STABILITY OF ESTIMATED BREEDING VALUES FOR AVERAGE DAILY GAIN IN PANNON WHITE RABBITS

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ABSTRACT

Stability of estimated breeding values for average daily gain (ADG) between the age of 5 and 10 weeks was analyzed for 50,869 Pannon White rabbits, reared in 7,911 litters and born between 1999 and 2007. The data set was divided into successive 5-year long periods (1999-2003, 2000-2004, 2001-2005, 2002-2006 and 2003-2007), then after selecting the appropriate part of the pedigree for these sub-datasets genetic parameters and breeding values were estimated for ADG using REML and BLUP methods. Estimated heritabilities for the successive 5-year long periods were moderate and stable (0.24±0.01, 0.28±0.02, 0.25±0.02, 0.25±0.02 and 0.26±0.02). Magnitudes of random litter effects were low and stable (0.17±0.01, 0.16±0.01, 0.16±0.01, 0.16±0.01 and 0.15±0.01). After breeding value estimation the most recent sub-dataset (2003-2007) was merged pair wise with each sub-dataset (2002-2006, 2001-2005, 2000-2004 and 1999-2003) using inner join. Thus, in the merged datasets only those records of most recent sub-dataset (2003-2007) were included that matched the other datasets records (i.e. records of rabbits born in 2003-2006, 2003-2005, 2003-2004 and 2003, respectively). In these merged datasets, each rabbit had two breeding values for ADG based on two different 5-year long dataset. The breeding values based on the most recent dataset were regressed on the breeding values based on other 5-year long datasets. With the successive years the coefficients of determination decreased (0.976, 0.963, 0.929 and 0.848). However, the coefficients of determination were moderately high, even when the proportion of the common rabbits in the merged datasets was low. Using a rolling base dataset, therefore, did not result the instability of breeding values estimated for ADG.

Key words: Stability of breeding values, Average daily gain, Rabbits.

INTRODUCTION

The BLUP procedure is the most widely accepted and used method for breeding value estimation (Henderson, 1988) which probably can be explained by its favourable mathematical properties (Kennedy *et al*., 1988). Its first application for cattle was published three decades ago (Van Vleck *et al*., 1977) and nowadays it is also applied in most rabbit breeding programmes (Baselga, 2004). One of the favourable characteristics of BLUP is that it accounts for the effect of selection when the pedigree of each animal is traceable to an unselected base population (Sorensen and Kennedy, 1988). This requirement can hardly be fulfilled in real breeding programs as the selection of several breeds initiated more than a century ago therefore the resulting datasets would become unmanageably large. As a result it is a common practice to cut the dataset and the pedigree according to a predefined time interval (eg. dataset and pedigree contain records of a 5 and 6 year long period, respectively) keeping the necessary computing capacity at a reasonable level. With the progressing time the dataset is modified both with incoming and outgoing records. One may be interested what is the stability of the estimated breeding value for a given animal and trait with the progressing time. This was the objective of this study.

MATERIALS AND METHODS

In the present study records of 50869 Pannon White rabbits analysed that were born between 1999 and 2007 and reared in 7911. The number of base animals was 152 and the total number of rabbits in the pedigree was 52701. Growing rabbits were housed in a closed rabbitry, in fattening cages (2-3 rabbits per cage). After weaning (35 d) they were fed a commercial pellet (16.3% crude protein, 15.2% crude fibre, 10.6 MJ DE/kg). In winter the rabbitry was heated to a minimum temperature of 15–16°C, while – in the absence of air conditioning – in the summer the temperature occasionally reached levels as high as 28°C. The animals were weighed at 5 and 10 weeks of age, to calculate the average daily weight gain (ADG). The dataset was divided into successive 5 year long periods (1999-2003, 2000-2004, 2001-2005, 2002-2006 and 2003-2007) and analyzed separately. Descriptive statistics of the dataset and for the sub-datasets are presented in Table 1.

Table 1: Descriptive statistics for average daily gain (ADG) between the age of 5 and 10 weeks

Trait	Analyzed period	No. of records	Mean	S.D.	CV%
ADG (g/day)	2003-2007	25964	42.56	6.22	14.6
	2002-2006	28257	42.29	6.25	14.8
	2001-2005	29769	42.16	6.11	14.5
	2000-2004	27588	41.65	6.22	14.9
	1999-2003	31889	41.09	6.33	15.4
	1999-2007	50869	41.75	6.39	15.3

ADG between the age of 5-10 weeks was evaluated with the REML and BLUP procedures in order to estimate its genetic parameters and breeding values. The applied softwares were PEST (Groeneveld *et al*., 1990) and VCE 5 (Kovac and Groeneveld, 2003.) Using univariate animal models for the various sub-datasets authors considered the sex, year-month, animal and random litter effects (Table 2). After breeding value estimation the most recent sub-dataset (2003-2007) was merged pair wise with each sub-dataset (2002-2006, 2001-2005, 2000-2004 and 1999-2003) using inner join. Thus in the merged datasets only those records of most recent sub-dataset (2003-2007) were included that matched the other datasets records (i.e. records of rabbits born in 2003-2006, 2003-2005, 2003-2004 and 2003, respectively). In these merged datasets each rabbit had two breeding values for ADG based on two different 5 year long dataset. The breeding values based on the most recent dataset were regressed on the breeding values based on other 5 year long datasets using the REG procedure of SAS (SAS Institute SAS Institute 2002-2003) software package.

Table 2: Model information

Effect	Type	Levels 2003-2007	Levels 2002-2006	Levels 2001-2005	Levels 2000-2004	Levels 1999-2003	Levels 1999-2007
Sex	Fixed	2	2	2	2	2	2
Year-month	Fixed	56	58	59	60	60	104
Animal	Additive Genetic	27731	30088	31560	29380	33557	52701
Litter	Random	3831	4326	4601	4424	5082	7911

RESULTS AND DISCUSSION

The estimated heritabilities and random litter effects for ADG based on the various datasets can be seen in Table 3. Estimated heritabilities for the successive 5 year long periods were moderate and stable. Magnitudes of random litter effects were low and stable. Magnitudes of both effects were in accordance with our previous estimates (Szendrő *et al*., 2004; Nagy *et al*., 2006) for Pannon white rabbits. Using the Hungarian National Pig dataset, Farkas (2008) analyzing the stability of breeding values gave a detailed treatment of this issue. For ADG using the same data structure as in this study (5 year long sub-datasets) he also observed very stable heritabilities (0.33-0.38 or 0.48-0.51 depending on the used model groups). The slight irregular modifications of the ADG heritability estimates might be caused by the changing environmental effects and/or by the *cca* 20% change of individuals in the successive sub-datasets.

Table 3: Heritability estimates (h^2) and magnitudes of random litter effects (c^2) for ADG. Standard errors of estimates are given in brackets

Analyzed period	h^2	c^2
2003-2007	0.26 (0.02)	0.15 (0.01)
2002-2006	0.25 (0.02)	0.16 (0.01)
2001-2005	0.25 (0.02)	0.16 (0.01)
2000-2004	0.28 (0.02)	0.16 (0.01)
1999-2003	0.24 (0.01)	0.17 (0.01)
1999-2007	0.25 (0.01)	0.17 (0.01)

Number and percentage of common records between the various sub-datasets and the results of regression of breeding value equivalents based on different sub-datasets (stability of breeding values) are provided in Table 4 and were depicted in Figures 1-4.

Table 4: Descriptive statistics of the merged datasets and breeding value stability for ADG

Merged datasets (periods)	No. of common records	% of common records	b[1]	Pr > |t|	R-Square
2003-2007 - 2002-2006	22555	71.22	0.997	0.0001	0.976
2003-2007 - 2001-2005	19171	52.43	0.990	0.0001	0.963
2003-2007 - 2000-2004	12982	31.99	0.905	0.0001	0.929
2003-2007 - 1999-2003	6984	13.73	0.953	0.0001	0.848

[1]Linear regression coefficient of breeding values based on the most recent sub-dataset on the breeding values based on other 5 year long sub-datasets

With the successive years the coefficients of determination decreased. However, the coefficients of determination were moderately high, even when the proportion of the common rabbits in the merged datasets was low. Using much larger datasets (although the same data structure) Farkas (2008) observed much lower stability of breeding values, the R-square estimates ranged between 0.56-0.87. The proportions of the incoming and outgoing records for the successive 5 year long sub-datasets were similar in the study of Farkas (2008) and in this study. The lower stability for ADG in pigs compared to Pannon white rabbits can be probably explained by the large number of pig herds taken into the analysis while in this study we only evaluated the population of the experimental rabbit farm of the Kaposvár University.

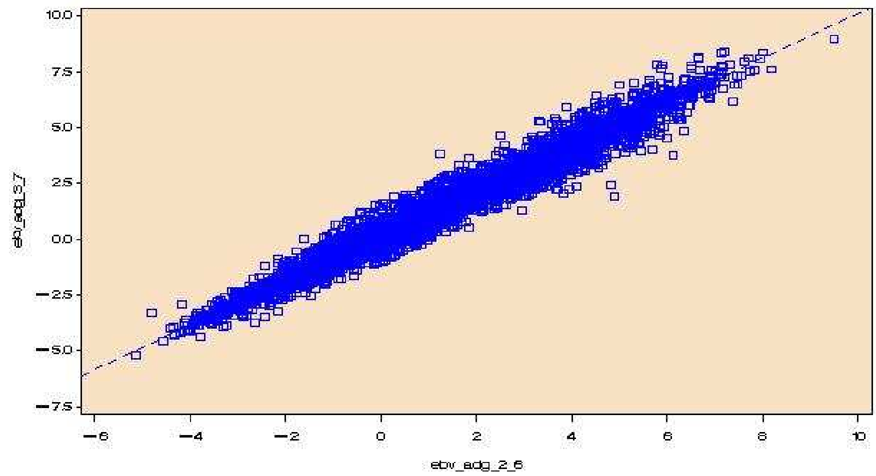

Figure 1: Regression of breeding values for average daily gain of rabbits based on the most recent sub-dataset on the breeding values for average daily gain of the same individuals based on other five year long sub-dataset (2003-2007 and 2002-2006)

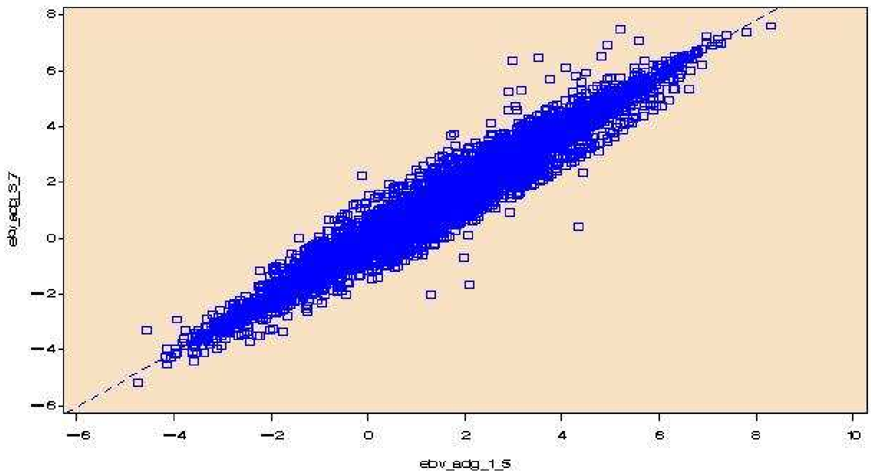

Figure 2: (2003-2007 and 2001-2005)

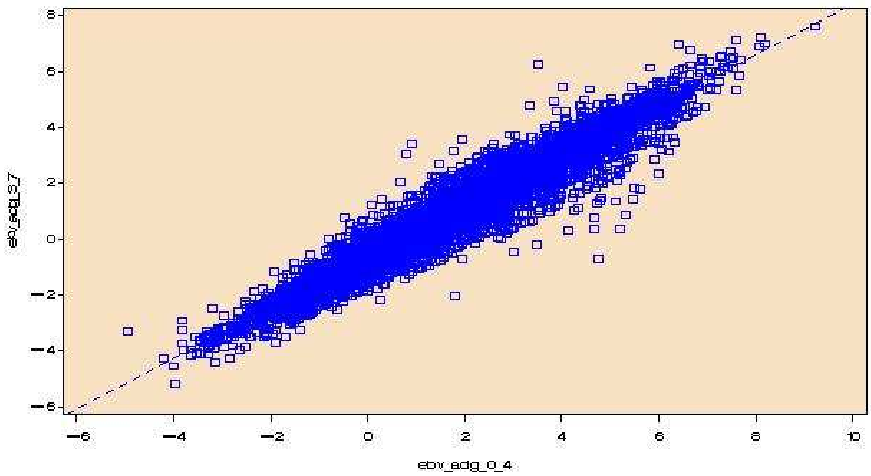

Figure 3: (2003-2007 and 2000-2004)

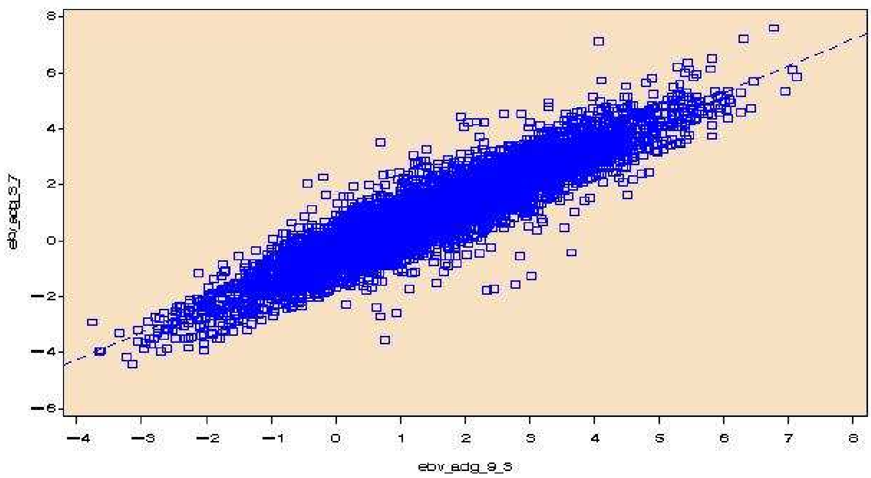

Figure 4: (2003-2007 and 1999-2003)

CONCLUSIONS

With the successive years the proportion of common rabbits in the merged datasets decreased together with the stability of breeding values. However, the stability of breeding values was high unless the evaluation was based on merged datasets with very low proportion of matching records. But even in that case the stability of breeding values was moderately high. These results are favourable and show that applying a rolling base dataset the computing capacity can be held at a reasonable level without the risk of estimating unstable breeding values.

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