IDENTIFICATION OF RAMS CARRYING THE BOOROOLA GENE IN THE STRUAN BORDER LEICESTER BOOROOLA PROJECT

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INTRODUCTION

The Booroola gene, (F) was originally identified in Merino (M) sheep by Piper and Bindon (1982). This encouraged C.S.I.R.O. researchers at Armidale to transfer the Booroola gene into the Border Leicester where it could have greater application in the prime lamb industry. To this point these researchers have produced a 7/8 Border Leicester - 1/8 Merino carrying 1 copy of the F gene.

In collaboration with C.S.I.R.O., researchers at Struan Research Centre have also established a Booroola Border Leicester breeding program. The two groups collaborate in that rams bred by the C.S.I.R.O. are progeny tested and mated at Struan Research Centre before being returned to Armidale where they are mated to produce more rams for testing.

One of the central problems involved a breeding program of this nature is the identification of rams which carry the gene.

IDENTIFICATION OF RAMS CARRYING THE F GENE

The identification of Merino rams of genotype FF, F+, or ++ on the basis of natural ovulation rate has been demonstrated by Davis et al (1982). Oldham et al (1984) have used a single ovulation rate induced by 500 iu of pregnant mares serum gonadotrophin (PMSG) in prepubertal ewe lambs to differentiate between ++ and F+ Merino rams.

At Struan we have attempted to test the accuracy of identification of heterozygous sires on the basis of ovulation rate by comparing the ovulation rates from the progeny of six potentially heterozygote 7/8 Border Leicester 1/8 Merino rams at 6, 10, 16 and 20 months of age. The ovulations at 6 and 16 months were induced by PMSG (400 iu). Analysis of variance and least significant differences were used to show similar groups (SAS 1988)

TABLE 1: Mean ovulation rate of ewe progeny of 6 sires at 6, 10, 16 & 20 months of age

Sire	November 1987 6 months	March 1988 10 months	September 1988 16 months	January 1989 20 months
1	1.15 a* (26)**	1.31 a (32)	1.42 a (24)	1.37 a (30)
2	1.57 bc (21)	1.43 ba (21)	1.50 a (20)	1.52 a (23)
3	1.10 a (20)	1.37 a (30)	1.30 a (27)	1.46 a (26)
4	1.25 ac (16)	1.67 b (21)	1.43 a (21)	1.37 a (19)
5	1.09 a (23)	1.36 a (28)	1.52 a (25)	1.41 a (27)
6	1.84 b (25)	1.70 b (23)	1.90 b (30)	2.11 b (27)

* groups with the same character are not different P>0.05
** numbers in brackets - records of zero ovulations were excluded

The ovulation rates at 16 and 20 months of age clearly indicated that ram 6 was the only carrier of the F gene. It appears therefore, that the PMSG stimulation at 6 months of age and even the natural ovulation rate at 10 months of age cannot be reliably used to identify the genotype of some rams. We used the November ovulation rate to identify rams 2 and 6 as F gene carriers. We subsequently had to reject some of ram 2's offspring. If we had used the second ovulation rate alone we would have incorrectly identified ram 4.

Since the female progeny of a ram will be only 7 months of age at the commencement of the next breeding season, a more accurate method of determining the genotype of the sire from the ovulation rates of the ewe lamb is needed. We therefore looked at the November and March ovulation rates to see if there was some way of reducing the chance of selecting a ram which does not carry the F gene.

TABLE 2: Uses of November and March ovulation rate to determine presence of F+ sires.

Sire	Proportion of ewes with Ovulation rate >=3		Mean of November and March ovulation rates	Proportion of ewes with mean Nov-Mar ovulation rate >=2
	Nov. %	Mar. %		%
1	0	0	1.25ab* (58)**	5
2	9	0	1.48abc (42)	19
3	0	0	1.27abc (50)	10
4	0	0	1.52bc (37)	21
5	4	0	1.26ab (51)	10
6	20	13	1.86d (48)	40

* ** See table 1

One alternative is to check for the presence of ewes with ovulation rate >=3 (Davis et al 1982). In both November and March, ram 6 had more than twice the number of these than the other rams, although numbers of ewes with >=3 ovulations were small.

Another alternative is to find the mean ovulation rate of the November and March measurements for each ewe progeny. The mean of this for ram 6 was significantly higher than for other rams. The number of ewes with mean ovulation rate (Nov-March) >=2 also gave a quite distinct differentiation.

It is not known if the time between ovulation counts is important or if measurement on two successive cycles would be satisfactory. The use of 400 iu PMSG here instead of the 500 iu used by other authors may have contributed to the lack of differentiation experienced at the first endoscopy. Where there are more Booroola rams in a progeny test, the differentiation between the group of Booroola rams and non Booroola rams in likely to be less distinct.

THE STRUAN BORDER LEICESTER BOOROOLA PROGRAM

When Booroola Border Leicester rams are used by the breeders of prime lamb dams the proportion of ewes produced which carry the gene will be the same as the frequency of occurrence of the F gene in the group of rams used. Flocks in which all ewes carry the F gene have lambing percentatges of approximately 220% in our environment. As the frequency of ewes carrying the F gene decreases so does the lambing percentage. Thus a ram breeder has to provide rams with as high an F gene frequency as possible. When starting to breed these sheep a ram breeder would have to mate non carrier ewes with FF rams to produce offspring which are all F+ (gene frequency 50%). These mated to a further FF ram would produce offspring of gene frequency of 75%. This gene frequency will increase as more generations are produced using FF rams. In the first place the source of these FF rams would be the Struan or Armidale flocks. However, these ram breeders may choose to breed their own FF rams by crossing their own Booroola ewes and rams and progeny testing. In this way they can restrict the influence of the Struan flock in characters other than the F gene, but progress towards a high F gene frequency would be slowed.

Border Leicester Merino ewes have traditionally been used as dams for lamb production because of their high reproduction rate, lamb rearing ability and lamb growth. However, the value of the wool they produce is less than that of Merino ewes. With the Booroola gene ensuring a high reproduction rate, it is possible that a ewe with more Merino and less Border Leicester ancestory will be more economic because of higher wool value. However, the effect of this on lamb rearing ability and lamb growth is not known.

At Struan we aim to produce two lines of rams, one with a greater than 87% Border Leicester ancestory (BL87 line) which is expected to produce ewes which perform similarly to BL x MO ewes. The other, with 60 - 70% Border Leicester ancestory (BL65 line) will produce ewes with a higher fleece value.

To produce these rams, ewes from two sources have been mated to carrier rams. The first group are BL x MO ewes which had been identified as F+ on the basis of three years lambing records. The female offspring of these ewes will be used to establish the BL65 line. The other source is Border Leicester ewes from which the female offspring will go to developing the BL87 line. Once available, rams identified as homozygous for the F gene will be used. In the early part of the project rams have been used before the results of progeny testing were available so that some progeny may be discarded once the test mating results become available.

For use in ram production in both our own, C.S.I.R.O's and other flocks, it is necessary to use rams which are tested homozygous for the F gene. Thus we will maintain a testing program for rams and will make available semen and/or rams to ram breeders.

As ram testing is expensive, it is impractical to supply tested rams for ewe production. For this we will initially provide groups of rams which are expected to have at least 75% F gene frequency. Subsequently, ram groups with a greater F gene frequency will be provided as the gene frequency of our flock is increased. Other flocks supplying rams would also supply rams in this way.

It is expected that some semen from BL65 FF rams will be available from Struan in 1990 and a small number of untested BL65 ram lambs with expected 75% gene frequency may be available in 1991. For the BL87 line there is a possibility that some FF semen will be available in 1990, but it is more likely that this stage will not be reached until 1991.

As more FF rams become available, selection for production characters and mating to reduce inbreeding will become more important.

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