

COMPARISON OF GROWTH TRAITS IN TERMINAL CROSSES OF DIFFERENT RABBIT COMMERCIAL HYBRIDS

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ABSTRACT

An experimental trial was carried out on three commercial rabbit farms (A, B and C) by evaluating the growth traits of terminal crosses obtained from both bucks of different genetic level of a new Italian synthetic line and two different commercial hybrids. A total no. 230 does (82, 80 and 68 in A, B and C farms, respectively) were artificially inseminated simultaneously on the same season (i.e., autumn) using semen from bucks of a new Italian synthetic line, pooled by genetic level (excellent E, medium M, and fair F) depending on different mean genetic index of bucks for average daily gain (ADG) up to 81 d. In addition, in A farm, other 15 and 14 does were inseminated with semen of two types of common commercial hybrids (H₁ and H₂), and 19 does were inseminated with mixed semen from bucks of E and M genetic levels (i.e. normal commercial semen sold, N). After weaning, a standard performance trial on young rabbits was carried out and weights were registered individually at 32, 60 and 81 days. Data were used to compare the growth traits within the new Italian hybrid line (WH) and among the Italian hybrid line and the other commercial hybrids (AH). In the WH comparison, weight at 60 d (W60) and the ADG were greatly influenced in rabbits born from bucks of different genetic level, with animals obtained from E bucks that resulted 51 g heavier at 60 d and gained on average 3.2 g/d faster than rabbit born from bucks of M and F genetic level. The ADG was also significantly influenced by farm management: 41.2 vs. 39.2 vs. 37.6 g/d for A, B and C farms respectively (P<0.01). In the AH comparison different hybrids showed no different W60 in fattened rabbits. ADG resulted significantly higher in H₂ hybrids than in H₁ (42.8 vs. 39.6 g/d, respectively), while N semen (i.e. the mixture of semen from E and M genetic levels) produced rabbit that had an intermediate growth rate compared with the other two commercial hybrids (41.2 g/d). However, the rabbits obtained from buck of E genetic level were significantly heavier at 60 d, showing an ADG equivalent to that exhibited by more selected commercial hybrid as the H₂ (41.4 g/d).

Key words: Rabbit, Growth traits, Terminal crosses, Commercial hybrids, Genetic levels.

INTRODUCTION

In Italy the rabbit meat production system is based mainly on the use of terminal crosses, i.e. hybrids, which allow obtaining very homogeneous animals with a high growth rate and maximized feed efficiency. In most cases, commercial hybrids are the result of a three or four-way crossbreeding schemes, where maternal and paternal line are crossed in order to take advantage of the expected positive heterosis in reproductive and growth traits (Baselga, 2004). Within these schemes the female lines are selected for litter size at birth and/or weaning, while the paternal lines are always selected for conversion index, that is indirectly evaluated through the average daily gain (ADG) or the weight at the end of the fattening period (Sánchez *et al.*, 2004). The 70% of the Italian hybrids originate from French selections (Xiccato and Trocino, 2007) with simple or complex crossing of lines, virtually selected with reduced inbreeding (Masero, 1992). Only 30% of the hybrids used in Italy are the result of Italian selection, nevertheless the dependence on foreign lines and genetic resource is very strong. The hybrids might satisfy the need of homogeneity, healthiness and productivity requested by rational forms of breeding (Corrent, 2002); moreover, some of the most required traits in hybrids are the resistance to main farm diseases and reduction of running costs, particularly of feed costs that account

for about 70% total costs (Larzul *et al.*, 2004). In this scenario, new local purebred lines to get hybrids that could respond more precisely to farmer request were created starting from year 2004 in the north east of Italy. After few generation of selection, improved meat bucks from a paternal line are used to produce terminal crosses with a commercial maternal line. At this point of the selection process, a comparison within the new paternal line and with other commercial paternal line was planned. Therefore, the aim of this study was both the comparison of the new paternal line using semen of bucks of three different mean genetic level (within hybrids comparison, WH), and the comparison of this new line with other most common commercial line diffused in the north east of Italy (among hybrids comparison, AH). All comparisons were made on the basis of weight performance and the average daily gain of the all F1 obtained.

MATERIALS AND METHODS

Animals and experimental design

The trial was carried out in three commercial farms belonging to CPC (a rabbit producers' cooperative) located in Pordenone Province, North-east of Italy, during the autumn season of the year 2006. The farms are typical commercial rabbit farm; two of them (A and B farms) accounts for about 750 does cages, with the females conducted in two bands (21 and 28 days), while the last one (C Farm) has 480 does cages with only one band (49 days). An overall no. of 230 multiparous does (4th parity) of commercial maternal lines was used in the study: 82 and 80 does were located in A and B farms, respectively, while 68 were in the C farm. All available does were inseminated at the same time and season with three types of semen obtained from bucks of a new Italian synthetic rabbit line selected for average daily gain from weaning up to 81 d. ADG indexes were expressed as standard deviation units (SDU) with mean 100 and standard deviation 10. The semen was mixed from bucks that were classified as excellent (E), medium (M) and fair genetic level (F). Indeed, E buck were accredited of a mean genetic ADG index of 121.4 ± 2.4 SDU, M bucks had a mean genetic index of 104.5 ± 0.1 SDU, and F bucks 99.2 ± 0.3 SDU (all obtained at the same round of genetic evaluation). After birth the total number of kits born, born alive, weaned kits, litter weight at birth and at weaning were recorded for each doe. At weaning, kits were placed in fattening cages (bi-cellular cages) and were fed with a standard commercial pellet until slaughter, which was performed at an age of 81 d. During the fattening period the individual live weight was recorded at standard time (32, 60 and 81 days from birth) and data were used to calculate the individual average daily gain (ADG) using a regression of weight on age method with the REG procedure of SAS (SAS, 1998). Simultaneously, in the A farm other 48 does were used for an among hybrids comparison (AH). Twenty-nine does were inseminated with two different paternal commercial lines (15 does with H₁ semen, 14 does with H₂ semen), while other 19 does, with mixed semen from bucks of E and M genetic level, i.e. normal commercial semen (N) distributed by CPC to their partners to obtain terminal crosses. As in the WH comparison, also in this case maternal performances were recorded at birth and at weaning and, after weaning, weights at standard age were measured individually to calculate ADG as previously described.

Statistical Analysis

Data on weight at 60 d of age (W60) and ADG measured individually were analyzed by the GLM procedure of SAS (SAS, 1998), using the following linear models for the WH (1) and the AH (2) comparison:

$$y_{ijlm} = Fa_i + G_j + (FaxG)_{ij} + D_l(FaxG)_{ij} + e_{ijlm} \quad (1)$$

$$y_{lkm} = H_k + D_l(H)_k + e_{lkm} \quad (2)$$

where:

y_{ijlm} or y_{lkm} are the individual W60 or ADG;

Fa_i is the farm effect ($i=1, \dots, 3$);

G_j is the genetic level effect in the WH comparison ($j=1, \dots, 3$);

H_k is the effect of different hybrid and/or genetic level in the AH comparison ($k=1, \dots, 3$);

$(FaxG)_{ij}$ is the first order interaction between Fa_i and G_j ;

$D_i(\text{FaxG})_{ij}$ is the doe effect within $(\text{FaxG})_{ij}$ used as error term to test the effect of F_a , G_j and $(\text{FaxG})_{ij}$; $D_i(H)_k$ represents the doe effect within $(H)_k$ used as error term to test the effect of H_k ; e_{ijlm} or e_{iji} are the e is the random normal error $N(0, \sigma_e^2)$.

RESULTS AND DISCUSSION

The W60 and ADG were both significantly influenced ($P < 0.01$) by the genetic levels in the WH comparison of the new Italian synthetic line. While for W60 the interaction effect was significant and adsorbed the highest amount of variability, for ADG no significant differences were observed for the FaxG. On the other hand, at main level, the F_a effect resulted significant, indicating the presence of a different management among the three farms considered in the experiment. Indeed, A, B and C farms had very different mean ADG (41.2 vs. 39.2 vs. 37.6 g/d; Figure 1), due to differences not only for the management, but also for the number of cages, animal density, disposition of the cages, the feeding system and environment control. Some studies have shown that rabbit management and housing, in the intensive rearing system, could create the homeostasis problems (Verga, 2000), operating like a stress agent and reducing the rabbit welfare and productivity (Drescher, 1996).

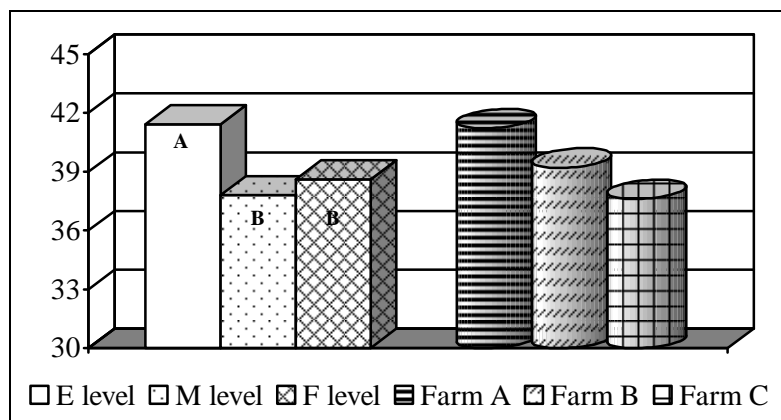


Figure 1: ADG due to the different genetic levels (bars with different letters differs for $P < 0.01$) and in the three farms involved in the trial

Figure 1 shows the differences for ADG between rabbits from bucks of E, M and F genetic levels. Bucks of E genetic level produced rabbit with the highest ADG, while no significant differences were detected as regard the ADG of rabbits obtained from bucks of M and F genetic level. This was due to the reduced mean breeding value difference for ADG between buck of M and F level (+5.3) that was necessarily minimized in order to use males with still a good growth potential, not affecting too much the performance and, therefore, the farm income from the fattening of rabbits.

In experiments of selection for daily gain, direct response was always found for daily gain and indirect response for weight traits (Piles and Blasco, 2003; Moura *et al.*, 1997; Rochambeau *et al.*, 1989; Estany *et al.*, 1992). Indirect response was also found when the criteria were either feed conversion (Moura *et al.*, 1997) or weight at market time (Larzul *et al.*, 2003; Lukefahr *et al.*, 1996).

The phenotypic differences between F1 rabbits obtained from different selected commercial hybrids were significant both for W60 and ADG ($P < 0.01$).

To eliminate the farm and season effects the comparison was realized only in A farm, using the does as an error for the hybrids effect.

Figure 2 shows the different effects in ADG produced by the commercial and the selected genetic levels. The best ADG, among H_1 , H_2 and N, was obtained from H_2 hybrids (42.8 g/d), while the worst was by H_1 hybrids (39.6 g/d).

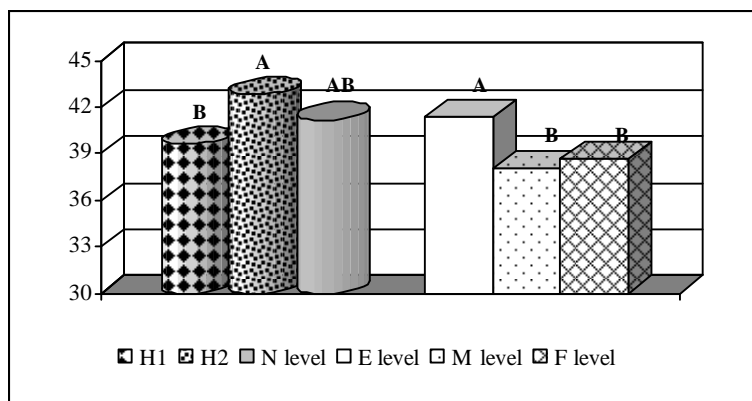


Figure 2: ADG in the AH comparisons of three hybrids in one single farm (bars with different letters differs for $P < 0.01$)

The N genetic level group had medium ADG with respect to H_2 and H_1 hybrids. In fact, the ADG of N group was lower than H_2 only for 1.6 g/d but higher for 1.6 g/d than H_1 . Comparing the performance of rabbits obtained from E bucks and from H_2 , the difference between mean growth rates was reduced to 1.4 g/d while it was positively increased to 1.8 g/d with respect to H_1 group. Moreover, in terms of W60 (Table 1) the E group achieved the highest weight (2128 g) with respect to the commercial rabbit hybrids H_2 (2004 g) and H_1 (1964 g), while the weight achieved by the N group was comparable to both these commercial hybrids. The weight of H_1 was the lowest in the AH comparison, but resulted within theoretical growth curve indicated by the owner company. The best weight at 60 days was obtained from bucks of E level that were significantly different from the others.

Table 1: LSM means for W60 in different genetic comparisons (WH and AH) carried out in the trial

Genetic Level	WH	AH
Excellent (E)	2071 ^A	2128 ^A
Medium (M)	2001 ^{AB}	1989 ^B
Fair (F)	2039 ^B	2025 ^B
Normal commercialized (E+M)		2021 ^B
Hybrid H1		1964 ^B
Hybrid H2		2004 ^B

CONCLUSIONS

This study indicates that the different genetic level in a new Italian line selected for terminal crosses produce the expected differences in terms of growth traits in F1 obtained under commercial conditions. The comparison of this new line with other hybrids diffused in the north east of Italy, suggest an interesting performance for the Italian line, with growth rates for crosses obtained using normal commercial semen that resulted intermediate as respect to crosses obtained from more selected hybrids. However, crosses obtained from more selected Italian bucks, i.e. excellent genetic level for ADG, produced F1 rabbits that had growth traits similar to those obtained from the best commercial hybrids, indicating that more generations of selection are still necessary in the new Italian line to recover the gap with other more specialized commercial hybrids. Moreover, other aspects such as the slaughtering yield and meat quality could be taken into account in order to get a more complete analysis of crosses performance.

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