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Boll Weevil Resistance, Agronomic Characteristics, and Fiber Quality in Progenies of a Cotton Cultivar Crossed with 20 Primitive Stocks[1]

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ABSTRACT

Primitive race stocks of cotton (*Gossypium hirsutum* L.), were crossed and backcrossed twice to the recurrent cultivar 'Deltapine 16.' These progenies were evaluated for boll weevil (*Anthonomus grandis* Boheman), oviposition suppression in 1973, 1974 or both, and for agronomic characteristics and fiber quality in 1973. Lines were grown in replicated field tests, and oviposition was measured weekly during the fruiting period under boll weevil infestations. T-25B-58 (BC_2F_3), T-80 (BC_2F_2), and T-209 (BC_2F_2) had significantly less oviposition than the control, Deltapine 16 in 1973. Resistance is in diverse genetic stocks of cotton, which might be of economic importance. The agronomic characteristics and fiber properties of the progenies have rapidly approached those of commercial cultivars. Since no character associated with the primitive race stock adversely affected agronomic quality, these lines might be useful in the development of boll weevil-resistance cottons if satisfactory yields could be obtained.

***Additional index words:* *Gossypium hirsutum* L., *Anthonomus grandis* Boh., Host-plant resistance.**

FOR over 50 years, boll weevils (*Anthonomus grandis* Boheman) on cotton (*Gossypium hirsutum* L.) have been controlled successfully in the southern USA with consistently improved insecticides. The mounting costs of insecticides and their application have reduced the narrow profit margin of production. The banning of DDT and the possibility that other hydrocarbon and phosphate insecticides used extensively in controlling cotton insects could be banned has caused researchers to investigate other possible control methods.

Cook (1904) suggested that development of a cotton cultivar in which the boll weevil larvae could not mature seemed to be the only way to prevent this insect from destroying the cotton industry. The most important genetic step taken to reduce damage has been the development of early maturing cultivars that escape much of the boll weevil infestation period (Hunter and Coad, 1922).

Studies of plant collections taken from the center of origin where the plant and pest have co-existed for centuries, could provide a source of resistance to boll weevils. The centers of origin for upland cotton are considered to be Mexico and Central America, and several expeditions (Agricultural Research Service, 1974) have been made into these areas to collect plants. After extensive study of those wild cottons, Hutchinson (1951) proposed seven geographic races of *G. hirsutum: latifolium, morrilli, palmeri, richmondi, punctatum, marie-galante,* and *yucatanense.*

In 1968, researchers screened 77 entries from the Texas race collection for boll weevil oviposition suppression using a technique described by Buford et al. (1967). The test was conducted at Brownsville, Texas, and 20 entries originating from either the race *latifolium* or *punctatum* exhibited a reduction in oviposition when compared to the control, a commercial cultivar. Most of the stocks were photoperiodic. A few of the stocks will flower 6 to 8 weeks after upland cultivars but they are poor lint producers.

A backcrossing program was initiated to eliminate the photoperiodic response of the 20 selected entries so that they could be evaluated for boll weevil resistance and agronomic characteristics under cotton belt conditions. Insect resistance is valuable in agronomically acceptable cultivars in which yield and fiber quality are equivalent to commercial cultivars or when profitable yield of acceptable fiber can be obtained under reduced insecticide applications. The purpose of this study was to evaluate backcross progenies for boll weevil resistance, agronomic characteristics, and fiber quality.

MATERIALS AND METHODS

Twenty different primitive race stocks of *G. hirsutum*, races: *punctatum* or *latifolium*, that exhibited resistance to boll weevil oviposition were crossed with 'Deltapine 16' at Iguala, Mexico, during the winter of 1969-70, and backcrossed twice with the recurrent parent, Deltapine 16, at Iguala during the winters of 1970-71 and 1971-72. The progenies were then selfed to produce the various generations for testing. Two of the stocks, T-25 and T-495, were race *punctatum* and the other primitive stocks were race *latifolium*. The T number refers to the Texas Accession number of the primitive race stock in the cross.

1973 Field Test. A randomized, complete block design with six replications was used to compare boll weevil oviposition resistance of 23 backcross progenies and three controls, Deltapine 16, 'La. Frego-2', and 'Pilose.' Deltapine 16 and La. Frego-2 were replicated three and two times, respectively, per replication to insure adequate control material. Seeds were planted 25 May in plots of six rows (rows 1.0 m apart), each 6.1 m long. Good cultural practices were followed throughout the growing season. A boll weevil infestation developed naturally when insecticide applications were delayed. After the entries began to square rapidly, 50 squares were taken at random from each plot and examined for oviposition punctures. Everett and Ray (1962) reported that the female boll weevil secretes a substance which seals her egg puncture in the square. The sealed punctures were counted for a rapid estimation of oviposition on 23 and 30 July, 6, 13, and 20 August, and the counts were converted to percent oviposition-damaged squares per plot. The data were then analyzed as a split-plot in time with the five dates comprising the subplot.

When the bolls were open and ready for harvest, a 50-boll sample was hand picked at random from the plants in each entry. Each sample was saw ginned, and lint percentage, boll size, and seed index were determined. Lint percentage was estimated as the weight of lint ginned from a sample of cotton and expressed as a percentage of the weight of seed cotton. Boll size

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Table 1. Mean oviposition for selections from backcrosses between primitive race stocks and Deltapine 16.

	Mean % oviposition punctured squares†		
	BC_2F_2		BC_2F_3
Material	1973	1974	1974
T-25	26.3 f–h	26.1 b–i	28.9 a–f
T-25B-58	20.9 h–i‡	--	25.2 b–j
T-25B-58	--	--	20.5 e–j§
T-25B-58-1	--	--	25.4 b–j
T-25B-58-2	--	--	19.1 f–j
T-25B-58-3	--	--	17.8 g–j
T-25B-58-4	--	-	27.1 b–g
T-25B-58-5	--	--	27.2 b–i
T-25B-58-6	--	--	26.5 b–i
T-25-59	30.1 c–h§	26.5 b–i§	20.7 d–j¶
T-59	25.1 g–h	23.1 b–j	30.4 a–e
T-66	26.5 f–h	23.9 b–j	29.8 a–e
T-69	32.1 c–h	--	30.5 a–e
T-75	26.5 f–h	16.5 h–j	29.0 a–f
T-78	27.6 d–h	23.4 b–f	25.3 b–j
T-80	20.9 h–i*	28.8 a–f	30.3 a–e
T-84	25.8 f–h	27.0 b–g	22.8 b–j
T-87	28.7 d–h	--	27.5 a–g
T-88	33.6 b–g	30.5 a–e	23.7 b–j
T-91	35.1 b–f	--	31.4 a–c
T-100	27.9 d–h	--	22.4 b–j
T-106	31.1 c–g	28.0 a–g	25.0 b–j
T-113	25.6 g–h	24.3 b–j	24.5 b–j
T-158	29.9 c–h	31.0 a–d	32.6 a–b
T-195	28.0 d–h	25.3 b–j	26.0 b–i
T-201	27.6 d–h	26.1 b–i	31.1 a–d
T-209	16.2 i–j*	--	21.7 c–j
T-223	26.9 e–h	--	29.7 a–e
T-223	26.3 f–h‡	--	24.3 b–j§
T-495	28.4 d–h	21.6 c–j	25.8 b–i
Pilose	13.1 i–j*	--	--
La. Frego-2	8.5 j*	16.4 i–j*	--
Deltapine 16	30.8 c–g	26.9 b–h	--

† Means within years followed by the same letter were not significantly different at the 0.05 level using Duncan's New Multiple Range Test. * Lines which received significantly less oviposition than Deltapine 16 at the 0.05 level. ‡ BC_2F_3. § BC_2F_4. ¶ BC_2F_5.

was determined as the weight in grams per boll of seed cotton. Seed index was measured as the weight (g) of 100 seeds. Lint samples of each entry from two replications were sent to the USDA Cotton Quality Laboratories at Knoxville, Tenn., for analysis of the following fiber characteristics: fiber length, 2.5% span length in mm; micronaire, a measure of fiber fineness; T_o fiber strength, measured on the stelometer with the jaws separated by a 3.2 mm spacer; E_1 fiber elongation, expressed as a percentage; and yarn tenacity, the force required to break skeins of yarn.

1974 Field Tester. A randomized, complete block design with five replications was used to study the performance of entries and control cultivars. Deltapine 16 was included three times per replication to insure adequate check material throughout the test. Seeds were planted 21 May in plots of four rows (rows 1.0 m apart) each 7.6 m long. Recommended cultural practices were followed throughout the season.

A high level of overwintering weevils was present in 1974. An insecticide, methyl parathion (280 g/ha), was applied on 12 July, at the beginning of squaring. Starting 9 August, azinphosmethyl (280 g/ha) was applied weekly for boll weevil control.

The oviposition damage square counts were made on 18 and 25 July, 1, 8, 15, and 22 August. The counts were taken and analyzed as in the 1973 field test.

RESULTS AND DISCUSSION

In 1973, oviposition was significantly lower in T-25B-58 (BC_2F_3), T-80 (BC_2F_2), T-209 (BC_2F_2), La. Frego-2, and Pilose than in the susceptible control, Deltapine 16 (Table 1). Pilose and La. Frego-2 were entered as controls because they have been reported to carry resistance to boll weevil (Wannamaker, 1957; Wessling, 1958a, 1958b; Jones et al., 1964; Hunter et al., 1965; Lincoln and Waddle, 1966; and Jenkins et al., 1969). In 1974, boll weevil infestation was heavier than in 1973 and La. Frego-2 was the only entry with significantly less oviposition than Deltapine 16. T-25B-58 (BC_2F_3 and BC_2F_4) and T-209 (BC_2F_3), which had less oviposition in 1973 also had the lower counts in 1974.

The BC_2F_2 and BC_2F_3 mean for each line tested in 1974 were in the same statistical class for all entries, except T-75. In 1974, but not in 1973, the number of overwintered weevils necessitated the use of insecticides for maintenance of a desirable weevil population. In general, the selections with higher resistance in 1973 had lower oviposition in 1974. Those stocks are important not only for their boll weevil resistance but also for their genetic diversity.

All backcross progenies flowered at Mississippi State, Miss. These progenies had not been deliberately selected for agronomic characteristics. Lint percentage was significantly lower than that of Deltapine 16 in all but nine BC_2F_2 progenies (T-59, T-66, T-80, T-84, T-113, T-195, T-201, and T-495). The only populations that were significantly different from Deltapine 16 for boll size were T-25B-58 (BC_2F_3), T-223 (BC_2F_2) and T-223-B56 (BC_2F_3) which were significantly smaller. In general, the agronomic properties of the progenies had rapidly equaled those of the recurrent parent Deltapine 16.

All fiber quality measurements were markedly improved over the original parental race stock (Agricultural Research Service, 1974), and most were equivalent to those of Deltapine 16. A few progenies had greater fiber and yarn strength than Deltapine 16, but the findings are questionable because only two measurements of fiber quality were made. The recovery of acceptable fiber and spinning properties in addition to boll weevil resistance in these backcross progenies is encouraging.

Raising the yield level of these progenies is more difficult. Improvement of yield and quality in interspecific crosses, which might be comparable with the primitive races has been slow and tedious. We believe that this material might be useful in insect management systems in that a yield reduction could be tolerated if reduced insecticide applications cut production costs. Additional studies are needed to determine the value of this material in cotton insect management programs, particularly after additional cultivar improvements are made.

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