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Partial Suppression of Boll Weevil Oviposition by a Primitive Cotton[1]

Jack C. McCarty, Jr., J. N. Jenkins, and W. L. Parrott[2]

ABSTRACT

Four photoperiodic, primitive race stocks of cotton, *Gossypium hirsutum* L., which had previously exhibited resistance to oviposition by the boll weevil, *Anthonomus grandis* Boheman, were each crossed to 'Deltapine 16' and subsequently selected for the day-neutral flowering habit. These progeny were then backcrossed twice to their respective original primitive stocks and selected for day neutrality after each backcross. The resulting progenies were evaluated using a laboratory technique which measures boll weevil oviposition. Weevils oviposited significantly ($\alpha = 0.10$) less often on a BC_2F_3 progeny of T-78 than on the controls, Deltapine 61 and 'Stoneville 213'. The level of resistance in the day-neutral T-78 progeny approached that of the original photoperiodic stock. No differences in amount of oviposition among the controls and the other three BC_2F_3 progenies (i.e., T-80, T-759, and T-1149) were detected.

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

THE boll weevil, *Anthonomus grandis* Boheman, entered Texas from Mexico in the early 1890's and began its journey across the southern and southeastern United States, reaching the east coast in the early 1920's. The weevils' march and destruction through the rain-grown Cotton Belt is recorded in the annals of history. Ever since its arrival, farmers and scientists have been searching for ways to control or eliminate this destructive pest.

Cook (1904) suggested that development of cotton, *Gossypium hirsutum* L. and *G. barbadense* L., in which the boll weevil larvae could not mature seemed to be the only way to prevent this insect from destroying the cotton industry. However, this possibility received little emphasis after the development of effective insecticides. In recent years (i.e., since 1960), the increasing resistance of pests to insecticides, the buildup of pesticide residue levels in the environment, the banning and possibility of banning pesticides, and the mounting costs of insecticides and their application have increased the emphasis placed on alternative methods of control.

Painter (1951) suggested that plant collections made in centers of origin where the plant and the pest coexisted for many years may provide sources of resistance. On collection trips in 1946, 1947, and 1948 to the center of origin (Mexico and Central America) of Upland cotton, more than 600 primitive accessions were collected and brought to the United States (Anonymous, 1974). When grown in the summer growing season at College Station, Tex., more than one-half of those accessions remained vegetative (Lewis and Richmond, 1957). Hutchinson (1951) grew most of the stocks in Africa and proposed a classification of seven geographic races of *G. hirsutum: latifolium, morrilli, palmeri, richmondi, punctatum, marie-galante,* and *yucatanense.* The term "race" is not recognized as a formal taxonomic category (Fryxell, 1976), but the above names are useful in discussing the various groups of noncultivated stocks of *G. hirsutum.*

During 4 years of testing (1967, 1968, 1972, and 1973), 191 primitive race stock accessions were, because of photoperiod, grown in Mexico and evaluated in the United States for suppression of oviposition by the boll weevil; and 69 were rated as resistant (Jenkins et al., 1978). The evaluation was conducted using a technique described by Buford et al. (1967). Most of the stocks evaluated were photoperiodic and would not flower during the long days of the growing season in the rain-grown Cotton Belt. A program was initiated in our laboratory in 1976 to incorporate day-neutral genes into photoperiodic primitive race stocks of cotton (McCarty et al., 1979). The purpose of the study reported herein was to evaluate day-neutral backcross progenies of four race stocks for their resistance to oviposition by the boll weevil.

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[2]Research agronomist, research geneticist, and research entomologist, respectively, Crop Sci. and Eng. Res. Lab., P. O. Box 5367, Mississippi State, MS 39762.

MATERIALS AND METHODS

Four primitive race stock accessions (T-78, T-80, T-759, and T-1149) which had exhibited resistance to boll weevil oviposition in previous studies were crossed with 'Deltapine 16' (DPL-16) at Iguala, Mexico, during the winter of 1970–1971 or 1973–1974. In 1975, F_2 populations of the crosses were grown at Mississippi State; and day-neutral plants were selected. The first backcrosses of day-neutral plants to their respective accessions were made in 1975–1976 at Iguala. In 1977, BC_1F_2 plants were grown at Mississippi State where day-neutral plants were again selected for backcrossing to the race stock. The second backcross was made during the winter of 1977–1978 in Mexico, and subsequent BC_2F_2 plants were grown at Mississippi State in 1979. At that time one boll was harvested from each plant that set fruit, and the bolls were bulked for each of the four race stock populations. That bulked seed was used to produce the generation tested herein. Two of the primitive stocks (T-78 and T-80) were classified as race *latifolium*; the other two were unclassified (Anonymous, 1974), though their morphology and collection location indicate that they probably should also be classified as race *latifolium*.

The procedure developed by Buford et al. (1967) was used to test for relative amounts of boll-weevil oviposition. The BC_2F_3 version of the four primitive stocks and two cultivars, 'Deltapine 61' (DPL-61) and 'Stoneville 213' (ST-213) were planted in a leeper silty clay loam (fine, montmorillo nitic, nonacid, thermic Vertic Haplaquepts) soil on 30 Apr. 1980 in four-row plots 10 m long in a randomized, complete block experimental design with four replications. Rows were 1.0 m apart, and plants within rows were approximately 10 cm apart.

Weevils were obtained from the R. T. Gast Rearing Facility at Mississippi State University. On 28 July, newly emerged weevils were placed in a 30.5 cm^3 screened cage where they were fed fresh, debracted cotton flower buds (called "squares"). On the 4th day after emergence, weevils were sexed and five females were placed in a ¼-liter glass jar equipped with a screen lid. Females were replaced when mortality occurred. Five fresh, debracted, and washed squares from a plot were placed in a jar with the female weevils. on each of the 4 following days, the squares were removed from the jar and replaced with fresh ones. After squares were removed, the number of apparent eggs oviposited was determined by counting sealed punctures using a binocular dissecting microscope (Everett and Ray, 1962). The laboratory was maintained at a temperature of 27 ± 1 C, a relative humidity of 70 ± 5%, and a 12-hour light-dark cycle.

The above procedure was repeated for 3 more weeks. The amount of oviposition was measured during the time the cotton plants were changing from peak squaring to increased boll retention with four different groups of weevils. The data were analyzed as a split-split-plot arrangement. Entries constituted the whole plot, weeks were the first split, and days within weeks were the second split.

RESULTS AND DISCUSSION

The BC_2F_3 progeny of T-78 received significantly (α = 0.10) less oviposition than DPL-61 and ST-213 (Table 1). No differences among the other primitive race stock progenies and the controls were detected. The degree of resistance in the BC_2F_3 of T-78 approached that of the original primitive stock which was tested in 1968 and 1973. During those 2 years, the rate of oviposition on T-78 was 63.5 and 62.3%, respectively, of the control, M8 — a double haploid of 'Deltapine 14' (Jenkins et al., 1978).

The amount of boll weevil oviposition on the BC_2F_3 of

Table 1. Boll weevil oviposition on four backcross day-neutral progenies of primitive race stocks (T—) and two cultivars of cotton.

Entry†	Eggs/female/day
	no.
ST-213	14.0 a‡
T-1149	13.5 a
DPL-61	12.4 a
T-80	12.3 ab
T-759	12.0 ab
T-78	10.2 b

† Race stock progenies were BC_2F_3.
‡ Means followed by the same letter were not significantly different at the 0.10 level of probability according to a Duncan's Multiple Range Test.

T-78 was 72.9 and 82.3%, respectively, of the rates of ST-213 and DPL-61. This degree of oviposition was significantly (α = 0.10) lower than on the controls and was consistently lower each week. Over all entries, oviposition increased each week resulting in the week effect being significant. This trend has been observed in previous tests conducted at this time of year with boll weevils; and it is probably related to the physiological changes of the plants, boll weevil behavior, and environment. The entry by week effect was not significant.

Low levels of oviposition suppression result in insect populations increasing at slower rates. The reduction in oviposition which was obtained (27.1%) is insufficient in itself to control the boll weevil. However, when combined with other sources of resistance, it may be valuable for a pest management system. In addition to boll weevil resistance, germplasm containing T-78 has been reported to carry resistance to fusarium wilt [*Fusarium oxysporum* Schlect. f. *vasinfectum* (Atk.) Snyd. & Hans.], tarnished plant bug [*Lygus lineolaris* (Palisot de Beauvois)], and root-knot nematodes [*Meloidogyne incognita acrita* (Kofoid & White, 1919) Chitwood, 1949] (Jenkins et al., 1979a; 1979b). Other primitive accessions with higher levels of boll weevil resistance than T-78 are currently being converted to day-neutral stocks. Our data indicate that resistance to boll weevils should be recoverable at least in some of those accessions.

The plots were machine harvested on 26 Sept. 1980. The BC_2F_3 of T-78 yielded 1,989 kg/ha of seedcotton while DPL-61 and ST-213 yielded 2,738 and 2,704 kg/ha, respectively. Even though the backcross progeny is later in maturity than these cultivars and its original photoperiodism may not have been completely overcome, these data suggest that it possesses moderate yielding ability and thus should be useful as a germplasm line with a moderate level of boll weevil resistance.

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