INVESTIGATIONS OF CARPET WOOL GENES IN SHEEP

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SUMMARY

The genetic control of carpet-wool production in Tukidale and Carpetmaster sheep has been investigated. Trial matings with Romney and Drysdale (*N/N*) ewes indicated that both strains have a major gene for medullation and these genes were completely dominant for hairy birthcoat. The genes are shown to be allelic to the *N*-gene. It is suggested that the genes of this multiple allelic series be given the symbols N^t (Tukidale), N^j (Carpetmaster), N^d (Drysdale) and *n* (Romney and other non-medullated breeds).

INTRODUCTION

The demand for coarse, medullated wool for carpet manufacture has led to strains of sheep being developed to produce this wool.

In addition to the Drysdale two other strains have been developed — the Tukidale and the Carpetmaster. The Tukidale has been developed by M. W. Coop. The Carpetmaster results from Prof. K. B. and G. Cumberland's matings of Perendale ewes to hairy rams bred by L. Johnstone of Te Puke. Some other flocks have also had rams from this source.

The presence and the effects of the *N*-gene were thoroughly established (Dry, 1955) before the gene was used in the commercial development of the Drysdale. The genetics of the other strains is imperfectly understood. Preliminary observations suggest the presence of a major gene in both strains. The symbol *T* has been tentatively proposed for the gene in Tukidales (F. W. Dry and M. W. Coop, pers. comm.; Dalton *et al.*, 1973) while both *K* and *J* have been used for the proposed gene used in the development of the Carpetmaster.

The present study aimed to provide further information on the genetics of these strains and particularly the relation of the genes to the *N*-gene.

MATERIALS AND METHODS

A son of the original Tukidale ram was donated by M. W. Coop and was mated to 31 Drysdale and 20 Romney ewes. At the same time the progenitor of the Johnstone flock was donated

by H. B. Johnston and was mated to 18 Drysdale and 20 Romney ewes.

The progeny of these matings and later generations were examined for the density of halo hairs in the birthcoat and for horn growth. Birthcoats were classified using the system cited by Ryder and Stephenson (1968). Dry (1955) showed that this grading system allows accurate recognition of *N*-genotypes; *N/N* lambs have grade VIIf birthcoats with dense halo hairs over the body; *N/+* lambs usually have grade VI or VIIa, VIIb, or VIIc, VIId or VIIe birthcoats with areas of reduced halo hair density on the front of the body; non-*N* lambs usually have birthcoats of grades I to V.

RESULTS AND DISCUSSION

Matings with Romney Ewes

The birthcoats of lambs born to Romney ewes mated to the original rams are summarized in Table 1.

TABLE 1: BIRTHCOAT GRADE FREQUENCY OF LAMBS BY THE ORIGINAL SIRES FROM ROMNEY EWES

	Birthcoat Grade							
Sire	*I*	*II*	*III*	*IV*	*V*	*VI*	*VIIa-e*	*VIIf*
T	12	2	2	0	0	0	2	7
		16					9	
J	0	4	2	0	0	0	0	5
		6						–

Of the progeny of the Tukidale ram, 16 lambs were identical with normal Romney lambs except that they had fewer halo hairs than most Romneys. The other 9 lambs had hairy birthcoats, most being completely covered with halo hairs all over the body like *N/N* Drysdales. Two had areas of reduced halo hair density and resembled *N/+* Drysdales.

Although only few sheep were involved, the results of this mating support the more numerous observations of F. W. Dry and M. W. Coop (pers. comm.) that a major gene causes the hairy birthcoats of the Tukidale sheep. The results indicated that the ram used was probably heterozygous for this gene.

The small number of lambs by the Johnstone ram from Romney ewes also had non-hairy to hairy birthcoats approaching the

1:1 ratio expected if the ram was heterozygous for a major gene for medullation. H. B. Johnston (pers. comm.) and G. L. B. Cumberland (pers. comm.) have obtained similar results from mating rams of this strain to non-hairy ewes. All the hairy lambs looked like *N/N* Drysdales.

Matings with Drysdale Ewes

Of the 25 lambs by the Tukidale ram from Drysdale ewes, 12 had birthcoats typical of single-*N* Drysdales; two were only moderately hairy but had to inherit an *N*-gene from their dams and were judged single-*N*; 11 were completely covered with halo hairs (grade VIIf) and were assumed to have the hairy gene from the Tukidale sire as well as the *N* gene from the dam. The result is as expected from mating *N/N* ewes to a ram heterozygous for a main gene for hairy birthcoats.

TABLE 2: BIRTHCOAT GRADE FREQUENCY OF LAMBS BY THE ORIGINAL SIRES FROM *N/N* DRYSDALE EWES

	Birthcoat Grade			
Sire	*V*	*VI*	*VIIa-e*	*VIIf*
T	2	2	10	11
		14		
J	0	0	1*	9*

*χ^2 for differences from 1:1 ratio = 4.9, $P < 0.05$

All except one of the 10 lambs born to *N/N* ewes mated to the Johnstone ram had complete coverage of halo hairs over the body. If this is not a chance effect it may indiacte that the ram carried modifiers which resulted in *N/+* lambs having grade VIIf birthcoats. Dry (1955) has shown that this occurs in 1% of *N/+* lambs.

Mating Rams with *N* and Tukidale Genes to Romney Ewes

Two rams sired by the Tukidale ram from *N/N* ewes were mated with Romneys. These rams must have inherited the *N*-gene from their dams and, since their birthcoats were grade VIIf, they also appeared to have the hairy gene from their Tukidale sire. Table 3 shows the birthcoats of the lambs sired by these rams and the expected numbers in the various birthcoat grades if the genes were allelic or non-allelic. The presence of

lambs of non-*N* genotype would indicate that the genes were not allelic. The 5 lambs grade III, IV and V were at first taken as evidence that the situation was not as simple as straight allelism. However, the ratio is significantly different ($P < 0.01$) from the 2:1:1 ratio expected if the genes were independent and progeny tests on two ram lambs, one grade IV and one grade V, indicated that these were $N/+$. Dry (1955) reported that in certain families a number of $N/+$ lambs had birthcoats less than grade VI.

TABLE 3: BIRTHCOAT GRADE FREQUENCY OF LAMBS BORN TO ROMNEY EWES MATED TO RAMS CARRYING THE *N* GENE AND THE TUKIDALE GENE

	Birthcoat Grade						
	< III	*III*	*IV*	*V*	*VI*	*VIIa-e*	*VIIf*
Observed	0	1	2	2	2	18	21
Expected-Allelic			0			23	23
Non-allelic			11.5			11.5	23

Hence it seems that all lambs were of Tukidale or single-*N* genotype and this suggests that the genes are allelic.

Mating Rams with *N* and Johnstone Genes to Romney Ewes

Two grade VIIf rams, sired by the Johnstone ram from N/N ewes, were mated with Romneys. Table 4 summarizes the birthcoats resulting from this mating. The results are very close to the

TABLE 4: BIRTHCOAT GRADE FREQUENCY OF LAMBS BORN TO ROMNEY EWES MATED TO RAMS CARRYING THE *N* GENE AND THE JOHNSTONE GENE

	Birthcoat Grade				
	< V	*V*	*VI*	*VIIa-e*	*VIIf*
Observed	0	1	1	55	48
Expected allelic		0		52.5	52.5
Expected non-allelic		26.3		26.3	52.5

1:1 ratio of VIIf to $N/+$ type birthcoats expected if the genes are allelic and are very different ($P < 0.001$) from a 2:1:1 ratio.

NOMENCLATURE

The evidence points strongly to the genes in the new strains being allelic to the *N*-gene. Whether the Tukidale has the same gene as the Carpetmaster is less clear. The effects are very similar both in the birthcoat and in horn growth where heterozygous rams and ewes are both horned. In view of the degree of dominance of the genes and the lack of relationship between the stocks it seems that both genes must have arisen from a separate mutation. It is therefore safer to assume that the genes are different until more evidence accumulates.

Thus the genes form part of a multiple allele series. This means that the previous symbols used are no longer appropriate and it is suggested that the following symbols be used:

N^j — Carpetmaster — previously referred to as *J* or *K*

N^t — Tukidale — previously referred to as *T*

N^d — Drysdale — previously referred to as *N*

n — Non hairy — previously referred to as + or *n*

REFERENCES

Dalton, D. C.; Bigham, M. L.; Wiggins, L. K., 1973. *Proc. Ruakura Fmrs' Conf.*: 21.

Dry, F. W., 1955. *Aust. J. agric. Res.*, 6: 725.

Ryder, M. L.; Stephenson, S. K., 1968. *Wool Growth.* Academic Press, London, p. 355.