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EFFECTS OF THE PILOSE ALLELE, H_2, ON A LONG STAPLE UPLAND COTTON[1]

Joshua A. Lee[2]

DENSE pubescence on the leaves of Upland cotton (*Gossypium hirsutum* L.) imparts resistance to the attacks of certain insect pests. Thus Knight (1) found that the "hairy" allele, H_1, when homozygous, increases resistance to the cotton jassid (*Empoasca* spp.). The pilose allele, H_2, not allelic to H_1, produces an even more dense pubescence than the H_1 allele. Stephens (3) (4), Stephens and Lee (5), and Wessling (6) (7) reported that H_2, when homozygous and in combination with H_1 and some other characters, provides measurable resistance to the boll weevil (*Anthonomus grandis* Boh.).

Unfortunately, H_2 is invariably associated with decreased lint length coupled with increased Micronaire.[3] Simpson (2) noted that the pilose allele had this property when it appeared *de novo* among his stocks and ascribed its effects on lint to pleiotropism. Reductions in lint length of 1/8 inch or more were recorded. H_1, according to Knight (1), has no known effects upon lint properties. Thus the foreseeable difficulties in using the aforementioned character complex in attempts to ameliorate the boll weevil problem in the Southeastern cotton-growing region, seemingly, reside mostly with the H_2 allele.

The marketing structure in the Southeast generally expects locally grown fiber to exceed 1 inch in length. The staple length of the best adapted varieties in this region usually falls within the range of 1 1/32 to 1 1/16 inches. Allowing for a loss of 1/8 of an inch, this fiber is too short to combine with pilose without suffering an objectionable sacrifice in staple length.

If the 1/8-inch toll noted by Simpson is the general amount exacted by H_2, the so-called long staple cottons in the 1 1/8- to 1 1/4-inch range should be long enough to compensate for this loss and give fiber with length acceptable for Southeastern conditions. Some of the findings of Stephens (data unpublished) tended to sustain this hope. Stephens was able to produce pilose cottons of acceptable length by incorporating germ plasm from *Gossypium barbadense* L. into pilose *G. hirsutum*. The "background" length of these introgressants has not been determined. It could have been as long as 1 1/2 inchs, since strains which are basically *G. hirsutum*, but which contain much *G. barbadense* germ plasm are available in this fiber length range. The Sealand cottons are examples of this type. These "extra-long" cottons are very poor yielders in the Southeast, however; and, a strain with fiber length in the range of 1 1/8 to 1 1/4 inches with reasonably good yield would probably be more easily obtained. Therefore, the effects of pilose on lint within this length interval seemed to offer a study of some pertinence.

In 1958 D. C. Harrell of the Pee Dee Experiment Station, Florence, S. C., kindly supplied seed of Earlistaple 7, and Upland strain having a minimum upper-half-mean lingth of 1.20 to 1.25 inches (equals about 1 3/16 inches, classer's staple length). On the average Earlistaple 7 yields only 75% as much fiber as a common commercial variety Coker 100–A.

Earlistaple 7 was crossed to the strain T × T Hairy Plant, Regional Collection ascession No. 117. T × T Hairy Plant is of the genotype H_2H_2 and has an upper-half-mean length of about 0.90 or less than 1 inch, classer's staple length. Following 3 backcrosses to Earlistaple 7, 11 plants heterozygous for pilose were selfed and the seed saved to rear sets of segregating progenies. The 11 progenies were grown in adjacent rows of 25 hills each, the hills spaced 18 inches in the drill. Before the onset of flowering, the plants heterozygous for pilose were rogued, leaving only plants homozygous for pilose or non-pilose. The remaining plants were allowed to produce a crop under open pollination. A random sample of seed cotton was taken from each phenotype in each progeny row and the samples ginned on a roller gin. A 15-gram sample of fiber from each phenotype in each progeny row was analyzed by the U. S. Fiber Laboratory, Knoxville, Tennessee. The results are presented in Table 1.

Table 1. Comparative staple lengths and Micronaire values, pilose and nonpilose sibling pairs from introgression of pilose into Earlistaple 7 cotton.

Family	Pilose ($H_2 H_2$)		Nonpilose ($h_2 h_2$)	
	Upper-half-mean length, inches	Micronaire values	Upper-half-mean length, inches	Micronaire values
1	0.95	6.23	1.21	4.99
2	0.99	5.87	1.20	4.68
3	0.90	5.70	1.15	4.15
4	0.97	6.00	1.14	4.92
5	0.97	5.88	1.14	4.65
6	0.97	4.98	1.13	4.58
7	0.99	5.45	1.13	5.08
8	0.95	5.83	1.10	4.80
9	0.89	6.00	1.10	4.63
10	0.93	5.95	1.09	5.00
11	0.83	6.43	1.06	5.33
T × T Hairy Plant	0.90	6.28		
Earlistaple			1.23	4.27
Coker 100-A			1.13	5.07

Introduction of pilose into a fairly long background does result in plants with fiber longer than that of the original pilose parent. However, the best of the pilose siblings have fiber shorter than the modal length of current Southeastern varieties, of which the variety Coker 100–A is typical. In addition the Micronaire values are generally somewhat above values demanded in Southeastern cottons. No selection for fiber properties was practiced during the backcrossing phase of the experiment. Thus considerable variation exists within both the pilose and non-pilose arrays. However, the arrays do not overlap, making it reasonably clear from the small sample studied that H_2 alters fiber in the 1 3/16-inch range to proportions of both length and micronaire not eminently suited to current demands for Southeastern cotton. The prospects for using pilose in attemps to ameliorate the boll weevil problems of the Southeast do not appear to be good.

Literature Cited

1. KNIGHT, R. L. The genetics of jassid resistance in cotton. I. The genes H_1 and H_2. J. Gen. 51:47–66. 1952.
2. SIMPSON, D. M. Fuzzy leaf in cotton and its association with short lint. J. Hered. 38:153–156. 1947.
3. STEPHENS, S. G. Sources of resistance of cotton strains to the boll weevil and their possible utilization. J. Econ. Ent. 50: 415–418. 1957.
4. ————. Laboratory studies of feeding and oviposition preferences of *Anthonomus grandis* Boh. J. Econ. Ent. 52: 390–396. 1959.

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[2] Geneticist, Crops Research Division, ARS, USDA.

[3] A measure of fineness determined by an air-flow instrument and expressed as Micronaire values.

5. ——————, and HONG SUK LEE. Further studies on the feeding and oviposition preferences of the boll weevil *(Anthonomus grandis)*. J. Econ. Ent. 54:1085–1090. 1961.
6. WESSLING, W. H. Resistance to boll weevil in mixed populations of resistant and susceptible cotton plants. J. of Econ. Ent. 51:502–506. 1958.
7. ——————. Genotypic reactions to boll weevil attack in upland cotton J. of Econ. Ent. 51:508–512. 1958.

INHERITANCE OF GREENBUG RESISTANCE IN OATS[1]

James H. Gardenhire[2]

RESISTANCE to the greenbug, *(Toxoptera graminum* Rond.), was first observed in small grains by Atkins and Dahms (1) during greenbug outbreaks in 1942. Several barley varieties, all of Oriental origin, were observed to have tolerance to the greenbug in this natural infestation. Only small differences in reaction were observed between genetypes of oats and wheat. Additional field observations were made in 1943 and 1944 but no high degree of resistance was observed in wheat and oats. Dahms et al. (5) tested 221 varieties and strains of oats in search for resistance but observed only minor degrees of resistance. Chada et al. (3), in 1955 and 1956, screened the USDA world collection of oats for greenbug resistance and found several strains to have a relatively high degree of tolerance. Seventy-four of the 77 oats that were found to have some tolerance were subjected to additional testing and 10 of the most resistant strains were listed (3).

Several authors have reviewed the literature (3, 5, 6) on greenbugs. Also, several papers have been published on the inheritance of greenbug resistance in barley and wheat (3, 4, 5, 7, 8, 9, 10).

Two crosses were made in 1958 to study the mode of inheritance of greenbug resistance in oats. 'Russian 77', C.I. 2898), *Avena sativa L.,* was used as the resistant parent and was crossed to 'New Nortex', (C.I. 3422), *Avena byzantina* C. Koch, and to (Red Rustproof-Victoria × Richland) × Ranger, Texas Selection 2, hereafter referred to as Selection 2.

The procedure used for testing F_2 plants and F_3 families in a controlled environmental insectary was that described by Chada (2) and Gardenhire and Chada (8), with one exception. Twenty plants were tested from each F_3 family instead of 10; therefore, 6 F_3 families were tested in each flat instead of 12. The rating of the plants was the same as described by Gardenhire and Chada (8). The parents of each cross were included in each flat as the susceptible and resistant checks for comparison. The scale used was 1 to 5, with a rating of 1 indicating little or no damage and 5 indicating a plant beyond recovery. Plants rating 1, 2, and 3 were called resistant and those rating 4 and 5 were called susceptible.

The variety, Russian 77, was not immune but had a high degree of tolerance to greenbugs when grown in the insectary. When infested with large populations of greenbugs for a prolonged period Russian 77 can be killed. After 14 days of infestation, Russian 77 howed some leaf discoloration and was usually rated 2 or 3 using the 1 to 5 scale. Plants of susceptible check varieties and susceptible F_2 plants and F_3 families were all dead at the end of 14 days of infestation.

[1] Contribution of the Texas Agricultural Experiment Station, Substation No. 6 Denton, Texas. Received Feb. 20, 1964.

[2] Assistant Agronomist, Texas Agricultural Experiment Station.

Table 1. Greenbug reaction of susceptible × resistant F_2 plants, F_3 families, and unselected F_3 heads from F_2 population and tests for goodness-of-fit for monogenic inheritance.

Cross	Generation	Resistant	Segregating	Susceptible	P
Russian 77 × Sel. 22	F_2	84		44	0.02-0.01
	F_3	30	64	26	0.70-0.50
New Nortex × Russian 77	F_3	7	11	6	0.98-0.95
Unselected heads from F_2 bulk population	F_3	42	101	56	0.50-0.30

The reaction of the F_2 plants, F_3 families, and F_3 random head selections from F_2 bulk are given in Table 1. No F_1 plants and only F_2 plants from one cross were tested because of inadequate seed supplies. F_2 plants from the cross Russian 77 × Selection 2 gave a poor fit ($P=0.02$–0.01) to a 3:1 ratio. Some plants died several days before susceptible parent plants were killed. They were probably killed by seedling diseases, but this was not definitely determined and these plants were included in the susceptible group. Randomly selected F_3 families of this cross gave a close fit to a 1:2:1 ratio ($P=0.70$–0.50). In some instances the susceptible plants in the F_3 families lived a day or two longer than plants of the susceptible check. This may have been caused by the age or number of aphids on the plants as it has been observed that aphids do not multiply in some flats as fast as in others for reasons unknown.

Only 24 F_3 families were tested from the second cross, New Nortex × Russian 77. Although the number was very small, a good fit ($P=0.98$–0.95) was obtained for a 1:2:1 ratio. The F_3 families were easily classified as resistant, segregating or susceptible.

Also tested from the New Nortex × Russian 77 cross, were 199 heads selected from F_2 bulk population. Assuming that the F_2 plants produced equal number of heads a good fit ($P=0.50$–0.30) was obtained for a 1:2:1 ratio, giving further evidence in support of the F_3 family test.

Based on the present data it is hypothesized that the inheritance of greenbug resistance in the oat variety Russian 77 is conditioned by a single gene pair.

Literature Cited

1. ATKINS, I. M., and Dahms, R. G. Reaction of small-grain varieties to greenbug attack. USDA Tech. Bul. 1945.
2. CHADA, HARVEY L. Insectary technique for testing the resistance of small grains to the greenbug. J. Econ. Ent. 52:276–279. 1959.
3. ——————, ATKINS, I. M., GARDENHIRE, J. H., and WEIBEL, D. E. Greenbug resistance studies with small grains. Texas Agr. Exp. Sta. Bul. B982. 1961.
4. CURTIS, B. C., SCHLEHUBER, A. M., and WOOD, E. A., JR. Genetics of greenbug (*Toxoptera graminum* Rond.) resistance in two strains of common wheat. Agron. J. 52:499–602. 1960.
5. DAHMS, R. G., JOHNSTON, T. H., SCHLEHUBER, A. M., and WOOD, E. A., JR. Reaction to small grain varieties and hybrids to greenbug attack. Okla. Agr. Exp. Sta. Bul. Tech. Bul. T-55. 1955.
6. DANIELS, N. E., CHADA, H. L., ASHDOWN, D., and CLEVELAND, E. A. Greenbugs and some other pests of small grain. Texas Agr. Exp. Sta. Bul. 845. 1956.
7. ——————, and PORTER, K. B. Greenbug resistance studies in winter wheat. J. Econ. Ent. 51:702–704. 1958.
8. GARDENHIRE, J. H., and CHADA, HARVEY L. Inheritance of greenbug resistance in barley. Crop. Sci. 1:349–352. 1961.
9. PAINTER, R. H. Insect resistance in crop plants. The MacMillan Co. 1951.
10. SMITH, O. D., SCHLEHUBER, A. M., and CURTIS, B. C. Inheritance of greenbug (*Toxoptera graminum* Rond.) resistance in four varieties of winter barley. Crop Sci. 2:489–491. 1962.