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Short communication

Birth weight, and pre- and postweaning growth rates of lambs belonging to the Afec-Assaf strain and its crosses with the American Suffolk

A. Rosov, E. Gootwine*

Institute of Animal Science, A.R.O., The Volcani Center, P.O. Box 6, Bet Dagan 50250, Israel

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ABSTRACT

We evaluated the contribution of the American Suffolk, a known terminal sire breed, to growth traits of lambs born to Afec-Assaf ewes. By contemporaneous comparisons during 10 lambing periods, birth weight, preweaning and postweaning Average Daily Gain (ADG) of Afec-Assaf lambs ($n = 1301$), 1/2 Suffolk lambs ($n = 98$), 1/4 Suffolk lambs ($n = 598$) and 1/8 Suffolk lambs ($n = 237$) were compared. On average (mean ± SD) lambs' birth weight, weaning age, weaning weight, final weight and final age were 4.5 ± 1.2 kg, 35 ± 6 days, 14.7 ± 3.3 kg, 54.7 ± 8.2 kg and 153 ± 12 days, respectively. Preweaning, postweaning and overall ADG was: 294 ± 66, 343 ± 62 and 330 ± 53 g/day, respectively. Birth weight of 1/2 Suffolk, 1/4 Suffolk and 1/8 Suffolk lambs, all born to Afec-Assaf ewes, did not differ ($P > 0.05$) from that of Afec-Assaf lambs. Lambs belonging to the 1/2 Suffolk and 1/4 Suffolk crosses had higher ($P < 0.05$) preweaning and postweaning ADG than Afec-Assaf lambs. The difference in total ADG between Afec-Assaf and 1/2 Suffolk lambs was about 22 g/day, leading to an estimated body weight difference of 3.3 kg between lambs of the two genotypes at the age of 150 days. Genetic analysis suggested no significant ($P > 0.05$) differences between the Suffolk and Afec-Assaf in birth weight or in postweaning ADG. However, additive, heterosis and recombination effects significantly ($P < 0.05$) contributed to the difference between the two genotypes in preweaning ADG, and additive and heterosis effects significantly ($P < 0.05$) contributed to the difference between the two genotypes in total ADG.

1. Introduction

Sheep breeding has resulted in the creation of specialized sire and dam lines. Sire lines manifest superior growth traits, feed efficiency and carcass merits, while dam lines are characterized by superior maternal-related traits, including reproductive traits, prolificacy, milk production and mothering ability. Breeding ewes from dam lines with sire line rams has long been a fundamental strategy in sheep breeding, aimed at maximizing profit from the sale of slaughtered lambs (Dickerson, 1969; Nitter, 1978). The advantage in growth and body composition of crossbred lambs over pure bred dam line lambs may result from the additive contribution of the sire line and from the heterosis effect.

Introgression of the *B* (Booroola) mutation of the *FecB* locus (Piper et al., 1985) into the Assaf dairy breed (Pollott and Gootwine, 2004) resulted in the creation of the highly prolific Afec-Assaf strain, with an average 2.8 and 2.5 lambs born/ewe lambing for *BB* and *B+* ewes, respectively (Gootwine et al., 2008). Most Afec-Assaf ewes in Israel are managed in nondairy flocks, where lamb production is the main source of income. As lamb marketing price depends mainly on the animal's body weight, improvements in lamb birth weight as well as preweaning and postweaning growth rates are of interest.

* Corresponding author. Tel.: +972 3 9683752; fax: +972 8 9603678.
E-mail address: gootwine@agri.gov.il (E. Gootwine).

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Table 1
Distribution of lambs belonging to Afec-Assaf (AA), 1/2 Suffolk, 1/4 Suffolk and 1/8 Suffolk according to crop.

Crop no.	Year	Season[a]	Number of lambs			
			AA	1/2 Suffolk	1/4Suffolk	1/8 Suffolk
1	2007	Spring	90	37	–	–
2	2008	Spring	173	24	56	–
3	2008	Summer	181	–	48	–
4	2009	Autumn	141	–	90	–
5	2009	Spring	138	–	122	31
6	2009	Summer	113	–	62	39
7	2009	Autumn	120	–	71	50
8	2010	Spring	169	37	37	32
9	2010	Summer	72	–	33	28
10	2010	Autumn	104	–	79	57
Total			1301	98	598	237

[a] Spring: March to June; summer: July to September; autumn: November to January.

The American Suffolk is one of the top sire breeds, with high growth rate ability and notable body conformation (Leymaster and Jenkins, 1993; Leeds et al., 2012; Notter et al., 2012). Purebred American Suffolk rams lambs ($n = 22$) and hoggets ($n = 28$) originated from 11 farms were introduced to Israel in 2005. The aim of the present study was to evaluate the American Suffolk as a sire breed for terminal crossing with Afec-Assaf ewes, and to gain insight into the mode of inheritance of the possible differences in growth traits between the Suffolk and Afec-Assaf.

2. Materials and methods

2.1. Animals

Experimental protocols were approved by the Volcani Center's Animal Care Committee. The data for this study were derived from the Afec-Assaf flock of the Volcani Center in Bet Dagan, Israel, where the FecB (Booroola) mutation is segregating (Gootwine et al., 2008). The flock was kept indoors year-round under nondairy management and ewes were fed with concentrates, corn silage and hay to meet their nutritional requirements according to US NRC recommendations (National Research Council, 1985). Reproductive management included three to four breeding periods annually in which ewes were each hand-mated to a single ram following hormonally synchronized estrus. Lamb paternity was verified using breeding and lambing records.

Each ewe ($n = 483$) reared no more than two lambs. Lambs that were removed from their dams were reared in an artificial rearing unit where they were offered ad libidum milk replacer for lambs (Halavit 335, Maabarot Products Ltd., Israel). Following weaning, at about 35 days of age, lambs were fed concentrates ad libitum (16% crude protein and hay at 0.4 kg/day, and had free access to water. Lamb birth weight was determined within a few hours of lambing. Lambs were then weighed at weaning and at about 5 months of age, and preweaning Average Daily Gain (ADG), postweaning ADG and overall ADG were calculated.

2.2. Crossbreeding with Suffolk rams

Contemporaneous comparison of birth weight and growth traits until 5 months of age between Afec-Assaf lambs and Suffolk crossbred lambs was carried out in 10 crops (groups of lambs born during the same lambing period) in the years 2007–2010 (Table 1). Afec-Assaf lambs were progeny of 22 rams. First cross lambs (1/2 Suffolk) were born following insemination of Afec-Assaf ewes with semen collected from seven American Suffolk rams from an insemination center. Lambs belonging to first backcross to the Afec-Assaf (1/4 Suffolk) were born following mating of Afec-Assaf ewes with five 1/2 Suffolk rams. Second backcross lambs (1/8 Suffolk) were born following mating of Afec-Assaf ewes with three 1/4 Suffolk rams.

Table 2
Expected relative performance of Afec-Assaf and Suffolk-Afec-Assaf crosses. Coefficients for transmitted (gi), heterosis (hi), and recombination (ri) effects are relative to the Afec-Assaf.

Genotype	Coefficients for		
	gi	hi	ri
Afec-Assaf	1.0	0	0
1/2 Suffolk	0.5	1.0	0
1/4 Suffolk	0.25	0.5	0.5
1/8 Suffolk	0.125	0.25	0.25

2.3. Statistical analyses

Data on birth weight, preweaning, postweaning and total ADG, were subjected to analysis of variance (ANOVA) using the General Linear Model procedure of the Jump In® computer package (SAS 2001). The statistical model included the effects of: breed/cross (Afec-Assaf, 1/2- 1/4- and 1/8 Suffolk), sire within breed/cross taken as random effect, sex, parity (1–5 and ≥6), lambing season (Spring: March to June; Summer: July to September; Autumn: November to January), crop within season ($n = 10$) and type of birth (single, twin, triplet, quadruplet and more). Differences of $P < 0.05$ were considered significant.

2.4. Crossbreeding effects

The transmitted (gi), direct heterosis (hi) and recombination (ri) effects (Dickerson, 1969) for each trait were estimated by replacing the genotype effect in the analysis with the effect's expectations as defined in Table 2. The recombination effect was taken as the deviation due to changes in nonallelic gene interactions in the crosses relative to those of the F1 generation.

3. Results and discussion

The average ewe prolificacy in this study was 2.44 lambs born/ewe lambing and 2.02 lambs born alive/lambing. On average (mean ± SD), lamb birth weight was 4.5 ± 1.2 kg, weaning age was 35 ± 6 days, weaning weight was 14.7 ± 3.3 kg, and final weight was 54.7 ± 8.2 kg as was recorded at an average age of 153 ± 12 days. Preweaning, postweaning and total ADG averaged 294 ± 66, 343 ± 62 and 330 ± 53 g/day, respectively. Afec-Assaf and Suffolk crossbreeds showed similar survival rates (data not shown).

Significance levels for the main effects on birth weight and preweaning, postweaning and total ADG are presented in Table 3. Sire, sex, parity, season, crop, and litter size,