

EFFECT OF CROSSING MERINO WITH OSSIMI SHEEP ON BODY MEASUREMENTS AND DEVELOPMENT

By

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Summary

One hundred and seventy single lambs of the 1963 lambing season from 4 breeding groups (Merino, Ossimi, $1/2$ Merino and $3/4$ Merino) were used in the present investigation. Body length, width at hook, heart girth and height at withers were measured for each individual at birth and every 2 weeks till weaning; then at monthly intervals up to yearling and every 3 months till 18 months of age.

The crossbred ($1/2$ Merino and $3/4$ Merino) lambs showed a superiority in those body dimensions to the two purebred parental breeds throughout the period of the study. The Ossimi lambs were inferior to the Merinoes in the different body measurements except for height at withers. The $1/2$ Merinoes were slightly higher in most body dimensions than the $3/4$ Merinoes, the differences between those two groups were only significant for height at withers.

Males in all groups had larger body measurements than females for width at hook.

Introduction

This experiment was conducted at the Animal Production Department, Ministry of Agriculture, in an attempt to study the differences in body measurements between Merino; Ossimi, $1/2$ Merino and $3/4$ Merino lambs and to investigate the development of body dimensions for these four groups. Body measurements as shown by many investigators are not only essential for studying and evaluating the development of the animal, but they could be also used as indicators for body conformation.

Materials and Methods

Four breeding groups were used in the present study including Ossimi, Merino, Merino x Ossimi ($1/2$ Merino) and the backcrosses with Merino

(3/4 Merino). One hundred and seventy lambs born from 10-30th October 1963 were used. The procedure of management was previously described by Ghoneim *et al.* (1968). At the age of 2-3 weeks

Body measurements were taken at birth and every two weeks up to weaning age (16th week), after that the lambs were measured at monthly intervals till yearling age. The animals were measured also at the 15th and the 18th month of age. Four body dimensions were taken at each age and the measurements were recorded to the nearest 0.5 cm. as follow:

(1) Body length, the longitudinal distance between the point of the shoulder (anterior part of the scubula) to the hip joint.

(2) Width at hooks was measured to the extreme outside edges of hook bones.

(3) Heart girth was taken by drawing a tape around the chest closed to the skin as possible.

(4) Height at withers was measured by resting the moving arm of the calliper on the top projection of the dorsal vertebrae.

Suitable callipers were used for longitudinal and vertical measurements. Two measurements were taken each time and the mean of the two readings was recorded to the nearest 0.1 cm. The methods suggested by Snedecor (1962) were used for statistical analysis.

Results and Discussion

Body Length

Ossimi and 1/2 Merino lambs were born significantly larger ($P < 0.01$) than the Merino and 3/4 Merino lambs. No significant differences were demonstrated between body length of Ossimi and 1/2 Merino lambs at birth. From weaning up to the end of the study (18 months old) the Ossimi group was the shortest and the differences between groups were highly significant. The two crossbred groups significantly exceeded the purebred-ones in their body length ($P < 0.01$).

Crossing Rahmani and Ossimi sheep, Asker *et al.* (1954 B) found a difference between crossbred and purebred lambs in their body length at birth, but not at 4 and 8 months of age where the crossbreds were significantly longer than the purebreds ($P < 0.05$). Comparing Pramenka \times Merino crossbred lambs with purebred Pramenka, Palian *et al.* (1959) concluded that differences at birth in body measurements of the two groups were not significant.

In the present study body length at all ages (except at birth) was significantly affected by sex ($P < 0.01$). However, at birth females were

TABLE 1

Average body length for different breeding groups in cms.

	Females			Males			Total		
	No.	Mean	CV	No.	Mean	CV	No.	Mean	CV
			%			%			%
<i>At birth</i>									
Ossimi	21	29.3±0.5	7.4	26	28.8±0.3	5.9	47	29.1±0.3	6.6
Merino	21	26.6±0.4	6.8	21	26.2±0.5	7.8	42	26.4±0.3	7.3
1/2 Merino	16	30.1±0.9	1.5	28	29.4±0.5	5.6	44	29.6±0.4	9.5
3/4 Merino	20	27.9±0.3	4.7	17	26.9±0.3	5.2	37	27.9±0.2	4.8
<i>At weaning</i>									
Ossimi	21	45.2±0.3	4.7	26	47.2±0.6	6.0	47	46.3±0.4	5.8
Merino	17	48.4±0.9	7.2	18	49.3±0.8	6.9	35	48.8±0.6	6.8
1/2 Merino	15	51.5±0.6	4.5	26	52.3±0.7	6.8	41	52.0±0.5	6.1
3/4 Merino	18	50.3±0.4	3.7	16	52.1±0.8	6.0	34	51.1±0.5	5.2
<i>At 6 months</i>									
Ossimi	21	52.4±0.5	4.7	22	53.6±0.7	5.8	43	53.0±0.4	4.3
Merino	17	53.4±0.9	7.2	17	56.2±0.8	5.9	34	54.8±0.7	7.0
1/2 Merino	15	58.1±0.6	4.1	24	60.3±0.7	5.6	39	59.5±0.5	5.3
3/4 Merino	18	57.3±0.6	4.4	15	60.4±0.7	4.2	33	58.6±0.5	4.9
<i>At 8 months</i>									
Ossimi	21	54.7±0.4	3.7	22	58.6±0.8	6.3	43	56.2±0.6	7.1
Merino	17	57.2±0.8	5.7	17	60.2±1.0	6.6	34	58.7±0.7	6.6
1/2 Merino	15	62.4±0.5	3.4	24	64.0±0.5	4.0	39	63.4±0.4	4.0
3/4 Merino	18	60.5±0.7	4.8	15	64.8±1.3	5.5	33	62.4±0.6	5.6
<i>At yearling</i>									
Ossimi	21	58.7±0.6	4.4	12	60.9±0.9	5.2	33	59.5±0.5	5.0
Merino	16	60.9±0.9	5.9	15	62.8±1.0	5.7	31	61.8±0.7	4.8
1/2 Merino	15	64.4±0.4	2.5	22	68.0±0.9	4.7	37	66.6±0.5	4.9
3/4 Merino	17	63.0±0.7	4.5	14	66.9±0.8	4.5	31	64.7±0.6	5.4
<i>At 81 months</i>									
Ossimi	21	62.9±0.6	4.1	5	61.8±0.8	2.9	26	62.7±0.5	4.0
Merino	15	64.0±1.0	6.0	14	69.2±1.3	6.9	29	66.5±0.9	7.5
1/2 Merino	18	68.2±0.7	3.9	21	74.3±0.7	4.1	39	71.8±0.7	5.8
3/4 Merino	16	67.9±0.9	5.5	12	72.4±0.7	3.5	28	69.9±0.8	5.7

slightly longer than males in all groups studied. Sex differences in body length at birth were 0.46, 0.39, 0.71 and 0.97 cm. for the Ossimi; 1/2 Merino and 3/4 Merino respectively (Table 1). At weaning, and up to the end of the study, males became longer than females and the differences became greater when age progressed. Studying Ossimi and Rahmani sheep Asker *et al.* (1954 A) found that males were significantly longer at birth and at weaning than the reciprocal females. However, Ragab *et al.* (1953) found no sex differences in body measurements of Ossimi lambs, while these differences were significant for Rahmani sheep.

TABLE 2

Average, width at hook for different breeding groups in cms.

	Females			Males			Total		
	No.	Mean	CV	No.	Mean	CV	No.	Mean	CV
<i>At birth</i>			%			%			%
Ossimi	21	5.0±0.4	6.7	26	6.1±0.1	7.5	47	6.0±0.1	7.1
Merino	21	6.0±0.4	6.8	21	6.0±0.1	8.7	42	6.0±0.1	7.7
1/2 Merino	16	6.2±0.4	6.2	28	6.3±0.1	8.6	44	6.3±0.1	7.4
3/4 Merino	20	6.3±0.1	7.5	17	6.5±0.1	8.4	37	6.4±0.1	8.3
<i>At weaning</i>									
Ossimi	21	10.7±0.2	7.2	26	10.8±0.2	8.7	47	10.7±0.1	8.0
Merino	17	12.2±0.2	7.1	18	12.2±0.3	8.8	35	12.2±0.2	7.9
1/2 Merino	15	13.1±0.2	4.8	26	13.0±0.3	9.9	41	13.1±0.2	8.4
3/4 Merino	18	13.1±0.2	6.5	16	13.3±0.2	7.1	34	13.2±0.2	7.2
<i>At 6 months</i>									
Ossimi	21	12.7±0.2	6.8	22	15.6±0.2	8.5	43	12.6±0.2	7.8
Merino	17	14.2±0.3	7.3	17	14.4±0.3	8.3	34	14.3±0.2	7.8
1/2 Merino	15	15.1±0.2	5.9	24	15.6±0.2	6.0	39	15.4±0.2	6.1
3/4 Merino	18	15.3±0.2	6.8	15	15.7±0.3	7.8	33	15.5±0.2	7.2
<i>At 8 months</i>									
Ossimi	21	13.6±0.2	7.6	22	13.7±0.2	7.6	34	13.7±0.3	7.4
Merino	17	15.3±0.1	2.3	17	15.9±0.1	2.5	34	15.6±0.2	7.8
1/2 Merino	15	16.6±0.2	5.1	24	17.0±0.2	6.8	39	16.9±0.2	6.3
3/4 Merino	18	16.5±0.4	11.2	15	17.1±0.3	6.5	33	16.8±0.2	6.6
<i>At yearling</i>									
Ossimi	21	14.7±0.2	7.5	12	14.2±0.4	9.0	33	14.5±0.2	7.6
Merino	16	16.2±0.2	4.7	15	16.2±0.3	6.8	31	16.2±0.2	7.2
1/2 Merino	15	17.4±0.2	5.4	22	17.7±0.2	5.9	37	17.6±0.2	5.7
3/4 Merino	17	17.1±0.2	5.7	14	17.5±0.2	4.8	31	17.3±0.2	5.3
<i>At 18 months</i>									
Ossimi	21	16.3±0.2	6.2	5	15.7±0.4	5.7	26	16.2±0.2	6.3
Merino	15	19.1±0.2	4.7	14	18.8±0.3	6.6	29	17.3±0.2	6.2
1/2 Merino	15	19.2±0.2	4.5	21	19.9±0.2	3.9	36	19.6±0.2	4.5
3/4 Merino	16	19.3±0.9	5.4	12	20.1±0.7	4.8	28	19.6±0.2	4.9

Width at Hook

At all ages studied, the crossbred groups were wider at hook than both the purebreds (Table 2). The weighted mean differences were always significant. This is in accordance with The results reported by Cumliviski (1959) on Valachian × Württemberg crossbred lambs. However, Fahmy (1964) found that the differences for width at hook and at shoulder between Merino, Barki purebreds and their crosses were significant at weaning but not at yearling age. From weaning to the age of 18 months Merino lambs surpassed the Ossimi lambs significantly ($P < 0.01$) in width at hooks.

TABLE 3

Average heart girth for different breeding groups in cms.

	Females			Males			Total		
	No.	Mean	CV	No.	Mean	CV	No.	Mean	CV
<i>At birth</i>			%			%			%
Ossimi	21	34.8±0.6	7.2	26	34.7±0.4	6.3	47	34.8±0.3	6.7
Merino	21	34.2±0.5	6.3	21	33.5±0.6	8.2	42	33.8±0.4	7.3
1/2 Merino	16	36.2±0.5	5.4	28	35.2±0.8	11.1	44	35.5±0.5	9.4
3/4 Merino	20	34.9±0.5	5.8	17	36.4±0.6	6.3	37	35.6±0.4	6.3
<i>At weaning</i>									
Ossimi	21	57.7±0.7	5.6	26	59.1±0.8	6.9	47	58.0±0.6	6.4
Merino	17	60.7±1.2	7.8	18	61.2±1.2	8.3	35	61.0±0.8	8.0
1/2 Merino	15	64.9±0.6	3.4	26	65.1±1.0	8.0	41	65.0±0.6	6.5
3/4 Merino	18	64.2±0.7	4.9	16	65.3±1.2	7.3	34	64.7±0.7	6.3
<i>At 6 months</i>									
Ossimi	21	65.2±0.7	5.1	22	66.5±0.9	6.7	43	65.9±0.6	6.0
Merino	17	68.2±1.2	7.3	17	69.3±1.1	6.7	34	68.7±0.8	6.9
1/2 Merino	15	73.4±1.0	5.2	24	75.1±1.3	8.4	39	74.4±0.9	7.4
3/4 Merino	18	73.4±0.8	4.6	15	74.9±1.0	5.3	33	73.5±0.6	5.0
<i>At 8 months</i>									
Ossimi	21	68.4±0.7	4.7	22	70.8±1.0	6.5	43	69.6±0.6	5.9
Merino	17	71.6±1.2	7.0	17	73.3±1.1	6.4	34	72.4±0.8	6.7
1/2 Merino	15	78.0±0.8	4.0	24	80.5±1.1	6.9	39	79.5±0.8	6.1
3/4 Merino	18	76.5±0.9	4.8	15	79.4±1.1	5.4	33	77.8±0.7	5.3
<i>At yearling</i>									
Ossimi	21	73.2±0.7	4.3	12	75.3±1.3	6.0	33	74.0±0.7	5.2
Merino	16	76.3±1.1	5.9	15	76.5±1.0	5.2	31	76.4±0.8	5.5
1/2 Merino	15	80.9±0.6	3.1	22	84.8±0.9	5.1	37	83.2±0.7	5.0
3/4 Merino	17	79.0±0.7	3.7	14	82.9±1.1	4.8	31	80.8±0.8	5.0
<i>At 18 months</i>									
Ossimi	21	79.0±0.8	4.0	5	79.3±1.3	6.4	26	79.0±0.6	4.1
Merino	15	85.0±0.9	4.3	14	87.8±1.5	6.2	29	86.3±0.9	5.5
1/2 Merino	15	88.8±0.8	3.4	21	95.1±0.8	3.8	36	92.5±0.8	5.0
3/4 Merino	16	86.7±0.9	4.2	12	92.6±0.6	2.2	28	89.6±0.9	5.2

Comparing the two crossbred groups with each other, they were nearly close in their width at hooks during the whole period of the experiment.

The differences between the two sexes in their width at hook for the four groups at all ages were too small to be significant. Badawy and Hamada (1959) working with Rahmani sheep found non significant differences between males and females in their width at hooks. However, it seems that females have relatively wide hooks because of their natural reproductive function. Sex had insignificant effect on the variation of this character except at 8 and 18 months old, where sex differences in this measurement became obvious.

TABLE 4

Average height at withers for different breeding groups in cms.

	Females			Males			Total		
	No.	Mean	CV	No.	Mean	CV	No.	Mean	CV
<i>At birth</i>			%			%			%
Ossimi	21	35.4±0.5	6.1	26	36.4±0.3	4.6	47	35.9±0.3	5.3
Merino	21	33.6±0.4	5.8	21	33.1±0.6	7.6	42	33.4±0.4	6.7
1/2 Merino . .	16	36.7±0.5	5.3	28	36.6±0.5	7.0	44	35.4±0.4	6.5
3/4 Merino . .	20	34.0±0.5	6.0	17	35.6±0.5	6.2	37	34.7±0.4	6.4
<i>At weaning</i>									
Ossimi	21	53.3±0.6	5.2	26	55.0±0.6	5.5	47	54.0±0.4	5.6
Merino	17	51.9±0.7	5.1	18	52.1±0.8	6.4	35	52.0±0.5	5.8
1/2 Merino . .	15	55.8±0.5	3.3	26	56.5±0.6	7.1	41	56.2±0.5	6.0
3/4 Merino . .	18	53.7±0.4	3.5	16	55.7±0.8	5.8	34	54.6±0.5	5.1
<i>At 6 months</i>									
Ossimi	21	57.7±0.7	5.9	22	60.1±0.6	5.7	43	58.9±0.5	5.6
Merino	17	57.0±0.8	5.6	17	57.5±0.9	6.5	34	57.3±0.6	6.0
1/2 Merino . .	15	61.8±0.5	3.2	24	63.3±0.9	6.6	39	62.8±0.6	5.5
3/4 Merino . .	18	59.2±0.5	3.2	15	62.2±0.7	4.3	33	60.5±0.5	4.4
<i>At 8 months</i>									
Ossimi	21	60.0±0.6	4.9	22	62.4±0.7	5.3	43	61.2±0.5	5.4
Merino	17	59.4±0.7	6.7	17	60.3±0.8	5.3	34	59.8±0.5	5.0
1/2 Merino . .	15	63.9±0.6	3.8	24	66.5±0.8	6.2	39	65.5±0.6	5.7
3/4 Merino . .	18	61.2±0.5	3.7	15	65.0±0.7	4.8	33	62.9±0.5	4.8
<i>At yearling</i>									
Ossimi	21	63.9±0.6	4.2	12	65.8±0.8	4.2	33	64.4±0.5	4.4
Merino	16	61.3±0.7	2.0	15	62.4±0.8	3.0	31	61.8±0.5	4.7
1/2 Merino . .	16	66.1±0.3	2.0	22	68.3±0.9	6.6	37	67.4±0.6	5.5
3/4 Merino . .	17	63.7±0.6	4.1	14	67.3±0.7	3.7	31	65.3±0.6	4.7
<i>At 18 months</i>									
Ossimi	21	67.2±0.4	2.8	5	70.6±0.5	7.9	26	67.8±0.6	4.6
Merino	15	64.3±0.9	4.1	14	66.4±0.7	4.2	29	65.3±0.5	4.4
1/2 Merino . .	15	69.1±0.7	3.8	21	72.6±0.8	4.8	36	71.1±0.6	5.1
3/4 Merino . .	16	65.9±0.7	6.7	12	70.6±0.7	3.4	28	67.9±0.7	5.1

Heart Girth

Merino lambs were born with smaller chest circumference than the four groups studied (Table 3). Although, no significant difference in heart girth between Merino and Ossimi lambs was observed at birth, yet significant differences in this measurement were found between Merino lambs and the crossbreds: 1/2 Merino ($P < 0.05$) and 3/4 Merino ($P < 0.01$). From weaning age and up to the end of the study, the breeding groups could be arranged in discendent order with respect to their heart girth as follows : 1/2 Merino, 3/4 Merino, Merino and Ossimi groups. Significant

TABLE 5

Correlation coefficients between different ages for different measurements.

The measurement	Ossimi	Merino	1/2 Merino	3/4 Merino
<i>Yearling and weaning</i>				
Length	0.21	0.18	0.27	0.23
Width	0.50**	0.59**	0.56**	0.61**
Heart girth	0.53**	0.65**	0.71**	0.57**
Height	0.58**	0.68**	0.55**	0.76**
<i>18 months and weaning</i>				
Length	0.50**	0.62**	0.41**	0.41**
Width	0.43**	0.29	0.26	0.46*
Heart girth	0.30	0.35	0.38*	0.45*
Height	0.52**	0.81*	0.48**	0.66**
<i>Yearling and yearling</i>				
Length	0.70**	0.84**	0.82**	0.81**
Width	0.85**	0.31*	0.49**	0.82**
Heart girth	0.77**	0.63**	0.80**	0.89**
Height	0.82**	0.85**	0.63**	0.84**

* Significant (at 5%)

** Highly significant (at 1%)

differences in heart, girth between Ossimi and Merino, and between either purebreds and their crosses were found. The two crossbreds insignificantly differed in respect to this measurement, except at yearling age. Most of the investigations concerning the fundamental body measurements indicated that crossbreds exceeded the purebreds in this body dimension (Asker *et al.* 1954; Koncar, 1957; Palian, 1959; Cumlivski, 1959; and Fahmy, 1964). On the other hand Ritzman and Davenport (1920) reported that the chest circumference of the F₁ and F₂ of crossing Southdown and Rambouillet was about midway between the two parental breeds.

Although sex had no remarkable effect on heart girth at birth and weaning in the present study, yet it had a significant effect at 6 months of age ($P < 0.05$) and afterwards ($P < 0.01$). Working with Rahmani and Ossimi up to 27 weeks of age Ragab *et al.* (1953) observed an increase in

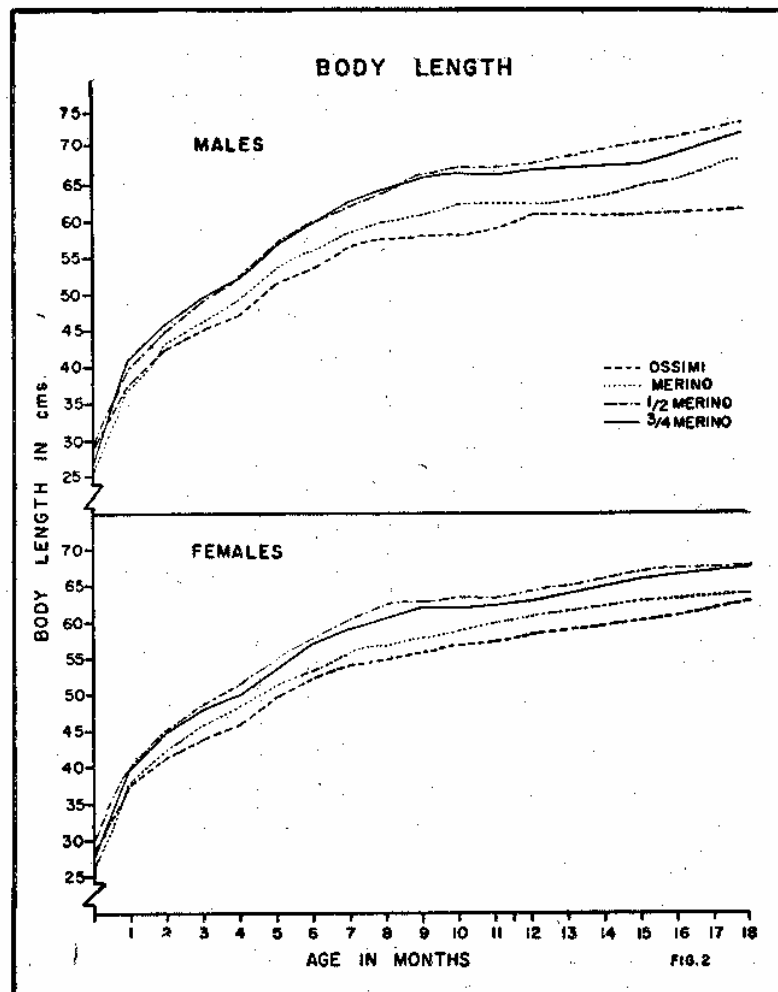


Fig. 1

sex differences for chest circumference with advance in age for Rahmani but not for Ossimi sheep.

Height at Withers

The half-Merino group was the highest at withers among all groups studied followed by Ossimi, 3/4 Merino and Merino (Table 4). The weighted mean differences between Merino and the two crossbred groups and between the 1/2 Merino and 3/4 Merino were highly significant ($P < 0.01$).

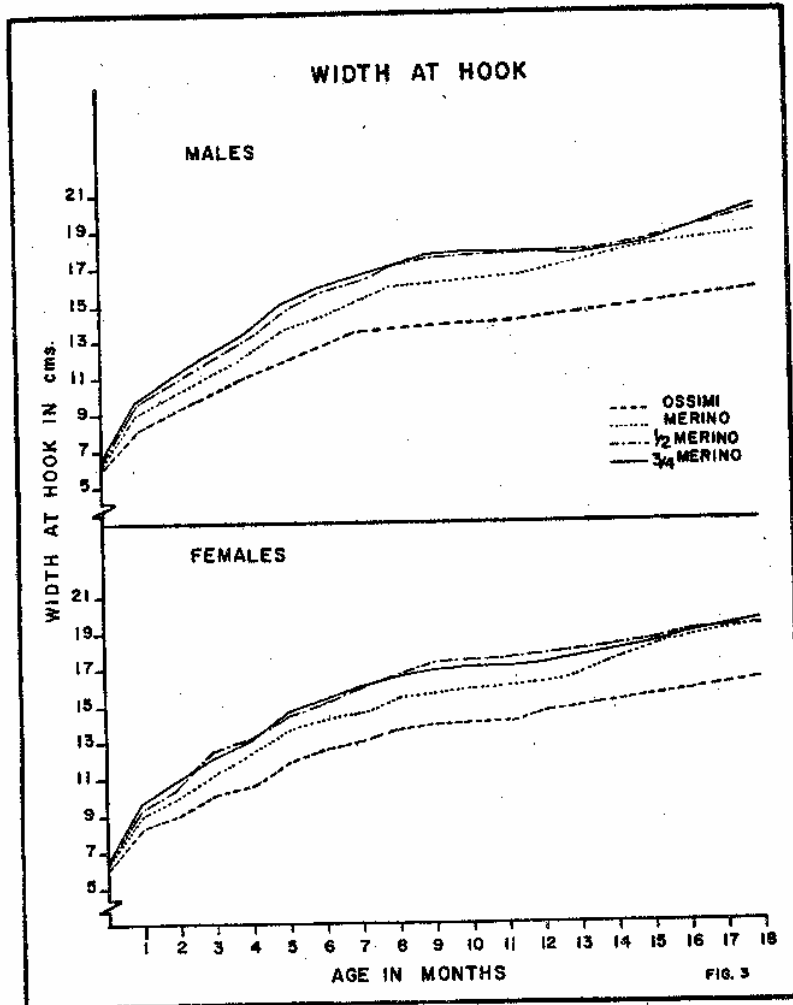


Fig. 2

Males were higher at withers than females and the differences became more pronounced with advance in age. Similar findings concerning the effect of sex on height at withers were obtained by Ragab *et al.* (1953), Palian *et al.* (1952), Sliwa *et al.* (1962) and Fahmy (1964) using different breeds of sheep. In the present study crossbred groups showed greater sex differences than purebreds at all ages. Variation due to sex was significant at weaning, and became highly significant afterwards.

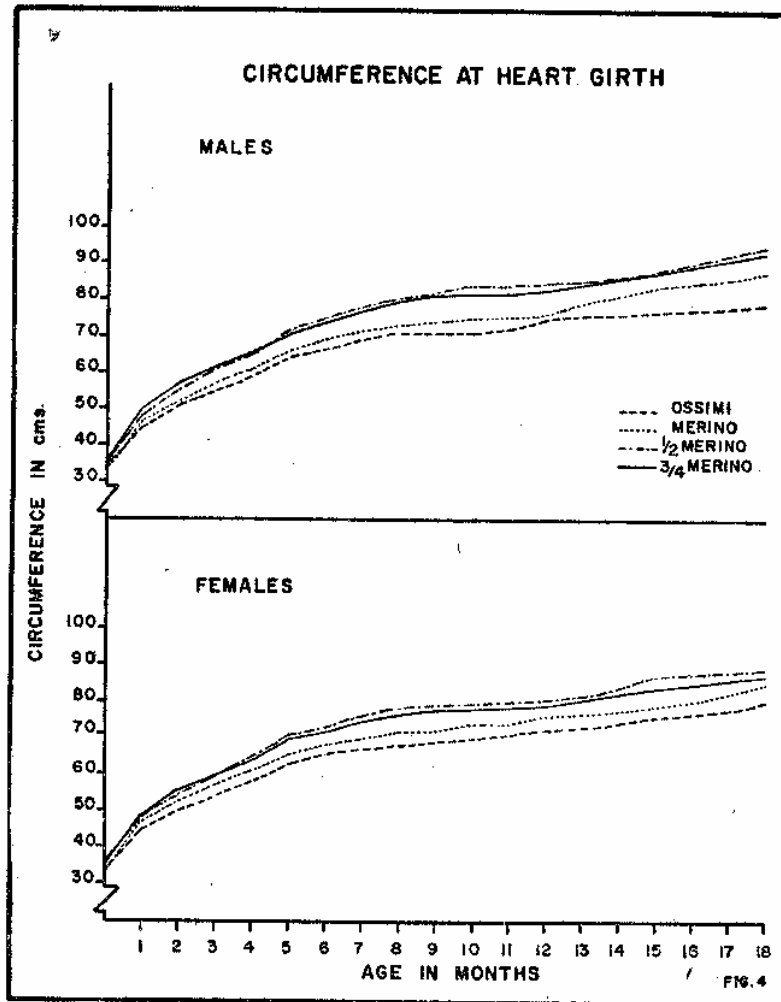


Fig. 3

Body development and relative change in body dimensions

The relative changes in body dimensions studied were found to be different from one character to another (Figs 1, 2, 3 and 4). The four body measurements could be ranked in the following decreasing order according to this rate of change and development, width at hooks, length, heart girth and finally the height at withers. Working with Ossimi and Rahmani sheep Ragab *et al.* (1953) and Badawi and Hamada (1959) showed that length and width at hook had the highest development rate

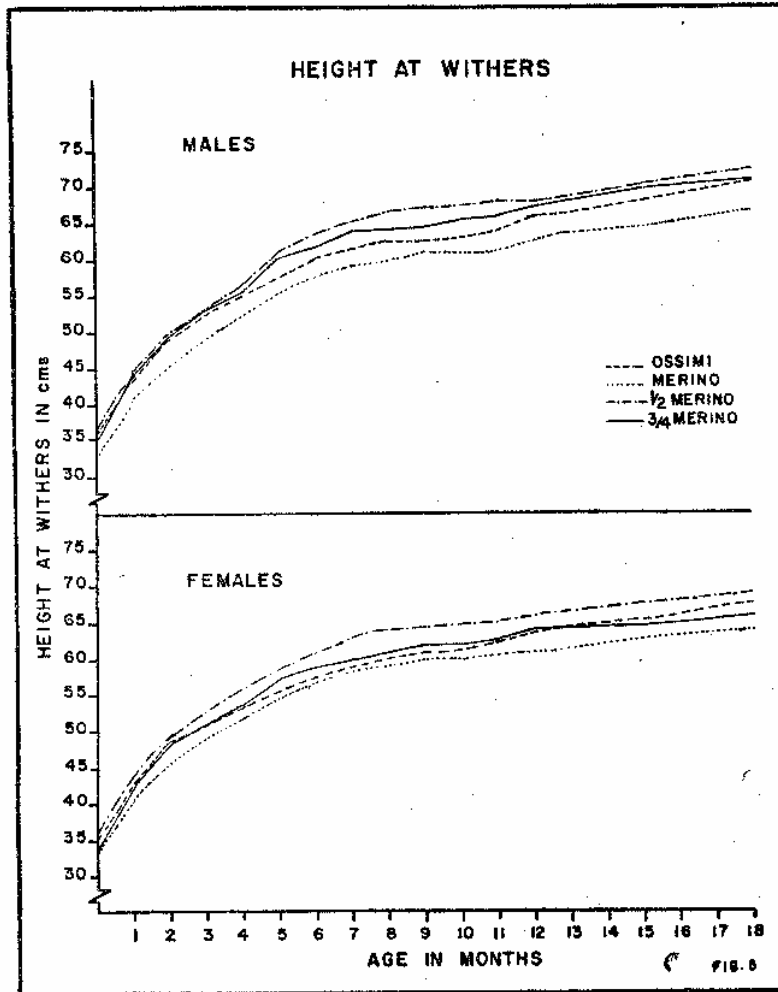


Fig. 4

among different body dimensions. They also pointed out that longitudinal measurements grew at a faster rate than transverse ones.

The relative changes in body dimensions were affected by differences in the breeding structure and sex of the sheep. The development curves showed, in general, that crossbred lambs were superior to the purebred ones in body dimensions particularly in length and heart girth. Considering the effect of sex on relative changes, males grew faster than females in body length, heart girth and height at withers. This was not true in the case of width at hooks.

Two distinctive periods were observed in the development rates of body measurements of the different groups. The first period showing a remarkable rapid growth was that from birth to weaning for all dimensions except for body length, which observed from birth up to the 10th week of age. The second stage which was characterised of less and recessing growth rate followed the first period and lasted to the end of the investigation for all measurements.

It could be generally concluded that the Ossimi breed is relatively long-legged and narrower in body; than the Merino which is short-legged, broad and of a compact body type. On the other other hand, the 1/2 Merino group because of its large body length, great height and broad transverse dimension gives the impression of large framed animals capable carrying more flesh. However, the 1/2 Merinoes showed the same trend as 3/4 Merinoes but with lower height and nearly the same width of body.

Thus, it could be suggested that the 3/4 Merino lambs might have a better type of mutton form among all groups studied. Comparing the two purebred groups, it seems that Merinoes may score a better body conformation than the local Ossimi breed as far as mutton type is concerned.

Relation between body measurements

The correlation coefficients between body measurements given in appendix (5) showed that height at withers had the most strongly and highly significant relationship between the different ages. The correlations for width and heart girth between weaning and yearling ages were highly significant and higher than that between weaning and 18 months which was mostly insignificant. This was not the case for body length where the coefficients of correlation between weaning and yearling dimensions were insignificant for the different groups, and it became significant for 18 months-weaning correlations. All the body measurements studied at 18 months old were highly correlated with those at yearling age.

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تأثير الخلط بين أغنام المرينو والاوزيمى على مقاييس الجسم وتطوره

الملخص

استخدم فى هذه التجربة ١٧ حملا مولودة فى عام ١٩٦٣ بسبخا ومحلة موسى من أربعة مجاميع مختلفة من الأغنام هى المرينو الأصيل والاوزيمى وخليط نصف مرينو وخليط ثلاثة أرباع مرينو . وقيست الأبعاد الآتية :

طول وعمق وارتفاع الجسم ومحيط الصدر لكل فرد عند الميلاد وكل أسبوعين حتى الفطام ثم كل شهر حتى عمر سنة ثم كل ثلاث شهور حتى عمر ١٨ شهرا .

أظهرت نتائج هذا البحث أن الأغنام الخليطة « نصف مرينو وثلاثة أرباع مرينو » كانت متفوقة على الأغنام الأصيلة فى جميع مقاييس الجسم السابقة وفى الأعمار المختلفة . وكانت أغنام الاوزيمى أقل من أغنام المرينو فى طول وعمق الجسم ومحيط الصدر بينما كانت أعلى منها فى الارتفاع عند الكتفين فى جميع الأعمار السابقة .

ورغم أن الأغنام الخليطة « نصف مرينو » قد تفوقت عن الأغنام الخليطة « ثلاثة أرباع مرينو » فى جميع الصفات التى درست إلا أن الفروق بينهما كانت معنوية فقط فى الارتفاع عند الكتفين . كما وجد أن الذكور كانت متفوقة عن الإناث فى أبعاد الجسم لمختلفة ما عدا عمق الجسم .

وجد كذلك هناك مرحلتين متميزتين لسرعة التطور فى أبعاد الجسم المختلفة فالمرحلة الأولى « من الميلاد حتى الفطام » تميزت بسرعة نمو وتطور أبعاد الجسم بينما كانت المرحلة الثانية « من الفطام حتى عمر ١٨ شهرا » أقل منها فى سرعة التطور . وقد درس معامل التلازم بين الأعمار المختلفة لأبعاد الجسم السابقة .