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ESTIMATION THE GENETIC PARAMETERS FOR MILK YIELD AND WOOL IN TURCANA BREED

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Abstract

The objective of this study was to estimate the breeding values and genetic parameters for milk yield in population of Țurcana breed and wool yield with animal model for selection. Data for milk yield consisted of records of 315 sheep and for wool yield records of 431 young sheep aged one year from Dacia County Association of sheep breeders. The mean for milk yield in milking period from sheep was 59±0.816 kg. The mean for wool yield for young sheep was 3.95±0.03kg. The studied population for milk yield of Turcana breed had two variety: Belă, 228 ewes with records and Breazǎ, 87 ewes with records. For wool yield the young sheep were 271 from Belă variety and 160 from Breaza variety. The breeding values for milk yield in milked period for sheep with records were between -3.56 and 5.55 and ranged between -5.65 and 5.55 in Țurcana population. The breeding values for wool production ranged between -0.412 and 0.631. The heritability for milk yield in milking period for Țurcana population was 0.21. The heritability for wool production was 0.34.

Key words*: animal model, genetic parameters, milk yield, sheep, wool production.*

INTRODUCTION

Țurcana is local sheep breed adapted to environmental condition of our country. All our native sheep breeds have mixed production, milk, meat and wool (Tafta, 2010).

The milk of sheep has biologique and economic importance, having a high level of protein and fat. Turcana is a rustic and resistant sheep breed, it is mixed morpho-productive type, being bred for milk, meat and wool. The mean of total milk yield during the lactation in Țurcana breed ranged between 90-120 kg (Pascal, 2015).

Țurcana is the most representative breed sheep in Romania (Pădeanu et al., 2015). Țurcana was reared in all the country. Țurcana is the oldest local breed in our country, being widespread in the submontane and mountain areas throughout the country and less in the plain areas (Taftă, 2010).

The factors which influence the milk production are genetic factors: breed, variety, individual. Age, prolificity, duration of lactation, level of nutrition, climate influenced the milk yield.

The varieties of Țurcana breed are: Țurcana Bucălaie, Țurcana Belă, Țurcana Breazǎ and Țurcana Oacheșă. Țurcana Belă is raised in counties: Alba, Bistrița, Cluj, Maramureș, Satu Mare, Gorj. Also, this variety is raised in Moldova. Țurcana Breaza is raised in Petrila, Lupeni, Straja in countie Hunedoara.

In the breeding program of Țurcana breed, the objective is the improvement of milk, meat and wool yields for the efficient and sustainable growth of the breed. Sheep breeding is done in an extensive system using a long period of the year the grazing and a short stable period the growth in shelters.

The milk yield of the Țurcana breed varies widely depending on variety, ecotype and welfare level. Țurcana Bucălaie produces 80-100 kg milk, Țurcana Belă 100-120 kg and Țurcana Breazǎ 120-150 kg. Țurcana Breaza has high milk yield during the lactation.

The total production of milk is given by the milk suckled by lambs and the milk milked. The period of standard lactation in Țurcana breed was 190 days, milking period was 120 days and suckling period was 70 days. For meat production, Țurcana young ewes obtained average daily gain over 190 g.

The wool production is influenced by breed, individual, age, sex, breeding, nutrition.

In Țurcana breeed the average wool production is 1.7-2.2 kg for ewes and 2.5-3.5 kg for rams. The white variety of Țurcana has a higher wool production with an average of 5 kg (Pascal, 2015).

The choice of the best method for genetic evaluation of ewes is very important for improvement the milk and wool production.
BLUP methodology applied to an animal model presents the following advantages: it uses information from all known relatives of an individual, it allows genetic comparisons betweeen animals that performed in different environments or different time periods, facilitates genetic comparisons between animals with different sources of information, allows genetic comparesons between animals that have been selected with different selection intensities, it makes possible the accurate measurement of the response to the selection (Grosu & Oltenacu, 2005).
The objective of this study was to estimate the breeding values and genetic parameters for milk yield in milking period and wool production in Țurcana with animal model for selection of the best sheep.

MATERIALS AND METHODS

The data used in this study provide from Dacia County Association of sheep breeders.
The pedigree contents 737 animals: 315 ewes with milk records, 117 sire and 305 dams from Țurcana breed. The ewes with records 315 from Țurcana breed are from 20 herds. The milk yield of ewes recorded in 2022, only first lactation was taken into account.
The pedigree for sheep with wool records consisted in 944 sheep: 431 young sheep with wool records, 99 sire and 414 dams. From 431 yearly ewes 381 were females and 50 were males. The sheep were from 25 herds. The wool production of young sheep was recorded in 2022, the quantity of wool from first cut.
The model used was animal model (Grosu & Oltenacu, 2005).
The model 1 can be written as:

yijk =Vi+Hj+ak+eijk

yijk = is the vector of observations, the phenotypic information was the total amount of milk after lambs suckling until the drying of the ewes;
Vi =is the fixed effect of variety of breed;
Hj= is the fixed herd effect;
a = is a sheep additive genetic effect;
e = is a residual error effect.
The model included the fixed effects: the variety of breed and the herd.

The model 2 can be written as:

yijk =Si+Hj+ak+eijk

yijk = is the vector of observations and is the quantity of wool from the first cut;
Si =is the fixed effect of sex;
Hj= is the fixed herd effect;
a = is a sheep additive genetic effect;
e = is a residual error effect.

The relative breeding value is:

$$BV\% = 100 + 6 * (\frac{BV_{abs} - Average\ BV_{abs}}{\sigma_{BVabs}})$$

BV% = relative breeding value;
BVabs = absolute breeding value;
σBVabs = standard deviation of absolute breeding values.
The breeding values and genetic parameters were calculated with R 4.1.2. software.
The values were checking with Grubs test if the values were in acceptable limits.

$$\hat{v} = \frac{X_{MIN,MAX} - \bar{X}}{\sigma}$$

$\hat{v} = the\ tested\ value$;
X= the value tested;
σ = standard deviation;
$\bar{X}$ = the mean.

RESULTS AND DISCUSSIONS

The breed has a great influence on the milk yield. Friza, Lacaune and Awassi are the breeds with high milk yield. The Țurcana breed has low milk yield compared to dairy sheep from Europe. The parity of sheep is a factor that influences the milk yield which it increases throughout the first three parities in sheep, in this study only record from the first lactation were considered, after which remained constant. The age of ewes influences the milk yield, up to 3-4 years the milk yield increases. The year of lactation and the lambing season influences the milk yield, the lambing in early spring extending the lactation period. The duration of lactation greater determines a high milk production. Food level influences the milk yield, a good nutrition determines high milk yield. Rational feeding of sheep based on category of age and category of production it is necessary in Țurcana breed. The main source of food was the green grass from pastures natural and cultivated and during the stable the food sources were represented by hay

and roughage, industrial residues, sillage fodder and combined fodder. During the lactation period the level of nutritional requirement increases (Pascal, 2015). Țurcana and Țigaia are the breeds in Romania with extensive system of growing based on transhumance. The high milk yield in Țurcana breed is in the second and third month of lactation. In the first 90 days of lactation obtained 65% from the total milk yield. In second part of lactation the milk yield decreases but increase the quality of milk by increasing the protein and fat levels.

The mean of milk yield in milking period for Țurcana breed was presented in Table 1.

Table 1. The descriptive statistics for milk yield in milking period in Țurcana breed for the first lactation

Specification	Țurcana	Țurcana Belă	Țurcana Brează
Mean± Standard error (kg)	59±0.816	58.95±0.8	59.14±2.04
Standard deviation	14.49	12.43	19.05
Coefficient of variability %	24.56	21.09	32.22
Number of ewes	315	228	87

In Table 2 are presented the means from BLUP that realized a reciprocal correction of effects in model. The standard errors associated with the results were computed from the square root of the diagonal of the generalized inverse (Mrode and Thompson, 2005).

Table 2. The means from BLUP solutions

Specification	Țurcana Belă	Țurcana Brează
Mean± Standard error (kg)	61.369±0.200	75.875±0.248

By Student test observed that were very significant difference between means from BLUP solutions for Țurcana Belă and Țurcana Brează for milk yield ($t_{calc} > t_{\infty;0.001}$) 6.6 >3.29. The milk yield in milking period was higher for the variety Țurcana Brează than for the variety Țurcana Belă, showing that the variety of Țurcana breed influenced the milk yield. In the population of Țurcana breed were ewes with milk yield in milking period higher than 100 kg milk, the maximum limit was 116.13 kg milk. All the ewes with milk yield higher than 100 kg milk were from variety Țurcana Brează. The second part of lactation takes place entirely during the grazing period.

In our study the milk yield in milking period was specific to the values of the breed. The coefficient of variability value was high showing a high variability in the population of variety Breaza. Kusza et al. (2018) reported the milk yield per lactation 76.8 kg in Țurcana breed. Trică et al. (2018) reported a mean of 76.81 kg milk in Țurcana breed. Sauer et al. (2016) reported milk yield in Țurcana ewes on average 77.98 kg.

In the suckling period an average milk yield of 92.23 during the first 85 days of lactation was reported by Pascal et al. (2010) in Țurcana breed. Taftă (2010) showed that the local sheep breeds have a great variability in milk, meat and wool. Puie et al. (2020) reported a mean of 82 kg milk in Bălă ecotype of the Țurcana breed. Caraba (2023) showed that an efficient feeding system for sheep determines an increase in the quantity and quality of milk in Țurcana breed.

The mean of wool production is presented in Table 3.

Table 3. The descriptive statistics for wool production in Țurcana breed for the first cut

Specification	Țurcana	Males	Females
Mean±Standard error (kg)	3.95±0.03	5.37±0.1	3.76±0.023
Standard deviation	0.73	0.85	0.45
Coefficient of variability %	18.51	15.82	12.17
Number of yearling ewes	431	50	381

For the selection of ewes for milk yield it is necessary the selection for the size of mammary gland, duration of lactation, the productive longevity, the prolificity, the weight of lambs at 20 days.

Table 4. The means for sex effects from BLUP solutions

Specification	Males	Females
Mean±Standard error (kg)	5.421±0.023	3.637±0.012

In Table 4 we can observe the BLUP means separated for the two sexes.

By Student test observed that were very significant difference between means from

BLUP solutions for males and females for wool ($t\ calc > t_{\infty;0.001}$) 14.55>3.29.

The wool production was higher for males 5.37 kg than for females 3.76 kg, showing that the sex had a great influence of the wool yield. The rams of both variety Belă and Breazǎ had a high wool production over 5 kg. The white variety of Țurcana is appreciate for long white wool. The yield of wool at washing was 65-70%.

Pădeanu et al. (2015) reported a mean of 3.94 kg in Țurcana yearling ewes. To increase wool production and improve quality, the selection methods must be combined with those of feeding ensuring a higher protein level. The selection of sheep for wool production is based on quantity, fineness, homogeneity, length, thickness, washing yield (Taftă, 2010).

The factor that influences the wool production is the breed. Mortimer et al. (2017) reported the yearling greasy fleece weight in Merino breed was 3.97 kg and the yearling clean fleece weight was 2.79 kg. The age of sheep influences the wool yield was higher at adult sheep. The higher quantity of wool was obtained until 5-6 years. Taftă et al. (2010) reported that the wool production depens the following factors: breed, individual, age, sex, level of selection, nutrition, and harvesting technique. The higher productions are in the Merino breeds and lower yield in the breeds with thick wool.

The breeding values for the milk yield in milking period for the best ewes with records in Țurcana breed sheep were presented in the Table 5.

Table 5. The breeding values for the 10 best sheep for milk yield

No	Absolute breeding values	Relative breeding values
1	3.979	121.20
2	3.815	120.37
3	3.735	119.97
4	3.629	119.44
5	3.433	118.45
6	2.998	116.26
7	2.989	116.21
8	2.666	114.59
9	2.666	114.59
10	2.644	114.48

The absolute breeding values ranged between 2.644 and 3.979 for the best ewes. The relative breeding values for the best ewes ranged between 114.48 and 121.20. The individuality within in Țurcana breed is represented by a significant proportion of plus variants which under the same feeeding and environmental conditions produce a higher milk yield than the herd average. The higher breeding values for milk yield indicates the sheep's genetic merit. The breeding values are important for include in the calculation of the selection index values for rank the animals. The farmers will use rams with a higher breeding value for make fast, reliable and more predictable genetic gain in milk production traits. The breeding values for milk yield in milked period for sheep with records were between -3.485 and 3.979 and ranged between -3.56 and 3.979 in Turcana population. The wide range of estimated breeding values can be attributed to the high genetic variation in the Țurcana breed and variety. Jawasreh et al. (2022) reported the breeding values ranged between -36.34 to 72.01 in Awassi sheep. Jawasreh and Khasawneh (2007) obtained the breeding values between -205.1 and 441.2 kg in Awassi breed. Rotar et al. (2017) realized a comparison of breeding value methods for milk production in flock of Palas milk line and constated that the best results were obtained with the combination of the Individual Animal Model and Lush index. Popa et al. (2020) obtained the breeding values for the best Teleorman Black Head sheep between 14.56 and 28.48 kg.

In the Table 6 were presented the breeding values for the best yearling sheep for wool production.

Table 6. The breeding values for the 10 best sheep for wool production

No	Absolute breeding values	Relative breeding values
1	0.416	127.73
2	0.381	125.39
3	0.349	123.26
4	0.323	121.52
5	0.32	121.32
6	0.305	120.32
7	0.294	119.58
8	0.269	117.92
9	0.26	117.31
10	0.252	116.78

The absolute breeding values for the best yearling ewes for wool yield ranged between 0.252 and 0.416. The relative breeding values for the best ewes ranged between 116.78 and 127.73. The breeding values for wool production

ranged between -0.369 and 0.416. The estimated breeding values ranged wide showing a high genetic variation in studied population. In the population of Țurcana were sheep with high performances than the herd average for wool yield. Daetwyler et al. (2010) reported genomic estimated breeding values for wool traits in Merino sheep ranged from 0.15 to 0.79. The breeding values of sheep depends of the variability from breeds. Moghaddar et al. (2014) reported the accuracy of genomic estimated breeding values of yearling and adult wool traits in Merinos was an average high (0.33-0.75).
In the Table 7 was shown the heritability for milk yield in milked period and wool production in two populations of Țurcana breed.

Table 7. The heritability for milk yield and wool production in the populations of Țurcana breed

Item	Milk yield	Wool production
h^2	0.21	0.34

The heritability for milk yield in Țurcana breed was 0.21 and the heritability for wool yield was 0.34. Barillet et al. (2001) reported the heritability for milk yield in Lacaune sheep 0.34. El-Saied et al. (1999) found a heritability of 0.24 for milk yield in Spanish Churra and Ligda et al. (2002) reported a heritability of 0.35 in Greek Chios sheep breed. The heritability for wool yield in our study was lower than heritability reported by Singh et al. (2019), Hanford et al. (2002) 0.53 for fleece weight in Columbia sheep, Bromley et al. (2000) 0.47 and Fogarty et al. (1995) 0.36. Mortimer et al. (2017) reported the heritability for yearling gresy fleece 0.57 and for yearling clean fleece 0.52. Safari et al. (2005) reported mean heritabilities for greasy fleece weight in wool breeds 0.37 and dual-purpose breeds 0.38 and for clean fleece weight in wool breeds 0.36. By genetic improvement of the breed it is possible to increase sheep milk and wool yields efficiently and sustainably (Flint and Woolliams, 2008). Implementation selection programs in smaller flock can has positive economic and social impacts, preserve breeds and facilitate the genetic progress in sheep populations (Marshall et al., 2024).

CONCLUSIONS

The selection of sheep for milk yield and wool yield must realize take in consideration the breeding values. The heritability for milk yield was low 0.21 and for wool production was moderate 0.34 ranged in the values reported in literature.

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