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GROWTH PERFORMANCE OF SIMPLE- AND TRIRACIALI CROSSBRED LAMBS AND EWES PRODUCTIVITY OF R1 GERMAN BLACKFACE X TSIGAI CROSSED WITH FRENCH MEAT BREED

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Abstract

Crossbreeding of three French meat breeds rams and one R1 German Blackface (75%) x Tsigai (25%) ram with R1 crossbreed ewes German Blackface (75%) x Tsigai (25%) was carried out to determine the ram breed effects on productivity of ewes and growth performances of the lambs. A total of 151 crossbreed ewes R1 German Blackface x Tsigai were divided into four groups for mating with 4 rams from Berrichon du Cher (BC) - group 1, Blanche du Massif Central (BMC) - group 2, Mouton Vendèen (MV) - group 3, and R1 German Blackface (BF) - group 4, resulting in total 147 lambs. Ram breed had a significant influence on growth performances of the lambs. The lambs obtained from the R1 German Blackface ram were heavier than the lambs from groups 1 and 3 (P< 0.001) at birth, 28 day and 56 day. Significant differences were recorded between group 2 and 4 with regard at weight at 28 day (P< 0.01) and 56 day (P< 0.05). Body weight at 5 months in group 1 of crossbred lambs was significantly higher than to the crossbreed lambs obtained from the group 2 (P< 0.01), 3 (P< 0.05) and 4 (P< 0.01). The number of lambs born per ewe, number of lambs weaned per ewe, and lamb survival rate at weaning were similar among the four groups, while the lambs survival rate at 5 months at the lambs obtained from ewes mated to Blanche du Massif Central ram was higher compared to the others, the differences being significant (P< 0.05) compared to the lambs obtained from ewes mated to Mouton Vendèen ram.

Key words*: productivity, Berrichon du Cher, Blanche du Massif Central, Mouton Vendèen, German Blackface, Tsigai*

INTRODUCTION

The Tsigai sheep is the second most important sheep breed in Romania with 24.3% of the national sheep herds (the first is the Tsurcana sheep with 52.4%). Tsigai is a traditional triple-purpose sheep group, widely distributed across regions of Central, Eastern and Southern Europe (Cinkulov et al., 2008). Production levels vary greatly among countries and regions which rear Tsigai sheep (Kusza et al., 2008). Because the Tsigai race is a rustic breed, research conducted in Romania over time attempted to improve milk and meat production, most work was based on the use of industrial crossings with specialized imported breeds.

To improve meat production, the research was focused on increasing prolificacy, improving skills for meat production and carcass quality. Imported specialized breeds to improve meat production were: Suffolk, Ile de France, Merinofleisch, German Blackface. The obtained results were in all cases higher than those obtained from Tsigai breed (Ilișiu et al., 2010), but under the potential of improved breed (for lamb).

Recently, the Berrichon du Cher, Blanc du Massif Central and Mouton Vendeèn was introduced in Romania and crossed with Tsurcana and Tsigai breeds. The results have shown that the performances of lambs obtained from crossbreeding were higher than the lambs of local breeds (Borzan et al., 2017; Frujină et al., 2019). Blanc du Massif Central are kept in France in areas with harsh environmental conditions, and both robustness and good maternal abilities are their main characteristics. The Berrichon du Cher are kept in more favourable areas, are specialised in growth and

carcass traits and are widely used for terminal crossing (Hubby et al., 2003). The Mouton Vendeèn is well-adapted to temperature variations, as well as to alternating periods of drought and heavy rainfall. The meat production traits of the breed have gained a good reputation, resulting from good growth potential and excellent conformation. For these reasons, rams are often used for crossbreeding, which has extended the Vendéen's popularity towards the Limousin, central France, the Midi-Pyrénées, etc. as well as internationally (http://en.france-genetique-elevage.org). At the present there is little information to highlight the growth performance of the lambs obtained by crossing of the above mentioned three races with purebred or crossbreed ewes from other countries.

Within of some research projects funded by the Ministry of Agriculture and Rural Development of Romania, at the Research and Development Station for Sheep and Goats Reghin (the current Experimental Base Reghin of the Research Institute for Sheep and Goats of Palas Constanța), were achieving crossings between German Blackface x Tsigai breed – rusty variety in order to make a precursors for a meat sheep breed adapted to the submontane area. So far, has been obtained R1 crossbreed ewes (75% German blackface; 25% Tsigai – rusty variety). In order to choose the correct breed to continue the work to forming the sheep population above mentioned, it was decided that in 2018, the female R1 German Blakface x Tsigai to be crossed with males from french meat breed: Berrichon du Cher, Blanc du Massif Central and Mouton Vendeen.

The compatibility of breed crossing is essential for achieving high lambs performance. Knowledge of the occurrence rates of various health disorders is important for both veterinarians and researchers, in order to set-out, alarm thresholds', which will then help sheep breeders to monitor flock's health and in the decision making process (Gavojdian, 2015).

The objective of the current study was to evaluate the reproductive performance of R1 German Blackface (75%) x Tsigai (25%) ewes when mated with French meat breeds, and growth performances of crossbreed lambs reared intensively under Romanian conditions.

MATERIALS AND METHODS

The present research was conducted in Experimental Base Reghin of Research Institute for Sheep and Goat Palas Constanta, Mures County, 46°46' N/ 22°42'E; 395 m altitude; annual rain fall varies between 650-700 mm; average temperatures 19/–3°C during summer/winter).

Animals and management

A total 151 simple crossbreed ewes R1 German Blackface (75%BF) x Tsigai (25%TI) were divided into four groups and mated with three french meat breed rams and one R1 German Blackface x Tsigai (75% BF x 25% Tsigai) ram in 2018, as follow: groups 1 (41 ewes) Berrichon du Cher x German Blackface x Tsigai (BCxBFxTI), group 2 (31 ewes) Blanche du Massif Central x German Blackface x Tsigai (BMCxBFxTI), group 3 (40 ewes) Mouton Vendèen x German Blackface x Tsigai (MVxBFxTI). The control group (4) were formed of 39 R1 German Blackface x Tsigai (BFxTI) ewes. At the beginning of the experiment, all ewes and rams were kept in the shelter in the mating period (01.09.2018-20.10.2018) and feeded with hill heu (1 kg/head), maize (0.4 kg/head) and barley grain (0.2 kg/ewe). In the following period (October – November), the ewes grazed on natural pastures and were provided 0.6 kg barley grain per ewe. In winter (beginning of December until 13. May), the animals were held in the shelter and provided 0.4 kg maize, 0.1 kg sunflower groats and 2 kg hill heu per ewe.

A well recognized annual health program was carried out for all groups. Animals were treated with antiparasite drugs to control internal and external parasites. Lambs were born from January through March. At birth or shortly thereafter, lambs were identified with ear tags and weighed (±0.1 kg). Sex, date of birth, type of birth, dam and ram group were recorded. The lambs were also weighed monthly (±0.1 kg) up to 5 months age. Ewes and their lambs were kept together under the same management condition. Lambs were weaned at approximately 98 ± 9 days of age and kept under range conditions for two months. The diet was formulated for 300 g/head/day growth potential according to NRC (1985) requirements and digestible protein was 130 g. Flocks structure

and genotype used in the study are presented in Table 1.

Table 1. Number of lambs by gender and genotype

Gender	Genotype			
	BCxBFxTI[a]	BMCxBFxTI[b]	MVxBFxTI[c]	BFxTI[d]
Male	20	17	12	17
Female	18	14	27	22
Total	38	31	39	39

[a] Sire = Berrichon du Cher, Dam = German Blackface x Tsigai; [b] Sire = Blanche du Massif Central, Dam = German Blackface x Tsigai; [c] Sire = Mouton Vendèen, Dam = Blackface x Tsigai, [d] Sire = German Blackface x Tsigai, Dam= German Blackface x Tsigai.

The diet of lambs consisted of lucerne hay and concentrated fodder. The structure of concentrated fodder was as followed: 30% granulated fodder for lambs (16% CP), 30% maize, 15% barley, 12% wheat bran, 12% sunflower groats and 1% calcium. The fodder, water and salt were provided at discretion.

Traits definition

The traits investigated were classified as lamb and ewe traits. Early growth traits consisted of birth weight (BW); weight at 28 day (W28); weight at 56 day (W56); weaning weight (WW) (98.30 ± 8.66 days of age), post weaning weights at 4 months (W4M) and post weaning weights at 5 months (W5M).

Reproductive traits of R1German Blackface x Tsigai ewes included the prolificacy, fecundity number of weaned lambs per ewe mated (NWLEM); number of weaned lambs per ewe lambed (NWLEL); lamb survival rate at weaning*;* lamb survival rate at 5 months.

Statistical analysis

The mean comparisons between the four groups of the variables were carried out using independent samples t-test of the JASP procedure.

RESULTS AND DISCUSSIONS

Early growth traits

Least-squares means (±S.E.) for early growth traits of lambs by crossbreeds are presented in Table 2.

According to the traits considered, some variations were observed. The rams breed had significant influence on body weight at birth, 28 day, 56 day, at weaning, at 4 and 5 month. BW, W28 and W56 of group 1 and 3 were significantly higher (P<0.001) than of group 4. Also, significant differences were recorded in BW between the groups 1 (P< 0.05) and 2 (P< 0.001) when compared with group 3, as well as between group 1 and 2 (P<0.05).

Table 2. Least-squares mean (S.E.) for growth traits of crossbreed lambs (kg)

Trait	Genotype	N	Mean (kg)	Min. (kg)	Max. (kg)
BW	BFxTI	39	3.86 ± 0.10^{AC}	2.5	5.4
	BCxBFxTI	38	4.71 ± 0.18^{bcD}	2.3	7.6
	BMCxBFxTI	31	4.07 ± 0.16^{acD}	2.2	5.9
	MVxBFxTI	39	5.15 ± 0.13^{aBD}	4.0	7.2
W28	BFxTI	35	9.27 ± 0.56^{AbC}	4.5	15.1
	BCxBFxTI	38	13.09 ± 0.6^{BD}	4.4	20.4
	BMCxBFxTI	28	10.99 ± 0.38^{ad}	7.2	14.5
	MVxBFxTI	34	11.85 ± 0.27^{d}	8.8	15.6
W56	BFxTI	35	14.64 ± 0.75^{ABC}	6.0	25.0
	BCxBFxTI	37	19.97 ± 0.78^{AD}	7.1	30.0
	BMCxBFxTI	28	18.20 ± 0.60^{BD}	12.8	25.9
	MVxBFxTI	34	19.95 ± 0.51^{aD}	13.1	25.4
WW	BFxTI	35	27.10 ± 1.23^{abc}	15.1	42.6
	BCxBFxTI	35	28.95 ± 1.05^{b}	15.5	43.2
	BMCxBFxTI	28	25.88 ± 0.87^{a}	16.1	37.5
	MVxBFxTI	34	27.16 ± 0.98^{abc}	16.4	41.0
W4M	BFxTI	35	33.58 ± 1.43^{abc}	19.7	49.0
	BCxBFxTI	34	36.48 ± 1.13^{B}	26.1	47.7
	BMCxBFxTI	28	33.66 ± 1.20^{A}	21.6	46.3
	MVxBFxTI	33	33.56 ± 1.44^{abc}	17.8	48.5
W5M	BFxTI	34	39.69 ± 1.65^{AD}	22.0	59.0
	BCxBFxTI	32	45.56 ± 1.33^{BCD}	32.0	61.2
	BMCxBFxTI	28	39.52 ± 1.34^{AB}	21.6	54.5
	MVxBFxTI	31	$40.86 \pm 1.35^{a\,c}$	25.0	59.4

Means with different superscripts (^{a}, ^{b}, ^{c}, ^{d}) in each traits differ (P< 0.05).

Means with different superscripts (^{A}, ^{B}, ^{C}, ^{D}) in each traits differ (P< 0.01 and P< 0.001).

In W28, were significant differences recorded between group 1 and 2 (P<0.01), as well as between group 2 and 4 (P<0.05). Daily average gain is the primary and important indicator of selection (Frujină et al., 2019). At weaning (WW), only between groups 1 and 2 were the differences significant (P<0.05). In W4M the differences recorded were significant (P<0.01) between the groups 1 and 2. In W5M were recorded significant differences (P<0.01) between group 1 and the groups 2 and 4, as well as between the group 1 and 3 (P<0.05).

With regard at average daily gain, the BCxBFxTI crossbreed lambs had the highest ADG pre- and post-weaning (table 3), while the BFxTI lambs had the lowest ADG. It is observed the highest ADG to group 1 in the first month of birth, while in the second month of life the highest ADG were recorded to group 3, followed by group 2.

Significant differences (P<0.001) with regard at ADG in the first month of life were recorded

between the groups 1 and 3 and 1 and 4, as well as between the groups 1 and 2 (P<0.01).

Table 3. Least-squares mean (S.E) for average daily gain (ADG) of crossbreed lambs (g)

Trait	Genotype	N	Mean (kg)	Min. (kg)	Max. (kg)
ADG 0-28 days	BFxTI	35	195.00±20.28^{Abc}	50	409
	BCxBFxTI	37	307.54±18.07^{BCD}	79	554
	BMCxBFxTI	28	245.79±12.92 ^{ACD}	130	409
	MVxBFxTI	34	237.18± 7.25^{Ad}	154	329
ADG 28-56 days	BFxTI	35	191.87±15.46^{abc}	35	413
	BCxBFxTI	37	237.03±11.23^{Cd}	18	461
	BMCxBFxTI	27	258.04±11.21^{D}	139	406
	MVxBFxTI	34	289.29±14.03^{aD}	29	450
ADG birth – weaning	BFxTI	35	221.17± 9.32^{a}	104	350
	BCxBFxTI	35	253.66± 9.57^{d}	152	383
	BMCxBFxTI	28	226.00± 7.92^{ab}	151	322
	MVxBFxTI	34	225.74± 7.88^{ac}	133	339
ADG birth – 4 month	BFxTI	35	219.74± 8.75^{A}	112	321
	BCxBFxTI	34	251.88± 8.27^{bcD}	167	358
	BMCxBFxTI	28	223.32± 7.46^{ab}	159	320
	MVxBFxTI	33	224.09± 7.08^{ac}	94	319
ADG birth – 5 month	BFxTI	34	218.29± 8.65^{A}	107	328
	BCxBFxTI	32	263.72± 8.24^{BCD}	177	350
	BMCxBFxTI	28	227.75± 7.84^{AD}	128	310
	MVxBFxTI	31	228.94± 7.12^{AC}	148	325

Means with different superscripts (^{a}, ^{b}, ^{c}, ^{d}) in each traits differ (P< 0.05).
Means with different superscripts (^{A}, ^{B}, ^{C}, ^{D}) in each traits differ (P< 0.01 and P< 0.001).

Between the groups 2 and 4, as well as between 3 and 4, the differences founded were significant (P< 0.05). In the second month of life (28-56 day) were recorded significant differences (P<0.001) between group 4 and the groups 2 and 3, as well as between group 1 and 4 (P<0.05). Also, significant differences (P<0.05) were found between group 1 and 3. Pre-weaning, the differences recorded with regard at ADG were significant (P<0.05) between group 1 and another groups. Post-weaning was found significant differences (P<0.001) between group 1 and 4, as well as between the group 1 and the other two groups (P<0.01). From the data of the table 3, it can be observed the high variability of the daily average gain, the highest variability being recorded in the first 2 months of life, and inside of the group 1.

Reproductive Traits

The ram breed effect was not significant (P>0.05) for fecundity, prolificacy, NWLEM NWLEL and LSRW, expect LSR5M (P<0.05) (Table 4). The lambs obtained from ewes mated to Blanche du Massif Central ram had higher lamb survival rate at 5 months compared to the others, the differences being significant (P< 0.05) compared to the lambs obtained from ewes mated to Mouton Vendèen and not significant (P>0.05) compared to the others.

Table 4. Least-squares mean (S.E.) for reproductive traits of German Blackface x Tsigai ewes

Trait	Genotype				
	BCxBFxTI	BMCxBFxTI	MVxBFxTI	BFxTI	t-test
Fecundity	82.93 ± 5.95^{a}	83.87 ± 6.72^{a}	87.50 ± 5.30^{a}	84.62 ± 5.85^{a}	N.S
Prolificacy	114.71 ± 7.47^{a}	119.23 ± 7.88^{a}	108.57 ± 4.80^{a}	118.18 ± 6.82^{a}	N.S.
NWLEM ^{a}	0.90 ± 0.10^{a}	0.90 ± 0.10^{a}	0.83 ± 0.07^{a}	0.90 ± 0.10^{a}	N.S.
NWLEL^{b}	1.09 ± 0.09^{a}	1.08 ± 0.08^{a}	0.94 ± 0.06^{a}	1.06 ± 0.09^{a}	N.S.
LSRW ^{c}	108.82 ± 8.82^{a}	107.69 ± 7.69^{a}	94.29 ± 5.71^{a}	106.06 ± 8.64^{a}	N.S.
LSR5M ^{d}	97.06 ± 9.89^{a}	107.69 ± 7.69^{b}	85.71 ± 7.27^{b}	106.06 ± 8.64^{a}	*

^{a} Number of weaned lambs per ewe mated; ^{b}Number of weaned lambs per ewe lambed; ^{c}Lamb survival rate at weaning; ^{d}Lamb survival rate at 5 month; N. S. *P*> 0.05 and * *P*< 0.05, respectively. Means with different superscripts in each row differ (P< 0.05).

Discussions

As it can be seen from Table 2, the lambs obtained in the group 3 had an average weight at birth higher than the other three groups, the minimum weight recorded being 4.0 kg and the maximum weight 7.2 kg. However, the maximum birth weight of 7.6 kg was recorded in the group 1. The higher birth weight in the 1 groups has led to the occurrence of dystocia, so that in group 1, there were recorded 2 cases of dystocia, and in the case of group 3 was registered one case of dystocia.

BCxBFxTI lambs exceeded other crossbred lambs in early growth rate (up to 5 months) under intensive fattening system. We mention that the average daily gain was superior at BCxBFxTI during the 5 months, except for the second month of life, when was inferior to BMCxBFxTI and MVxBFxTI. In contrast with the groups 2 and 4, where the lambs had similar average daily gain in the first and second month of life, by groups 1 is recorded superior daily gain in the first month after birth, and by group 3, in the second month after birth. After weaning, except for the group

1, the evolution of the average daily gain was similar for the other 3 lots. The superiority of BCXBFxTI lambs can be attributed to growth characteristic of Berrichon du Cher breed. In the years 2016 and 2017, the same rams were used for mating and were crossed with the local Tsigai breed. The result reveals that the body weight at 90 days was superior to Blanch du Massif Central x Tsigai (26.82 kg) when compared with Mouton Vendeèn x Tsigai (21.74 kg), Berrichon du Cher x Tsigai (21.28 kg) and Tsigai pure breed (17.54 kg) (Borzan et al., 2017).

In one crossbreeding experiment who were used Mouton Vendeen and Blanc du Massif Central as paternal breeds and Tsurcana as maternal breed (Frunjină et al., 2019), at the same age as in our experiment, the crossbreed lambs had the following weights at the age of 98 days: 26.40 kg for female and 28.71 kg for male Mouton Vendeen x Tsurcana lambs, as well as 27.63 kg for female and 29.37 kg for male Blanc du Massif Central x Tsurcana lambs, compared to 19.87 kg for female and 21.40 kg for male Tsurcana pure breed.

During the 5 months, mortality was recorded in all 4 groups, the causes being different both between the groups, and during breeding periods, within the same group. Thus, from the data of Table 5 it can be observed that the highest mortality rate was registered during the birth-weaning period in the group of crossbreed MVxBFxTI. The highest mortality rate in the first months after lambing is due in particular to the insufficient milk supply of the mothers sheep, which could not support the accelerated growth rate of the lambs during the first 2 months of life, associated with the growth of the lambs from twins lambing. After weaning, with the exception of MVxBFxTI group, diarrhea was present in all the other three groups, which also led to the occurrence of deaths due to this cause.

On the other hand, within group 3 there were highlighted 2 cases of mortality due to respiratory diseases, pneumonia respectively, as well as one case due to indigestion, constipation respectively, followed by occurrence of rectal prolaps.

The same situation was encountered in group 1, where there were 2 cases of indigestion which led to the death of the lambs.

With regard at reproductive indices, it should be mentioned that the highest fecundity rate was recorded in group 3 and the smallest in group 1. In the same time, the highest prolificacy rate was found in the group 2 and the smallest in the group 3. In contrast with our finding, the smallest reproductive indices were found by natural mating of Tsigai ewes crossed with BMC ram (fecundity 90% and 102 prolificacy) (Borzan et. al, 2017).

Table 5. The mortality and disease occurrence rates

Genotyp	Total mortality, from which:								Proportion of occurrence of diarrhea after weaning	
	Befor weaning		After weaning							
	Insufficient milk to the sheeps mothers		Diarrhea		Indigestion		Pneumonia			
	No.	Proportion (%)	No.	Proportion (%)	No.	Proportion (%)	No.	Proportion (%)	No.	Proportion (%)
BCxBFxTI	2	5.30	3	7.90	2	5.30	0	0.00	8	22.20
BMCxBFxTI	3	9.70	0	0.00	0	0.00	0	0.00	7	25.00
MVxBFxTI	5	12.80	0	0.00	1	2.60	2	5.10	0	0.00
BFxTI	4	10.30	0	0.00	0	0.00	0	0.00	3	8.60
Total	14	38.10	3	7.90	3	7.90	2	5.10	18	55.80

At artificial insemination, the Tsigai breed ewes has showed superior value of reproductive indices (100% fecundity and 106% prolificacy) when was used seminal material coming from Tsigai ram, compared with them coming from Berrichon du Cher (96% fecundity and 104% prolificacy) and Mouton Vendeèn (94% fecundity and 106% prolificacy).

It is necessary to improve the reproductive indices (fecundity, prolificacy) and some technical parameters (e.g. the number of weaned lambs per ewe mated; the number of weaned lambs per ewe lambed; lamb survival

rate at weaning) due their ability to influence the economic indicators of sheep farms.

CONCLUSIONS

Improving of reproductive performances of the sheep through selection, as a measure to improve the economic efficiency of the farms. Due to growth performances of crossbreed lambs, the three French meat breeds could be used for crossbreeding to Tsigai pure breed and/or other simply crossed ewes to improve early growth, but due to dystocia, there is needed special attention for ewes at birth.
Based on our findings, we consider that further research on fattening technology of crossbreed lambs is necessary.

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