REPRODUCTIVE PERFORMANCE IN A LOCAL RABBIT POPULATION REARED UNDER ORGANIC AND CONVENTIONAL SYSTEM

PRESTAZIONI RIPRODUTTIVE DI UNA RAZZA/POPOLAZIONE LOCALE ALLEVATA CON METODO BIOLOGICO E CONVENZIONALE

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SUMMARY

The aim of this work was to compare the reproductive performances of a local rabbit-population reared under organic or conventional systems. A total of 35 does and 10 bucks were reared under conventional system in the Experimental Rabbit Station of the Department of Animal Production and a total of 22 does and 6 bucks were reared under organic technique in a certified farm. During the two-years period, the following reproduction parameters were calculated: fertility, delivery-interval, gestation-length, birth mortality-rate and pre-weaning mortality-rate.

Fertility rate showed good values independently from the rearing technology (94.3% in nulliparous). The organic system significantly reduced the gestation-length (31.1d *vs.* 31.7d) and the birth-mortality (9.1% *vs.* 23.5%). Delivery periods significantly influenced fertility (better performances resulted during June-September, 97.6%, than February-May, 94.0%, and October-January, 85.7%). Number of weaned per doe resulted better during October-January than February-May and June-September (6.1 *vs.* 5.2 and 3.1, respectively).

The studied population showed adequate productive response and, for this reason, could be reared under conventional technology but was better fitted to the organic system for their rusticity, good fertility, prolificacy and resistance in poor rearing-conditions.

Key words: rabbit, population, organic production, reproduction.

RIASSUNTO

Scopo del presente lavoro è stato quello di valutare le prestazioni riproduttive di una razza/popolazione locale di conigli, allevata con metodo convenzionale e sistema biologico.

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35 femmine e 10 maschi sono stati allevati con il metodo convenzionale presso la stazione sperimentale del Dipartimento di Produzioni Animali, e 22 femmine e 6 maschi sono stati allevati con il metodo biologico presso un allevamento certificato. Per un periodo complessivo di due anni sono stati raccolti i seguenti dati: data presentazione al maschio, data parto, numero coniglietti nati vivi, mortalità e numero coniglietti svezzati per nidiata. Sono stati quindi determinati i principali parametri di valutazione dell'efficienza riproduttiva: fertilità, intervallo interparto, durata di gestazione, mortalità alla nascita e pre-svezzamento.

La fertilità complessiva della popolazione è risultata più che soddisfacente (94,3% nelle nullipare). L'allevamento biologico ha ridotto significativamente la mortalità alla nascita (9,1% vs. 23,5%) e la durata della gestazione (31,1 giorni vs. 31,7 giorni). L'epoca di parto ha influenzato significativamente la fertilità (le migliori performance sono state rilevate nel periodo primavera-estate: 97,6%, vs. 94,0% e 85,7% rispettivamente in febbraio-maggio e ottobre-gennaio). Il numero di svezzati per coniglia è risultato più favorevole nell'autunno-inverno indipendentemente dalla tecnica di allevamento adottata (6,1 vs. 5,2 e 3,1 rispettivamente nei periodi febbraio-maggio e giugno-settembre). Nel complesso i risultati conseguiti su un numero relativamente contenuto di soggetti, scarsamente selezionati, hanno evidenziato un buon grado di rusticità e pertanto una valida capacità di adattamento alla tecnica di allevamento biologico della razza popolazione esaminata.

Parole chiave: coniglio, popolazione, produzione biologica, riproduzione.

INTRODUCTION

In recent years nutrition and health have had an increasing influence on consumers' food choices, actually consumers prefer food produced in according to organic production and prefer to pay higher prices to obtain this kind of products.

The organic rabbit production must be considered as an important contribution to assure food security, even if, actually, it is quite limited.

The EEC-Regulation 1804/1999 provides the guidelines for the organic livestock system which sets the rules for housing conditions, nutrition, breeding and animal care, disease prevention and veterinary treatments but gives insufficient indications for rabbit rearing.

Particularly, regarding to the choice of breed, the Regulation states that "account must be taken of the capacity of animals to adapt to local conditions, their vitality, and their resistance to disease". In addition slow-growing animals are recommended for the capacity of fitting the open air breeding system and to support a long rearing period for meat production.

Actually regarding the "origin of the animals", the role of pure breeds and local strains in rabbit meat production has been dramatically broken. However pure breeds and local strains constitute an unique reserve of genetic variability for their fitness to open air rearing and potential diversity (Bolet et al., 2000). They can adapt to organic production, improving also meat quality, for their vitality, capacity to adapt to local conditions, better thermoregulation and slow-growing. Slow-growing genotypes are needed in the organic systems and their use is related to the combination of a lower nutrition requirement, a better rusticity and a satisfactory productive performance.

Few investigations have been carried out on the organic rabbit production at the present and the carried out trials often considered only single effects. The results, shown by the literature, even if supply useful suggestions for the alternative production, advise the need to carry out further researches on the effect of the organic method applied to the rabbit production.

The aim of this work was to compare the reproductive performances of a small rabbit population (a local breed), reared under organic and conventional systems.

MATERIAL AND METHODS

The starting population, (recovered in 2002) was constituted by 25 does and 6 males. From this population a total of 35 does and 10 bucks were reared under the conventional system and 22 does and 6 bucks were reared under organic technology.

The rabbit reared under conventional system were kept in the Experimental Rabbit Station of the Department of Animal Production, Pisa-University; the rabbitry was supplied by a forced ventilation system under a light program of 16 hours per day and the rabbits were housed in wire flat-deck cages measuring cm 50 x60 x h 45 with a nest-box (35 x 35 x h 30 cm) outside the cage. The rabbits reared under the organic technology were kept in a certified farm, according to the directions of the EC Regulation (1804/1999 and following supplementing) and of an official organism of certification (AIAB); the animals were housed in wooden cages in pen at open-air under natural light, the wooden-cages: cm 131 x 160 x h 55, were provided with

plastic slats floor and divided in three sections by wooden walls to house three does or bucks each; internal nest-boxes (cm 30 x 55 x h 55) were supplied 3-4 days before the foresee delivery date.

The data of 184 deliveries were collected during a two-years period (2002-2003).

Males were first mated at 5 months of age; females reared under the conventional system were mated at 4.5 months of age while females reared under the organic system were mated at 5.5 months of age. Natural mating was applied with a theoretical semi-intensive reproduction rhythm (females were presented to the male 15 days after parturition: 47 days delivery interval) but sometimes the parturition interval was extended until post-weaning, to respect the rules stated by the certification organism, which states no more than 6 deliveries per female per year.

Pregnancy diagnosis (abdominal palpation) took place 15 days after each mating. No pregnant does were re-presented to male the day after palpation and re-bred three times until diagnosed as pregnant. After the third negative mating the female was culled. Receptivity of every doe was based on the colour and turgency of the vulva observed just before the mating. The mating program was performed to reduce the inbreeding.

Free suckling system was applied in both rearing techniques. Nest boxes were inspected every morning and day old dead rabbits were removed. Suckling rabbits were weaned at 35 days of age, according to the rules of the certification organism.

Animals were *ad libitum* fed with an organic diet constituted by hay (about 60%) and concentrate (about 40%): alfalfa was used as hay (chemical composition on dry matter: crude protein 14.1%, ether extract 1.8%, crude fibre 39.9%); concentrate was constituted by barley, oat and wheat (chemical composition on dry matter: crude protein 12.5%, ether extract 3.3%, crude fibre 7.9%).

Disease prevention was based exclusively on phyto-therapy and homeopathic products.

The following parameters were monitored: mating-day, delivery-day, total born, total alive, and weaned rabbits. During the two-years period, the following reproduction parameters were calculated: fertility, delivery-interval, gestation-length, birth mortality-rate and pre-weaning mortality-rate.

Birth litter size (born rabbits and born-alive rabbits), weaned-rabbits per delivery, delivery interval, gestation length, total litter weight and weaning weights were analysed in relationship to the two rearing technologies (organic or conventional), the three physiological conditions (nulliparous, primiparous, and multiparous) and the three delivery periods (October-January, February-May, and June-September) by ANOVA with minimum statistical differences calculated according to Bonferroni confidence intervals (either main effects and all possible interactions, calculated). Fertility and mortality rates (at birth and during suckling) were analysed by chi-square tests (SAS, 2002).

RESULTS AND DISCUSSION

The main effects of rearing technology, physiological status and delivery period on reproductive performances are reported in Table I. Only the results of the interaction between rearing system * physiological status and between rearing system * delivery period were reported since the 2nd level interaction and the physiological status * delivery period interaction were not significant.

Fertility rate, considered as percentage of services per delivery, showed good values (92.5%), particularly if compared with the production obtained by the selected lines in which the fertility can be vary from 85% to 40% in relationship with their physiological status (Castellini & Boiti, 1999). This local population show good fertility rates not only in the nulliparous (94.3%) but also in the primiparous (91.9%), while in commercial hybrids the primiparous often show the lowest fertility-rates in relationship to their uncompleted body-growth. In our experience, in both the rearing technologies, a semi-intensive and an extensive reproduction-rhythm were adopted so that the females completed their growth before the second mating. Probably, the highest level of fertility could be also explained by the receptivity condition, since the females were mated only when the receptivity signs were well clear. Delivery periods significantly affected the fertility-rate (Tab. I): the best fertility was observed during spring-summer, when the photoperiod is longer than 12-14 hours (97.6% in June-September *vs.* 94.0% and 85.7% during February-May and October-January, respectively, $P < 0.05$).

Tab. I. Main effect of rearing system, physiological status, and delivery period on rabbit reproductive performance.

		Rearing system		Physiological status			Delivery period			Overall mean
		Organic	Conventional	Nulliparous	Primiparous	Multiparous	Oct.-Jan.	Feb.-May	June-Sept.	
Litters	n.	106	78	56	36	92	84	54	46	184
Fertility	%	91.7	93.2	94.3	91.9	91.3	85.7 b	94.0 ab	97.6 a	92.5
Gestation length	d	31.1 b ± 0.71	31.7 a ± 0.84	31.2 ± 0.75	31.6 ± 0.79	31.5 ± 0.79	31.2 ± 0.79	31.6 ± 0.76	31.4 ± 0.78	31.4
Delivery interval	d	66 ± 24.6	80 ± 38.1	-	76 ± 27.9	71 ± 30.7	73 ab ± 31.4	87 a ± 32.1	60 b ± 30.0	74
Total born	n.	7.5 b ± 3.11	8.9 a ± 2.78	7.9 ± 2.97	8.6 ± 3.60	8.1 ± 2.87	8.8 ± 2.81	8.0 ± 3.32	7.8 ± 3.11	8.2
Born alive	n.	6.7 ± 3.09	7.1 ± 3.63	6.8 ± 3.37	6.7 ± 3.97	7.2 ± 3.08	7.7 ± 3.35	6.6 ± 3.49	6.4 ± 3.07	6.9
Birth mortality	%	9.1 a	23.53 b	14.8	21.6	12.5	11.1	18.1	19.8	16.3
Pre-weaning mortality	%	25.2	30,5	25.1	34.0	24.4	18.9 b	20.1 ab	44.4 a	27.8
Weaned	n.	5.0 ± 3.28	4.6 ± 3.66	5.2 ± 3.56	3.9 ± 3.65	5.4 ± 3.30	6.1 a ± 3.18	5.2 ab ± 2.29	3,1 b ± 3.54	4.9
Weaning weight	g	722 ± 237.1	803 ± 214.9	787 ± 251.7	724 ± 287.2	775 ± 212.7	787 ± 240.5	678 ± 211.6	822 ± 252.6	708.9

The high fertility-rates showed the typical variation in relationship with the different seasons. In both the rearing systems and in the same season the females showed similar fertility values (Tab. II), but fertility increased in advance (February-May) under conventional conditions (natural light + artificial light = 16L:8D) while, under organic-conditions (natural light), fertility-rates increased only during the long days (June-September). In fact, the favourable influence of long daylights and the positive effect of increasing day-lengths is well known on the reproductive performance of the rabbit reared under temperate climates (Depres et al., 1996; Theau-Clement et al., 1991; Theau-Clement, 2000; Uzcategui & Johnston, 1992). Day-length affect the emission of pheromones, and, the 16-h day-length is considered the daylight which can increase the emission of pheromones, the receptivity of the doe and the litter size compared to shorter day-lengths (Hudson & Distel 1990, Depres et al., 1996).

The rearing technology also significantly affected the gestation-length (Tab. I): the does reared in rabbitry showed the longest gestation than the females reared under organic system at open air (31.7d *vs.* 31.1d, $P < 0.05$). It has been recognised that the environment plays an important role in the regulation of reproductive function and that environmental-*stimuli*, which acts through the nervous system and the hypothalamo-pituitary axis, can affect the reproductive physiology controlled by hormones (Theau-Clèment, 2000). Environmental-*stimuli*, more strong at open air, such as temperature variations, auditory and/or olfactory -*stimuli*, affect the animals by stressing them. These *stimuli* associated with the natural day-length changings, can modify the reproductive performance and the hormonal balance, consequently, the onset of the deliveries.

The seasons significantly affected also the delivery interval (Tab. I). The does during the February-May period showed the longest deliveries intervals (87d in February-May *vs.* 60d in June-September, $P < 0.05$). The observed intervals were unusually long, since the reproduction rhythm used (15 days after delivery alternate with post-weaning) affected the obtained intervals, in addition to the big variance observed between females.

The rearing system significantly also affected the prolificacy (Tab. I). The females reared under the conventional system produced the higher number of born per litter than those reared under the organic

system (8,9 *vs.* 7,5, $P < 0.05$). The environmental condition affected prolificacy, probably due to the better condition of the rabbitry-housed does; moreover prolificacy is a maternal trait which can be affected by individuals, physiological status and sanitary condition and not only by the environment and the nutritional status which could differ between the two different farms.

Rearing-system and the interaction between rearing-system and delivery-season also affected birth-mortality. The litters of does housed under conventional system showed the higher percentages of mortality than those reared at open air (23.5% *vs.* 9.1%, $P < 0.05$; Tab. I); the worst results appeared in the conventional system during the spring-summer period ($P < 0.05$, Tab. II).

Delivery periods significantly affected pre-weaning mortality-rates (Tab. I): the higher mortality-values were observed during the spring-summer period (44.4% *vs.* 18.9% during June-September and October-January, respectively; $P < 0.05$). The interaction between rearing-system and physiological-status significantly affected the pre-weaning mortality, the litters of nulliparous reared at open air showed the lower mortality rate than those of the nulliparous reared under conventional system (Tab. II).

The number of weaned rabbits was significantly affected by the season (Tab. I) (6,1 in October-January *vs.* 3,1 in June-September, $P < 0.05$).

The number of weaned was similar in the two rearing system because, even if mortality-rate was lower in the organic system, the number of total born and alive was lower than in the conventional system (Tab. I). The observed results on mortality could be determined by several factors which could have differently acted in the two farms: -environmental-temperature, -diseases, -free suckling system (mortality in the nest during the first 10 days due to the behavioural answer to the environmental-stimuli of the females), -inbreeding (due to the restricted number of males and females), etc.

The rearing system and season strongly affected mortality. It is necessary underline that, during the end of the spring and for the whole summer of the second study-year, we observed the worst climatic conditions for the rabbit welfare, particularly for rabbitry-reared animals, since the temperature was over 30°C for long periods. Authors reported high mortality in summer due to the direct effect of

Tab. II. Rabbit reproductive performance in relationship to physiological status and delivery period in the two rearing systems.

Rearing system X Physiological status		Organic system			Conventional system		
		Nulliparous	Primiparous	Multiparous	Nulliparous	Primiparous	Multiparous
Litters	n	21	20	65	35	16	27
Fertility	%	92.1	91.0	92.0	96.4	92.8	90.5
Gestation length	d	31.0 ± 0.63	31.0 ± 0.69	31.3 ± 0.73	31.3 ± 0.80	32.1 ± 0.81	31.7 ± 0.88
Delivery interval	d	-	66 ± 28.8	66 ± 30.7	-	86 ± 27.7	75 ± 43.6
Total born	n	7.2 ± 2.99	7.6 ± 3.49	7.7 ± 3.07	8.7 ± 2.83	9.5 ± 3.18	8.5 ± 2.22
Born alive	n	6.5 ± 2.71	6.8 ± 3.61	6.8 ± 3.07	7.1 ± 3.71	6.7 ± 4.29	7.5 ± 3.11
Birth mortality	%	6.5	10.3	10.7	23.2	33.0	14.4
Pre-weaning mortality	%	9.0 b	40.4 ab	26.1 ab	41.2 a	27.5 ab	22.7 ab
Weaned	n	6.0 ± 2.95	3.8 ± 3.53	5.3 ± 3.30	4.4 ± 3.90	4.0 ± 3.81	5.5 ± 3.33
Weaning weight	g	729 ± 281.1	746 ± 302.7	690 ± 189.2	845 ± 165.5	702 ± 277.3	862 ± 217.0
Rearing system X delivery period		Organic system			Conventional system		
		Oct.-Jan.	Feb.-May	June-Sept.	Oct.-Jan.	Feb.-May	June-Sept.
Litters	n	40	37	29	44	17	17
Fertility	%	87.3	89.7	98.1	84.1	98.3	97.2
Gestation length	d	31.0 ± 0.65	31.2 ± 0.70	31.2 ± 0.79	31.4 ± 0.88	31.9 ± 0.87	31.7 ± 0.81
Delivery interval	d	70 ± 21.1	72 ± 29.4	57 ± 22.6	77 ± 42.2	102 ± 41.8	62 ± 24.8
Total born	n	7.9 ± 2.67	7.6 ± 3.64	7 ± 3.03	9.7 ± 2.73	8.5 ± 2.48	8.5 ± 3.16
Born alive	n	6.7 ± 2.89	7.0 ± 3.51	6.4 ± 2.88	8.8 ± 3.59	6.1 ± 3.56	6.3 ± 3.46
Birth mortality	%	11.6 ab	6.9 b	8.9 ab	10.6 ab	29.3 ab	30.7 a
Pre-weaning mortality	%	16.5	24.0	35.1	21.4	16.3	53.8
Weaned	n	5.8 ± 3.12	5.6 ± 3.2	3.6 ± 3.42	6.5 ± 3.23	4.8 ± 3.59	2.5 ± 3.75
Weaning weight	g	707 ± 257.4	667 ± 208.7	791 ± 242.3	868 ± 176.5	689 ± 225.3	852 ± 298.3

heat stress on the sensitive young offspring, in addition to reduction of dam's milk production as a result of the general depression of metabolic activity (Ayyat & Marai, 1998; Ayyat et al., 1995; Marai et al., 1996; Rashwan & Marai, 2000).

CONCLUSION

The studied population showed the capacity of fitting either to the organic rearing system or to the conventional system. The rearing technology at open air positively affected the sanitary condition and the productive performances, particularly during summer (the most unfavourable rabbit-season in our climate). The population showed good fertility and prolificacy and resistance to the poor rearing-conditions typical of the organic system. However, productive responses were adequate in relationship to the reason that, no allopathic treatment was used to control sanitary condition either under organic rearing (not allowed) or under conventional system (to maintain the rusticity of the population).

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