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REPRODUCTIVE CHARACTERS IN CROSSBREEDING AMONG THREE MATERNAL LINES OF RABBITS[*].

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ABSTRACT

The Department of Animal Science of the Polytechnic University in Valencia, has been selecting three lines of rabbits, line A, H and V on litter size. These lines are crossed to produce the crossbred does, which are the productive females in many Spanish production farms. The aim of this paper is to know the reproductive performance of nine types of does, three purebred females (AA, VV and HH) and six crossbred females (AH, AV, HA, HV, VA, VH). The heterosis in the crosses AH and AV was 7.3% and 6.4% for total litter size at birth and 10.4% and 7.4% for number of born alive, all of them significant. The effect of the reciprocal cross was always no significant. The line H, recently originated, could be used like another maternal line for producing the crossbred female.

INTRODUCTION

The production scheme for genetic gain diffusion in rabbits are based on three way cross (Baselga y Blasco, 1989). Two maternal lines, selected for reproductive characters, are crossed in order to produce the crossbred does, which will be the productive females in the commercial farms. Males of line selected for growth characters mate to crossbred females, and the offspring will be the slaughter rabbits.

The first cross is justified for the heterosis effect of the reproductive characters (Brun et al, 1998) and the second one for the complementary effect in growth traits (Brun and Ouhayoun, 1990).

Crossbreeding researches allow estimation of genetic parameters like additive genetic effects and direct or maternal heterosis. With this estimation, it is possible to understand the most important components of the cross. Nevertheless, the results are valid for the environmental condition of the experiment and the crossbreeding parameters may evolve when the lines are selected. So, it may be useful to repeat, from time to time, this kind of experiment (Rouvier and Brun, 1990).

In Spain, the crossbred females, obtained from lines A and V (Baselga et al, 1984 and Estany et al, 1989) are very spread in the meat production farms (Torres et al, 1997).

Line H is a maternal line, recently originated according to a prolific criterion. It is interesting to know the performance of this line in the crossbreeding schemes. The purpose of the present research is to study the reproductive characters in all types of purebred and crossbred females with lines A, H and V and the direction of the cross more adequate.

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MATERIAL AND METHODS

Three lines of rabbit were used in the experiment:

- Line A is selected since 1980 on litter size at weaning with a family index (Baselga et al, 1984).
- Line H is selected since 1996 on number of born alive with a BLUP under a repeatability animal model (Cifre, 1997).
- Line V is selected since 1982 on litter size at weaning with a BLUP under a repeatability animal model (Estany et al, 1989).

Nine types of does were controlled: three purebreed does (AA, HH and VV) and six crossbreed does (AH, AV, HA, HV, VA, VH), indicating the first letter the line of the sire and the second one shows the line of the dam. For example, type of doe, AH, is a crossbreed female with sire of line A and dam of line H (see Table 1). The females came from 40, 41 and 48 dams of lines A, H and V, respectively, and from 31, 37 and 25 sires of lines A, H, and V, respectively (Table 1).

A number of 730 females were breed in a commercial farm from January 1998 to September 1999. All the females were born in the farm. The first artificial insemination was about 17 weeks of age. The females were inseminated with pooled semen of line R selected for postweaning daily gain (Estany et al, 1992).The interval kindling-mating was 11 days. Total litter size at birth (TB) and number of born alive (BA) were controlled in 3 parities per female, approximately.

The following mixed model was applied:

$Y_{ijklm} = \mu\mu + Td_i + Ys_j + Ps_k + pe_{ijkl} + a_{ijkl} + e_{ijklm}$ where,

- $\mu\mu$ is the population mean.
- Td_i is the type of doe, fixed effect with 9 levels.
- Ys_j is the fixed effect farm-year-season with 5 levels.
- Ps_k is the physiological state of the doe(includes parity orders and lactation state).
- pe_{ijklm} is the permanent non additive effect of the doe (random).
- a_{ijklm} is the additive value of the doe (random).

All the models have been solved using the PEST software package (Groeneveld, 1990). The variance component ratios needed to solve the models have been taken from Gómez (1994).

Linear contrasts were used to estimated the direct additive effect ($g^0_I - g^0_J$), direct heterotic (h_{IJ}) and reciprocal effects (r_{ij}):

$$g^0_I - g^0_j = LS_{II} - LS_{JJ} - LS_{JI} + LS_{IJ}$$

$$h_{IJ} = 0.5 (LS_{IJ} + LS_{JI} - LS_{II} - LS_{JJ})$$

$$r_{IJ} = 0.5 (LS_{IJ} - LS_{JI})$$

where, LS_{II} is the estimated least square mean of the purebred doe I and LS_{IJ} the least square mean for the crossbred doe IJ.

I,J = A; H and V.

The interpretation of these effects is realised with the Dikerson´s model (1969).

Table 1.- Number of dams, sires and purebreed and crossbred females .

DAM / SIRE	A	H	V
	40	41	48
A	AA	AH	AV
31	72	101	110
H	HA	HH	HV
27	89	60	86
V	VA	VH	VV
25	75	77	60

RESULTS AND DISCUSSION

A number of 2384 litters were controlled (Table 2). The does VV and HH have higher litter size at birth than does AA, but only the differences between direct additive effects of does AA and VV for total born were significant (Table 4).

The crossbred females show litter size at birth higher than does AA and HH, and higher or similar than does VV. Previous researches of these females reported litter sizes at birth around 10.4 total born and 9.6 born alive for females VV, HH and AV being the comparison between them favourable to HH(Cifre et al, 1998).

Table 2.- Number of records (N.REC) and least square means and standard errors for total litter size at birth (TB) and number of born alive (BA).

DOES	N.REC	TB	BA
AA	198	9.46 ±± 0.30	8.59 ±± 0.36
AH	317	10.70 ±± 0.24	9.99 ±± 0.31
AV	395	10.70 ±± 0.26	9.88 ±± 0.32
HA	306	10.46 ±± 0.25	9.84 ±± 0.30
HH	168	10.26 ±± 0.32	9.38 ±± 0.38
HV	268	10.70 ±± 0.28	9.65 ±± 0.33
VA	254	10.63 ±± 0.23	9.84 ±± 0.30
VH	249	10.53 ±± 0.26	9.66 ±± 0.31
VV	229	10.58 ±± 0.29	9.77 ±± 0.35

The differences between females A and females H are showed in Table 3. The heterosis was significant for total litter size and number of born alive. The heterosis percentage was 7.3% and 10.4% for both traits, respectively. Nevertheless, it is possible to use the females AH and HA, indistinctly, because, the reciprocal cross effect is not significant.

With respect to the comparison between females A and females V. The direct additive effect is favourable to line V for total litter born in 1.04 ±± 0.52 young rabbits (Table 4). The heterotis are 0.65 ±± 0.24 and 0.68 ±± 0.28 for total and alive rabbits at birth. These values represent a heterosis of 6.4% and 7.4% . Again, the direction of the cross, when lines A and V are involved, is not significant.

None of the studied effects were significant when lines V and H take part in the cross

(Table 5), but results of Cifre et al.(1998), commented above reported significant differences between both lines favouring line H.

In France, the maternal lines, 2066 and 1077, have been selected on litter size. The strains are used in crossbreeding to produce the female 1067. Brun and Saleil (1994) showed for this cross that heterosis was 15.2%, 20.1% and 6.7% for total number of young rabbits born, number of young rabbits born alive and number of young rabbits weaned. The heterosis was higher than the values obtained in our crossbreeding experiment.

The crossbred doe, coming from the cross between line V and 2066, has been studied by Brun et al (1998). The heterosis was 13.6% for total litter born and 20.7% for number of born alive.

Khalil et al (1995) estimate heterosis percentages for total litter size, number of born alive and number of weaned equal to –2.0%, -3.8% and 6.9%, respectively, when New Zealand breed and Baladi Red breed are crossed.

The new maternal line, H, could participate in the cross with line A, because this cross exhibit an important heterosis and performances similar to the cross between lines A and V. So, the use of a crossbred doe coming from any of these lines, mated to a terminal sire, is suggested.

Table 3.- Estimates in lines A and H of direct additive effect (g^0_A - g^0_H), direct heterotic effect (h_{AH}) and reciprocal effect (r_{AH}) for total litter size (TB) and number of born alive (BA).

CHARACTER	$g^0_A - g^0_H$	h_{AH} (%)	r_{AH}
TB	-0.56 ±± 0.54	0.72* ±± 0.24 (7.3%)	0.12 ±± 0.17
BA	-0.63 ±± 0.65	0.93* ±± 0.28 (10.4%)	0.08 ±± 0.20

*****P<0.05%.

Table 4.- Estimates in lines A and V of direct additive effect (g^0_A - g^0_V), direct heterotic effect (h_{AV}) and reciprocal effect (r_{AV}) for total litter size (TB) and number of born alive (BA).

CHARACTER	$g^0_A - g^0_V$	h_{AV}(%)	r_{AV}
TB	-1.04* ±± 0.52	0.65* ±± 0.24(6.4%)	0.04 ±± 0.17
BA	-1.14 ±± 0.63	0.68* ±± 0.28(7.4%)	0.02 ±± 0.20

*****P<0.05%.

Table 5.- Estimates in lines V and H of direct additive effect (g^0_V - g^0_H), direct heterotic effect (h_{VH}) and reciprocal effect (r_{VH}) for total litter size (TB) and number of born alive (BA).

CHARACTER	g^0_V - g^0_H	h_{VH}(%)	r_{VH}
TB	0.15 ±± 0.54	0.20 ±± 0.24 (1.9%)	-0.09 ±± 0.18
BA	0.40 ±± 0.65	0.08 ±± 0.29 (0.8%)	0.01 ±± 0.21

*****P<0.05%.

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