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A. P. Mavrogenis and S. Economides

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ABSTRACT

A total of 280 Chios ewes with their offspring (385 lambs of both sexes) were used to study environmental effects on production characters of Chios ewes and lambs, and the interrelationships among them before and after weaning. Year and month of lambing significantly affected ewe milk production and lamb growth rate. Male lambs consumed considerably more milk ($P<0.01$) and had a faster growth rate ($P<0.01$) than female lambs, both before and after weaning. Lambs born as singles grew faster than twins ($P<0.01$) before weaning, but no differences were found for postweaning growth rate. Milk sucked and total milk yield were significantly higher for ewes rearing twins. Commercial milk yield, however, was similar for single and twin-rearing ewes. Milk production after weaning is, therefore, a much better selection criterion than total milk yield.

Milk intake and preweaning growth rate were moderately correlated ($r = 0.38$), but postweaning growth rate and milk intake were virtually unrelated ($r = 0.12$).

INTRODUCTION

Real genetic differences can accurately be assessed when variation due to environmental influences masking the expression of genotypes is eliminated.

Weaning weight is being extensively used as a criterion of selection for beef cattle and sheep. However, because of its obvious relevance to lactational traits it may be considered both as a dam and as a lamb trait. Maternal effects, which may be manifest in the form of embryo competition in multiparous species or as the ability of the mother to provide adequate milk for the growth of her young, have been recognized since the earliest attempts to improve livestock production. The antagonisms between maternal environment, whether intrauterine or postnatal, and the genetic make-up of the offspring for growth have concerned a number of investigators (Dickerson, 1947; Koch and Clark, 1955a; Cox **et al.**, 1959; Young and Legates,

1965; Vesely and Robison, 1971; Ahlschwede and Robison, 1971; Robison, 1972). Most of these studies have been carried out on laboratory animals, on swine and beef cattle. Very limited information is available on sheep (Folman **et al., 1966**a,b,c; Ch'ang and Rae, 1972; Hanrahan, 1976).

The present work aimed at investigating the effects of season and month of lambing, sex and type of birth of lambs on lamb and ewe production characters, and the relationships among preweaning and postweaning performance of ewes and their offspring.

MATERIALS AND METHODS

A total of 280 Chios ewes and 385 lambs of both sexes were used in a study conducted from 1975 to 1978, i.e. for three consecutive lambing seasons. All ewes and lambs were identified with ear tags and tattoos. Date of lambing, sex and type of birth (single or twin), birth weight, weaning weight (at 42 days of age) and 140-day weight of lambs were individually recorded. Preweaning (ADG1) and postweaning rate of gain (ADG2) were computed using individual live weights at birth, weaning and at 140 days of age.

Milk production of each ewe was recorded weekly until weaning and bi-weekly thereafter. Milk production until weaning and at 90 or 150 days post-partum was estimated using test-day records. Milk suckled was determined using the "weigh-suckle-weigh" method described by Lawlor **et al.** (1974). Commercial milk production, in this study, refers to milk produced after weaning since in common practice only this milk is sold.

Statistical analyses were by least squares (Harvey, 1975), and accounted for the variation in lambing seasons, month of lambing, sex and type of birth of lambs. No significant interaction effects among season and month of lambing were found in preliminary analyses; this term was, therefore, deleted from the model. Furthermore, it was considered unnecessary to account for variation in age or parity of ewes since all ewes were of more than two lambings. Previous studies (Mavrogenis and Louca, 1980) showed no significant parity effects on production characters.

RESULTS AND DISCUSSION

Mean squares and tests of significance for all traits studied are given in Table 1. Year and month of lambing had a significant effect on lamb growth before and after weaning (Table 2). The preweaning growth rate of lambs was higher during the 1977-8 period despite

their lower milk intake. This was partly due to the fact that these lambs were born in September and October (Table 2) and were favoured by the dry and cool weather, whereas lambs born in December were adversely affected by the cold and rainy conditions of that period. Furthermore, contamination by various microorganisms affecting performance through the infestation of the digestive tract is higher with higher stocking rate, and is more frequent in late born lambs. Significant effects of season of lambing on lamb weights have been reported by Acharya and Bawa (1971) and on calve weights by Vesely and Robinson (1971).

TABLE 1. Mean squares and tests of significance for lamb growth and ewe performance traits.

Source		Pre-weaning growth rate	Post-weaning growth rate	Milk suckled	Milk to weaning	Total milk yield	Commercial milk yield
Lambing season	2	0.040**	0.042**	12353**	10112**	26469**	7863*
Month of lambing	3	0.009**	0.031**	1606**	2376**	22165**	17029**
Sex of lamb	1	0.100**	0.242**	2220**	2241	11621	4862
Type of birth	1	0.086**	0.006	39897**	32632**	22388*	615
Error	377	0.002	0.003	329	622	3638	2131

* $P<0.05$; ** $P<0.01$

TABLE 2. Least squares means and standard errors for lamb growth and ewe performance traits.

Main effect	Subclass	Number of obs.	Preweaning growth rate (g/day)	Postweaning growth rate (g/day)	Milk suckled (kg)	Milk to weaning (kg)	Total milk yield (kg)	Commercial milk yield (kg)
Lambing season	1975–76	163	202 ±3	197 ±4	68 ±2	105 ± 2	197 ± 5	94 ± 4
	1976–77	139	200 ± 4	211 ± 5	60 ± 2	99 ± 2	204 ± 6	105 ± 5
	1977–78	83	293 ± 5	238 ± 7	45 ± 2	120 ± 3	230 ± 8	110 ± 6
Month of lambing	September	150	225 ± 3	241 ± 5	62 ± 2	108 ± 2	192 ± 5	84 ± 4
	October	122	215 ± 4	222 ± 5	57 ± 2	102 ± 2	203 ± 6	101 ± 4
	November	76	221 ± 5	207 ± 7	61 ± 2	116 ± 3	230 ± 8	114 ± 6
	December	37	197 ± 7	192 ± 9	50 ± 3	106 ± 4	217 ± 10	112 ± 8
Sex of lamb	Male	183	230 ± 3	241 ± 5	60 ± 2	110 ± 2	216 ± 5	106 ± 4
	Female	202	198 ± 3	190 ± 4	55 ± 2	105 ± 2	205 ± 5	99 ± 4
Type of birth	Single	135	230 ± 4	220 ± 5	47 ± 2	98 ± 2	202 ± 6	104 ± 4
	Twin	250	198 ± 3	211 ± 4	68 ± 1	118 ± 2	218 ± 5	102 ± 4
Overall		385	214 ± 3	215 ± 3	58 ± 1	108 ± 2	210 ± 4	103 ± 3

Significant effects of lambing season were also found for all milk traits. The somewhat higher milk production of ewes lambing in November and December probably reflects higher feed intake (energy intake) during the cold season. Any effects of lactation length should be excluded since milk production was considered at a constant 150-day lactation in the present study.

There was an obvious antagonism between lamb and ewe production traits. Dry weather seems to favour lamb growth, but not milk production. However, this could be corrected by management practices such as avoidance of overcrowding and pen contamination, and availability of forage for lactating ewes during the dry season.

Male lambs grew faster than female lambs both before and after weaning ($P<0.01$). Males sucked considerably more milk ($P<0.01$) than females, which in combination with their higher birth weight and inherent potential for faster growth resulted in their early differentiation from females. Similar findings have been reported by Mavrogenis **et al.** (1973) and Lawlor **et al.** (1974). However, in agreement with the results of Acharya and Bawa (1971), milk production until weaning and at 150 days post-partum was not affected by sex of lamb.

Single lambs grew faster than twins until weaning ($P<0.01$), but at a similar rate thereafter. Bichard and Cooper (1966), Gjedrem (1967) and Louca **et al.** (1974) reported similar findings for post-weaning growth of lambs. Milk suckled and total milk yield were significantly higher in ewes rearing twins, but no differences were detected for commercial milk yield. It is obvious that while the total milk production of ewes may somewhat increase under the influence of the suckling stimulus of twin lambs, such effects are greatly diminished after weaning, when lambs become independent of milk supply (Lawlor **et al.**, 1974; Louca **et al.**, 1975).

Ewe milk production should, therefore, be evaluated when most environmental differences are removed. Since suckling significantly affects yield, dam evaluations and comparisons should be made when the suckling stimulus is removed. Hence, milk production after weaning is a much better selection criterion than total milk yield.

Preweaning growth rate (ADG1) was moderately correlated with milk suckled ($r=0.38$) and with milk production until weaning ($r=0.35$). The relationships between preweaning growth rate and total or commercial milk yield were even lower (0.28 and 0.18, respectively). High correlations between preweaning growth rate and milk production until weaning have been reported by Owen (1957) and Folman **et al.** (1966 b, c). The correlation, however, between the amount of milk suckled and that available for commercial purposes

was only 0.07, suggesting that there were no carry-over effects from the preweaning period. Differences, therefore, in milk production during the preweaning period can be partly attributed to the suckling stimulus and the litter size which promote higher milk secretion. In addition, differences among lambs in preweaning growth rate are probably due to the synergistic effect of the genotype of the lamb and the nutritional environment provided by its dam (in essence a genotype by environment interaction). Hence, preweaning growth rate or live weight at weaning should be used with utmost caution as a selection criterion. Furthermore, ewe characters such as mothering ability and milk production used routinely to evaluate phenotypes may have to be reconsidered, for mothering ability, expressed as total liveweight of lambs weaned, seems to be a doubtful criterion. Total milk production, including milk suckled, presents similar difficulties since it is considerably affected by the number of lambs suckling.

TABLE 3. Partial correlations among ewe and lamb performance traits.

Trait	Postweaning growth rate	Milk suckled	Milk to weaning	Total milk yield	Commercial milk yield
Preweaning growth rate	0.33	0.38	0.35	0.28	0.18
Postweaning growth rate		0.12	0.12	0.06	0.01
Milk suckled			0.57	0.29	0.07
Milk to weaning				0.71	0.41
Total milk yield					0.93

There is some evidence that lamb growth rate and milk production until weaning are genetically antagonistic (Robison, 1972). Hence, response to single trait selection for either preweaning growth rate or milk production until weaning may be doubtful.

On the other hand postweaning growth rate was virtually unrelated to milk production both before and after weaning (Table 3) suggesting that differences among lambs during that phase of growth reflect mostly differences among genotypes. Hence, it would be more rational to base selection on postweaning measures of growth and milk production after weaning rather than preweaning lamb or ewe performance.

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