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BOLET G.. ZERROUKI N., GACEM M., BRUN J.M., LEBAS F.

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Pages 195 - 199

GENETIC PARAMETERS AND TRENDS FOR LITTER AND GROWTH TRAITS IN A SYNTHETIC LINE OF RABBITS CREATED IN ALGERIA

Bolet G.[1*]. Zerrouki N.[2], Gacem M.[3], Brun J.M.[1], Lebas F.[4]

[1] INRA, UR631, Station d'Amélioration Génétique des Animaux, BP52627,31326 Castanet Tolosan Cedex France
[2] Faculty of Biological and Agronomic Science. University Mouloud Mammeri, Tizi-Ouzou, Algeria.
[3] ITELV – Baba Ali , BP03/A Birtouta-Alger, Algeria
[4] Cuniculture, 87A Chemin de Lasserre, 31450 Corronsac, France
[*]Corresponding author: Gerard.bolet@toulouse.inra.fr

ABSTRACT

A synthetic strain (called ITELV2006) has been created to improve the genetic stock for rabbit meat production in Algeria, obtained by a crossing between the local population and the INRA2666 strain. This paper gives estimations of heritabilities and genetic progress for some reproductive and productive traits, after 4 generations of homogenization (F1 to F4) followed by 4 generations of selection for litter size at birth and 75 days weight (G0 to G3). Heritabilities of litter size are in a range of 0.08 to 0.11; doe environment components are similar to heritabilities. For young individual weight at weaning, at 75 days and growth rate, heritabilities are low (0.12 to 0.16) and common litter component are high (0.45 to 0.62). The very high values of common litter effect can be explained by strong environmental effects. A high heritability of 0.43 was observed for doe weight at parturition. There was a genetic progress on all traits (except mean kit weight at birth), ranging from 0.3 to 0.6 units of standard error of genetic value. As a genetic progress has been obtained on selected and correlated traits, the superiority of this strain on local populations, observed in F4, is confirmed and amplified. The selection nucleus keeps on breeding in the ITELV experimental farm at Baba Ali. In January 2012, animals have been sent in some farms to confirm the value of this strain in different environmental conditions before distributing it to other farms to improve reproductive and productive performances of rabbits used in Algeria for meat production.

Key words : Algeria, rabbit, synthetic strain, selection, genetic parameters.

INTRODUCTION

Rabbit meat production can represent for Algeria a valuable source of proteins given its prolificacy and its ability to use agro-industrial by-products. Production is mainly based on small units using rabbits from local populations. Since 1990, the Institut Technique de l'Elevage (ITELV) and some universities, in particular that of Tizi Ouzou, have set up programmes for the characterization of these populations (Gacem and Lebas, 2000, Belhadi, 2004; Zerrouki *et al.*, 2005). They highlighted the defects of these populations, namely their too weak prolificacy and insufficient adult weight, but also their qualities, namely a good adaptation to the local climatic conditions, without any significant loss of productivity in summer. To provide farmers with more productive animals, the ITELV, in collaboration with the INRA and the university of Tizi-Ouzou, chose to create a synthetic strain (called ITELV2006) obtained by a crossing between the local population and an INRA strain (Gacem *et al.*, 2008). The objective of this article is to give estimations of heritabilities and genetic progress for some reproductive and productive traits, after four generations of homogenization followed by four generations of selection for litter size and 75 days body weight.

MATERIALS AND METHODS

The first generation of the synthetic strain (F1) was obtained by inseminating in December 2003 eighty females of the local population (called thereafter F0), maintained in the experimental farm of the ITELV at Baba Ali, with semen from males of the INRA2666 strain, which was itself an experimental synthetic strain, resulting from the crossbreeding between the INRA2066 strain and the Verde strain of the Polytechnic University of Valencia, in Spain (Brun and Baselga, 2004). The F1 offspring were thus distributed on this basis in 9 families of 9 females and 2 to 4 males each; 81 F1 does and 18 F2 males were thus used to produce F2 by using a system of rotation between families to minimize inbreeding. F3 and F4 were obtained in the same way. After F4, the next generation was considered as the first generation (G0) of the true ITELV2006 strain and selected for live litter size at birth and body weight at 75 days from G0 to G3.

Animals were housed in buildings equipped with wired cages in flat-deck, and ventilated with a "cooling" system. Females were mated from the age of 20 weeks and 10-12 days after kindling, or the day following a negative palpation. They were fed *ad libitum* a balanced feedstuff, whose characteristics could vary, because of the difficulties in the supply of raw materials and had automatic watering. The young rabbits were weaned at about 35 days, weighed individually, identified then placed by group of 8 in fattening cages. They were weighed individually at about 75 days.

Statistical analysis

The analysed traits were total litter size at birth, the number of kits born alive in the litters with at least one born alive, the number of kits weaned in the litters with at least one weaned, litter weight and individual mean weight at birth, the weight of the female at parturition, the individual body weight of young at weaning and at 75 days.

To estimate heritabilities, we used a mixed linear model with the REML method applied to an animal model, using the VCE software (Neumaier and Groeneveld, 1998). These genetic parameters enabled us to calculate for each animal of the population a BLUP genetic value, by using the PEST software (Groeneveld and Kovac, 1990). Fixed and random effects used in the model according to traits analyzed are summarized in Table 1. To estimate heritabilities, we used only data from generations F2 (considered as the first “stabilized” generation) to G3. Genetic values for reproduction traits were estimated with data of all generations (F0 to G3) whereas only data from F2 to G3 were available for weaning and 75 days weight. Fixed effects were defined in the same way as Lebas *et al*. (2010) or Gacem *et al*. (2009) who compared this strain to local populations. Significance and values of fixed effects and covariates were similar to those presented in these two papers and are not commented here.

Table 1. Fixed effects, covariates and random effects used in the models to estimate variance components and genetic values.

	Fixed effects				Covariates			Random effects		
	Year-season	Sex	Parity	Physio. status	Weaned number	Age at weaning	Age at 75 days	Common litter	Doe permanent effect	Animal
Total Born/litter	X		X	X					X	X
Born alive/litter	X		X	X					X	X
Weaned/litter	X		X	X					X	X
Litter weight at birth	X		X	X					X	X
Individual mean weight at birth	X		X	X					X	X
Doe weight at parturition	X		X	X					X	X
Young weight at weaning	X	X	X		X	X		X		X
Young weight at 75 days	X	X	X				X	X		X

RESULTS AND DISCUSSION

Number of data and mean values are presented in table 2. According to Gacem *et al* (2009) and Lebas *et al*. (2010), all these means were significantly greater than in local populations in the same conditions, except for mean kit weight at birth. Growth rate between weaning and 75 days was low due to unfavourable environmental conditions, namely feeding quality.

Table 2: Average litter traits, individual weights and daily weight gain over all generations: number of data, mean and standard deviation (S.D.)

Trait	N	Mean	S.D
Total Born/litter	2154	9.13	2.78
Born alive/litter	2152	8.40	2.85
Weaned/litter	2154	6.36	2.21
Litter weight at birth (g)	2141	425	134
Individual mean weight at birth (g)	2141	53	12
Doe weight at parturition (g)	2135	3436	439
Young weight at weaning (g)	12442	577	154
Young weight at 75 days (g)	8463	1664	367
Daily gain between weaning and 75 days	6782	25.56	7.04

Variance components and heritability estimates.

Table 3 summarizes the genetic and environmental (doe permanent environment for litter traits, common environment for individual weights) variance components. Heritabilities of litter size are in a range of 0.08 to 0.11 ; these values are somewhat higher than most estimates in the literature (Blasco *et al*, 1993; Mantovani *et al*, 2008; Lenoir and Garreau, 2009), but similar to values obtained by Lenoir *et al*. (2011). Doe permanent environment component is similar to heritability and higher than in the same papers, except for Lenoir *et al*. (2011).
Parameters for litter weight at birth are similar to values obtained by Lenoir *et al* (2011). They are lower for mean weight but, in our case, kits are not weighted individually at birth.
For body weight at weaning, at 75 days and growth rate, heritabilities are lower than values obtained by Larzul *et al*. (2003) or Loussouarn *et al*. (2011). Common litter variance component are high, which can be explained by strong environmental effects. The high heritability observed for doe weight is similar to values observed by Umesh *et al*. (2005).

Table 3: Genetic and environmental variance components (Genetic Standard Deviation GSD, Genetic variance GV, doe or litter variance MV , residual variance RV), heritability (h^2) and ratio

Parameters	h^2	Dam permanent or common litter environmental effect	GSD	GV	MV	RV
Total Born	0.109±0.023	0.099±0.021	0.901	0.811	0.741	5.915
Born alive	0.102±0.023	0.089±0.021	0.899	0.809	0.703	6.425
Weaned	0.086±0.022	0.027±0.018	0.634	0.404	0.130	4.185
Litter weight at birth	0.124±0.027	0.070±0.024	44.65	1994	1128	12970
Average young weight at birth	0.045±0.022	0.117±0.024	2.14	4.56	11.86	84.77
Doe weight at parturition	0.426±0.052	0.289±0.046	282	79681	53997	53456
Young weight at weaning	0.100±0.017	0.642±0.009	41	1655	10675	4294
Young weight at 75 days	0.158±0.019	0.454±0.011	121	14641	42162	35980
Daily gain between weaning and 75 days	0.144±0.025	0.325±0.012	2.21	4.90	11.06	18.09

Number of data : see table 2

Genetic trends

Figure 1. Genetic trends for selected traits (number born alive and 75 days body weight) and other correlated traits (in dotted line) in units of genetic standard deviation.

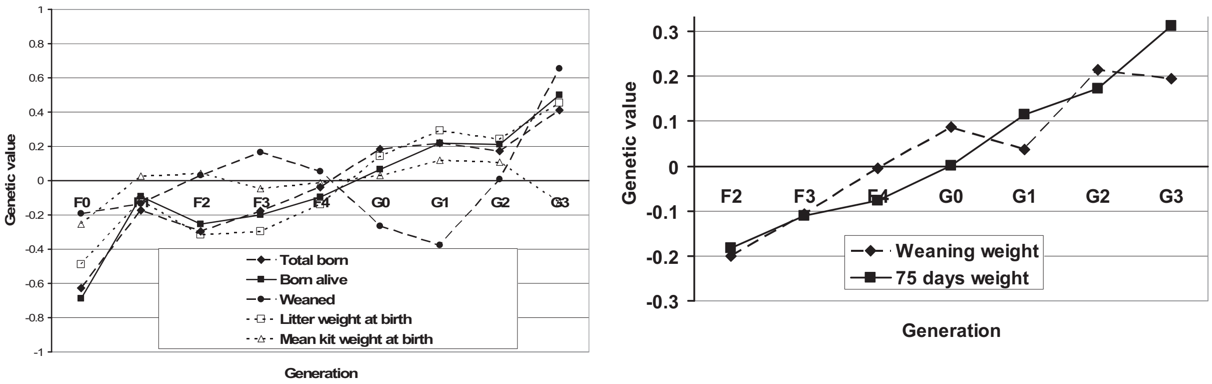

Figure 1 shows the genetic trends for selected traits (Number born alive and 75 days weight) and other correlated traits (in dotted line). The estimation of genetic values from F0 to G3 does not take into account the fact that F0 is the local population, F1 is a crossbred population submitted to heterosis, which decreases thereafter. So, genetic values are not only additive genetic values. However, it is clear that there was a genetic progress on all traits (except mean kit weight at birth), ranging from 0.3 to 0.6 units of standard error of genetic value. For some traits, genetic progress began in F2, because of some selection within litters, even if true selection began in G0. These results are in good agreement with most estimates of literature (see review by Khalil and Al-Saef, 2008).

CONCLUSION

After four generations of homogenization followed by four generations of selection, it was possible to estimate genetic parameters and genetic trends in the ITELV2006 strain. Genetic parameters are in the same range as classical values of literature, even if in some cases they diverge somewhat. So, the genetic parameters which were used till now to calculate genetic values for selection were valuable, but can now be replaced by the estimated values of this population. Strong environmental components of variance, especially for growth, show that environmental control has to be improved to better estimate genetic values.

In F4, this strain was superior to local populations (Gacem *et al*., 2009; Lebas *et al*., 2010). As a genetic progress has been obtained since then on selected and correlated traits, the superiority of this strain is confirmed. The selection nucleus keeps on breeding in the ITELV experimental farm at Baba Ali. In January 2012, animals have been sent in some farms to confirm the value of this strain in different environmental conditions before distributing it to other farms to improve reproductive and productive performances of rabbits used in Algeria for meat production.

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