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Genetic studies on reproductive and productive traits in German Angora rabbits under temperate climatic conditions of Garhwal Himalayas

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ABSTRACT

The present study was conducted during 2002-2004 on 350 adult German Angora rabbits (> 6 months of age) produced from 16 sires and 40 dams in 60 litters, maintained at rabbit research unit, GBPUAT, Hill Campus, Ranichauri, Tehri Garhwal. Least squares means, heritability and genetic and phenotypic correlations were computed to evaluate the performance of reproductive and productive traits of German Angora rabbits. The average litter size at birth, litter size at weaning, litter weight at birth, litter weight at weaning, pre-weaning mortality, wool yield at first, second, third, fourth, fifth clips and annual wool yield in adults rabbits were found as 5.30±0.14 kits, 4.60±0.12 kits, 254.35±5.21 g, 2745.10±24.35 g, 12.90±0.70%, 160.45±7.85 g, 142.25±5.20, 165.35±5.25 g, 135.85±6.22 g, 142.20±9.35 g and 775.75±20.45 g, respectively. Pooled heritability estimates of the corresponding traits based on sire component of variance were 0.439±0.254, 0.491±0.071, 0.401±0.101, 0.592±0.155, 0.066±0.072, 0.442±0.151, 0.399±0.198, 0.484±0.112, 0.208±0.24, 0.255±0.125 and 0.515±0.100, respectively. The genetic and phenotypic correlations of litter size at birth with litter size at weaning, litter weight at birth and litter weight at weaning were found positive and significant. The genetic and phenotypic correlations of litter size at weaning with litter weight at weaning were found positive and significant, whereas the genetic and phenotypic correlation between wool yield at first clip with wool yield at second clip were positive, the genetic and phenotypic correlations between wool yield at first clip with annual wool yield were positive and significant.

Key words: German Angora rabbit, Heritability, Productive traits, Reproductive traits

The Angora breed of rabbits is a prolific breed and has the capability to multiply and grow at a faster rate. Due to shorter gestation length, genetic progress is expected to be realized within a short spell of time (Risam and Das 2004, Risam *et al.* 2006). Therefore, knowledge of genetic and phenotypic parameters of German Angora rabbits is essential in designing and application of breeding and improvement programmes. Keeping this in view, the present investigations were undertaken to study the performance and genetic parameters of the German Angora breed of rabbit.

MATERIALS AND METHODS

The data for the present study were taken from 350 adult German Angora rabbits, produced from 16 sires and 40 dams in 66 litters, maintained at Rabbit Research Unit, GBPUAT, Hill campus, Ranichauri, during 2002-2004. This research unit is located in Garhwal Himalayas of Uttarkhand at an attitude of about 1900 m above mean sea level at 30°-15' N latitude and 78°-30' E longitude. The temperature and humidity ranged from –5°C to 25°C and 60-90%, respectively. All the German Angora rabbits were kept individually in standard size cages and provide similar housing, feeding and management throughout the experiment. The reproductive and wool production traits were recorded as litter size at birth (nos.), litter size at weaning (nos.), litter weight at birth (g), litter weight at weaning (g), pre-weaning mortality (%), wool yield at first, second, third, fourth, fifth clips (g) (shearing interval was 72 days) and annual wool yield (g) of adult German Angora rabbits. The performance level of different traits were analyzed by using least squares method of fitting constant as per Harvey (1975). The heritability of different reproduction and wool production traits were computed using sire component of variance as described by Hazel and Terril (1945). The standard errors of heritability estimates were computed as per Swiger *et al.* (1964).

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RESULTS AND DISCUSSION

Least squares means along with their standard errors for the reproduction and wool production traits are presented in Table 1. The average litter size at birth was higher than those

Table 1. Least square means ± SE and h^2 ± SE of reproductive and wool production traits of German angora rabbits

Traits	Means±SE	h^2±SE
Litter size at birth (Nos)	5.30 ± 0.14	0.439 ± 0.254
Litter size at weaning (Non)	4.60 ± 0.12	0.491 ± 0.071
Litter weight at birth (g)	254.35 ± 5.21	0.401 ± 0.101
Litter weight at weaning (g)	2745.10 ± 24.35	0.592 ± 0.155
Pre-weaning mortality (%)	12.90 ± 0.70	0.066 ± 0.072
Wool yield at first clip (g)	160.45 ± 7.85	0.442 ± 0.151
Wool yield at second clip (g)	142.25 ± 5.20	0.399 ± 0.198
Wool yield at third clip (g)	165.35 ± 5.25	0.484 ± 0.112
Wool yield at fourth clip (g)	135.85 ± 6.22	0.208 ± 0.141
Wool yield at fifth clip (g)	142.20 ± 9.35	0.255 ± 0.125
Annual wool yield (g)	775.75 ±20.45	0.515 ± 0.100

reported by Sambher (1992) and Swain *et al.* (1998). However, Bhasin *et al.* (1998) and Sood (2003) in German Angora reported higher values than the present study. The average litter size at weaning was higher than those reported by Caro *et al.* (1984), Sambher (1992) and Bhasin *et al.* (1998), but lower than those reported by Sood (2003). The average of litter weight at birth and at weaning were comparable with the report of Sood (2003), but higher than those reported by Gaur *et al.* (1992) and Bhasin *et al.* (1998) in German Angora rabbits. The average pre-weaning mortality was comparable with the reports of Gaur *et al.* (1992) and Sood (2003) in German Angora rabbits, but lower than those reported by Swain *et al.* (1998) and Bhasin *et al.* (1998) in German angora rabbits. The mortality up to weaning age can be minimized by improving the management techniques and providing better environmental conditions. The average wool yield at firts clip of adult German angora rabbits (> 6 months of age) was in close agreement with the finding of Risam and Das (2004), but higher than reported by and Swain *et al.* (1998) in adult angora rabbits. The average wool yield at second clip in adult German Angora rabbits was 142.25 ± 5.20g. Almost similar finding for wool yield at second clip was reported by Risam and Das (2004) in the herd of German Angora rabbits. The average wool yield at third clip was comparable with the report of Szendro *et al.* (1990) in the same breed. However, higher values than the present study were reported by Kappel (1985) in German angora rabbits.

Heritability along with their standard errors for the reproductive and productive traits are presented in Table 1. The heritability estimate of litter size at birth was in close conformity with the estimates reported by Sood (2003) and Sambher (1992) in German Angora rabbits. The higher heritability estimate is indicative of a high genetic variability among the population for the particular trait. Thus, mass selection for this trait is recommended for future genetic improvement programme. The heritability of litter size at weaning was in close agreement with the estimates of Gaur *et al.* (1992) and Sambher (1992). High heritability estimates of this particular trait reveals its governance by genotype of the individual. The heritability of litter weight at birth was 0.401 ± 0.101, nearly similar magnitude of heritability estimates reported by Gaur *et al.* (1992) and Sood (2003) in the same breed. The heritability of litter weight at weaning was 0.592 ± 0.155, which was higher than reported by Sood (2003). The heritability of pre-weaning mortality was 0.066 ± 0.072, which was in close agreement with the estimates of Sambher (1992) and Gaur *et al.* (1992) in the same breed. Very low heritability for pre-weaning mortality traits indicated low genetic variability, which means the traits cannot be improved by selection and only managemental aspects should be taken into consideration. The heritability of wool yield at first clip of adult German angora rabbits was 0.442 ± 0.151, which was in close agreement with the estimates reported by Gaur *et al.* (1992) in the same breed. The heritability of second clip wool yield was 0.399 ± 0.198. Similar heritability estimate has been reported by Katoch *et al.* (1999) in the same breed. The lower heritability than the present study has been reported by Caro *et al.* (1984) in the same breed. The heritability of adult German angora rabbits for third clip was 0.484 ± 0.112. Caro *et al.* (1984) and Katoch *et al.* (1999) recorded very low heritability for third clip than the present study. The heritability for the wool yield at fourth clip was 0.208 ± 0.141. Similar heritability estimates for wool yield at fourth clip was also reported by Katoch *et al.* (1999) in the same breed. In contrast to it, lower heritability for this trait was recoded by Caro *et al.* (1984) in German Angora rabbits. The heritability for wool yield at fifth clip was 0.255 ± 0.125 in adult German Angora rabbits. Similar estimates of heritability were reported by Soood (2003) in same breed.

Table 2. Genetic and phenotypic correlations among reproductive traits in German Angora rabbits

Traits	Litter size at birth	Litter size at weaning	Litter weight at birth	Litter weight at weaning	Pre-weaning mortality
Litter size at birth	-	0.728 ± 0.20	0.791 ± 0.18	0.611 ± 0.22	0.524 ± 0.19
Litter size at weaning	0.699 ± 0.20**	-	0.722 ± 0.16	0.756 ± 0.17	-0.255 ± 0.18
Litter weight at birth	0.754 ± 0.21**	0.591 ± 0.31	-	0.490 ± 0.11	0.065 ± 0.22
Litter weight at weaning	0.515 ± 0.11**	0.812 ± 0.22*	0.581 ± 0.25	-	-0.412 ± 0.21
Pre-weaning mortality	0.319 ± 0.08*	0.253 ± 0.151	0.015 ± 0.91	-0.491 ± 0.26	-

Above diagonal genetic correlation, below diagonal phenotypic correlation, *P<0.05, **P<0.01.

Table 3. Genetic and phenotypic correlations among wool production traits in German Angora Rabbits

Traits	WY1	WY2	WY3	WY4	WY5	AWY
WY1	-	0.059 ± 0.25	0.410 ± 0.15	-0.059 ± 0.31	0.061 ± 0.40	0.223 ± 0.09
WY2	0.399 ± 0.21	-	0.070 ± 0.44	0.331 ± 0.02	0.031 ± 0.29	0.301 ± 0.19
WY3	0.033 ± 0.14	0.071 ± 0.16	-	0.456 ± 0.16	-0.311 ± 0.19	0.392 ± 0.13
WY4	0.044 ± 0.20	0.051 ± 0.24	0.581 ± 0.15**	-	-0.254 ± 0.17	0.447 ± 0.31
WY5	0.045 ± 0.24	0.024 ± 0.11	-0.112 ± 0.18	-0.221 ± 0.13	-	0.542 ± 0.16
AWY	0.252 ± 0.16	0.281 ± 0.12	0.355 ± 0.13*	0.311 ± 0.15	0.513 ± 0.19*	-

Above diagonal genetic correlation, below diagonal phenotypic correlation, *P< 0.05, **P<0.01. Where, WY1, wool yield at first clip (g); WY2, wool yield at second clip (g); WY3, wool yield at third clip (g); WY4, wool yield at fourth clip (g); WY5, wool yield at fifth clip (g); and AWY, annual wool yield (g).

However, lower heritability for the same trait was reported by Sambher (1992). The heritability for annual wool yield of adult Angora rabbit was 0.515 ± 0.100. Similar estimates of heritability were reported by Katoch *et al.* (1999) in German Angora rabbits. The heritability estimates had been computed to know the genetic variability in various reproductive traits and to explore the possibility using additive genetic variance through selection for improvement of these traits. However, a very low heritability estimates was recorded for pre-weanning mortality, which indicated a low genetic variability. Therefore, the mortality rate can be recorded by improving management practices. The heritability estimates for wool production traits were moderate. The moderate heritability estimates are due to more additive genetic variance for the concerned traits.

The genetic and phenotypic correlations among the productive traits in German Angora rabbits are presented in Table 2. The genetic and phenotypic correlations of litter size at birth with litter size at weaning, litter weight at birth, at weaning, and preweaning mortality were positive and significant (P<0.01). Similar correlations between these traits were observed by Sood (2003) and Sambhar (1992) in the same breed. The genetic and phenotypic correlations of litter size at weaning with litter weight at weaning were positive and significant (P<0.05). Similar correlations between these traits were observed by Sood (2003) in German Angora rabbits. The genetic and phenotypic correlations of litter size at weaning with pre-weaning mortality were negative. Similar correlations between these traits were also observed by Sood (2003) in German Angora rabbits, which indicate that increase in pre-weaning mortality of kits leads to reduced number of kits at weaning. The phenotypic and genetic correlations of litter weight at birth with litter weight weaning and pre-weaning mortality were positive, which was in close agreement with the estimates reported by Sood (2003) and Sambher (1992) in the same breed. The phenotypic and genetic correlations of litter weight at weaning with pre-weaning mortality were negative and nonsignificant. Similar correlations between these traits were also reported by Sood (2003) in German Angora rabbits.

The genetic and phenotypic correlations among wool production traits in German Angora rabbits are presented in Table 3. The genetic and phenotypic correlations of wool yield at first clip with wool yield at second, third clip and annual wool yield were positive, which were in close agreement with the estimate reported by Sood (2003) except phenotypic correlations with wool yield at third and fourth clip in the same breed. The genetic and phenotypic correlations of wool yield at second clip with wool yield at third, fourth and annual wool yield were positive and nonsignificant. However, genetic and phenotypic correlations of wool yield at second clip with wool yield at fourth clip were observed negative. These findings were in close agreement with the report of Sood (2003) in the same breed. The genetic and phenotypic correlations of wool yield at third clip with wool yield at fourth clip and annual wool yield were positive and significant (P<0.01 and P<0.05). However, the genetic and phenotypic correlations of wool yield at third clip with dwool yield at fifth clip were negative and nonsignificant. These findings were in close conformity with the reports of Sood (2003) in the same breed. The genetic and phenotypic correlations of wool yield at fourth clip with wool yield at fifth clip were negative and nonsignificant, however, genetic and phenotypic correlations of wool yield at fourth clip with annual wool yield were positive and nonsignificant. Similar correlations between these traits were reported by Sood (2003) in German Angora rabbits. The genetic and phenotypic correlations of wool yield at fifth clip with annual wool yield were positive and significant (P<0.05). Similar observations were made by Samber (1992) in German Angora rabbits.

The estimates for genetic and phenotypic correlations among the reproductive traits were mostly positive and moderate to high ranging. However, pre-weaning mortality is negative correlated with litter weight at weaning. The genetic and phenotypic correlations among the wool production traits were moderate, which indicates that there is possibility of simultaneous imporvement of wool traits.

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