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Field Studies of Boll Weevil Resistant Cotton Lines Possessing the Okra Leaf-Frego Bract Characters[1]

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ABSTRACT

Cotton lines (*Gossypium hirsutum* L.) possessing the okra leaf (L^oL^o) — frego bract (*fg fg*) characters were evaluated in a 3-year field study in the Coastal Bend area of Texas. Two locations were used in 1974 and 1975 and one location in 1976. The number of squares (flower buds) with boll weevil (*Anthonomus grandis* Boheman) ovipositional punctures was recorded on a total of forty cotton lines.

Cotton lines possessing the okra leaf-frego bract characters averaged about 60% fewer boll weevil ovipositional punctured squares than the broad leaf — normal bract cottons.

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

MAXWELL et al. (1972) have recently summarized the known sources and types of resistance to the boll weevil (*Anthonomus grandis* Boheman). Perhaps the most promising of these sources is the character known as "frego bract". The frego bract mutant, first reported in Arkansas (Lincoln and Waddle, 1966), is controlled by a single recessive gene (*fg fg*) (Green, 1955). The dominant morphological feature of frego bract cotton (*Gossypium hirsutum* L.) is narrow and twisted or rolled bracts which contrast to the flat and more or less enclosing bracts of conventional agronomic lines. Jones et al. (1964) and Hunter et al. (1965) were the first to report that frego bract cotton was less preferred by the boll weevil. Subsequently, various investigators have reported the effectiveness of frego bract as a boll weevil resistant character in cotton, Lincoln and Waddle (1966), Jenkins and Parrott (1971), Jenkins et al. (1969), Lincoln et al. (1971), Leigh et al. (1972), Jenkins et al. (1973).

A current program at the Texas Agricultural Experiment Station is dedicated toward developing Multi-Adversity-Resistance (MAR) cottons. Resistance of cotton lines to seed mold, seed deterioration, seedling diseases, bacterial blight, [*Xanthomonas malvacearum* (E. F. Smi.) Dows] *Fusarium* wilt [*Fusarium oxysporum* Schlecht. *f. vasinfectum* (Atk.) Snyder and Hansen], root-knot, (*Meloidogyne incognita* Chitwood), *Verticillium* wilt, (*Verticillium albo-atrum* Reinke and Berth.), nematodes, root rot [*Phymatotrichum omnivorum* (Shear) Dug.], boll rots, fungus leaf spots, Southwestern cotton rust (*Puccinia stakmanii* Presley), as well as insects is being investigated (Bird, 1975a).

The first cultivar releases ('Tamcot SP21', 'SP23', and 'SP37',) from the MAR program represent a new germplasm for cottons (Bird, 1975b).

Presently the okra leaf and frego bract characters are being incorporated into MAR strains (Bird et al., 1974). Isely (1928) concluded that the okra leaf character was neutral in regard to boll weevil resistance. However, the earliness and determinance of the okra leaf cotton could enhance its ability to escape severe boll weevil populations.

The introduction of okra leaf-frego bract characters into MAR material provides an opportunity for evaluating the effectiveness of these traits in a new genetic background for controlling insects. Thus, the objective of this study was to determine under Texas conditions to what degree MAR cotton lines possessing the okra leaf-frego bract characters were resistant to boll weevils. These initial studies could thus serve as basic breeding material for the MAR program and also serve to evaluate the potential use of these lines in an overall cotton pest management program.

METHODS AND MATERIALS

Except for standard cultivars which were utilized as checks, the cotton lines used in these studies were derived from the MAR genetic improvement program of the Texas Agricultural Experiment Station. The MAR lines have several combinations of morphological characters. OR-S is okra leaf-frego bract and glabrous. OR-BO, OR-H, and OR-LE are okra leaf-frego bract and hirsute. SP37, Bonham, Lewis, CAMD-H, and MAR are broad leaf-normal bract and hirsute. SP21, CAMD-S, and Blank are broad leaf-normal bract and glabrous. CAMD-E is broad leaf-normal bract and has ca. 75% hirsute and 25% glabrous plants. Lyman and GN are glandless, broad leaf-normal bract, and hirsute with the latter also being nectariless. DOR-S is a dwarf line of okra leaf-frego bract and glabrous. HG-E is a high gossypol, broad leaf-normal bract line.

During 1974 test plots were established at two locations. At the Perry Foundation, Robstown, Tex., two okra leaf-frego bract lines, OR-S-73C and OR-H-73C, were planted. The major distinction between these two lines was the number of trichomes present. Trichomes were relatively sparse on the OR-S (smooth) line and abundant on the OR-H (hairy) line. Besides differences in smoothness, the frego bract of the OR-H line was wider and did not twist as much in comparison with the bract of the OR-S line. In addition to the OR lines, an advanced MAR line, SP37-73C, and a standard cultivar, 'Stoneville 7A', were planted at the Perry Foundation during 1974. The lines were planted in plots six rows wide by 10 m long, and replicated four times in a randomized complete block design. At Violet, Tex., the following lines were planted, OR-H-73C, SP37-73C, and 'Stoneville 213'. The test plots, 12 rows wide by 12.2 m long, were replicated three times in a randomized complete block design. The number of undamaged squares (flower buds), and squares with boll weevil damage were recorded weekly (14 May through 2 July) until squaring ceased at each location. The sampling procedure employed during 1974 involved sampling individual whole plants in a stratified-random manner throughout the test plots. A total of five and 10 plants per plot was sampled at the Perry Foundation and Violet, respectively. Covariance was used to adjust the differences in squaring rates between the different lines, and the data are expressed

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Table 1. Mean number of squares per ha with boll weevil ovipositional punctures from 14 May to 2 July 1974.

Line	Perry Foundation	Violet
OR-S-73C	896 a*	
OR-H-73C	2,425 ab	5,219 a
Stoneville 7A	3,941 b	
SP37-73C	4,078 b	7,194 a
Stoneville 213		8,563 a

* Means are compared vertically, those followed by the same letter are not significantly different at the 0.05 level using Duncan's new multiple range test.

Table 2. Mean number of squares per ha with boll weevil ovipositional punctures from 20 May to 1 July 1975.

Line	Perry Foundation	Massey Farm
OR-S-74C	119 a*	
OR-BO-1-74	171 a	
OR-LE-74C	1,135 ab	
OR-74S-74C	1,191 ab	
OR-SX-74C		122 a
OR-H-74C	1,281 abc	1,664 b
CAMD-E-74C	1,916 bcd	
Tamcot SP37	2,316 bcde	
SP21-74C	2,372 bcde	3,093 c
CAMD-S-74C	2,385 bcde	4,282 c
Lyman-74C	2,620 bcde	
Blank-74	2,743 bcde	
Bonham-74C	2,848 bcde	
SP37-74C	2,959 cde	3,443 c
CAMD-H-74C	3,221 de	4,971 c
MAR-2C-74	3,286 de	
Lankart 57	3,728 e	
Lewis-74C	3,739 e	
Stoneville 213	3,958 e	

* Means are compared vertically, those followed by the same letter are not significantly different at the 0.05 level using Duncan's new multiple range test.

as the adjusted mean number per ha for the entire sampling period.

In 1975, 15 advanced selections from the MAR program and three standard cultivars were planted in single row plots, 12.2 m long, at the Perry Foundation. These plots were in a randomized complete block design replicated six times. Included in this test were five lines (designated by the "OR" prefix) which possessed the okra leaf-frego bract characters. The sampling procedures consisted of recording all the undamaged squares and the squares damaged by boll weevils on a weekly basis (20 May through 1 July) until the end of squaring. A permanent sampling station, 1.0 linear m of row, was established within each plot.

The second location during 1975 was the Massey Farm at Robstown, Tex. At this location six MAR cotton lines were planted in 0.23 ha plots, replicated four times in a randomized complete block design. The lines consisted of glabrous and hirsute counterparts of SP, CAMD, and OR types. The glabrous lines were SP21-74C, CAMD-S-74C, and OR-SX-74C. The hirsute lines were SP37-74C, CAMD-H-74C, and OR-H-74C. Four permanent sampling stations, 1.0 linear m of row long, were established within each plot. Otherwise the sampling procedures were identical to those used at the Perry Foundation during 1975.

During 1976, 16 advanced selections from the MAR program and two standard cultivars were planted in two row plots, 12.2 m long at the Perry Foundation, Robstown, Tex. Six of these lines possessed the okra leaf-frego bract characters. Two permanent sampling stations each 1.0 linear m of row long were established within each plot. The number of undamaged squares and squares with boll weevil damage was recorded weekly (19 May through 30 June) until the end of squaring. Covariance was used to adjust the differences in squaring rates between the different lines, and the data are expressed as the adjusted mean number per ha for the entire sampling period. Squares damaged by bollworms (*Heliothis zea* Boddie) and budworms (*H. virescens* F.) were also recorded in these tests but infestations were not large enough to detect genetic differences. Hence, these data are not presented.

Table 3. Mean number of squares per ha with boll weevil ovipositional punctures from 10 May to 30 June 1976.

Line	Perry Foundation
OR-S-13-75C	2,057 a*
OR-Lew-75C	2,614 a
DOR-S-75	2,838 a
OR-LE-75C	3,114 a
OR-H-75C	3,845 a
OR-S-75C	4,457 a
CAMD-E-75	9,464 b
Blank-75	11,145 bc
SP37-75C	11,151 bc
Lewis-75	11,347 bc
SP21-75C	12,179 bc
Tamcot SP21	12,367 bc
CAMD-H-75C	12,389 bc
HG-E-12	12,609 bc
GN-15	12,666 bc
CAMD-S-75C	13,126 bc
Tamcot SP37	13,828 c

* Means followed by the same letter are not significantly different at the 0.05 level using Duncan's new multiple range test.

RESULTS AND DISCUSSION

Population levels of boll weevils were moderate during 1974, low during 1975, and high during 1976. The mean number of squares per ha with boll weevil ovipositional punctures at the Perry Foundation during 1974 was significantly less for OR-S-73C, than for SP37-73C and the standard cultivar, Stoneville 7A (Table 1). Although OR-H-73C had fewer squares with boll weevil ovipositional punctures than SP37-73C and Stoneville 7A, the difference was not significant. Similar results were obtained at the Violet location during 1974 (Table 1).

Consistently throughout this study the okra leaf-frego bract lines sustained fewer boll weevil ovipositional punctures than the broad leaf-normal bract lines (Tables 1, 2, and 3). Another trend that emerged was that the glabrous, OR-S lines tended to have significantly less boll weevil ovipositional punctures than the broad leaf-normal bract lines, whereas the number of squares punctured in the hirsute OR-H lines was intermediate between the OR-S and broad leaf-normal bract lines. A possible explanation for this could be that the OR-H lines displayed a boarder and less curled frego bract than the OR-S lines.

These data confirm that the combination of okra leaf and frego bract in the MAR genetic background display resistance to boll weevil oviposition under Texas growing conditions.

REFERENCES

1. Bird, L. S. 1975a. Genetic improvement of cotton for multi-adversity resistance. Proc. Beltwide Cotton Prod. Res. Conf. p. 150-152.
2. ———. 1975b. Tamcot SP21, SP23, SP37 cotton varieties. Tex. Agric. Exp. Stn. Leaflet 1358. 6 p.
3. ———., F. M. Bourland, J. E. Hood, and D. L. Bush. 1974. Adversity-multi-disease resistant okra leaf and frego bract cottons. Proc. Beltwide Cotton Prod. Res. Conf. p. 95-96.
4. Green, J. M. 1955. Frego bract, a genetic marker in upland cotton. J. Hered. 46:232.
5. Hunter, R. C., T. F. Leigh, C. Lincoln, B. A. Waddle, and L. A. Bariola. 1965. Evaluation of a selected cross-section of cottons for resistance to the boll weevil. Ark. Agric. Exp. Stn. Bull. 700. 39 p.

6. Isley, D. 1928. The relation of leaf color and leaf size to boll weevil infestations. J. Econ. Entomol. 21:253-259.
7. Jenkins, J. N., F. G. Maxwell, W. L. Parrott, and W. T. Buford. 1969. Resistance to boll weevil (*Anthonomus grandis* Boh.) oviposition in cotton. Crop Sci. 9:369-372.
8. ———, and W. L. Parrott. 1971. Effectiveness of frego bract as a boll weevil resistance character in cotton. Crop Sci. 11:739-743.
9. ———, ———, and J. C. McCarty, Jr. 1973. The role of boll weevil resistant cotton in pest management research. J. Environ. Qual. 2:337-340.
10. Jones, J. S., L. D. Newsom, and K. W. Tipton. 1964. Differences in boll weevil infestation among several biotypes of upland cotton. Proc. Beltwide Cotton Prod. Res. Conf. p. 48-55.
11. Leigh, T. F., A. H. Hyer, and R. E. Rice. 1972. Frego bract condition of cotton in relation to insect populations. Environ. Entomol. 1:390-391.
12. Lincoln, C., G. Dean, B. A. Waddle, W. C. Yearian, J. R. Phillips, and L. Roberts. 1971. Resistance of frego-type cotton to boll weevil and bollworm. J. Econ. Entomol. 64:1326-1327.
13. ———, and B. A. Waddle. 1966. Insect resistance of frego bract cotton. Ark. Farm Res. 15 (1):5.
14. Maxwell, F. G., J. N. Jenkins, and W. L. Parrott. 1972. Resistance of plants to insects. Adv. Agron. 24:187-265.