Effect of crossbreeding on lamb performance

Mavrogenis A.P.

Le croisement industriel ovin en Méditerranée

Paris : CIHEAM
Options Méditerranéennes : Série Etudes; n. 1981-III

1981
pages 61-66

Effects of crossbreeding on lamb performance

A. P. Mavrogenis

Agricultural Research Institute

NICOSIA (Cyprus)

ABSTRACTS-RESUME

Data on 2852 purebred and crossbred lambs of both sexes (1407 males and 1445 females) representing three lambing seasons (1977/78, 1978/79 and 1979/80) were used to study environmental and genetic factors influencing growth characters in lambs. Heterotic effects of crossbreeding on lamb growth characters were also examined.

Male lambs were significantly heavier at birth and at weaning and had a faster postweaning growth rate ($P < 0,01$) than female lambs. Lambs born and reared as singles were the heaviest at birth and at weaning ($P < 0,01$), but had a similar postweaning growth rate to that of lambs born and reared as twins. Differences in lamb liveweight at birth and at weaning attributed to age of dam were significant between lambs from primiparous and multiparous ewes.

AWASSI lambs were the heaviest of all purebreds at birth and at weaning. Postweaning growth rate was similar for *AWASSI* and *CHIOS* lambs, while both breeds exhibited a higher growth potencial than the *CYPRUS FATTAILED* breed. All F_1 crossbreds exceeded the parental mean for birth and weaning weight. Backcrosses exhibited mostly a regression towards the mean of the parental breeds, although in the case of the backcross of Ch×(Ch×CFT), maternal effects in the crossbred dam must have outweighed the effects of backcrossing.

Heterotic effects were estimated only for the *AWASSI*×*CHIOS* crossbreds, where both reciprocal crosses were available. Percent heterosis for birth weight and weaning weight was 5 % and 6.5 %, respectively. Postweaning daily gain, a trait regarded as moderately heritable, showed only 4 % heterosis.

EFFETS DU CROISEMENT SUR LA PRODUCTION D'AGNEAUX

L'analyse des effets génétiques et non génétiques sur la vitesse de croissance des agneaux a été réalisée sur un ensemble de données recueillies sur 2852 agneaux de race pure et croisée des 2 sexes (1407 mâles et 1445 femelles) durant 3 campagnes successives (1977/78, 1978/79, 1979/80). Les effets

d'hétérosis susceptibles d'intervenir sur la vitesse de croissance des agneaux croisés sont également examinés.

Les agneaux mâles sont significativement plus lourds à la naissance et au sevrage et ont une vitesse de croissance post-sevrage plus élevée que les agneaux femelles ($P<0,01$). Les agneaux nés et élevés simples sont plus lourds à la naissance et au sevrage ($P<0,01$) mais ont une vitesse de croissance post-sevrage similaire à celle des agneaux nés et élevés doubles. Les différences pour les poids à la naissance et au sevrage relatives à l'âge des mères sont significatives entre les agneaux nés de primipares et ceux nés de multipares.

Parmi les agneaux de race pure, les agneaux *AWASSI* obtiennent les poids à la naissance et au sevrage les plus élevés. La vitesse de croissance post-sevrage est similaire pour les agneaux *AWASSI* et *CHIOS*, ces 2 races ayant elles-mêmes un potentiel de croissance plus élevé que la race locale de *CHYPRE A QUEUE GRASSE*. Tous les agneaux croisés F1 manifestent un potentiel de croissance plus élevé que les races parentales. On observe pour les agneaux 3/4 (back-cross) une diminution des performances par rapport aux F1 et vers le niveau des races parentales, quoique dans le cas des 3/4 *CHIOS* × *CHYPRE*, les effets maternels au niveau des mères croisées ont dû limiter les effets du croisement en retour.

Les effets d'hétérosis ont été estimés seulement pour les croisés *AWASSI* × *CHIOS* pour lesquels les 2 croisements réciproques sont disponibles. Les taux d'hétérosis pour les poids à la naissance et au sevrage ont été estimés respectivement à 5 et 6,5 %. Pour la vitesse de croissance post-sevrage qui est considérée comme un caractère modérément héritable, le taux d'hétérosis s'élève seulement à 4 %.

INTRODUCTION

The general strategy in livestock improvement lies mainly with the definition of goals and the appropriate techniques to measure them. The first problem the investigator must face is the degree to which the traits are heritable, since the magnitude of the heritability estimates will determine to a great extent the choice of methods and procedures for livestock improvement.

Sheep in most Mediterranean countries are kept for the production of both milk and meat. Therefore, most programs aimed at improving productivity have a two-fold objective. The alternative to simultaneous improvement of both milk and meat production is to hold one of the two traits constant. The methods for improvement lie principally with the utilisation of genetic variability within and among breeds.

Up-grading of native populations using an «improver» breed, systematic crossbreeding schemes aiming at the utilization of general and specific combining ability and breed substitution are some of the methods used to increase product output from sheep. Positive effects of crossbreeding on lamb growth have been reported by DONALD, READ and RUSSEL (1963), SIDWELL, EVERSON and TERRIL (1964), SIDWELL and MILLER (1971) and MAVROGENIS and LOUCA (1979).

The purpose of the present study was to investigate further some environmental and genetic factors influencing the performance of purebred and crossbred lambs under similar conditions of feeding and management and to examine possible heterotic effects for lamb growth traits.

MATERIAL AND METHODS

Data on 2852 purebred and crossbred lambs of both sexes (1407 male and 1445 female lambs) born in three consecutive lambing seasons (1977/78, 1978/79 and 1979/80) were used in this study. The breed groups used were the *CYPRUS FAT-TAILED* (CFT), *CHIOS* (Ch), *AWASSI* (Aw), Ch × CFT, Aw × Ch, Ch × Aw, *EAST FRIESIAN* × Ch (F_1 and F_2) Ch × (ch × CFT), Ch × (Aw × Ch), Ch × (Ch × Aw) and 7/8 CHIOS × 1/8 CFT.

The lambs were born and reared at two government farms (Athalassa and Orites), where feeding and management were as near identical as possible. They were allowed to suckle at will for the first 28±4 days after birth and were completely weaned at 45±4 days, following a restricted suckling period during which a pelleted high protein starter was offered AD LIBITUM. The lambs were subsequently fattened to the age of 105 days using good quality hay and a 16 % crude protein concentrate diet. Birth weight, weaning weight and 105-day weight, sex, date of birth and weaning, type of birth, age of dam and postweaning growth rate were individually recorded.

The data were analysed using least squares procedures (HARVEY, 1975) according to a mathematical

Table 1

MEAN SQUARES AND TESTS OF SIGNIFICANCE FOR PREWEANING AND POSTWEANING GROWTH TRAITS OF PUREBRED AND CROSSBRED LAMBS

ANALYSE DE VARIANCE DES POIDS A LA NAISSANCE ET AU SEVRAGE ET DE LA VITESSE DE CROISSANCE DES AGNEAUX DE RACE PURE ET CROISES: CARRES MOYENS ET TESTS DE SIGNIFICATION DES EFFETS

Source	DF	Birth weight *Poids à la naissance*	Weaning weight *Poids au sevrage*	Postweaning growth rate *Vitesse de croissance post-sevrage*
Flocks ..... *Troupeaux*	1	20.77**	302.2**	0.243**
Year-seasons ..... *Année-saisons*	2	13.18**	720.5**	0.081**
Breeds ..... *Races*	11	11.67**	123.5**	0.060**
Lactation No ..... N.° Lactation	4	6.27**	171.1**	0.097**
Type of birth ..... *Mode de naissance*	2	300.14**	2,751.3**	0.054**
Sex ..... *Sexe*	1	47.82**	1,283.5**	1.642**
Age at weaning ..... *Age au sevrage*	1	—	973.7**	—
Error ..... *Résiduelle*	2829	0.48	7.4	0.005

model (table 1) which accounted for the effects of flocks, lambing season, breeds, dam lactation number, type of birth and sex of lamb and age at weaning, which was used to adjust for differences in weaning weight only. Other dependent variables examined (in addition to weaning weight) were birth weight and post-weaning rate of growth (from weaning to 105 days of age).

RESULTS AND DISCUSSION

Male lambs were significantly heavier than female lambs at birth and at weaning. They also grew faster (P 0.01) than females after weaning (table 2) Similar findings have been reported by GJEDREM (1966) and FIMLAND et al. (1969) for 42-day weight, and by MAVROGENIS, LOUCA and LAWLOR (1973), LAWLOR, LOUCA and MAVROGENIS (1974) and MAVROGENIS and LOUCA (1979) for preweaning and postweaning lamb growth traits.

Single lambs were heavier than twins and other multiples at birth and at weaning (table 2). Differences in growth rate after weaning were significant between singles and multiples, but not between singles and twins or between twins and multiples. Similar findings regarding lamb at birth and at weaning have been reported by BICHARD and COOPER (1966), GJEDREM (1967), LOUCA et al. (1974) and MAVROGENIS and LOUCA (1979). With regard to growth rate after weaning, results of the present study are at variance with the study of MAVROGENIS and LOUCA (1979). These differences can be probably attributed to the shorter postweaning period used for evaluation, not allowing the multiple lambs to fully express their potential and overcome the handicap of lower weaning weight in such a short postweaning period.

The significant effect of dam lactation number on birth weight, weaning weight and postweaning growth rate (table 3) are generally in agreement with reports from other investigators (BICHARD and COOPER, 1966; GJEDREM, 1967; MAVROGENIS and LOUCA, 1979). Essentially, differences in lamb liveweight or growth rate were important between the progeny of primiparous and all other multiparous ewes. The slight reduction in the weaning weight of lambs from

Table 2

EFFECTS OF SEX AND TYPE OF BIRTH OF LAMB ON PREWEANING AND POSTWEANING GROWTH TRAITS OF PUREBRED AND CROSSBRED LAMBS

EFFETS DU SEXE ET DU MODE DE NAISSANCE DES AGNEAUX SUR LES POIDS A LA NAISSANCE ET AU SEVRAGE ET LA VITESSE DE CROISSANCE

Item *Facteurs*	No. of obser.	Birth weight (kg) *Poids à la naissance*	Weaning weight (kg) *Poids au sevrage*	Postweaning growth rate (g) *Vitesse de croissance post-sevrage*
Males ..... *Mâles*	1407	4.01±0.05	16.3±0.2	236±5
Females ..... *Femelles*	1445	3.75±0.05	15.0±0.2	188±5
Singles ..... *Simples*	1335	4.72±0.04	18.2±0.2	223±4
Twins ..... *Doubles*	1239	3.87±0.05	15.3±0.2	212±5
Multiples ..... *Multiples*	278	3.07±0.06	13.5±0.3	201±6

dams milked for more than five lactations (table 3) suggests a quadratic effect of lactation number on weaning weight.

Highly significant differences were found among breed groups for all the traits studied (table 4). *AWASSI* lambs were the heaviest of purebreds at birth and at weaning. Similar findings were reported by MAVROGENIS and LOUCA (1979) for the same breeds. No differences, however, were found between *CHIOS* and CFT lambs in the present study. Postweaning growth rate was similar for *AWASSI* and *CHIOS* lambs, while lambs of both these breeds grew faster than CFT lambs. All F_1 crossbreds exceeded the parental mean for birth and weaning weight. Backcrosses exhibited mostly a regression towards the mean of the parental breeds, although in the case of the backcross of Ch × (Ch × CFT) the crossbred dam must have exerted maternel effects that outweighed the effects of backcrossing. The best lamb perfor-

Table 3

EFFECTS OF LACTATION NUMBER ON PREWEANING AND POSTWEANING GROWTH TRAITS OF PUREBRED AND CROSSBRED LAMBS

EFFET DU NUMERO DE LACTATION SUR LES POIDS A LA NAISSANCE ET AU SEVRAGE ET LA VITESSE DE CROISSANCE DES AGNEAUX DE RACE PURE ET CROISES

Lactation No.	No. of obser.	Birth weight (kg) *Poids à la naissance*	Weaning weight (kg) *Poids au sevrage*	Postweaning (g) *Vitesse de croissance post-sevrage*
1	326	3.61±0.07	14.3±0.3	177±7
2	322	3.86±0.06	16.1±0.2	214±6
3	277	3.93±0.06	16.1±0.3	220±6
4	196	3.99±0.07	16.1±0.3	221±7
5 and over	1731	4.02±0.04	15.6±0.1	226±4

Table 4

LEAST SQUARES MEANS AND STANDARD ERRORS FOR PREWEANING AND POSTWEANING GROWTH TRAITS OF PUREBRED AND CROSSBRED LAMBS

ESTIMES DES MOINDRES CARRES ET INTERVALLES DE CONFIANCE POUR LES POIDS A LA NAISSANCE ET AU SEVRAGE ET LA VITESSE DE CROISSANCE DES AGNEAUX DE RACE PURE ET CROISES

Breed group *Type génétique*	No. of obser.	Birth weight (kg) *Poids à la naissance*	Weaning weight (kg) *Poids au sevrage*	Postweaning growth rate (g) *Vitesse de croissance post-sevrage*
Cyprus Fat-tailed	213	3.78±0.07	14.4±0.3	170±7
Chios	1228	3.68±0.04	14.7±0.1	207±4
Awassi	389	4.12±0.06	16.0±0.2	199±6
Chios × CFT.....	114	3.82±0.08	15.4±0.3	223±8
Ch × Aw	148	4.19±0.08	16.7±0.3	202±7
Aw × Ch	231	3.99±0.07	16.0±0.3	221±6
E.F. × Ch (F_1)	230	4.47±0.06	16.4±0.2	217±6
E.F. × Ch (F_2).....	75	3.81±0.09	17.0±0.4	268±9
Ch × (Ch × CFT)	95	3.86±0.08	15.4±0.3	215±8
Ch × (Ch × Aw)	61	3.75±0.10	15.9±0.4	221±10
Ch × (Aw × Ch)	38	3.52±0.12	14.7±0.5	188±12
Ch × [Ch × (Ch × CFT)]	30	3.61±0.13	15.2±0.5	209±13

mance was exhibited by the F_2 cross of *EAST FRIESIAN × CHIOS.* Although the characteristic regression in hybrid advantage was shown in birth weight, weaning weight and especially postweaning growth rate were even higher compared to the F_1 crossbreds, owing probably to maternal as well as individual heterosis.

It is obvious that a sire line with a better growth potential is needed to replace the breeds currently used as terminal sires. This assumes that all offspring, irrespective of sex, are slaughtered. At present local shepherds are not ready to do this, unless a lamb fattening industry is developed and most of them tend to keep all female offspring, regardless of breed composition, as replacements. This could prove disadvantageous in the long run, since it could make breeding decisions very difficult.

Heterotic effects

Heterotic effects were estimated for the *AWASSI × CHIOS* crossbreds, where both reciprocal crosses were available. Percent heterosis was approximately 5 % for birth weight and 6,5 % for weaning weight. These values for lamb weights in early postnatal development are within the range reported by most investigators. Similar values have been reported for crossbred dairy × beefcattle. As would be expected postweaning daily gain, a trait regarded as moderately heritable, showed only 4 % heterosis. MAVROGENIS, LOUCA and ROBINSON (1980) estimated a heritability of 0.56 for postweaning growth rate, while ERCANBRACK and PRICE (1972) reported values of 0.40, 0.52 and 0.58 for the feedlot period of three North American breeds (*RAMBOUILLET, TARGEE* and *ROMNELET).*

Some aspects of precocity and reproductive ability should provide a more complete picture of the effectiveness of crossbreeding. The main disadvantages of the *AWASSI* and CFT purebreds are low prolificacy, average fertility and late sexual maturity. On the other hand the *CHIOS* breed excels in all three attributes. *CHIOS* lambs can be bred to lamb at about 12 to 15 months of age (75 % actually lamb by about 1 year of age). AWASSI and CFT lambs are not sexually mature at such an early age and only about 20 to 30 percent are mated and lamb as yearlings. Preliminary results indicate that precocity is higher in the crossbreds (Ch × CFT:60 to 70 %; Ch × Aw or Aw × Ch:50 to 60 %). Prolificacy is also higher in the Chios breed, averaging 1.70 lambs at birth and 1.45 lambs at weaning, compared to 1.05 and 0.97 and 1.06 and 0.98 for the CFT and *AWASSI* sheep, respectively. Crossbred Ch × CFT and Ch × Aw are intermediate in this respect, averaging 1.26 and 1.10 and 1.15 lambs at birth and at weanling, respectively.

Information on the production of and milk consti-

tuents are given in a paper by MAVROGENIS and LOUCA (1980) on the effects of different husbandry systems on milk production of purebred and crossbred sheep.

ACKNOWLEDGEMENTS

We wish to acknowledge the financial assistance of F.A.O. that enabled us to participate at this meeting. Thanks are also due to Mr. C. Heracleous for assistance in preparing this report.

BIBLIOGRAPHY

BICHARD, M. and COOPER, M. McG., 1966. Analysis of production records from a lowland sheep flock. 1. Lamb mortality and growth to 16 weeks. *Anim. Prod.,* **8:** 401-410.

DONALD, H. P., READ, J. L. and RUSSEL, W. S., 1963. Heterosis in crossbred hill sheep. *Anim. Prod.,* **5:** 289-299.

ERCANBRACK, S. K. and PRICE, D. A., 1972. Selecting for weight and rate of gain in noninbred lambs. *J. Anim. Sci.,* **34:** 713-725.

FIMLAND,E., ERI, J., LILAND, P. J. and GJEDREM, T., 1969. Resultat fra Kryssningsforsok med sau. *Mald. Norg. LandbrHoisk,* **13:** No. 35.

GJEDREM, T., 1966. Selection index for ewes. *Acta Agric. Scand.,* **16: 21-29.**

GJEDREM, T., 1967. Phenotypic and genetic parameters for weight of lambs at five ages. *Acta Agric. Scand.,* **17:** 199-216.

HARVEY, W. R., 1975. Least squares analysis of data with unequal subclass numbers. *US Dep. Agric.,* ARS-H-4.

LAWLOR, M. J., LOUCA, A. and MAVROGENIS, A., 1974. The effect of three suckling regimes on the lactation performance of *CYPRUS FAT-TAILED, CHIOS* and *AWASSI* sheep and the growth rate of the lambs. Anim. Prod., **18:** 293-299.

LOUCA, A., MAVROGENIS, A. and LAWLOR, M. J., 1974. Effects of plane of nutrition in late pregnancy on lamb birth weight and milk yield in early lactation of *CHIOS* and *AWASSI* sheep. *Anim. Prod.,* **19:** 341-349.

MAVROGENIS, A. P. and LOUCA, A., 1979. A note on some factors influencing post-weaning performance of purebred and crossbred lambs. *Anim. Prod.,* **29:** 415-418.

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.

MAVROGENIS, A., LOUCA, A. and LAWLOR, M. J., 1973. The use of grape seed meal and barley straw in lamb fattening diets. Agric. *Res. Inst. Tech. Bull.* No. 12, Nicosia, Cyprus.

MAVROGENIS, A. P., LOUCA, A. and ROBISON, O. W., 1980. Estimates of genetic parameters for pre-weaning and post-weaning growth traits of *CHIOS* lambs. *Anim. Prod.,* **30:** 271-276.

SIDWELL, G. M., EVERSON, D. O. and TERRIL, CLAIR. E., 1964. Lamb weights in some pure breeds and crosses. *J. Anim. Sci.,* **23:** 105-110.

SIDWELL, G. M. and MILLER, L. R., 1971. Production in some pure breeds of sheep and their crosses. II. Birth weights and weaning weights of lambs. *J. Anim. Sci.,* **32:** 1090-1094.