Across Country Genetic Evaluation of Beef Traits in Middle European Dual Purpose Breeds

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Abstract

Joint genetic evaluation of beef characters across federal States of Germany and Austria has been applied in Simmental, Gelbvieh, Vorderwälder, Pinzgauer, Grey Cattle and other dual purpose breeds since 2002. The evaluation is based on a multiple-trait animal model using raw data. A total of 10 traits out of 5 beef recording schemes enters to the analysis. The selection goal is a beef index that is composed of net gain, meat percentage and EU carcass conformation score. The calculation is done by the ALLB Ludwigsburg using the PEST program package.

Introduction

The biggest subpopulations of Middle European dual purpose breeds like Fleckvieh (Simmental), Gelbvieh, Vorderwälder, Pinzgauer, Grey Cattle etc. are kept in southern Germany (Bavaria and Baden-Wurttemberg) and Austria. Genetic exchange and joint bull testing across borders has been applied here for decades and many genetic ties exist across regional sub-populations (see Table 1). Therefore many breeders wish to compare the genetic value of the animals on a common scale and asked for a joint genetic evaluation including beef traits.

Table 1. Connectedness across Hesse, Baden-Wurttemberg, Bavaria and Austria in Simmental cattle by common sires (Genetic evaluation May 2003).

	Hesse	Baden-W.	Bavaria	Austria
Hesse	144 1)	27	39	30
	92 2)	6/6	8/6	6/5
Baden-Wurttemberg		4792	1828	292
		34	66/50	33/16
Bavaria			18047	809
			45	35/33
Austria				9201
				67

1) First line: Diagonals: Sires used within region only; off-diagonals: Common sires

2) Second line: Diagonals: % progenies within region accounting for sires used within region only; off-diagonals: % progenies within region 1 and within region 2 accounting for common sires

In a first stage, joint genetic evaluation of dual purpose breeds was established across Bavaria, Baden-Wurttemberg and Hesse in early 1996. In Austria, genetic evaluation for beef traits was introduced separately in 1995. After common review of all information traits and full harmonisation of the objective traits and their appropriate relative economic weights for final genetic indexes, a joint evaluation system across all involved countries for all traits and breeds was established in November 2002.

Beef recording activities

The evaluation is based on 13 information traits coming from 5 beef recording schemes which are applied in southern Germany and Austria:

- Individual station performance test of young breeding bulls (testing period from 112 to 420 days of age) (ITS)
  - Daily gain within testing period
  - Muscling score at the and of test

- Individual performance test of young breeding bulls on official auctions sales (testing period from birth to sales date) (IAS)
  - Daily gain within testing period
  - Muscling score at the and of test

- Progeny station tests (testing period from 112 to 450 days of age) (PTS)
  - Net gain from birth to finish
  - EU carcass conformation score
  - Estimated meat percentage

- Progeny tests in contracted field farms (commercial production) (PCF)
  - Net gain from birth to finish
  - EU carcass conformation score
  - Estimated meat percentage (Gelbvieh only)

- Progeny tests in commercial abattoirs (commercial production) (PCA)
  - Net gain from birth to finish
  - EU carcass conformation score
  - Dressing percentage (Austria only)

The total extent of data provided by each of the testing schemes is shown in Table 2.

Table 2. Included beef recording schemes by breeds (March 2003).

Breed	Animals	%	ITS	IAS	PTS	PCF	PCA
Fleckvieh (Simmental)	2 465 065	92.3	16 949	98 453	7 334	56 443	2 285 886
Gelbvieh	31 441	1.2	188	2 815	358	3 848	24 232
Vorderwälder	7 384	0.3	489	6 253			642
Pinzgauer	2 048	0.1	101	1 033			914
Grauvieh (Grey Cattle)	1 091	0.04		316			775
Others	164 672	6.2	1 211	49 764	1 213		112 484

Statistical approach

With regard to program limitations, genetic evaluation is done by applying a multiple trait animal model that takes a maximum of 10 information traits into account. Therefore – with regard to 13 recorded traits - meat percentage from progeny test stations on the on hand and that obtained from contracted field farms on the other hand are treated as identical traits. The same applies for net gain and carcass conformation score obtained from contracted field farms resp. from progeny test in commercial abattoirs.

Genetic evaluation is performed across breeds simultaneously. As shown in Table 3, breed effects are taken into account additionally to other cross-classified fixed effects. All effects are contained directly in the mixed-model-equations, i.e. no pre-correction for any fixed effect is applied.

Table 3. Effects taken into account in genetic evaluation of beef characters.

Effect	No. of effects	ITS	IAS	PTS	PCF	PCA
Station x Finish year x Quarter	308	*				
Location x Finish year x Quarter	7.434		*			
Station x Slaughter date	1.312			*		
Finishing group	4.225				*	
Finishing farm x Slaughter year	162.057					*
Abattoir x Slaughter year x Slaughter month	104.234					*
EU Carcass fat grade (1-5)	5				*	*
Parity (1st, 2nd, further)	3	*	*	*	*	*
Type of birth (Single, twins, further)	3	*	*	*	*	*
Abattoir	42				*	*
Slaughter month	12					*
Slaughter age (cubic regression)	-				*	*
Breed	14	*	*	*	*	*
Genetic group (Birth year)	8	*	*	*	*	*
Animal	5.927.070	*	*	*	*	*

Breeding values are calculated by use of the PEST-Program package of GROENEVELD (1990), whereas the accuracy of prediction (R^2) is calculated by a program of MISZTAL and WIGGANS (1988).

The genetic parameters used in the evaluation system are shown in Table 4. They were recently estimated by pairwise analysis of large samples of the whole data set (NIEBEL & HEINKEL, 2002) using the VCE program package (GROENEVELD, 1997) and subsequent bending of the whole solution matrix (ESSL A., 1991).

Breeding Values

At present, beef performance in dual purpose breeds is defined by the following target traits:

- Net gain (g/day)
- EU carcass conformation score (pts.)
- Meat percentage (%)

Similar to the approach for breeding values of dairy and other traits, the estimated breeding values are combined to a final selection index, the so called beef index (beef value). All breeding values refer to a floating genetic base. The genetic base by definition shows a mean of 100 and a genetic standard deviation of 12 pts. Within breed it comprises the same bulls as used in the evaluation of dairy and other traits (fully tested bulls of the most recent 3 birth years with at least 10 daughters from 5 herds).

Table 4. Genetic parameters of information traits (Niebel & Heinkel, 2002).

Trait	ITS-DG	ITS-MS	IAS-DG	IAS-MS	PTS-NG	PTS-MP	PTS-CC	PCF-NG	PCF-CC	PCA-NG	PCA-CC	PCA-DP
ITS-DG	**0.36**	0.12	0.64	0.11	0.67	-0.20	0.05	0.55	0.08	0.34	0.08	-0.02
ITS-MS		**0.24**	0.12	0.06	0.22	0.11	0.44	0.21	0.14	0.21	0.14	0.11
IAS-DG			**0.31**	0.35	0.47	0.15	-0.02	0.46	0.17	0.46	0.17	0.08
IAS-MS				**0.14**	0.23	0.01	0.11	0.12	0.10	0.12	0.10	0.22
PTS-NG					**0.60**	0.11	0.49	0.48	0.27	0.48	0.27	0.41
PTS-MP						**0.40**	0.11	0.21	0.39	0.21	0.39	0.50
PTS-CC							**0.36**	0.34	0.40	0.34	0.40	0.38
PCF-NG								**0.27**	0.39	1.00	0.39	0.34
PCF-CC									**0.24**	0.39	1.00	0.43
PCA-NG										**0.27**	0.39	0.34
PCA-CC											**0.24**	0.43
PCA-DP												**0.49**

Diagonal (bold): Heritabilties, above diagonal: Genetic correlations

ITS-DG	Daily gain at individual station test
ITS-MS	Muscling score at individual station test
IAS-DG	Daily gain at official auctions sales
IAS-MS	Muscling score at official auctions sales
PTS-NG	Net gain in progeny station tests
PTS-MP	Meat percentage in progeny station tests
PTS-CC	Carcass conformation score in progeny station tests
PCF-NG	Net gain in contracted practice farms
PCF-CC	Carcass conformation score in contracted practice farms
PCA-NG	Net gain in commercial abattoirs
PCA-CC	Carcass conformation score in commercial abattoirs (E-U-R-O-P)
PCA-DP	Dressing percentage in commercial abattoirs

The beef index is calculated from the natural target traits by weighing them according to their mutual genetic correlation and appropriate economic weights (expected marginal profit taking price expectations into account resulting from EU agenda 2000). A final economic weight ratio of 60:20:20 applies for each of the index components.

Table 5. Economic weights for calculation of the beef index.

Trait	Economic weights
Net gain	1,34 €/s_A
Meat percentage	0,45 €/s_A
Carcass conformation score	0,45 €/s_A

Results of genetic evaluation of beef traits are published quarterly and simultaneously with any other genetic proofs.

Prospects

Genetic evaluation of dual purpose breeds is executed by a small team of involved German and Austrian experts. In defiance of staff limitations, there is the opportunity for further sub-populations from abroad to benefit from this approach and to participate in the joint genetic evaluation.

However, any inclusion of new sub-populations can only be done, if comparable data- and breeding structures are met and if compromises with regard to the evaluation model do not result in deterioration of the quality of the existing genetic evaluation system. This applies especially for specific components of animal recording:

- Identification of the animal (15-digit ISO code)
- Definition of traits
- Frequency of data recording
- Measurement procedures
- Data storage

Furthermore, a comparable genetic composition of the sub-population as well as similar breeding objectives are required, i.e. countries that only breed for pure beef- or milk production cannot join the common evaluation.

However, the most important condition for joint genetic evaluation is the existence of sufficient genetic ties between the centre population and the foreign sub-population. Apart from a regular exchange of semen and breeding animals, this requires accurate herdbook registration where foreign animals are not re-numbered but keep their original number.

Genetic variances should be homogeneous and the amount of animals with foreign blood should not be excessive, as unfavourable adaptation of the evaluation model would be required otherwise.

If the differences in the above mentioned aspects become too big, then the MACE approach as applied by INTERBULL would be a better solution.

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