COMMUNICATION

Heritability and genetic trends of number of kits born alive in a synthetic maternal rabbit line

Petra Gyovai, István Nagy, István Radnai, Edit Bíróné Németh, Zsolt Szendrő

Department of Pig and Small Animal Production. Kaposvár University, Hungary

Corresponding author: Dr. Petra Gyovai. Department of Pig and Small Animal Production, Kaposvár University, Guba S. str. 40, 7400 Kaposvár, Hungary – Tel. +3630/389-3666 – Fax: +3682/320-167 – Email: petra.gyovai@gmail.com

ABSTRACT - Heritability and genetic trends for number of kits born alive in a synthetic maternal rabbit line were estimated in this study. The data were collected from 1999 to 2007 on 5640 kindlings of 1425 does. The total number of animals in the pedigree was 2576. The mean number of kits born alive was 8.42 with a standard deviation of 2.87. Genetic parameters and breeding values were estimated using the VCE-5 and PEST software based on the REML and BLUP methods using a repeatability animal model. For litter size, the first, second and third parities were treated as repeated trait, while the fourth and further parities were pooled and considered as same repetition. The estimated heritability and the repeatability for number of kits born alive were low (0.05 and 0.14). The observed selection response was about 0.04 rabbits/year.

Key words: Heritability, Genetic trend, Litter size, Rabbit.

Introduction – The Pannon White rabbit breed (PW), developed and selected at Kaposvár University, has a large impact on the Hungarian rabbit breeding sector. However, recently it has shown a decreasing trend in the Hungarian rabbit population (from 43% in 2004 to 20% in 2007). In order to increase the competitiveness of its rabbit program, especially with respect to hybrids present in the Hungarian market (Hyplus, Hycole, etc.), some years ago, the Kaposvár University decided to develop maternal and paternal lines which, when crossed with Pannon White breed, utilize heterosis with respect to litter size (maternal line), to weight gain (paternal line) and to carcass traits (based on the selection of the PW breed; Szendrő et al., 2008). The present study aimed to estimate heritability and genetic trends for number of kits born alive in this new synthetic maternal rabbit line.

Material and methods – The development of the studied maternal line (ML) started in 1995 with importation of sperm from prolific rabbit population. However, from the progeny of inseminated PW does, only a few animals were kept. Four years later, 114 female and 48 male newborn kits with high reproductive performance were imported and mated within “prolific” population creating the base of ML. In years 1999, 2004 and 2005, individual sperm of rabbits with prolific performance was imported from different sources and used
for the insemination with selected maternal does. From subsequent progeny, 136 does and 34 bucks were selected and crossed with ML rabbits.

Since 2005 the ML has been closed and selected for teats number and number of kits born alive. This selection was based on phenotypes. Since April 2008 the response of selection on number of kits born alive was estimated based on animal model BLUP.

The present study was based on the 5640 kindlings of 1425 does, collected from September 1999 to October 2007. The total number of animals in the pedigree was 2576. The mean number of kits born alive was 8.42 with a standard deviation of 2.87.

Heritability and breeding values were estimated using the VCE-5 (Kovac and Groeneveld, 2003) and PEST (Groeneveld, 1990) software based on the REML and BLUP methods. Repeatability animal models were used for litter size, where the first, second and third parities were treated as a repeated trait, while the fourth or further parities together were considered as the same repetition.

The basic linear model was as follows:

\[ y = Xb + Za + Wc + \varepsilon \]

Where \( y \) is the vector of observations; \( b \) is the vector of fixed effects; \( a \) is the vector of additive genetic effects; \( c \) is the vector of permanent environmental effects; \( \varepsilon \) is the vector of random residual effects and \( X, Z, W \) are incidence matrices relating the data to the fixed, genetic and environmental effects, respectively.

Using a repeatability animal model the effects of parity (fixed effect, 4 levels), year-month of kindling (fixed effect, 107 levels), animal (additive genetics effect, 2576 levels), and permanent environmental (random effect, 1425 levels), were considered. Mean of breeding values of does born in the same year were calculated for number of kits born alive (from 1999 to 2007) to measure selection response.

**Results and conclusions** – The estimated heritability in the repeatability model for number of kits born alive was low (Table 1), but generally agrees with previously reported estimates (0.07-0.13) for a same trait by Piles et al. (2006) and Rastogi et al. (2000) for 3 breeding programs for litter size at weaning and in an experimental herd of predominately New Zealand White rabbits, respectively.

| Trait             | Statisticsa          |
|-------------------|----------------------|
| Kits born alive (No.) | \( h^2 \pm S.E. \) | \( p^2 \pm S.E \) | \( R \) | \( B \pm S.E. \) | \( P \) |
| Kits born alive (No.) | 0.05 ± 0.03  | 0.09 ± 0.03  | 0.14  | 0.0378 ± 0.006   | 0.0002 |

\( h^2: \) heritability (additive genetic variance as a proportion of phenotypic variance); \( p^2: \) paratipic effect (permanent environmental effects variance as a proportion of phenotypic variance); \( R: \) repeatability (sum of \( h^2 \) and \( p^2 \)); \( B: \) selection response, \( P: \) significance of the selection response.

However the repeatability of the trait resulted substantially lower than that reported by Rastogi et al. (2000), who found a value of 0.32.

The low heritability of the number of kits born alive is further reflected in low response
to direct selection. Applying BLUP, the estimated selection response was about 0.04 rabbits/year (Figure 1). The observed genetic trend was in accordance with that (0.05 rabbits/year) found by Estany et al. (1989).

Figure 1. Selection responses for number of kits born alive.

However it has to be noted that for the present study the BLUP selection was conducted for less than one year. Therefore an increase in the selection response is expected in the next future.

This study was financially supported by the Bolyai Research Grant (BO/00659/08/04).

REFERENCES – Estany, J., Baselga, M., Blasco, A., Camacho, J., 1989. Mixed model methodology for the estimation of genetic response to selection in litter size of rabbits. Livest. Prod. Sci. 21(1): 67–75. Groeneveld, E., 1990. PEST Users’ Manual. Institute of Animal Husbandry and Animal Behaviour Federal Research Centre, Neustadt, Germany. 1-80. Kovac, M., Groeneveld, E., 2003. VCE-5 Users’ Guide and Reference Manual Version 5.1. University of Ljubljana, Biotechnical Faculty, Department of Animal Science, Domzale, Slovenia. Institute of Animal Science Federal Agricultural Research Centre, Neustadt, Germany. 1-68. Piles, M., García, M.L., Rafel, O., Ramón, J., Baselga, M., 2006. Genetics of litter size in three maternal lines of rabbits: Repeatability versus multiple-trait models. J. Anim. Sci. 84(9): 2309-2315. Rastogi, R.K., Lukefahr, S.D., Lauckner, F.B., 2000. Maternal heritability and repeatability for litter traits in rabbits, Livest. Prod. Sci. 67(1-2): 123–128. Szendrő, Zs., Metzger, S. Z., Romvári, R., Szabó, A., Locsmándi, L., Petrási, Z. S., Nagy, I., Nagy, Z., Biró-Németh, E., Radnai, I., Matics, Zs., Horn, P., 2008. Effect of divergent selection based on CT measured hind leg muscle volume on productive and carcass traits in rabbits. Proc. 9th World Rabbit Congr. Verona, Italy, 249-253.