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Mavrogenis A.P.

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Comparative performance of purebred and crossbred sheep in three different production systems

A.P. MAVROGENIS
AGRICULTURAL RESEARCH INSTITUTE
1516 NICOSIA
CYPRUS

SUMMARY - The performance of three purebred and five crossbred groups of ewes was evaluated under three different production systems, i.e., intensive, semi-intensive and extensive. The breed groups were the Cyprus Fat-tailed (L), Chios (C), Awassi (A), first generation crosses (C x L, A x L and A x C) and two backcrosses to Chios (C x C x L and C x A x C). Only Chios and Awassi ewes were represented in the intensive production system. All three purebreds and crossbred groups were represented in the extensive system, whereas the two backcrosses were not present in the semi-intensive system. Feeding was based on concentrates, straw and hay (cereal and alfalfa) and quantity and quality was regulated according to the stage of the production cycle within a production system. Production systems significantly affected litter weight at birth and at weaning (P<0.01) and milk production (P<0.01). There were no serious effects on litter size either at birth or at weaning (P>0.05). Chios ewes had a higher litter size and litter weight at birth and at weaning than both other purebreds and most crossbred groups. The milk production of Chios and Awassi ewes was similar and higher than that of the Local and A x L breed groups. The most serious interaction effects between genetic groups and production systems occurred in milk production and litter weight at weaning. There was a change in rank between two crossbred genotypes (C x L and A x L) and a change in scale involving the Chios and Awassi purebreds. The question, however, is how to overcome the problems of genotype x environment interactions. Should we breed for a particular environment or improve the environment when better genotypes are introduced to unfavourable ones.

Key words: Sheep, prolificacy, milk, production systems.

RESUME *- "Performances comparatives des ovins de race pure et des ovins croisés dans trois systèmes de production différents". Les performances de trois groupes de brebis de race pure et cinq groupes de brebis croisées ont été estimées sous trois systèmes de production différents, à savoir intensif, semi-intensif et extensif. Les groupes correspondaient aux races Queue Grasse de Chypre (L), Chios (C), Awassi (A), première génération de croisements (C x L, A x L, et A x C) et à deux croisements en retour avec Chios (C x C x L et C x A x C). Il n'y avait que les brebis Chios et Awassi qui étaient représentées dans le système de production intensif. Les trois groupes de races pures ainsi que les groupes croisés étaient représentés dans le système extensif, tandis que les deux croisements en retour n'étaient pas présents dans le système semi-intensif. L'alimentation était à base de concentré, de paille et de foin (céréales et luzerne) et la quantité et qualité étaient déterminées selon le stade du cycle productif dans un système de production. Les systèmes de production ont influencé de façon significative le poids de la portée à la naissance et au sevrage (P<0,01) et la production de lait (P<0,01). Il n'y a pas eu d'effets notables sur la taille de la portée que ce soit à la naissance ou au sevrage (P>0,05). Les brebis Chios avaient une plus grande taille et poids de portée à la naissance et au sevrage que les autres groupes en race pure et la plupart des groupes croisés. La production de lait des brebis Chios et Awassi était semblable, plus élevée que celle des groupes de races locales et A x L. Les effets d'interaction les plus notables entre groupes génétiques et systèmes de production ont eu lieu pour la production de lait et le poids de la portée au sevrage. Il y a eu une modification du classement entre les deux génotypes croisés (C x L et A x L) et un changement d'échelle en ce qui concerne les races pures Chios et Awassi. La question cependant était de trouver la façon de surmonter les problèmes d'interactions génotype x milieu. Peut-être faudrait-il sélectionner pour un environnement particulier ou améliorer le milieu lorsque de meilleurs génotypes sont introduits dans des milieux défavorables.*

Mots-clés : *Ovins, prolificité, lait, systèmes de production.*

Introduction

Sheep and goats in the Mediterranean area are called to perform under a wide range of production systems. Natural selection and the process of adaptation to many diverse environments have produced breeds which are capable of performing in unfavorable as well as more favourable environments. Such qualities are valuable and native breeds should be utilized as a potential genetic material in breeding programs.

Introduction of new breeds to the diverse environments of the Mediterranean basin should always be associated with performance evaluation of at least under that particular production environment. Woolaston (1987) suggested that sheep breeds in Australia are still far from being properly adapted to the environment. Hence, we have on one hand improvements of the environment to accommodate the needs of new introduced breeds. Whatever is the case the phenomenon we are faced with is a genotype x environment interaction which should be thoroughly investigated.

Woolaston (1987) concluded that genetic gains from selection on source traits, and specifically wool, are transferable to other environments, implying that there are no serious genotype x environment interactions. Such environments were nutritional regimes, age classes and sexes. On the other hand, Sanna *et al.* (1994) suggested that the transfer of genetic progress from the nucleus to the commercial flocks is difficult, because of the lower adaptation of improved stock to traditional production systems (from an improved environment to a harsh one).

It is probable, therefore, that some traits are more sensitive than others to changes in the production environment. With this in mind Bouix (1992) examined breeding objectives and selection criteria, with regard to adaptation of sheep in harsh environments.

The very purpose of this session is to define breeding goals in sheep and goats in relation with the environment. The objectives of the present work are to examine the performance of different genotypes in three different production systems.

Materials and methods

Data on three purebred and five crossbred groups of ewes were evaluated for two successive lambing seasons (1972/73 and 1973/74) under three different production systems. The groups were: Cyprus Fat-tailed (L), Chios (C), Awassi (A), C x L, A x L, A x C, C x C x L and C x A x C. Reciprocal crosses were not available in this study.

Ewes from all groups were allocated at random to three different production systems as follows:

(i) System 1 (intensive). The ewes had free access (*ad libitum*) to barley hay and 0.5 kg of concentrates per ewe daily, up to 6 weeks prior to lambing. During the last 6 weeks of pregnancy hay was replaced by barley silage fed *ad libitum*. After lambing all animals were fed *ad libitum* on both concentrates and silage. Only two purebred groups (Chios and Awassi) were allocated to this system.

(ii) System 2 (semi-intensive). During the maintenance period, the ewes received 0.5 to 0.75 kg of concentrates per head daily and wheat straw *ad libitum*. Over the last 6 weeks of pregnancy they received 1.0 kg of concentrates and wheat straw *ad libitum*. After lambing they were fed wheat straw *ad libitum* and concentrates according to requirements for lactation. (National Research Council, 1975). All three purebreds and two crossbreds (C x L and A x L) were assigned to this system.

(iii) System 3 (extensive). The ewes were kept on stubble grazing and/or fed wheat straw throughout the maintenance and gestation periods. After lambing they received 1.25 to 1.4 kg of concentrates and wheat straw *ad libitum*. Ewes of all genetic groups were allocated to this system of production.

All lambs following weaning were fed the same diet (concentrates and cereal hay) until the age of 20 weeks).

Allocation of ewes to the various systems was at random within breed and age class. Crossbred ewes were mostly in their first and second lactation. The ewes were housed by system and breed in adjacent pens. Weaning was at approximately 37 days *post-partum* regardless of system or breed.

Following weaning, the ewes were hand milked twice daily and individual milk yields, fat and protein tests were recorded at monthly intervals.

Data were analysed using generalized least squares procedures (SAS, 1989) with unequal subclass numbers. Two models were used. The first model (Table 1) included the effects of lambing season, system, lactation number of the ewe, breed group and the interaction of system by breed group on production traits. The second model was used to compare the performance of crossbreds and purebreds in system 3 and was identical to the first model, except for the interaction which was deleted. Traits examined included litter size and litter weight at birth and at weaning and total milk production adjusted for lactation length. Milk yield refers to production after weaning.

Results

Lambing seasons had a significant effect (P<0.01) only on litter size at birth, when purebreds were examined under model 1 (Table 1). On the other hand, the same source of variation was significant for all traits studied, except litter size at weaning, when the performance of all breed groups was examined under the extensive production system (Table 2). This can probably be attributed to the fact that ewe performance in the extensive system was more dependent on climatic conditions and vegetation than in the other systems. In fact the 1972/73 season was extremely dry.

Table 1. Mean squares and tests of significance for ewe production and reproductive traits (model 1)

Source	df	LSB	LWTB	LSWN	LWTWN	MILK
Lambing season	1	5.08**	2354	0.15	19	13238
System (S)	2	0.09	16378**	0.10	2531**	221997**
Breed group (B)	2	19.11**	4615**	6.73**	1361**	138083**
Lactation number	5	2.26**	14950**	0.75**	164*	37175**
S x B	3	0.07	169	0.60	402**	20392**
Error	3016	0.24	948	0.30	64	6040

*P<0.05; **P<0.01

Table 2. Mean squares and tests of significance for ewe production and reproductive traits (model 2)

Source	df	LSB	LWTB	LSWN	LWTWN	MILK
Lambing season	1	1.56**	834*	0.58	307**	63857**
Breed group	7	3.37**	1220**	0.97**	128**	39056**
Lactation number	5	0.47	794**	0.70*	203**	59107**
Error	1173	0.26	252	0.28	49	5993

*P<0.05; **P<0.01

Production systems significantly affected litter weight at birth and at weaning, litter size at weaning and milk production (Table 1). Ewes in the intensive production system had a higher litter weight at birth and at weaning, and higher milk production than those in the other two systems of production (Table 3).

Lactation number had a significant effect on all traits studied with both models, except for litter size at birth in the extensive system of production (Tables 1 and 2). Milk production was also significantly affected by lactation length. There was a linear increase in yield with increasing number of days milked.

Table 3. Production and reproductive characteristics of ewes by system of production and breed group

Effect	Subclass	N	LSB	LWTB	LSWN	LWTWN	MILK
System	1	815	1.33	6.1	1.09	14.1	130
	2	1209	1.28	5.5	1.05	12.2	108
	3	1012	1.30	5.5	1.03	13.8	93
Breed group	Cyprus Fat-tailed (L)	345	1.22	5.5	1.07	10.0	74
	Chios (C)	845	1.49	6.1	1.17	14.1	116
	Awassi (A)	709	1.13	5.4	0.93	11.0	117
	C x L	46	1.23	5.3	1.06	14.4	116
	A x L	79	1.19	5.1	1.01	13.5	95

The performance of purebreds in all systems of production is given in Table 3. Performance comparisons among purebred and crossbred ewes are given in Tables 2 and 3. Chios ewes had the highest prolificacy at birth and at weaning than any other breed group. Litter weight at birth was also higher, whereas at weaning two crossbred groups (C x L and A x L) had a similar litter weight to that of Chios. Chios, Awassi and C x L genotypes had similar milk production, which was higher than that of the other breed groups.

Interactions among production systems and breed groups were significant only for litter weight at weaning and milk production (Table 1). The most probable explanation for the interaction appears to be the similar performance of genotypes in the extensive production system. It is evident that under this system genotypes with lower prolificacy are less seriously affected than those with high prolificacy (Table 4). A more serious interaction was observed for milk production. The milk yield of Chios ewes was higher in two systems and lower in the extensive system than that of Awassi ewes. A similar case was observed for breed groups C x L and A x L (Table 4), where there was a change in the rank of the two genetic groups in the two systems (semi-intensive and extensive) that were comparable.

Table 4. Interaction effects of production system by breed group for traits studied

Trait	System	Breed group							
		Local	Chios	Awassi	C x L	A x L	A x C	C x C x L	C x A x L
LSB	1	-	1.48	1.13	-	-	-	-	-
	2	1.24	1.49	1.13	1.17	1.20	-	-	-
	3	1.15	1.49	1.13	1.26	1.17	1.34	1.35	1.36
LWTB	1	-	6.3	5.7	-	-	-	-	-
	2	5.6	6.0	5.3	4.9	4.9	-	-	-
	3	5.2	5.8	5.2	5.4	5.3	-	-	-
LSWN	1	-	1.16	0.90	-	-	-	-	-
	2	1.08	1.26	0.97	1.02	0.92	-	-	-
	3	1.02	1.11	0.91	1.08	1.07	0.90	1.06	1.13
LWTWN	1	-	15.0	12.9	-	-	-	-	-
	2	11.2	13.0	11.6	13.6	12.3	-	-	-
	3	13.1	14.1	12.9	14.8	14.4	-	-	-
MILK	1	-	132	126	-	-	-	-	-
	2	82	124	118	135	88	-	-	-
	3	46	99	106	106	100	138	95	126

Although only two crossbred groups were represented in two systems and all others were present in a single system (extensive), their performance may be indicative of what can be expected of them under such a system. Results showed that their performance (despite the small number of observations) is at least as good if not better than that of the Cyprus Fat-tailed sheep.

Discussion

Despite the absence of the Local breed from system 1, the response of purebred and crossbred sheep in the various production systems provides very useful information on their future performance under such conditions. It was evident that ewe productive and in some cases, reproductive traits were seriously affected by systems of production. Milk production was more adversely affected. Although only two significant interaction effects of system by breed group were found, Chios performed poorly in system 3. In addition, production level deteriorated with deteriorating environment (feeding level), and the rank of the genotypes involved in this study changed. The present findings are in agreement with those of Woolaston (1987), who concluded that genetic gains from selection on some traits are transferable to other environments, implying that there were no genotype x environment interactions. On the other hand Sanna *et al.* (1994) suggested that genetic progress made in one environment is not easily transferable to an inferior environment because of the lower adaptation of the improved stock to this new environment. Similar findings have been reported by Mavrogenis and Louca (1980) who concluded that the milk production of different breeds was variably affected in different environments. No change in rank, however, was then reported. Since milk production is dependent on feed supply during the lactation period, it is not surprising that the more productive breed (Chios) was the one affected the most.

Conclusions

The results of the present study suggest that there are serious genotype x environment interactions on production traits of ewes. There is evidence that litter weight and milk production are more seriously affected. They all, however, lead to a philosophical question. "Should we breed genotypes for different environments or improve the environment in which genotypes are called to perform"? "Should we leave the environment (whatever we mean by this term) unchanged or improve it, without destroying it, so that better, more productive genotypes can perform to their potential"?

References

Bouix, J. (1992). Breeding objectives and criteria. Adaptation of sheep to harsh environmental conditions. *INRA,* 179-184.

Mavrogenis, A.P. and Louca, A. (1980). Effects of different husbandry systems on milk production of purebred and crossbred sheep. *Anim. Prod.,* 31: 171-176.

Sanna, S.R., Carta, A., Ugarte, E., Barillet, F., Gabiña, D., Portolano, B. and Casu, S. (1994). Implementation of breeding schemes for dairy sheep in Mediterranean areas. In: *Proceedings of the 45th Annual Meeting of the European Association for Animal Production*. Edinburgh, 5-8 September, 1994.

SAS/STAT. (1989). *Users guide, Version 6, fourth edition*. SAS Institute Inc., Cary, NC.

Woolaston, R.R. (1987). Genotype x environment interactions and their possible impact on breeding programs. In: *Proceedings of the National Symposium: Merino Improvement Programs in Australia.* Australian Wool Corporation, Melbourne, Vic, pp. 421-437.