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Effects of Two Pilosity Alleles on Agronomic and Fiber Traits in Upland Cotton[1]

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ABSTRACT

The pilosity alleles H_2 and Pilose impart dense pubescence to various plant parts of upland cotton (*Gossypium hirsutum* L.). The effects of the two alleles on selected agronomic and fiber traits were studied in 1982 in two environments on the background of 'Empire', a cultivar which displays a normal density of pubescence. Four entries were compared, i.e., i) homozygous Pilose; ii) normally pubescent siblings of Pilose, designated as C-1; iii) homozygous H_2; and iv) normally pubescent siblings of H_2, designated as C-2. The density of pubescence on leaves of Pilose and H_2 did not differ, and both were about 2.5 times more pubescent than the controls. Pilose did differ from the other three entries in having pubescent bolls. Boll weight was virtually the same for all entries, as was lint percentage. Fiber length varied among entries. C-1 had 21% greater 2.5% span length than Pilose (28.4 vs. 23.4 mm). C-2 displayed 4% greater 2.5% span length than H_2 (27.8 vs. 26.7 mm), a difference not significant at the 0.5 probability level. The 50% span length of the entries correlated closely with 2.5% span length (r = 0.89), and Pilose differed significantly from the other entries in fiber length uniformity index. Micronaire was significantly greater for Pilose than for the other three entires (5.2 vs. 4.4 to 4.5), and the coarser fiber of Pilose was accompanied by a small loss in fiber tensile strength. There were no significant differences in fiber elongation. The possible uses for H_2 in breeding for insect resistance were discussed.**

Additional index words: ***Gossypium hirsutum*** **L.,** ***Gossypium tomentosum*** **Nutt. ex Seem., Plant pubescence, Plant characteristics.**

THE fuzzy-leaf allele of Simpson (6), most often referred to as "Pilose," as in Knight and Sadd (2), imparts dense pubescence on leaves, stems, bracteoles, and carpel walls of upland cotton (*Gossypium hirsutum* L.). The Pilose phenotype provides resistance to *Anthonomus grandis* Boh., the boll weevil (7, 8, 9, 10, 11); but unfortunately, the allele is also associated with a reduction in lint length coupled with an increase in fiber perimeter (micronaire). Simpson (6) noted such a relationship when he reported the fuzzy leaf character, and all subsequent comparisons of Pilose vs. the normally pubescent phenotype on common cultivar backgrounds have shown such an association (1, 3, 4). Therefore, the effects of the Pilose allele on fiber seem attributable to pleiotropy rather than to linkage.

The tetraploid wild cotton, *G. tomentosum* Nutt. ex Seem., displays a dense coat of tomentum on most plant surfaces. Knight (1) showed that a single allele conditioned the dense pubescence of the Hawaiian wild species and designated the allele H_2. Later, Knight and Sadd (2) demonstrated allelism between H_2 and Pilose and declared that the two alleles were identical in expression. Perhaps, the latter statement is the chief reason subsequent workers have referred to Pilose as H_2 (1, 3, 4).

Patel and Thakar (5) transferred H_2 from *G. tomentosum* to *G. hirsutum* and concluded that the allele reduced lint length in the new background. However, no data were given. During the last decade, I also transferred H_2 from a stock of *G. tomentosum* to the upland cultivar Empire and, judging from comparisons of combed fiber, did not detect serious reductions in fiber length. Pilose was simultaneously introgressed into Empire, and the effects of the second allele on fiber length were obvious.

The purpose of the research reported herein was to compare the effects of the H_2 and the Pilose alleles on selected agronomic and fiber traits. Controls were taken as normally pubescent siblings from the backcross programs used to transfer the alleles into the Empire background. The experiments were performed in 1982 in two environments, and the alleles were designated H_2 and Pilose throughout for the sake of clarity.

MATERIALS AND METHODS

Seven backcrosses were used to transfer H_2 from *G. tomentosum* into Empire, and five to transfer Pilose from Simpson's (6) fuzzy-leaf stock into the same cultivar. At the conclusion of the respective backcross programs, plants heterozygous for the alleles were self-pollinated; and the following stocks were selected for seed increases: i) homozygous Pilose; ii) normally pubescent siblings of Pilose, designated as C-1; iii) homozygous H_2; and iv) normally pubescent siblings of H_2, designated as C-2.

The four entries were planted in 1982 in randomized, complete block designs at the Central Crops Res. Stn., Clayton, N.C., and at the Upper Coastal Plains Res. Stn., Rocky Mount, N.C. The single-row plots, 25 m in length, were planted 1 m apart; and six replications per experiment were used. Standard cultural practices were employed throughout the season. Soil at Rocky Mount was a Marlborough silt loam, a member of the clayey, kaolinitic, thermic Typic Paleudults, and at Clayton a Dothan loamy sand, a member of the fine-loamy, siliceous, thermic Plinthic Paleudults.

Number of trichomes were counted along a 1 cm transect on the abaxial surface of the seventh or eighth leaf from the main plant axis. Each sample was taken from an area near the confluence of the main leaf vein, and each plot datum was the average of the samplings of two plants.

Fifty well-filled bolls were harvested at random from each plot, and lint percentage and boll weight in grams of seed cotton were estimated from these samples. Fifty grams of ginned lint were retained from each plot for the estimation of the following fiber properties: i) 2.5% span length in mm, a measure wherein 2.5% of the fibers exceed the length given; ii) 50% span length in mm, a measure wherein 50% of the fibers exceed the length given; iii) fiber length uniformity index, the ratio between 50 and 2.5% span lengths expressed as a percent; iv) T_1 fiber strength, a 3 mm gauge, given in centinewtons per tex; v) micronaire, a measure of fiber perimeter, given as $\mu g\ in^{-1}$; and vi) fiber elongation, a measure of the elasticity of fiber taken during the breaking process, given as a percentage.

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RESULTS AND DISCUSSION

Agronomic Traits

Means and Tukey's honestly significant differences at the 0.05 level of probability for all traits measured are given in Table 1. No significant differences were detected in trichome count between H_2 and Pilose; whereas, both phenotypes displayed about 2.5 times the density of pubescence for their respective controls. Cursory examination of plants homozygous for Pilose and H_2 under field growth suggested that the latter developed the maximum density of pubescence somewhat later in the season than plants homozygous for Pilose. The difference in seedlings is obvious. Perhaps, the most striking difference between the mature plants of Pilose and H_2 is that plants homozygous for the former allele have pubescent bolls; whereas, the *tomentosum* gene does not extend pubescence to the carpel walls.

There were no significant differences in lint percentage among the entries. However, Empire—now virtually obsolete as a cultivar—was never outstanding for lint percentage. Whether or not H_2 would alter the trait in modern, higher lint percent cultivars remains to be seen. Boll weight (g seed cotton boll^{-1}) was not significantly different among entries.

Fiber Properties

Pilose, as expected, lowered 2.5% span length significantly. The 2.5% span length of C-1 was 21% longer than that of Pilose, which was about the same relative difference as had been reported previously when Pilose and normally pubescent siblings were compared (3, 4, 6). The 2.5% span length of H_2 was about 4% less than that of C-2, a difference not significant at the 0.05 level of probability. However, when block pairs of C-2 vs. H_2 were compared, only 1 of 12 of the latter exceeded C-2 for 2.5% span length. Therefore, I concluded that H_2 exacts a small penalty in 2.5% span length in the Empire background.

The estimates for 50% span length correlated closely with those for 2.5% span length over all entires (r = 0.89**); and length uniformity index was, not unexpectedly, highest for Pilose, the shortest-fibered entry.

Micronaire for the Pilose entry was about 16% higher than for C-1. A value of 21% greater for Pilose than its normally pubescent siblings was reported earlier by Lee (4). H_2 did not alter micronaire.

Tensile strength was significantly lower for the short, coarse fibers of Pilose; and the entries did not differ in fiber elongation.

General Conclusions

The H_2 allele, after transfer to the Empire cultivar, imparted a level of tomentum on mature leaves as dense as that conditioned by Simpson's (6) Pilose allele and about 2.5 times as dense as that of the "normally pubescent" Empire cultivar. However, cursory observations of field-grown material led to the conclusion that H_2 maximizes density of pubescence somewhat later in plant development than Pilose.

Unlike Pilose, H_2 did not increase fiber perimeter, and the lack of an effect upon micronaire was accompanied by only a small—not significant at the 0.05 level of probability—reduction in 2.5% span length. None of the remaining fiber properties was affected.

One could speculate that the modest effects of the H_2 allele on fiber, in contrast with the drastic effects of Pilose, are related to the fact that the *tomentosum* allele does not extend pilosity to the boll surfaces. Thus, the gene's action might be minimal in the development of the fruit. Whatever the effects—if any—of H_2 on fruit and fiber, the lack of tomentum on bolls serves to distinguish plants homozygous for H_2 from siblings homozygous for Pilose at a glance. That difference alone counters Knight and Sadd's (2) notion that the effects of Pilose and H_2 are identical.

As cited earlier, Pilose provides antibiosis against the boll weevil, apparently by sealing the bracteoles about the developing flowerbud and thereby excluding the weevil. Pilose cottons are also highly resistant to *Pseudatomoscelis seriatus* (Reuter), the cotton fleahopper (G. A. Niles, Texas A & M Univ., personal communication), a serious pest on cotton seedlings in Texas and Oklahoma.

Unfortunately, Pilose has been invariably found to be associated with shortened lint coupled with increased micronaire, fiber traits not acceptable on current markets. H_2 imparts a density of pubescence similar to that of Pilose, micronaire is not a problem, and the prospects appear good for selecting acceptable fiber length on an H_2 background. Research is required on the effects of H_2 in cultivars with longer staple length and higher lint percentage than Empire and on the reaction of the H_2 phenotype to the boll weevil and other cotton pests.

Table 1. Means for selected agronomic and fiber traits among four genotypes of Empire cotton.

Traits	Entries				Tukey's HSD (0.05)
	Pilose	C-1	H_2	C-2	
Trichomes cm^{-1} of leaf transect	20.3 a*	7.8 b	20.2 a	8.9 b	3.1
Lint percentage	37.1 a	37.5 a	37.7 a	37.5 a	1.2
Boll weight, g	8.9 a	8.4 a	8.8 a	8.4 a	0.5
2.5% span length, mm	23.4 c	28.4 a	26.7 b	27.8 ab	1.5
50% span length, mm	11.2 b	13.0 a	12.4 a	12.7 a	1.0
Length uniformity index, %	47.8 a	44.9 b	46.3 ab	45.3 ab	2.8
Micronaire, μg in^{-1}	5.2 a	4.5 b	4.5 b	4.4 b	0.4
T$_1$ fiber strength, cN, tex^{-1}	16.9 b	18.4 a	18.0 ab	18.3 a	1.3
Elongation, %	7.2 a	6.7 a	6.8 a	6.6 a	0.8

* Means for a trait followed by the same letter were not significantly different at the 0.05 level of probability.

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