APPENDIXES A AND B
AWASSI CROSS-BREDS

Appendixes A and B
Awassi cross-breds

In several countries the Awassi has been crossed with other breeds of sheep. In some cases Awassi rams, more especially of the improved dairy type, have been mated with ewes of local unimproved breeds for the purpose of increasing the milk yields of their progeny. In others, rams of European origin have been used for cross-breeding with the Awassi to improve certain features in which the Awassi does not meet modern economic requirements.

Generally, cross-breeding with the Awassi has been conducted under experimental conditions. The tests have been of a variable nature and the data on the cross-breds have usually been restricted to the F_1 generation. East Friesian-Awassi cross-breds form an exception; these are being developed into a new type on which a considerable amount of material has been published.*

Appendix A

Awassi x Baluchi

The cross-breeding of improved Awassi rams from Israel with local Baluchi ewes in the Qazvin area of Iran followed the same plan at the village level, in parallel with an intensively managed demonstration flock, as that of crossing the Awassi with the Shal (see p. 249).

In its purest form the Baluchi occurs in the region of Kalat and the Bolan Pass in Pakistan and in the area of Saravan in the southeastern corner of Iran. It is a large and very hardy sheep, capable of withstanding long periods of drought, yet also suitable for stall-feeding and fattening. The average live weight of adult rams is 44 kg and of ewes 33 kg; the withers height of rams is 65 cm and of ewes 62 cm. The head is large with a convex profile and long pendulous ears. The rams have large horns curving in an open spiral, while the ewes are either polled or have rudimentary scurs. The body is broad and fairly deep, the rump wide and drooping to the short broad fat tail from which a thin end hangs down to the hocks or the fetlocks. The udder is well shaped with large teats. The average milk yield during the lactation period is 1.5-2.0 kg a day. The fleece consists of long, coarse carpet wool with a strong admixture of hair. The annual fleece weight ranges from 1.5 to 2.0 kg. The fleece is yellowish-white with many black or brown patches. The oral part of the head is usually black (Epstein, 1970).

In the Qazvin area the Baluchi is not of a pure type, but seems to have been influenced by Ak-Karaman and Mor-Karaman sheep formerly introduced by immigrants from Turkey. In contrast with the original type, the Baluchi rams of the Qazvin area are usually polled. The average weight of 1 300 Baluchi ewes collected in the villages of the Qazvin area was 34 kg and after fattening in feed-lots, 55 kg (Wallach & Eyal, 1974).

Tables A-I to A-5 give data recorded by Wallach and Eyal (1974) in Awassi, Baluchi and Awassi-Baluchi F_1 cross-breds.

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* Although not always representing the sire in the mating, the Awassi has been given precedence in the Appendixes in order to emphasize its importance in the cross.

TABLE A-1. **Average body weights of Awassi, Baluchi and Awassi-Baluchi cross-bred ewes 3 days after lambing (kg)**

Breed	1 year		2 years		3 years and older	
	Number	Weight	Number	Weight	Number	Weight
Awassi	54	66.8	19	78.2	21	82.0
Baluchi	4	61.3	—	—	9	71.8
Cross-bred	10	60.0	13	74.3	5	72.3

TABLE A-2. **Average body weights of Awassi, Baluchi and Awassi-Baluchi cross-bred ewes at the end of the lambing season (kg)**

Breed	1 year			2 years			3 years and older		
	No.	Days from lambing	Weight	No.	Days from lambing	Weight	No.	Days from lambing	Weight
Awassi	71	67	62.2	33	82	68.3	53	94	74.6
Baluchi	5	26	59.8	8	104	63.9	55	97	61.8
Cross-bred	10	49	59.1	10	81	63.3	14	98	63.6

TABLE A-3. **Average fleece weights of adult Awassi, Baluchi and Awassi-Baluchi cross-bred ewes at Esmailabad Demonstration Farm, 1968 (kg)**

Breed	Number of ewes	Fleece weight
Awassi	111	2.43
Baluchi	95	1.76
Cross-bred	17	2.39

TABLE A-4. **Fate and disposal of Awassi, Baluchi and Awassi-Baluchi cross-bred ewes of different ages; average annual percentages for 4 years**

Age (years)	bred	% mortality from		% culled because of				Total
		mastitis	other diseases	low milk yield	barrenness	disease	miscellaneous	
1	Awassi	—	2.6	—	—	2.1	0.8	5.5
	Baluchi	—	2.1	2.1	—	6.3	4.2	14.7
	Cross-bred	—	—	—	—	6.0	—	6.0
2	Awassi	0.6	1.8	8.5	3.6	10.9	0.6	26.0
	Baluchi	—	—	25.0	—	3.6	—	28.6
	Cross-bred	—	3.2	3.2	—	9.7	—	16.1
3 and older	Awassi	0.5	3.8	18.1	2.7	5.5	0.5	31.1
	Baluchi	—	3.0	11.3	0.7	2.7	3.6	21.3
	Cross-bred	—	13.3	13.3	—	—	—	26.6

Note. Numbers of ewes in the flock at beginning of year given in Table A-5.

Tables A-6 to A-10 give the average growth from birth to weaning of single and twin, male and female Awassi, Baluchi and Awassi-Baluchi cross-bred lambs during four seasons (1967-70).

Table A-ll gives the average, minimum and maximum milk yields of Awassi, Baluchi (designated as local) and Awassi-Baluchi cross-bred ewes as recorded in the demonstration flock of the Qazvin Development Area in 1969 (QDA, 1970). Table A-12 presents average lactation periods for three age groups of the cross-breds.

TABLE A-5. **Reproductive performance of Awassi, Baluchi and Awassi-Baluchi cross-bred ewes of different ages for 4 years**

Age (years)	Breed	No. of ewes		Lambs born	Lambs per ewe (%)	
		In flock	Lambed		In flock	Lambing
1	Awassi	234	100	102	0.44	1.02
	Baluchi	50	19	22	0.44	1.16
	Cross-bred	50	15	16	0.32	1.07
2	Awassi	165	141	151	0.92	1.07
	Baluchi	28	28	30	1.07	1.07
	Cross-bred	31	27	31	1.00	1.15
3 and older	Awassi	182	173	217	1.19	1.25
	Baluchi	301	277	328	1.09	1.18
	Cross-bred	15	14	20	1.33	1.43

TABLE A-6. **Average growth of single male and female Awassi, Baluchi and Awassi-Baluchi cross-bred lambs from birth to weaning**

Sex and breed	No.	Birth weight (kg)	Weaning weight (kg)	Age at weaning (days)	Daily weight gain (9)
Male					
Awassi	144	5.1	29.1	89	269
Baluchi	64	4.6	29.2	90	277
Cross-bred	52	4.8	30.9	92	284
Female					
Awassi	135	4.8	25.9	90	235
Baluchi	67	4.5	25.4	90	231
Cross-bred	39	4.7	25.6	89	231

TABLE A-7. **Average growth of twin male and female Awassi, Baluchi and Awassi-Baluchi cross-bred lambs from birth to weaning**

Sex and breed	No.	Birth weight (kg)	Weaning weight (kg)	Age at weaning (days)	Daily weight gain (g)
Male					
Awassi	36	4.3	30.3	92	282
Baluchi	21	3.9	25.9	90	244
Cross-bred	22	4.5	27.6	89	260
Female					
Awassi	50	4.2	23.9	88	224
Baluchi	28	3.6	23.5	92	217
Cross-bred	28	3.6	24.2	96	214

Awassi x Barki

At the Ras El-Hekma Desert Research Station in the western coastal desert of Egypt, Syrian Awassi and Hungarian Merino rams have been crossed with Barki ewes with the aim of improving the productivity of the Barki (Fig. A-l). The semi-nomadic bedouin of this region depend mainly on sheep and goats for their income, but the mutton and wool production of the local Barki sheep is unsatisfactory.

The Barki, also called Arab, Bedouin, Libyan or Dernawi, is a very hardy fat-tailed breed, well adapted to desert conditions. It is rather short-legged, narrow and flat-sided. The average withers

TABLE A-8. **Average daily weight gains of Awassi, Baluchi and Awassi-Baluchi cross-bred lambs from weaning to sale for slaughter (g)**

Breed	Single		Twin	
	Male	Female	Male	Female
Awassi	248	170	245	192
Baluchi	243	153	234	173
Cross-bred	231	168	198	167

TABLE A-9. **Mortality of male and female lambs of Awassi, Baluchi and Awassi-Baluchi cross-bred ewes as percentage of lambs born**

Sex and breed	No. of lambs born	Age at death (days)			Total
		1-3	4-90	90-180	
Male					
Awassi	241	8.2	9.5	5.7	23.4
Baluchi	192	5.4	3.0	1.7	10.1
Cross-bred	39	3.5	6.7	1.7	11.9
Female					
Awassi	217	6.6	5.3	1.1	13.0
Baluchi	188	3.2	3.2	0.4	6.8
Cross-bred	91	5.9	6.5	0	12.4

TABLE A-10. **Average annual milk yields in 2-4 years of three age groups of Awassi, Baluchi and Awassi-Baluchi cross-bred ewes (kg)**

Age (years)	Awassi		Baluchi		Cross-bred	
	No.	Yield	No.	Yield	No.	Yield
1	95	222.5	14	70.4	13	121.6
2	129	267.8	26	146.2	28	186.7
3 and older	164	297.6	264	142.5	14	211.0

TABLE A-11. **Average, minimum and maximum milk yields of Awassi, Baluchi and Awassi-Baluchi cross-bred ewes**

Breed	Age	Number of ewes	Milk yield (kg)		
			Average	Minimum	Maximum
Awassi	Yearlings	11	289	199	394
	Adult ewes	67	333	139	593
Baluchi	Yearlings	18	148	71	233
	Adult ewes	48	189	76	309
Cross-bred	Yearlings	16	200	134	280

TABLE A-12. **Average lactation lengths in 2-4 years of three age groups of Awassi, Baluchi and Awassi-Baluchi cross-bred ewes**

Age (years)	Awassi		Baluchi		Cross-bred	
	Number	Days	Number	Days	Number	Days
1	99	214.9	14	146.7	13	154.5
2	129	219.3	26	199.1	24	204.5
3 and older	157	219.8	260	190.5	29	206.0

height is 65 cm, the average weight of rams 60 kg and of ewes 45 kg. Adult rams carry heavy horns curved around semi-pendulous ears; the ewes are polled. The fleece consists of carpet wool with over 8 percent kemp and a staple length of about 8 cm. The weight of the fleece is approximately 1.8 kg. The colour is white, the white extending to the poll and upper part of the forehead, while the remaining part of the head is either black, brown or red. The fat tail is flat; the thin twisted terminal section extends to the hocks or fetlocks. The fecundity of the ewes is low, the twinning rate rarely exceeding 5 percent (Epstein, 1970; 1971).

Figure A-1. Barki ram and ewe

Reciprocal first crosses between Barki and Awassi, a few back-crosses to Awassi, and also a small number of three-breed-cross lambs from mating Awassi rams to Merino-Barki cross-bred ewes have been studied by Fahmy *et al.* (1968) (Table A-13). The breeding animals were kept in fenced yards provided with ample shade. In winter they were pastured for four to five months, the grazing being supplemented by a pelleted concentrate ration of 750 g a day and an unlimited quantity of wheat or barley straw. In summer they received about 500 g of Egyptian clover in addition to the above concentrate and straw rations. The lambs were weaned at an approximate age of 130 days, their feeding during the post-weaning period consisting of straw and 250-500 g of pelleted concentrates.

The cross-bred lambs developed well until weaning but were unsatisfactory at yearling age. They were almost exactly intermediate between the pure-bred Awassi and Barki parental stocks for all characteristics except fleece weight in which they showed a decrease. The percentage increase over, or decrease from, the expected mean of the parents was as follows: birth weight -2, weaning weight 0, yearling weight 0, daily pre-weaning weight gain 1, daily post-weaning weight gain -2, and greasy fleece weight-14.

Fahmy *et al.* (1968) suggest that the lack of superiority of the cross-breds over the mean of the parental breeds may be attributable to the insignificant genetic difference between the geographically near and physically similar Barki and Awassi. It is notable that in all characteristics studied these cross-breds were much inferior to Merino-Barki cross-breds.

In view of the special demand in Egypt for yearling rams raised on the range and fattened near the large consumption centres, Galal *et al.* (1976) compared the feed-lot performance and mutton yields of 11 male Awassi-Barki F_1 cross-bred rams with those of nine Syrian Awassi and 11 Barki pure-bred rams of similar age and rearing. At the commencement of the fattening period of nine weeks, the animals were about 15 months old. Weights were taken at the beginning and end of fattening, and body measurements on the day of slaughter. The average daily weight gains and total digestible nutrient requirements (TDN) for each 1-kg gain were also recorded (Table A-14).

Contrary to the Awassi-Barki cross-breds' lack of superiority to the mean of the parental breeds in the growth test, in the fattening trial heterosis of the cross-breds was highly conspicuous. The cross-breds were superior to the pure-bred rams in initial live weight and daily weight gain. Their economic gains were larger than those of the pure-bred Awassi and Barki rams. The Barki had the shortest body length from withers to tail, the shallowest depth of chest and the narrowest width, but in heart girth it exceeded the Awassi. In all these measurements the cross-bred rams surpassed the pure-breds (Table A-15).

In dressing percentage based on the warm carcass weight, the Awassi rams, owing to their heavy fat tails, exceeded both the Barki and Awassi-Barki rams. But the cross-breds surpassed the purebred Awassi and Barki rams in the dressing percentage of the carcass without the fat tail (Galal *et al.,* 1976).

All edible inner organs were heavier in the Awassi-Barki cross-breds than in the pure-breds. In total quantity of separable tail, kidney and caul fat, the cross-bred rams — with 3.3 kg — held an intermediate position between the Awassi (4.4 kg) and Barki (2.2 kg).

The carcass dimensions of the Awassi-Barki cross-bred rams exceeded those of the pure-bred Awassi and Barki rams.

TABLE A-13. **Average weights and weight gains of Awassi-Barki F_1 cross-bred lambs and F_2 lambs by Awassi rams out of Awassi-Barki F_1 cross-bred ewes**

Weight	Awassi-Barki		Awassi-Barki back-cross to Awassi	
	Number	Weight	Number	Weight
Birth weight (kg)	270	3.52	12	3.91
Weaning weight (kg)	185	18.59	8	16.13
Yearling weight (kg)	76	32.36	—	—
Daily pre-weaning weight gain (g)	185	125	8	110
Daily post-weaning weight gain (g)	76	53	—	—
Greasy fleece weight (kg)	82	3.24	—	—

TABLE A-14. **Average body weights, daily weight gains and TDN requirements of Awassi-Barki, Awassi and Barki yearling rams in Egypt**

Breed	Awassi-Barki	Awassi	Barki
Trait			
Initial weight (kg)	43.300	39.000	35.300
Daily weight gain (g)	0.160	0.144	0.128
TDN/kg gain	7.100	7.900	8.400
Pre-slaughter measurements (cm)			
Length of body	53.5	52.9	52.5
Depth of chest	31.1	30.5	29.1
Heartgirth	87.0	83.4	84.4
Width at hook bones	17.2	16.5	16.0
Width at loins	12.9	12.1	11.9

TABLE A-15. **Average carcass weights and measurements and weights of edible inner organs of fattened Awassi-Barki, Awassi and Barki rams in Egypt**

Breed	Awassi-Barki	Awassi	Barki
Slaughter weights (kg)			
Carcass with fat tail	25.400	23.700	21.300
Carcass without fat tail	23.200	20.400	20.200
Fat tail	2.200	3.300	1.100
Forequarters	12.800	11.000	11.000
Hindquarters	12.600	12.700	10.300
Liver	0.863	0.760	0.731
Lungs and trachea	0.536	0.484	0.458
Heart	0.180	0.177	0.161
Kidneys	0.160	0.149	0.137
Empty digestive tract	3.900	4.100	3.900
Measurements (cm)			
Carcass length	55.4	54.1	54.6
Carcass width at shoulder	20.1	19.7	19.7
Carcass width at loin	11.0	10.0	10.0
Heartgirth	83.4	83.3	82.0
Length of leg	25.8	24.9	24.1

TABLE A-16. **Numbers of births and lambs of Awassi, Chios and cross-bred sheep, 1969/70-1971/72**

Breed	No. of lambings	No. of lambs	No. of lambs per lambing (%)
Awassi	180	200	1.10
Chios	258	409	1.59
Cross-bred	148	238	1.61

Awassi x Chios

In Cyprus, Awassi rams of the improved dairy type were crossed with Chios ewes in the same tests and under the same conditions under which the performance of Awassi x Cyprus Fat-tailed cross-breds was studied in 1969/70 and 1970/71-1971/72 (Tables A-16 to A-18) (Cyprus ARI, 1972; 1973; 1975).

The least squares means for breed effects on live weights and post-weaning daily gains of purebred Chios and Awassi and cross-bred Chios-Awassi lambs, studied by Mavrogenis and Louca (1979), show that the cross-breds had a faster growth rate and were heavier at 140 days than the pure-bred lambs (Table A-19).

A comparison of the lactation yield and milk constituents of Awassi-Chios cross-breds with those of pure-bred Awassi and Chios ewes under different feeding-management systems showed that the cross-breds, although inferior to the parent breeds' milk in fat percentage, greatly exceeded both parent stocks in total quantities of milk, fat and protein, indicating a high degree of heterosis (Table A-20) (Cyprus ARI, 1979).

TABLE A-17. **Mean birth weights and weight gains of male and female Awassi, Chios and cross-bred lambs, 1969/70**

Sex and breed	No. of lambs	Birth weight (kg)	Weaning age (days)	Weaning weight (kg)	140-day weight (kg)	Mean daily weight gain (g)
Male						
Awassi	32	5.3	44.6	15.7	35.9	219
Chios	17	4.5	44.9	12.7	32.3	199
Cross-bred	27	4.6	45.7	15.2	38.6	243
Female						
Awassi	22	5.0	42.0	14.8	33.6	204
Chios	41	4.4	45.9	13.9	30.2	182
Cross-bred	27	4.3	45.6	13.2	31.4	194

TABLE A-18. **Mean birth weights and weight gains of single and twin Awassi, Chios and cross-bred lambs, 1970/71-1971/72**

Breed	Birth	No. of lambs	Birth weight (kg)	140-day weight (kg)	Mean daily weight gain (g)
Awassi	Single	90	5.06	29.6	175
	Twin	30	4.44	27.7	166
Chios	Single	62	4.75	32.5	198
	Twin	195	3.87	28.3	175
Cross-bred	Single	46	5.02	31.5	189
	Twin	122	3.84	28.0	173

TABLE A-19. **Least squares means for breed effects on live weights and post-weaning daily gains of Chios, Awassi and Chios-Awassi cross-bred lambs**

Breed	No. of lambs	Weaning weight (kg)	140-day weight (kg)	Daily weight gain (g)
Chios	401	11.4	33.7	217
Awassi	103	12.4	35.0	222
Chios x Awassi	25	11.4	35.6	236
Chios x Awassi-Chios	57	12.1	36.2	228

TABLE A-20. **Comparison of lactation yield and milk constituents of Awassi-Chios cross-breds with those of purebred Awassi and Chios ewes**

Breed	No	Milk yield per lactation (kg)	Length of lactation (days)	Fat		Protein		Average daily milk yield (kg)
				%	Kg	%	Kg	
Awassi	212	141	150	6.7	9.5	6.0	8.5	0.94
Chios	263	137	143	6.5	8.9	6.1	8.4	0.95
Awassi-Chios	82	171	146	6.1	10.5	6.0	10.2	1.17

Awassi x Cyprus Fat-tailed

In Cyprus, Awassi rams of the improved dairy type, imported from Israel, were crossed with Cyprus Fat-tailed ewes (Figs A-2 and A-3) during the period 1969/70-1971/72 in order to compare the performance of the cross-bred progeny with that of the pure-bred parent stocks (Table A-21). The feeding and management of the lambs were similar for the three groups. In 1969/70 the performance

of male and female lambs was recorded separately, while no distinction in birth weights and weight gains was made between single and twin lambs (Table A-22). In the test period, 1970/71-1971/72, the performance of single and twin lambs was recorded separately, while the sex of the lambs was ignored (Table A-23) (Cyprus ARI, 1972; 1973; 1975).

The least squares means for breed effects on live weights and post-weaning daily gains of purebred Cyprus Fat-tailed and Awassi and cross-bred Awassi-Cyprus lambs, studied by Mavrogenis and Louca (1979), show that the cross-breds had a faster growth rate and were heavier at 140 days than the pure-bred lambs (Table A-24).

Table A-25 gives the results of comparison of the quantity and constituents of the milk of Awassi-Cyprus Fat-tailed cross-bred ewes with those of the pure-bred parent stocks under intensive, semi-intensive and extensive feeding-management systems (Cyprus ARI, 1979).

While the percentages of fat and protein in the milk of the cross-bred ewes were lower than the mean of the parent breeds in the same trial, the quantities of milk, fat and protein for each lactation were considerably higher than the averages of the pure-bred ewes.

Figure A-2. Cyprus Fat-tailed ewe. (Photograph by Dr S. Economides)

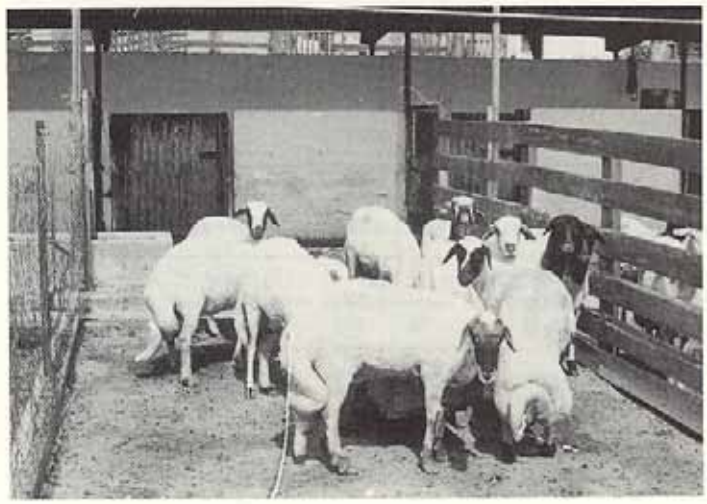

Figure A-3. Cyprus Fat-tailed sheep (after shearing) showing caudal conformation. (Photograph by Dr S. Economides)

TABLE A-21. **Numbers of births and lambs of Awassi, Cyprus Fat-tailed and cross-bred sheep, 1969/70-1971/72**

Breed	Number of lambings	Number of lambs	Number of lambs per lambing
Awassi	182	200	1.10
Cyprus Fat-tailed	220	235	1.07
Cross-bred	84	98	1.17

TABLE A-22. **Mean birth weights and weight gains of male and female Awassi, Cyprus Fat-tailed and cross-bred lambs, 1969/70**

Sex and breed	No. of lambs	Birth weight (kg)	Weaning age (days)	Weaning weight (kg)	140-day weight (kg)	Mean daily weight gain (g)
Male						
Awassi	32	5.3	44.6	15.7	35.9	219
Cyprus Fat-tailed	21	4.7	46.7	13.7	30.8	186
Cross-bred	5	5.1	45.4	13.0	28.7	168
Female						
Awassi	22	5.0	42.0	14.8	33.6	204
Cyprus Fat-tailed	18	4.3	46.8	13.2	25.1	144
Cross-bred	5	4.6	47.6	14.2	29.8	183

TABLE A-23. **Mean birth weights and weight gains of single and twin Awassi, Cyprus Fat-tailed and cross-bred lambs, 1970/71-1971/72**

Breed	Birth	No. of lambs	Birth weight (kg)	140-day weight (kg)	Mean daily weight gain (g)
Awassi	Single	90	5.06	29.58	179
	Twin	30	4.44	27.67	165
Cyprus Fat-tailed	Single	115	4.70	25.75	150
	Twin	25	4.20	23.75	140
Cross-bred	Single	58	5.18	28.64	168
	Twin	21	3.85	25.07	147

TABLE A-24**. Least squares means for breed effects on live weights and post-weaning daily gains of Cyprus Fat-tailed, Awassi and Awassi-Cyprus Fat-tailed cross-bred lambs**

Breed	No. of lambs	Weaning weight (kg)	140-day weight (kg)	Daily weight gain (g)
Cyprus Fat-tailed	23	9.8	28.5	185
Awassi	103	12.4	35.0	222
Awassi x Cyprus	22	11.1	35.8	239
Awassi x Awassi-Cyprus	18	12.2	38.2	243

TABLE A-25. **Comparison of milk of Awassi-Cyprus Fat-tailed cross-bred ewes with milk of pure-bred parent stocks**

Breed	No.	Average milk yield per lactation (kg)	Average length of lactation (days)	Fat		Protein		Average daily milkyield (kg)
				%	Kg	%	Kg	
Awassi	212	141	150	6.7	9.5	6.0	8.5	0.94
Cyprus Fat-tailed	60	65	106	7.1	4.6	6.0	3.9	0.61
Awassi-Cyprus Fat-tailed	35	122	134	6.7	8.2	6.5	7.9	0.91

Awassi x Finnish Landrace

Cross-breeding experiments with local Awassi ewes and imported Finnish Landrace and Romanov rams have been conducted in Israel for the purpose of increasing fecundity and the number of lambs marketed yearly for each ewe, traits in which the pure-bred Awassi is unsatisfactory.

In an experiment carried out by Goot *et al.* (1976), Awassi ewes were inseminated with semen

from Finnish Landrace rams which have difficulty in serving fat-tailed ewes. The ewes were fed concentrates and wheat straw, while their cross-bred lambs had free access to a concentrate mixture until weaning at a weight of approximately 12 kg. Tables A-26 and A-27 give the data recorded.

Further cross-breeding trials with Finnish Landrace rams and Awassi ewes for increased meat production were conducted by Goot *et al.* (1978) in 1976/77 and 1977/78. The average length of the gestation period of 36 Awassi ewes inseminated with Finnish Landrace semen was 149.2 days, and of two- to four-year-old Finnish Landrace-Awassi F_1 cross-bred ewes inseminated with Finnish Landrace semen, 148.0 days. (See Table A-28.)

In early sexual maturity and prolificacy, Finnish Landrace-Awassi females of the first cross-bred generation or back-crosses to Finnish Landrace rams were superior to Awassi ewe hoggets. Eighty-three percent of the F_1 cross-breds and 58 percent of the back-cross ewes lambed as yearlings versus 30 percent of the pure-bred Awassi females. The percentage of multiple births was only 3 percent in the Awassi, but 28 percent in Finnish Landrace-Awassi F_1 cross-breds and 50 percent in those derived from back-crosses to Finnish Landrace rams. (See Table A-29.)

For all the reproductive traits tested, two- to three-year-old Finnish Landrace-Awassi F_1 cross-bred ewes greatly excelled hormone-treated Awassi ewes of the same age. The average number of lambs born to each cross-bred ewe put to the ram was 1.52 versus 0.95 in the Awassi. Again, the percentage of multiple births in the lambings of the F_1 cross-breds was 59 and in the Awassi ewes 10.5. The lambs born to Finnish Landrace-Awassi F_1 cross-bred yearling ewes, inseminated with Finnish Landrace semen, were smaller at birth and at 150 days of age, and showed lower daily pre-weaning weight gains than those out of adult ewes, as shown by the comparison in Table A-32 of data from Tables A-30 and A-31 (see also Tables A-33 and A-34).

TABLE A-26. **Fecundity of Awassi and Finnish Landrace-Awassi cross-bred ewes** (**number of ewes and percentage of lambings)**

Breed	1 year of age		2 years of age	
	Number	Lambing %	Number	Lambing %
Awassi	142	33	96	86
Finn-Awassi F_1 cross-bred	43	81	8	75
Percentage of twin lambings				
Awassi		2		9
Finn-Awassi F_1 cross-bred		20		67
Number of lambs per ewe put to the ram Awassi		0.3		0.9
Finn-Awassi F_1 cross-bred		1.0		1.3

TABLE A-27. **Average weight and growth rate of Awassi and Finnish Landrace-Awassi cross-bred lambs**

Breed	Birth weight		Daily pre-weaning weight gain (g)	Daily post-weaning weight gain (g)	150-day weight (kg)
	No. of lambs	Kg			
Awassi	38	4.5	211	230	39
Finn-Awassi F_1 cross-bred	132	4.1	227	273	42

TABLE A-28**. Reproductive performance of Awassi and Finnish Landrace-Awassi F_1 and F_2 cross-bred yearling ewes**

Breed	No. of ewes put to the ram	Lambing (%)	Lambs per ewe put to the ram (%)	Multiple births per lambing (%)	Mean lambing age (days)	Mean 3rd day post-partum weight (kg)
Awassi	253	30	29	3	457	49
F_1 cross-bred	77	83	99	28	404	53
F_2 back-cross	24	58	88	50	397	52

TABLE A-29. **Reproductive performance of 2- and 3-year-old hormone-treated Awassi and Finnish Landrace-Awassi F_1 cross-bred ewes**

Breed	Age (years)	No. of ewes put to the ram	Lambing (%)	Lambs per ewe put to the ram (%)	Multiple births per lambing (%)	Mean 3rd day post-partum weight (kg)
Awassi	2	96	85	93	9	57.0
Cross-bred	2	56	91	146	59	58.7
Awassi	3	90	87	98	12	58.2
Cross-bred	3	35	97	162	59	58.9

TABLE A-30. **Average body weights and daily weight gains of Finnish Landrace-Awassi cross-bred lambs by Finnish rams out of F_1 cross-bred yearling ewes**

Sex	Birth	Birth weight		Weaning weight		Weaning age (days)	Daily pre-weaning weight gain (g)	Daily post-weaning weight qain		150-day weight	
		Number	kg	Number	kg			Number	kg	Number	kg
Male	Single	10	3.9	10	14.8	57.1	188	9	228	6	38.1
	Twin	16	2.9	7	12.6	56.0	167	7	252	4	37.9
Female	Single	16	3.7	16	14.8	58.2	190	12	270	9	39.8
	Twin	9	3.3	4	11.4	63.0	116	2	267	2	32.0

TABLE A-31. **Body weights and daily weight gains of Awassi and Finnish Landrace-Awassi F_1 and F_2 cross-bred lambs out of adult ewes**

Sex	Birth	Breed	Birth weight (kg)	Weaning weight (kg)	Weaning age (days)	Daily pre-weaning weight gain (g)	Daily 21-day post-weaning weight gain (g)	150-day weight (kg)
Male	Single	Awassi	5.1	18.8	57.4	241	260	44.4
		F_1 cross-bred	5.2	21.5	62.0	256	321	48.7
		F_2 cross-bred	4.4	17.7	48.7	277	275	44.2
Female	Single	Awassi	5.8	16.8	54.0	224	219	37.8
		F_1 cross-bred	5.0	21.0	62.9	239	242	42.2
		F_2 cross-bred	4.1	14.7	51.5	204	254	38.7
Male	Twin	Awassi	4.4	15.4	54.2	194	240	43.7
		F_1 cross-bred	3.6	16.4	65.2	202	317	44.4
		F_2 cross-bred	3.5	14.8	53.8	208	285	41.2
Female	Twin	Awassi	3.7	13.4	51.3	177	293	44.5
		F_1 cross-bred	3.5	16.4	59.2	222	259	39.4
		F_2 cross-bred	3.2	14.2	60.3	192	235	35.6

In two further fattening trials on an all-concentrate diet lasting 84 and 56 days, there were no statistically significant differences in daily gain, feed intake and feed conversion between Finnish Landrace-Awassi F_1 and F_2, East Friesian-Awassi Finnish Landrace-Awassi, East Friesian-Awassi Finnish Landrace-Mutton Merino, and Australian Suffolk Finnish Landrace-Awassi cross-breds. The performance of the progeny of Finnish Landrace-Awassi rams was similar to those sired by East Friesian-Awassi rams. The pre-fattening conditions of the lambs until weaning at 61-68 days, although involving significant differences in type of birth, birth weight, weaning age and initial weight, did not affect the daily gain during the trials (Goot *et al.*, 1982).

The carcass weight and composition of a male cross-bred lamb by a Finnish Landrace ram out of a Finnish Landrace-Awassi F_1 cross-bred ewe, which was fed, without roughage, on an unlimited quantity of concentrates until slaughter at the age of 177 days, were as shown in Table A-35 (Goot *et al.,*1978)

TABLE A-32. **Birth weights and pre-weaning and post-weaning weight gains of cross-bred lambs by Finnish Landrace rams out of Finnish Landrace-Awassi F_1 cross-bred ewes**

Age of dam	Sex of lamb	Birth	Birth weight (kg)	Daily pre-weaning weight gain (g)	Daily 8-week post-weaning weight gain (g)
Yearling	Male	Single	3.9	188	228
		Twin	2.9	167	252
Adult	Male	Single	4.4	277	275
		Twin	3.5	208	285
Yearling	Female	Single	3.7	190	270
		Twin	3.3	116	267
Adult	Female	Single	4.1	204	255
		Twin	3.2	192	235

TABLE A-33. **Mortality among 45 Finnish Landrace-Awassi F_1 cross-bred lambs from birth to 150 days of age(%)**

Age (days)	Still birth and mortality
0-7	6.7
8-70	11.1
71-150	2.2
Total	20.0

TABLE A-34. **Still birth and mortality from birth to 150 days among 158 Finnish Landrace-Awassi F_1 crossbred and 107 F_2 back-cross lambs out of adult ewes (%)**

Sex	Birth	Age (days)	Still birth and mortality	
			F_1	F_2 (back-cross)
Male	Single	0-7	3.6	—
		8-70	5.5	7.7
		71-150	1.8	7.7
		Total	10.9	15.4
Female	Single	0-7	4.7	4.3
		8-70	1.6	8.7
		71-150	—	—
		Total	6.3	13.0
Male	Twin	0-7	18.2	5.7
		8-70	9.1	11.4
		71-150	—	2.9
		Total	27.3	20.0
Female	Twin	0-7	5.9	8.3
		8-70	—	8.3
		71-150	—	8.3
		Total	5.9	25.0
Total still birth and mortality			12.6	18.4

Nearly all improved Awassi sheep of Israel are of haemoglobin type B (see p. 40), whereas imported Finnish Landrace rams have a high frequency of A. In 49 Finnish Landrace-Awassi F_1 cross-breds, Gootwein and Goot (1979) found the haemoglobin types in three successive years given in Table A-36.

Awassi x Hungarian Combing Wool Merino, French Merino and German Mutton Merino

The cross-breeding of Merino rams and Awassi ewes has been carried out in the range of the Awassi mainly on an experimental basis for the purpose of improving the quantity and quality of lamb, mutton and wool.

TABLE A-35. **Carcass weight and composition of a male cross-bred lamb**

Carcass weight (kg) and dressing percentage		*Carcass composition (%)*		
Slaughter weight	41.0	Muscle		54.9
Hot carcass weight	21.4	Carcass fat		27.7
Cold carcass weight	20.9	Subcutaneous fat	11.1	
Dressing percentage	53.0	Intermuscular fat	16.6	
		Bone		14.4
		Waste		2.9
		Dissection loss		0.1

Weight of body parts (g)			
Tail	372	Liver	705
Head with horns	2 120	Lungs with trachea	625
Unshorn skin	4 120	Spleen	55
Blood	1 720	Heart	160
Full stomach	3 005	Pericardium	120
Empty stomach	1 172	Kidneys	120
Kidney fat	390		
Caul fat	880		
Gut fat	140		

Weight and composition of carcass joints

Joint	Weight (kg)	Bone (%)	Muscle (%)	Subcutaneous fat (%)	Intermuscular fat (%)	Total fat (%)	Waste and dissection loss (%)
Neck	2.225	13.3	49.2	8.2	21.8	30.0	7.5
Thorax	5.203	17.7	44.6	6.4	27.4	33.8	3.9
Shoulder	2.165	14.8	61.8	13.2	11.1	24.3	0.9
Loin	2.150	10.7	52.2	15.7	18.4	34.1	3.0
Psoas muscles	0.264	—	82.2	—	16.7	16.7	1.1
Pelvis	2.280	12.6	50.1	21.1	14.9	36.0	1.3
Leg	2.235	14.4	65.2	9.1	6.8	15.9	4.5

TABLE A-36. **Frequencies of haemoglobin types A and B in Finnish Land-race-Awassi cross-breds**

Year of birth	AA	AB	BB	Gene frequency of A
1973/74		3	3	0.25
1974/75		20	5	0.45
1975/76	1	17		0.53

At the Ras El-Hekma Desert Research Station in the western coastal Egyptian desert, a small number of Awassi rams of Syrian derivation were crossed with F_1 cross-bred ewes descended from Hungarian Combing Wool Merino rams and Barki ewes. Fahmy *et al.* (1968) recorded the birth weight and weight gains of the cross-bred lambs in comparison with those of the three parental breeds involved (Table A-37).

In Lebanon, at the experimental farm of the American University of Beirut, a limited number of matings between French Merino rams and Awassi ewes were arranged over a period of four years mainly for the purpose of reducing the fat tail in slaughter lambs.

The weight of the tail as a percentage of the carcass weight was 8.95 in pure-bred male Awassi lambs, 3.84 in Merino-Awassi F_1 cross-breds, and 2.26 in back-crosses to Merino rams (Table A-38).

TABLE A-37. **Average weights and weight gains of cross-bred Awassi-Merino-Barki and pure-bred Awassi, Hungarian Combing Wool Merino and Barki lambs**

Weight		Awassi-Merino-Barki		Awassi		Merino		Barki	
		No.	Weight	No.	Weight	No.	Weight	No.	Weight
Birth-weight	(kg)	25	3.64	140	3.78	614	3.28	996	3.41
Weaning weight	(kg)	20	16.92	97	18.86	278	16.02	796	18.37
Yearling weight	(kg)	17	31.98	44	31.60	177	27.80	439	33.40
Daily pre-weaning weight gain	(g)	20	112	97	122	278	111	796	125
Daily post-weaning weight gain	(g)	17	54	44	51	177	42	439	57

TABLE A-38. **Average weight of fat tail in male Awassi and Merino-Awassi cross-bred lambs**

Breed composition	No. of lambs	Age (days)	Live weight (kg)	Carcass weight (kg)	Dressing percentage	Tail weight (kg)	Tail weight as % of carcass weight
Awassi	9	137	37.267	17.427	46.76	1.560	8.95
Merino-Awassi F_1 cross-bred	4	122	38.896	20.697	53.21	0.794	3.84
Back-cross to Merino	2	96	32.432	17.577	54.20	0.397	2.26

TABLE A-39. **Iodine numbers of fat from different body parts of Awassi lambs, Merino-Awassi F_1 cross-breds, and back-crosses to Merino**

Breed composition	No. of lambs	Age (days)	Fat source and iodine number			
			Back	Tail	Mesenteric	Kidney
Awassi	10	150	44.74	51.44	38.12	37.64
Merino-Awassi F_1 cross-bred	3	137	47.11	53.25	41.11	42.11
Back-cross to Merino	3	123	51.05	54.07	45.37	46.35

If tail weight in the carcass of Awassi lambs was taken as 100, it decreased roughly in proportion to the share of Awassi blood in the lambs; in those with 50 percent Awassi blood, the percentage of the tail weight in the carcass was 42.90, and in lambs with a share of 25 percent Awassi blood 25.25. From these results McLeroy, Ananian and Kurdian (1959) concluded that a limited number of genes acting in an additive manner were involved in fat-tail weight. They suggested further that the sigmoid curvature in the coccygeal vertebrae of Awassi sheep represented a simple homozygous recessive condition.

Fat samples taken from various parts of the body of Awassi lambs, Merino-Awassi F_1 cross-breds, and back-crosses to Merino showed an increasing iodine number as the share of Merino in the breeding increased (Table A-39). The iodine number, that is, the grams of iodine absorbed by 100 g of fat, is a measure of the degree of the unsaturation of fatty acids contained in the fat, and of the hardness and melting point of the fat. Generally, the internal fats are harder than the external ones. McLeroy, Ananian and Kurdian (1959) suggest that the relatively low iodine numbers of the fat of Awassi lambs may provide an indication of the nature of the agreeable flavour of Awassi lamb and mutton.

Cross-breeding experiments with German Mutton Merino rams and Awassi ewes have been conducted in Israel on a moderate scale with the aim of improving fat lamb production in which the Mutton Merino is superior to the Awassi.

In an experiment to ascertain the optimal plane of nutrition and slaughter weight, 45 male Mutton Merino-Awassi F_1 cross-bred lambs of an average initial weight of 49 kg were divided into three groups of 15 each and fattened on three different planes of nutrition for 5½ months, at the end of which they weighed 77, 85 and 86 kg, respectively, on average. The mean daily weight gains of the three groups during the fattening period were 181, 232 and 243 g. A fourth group of 15 lambs commenced the same fattening period at an average weight of 62 kg and ended it at 95 kg, the daily weight gains during the trial period averaging 215 g. Folman *et al.* (1966) concluded that Mutton

Merino-Awassi cross-bred lambs could be fattened up to a weight of 85 kg without a decrease in the rate of weight gain and with only a slight reduction in the conversion rate of the feed toward the end of the fattening period.

In another experiment conducted by Folman, Eyal and Benjamin (1967), 48 male Mutton Merino-Awassi F_1 cross-bred lambs were divided into four equal groups with average initial weights ranging from 39.2 to 41.3 kg and were fed on different high to very high planes of nutrition. At the end of the fattening period of seven months, the average weights of the lambs in the four groups amounted to 80.7-83.3 kg, the daily weight gains during this period varying between 204 and 233 g. In this trial both the rate of weight gain and feed conversion decreased toward the end of the fattening period.

From the second trial series Goot, Folman and Eyal (1967) selected 21 lambs to determine the loss in weight in transit from farm to slaughterhouse and during 18 hours of abstention from feed and water. In addition, the carcass weight and the weights of different parts and organs of the lambs were recorded immediately after slaughter (for comparison with male Awassi lambs used in the same experiment, see p. 191) (Tables A-40 and A-41 and Fig. A-4). The mean shrinkage in transit from farm to slaughterhouse and the weight loss during 18 hours without feed and water amounted to 5.6 kg, or 7.3 percent.

TABLE A-40. **Mean live and carcass weights of 21 male Awassi-Mutton Merino cross-bred lambs (kg)**

Age (days)	Live weight			Warm carcass weight	Carcass yield (%)
	On farm	Before slaughter (in wool)	Before slaughter (shorn)		
226	77.2	71.6	70.3	38.8	54.1

TABLE A-41. **Mean weights of inner organs, kidney and caul fat, and tail of 21 male Awassi-Mutton Merino crossbred lambs (kg)**

Live weight	Liver, lungs and heart	Kidneys	Kidney fat	Caul fat	Total kidney and caul fat	Fat tail
71.6	2.5	0.159	1.7	4.0	5.7	2.0

The average fleece weight of the 21 lambs examined by Goot, Folman and Eyal was 1.3 kg, or 1.8 percent, of the weight of the unshorn lambs. The cold carcass weight was estimated at 2 percent less than the warm carcass weight. The slaughter yield without inner organs and fat tail amounted to 54.1 percent; the addition of the edible inner organs increased it to 57.8 percent, and of the inner organs and fat tail to 60.5 percent.

The three heaviest lambs were selected for an analysis of their carcass composition, for which one-half of each carcass was used. The average live weight of these lambs on the farm of origin was 80.3 kg; shearing and shrinkage in transit and during the period of abstention from feed and water prior to slaughter reduced it to 74.2 kg. (See Tables A-42 to A-44.) The ratio of subcutaneous to intermuscular fat in the trunks of the Awassi-Mutton Merino cross-bred lambs was 50:50.

The amount of intramuscular fat, which exists in addition to the subcutaneous and intermuscular fat, can only be determined by chemical analysis. Tables A-45 and A-46 give the chemical composition of the 'eye muscles' and energy value of muscle and fat of heavy male Awassi-Mutton Merino cross-bred lambs.

In two male lambs sired by Mutton Merino rams out of Finnish Landrace-Awassi cross-bred ewes, Goot *et al.* (1978) recorded a mean birth weight of 3.8 kg, a daily weight gain from birth to slaughter at six months of 204 g, and during a fattening period of 98 days, 263 g. These gains were regarded as unsatisfactory. Table A-47 gives the weights of the carcasses and some body parts of the two lambs.

The carcasses of the cross-bred lambs were shorter than those of the male Awassi lambs of similar age and rearing. As compared with Awassi analogues, the weight of the tail of the cross-breds was reduced by 4.283 kg, or over 96 percent. The cold carcass weight was 11 percent and the weight of the muscle 2 percent higher, whereas that of the total carcass fat was 4.25 percent lower. While in the Awassi carcasses the ratio of subcutaneous to intermuscular fat was as 1:0.66, in those of the crossbred lambs it was as 1:1.99. In the carcasses of the cross-breds the loin, pelvis and leg were leaner and the neck was fatter than in those of the Awassi lambs (Goot *et al.*, 1978).

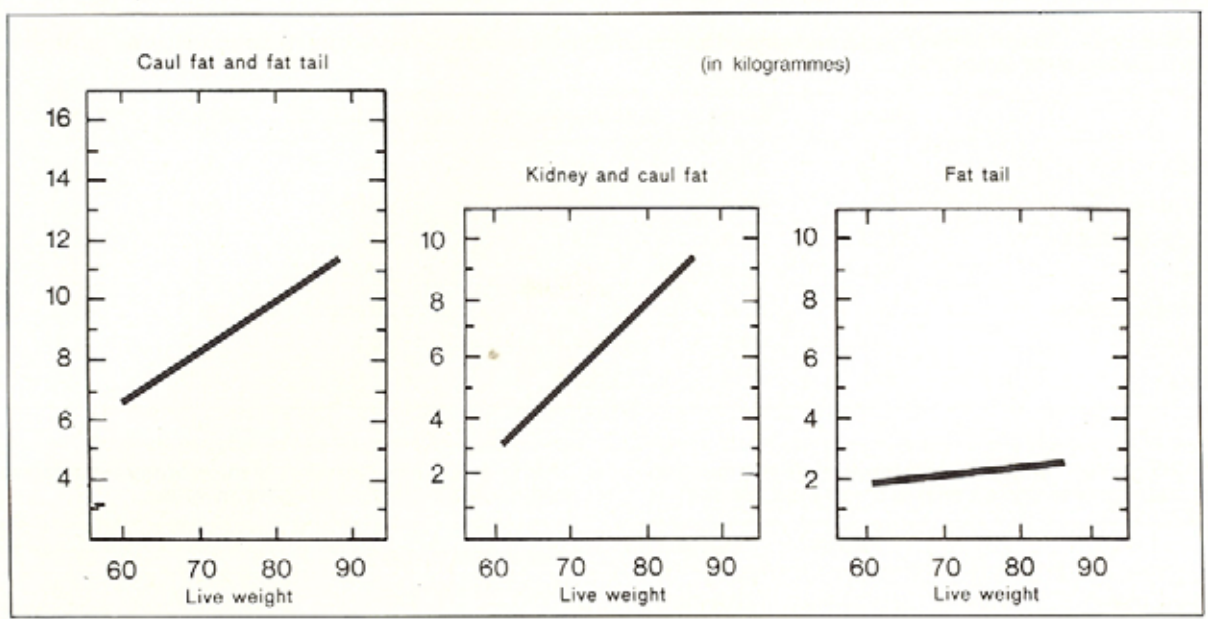

Figure A-4. Weight of kidney and caul fat and fat tail in relation to live weight of Awassi-Mutton Merino cross-bred lambs. (**Source:** Goot, Folman & Eyal, 1967)

TABLE A-42. **Mean percentages of bone, muscle and fat tissue in the carcasses of three male Awassi-Mutton Merino cross-bred lambs**

Carcass weight (kg)	39.3
Carcass yield	53.0
Bone	10.0
Muscle	45.3
Fat	42.8
Weight loss	1.9

TABLE A-43. **Mean weight and percentage of various carcass parts of three male Awassi-Mutton Merino cross-bred lambs**

	Kg	%
Forequarters	21.92	55.76
Hindquarters	17.39	44.24
Neck	4.75	12.09
Breast	10.02	25.49
Shoulders	7.15	18.18
Loin	4.95	12.59
Psoas muscles	0.47	1.19
Pelvis	4.23	10.76
Thighs	7.73	19.70
Total	39.30	100.00

Awassi x Kurdi

In a reciprocal cross-breeding experiment between Awassi and Kurdi sheep in Iraq, Guirgis *et al.* (1978) studied the effects of breed, sex, type of birth, and heterosis on length, diameter, type ratio and medullation of wool.

The Kurdi is a fat-tailed sheep, bred on the high plateaux and in the mountains of Kurdistan in northern Iraq. The head of the ram is slightly convex in profile and that of the ewe long and straight. The ears are pendulous; both sexes are polled. The thin end of the tail emerging from the fat cushion reaches nearly to the ground (Williamson, 1949). The majority of Kurdi sheep have a yellowish-white fleece, but some are variegated. The head and legs are usually black, occasionally brown. The fleece is longer and coarser than that of the Awassi sheep of Iraq (Gillespie, 1943).

Wool samples were taken from the mid-side of pure-bred Awassi and Kurdi and their reciprocal cross-breds at the weaning age of four months and at 12 months, and the length and diameter of the fibres were measured (Table A-48). Pure-bred Kurdi sheep had the longest fibres at both ages of study. The reciprocal crosses showed more or less intermediate values between the parental breeds, the monthly growth rates of fibres between the ages of four and 12 months amounting to 8.8 mm in

TABLE A-44. **Distribution of bone, muscle and fat tissue in various parts of the carcass of three male Awassi-Mutton Merino cross-bred lambs (%)**

	Bone	Muscle	Subcutaneous fat	Intermuscular fat	Total fat	Weight loss
Neck	9.6	40.9	15.3	31.7	47.0	2.5
Breast	12.1	39.4	13.6	33.3	46.9	1.6
Right shoulder	11.1	50.6	23.1	13.6	36.7	1.6
Loin	6.0	36.7	34.6	22.0	56.6	0.7
Psoas muscles	—	67.4	—	30.9	30.9	1.7
Pelvis	8.4	39.9	31.4	18.2	49.6	2.1
Thigh	10.3	57.9	20.9	7.9	28.8	3.0

TABLE A-45. **Chemical composition of 'eye muscles' of male Awassi-Mutton Merino cross-bred lambs (%)**

	Mean	Range
Dried matter	28.0	26.4-29.4
Protein	21.6	21.1-22.0
Fat	5.6	3.7- 7.0
Ash	0.9	0.9- 1.0

Source: Goot, Folman & Eyal, 1967

TABLE A-46. **Energy value of muscle and fat of heavy Awassi-Mutton Merino cross-bred lambs**

Weight of carcass (kg)	39.30
Weight of muscle (kg)	17.81
Weight of fat (kg)	16.84
Muscle, calories	27 000-43 000
Fat, calories	127 000
Energy value of protein content (%)	11-12
Energy value of fat content (%)	88-89

Source: Goot, Folman & Eyal, 1967

Awassi, 9.9 mm in Kurdi, 8.6 mm in Awassi-Kurdi and 9.2 mm in Kurdi-Awassi on average. The Awassi and Kurdi exceeded the cross-breds in variability of fibre length at the age of a year.

Heterosis in fibre length in the reciprocal crosses was small and insignificant at both ages, owing, as Guirgis *et al.* (1978) suggest, to genetic similarity between the Awassi and Kurdi. The maternal influence, measured as the difference between the two cross-bred types, was also small and insignificant. The distribution of fibre length showed two peaks in different frequencies, the bimodality being most marked in the Kurdi and least in the Awassi (Fig. A-5). The Awassi-Kurdi cross-breds were closer to the Kurdi, and the Kurdi-Awassi cross-breds closer to the Awassi.

In fibre diameter the reciprocal crosses occupied an intermediate position between the parent breeds at the age of a year. The effect of heterosis on fibre diameter was significant at both ages studied, that is, four and 12 months. The Awassi had the highest percentage of fine fibres and the Kurdi the highest of coarse fibres (Table A-49). In the frequency of fine, coarse and kemp fibres, the Kurdi-Awassi cross was closer to the Awassi and the Awassi-Kurdi cross-bred closer to the Kurdi.

The medullation of fibres was highest in the Kurdi and lowest in the Awassi and Kurdi-Awassi wool samples. The Awassi-Kurdi had a higher medullation of fibres than the reciprocal cross.

Awassi x Mancha, Talavera, Churro and Castilian

On the dairy sheep farms of the Malpica estates of Malpica-Tajo near Toledo, improved Awassi rams imported from Israel in 1971 and 1974, or bred in Spain from imported stock, have been crossed with several thousand local ewes. Welham (1976) estimated the numbers of F_1 cross-breds by Awassi rams out of Talavera and Mancha ewes at 15 000, and from Churro and Castilian ewes at 25 000. Now a large variety of Awassi crosses, called Malpica, occurs throughout Spain, and particularly in the Toledo province.

For fat lamb production the cross-bred lambs are superior to pure-bred lambs of the Spanish breeds. Talavera or Mancha lambs show an average weight gain of 214 g a day, while that of Awassi-Talavera or Mancha cross-breds amounts to 257 g. The pure-bred native lambs show a check in growth at 28-29 kg, but the Awassi-Talavera or Mancha cross-breds will grow well to 32 kg. The advantages shown by Awassi-Churro cross-breds over pure-bred Churro lambs are even greater. The fat tail development of the various F_1 cross-breds is negligible, the fat covering weighing only 150 g on

TABLE A-47. **Mean weights of carcasses and body parts of two male lambs (kg)**

Mean carcass weight and dressing percentage		*Mean carcass composition (%)*		
Slaughter weight	41.0	Muscle		53.1
Hot carcass weight	21.0	Carcass fat		29.8
Cold carcass weight	20.5	Subcutaneous fat	9.9	
Dressing percentage	51.5	Intermuscular fat	19.9	
		Bone		15.3
		Waste		1.4
		Dissection loss		0.4

Mean weight of different body parts (g)			
Tail	152	Liver	656
Head with horns	2 130	Lungs with trachea	700
Unshorn skin	4 225	Spleen	143
Blood	1 800	Heart	176
Full stomach	4 250	Pericardium	102
Empty stomach	2 058	Kidneys	123
Kidney fat	282		
Caul fat	815		
Gut fat	332		

Mean weight and composition of different carcass joints

Joint (kg)	Weight	Bone (%)	Muscle (%)	Subcutaneous fat (%)	Intermuscular fat (%)	Total fat (%)	Waste and dissection loss (%)
Neck	1.923	16.6	46.4	4.5	27.3	31.8	5.2
Thorax	4.964	18.3	44.3	7.6	28.6	36.2	1.2
Shoulder	2.025	15.9	54.3	10.0	19.5	29.5	0.3
Loin	2.036	10.4	54.2	15.4	18.7	34.1	1.3
Psoas muscles	0.240	—	81.2	—	15.8	15.8	3.0
Pelvis	2.605	11.8	46.8	20.2	18.5	38.7	2.7
Leg	2.225	15.8	67.3	6.8	8.7	15.5	1.4

TABLE A-48. **Fibre length and diameter of wool from 4- and 12-month-old Awassi, Kurdi, Awassi-Kurdi and Kurdi-Awassi sheep**

Breed	Weaning age			1 year of age		
	No. of samples	Fibre length (cm)	Diameter (H)	No. of samples	Fibre length (cm)	Diameter
Awassi	49	6.48	32.76	32	12.78	35.74
Kurdi	12	6.92	34.22	7	14.83	40.69
Awassi-Kurdi cross-bred	25	6.51	37.23	11	13.42	37.72
Kurdi-Awassi cross-bred	25	6.38	37.08	18	13.73	39.35

TABLE A-49. **Mean percentages of fibre types in Awassi, Kurdi, Awassi-Kurdi and Kurdi-Awassi wool**

Breed	Fine fibres	Coarse fibres	Heterotypes	Kemp
Awassi	57.1	42.4	1.2	0.13
Kurdi	34.8	61.4	2.0	0.87
Awassi-Kurdi cross-bred	49.8	47.5	1.7	0.80
Kurdi-Awassi cross-bred	54.9	43.6	1.5	0.22

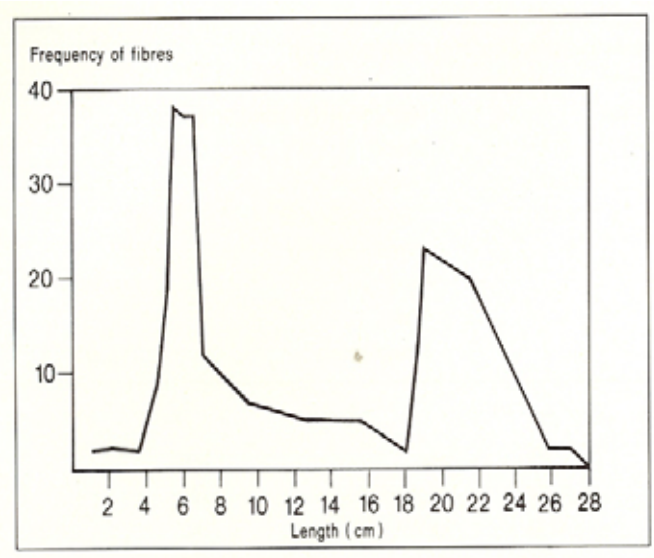

Figure A-5. Fibre length distribution in a Kurdi-Awassi wool sample. (**Source:** Guirgis *et al.,* 1978)

average. The Mancha ewe has advantages over the Awassi, such as a very short or non-existent anoestrus period, higher lambing percentages, and superior carcass and wool qualities. However, compared with 80-95 kg of milk obtained from Mancha ewes during their lactation period, the yields obtained from Awassi-Mancha F_1 cross-breds by machine milking are considerably higher, namely 180 kg in an average lactation of 170 days from yearling ewes, and 210 kg in 200 days from two-year-old ewes. Under the same conditions pure-bred Awassi yearlings yielded 348 kg of milk in 232 days and two-year-old ewes 410 kg in 264 days, the overall average, including ewes lambing at 12-13 months of age, coming to 356 kg in 234 days.

Eighty-four percent of Mancha ewes, inseminated with semen from Awassi rams, lamb three times in two years, but the cross-bred ewes do not. Welham (1976) considers the F_1 cross as the most suitable one commercially, adding, however, that with high milk prices the higher-yielding but less prolific Awassi-Mancha F_2 cross-breds may be acceptable. The udders of Awassi-Mancha or Talavera F_2 cross-breds are noticeably larger than those of the F_1 cross-bred ewes.

Awassi x Ovče Polje and Kosovo

In Yugoslavia, Awassi rams of improved dairy stock, imported from Israel in 1969 and 1970, have been crossed with Ovče Polje and Kosovo ewes for improvement of milk production of the local breeds. The Ovče Polje, a variety of Pramenka type, is bred in eastern Macedonia for mutton, milk and wool. Rams are horned and ewes usually polled. The carpet wool fleece is white, occasionally black or grey. The head and legs are partly or wholly black or brown. The Kosovo is bred in the southern part of Serbia for meat. Like the Ovče Polje, it is of the coarse-wooled Pramenka type. Both rams and ewes are usually polled. The fleece is commonly white with a black face and legs (Mason, 1969).

In 1974/75 a random group of 23 yearling ewes was picked from a flock of Awassi-Ovče Polje F_1 cross-bred sheep kept on a large farm of the socialist sector in Macedonia. In accordance with general practice in Yugoslavia, the animals were not specially prepared for freshening. After lambing they remained with their lambs until they were weaned at 28 days. Thereafter the ewes were transferred to a shed where they received 600 g of concentrates and an unlimited quantity of green fodder a day.

The milk was recorded once a month. The average production in a lactation of 163 days was 83.981 with a maximum yield of 114.751. The daily average was 515 ml, 605 ml at the first control and 408 ml at the sixth. Lactation yieras of the ewes were very variable as shown by the wide range in gradations of 101 (Table A-50).

Records of average lactation and daily yields of pure-bred Ovče Polje ewes have been 72.49 1 in 191 days, with an average of 378 ml a day (Taškovski, 1962); 92.601 in 199 days, with a daily average of 464 ml; 64.38 kg in 162 days, with 361 g a day on average. As pure-bred Awassi ewes of the improved dairy type yield considerably larger quantities of milk, the relatively low production of the 23 cross-bred yearling ewes must be attributed to the lack of nutritional preparation for freshening that prevented them from displaying their full genetic capacity in yield (Tokovski, Šokarovski & Jordanovski, 1977a).

TABLE A-50. **Number of ewes per gradation of 10-l lactation yield**

Lactation yield (l)	Number of ewes
25-35	1
36-45	1
46-55	4
56-65	1
66-75	1
76-85	4
86-95	2
96-105	6
106-115	3

In 1975/76 the milk of 16 Awassi-Ovče Polje F_1 cross-bred and 12 pure-bred Ovče Polje ewes in their second lactation was recorded by Tokovski, Šokarovski and Jordanovski (1977b). The ewes were again picked from a larger flock at random and were not specially prepared for freshening, but during lactation they received 400 g of concentrates and lucerne *hay ad libitum* a day. The lambs were weaned at the age of 28 days, and the milk of the ewes was recorded for a period of 180 days during which the cross-breds yielded 128.541 at each lactation and 714 ml a day on average, and the Ovče Polje control animals 65.42 1 of milk for each lactation and 363 ml a day. The cross-breds, therefore, yielded 96.5 percent more milk than the pure-bred Ovče Polje ewes, but only 36.7 percent of the 3501 accepted by the authors as the standard production of the improved Awassi dairy type.

In 1976, in a third study on Awassi-Ovče Polje F_1 cross-breds in Macedonia, 15 ewes in the second half of pregnancy were selected from a flock at pasture according to phenotype and were steamed up for lactation. The average yield was 195.41 in 184 days, the daily average 1.061, and the maximum daily average 1.621, confirming that the low lactation yields obtained in the first two trials were a result of insufficient nutritional preparation of the ewes for freshening. The average fat content of the milk of the cross-bred ewes was 7 percent (Todorovski, Tokovski & Lakićević, 1979).

In 1978/79 two studies of the milk yields of Awassi-Kosovo F_1 cross-bred ewes were made at Kosovo-Polje in southern Serbia, one during the first and the other one during the second lactation. In the first trial the ewes were kept in conditions of mediocre management but sound veterinary care on pastures and harvested grain fields near the shed, and received an additional ration of 150 g of dried shredded beetroots a day. The average yield in a lactation of 174.1 days was 199.651 and the average daily yield 1.15 1 of milk with a fat content of 6.97 percent.

In their second lactation period, the Awassi-Kosovo F_1 cross-bred ewes produced 261.811 of milk with an average fat content of 6.99 percent; the daily yield was 1.491 on average. These yields compare with an average production of 95 1 milk for each lactation obtained from pure-bred Kosovo ewes (Todorovski, Tokovski & Lakićević, 1979).

In a study of the wool characteristics of 19 Awassi-Ovče Polje F_1 cross-bred ewes, Todorovski and Bakalovska (1978b) measured the length, fineness, tensile strength and elasticity of fibres. The same measurements of wool from pure-bred Awassi ewes, taken by Todorovski and Bakalovska (1978a) in Macedonia and of pure-bred Ovče Polje sheep, recorded by Taškovski (1962), are given for comparison (Table A-51).

The great difference in the length of wool between Awassi-Ovče Polje cross-bred and Awassi and Ovče Polje pure-bred ewes is attributed by the authors to different methods of measurement. The measurements of wool samples taken from different parts of the body of Awassi-Ovče Polje cross-bred ewes differ (Table A-52).

Awassi x *Ovis ammon ophion*

The Cyprian mouflon or agrinon *(Ovis ammon ophion),* of which less than a hundred survive in the Paphos forest of the Troödos Mountains, stands approximately 65 cm at the shoulder and weighs 30-40 kg (Fig. A-6). The colour of the short summer coat is bright red, with a lighter ventral part and some whitish hair on the sides of the back. In the winter coat a short dark throat ruff and a whitish saddle patch appear, while the general colour of the coat changes from foxy red to brown. The horns reach a length of 60 cm; the prick ears and tail are short (Lydekker, 1912; FAO, 1974).

ABLE A-51. **Characteristics of wool from Awassi-Ovče Polje F_1 cross-bred and Awassi and Ovče Polje pure-bred ewes in Macedonia**

Breed	Staple length (mm)	Fineness (μ)	Tensile strength (g)	Elasticity (%)
Awassi-Ovče Polje F_1 cross-bred	51.6	32.8	29.0	82.9
Awassi	84.5	36.9	31.6	85.8
Ovče Polje	134.8	33.2	29.9	41.0

TABLE A-52. **Measurements of wool from different parts of body of Awassi-Ovče Polje F_1 cross-bred ewes**

	Staple length (mm)	Fineness (μ)	Tensile strength (g)	Elasticity (%)
Shoulder	34.9	31.2	28.2	82.9
Ribs	50.9	31.7	28.3	88.3
Thigh	69.0	35.7	30.5	77.7
Average	51.6	32.8	29.0	82.9

Figure A-6 Mouflon ram in summer coat

A flock of about 40 adult mouflon rams and ewes is kept in semicaptivity at the forestry station of Stavros Psokas. As the animals are extremely timid, their domestication is considered to be a most difficult task. It was therefore decided to develop a domesticated flock from a cross of mouflon rams and domestic ewes, followed by crossing back to the mouflon. Natural mating was unsuccessful; hence fresh undiluted semen of mouflon rams, collected by electro-ejaculation, was used for the insemination of Awassi, Chios and a few Finnish Landrace ewes. Of these, only two Awassi ewes held to the service, and one male and one female hybrid were born after gestation periods of 150 and 151 days, respectively, the male lamb weighing 4.7 kg and the female 3.7 kg at birth. In comparison, the birth weight of contemporary single male Awassi lambs at the same station averaged 5.6 kg and of single females 5.3 kg. At five weeks the male hybrid reached a weight of 12 kg, compared with an average weight of 14.6 kg for single male Awassi lambs under the same conditions.

The appearance of the hybrids is startingly unlike their Awassi dams. In the shape of the head and ears, the hairy coat and length and weight of the tail, they resemble their mouflon sire. In contrast with the typical Awassi tail, the tail of the hybrid is thin and short, reaching a length of 10 cm at the age of ten weeks.

The aim is to obtain at least 30 hybrids in order to estimate the meat quality of the males with special reference to its suitablity for the tourist trade (FAO, 1974).

Awassi x Romanov

Only a small number of trials have been conducted with Romanov-Awassi cross-breds. In general there were no statistically significant differences between the cross-bred progeny of Romanov-Awassi and Finnish Landrace-Awassi matings (Goot *et al.*, 1978). The average length of pregnancy of 38 Awassi ewes inseminated with Romanov semen was 149.6 days. The percentage of multiple births in the lambings of two-year-old Romanov-Awassi F_1 cross-bred ewes was 80. (See Tables A-53 and A-54.)

In a fattening trial on an all-concentrate ration with five Romanov-Awassi F_2 cross-bred lambs of an initial age of 67.6 days and a weight of 16.1 kg, the final weight after 84 test days was 50.7 kg on average, the daily gain 412 g, the dry matter intake 1.5 kg a day, and the feed conversion 3.6 kg of dry matter for each 1-kg gain. The performance of the progeny of the Romanov-Awassi rams was similar to that of Finnish Landrace-Awassi and East Friesian-Awassi rams included in the same trial (Goot *et al.*, 1982) (see Table A-55).

TABLE A-53. **Reproductive performance of 14 Roma-nov-Awassi F_1 cross-bred yearling ewes**

	Number	%
Lambings	10	71
Lambs from ewes put to the ram	16	114
Multiple births per lambings	5	50
Lambing age (days)	384	

TABLE A-55. **Mortality among 50 Romanov-Awassi F_1 cross-bred lambs from birth to 150 days (%)**

Age (days)	Mortality
0-7	10
8-70	10
71-150	4
Total	24

TABLE A-54. **Average body weights and daily weight gains of Romanov-Awassi F_1 cross-bred lambs**

Sex	Birth	Birth weight		150-day weight		Daily pre-weaning weight gain (g)	8-weeks' post-weaning daily weight gain (g)	Birth-to-150-days' daily weight gain (g)
		Number	Kg	Number	Kg			
Male	Single	25	5.5	21	49.8	280	316	298
	Twin	14	3.8	9	43.6	206	251	290
Female	Single	20	5.3	15	40.6	231	227	236
	Twin	7	3.7	6	31.9	140	186	211

Awassi x Shal

In an effort to increase the milk production of Iranian sheep, an improvement programme was started in the Qazvin area, which is situated in the northwestern corner of the central Iranian plateau, west of Tehran. The breeding plan included the crossing of improved Awassi sheep, imported from Israel in 1965 and 1966, with Baluchi and Shal sheep bred in the Qazvin area. The Shal is a local variety of fat-tailed sheep common in the village of Shal and a few neighbouring villages. It is of a fairly large size, black or brown in colour, and reputed to be highly fertile.

Breeding work in the demonstration flock included 100 Awassi and 100 Shal sheep of mixed age. The animals were mainly stall-fed, natural or sown pasture making up less than 20 percent of the total ration at any time. The breeding season, during which the ewes were inseminated, lasted from September to December. For 10-14 days after lambing, the ewes were not milked but stayed with their lambs. After this period the ewes were milked twice a day. On completion of each milking they were joined by their lambs for residue suckling, beginning with six hours twice a day at the age of three weeks, gradually decreasing to one hour after each milking during the ninth week, and ending with five minutes twice a day from the thirteenth to the sixteenth week. The data recorded by Wallach and Eyal (1974) in Awassi, Shal and Awassi-Shal F_1 cross-breds are given in Tables A-56 to A-60.

In four seasons (1967-70) the average growth from birth to weaning of single and twin, male and female Awassi, Shal and Awassi-Shal cross-bred lambs was as given in Tables A-61 and A-62.

The average daily weight gains of the lambs from the time of weaning to sale for slaughter are given in Table A-63. The average lengths of this period were 68 and 100 days for single male and

female lambs, respectively, and 73 and 90 days for twin male and female lambs. (The numbers of lambs in the different categories were the same as those in Tables A-61 and A-62.) Table A-64 gives the mortality figures of male and female Awassi, Shal and Awassi-Shal ewes and Table A-65 gives the average annual milk yield for the three groups of ewes. Table A-66 gives the average, minimum and maximum milk yields of Awassi, Shal and Awassi-Shal F_1 and F_2 cross-bred ewes as recorded in the demonstration flock of the Qazvin Development Area in 1969 (QDA, 1970). Table A-67 gives average lactation lengths for three age groups of Awassi, Shal and Awassi-Shal cross-bred ewes.

TABLE A-56. **Average body weights of Awassi, Shal and Awassi-Shal cross-bred ewes three days after lambing (kg)**

Breed	2 years		3 years and older	
	Number	Weight	Number	Weight
Awassi	19	78.2	21	82.0
Shal	6	80.3	22	80.0
Cross-bred	6	73.6	6	78.4

TABLE A-58. **Average fleece weights of adult Awassi, Shal and Awassi-Shal cross-bred ewes at Esmailabad Demonstration Farm, 1967 and 1968 (kg)**

Breed	1967		1968	
	Number of ewes	Fleece weight	Number of ewes	Fleece weight
Awassi	100	2.95	111	2.43
Shal	97	1.99	90	2.04
Cross-bred	52	2.62	35	2.20

TABLE A-57. **Average body weights of Awassi, Shal and Awassi-Shal cross-bred ewes at the end of the lambing season (kg)**

Breed	2 years			3 years and older		
	Number	Days from lambing	Weight	Number	Days from lambing	Weight
Awassi	33	82	68.3	53	94	74.6
Shal	7	88	74.4	58	98	73.3
Cross-bred	18	96	69.9	25	100	74.0

TABLE A-59. **Fate and disposal of Awassi, Shal and Awassi-Shal cross-bred ewes of different ages; average annual percentages for 4 years**

Age (years)	Breed	% mortality from			% culled because of			Total
		mastitis	other diseases	low milk yield	barrenness	disease	miscellaneous	
1	Awassi	—	2.6	—	—	2.1	0.8	5.5
	Shal	—	9.8	—	—	5.9	—	15.7
	Cross-bred	—	—	—	—	2.0	2.0	4.0
2	Awassi	0.6	1.8	8.5	3.6	10.9	0.6	26.0
	Shal	—	8.0	12.0	4.0	12.0	4.0	40.0
	Cross-bred	2.1	—	6.3	—	—	—	8.4
3 and more	Awassi	0.5	3.8	18.1	2.7	5.5	0.5	31.1
	Shal	—	3.2	14.9	0.9	2.8	1.2	23.0
	Cross-bred	—	4.8	14.3	—	4.8	—	23.9

Note. Numbers of ewes in the flock at beginning of year given in Table A-60.

TABLE A-60. **Reproductive performance of Awassi, Shal and Awassi-Shal cross-bred ewes of different ages for 4 years**

Age (years)	Breed	No. of ewes		Lambs born	Lambs per ewe (%)	
		In flock	Lambed		In flock	Lambing
1	Awassi	234	100	102	0.44	1.02
	Shal	51	11	12	0.24	1.09
	Cross-bred	50	30	36	0.72	1.20
2	Awassi	165	141	151	0.92	1.07
	Shal	25	22	24	0.96	1.09
	Cross-bred	48	46	52	1.08	1.13
3 and older	Awassi	182	173	217	1.19	1.25
	Shal	314	303	427	1.36	1.41
	Cross-bred	42	42	61	1.45	1.45

TABLE A-61. **Growth of single male and female Awassi, Shal and Awassi-Shal cross-bred lambs from birth to weaning**

Sex and breed	No.	Birth weight (kg)	Weaning weight (kg)	Age at weaning (days)	Daily weight gain (g)
Male					
Awassi	144	5.1	29.1	89	270
Shal	50	5.1	31.7	90	296
Cross-bred	39	5.5	32.2	90	297
Female					
Awassi	135	4.8	25.9	90	234
Shal	51	4.8	27.8	89	258
Cross-bred	40	4.7	25.9	90	236

TABLE A-62. **Growth of twin male and female Awassi, Shal and Awassi-Shal cross-bred lambs from birth to weaning**

Sex and breed	No.	Birth weight (kg)	Weaning weight (kg)	Age at weaning (days)	Daily weight gain (g)
Male					
Awassi	36	4.3	30.3	92	282
Shal	45	4.6	29.2	90	272
Cross-bred	66	4.4	28.4	92	260
Female					
Awassi	50	4.2	23.9	88	224
Shal	58	4.0	23.8	92	217
Cross-bred	69	4.0	26.1	91	243

TABLE A-63. **Average daily weight gains of Awassi, Shal and Awassi-Shal cross-bred lambs from weaning to sale for slaughter (g)**

Breed	Single		Twin	
	Male	Female	Male	Female
Awassi	248	170	245	192
Shal	220	158	243	199
Cross-bred	274	170	258	183

TABLE A-64. **Mortality of male and female lambs of Awassi, Shal and Awassi-Shal cross-bred ewes as percentage of lambs born**

Sex and breed	No. of lambs -born	Age at death (days)			Total
		1-3	4-90	90-180	
Male					
Awassi	241	8.2	9.5	5.7	23.4
Shal	231	3.0	3.9	0.9	7.8
Cross-bred	81	6.7	3.1	4.6	14.4
Female					
Awassi	217	6.6	5.3	1.1	13.0
Shal	227	3.5	3.0	2.6	9.1
Cross-bred	69	1.7	10.1	0	11.8

TABLE A-65. **Average annual milk yields in 2-4 years of three age groups of Awassi, Shal and Awassi-Shal cross-bred ewes (kg)**

Age (years)	Awassi		Shal		Cross-bred	
	No.	Yield	No.	Yield	No.	Yield
1	95	222.5	8	59.4	28	127.2
2	129	267.8	18	133.4	47	205.6
3 and older	164	297.6	287	163.4	38	274.3

TABLE A-66. **Average, minimum and maximum milk yields of Awassi, Shal and Awassi-Shal F_1 and F_2 cross-bred ewes**

Breed	Age	Number of ewes	Milk yield (kg)		
			Average	Minimum	Maximum
Awassi	Yearlings	11	289	199	394
	Adult ewes	67	333	139	593
Shal	Yearlings	10	142	91	242
	Adult ewes	57	210	105	322
F_1 cross-bred	Yearlings	10	249	194	322
	Adult ewes	15	284	188	534
F_2 cross-bred	Yearlings	2	317	243	390

TABLE A-67. **Average lactation lengths in 2-4 years of three age groups of Awassi, Shal and Awassi-Shal crossbred ewes (days)**

Age (years)	Awassi		Shal		Cross-bred	
	Number	Days	Number	Days	Number	Days
1	94	214.9	8	118.1	28	170.5
2	129	219.3	18	180.3	47	201.4
3 and more	157	219.8	286	189.9	38	224.6

Appendix B

Awassi x East Friesian

The Awassi-East Friesian is doubtless the most important among the various Awassi cross-breds. In Israel it has replaced the pure-bred Awassi in many improved dairy flocks since the first importation of a consignment of East Friesian breeding stock in 1955. This is not owing to higher milk or butterfat yields of the cross-breds; in these respects they are not superior to the improved Awassi in the subtropical environment. The reason for many breeders' preference for them is the greater fecundity of the cross-bred ewes, the speedier growth of the lambs, and the smaller fat tail.

Acclimatization difficulties of East Friesian sheep in the range of the Awassi

The East Friesian does not acclimatize readily in the range of the Awassi. At an experiment station in Israel, where it has been kept under favourable conditions of nutrition and management, the annual mortality rate of adult ewes in 1962-71 was 19 percent as against 11 percent in Awassi ewes. The death rate of East Friesian lambs was particularly high, as a comparison with Awassi lambs kept in the same conditions shows (Table B-1).

TABLE B-1. **Death rates of East Friesian and Awassi lambs over 4 years (%)**

	East Friesian	Awassi
1963/64	40	13
1964/65	70	13
1965/66	40	9
1966/67	58	13
Average	52	12

Source: : Shimshoni & Lavi, 1972

TABLE B-2. **Aberrant oestrous cycles in Awassi and East Friesian-Awassi F_1 cross-bred ewes**

Duration of oestrous cycle (days)	Awassi (%)	East Friesian-Awassi (%)
8-13	15.6	3.0
20-25	21.9	11.7
27-37	37.5	47.1
38-77	25.0	38.2

Three outstanding syndromes contribute to the high mortality rate in East Friesian lambs: pneumonia in one- to six-month-old lambs; urolithiasis (the shoppage of urination) in males two to five months of age; and acute jaundice in seven- to ten-month-old females.

In the experimental flock, 64 percent of the mortality was caused by pneumonia which attacked lambs of both sexes, mainly at the age of three to five months and never during the first month of life. In an experiment in which the lambs were kept in pens with slatted floors, separated from their dams except for two sucklings a day, the death rate was reduced to 12-13 percent, as compared with a rate of 32-54 percent in lambs that were in continuous contact with the ewes. The antibiotic treatment of sick lambs was disappointing.

In four years (1966-69) urolithiasis caused an average death rate of 6 percent, with a range of 2-11 percent, in the male East Friesian lambs of the experimental flock. Awassi lambs fed the same rations were not affected. In the following years, the disease was nearly completely eradicated by the

inclusion of 5-percent sodium chloride in the concentrate ration. East Friesian-Awassi cross-bred ram lambs and adult rams are also more prone to the formation of urinary calculi than are pure-bred Awassi sheep (Rapaport, 1979).

For three years (1968-70) acute jaundice and haematuria, diagnosed as chronic copper poisoning, occurred at an average rate of 9 percent in East Friesian hoggets kept indoors on a high plane of nutrition. No Awassi hoggets on the same nutritional level were affected (Shimshoni & Lavi, 1972).

Biology of reproduction in East Friesian-Awassi cross-bred ewes

In an experimental flock in Israel, Goot (1966) recorded many data on the biology of reproduction, growth, milk yields, tail development, fleece weight and mortality of East Friesian-Awassi cross-breds with different shares of the parent breds.These comprised F_1 and F_2 cross-breds, $^5/_8$ Awassi, $^3/_4$ Awassi, $^5/_8$ East Friesian and $^3/_4$ East Friesian. Their performance was compared with that of the purebred Awassi which was to be improved by the introduction of East Friesian genes.

On six farms situated in different climatic regions of Israel, Eyal and Goot (1968) compared the biology of reproduction and productive capacity of 1 280 pure-bred Awassi with 687 Awassi-East Friesian F_1 cross-bred ewes.

In 34 milk-recorded Awassi and 18 Awassi-East Friesian cross-bred farm flocks in various parts of Israel, the fecundity of yearling, two-year-old and adult ewes has been summarized by Carasso (1974) for the year 1972/73. The major part of the ewes lambed only once a year, but some of them twice.

At an experiment station in Turkey, Lischka (1976) compared the birth weight, growth rate, milk yield, butterfat percentage, and mortality of pure-bred İvesi with those of İvesi-East Friesian crossbred sheep.

Oestrous cycle

In the six farm flocks there was no difference between the pure-bred and cross-bred animals in the average date of the first oestrus in the breeding season. But in the experimental flock, studied by Goot (1966), Awassi-East Friesian F_1 cross-breds had their first oestrous 7-14 days later than Awassi ewes. In the farm flocks, possible differences between the two groups may have been concealed by the hormonal application in common use for the concentration of lambings.

At the experiment station the oestrous cycle was normal, that is, within the range of 14-19 days, in 70 percent of the Awassi, 69 percent of the East Friesian-Awassi F_1 cross-bred, 50 percent of the F_2 cross-bred, 57 percent of the $^3/_4$ East Friesian-$^1/_4$ Awassi, and 80 percent of the $^5/_8$ East Friesian-$^3/_8$ Awassi ewes. The percentage of the aberrant cycles in Awassi and East Friesian-Awassi F_1 crossbred ewes was as given in Table B-2.

In the six farm flocks, 2.2 services were required to get the Awassi ewes in lamb, and in the cross-breds 2.8 services on average. These figures are considerably higher than those recorded at the experiment station where Awassi ewes had to be served only 1.6 times and F_1 cross-breds 1.4 times to attain pregnancy.

Gestation period

At all ages the gestation period of the ewes was shorter in East Friesian-Awassi than in Awassi ewes. Male Awassi lambs were carried 151.53 days on average and female lambs 151.40 days. The respective figures for the cross-breds were 149.50 and 149.06 days.

The shares of the parent breeds in the cross-breds had a marked influence on the length of the gestation period, as shown by the data in Table B-3 referring to single-born lambs.

Fecundity

Records of the fecundity of pure-bred Awassi and East Friesian and cross-bred ewes with different shares of the two parent breeds, taken by Goot (1966) during seven years of the cross-breeding experiment, show a particularly low percentage of lambings in the total number of East Friesian ewes that were mated, while the various cross-breds approximated the Awassi in this respect.

TABLE B-3. **Gestation lengths according to breed for ewes and lambs**

Breed of ewes	No. of births	Average gestation (days)	Breed of lambs	No. of lambs	Average gestation (days)
Awassi	85	151.5	Awassi	104	151.4
East Friesian	8	145.1	East Friesian	18	145.9
F_1 and F_2cross-breds	195	148.5	F_1, F_2 and F_3 cross-breds	274	147.6
$^5/_8$ and $^3/_4$ Awassi	40	151.4	$^5/_8$ and $^3/_4$ Awassi	42	151.3
$^5/_8$ and $^3/_4$ East Friesian	76	147.4	$^5/_8$, $^{11}/_{16}$ and $^3/_4$ East Friesian	135	147.4

TABLE B-4. **Annual average percentages of lambing, twinning and number of lambs per ewe and birth in Awassi, East Friesian and cross-bred ewes** (1 = ewes that were mated; 2 = ewes that lambed)

Breed		No. of ewes	Lambings	Twin lambings	No. of lambs born
Awassi	1	414	90.6	10.1	100.7
	2	375		11.2	111.2
East Friesian	1	97	71.1	41.2	112.3
	2	69		58.0	158.0
F_1 and F_2 cross-bred	1	306	92.9	30.3	123.2
	2	283		32.7	132.7
$^5/_8$ and $^3/_4$ Awassi	1	32	90.9	8.4	99.3
	2	29		9.1	109.1
$^5/_8$ and $^3/_4$ East Friesian	1	41	89.5	34.0	123.5
	2	36		38.8	138.8

TABLE B-5. **Fecundity of Awassi and Awassi-East Friesian cross-bred ewes in farm flocks**

Age (years)	Breed	No. of ewes (%)	Lambing	No. of ewes	No. of lambs per	
					100 ewes	100 lambings
1	Awassi	1 262	43.5	593	46.9	113.3
	F_1 cross-bred	648	75.1	631	97.3	123.8
	F_2 cross-bred	26	84.6	31	119.2	140.9
	$^3/_4$ Awassi	16	50.0	9	56.3	112.6
2	Awassi	944	90.6	931	98.6	110.7
	Awassi-East Friesian	524	90.5	624	119.1	130.7
	$^3/_4$ Awassi	3	100.0	4	133.3	133.3
3-4	Awassi	702	95.2	754	107.4	118.5
	Awassi-East Friesian	357	94.5	471	131.9	138.1

There was a high percentage of twinning in East Friesian and cross-bred ewes with a large East Friesian share, and a low percentage of twin births in Awassi and cross-bred ewes with a large share of Awassi blood. The F_1 and F_2 cross-breds were nearly intermediate in the twinning rate. The $^5/_8$ and $^3/_4$ Awassi ewes had a similarly low percentage as the pure-bred Awassi, while the $^5/_8$ and $^3/_4$ East Friesians exceeded the F_1 and F_2 cross-bred ewes in twin births, but did not come up to the pure-bred East Friesians. (See Table B-4.)

In six farm flocks the fecundity of yearling, two- and three- to four-year-old Awassi and Awassi-East Friesian cross-bred ewes during a period of four years was as shown in Table B-5 (Eyal & Goot, 1968). The Awassi-East Friesian cross-bred yearlings exceeded the pure-bred Awassis in lambing percentage to a marked degree. In two-year-old and older ewes there was no difference in the lambing rate between the Awassi and cross-bred groups.

TABLE B-6. **Fecundity of yearling, 2-year-old and adult Awassi and Awassi-East Friesian cross-bred ewes in one or two lambings a year**

Breed	No. of lambings yearly	No. of ewes	Pregnancy (%)	Abortion (%)	No. of lambs per ewe	Still birth and mortality in first week(%)
Yearling						
Awassi	1	3 255	59.7	0.8	1.1	5.7
	2	3	100.0	—	1.2	—
Awassi-East Friesian cross-bred	1	699	81.4	0.8	1.2	6.5
	2	15	100.0	—	1.3	10.1
2-year-old						
Awassi	1	2 839	90.6	1.2	1.1	4.4
	2	132	100.0	1.1	1.2	6.6
Awassi-East Friesian cross-bred	1	545	94.9	1.3	1.3	5.9
	2	77	100.0	0.6	1.5	4.9
Adult						
Awassi	1	6 487	94.6	0.7	1.2	4.4
	2	679	100.0	1.1	1.2	5.6
Awassi-East Friesian cross-bred	1	1 114	95.2	0.9	1.4	5.9
	2	204	100.0	0.7	1.5	7.0

TABLE B-7. **Average birth weights of male and female, single and twin Awassi, East Friesian and cross-bred lambs with different shares of parent breeds**

Breed	Single				Twin			
	Male		Female		Male		Female	
	No.	Kg	No.	Kg	No.	Kg	No.	Kg
Awassi	98	5.36	84	4.84	31	4.40	26	3.90
East Friesian	11	4.47	16	4.39	45	4.07	37	3.76
F_1, F_2 and F_3 cross-•bred	112	5.53	138	5.08	76	4.60	67	4.16
$^5/_8$ and $^3/_4$ Awassi	6	6.21	22	5.28	—	—	2	4.10
$^5/_8$, $^{11}/_{16}$ and $^3/_4$ East Friesian	43	5.15	41	4.84	44	3.84	38	3.54

At the experimental farm, prior to the year 1962, 17 percent of Awassi and 62 percent Awassi-East Friesian cross-breds lambed without hormone application as yearlings. With a continuous improvement in feeding, the lambing rate of Awassi yearlings rose in 1966 to 56 percent, and of cross-breds to 100 percent.

The percentage of twin births in the Awassi-East Friesian cross-bred ewes of the farm flocks was much higher than in the Awassi. At the experimental farm the twinning rate of Awassi ewes on a particularly high plane of nutrition rose to 133 percent and in Awassi-East Friesian cross-breds to as much as 190 percent of the number of ewes put to rams during the breeding season of 1966. It would therefore appear that the twinning percentages obtained in the farm flocks do not express the full genetic potential of the cross-bred ewes (Eyal & Goot, 1968).

In another farm flock of East Friesian-Awassi cross-breds purchased as five-month-old lambs, the birth rate was 152.7 percent in yearlings and 155.5 percent in two-year-old ewes (Alef, 1979).

In 34 Awassi and 18 Awassi-East Friesian cross-bred farm flocks, the average fecundity of yearling, two-year-old and adult ewes with one or two successive lambings in the year 1972/73 was as shown in Table B-6 (Carasso, 1974).

In all age groups of ewes lambing once a year, but especially in yearlings, a higher percentage of Awassi-East Friesian cross-bred than of Awassi ewes put to rams became pregnant. Although in the cross-breds fecundity was higher than in the pure-bred Awassi ewes, the mortality rate of the crossbred lambs was also higher than that of the Awassi lambs. In the Awassi as well as the cross-bred

lambs, still birth and mortality in the first week after birth were higher at two lambings a year than at one lambing.

Practically all improved Awassi sheep in Israel have haemoglobin type B (see p. 40). In Germany, East Friesian sheep are mostly of haemoglobin type A. In Israel the frequency of type B appears to be on the increase not only in East Friesian-Awassi cross-breds, but also in locally produced East Friesian pure-breds. Ewes of BB genotype showed a higher fecundity as expressed by the number of lambs born to each ewe exposed to the ram and by the proportion of multiple births than ewes of AB type. The latter again had a higher milk yield and AB lambs were heavier at birth than BB lambs. As high fecundity was the main object in the crossing of the Awassi with the East Friesian, the BB genotype was added as a desired trait in the importation of East Friesian rams from Germany (Gootwein & Goot 1979).

Birth weight

In an experimental flock of Ege University, Bornova/İzmir in Turkey, Lischka (1976) found no significant difference in birth weight between İvesi and İvesi-East Friesian F_1 cross-bred lambs. Newborn İvesi lambs weighed 4.63 kg and cross-breds 4.83 kg on average (see also Table 3-48).

Birth weights and weights at various ages of Awassi, East Friesian, East Friesian-Awassi F_1, F_2 and F_3 cross-bred lambs, and back-crosses with different shares of Awassi and East Friesian, were recorded by Goot (1966) in an experimental flock in Israel for seven years. In Table B-7, F_1, F_2 and F_3 cross-breds are grouped together, as are the $^5/_8$ and $^3/_4$ Awassi, and the $^5/_8$, $^{11}/_{16}$ and $^3/_4$ East Friesian lambs.

The average birth weights of single-born Awassi and cross-bred lambs exceeded those of purebred East Friesians. The birth weights of half-bred twins were also higher than those of East Friesian twin lambs, but the average weights of twin lambs with a larger East Friesian share fell below these.

All cross-bred lambs with a $^1/_2$, $^5/_8$ or $^3/_4$ share of Awassi exceeded the birth weights of pure-bred Awassi lambs, save for the Awassi-East Friesian F_2 cross-bred generation which equalled the Awassi in birth weight. Cross-bred lambs with a larger East Friesian than Awassi share had lower birth weights than Awassi lambs.

The weights of single-born lambs have been compared by Goot (1966) with the lighter average weights of one twin of Awassi, East Friesian and their crosses with different parental shares, and the heavier weights of both twins of the same parental breeds and crosses (Table B-8).

While at the experiment farm the birth weights of cross-bred lambs with equal Awassi and East Friesian shares exceeded those of Awassi lambs, the opposite was observed in six farm flocks where male and female, single and twin F_1 cross-bred lambs were lighter than Awassi lambs of the respective birth types (Table B-9) (Eyal & Goot, 1968).

On one of the farms there was also a small number of F_2 cross-breds. Their birth weights were still lighter than those of the F_1 generation and much lighter than the birth weights of the Awassi lambs (Table B-10).

Growth

In the experimental flock belonging to Ege University, the birth, 30-, 60- and 90-day weights of male and female, single and twin İvesi-East Friesian F_1 cross-bred lambs were recorded during the period 1972-74 (Table B-11). The lambs were reared under two different systems, suckled by their dams for about two months or reared on a milk substitute in a self-feeder to a weight of 10-12 kg. During the trial the lambs had free access to concentrates and water. (For a comparison with pure-bred İvesi lambs in the same experiment, see Table 3-108.)

The İvesi-East Friesian F_1 cross-breds generally reached higher weights at the different ages than pure-bred İvesi lambs reared in similar conditions (see Table 3-108). The heavier birth weights of female cross-bred twins affected growth until the age of 60 days. Thereafter the males exceeded the female lambs in growth rate. In single-born lambs, suckling proved to be superior to rearing on a milk substitute. In twins the reverse obtained, probably owing to an insufficient milk supply of the ewes.

At an experiment station in Israel Goot (1966) recorded or estimated the weights of Awassi, East Friesian and cross-bred lambs at different ages (Tables B-12 to B-17).

In the pure-bred Awassi and East Friesian and in all cross-bred generations, the males grew faster than the females. At the age often weeks the male single-born cross-breds exceeded the Awassi lambs

TABLE B-8. **Birth weights of twins in comparison with single-born Awassi, East Friesian and cross-bred lambs**

Breed	One twin (- %)	Both twins (+ %)
Awassi	18	63
East Friesian	12	77
F_1 cross-bred	22	56
F_2 cross-bred	15	69
$^5/_8$ East Friesian	14	72
$^3/_4$ East Friesian	28	44

TABLE B-9. **Average birth weights of male and female, single and twin Awassi and Awassi-East Friesian F_1 crossbred lambs in six farm flocks**

Breed	Single				Twin			
	Male		Female		Male		Female	
	No.	Kg	No.	Kg	No.	Kg	No.	Kg
Awassi	600	4.9	694	4.9	168	4.1	193	3.8
F_1 cross-bred	401	4.7	386	4.3	321	3.6	340	3.5

TABLE B-10. **Average birth weights of male and female, single and twin Awassi and Awassi-East Friesian F_1 and F_2 cross-bred lambs in a farm flock**

Breed	Single				Twin			
	Male		Female		Male		Female	
	No.	Kg	No.	Kg	No.	Kg	No.	Kg
Awassi	233	5.1	288	4.8	41	3.9	39	3.7
F_1 cross-bred	160	4.5	142	4.1	84	3.3	95	3.3
F_2 cross-bred	9	5	5	4.0	8	2.9	8	2.6

TABLE B-11. **Average birth, 30-, 60- and 90-day weights of Awassi-East Friesian F, cross-bred lambs in Turkey under different systems of rearing**

Type of birth		Birth weight		30-day weight		60-day weight		90-day weight	
		No.	Kg	No.	Kg	No.	Kg	No.	Kg
a) Single	Male	7	5.11	7	14.18	7	22.97	7	29.27
	Female	2	4.68	2	13.46	2	21.09	2	26.39
Twin	Male	3	3.33	3	8.79	3	14.07	3	20.62
	Female	5	3.78	5	9.45	5	15.32	5	19.66
b) Single	Male	20	4.88	20	10.33	20	17.19	19	26.17
	Female	17	4.70	16	9.92	17	16.15	4	21.33
Twin	Male	9	3.40	9	10.00	8	15.38	8	24.21
	Female	11	3.86	11	10.13	5	15.91	—	—

Note. a) Suckled by dams until the age of 2 months; b) reared on a milk substitute after 2 days of suckling.

Source: Lischka, 1976

TABLE B-12. **Average weights of 7-week-old male and female, single and twin Awassi, East Friesian and cross-bred lambs with different shares of parent breeds**

Breed	Single				Twin			
	Male		Female		Male		Female	
	No.	Kg	No.	Kg	No.	Kg	No.	Kg
Awassi	66	17.86	76	15.93	27	14.09	25	13.10
East Friesian	4	14.55	6	17.37	13	15.04	12	13.85
F_1, F_2 and F_3 cross-bred	107	18.98	132	16.79	71	17.26	63	15.32
⅝ and $^3/_4$ Awassi	6	18.25	22	17.59	–	–	2	14.50
$^5/_8$, $^{11}/_{16}$ and $^3/_4$ East Friesian	49	18.02	41	17.11	36	14.79	35	14.32

TABLE B-13. **Estimated weights of 10-week-old male and female, single and twin Awassi, East Friesian and cross-bred lambs with different shares of parent breeds**

Breed	Single				Twin			
	Male		Female		Male		Female	
	No.	Kg	No.	Kg	No.	Kg	No.	Kg
Awassi	666	22.40	664	20.20	177	18.80	122	16.50
East Friesian	–	–	42	20.60	53	20.60	191	18.00
F_1, F_2 and F_3 cross-bred	860	24.03	836	22.55	302	21.05	140	18.50
$^5/_8$ and $^3/_4$ Awassi	66	23.70	214	22.65	–	–	–	–
$^5/_8$ and $^3/_4$ East Friesian	406	23.85	294	22.40	182	18.55	313	18.55

TABLE B-14. **Daily weight gains from birth to 10 weeks of Awassi, East Friesian and cross-bred lambs with different shares of parent breeds**

Breed	Single		Twin	
	Male (g)	Female (g)	Male (g)	Female (g)
Awassi	252	226	216	188
East Friesian	–	–	–	204
F_1, F_2 and F_3 cross-bred	281	256	232	227
$^5/_8$ and $^3/_4$ East Friesian	283	242	234	214

TABLE B-15. **Average weights of 16-week-old male and female, single and twin Awassi, East Friesian and cross-bred lambs with different shares of parent breeds**

Breed	Single				Twin			
	Male		Female		Male		Female	
	No.	Kg	No.	Kg	No.	Kg	No.	Kg
Awassi	–	–	32	24.92	–	–	6	23.77
East Friesian	2	29.95	–	–	–	–	7	27.40
F_1, F_2 and F_3 cross-bred	11	37.39	69	29.08	9	33.72	49	27.91
$^5/_8$ Awassi	–	–	9	26.80	–	–	–	–
$^5/_8$, 11/16 and $^3/_4$ East Friesian	8	37.74	37	28.93	5	30.98	29	25.75

TABLE B-16. **Estimated weights of 5- to 7½-month-old female single and twin Awassi, East Friesian and cross-bred lambs with different shares of parent breeds**

Breed	Single		Twin	
	No.	Kg	No.	Kg
Awassi	149	26.4	57	23.8
East Friesian	–	–	44	31.9
F_1 and F_2 cross-bred	296	32.0	90	28.0
$^5/_8$ and $^3/_4$ Awassi	103	29.8	–	–
$^5/_8$ and $^3/_4$ East Friesian	138	30.5	156	26.2

TABLE B-17. **Weights of 9-month-old female single and twin Awassi, East Friesian and cross-bred lambs with different shares of parent breeds**

Breed	Single		Twin	
	No.	Kg	No.	Kg
Awassi	38	32.3	12	32.6
East Friesian	2	34.7	11	40.1
F_1 and F_2 cross-bred	94	39.8	18	37.9
⅝ and $^3/_4$ Awassi	21	35.9	2	34.6
$^5/_8$ and $^3/_4$ East Friesian	21	32.5	27	33.8

in weight and only $^3/_4$-bred East Friesian male twins weighed 2 kg less than Awassi twins. Similarly, the single-born female cross-breds, save for the F_2 generation, were heavier than the corresponding Awassi lambs and all female twins weighed more than female Awassi twins.

At the age of 20 weeks the Awassi lambs and cross-breds with a large Awassi share had the lightest weights of the pure-bred and cross-bred lambs. Between the ages of 11 and 20-31 weeks, single-born Awassi and $^5/_8$-bred East Friesian lambs continued to grow faster than twins. In the F_2 generation, the growth rate of twins was still slightly slower than that of single-born lambs, but in the $^3/_4$-bred East Friesian it rose to that of the corresponding singles. The daily weight gain in single lambs was as follows: East Friesian 132 g, F_1 cross-breds 128 g; F_2 cross-breds 125 g, $^5/_8$-bred East Friesian 102 g; $^3/_4$-bred East Friesian 89 g; Awassi 88 g; and $^3/_4$-bred Awassi 80 g; in twins: East Friesian 158 g; F_2 cross-breds 127 g; $^5/_8$-bred East Friesian 99 g; $^3/_4$-bred East Friesian 90 g; and Awassi 70 g. From the age of nine months the difference in weight between single and twin hoggets disappeared (Goot, 1966).

In an experiment conducted by Folman, Eyal and Benjamin (1967) 20 male four-month-old Awassi-East Friesian cross-bred lambs were divided into two equal groups with average initial weights ranging from 41.8 to 43.2 kg. Group I was kept on a high plane of nutrition (hay and concentrates) and group II on a very high plane of nutrition (hay and free access to concentrates). In the first group the trial lasted 7½ months, at the end of which the lambs had reached an average weight of 75.6 kg. In the second group the trial lasted 6½ months when the lambs weighed 82.9 kg on average. The daily weight gain of the lambs of group I was 141 g and the feed conversion rate 10.1; in group II the weight gain was 212 g a day and the conversion rate 9.2.

During the first part of the fattening period, from the middle of April to the beginning of July, the growth rate of the Awassi-East Friesian cross-bred lambs was very high; thereafter it dropped markedly. While for a 1-kg live weight increase seven feed units were required in the first phase of the trial, more than 12 feed units were necessary for the same weight gain during the second phase. Folman, Eyal and Benjamin (1967) attribute the reduction in the growth rate of the cross-bred lambs in the hot summer months to the inadequate acclimatization of the East Friesian parent breed to high ambient temperatures. The very high plane of nutrition enhanced the growth rate and feed conversion and gave better economic results than those obtained from the high plane.

Live weight of ewes

The live weights of Awassi, East Friesian and cross-bred ewes, three days after lambing, have been recorded by Goot (1966) in an experimental flock. The weights of two- and four-tooth ewes are given in Table B-18; it is only in these two age groups that full records for all crosses have been published.

The greatest differences in weight between the various pure-bred and cross-bred groups occurred in the two-tooth generation. The $^3/_4$-bred East Friesian was the lightest at 50.7 kg; it was preceded by Awassi at 52.6 kg, $^3/_4$-bred Awassi at 53.8 kg, $^5/_8$-bred East Friesian at 55.6 kg, F_2 cross-bred at 56.7 kg, F_1 cross-bred at 58.0 kg, $^5/_8$-bred Awassi at 58.5 kg and East Friesian at 67 kg.

Monthly changes in the weight of six-tooth Awassi, East Friesian and cross-bred ewes with different shares of the parent breeds were recorded by Goot (1966) in 1962/63 and are given in Table B-19. The pure-bred East Friesian ewes exceeded all cross-bred groups in monthly live weights. They were followed by the F_1 cross-breds which were still markedly heavier than the Awassi ewes. The weights of the other cross-bred ewes approximated those of the latter.

TABLE B-18. **Average weights of 2- and 4-tooth Awassi, East Friesian and cross-bred ewes with different shares of parent breeds, three days after lambing**

Breed	Number of ewes	Weight (kg)
Awassi	84	55.8
East Friesian	18	68.4
F_1 cross-bred	170	59.9
F_2 cross-bred	38	59.4
$^5/_8$ Awassi	21	61.9
$^3/_4$ Awassi	17	58.6
$^5/_8$ East Friesian	27	58.3
$^3/_4$ East Friesian	25	56.3

TABLE B-19. **Monthly changes in weight of 6-tooth Awassi, East Friesian and cross-bred ewes**

Breed	Month												3 days after lambing
	6	7	8	9	10	11	12	1	2	3	4	5	
Awassi	61	63	65	67	68	70	73	74	73	72	72	69	70
East Friesian	88	86	84	83	84	86	88	89	90	86	88	89	88
F_1 cross-bred	73	75	77	75	74	76	80	81	83	84	83	79	78
F_2 cross-bred	65	65	65	66	65	68	71	71	70	67	66	66	69
$^3/_4$ Awassi	66	66	67	67	65	67	70	71	68	65	64	63	67
$^3/_4$ East Friesian	64	65	66	64	62	63	64	66	66	63	63	62	65

Milk

In an experimental flock in Turkey, İvesi-East Friesian cross-bred ewes had significantly higher milk yields than pure-bred İvesi ewes. The first lactation yield of cross-bred ewes after removal of their lambs at the age of two days was 210.0 kg and of İvesi ewes without lambs 173.8, 174.5, 162.1 and 130.5 kg at the second, third, fourth and fifth lactations. İvesi-East Friesian cross-bred ewes with lambs yielded 174.3 kg and İvesi ewes with lambs 133.1 kg of milk at the first lactation. In the first month of the lactation period, the average milk yield of İvesi-East Friesian ewes was 43.7 kg and of İvesi ewes 33.3 kg (Lischka, 1976). Kizilay (1975) recorded an average lactation yield of 166.9 kg in İvesi-East Friesian cross-bred ewes and 122.8 kg in İvesi ewes.

In 1979/80, the average lactation yield of Awassi-East Friesian cross-bred ewes in Israel was 337.6 1, with a record yield of 1 100 1. One flock produced 4101 on average for each lactation, in addition to the milk consumed by the lambs (Fái, 1981).

Because of the difficulty of making an exact assessment of the actual quantity of milk consumed by lambs before weaning, or the amount of milk not yielded to the pail or milking machine but retained in the udder, Goot (1966) has limited the comparison of lactation yields between the improved Awassi and various crosses with the East Friesian to the marketable milk recorded at an experimental farm in Israel (Table B-20). The $^3/_4$-bred Awassi ewes had the highest lactation yields, while the $^5/_8$- and $^3/_4$-bred East Friesian ewes yielded less than the $^5/_8$- and $^3/_4$-bred Awassi.

Persistency in lactation has been expressed by Goot (1966) as the number of ewes in milk each month in relation to the number (= 100) milked the first month of the lactation period (Table B-21).

Awassi, Awassi-East Friesian F_1 and F_2 cross-bred, $^3/_4$-bred Awassi and $^3/_4$-bred East Friesian two-tooth ewes had a similar persistency during the first five months of the lactation period. In the sixth month, the F_2 cross-bred group showed a decline of 20 percent from the original number, while all ewes of the other groups were still in milk. During the seventh and eighth months of lactation, all groups shrank in number, the Awassi group least and the F_2 cross-bred generation most. There was little difference in persistency between the $^3/_4$-bred Awassi and the $^3/_4$-bred East Friesian ewes (Goot, 1966).

TABLE B-20. **Average lactation yields of Awassi-East Friesian F_1 and F_2 cross-breds, $^5/_8$ Awassi, $^3/_4$ Awassi, $^5/_8$ East Friesian and $^3/_4$ East Friesian ewes at different ages**

Breed	Age:	2-tooth		4-tooth		6-tooth		$4\ ^1/_2$ years	
		Milk (kg)	Lactation (days)	Milk (kg)	Lactation (days)	Milk (kg)	Lactation (days)	Milk (kg)	Lactation (days)
Awassi		191.5	188	176.0	197	227.5	212	209.0	208
F_1 cross-bred		236.3	200	234.5	211	252.2	222	274.6	209
F_2 cross-bred		169.6	183	289.9	217	—	—	—	—
$^5/_8$ Awassi		248.4	209	—	—	—	—	—	—
$^3/_4$ Awassi		262.3	210	299.2	219	—	—	—	—
$^5/_8$ East Friesian		183.0	191	—	—	—	—	—	—
$^3/_4$ East Friesian		174.1	209	213.8	220	—	—	—	—

TABLE B-21. **Persistency in lactation of 2-tooth Awassi and Awassi-East Friesian cross-bred ewes**

Breed	Lactation month			
	1-5	6	7	8
Awassi	100	100	91	55
F_1 cross-bred	100	100	69	39
F_2 cross-bred	100	80	80	30
$^3/_4$ Awassi	100	100	78	33
$^3/_4$ East Friesian	100	100	77	38

TABLE B-22. **Average length of lactation period of Awassi and Awassi-East Friesian F_1 cross-bred ewes at different ages in farm flocks (days)**

Breed	Age (years)				Average
	1	2	3	4	
Awassi	177	206	208	193	196
F_1 cross-bred	169	200	202	197	192

TABLE B-23. **Average annual milk yields (A), highest daily yields (B), and daily yields in 6th lactation month (C) of Awassi and Awassi-East Friesian F_1 cross-bred ewes at different ages in farm flocks (kg)**

Breed		Age (years)				Average
		1	2	3	4	
Awassi	A	236	303	331	338	300
F_1 cross-bred		240	303	332	356	306
Awassi	B	2.042	2.407	2.719	2.926	2.481
F_1 cross-bred		2.212	2.623	2.885	3.119	2.660
Awassi	C	0.297	0.553	0.563	0.525	0.486
F_1 cross-bred		0.232	0.478	0.565	0.669	0.454

In six farm flocks Eyal and Goot (1968) recorded the average length of the lactation period, annual milk yield, highest daily yield at the height of lactation, and daily yield in the sixth lactation month of Awassi and Awassi-East Friesian F_1 cross-bred ewes at different ages (Tables B-22 and B-23).

The differences in annual milk yield between the Awassi and Awassi-East Friesian cross-bred ewes were negligible. A milking trial conducted by Jatsch and Sagi (1979) in an experimental flock of 40 Awassi and 229 East Friesian-Awassi cross-bred ewes in northern Israel also showed no substantial effect on yield or milkability of upgrading to the East Friesian. Eyal and Goot (1968) suggest that the lack of superiority in lactation yield of the Awassi-East Friesian cross-breds over the pure-bred Awassi ewes may be a result of the inadequate acclimatization of the East Friesian to subtropical conditions and a greater susceptibility of the cross-bred ewes to environmental stress.

The maximum daily yield, represented by the highest yield on a day of control in the course of the lactation period, was usually obtained in the first or second month of lactation. In all age groups, the F_1 cross-bred ewes exceeded the Awassi in the maximum daily yield.

TABLE B-24. **Average full lactation yields of yearling, 2-year-old and adult Awassi and Awassi-East Friesian crossbred ewes in farm flocks**

Breed	Yearling			2 years of age			Adult		
	No. of ewes	Lactation (days)	Milk (kg)	No. of ewes	Lactation (days)	Milk (kg)	No. of ewes	Lactation (days)	Milk (kg)
a) Awassi	1 341	192	264	1 962	212	312	4 702	220	334
Awassi-East Friesian	397	206	304	395	220	363	843	223	383
b) Awassi	2	177	255	110	182	278	488	170	287
Awassi-East Friesian	13	173	251	60	177	328	181	179	314

Note. a) One lambing and lactation a year; b) Mean of two lambings and lactation a year.

The persistency of lactation was measured by the daily yield during the sixth month of control. By this standard the cross-breds were less persistent than the Awassi ewes during the first two lactations. In the third year, the two groups were similar in this respect, while at the fourth lactation the cross-breds proved more persistent than the Awassi ewes.

The milk yields of full lactations, that is, of not less than 150 days, were recorded in yearling, two-year-old and adult Awassi and Awassi-East Friesian cross-bred ewes of 32 farm flocks in 1972/73 (Carasso, 1979). The records were divided into two groups: one of ewes with one lambing and lactation during the year, and the other one of those with two consecutive lambings and full lactations (Table B-24). There was little difference in lactation length between the pure-bred and cross-bred groups, but the cross-breds yielded more milk in either one or two consecutive lactations a year.

In a test with 239 single- and 187 twin-rearing two- to nine-year-old Awassi-East Friesian F_2, F_3 and F_4 cross-bred ewes of an experimental flock, Goot (1974) recorded a slightly longer length of lactation in twin-rearing ewes than in single-rearing ewes, namely 234.9 versus 230.1 days. However, the difference was statistically insignificant save for the two-year-old ewes which on average were milked 15 days longer than the ewes of the same age group with single lambs.

In the same test the milk yield of twin-rearing ewes exceeded that of ewes with single lambs by 17:4 kg or 5.9 percent on average (311.2 kg versus 293.8 kg). In every age group, except that of four-year-old ewes, the recorded milk yields of the twin-rearing dams were higher than those of contemporaries with one lamb.

Further, there is indirect evidence to suggest that the additional stimulus derived from suckling twins increases residual milk production and that twin-rearing ewes that are adequately fed retain approximately 24 percent more milk for their lambs after machine milking and hand stripping than ewes rearing single lambs (Goot, 1974).

Butterfat

In Turkey the average butterfat percentage of the milk of İvesi-East Friesian cross-bred ewes during the lactation period was 6.4 percent and that of pure-bred İvesi ewes of the same experimental flock 6.9 percent. The total average quantity of fat produced in the course of the lactation was 13.2 kg in the İvesi-East Friesian cross-bred ewes and 10.2 kg in the İvesi (Lischka, 1976).

In Israel, the average fat content of 989.81 of milk delivered to central dairies in 1976/77 from 13 Awassi-East Friesian cross-bred flocks was 5.31 percent, that is, only slightly less than the 5.44 percent fat in 1 734.21 of milk from 30 pure-bred Awassi flocks marketed in the same year (Table B-25).

Meat (lamb)

In 16 male Awassi-East Friesian cross-bred lambs that had been used in a fattening test, Goot, Folman and Eyal (1967) recorded the loss in weight in transit over a distance of 20 km from farm to slaughterhouse and during 18 hours of abstention from feed and water (Table B-26). In addition, the carcass and different parts and organs were weighed immediately after slaughter (Table B-27). (For a comparison with male Awassi and Awassi-Mutton Merino cross-bred lambs, see p. 191, para. 2, p. 195, para. 3, and p. 242, paras. 2-5).

TABLE B-25. **Average monthly fat content of milk from Awassi-East Friesian cross-bred flocks, delivered to central dairies in Israel, 1976/77**

Month	Milk (t)	Butterfat	
		Kg	%
October	13.0	720	5.55
November	27.7	1 273	4.60
December	60.0	3 036	5.06
January	112.2	5 394	4.81
February	131.7	7 130	5.41
March	150.5	7 630	5.07
April	131.7	6 884	5.23
May	125.6	6 920	5.51
June	103.9	5 852	5.63
July	83.6	4 783	5.72
August	39.5	2 322	5.88
September	10.3	616	5.98

TABLE B-26. **Mean live and carcass weights of 16 male Awassi-East Friesian cross-bred lambs (kg)**

Age (days)	304
Live weight	
On farm	74.6
Before slaughter (in wool)	69.8
Before slaughter (shorn)	68.1
Warm carcass weight	36.6
Carcass yield (%)	53.7

TABLE B-27. **Mean weights of inner organs, kidney and caul fat, and tail of 16 male Awassi-East Friesian cross-bred lambs (kg)**

Live weight	69.8
Liver, lungs and heart	2.5
Kidneys	0.174
Kidney fat	1.4
Caul fat	3.9
Total kidney and caul fat	5.3
Fat tail	1.1

TABLE B-28. **Mean percentages of bone, muscle and fat tissue in the carcasses of three male Awassi-East Friesian cross-bred lambs**

Carcass weight (kg)	37.8
Carcass yield	52.0
Bone	12.7
Muscle	52.5
Fat	32.7
Weight loss	2.1

TABLE B-29. **Mean weight and percentage of various carcass parts of three male Awassi-East Friesian cross-bred lambs**

Forequarters	Kg	%
	21.78	57.59
Hindquarters	16.04	42.41
Neck	5.31	14.04
Breast	9.42	24.91
Shoulders	7.05	18.64
Loin	4.23	11.19
Psoas muscles	0.43	1.13
Pelvis	3.87	10.23
Thighs	7.51	19.86
Total	37.82	100.00

The mean shrinkage in transit from farm to slaughterhouse and the weight loss during 18 hours without feed and water amounted to 4.8 kg or 6.4 percent. The average fleece weight of the 16 lambs was 1.7 kg or 2.4 percent of the weight of the unshorn lambs. The cold carcass weight was estimated at 2 percent less than the warm carcass weight. The slaughter yield without inner organs and fat tail amounted to 52.7 percent; the addition of the edible inner organs increased it to 56.5 percent and of the inner organs and fat tail to 58.1 percent (Fig. B-l).

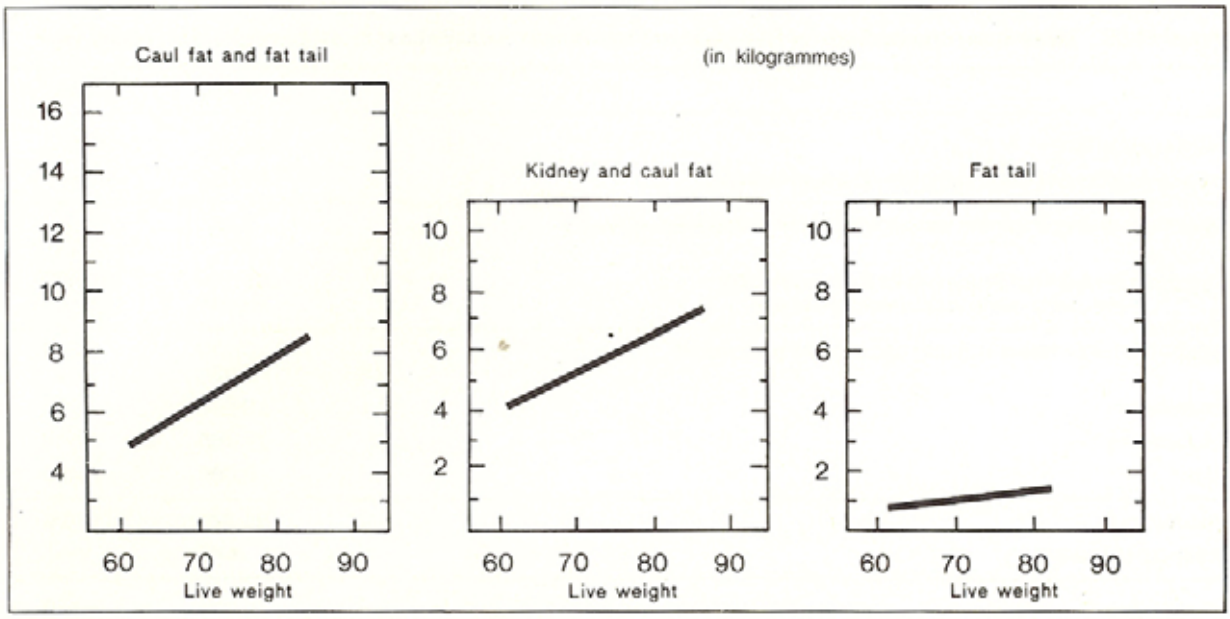

Figure B-1. Weight of kidney and caul fat and fat tail in relation to live weight of Awassi-East Friesian cross-bred lambs. (**Source:** Goot, Folman & Eyal, 1967)

The heaviest three lambs were selected for an analysis of their carcass composition, for which one-half of each carcass was used (Tables B-28 to B-32). The average live weight of these lambs on the farm of origin was 81.7 kg; shearing and shrinkage in transit and during the period of abstention from feed and water prior to slaughter reduced it to 72.8 kg. The ratio of subcutaneous to intermuscular fat in the trunks of the Awassi-East Friesian cross-bred lambs was 48:52.

In 1977 Epstein (unpublished) examined the body composition of two male and two female Awassi-East Friesian cross-bred lambs at marketing weights then common in Israel. Before despatch to the slaughterhouse the male lambs weighed 54 and 55 kg, respectively, and the female lambs 35 kg each (Table B-33). (For Awassi lambs included in the investigation, see Table 5-5.)

TABLE B-30. **Distribution of bone, muscle and fat tissue in various parts of the carcass of three male Awassi-East Friesian cross-bred lambs (%)**

Part of carcass	Bone	Muscle	Subcutaneous fat	Intermuscular fat	Total fat	Weight loss
Neck	11.0	52.6	12.6	20.8	33.4	3.0
Breast	16.4	45.4	10.9	26.1	37.0	1.2
Right shoulder	13.5	60.0	13.4	11.5	24.9	1.6
Loin	8.7	43.6	26.8	19.0	45.8	1.9
Psoas muscles	—	77.7	—	21.3	21.3	1.0
Pelvis	11.1	47.3	22.8	17.1	39.9	1.7
Thigh	12.0	60.9	16.4	7.3	23.7	3.4

TABLE B-31. **Chemical composition of 'eye-muscles' of three male Awassi-East Friesian cross-bred lambs (%)**

	Mean	Range
Dried matter	26.2	25.4-27.9
Protein	21.1	20.6-21.7
Fat	3.4	3.2- 3.6
Ash	0.9	0.9-1.0

TABLE B-32. **Energy value of muscle and fat of three heavy Awassi-East Friesian cross-bred lambs**

Weight of carcass (kg)	37.82
Weight of muscle (kg)	19.80
Weight of fat (kg)	12.37
Muscle, calories	30 000-48 000
Fat, calories	93 000
Energy value of protein content (%)	14-17
Energy value of fat content (%)	83-86

TABLE B-33. **Mean body composition of two male and two female Awassi-East Friesian cross-bred lambs (kg)**

			Male	Female
Live weight on farm			54.50	35.0
Live weight after 24 hours' starvation at slaughterhouse			51.25	32.5
Weight loss during shipment and 24 hours withholding feed and water		(%)	3.25 6.0	2.5 7.14
Carcasses at slaughterhouse (warm dressed weight)			25.160	16.460
	at butcher-shop (cold dressed weight)		25.020	16.160
Weight difference between warm and cold dressed weight			0.140	0.300
		(%)	0.56	1.82
Forequarters			12.870	7.800
Hindquarters			11.485	7.960
Fat tail			0.665	0.400
Carcass, total			25.020	16.160
Killing-out percentage			48.8	49.7
Forequarters	Neck		2.565	1.290
	Leg and shoulder		3.550	2.580
	Chest		6.730	3.900
	Weight loss		0.025	0.030
	Total		12.870	7.800
Hindquarters Loin and rump			4.765	2.960
	Leg and thigh		6.705	4.985
	Weight loss		0.015	0.015
	Total		11.485	7.960
Fat tail Tail fat			0.545	0.310
	Tail		0.120	0.090
	Total		0.665	0.400

TABLE B-33. (cont.)

	Male			Female		
Forequarters	Neck	Leg and shoulder	Chest	Neck	Leg and shoulder	Chest
Bone	0.545	0.770	1.330	0.300	0.540	0.815
Muscle	1.545	2.340	3.605	0.885	1.820	2.705
Fat tissue	0.430	0.440	1.780	0.090	0.215	0.380
Weight loss	0.045	—	0.015	0.015	0.005	—
Total	2.565	3.550	6.730	1.290	2.580	3.900

Hindquarters	Loin and rump	Leg and thigh	Loin and rump	Leg and thigh
Bone	0.410	1.280	0.290	0.960
Muscle	2.170	4.595	1.710	3.645
Fat tissue	2.150	0.805	0.930	0.350
Weight loss	0.035	0.025	0.030	0.030
Total	4.765	6.705	2.960	4.985

Forequarters, total		
Bone	2.645	1.655
Muscle	7.490	5.410
Fat tissue	2.650	0.685
Weight loss	0.060	0.020
Total	12.845	7.770

	Male	Female
Hindquarters, total		
Bone	1.690	1.250
Muscle	6.765	5.355
Fat tissue	2.955	1.280
Weight loss	0.060	0.060
Total	11.470	7.945

Carcass, total	Kg	% of live weight [51.25 kg]	Kg	% of live weight [32.5 kg]
Bone	4.335	8.46	2.905	8.94
Muscle	14.255	27.81	10.765	33.12
Fat tissue	5.605	10.94	1.965	6.05
Weight loss	0.120	0.23	0.080	0.24
Total	24.315	47.44	15.715	48.35
Fat tail				
Tail fat	0.545	1.06	0.310	0.95
Tail	0.120	0.23	0.090	0.28
Total	0.665	1.29	0.400	1.23

TABLE B-33. (cont.)

		Male	Female
	Head, feet and inner organs		
Head (without skin)	Total	2.585	1.250
	Tongue	0.110	0.075
	Brain	0.110	0.095
	Horns	0.225	0.035
Feet (without skin)		0.820	0.550
Inner organs	Liver	0.860	0.540
	Lungs with trachea	0.700	0.665
	Spleen	0.070	0.050
	Heart	0.185	0.130
	Kidneys	0.145	0.090
	Diaphragm	0.165	0.160
	Oesophagus	0.040	0.035
	Oesophagus fat tissue	0.155	0.210
	Thymus	0.020	0.020
	Testes	0.465	—
	Uterus	—	0.065
	Udder	—	0.115
	Skin and intestines		
Weight of wet skin	Body	5.700	3.800
	Head and ears	0.700	0.460
	Legs	0.305	0.210
	Total	6.705	4.470
Length of intestines (m)	Small intestine	29.650	25.300
	Large intestine	7.825	7.500
	Total	37.475	32.800

Tail development

One of the purposes of crossing the Awassi with the East Friesian is the reduction in the size of the fat tail which constitutes an impediment to the mating, shearing and clean milking of Awassi ewes.

The width of the tail at the broadest section has been measured by Goot (1966) in Awassi, East Friesian and Awassi-East Friesian cross-bred lambs, yearlings and adult ewes with different shares of the parent breeds (Table B-34).

The width of the tail seems to follow the different genetic compositions of the various cross-breds fairly closely, except for a certain tendency of dominance of the narrow East Friesian to the broad

TABLE B-34. **Average width of tail in Awassi, East Friesian and Awassi-East Friesian cross-bred sheep with different shares of parent breeds**

Breed	Lambs		Yearlings		Adult ewes	
	No.	cm	No.	cm	No.	cm
Awassi	13	18.4	20	20.1	91	23.5
East Friesian	8	2.8	5	4.6	6	5.3
F_1, F_2 and F_3 cross-bred	89	6.9	19	7.6	62	11.0
$^5/_8$ and $^3/_4$ Awassi	7	9.1	5	10.6	7	18.8
$^5/_8$ and $^5/_8$ East Friesian	40	5.1	16	6.4	23	7.9

Figure B-2. Caudal view of Awassi-East Friesian F_1 cross-bred sheep

Awassi tail observable in all cross-breds save the $^3/_4$-bred Awassi generation. (See Fig. B-2.)

The shape of the tail in the cross-breds varies in accordance with the different shares of the parent breeds. In the F_1 generation, the tail consists of a round disc of fatty tissue in the uppermost part, from which the straight, narrow, short-haired tail characteristic of the East Friesian descends to the hocks. The $^5/_8$-bred Awassi shows a similar caudal conformation, while the tail of the $^3/_4$-bred Awassi approximates that of the Awassi. In cross-breds with a preponderant East Friesian share, the curvature of the Awassi tail is absent.

Udder

In dairy ewes the milk flow is markedly influenced by the shape of the udder (see Figs B-3 and B-4). From baggy udders with laterally projecting teats, the flow is generally less satisfactory than from those of adequate shape with teats pointing downwards; the inferiority of the former is not fully neutralized by the udder-lifting device connected to the milking machine. In view of the importance of this problem in East Friesian-Awassi cross-bred sheep, the frequencies and heritability of different udder types have been studied by Gootwein, Alef and Gadish (1979) in a flock of 1 000 stall-fed ewes.

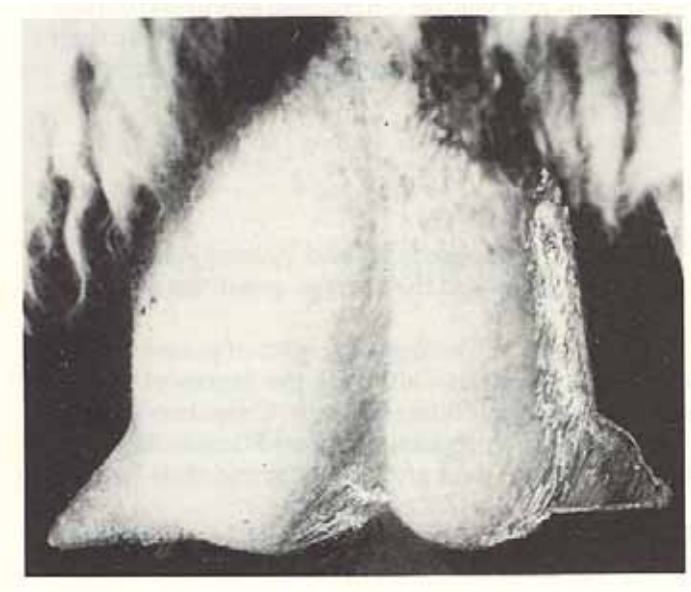

Figure B-3. Well-shaped udder of an East Friesian cross-bred ewe

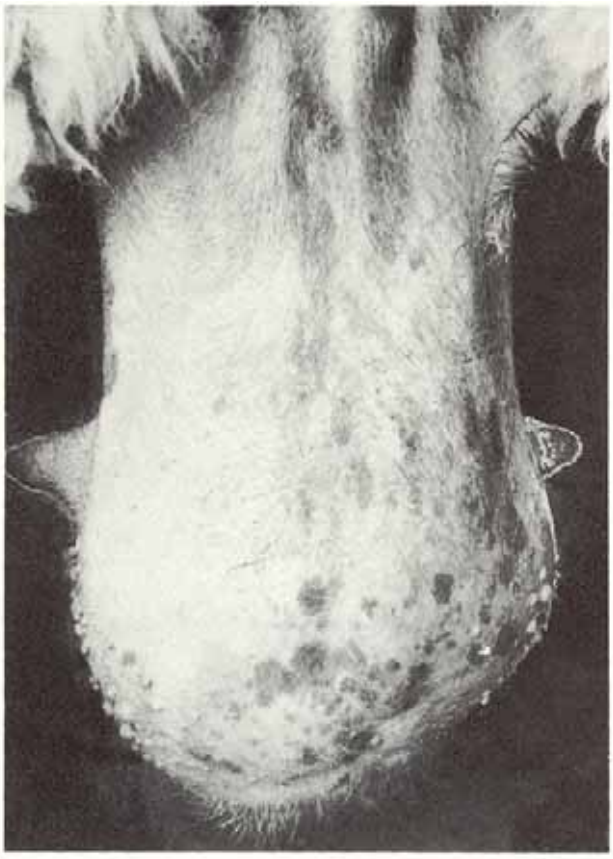

Figure B-4. Baggy udder with laterally projecting teats of an East Friesian-Awassi Cross-bred ewe

In the examination of the udder, four traits were considered and each trait was classed into four grades. The udders were examined at the first milk test of the lactation, 20-60 days after lambing. The percentages of the different grades of the mammary traits were separately recorded in 269 yearling and 544 two- to five-year-old cross-bred ewes (Table B-35).

In 27 percent of the adult ewes the type of udder was undesirable from the point of view of milk flow. Between yearling and adult ewes considerable differences were found in the shape of the udder and the situation of the teats, while the differences in length and thickness of teats between the two age groups were negligible.

To estimate the heritability of different traits, groups comprising a total of 451 half-sisters were used; among these were 68 adult dam-daughter pairs. The traits were graded as follows: shape of udder, baggy or not baggy; situation of teats, lateral or not; length of teats, short or not; and thickness of teats, thin or not.

In the frequency of udder shape and situation of teats a significant correlation was found between dams and daughters. Dams with a desirable udder showed a tendency to transmit this quality to their daughters and vice versa. In other traits there was no correlation between the dam and daughter groups (Gootwein, Alef & Gadish, 1979).

Wool

Awassi, East Friesian, Awassi-East Friesian F_1, F_2 and F_3 cross-bred, $^5/_8$- and $^3/_4$-bred Awassi, and $^5/_8$- and $^3/_4$-bred East Friesian ewes of different age groups produced the average quantities of wool of 12 months' growth given in Table B-36 (Goot, 1966).

The Awassi ewes had lighter fleeces than the cross-breds. The fleece weights of pure-bred East Friesians and Awassi-East Friesian F_1 half-breds were the heaviest, although the fleeces of the East Friesian ewes did not reach the average weight common in their home country. Cross-breds with a predominant Awassi share had lighter fleeces than those with a predominant East Friesian share. No correlation was found between the body weight of ewes three days after lambing and their fleece weights of 12 months' growth.

The fibre length of the Awassi wool was 13.0 cm on average, East Friesian 10.3 cm, $^3/_4$-bred Awassi 13.4 cm, and $^3/_4$-bred East Friesian 9.4 cm (Goot, 1966).

TABLE B-35. **Frequency percentage of mammary trait grades in yearling (A) and adult (B) East Friesian-Awassi cross-bred ewes**

Trait		Grades (%)							
Shape of udder	A	Attached	67.3	Medium	28.6	Baggy	4.1	Irregular	–
	B		42.8		43.0		13.6		0.6
Situation of teats	A	Lateral	9 3	Obliquely downwards	89.2	Downwards	1.5	Irregular	—
	B		27.0		69.7		3.0		0.3
Length of teats	A	Short	13.4	Medium	84.7	Long	1.9	Irregular	—
	B		9.5		86.2		4.3		—
Thickness of teats	A	Thin	15.7	Medium	81.7	Thick	2.6	Irregular	—
	B		13.3		83.1		3.3		0.3

TABLE B-36. **Average fleece weights of Awassi, East Friesian and Awassi-East Friesian cross-bred ewes with different shares of parent breeds**

Breed	Age (years)	Number of fleeces	Fleece weight (kg)
Awassi	1-6 $^{1}/_{2}$	658	2.12
East Friesian	1-5$^{1}/_{2}$	113	2.98
F_1, F_2 and F_3 cross-bred	1-5$^{1}/_{2}$	567	2.89
$^{5}/_{8}$ and $^{3}/_{4}$ Awassi	1-4	67	2.61
$^{5}/_{8}$ and $^{3}/_{4}$ East Friesian	1-4	126	2.80

TABLE B-37. **Mortality of male and female, single and twin Awassi and Awassi-East Friesian cross-bred lambs with different shares of parent breeds in an experimental flock in Israel**

Breed	Single						Twin					
	Male			Female			Male			Female		
	No. born	Mortality		No. born	Mortality		No. born	Mortality		No. born	Mortality	
		No	%		No.	%		No.	%		No.	%
Awassi	81	8	9.9	64	0	0	38	9	23.7	27	3	11.1
East Friesian	12	4	33.3	15	3	20.0	46	17	37.0	42	16	38.1
F_1, and F_2 cross-bred	118	12	10.2	137	16	11.7	82	9	11.0	69	7	10.1
$^{5}/_{8}$ and $^{3}/_{4}$ Awassi	20	2	10.0	20	1	5.0	1	0	0	3	0	0
$^{5}/_{8}$ and $^{3}/_{4}$ East Friesian	52	10	19.2	38	4	10.5	28	10	35.7	38	4	10.5

Mortality

In a farm flock of East Friesian-Awassi cross-bred ewes in Israel, the percentage of stillborn lambs from yearlings was 12.6 and from two-year-old ewes 10.5, with an average of 11.1 percent (Alef, 1979).

In an experimental flock in Turkey the average mortality rate of lambs between the second and ninetieth day after birth was 1.9 percent in İvesi and 6.3 percent in İvesi-East Friesian cross-bred lambs in 1973 and 1974 (Lischka, 1976).

In an experimental flock in Israel, the mortality among 1 143 male and female, single and twin Awassi and Awassi-East Friesian cross-bred lambs, 338 yearlings and 890 breeding ewes was recorded over the course of 11 years (Table B-37) (Goot, 1966).

The highest total death rate was among East Friesian lambs (34.8 percent), followed by the $^{3}/_{4}$-bred East Friesians (27.4 percent), the $^{11}/_{16}$-bred East Friesian (19.2 percent), the F_2 cross-bred

(12.8 percent), the $^5/_8$-bred East Friesian (11.7 percent), the Awassi, F_1 and F_3 cross-bred and $^3/_4$-bred Awassi (9.5-9.1 percent), and finally $^5/_8$-bred Awassi lambs (4.5 percent) (see Table B-38).

Pure-bred East Friesian females again had the highest death rate. Awassi lambs and yearlings showed the lowest mortality, while the cross-breds ranged between the parent breds, although somewhat nearer the Awassi.

As in the case of the 6- to 18-month-old female lambs and yearlings, the mortality of adult ewes was lowest in the Awassi and highest in the East Friesian, with the F_1 cross-breds in between, but much closer to the death rate of the Awassi than the East Friesian ewes (Table B-39).

In six farm flocks Eyal and Goot (1968) recorded the mortality among 1 759 lambs born to Awassi ewes and of 1 526 lambs out of Awassi-East Friesian F_1 cross-breds until the age of six months (Tables B-40andB-41).

The slightly greater mortality of the lambs born to F_1 cross-bred ewes is attributed by the authors to the higher twinning rate since twins, owing to their smaller birth weight, are weaker than single-born lambs.

One of the principal causes of the death or culling of ewes in dairy flocks is mastitis (see pp. 62-3). In six farm flocks Awassi ewes suffered more from mastitis including gangrene (20 percent) than Awassi-East Friesian cross-breds (15 percent), and less from abortion (1.0 percent versus 3.7 percent) and other diseases (9.7 percent versus 11.4 percent) (Eyal & Goot, 1968).

In 34 farm flocks comprising 22 000 milk-recorded Awassi and Awassi-East Friesian cross-bred ewes in Israel, the reverse in the incidence of mastitis emanates from a report of the year 1972/73 (Carasso, 1979). There was a higher percentage of mastitis in all age groups of cross-breds than in Awassi ewes. The same applies to udder gangrene in yearlings, but in the two-year-old and adult age groups its incidence was higher in the Awassi than in the Awassi-East Friesian cross-bred ewes (Table B-42).

TABLE B-38. **Mortality of female Awassi, East Frie-sian and Awassi-East Friesian cross-bred lambs and yearlings, 6-18 months old**

Breed	Number in June	Mortality	
		No.	%
Awassi	71	2	2.8
East Friesian	35	6	17.1
F_1 and F_2 cross-bred	151	8	5.3
$^5/_8$ and $^3/_4$ Awassi	25	2	8.0
$^5/_8$ and $^3/_4$ East Friesian	56	4	7.1

TABLE B-39. **Mortality of adult Awassi, East Friesian and F_1 cross-bred ewes in an experimental flock in 4-7 years**

Breed	Number at mating	Mortality	
		No.	%
Awassi	414	9	2.2
East Friesian	97	21	21.6
F_1 cross-bred	276	15	5.4

TABLE B-40. **Mortality of lambs out of Awassi and Awassi-East Friesian F_1 cross-bred ewes in six farm flocks**

Breed of dam	Age (days):	Mortality (%)			Total
		0-3	4-60	61-180	
Awassi		5.9	2.9	0.7	9.5
Awassi-East Friesian F_1 cross-bred		7.4	2.8	0.6	10.8

TABLE B-41. Mortality of 1- to 4-year-old Awassi and Awassi-East Friesian cross-bred ewes in six farm flocks

Breed	Age (years):	Mortality (%)				Total
		1	2	3	4	
Awassi		1.10	3.03	2.41	1.80	8.34
Awassi-East Friesian cross-bred		1.98	2.64	1.67	3.95	10.24

TABLE B-42. **Percentage of mastitis and udder gangrene in yearling, 2-year-old and adult Awassi and Awassi-East Friesian ewes in farm flocks**

Breed	Mastitis			Udder gangrene		
	Yearling	2-year-old	Adult	Yearling	2-year-old	Adult
Awassi	1.5	2.8	4.8	1.2	1.8	1.9
Awassi-East Friesian cross-bred	3.6	3.9	7.9	2.3	0.5	1.3