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SELECTION FOR WEANING WEIGHT IN HYLA BREED: GENETIC PARAMETERS AND TRENDS

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ABSTRACT

Maternal ability is a key factor in rabbit farming. Improvement of maternal ability for the young rabbit growth is one of the selection aims of the Hyla D line. This trait is evaluated by the individual weight at weaning (35 days). Direct and maternal genetic values are estimated using the BLUP methodology applied to an animal model. Since the second quarter of 2007, the genetic gain was estimated at 115 grams for direct effects and 53 grams for maternal effects. Estimates of heritability are 0,20 and 0,06 for direct effects and maternal effects, respectively. Selection for weaning weight was efficient. Weights of the two genetic values in the breeding objectives are discussed in order to favor improvement of maternal effects on weaning weight.

Key words: Rabbits, maternal abilities, breeding values, blup, heritability, weaning weight.

INTRODUCTION

Hyla D line is used to produce grand-parent females D (GPD) for multiplication farms or for grand-parent pool in production farms.
The main selection goal is increasing maternal abilities for rabbit growth and survival. Maternal qualities for growth are evaluated by rabbits weaning weight (35 days-old). BLUP (Best Linear Unbiased Predictor) animal model is used to calculate the 35 days-old weight genetic value, with a separation of direct and maternal effect. Direct effect considers growth potential, whereas maternal effect mainly expresses the mother milking potential (Garreau and Rochambeau, 2003). A bibliographic study showed good results of selections test and confirmed that it could be interesting to consider this maternal criteria (Garreau *et al.*, 2005). Afterwards, those parameters have been included in the Hyla selection scheme.
The aim of this study is to calculate genetics parameters and to produce results of a commercial breeding rabbits line using this maternal selection. Furthermore, this study is considering data collecting during 4 years in a professional selection program.

MATERIALDS AND METHODS

Animals

All studied animals are included in the Hyla D selection nucleus installed in 2007 in a new high sanitary level Selection Center (Gosné, France). Production cycle is 42 days: females are inseminated 11 days after farrowing. At the end of the farrowing period, the number of rabbit per litter are equalized by adoptions and withdrawals in order to keep 9 rabbits under the primiparous does and 10 rabbits under multiparous ones.
Rabbits are weaned at 32 days-old and are weighted at 35 days-old. Does and rabbits get exactly the same feed from birth to weaning.

Data

All pedigree data have been collected and recorded since BLUP animal model indexation begins by Eurolap in 2002. Considering Hyla selection scheme D line, first recorded parents in genealogy are born in year 1998. Then, 75151 individuals are registered.
Performance records concerns all births between the second trimester of 2007 and the first trimester of 2011. Analyzed data are 35 days-old weight for rabbits from birth rank #1, #2 and #3 (21465 individual weights from 2759 different litters).

Methods

Analysis method used in this paper is built on methods developed with bovine and ovine models, that have been adapted later to rabbit by Garreau *et al.* (2003, 2005).
Genetic component of performance (weaning weight) subjected to a maternal influence is divided into a direct genetic effect (influence of animal genotype measured on its performances) and into a maternal genetic effect (incidence of mother genotype on animal measured performance, trough expression of maternal abilities).
One data of growth or weaning weight is therefore used to estimate two components: direct ability of animal for growth and maternal ability of its mother for growth processing. Genetic parameters are estimated by the method of restricted maximum likelihood (REML) applied to an animal model with direct and maternal effect using the software ASReml (Gilmour *et al.*, 2002). BLUP breeding values are estimated by the same software and same model. This model includes different fixed effects: birth year-season ; sex ; weaning age ; litter size at birth ; litter size at weaning ; adoption ; combined effect of birth rank and physiological stage of milking mother. Random effects are: common environment of the young rabbits from the same litter ; maternal environment ; maternal genetic effect ; direct genetic effect. Genetic trend is obtained by average of BLUP breeding values of all individuals born per trimester.

Selection

Line D breeding males and females are selected considering other breeding values: alive born rabbits number at each round and weaning weight homogeneity. Unlike weaning weight, prolificacy performances are recorded during the whole doe career. The tested litter number per doe stands between 1 and 18. Breeding value estimation for homogeneity is completed with canalizing selection model developed by Sancristobal-Gaudy *et al.* (1998) and applied to rabbit by Garreau *et al.* (2008).
All those breeding values are used to calculate a global index in order to select breeding rabbits. The weight assigned to the maternal breeding value of weaning weight is 6 times higher than the weight assigned to the direct breeding value.
The main selection is completed by the genetic index but a phenotypic selection is added to get a homogeneous group of young females: satisfying sanitary level and highest 66 days-old weight.

RESULTS AND DISCUSSION

Fixed effects analysis

Estimation of the weaning litter size effects on weight at 35 days-old are shown in Figure 1. There is an almost linear relationship between weaning litter size and weaning weight. Logically, the smaller is the litter size, the heavier are the rabbits. Rabbits from small size litter have a quantity of milk and food proportionally greater than the rabbits from higher litter size (Lebas, 2002).

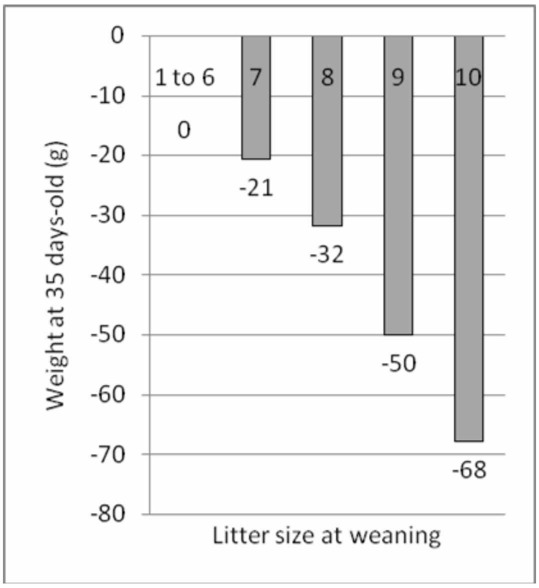

Figure 1: Estimation of weaning litter size effects (number of weaned rabbits: 1 to 6 ; 7 ; 8 ; 9 ; 10) on rabbit weight at 35 days-old (grams).

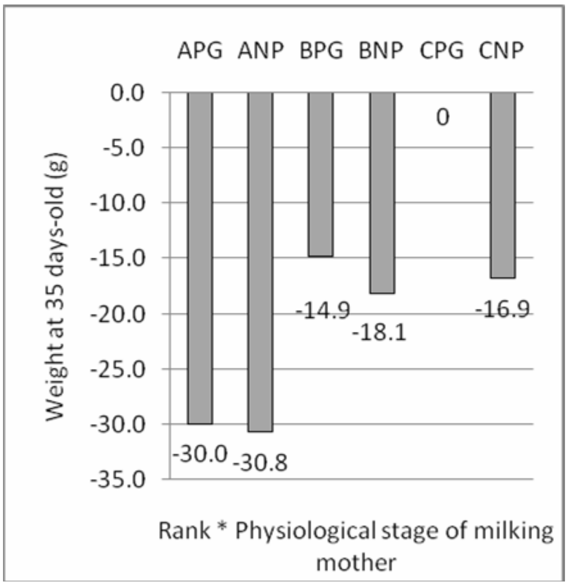

Figure 2: Estimation of combine effects of birth rank (A=1, B=2, C=3) and physiological stage of milking mother (NP = Non Pregnant, PG = Pregnant) on rabbit weight at 35 days-old (in grams).

The estimation of combine effects of birth rank and physiological stage of milking mother is summarized in Figure 2. Estimated values increase with the birth rank. The birth rank 3 (C) corresponds to the highest weights. There is also, for a same rank comparison, a negative effect for non-pregnant physiological state. The effect of non-pregnancy is more important at rank 3 than at rank 2 and 1. This phenomenon can be explained by a deteriorated fitness of the female, revealed by the absence of pregnancy due to non-fertilization, which is unfavorable to young rabbits growth. Theau-Clement and Poujardieu (1995) also described the negative effect of physiological stage 'no milking' of the female, resulting from a lack of fertilization, on performances for litter size and weight of these rabbits litters.

Genetic parameters

Table 1 shows genetic parameters of weight at 35 days-old, dividing direct and maternal effects. Estimated heritability for direct effect (0.20) is higher than that one obtained by Garreau et al. (2003) in a maternal line (0.11) but corresponds to the one reported by Larzul *et al.* (2003) in a paternal line (0.16). Estimated heritability for maternal effect (0.06) is equal to the one given by Garreau et al. (2003) but it is less than the one given by Larzul *et al.* (2003).

A weakly positive correlation between direct and maternal effect (0.15) is opposed to negative values (-0.30 and -0.43 respectively) obtained by Garreau *et al.* (2003) and Larzul *et al.* (2003) but precision is there lower. Genetic antagonism described by those authors do not seem to exist in the D line Hyla.

Table 1: Genetic parameters of weight at 35 days-old, direct and maternal effect obtained from univariate analysis.

	Direct effects	Maternal effects
Heritability (± standard error)	0,20 (±0,02)	0,06 (±0,02)
Environment effect of original litter (± standard error)	0,11 (±0,01)	0,01 (±0,01)
Direct / maternal effect correlation (± standard error)	0,15 (±0,13)	

Genetic trend

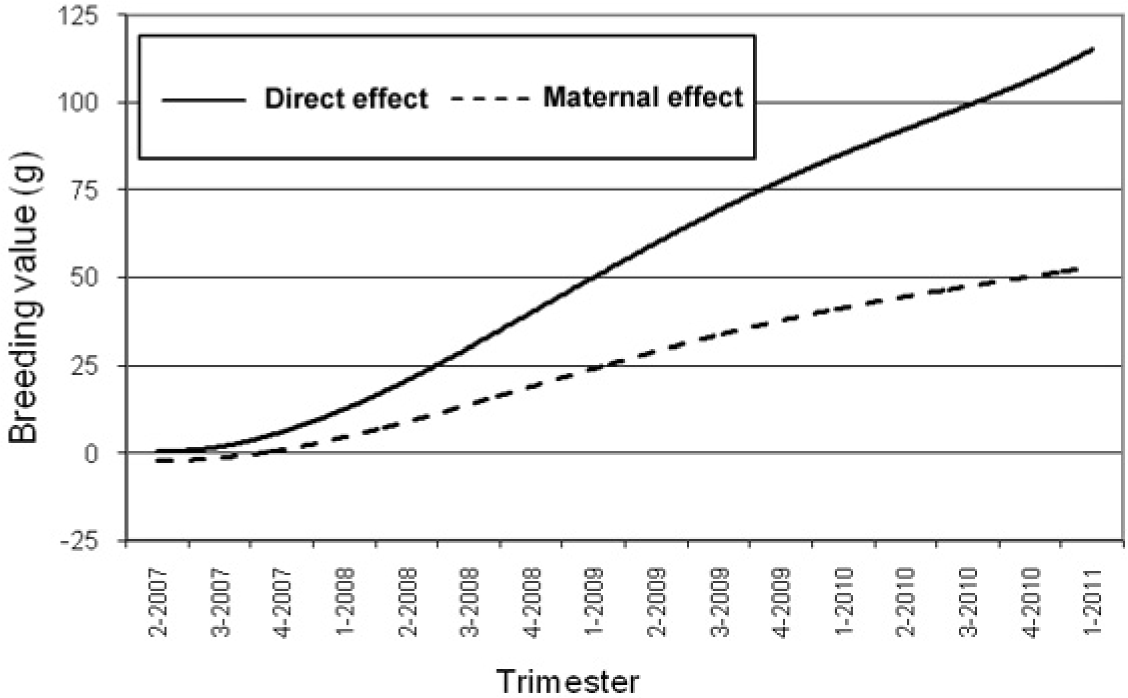

Figure 3: Genetic trend of direct and maternal effects of weight at 35 days-old depending on birth trimester.

The genetic trend of weight 35 days-old is shown in Figure 3. Although the weighting of maternal genetic value is 6 times stronger than direct genetic value, genetic progress on the direct effect is much higher than the one on maternal effect: 115g against 53g during the studied period. This can be explained by a strong heritability difference, as shown in Table 1. Furthermore there is no genetic opposition between direct and maternal components of weaning weight. Methods used in the scheme for females renewal may also increase genetic progress on direct effects. Indeed, candidate females for selection are selected on their genetic index but also according to their weight at 66 days-old in order to keep heaviest females. According to Garreau *et al*. (2003) and Larzul *et al.* (2003), there is a strong correlation between direct effects of weaning weight and weight at the end of fattening period (0.70). This additional sorting could indirectly increase direct effects of weaning weight genetic progress.

Direct and maternal components being additive, genetic progress of weaning weight between 2007 and 2011 is 168g, an annual progress average of 42 grams. For weaning weight at 28 days-old, *Garreau et al.* (2003, 2005) reported a genetic gain of 14,7 grams per generation, which means an increase of 18 grams per year.
Those genetic changes are supported by phenotypic observations. Indeed, some weightings issues from a trial in year 2005 showed an average weight for GPD female at the age of 19 weeks-old of 3,950 kg. In the second half of 2009, GPD females selection center had an average weight to 19 weeks-old of 4,250 kg. This partly results on genetic progress achieved on weaning weight and phenotypic selection by weight to 66 days-old.

CONCLUSION

Hyla D line selection on weight at 35 days-old was efficient. Genetic progress estimated during 4 years is 115 grams for direct effect and 53 grams for maternal effect. However, the priority still remains in improving female milking ability and not the increase of female size. It is therefore intended to increase the weight of maternal effect significantly in the global index, especially as the positive correlation between direct and maternal effects will continue to improve direct genetic value. A test of a new index weight will be made.

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