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GENETICS OF PLANT PUBESCENCE IN UPLAND COTTON[1]

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UPLAND cotton (*Gossypium hirsutum* L.) normally varies only slightly in plant pubescence. However, three factors which greatly affect the pubescence have been reported. Knight (2) reported two genes, H_1 and H_2, which cause increased plant pubescence. The gene H_2 or an allele of it, which may be associated with shortness of lint (4), occurs in *G. tomentosum* (5). Meyer (3) transferred a gene, Sm, which causes reduced pubescence from *G. armourianum*. The objective of this paper is to report the interactions of pairs of these three genes in segregating populations.

Materials and Methods

The substitution of either H_1 for h_1 or H_2 for h_2 results in a velvety appearance of the terminals, leaves and stems due to increased pubescence. The trichomes are predominantly simple and erect when H_1 is substituted and predominantly stellate and recumbent when H_2 is substituted. The substitution of Sm for sm results in glabrous stems and mature leaves but the terminals remain pubescent.

Three strains carrying H_1, H_2 and Sm, respectively, were crossed in all possible combinations. The three F_1's were then outcrossed to a normal (recessive) strain to produce the outcross generation. Additionally, the F_1's were selfed to produce seed for the F_2 generation. Plots of each of the parental strains, F_1's, F_2's and outcrosses were grown adjacently in 1956.

Results

H_1 × H_2—The F_1 was extremely pubescent as would be expected from bringing together two dominant genes for pubescence. Difficulty was encountered in separating into classes the types having increased pubescence in the F_2 and outcross populations. Therefore, the segregation of pubescence is reported as either normal or increased. In each population (Table 1) there was a good fit to a 2-class, 2-factor ratio.

H_2 × Sm—The F_1 had increased pubescence of terminals, mature leaves and stems indicating that H_2 is epistatic to Sm. Three classes were readily identified in the F_2 and outcross populations: *(1)* Normal pubescence; *(2)* normally pubescent terminals, glabrous stems; and *(3)* increased pubescence. The latter class could not be further subdivided which lends additional weight to the observation in the F_1 that H_2 is epistatic to Sm. The segregations (Table 1) fit dominant epistasis ratios.

H_1 × Sm—The F_1 had increased pubescence in the terminal but the stems were glabrous. Four classes were distinguished in the F_2 and outcross populations: *(1)* Normal pubescence; *(2)* normally pubescent terminals, glabrous stems; *(3)* increased pubescence; and *(4)* increased pubescence in terminals, glabrous stems. The segregations (Table 1) fit normal two-factor ratios.

Table 1—Observed frequencies of pubescence patterns when genes affecting pubescence are segregating in F_2 and outcross populations and chi square tests for goodness of fit.

Population	Pubescence pattern				Ratio	χ^2	P
	Normal	Normal terminal glabrous stems	Increased	Increased terminal glabrous stems			
$H_1 \times H_2$ F_2	8		133		1:15	0.080	.80-.70
$H_1 \times H_2$ OC	12		33		1:3	0.067	.80-.70
$H_2 \times$ Sm F_2	5	7	51		1:3:12	2.546	.30-.20
Sm $\times H_2$ F_2	4	8	41		1:3:12	0.560	.80-.70
Total	9	15	92			3.106	
Deviation						2.804	.30-.20
Heterogeneity						0.302	.90-.80
$H_2 \times$ Sm OC	9	11	15		1:1:2	0.943	.70-.50
Sm $\times H_2$ OC	16	22	28		1:1:2	2.606	.30-.20
Total	25	33	43			3.549	
Deviation						3.495	.20-.10
Heterogeneity						0.054	.98-.95
$H_1 \times$ Sm F_2	10	25	36	70	1:3:3:9	4.790	.20-.10
$H_1 \times$ Sm OC	12	12	21	19	1:1:1:1	4.126	.30-.20

Discussion and Summary

Knowing that Upland cotton is of amphidiploid origin (1), one would tend to surmise that the two genes, H_1 and H_2, which increase the plant pubescence, are duplicates. Yet the actions of these genes in the presence of a factor for glabrousness are different. If they are duplicates and of common origin, their functions have diverged; or, they may not be duplicates. The latter is more plausible since the trichomes differ.

Thrips tolerance—All populations suffered from a heavy infestation of thrips. It was observed that plants having more pubescence in the terminals suffered less from thrips attack. Increased pubescence in the terminals may be a method of reducing the susceptibility of Upland cotton to thrips' attack. However, increasing the pubescence of the entire plant by use of H_1 as has been done to reduce susceptibility to Jassid attack in Africa (2) does not appear feasible since this would increase the trash content of lint that is mechanically harvested.

It appears the breeder is in a dilemma. When he reduces pubescence of the plant to reduce the trash content of mechanically harvested cotton, he increases susceptibility of the plants to thrips attack. However, there may be a way out of this dilemma as indicated by the segregations of H_1 and Sm. The pubescence of the plant is increased by H_1. When Sm is also present the stem and mature leaves have very few trichomes even though the terminal has increased pubescence. The combination of these two genes offers a possibility to reduce both trash content and thrips susceptibility.

The gene H_2 appears to be epistatic to Sm; H_1 does not.

A combination of H_1 and Sm may offer a feasible approach to reduction of thrips damage combined with retention of lint cleanability.

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