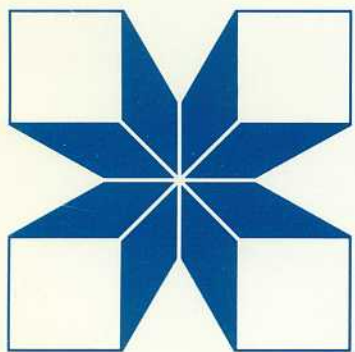


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**SMALL RUMINANTS  
RESEARCH  
AND DEVELOPMENT  
IN THE NEAR EAST**

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# CROSSBREEDING FOR IMPROVING FECUNDITY IN NATIVE SHEEP

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## ABSTRACT

This review deals with crossbreeding experiments conducted at different research organization in subtropical countries which involved prolific crossed with native breeds of sheep. The Finnsheep and Romanov originated in temperate regions have been intensively used for crossing in Egypt, Israel and Cyprus. Chios and D'man are two prolific breeds originated in subtropical countries and the first has been widely used in crossbreeding in Cyprus, Lebanon, Iraq, Israel, Turkey and Egypt. Crossing prolific with native breeds resulted in an improvement ranging between 29% (Rahmani) to 4% (Assaf) in the crossbreds over the purebred native (Avg. 17.4%). When compared with mid-parent average the crosses were 8% inferior. The increase in performance by crossing with prolific breeds was lower in subtropical countries than in temperate countries. Available results on the performance of other combinations i.e.  $< 1/2$  and  $> 1/2$  prolifics are presented.

## INTRODUCTION

In the dry subtropical regions (e g. near and middle east) the tradition has been to raise sheep under extensive production system. However, with the deterioration of natural pastures and changes in socio-economic conditions which increased demand for meat, other alternative systems such as crop-sheep production and small unit production (small holder) are increasingly playing significant roles. Local sheep breeds in the dry subtropic regions are hardy and well suited for the extensive system but their fecundity is rather limited. A high level of fecundity is needed in intensive systems to improve economic efficiency of sheep production. Improving fecundity in native sheep by intrabreed selection has a very limited success mainly

because the heritability of related traits is low and the lack of long term plans. Crossing among native breeds to capitalize on heterosis had a limited success. With the recent availability of a number of prolific breeds, the possibility of fast improvement in fecundity in native breeds by crossbreeding with such prolific breeds becomes apparent. The objective of this report is to review some of the recent research conducted in subtropical countries in crossing prolific with native breeds.

### Finnsheep

Finnsheep was the first prolific breed to be introduced in the region. A private breeder in Algeria imported the first shipment in 1969. Other importations to Egypt and Israel (1970), Cyprus (1972), Iraq (1973), Lebanon (1974) and Libya (1979) followed. Large scale crossbreeding experiments with Finnsheep were carried out in Egypt and Israel while those conducted in Cyprus and Lebanon were rather limited in size and scope (Aboul-Naga, 1988).

The study conducted by the Egyptian Ministry of Agriculture involved F<sub>1</sub> ewes from Finnsheep with local Rahmani and Ossimi, backcross ewes to the local and backcross ewes mated inter se under an accelerated mating system of lambing each eight months (Aboul-Naga et al. 1988). The crosses were 10% higher than the purebred locals in fertility, the F<sub>1</sub> averaging 27% higher in prolificacy and 38% higher in yearly lamb production. The corresponding figures for backcrosses were 10 and 23%, and for backcrosses mated inter se 8 and 18%, respectively. However, when calculating the deviation of the crosses from the appropriate means of the two parental breeds, both first crosses and backcrosses showed negative values in prolificacy (around 10%). Under accelerated lambing system, the crosses produced an average of 1.16 litters per year compared to 1.07 for the local breeds and only 0.78 litters for the Finnsheep. As a result of the accelerated lambing ability of the Finn crosses and the rather poor ability of the pure finnsheep to cope with such system under subtropical conditions, the crosses produced about 11% more lambs per year than the appropriate average of their parental breeds.

In another crossbreeding study conducted in Egypt (Zahed, 1988) the local Rahmani and Ossimi breeds in addition to the Barki were crossed with Finnsheep. The F<sub>1</sub> crosses of Rahmani and Ossimi gave similar trend to that reported by Aboul-Naga et al. (1988). The cross of Barki excelled in fertility and yearly lamb production (30 and 53% above pure Barki respectively).

In Israel, the Finnsheep were crossed and backcrossed with both Mutton type Merino (another imported breed) and the local Awassi. The F<sub>1</sub> Finn-Awassi ewes were either bred inter se, backcrossed to Finnsheep or crossed with Assaf breed (Goot et al 1984). The first cross Finnsheep x Awassi and the backcross 3/4 Finn 1/4 Awassi, both averaged two lambs per litter and 1.4 litters per year with fertility of 80% or better. Both crosses averaged close to 3 lambs per ewe per year. The Finnsheep x Awassi cross bred inter se and the Assaf cross produced at a lower level, yet compared to the average productivity of local breeds in the region, the performance can be considered satisfactory.

The study conducted in Cyprus, crossing Chios with Finnsheep, also involved accelerated lambing (Cyprus Agriculture Research Institute, 1980). Prolificacy in the cross was 2.88 lambs, 35% higher than in the Chios. Both genetic groups were subjected to a twice per year lambing system but succeeded in producing only 1.2 litters per year.

### Romanov

The Romanov breed was imported from France by Israel (1975) and Egypt (1982 and 1985). The first importations in both countries were of only males which were crossed with Mutton Merino and Awassi in Israel and with the Rahmani in Egypt. In both countries similar crosses with Finnsheep were available and a comparison between the crosses of the two prolific breeds were made under accelerated lambing systems. The Romanov crosses were generally superior to the Finn crosses in fertility and overall productivity (Table 1). However, little difference (1.6%) was observed between respective crosses of the two prolific breeds in prolificacy in both trials. In Egypt and Israel, the first Romanov cross produced 16.7 and 8.1% more lambs per ewe per year than Finn sheep crosses, respectively (Aboul-Naga, unpublished data and Goot et al. 1979). Both first crosses produced at a level much higher than pure indigenous breeds in the region. The two trials are continuing to evaluate other Romanov crosses vs Finn and locals.

### Chios

Although the Chios sheep have been recognized as one of the prolific subtropical breeds for at least three decades, their importance for improving sheep production in the subtropics became apparent only recently when the other prolific breeds from temperate areas (Finnsheep and Romanov) failed to adapt adequately (as pure breeds) to the conditions of the subtropical countries.

TABLE 1

Contemporary comparisons between Romanov (R) and Finnsheep (F) crosses under accelerated lambing systems in two Near East countries.

	with Awassi+			with Rahmani++		
	R	F	R-F/F%	R	F	R-F/F%
Lambs born/ewe exposed	1.86	1.54	20.8	1.31	1.12	17.0
Lambs born/ewe lambing	1.96	1.93	1.6	1.57	1.51	4.0
No of lambing/year	1.43	1.35	5.9	1.25	1.11	12.6
Lambs born/ewe exposed/year	2.81	2.60	8.1	1.96	1.68	16.7

+ Goot et al. (1979)

++ Aboul-Naga (unpublished results)

Cyprus was the first country to import Chios sheep from its home island of Chios, Greece in 1954 followed by other large importation, (Lysandrides, 1981). In Cyprus, the Chios are raised pure and also crossed with Cyprus Fat-tailed sheep (CFT), Awassi and on a smaller scale with Finnsheep and East Friesian. Chios sheep were imported into Israel, Lebanon, Turkey, Oman, Iraq and Egypt to cross with indigenous breeds. Most of these importations took place recently and the results on the crossbreeding with Chios have just started to appear in the literature (Table 2).

A comparison between Chios and Cyprus fat tailed sheep was reported in 1974 (Cyprus Agriculture Research Institute). The Chios exceeded the native breed by 10% in fertility, 48% and 40% in number of lambs born and weaned per ewe exposed, respectively. Mavrogenises (1985) reported on a crossbreeding experiment between Chios and Awassi sheep in Cyprus. The two reciprocal F<sub>1</sub> exceeded the Awassi by 14 and 18% in prolificacy and 13 and 22% in lamb production at birth and weaning, respectively. However, when compared with mid-parent averages, the crosses were lower (-11% at birth and -5% at weaning) in prolificacy and lamb production at birth (-1.6%) and only lamb production at weaning was little heavier (7.1%).

Chios sheep were crossed with Awassi in Lebanon (Fox et al. 1977). Fertility of both Chios and Awassi was high and similar in the two breeds. F<sub>1</sub> ewes averaged 1.42 lambs, 38% more per ewe exposed than the Awassi but 20% less than the pure Chios (1% more than mid-parent average). The performance of F<sub>2</sub> was close to that of pure Awassi. Chios had 60% multiple births compared to 36% for F<sub>1</sub> and 14% for

Awassi. Lamb mortality in the Chios was higher, however, than in Awassi (25 vs 12%).

TABLE 2

Reproductive Performance of Chios sheep and their crosses in the Near East.

Country	Native breed	Trait	Native	F <sub>1</sub>	Chios	Reference
Cyprus	CFT	EL/EE*	0.78		0.86	(CARI 1974)
		LB/EE	0.89		1.32	
		LW/EE	0.83		1.16	
	Awassi	LB/EL	1.07	1.28	1.69	(Mavrogenises 1985)
		LW/EL	1.03	1.27	1.54	
	Finn	LB/EL/yr	2.88	2.13	1.89	(CARI 1980)
LW/EE/yr		2.88	1.00	1.59		
Lebanon	Awassi	EL/EE	0.95	0.95	0.93	(Fox et al 1977)
		LB/EE	1.60	1.68	1.96	
		MB%	14.0	36.5	60.0	
Israel	Assaf.	EL/EE	0.95		0.97	(Eyal et al 1986)
		LB/EL	1.69	1.75	2.10	
		LM	10.1	12.2	10.2	
		LIN	294	293	304	
Turkey	Karayka	LB/EE	0.83	0.91		(Ariturk et al 1987)
		LB/EL	1.09	1.30		
Oman	Awassi	EL/EE	0.86		1.0	(Steele 1983)
		LB/EL	1.44		1.83	
Iraq	Awassi	LB/EL	1.01	1.30	1.46	(Badawi et al 1983)
		LM	16.8	7.1	13.3	
Egypt	Ossimi	EL/EE	0.90		0.90	(Aboul-Naga, Unpublised data)
		LB/EL	0.95		1.77	
		LB/EL	1.05		1.96	
		LM	8.0	6.7	12.6m	

\* EL : ewe lambed, EE: ewe exposed, LB : lambs born,  
 LW : lambs weaned, MB : multiple births, LM : lamb mortality,  
 LIN : lambing interval in days

Results on crossing Chios with Awassi sheep were reported in Iraq (Badawi et al. 1983). The F<sub>1</sub> ewes exceeded the Awassi in litter size by 30% and exceeded the average of the two pure breeds by 5%. Lamb mortality at birth was similar in Awassi and F<sub>1</sub> ewes at 7% which was close to half that of Chios at 13%. The percentage of lambs weaned of those born was 87% for crossbreds, 83% for Awassi and only 30% for pure Chios.



Chios sheep were also crossed with Awassi in Oman (Steele, 1983). No results on the performance of the crosses compared to the purebreds are yet available. The Chios showed a superiority over Awassi in fertility (100 vs 86%) and prolificacy (1.83 vs 1.44).

In Israel, the Chios sheep were crossed with the Assaf breed which is itself a cross between East Friesian and Awassi (Eyal et al 1986). The Chios-Assaf crossbred ewes averaged 1.75 lambs (per ewe lambing), 12% lamb mortality, 1.71 lambs and 10% for the Assaf. The authors reported an advantage of 33 and 24% in favour of Chios over the Assaf in prolificacy of yearling and older ewes, respectively. On the other hand, the Assaf exceeded the Chios and the cross in milk production.

In Turkey, the Chios and Ile de France breeds were crosses with the Karayka sheep native to Turkey. The Chios cross had 8% better fertility and 19% better prolificacy than the Ile de France cross (Ariturk et al. 1987).

The Chios sheep were also imported into Egypt and crossed with the native Ossimi breed. Both pure breeds had a high fertility of 90%, but the Chios was more prolific than the Ossimi (1.96 vs 1.05 lambs, Aboul-Naga, unpublished data). Information on the reproductive performance of the crosses as compared to the pure breeds is not yet available.

### **The D'man Sheep**

The D'man breed originated in an oasis south of the Atlas Mountain in Morocco was reported to be highly prolific with short lambing interval (Lahlou-Kassi and Marie, 1985). So far, it is the only breed originating from arid regions to be recognized as prolific. Its importance is that the sheep are adapted to the harsh and adverse conditions of the region.

Unfortunately, none of the countries in the Near East has imported the D'man, thus all the information on the D'man and its crosses with other breeds come only from its native country, Morocco, and the adaptability and performance of the breed under other environments has yet to be tested.

A crossbreeding experiment with the Sardi Mountain breed was conducted under accelerated lambing system of four lambings in 30 months (Lahlou-Kassi et al. 1988). The crossbred ewes had 41% more ova at 10 months and 76% more at 20 months than the pure Sardi, however, when compared with mid-parent average the cross was 4 and 13% inferior at the two ages, respectively. Prolificacy in the cross was 22 and

69% higher than the Sardi but -2 and 11% higher than mid-parent average, for the two ages, respectively. In other Moroccan studies involving the D'man and Timahadit breeds, the F<sub>1</sub> cross produced 14% more lambs born per ewe than the pure Timahadit under a one lambing per year system (Hassan II, 1981) however, when subjected to an accelerated lambing

system in a second experiment, the F<sub>1</sub> cross produced 24% more lambs than the Timahadit but 9% less than the average of the two parental breeds.

#### Other prolific breeds with possible use in subtropical regions

East Friesian sheep were imported into Israel and Cyprus and crossed with Awassi and Chios, respectively, in an attempt to improve both reproduction and milk yield. (Eyal et al., 1974) reported that the annual lambing rate averaged 1.23 for Awassi compared to 2.20 for East Friesian x Awassi in ewes on accelerated lambing management and hormone treatment.

Mason (1967) reported on other prolific breeds of sheep originating in the subtropics which included the Omani sheep of Oman, the Hy-Yang of China and Svanka of USSR. No information is available on these breeds, and their importance seems to be of local nature. So far none of these breeds was examined under other environments or was crossed with other breeds.

The Barbados Blackbelly originated in Barbados and is presently available in many Central American countries, and in USA is another prolific breed with many potentials for the subtropics. Litter size was reported at 2.0 lambs in Barbados (Patterson, 1976). In over 1000 litters, 26% were singles, 47% twin and 22% triplets. In USA the Barbados were crossed with Dorset, Rambouillet and Targhee (Bradford and Quirke, 1986). The crosses performed at higher levels than the pure American breeds. However, the use of Barbados sheep in crossbreeding with native Near East breeds is not foreseen in the near future.

The discovery of the major fecundity gene (F) in the Booroola Merino, and possibly in other breeds, may add new dimension in improving fecundity in sheep breeds, including those in the subtropics. Crossbreeding to introduce the fecundity gene then backcross to the native breed to capitalize on the super adaptability of the latter while maintaining the gene (F) may become an alternative method to increase fecundity in subtropical breeds.



## DISCUSSION

The use of prolific breeds of sheep and their introduction into many countries to improve the prolificacy of native sheep produced information on the performance of different

crosses of prolific x native sheep. An intensive review of experiments conducted in temperate countries was published by Jakubec (1977) and for those involving only Finnsheep, by Maijala (1984). Table 3 presents the superiority of first

**TABLE 3**

Superiority of F<sub>1</sub> ewes over native and mid-parent in temperate and subtropical countries.

Native x Prolific	Native mean	% over native	% over mid-parent	Reference
<b>A: Temperate</b>				
Mutton Merino x Finn	1.34	29.1	-1.7	after Jakubec (1977).
Mutton Merino x Rom.	1.34	36.6	0	
Berrichon x Rom.	1.27	50.4	3.8	
Roma x Berrichon	1.27	44.0	0	
Ile de France x Rom.	1.63	33.1	---	
Galway x Finn.	1.40	42.8	2.6	
Blackhead x Finn.	1.56	35.9	7.6	
Merino L x Finn.	1.23	49.6	---	
Blackhead x Finn	1.41	56.7	---	
Ile de France x Finn.	1.86	40.0	5.2	Visscher (1986).
3 US breeds x Finn.	1.19	39.5	-1.8	Oltenacu and Boylan
DLS x Finn.	1.44	47.2	-1.4	Fahmy and Dafour (1988).
Unweighted means		40.7	1.6	
<b>B. Subtropics</b>				
Rahmani x Finn.	1.31	28.2	-10.2	Aboul-Naga et al. (1988).
Ossimi X Finn.	1.22	24.6	-16.7	
Awassi x Finn.	1.00	30.0	---	Goot et al. (1976).
Assaf x Chios	1.69	3.6	- 7.6	Eyal et al. (1986).
Awassi x Chios	1.01	28.7	5.3	Badawi et al. (1963).
Awassi X Chios	1.03	37.8	0	Fox et al. (1977).
Awassi x Chios	1.07	14.5	-11.2	Mavrogenises (1985).
Unweighted means		23.9	-6.5	

cross over the native breed and its deviation from mid-parent average in temperate and subtropical regions. It can be observed that in all the studies the cross average exceeded that of the native breed by as much as 57% in temperate and 38% in subtropical regions. The average superiority of the cross was 41% for temperate but only 24% for subtropical regions. The corresponding estimate for the deviation of the cross from mid-parent were 1.6 and -6.5% respectively.

The performance of the crosses in subtropical regions was markedly lower than that expected assuming additive gene action. The review of Maijala (1984) and the study of Fahmy and Dufour (1988) indicated that ovulation rate and subsequently litter size increase almost linearly with increase in Finnsheep breeding and that these characters showed small, or no heterosis at all. With limited studies available from subtropical region on ovulation rate or embryonic mortality it is difficult to speculate whether the lower prolific performance in prolificacy of the crosses is a result of lower ovulation, limited uterine capacity or higher embryonic mortality. Lahlou-Kassi and Marie (1985) stated that D'man breed does not seem to possess a greater uterine capacity than other non-prolific breeds and that embryonic survival was low, 72% for monoparous and 59% for multiparous D'man ewes.

In most subtropical countries, the introduction of prolific breeds was to develop composites suitable for the prevailing conditions. The tendency has been to reduce the prolific proportion to no more than fourth. Most of the studies on these composites are still going on, preliminary results indicate that the composites are well adapted to local conditions and produce higher than pure local breeds.

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