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STRATEGY FOR DEVELOPING RABBIT MEAT PRODUCTION IN ALGERIA: CREATION AND SELECTION OF A SYNTHETIC STRAIN

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ABSTRACT

There is in Algeria a local population well adapted to the climatic conditions, whose prolificacy and adult weight are too low. In the frame of a co-operation between INRA and ITELV, a new synthetic strain has been formed from the insemination of females of this local population by fresh semen of males from the INRA2666 strain. The main interest of the crossbreeding between breeds or strains is to profit from their complementarity and the effect of heterosis. The two possible strategies are, on one hand, the crossbreeding at each generation between the selected pure stocks to produce F1 parental females and, on the other hand, the constitution of a synthetic line whose nucleus is submitted to selection. The first solution has the advantage of exploiting at each generation the entirety of the effect of heterosis, but it requires a complex scheme based on the maintenance and selection of the pure stocks and the multiplication and diffusion of the crossbred females. This solution seemed too complex to set up in Algeria, where the structures were not enough developed to accompany this process. This is why the creation of a synthetic line was chosen, making possible to ensure the independence of the farmers. Indeed, while not excluding the terminal crossbreeding with a male, this solution lets to the farmers the faculty to adapt their strategy of renewal of their herd to their possibilities: they can renew their stock themselves without loss of its genetic level, they can also buy males or the two sexes to the nucleus, permanently or punctually to profit from the genetic progress carried out. After 4 generations of matings, this synthetic strain can be considered as stable. This analysis is not a fair comparison of the generations, because of the year-season effects; however, compared to the average characteristics of the local population, the F4 females have a prolificacy higher by approximately 1.8 young rabbits born alive, a strongly decreased stillbirth rate, they weigh approximately 500 g more. They do not seem to be more sensitive to the summer conditions than the local population. However, their litter size at weaning and the weight of the young rabbits at slaughter are yet too low. These two traits will be the main objective of selection of the nucleus.

Key words: Rabbit, Genetics, Synthetic line, Algeria.

INTRODUCTION

The rabbit can represent for Algeria a valuable source of proteins given its prolificacy and its capacity to use agro-industrial by-products. In Algeria, an attempt of introduction of selected strains and development of rabbit meat production between 1985 and 1988 failed because of many factors, among which the lack of knowledge of the animal, the absence of an adapted industrial feedstuff, the absence of a prophylactic program. Afterwards, the strategy of development of this species was based on the use and upgrading of local populations. Thus, since 1990, the Institut Technique de l'Elevage (ITELV) and some universities, especially that of Tizi Ouzou, set up programmes of characterization of these populations and control of their productive performances (Gacem and Lebas, 2000; Belhadi, 2004; Berchiche *et al.*, 2000; Zerrouki *et al.*, 2005a and 2005b). They highlighted the defects of these populations, namely their too weak prolificacy and their low adult weight, but also their qualities, namely a good adaptation to the local climatic conditions, without any loss of productivity in summer.

This was shown by the absence of effect of the season during 5 generations on the majority of the performances of reproduction in a context of breeding in wired cages and semi-intensive rhythm (Zerrouki *et al.*, 2005a). To provide to the farmers more productive animals, the ITELV, in collaboration with the INRA, chose to create a synthetic strain obtained by a crossing between a local population and a strain of the INRA. The objective of this article is to give a progress report on this synthetic strain after 4 generations of formation.

MATERIALS AND METHODS

Creation of the synthetic strain

The first generation (F1) was obtained by inseminating in December 2003 eighty females of the local population (called thereafter F0), maintained in the arm of the ITELV at Baba Ali with semen from males of the INRA2666 strain, which was itself an experimental synthetic strain, resulting from the crossbreeding between the INRA2066 strain and the V strain of the Polytechnic University of Valencia, in Spain (Brun and Baselga, 2005). The semen had been taken on the males at the experimental farm of the INRA at Auzeville, diluted according to the classical technique, transported in straws in an isothermal box by aircraft and inseminated the day after at the farm of the ITELV. The males used belonged to the 9 families of the strain INRA2666. The F1 descendants were thus distributed on this basis in 9 families of 9 females and 2 to 4 males. 81 F1 does and 18 F1 males were thus used to produce F2 by using the system of rotation between families to minimize the increase in consanguinity. F3 were obtained in the same way by mating between F2 males and females, then F4 by mating between F3 males and females.

Experimental design

The ITELV experimental station of Baba Ali is composed of 3 buildings devoted to this project: i) a building made up of a maternity of 81 cages and 120 cages for fattening, ii) a new building made up of a maternity of 100 cages on the one hand, and 200 fattening cages on the other hand, iii) a building of 100 general-purpose cages; These buildings are equipped with wired cages in flat-deck, and are ventilated with a "cooling" system. The females were mated from the age of 20 weeks and 10-12 days after kindling, or the day following a negative palpation. If they refused the mating, they remained in the cage of the male during some hours, when possible, or were presented again in the following days. They were fed *ad libitum* with a balanced feedstuff, whose characteristics could vary, because of the difficulties of supply of raw materials. The young rabbits were weaned around 35 days, weighed individually, identified, then placed by group of 8 in cages for fattening. They were weighed individually around 75 days.

Statistical analysis

Reproduction
The analysed variables were the litter size at birth, the number of kits born alive in the litters with at least one born alive, the number of kits weaned in the litters with at least one weaned, the death rate at birth and between birth and weaning, including the litters without any born alive or any weaned, the total and average weight of the litters at birth, the weight of the female at mating and palpation. We performed a variance analysis with the fixed effects of the generation (F0 to F4), parity (1, 2 3 and more) and physiological status (nursing or not at the time of the mating) within parity. For the weights of kits, the covariate number of born alive was added. The year-season effects were considered neither here nor for the growth traits because there was confounding between generation and time.

Growth of the kits
We analysed the weight at weaning, at 11 weeks and the average daily gain from weaning to 11 weeks with the fixed effects of the generation, date of weaning within generation and the covariates age at weighing and litter size at weaning. These data were available only for the generations F2 to F4.

Effect of the season
To study the effect of the season over several years, we then analysed only the data of F2, F3 and F4, considering that the genetic background of these 3 generations was comparable (results of the preceding analysis). For the reproduction traits, we introduced the fixed effects of the parity, the physiological status and the combined effect year (2005 to 2007) X season of birth (Winter=January-March, Spring=April-June, Summer=July-September, Autumn=October-December). For the growth traits, we used only the combined effect year X weaning season, with the same covariates.

RESULTS AND DISCUSSION

Evolution of the performances from F0 in F4

In our data the generation effects are confounded with the time effects and, consequently, the differences between generations are the differences between the genetic level of the generations and the differences of the time effects in which they are raised. Next, if we admit that here the time effects are small compared to the genetic effects we can say that, respect to the local population (F0), all the performances of reproduction, except the number of weaned, significantly increased in the crossbred females (F1), as well as for the weight of the females at palpation. These results were compared by Gacem and Bolet (2005) with the performances of the INRA strain used for the constitution of this F1; although its performances were not measured in the same environment; they highlighted a strong effect of heterosis on these traits. A very strong improvement of the viability of the young at birth was noted, in particular an important reduction of the number of litters without live kits. From F2 to F4, most of the reproduction traits were constant, significantly higher than that of the local population, but lower than that of F1. This is explained by the reduction of half of the direct heterosis from the F2 onwards (Bidanel, 1992). Although the maternal heterosis also decreases by half from the F3 onwards, one does not observe a significant reduction of the performances. The only character which did not benefit from this crossbreeding effect was the viability of the young rabbits from birth to weaning, so that there was no significant improvement of the litter size at weaning. This is probably due to unfavourable conditions of environment, which mask the potential of improvement of this character. The increase in the weight of the females was 600 g in F1 and was maintained at 500 g from F2 to F4. The young rabbits of F2 to F4 weigh approximately 1650 g at 75 days, with an average daily gain between weaning and 11 weeks of 26 g/day. Surprisingly, these performances are not higher than that of a local population similar to the F0, observed in the Tizi Ouzou university (Lakabi *et al.*, 2004).

Effect of the season
To be dissociated from a temporary effect, the effect of the season on the performances must be observed over several years. The data from F2 to F4 can be regarded as homogeneous from a genetic point of view, in the absence of significant differences between these 3 generations for the majority of the traits (Table 1).

Figure 1 shows that there was no effect of the season observed all over the period. Contrary to the current practices in Algeria, the females were put at reproduction in summer, and they did not observe significant reduction neither of the fertility (Figure 1a) nor of the prolificacy (Figure 1b). On the other hand, there was a reduction in the performances during the 3 last trimesters independently of the season. Zerrouki et *al* (2005a) had highlighted the absence of effect of the summer on the reproduction of the females of the local population at Tizi Ouzou, whereas Moulla *et al.* (2007) observed a reduction in the receptivity in summer. Our results on the females of F2 to F4 do not confirm this observation, and seem to show that this synthetic strain has the same aptitudes of adaptation to the climatic conditions as the local population. We, also, did not observe an unfavourable effect of summer season on growth of young (Figures 1c and 1d), contrary to Lakabi *et al.* (2004).

Table 1: Evolution of reproduction and growth performances according to the generation of formation of the synthetic strain

	N data	Mean ± Standard Deviation	Anova				Generation				
Trait			Gen	Parity	Lact.	Cov	F0	F1	F2	F3	F4
Litter size											
total	1469	8.6 ± 2.8	***	NS	*	-	6.7a	9.2b	8.0c	8.6d	8.7d
alive	1403	7.9 ± 2.9	***	NS	NS	-	6.2a	8.6b	7.6c	7.8c	8.0c
weaned	1237	6.3 ± 2.2	NS	NS	NS	-	6.1a	5.9a	6.3a	6.3a	6.5a
Stillbirth rate (%)*	1469	13.8 ± 25.6	***	***	NS	-	28.0a	8.5b	9.3b	13.9c	14.5c
Preweaning mortality rate (%)*	1076	17.5 ± 30.9	NS	NS	NS	-	12.6a		17.4a	17.6a	19.3a
Litter weight at birth (g)	1393	385 ± 128	***	***	*	-	290a	389bc	377c	382c	403b
Litter weight at birth (g)	1393	387 ± 70	***	***	NS	***	379a	364a	389a	385a	400b
Mean weight at birth (g)	1393	51 ± 12	***	***	NS	-	52a	47b	52a	52a	52a
Mean weight at birth (g)	1393	51 ± 11	***	***	NS	***	48a	49a	52b	51b	52b
Female weight at mating (g)	2350	3543 ± 493	***	*	***	-	3055a	3668b	3515c	3563c	3580c
Female weight at palpation (g)	1826	3588 ± 505	***	***	***	-	2881a		3469b	3585c	3591c
			Gen	Weaning date	Cov. weaned	Cov. Age			F2	F3	F4
Weight at weaning (g)	5590	593 ± 124	***	***	-	*			643a	586b	579b
Weight at weaning (g)	5590	593 ± 114	***	***	***	NS			605a	571b	580b
Weight at 77 days (g)	3617	1684 ± 281	NS	***	-	***			1681a	1646a	1664a
Weight at 77 days (g)	3617	1684 ± 277	*	***	***	*			1665ab	1621b	1661a
ADG weaning-77 days (g/d)	3616	26 ± 6	***	***	-	***			28a	26b	26b
ADG weaning-77 days (g/d)	3616	26 ± 6	*	***	NS	***			28a	26b	26b

* including litters without any kits born alive. ** including litters without any kits weaned

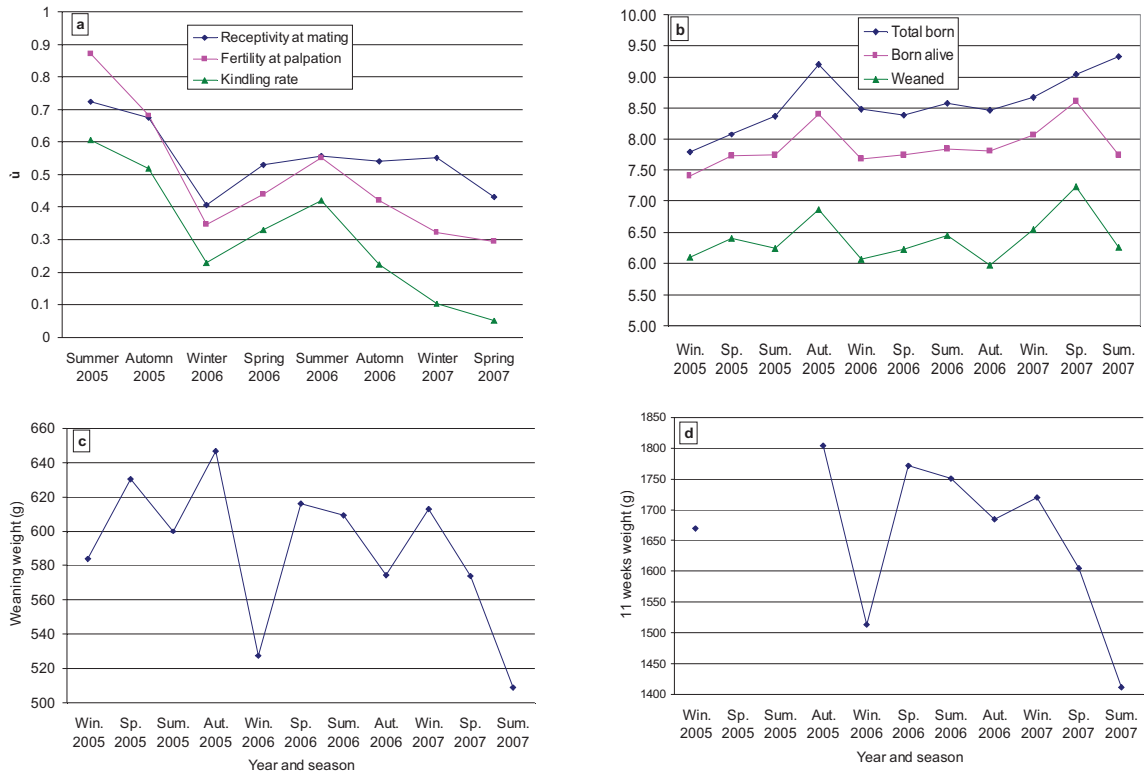

Figure 1: Variation of the reproduction and growth performances according to the year and season

CONCLUSIONS

The main interest of the crossbreeding between breeds or strains is to profit from their complementarity and the effect of heterosis (Bidanel, 1992). The two possible strategies are, on the one hand the crossbreeding at each generation between the selected pure stocks, to produce F1 parental females and on the other hand the constitution of a synthetic line whose nucleus is submitted to selection. The first solution has the advantage of exploiting at each generation the entirety of the effect of heterosis, but it requires a complex scheme, based on the maintenance and selection of the pure stocks and the multiplication and diffusion of the crossbred females. This solution had seemed too complex to set up in Algeria where the structures were not enough developed to accompany this process. This is why the choice of the creation of a synthetic line had been made; it makes possible to ensure the independence of the farmers. Indeed, while not excluding the terminal crossbreeding with a male, this solution lets to the farmers the faculty to adapt their strategy of renewal of their herd to their possibilities: they can practise self-replacement without loss of the genetic level, buy males or the two sexes to the nucleus, permanently or punctually to profit from the genetic progress carried out. Compared to the average characteristics of the local population, despite the confusion between generation effects and time effects, if these are of small importance, it can be said that the F4 females have a prolificacy higher by approximately 1.8 young rabbits born alive, a strongly decreased stillbirth rate, they weigh approximately 500 g more. They do not seem to be more sensitive to the summer conditions than the local population. However, their litter size at weaning is still low, as well as the weight of the young rabbits at the age of slaughter. These two traits will have to be the main objective of the selection of the nucleus.

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