

STUDIES ON INTEGRATIVE MEASURES FOR RAISING THE REPRODUCTIVITY ABILITY OF THE DOMESTIC RABBIT DURING HOT SEASONS

Xu Lide¹, Yang Guanfu¹, Chen Zanmou¹, Huang Shaorong²,
Chen Jianru², Jin Shiyuan², and Ye Youfu³

¹ South China Agricultural University

² Guangdong Provincial Animal Husbandry Bureau

³ Hui Yuan Rabbit Farm

People's Republic of China

Abstract

The Angora rabbit can be made to maintain its normal reproductive level during hot seasons by applying integrative measures including supplemented feed additives, artificial insemination, manual assistance during natural mating, improved nutrition and selection of heat tolerant breeding bucks. Results of experiments over two years showed a conception rate for does of 89.3% and a survival rate for weaned young rabbits of 84.2%. Breeding does were fertilized under conditions of 34° C ambient temperature and had natural parturition at 36° C ambient temperature.

Introduction

The domestic rabbit is a homoiothermal mammal. It has a high metabolic rate, undeveloped sweat glands and slow heat loss. Suitable ambient temperatures for reproduction of rabbits are 15-25° C. If the ambient temperature is over 25° C, reproductive ability is affected. Reproduction stops during the hot season in the tropical and subtropical zones of China, sometimes for up to 5 months. Closed rabbit houses with controlled temperature and humidity are used in some foreign countries but at great expense. These are not feasible in China. The aims of this study were to investigate efficient measures of improving the fertility of rabbits during hot seasons. Several similar studies have been reported.

Materials and Methods

The experiment was carried out in the Breeding Rabbit Farm of South China Agricultural University. Sixty homebred offspring of Angora rabbits originating in Germany were selected for good health, normal reproduction, moderate figure type and similarity of age and embryo number. The experimental animals were kept in one house. The experiment was carried out during the hot seasons of June-September, 1987 and 1988, with results checked in the first year and the experiment repeated the second year. Integrative measures for raising the reproductive ability of rabbits during the hot season were as follows:

1. Feed additives were used, especially additives No. 101-105.
2. Semen samples were evaluated by volume, sperm motility, sperm concentration, and pH two times per month during the two year experimental period. If sperm motility was up to 0.6, semen freezing conservation would be used. Heat-tolerant bucks were selected according to semen quality.
3. Mating: Artificial insemination required that sperm motility of fresh semen was up to 0.5 and that of frozen semen up to 0.3. The semen dosage was 0.2 ml. Natural mating was manually assisted. After mating, semen quality was examined. If the sperm motility was low to 0.4, mating would be done again.
4. Improvement of nutritive level and environmental conditions: Mixed granular feeds were made according to N.R.C. and F. Lebas feeding standards for the domestic rabbit. The animals were fed at fixed times, and given fixed quality feed in fixed quantities, to meet the nutrient requirements of reproduction. To circulate air in the rabbit house electric fans were installed and the gates and windows were opened. Wool of the Angora rabbits had been sheared before mating.
5. The semen quality of bucks fed in the artificial climatic box was examined at different temperatures to study the relationship between high temperature and semen quality. Bucks whose semen quality was better were selected for breeding during the hot season.
6. To investigate the relationship between genetic variant type and reproductivity, the esterase-1 (ES-1) genetic variant type of Angora was checked with polyacrylamide gel electrophoresis. This provided the basis for selection of a heat-tolerant rabbit line for using ES-1 as genetic sign.

Results

The integrative measures for raising reproductive ability of the domestic rabbit during hot seasons were applied from June to December, 1987 and 1988. Experimental results are shown in Tables 1 through 4.

Results showed that the Angora rabbit could be made reach normal or close to normal reproductive level during hot seasons. The measures taken had a significant effect. Results over two years showed that average conception rate of does was 89.3%, kindling rate of does was 98.7%, survival rate of weaned young was 84.2% (Tables 1 and 2). Breeding does were fertilized under 35° C ambient temperature and had natural parturition at 36° C ambient temperature.

Table 1. Actual reproductive effects of the domestic rabbit during hot seasons.

Item/Year	Does No.	Heat & Mating Doe No.	Conception Does No.	Mating No. in Heat Period	Conception Does No. in Heat Period	Kindling No.	Total Kindled No.	Total Weight Newborn kits (g)	Weaning Kit No.
1987	50	44	39	89	39	38	150	7279	148
1988	50	50	45	68	45	45	151	7332	105
Sum	100	94	84	157	84	83	301	14611	253

Table 2. Reproductive ability of the domestic rabbit during hot seasons.

Item/Year	Does Conception Rate (%)	Conception Rate During Heat Period (%)	Kindling Rate (%)	Kindling No. Each Litter	Live Weight Newborn Kits (g)	Survival Rate of Weaning Kits (%)
1987	88.6	43.82	97.4	3.87 ± 0.91	49.232 ± 3.90	98.70
1988	90.0	66.18	100.0	3.56 ± 0.79	52.40 ± 5.80	69.60
Average	89.3	55.00	98.7	3.60 ± 0.89	50.92 ± 5.25	84.15

Table 3. Mating and kindling temperature of reproductive does during hot seasons.

Items	Year	No.	Temperature (° C)											
			<25	26	27	28	29	30	31	32	33	34	35	36
Mating	1987	44	7	12	14	7		1	2			1		
	1988	45	6	5	4	10	20							
	Sum	89	13	17	18	17	20	1	2			1		
Kindling	1987	39	10	6	9	3	2	2	1	1		3	1	1 *
	1988	45	7	9	16	2		1	1	1		1	3	4
	Sum	84	17	15	25	5	2	3	2	2		4	4	5

* death.

Table 4. Distribution and proportion of temperature in mating and kindling of breeding does.

Item	Year	Total No.	<25° C		26-30° C		31-36° C	
			No.	%	No.	%	No.	%
Mating	1987	44	7	15.9	34	77.3	3	6.8
	1988	45	6	13.3	39	86.7		
	Sum	89	13		73		3	
	Average			14.6		82.0		3.4
Kindling	1987	39	10	25.6	22	56.4	7	18.0
	1988	45	7	15.6	28	62.2	10	22.2
	Sum	84	17		50		17	
	Average			20.6		59.2		20.1

The effects of supplementing feed additives were significant. According to two years' statistical data, comparing the experimental group with the contrast group, the increment of does conception rate was 32%; the increment of average kindling number was 57; the increment of nest weight was 3167 g; and the increment of newborn kit weight was 2.5 g. No. 105 feed additive was best for raising the reproductive ability of Angora rabbits: the average kindling number in two years was 4.5 ± 1.063 and newborn weight was 51.58 ± 3.15 g.

Results of examination of semen quality showed that semen quality changed as ambient temperatures increased or decreased. Semen quality was poorest in hot seasons. The percentage of bucks with sperm motility up to 0.5 was 47% in April and 18% in September (the highest ambient temperature month) in 1987. It began to increase in October and was up to 61% in December of 1987. Semen quality of the breeding buck increased very significantly in 1988 through selection of heat-tolerant bucks in 1987. For example, the percentage of bucks with sperm motility up to 0.5 was 36.3% in April to October and 25.7% during the hot seasons in 1987. But it was 61.0% in January to October and 50.5% during the hot season in 1988. Some bucks maintained their sperm quality in good state during the hot seasons of two years.

Desirable conception rate was gained by means of artificial insemination and manual assistance during mating. Conception rate for does in heat period were 43.8% in 1987 and 66.2% in 1988. Mating conception rate during hot seasons were 88.6% in 1987 and 90.0% in 1988. Sperm motility of 0.5 for fresh semen and 0.3 for frozen semen was required.

The sperm quality of bucks fed under conditions of an artificial climatic box decreased as temperature increased, with the effect of 31° C in the box greatest. With increased temperatures semen volume decreased and sperm motility decreased. Some bucks died during the highest temperatures. Experimental results showed that domestic rabbits respond individually to high

temperatures. Some maintain good semen quality, whereas others are negatively affected by high temperatures.

Polyacrylamide gel electrophoresis was used to check the esterase-1 (ES-1) genetic variant type of domestic rabbit. Kindling number of does and semen volume and sperm motility of bucks were investigated to compare with the reproductive ability of various genetic variant types. Results showed that the AB and BB types were better (Tables 5 and 6) and that esterase variant types were connected with the adaptation.

Table 5. Relationship between ES-1 phenotype and kindling number of does, semen volume and sperm motility of bucks.

Item	AA			BB			AB			Variance Analysis
	ΣXi	Ni	\bar{x}_i	ΣXi	Ni	\bar{x}_i	ΣXi	Ni	\bar{x}_i	
Kindling number each litter, 1987	24	7	3.43	21	5	4.2	44	12	3.67	F=0.978, P<0.05
1988	18	6	3.00	36	12	3.0	58	17	3.40	F=0.93, P>0.05
Semen volume (ml)	1.67	16	0.27	2.08	7	0.30	4.29	12	0.36	F=0.315, P>0.05
Sperm motility	1	6	0.17	2.12	7	0.30	3.50	12	0.29	F=1.64, P>0.05

Table 6. The ES-1 phenotype distribution of experimental animals.

Item/Phenotype	AA	BB	AB	SUM
Buck	1 (0.111)	1 (0.111)	7 (0.778)	9 (1.000)
Does	7 (0.170)	17 (0.415)	17 (0.415)	41 (1.000)
SUM	9 (0.180)	19 (0.380)	22 (0.440)	50 (1.000)

Note: Numbers in brackets are percentage.

Discussion

This study illustrated a series of measures which brought Angora rabbits to normal or close to normal reproductive level during hot seasons. It provides a scientific basis for the possibility of raising a heat-tolerant domestic line.

Heat loss from the rabbit's body is impeded under high temperatures. Increased temperatures result in physiological dysfunction and decreased reproductivity, as illustrated by

decreased semen quality in bucks and decreased conception rate in does, hypoplasia in embryos and abnormal parturition in does. To alleviate these problems, feed additives were used to adjust metabolism, promote heat loss, increase appetite and digestive function, and improve nutritional status. As a result, sperm production and semen quality were normal in bucks, and oestrus and number of live embryos during early pregnancy were normal in does. Embryos were prevented from being absorbed during middle pregnancy, and death and premature delivery or delayed delivery during late pregnancy were also prevented. Evaluating the semen quality of bucks and using artificial insemination and manual assistance during natural mating were important factors in guaranteeing good quality semen.

The semen quality of bucks fed under natural ambient conditions and in the artificial climatic box was checked. Results showed that semen quality decreased under conditions of high temperatures. Using artificial insemination with high quality semen collected during non-hot seasons and frozen was significantly effective. Examination of semen collected during high temperatures from bucks of various ES-1 types showed that heat tolerance differed individually and that it was possible to select a heat-tolerant line over time in a large colony of rabbits.

