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Pages 371 - 377

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ABSTRACT

A total of 287 females of a Kabylian local population of rabbits were studied at the University of Tizi-Ouzou (Algeria) over 6 years. The females were mated at first time at the age of 4.5 months and remated 10-12 days after parturition. The females are characterized (average ± standard deviation) by a medium to small adult weight (2.81±0.38 kg) and a rather low prolificacy at birth and weaning (7.2±2.5 total born of which 6.1±3.0 born alive and 5.4±2.3 weaned). Based on the registration of 1377 presentation of does to a male, acceptation of mating and conception rates were 74.3±3.8% and 73.3±4.3% respectively. The Algerian hot summer season did not seem to affect parameters of practical importance such as fertility or litter size at weaning. The only significant effect (P<0.01) was a reduction of litter weight at weaning (-13%) compared with the average of the 3 other seasons (1070 g vs 2368 g at 28 days). Acceptation and conception rates were not significantly affected by mating number. At first parturition, total number of kits (6.6/litter) was significantly lower when compared to that of multiparous does (7.3 to 7.4), and individual birth weight of first litter's kits was 10% lower than that observed for subsequent litters (51.4 g on average). On the other hand, it must be emphasised that for this sample of the Kabylian population, the kit's individual weight at weaning did not vary significantly with parturition number. Birth to weaning mortality was the lowest for parturition of rank 4 and more (9.8% *vs* 14.4 to 16.9% for previous ones).

Key words: rabbit, local population, Algeria, reproduction, season.

INTRODUCTION

In Algeria, there is a great necessity for increasing animal production to fulfil the over growing demand for animal proteins. Rabbits provide an excellent source of protein for human consumption and may play a significant role in solving a part of meat shortage in Algeria. Rabbits are characterised by high reproduction ability and short generation interval, so they can produce high quantity of meat in a short period. The utilisation of local genetic resources requires a characterisation of the population existing in the country. Some measurements have already been made (BERCHICHE *et al.,* 2000;

ZERROUKI *et al*., 2001; 2002a; 2003). The present study is a continuation of this work and describes the reproductive performance of does of this local population raised in Kabylian region of Algeria (around Tizi-Ouzou). Growth performances of young rabbits of this population are described separately (LAKABI *et al*., 2004)

MATERIAL AND METHODS

Animals

The work was carried out at the animal unit of the University of Tizi-Ouzou during r six generations (each one being studied over one year of production) on a total of 287 reproductive females. The 32 females and 6 males making up the "G0" generation were acquired in 1998 from farmers in the Tizi-Ouzou region, roughly representative of the local rabbit population. To produce each of the five following generations (G1 to G5), about 40 females and 8 males were chosen among offspring of the best females (adapted to the breeding system, reproducing regularly and in a good state of health). Each generation was divided into families, composed of a male and 5 or 6 females descendant from other families of the preceding generation, so as to minimise inbreeding.

Management

The breeding unit consisted of 46 breeding cages dispatched among three cells. The animals were housed individually in wire mesh cages arranged in flat deck disposition. The animals of the G0 and G1 generations received the same commercial rabbit feed containing 16.6% crude protein and 12.3% crude fibre. Another feed was formulated by the laboratory and fed to animals of the following generations (17.8% crude protein and 14.4% crude fibre). The pelleted feed was given *ad libitum* and watering was automatic. Natural lighting was used for G0 to G2, but for G3 to G5, the lighting period was controlled and fixed at 16h per day. For each generation, the reproductive process was initiated mostly in the autumn. The reproductive rhythm was semi intensive (minimum interval of 10-12 days between kindling and natural mating attempt). Females were presented to a male for the first time when they were 4.5 month old. A diagnosis of gestation was made by doe's abdominal palpation 10 days after mating. The females negatively tested or which had refused the buck, were presented again to a male the following day. If they refused, they were not represented to a male until the following week. A female was eliminated after 5 successive failing matings (refuse or sterile). Receptivity was defined as the proportion of females which had accepted service, and fertility or conception rate as the proportion of mated females giving birth. Litter size and weight were determined at birth and at weaning (28^{th} day after parturition).

Statistical analysis

Two models were used for the analysis of variance. Both included the fixed effects of the generation (6 levels) and of the mating season (4 levels: autumn, winter, spring, summer). For the analysis of receptivity and conception rates and of mating weight of does, the effect of the expected litter parity (5 levels: 1, 2, 3, 4, 5 and more) and the

physiological status (lactating or not at mating) of the females within mating number were added. For the analysis of litter data (size, weight, mortality), the effect of litter number (4 levels : 1, 2, 3, 4 and more), the season of kindling and the physiological state of the females (lactating or not at fertile mating) within litter number were added. All the analyses were done with the SAS software. Only effects of mating or parturition number and of season are presented in the present paper. Results obtained after three successive mating failures were not taken into account in the analysis

RESULTS AND DISCUSSION

Average characteristics of the local Kabylian population

The average does weight at mating was 2.8 kg, a value similar to the 2.89 kg previously described for this population, but on the basis of a fewer number of observation (ZERROUKI *et al.*, 2001). This value makes possible to classify this population in the group of the small breeds such as *e.g.* Dutch or Himalayan rabbits (FFC, 2000).
The mean receptivity rate of the studied population (74.3%) was similar to that observed by GARCIA and PEREZ (1989) for New Zealand does bred with the same reproductive frequency. The fertility and the prolificacy at birth or at weaning of the females of this local population were low (73.0% and 7.2 born in total with 6.1 born alive per parturition and 5.4 weaned rabbits per weaned litter) compared with results obtained in well-managed French rabbit farms using selected rabbits (77.1% and 7.7 weaned per litter; GUERDER, 2001). In Egypt, GALAL and KHALIL (1994) recorded conception rates in Giza White females in the region of 76% and in France KOEHL ands VAN DER HORST (1998) recorded an average conception rate of 74.7% for "Normand" pure bred. On the other hand, KENNOU and BETTAÏB (1990) found a lower fertility rate of only 61% for does of local Tunisian population. In our case, the fertility could be improved if a solution is obtained for the too frequent problems of abortion and for cases of pseudo pregnancy in females. Birth out of the nest box and the poor maternal behaviour of some females, causing losses of their whole litter, explain the reduced prolificacy observed at birth in terms of kits born alive and the high proportion of kits counted as stillborn. The individual mean weight of the kits 49.4 g at birth and 451 g at weaning are in agreement with the modest adult live weight of the studied population (2.8 kg). Mortality between birth and weaning recorded over the course of the study was 13.3%, a value between the 11.4% and the 15.7% obtained in France for birth to weaning mortality calculated on the basis of lived kits maintained in the litters (after culling) and on the basis of the kits effectively born alive, respectively (GUERDER 2002).

Effects of season

The season exerts a significant influence only on some of the reproduction traits of the females. The summer, characterized by high temperatures in Algeria (average of 30°C), does not seem to affect hardly the females fertility, whereas ARVEUX (1988) emphasised the difficulties of inducing fertile mating in hot weather. Nevertheless, females were insignificantly less receptive in summer (69%) than in the other seasons (75-80%) but effective summer matings were numerically the most fertile (table 1). On the other hand,

it could be emphasised that the highest receptivity rate was recorded in autumn (80 %) when the weight of does at mating was one of the lowest (P<0.001).
The lowest litter size at birth was observed in summer (*e.g.* 5.4 born alive *vs* 6.0 to 6.72) as it was for example observed in Spain by GARCIA *et al*. (2000) with selected lines. But at weaning the differences between seasons were reduced and became non significant (table 2). According to the statistical analysis, birth to weaning mortality was not significantly affected by season, but it could be emphasised that it was numerically higher for autumn litters (19.6% *vs* 12 to 14.8%). Individual kit's weight at birth or at weaning was not affected by the season. But due to the effect of litter size, litter weight at birth or at weaning was the highest in winter and the lowest in summer. In the same way, HASSAN *et al*. (1994) found a very clear reduction in litter weight at weaning for animals born in June or July in Egypt.

Table 1. Effect of season and mating order on reproduction parameters and weight of does.

	Receptivity rate (%)	Conception rate (%)	Weight at mating (g)
Number of data	***1377***	***1025***	***1025***
General mean	74.3	73.1	2809
Residual S.D.	3.8	4.3	377
Effect of season	NS	NS	***
Autumn	80.5	73.0	2763.4a
Winter	77.7	66.1	2863.8b
Spring	74.7	74.7	2863.6b
Summer	67.4	79.5	2701.5a
Effect of mating order	NS	NS	***
1	77.3	65.8	2578.4 a
2	72.4	71.5	2786.1 b
3	76.6	75.2	2819.3 b
4	75.3	73.8	2898.8bc
5 and more	72.6	75.7	2974.51 c

* P<0.05 ** P<0.01 ***P<0.001; NS : Not significant.
Means with different letters are significantly different (P<0.05)

Effect of mating or parturition number

The receptivity rate was not significantly affected by mating order (table 1). In the same way, when mating was accepted by the female, the conception rate was not significantly affected by mating number despite a numerically lower value for the first matings. These results disagree with those of LAVARA *et al*. (2000) which observed after artificial insemination a significantly better conception rate for nulliparous than for older rabbit does (84% *vs* 63-67%).
At first parturition, total number of kits (6.6) was significantly lower when compared to that of multiparous does (7.3 to 7.4) as it was, for example, observed by KOEHL and VAN

DER HORST (1998) for the French "Normand" breed managed in a similar way. But if numbers of born alive or weaned kits are taken in consideration, differences in litter size in relation with parturition number were not significant. Individual birth weight of first litter's kits was 10% lower than that observed for subsequent litters (51.4 g on average). This lower weight was related with a lower mother's weight since at first mating the female's weight was a little bit lower than that observed after numerous matings (2578.4g *vs* 2947.5 g for 5 matings and more). It would be added that in the same time the number of young born alive was significantly higher for old does than for primiparous. Thus the low individual weight of kits born from the first litters must be considered as a characteristic of this population since the classical relation between individual weight and litter size is an increase of weight with the decrease of litter size (LEBAS, 1974). On the other hand, it must be emphasised that for this sample of the Kabylian population, the kit's individual weight at weaning did not vary significantly with parturition number. Mortality at weaning was the lowest for parturition of rank 4 and more (9.8% *vs* 14.4 to 16.9% for previous ones).

Table 2 – Effect of season and does parturition number on litter traits.

	Litter size			Kits individual weight (g)		Litter weight (g)		Young mortality (%)	
	Born alive	Total born	At weaning (28 d)	At birth	28 d.	At Birth	28 d.	Still-born	0-28 d.
Data No.	*660*	*740*	*536*	*659*	*536*	*659*	*536*	*660*	*536*
Mean	6.08	7,17	5,41	49,4	451	292	2289	16.4	13.3
Residual S.D.	2.54	2,43	2,26	9,9	112	113	803	23.2	20.2
Season effect	**	**	**NS**	**NS**	**NS**	***	**	**NS**	**NS**
- Autumn	6,42a	7.25 a	5,14	50.5	471	325a	2281a	12.6	19.6
- Winter	6.72a	7.68 a	5.60	51.2	480	330a	2501b	13.1	14.8
- Spring	6.03a	7.37a	5.55	49,0	446	294b	2321ab	18.4	12.0
- Summer	5.44b	6.63b	5.06	49.0	432	261c	2070a	19.8	12.0
Parturition order effect	**NS**	**	**NS**	***	**NS**	***	**	**NS**	*
Parturition 1	5.80	6.63a	5.16	46.4a	444	259a	2125a	14.2	14.6ab
Parturition 2	6.22	7.28b	5.29	50.0b	453	305b	2226ab	16.2	16.9a
Parturition 3	6.2	7.40b	5.33	51.1bc	465	310b	2362bc	17.4	16.9a
Part. 4 & +	6.25	7.40b	5.60	53.0c	465	321b	2441c	16.1	9.8b

* P<0.05 ** P<0.01 ***P<0.001 NS : Not significant.
Within each effect, means with different letters are significantly different (P<0.05)

CONCLUSION

This 6 years study confirms the first results obtained with this Kabylian rabbit population. It is characterised by a small adult weight (2.8 kg), a moderate conception rate after natural mating (73.1%) and a relatively low prolificacy at birth and at weaning (7.2 total

born with 6.1 live born and 5.4 weaned per litter born). For this population, the hottest Algerian period characterized by high temperatures (average of 30°C) has no significant effect on mating acceptation rate or on conception rate, nor on litter size at weaning. The only significant effect with practical consequences is a reduction of 11% of the litter weight at weaning (28 days).

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