Proceedings of the

7th World Rabbit Congress

4-7 july **2000** – Valencia Spain

These proceedings were printed as a special issue of WORLD RABBIT SCIENCE, the journal of the World Rabbit Science Association, Volume 8, supplement 1

ISSN reference of this on line version is 2308-1910
(ISSN for all the on-line versions of the proceedings of the successive World Rabbit Congresses)

PONCE DE LEÓN R., GUZMÁN G., QUESADA MAE., MORA M., FEBLES M.

REPRODUCTIVE PERFORMANCE OF FOUR RABBIT BREEDS WITH CONCENTRATE:FORAGE DIETS IN THE SUBTROPICS

Volume A, pages 475-481

REPRODUCTIVE PERFORMANCE OF FOUR RABBIT BREEDS WITH CONCENTRATE:FORAGE DIETS IN THE SUBTROPICS

PONCE DE LEÓN R.*, GUZMÁN G.*, QUESADA MAE., MORA M.*, FEBLES M.***

* Dpto. de Genética, Instituto de Ciencia Animal, Apto. 24 San José de las Lajas, Habana, Cuba. ica @ ceniai.inf.cu
** Empresa Nacional de Ganado Menor. Carr. Stgo. de las Vegas–Rincón km 1½ C. Habana , Cuba

ABSTRACT

Reproductive records produced in 1991, 1995 and 1996 in a genetic unit using concentrate: forage diets were used to study environmental effects and to compare four rabbit breeds: Californian (C), New Zealand White (N), Chinchilla (Ch) and Semigiant White (S). Fixed effects linear models considering breed (1-4), parity (1-9 or more), year (3) and month of service (fertility) or kindling and the interactions: year x month and breed x year were applied to 32,822 records of fertility, 21,088 of litter and mortality traits at birth and at weaning, and 10,284 of individual and litter weight traits at weaning. Effects had significant influence ($P<0.001$) on all traits, except year of service on fertility and year and parity in mortality at birth. The rank of the breeds was: N, S, Ch and C for the majority of the traits, with statistical differences between all means in fertility (70.9; 65.8; 63.8; 62.2% resp.) and in total born. Means for born alive were $6.08^{a} \pm 0.03$; $5.83^{b} \pm 0.03$; $5.61^{b} \pm 0.03$; $5.38^{d} \pm 0.03$ resp., with the same significance scheme in number weaned. First litters had the poorest results without differences with the 9^{th} parity. For birth traits a plateau is found from the second to 8^{th} kindling, while for weaning traits peaks are found around the 5 -6^{th} parity. Summer months mainly affected weaning traits with 10.7% less weaning weight /litter born. These medium size breeds have a very variable reproductive performance, being Semigiant and New Zealand the most promising maternal breeds.

INTRODUCTION

Breed comparisons are scarce in the last 10 years in Europe as more attention is paid to selection programs with specialised lines. However, some attempts are made in not temperate climates to establish breed potentials under different production conditions (Ponce de León 1977,Ferraz et al 1991, Khalil 1993, Ehiobu et al 1997). In Cuba four main breeds are maintained. The New Zealand, California and Chinchilla breeds are world wide spread and their general phenotypical and productive characteristics are well known, although a high variability of performances has been found within these breeds. The Semigiant breed is a Cuban variety of albino rabbits, named by Raichev (1968) according to the average adult weight of the adults (3.6- 4.2 kg). Other general characteristics are a less compact body, narrower head, longer ears and similar adult weight as the New Zealands that have been established in the country for more than 40 years. This " breed" had a national diffusion with maternal and paternal lines (Ponce de León, Ribas, Cervantes 1976,not published) which were integrated in the Elite line in 1988 after three generations of selection for litter size at weaning. Previous reports on this breed appear in Ponce de León (1977) and Ponce de León et al (1989).

The present study has the main objective of comparing these four breeds in a genetic unit with concentrate:forage restricted diets in subtropical conditions. Other environmental factors were also considered to establish more adecuate management policies. Intra breed studies for genetic analysis will be object of future articles.

MATERIALS AND METHODS

Reproductive data produced in 1991, 1995 and 1996 in a genetic unit of the Havana province were used to compare the four main rabbit breeds established in Cuba: California, New Zealand White, Chinchilla and Semigiant White and to study the influence of environmental effects. The four breeds were raised in different open sided buildings of one battery cages and allotted in individual wire cages with metal nests. Management and feeding were similar for all breeds. Each breed was represented by 400 does and 48 bucks with an annual replacement rate of 100-110%. Inbreeding was controlled by rotational matings of four subpopulations of 100 does and 12 bucks. Litter size was recorded at kindling and new services were done 10 –15 days later. Weaning was at 35 days of age, when rabbits were counted, sexed and individually identified and weighted.
The feeding system consisted of a concentrate : forage ration. Rations of 200-220g of pellets per doe were offered daily combined with 300-400 g of graminaes forages of medium to poor quality, although occasionally up to 80% restriction was applied. Pellets contained 17-18% crude protein, 10-11 MJ of digestible energy and 5-11% of crude fiber.

Statistical analysis consisted of fixed effects linear models applying SAS GLM procedures (1996) that considered breed (1-4), parity (1-9), year (1-3) and month of service(fertility) or of kindling, as the main effects and the year x month and breed x year interactions. Three groups of traits were analyzed taking into account different number of observations and environmental effects:

- Fertility –considered as a categorical trait (kindlingsx100/services)
- Prolificacy–mortality traits: Total born, born alive, number weaned, mortality at birth and at weaning, percentage of weaned litters.
- Traits measured in weaned litters: no. weaned, litter and individual average weight.

The number of observations per breed and group of traits are shown in table 1. All breed x year x month cells were well represented for breed comparison.

Table 1. Number of observations per breed and trait group

breed	fertility	prolificacy	weights
california	9071	5713	2550
semigiant	5690	3810	1955
chinchilla	8161	4626	2421
New Zealand	9944	6939	5352
total	32822	21088	10284

RESULTS AND DISCUSSION

General statistics are presented in table 2. High variation coefficients are found for all traits as also found by Afifi et al (1992) and Khalil (1993). Low prolificacy and high mortality characterize the preweaning performance in this production system as well as in other subtropical and tropical studies (Ferraz et al 1991, Khalil 1993, Ehiobu et al 1997).

For fertility , fluctuations were between 74-77% in a previous evaluation of breeds in 1978-1986 (Ponce de León et al 1989) . The present lower results are due to nutritional stress during the years of economical restrictions that are covered in his study and that affected the production system as a whole. Mortality at birth is very low with respect to the 6-10% found in literature (Ponce de León 1977). Total born and born alive are in the range of what is reported for the same enterprise between 1978 and 1986, but a marked decrease was found in the number weaned since it was previously around 3.5- 3.8 (Ponce de León 1989).

TABLE 2. Statistics for preweaning traits of purebred rabbits in the tropics

traits	GENERAL MEAN	SD	COEFFICIENT of VARIATION (%)
fertility (%)	0.665	0.466	70.2
born litters			
total born(no)	5.81	1.77	30.4
born alive(no)	5.66	1.82	32.2
mort.birth(%)	2.58	10.2	395.9
mort. wean.(%)	50.7	38.1	75.1
Weaned lit.(%)	67.0	45.O	67.9
no. weaned	2.84	2.27	79.8
weaned litters			
no. weaned	4.40	1.53	34.9
litter weight(g)	2519	904	35.9
indiv. weight(g)	583	124	21.3

All the factors studied had significant effect (P<0.001) on preweaning traits, except year of service on fertility and year of kindling and parity on mortality at birth. Interactions with the breed present low partial determination coefficients compared to those of the main effects for fertility and prolificacy traits measured at birth. However, more important contribution of the interactions are present at weaning time and will be discussed later.

Table 3. breed effects in preweaning traits

traits	california	semigiant	chinchilla	n. zealand
fertility (%)	62.2^{d} 0.5	$65.8^{b} \pm 0.7$	$63.8^{c} \pm 0.6$	$70.9^{a} \pm 0.8$
born litters				
total born(no)	$5.38^{c} \pm 0.03$	$5.83^{ab} \pm 0.03$	$5.70^{b} \pm 0.03$	$6.08^{a} \pm 0.03$
born alive(no)	$5.28^{c} \pm 0.03$	$5.68^{b} \pm 0.03$	$5.61^{b} \pm 0.03$	$5.86^{a} \pm 0.03$
mort.birth(%)	$1.90^{a} \pm 0.16$	$2.48^{b} \pm 0.20$	$1.51^{a} \pm 0.19$	$3.51^{c} \pm 0.17$
mort. wean.(%)	$53.4^{c} \pm 0.6$	$54.5^{c} \pm 0.7$	$51.1^{b} \pm 0.7$	$48.8^{a} \pm 0.6$
Weaned lit.(%)	$62.3^{b} \pm 0.7$	$62.9^{b} \pm 0.9$	$68.8^{a} \pm 0.8$	$68.5^{a} \pm 0.8$
no. weaned	$2.52^{c} \pm 0.04$	$2.68^{b} \pm 0.04$	$2.75^{b} \pm 0.04$	$3.00^{a} \pm 0.04$
weaned litters				
no. weaned	$4.02^{c} \pm 0.04$	$4.23^{b} \pm 0.05$	$4.17^{b} \pm 0.04$	$4.41^{a} \pm 0.04$
litter weight(g)	$2239^{c} \pm 24$	$2337^{b} \pm 29$	$2272^{bc} \pm 24$	$2615^{a} \pm 25$
indiv.ave. weight	$569^{b} \pm 3$	$564^{b} \pm 4$	$554^{c} \pm 3$	$605^{a} \pm 3$

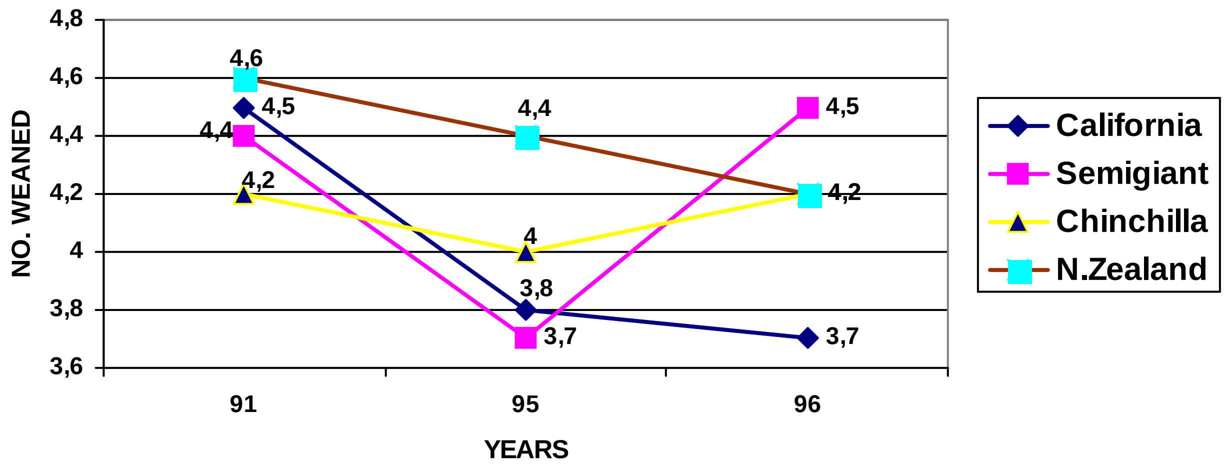
abc Means with different supersripts differ at P<0.05

Breed effects are shown in table 3. All breeds differ at P< 0.05 in fertility with an advantage for N, followed by S, while C breed had the worst performance with a total range of 9%. Prolificacy traits present the same pattern of performance, with NZ and C at extreme values and S and Ch were intermediate. N was better for total born not differing from S, but for born alive and number weaned S did not differ from Chinchilla. There was less mortality and more percentage of weaned litters in N and Ch than in S and California breeds. For litter size in weaned litters the breeds ranked approximately the same as for litter size / litters born. For litter weight, however the scheme change in that California did not differ from Chinchilla as individual average weight of the latter was the poorest.

Despite its interactions with the breed, the main effect of the year was clearly expressed by advantages for the first year of the study, that were in the range of 18 to 30 % for the different traits in contrast to the last two years affected by extreme economical constraints. Breed by year interaction in number weaned is shown in figure 1. N and C had a sustained declining trend, Ch was stable, while the S breed showed a marked recovery in the last year.

In annual bulletins (1978 to 1986) on rabbit production in the Havana Province, summarized by Ponce de León (1989), the relative inferiority of C with respect to other six breeds for fertility, litter size at birth and at weaning was evidenciated. One of the Semigiant lines excelled the Ch and N breeds in preweaning performance. In this same report the Elite line of Semigiant (1986-8) presented advantage of 0.7 and 1.4 born alive above the mean of

BREED BY YEAR INTERACTION IN NUMBER WEANED



the other breeds after the second and third generation of selection. However, a true comparison is not possible, as all breeds were not kept in the same unit. Up to the present study only the experimental breed comparison of Ponce de León (1977) is available, in which no differences among pure breeds were found, except in litter weight in favour of Semigiants.

Comparable prolificacy performances of N and C breeds are reported by most tropical and American authors. Nofal et al (1996), Flores et al (1998) and Ferraz et al (1991) encountered no differences between C and N in most reproductive traits, although in the latter, C had higher litter weaning weight. This is in line with Mc Nitt & Lukefahr (1990) showing more milk production in Californians. Evaluating also the Chinchilla breed, Flores et al (1998) found advantages of this breed over the C and N breeds which did not differ between them. Only Khalil (1993) reported in a non comparative study higher reproductive performance of N than in the C breed as in the present work.

Seasonal effects for representative preweaning traits are shown in table 4. Summer months (June, July, August) and surprisingly, November, were below the mean in fertility. For prolificacy traits at birth a trend to decline throughout the year was found with a range between the best and worst months of only 10 %. Seasonal effects are more conspicuous at weaning with the poorest results in June-July and below mean values between March to August. Number weaned decreased in a 32 % from January to June-July and was stabilized later at 2.6-2.8 kids .

Heat stress in the tropics had lead to analyse the usefulness of stopping services (Ehiobu et al 1997), during summer time. In our study 19.5% of the kindlings occurred in this period, with 10.7% less weaning weight/kindling and the need of 4.6% more services /kindling. However, a 17% of the production would be lost if this practice is applied, so it is not recommended for large commercial units, but in any case, for small producers when doing replacements and general sanitary activities.

TABLE 4 . EFFECTS OF MONTH OF SERVICE (FERTILITY) OR OF KINDLING ON PREWEANING TRAITS IN RABBITS.

MONTHS	FERTILITY (%)	BORN ALIVE (NO)	No.WEANED (NO)	LITTER WEIGHT(g)
JAN	71.8^{a} ±0.8	5.87^{a} ±0.05	3.4^{a}±0.06	2726^{a} ±43
FEB	64.7^{d} ±0.9	5.77^{ab}±0.05	3.1^{b}±0.06	2476^{c} ±50
MAR	68.0^{bc}±0.9	5.86^{a} ±0.05	2.8^{c}±0.06	2533^{bc}±43
ABR	69.6^{ab} ±0.9	5.78^{ab}±0.05	2.7^{cd}±0.06	2436^{cd}±40
MAY	67.0^{cd} ±0.8	5.74^{b} ±0.05	2.6±^{d}0.06	2325^{e} ±33
JUN	61.6^{e} ±0.9	5.70^{b} ±0.04	2.3^{e}±0.05	2229^{fg}±34
JUL	60.8^{e} ±0.9	5.57^{c} ±0.05	2.3^{e}±0.06	2046^{g} ±35
AUG	65.3^{cd} ±1.2	5.55^{c} ±0.05	2.7^{d}±0.07	2287^{ef}±37
SEP	66.2^{cd} ±1.2	5.44^{cd}±0.05	2.8^{c}±0.06	2234^{fg}±35
OCT	66.0^{cd} ±1.0	5.38^{d} ±0.05	2.6^{d}±0.06	2117^{g} ±37
NOV	58.9^{e} ±1.2	5.30^{d} ±0.05	2.7^{cd}±0.07	2355^{de}±39
DIC	67.3^{cD} ±0.9	5.37^{d} ±0.06	2.8^{c}±0.07	2624^{ab}±46

abc Means with different supersripts differ at P<0.05

TABLE 5. EFFECT OF PARITY IN PREWEANING TRAITS OF purebred RABBITS in the tropics

PARITY	BORN ALIVE (NO)	WEANED LITTERS (%)	WEANED (NO)	LITTER WEIGHT(g)
1	5.46^{b} ±0.03	62.0^{c} ±0.6	2.55^{d} ±0.07	2293^{c} ±20
2	5.67^{a} ±0.03	63.8^{be} ±0.7	2.75^{bc} ±0.03	2414^{b} ±22
3	5.65^{a} ±0.03	65.2^{abe}±0.8	2.74^{bc} ±0.04	2412^{b} ±24
4	5.72^{a} ±0.04	64.6^{be} ±0.9	2.69^{be} ±0.04	2393^{b} ±28
5	5.62^{a} ±0.05	68.0^{a} ±1.2	2.91^{a} ±0.05	2489^{a} ±33
6	5.59^{ab}±0.06	68.2^{a} ±1.5	2.80^{ab} ±0.06	2337^{bc} ±41
7	5.65^{a}± 0.07	64.9^{abe}±1.8	2.66^{bce}±0.07	2407^{b} ±53
8	5.72^{a} ±0.09	69.1^{ab} ±2.3	2.91^{ac} ±0.09	2405^{abc}±64
9	5.50^{ab}±0.11	60.6^{ce} ±2.8	2.44^{de} ±0.11	2250^{abc}±82

abc Means with different supersripts differ at P<0.05

First parity (table 5) showed the poorest results with no differences with the 9th for all preweaning traits. For total born and born alive a plateau is found between the second to 8th parity, while for weaning traits the effect is more conspicuous with peaks around the 5 -6th parity for prolificacy traits and at the 5th kindling for litter weight , although relative acceptable performance is obtained up to the 8th parity. The inferiority of first litters is also reported by Ferraz et al (1991) and Nofal et al (1996), although Khalil (1993) reports no influence of parity in Egyptian conditions. As recommended by Ferraz et al (1991) the replacements will be more necessary around the 8th parity, which would correspond to 1.3 to 1.4 years of productive life in our conditions.

From here it can be concluded that these medium size rabbit breeds considered have a very variable reproductive performance under our environmental conditions. The Semigiant breed and New Zealand White are the most promising maternal breeds, taking into account productive results and population size.

REFERENCES

AFIFI EA., YAMANI KA., MARAI IFM., EL MAGHAWRY. 1992: Environmental and genetic aspects of litter traits in New Zealand rabbits under Egyptian conditions. *J. Applied Rabbit Res*. **15**:335-351

EHIOBU NG., UTIM A., GWAZA SD. 1997: Some observations on reproductive performance of rabbits obtained in semi-humid tropical conditions in Nigeria. *World Rabbit Science* **5**:47-49.

FERRAZ JBS., JOHNSON RK., ELER JP. 1991: Breed and environmental effects on reproductive traits of Californian and New Zealand White rabbits. *J. Applied Rabbit Res*. **14**:172-179.

FLORES M. ZAMORA M.M., GUEVARA J. 1998: Seasonal effects on reproductive performance in Mexican Altiplane on three breeds of rabbits. *Memoria Primer Congreso de las Américas G26-29, Montecillo, Mexico.*

KHALIL MH. 1993: Diversity of repeatability between parities for litter traits and reproductive intervals in doe rabbits. *World Rabbit Science* **1**:147-154.

MCNITT JI., LUKEFAHR SD. 1990: Effect of breed, party, day of lactation and number of kids on milk production on rabbits. *J. Anim. Sci*. **68**:1505-1512.

NOFAL RY.,TOTH S., VIRAG GY. 1996: Evaluation of seven breed group of rabbits for litter traits. *6th World Rabbit Congress. Toulouse*. **Vol 2**:335-340.

PONCE DE LEÓN R. 1977: Fuentes genéticas de variación y heterosis de caracteres maternos en cruces simples, triples y de cuatro razas de conejos. *Tesis de Doctorado en Ciencias Veterinarias.Inst. Ciencia Animal. 328 pp.*

PONCE DE LEÓN R. 1989: Recuento del trabajo genético de la Cunicultura Cubana. *En Investigaciones sobre el mejoramiento genético del conejo. pag 69-86. EDICA, La Habana.*

PONCE DE LEÓN R.,GUZMÁN G., PEREZ B., MORA M., CERVANTES L.1989: Heredabilidades y tendencias genéticas y ambientales en el crecimiento posdestete de conejos. *En Investigaciones sobre el mejoramiento genético del conejo. pag 145-156. EDICA, La Habana.*

RAICHEV B.1968. Informe al Plan Cunícula Nacional. *Mimeo 41 pp. Min. Agricultura. La Habana.*