Genetic evaluation of linear type traits for Swiss Braunvieh

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Introduction

In summer '92 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, geographical 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 program 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

Table 1

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

<table>
<thead>
<tr>
<th>Trait</th>
<th>Abbreviation</th>
<th>Mean</th>
<th>SD</th>
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</thead>
<tbody>
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<td>Height at withers (cm)</td>
<td>HAW</td>
<td>135.7</td>
<td>3.5</td>
</tr>
<tr>
<td>Height at rump (cm)</td>
<td>HAR</td>
<td>139.1</td>
<td>3.5</td>
</tr>
<tr>
<td>Circumference of chest (cm)</td>
<td>COC</td>
<td>190.1</td>
<td>6.7</td>
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**Body**

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<th>Abbreviation</th>
<th>Mean</th>
<th>SD</th>
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<td>Rump length</td>
<td>RUL</td>
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<td>1.6</td>
</tr>
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<td>RUA</td>
<td>4.8</td>
<td>1.1</td>
</tr>
<tr>
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<td>BOD</td>
<td>5.7</td>
<td>1.5</td>
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<td>5.4</td>
<td>1.0</td>
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<td>BOW</td>
<td>5.6</td>
<td>1.3</td>
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**Feet and legs**

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<tr>
<td>Hock joint</td>
<td>HOJ</td>
<td>5.8</td>
<td>1.5</td>
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<tr>
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<td>STR</td>
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<td>0.9</td>
</tr>
<tr>
<td>Pastern</td>
<td>PAS</td>
<td>4.4</td>
<td>1.0</td>
</tr>
<tr>
<td>Hoof; Depth of heel</td>
<td>DOH</td>
<td>5.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Hooves</td>
<td>HOO</td>
<td>6.5</td>
<td>1.1</td>
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<tr>
<td>Front feet</td>
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**Udder**

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<td>RUD</td>
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<td>Rear udder attachment</td>
<td>RUA</td>
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<td>1.6</td>
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<td>1.2</td>
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<td>5.8</td>
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**Teats**

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<tr>
<td>Placement rear</td>
<td>PLR</td>
<td>4.7</td>
<td>1.2</td>
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<tr>
<td>Placement side view</td>
<td>PL S</td>
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<td>1.0</td>
</tr>
<tr>
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<td>TAR</td>
<td>5.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Teat angle - side view</td>
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### Table 2

Heritability estimates (h² on diagonal) plus standard errors of h² for body traits; Genetic (below diagonal) and phenotypic (above diagonal) correlations amongst body traits.

<table>
<thead>
<tr>
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<th>HAR</th>
<th>COC</th>
<th>BOL</th>
<th>RUL</th>
<th>RUA</th>
<th>BOD</th>
<th>TOL</th>
<th>BOW</th>
<th>MUS</th>
<th>COL</th>
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<td></td>
<td>0.57</td>
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<tr>
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<td>0.69</td>
<td>0.57</td>
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<td>0.08</td>
<td>0.24</td>
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<td>0.11</td>
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<td>0.06</td>
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### Table 3

Heritability estimates (h² on diagonal) plus standard errors of h² for feet and leg traits; Genetic (below diagonal) and phenotypic (above diagonal) correlations amongst feet and leg traits.

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<tr>
<th>Traits</th>
<th>HOA</th>
<th>HOJ</th>
<th>STR</th>
<th>PAS</th>
<th>DOH</th>
<th>HOO</th>
<th>FFE</th>
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<tbody>
<tr>
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**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.

<table>
<thead>
<tr>
<th></th>
<th>FUD</th>
<th>RUD</th>
<th>RUA</th>
<th>SOA</th>
<th>VEI</th>
<th>SLI</th>
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**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.

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<tr>
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<th>SHA</th>
<th>LEN</th>
<th>PLF</th>
<th>PLR</th>
<th>PLS</th>
<th>TAR</th>
<th>TAS</th>
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<td>0.27</td>
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<td>0.01</td>
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<td>0.63</td>
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Linear type traits for dual purpose cows

**Appendix 1**

**Swiss Herdbook for Braunvieh**

<table>
<thead>
<tr>
<th>Trait</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Appendix 1</strong></td>
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<tr>
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**Linear type traits for dual purpose cows**

**COW:**

**OWNER:**

**date of birth:**

**Lect. No:**

**calved:**

**previous classification:**

**inseminated/bred:**

**printed:**

**phone:**

**breeding Coop. No**

**herd No**

<table>
<thead>
<tr>
<th><strong>HEIGHT AT WITHERS CM</strong></th>
<th><strong>HEIGHT AT RUMP CM</strong></th>
<th><strong>CIRCUMFERENCE OF CHEST CM</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
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</tbody>
</table>

| **LENGTH**                | 1 short 9 long        |
| **RUMP LENGTH**           | 1 short 9 long        |
| **RUMP ANGLE**            | 1 slope 9 reverse tilt|
| **BODY DEPTH**            | 1 shallow 9 deep      |
| **TOP LINE**              | 1 weak 9 roached      |
| **WIDTH**                 | 1 narrow 9 wide       |
| **MUSCULING**             | 1 thin 9 thick        |
| **COLOR**                 | 1 light 9 dark        |

<table>
<thead>
<tr>
<th><strong>NICK</strong></th>
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</thead>
<tbody>
<tr>
<td>HOCK ANGLE</td>
<td>1 straight 9 sickled</td>
</tr>
<tr>
<td>JOINT</td>
<td>1 puffy 9 clean</td>
</tr>
<tr>
<td>STRENGTH</td>
<td>1 fine 9 coarse</td>
</tr>
<tr>
<td>PATTERN</td>
<td>1 weak 9 steep</td>
</tr>
<tr>
<td>HOOF: DEPTH OF HEEL</td>
<td>1 shallow 9 deep</td>
</tr>
<tr>
<td>HOoves</td>
<td>1 open 9 closed</td>
</tr>
<tr>
<td>FRONT FEET</td>
<td>1 toe out 9 toe in</td>
</tr>
</tbody>
</table>

| **FORE UDDER**            | 1 short 9 large capacity       |
| **REAR UDDER**            | 1 underdeveloped 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                |

| **QUARTERING**            | 1 uneven 9 bulgy 9 edema       |
| **SIDE VIEW**             | 1 straight 9 sickled           |
| **QURING**                | 1 short 9 reverse tilt        |
| **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                |

| **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 9 strutting        |
| **TEAT ANGLE: SIDE VIEW** | 1 forwards 9 backwards        |
| **EXTRA TEATS**           | 1 extra 9 clear               |

| **QURING**                | 1 uneven 9 bulgy 9 edema       |
| **SIDE VIEW**             | 1 straight 9 sickled           |
| **QURING**                | 1 short 9 reverse tilt        |
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