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Performance traits of purebred Ossimi and Rahmani lambs and their crosses with Finnsheep born under two accelerated mating systems

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Abstract

The aim of the study was to carry out crossing of the local breeds with a known prolific breed with the hope to be a beginning to develop improved synthetic lines under the sub-tropical conditions. In the present study, the data represented 4 genotypes: 2 pure Egyptian local fat-tailed breeds [Ossimi (O) and Rahmani (R)], one back-cross [1/4 Finnish Landrace (F) 3/4 O] and one 3-breed-cross [1/4 F 1/4 O 1/2 R]. The lambs resulted from two accelerated systems: 3 lambings/2 years and 2 lambings/1 year.

The results showed that in 3 lambings/2 years and 2 lambings/1 year systems, the crossbred lambs were significantly ($P<0.01$ or 0.05) higher in most of the growth traits, carcass characteristics and weight of ewe lambs at first mating, and were significantly ($P<0.01$) lower in percentages of the tail and bone and age of ewe lambs at first mating than in their maternal (local) breeds.

Spring born lambs were significantly ($P<0.01$ or 0.05) higher than those born in the other seasons of the year in body weights at 16 and 24 weeks of age and daily gain weight during 0-<8 weeks in 3 lambings/2 years system, and in daily gain weight during the period 8-<16 weeks of age in 2 lambings/1 year system.

When using some indices based on combining a number of economic traits of the study (including slaughter weight, feed efficiency, dressing percentage, percentage of lean in the carcass, conception rate, lambing rate and average litter size) to compare the crossbreds with the local ones, the obtained values were not in favour of the crossbreds, which may throw some shadows on feasibility of applying crossing of the Egyptian local sheep with the Finnsheep.

Comparison between the two mating systems showed that the 3 matings/2 years surpassed the 2 matings/1 year system in all the indices developed. When calculating the productive efficiency per one year by combining the traits: survivals ratio – that equals: 1–(mortality rate at 8 weeks) – and frequency of lambing per one year, the values were 15.0 and 13.2 % in the two systems, respectively, confirming the previous results.

Keywords: carcass, crossbreds, Finnsheep, growth, mating systems, Ossimi, Rahmani, reproductive traits, trait indices

Zusammenfassung

Leistungsmerkmale von Lämmern der Rassen Ossimi, Rahmani und deren Kreuzungen mit Finnschafen bei zwei unterschiedlichen Paarungssystemen

Untersucht werden die Ergebnisse von Kreuzungen einheimischer Fettschwanzschafrassen und dem als fruchtbar bekannten Finnschaf (F) mit dem Ziel der Schaffung einer synthetischen Linie unter subtropischen Bedingungen. Es konnten die Daten von 4 Genotypen genutzt werden nämlich Ossimi (O), Rahmani (R), Rückkreuzungen (1/4 F, 3/4 O) und Tiere aus der Dreiwegkreuzung (1/4 F, 1/4 O, 1/2 R). Verglichen wurden die Paarungssysteme nämlich drei Lammungen in zwei Jahren (II) sowie zwei Lammungen in einem Jahr (I). In beiden Systemen erreichten die Kreuzungstiere signifikant bessere Ergebnisse in den Wachstums-, Schlachtkörpermerkmalen und den Mutterschafgewichten bei der ersten Paarung sowie geringere Anteile von Schwanz und Knochen verglichen mit den Reinzuchttieren. Die Körpergewichte der im Frühjahr gegenüber in anderen Jahreszeiten geborenen Tiere im Alter von 16 bzw. 24 Wochen lagen signifikant höher. Die tägliche Zunahme in den Wochen 0 bis <8 lag beim System II und in den Wochen 8 bis <16 bei System I am höchsten. Bei der Bewertung der Ergebnisse mittels einiger Indizes welche wichtige ökonomische Merkmale beinhalten wie Futtereffizienz, Schlachtgewicht, Ausschlachtungsanteil, Fleischanteil, Konzeptionsrate, Ablammrate oder Wurfgröße schneiden die Kreuzungstiere nicht immer günstiger als die Reinzuchttiere ab. Beim Vergleich der Paarungssysteme waren die Ergebnisse der Indizes sowohl bei den einzelnen Merkmalskomplexen als auch in der gesamten Produktionseffizienz beim System II stets besser.

Schlüsselwörter: Schlachtkörper, Rassenkreuzung, Finnschaf, Wachstum, Paarungssystem, Ossimi, Rahmani, Fruchtbarkeitsmerkmale, Merkmalsindizes

Introduction

Improvement of the local, late mature (poor growth) unprolific Egyptian fat-tailed sheep could be achieved by reducing age at first mating and increasing each of litter size and frequency of lambing (through their ability to breed at different times of the year).

In 1974, the Egyptian Ministry of Agriculture started a crossbreeding program to improve the productivity of two native sheep breeds: Rahmani (R) and Ossimi (O) through crossing with Finnsheep (F). The breeding plan was to mate F rams to both R and O ewes to produce half-breds (FR and FO), respectively, which were used to produce both reciprocal back-crosses, (RFR and FRR) and (OFO and FOO), respectively, to be inter se mated. However, the results were conflicting. ABOUL-NAGA (1988) showed that crossbreeding increases 31 and 25% in the number of lambs/ewe/year in (3/4 F 1/4 O) and (1/4 F 3/4 R), respectively, than in the local breeds. Meanwhile, GALAL *et al.* (1996) concluded in their study on [1/4 F 3/4 L (Local)] ewes raised under the Egyptian small-holder sheep production system for a period of 2 years, that the introduction of Finnsheep genetics did not improve the performance of the local sheep. Similarly, ALMAHDY *et al.* (2000) found that breed type rankings changed depending on the measure of evaluation which was biological efficiency or profit. The latter study was achieved on F_1

[1/2 F 1/2 R (FR)] and 1/2 F 1/2 O (FO)], and inter se matings of [1/4 F 3/4 R (RFR)] and [1/4 F 3/4 O (OFO)] crosses.

From another point of view, in the studies on the mating systems, ALMAHDY *et al.* (2000) found that the profit values for FR and RFR were 42 and 6% higher in one mating per year (1M) than in three matings per 2 years (3M), while profit values for all other genetic types were 4 to 8% greater in 3M than in 1M. The same authors concluded that genetic stocks should be matched to resources and management systems when evaluating life-cycle performance of flocks of O and R and their crosses with F in the two mating systems.

Generally, the above results showed significantly higher prolificacy for crossbreds on station, and insignificant difference in either prolificacy or economic return on-farm trials with (1/4 F, 3/4 L).

Due to such contradiction in the results, a project was carried out in the Department of Animal Production, Faculty of Agriculture, Zagazig University, Zagazig, Egypt, in order to evaluate the Ministry of Agriculture trial.

The objectives of this investigation were to study growth of male lambs from birth to 24 weeks of age and efficiency of feed utilization, growth and some carcass characteristics of male lambs fattened between 20 and 50 weeks of age, reproductive performance of ewe lambs at first mating and development of some indices to evaluate the results. The data represented four genotypes: two pure Egyptian local fat-tailed breeds (O and R), one back-cross (1/4 F 3/4 O) and one 3-breed-cross (1/4 F 1/4 O 1/2 R). The lambs were produced from two accelerated systems (3/2 or 2/1 lambings/year).

Material and methods

Animlas were kept in the Department farm located in east of Nile Delta (30.5° N) and the lab work was conducted in the Department Labs.

A total of 271 matings were used in 2 breeding systems; 177 at 3 lambings/2 years during May, January and September, and 94 at 2 lambings/1 year system during May and November. Ossimi (O) and Rahmani (R) dams of 4.0-4.5 years, were used. Each type of dams was divided randomly into two groups (4 groups in all). Each group comprised of 10-25 ewes at the start of each mating season. Mating was carried out by running fertile rams of 3-4 years old of each of O, R and 1/2 F 1/2 O breed types. The ewes that did not conceive were remated and included in the same group. The matings which were carried out were O × O, R × R, FO × O and FO × R. The numbers of lambs born were 153 singles, 24 twins and 3 triplets (total 210), of which 101 were males and 109 were females. The obtained offspring were O, R, (1/4 F 3/4 O) and (1/4 F 1/4 O 1/2 R). All lambs were kept with their dams till weaning which was carried out at 8 weeks of age for lambs born in 3 lambings/2 years system and at 2 weeks of age for those born in 2 lambings/1 year system. The growth data was carried out on single-born lambs only (n=153 : 101 at 3/2 and 52 at 2/1 lambings/year) and their weights were recorded at birth, 8, 16 and 24 weeks of age.

When the male single lambs reached 20 kg live weight, a total number of 71 animals of which 29 O, 16 R, 16 (1/4 F 3/4 O) and 10 (1/4 F 1/4 O 1/2 R) were fattened between 20 kg until they reached 50 kg live weight. The number of lambs was 50 in 3 lambings/2 years system and 21 in 2 lambings/1 year system. Slaughter test was carried out on 3 lambs from each male group in each of the two mating systems, i.e. 24 lambs in total.

Early breeding of ewe lambs was firstly tried by running FO rams when the ewe lambs were 6 months old. The numbers of ewe lambs matings were 44 and 27 in 3 lambings/2 years and 2 lambings/1 year systems, respectively. Weight and age of ewe lambs at first mating were recorded.

Using FO crossbred sires on a national scale by Ministry of Agriculture for mating the domestic flock ewes was due to that the studies showed that varying proportions of germ plasm from highly prolific breeds such as the Finnsheep can be realized through the use of crossbred sires to set reproductive rates at desired levels. In other words, the use of composite F_1 sires can be used as effective method to optimize the additive breed effects to a great extent. The same studies showed that the progeny of crossbred and purebred sires were similar in weights at birth and weaning, post-weaning growth rate and in phenotypic variation for these growth traits (LEYMASTER 1987).

The dams were fed 500 g co-op feed mixed with chopped wheat straw in the morning and green Egyptian clover (*Trifolium alexandrinum*) *ad libitum* in the afternoon during the green season (November-May), whereas 750 g of the same co-op and hay *ad libitum* were offered during the remaining period of the year (June-October). Each kilogram of co-op consisted of 280 g undecorticated cottonseed meal, 420 g wheat bran, 210 g ground maize, 30 g rice bran, 30 g molasses, 20 g limestone and 10 g common salt. The rams used for breeding were given 750 g co-op in addition to the above mentioned roughages *ad libitum* during the same seasons. Hay and co-op were introduced for lambs after 10 days of age. Before and after weaning, the lambs were fed *ad libitum* on ground co-op mixed with green Egyptian clover in autumn season or hay in spring and summer seasons in group feeding. The males fattened between 20 kg live weight and 50 weeks of age, were fed *ad libitum* on TOMMI Standards (1963) according to their body weights. The ingredients given were co-op feed, corn, Egyptian clover and common salt. The standards fed were 500, 200, 200 and 5 g for groups of animals averaged 20-<30 kg, 600, 300, 300 and 5 g for those averaged 30-<40 kg and 750, 400, 400 and 8 g, respectively, for those of average weight of 40-<50 kg. The nutritive values for the three groups of animals were 0.52, 0.69 and 0.98 as starch equivalent, 4.16, 5.52 and 7.84 as net energy (MJ/kg DM) and 87.27, 114.62 and 147.40 digestible crude protein (g/kg DM), respectively. The digestible protein was estimated according to ABOU-RAYA (1967) and net energy was calculated assuming that net energy for starch is 80 MJ/kg DM according to EL-MASRY and MARAI (1991). The estimated nutritive value of co-op feed was 58.99% starch equivalent and 10.853 digestible protein. The feeds were offered twice daily. Mineral blocks and access fresh water were available two times daily. When fattening the males, feed refusals were collected, weighed and recorded daily before morning feed.

All sheep were housed in semi-open sheds and were under the same managerial and environmental conditions and were kept, maintained and treated in adherence to accepted standards for the humane treatment of animals. The animals were healthy and clinically free of external and internal parasites.

Sheep were shorn twice a year (during March and September).

When mating, oestrous synchronization of all ewes was carried out by injection of 1 mm of Prosolvin (1 ml contained 7.5 mg Leuprastion; PGF2a) intramuscularly. Mating was carried out naturally after 2 h from appearance of heat symptoms. Ewes that lambed in 2 lambings/1 year system were injected again approximately 30 days *post partum*.

Before slaughter of the fattened male lambs, fasting was carried out for overnight (12 h). Weights of slaughter, hot carcass, organs and offals, were recorded. The weight of the full digestive tract and its content were also determined to facilitate the calculation of empty body weight. The hot carcasses were dejointed into the following wholesale cuts: legs, loin, rack, shoulder, neck, flank brisket and tail. The first four cuts were considered as prime cuts, while the latter four were considered as the secondary cuts. The *longissimus dorsi* muscle and fat thickness at 9th, 10th, and 11th rib were determined in duplicates by tracing on semi-transparent waxed paper by a polar planimeter. The chilled 9th, 10th, 11th rib cuts were dissected into their physical composition: lean, fat and bones and percentage of each was calculated. Dressing percentage was calculated as (hot carcass weight/slaughter weight)·100. The weights of lean meat, fat and bone in the carcass were estimated according to FIELD *et al.* (1963) and MOKHTAR (1974).

Statistically, the data were analyzed by 2×2 factorial design using the following model according to SNEDECOR and COCHRAN (1982):

$$Y_{ijl} = \mu + B_i + S_j + BS_{ij} + e_{ijl} \quad (1)$$

where is μ the overall mean, B_i the fixed effect of *i*-th breed type ($i = 1,\ldots 4$), S_j the fixed effect of *j*-th season of birth ($j = 1,\ldots 4$), BS_{ij} the interaction between the *i*-th breed type and *j*-th season of birth and e_{ijl} the random error. Significance was tested by Duncan's New Multiple Range Test (DUNCAN 1955).

Results and discussion

Crossbreeding is used in order to take advantage of better combinations of the best characteristics of two or more breeds, i.e. breed complementarity and to utilize hybrid vigor, which are translated to improvement of survival, fertility, growth and disease resistence.

In this respect, the breeds of sheep can be broadly classified into three groups based on their level of performance for certain traits: ram breeds, ewe breeds, and general purpose breeds. Ram breeds should excel in one or more of the traits of: growth, feed efficiency, carcass merit, and lamb survival. Ewe breeds should have superior levels of performance for one or more of the traits of: adaptability to the production environment, small to moderate body size for lower maintenance costs, non-seasonal breeding, litter size, milk production, mothering ability, wool production, and fleece quality. General purpose breeds have good levels of performance for some ram breed and some ewe breed traits. From the standpoint of breed complementarity, the ideal crossbreeding system would have all market lambs sired by purebred or crossbred rams of the ram breeds and all ewes in the flock would be crossbred ewes of the ewe breeds.

In a 2-way cross breed, improvement occurs in vitality, fertility, health and survival. The 3-way-cross lambs retain many of the characteristics of the sire breed. This crossbreeding system allows large-scale breeding flocks to be established quickly at a lower cost than using local breed ewes (BRIGHTLING and LIGHTFOOT 2000).

Ossimi and Rhamani, are 2 of the 3 major Egyptian sheep breeds (the 3rd breed is named the Barki). They are well adapted to local conditions, small to medium size and have a twinning rate ranging from 1.05 to 1.30. The Finnish Landrace sheep are extremely early maturing and have a very high lambing rate (KALLWEIT and BAULAIN 2001).

Growth performance and carcass traits

Breed type affected significantly (*P*<0.01 or 0.05) live weight of lambs at birth and 8, 16 and 24 weeks and daily gain during the periods 0-<8 and 16-24 weeks of age, in 3 lambings/2 years system (Table 1), while only daily gain weight during the period 8-<16 weeks was significantly (*P*<0.05) affected, in 2 lambings/1 year system (Table 1). Such results were similar to those reported by EL-SHOBOKSHY and ABOUL-NAGA (1978) and ABOUL-NAGA (1985). Within the crossbred lambs, although the body weights at birth were significantly (*P*<0.05) lighter in (1/4 F 1/4 O 1/2 R) than in (1/4 F 3/4 O) lambs, they became nearly equal in body weights at 8 (weaning) up to 24 weeks of age in 3 lambings/2 years system (Table 1). In 2 lambings/1 year system, the differences between the two crossbred groups were not significant, in all the ages studied.

Table 1
Growth performance of pure- and cross-bred lambs from birth until 24 weeks of age in 3 lambings/2 years and 2 lambings/1 year systems
Wachstumsmerkmale in den Lebenswochen

Classification	Initial-weight, kg	Weight, kg at weeks			Daily gain weight, gm at weeks			MR, %
		8	16	24	0-<8	8-<16	16-24	
3 lambings/2 year system								
General mean (A)	3.7 ± 0.1	12.2 ± 0.3	16.6 ± 0.3	21.6 ± 0.3	150.6 ± 4.9	79.6 ± 1.8	88.4 ± 1.8	10.9
Breed type								
Ossimi (O)	3.9^a ± 0.1	12.0^a ± 0.6	16.1^a ± 0.4	20.8^b ± 0.4	147.5^b ± 7.8	74.2 ± 2.9	83.4^b ± 2.4	8.7
Rahmani (R)	3.4^b ± 0.1	10.4^b ± 0.5	14.6^b ± 0.5	19.1^b ± 0.6	122.9^c ± 8.4	76.2 ± 2.5	80.0^b ± 3.6	14.3
1/4 F 3/4 O	4.1^a ± 0.2	13.2^a ± 0.6	18.0^a ± 0.5	23.2^a ± 0.5	161.7^b ± 9.7	85.4 ± 3.5	93.2^a ± 4.5	9.5
1/4 F 1/4 O 1/2 R	3.5^b ± 0.2	13.2^a ± 0.5	17.7^a ± 0.4	23.3^a ± 0.5	174.4^a ± 11.6	82.7 ± 5.3	97.0^a ± 4.1	15.4
Significance	*	**	**	**	**	ns	**	ns
Season of birth								
Autumn	3.8 ± 0.1	13.0 ± 0.6	17.7^a ± 0.5	22.7^a ± 0.6	166.4^a ± 8.7	84.6 ± 3.2	90.7 ± 3.2	8.3
Summer	3.7 ± 0.1	11.3 ± 0.5	15.4^c ± 0.6	20.0^b ± 0.6	135.0^c ± 9.3	73.7 ± 3.9	82.7 ± 4.5	8.3
Spring	3.8 ± 0.1	12.2 ± 0.3	16.7^b ± 0.3	21.8^a ± 0.3	148.6^b ± 6.1	80.5 ± 2.5	91.8 ± 2.1	14.6
Significance	ns	ns	**	**	*	ns	ns	ns
2 lambings/1 year system								
General mean (B)	3.6 ± 0.1	10.8 ± 0.3	13.7 ± 0.3	17.9 ± 0.4	115.2 ± 4.6	64.6 ± 1.1	75.5 ± 1.8	13.5
Breed type								
Ossimi (O)	3.7 ± 0.2	9.8 ± 0.7	13.2 ± 0.7	17.2 ± 0.8	108.3 ± 9.6	61.1^d ± 1.8	71.4 ± 2.9	6.7
Rahmani (R)	3.5 ± 0.2	9.9 ± 0.5	13.5 ± 0.5	17.5 ± 0.6	112.2 ± 8.9	63.1^c ± 1.8	71.8 ± 3.5	25.0
1/4 F 3/4 O	3.7 ± 0.3	10.3 ± 0.4	14.0 ± 0.5	18.5 ± 0.7	118.3 ± 7.0	65.9^b ± 2.2	79.1 ± 5.0	10.0
1/4 F 1/4 O 1/2 R	3.4 ± 0.1	10.3 ± 0.6	14.1 ± 0.6	18.6 ± 0.7	122.2 ± 10.4	68.1^a ± 2.5	79.8 ± 3.0	9.1
Significance	ns	ns	ns	ns	ns	*	ns	ns
Season of birth								
Autumn	3.6 ± 0.1	10.5 ± 0.3	14.3 ± 0.4	18.6 ± 0.4	122.6 ± 5.7	67.8^a ± 1.2	76.7 ± 2.1	7.1
Spring	3.5 ± 0.2	9.7 ± 0.5	13.1 ± 0.5	17.3 ± 0.6	107.9 ± 7.3	61.3^b ± 1.6	74.4 ± 3.2	20.8
Significance	ns	ns	ns	ns	ns	**	ns	ns
B/ A, %	95.4	82.6	82.4	83.0	76.5	81.1	85.5	123.6

MR mortality rate, up to 8 weeks, Means bearing different superscripts within the same classification differ significantly, *P*<0.05. ***P*<0.01, **P*<0.05, ns not significant

In fattened male lambs, breed type showed significant (P<0.05) effect only on final weight in 3 lambings/2 years system. The (1/4 F 3/4 O) and (1/4 F 1/4 O 1/2 R) crossbred lambs were heavier than their maternal breeds with 6.8 and 25.3%, respectively (Table 2). EL-SHOBOKSHY and ABOUL-NAGA (1978) reported that the 50-59% Suffolk crossbred lambs were 17.1% heavier than the Egyptian local lambs. UNAL *et al.* (2006) reported similar results in crossing local Turkish sheep breeds of Kivircik × White Karaman and Chios × White Karaman. However, MOHAMMED *et al.* (2009) reported a contrary trend when comparing between Naeemi (a local strain of the Awassi breed) and Naeemi × Border Leicester Merino crossbred lambs at 5 months of age. Mortality rate was not significantly affected by breed type, season of birth or sex of lambs, in the two lambings systems (Table 1). The variation within each classification was high. In the slaughter traits, the breed type affected significantly percentages of tail, prime cuts, lean meat (P<0.01), eye muscle weight (P<0.05) and bone (P<0.01) in 3 lambings/2 years system. The crossbreds surpassed their maternal breeds in percentages of prime cuts and lean meat (P<0.01 or 0.05), while contrary trends were recorded in percentages of tail and bone (Tables 3 and 4).

Table 2
Performance of pure- and cross-bred male lambs fattened from 20 kg weight to 50 weeks of age as affected by breed type and season of birth, in 3 lambings/2 years and 2 lambings/1 year systems
Wachstumsmerkmale ab 20 kg Gewicht bis zur 50. Lebenswoche

Classification	Initial weight, kg	Final weight, kg	FP, days	Daily gain, gm	FE, kg gain/kg DP
3 lambings/2 years system					
General mean (A)	20.2 ± 0.2	41.3 ± 0.9	198.0	106.9 ± 2.90	1.113
Breed type					
Ossimi (O)	20.2 ± 0.3	40.6^{b} ± 1.0	196.2	103.9 ± 3.4	1.106
Rahmani (R)	20.2 ± 0.5	36.9^{c} ± 1.9	173.3	96.6 ± 6.0	1.062
1/4 F 3/4 O	20.1 ± 0.4	43.2^{ab} ± 1.7	217.0	107.0 ± 5.9	1.092
1/4 F 1/4 O 1/2 R	20.3 ± 0.4	46.2^{a} ± 4.3	209.4	123.9 ± 13.7	1.226
Significance	ns	*	ns	ns	ns
Season of birth					
Autumn	20.1 ± 0.3	42.9 ± 2.0	209.5	109.1 ± 6.0	1.113
Summner	20.2 ± 0.4	38.6 ± 1.0	183.2	100.5 ± 4.1	1.081
Spring	20.2 ± 0.3	41.8 ± 1.3	197.6	109.1 ± 4.3	1.136
Significance	ns	ns	ns	ns	ns
2 lambings/1 year system					
General mean (B)	20.1 ± 0.1	35.0 ± 1.3	167.9	89.1 ± 5.5	1.001
Breed type					
Ossimi (O)	20.1 ± 0.3	33.6 ± 3.0	148.2	91.1 ± 8.9	1.012
Rahmani (R)	20.1 ± 0.1	33.4 ± 1.8	168.0	79.0 ± 6.0	0.898
1/4 F 3/4 O	20.2 ± 0.3	37.7 ± 3.5	175.0	100.1 ± 18.7	1.125
1/4 F 1/4 O 1/2 R	20.1 ± 0.1	35.6 ± 2.3	180.0	86.6 ± 8.3	0.973
Significance	ns	ns	ns	ns	ns
Season of birth:					
Autumn	20.2 ± 0.1	36.5 ± 1.8	179.1	91.5 ± 8.8	1.016
Spring	20.1 ± 0.2	33.6 ± 2.0	156.6	86.5 ± 6.5	0.983
Significance	ns	ns	ns	ns	ns
B/A, %	99.7	84.9	84.8	83.4	89.9

FP fattening period, FE feed efficiency, DP digestible protein, Means bearing different superscripts within the same classification differ significantly, P<0.05. **P<0.01, *P<0.05, ns not significant

Season of birth affected significantly ($P<0.01$) live body weight at 16 and 24 weeks of age and daily gain weight during the period 0-<8 weeks of age, in 3 lambings/2 years system. In 2 lambings/1 year system, the season effect was significant ($P<0.05$) on daily gain weight during the period 0-<8 weeks of age (Table 1). Autumn and spring born lambs were significantly ($P<0.01$ or 0.05) heavier than those born in summer in body weights at 16 and 24 weeks of age and daily gain weight during 0-<8 weeks, in 3 lambings/2 years system. In 2 lambings/1 year system, the autumn born lambs were significantly heavier ($P<0.01$) than those born in spring in only daily gain weight during the period 8-<16 weeks of age (Table 1). Such findings may be due to suitability of the weather and to increase in amounts of feeds, since feeding on green Egyptian clover begins at autumn and extends nearly till the end of spring. These results were similar to those of MARAIS and PRETORIUS (1976). In fattened male lambs, season of birth did not show significant effects on growth performance (Table 2) and carcass traits, except the edible offals percentage which was higher significantly ($P<0.05$) in the spring than in the autumn season (Tables 3 and 4).

Table 3
Slaughter traits of male lambs fattened from 20 kg weight until 50 weeks of age as affected by breed type and season of birth, in 3 lambings/2 years and 2 lambings/1 year systems
Schlachtmerkmale in 50. Lebenswoche

Classification	Dressing percentage, %[1] With tail	Dressing percentage, %[1] Without tail	Tail, %	Prime cuts, %[2]	Edible offals, %[3]
3 lambings/2years system					
General mean (A)	52.1	49.9	8.2	74.1	1.9
Breed type					
Ossimi (O)	52.8	49.5	11.9[a]	71.7[b]	1.9
Rahmani (R)	50.8	47.5	11.7[a]	70.3[b]	1.9
1/4 F 3/4 O	51.7	50.6	3.6[b]	78.5[a]	2.0
1/4 F 1/4 O 1/2 R	53.5	52.7	4.1[b]	77.1[a]	1.7
Significance	ns	ns	**	**	ns
Season of birth					
Autumn	53.6	51.5	8.0	74.0	1.8
Summner	51.5	48.9	8.9	73.4	2.1
Spring	51.2	49.0	7.8	74.8	1.9
Significance	ns	ns	ns	ns	ns
2 lambings/1 year system year system					
General mean (B)	50.3	48.3	7.8	75.0	2.0
Breed type					
Ossimi (O)	50.4	47.1	12.8[a]	71.1[b]	2.1
Rahmani (R)	51.0	48.1	10.9[a]	71.2[b]	2.1
1/4 F 3/4 O	48.4	47.4	3.9[b]	79.9[a]	2.1
1/4 F 1/4 O 1/2 R	51.4	50.5	3.5[b]	77.8[a]	1.9
Significance	ns	ns	**	**	ns
Season of birth					
Autumn	49.4	47.4	7.7	75.2	1.9[b]
Spring	51.2	49.1	7.9	74.8	2.1[a]
Significance	ns	ns	ns	ns	*
B/A%, Tail	96.4	96.8	98.1	101.2	105.8

[1]hot carcass weight relatively to slaughter weight, [2]prime cuts include legs, flank, rack and shoulder, [3]classification according world system (heart+liver+kidneys) Means bearing different superscripts within the same classification differ significantly, $P<0.05$. **$P<0.01$, *$P<0.05$, ns not significant

Table 4
Eye muslce (9th-10th-11th ribs cut) and physical composition of the pure- and cross-bred lambs as affected by breed type and season of birth, in 3 lambings/2 years and 2 lambings/1 year systems
Gewebeanteile am Schlachtkörper

Items	Eye muscle cm^2	Eye muscle kg	Fat thickness, mm	Ommentum + kidney's fat, %	Lean, %	Fat, %	Bone, %
3 lambings/2 years system							
General mean (A)	13.7	0.5	3.8	0.3	63.4	16.6	20.0
Breed type							
Ossimi (O)	12.6	0.4^b	3.4	0.3	63.2^b	16.8	20.1^{ab}
Rahmani (R)	13.6	0.3^b	3.7	0.1	62.0^c	16.9	21.2^a
1/4 F ¾ O	14.3	0.4^b	3.8	0.4	64.3^a	16.3	19.4^b
1/4 F 1/4 O 1/2 R	14.7	0.7^a	4.3	0.4	65.0^a	16.0	19.0^b
Significance	ns	*	ns	ns	**	ns	**
Season of birth							
Autumn	13.8	0.5	3.6	0.3	63.5	16.2	20.3
Summer	12.8	0.4	4.2	0.4	63.0	16.9	20.1
Spring	14.3	0.5	3.5	0.2	63.7	16.6	19.7
Significance	ns	ns	ns	ns	ns	ns	ns
2 lambmgs/1 year system							
General mean (B)	12.5	0.4	2.6	0.2	62.8	16.8	20.4
Breed type							
Ossimi (O)	11.2	0.4	2.8	0.2	62.3^b	17.5^a	20.2
Rahmani (R)	13.3	0.3	2.7	0.1	60.8^c	18.1^a	21.1
1/4 F 3/4 O	12.2	0.4	2.4	0.3	63.7^a	16.7^b	19.6
1/4 F 1/4 O 1/2 R	13.4	0.4	2.6	0.3	64.4^a	15.0^c	20.6
Significance	ns	ns	ns	ns	**	*	ns
Season of birth							
Autumn	12.8	0.4	2.5	0.2	63.2	16.4	20.5
Spring	12.2	0.3	2.7	0.2	62.4	17.3	20.3
Significance	ns	ns	ns	ns	ns	ns	ns
B/A, %	91.2	86.7	68.6	73.3	99.0	101.5	101.8

Means bearing different superscripts within the same classification differ significantly, $P<0.05$. **$P<0.01$, *$P<0.05$, ns not significant

The comparison between the two mating systems (general means) showed that all values estimated for live weight and daily gain weight were higher in 3 lambings/2 years than in 2 lambings/1 year system (Table 1). The low values of birth weight in lambs born in the latter system is due to the stress that was exerted on the dams because of the high frequency of lambing, while the differences shown in the later ages were due to the differences that relate to the two types of weaning (normal; at 8 weeks in 3 lambings/ 2 years system and early weaning at 2 weeks in 2 lambings/1 year system), in addition to that the lambs at 2 weeks of age were still unable to consume reasonable quantities of dry feeds and can not ruminate, since the latter function do not commence before the third week of lambs life as claimed by OWEN *et al.* (1969). LARGE (1965) reported that the substantial growth of the rumen occurs in the first five weeks of lambs life. Incidence of mortality was insignificantly higher (23.6%) in 2 lambings/1 year system than in 3 lambings/2 years system (Table 2). In fattened male lambs, the 3 lambings/2 years system was higher than the 2 lambings/1 year system, in all growth performance traits studied (Table 2). These results were in agreement with those of MOHAMMED and MUSTAFA (1986). However, SHARAFELDIN *et al.* (1968) reported different results. In the slaughter test, the 3 lambings/2 years system was higher than in the 2 lambings/1 year system in most of the traits studied, except percentages of prime cuts, edible offals and fat which showed contrary trends (Tables 3 and 4).

Reproductive performance of ewe lambs

Breed type affected significantly (P<0.01) age of ewe lambs at first mating in the two mating systems and their weight (P<0.05) in 3 lambings/2 years system (Table 5). The crossbred ewe lambs showed significantly lower (P<0.01 or 0.05) ages and higher (P<0.05) weights than in their maternal (local) breeds. Particularly, the (1/4 F 3/4 O) and (1/4 F 1/4 O 1/2 R) lambs reached age at first lambing at earlier ages with 47 and 96 days in 3 lambings/ 2 years system and with 77 and 95 days in 2 lambings/1 year system, respectively, than in their maternal breeds due to the high growth of the crossbreds (Table 1). These results were in agreement with those of SHARAFELDIN *et al.* (1969) and ABOUL-NAGA (1988).

Season of birth affected significantly (P<0.01) ewe lambs weight at first mating in 3 lambings/2 years system and ewe lambs age in 2 lambings/1 year system (Table 5). The spring season showed the highest values in the two lambing systems. This may be due to the better feed and climate during the spring season. MALIK *et al.* (1978) found that age at first lambing was significantly higher in spring born ewe lambs than in those born in the rainy season.

Comparison between the two mating systems (general means) showed that ewe lambs were first mated at younger age and heavier live weight in 3 lambings/2 years system (weaned at 8 weeks of age) than in 2 lambings/1 year system (weaned at 2 weeks of age). DYRMUNDSSON (1973) clarified that enhanced sexual performance in ewe lambs is, as a rule, associated with high growth rate and heavy body weight. The same author added that wide variations in body weight and age at puberty are mainly attributed to differences in the season of birth.

With regard to the reproductive performance of ewe lambs, the (1/4 F 3/4 O) ewe lambs showed the highest lambing rate and litter size in the two lambing systems. The spring born ewe lambs showed the highest conception rate, lambing rate and litter size in 3 lambings/2 years system and the lowest conception rate and the highest lambing rate and litter size in 2 lambings/1 year system. However, the conception rate, lambing rate and litter size of the studied ewe lambs were not significantly affected either by breed type or season of birth (Table 5). These results were similar to those reported by ABOUL-NAGA and ABOUL-ELA (1985, 1987a,b). Comparison between the two mating systems (general means) showed that conception rate and litter size were lower in ewes rebred each 6 months (2 matings/1 year system) than in those rebred each 8 months (3 matings/2 years system).

The twinning rate values did not show a definite trend in the studied different genotypes. The obtained values were 6.1, 8.7, 8.3 (+4.2% triplets) and 7.7% in O, R, (1/4 F 3/4 O) and (1/4 F 1/4 O 1/2 R) groups, respectively.

Table 5
Reproductive performance of ewe lambs produced by 3 lambings/2 years and 2 lambings/1 year systems
Fruchtbarkeitsmerkmale bei unterschiedlichem Paarungssystem

Classification	CR, %	Ewe lambs at 1st mating		Lambing rate, %	Litter size
		Age, days	Weight, kg		
3 lambings/2 years system					
General mean (A)	65.5	491.9 ± 10.0	35.2 ± 0.3	103.5	1.09
Breed type					
Ossimi (O)	75.4	513.0^b ± 14.5	34.7^b ± 0.5	106.1	1.06
Rahmani (R)	78.1	542.2^a ± 28.9	34.1^b ± 0.7	100.0	1.09
1/4 F 3/4 O	52.0	465.6^c ± 12.3	36.5^a ± 0.7	107.7	1.17
1/4 F 1/4 O 1/2 R	53.3	446.7^d ± 13.5	35.3^b ± 0.5	96.8	1.07
Significance	ns	**	*	ns	ns
Season of birth					
Autumn	65.0	451.4^c ± 12.3	34.0^c ± 0.5	102.6	1.05
Summer	54.6′	494.2^b ± 12.4	35.0^b ± 0.5	86.7	1.04
Spring	75.8	529.8^a ± 17.1	36.4^a ± 0.5	114.9	1.15
Significance	ns	**	**	ns	ns
2 lambings/1 year system					
General mean (B)	60.6	522.0 ± 12.5	29.8 ± 0.6	105.3	1.07
Breed type					
Ossimi (O)	65.4	556.8^b ± 16.9	29.5 ± 0.8	111.8	1.12
Rahmani (R)	70.8	573.8^a ± 28.8	30.4 ± 0.9	94.1	1.00
1/4 F 3/4 O	50.0	478.3^c ± 9. 2	29.8 ± 0.6	116.7	1.17
1/4 F 1/4 O 1/2 R	55.0	479.3^c ± 13.4	29.6 ± 0.6	100.0	1.00
Significance	ns	**	ns	ns	ns
Season of birth					
Autumn	66.0	496.8^b ± 1.4	29.8 ± 0.4	103.2	1.07
Spring	55.3	547.3^a ± 24.3	29.9 ± 0.5	107.7	1.08
Significance	ns	**	ns	ns	ns
B/A, %	92.5	106.1	84.8	101.7	98.2

CR conception rate: no of ewes conceived/no of ewes joined, Lambing rate: no of lambs born/no of ewes conceived, Litter size: no of lambs born/no of ewes lambed, Means bearing different superscripts within the same classification, differ significantly, $P<0.05$. $^{**}P<0.01$, $^{*}P<0.05$, ns not significant

Evaluation of crossing Egyptian fat-tailed sheep with Finnsheep and the two accelerating systems

In an attempt to study the feasibility of crossing Egyptian fat-tailed sheep with Finnsheep, a trial was carried out to estimate an index for the lean meat production efficiency (LMPE) (Formula 2, Table 6):

$$LMPE = SW \cdot FE \cdot DP \cdot LM \qquad (2)$$

where is *SW* the slaughter weight of the fattened animals, *FE* their feed efficiency, *DP* the dressing percentages of their carcasses (including the tail) and *LM* the percentages of lean meat in their carcasses. The results obtained (Table 6) showed nearly similar trends to those of lean percentages in the carcasses shown in Table 4. However, when estimating the percentages of the lean meat in the live weights (LMLW) the obtained values did not show clearly the above mentioned trends (Formula 3, Table 6):

$$LMLW = SW \cdot DP \cdot LM \qquad (3)$$

where is *SW* the slaughter weight of the fattened animals, *DP* dressing percentages (including the tail in each carcass) and *LM* the lean meat percentages in the carcasses. This may be due to that the Finnish Landrace sheep have relatively poor conformation. KEMPSTER *et al.* (1987) reported that the key factor in an improvement scheme of sheep production is the matching of breed and production system to obtain lean carcasses at an optimum slaughter weight and age.

In another trial carried out to estimate indices for the capacity of reproduction (RC) for the different breed types (Formula 4, Table 6):

$$RC = (CR \cdot LR \cdot LS) \cdot 100 \quad (4)$$

where are *CR* the conception rates, *LR* the lambing rates and *LS* the averages of litter size. The obtained values showed that the Egyptian local fat-tailed sheep surpassed remarkably the crossbreds, in the two lambing systems.

From another point of view, comparison between the indices representing the productive efficiencies of the studied groups obtained by multiplying Formula 2 · Formula 4 (Table 6), showed that the values for local sheep are either very close to or higher than those of the crossbreds. Such results confirm other studies carried out for evaluation similar crossbreds of Finn × Egyptian local breeds. In this respect, GALAL *et al.* (1996) reported that the introduction of Finnsheep genetics did not improve the performance of the system, and ALMAHDY *et al.* (2000) confirmed that genotype rankings changed depending on the measure of evaluation (i.e., biological efficiency or profit), when evaluation of the Egyptian same breeds and some other similar Finn crosses under sheep production systems.

To assist farmers identify the most profitable crosses to use in their own environment in New Zealand (NZ), a sheep crossbreeding decision support system (DSS) is being developed at WRONZ and Lincoln University. For the DSS Data, it is needed a functional database containing collated data from published literature, farm trials and field data supplied by farmers for 42 traits in 6 categories and are aligned with the traits defined in the NZ Sheep Improvement Limited (SIL) database as much as possible. The main traits are: carcass: carcass weight (Carcass Wt), eye muscle area (EMA), fat depth at GR (tissue depth on the 12th rib); growth: birth weight (BWT), weaning weight (WWT), live weight at 6, 8, 12 months old (LW6, LW8, LW12, respectively); hogget wool brightness, bulk, yellowness (COLM), curvature (Curv), fibre diameter (FDIAM12),fibre diameter variation (FDCV), fleece weight (FW12), staple length (StLgth), yield; ewe wool: denoted by prefix E; reproduction: number of lambs born per ewe joined (NLB), number of lambs weaned per ewe joined (NLW), litter size (LitSize); reproductive traits for hogget ewes were denoted as HNLB, HNLW and HlitSize; disease: faecal egg count before/after 1 March (FEC1/FEC2), nematode count before/after 1 March (NEM1/NEM2), pinhole/ribbyness score (1-5) for lambskins (Pinhole/ Ribby), and foot rot. (WEI *et al.* 2001).

Comparison between the two mating systems showed that the 3 matings/2 years surpassed the 2 matings/1 year system in all the indices developed. Similarly, it was found that the productive efficiency values were 16.8 and 15.2% in the two systems, respectively, with a difference of 10.5% per one year (Table 6). Such results were confirmed when calculating the productive efficiency per one year by combining survivals ratio [that equals 1 – (mortality rate at 8 weeks)] and frequency of lambing per one year. It was found that the values were 15.0 and 13.2%, in 3 matings/2 years and 2 matings/1 year system, respectively. Particularly, the crossbreds showed lower value in 2 lambings/3 years system (13.5 vs. 15.5%) and higher value in 2 lambings/1 year system (13.9 vs. 12.9%) than in the local breeds, when calculating the productive efficiency per one year by combining survivals ratio [that equals 1 – (mortality rate at 8 weeks)] and frequency of lambing per one year. ALMAHDY *et al.* (2000) reported that profit for experimental flocks of the same genetic stocks in Egypt was 4 to 8% greater in 3 matings/2 years system than in 1 mating/1 year system, except in [1/2 F 1/2 R (FR)] and inter se matings of [1/4 F 3/4 R (RFR)] for which the profit values were 42 and 6% higher in 1 mating/1 year system than in 3 matings/2 years system.

The results show the feasibility of applying crossing of the unprolific sheep with Finnsheep and suggest that crossing or grading up the Egyptian local breeds should be carried out with improved breeds characterized by a moderate (i.e. not high) reproductive or productive efficiency level and such breeds should be originated in a nearly similar environment to that of the local ones.

Table 6
Some indices estimated to evaluate the results obtained in the present study.
Vergleich unterschiedlicher Merkmalsindizes

Classification	Lean meat production efficiency[1]	Lean meat/ Live weight[2]	Reproduction capacity, %[3]	Productive efficiency, %[4]
3 lambings/2 years system				
General mean (A)	15.2	33.0	73.9	11.2
Breed type				
Ossimi (O)	15.0	33.3	84.8	12.7
Rahmani (R)	12.3	31.5	85.2	10.5
1/4F 3/4O	15.3	33.3	65.5	10.0
1/4F 1/40 1/2R	19.7	34.8	53.5	10.5
Season of birth:				
Autumn	16.3	34.0	70.0	11.4
Summer	13.6	32.4	49.2	6.7
Spring	15.5	32.6	100.2	15.5
2 lambings/1 year system				
General mean (B)	11.1	31.6	68.3	7.6
Breed type				
Ossimi (O)	10.7	31,4	81.8	8.8
Rahmani (R)	9.3	31.0	66.7	6.2
1/4F3/40	13.1	30.8	68.3	9.0
1/4F 1/4O 1/2R	11.5	33.1	55.0	6.3
Season of birth:				
Autumn	11.6	31.2	72.9	8.5
Spring	10.6	31.9	64.3	6.8
B/A, %	73.0	95.8	92.4	67.5

[1]formula 2: LMPE=SW·FE·DP·LM, [2]formula 3: LMLW=SW·DP·LM, [3]formula 4: RC=(CR·LR·LS)·100, [4]formula 2·formula 4

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