THREE-YEAR COMPARISON OF PRODUCTIVITY OF BOOROOLA CARRIER AND NON CARRIER MERINOS D'ARLES EWES

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SUMMARY

A comparison of the productivity of introgressed Mérinos d'Arles MAF+ females with equivalent non carrier MA++, pure-bred MA and F1 Romanov x MA was conducted over 3 years under extensive management, with an out of breeding season. MAF+ were more efficient for lamb production: + 41% weight of 70-day lamb per ewe joined compared to MA++ or MA, resulting from + 1.2 ovulations/ ovulating ewe, + 0.9 lambs born and + 0.6 lambs weaned/ ewe lambing and despite a lower lamb liveweight at 70 days. This increase in ewe productivity was obtained at the expense of the artificial rearing of one third of the lambs mainly due to a high percentage of litter sizes ≥ 3 (30%).

Keywords: Sheep, Booroola, fecundity gene, ovulation rate, ewe productivity.

INTRODUCTION

In a review of numerous studies in different breeds and managements, Davis *et al* (1991) reported highly variable estimations of the efficiency of the FecB gene assessed by the weight of lamb weaned per ewe joined. More recently, Meyer *et al* (1994) and Southey *et al* (1994) did not find any difference in productivity between heterozygous carriers and non carriers. Thus, it is clear that the potential interest of increasing prolificacy by the FecB gene in a local breed must be carefully evaluated. In this work, we report an evaluation concerning the Mérinos d'Arles breed. This non prolific (< 1.4) local breed is essentially reared for lamb meat production in less favoured areas of south-eastern France.

MATERIALS AND METHODS

Animals and management. The MAF+ and MA++ females resulted from the introgression of the FecB ("F") gene in the Mérinos d'Arles breed which started in 1983 following the importation of 5 Australian Booroola Merino rams from the CSIRO. In 1993, sufficient numbers of MAF+ and MA++ females, 7/8 to 15/16 MA, were available to undertake a comparison of the productivity of MAF+, MA++ and pure-bred MA from groups of similar age structure. In addition, F1 Romanov x MA were involved as a prolific genetic type of reference. This 3-year study was based on a total of 1240 mating records concerning 609 females run as one group under the extensive management of the Mediterranean Crau plain.

Mating and lambing. Natural matings were made in Spring using the "ram effect". Ten or 14 days after the introduction of vasectomised rams, all females were exposed to about 20 harnessed Ile-de-France meat rams, for 37 days on average, and their ovulation rate corresponding to the first mating was measured by endoscopy. At lambing, day and night, the ewes were identified and their lambs were weighted and tagged. From multiple births, one or

2 lambs only were left with their dam according to the decision of the experienced staff. The remaining lambs were artificially reared. Weaning was at 2.5 to 3 months of age for lambs suckled by their dam, at 12 to 15 kg for artificially reared lambs.

Data analysis. Oestrus and lambing dates were used to determine lambings which corresponded to recorded ovulation rates. When the litter size (LS) exceeded the ovulation rate (OR), this last was adjusted to the litter size. Embryo losses were assessed by the ratio: (OR - LS)/ OR (corrected OR).

All lambs were weighted 3 or 4 times, at 3-week intervals, according to the national performance recording scheme. Overall ewe productivity was estimated as weight of 70-day lamb produced per ewe joined. The data on sale of lambs were analysed by sex since the 2 market outlets involved quite different lamb bodyweights (mainly females for lighter lambs and males for heavier lambs). Furthermore, many carcasses from the male lambs born the 2nd and 3rd years were weighted and classified for conformation and fatness.

Ewe liveweight after the mating period, OR and LS of lambing females on the first oestrus, lamb birthweight were analysed using the GLM procedure in SAS (SAS Institute Inc., 1985).

RESULTS AND DISCUSSION

Ewe liveweight. After the mating, mean liveweights were the highest (50 kg) for F1 females and the lowest for MAF+ (44 kg). There were highly significant effects ($p < 0.001$) of year, genotype, age and birth weight introduced as a covariable. Least squares means showed that F1 females were significantly heavier than MA (+ 1.6 kg) which were heavier than MA++ or MAF+ females (+ 1.7 or + 2.0 kg). These last differences should be the result of a lower selection pressure in the introgressed population than in the pure-bred MA flock.

Ovulation rate, embryo loss. Over a 4-week checking period, more than 90% of the females were raddle marked regardless of the genotype and the year, most of them being marked within 2 weeks. The mean OR for females which lambed on this first oestrus are reported in Table 1. Mean corrected OR of MAF+ ewes was 1.2 ovulation more than MA++ (0.9 lambs for the corresponding litter size). These large increases are in total accordance with the results summarised by Piper *et al* (1985). MAF+ had also a higher mean OR and a larger variability of OR than the F1. For instance, the percentages of OR recordings of 1 and 3 or more, for all ovulating ewes, were respectively 12, 48% for the MAF+ and 12, 11% for the F1. Analysis of corrected OR and corresponding LS for lambing females, including year, genotype, age and dam genotype within genotype effects, revealed a significant effect ($p < 0.05$) of the dam genotype on OR. Least squares means showed that OR for MA++ born of MAF+ dam was significantly higher than for MA++ born of MA++, thus indicating a possible effect of the selection of females during the introgression. In both analyses, for OR and LS, MA++ and MA females did not differ significantly. On the other hand, significant differences were found between the prolific MAF+ and F1, MAF+ having the highest adjusted means. For OR=2, embryo losses were lower in the prolific genotypes than in the non prolific even though a part

of this discrepancy can be partly explained by the high frequency of corrected OR in MAF+. It is also worth to note that embryo losses were equivalent for OR of 3 and 4 in MAF+ females.

Table 1. Mean ovulation rates, embryo losses for lambing females on the first oestrus

		Ewe genotype			
		MA	MA++	MAF+	F1(ROxMA)
Observed OR		1.27	1.37	2.46	2.01
Percentage of underestimated OR		3.0	1.9	11.5	6.7
Corrected[A] OR		1.30	1.38	2.57	2.08
Percentage of embryo losses	OR=2	16.7	21.2	12.2	10.9
	OR=3			19.8	16.7
	OR=4			20.0	

[A] After adjustment of underestimated OR to litter size.

Productive performance. Productive performance for the whole mating period are presented in Table 2. First of all, the MA++ and MA females were very similar in all productive traits thus indicating that the introgression is probably sufficient to lessen the possible breed differences on these traits.

Table 2. Productive performance for the whole mating period of ewes naturally mated by Ile-de-France rams (weights in kg)

		Ewe genotype			
		MA	MA++	MAF+	F1(ROxMA)
N° of ewes joined[A]		299	269	417	237
Percent. of lambing ewes (Fertility)		90.0	88.1	91.1	89.0
Litter size at birth (Prolificacy)		1.19	1.21	2.10	1.83
Percentage with litter size	1	80.7	79.8	22.4	26.1
	2	19.3	19.8	48.1	65.9
	3 or 4		0.4	29.5	8.0
Lamb birthweight	single	4.4	4.4	4.1	4.3
	twins	3.8	3.7	3.3	3.6
	triplets			2.8	3.1
Percent. of artificial rearing lambs		6.9	8.2	34.1	17.2
Lamb mortality[B]	within 2 days	6.2	3.1	11.8	4.7
	within 70 days	8.4	5.6	18.4	9.6
Litter size at 70 days		1.09	1.14	1.72	1.65
Lamb bodyweight at 70 days		21.4	20.6	18.8	20.0
Weight of 70-day lamb/ ewe joined		21.0	20.9	29.5	29.4

[A] After deletion of records from ewes dead before lambing. [B] Total mortality in percentage.

The highly prolific MAF+ (L.S.=2.1) gave + 0.9 lambs at birth, + 0.6 lambs at 70 days per ewe lambing and finally + 41% of 70-day lamb weight per ewe joined (compared to non carrier MA females), despite a lower individual lamb liveweight at 70 days. Such an increase in the ewe productivity by weaning is higher than the highest gain reviewed by Davis *et al* (1991). It should be noted that our result was obtained thanks to a limited period of more intensive management during the lambing with artificial rearing of one third of the lambs. Indeed, the main problems with MAF+ females are the high frequency of litters of 3 or 4 lambs (30%) and mortality of the lambs (18% at 70 days). Mortality of lambs from MAF+ was also higher at the same birth type (single or twins). A further analysis of lamb birthweight found significant differences ($p < 0.05$) between ewe genotypes for the same litter size: single and twins from MAF+ ewes were respectively lighter than single and twins from MA++ and MA. Thus, other factors that the direct effect of LS may influence the lamb production of MAF+ females (ewe liveweight, embryo loss). The F1 ewes appeared as efficient as MAF+ mainly as a result of their lower variability of LS and their heavier lambs at birth. However, these F1 females had only a marginal impact in the South East France considering their flocking behaviour on extensive and not fenced pastures.

The mean live bodyweights ($\pm$ SD) at sale, over the 3 years, were 24.6 $\pm$ 3.6 kg for female lambs and 36.4 $\pm$ 4.6 kg for male ones. No significant differences were observed among genotypes for sale weights of lambs. Least squares means for age of lambs at sale (adjusted by year and sale liveweight) showed that ewe lambs from MAF+ reached later the same sale weight than lambs from non carrier MA ewes (+ 11 days) and F1 (+ 7 days). For the heaviest male lambs, these discrepancies were less important but they appeared dependant of the year ($p < 0.05$). Data available on carcasses from male lambs (n=429) slaughtered at an average liveweight of 37.4 kg, did not show any difference on dressing percentage (around 44%) and carcass classification, between the MA genotypes.

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