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Contemporary performance comparisons of *Chios* and *Assaf* sheep and of their crosses under intensive indoor management. Preliminary results

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Summary

Ten *Chios* ewe hoggets and three rams were imported from Cyprus and their performance was compared with that of 49 *Assaf (East Friesian* × *Awassi)* contemporaries. Lambing rates (lambs/ewe/year) for the *Chios* and *Assaf* ewes in the first and second to fifth lambings were 1.89 and 1.42 ($P < 0.01$), and 2.10 and 1.69 ($P < 0.03$), respectively. Yearly milk yields were 206 ± 30 and 225 ± 16 ; not significant (NS) and 269 ± 31 and 345 ± 22 kg ($P < 0.05$), respectively. There were no significant differences between the two breeds in lambing interval and in lamb mortality.

There were no significant differences between 47 *Assaf* and 35 *Chios* × *Assaf (ChAs)* ewes born in Israel for age at first lambing (435 and 428 days), percent of ewes lambing (96), lambing interval (280 and 293 days), mature body weight (80.5 and 77.4), lambs born/lambing (1.40 and 1.59 at first and 1.71 and 1.75 at 2nd to 5th lambings), lamb mortality (9.9 and 12.2 p. 100), or milk production per lactation (211 and 192 kg) in first lactation. Mean milk yields in 2nd to 5th lactation were 270 ± 18 and 219 ± 16 kg, respectively ($P < 0.05$).

Chios lambs grew significantly slower compared with the *Assaf* and crossbred lambs. There were no significant differences between *Assaf* and crossbred lambs. Least squares mean slaughter yields (p. 100 of live weight) for *Assaf* and *ChAs* lambs were 47.6 and 47.4 (NS) for hot carcass, 1.36 and 2.03 ($P < 0.002$) for the tail and 3.55 and 3.78 (NS) for kidney + caul fat, respectively.

Mean lung infection scores (scale : 0-4) after slaughter were 1.46 and 1.88 (NS) for *Assaf* and *ChAs* in autumn-born lambs, and 1.20, 2.88 and 2.10 ($P < 0.05$) for *Chios, Assaf* and *ChAs* lambs, respectively, born in the spring.

Key words : Sheep, Chios, Assaf, *crosses.*

I. Introduction

The crossing of *East-Friesian* and *Awassi* sheep (GOOT, 1966 ; EYAL & GOOT, 1968) resulted in the formation of the *Assaf* breed, which is both high milk- and high lamb-producing (EYAL *et al.*, 1978). Weaknesses of the breed, when compared

with the *Awassi,* are its somewhat greater susceptibility to pneumonia, chronic copper intoxication and urolithiasis (urine calculi), that was contributed by the *East-Friesian* parent (SHIMSHONY, 1969, 1983 ; SHIMSHONY & LAWI, 1972). Regarding pneumonia, similar results were reported by ZERVAS *et al.* (1975) for *East-Friesian* sheep and their crosses with the *Chios* in Greece. According to MASON (1967), *Chios* sheep are kept mainly in coastal areas, which are relatively hot and humid, under moderately intensive management conditions. They are early maturing (8-9 months of age), and prolific (1.8-2.0 lambs per lambing), and can yield 250-300 kg of milk per lactation (LOUCA, 1972 ; LOUCA, MAVROGENIS & LAWLOR, 1974 ; ZERVAS *et al.,* 1975 ; KALAISSAKIS *et al.,* 1977 ; LAWLOR, LOUCA & MAVROGENIS, 1977). Recent data reported by LOUCA *et al.* (1974), HADJIPANAYIOTOU & LOUCA (1976) and LAWLOR *et al.* (1977) indicate relatively slow growth rates. The objectives of the present observation were :

a) to provide information on the performance of crossbred progeny of *Assaf* ewes mated with *Chios* rams ;

b) to examine whether the introduction of *Chios* blood would improve the resistance of *Assaf* progeny to pneumonia ;

c) to obtain preliminary performance data for *Chios* sheep under management practices comparable to those common for the *Assaf* in Israel.

II. Materials and methods

A. *Experimental site*

The experiments were conducted at the Newe Yaar Experimental Station in the Yizre'el Valley, northern Israel (32° 45′ N, 35° 12′ E). Average maximum and minimum daily temperatures over the years are 34 °C and 19.8 °C, respectively, in August, and 17.6 °C and 7.8 °C, respectively in January ; mean annual rainfall is 560 mm.

B. *Animals and crossing program*

Ten ewe- and three ram-hoggets of approximately 8 to 10 months of age were imported from Cyprus in March 1978. The ewe-hoggets were maintained as a separate group until the end of their first pregnancy, after which time they were joined with the *Assaf* flock. Their body weight upon arrival was 36 ± 3.6 kg ($\pm$ s.d.) and 54 ± 5.9 kg 7 months later, which is considerably lower than that of *Assaf* ewes of the same ages (see tables of results). *Chios* ewes were mated with *Chios* rams, and *Assaf* ewes were split between *Assaf* and *Chios* rams. It was intended to mate equal numbers of ewes with either sire breed, but in practice more pure *Assaf* offspring were produced. *Chios* × *Assaf* ewes that were kept in the flock for replacement were all crossed back to *Assaf* rams and results for their offspring over 2 years are also reported.

C. *Mating seasons and management procedures*

There were two breeding seasons each year to result in two lambing seasons, namely autumn (October-January) and spring (April-May). At lambing, ewes and

lambs stayed in maternity pens for 48 hrs. After this, lambs were separated from their dams. One lamb was raised on residual milk of its dam by suckling after each of the twice daily milkings. Other lambs, out of multiple births, were reared artificially on a commercial milk substitute. Milk yield (« dairy yield », as defined by MORAG *et al.*, 1973) was recorded monthly and the sum of these records was multiplied by 30 to arrive at lactational or yearly production. The lambs were offered concentrates *ad lib.* and approximately 100 g/head daily of hay. The concentrate mixture was pelleted (6 mm cubes) and composed (kg/ton) of maize (360), barley (360), soya bean meal (220), lucerne meal (30) and limestone, salt and minerals and vitamins as described by FOLMAN & EYAL (1978). After the age of 5 months, replacement ewe-lambs were fed on hay and concentrates in quantities calculated to produce a gain of 100-150 g per day until their first lambing, which occurred when they were about 14 months old.

Sheep were maintained indoors throughout the year and lactating ewes were fed on hay, green fodder and concentrates as described by EYAL *et al.* (1978).

D. *Clinical observations and slaughterhouse records*

Clinical follow-up was carried out during the first two seasons (autumn 1978 and spring 1979). Individual lambs were inspected twice daily during the entire observation period.

In the first two seasons, a total of 63 lambs were examined at the slaughterhouse. They were not fasted prior to slaughter. Carcass (without tail), tail and visceral fat (caul + kidney fat) were weighed.

All visceral organs were inspected at slaughter for gross pathological changes (GILMOUR & BROTHERSTON, 1963 ; PFEFFER, 1981). Lungs were scored for lesions on a scale of 0 to 4 as follows :

0 = No gross lesions recorded ;

1 = Single or few band lesions in the apical lobes ;

2 = Band and localized lesions in apical and cardiac lobes ;

3 = Grey consolidation in apical, cardiac and intermediate lobes ;

4 = Grey and red consolidation in apical, cardiac, intermediate and the anterior ventral parts of the diaphragmatic lobes, with adhesions.

Lungs scored 4 were taken for bacteriological examination.

Livers and kidneys were sampled for biochemical assays and for copper contents evaluation. Cu determinations were made on 1 g of liver and 3 g of kidney (dry matter basis) using a Unicam SP 90 A (Oxford) Atomic absorption spectrophotometer.

E. *Culling procedures for ewes*

Apart from ewes which died and those which had to be sold due to disease (mainly mastitis), ewes that failed to conceive in two consecutive breeding seasons, or those with low production records, were culled. For this purpose, an index — M + 200 L — was calculated in which M is mean yearly milk production (kg) of

the ewe, and L is the mean number of lambs produced per year. A ewe was culled if its mean index was more than one standard deviation below the average of its contemporaries, all genotypes combined.

III. Results

A. *Reproductive performance and milk production*

The performance of the imported *Chios* and of their approximately contemporary *Assaf* ewes in three consecutive years is presented in table 1, and that of *Assaf,* and *Chios* × *Assaf (ChAs)* ewes that were born in Newe Yaar is shown in table 2.

TABLE 1

Lambing performance and milk production of imported Chios *sheep and of their* Assaf *contemporaries in five consecutive lambings.*

Performance d'agnelage et production laitière de brebis Chios *importées et de leurs contemporaines* Assaf *pendant 5 campagnes consécutives.*

Variable	Breed		P
	Assaf	*Chios*	
First lambing			
Ewes present	49	10	—
Ewes lambed, p. 100	98.0	90.0	—
Lambs born/ewe lambed	1.42	1.89	0.01
Lamb mortality, p. 100	22.6	17.6	—
Lactational milk yield, kg	225 ± 16	206 ± 30	—
Second to fifth lambing *			
Ewes present **	35-16	9-4	—
Ewes lambed, p. 100	94.5 ± 2.08	97.5 ± 2.50	—
Lambs born/ewe lambed	1.69 ± 0.02	2.10 ± 0.10	0.03
Lamb mortality, p. 100	10.1 ± 0.97	10.2 ± 1.68	—
Interval between lambings, days	294 ± 9	304 ± 16	—
Lactational milk yield, kg ***	345 ± 22 (98)	269 ± 31 (24)	0.05

* Means are ± s.e. between lambings, except for « ewes lambed » which is on yearly basis, n = 3.

** Number of ewes in second and fifth lambing, respectively.

*** Mean is between lambings ; s.e. is for second lambing, which would be taken for an upper bound to the appropriate s.e. This value is not affected by culling, nor does it contain variability from repeated measurements from the same animals. Total number of lactations is given in parentheses.

TABLE 2

Reproductive performance of contemporary Assaf *and* Chios × Assaf (ChAs) *F_1 ewes, all mated with* Assaf *rams. Means ± s.e.*

Fécondité des brebis contemporaines Assaf *et* Chios × Assaf (ChAs) *saillies par des béliers* Assaf. *Moyenne et erreur standard.*

Variable	Genotype	
	Assaf	*ChAs*
First lambing		
Ewes present	47	35
Ewes lambed, p. 100	95.7	97.1
Age at first lambing, d	435 ± 8.7	428 ± 9.5
Weight at first lambing, kg	71.4 ± 1.06[a]	67.4 ± 1.57[b]
Lambs born/ewe lambing	1.40	1.59
Lamb mortality, p. 100	10.7	18.0
Milk/lactation, kg	211 ± 12	192 ± 14
Second to fifth lambing *		
Ewes present **	32-18	30-11
Ewes lambed, p. 100	96.1 ± 2.12	95.6 ± 3.12
Interval between lambings, d	280 ± 5.1	293 ± 11.4
Weight at lambing, kg	80.5 ± 2.43	77.4 ± 1.72
Lambs born/ewe lambing	1.71 ± 0.09	1.75 ± 0.07
Lamb mortality, p. 100	9.9 ± 4.22	12.2 ± 5.69
Milk/lactation, kg ***	270 ± 18[a] (93)	219 ± 16[b] (64)

*, **, *** : See table 1.

There were no differences between genotypes in percent of ewes lambing. Lambs born per lambing of the imported *Chios* ewes alone were significantly higher than in their *Assaf* contemporaries. *Assaf* ewes produced more milk than *Chios* or *ChAs* and had a slightly shorter lambing interval. Difference in body weight between *Assaf* and *ChAs* was statistically significant at the first lambing (age 14 months) but lost significance at maturity (table 2).

B. *Growth of lambs and slaughter yields*

There were no significant differences in birth weight between *Chios* lambs and those of other genotypes. However, *Chios* lambs grew significantly slower and were lighter than *Assaf* and crossbred lambs at the age of 5 months. There were no differences between the other genotypes (table 3).

TABLE 3

Least-squares means of birth weights and growth parameters of Chios *(Ch),* Assaf (As) *and* Ch × As *crossbred lambs, born contemporarily in two seasons in three consecutive years* *.

Moyennes « Least squares » des poids à la naissance et des paramètres de croissance d'agneaux contemporains Chios (Ch), Assaf (As), *et* Ch × As *pendant deux saisons de trois campagnes consécutives.*

Season of birth	Genotype	n	Birth weight (kg)	Weaning age, days	Growth rate (GR) g/day***		Weight at 150 days, kg
					GR 1	GR 2	
Autumn (Oct.-Dec.)	*Chios*	32	3.89	49	220[a]	292[a]	43.9[a]
	Assaf	557	3.93	49	247[b]	354[b]	49.3[b]
	ChAs	155	4.23	51	263[b]	363[b]	52.3[b]
	*As × ChAs***	40	3.98	40	246[b]	346[b]	46.7[b]
Spring (Apr.-May)	*Chios*	20	3.95	54	203[a]	304[a]	43.4[a]
	Assaf	293	4.15	52	235[b]	339[b]	49.4[b]
	ChAs	85	4.08	58	232[b]	317[a,b]	46.7[a,b]
	*As × ChAs***	57	4.09	55	243[b]	346[b]	47.7[b]

* The least-squares model included, birth weight, sex, type of birth, type of rearing, genotype and sire.

** Two years only.

*** GR1 = birth-weaning ; GR2 = 8 weeks post weaning.

a, b Means in the same column and same season, followed by different superscripts, differ at $P < 0.05$.

TABLE 4

Mean slaughter yields of Assaf *and* Chios × Assaf (ChAs) *lambs (two seasons combined).*

Rendements moyens à l'abattage d'agneaux Assaf *et* Chios × Assaf (ChAs) *(combinaison de 2 saisons).*

Sex	Genotype	n	Live-weight kg[a]	Yield, p. 100 of live weight		
				carcass	tail	visceral fat[b]
♂	*Assaf*	17	51.3	47.0	1.37	2.94
	ChAs	18	51.5	47.6	1.71	3.01
♀	*Assaf*	10	47.0	48.5	1.50	4.12
	ChAs	11	44.4	48.2	2.38	4.77
LSM ± s.e.	*Assaf*	27	48.9 ± 1.45	47.6 ± 0.32	1.36 ± 0.16	3.55 ± 0.24
	ChAs	29	47.8 ± 1.36	47.4 ± 0.34	2.03 ± 0.15	3.78 ± 0.23
	P <		NS	NS	0.002	NS

a : Not fasted ; b : Caul + kidney fat.

It is noteworthy that weight gains of *Assaf* and *ChAs* lambs from birth to weaning and during the first 8 weeks post-weaning were somewhat reduced in spring- as compared with autumn-born lambs. However, there were no differences in the 150-days' weight, which indicates higher growth rates during older age of the spring lambs than those of autumn lambs.

The only significant differences between *Assaf* and *ChAs* lambs was in the size of the fat tail (table 4). There was an apparent breed × sex interaction in the amount of visceral fat, female *ChAs* lambs having relatively more fat than *Assaf* females ($P < 0.1$), whereas no such difference was found in males.

C. *Clinical observations and pathological changes*

No clinical symptoms of chronic copper intoxication or urolithiasis were observed throughout the entire period in any of the three genotypes. Results of biochemical variables were published elsewhere (BOGIN *et al.*, 1982).

Contagious ecthyma (orf) was recorded in 10/22 (45.5 p. 100) *Assaf* and 12/23 (52.2 p. 100) *ChAs* lambs during December 1978 without complications and without significant differences between the two groups in regard to the severity and duration of the infection.

Three lambs, one of each genotype *(Assaf, Chios, ChAs),* showed during the observation period signs of respiratory disorders with elevated body temperatures. At slaughter, which was performed within 2 months, two of these lambs were scored 3 for lung changes ; one of them, slaughtered 3 weeks after the onset of symptoms, was found positive for *Pasteurella multocida,* isolated from the lung.

Lung infection (pneumonia) scores are presented in table 5. Evidently, the degree of infection was lower in autumn-born than in spring-born lambs, this seasonal difference being more pronounced in *Assaf* than in *ChAs* lambs. Furthermore, in spring-born lambs, there as a significant difference between *Chios* and *Assaf* lambs, in favour of the *Chios.* Three of the affected lungs were examined bacteriologically, and *P. multocida* was isolated in two. No gross pathological lesions were recorded in other visceral organs.

TABLE 5

Mean (± s.e.) lung infection scores (0 to 4 scale) in lambs born during two seasons of the year.

Index (moyenne ± s.e.) d'infection pulmonaire (échelle de 0 à 4) d'agneaux nés à deux saisons de l'année.

Season	Genotype		
	Chios	*Assaf*	*ChAs*
Autumn	no data	1.46 ± 0.29^{a}	1.88 ± 0.19^{a}
Spring	1.20 ± 0.57^{a}	2.88 ± 0.34^{b}	$2.10 \pm 0.37^{a,b}$

a, b Means with no common superscript differ at $P < 0.05$ between genotypes and at $P < 0.01$ between seasons.

Liver copper levels (mg per kg dry matter) were somewhat higher in *ChAs* (415 ± 36, S.E. of mean, n = 23) than in *Assaf* (352 ± 27, n = 22) (NS). Kidney copper levels were 21.55 ± 1.78 and 20.5 ± 2.09, respectively.

IV. Discussion

A. *Performance of the pure Chios ewes*

The present results should be regarded as preliminary, due to the small number of individuals involved. Furthermore, there may have been carryover effects of the different system under which they were raised, which must be considered when comparing them with the *Assaf* or its crosses. There could be differences between *Chios* sheep coming from Cyprus compared with the original Greek population. There are no published data to support such an assumption.

The reproductive performance of the *Chios* ewes was within the range of previously published results (MASON, 1967 ; ZERVAS *et al.*, 1975). It is difficult to compare the milk production records with those reported in the literature due to differences in the mother-offspring management, i.e. concurrent milking and milk-residue suckling in the present work, as against post-weaning milking in most hitherto published reports. Nevertheless, the figures indicate a good potential for milk production, somewhat lower than that of contemporary *Assaf* ewes.

The smaller *Chios* ewes were kept in mixed groups with the *Assaf*. This could have an adverse effect on the expression of their productive capacity. However, it may be assumed that any such adverse effect has been minimized by the *ad lib.* feeding during the critical period of peak milk production in the first few weeks post-partum.

Growth rates of *Chios* lambs were significantly lower than those of *Assaf* or the *ChAs*. It is worth noting that HADJIPANAYIOTOU (1982) is the only one who reported daily gains in *Chios* lambs similar to those recorded here, when the lambs were fed on concentrate mixtures which also were similar to ours in their composition.

B. *Performance of* Chios × Assaf *crossbreds*

None of the differences between the *ChAs* and *Assaf* ewes or lambs was statistically significant. However, the trends which are evident seem to indicate that the *Chios* parent contributed a little to lambing rate, which may have been partly marred by a somewhat longer lambing interval. *ChAs* lambs grew at the same rate as *Assaf* lambs, rather than being intermediate between the two parent breeds. This may be indicative of heterosis. However, it could also be a result of the fact, at least in spring-born lambs, that the *Assaf* — due to its *East-Friesian* component — suffered from a higher rate of respiratory difficulties (table 5), and therefore could not express its full genetic potential. In a previous report (SHIMSHONY, 1983) *East-Friesian* lambs, on the same farm and under similar management conditions, were shown to have been severely affected by pneumonia. The main pathogens involved were *P. haemolytica, P. multocida* and, to a lesser extent, mycoplasma, chlamydia, coliform bacteria and

P.I.3 virus. It is generally believed that pneumonia in lambs is related etiologically to a combination of various infective agents and stress factors (BIBERSTEIN, NISBET & THOMPSON, 1967 ; STEVENSON, 1969). The higher lung infection rate in spring-born *Assaf* lambs in the present observation may reflect the greater climatic-stress during the hot summer months in Israel. BOYAZOGLU, CASU & FLAMANT (1979), working with a cross of the *East-Friesian* breed and *Sardic,* another *Mediterranean* breed, likewise reported a considerably increased incidence of pneumonia in the crossbred lambs.

It is noteworthy that the 150-days' weight of lambs of all genotypes did not differ in spring-born lambs compared with those born in autumn, in spite of the slightly retarded growth during early life of the spring lambs. This is in agreement with GOOT *et al.* (1984), who reported that the growth rate of Finn-cross Lambs was not depressed when the growing period extended over late summer, when temperatures — although still high — were gradually declining.

V. Conclusions

It may be concluded that the *Chios* cross has contributed subtle improvements to prolificy and health to the *Assaf,* but at the cost of loss in milk production and an enlargement of the fat tail. Nevertheless, the *Chios* has been shown to be a breed of high potential production and may have some advantages over the *Assaf* under less protected conditions than in the present study, or under grazing conditions. However, it should be borne in mind that the *Chios,* itself, has been shown to be insuitable for extensive husbandry (MAVROGENIS & LOUCA, 1980).

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Résumé

Comparaison des performances de brebis Chios *et* Assaf
et de leurs croisements en programme intensif en bergerie - Résultats préliminaires

Dix agnelles et 3 béliers de race *Chios* ont été importés de Chypre au troupeau expérimental de Newe Yaar et leurs performances ont été comparées à celles de leurs 49 contemporaines de race *Assaf (Awassi × Frisonne de l'Est),* menées en programme intensif. Les productivités numériques (agneaux/brebis/agnelage) des brebis *Chios* et *Assaf* dans la première et dans les seconde à cinquième années ont été respectivement de 1,89 et 1,42 ($P < 0,01$), et $2,10 \pm 0,10$ et $1,69 \pm 0,02$ ($P < 0,03$). La production de lait par lactation a été 206 ± 30 et 225 ± 16 (NS) et 269 ± 31 et 345 ± 22 kg, respectivement pour les deux races. Les différences entre les deux races des intervalles des agnelages et de la mortalité des agneaux n'étaient pas significatives.

On n'a pas trouvé de différence statistiquement significative entre les 47 brebis *Assaf* et les 35 brebis *Chios* × *Assaf*, concernant l'âge au premier agnelage (435 ± 8,7 et 428 ± 9,5 jours), le taux d'agnelage (96), l'intervalle d'agnelage (280 ± 5,1 et 293 ± 11,4 jours), le poids adulte (80,5 ± 2,43 et 77,4 ± 1,72 kg), la prolificité (1,40 et 1,59 au premier agnelage, 1,71 et 1,75 du second au cinquième agnelages), le taux de mortalité des agneaux (9,9 ± 4.22 et 12,2 ± 5,69 p. 100) ou la production de lait par lactation (211 ± 12 et 192 ± 14 kg). Les productions annuelles de lait de la seconde à la cinquième lactation ont été 270 ± 18 et 219 ± 16 kg, respectivement ($P < 0,05$).

Les vitesses de croissance ont été comparées chez des agneaux d'automne et de printemps trois années consécutives : 32 agneaux *Chios*, 557 *Assaf*, 155 *ChAs* et 40 *As* × *ChAs* ont participé à cette comparaison en automne et 20 *Chios*, 293 *Assaf*, 85 *ChAs* et 57 *As* × *ChAs* au printemps (tabl. 3).

La croissance des agneaux *Chios* et leur poids à 150 jours ont été inférieurs à ceux des agneaux *Assaf*. On n'a pas trouvé de différence entre les gains journaliers des *Assaf* et ceux des croisés.

Les rendements en viande, exprimés en pourcentage du poids vif (48,9 et 47,8 kg) des *Assaf* et *ChAs* ont été 47,6 et 47,4 (NS) de carcasse chaude, 1,36 et 2,03 ($P < 0,002$) de queue, 3,55 et 3,78 (NS) de reins et gras caudal.

Le score d'infection pulmonaire (échelle 0-4) à l'abattage a été de 1,46 et 1,88 (NS) pour les agneaux *Assaf* et *ChAs* nés en automne, et 1,20, 2,88, 2,10 ($P < 0,05$) pour les agneaux *Chios*, *Assaf* et *ChAs*, respectivement, nés au printemps.

Aucune différence n'a été notée concernant la sensibilité aux troubles métaboliques : intoxication par le cuivre, ou urolithiase, dans les conditions décrites.

Mots clés : Brebis, Chios, Assaf, *croisements.*

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