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Genetic Resistance to Boll Weevil Oviposition in Primitive Cotton[1]

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ABSTRACT

Boll weevil (*Anthonomus grandis* Boheman) resistance was identified in several photoperiodic primitive accessions of cotton (*Gossypium hirsutum* L.) in the early 1970s. Two of these primitive accessions, T-326 and T-1180, were each crossed to 'Deltapine 16' and progeny with day-neutral (DN) flowering habit were selected. These progeny were then backcrossed twice to their respective primitive parent and selected for day neutrality after each backcross. The resulting progenies were evaluated for boll weevil oviposition using a new laboratory technique. Significantly less oviposition was found on BC_2F_4 progeny of T-326(DN) and T-1180(DN) than on the control, 'Stoneville 213'. These progeny expressed resistance as 57 and 54% as much oviposition, respectively, as on Stoneville 213 in the laboratory test; resistance also was noted by others in field tests. The level of boll weevil resistance found in the progenies of T-326(DN) and T-1180(DN), when combined with acceptable agronomic performance, should be of value in pest management.

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

THE boll weevil (*Anthonomus grandis* Boheman) entered the USA from Mexico in the early 1890s and is a major pest in areas of the Cotton Belt. One of the earliest impacts of the boll weevil invasion was a widespread change in the types of cotton (*Gossypium* spp.) for production. The slow fruiting, late maturing, mostly long staple types being grown in the Midsouth and Southeast were replaced by earlier and more rapid-fruiting types of short staple cotton (*G. hirsutum* L.). Hunter and Coad (1922) reported that development of early maturing cultivars was an important step taken to reduce boll weevil damage.

The expense of controlling insect pests, such as the boll weevil, constitutes an important part of the total cotton production cost. The development and use of resistant cotton to control insect pests is a desirable alternative to the use of insecticides. Boll weevil resistant cotton could reduce insecticide cost and eliminate the potential for buildup of pesticide residue levels in the environment.

Painter (1951) suggested that centers of origin where the plant and the pest have coexisted for many years may provide sources of resistance. The centers of origin for upland cotton are considered to be Mexico and Central America, and primitive cotton plants were collected in these areas on several occasions (Anonymous, 1974). Most of the accessions collected are photoperiodic and will not flower during the long days of the growing season in the rain-grown Cotton Belt.

Jenkins et al. (1978) tested 191 primitive *G. hirsutum* accessions during 4 yr (1967, 1968, 1972, and 1973) and rated 69 as resistant to the boll weevil based on oviposition suppression. They grew the stocks in Mexico, because of photoperiodism, and evaluated them in the USA utlizing a technique described by Buford et al. (1967). A program was initiated to incorporate day-neutral (DN) genes into photoperiodic primitive accessions of cotton (McCarty et al., 1979). McCarty et al. (1982) evaluated BC_2F_3 DN progenies of T-78, T-80, T-756, and T-1149 for boll weevil resistance and reported that weevils oviposited significantly ($P = 0.10$) less often on DN progeny of T-78 than on the controls, 'Deltapine 61' and 'Stoneville 213'. The purpose of this study was to evaluate DN backcross progenies of two additional accessions, T-326(DN) and T-1180(DN), for resistance to oviposition by the boll weevil. The original accessions of T-326 and T-1180 were among the 69 primitive cotton plants reported by Jenkins et al. (1978) as being resistant to boll weevils.

MATERIALS AND METHODS

Two primitive accessions, T-326 and T-1180, which had exhibited resistance to boll weevil oviposition in 1972 (Jenkins et al., 1978) were crossed as males to 'Deltapine 16' at Iguala, Mexico in 1973. The F_1 was self-pollinated in Mexico in 1974 and F_2 populations of the crosses were grown at Mississippi State, MS in 1975, and DN plants were selected. One DN plant selection from each F_2 was backcrossed in the F_3 to the primitive accession in Mexico in 1976. The BC_1F_2 populations were grown in the field at Mississippi State in 1978, and DN plants were selected. One DN selection from each cross was selected and backcrossed in the BC_1F_3 to the primitive accession, and subsequently, the BC_2F_1 was self-pollinated. The BC_2F_2 populations were grown at Mississippi State in 1981, and one open-pollinated boll was harvested from each plant that set fruit and bulked to provide seed for increase. The increased open-pollinated BC_2F_4 populations of T-326(DN) and T-1180(DN) and one commercial cultivar, Stoneville 213, were grown at Mississippi State on a Marietta sandy loam (fine-loamy, siliceous, thermic Fluvaquentic Eutrochrepts) soil to produce flower buds (squares) for evaluation.

Suppression of boll weevil oviposition was evaluated utilizing the following previously unreported laboratory technique. Squares (8-mm diam.) were removed from plants on each test date, transported to the laboratory, and the bracts were removed. Two squares from each entry were placed into a container. The test container was a round paper cup (8.5-cm diam. × 4.5-cm height) equipped with a screen lid. On each test date, Mississippi native boll weevils from a colony maintained on an artificial diet by W.L. McGovern at the Boll Weevil Research Laboratory, Mississippi State, MS, were removed from active oviposition cages, sexed, and 10 females were placed in each test container. Females were allowed to feed and oviposit on the test squares for 3 h, after which they were removed. The squares were then examined for feeding punctures using a binocular microscope, dissected, and numbers of eggs were recorded. The laboratory was maintained at a temperature of 29 ± 1°C and a relative humidity of 70 ± 5%. The tests were conducted under normal laboratory light conditions.

The above procedure was replicated five times on each of

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nine test dates during August. A split-plot design was used for statistical analysis. Entries constituted whole plots and test dates were split plots.

RESULTS AND DISCUSSION

The BC_2F_4 progeny of T-326(DN) and T-1180(DN) received significantly fewer eggs per test date than did Stoneville 213 (Table 1). The interaction of dates by entries was nonsignificant. When the primitive accessions were tested in 1972, the rate of oviposition on T-326 and T-1180 was 36 and 30%, respectively, of the M8 control, which is a doubled haploid of 'Deltapine 14', (Jenkins et al., 1978). The rate of oviposition on the BC_2F_4 DN progeny was 57 and 54%, respectively, of the control, Stoneville 213.

Resistance in the backcross DN progeny was confirmed by J.E. Jones, J.P. Beasley, and S.J. Stringer in a five replicate field plot test at Baton Rouge, LA. The two lines, T-326(DN) and T-1180(DN) received 65 and 59% (mean of 4-weekly samples) as much square damage, respectively, as Stoneville 213. Also, 50 and 47% as many squares of the two accessions produced weevils as did Stoneville 213 (J.E. Jones, personal communication, 1985). Resistance of T-1180(DN) was further confirmed in a field test in Brazil. The progeny of T-1180(DN) received significantly less oviposition than a standard cultivar (Lukefahr and Vieriera, 1986).

The laboratory technique used in this study requires less time and labor to conduct than former methods and better utilizes laboratory reared boll weevils. The results of our laboratory test agrees closely with those found in field tests in Louisiana and Brazil. The BC_2F_4 lines were not deliberately selected for boll weevil resistance, however, a significant level of resistance has been recovered even though the mechanism of resistance is unknown. The level of boll weevil oviposition suppression found in T-326(DN) and T-1180(DN), when combined with acceptable agronomic performance, should be valuable for a pest management system.

This research reports significant levels of boll weevil resistance being transferred from primitive, daylength sensitive, to DN lines of cotton. Our results thus indicate that cotton strains can be developed that carry genetic resistance to the boll weevil. They also indicate that the resistance reported by Jenkins et al. (1978) in 69 primitive accessions is probably under genetic control as was found in T-326 and T-1180. It is reasonable to expect that genetic resistance to boll weevil oviposition exists in other primitive cotton plants and that it can be moved into day-neutral types.

Table 1. Boll weevil oviposition on two backcross day-neutral progenies of primitive accessions and one cultivar of cotton.

Entry	Eggs†
	no.
Stoneville 213	68.4a
T-326(DN) BC_2F_4	39.0b
T-1180(DN) BC_2F_4	36.8b

† Mean of nine test dates of five replications each. Means followed by the same letter are not significantly different at the 0.05 level of probability, according to Duncan's multiple range test. The interaction of dates × entry was nonsignificant.

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