Table 1. Results from crossing *G. barbadense* smooth with grade 2 upland tester stocks.

	Pubescent leaves	Semi-smooth and/or smooth leaves	Probability of fit to 15 to 1 ratio
Synthesized grade 2 stock X			
(i) N. C. Smooth 2	7	111	0.80-0.90
(ii) Coker's Smooth	0	109	0.001-0.01

Thus there appeared to be a single allelic pair involved in the determination of degree of plant pubescence in this progeny.

A few of the partially smooth BC_5 plants were selfed. One-half of the progeny had the parental phenotype, one-fourth was grade 4, or pubescent, and one-fourth was grade 2 in the classification of Lee (2). That is, stems are glabrous, and pubescence on leaves is largely confined to leaf margin. Some of these derived grade 2 plants were crossed with the following genetic tester stocks: (i) 'North Carolina Smooth 2,' genotype sm_1sm_1 Sm_2Sm_2, and (ii) 'Coker's Smooth,' genotype $Sm^{sl}_1Sm^{sl}_1sm_2$ sm_2. Both of these stocks are grade 2. F_2 populations were reared, and the distribution of phenotypes in these progenies are given in Table 1.

Only the progeny from the cross of the synthesized stock with North Carolina Smooth 2 segregated for grade of leaf smoothness. At least three phenotypes were detected in this progeny, but smooth and semi-smooth segregates were pooled to produce two clear-cut classes for fitting to a duplicate dihybrid ratio. There is thus evidence for a smoothness allele in AS-2 Sea Island that, after transfer to upland, is identical in expression to Sm_1^{sl}, and is apparently an allele at the sm_1 locus.

DISCUSSION

The expression of plant pubescence in *G. hirsutum* and *G. barbadense* when the species are homozygous for Sm^{sl}_1 is, in some ways, different. In *G. hirsutum*, as in *G. barbadense*, stems are glabrous ab initio. In *G. hirsutum* reduction of leaf pubescence follows a characteristic pattern. The laminal veins (those branching from the largest leaf veins) are glabrous on nascent leaves. There are trichomes on the major veins, but these are lost as the leaf matures. The only trichomes that persist are those around the leaf margin.

In *G. barbadense* there is no evidence that Sm^{sl}_1 reduces leaf tomentum. Some glabrous-stemmed accessions, such as the kidney cottons, *G. barbadense* var. *brasiliense* Macfayden, have sparse tomentum on leaves, whereas others with equally glabrous stems, such as 'Pima S-5', are virtually as pubescent on leaves as some grade 4 uplands. On all smooth-stemmed *G. barbadense* stocks, such pubescence as is present is seemingly distributed at random over the leaf's surface, and not patterned as in *G. hirsutum* stocks homozygous for Sm^{sl}_1.

The Tanguis cottons, *G. barbadense* cultivars from Peru, are much more pubescent than any of the *G. barbadense* cultivars grown in the USA. Moreover, these cottons do not have glabrous stems. The hiatus in pilosity grade between the Tanguis cottons and the most pubescent of the Pima cultivars might be interpreted to mean that Sm^{sl}_1 does reduce pilosity on leaves of *G. barbadense*. However, recent evidence from crossing a Tanguis stock with upland shows that these cottons might also harbour a smoothness allele. Tomentum potential in *G. barbadense* might thus be a matter of accumulation of genetical increment of small effect superimposed upon a basically smooth background.

REFERENCES

1. Ewing, Jr., E. C., E. L. Gilbert, and W. W. Bradford. 1958. The cleaning of smooth-leaved cottons. Proc. 11th Annu. Cotton Improvement Conf.: 17-27.
2. Lee, J. A. 1968. Genetical studies concerning the distribution of trichomes on the leaves of *Gossypium hirsutum* L. Genetics 60:567-575.
3. Lukefahr, M. J., C. B. Cowan, T. R. Pfrimmer, and L. W. Noble. 1966. Resistance of experimental cotton strain 1514 to the bollworm and cotton fleahopper. J. Econ. Entomol. 59: 393-395.
4. Meyer, J. R. 1957. Origin and inheritance of D_2 smoothness in upland cotton. J. Hered 48:249-250.

DIFFERENTIAL RESPONSE TO HAIL DAMAGE AMONG PIMA COTTON STRAINS[1]

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ABSTRACT

Large differences in vegetative regrowth among nine cultivars were noted in an American Pima cotton (*Gossypium barbadense* L.) regional test after severe hail damage on 22 July 1974. These differences were correlated negatively with the lint yield of the same cultivars in a nearby, undamaged, Pima cotton regional test. Correlations of number of new leaves and dry weight of new leaves 5 weeks after hail with lint yield on the undamaged test were —0.84 and —0.91, respectively. Theories on transport and utilization of photosynthate in cotton were used to explain differences in recovery among cultivars.

***Additional index words:* *Gossypium barbadense* L.**

On 22 July 1974, an American Pima cotton (*Gossypium barbadense* L.) regional test near Phoenix, Ariz., was damaged severely by hail. About 4 weeks later, recovery differences among strains were striking. We made this study to measure strain differences in recovery and to relate recovery to observed plant responses in an undamaged test.

Peacock and Hawkins (1974) reported no difference in seed cotton yield of Upland cotton (*G. hirsutum* L.) cultivars after early season hail damage. However, they noted an apparent difference among cultivars in recovery of the more severely damaged plants. Recovery from hail damage is slower from late season damage than from early season damage (Lane, 1954). He reported no significant yield loss from 67 or 75% defoliation, or from topping of plants from seedling to young boll stage of growth.

MATERIALS AND METHODS

Two Pima cotton tests were conducted in the Phoenix, Ariz. area in 1974. Each included the same nine cultivars in a randomized block with eight replications. Plots were 18 m long with four rows spaced 102 cm on center. The center two rows of one test were harvested for lint yield with a spindle picker. The other test received severe hail damage on 22 July 1974, and strain yields were not determined. The field continued to receive normal farm operations after the hailstorm.

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Table 1. New leaf growth in a Pima cotton test 5 weeks after a severe hail and lint yield from a similar undamaged test.

Pima strain	Hail-damaged cotton New leaves/plant		Undamaged cotton Lint yield
	no.	g	kg/ha
Pima S-5	21.8 d*	40.7 b	1,451 a
P30	29.8 bcd	50.1 b	1,413 a
P32	28.6 cd	38.2 b	1,296 b
P28	28.1 cd	44.6 b	1,277 b
Pima S-4	27.3 cd	44.7 b	1,264 b
P33	39.5 ab	86.6 a	999 c
E4	42.9 a	78.1 a	820 d
E6	43.6 a	88.2 a	748 e
Pima S-3	34.9 abc	84.8 a	651 f
C.V., %	29	43	6

* Means within a column followed by the same letter do not differ significantly. at the 0.05 confidence level from other means according to Duncan's multiple range test.

We estimated that 65 to 75% of the leaf area was removed by hail. At least 50% of the growing points were destroyed. Some bolls, particularly the small ones, were lost.

On 26 and 27 August, 5 weeks after hail, all new leaves and petioles of five consecutive plants/plot were picked, counted, ovendried, and weighed. Selection of plants was systematic. Plants in each plot were taken from the same row beginning with the sixth plant from one end of the plot. Bolls were not counted.

RESULTS AND DISCUSSION

Five weeks after hail damage, many small, immature bolls were desiccated and many of the larger bolls had partially opened and then became desiccated. During this time, there was no flowering or fruiting. Brown (1973b) reported defoliation (*G. hirsutum* L.) caused bolls up to 10 days old to shed. Older bolls grew slower, had lower dry weight at maturity, and often mummified on the branch.

The dry weight of new leaves (including petioles) and the number of new leaves, 5 weeks after severe hail damage, are given for nine American Pima cotton strains in Table 1. Lint yield for the same, but undamaged cotton strains, 16 km from the hail-damaged test, also is presented in Table 1. Cotton strains with fewer new leaves and lower new leaf dry weights in the damaged cotton had higher yields in the nearby undamaged cotton. Correlation between the average number of new leaves for each strain in the damaged cotton and mean lint yield per strain in the undamaged cotton was —0.84, and that between weight of new leaves and lint yield was —0.91. Both are statistically significant at the 0.01 probability level.

The negative correlations between plant recovery and lint yield suggest a difference in photosynthate available for initiation of early vegetative regrowth. Brown (1973a, b) and Ashley (1972) showed that most of the photosynthate produced by a cotton leaf remains in its sympodium (fruiting branch) with most of it going to the subtending boll. Brown (1973b) also reported that leaves on the middle and top of the plant contribute photosynthate to the bottom bolls, but with no apparent photosynthate flow in the reverse direction. The evidence in these and other papers suggests that immature bolls are attractive sinks for photosynthate and thus it is less available for vegetative growth.

The higher yielding strains of these tests exhibit heat tolerance at Phoenix, while the low yielding strains do not. Heat-tolerant strains produce more immature bolls at Phoenix during mid-season than heat-susceptible strains. We found that heat-susceptible strains had about twice as much regrowth 5 weeks after the hailstorm as heat-tolerant strains, suggesting that the fewer bolls on the heat-susceptible lines allowed more photosynthate for vegetative regrowth.

REFERENCES

1. Ashley, D. A. 1972. ^{14}C-labelled photosynthate translocation and utilization in cotton plants. Crop Sci. 12:69-74.
2. Brown, K. J. 1973a. Factors affecting translocation of carbohydrates to fruiting bodies of cotton. Cotton Grow. Rev. 50:32-42.
3. ———. 1973b. Effect of selective defoliation on development of cotton bolls. Cotton Grow. Rev. 50:106-114.
4. Lane, H. C. 1954. Effects of injuries simulating hail damage to cotton. Texas Agric. Exp. Stn. Prog. Rep. 1660. p. 1-7.
5. Peacock, H. A., and B. S. Hawkins. 1974. Hail damage to Upland cotton. Agron. J. 66:100-104.