COMPARISON OF GROWTH PERFORMANCES AND CARCASS QUALITIES OF CROSSBRED RABBITS FROM FOUR SIRE LINES IN QUEBEC

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ABSTRACT

A total of 146 male and female rabbits coming from four sire lines, Californian (CA), American Chinchilla (CH), Géant Blanc du Bouscat (GB) and New-Zealand white (NZ) mated to New-Zealand white dams were used for this study. The objective was to evaluate the combining ability of these sire lines selected for 63-day body weight by measuring growth and carcass traits of their offspring. Kits used for this experiment were weaned at 5 weeks of age. At weaning, three young rabbits were randomly taken from each litter. Rabbits were identified, weighed individually and placed in individual cages for the fattening period. Rabbits were fed *ad libitum* and good quality drinking water was available continuously. Rabbits were individually weighed and slaughtered after 18 h fasting from feeds only. The commercial carcass weight including liver, kidneys and perirenal fat was taken after 2 hours chilling at 4°C. After dissection, fore part, intermediate part and hind part of carcass were measured. Dressing out percentage was also calculated as chilled carcass weight x 100/live weight. One of the hind leg was used to evaluate meat/bone ratio. Statistical analyses were performed using the procedure GLM of SAS. Results of this study shows highly significant differences ($P<0.0001$) for individual live weight at 35 d, average daily gain, commercial carcass weight, intermediate part yield and hind part yield ($P<0.001$) between the four sire lines compared. Rabbits coming from GB line had the best growth traits and commercial carcass weight. However, concerning carcass traits, CH sire line significantly increased intermediate and hind part yield of their progeny whereas GB sire line decreased these traits (30 vs. 29% and 36 vs. 35% for intermediate and hind part yield respectively). Rabbits coming from the 2nd litter were significantly heavier at weaning and had the heaviest commercial carcasses. There was no significant effect of parity on carcass traits. Higher growth traits and commercial carcass weight were obtained with lower litter size at birth. For carcass qualities, there was no significant difference between rabbits coming from different litter size except for hind part yield.

Key words: Growth performance, Carcass traits, Meat/bone ratio, Sire lines.

INTRODUCTION

Canadian rabbit meat production is considered to be minor as compared with others types of meat. However, Canadian statistics from 1991 till 2001 demonstrate that even if the number of farms decreased by 77% the size of farms (as number of rabbits) increased by 340%. This justifies a better organization of the sector.

Rabbits commercially bred for meat production are mainly crossbred animals, generally produced by three-way crosses: crossbred dams are mated to bucks from specialized sire lines selected for growth traits. When designing a genetic improvement program, two steps have to be considered: the choice of the partner lines and the within-line selection. Concerning the latter point, there are two main selection ways to improve growth traits, either by selection for growth rate between two fixed ages, or by selection for weight at a fixed age (Larzul and Gondret, 2005). Because of the high genetic correlation between growth rate and weight at fixed age, these two ways lead to the same results. Rapid progress

was obtained because of the high heritability of growth traits. Rochambeau *et al.* (1989) reported that slaughter age is currently decreasing by 0.5 day per year for a fixed slaughter weight selection. However, the effects on carcass traits of these selection ways have to be taken into account (Pla *et al.*, 1996; Larzul *et al.*, 2005).

The present study deals with the former point, the critical choice of a terminal sire line, in the frame of a genetic improvement program which is being designed in Québec (Canada). It was aimed to evaluate four sire lines by measuring growth and carcass traits of their crossbred offspring.

MATERIALS AND METHODS

Animals

This experiment was carried out at the rabbitry of the *Centre de Recherche en Sciences Animales de Deschambault* (CRSAD) in Quebec from December 2006 to April 2007. A total of 146 male and female rabbits coming from four sire lines, Californian (CA), American Chinchilla (CH), Géant Blanc du Bouscat (GB) and New-Zealand White (NZ) mated to New-Zealand White dams were used for this study. The four genetic types compared were: NZ x NZ (38 rabbits), CA x NZ (62 rabbits), GB x NZ (30 rabbits) and CH x NZ (16 rabbits).

The initial parents of specific pathogen free New-Zealand purebred rabbits were acquired in Canada from the Charles River firm in 2002. CA, GB and CH purebred rabbits were introduced into the CRSAD rabbitry according to the caesarian procedure in order to minimize contamination. They were acquired in the United States from breeders of the American Rabbit Breeder Association (ARBA). Rabbits were housed in closed building in flat deck cages. Ventilation, temperature (18°C in maternity and 16°C in fattening in winter) and light (16 h light/24 h in maternity and 8 h light/24 h in fattening) were controlled. Does were mated first at 16 weeks of age and regularly on the 10-12th day after parturition. Sire lines reproduction performances (except for CH) were studied by Ouyed *et al.* (2007a). The objective of the selection program applied is to improve litter size at weaning and growth rate during fattening period. Kits used for this experiment were weaned at 5 weeks of age. At weaning, three young rabbits were randomly taken in each litter. Each rabbits were identified, weighed individually and placed in individual cages for the fattening period. Rabbits were fed *ad libitum* with a commercial diet covering the requirements for growth (2375 kcal/kg metabolisable energy and 16% crude protein). Good quality drinking water was available continuously from nipples. At the age of 63 days (±1 day), rabbits were individually weighed and they were slaughtered between 62 and 65 days of age, after 18 h fasting from feeds only.

Carcass and meat variables

About 40 minutes before slaughter, rabbits were individually weighed. The chilled carcass weight (commercial carcass weight) including liver, kidneys and perirenal fat (without head) was taken after 2 hours chilling at 4°C. Carcasses were placed in an identified bag and frozen at –18°C in order to be dissected by students of *Ecole Hôtelière de la Capitale* (EHC). After thawing, carcasses were dissected according to the norms of WRSA (Blasco and Ouhayoun, 1996). Fore part, intermediate part and hind part of carcass were measured. Dressing out percentage (commercial carcass yield) was calculated as chilled carcass weight x100/live weight. Fore part, intermediate part and hind part yields were expressed as percentage of chilled carcass weight. One of the hind legs was used to evaluate meat/bone ratio. Fresh hind leg, cooked hind leg (at standardized conditions under vacuum at 80°C during 2.30 hours as described by Blasco *et al.*, 1992), and hind leg bone were also weighed and the meat/bone ratio was calculated as (fresh hind leg weight - hind leg bone weight)/hind leg bone weight (Larzul and Rochambeau, 2004).

Analysed traits and statistical analysis

The analysis concerned the following variables: live weight at 35 days, average daily weight gain between 35 and 63 days (ADG), commercial carcass weight at 63 days, commercial carcass yield, fore part yield, intermediate part yield, hind part yield and meat/bone ratio of the hind leg. The breed types means were estimated by analysis of variance with the fixed effects of the breed types (4 levels), parity (4 levels: 1st, 2nd, 3 to 5 and 6 or more) and litter size (3 levels : <5, 6 to 7, 8 and more kits borne alive), using the procedure GLM of SAS. For the analysis of the commercial carcass weight, the age at slaughter was taken as covariate.

RESULTS AND DISCUSSION

Sire lines effect

Average rabbit performances (mean ± standard deviation) recorded in this experiment were 1037±146 g for live weight at weaning, 46±6 g/d for ADG, 1200±134 g for commercial carcass weight, 53±3% for commercial carcass yield, 36±2%, 30±2% and 30±2% for hind part, fore part and intermediate part yield respectively. Meat/bone ratio averaged 6±1. Results of this study showed highly significant difference (P<0.0001) for individual live weight at 35 d, ADG, commercial carcass weight, intermediate part yield and hind part yield (P<0.001) between the progeny of the four sire lines compared (Table 1). Rabbits from GB sire line had the best growth traits and commercial carcass weight while rabbits from CH sire line had the lowest performances (1270 vs. 1063 g for weaning weight, 57 vs. 43 g/d for ADG, 1432 vs. 1200 g for commercial carcass weight). These results are in agreement with many others concerning the potential of GB sires to improve growth performances of their offspring (Larzul and Gondret 2005; Ozimba and Lukefahr 1991; Prayaga and Eady 2003; Ouyed *et al.* 2007b).

Table 1: Growth and carcass traits for rabbits from four sire lines

	Breed type				Prob.	MSE
	CAxNZ	CHxNZ	GBxNZ	NZxNZ		
Rabbits, no.	62	16	30	38		
Individual live weight 35 d (g)	1127.8b	1063.8a	1270.7c	1091.2ab	<0.0001	101.8
Average daily gain (g/d)	46.9b	43.4a	57.3c	48.1b	<0.0001	4.4
Commercial carcass weight 63 d (g)	1242.7a	1207.6a	1423.2b	1235.2a	<0.0001	97.0
Commercial carcass yield (%)	53.7	54.8	52.4	53.5	ns	5.4
Fore part yield (%)	29.3	29.4	29.7	30.1	ns	2.2
Intermediate part yield (%)	30.8b	30.9b	29.6a	28.9a	<0.0001	1.8
Hind part yield (%)	35.1a	36.4b	35.2a	36.5b	<0.001	1.6
Meat/bone ration of the hind leg	6.25	7.11	6.52	6.17	ns	1.18

Means with different letters on the same row differ significantly (P<0.05); ns= no significant; MSE = mean square error

However, concerning carcass traits, results showed the inverse pattern. In fact, CH sire line significantly increased intermediate and hind part yield of their progeny whereas GB sire line decreased these traits (30 vs. 29% and 36 vs. 35% for intermediate and hind part yield, respectively). Concerning commercial carcass yield, fore part yield and meat/bone ratio, there was no significant difference. It seems that GB sire line rabbit had significantly higher pre-slaughter and carcass weights while dressing percentage was comparable with CA, NZ and CH sire lines. These results are in agreement with those reported by Lukefahr *et al.* (1983) comparing Flemish Giant, Californian and New-Zealand white sired rabbits.

Parity effect

Parity of the litter in which the rabbit was born affected significantly live weight at weaning, average daily gain, commercial carcass weight and meat/bone ratio (Table 2). Rabbits from 2nd litters were significantly heavier at weaning and had the highest commercial carcass weight, in agreement with the results reported by Prayaga and Eady (2003). They obtained significantly higher carcass weight in 2nd

and 3rd parity litters than in 1st and 4th ones. Concerning ADG, results showed the highest growth rate at the 1st parity (51.3 g/d) whereas the lowest was obtained by rabbits from the 6th or more parity (47.5 g/d). Growth rate regularly decreased as parity increased. Also, meat/bone ratio was higher for rabbits from the first litter. There was no significant effect of parity on carcass traits.

Table 2: Parity effect on growth performance and carcass traits

	Parity				Prob.
	1st	2nd	3nd to 5th	6th or more	
Rabbits, no.	15	17	29	85	
Individual live weight 35 d (g)	1116.6ab	1186.8b	1153.4b	1096.6a	<0.01
Average daily gain (g/d)	51.3b	48.9ab	48.0a	47.5a	<0.05
Commercial carcass weight 63 d (g)	1313.6b	1305.3b	1263.8ab	1227.5a	<0.01
Commercial carcass yield (%)	54.2	53.0	53.7	53.4	ns
Fore part yield (%)	29.2	29.3	29.7	30.2	ns
Intermediate part yield (%)	30.1	30.6	29.6	29.9	ns
Hind part yield (%)	35.9	35.8	35.9	35.4	ns
Meat/bone ration of the hind leg	7.1b	6.1a	6.5ab	6.1a	<0.05

Means with different letters on the same row differ significantly (P<0.05); ns= no significant; MSE = mean square error

Litter size effect

Litter size at birth significantly (<0.0001) affected individual weight at 35 d, ADG and commercial carcass weight (Table 3). As reported by Orengo *et al.* (2004), higher growth traits and commercial carcass weight were obtained when litter size at birth was lower. For carcass qualities, there was no significant difference between rabbits from different litter sizes except for hind part yield. In fact, rabbits coming from litters with 6 kits or more had higher hind part yield. Thus, increased litter size negatively affected growth performance without any effect on carcass traits except for hind part yield.

Table 3: Litter size effect on growth performance and carcass traits

	Litter size (alive at birth)			Prob.
	<5 kits alive	6 to 7 kits alive	>8 kits alive	
Rabbits, no.	14	20	112	
Individual live weight 35 d (g)	1245.3c	1159.5b	1010.3a	<0.0001
Average daily gain (g/d)	50.50b	50.13b	46.3a	<0.0001
Commercial carcass weight 63 d (g)	1356.4c	1280.7b	1195.5a	<0.0001
Commercial carcass yield (%)	53.8	53.4	53.5	ns
Fore part yield (%)	30.4	29.1	29.3	ns
Intermediate part yield (%)	30.2	30.3	29.7	ns
Hind part yield (%)	34.8a	36.4b	36.2b	<0.05
Meat/bone ration of the hind leg	6.6	6.4	6.4	ns

Means with different letters on the same row differ significantly (P<0.05); ns= no significant; MSE = mean square error

CONCLUSIONS

In conclusion, utilization of GB sire line selected for live weight at 63 days improved significantly growth performance and commercial carcass weight of their offspring. However, if the objective is to improve carcass traits, CH sire line should be used to obtain more intermediate and hind part yield and higher meat/bone ratio. In another study, weight of the parts will be used in order to identify the sire line giving the best fore, intermediate and hind part weight.

Taking together the results of the present experiment with previous ones (Ouyed *et al*., 2007b, Ouyed and Brun, 2008), we can conclude that a three-way cross involving crossbred dams (CA x NZ) mated to bucks from a sire line (GB) may help to increase complementarity and produce commercial rabbits with interesting growth and carcass traits.

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REFERENCES

Blasco A., Ouhayoun J., Masoero G. 1992. Status of rabbit meat and carcass: Criteria and terminology. *Options Méditerranéennes-Série Séminaire, n°17, 105-120.*

Blasco A., Ouhayoun J. 1996. Harmonization of criteria and terminology in rabbit meat research. Revised proposal. *World Rabbit Science, 4 (2), 93-99.*

Rochambeau H. de, Fuente L.F. de la., Rouvier R., Ouhayoun J. 1989. Sélection sur la vitesse de croissance post-sevrage chez le lapin. *Génét. Sél. Evol., 21, 527-546.*

Larzul C., Rochambeau, H. de 2004. Comparison of ten rabbit lines of termimal bucks for growth, feed efficiency and carcass traits. *Anim. Res., 53, 535-545.*

Larzul C., Gondret F., Combes S., Rochambeau H. de 2005. Divergent selection on 63-day weight in the rabbit: response on growth, carcass and muscle traits. *Genet. Sel. Evol., 37, 105-122.*

Larzul C., Gondret F. 2005. Aspects génétiques de la croissance et de la qualité de la viande chez le lapin. *INRA, Prod. Anim., 18(2), 119-129.*

Lukefahr S., Hohenboken W.D., Cheeke P.R., Patton N.M. 1983. Appraisal of nine genetic groups of rabbits for carcass and lean yield traits. *J. Anim. Sci., 57(4), 899-907.*

Orengo J., Gomez E.A., Piles M., Rafel O., Ramon J. 2004. Growth traits in simple crossbreeding among dam and sire lines. In: *Proc. 8th World Rabbit Congress, Puebla, Mexico, 2004 September, 114-120.*

Ouyed A., Lebas F., Lefrançois M., Rivest J. 2007a. Performances de reproduction des lapines de races pures (Néo-Zélandais Blanc, Californien et Géant Blanc du Bouscat) et des croisés, en élevage assaini au Québec. *In*: *Proc. 12èmes Journ. Rech. Cunicole, INRA-ITAVI, 2007 November, Le Mans, France, 145-148.*

Ouyed A., Lebas F., Lefrançois M., Rivest J. 2007b. Performances de croissance de lapins de races pures et de lapins croisés en élevage assaini au Québec. *In*: *Proc. 12èmes Journ. Rech. Cunicole, INRA-ITAVI, 2007 November, Le Mans, France, 149-152.*

Ouyed A., Brun J.M., 2008. Heterosis, direct and maternal additive effects on rabbit growth and carcass characteristics. *In*: *Proc. 9th World Rabbit Congress, 2008 June, Verona, Italy, 195-200.*

Ozimba C.E, Lukefahr S.D. 1991. Comparison of rabbit breed types for postweaning litter growth, feed efficiency, and survival performance traits. *J. Anim. Sci., 69,3494-3500.*

Pla M., Hernandez P., Blasco A. 1996. Carcass composition and meat characteristics of two rabbit breeds of different degree of maturity. *Meat Sci., 44, 85-92.*

Prayaga K.C., Eady S.J. 2003. Performance of purebred and crossbred rabbits in Australia: Individual growth and slaughter traits. *Aust. J. Agric. Res., 54 (2), 159-166.*