BREED AND SOME NON-GENETIC EFFECTS ON GROWTH OF CALIFORNIAN AND NEW ZEALAND WHITE RABBITS RAISED IN SOUTH-EASTERN BRAZIL[1]

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Abstract - Data from 3,168 Californian and New Zealand White rabbits, born between 1988 and 1992 in south-eastern Brazil were analyzed to evaluate the effects of sex, breed, year of birth, parity, season and litter size of weaning (LSW) on individual weights at weaning (WW), 5, 6, 7, 8, 9, 10 and 11 weeks (W5 - W11), and also weight gain from weaning to 11 weeks (WG11) and average daily gain from weaning to 11 weeks (ADG). The rabbits were born in ten parities and season was defined as trimesters of the year (January-March, April-June, July-September and October-December), being the first and the last the hot and humid seasons and the second and third the mild and dry ones.

Breed effects were not detected in any of the traits analyzed, but W11, the weight close to slaughter, when New Zealand White rabbits were around 31g heavier. The influence of parity, year and season and litter size on WW were statistically significant ($P<0.01$), but only year and season ($P<0.01$) affected the traits W5 to W11, WG11 and ADG. Season effects showed that lower weights were observed with rabbits born from January to March, the months with the highest temperatures, humidity and rain fall. The results showed that the majority of those effects should be considered as fixed effects in analysis of rabbit data raised under tropical conditions. The better performance of rabbits born in months with mild temperatures lead to the conclusion that both Californian and New Zealand White rabbits are not very well adapted to tropical or subtropical conditions.

INTRODUCTION

There is a big interest in the increase of rabbit production in many developing countries, because the average consumption of animal proteins in those countries is lower than the recommend amount of 21g people/day, and rabbits, that can be produced without important competition with humans for grains, can be a useful alternative.

A very important requirement for the development of the rabbit meat industry is establish the offer of that product along the year, and there are many causes for the float this offer (Mc NITT & MOODY, 1990). The correct knowledge of those factors can indicate to producers better ways of offer rabbit meat to the market all around the year, increasing productivity and profit and making possible the growth of rabbit meat industry.

Some authors found that rabbit data analyzed were affected by years, seasons or months, parity, sex, etc., besides breed effects (CAMACHO and BASELGA, 1991; FERRAZ *et al.*, 1991 a, b, c; MOURA *et al.*, 1991 a, b; OZIMBA & LUKEFAHR, 1991 a, b; RODELLAR *et al.*, 1991 a, b; BASELGA *et al.*, 1992; FERRAZ, 1993; AYYAT *et al.*, 1995).

South-eastern Brazil is a region with a transition climate, from tropical to sub-tropical, were agriculture and animal production is well developed. To know the effects of breed and some non-genetic effects on rabbit production, can help producers with management, nutrition and genetic decisions that will lead to larger productivity and lower prices of meat.

The objectives of the present study were analyse the effects of breed, sex, parity, season and year of birth and the covariate litter size of weaning on rabbit weight.

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MATERIAL AND METHODS

Data from Californian (CAL) and New Zealand White (NZB) rabbits were collected at the Rabbit Research Sector of the University of São Paulo, Campus of Pirassununga, state of São Paulo, south-eastern Brazil. The animals were born from 1988 and 1992 in litters of ten parities. To define season, the births were grouped in trimesters (January-March, April-June, July-September and October-December), being the first and the last the hot and humid seasons and the second and third the mild and dry ones.

The animals were housed in a closed building with lateral openings, in metal cages (85x95x45cm) with automatic waterers and feeders. and fed with a commercial pelleted feed (minimum of 18% crude protein and 17% fibre guaranteed). Internal temperatures of the housing facilities varied from 18°C to 35°C.

At weaning (30 days as an average) rabbits were identified by tattooing, weighed (WW), and the litter size of weaning (LSW) was taken. After weaning, at weeks 5 to 11, all rabbits were weighed weekly and individually, and those measurements resulted in the traits W5, W6, W7, W8, W9, W10, W11 where the number indicates the week of age of the rabbits when it was measured. From the weights, the traits weight gain from weaning to 11 weeks (WG11) and average daily gain (ADG) were calculated.

Data were analyzed with a linear procedure (least squares analyses), using SAS, version 6.04 for microcomputers, with the procedure PROC GLM (SAS INSTITUTE, 1985). The mathematical model, where all the effects were considered as fixed, was:

$$Y_{ijklmn} = \mu + S_i + B_j + Y_k + P_l + T_m + b(X_n - X) + e_{ijklmn}, \text{ where:}$$

Y_{ijklmn} = measured trait on the n^{th} rabbit the i^{th} sex, j^{th} breed, k^{th} year, l^{th} parity, m^{th} season and n^{th} litter size at weaning;

μ = overall mean;

S_i = effects of i^{th} sex;

B_j = effects of j^{th} breed;

Y_k = effects of k^{th} year;

P_l = effects of l^{th} parity;

T_m = effects of m^{th} season or trimester;

b = linear regression coefficient for litter size (considered only for WW);

X_n = litter size weaned;

X = overall mean litter size at weaning;

e_{ijklmn} = random error, NID$(0,\sigma^2)$

The statistical significance at $P<0.01$ for each effect, including the significance of the linear regression coefficient was tested by means of F test.

For each level of each source of variance, the least square constants were obtained and used to study the effect of the trait.

RESULTS AND DISCUSSION

Table 1 shows the probability of significance for F values for the analyses of variance for each one of the ten traits analyzed, and Table 2 presents the least squares means for the constraints between sex (males in relation to females) and among seasons (in relation to season four).

From the analysis of Table 1 it can be verified that there was no sex effect on any one of the variables studied. However, from the analysis of the least squares means, the females were always slightly heavier than the males.

Breed effects were not important for almost all the traits analyzed. Only W11, the market weight, was significantly affected by breed, being New Zealand White rabbits 31.0 g (1.45% of the mean of the trait) heavier than Californian ones.

As usually, the year affected all the traits. When analysing data collected along several years, this source of variation has to be always included in the model of analysis.

Parity effects were statistically significant for only for WW. Rabbits born in the 7^{th} parity had a weaning weight 41.9 g higher than the ones born in first parity and 22.1 g higher than those born in second parity. The heaviest WW were observed from parities 4 to 8, decreasing strongly after that. That can show that productivity of does under tropical or subtropical environments can be reduced to 8 parturitions. However, this effects wasn't important to any other traits studied.

The season of the year affected significantly every traits analyzed. The season that considered June, July and August showed heavier animals at weaning than the others. Rabbits born in the season that included March, April, and May, had higher weights after weaning. That maybe can be explained by mild temperatures when animals are growing, within the zone of heat comfort. That shows also that selection can be made trying to find better adapted animals or breeds to the tropics.

Litter size at weaning showed that the weight rabbit weaned decreased when the number of rabbits in the litter increase, affecting the animal performance in the weaning. However, the effect of number of rabbits lodged in the cage was not studied and can be an important source of variation of rabbit performance under tropical conditions, as it is related to heat comfort of animals.

Table 1 : Probability of statistical significance for F values of fixed effects sex, breed, year, parity and season for growth traits of Californian and New Zealand White rabbits

Trait	Sex	Breed	Year	Parity	Season
WW	.277	.599	.0001*	.003*	.0001*
W5	.523	.175	.0001*	.155	.0001*
W6	.371	.398	.0001*	.089	.0012*
W7	.571	.378	.0001*	.490	.0001*
W8	.665	.443	.0001*	.346	.0001*
W9	.439	.480	.0001*	.911	.0001*
W10	.713	.134	.0001*	.597	.0001*
W11	.637	.006*	.0001*	.736	.0001*
WG11	.914	.053	.0001*	.063	.0001*
ADG	.914	.086	.0001*	.062	.0001*

Table 2 : Least squares means constraints for sex (males in relation to females) and season (in relation to season 4) for growth traits of Californian and New Zealand White rabbits

Traits	Sex (males-females)	Season		
		1-4	2-4	3-4
WW	-5.625	-89.004	-57.640	-27.685
W5	-4.295	-74.539	-28.484	-19.498
W6	-7.595	-36.176	7.987	6.594
W7	5.000	-61.282	7.635	-1.230
W8	4.093	-37.887	51.874	16.537
W9	7.712	-32.902	80.821	38.311
W10	3.848	-52.770	77.213	0.377
W11	-5.316	-69.224	94.715	8.048
WG11	-0.995	-1.721	128.073	32.066
ADG	-0.020	-0.035	2.613	0.654

CONCLUSIONS

1-The most important effects analyzed were year and season. Those sources of variation should be always included in any kind of analysis of data that were collected over time;

2-Sex and breed effects were not important as causes of variation in the traits studied;

3-Parity effect was important only for weaning weight;

4-Litter size at weaning affected weight weaning.

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