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Kinetics of genetic progress on growth performance in a synthetic strain of rabbit

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ABSTRACT

The objective of this study is to evaluate the growth performances and some genetic parameters of a synthetic rabbit strain over 3 successive generations (G4, G5 & G6), resulted from crossing between the local population and the INRA2666 Strain (France).The results indicated that all the growth indicators (average live weights at birth, weaning and slaughter, average daily gain in pre-weaning and post-weaning) show overall better performance levels than those observed by Several authors for the local population. The crossing thus effectively improved the average daily gain and reduced the slaughter age by two weeks. The study of correlations between growth criteria showed that early selection of weight and average daily gain is effective but that direct selection on average daily gain may also improve the weight by indirect or correlative effect. Finally, the kinetics of genetic progress indicates a fluctuation in genetic progress from one generation to another, which proves that this synthetic strain benefited from the complementarity effect without having undergone a selection on the growth criteria.

Key words: Crossing, Genetic progress, Growth, Synthetic strain.

INTRODUCTION

The practice of rabbit breeding in Algeria is old. This activity, extensive type, uses locally sourced animals or from disparate crossings that are characterized by low productivity. In the 1980s, the state has tried to develop intensive rabbit breeding with selected strains (New Zealander and Californians).

This attempt, which resulted in failure due mainly to the inadequacy of imported breeds to local farming conditions (Belhadi *et al.,* 2002) led in the early 2000s, the Technical Institute of Breeding (ITELV) in collaboration with the National Institute for Agricultural Research (INRA) of Toulouse to develop, to produce efficient animals adapted to the Algerian context, a program that involves the creation of a synthetic strain by crossing between two breeds: the local population (females), known for its low sensitivity to heat and light but too little productive and INRA2666 strain (male), heavier and more productive(Gacem and Bolet, 2005 ; Gacem *et al.,* 2009). Thus, after three generations of homogenization, this cross gave birth to the synthetic strain ITELV2006.

The aim of this work, which covers the 4th, 5th and 6th generation, is to evaluate zootechnical performances during growth, to determine the dynamics of the characters through the study of correlations and to quantify genetic progress by generation and per unit time.

MATERIALS AND METHODS

Biological material: Rabbits of synthetic strain were obtained by genetic crossing of the local population with the INRA 2666 strain. The first generation of cross (F1) was obtained by inseminating 80 females of the local population reared in ITELV of Baba Ali, with the semen of males of INRA2666 strain (Gacem and Bolet, 2005) in December 2003.

This strain was itself an experimental synthetic strain, resulting from the cross between the INRA 2066 strain and the Verde strain of the University of Valencia in Spain (Brun et Balasga, 2005).

The animals were in 5th generation in maternity and in 6th generation in fattening. The numbers of the 4th, 5th and 6th generations are shown in Table 1.

The livestock housing: The livestock building, with an area of approximately 320 m^2, comprises a maternity cell with 80 females' cages and 20 cages for breeding animals and a fattening cell with 100 fattening cages.

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Table 1: Number of 4th, 5th and 6th generations rabbits used in the study.

Gn	Born	weaned	slaughtered
G4	3000	2093	1332
G5	3217	2374	2057
G6	2982	2090	1711

The animals were housed individually in galvanized Flat Deck type cages. Aeration is provided by windows and extractors. The brightness was natural with use of neon lights during the day (8-16h).

Cooling and heating were carried out respectively by Pad cooling coolers and butane gas-fired radians. The temperature in the building was controlled by a thermometer placed in each cell.

Breeding management: After 32 ± 3 days of life, weaned rabbits of the 6th generation (data for the 4th and 5th generations were previous and provided to us by ITELV) were weighed individually and transferred to the fattening area where they were installed in collective cages by siblings. Thereafter, they were weighed according to their weaning date, at fixed time (9h), from the 5th to the 11th week. The young rabbits receive *ad libitum* a standard type granulated feed, of which the chemical composition was recorded in the mixed Table 2. The water was supplied *ad libitum* by automatic drinking troughs.

Methods of calculation: The formulas applied for the evaluation of genetic parameters are as follows:

Correlation: The correlation between two characters in the same individual was determined using the formula of - Pearson -Bravais:

$$r_{XY} = \frac{\sum XY - \frac{\sum X . \sum Y}{n}}{\sqrt{\left(\sum X^2 - \frac{(\sum X)^2}{n}\right).\left(\sum Y^2 - \frac{(\sum Y)^2}{n}\right)}}$$

X = Performance of the first day; Y = the second character Performances measured on the same individual; n = number of individual.

Genetic progress: Genetic progress or response to selection is calculated using the formula of Minvielle (1990) and Bonnes *et al.* (1991): E = P (Gn + 1) – P (Gn).

Table 2: Percentage composition of the feed used.

	Feed used (%)	Recommandations in (%) Maertens (1996)
Dry matter	86.53	89-90
Mineral	9.61	7-8
Crude fiber	8.52	14,5
Fats	4.86	3-5
Total nitrogenous matter	12.48	16

P: Genetic Progress; Gen: parental generation; Gn + 1: Generation of descendants.

Statistical analysis: The data were entered with Excel 2007 and all the variables (mean, standard deviations, minimum values, maximum values, and correlations) were calculated using the SPSS software (Version 21).

RESULTS AND DISCUSSION

Growth performance

Evolution of live weight: Average individual weights and weights per litter by 4th, 5th and 6th generations at birth (J0), weaning (J35) and slaughter (J77) are shown in Table 3.

The average birth weight of 6th generation young rabbits was 51.97 ± 13.07 g. This result was close to those observed for 4th and 5th generation of young rabbits with 50.31 ± 9.66 and 52.04 ± 11.96 g, respectively. On the other hand, it was slightly higher than that recorded by Zerrouki *et al* (2005) for the local population, ie 49.4 g. It can be deduced that the weight of the rabbits at birth is improved by the crossing effect.

The individual weaning weight of the 6th generation young rabbits is 574.92 ± 141.45g. This value was higher than that obtained in the 4th generation (473.50 ± 123.12 g) and the 5th generation (565.98 ± 162.66 g). It was comparable to that obtained by Mulla (2006) on the local population, ie 579.39 g, which showed that there was no affecting selection on weaning criterion or that probably the low milk production did not allow the rabbits to express their genetic potential.

At slaughter, the average weight of young rabbits of the 6th generation is 1711.29 ± 311.85g. This average was lower than that observed for 5th generation young rabbits (1798.39 ± 625.49g) but remains higher than that of 4th generation young rabbits (1452.11 ± 265.91g). In the local population, Chaou (2006) obtained average weights of 1432 ± 277,43 and 1781,43 ± 314,18g respectively at 11 and 13 weeks of age. The genetic cross between the local rabbit and the INRA 2666 strain thus made it possible to reduce the rearing period by two weeks on average.

Coefficients of variation related to weights are significant. They vary from 18 to 42%, which indicates a great heterogeneity between individuals.

The examination of Fig. 1, which related the normal weight distribution to weaning, revealed a minimum weight of 200 g which could be judged too insufficient and a maximum weight of 1000 g which may correspond to in dividuals with good gr owth ability.

The distribution of weights at slaughter (Fig 2) shows the existence of minimum weights of minus 1000g which should be eliminated by selection, and maximum weights of over 2500g which should be attained by choosing High-index broodstock.

Table 3: Average weight of individual animal and litter of the 4th, 5th and 6th generations.

Gn	Live weight (g)					
	Litter			Individual		
	Birth	**Weaning (35J)**	**Slaughter (77J)**	**Birth**	**Weaning (35J)**	**Slaughter (77J)**
G4	428.48 ±132.40 (30.90%)	3360.36 ± 900.15 (26.79%)	7999.33 ± 3161.57 (39.52%)	50.31 ± 9.66 (19.20%)	473.50 ±123.12 (26%)	1452.11 ± 265.91 (18.31%)
G5	425.25±136.82 (32.17%)	4084.95±1425.67 (34.90%)	10298.06± 4295.95 (41.72%)	52.04 ±11,96 (22.98%)	565.98±162.66 (28.34%)	1798.39 ± 625.49 (34.78%)
G6	425.22 ± 144.46 (26.92%)	4020.34±1122.97 (27.93%)	10073.51± 4000.77 (39.72%)	51,97 ±13.07 (25.15%)	574,92±141.45 (24.60%)	1711.29 ± 311.85 (18.22%)

Values between parentheses represent coefficients of variation.

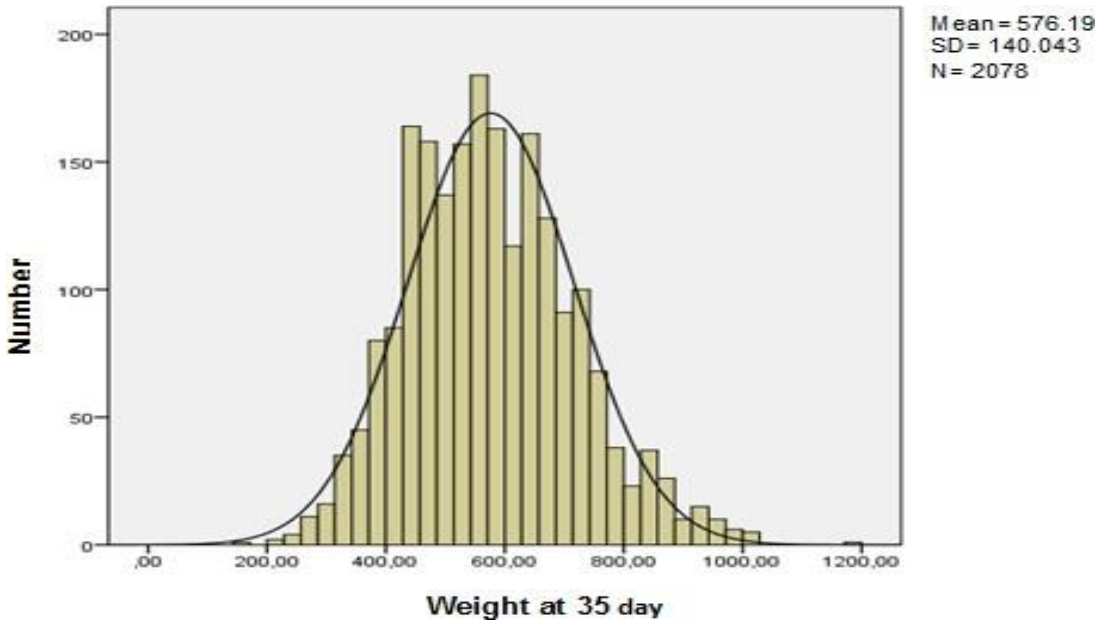

Figure 1: Weight distribution at weaning.

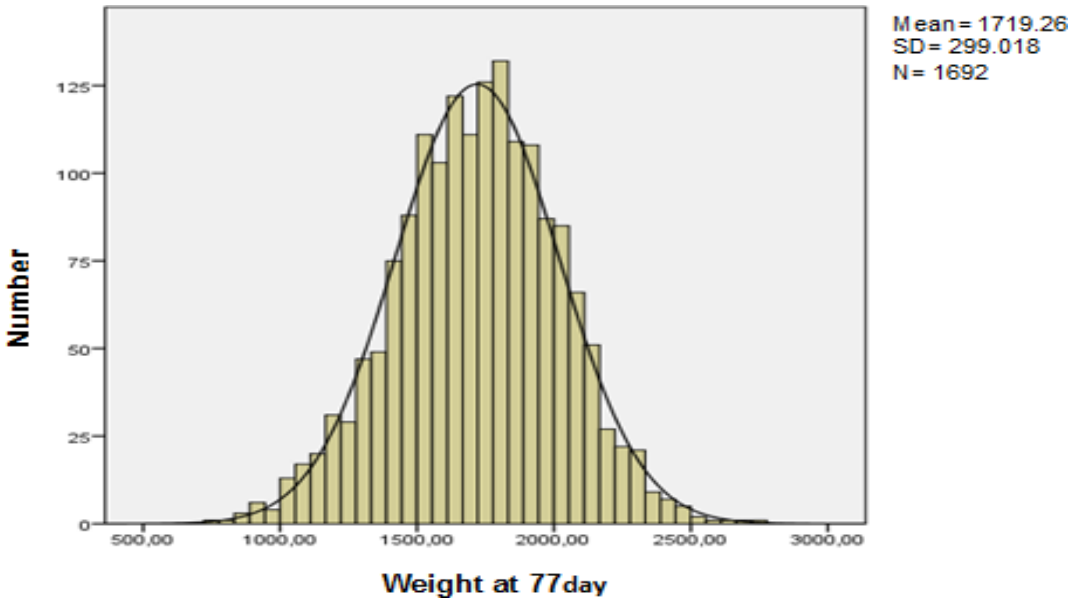

Figure 2: Distribution of weights at slaughter.

Table 4: Average Daily Gain (ADG) values of 4th, 5th and 6th generations.

Gn	ADG (g/d)	
	Birth - weaning	Weaning - Slaughter
G4	10.07 ± 3.02(30%)	22.55 ± 5.26(23,32%)
G5	12.24 ± 4.90(40.03%)	29.20 ± 13.93(47.70%)
G6	12.45 ± 5.04(40.48%)	26.91 ± 6.28(23.34%)

Values between parentheses represent coefficients of variation.

Evolution of the average daily gain (ADG): The average daily gain from birth to weaning of the 6th generation, which was 12.45 ± 5.04 g / d, was comparable with that of the previous generation (12.24 ± 4.90 g / d); It was higher than that of the 4th generation (10.07 ± 3.02 g / d) (Table 4).

At post-weaning, the growth rate was 22.55 ± 5.26, 29.20 ± 13.93 and 26.91 ± 6.28 g / d respectively for the 4th, 5th and 6th generation. These values were significantly higher than those observed in the local population by Moulla (2006) and Berchiche *et al.* (2000) with 20.44 and 21.22 g / d, respectively, but remained low compared to the ADG obtained by Laffolay (1985) on an improved strain (35.8 g / d).

This poor performance was probably related to the quality of the feed which did not allow the young rabbits to express their potential (Table 4).

Fig. 3, which reports the normal distribution of the birth-weaning ADG, showed an ADG of 20 g / d. This gain was insufficiently high for the pre-weaning period to allow the selection of young rabbits with good growth ability.

Figure 4 illustrates the normal distribution of weaning-felling ADG showing an ADG higher than 40 g / d. According to Mefti Korteby (2012), this gain corresponds to the standards of the selected rabbit of average size that exceeds 40g / d.

Mortality rate: The mortality rate of 6th generation young rabbits during the weaning period was 26% (Table 5). Similar values were recorded for 5th generation during the same period (26.20%), while for the 4th generation the rate was higher, i.e 30.23%. These mortality rates remain high considering that the limit tolerated in a rational farm was 10% (Lebas, 1991).

In post-weaning, the mortality rate calculated for the 6th generation is 18.13% (Table 5). This value was higher than that obtained for young rabbits of the 5th generation (13.35%) but remains significantly lower than that recorded for the 4th generation (30.32%). Gacem *et al.* (2009) report a mortality rate of 25% for previous generations (G1, G2 and G3) and a rate of 23% for the local population.

Genetic parameters

Correlations between the growth parameters of the synthetic strain at the 6th generation: The values of the correlations between the different growth parameters of the 6th generation synthetic strain were shown in Table 6. The weaning weight and the slaughter weight are positively significantly correlated (r = + 0.61 **). This correlation is + 0.72 ** for the local population according to Mefti Korteby (2012). The selection based on weight at weaning offers a high chance to find these selected individuals with a high weight at slaughter.

The correlation between weight at weaning and the average daily gain was + 0.21 **. For the local breed, Chaou (2006) reports a higher correlation, + 0.53 **. This observation should lead to a compulsory simultaneous selection on the weaning weight and the ADG in order to obtain individuals selected for both criteria at the same time.

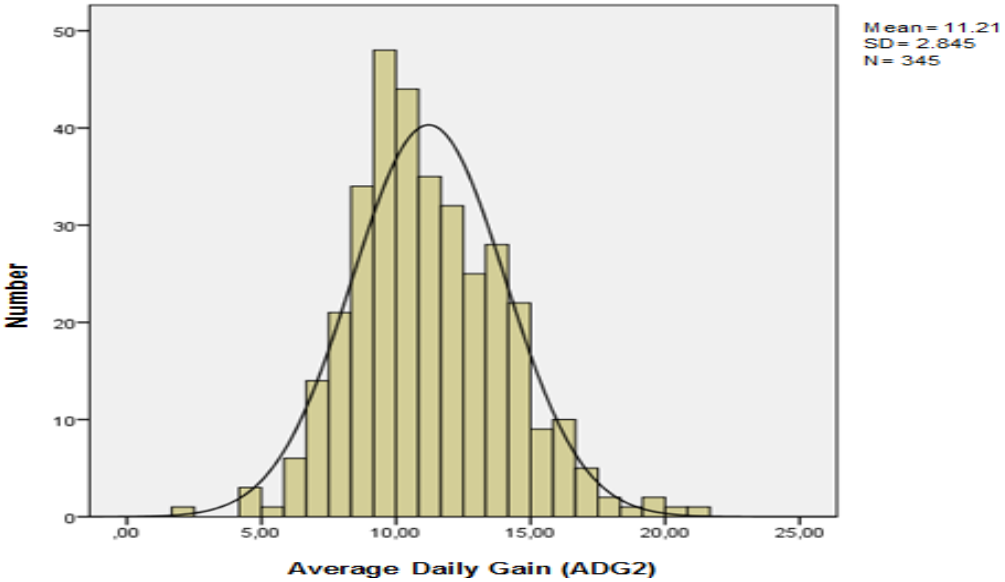

Figure 3: Distribution of the birth - weaning average daily gain (ADG).

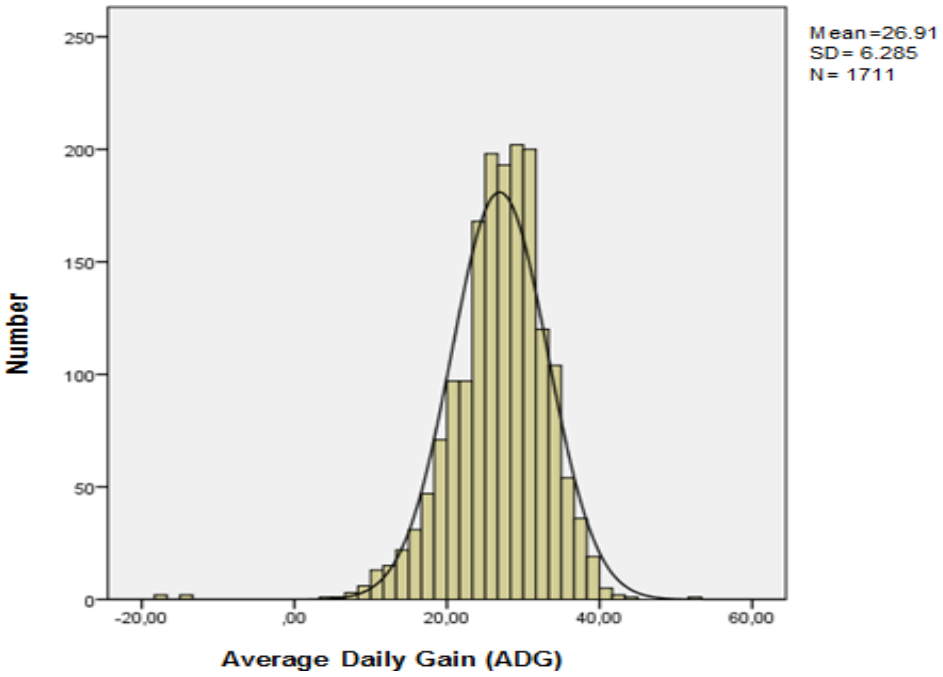

Figure 4: Distribution of ADG weaning - slaughter.

Table 5: Mortality rate of 4th, 5th and 6th generations from birth to slaughter.

	Mortality rate (%)	
Gn	**Birth-Weaning**	**Weaning-Salughter**
G4	30.23	32.32
G5	26.20	13.35
G6	26	18.13

Table 6: Correlations between growth criteria

Criteria	**Weaning weight**	**Weight at slaughter**	**ADG**
Weaning weight	1		
Weight at slaughter	+ 0,61**	1	
ADG	+ 0,21**	+ 0,90 **	1

** Highly significant correlation at p≤ 0.01.

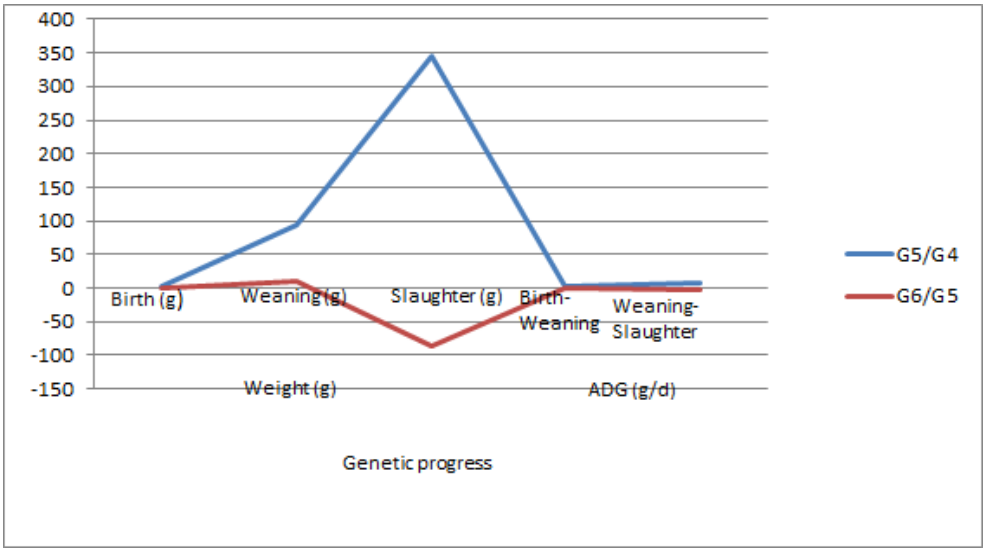

Figure 5: Evolution of the genetic progress related to the weight of the 4th, 5th and 6th generations of the synthetic strain.

Table 7: Genetic progress in growth performance.

Gn	Genetic progress				
	Weight (g)			ADG (g/d)	
	Birth	Weaning	Slaughter	Birth-Weaning	Weaning– Slaughter
G5/G4	+1.73	+92.48	+346.28	+2.17	+6.65
G6/G5	-0.27	+8.94	-87.1	+0.21	-2.29

The correlation between the average daily gain and the weight at slaughter was + 0.90 **. (Table 6) Thus, if the ADG increases, the weight at slaughter also increases. In this case, an indirect but rather late selection may be practiced. For the local population, Mefti Korteby (2012) shows that choosing a live weight at slaughter (r = + 0.72 **) was more profitable than choosing the average daily gain (r = + 0, 50 **).

Kinetics of genetic progress related to weight : The last two generations (G5 and G6) recorded a positive but weak genetic progress for the weaning period (+ 8.94 g), while for the period of birth and slaughter, theyrecorded losses of -0.27 and - 87.1 g respectively (Table 7).

Genetic progress for GMQ (birth-weaning) was positive but low (+ 0.21 g / d). The weaning-slaughter period showed no genetic progress (-2.29 g / d) (Table 7). These criteria therefore evolve randomly from one generation to another (Figure 5). Originally, the choice of broodstock or feed may be in cr iminated, which probably does not meet the requirements of the new synthetic strain.

CONCLUSION

The growth performances of rabbits of the synthetic strain for fattening are higher than those of the local population. The synthetic strain has a two-week slaughter age reduction while the local rabbit is at 13 weeks, which means it has a better average daily gain for achieving this performance. The objective of selection on growth is thus partially achieved, since its objective is either to reduce the age of slaughter or to increase the weight at a typical age.

The mortality rates recorded for the synthetic strain are very high. Improved management practices and modification of environmental conditions are the major thrust areas to reduce the mortality. The study of correlations on growth data shows the effectiveness of early selection on weight and average daily gain and that a direct selection on average daily gain can improve the weight by indirect or correlative effect. This work confirms the interest of the synthetic strain obtained from the cross between a local population and a strain of INRA France and this through the expression of the genetic potentialities clearly better than those of the local population.

Competing interests

The authors declare that they have no competing interests.

REFERENCES

Belhadi, S., Boukir, M. and Amriou, L. (2002). Non genetic factors affecting rabbit reproduction in Algeria, *Wrd. Rbt. Sci.*, **10** (3): 103-109.

Berchiche, M., Zerrouki, N. and Lebas F. (2000) Reproduction performances of local Algerian does raise in national condition, *7th World Rabbit Congress*, Valencia, 4-7 Juillet 2000, *Wrd. Rbt. Sci.*, **8:** 43-49.

Bonnes, G., Afke, A., Darre Fugit, G. and Gadoud, R. (1991) Amélioration génétique des animaux domestiques, Paris/ Foucher, 287 p.

Brun, J.M. and Baselga, M. (2005) Analysis of reproductive performances during the formation of a synthetic rabbit strain. *Wrd. Rbt. Sci.*, **13**: 239 – 252.

Chaou, T. (2006) Etudes des paramètres zootechniques et génétiques d'une lignée paternelle sélectionnée en GO et de sa descendance, du lapin local « *Oryctolagus Cuniculus* », Mémoire de Magistère en Médecine Vétérinaire, Ecole Nationale Supérieure Vétérinaire, El Harrach, 127 p.

Gacem, M. and Bolet, G. (2005) Création d'une lignée issue de croisement entre une population locale et une souche européenne pour améliorer la production cunicole en Algérie, *11ème journées de la Recherche Cunicole*, 29-30 Novembre, Paris, 15-18.

Gacem, M., Zerrouki, N., Lebas, F. and Bolet, G. (2009) Comparaison des performances de production d'une souche synthétique de lapins avec deux populations locales disponible en Algérie, *13ème Journées de Recherche Cunicole*, 17-18 Novembre 2009, Le Mans, France.

Laffolay, B. (1985) Croissance journalière du lapin, *Cuniculture*, **12** (6), pp 212-331.

Lebas, F. (1991) Alimentation pratique des lapins en engraissement, *Cuniculture*, **18** (6) : 273-281.

Mefti Korteby, H. (2012) Caractérisation zootechnique et génétique du lapin local (*Oryctolagus Cuniculus*), Thèse de Doctorat en Sciences Agronomiques, Spécialité : Zootechnie, USBD, Blida, Algérie, 163 p.

Maertens, L. (1994) Influence du diamètre du granulé sur les performances des lapereaux avant sevrage, In : *6ème Journées de Recherche Cunicole* (P. Coudert, Ed.), 6 et 7 Décembre, La Rochelle, ITAVI publication, France, vol.2, pp 325-332.

Minvielle, F. (1990) Principe d'amélioration génétique des animaux domestiques, Ed. INRA, Les presses de l'université Laval, pp 41-65.

Moulla, F. (2006) Evaluation des performances zootechniques de l'élevage cunicole de la ferme expérimentale de l'Institut Technique des Elevages, Baba Ali. Thèse de Magister en Sciences Agronomiques, Ecole Nationale Supérieure Agronomique, El Harrach, Alger, 66 p.

Zerrouki, N., Kadi, S.A., Berchiche, M. and Bolet G. (2005). Evaluation de la productivité des lapines d'une population locale algérienne, en station expérimentale et dans des élevages, *11ème Journées de la Recherche Cunicole*, 29-30 Novembre 2005, Paris (France), pp 11-14.