31** *0.06*

Table 3

Heritability estimates (h^2 on diagonal) plus standard errors of h^2 for feet and leg traits; Genetic (below diagonal) and phenotypic (above diagonal) correlations amongst feet and leg traits.

	HOA	HOJ	STR	PAS	DOH	HOO	FFE
HOA	**0.18** *0.04*	0.32	0.01	-0.16	-0.08	-0.06	0.04
HOJ	0.37	**0.18** *0.04*	-0.37	-0.01	0.00	0.00	0.00
STR	0.05	-0.74	**0.29** *0.06*	0.05	0.10	-0.04	0.04
PAS	-0.30	-0.12	0.05	**0.25** *0.05*	0.28	0.29	0.03
DOH	-0.34	-0.17	0.21	0.47	**0.18** *0.04*	0.15	0.01
HOO	-0.25	-0.07	-0.04	0.67	0.12	**0.15** *0.04*	0.07
FFE	0.41	-0.02	0.06	-0.01	-0.25	0.20	**0.13** *0.03*

Table 4

Heritability estimates (h^2 on diagonal) plus standard errors of h^2 for udder traits; Genetic (below diagonal) and phenotypic (above diagonal) correlations amongst udder traits.

	FUD	RUD	RUA	SOA	VEI	SLI
FUD	**0.34** *0.06*	0.35	0.33	0.33	0.30	-0.06
RUD	0.45	**0.28** *0.05*	0.53	0.25	0.31	-0.09
RUA	0.50	0.73	**0.21** *0.05*	0.58	0.33	-0.05
SOA	0.38	0.10	0.63	**0.25** *0.05*	0.32	0.02
VEI	0.42	0.44	0.55	0.50	**0.19** *0.04*	-0.05
SLI	-0.20	-0.28	-0.09	-0.02	-0.23	**0.09** *0.03*

Table 5

Heritability estimates (h^2 on diagonal) plus standard errors of h^2 for teat traits; Genetic (below diagonal) and phenotypic (above diagonal) correlations amongst teat traits.

	SHA	LEN	PLF	PLR	PLS	TAR	TAS
SHA	**0.22** *0.05*	0.35	0.08	0.04	0.00	0.16	-0.07
LEN	0.23	**0.40** *0.07*	0.10	0.05	-0.08	0.19	-0.10
PLF	0.22	0.27	**0.31** *0.06*	0.44	0.00	0.33	0.01
PLR	0.20	0.13	0.63	**0.33** *0.06*	0.08	0.44	0.05
PLS	-0.10	-0.22	-0.23	-0.01	**0.35** *0.06*	-0.01	0.20
TAR	0.30	0.18	0.62	0.71	-0.10	**0.32** *0.06*	-0.05
TAS	-0.07	-0.20	0.13	0.24	0.52	0.06	**0.26** *0.05*

Swiss Herdbook for Braunvieh

Linear type traits for dual purpose cows

official request ☐

special classification ☐

COW:

OWNER:

breeding Coop. No herd No

phone:

date of birth: calved: inseminated/bred:

Lact. No: previous classification: printed:

HEIGHT AT WITHERS CM ☐☐ HEIGHT AT RUMP CM ☐☐ CIRCUMFERENCE OF CHEST CM ☐☐

type

LENGTH	☐	1 short	9 long
RUMP LENGTH	☐	1 short	9 long
RUMP ANGLE	☐	1 slopy	9 reverse tilt
BODY DEPTH	☐	1 shallow	9 deep
TOP LINE	☐	1 weak	9 roached
WIDTH	☐	1 narrow	9 wide
MUSCLING	☐	1 thin	9 thick
COLOR	☐	1 light	9 dark

1 ☐ loose at withers

2 ☐ wing shouldered

3 ☐ high hips

4 ☐ weak loin

5 ☐ frail

6 ☐ too fat

RUMP

7 ☐ narrow pins

8 ☐ high tail head

COLOR

9 ☐ irregular

10 ☐ white spots

REMARKS

☐ x 0,3 ☐

feet and legs

HOCK ANGLE	☐	1 straight	9 sickled
JOINT	☐	1 puffy	9 clean
STRENGTH	☐	1 fine	9 coarse
PASTERN	☐	1 weak	9 steep
HOOF; DEPTH OF HEEL	☐	1 shallow	9 deep
HOOVES	☐	1 open	9 closed
FRONT FEET	☐	1 toe out	9 toe in

HOCKS

21 ☐ close

22 ☐ close at hocks

HOOVES

23 ☐ overgrown

WALKING

24 ☐ irregular

25 ☐ short

26 ☐ close on ground

REMARKS

☐ x 0,2 ☐

udder

FORE UDDER	☐	1 short	9 large capacity
REAR UDDER	☐	1 under-developed	9 full
REAR UDDER ATTACHMENT	☐	1 narrow	9 wide
STRENGTH OF ATTACHMENTS	☐	1 weak	9 strong
VEINING	☐	1 little	9 much
SUSPENSORY LIGAMENT	☐	1 weak	9 strong

31 ☐ uneven

32 ☐ bulgy

33 ☐ edema

QUARTERING

34 ☐ side view

REMARKS

☐ x 0,3 ☐

teats

SHAPE	☐	1 fine	9 thick
LENGTH	☐	1 short	9 long
PLACING-FRONT	☐	1 close	9 wide
PLACING-REAR	☐	1 close	9 wide
PLACING SIDE VIEW	☐	1 close	9 wide
TEAT ANGLE - REAR VIEW	☐	1 pointing inwards	9 strutting
TEAT ANGLE - SIDE VIEW	☐	1 forwards	9 backwards
EXTRA TEATS	☐	1 extra teat	9 clean

41 ☐ wedge-shaped

42 ☐ pointed

43 ☐ stump

44 ☐ bottle-shaped

45 ☐ funnel-shaped

46 ☐ long front teats

MILKING SPEED

47 ☐ very slow

48 ☐ slow

49 ☐ normal

50 ☐ fast

51 ☐ very fast

REMARKS

☐ x 0,2 ☐

Qualified for special matings? (only for special classification) YES ☐ NO ☐

TOTAL SCORE

DATE: Number and signature of judge No

90 – 99	85 – 89	80 – 84	75 – 79	65 – 74	<65