ANALYSIS OF THE EFFICIENCY AND THE REPRODUCTIVE SEASONALITY OF AN ALTERNATIVE RABBIT KEEPING SYSTEM

González-Redondo P.[1]*, Negretti P.[2], Finzi A.[2]

[1]Departamento de Ciencias Agroforestales, Escuela Universitaria de Ingeniería Técnica Agrícola, Universidad de Sevilla, 41013 Sevilla, Spain
[2]Rabbit and Guinea Pig Unconventional Keeping Experimental Centre, Animal Production Department, University of Tuscia, 01100 Viterbo, Italy
*Corresponding author: pedro@us.es

ABSTRACT

With the aim of analysing the reproductive seasonality of an alternative rabbit keeping system, the reproductive and productive parameters were checked for a whole year (from the spring of 2006 to the winter of 2007 included) in a farm located in the Viterbo province (Italy). Fifty-four does and 9 bucks belonging to the Leprino di Viterbo breed were kept in an alternative underground cells outdoors system. Animals were managed by natural mating 10 days after parturition according to a two-weeks cycle. Prophylaxis was done by stamping out any suspected animal. Does gave an average of 7.3 births per year, producing 56.7 total kits born, 52.1 kits born alive, 42.0 weaned kits, and 40.7 fattened kits per year. Fecundity was 80.3% and fertility was 67.6%. Observed differences according to season were not significant. Average fertility was slightly lower than in the Italian industrial rabbit farming. Total kits born (7.7), kits born alive (7.1), kits born dead (0.6) per litter, and perinatal mortality (9.0%) did not show differences between seasons. Mortality during lactation (19.8%) and the number of weaned kits per litter (5.7) showed variability throughout the seasons, being the mortality during lactation higher ($P<0.001$) and the number of weaned kits lower ($P<0.05$) in summer. Mortality during the fattening period was lower than in industrial farming. The analysis of the management of this alternative farm that raises the Leprino di Viterbo breed under an open air system without pharmacological treatments highlights that this alternative system can produce about 100 kg of high quality meat per doe and year. Rabbits are sold at the price of € 3.13/kg live weight offering a good income to small farmers that raise rabbits to integrate their income with a part-time work. Furthermore, this alternative system makes it possible to reduce the productive seasonality due to the fact that underground cells fit well with bioclimatic and ethological needs of the rabbit.

Key words: Rabbit, Unconventional keeping, Quality, Management.

INTRODUCTION

After the historical phase of the industrial development aimed to maximize meat production the interest of consumers has began to request, in Italy, an improvement of quality also with reference to rabbit meat (Dalle Zotte, 2002; D'Andrea *et al*., 2004; Failla *et al*., 2004; Finzi *et al*., 2004). Two points are emerging as most important to improve meat quality: animal welfare and reduction of pharmacological prophylactic or therapeutic means (Finzi, 2004; Finzi *et al*., 2005; Finzi, 2007; Finzi and Negretti, 2007).

This line of research has been followed by the Unconventional Rabbit Keeping Centre in Viterbo since the first 80's. This was not the consequence of a prevision of future exigencies, but simply the need of helping rabbit keeping in developing countries where industrial production was very impaired by specific climatic, nutritional and environmental conditions and where pharmacologic prophylaxis or therapy was impaired by costs, problems of conservation and difficult supply reasons.

An alternative keeping system was developed to protect the animal from heat stress in North Africa (Finzi, 1987; Finzi *et al.*, 1992a, 1992b). It was later found that it was a very appropriate system to maintain good health conditions when it was applied in Italy. The alternative units which raised rabbits to integrate the rural income in the small properties gave a good profit and the keeping system had a sufficient wide spreading, mainly in the Viterbo province (Finzi, 2004; Finzi and Macchioni, 2004; Finzi *et al*., 2004).

Small farmers generally don't keep any registration of management, but a good opportunity of getting production data was offered by a new unit set in function in 2005 by a cooperative to help the prisoners in the period of half-freedom.

MATERIALS AND METHODS

The small farm produced vegetables and had an available area of 1,300 m^2 where 63 underground cells were built to house 54 does and 9 bucks. The exceeding number of bucks was related with the adoption of a selection program for the breed Leprino di Viterbo (ANCI-AIA, 2006). This breed was specifically selected for open air keeping (Finzi, 1990; Finzi *et al.*, 1995). The sheltering system has been already described (De Lazzer and Finzi, 1992; Finzi, 2004). A full image is shown in Figure 1 and the underground explorable cell containing the nest is shown in Figure 2. The underground cell (50×50×50 cm^3) offers self-conditioned environmental conditions that are cooler in summer and fit to protect the animals from heath stress.

The management was characterised by: a two-weeks cycle; natural mating 10 days after parturition; pregnancy diagnose at 14 days; control of births and fostering to 8 kits (in some cases 7 or 9); weaning at 35 days; slaughtering at 11 weeks at a live weight of about 2.5 kg. Water (drinking nipple) and feed (industrial hopper) were administered *ad libitum*. The feed for reproduction and fattening was the same industrial no medicated pellet containing 17% both crude protein and crude fibre and added with a vitamin mash.

Microbial dispersion in the open air reduced the possibility of the transmission of illnesses from one animal to another and the physical separation of each doe avoided contamination by direct contact. Prophylaxis was improved by stamping out of any suspected animal. In the fattening cages, where three rabbits were kept, while the suspected animal was immediately eliminated, its brothers were transferred to a special quarantine area. Though allowed no vaccination was done, not anyway during the controlled period. The plastic slatted base platforms in the cage and in the underground cell were kept very clean to avoid coccidiosis. Anyhow they were substituted and put in a 0.5 chlorine solution after each reproduction cycle.

Figure 1: Overview of the keeping system

Figure 2: Underground cell

The reproductive and productive parameters were checked for a whole year, from the spring of 2006 to the winter of 2007 included. A descriptive analysis of the reproductive parameters was performed, and the influence of the season on fecundity and fertility was checked by chi-square tests. For the other parameters, one-way analysis of variance was performed if the variables showed homogeneity of variance, and Kruskall-Wallis tests' if the variables showed heterogeneity of variance. In the analysis of variance, differences between the means were evaluated by the Duncan's test. The statistical analyses were performed using the SPSS 9.0 program (SPSS Inc. 1999).

RESULTS AND DISCUSSION

Table 1 shows average productivity per doe and year. The average number of kits reached a good value (52.1 born alive) compared to that usual under industrial systems (Ramon *et al*., 2003; Xiccato and Trocino, 2007). This is partly due to the fact that the Leprino di Viterbo breed is slightly lower prolific than the hybrids used in industrial rabbit farming but fertility is higher (Finzi, 2007) The number of 42.0 weaned was rather low but mortality in the fattening period was also low (3.2%) so that the total of rabbits sold/doe/year was 40.7. This value must be considered quite satisfactory considering that the selling price was high (€ 3.13/kg live weight and the mean gross income was € 318.5/doe/year). As a logic consequence, the farm is now doubling the raising structures to increase the production. Another positive point is that the price was constant all the year long, due to the very appreciated quality of the meat and to the fact that the purchasers considered the keeping system as healthy and friendly to the animals.

Table 1: Average productivity per doe and year

	Value per doe and year	Ramon *et al.* (2003)		Xiccato and Trocino (2007)
		1992	2001	
Total kits born	56.7	62.9	63.0	-
Kits born alive	52.1	-	-	-
Kits born dead	4.6	-	-	-
Weaned kits	42.0	50.2	51.5	47.0
Fattened kits	40.7	47.1	47.0	43.7
Average number of births	7.3	7.3	6.7	6.5

Fecundity and fertility evolution throughout the four seasons (Table 2) evidenced that both parameters showed good values even in summer and autumn, when their values are usually more reduced, provided that the reduction of their values compared to the ones of the rest of the year was not significant. Average fecundity showed an optimum value compared to the typical one in industrial rabbit farming. However, fertility was of intermediate range, slightly lower than in the Italian industrial rabbit farming (Xiccato and Trocino, 2007).

Table 2: Seasonal variation in reproductive parameters

Reproductive parameter	Spring (n=138)	Summer (n=158)	Autumn (n=135)	Winter (n=153)	Mean (n=584)	P
Fecundity (%)[1]	83.3	75.9	77.0	85.0	80.3	0.127
Fertility (%)[2]	73.9	63.3	63.7	69.9	67.6	0.160

[1]Percent of positive palpations at 14 days after mating; [2]Percent of parturition of mated does

Fertility could be enhanced by optimizing the use of the bucks in mating. Indeed, the average number of matings per buck and day of mating was 2.3, but a detailed analysis revealed that a significant proportion of bucks was underutilised, being mated with a single doe. In contrast, other bucks were overexploited, being mated with three and four does per day (Table 3).

Variations in prolificacy (total kits born and kits born alive) and perinatal mortality values throughout seasons (Table 4) were not significant. However, mortality during lactation and, therefore, the number of weaned kits, showed variability throughout the seasons, being the mortality higher and the number of weaned kits lower in summer.

Table 3: Frequency of mating (*n* and percentage) done by bucks in one day[1]

Number of mating per day[2]	Spring (n=62)	Summer (n=60)	Autumn (n=59)	Winter (n=70)	Total (n=251)
1	10 (16.1)	6 (10.0)	11 (18.6)	13 (18.6)	40 (15.9)
2	30 (48.4)	22 (36.7)	27 (45.8)	34 (48.6)	113 (45.0)
3	20 (32.3)	21 (35.0)	14 (23.7)	19 (27.1))	74 (29.5)
4	2 (3.2)	11 (18.3)	7 (11.9)	4 (5.7)	24 (9.6)

[1] χ^2=13.610; P=0.137; [2]Number or does mated to each buck in the day in which mating were carried out

Perinatal mortality remained in the normal range if compared with industrial farming, thus revealing the suitability of the underground cell to be used as nest box (Finzi, 2007). But significant differences were observed with reference to mortality during the lactation period and to the number of weaned kits, being the mortality higher and the number of weaned lower in spring and mainly in summer (P<0.05).

Table 4: Seasonal variation in kits obtained and mortalities per litter

Parameter	Spring (n=102)	Summer (n=100)	Autumn (n=86)	Winter (n=107)	Mean (n=395)	P
Total kits born	8.0 ± 0.3	7.3 ± 0.3	7.6 ± 0.2	7.9 ± 0.3	7.7 ± 0.1	0.302
Kits born alive	7.3 ± 0.3	6.8 ± 0.3	7.1 ± 0.2	7.2 ± 0.3	7.1 ± 0.1	0.617
Kits born dead	0.7 ± 0.1	0.5 ± 0.1	0.5 ± 0.1	0.7 ± 0.2	0.6 ± 0.1	0.535
Perinatal mortality (%)[1]	9.8 ±1.8	10.7 ± 2.5	6.3 ± 1.3	9.6 ± 1.9	9.0 ± 1.0	0.302
Weaned kits[2]	5.6 ± 0.3 a,b	5.1 ± 0.3 b,c	6.0 ± 0.2 a	6.0 ± 0.3 a	5.7 ± 0.1	0.031
Mortality during lactation[2,3]	23.6 ± 3.1 a	25.1 ± 2.9 a	14.0 ± 2.4 b,c	17.0 ± 2.9 a,b	19.8 ± 1.4	0.000

[1]Calculated as kits born dead related to total kits born. [2]Values accompanied with different letter in the same row are significantly different (P<0.05). [3]Calculated as kits died during lactation related to kits born alive

CONCLUSIONS

The analysis of the management of an alternative farm that raises the Leprino di Viterbo breed under an open air system without pharmacological treatments and keeping the rabbits in underground cells highlight that this alternative system makes it possible to reduce the productive seasonality due to the fact that underground cells fits well with bioclimatic and ethological needs of the rabbit. About 100 kg of high quality meat per doe and year can be produced and the high selling price obtained, together with the low inversion costs, make well economically rentable the keeping system.

ACKNOWLEDGEMENTS

We thank the facilities given by the directive staff and workers of the Cooperativa Sociale Zaffa (Viterbo) to undertake this study in their farm.

REFERENCES

ANCI-AIA 2006. Norme tecniche del libro genealogico e del registro anagrafico della specie cunicola. *ANCI, Rome, Italy.*

Dalle Zotte A. 2002. Perception of rabbit meat quality and major factors influencing the rabbit carcass and meat quality. *Livestock Production Science, 75, 11-32.*

D'Andrea S., Pincu M., Menesatti P., Negretti P. 2004. Spectrocolorimetric recognition of Biological Rabbit Meat. *In: CIGR International Conference, 2004 October, Beijing, China, Paper n° 20-157A.*

De Lazzer M.J., Finzi A. 1992. Efficiency of three different housing systems in reducing heat stress in rabbits. *In: Proc. 5th World Rabbit Congress, 1992 July, Corvallis, USA, Vol. B, 745-750.*

Failla S., Contò M., Ballico S., Concetti S., Negretti P. 2004. Performances and meat quality of Leprino di Viterbese breed rabbit, bred with three different housing systems. *In: Proc. 50th Intern. Congress of Meat Science and Technology, Helsinki, Finland, 286.*

Finzi A. 1987. Technical support to agricultural development and settlements in West Noubaria – Egypt. *Technical report, FAO, Project EGY/85/001.*

Finzi A. 1990. Recherches pour la sélection de souches de lapins thermotolérants. *Options Méditerraéennes. Série Séminaires, 8, 41-45.*

Finzi A. 2004. An unconventional rabbit-keeping system to produce high quality meat. *In: Proc. 1ª Conf. Intern. Ecológica en el sur de Europa, Zamora, Spain, 83-89.*

Finzi A. 2007. From food security to high quality meat: only one unconventional system. *In: International Conf. on Rabbit Production, Indonesian Centre for Animal Research and Development y World Rabbit Science Association, 2007 July, Bogor, Indonesia.*

Finzi A., Bernava A., Macchioni P., Negretti P. 2005. Prove di valutazione del benessere nel coniglio. *In: Convegno: Approcci metodologici alla valutazione del benessere animale: esperienze a confronto. Fondazione Iniziative Zooprofilattiche e Zootecniche, 2005 December, Brescia, Italy.*

Finzi A., Macchioni P. 2004. WRSA points of view about rabbit welfare. *Agricolture and biotechnology, "Multi-facetted research in rabbits: a model to develop a healthy and safe production in respect with animal welfare". COST Action 848, WG2: Welfare and Housing, 2004 October, Milano, Italy.*

Finzi A., Margarit R., Macchioni P. 1995. Rabbit germplasm utilisation to produce a synthetic breed fit to Mediterranean climates*. In: Int. Symp. on Mediterranean Animal Germplasm and Future Human Challenges. Benevento, Italy, 201-202.*

Finzi A., Mariani G., Albani A. 2004. Producción cunícola de calidad. *In: Proc. XXIX Symposium de Cunicultura ASESCU, CD-ROM, Lugo, Spain.*

Finzi A., Negretti P. 2007. Un sistema alternativo di allevamento per il benessere e la sanità del coniglio. *In: Proc. Giornate di Coniglicoltura ASIC, 2007 September, Forlì, Italy, 41-54.*

Finzi A., Nyvold S., El Agroudi M. 1992a. Evaluation of heat stress in rabbits under field conditions. *In: Proc. 5th World Rabbit Congress, 1992 July, Corvallis, USA, Vol. B, 739-744.*

Finzi A., Nyvold S., El Agroudi M. 1992b. Efficiency of three different housing systems in reducing heat stress in rabbits. *In: Proc. 5th World Rabbit Congress, 1992 July, Corvallis, USA, Vol. B, 745-750.*

Ramon J., Rafel O., Piles M. 2003. GTE 2001. Resultados de gestión en España. *Boletín de Cunicultura, 130, 13-15.*

SPSS Inc. 1999. SPSS 9.0. Manual del usuario. *SPSS Inc., Chicago, USA.*

Xiccato G., Trocino A. 2007. Italia, un sistema de producción cunícola integrado. *In: Proc. II Congreso Ibérico de Cunicultura, ASESCU-APEZ, 2007 June, Vila Real, Portugal, 175-184.*