Proceedings of the

7th World Rabbit Congress

4-7 july **2000** – Valencia Spain

These proceedings were printed as a special issue of WORLD RABBIT SCIENCE, the journal of the World Rabbit Science Association, Volume 8, supplement 1

ISSN reference of this on line version is 2308-1910
(ISSN for all the on-line versions of the proceedings of the successive World Rabbit Congresses)

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Volume B, pages 599-604

SURVEY ON WOOL YIELD IN ANGORA RABBITS OF DIFFERENT GENETIC BACKGROUND

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ABSTRACT

The authors examined the wool production of rabbits born from various matings (AxA, AxF1 and F1xF1) of purebred Pannon White normal-haired (N), German angora (A) and their single-crossed (F1=NxA or AxN) rabbits; the angora progeny carried the genes of normal-haired ones in proportions of 0, 25 or 50% (n=104, 38 and 20, resp.). The angoras were first shorn at 60 days of age, and subsequently every 82 to 85 days. It was established that, in addition to the angora gene, the other part of the genome also plays an influencing role in the wool production of angora rabbits. That is, in the AxA, AxF1 and F1xF1 matings, wool yield was found to decrease proportionate to increase in the N genetic background (0, 25 and 50%). At the first shearing the quantity of wool produced was determined primarily by body weight, but by the second, third and fourth shearings the genetic background had begun to exert a decisive influence on wool production.

INTRODUCTION

In the 1960s the Chinese angora rabbit was produced by crossing British or French angoras with local meat type rabbits. The present coarse-wooled hybrids (Su, Zhe and Wan III) were created when another local meat type, the SAB rabbit, was introduced into breeding programmes (SHEN, 1996; SHEN *et al*., 1997). Two Chinese breeds, the Tang Hang Angla (Chinese x German angora) and the Wanxi (New Zealand White x German angora) are dual purpose breeds (COLIN, 1995).

At present the greatest proportion of angora rabbit wool is produced by Chinese angoras back-crossed to various degrees (LIN *et al*., 1994). With the exception of publications by DAMME *et al*. (1985) and SHEN (1992), there is only extremely sparse information available on how wool production in angoras changes if their genetic make-up also contains genes originating from normal-haired rabbits.

After various matings performed with purebred normal-haired (N), angora (A) and their single-crossed (F1) rabbits (NxN, F1xN, NxF1, F1xF1, AxF1, AxA) the authors compared some reproduction indicators (EIBEN *et al*., 2000a), and examined the growth and slaughter traits of progeny of normal-haired or angora phenotype which also carried in their genetic background different ratios of the genes of the other type (EIBEN *et al*., 2000b).

The objective of the present study was to examine wool production in angora rabbits, born from the matings listed above (AxA, AxF1 and F1xF1), which also carried the genes of normal-haired rabbits in ratios of 0, 25 and 50%.

MATERIAL AND METHODS

At the experimental site of the University of Kaposvár various matings (NxN, AxA, F1xN, NxF1, F1xF1 and AxF1) were performed with purebred Pannon White normal-haired (N), German angora (A) and their single-crossed (F1) rabbits.

The animals were kept in a closed building with artificial lighting (16L:8D), in individual flat-deck wire mesh cages (80x50x40 cm). In winter warm air was blown in to heat the building (15-16°C); in summer, in the absence of air conditioning, the temperature at times rose above 25°C.

Throughout their growth and as adults the wool producing rabbits were fed *ad libitum* with the same commercially available pelleted rabbit feed (86% dry matter, 16.5% crude protein, 2.7% crude fat, 15.5% crude fibre, 0.70% lysine, 0.32% methionine, 0.60% Met+Cys, 10.3 MJ/kg digestible energy; pellet ∅ 3 mm). Drinking water was freely available from nipple drinkers. No hay supplementation was given.

The wool production of the angora progeny born from the AxA, AxF1 and F1xF1 matings (n=104, 38 and 20 respectively), which carried the genes of normal-haired rabbits in ratios of 0, 25 and 50% respectively, was evaluated up to the fourth shearing. The animals were first shorn at the age of 60 days, and subsequently every 82 to 85 days.

Statistical evaluation was performed in accordance with the GLM (General Linear Models) procedure with SAS version 6.09 software. The tables give the least square means (LSM) and the residual standard deviation (RSD). The factors affecting the respective traits (individual body weight and wool yield) were tested in the analysis of variance procedure, on the basis of the individual data recorded, account being taken of the fixed effects (shearing number, sex and season), by means of the following model for the live weight and wool production traits:

$Y_{ijklm} = \mu + G_i + H_j + S_k + Se_l + e_{ijkm}$

ahol Y_{ijklm} individual examined
μ overall mean
G_i effect of the percentage of N genome (i=0 %N, 25 %N, 50 %N gene part)
H_j effect of wool harvesting number (j=1, 2, 3, 4)
S_k effect of sex (k=male, female)
Se_l effect of season (l=1, 2)
e_{ijklm} the random error

RESULTS AND DISCUSSION

At the first shearing the AxF1 and F1xF1 angora progeny, which carried the genes of normal-haired rabbits in ratios of 25 and 50% respectively, had greater body weight and produced more wool than those of the AxA group (Table 1). At that time the phenotypic correlation between live weight and total or daily wool production was still high (Table 2). However, when projected onto unit body weight, the wool yield of the purebred angoras exceeded that of the other two groups (16 vs. 14 g/kg).

At the second shearing the total amount of wool produced and that of the first class wool corresponded among the groups. The correlation between live weight and total quantity of wool was an intermediate one (r_p=0.39). When the data were calculated per unit body weight, however, the purebred angoras again proved to have produced the most wool. Thus, with increase in the N gene proportion (0, 25 and 50%) wool output decreased significantly (42, 38 and 33 g per kg live weight).

Table 1: Body weight and wool production of angora rabbits of different genetic background

No. shea-ring	Traits	Parents (sire x dam) **AxA** Genome part (N%) **0%N**	**AxF1** **25%N**	**F1xF1** **50%N**	RSD	**Effects** **Sex** male	female	**Season**
1^{st}	Body weight, g	1246^{A}	1592^{B}	1596^{B}	257	1463	1494	**
	Total wool yield, g	17.8^{A}	20.9^{B}	21.2^{AB}	5.29	19.4	20.5	*
	First class (> 6 cm) wool, g	-	-	-	-	-	-	-
	First class wool, %	-	-	-	-	-	-	-
	Wool production, g/day	0.32	0.33	0.34	0.08	0.33	0.33	NS
	Wool production, g/live weight kg	15.8^{A}	14.2^{B}	14.1^{AB}	2.86	14.2	15.1	NS
2^{nd}	Body weight, g	2707^{A}	3118^{B}	3239^{B}	340	2965^{A}	3078^{B}	NS
	Total wool yield, g	114	116	108	23.8	102^{A}	123^{B}	*
	First class (> 6 cm) wool, g	46	50	39	25.5	36^{A}	54^{B}	NS
	First class wool, %	40.4	43.1	36.1	-	35.3^{A}	43.9^{B}	NS
	Wool production, g/day	1.67	1.71	1.63	0.37	1.52^{A}	1.82^{B}	NS
	Wool production, g/live weight kg	42.4^{A}	37.5^{B}	33.1^{C}	7.34	34.9^{A}	40.4^{B}	**
3^{rd}	Body weight, g	3208^{A}	3548^{B}	3381^{AB}	442	3248^{A}	3509^{B}	NS
	Total wool yield, g	178^{A}	157^{B}	134^{C}	30.3	147^{A}	165^{B}	***
	First class (> 6 cm) wool, g	88^{A}	75^{AB}	56^{B}	35.3	69	77	*
	First class wool, %	49.4^{A}	47.8^{AB}	41.8^{B}	-	46.9	46.7	*
	Wool production, g/day	2.12^{A}	1.89^{B}	1.60^{C}	0.35	1.76^{A}	1.99^{B}	***
	Wool production, g/live weight kg	55.5^{A}	44.4^{B}	39.5^{C}	8.10	45.7	47.3	**
4^{th}	Body weight, g	3344^{A}	3585^{B}	3764^{B}	502	3447^{A}	3681^{B}	***
	Total wool yield, g	172^{A}	147^{B}	135^{B}	35.5	145	157	**
	First class (> 6 cm) wool, g	81^{A}	61^{B}	46^{B}	35.3	52^{A}	74^{B}	NS
	First class wool, %	47.1^{A}	41.5^{B}	34.1^{B}	-	40.4^{A}	47.1^{B}	NS
	Wool production, g/day	2.05^{A}	1.74^{B}	1.60^{B}	0.43	1.73	1.87	**
	Wool production, g/live weight kg	52.4^{A}	41.2^{B}	35.4^{B}	9.96	43.1	43.0	**

Different superscripts within rows denote significant difference.
(NS: P>0.05 * P<0.05 **P<0.01 ABC and ***P<0.001)

At the third shearing the purebred angora rabbits again had the lowest weight. Total, first class and daily wool yield and also wool amount per unit live weight were found to be in a significant relation with genetic background. So, in comparison with the AxA group wool production decreased proportionate to an increase in the N genome part (Table 1).

At the fourth shearing wool yield proved to be much more closely dependent on genetic background than on live weight (r_p=0.23): despite their 13% greater weight, the F1xF1 progeny produced 22% less wool than the AxA group, which had the lowest body weight. Both the wool amount and the live weight of the AxF1 progeny were between the values recorded for the other two groups (Table 1).

The angora gene is responsible for the development of the angora characteristic, but not for the quantity of wool produced. When this mutation emerged wool yield was still only 250-

300 g per year. This performance is an ancient quantity of the angora rabbit, and this ability is also present in normal-haired ones. Due to selection for wool production wool yield has increased continuously. When angora rabbits are mated with normal-haired ones the genes determining the ancient minimal performance enter the genetic make-up of the angora progeny resulting in a decrease of wool production proportionate to the ratio of the N gene present. Evidence for this is provided by the fact that (with the exception of the first shearing, when the influence of body weight was still stronger than that of genetic effects) the wool production of the AxF1 (25 %N) progeny lagged behind that of the purebred angoras to a slight but significant degree, while that of the F1xF1 (50 %N) offspring showed a more substantial lag. The above findings corroborate the hypothesis that complemental genes also play an influencing role in wool production (MIRGIYANTS cit. ROCHAMBEAU, 1988). On the other hand, SHEN (1992) ascertained only a slight difference between the annual wool yield of purebred German angora rabbits (820 g) and that of angoras derived from an (NZW x German angora) x German angora mating (816 g).

In rabbits the formation of hair follicles begins on the 12th to 18th day of foetal life and continues up to the age of 8 to 14 weeks; thus, the number of hair follicles which develop is dependent on the doe, via the supply of blood to the foetuses and their nutrition with her milk (ALLAIN *et al*., 1999). In the wool production of French angoras maternal effect can still be detected at the fifth plucking, i.e. at the age of 63 weeks (ALLAIN *et al*., 1996c). On the basis of the above, the angora progeny of the F1 does should, in theory, have produced more wool than the AxA group, particularly at the first and the second shearing, when the influence of body weight was still more substantial. The findings of this study indicate that the effect of body weight and maternal influence prevailed mainly up to the first shearing, but also, to a lesser degree, up to the second or third harvest. Thereafter it was primarily the genetic background (i.e. the proportion of genes originating from the N rabbits) which determined the level of wool production attained.

The *correlation coefficient values* provide a good illustration of the influence on wool production of body weight, an effect which diminishes with age (at the first shearing: r_p=0.42-0.64; at the fourth shearing: r_p=0.17-0.23).

Table 2: Phenotypic correlations (r_p) in angora rabbits born from AxA, AxF1 and F1xF1 matings

	Shearing							
	1st		2nd		3rd		4th	
Traits	r_p		r_p		r_p		r_p	
Body weight-total wool yield	0.64	***	0.39	***	0.40	***	0.23	*
Body weight-first class wool	-		0.33	***	0.28	**	0.17	NS
Body weight-wool/day	0.42	***	0.37	***	0.40	***	0.22	*
Total wool yield-1St class wool	-		0.64	***	0.65	***	0.71	***
Total wool yield-wool/day	0.78	***	0.76	***	0.99	***	0.99	***
Total wool yield-wool/live wt.	0.49	***	0.79	***	0.74	***	0.74	***
1st class wool-wool/day	-		0.43	***	0.64	***	0.71	***
1st class wool-wool/live wt.	-		0.45	***	0.46	***	0.53	***
Wool/day-wool/live wt.	0.61	***	0.54	***	0.73	***	0.74	***

NS: P>0.05 *P<0.05 **P<0.01 ***P<0.001

These data are in agreement with the findings that, up to the second shearing (MAGOFKE *et al*., 1982) or until the first plucking (THÉBAULT and ROCHAMBEAU, 1989), wool yield in the angora rabbit is still highly dependent on live weight (r=0.64-0.72), and that this relation gradually weakens with advancing age. In this study the total amount of wool produced and that of the first class wool showed a closer correlation with daily wool production than with wool yield calculated per unit live weight; the values of the phenotypic correlations were highest at the fourth shearing (Table 2). In French angora rabbits, ALLAIN *et al*. (1996b) ascertained similar phenotypic correlations: 0.43 between live weight and adult wool yield, and 0.35 between live weight and the quantity of first class wool.

The highest phenotypic correlation was found between live weight at the third and the fourth shearing (r_p=0.77). Wool yield at the fourth shearing was indicated the best (r_p=0.78) by the data recorded at the third shearing (Table 3). ALLAIN *et al*. (1996c) reported phenotypic correlation values for wool yield which were lower than those obtained in this study: between the first and the 2nd-5th pluckings 0.08 to 0.27, between the second and the 3rd-4th 0.20 to 0.44, and between the third and the 4th-5th 0.19 to 0.37.

Table 3: Phenotypic correlations (r_p) between number of shearings with respect to live weight and wool yield

No. shearing	Live weight				Wool yield			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th
1st	-				-			
2nd	0.61	-			0.11	-		
3rd	0.52	0.55	-		0.10	0.24	-	
4th	0.56	0.45	0.77	-	0.04	0.44	0.78	-

In summer the weight of the rabbits was 13% lower and their wool production decreased by 25% in spring and winter. The females, corresponding to findings reported by ALLAIN *et al*. (1996a), were 2 to 7% heavier than the males and produced 9 to 21% more wool; at the fourth shearing the quantity and ratio of first class wool produced by the females also proved significantly higher than the values recorded for the males (Table 1).

CONCLUSIONS

The data obtained in this study indicate that, in addition to the angora gene, the other part of the genome also plays an influencing role in the wool production of angora rabbits. The wool yield of the angora progeny derived from the AxA, AxF1 and F1xF1 matings, carrying the genes of normal-haired rabbits in proportions of 0, 25 and 50% respectively, was found to decrease proportionate to increase in the N genome part.

At the first shearing the quantity of wool produced was found still to have some dependence on body weight. At the second, third and fourth shearing the influence of live weight diminished gradually, wool yield then being determined primarily by genetic background.

This research project was supported by OTKA, the Hungarian National Fund for Scientific Research (project no. T-016168).

This publication was produced within the framework of Hungarian-French inter-governmental scientific and technological collaboration, as a result of cooperation in research supported by the Hungarian National Committee for Technical Development (OMFB) and its contractual partner in France, Le Ministère des Affaires Etrangères.

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