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THE PRODUCTIVE EFFICIENCY OF LITTERS DERIVING FROM DIFFERENT GENOTYPES

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Abstract

The productive efficiency (P.E.) in rabbits of different genotype, offsprings of single and heterospermic artificial insemination (A.I.) is considered. 1441 animals from 338 births were carried out in 6 months, using New Zealand White dams (n=129), 20 bucks of 4 breeds (New Zealand White, Californian, Burgundy Fawn and Carmagnola Grey). As far as the productive efficiency was concerned, daily weight gains (DWG) and weights (W) at 21-35-77-88 days were analyzed, considering litter size as Covariate.
The analysis showed the following results: 1) the W at the considered ages was influenced by litter size and buck genotype ($p<=0.001$): on the contrary, it wasn't influenced by parity; 2) the DWG at different period was influenced by buck genotype ($p<=0.05$): on the contrary, litter size was very important only in the first growth period; 3) the DWG and W at various ages were different in the analysis within single and heterospermic insemination groups ($p<=0.001$); 4) single insemination groups were homogeneus and showed a better P.E.; 5) high statistically significant differences ($p<=0.001$) between offsprings born from single and heterospermic A.I. were found for weights at 21-77-88 days of age; 6) low statistically significant difference ($p<=0.05$) between offsprings born from single and heterospermic A.I. was found for DWG (21-88 days); 7) a regression analysis between litters size, corrected by genotype, and productive parameters showed that, if the litter size increases, DWG and W, at different periods and ages, decrease.

Introduction

Very often in industrial rabbit breeding genotypes are used which are less and less assimilated with breeds traditionally used; in fact, Italy, which does not produce its own real commercial hybrids, is in debt to other countries as regards this particular type of selection, which uses allochthonous *germoplasma* in the Italian breeding situation . At the same time the ever more common commercial hybrid has brought to light certain problems concerning the conservation of animal auchthonous *germoplasma*; in fact the smaller breeds, perhaps because they are little known or developed, are often of less interest and less bred in current zootechnics. For the research purposes the male productive efficiency was evaluated with focus upon a recently reconstituted breed, the Carmagnola Grey. For certain of its characteristics this breed could be an interesting object of study, not only of marginal importance for breeding, but also, once known and appraised, of importance on a national scale for eventual selective programmes involving the breeding of commercial hybrids (23-28).

Materials and Methods

The breeding conditions in which the experiment took place have characteristics in common with intensive industrial ones. The principal microclimatic components (T, UR, ventilation, illumination) are to be considered unlistable in the range of average values suggested by the bibliography (9); the rabbits were housed in pyramidal cages of three floors with 2 rabbits to each cage. The does (n=129) at the beginning of the study, were all primiparous and New Zealand White. Over 6 months, 160 heterospemic and 178 single doses were administered. As far as possible the most balanced possible distribution was made in order to adequately represent the various genotypes. In the course of the study the reproductive rate scheduled the first covering of the does at 11 days after birth (semi-intensive rate). The does were inseminated, using standardized techniques, always in the morning (between 9 and 11) using the semen of the 4 breeds under study and/or mixing the semen in heterospermic doses containing equal amounts of semen (50%/50%) similar to each other for quali-quantitative characteristics and, in particular, the best ejaculate was used. The ejaculate, diluted 1:8 with mestruo Tris-Buffer was used for insemination in doses of 0.8 ml; subject to administration to the doe of 0.2 ml of synthetic hormone (Receptal/Hoechst) at the moment of fertilization, to induce ovulation (1-2-3-4-5-6-7-8-10-13-14-16-22-24-25-26). There were 1,441 rabbits used in the study, derived from 338 births from 20 males of 4 breeds and their relative crosses: New Zealand White (B), Californian (C), Burgundy Fawn (F) and Carmagnola Grey (G). All the rabbits born were ear-tagged and the following parameters were assessed: **a)** the number of live births (LS), b) the number of live births/buck genotype (LS/BG), c) litter size at 21-35-77-88 days (D) and **d)** individual weights at 21-35-77-88 days (W). Eventual differences between the parameters were evaluated: number of live births (NLB), daily weight gain and (DWG) and the body weights (W) at the 4 ages considered, using the Analysis of Variance as a linear model (GLM -27) with the litter size as Covariate. Also evaluated was the regression coefficient between litter size and body weight, as with the DWG (11-12-15-17-18-19-20-21). The reperted values, as with the analysis, refer to least squares means where not differently

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indicated; further, the figures, where necessary, were adjusted according to parity.

Results and Discussion

Analysis of the data collected produced the following results: 1) Table 1 - indicates the values of the regression coefficient calculated on litter size in relation to weights and daily weight gains at the various ages and period considered. 2) Table 2 and 3 - indicate the levels of statistical significance regarding the ages and periods of most zootechnical interest, obtained by statistical analysis (GLM), for all genotypes and inseminations (single and heterospermic) in relation to the weights and daily weight gains. 3) Histogram no. 1 - shows weight progression, at the four ages considered in the study, of the rabbits obtained from single and heterospermic doses. 4) Histogram no. 2 - shows the daily weight gains in the various periods considered, for the two groups. 5) Histogram no. 3 - shows for each genotype, the mortality rate for the entire survey period (21-88 days) and also the mortality rate for weaning period (35-88 days).

The results lead to the following main observations:

A) At 21 days the development of the kit is almost entirely attributable to maternal behaviour. The group studied, perhaps because over handled as necessitated by the requirements of the study, (individual weekly weighings) does not good performance; in fact the approximately g 300 reached at this age is not particularly productive. Further it should be noted that the circa g 730 reached at 35 days old weights recorded one week after weaning, indicate that the group studied is to be regarded as sufficiently valid. The weight reached at 77 days, g 2100 circa, is not very high, while that at slaughter (g 2450) is quite comparable to the national average, and meets the demands of the Italian market. B) The daily weight gain should be read with particular attention paid to the 21-88 days period, in so far as the values found, for example for 21-35 days may have been influenced by the typical crisis which affects kits at 21 days and/or weaning stress (28 days), and also by additional stress of the first post-weaning days. C) The losses of kits in the course of the study have resulted important. There may be several reasons, related to the conditions of both the animal and its housing. Clearly, birth-weaning mortality is concentrated in the first two weeks of kindling but it should also be remembered that there is a return to mortality in the fourth week, a period covered by this study. The values of mortality for the fattening period (from day 35 on) are still important, but less so. D) The high values of statistic significance shown for the weights and for the daily body weight gains at the ages and periods analysed, correspond to genetic type and litter size, while parity is never statistically significant. E) The two groups are different from each other only when the weight at 35 days and the daily weight gain between 21-35 and 35-77 days is considered. Litter size is statistically significant except when the daily weight gain is evaluated over the entire period. Parity shows as statistically significant for weight at 35 and 77 days., while for daily weight gain only in the period 35-77 days. F) The regression calculated on litter size in relation to body weights and the daily weight gains has shown a tendency towards a reduction of the values found, with an increase in litter size.

Conclusion

The aim of the study was principally to check the productive efficiency in breeding where all reproduction was by means of artificial insemination; in particular to check if the use of heterospermic artificial insemination, a common practice in breeding, could result an influencing factor. The study, which was undertaken on a representative group, has brought up the following points:
1) Litter size is not very big, but it should be remembered that the females used were primiparous; the litters born from heterospermic insemination are however, on average bigger. 2) A superiority of the progeny obtained through heterospermic insemination is shown both at 21 days and at 35 days; the differences are not statistically significant, but the trend should be noted. It is further shown that for each group the handling (weekly individual weighings) may have been disturbance factor that should not be under-estimated. 2.1) An inversion of the tendency is shown when at slaughter (88 days) the kits from monospermic doses are heavier than those in the other group. It should be noted that this difference, even if "small" is shown up in the final 11 days of the study period, the weights of the two groups on day 77 resulting to be practically the same and with the same standard error. 3) The daily weight gain, both for the entire period of the study as for the fattening period, shows higher values for the monospermic progeny; also here it should be noted that the average values found are certainly not exceptional (daily weight gain g 32), perhaps also because of the frequent handling that the rabbits underwent during the study period. 4) The mortality rate was greatly conditioned by several factors, relating to managerial decisions and uncontrollable conditions. 4.1) In the final analysis there is notably a lower mortality rate in the litters born from heterospermic insemination; this is clear both when considering both the entire experimental period (21-88 days) and the fattening period. The major difference shows up in the mortality rate in the 4th and 5th weeks of life, which show that litters born from single doses are smaller in both number and weight at 21 days. If on the one hand the smaller size of the litter could give the kits advantages (more milk to each kit) in the rabbits studied the most numerous litters are also the heaviest at 21 days. Not

knowing birthweight means that it is impossible to say if underweight newborn kits could be an influencing factor.

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Tab. 1 Regression coefficient between Weights (W), Daily Weight Gains (DWG) at different ages and periods considered and the Litter Size (all the values are in grams) [*].

W at 21 days	W at 35 days	W at 77 days	W at 88 days	DWG 21-88days	DWG 35-77days
- 28.3	- 51.2	- 97.2	- 62.1	- 0.45	- 1.04

[*] For each live born, Weights and Daily Weight Gains decrease on showed figures.

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Tab. 2 Least Square Means and *Standard Error* of Weights (W) and Daily Weight Gains (DWG) at ages and periods considered by Inseminations (single and heterospermic) and Parity (all the values are in grams).

Genotype	N	W 21	W 35	W 77	W 88	DWG 1	DWG 2	DWG 3	DWG 4
TOT. SIN.	693	298 *2.93*	714 *6.18*	2109 *12.93*	2469 *14.18*	32.4 *0.20*	29.6 *0.33*	33.2 *0.27*	31.5 *0.81*
TOT. HET.	748	306 *3.37*	756 *7.14*	2082 *14.72*	2434 *15.99*	31.7 *0.22*	32.1 *0.38*	31.6 *0.31*	30.7 *0.91*
Parity									
1	804	303 *2.31*	716 *4.88*	2071 *10.22*	2434 *11.00*	31.8 *0.15*	29.4 *0.26*	32.1 *0.21*	32.6 *0.62*
2	637	301 *4.06*	754 *8.59*	2120 *17.58*	2469 *19.28*	32.4 *0.27*	32.3 *0.45*	32.6 *0.37*	32.4 *0.27*

TOT. SIN. = Total single – TOT. HET. = Total heterospermic

Tab. 3 Least Square Means and *Standard Error* of Weights (W) and Daily Weight Gains (DWG) at ages and periods considered by Genotype and uParity (all the values are in grams).

Genotype	N	W 21	W 35	W 77	W 88	DWG 1	DWG 2	DWG 3	DWG 4
B	199	294 *3.46*	705 *8.82*	2010 *22.56*	2318 *24.96*	30.2 *0.35*	29.1 *0.50*	31.1 *0.49*	26.6 *1.45*
C	140	342 *4.76*	715 *11.66*	1978 *29.90*	2362 *32.82*	30.2 *0.47*	26.6 *0.66*	30.2 *0.65*	32.6 *1.95*
F	190	299 *3.05*	743 *7.51*	2229 *18.05*	2649 *20.57*	35.0 *0.29*	31.7 *0.43*	34.9 *0.39*	35.1 *1.21*
G	164	289 *3.33*	727 *8.36*	2193 *21.96*	2593 *25.18*	34.3 *0.36*	31.1 *0.47*	34.8 *0.48*	34.5 *1.48*
BC	113	298 *4.78*	717 *11.76*	1877 *28.88*	2266 *31.83*	29.4 *0.45*	29.9 *0.67*	27.5 *0.63*	33.0 *1.87*
BF	123	322 *4.13*	788 *10.17*	2195 *24.74*	2528 *26.85*	32.9 *0.38*	32.3 *0.58*	33.3 *0.54*	29.0 *1.58*
BG	85	307 *5.13*	755 *12.71*	1996 *31.20*	2385 *34.06*	31.1 *0.48*	32.0 *0.72*	29.6 *0.68*	34.4 *2.00*
CF	137	316 *3.95*	761 *9.81*	2068 *26.13*	2479 *30.45*	32.3 *0.43*	31.6 *0.56*	31.0 0.57	33.6 *1.79*
CG	134	302 *3.67*	731 *9.03*	2002 *21.32*	2314 *22.99*	30.1 *0.33*	30.6 *0.51*	30.2 *0.46*	27.0 *1.35*
FG	156	290 *4.18*	756 *10.46*	2084 *27.04*	2515 *29.88*	33.3 *0.42*	33.2 *0.59*	31.7 *0.59*	38.0 *1.76*
Parity									
1	804	313 *3.58*	745 *9.01*	2151 *22.59*	2493 *25.40*	32.4 *0.36*	30.8 *0.51*	33.2 *0.49*	30.8 *1.50*
2	637	299 *5.54*	735 *13.84*	1975 *34.36*	2389 *39.09*	31.3 *0.56*	31.0 *0.79*	29.6 *0.75*	34.1 *2.30*

N = Number of observat.
Parity 1 = Does primip.
Parity 2 = Does multip.

DWG1 = Daily Weight Gain at 21-88 days
DWG2 = " " " at 21-35 days
DWG3 = " " " at 35-77 days
DWG4 = " " " at 77-88 days

W 21 = Weight at 21 days
W 35 = " at 35 days
W 77 = Weight at 77 days
W 88 = " at 88 days

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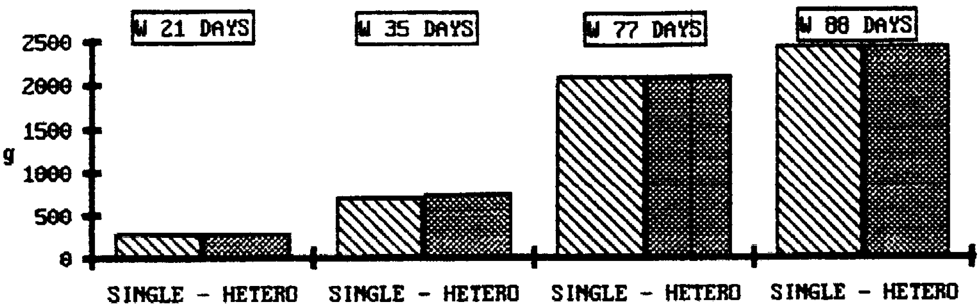
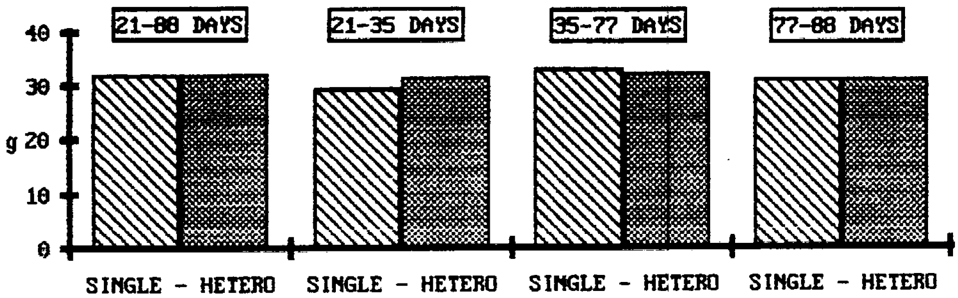
Graph 1

WEIGHTS AT 21-35-77-88 DAYS BY SINGLE AND HETEROSPERMIC INSEMINATIONS



Graph 2

DAILY WEIGHT GAINS AT CONSIDERED PERIODS BY SINGLE AND HETEROSPERMIC INSEMINATIONS



Graph 3

MORTALITY BETWEEN 21-88 AND 35-88 DAYS BY GENOTYPE