THE GENETICS OF JASSID RESISTANCE IN COTTON

II. PUBESCENT T 611

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Introduction

Leaf hairs of sufficient length and density to confer jassid resistance appear typically to be controlled by a major hairiness gene associated with a complex of minor genes. Such complexes are difficult to transfer from species to species in breeding. For this reason a search was made among a number of hairy varieties of cotton with a view to discovering any major genes, which in association with $\mathbf{H}_1$ would confer jassid immunity, thus obviating the need for a minor gene complex. Simpson (1947) had shown a strong hairiness gene to be present in the Upland type Pubescent T 611. This paper records the results of the genetic analysis of this type, showing that the main T 611 gene is allelic to $\mathbf{H}_2$.

Previous work

Knight (1952) showed that the hairiness gene $\mathbf{H}_1$ provides the core of jassid resistance in the *Gossypium barbadense* types Tanguis and Carpulla, and in the *G. hirsutum* varieties MU 8*b* and St Ignatius. In the *barbadenses* $\mathbf{H}_1$ was accompanied by a number of minor genes with direct effect, whereas in the *hirsutums*, resistance was achieved mainly by intensification of $\mathbf{H}_1$ by modifiers. $\mathbf{H}_2$ was shown to be responsible for the pubescence of *G. tomentosum*, and an unidentified **H** gene, phenotypically similar to $\mathbf{H}_1$, was found to be the basis of jassid resistance in the *hirsutum* type Kapas Purao.

Simpson (1947) described a mutant, extremely pilose Upland (*hirsutum*) type with monogenic 1 : 2 : 1 inheritance. Pilosity and short lint were universally associated, and are regarded as pleiotropic effects of a single gene. Patel & Thakar (1950) found that the leaf hairiness of *G. tomentosum*, when transferred to Upland, also adversely affected staple length.

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DESCRIPTION OF STRAINS

Pubescent T 611. Seed of Simpson's Pubescent T 611 was obtained in January 1948 through the courtesy of Dr C. B. Doyle, of the U.S. Department of Agriculture. Simpson (1947) gives its origin as a mutant which appeared in F_3 of a Trice × Tidewater hybrid. This plant 'had very dense pubescence, which gave the leaves a whitish cast and a feel of velvet. The pubescence was present on all the external surfaces of the plant, including stems, bracts, bolls, and even the petals of the flowers. (On a later selfed generation of this plant, hair counts showed an average of 12·0 hairs per square millimetre on the upper surface of the leaves and 18·8 on the lower. The counts were made on the fourth expanded leaf from the top of the plant; midribs and veins were excluded from the area on which counts were made)...the fibre...was very short.'

Sudan Sakel. The strain of Sudan Sakel (*G. barbadense*) used throughout was BLR 14/16. This is a leafcurl-resistant type carrying the blackarm resistance gene $\mathbf{B}_2$, transferred from *G. hirsutum*. Its leaves, when fully expanded, are almost glabrous, though a few short hairs, in widely separated tufts, are present.

TRANSFERENCE OF HAIRINESS FROM T 611 TO SAKEL

The F_1 of T 611 × Sakel was intermediate in pubescence. Backcrosses to Sakel were made and, in all of these, the pubescent and glabrescent phenotypes were distinct. The classification of these backcrosses is summarized in Table 1.

Table 1. *Hairiness classification of F_1's of Sakel backcrosses*

	Hairy	Glabrescent
1st backcross F_1	37	26
2nd backcross F_1	10	15
3rd backcross F_1	71	80
4th backcross F_1	13	25
5th backcross F_1	7	6
Totals	138	152
Expected (1 : 1)	145	145

These figures corroborate Simpson's findings that a single gene is responsible for the pilosity of T 611.

In each backcross progeny a number of hairy plants were selfed. Progenies of these were grown and their classification is summarized in Table 2.

Table 2. *Hairiness classification of F_2's of Sakel backcrosses*

	Hairy	Glabrescent
1st backcross F_2	200	66
3rd backcross F_2	10	5
4th backcross F_2	98	33
5th backcross F_2	46	23
Totals	354	127
Expected (3 : 1)	$360\frac{3}{4}$	$120\frac{1}{4}$

In these backcross F_2 progenies, it was not possible to distinguish with certainty between **HH** and **Hh** plants.

Seven hairy plants in the third Sakel backcross F_2 were selfed. Of the progenies from these, five split for hairiness and two were pure breeding (the latter comprised 64 and 57 plants respectively).

Check crosses

Crosses were made between Pubescent T 611 and $\mathbf{H_1H_1}$ Sakel. The F_1, consisting of 32 plants, was less hairy than T 611 though more hairy than the $\mathbf{H_1H_1}$ Sakel controls. Five plants were selfed and their progenies, grown in 1949, gave the ratios shown in Table 3.

Table 3. *Hairiness classification of T 611 × $\mathbf{H_1H_1}$ Sakel F_2*

Family no.	Hairy	Glabrescent
J 1232/49	122	5
J 1233/49	123	8
J 1234/49	118	7
J 1235/49	144	8
J 1236/49	124	6
Totals	631	34
Expected (15 : 1)	623·4	41·6

In these families the glabrescent class formed a reasonably clear group but included some plants slightly more hairy than Sakel. This suggests that T 611 carries some slight degree of hairiness other than that conferred by its main gene.

In 1949 three hairy heterozygotes from the second Sakel backcross were crossed with Sakel plants heterozygous for the *tomentosum* gene $\mathbf{H_2}$. The F_1 progenies of this cross gave 28 : 9, 11 : 5 and 3 : 2 hairy : glabrescent plants respectively. Twelve hairy plants were chosen at random from the first of these families. Self-bred progenies from these, grown in 1951, gave the results shown in Table 4.

Table 4. *Hairiness classification of* $\mathbf{H^{T\,611}h^{T\,611}}$ *Sakel* × $\mathbf{H_2h_2}$ *Sakel F_2*

Family no.	Hairy	Glabrescent
J 1134/51	23	8
J 1135/51	71	26
J 1136/51	52	15
J 1137/51	132	—
J 1138/51	33	12
J 1139/51	248	69
J 1140/51	42	15
J 1141/51	83	—
J 1142/51	88	27
J 1143/51	57	29
J 1144/51	34	—
J 1145/51	218	71

Three of the progenies in Table 4, namely, J 1137, 1141 and 1144/51, contained only hairy plants. The remaining families all gave reasonable approximations to expectation on a 3 : 1 basis. Clearly $\mathbf{H^{T\,611}}$ and $\mathbf{H_2}$ are allelic.

Discussion

At the beginning of this work it was considered that the gene controlling T 611 hairiness was 'the strongest **H** gene so far studied' (Knight & Sadd, 1951). As backcrossing progressed, however, the minor gene complex associated with this factor in the donor parent was eliminated, and it became apparent that $\mathbf{H^{T\,611}}$ and $\mathbf{H_2}$ are indistinguishable. Furthermore, $\mathbf{H^{T\,611}}$ has a precisely similar effect on leaf-lobe length to that noted by Harland (1939, p. 84) as a pleiotropic effect of $\mathbf{H^{TO}}(=\mathbf{H_2})$. In view of these facts, and since $\mathbf{H^{T\,611}}$ and $\mathbf{H_2}$ have been shown to occupy the same locus, the two genes are regarded

as identical. This is a matter of some interest, since $\mathbf{H}_2$ was previously only known in *G. tomentosum*. It is essentially a hair-density gene, so that, in the absence of intensifying factors for length, it confers only a tomentum of minute length. On an Upland background, however, $\mathbf{H}_2$ has all the attributes of a strong hairiness gene, because Upland cottons typically carry length intensifiers. Nevertheless, despite this length intensification, $\mathbf{H}_2$ confers a very typical tomentum in Upland, very different from the hairiness controlled by $\mathbf{H}_1$. A gene producing so marked a phenotype would almost certainly have been reported on, had it occurred at all frequently in Upland. The fact that Simpson's (1947) record is the only one suggests strongly that the mutation rate of $\mathbf{h}_2$ to $\mathbf{H}_2$ in Upland must be extremely low.

Work on the association between the $\mathbf{H}_2$ locus and the reduction in staple length (noted by Simpson (1947) in T 611 hybrids and by Patel & Thakar (1950) in *tomentosum* crosses) is being carried out and will be reported on in due course. Although definite data are not yet available, it appears that the reduction in lint length may be due to linkage rather than to pleiotropy.

The gene $\mathbf{H}_2$ also affects (or is linked with a gene affecting) plant height and segregates carrying $\mathbf{H}_2$ are about 20% shorter than $\mathbf{h}_2$ plants.

SUMMARY

The gene controlling hairiness in the Upland variety Pubescent T 611 has been transferred to Sakel and shown to be identical with the *G. tomentosum* gene $\mathbf{H}_2$.

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