Genetic analysis of growth performance in farm-bred New Zealand White rabbits

M. SAKTHIVEL
DPV (K) 12001 (AGB)

Thesis submitted in part fulfilment of the requirements for the degree of
DOCTOR OF PHILOSOPHY
in
ANIMAL GENETICS AND BREEDING
to the
Tamil Nadu Veterinary and Animal Sciences University, Chennai

Post Graduate Research Institute in Animal Sciences (PGRIAS),
Kattupakkam, Kancheepuram Dist., Tamil Nadu

Tamil Nadu Veterinary and Animal Sciences University
Chennai – 600051

2015

TAMIL NADU VETERINARY AND ANIMAL SCIENCES UNIVERSITY

CERTIFICATE

This is to certify that the thesis entitled **"Genetic analysis of growth performance in farm-bred New Zealand White rabbits"** submitted in part fulfillment of the requirements for the degree of **Doctor of Philosophy** in **Animal Genetics and Breeding** to the Tamil Nadu Veterinary and Animal Sciences University, Chennai is a record of *bonafide* research work carried out by **Dr. M. Sakthivel** under my supervision and guidance and that no part of this thesis has been submitted for the award of any other degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part or full in any scientific or popular journal or magazine.

Place : Kattupakkam
Date : 01.07.2015

(D. BALASUBRAMANYAM)
Chairman

Approved

Chairman : **(D. BALASUBRAMANYAM)** 01/07/2015

Members : **(H. GOPI)** 1/7/15

(P. KUMARASAMY) 01/07/15

(A. RAJA) 01/07/15.

(R. ANILKUMAR) 01/07/15

Date : 01.07.2015

EXTERNAL EXAMINER

(M.R. JAYASHANKAR)

ABSTRACT

GENETIC ANALYSIS OF GROWTH PERFORMANCE IN FARM-BRED NEW ZEALAND WHITE RABBITS

Name of the student	:	**M. SAKTHIVEL**
Degree for which submitted	:	Ph.D. (Animal Genetics and Breeding)
Name of the Chairman	:	**Dr. D. Balasubramanyam, Ph.D.** Professor Centre of Animal Production Studies TANUVAS, Chennai – 600 051
Discipline	:	Animal Genetics and Breeding
Institute	:	Post Graduate Research Institute in Animal Sciences, Kattupakkam - 603 203,
University	:	Tamil Nadu Veterinary and Animal Sciences University, Chennai-600 051
Year	:	2015

The population of New Zealand White rabbits was evaluated for its genetic structure and growth performance. Data on pedigree information for 18 years (1995-2012) and growth for 15 years (1998-2012), collected from records maintained at the Sheep Breeding Research Station, Sandynallah, The Nilgiris were utilized for the study. The different growth traits studied were body weights at weaning (W42), post-weaning (W70) and marketing (W135) age and growth efficiency traits *viz.*, average daily gain (ADG), relative growth rate (RGR) and Kleiber ratio (KR) estimated on a daily basis at different age intervals from weaning to marketing.

The pedigree analysis revealed that the mean values of generation interval, coefficients of inbreeding and equivalent inbreeding were 1.489 years, 13.233 per cent and 17.585 per cent, respectively. The proportion of population inbred was 100 per cent. The estimated mean average relatedness and individual increase in

inbreeding were 22.727 and 3.004 per cent, respectively. The per cent increase in inbreeding over generations was 1.94, 3.06 and 3.98 estimated through maximum generations, equivalent generations and complete generations, respectively. The number of ancestors contributing the most of 50% genes (f_{a50}) to gene pool of reference population was 4 which might have led to reduction in genetic variability and increased amount of inbreeding. The extent of genetic bottleneck as expressed by the f_e/f_a ratio was 1.1 which is indicative of absence of stringent bottlenecks. Up to 5th generation, 71.29 per cent pedigree was complete reflecting the well maintained pedigree records. The maximum known generations were 15 with an average of 7.9 and the average equivalent generations traced were 5.6 indicating of a fairly good depth in pedigree. The realized effective population size was 14.93 which is very critical and with the increasing trend of inbreeding the situation is going to be worse. The proportion of animals with GCI greater than 9 was 39.10 per cent which can be used as a scale to use such animals with higher GCI to maintain balanced contribution from the founders.

The various growth traits were analyzed using least-squares method for effect of sex of the kit, season and period of birth and inbreeding. (Co)Variance components were estimated through restricted maximum likelihood technique (REML) using an Animal model. The fixed effects found to be significant from the least-squares analyses were fitted for each trait.

The mean body weights at weaning, post-weaning and marketing were 0.715, 1.276 and 2.187 kg, respectively. The maximum growth efficiency was noticed between weaning and post-weaning. Season and period had highly significant influence on all the growth parameters studied and sex had significant influence on certain growth efficiency traits only. The regression of body weight traits on F and EF showed negative effect whereas most of the growth efficiency traits showed positive effects. Significant inbreeding depression was observed in W42 and W70. The depression in W42 was 0.214 kg and 0.139 kg and in W70 was 0.269 kg and 0.172 kg

for every 1 unit in proportion of increase in F and EF, respectively. Though the trait W135 showed positive value and ADG1 showed depression, the effects of inbreeding and equivalent inbreeding were non-significant in these traits. The analysis of effect of level of inbreeding on growth traits revealed that the inbreeding class was significant on W70, ADG2, RGR2 and KR2 while EF classes had significant influence only on ADG2, RGR2 and KR2.

The direct heritability (h^2) for W42, W70 and W135 estimated from the best model were 0.424±0.069, 0.400±0.077 and 0.269±0.071, respectively. The maternal genetic effect was found to be important in early body weight traits studied. The maternal heritability (m^2), estimated from best models for traits in which it was important, were 0.216±0.077 and 0.324±0.060 for W42 and W70, respectively. Direct maternal genetic correlations (r_{am}) for W42 and W70 were -0.955±0.095 and -0.569±0.112, respectively. The total heritability (h^2_t) values estimated from h^2, m^2 and σ_{am} were 0.254 and 0.274 for W70 and W135, respectively. The maternal across year repeatability for doe performance (t_m) were 0.213, 0.219 and 0.067 for W42, W70 and W135, respectively. Maternal permanent environment variance was found to influence the early body weight traits of W42 and W70 compared to W135. The maternal permanent environmental heritability estimated from model 4 for these body weight traits shows decreasing trend with advancement in age.

Maternal genetic variation was important for the ADG1 and neither maternal genetic nor maternal permanent environmental variation was important for ADG2 and ADG3. The estimates of h^2 and h^2_t were moderate to high for average daily gains and the maternal heritability which was significant in ADG1 was 0.139±0.043 and the direct maternal genetic correlation was -0.681±0.115. Permanent maternal environmental variation was important for all the three relative growth rates and two of the Kleiber Ratios.

All the estimates of genetic and phenotypic correlations among body weight traits were positive and the magnitude ranged between 0.53 and 0.66. The estimates

of genetic and phenotypic correlations among ADGs were low to high with varying signs. The estimates of correlation coefficients of body weights with growth efficiency parameters were mostly negative in direction and varied from negligible to high in magnitude.

The mean direct genetic trends for W42, W70 and W135 were 0.004, 0.004 and 0.011, respectively. The respective values for ADG1, ADG2 and ADG3 were -0.040, 0.086, 0.080, RGR1, RGR2 and RGR3 were -0.054, 0.032 and 0.025 and KR1, KR2 and KR3 were -0.037, 0.030 and 0.003. The mean maternal genetic trends for the traits in which maternal genetic effect was important were -0.003, -0.012 and -0.081 for W42, W70 and ADG1, respectively.

Moderate to high estimates of heritability, positive genetic trend and higher values of genetic correlation in body weight traits provided good scope for genetic improvement in New Zealand White rabbit provided measures are taken to keep the inbreeding at the lowest level.

Keywords: Rabbit, New Zealand White, Genetic structure, Growth, Genetic parameters