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Fruiting Behavior of Insect-resistant Cotton Strains in an Insect-free Environment[1]

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ABSTRACT

Nectariless and frego bract strains of cotton (*Gossypium hirsutum* L.) were compared with background-related strains or cultivars Bayou Sm 1, 'Deltapine 16,' and 'Stoneville 7A' on the basis of productivity and maturity in an insect-free greenhouse environment. The nectariless strain of Deltapine 16 was similar to its parent cultivar, whereas nectariless Bayou D_2Sm and Stoneville 7A were more productive from late flowers than their background-related nectaried counterparts. La Frego 2 was similar to its Stoneville 7A parent, whereas La Frego 3159 was more productive from midseason flowers, and La R^{ak} Frego 3161 yielded less and was earlier than Stoneville 7A. Neither trait differed consistently in fruiting behavior compared to that of its background-related nectaried and normal bract counterparts. Thus, the observed differences may be due to heritable factors not associated with the trait per se, or to selection during the backcross program.

Additional index words: **Cotton maturity, Biological control of insects, Plant bugs, *Gossypium hirsutum* L., Nectariless, Frego bract.**

CONSIDERABLE effort has been devoted to evaluating morphological characters of cotton (*Gossypium* spp.) that may provide tolerance of or resistance to serious insect pests. One of the more widely researched characters is the nectariless trait (8), or absence of extrafloral nectaries normally located on the involucral bracts and lower leaf surface. Another is the frego bract (3), in which the involucral bracts are narrow and twisted, rather than broad and encompassing the flower bud as in normal cotton. The nectariless trait has been associated with reduced populations of various piercing, sucking insects and reduced *Heliothus* spp. egg desposition (6). Frego bract has been related to boll weevil (*Anthonomus grandis* Boh.) resistance (3) and to more effective insecticide deposition on flower buds, and hence better insect control with lower application rates (9).

Transfer of these traits into established cultivars via backcross programs has produced several agronomically desirable strains (4, 7). Comparisons of nectariless and frego strains with their nectaried and normal bract counterparts in cage tests (10) have shown essentially similar fruiting when insects were excluded. However, damage from controlled infestation with tarnished plant bugs (*Lygus lineolaris,* Palisot de Beauvois) resulted in extensive differences in maturity after loss of early flower buds. Field comparisons of nectariless strains with their parent cultivars have shown some advantage in earliness (7).

Maturity is an important factor in cotton harvesting; thus, it is desirable to know whether the observed differences are essentially insect-related or are partly attributable to heritable influences on fruiting habit. The main objective of this study was to compare fruiting patterns of nectariless and frego strains with those of their recurrent parents in an insect-free environment.

MATERIALS AND METHODS

Three experimental nectariless and three experimental frego bract strains were compared with their respective background strain Bayou Sm 1 or cultivars 'Deltapine 16' (DPL 16) and 'Stoneville 7A' (Stv 7A) as follows:

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Bayou D_2Sm ne (nectariless)	vs.	Bayou Sm 1 (nectaries)
Stv 7A-731 ne (nectariless)	vs.	Stv 7A (nectaries)
DPL 16 ne (nectariless)	vs.	DPL 16 (nectaries)
La Frego 2 (frego bract)	vs.	Stv 7A (normal bract)
La Frego 3159 (frego bract, red leaf)	vs.	Stv 7A (normal bract)
La R^{ak} Frego 3161 (frego bract, red leaf)	vs.	Stv 7A (normal bract)

The Bayou and frego bract strains were developed at the La. Exp. Stn. Although closely related, the two Bayou strains differ in leaf character as well as nectaries, and therefore are not considered to be near-isogenic. Stv 7A-731 ne was developed by Stoneville Pedigreed Seed Co. It resulted from a cross of Stv 7A with a nectariless genotype released by the Miss. Exp. Stn., followed by backcrossing to Stv 7A and subsequent plant selection toward the Stv 7A type. DPL 16 ne was developed at the Miss. Exp. Stn., Stoneville, by five generations of backcrossing to DPL 16. La Frego 2 was established after five backcrosses to Stv 7A. La Frego 3159 and La R^{ak} Frego 3161 were developed from F_2 plants segregating for leaf color following a cross of Red^{ak} Stv 7A (BC_4) × Frego Stv 7A (BC_4) and are considered to be near-isogenic lines.

The experiment was conducted in the greenhouse, using a randomized, complete block design with six replication. Seeds of each strain and cultivar were planted July 3, 1973 in six 18.9 liter plastic containers of Bosket fine sandy loam. Plants were thinned for uniformity to two plants/container at the three-leaf stage. Each replication included one container of each strain and cultivar; thus, the total population of each entry was 12 plants. As soon as they could be distinguished, monopodial branches were removed in order to restrict fruiting to sympodia, which is the predominant condition in our field plant population. Vigorous plant development was sustained with weekly applications of a water-soluble complete fertilizer from the time of thinning until termination of flowering. Insects were controlled with weekly spray applications[3] of monocrotophos (dimethyl phosphate ester with 3-hydroxy-*N*-methyl *cis*-crotonamide). Flowers were tagged daily from September 4 to provide records of flowering, boll retention, and boll opening. Fruiting patterns were diagrammed at maturity, and seed cotton was harvested by weekly increments of flowering. Data on flowering and boll retention were subdivided into 10-day increments and analyzed as a split-plot, with strains as whole plots and flowering increments as split plots.

To measure maturity, lint production was plotted/weekly increment of flowering, and mean maturity date (MMD) and production rate index (PRI) were calculated with modifications of methods by Christidis and Harrison (2) and Bilbro and Quisenberry (1), as follows:

$$MMD = \frac{(W_1H_1) + (W_2H_2) + \cdots + (W_nH_n)}{W_1 + W_2 + \cdots + W_n}$$

where W = lint weight from each week of flowering, H = number of days from planting to complete opening of all bolls from each week of flowering, and 1, 2, . . . , n = consecutive weeks of flowering. PRI = total lint weight/MMD.

RESULTS AND DISCUSSION

Mean daily temperatures in the greenhouse during flowering (33 C max., 22 C min.) were similar to field temperatures recorded during flowering in July (33 C max., 21 C min.). However, the greenhouse environment during boll opening (32 C max., 22 C min.) averaged 2 C warmer than its comparable field environment (30 C max., 20 C min.). Day length during the preflowering and flowering periods, although shorter than those of field plantings, had no apparent effect on flowering responses. All plants produced first sympodia at the sixth to the ninth node, and first flowers between 60 and 70 days from planting. First-flower dates indicate also that, although the number of plants was small, the process of thinning for uniformity apparently left experimental samples centered around the means of populations being tested.

Rates of flowering and boll retention are given in Table 1; lint yields, mean maturity dates, and production rate indices are given in Table 2; and lint production by weeks of flowering is plotted in Fig. 1. The following major differences in fruiting behavior were observed between resistant strains and their respective parents.

Nectariless

In the Bayou background, the nectariless strain was associated with a significant increase in yield due to more lint from the latter weeks of flowering. This increased the PRI, but caused a slight delay in maturity as measured by MMD. These differences were not necessarily related to the nectariless trait since the strains are not near-isogenic. In the DPL 16 background, no significant changes in yield or maturity were observed. In the Stv 7A background, a yield increase resulted from more lint produced from the latter weeks of flowering (Fig. 1); however, this did not affect maturity significantly.

Table 1. Flowering and boll retention for strains and cultivars in greenhouse culture.

Strain or cultivar	10-day periods 1	2	3	4	5	Total
	Flowers/12 plants					
Bayou D_2Sm ne	30	126	150	78 a**	18	402 a*
Bayou Sm 1	36	132	138	42 b	6	354 b
DPL 16 ne	18	114	120	90	6	348
DPL 16	30	120	96	78	6	330
Stv 7A-731 ne	18	102	108	114	24	366
Stv 7A	24	102	84	102	24	336
La Frego 2	30	108	120 a*	114	24	396 a*
La Frego 3159	24	114	114 a	96	24	372 ab
La R^{ak} Frego 3161	30	132	120 a	114	24	420 a
Stv 7A	24	102	84 b	102	24	336 b
	Bolls retained/12 plants					
Bayou D_2Sm ne	30	120	54 a*	6	0	210
Bayou Sm 1	30	114	30 b	6	0	180
DPL 16 ne	18	111	66 a*	12	0	207
DPL 16	30	120	42 b	18	0	210
Stv 7A-731 ne	18	102	72	36	0	228
Stv 7A	18	96	60	30	0	204
La Frego 2	18	108 ab	72 a*	24	12	234
La Frego 3159	24	114 ab	60 ab	18	0	216
La R^{ak} Frego 3161	30	126 a	48 b	12	6	222
Stv 7A	18	96 b	60 ab	30	0	204

*,** Values followed by the same letter, within a family comparison, do not differ significantly by Duncan's new multiple range test at 0.05 and 0.01 levels, respectively.

Table 2. Yield and maturity values.

Strain or cultivar	Yield/12 plants†	MMD	PRI, lint/day
	g	days	g
Bayou D_2Sm ne	321 a*	119.3	2.7 a*
Bayou Sm 1	264 b	117.6	2.2 b
DPL 16 ne	321	120.5	2.7
DPL 16	321	119.7	2.7
Stv 7A-731 ne	324 a*	122.7	2.6
Stv 7A	300 b	121.3	2.5
La Frego 2	312 a	121.4 b*	2.6 a
La Frego 3159	324 a	119.6 ab	2.7 a
La R^{ak} Frego 3161	240 b	118.5 a	2.0 b
Stv 7A	300 a	121.3 b	2.5 a

* Values followed by the same letter, within a family comparison, do not differ significantly at the 5% level by Duncan's new multiple range test. † Lint yield, MMD = mean maturity dates, and PRI = production rate indices.

[3] The mention of specific chemicals is for identification only and does not imply endorsement by the USDA.

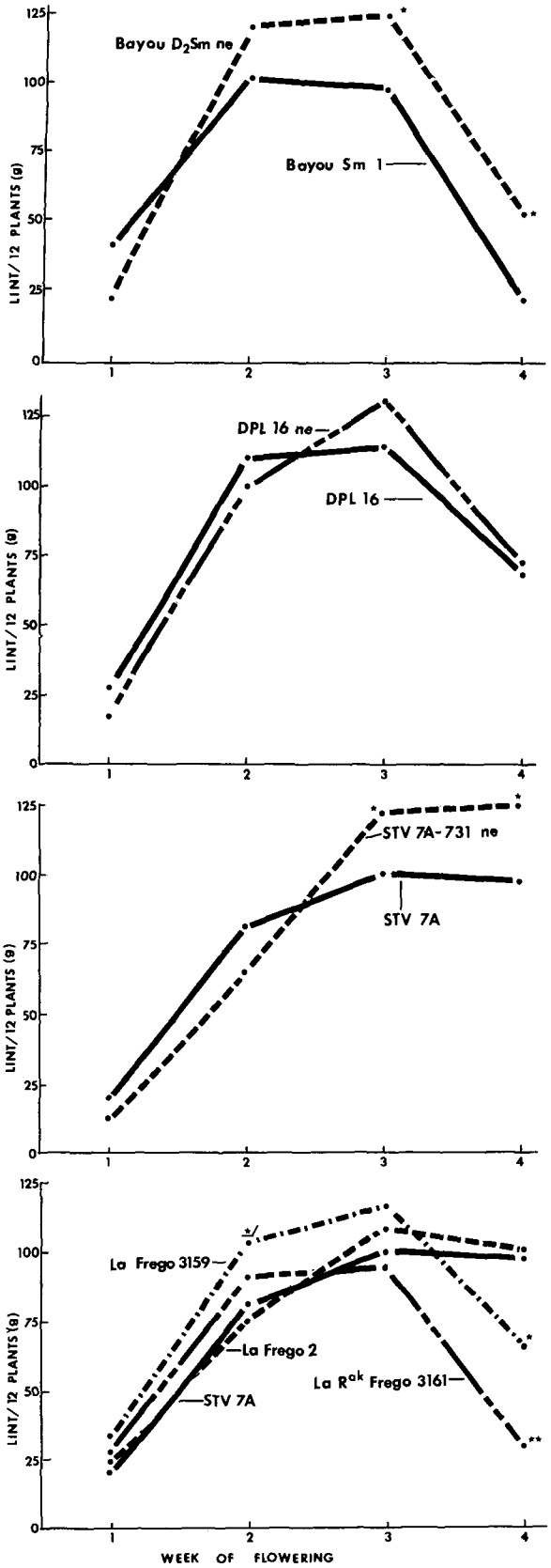

Fig. 1. Mean lint yield from weekly increments of flowering for insect-resistant strains and background-related strain or recurrent parents. ⁄ *, ** Difference within a family comparison significant at the 10%, 5%, and 1% levels, respectively.

Frego

The strains La Frego 2 and La Frego 3159, both in the Stv 7A background, were not significantly different from Stv 7A in yield and maturity. However, La Frego 3159 was more productive from midseason flowers (Fig. 1). The strain La R^{ak} Frego 3161, also in the Stv 7A background, was significantly earlier, but yielded less due to reduced boll retention and lint produced from late flowers.

These results confirm reports of isogenic studies that showed comparable yields and earliness for frego bract strains and background cultivars, where plant bugs were not an important factor (4), and occasional moderate yield reductions associated with the Red^{ak} leaf character (5). They do not confirm the maturity differences reported by Meredith et al. (7), who found a trend toward earliness among nectariless strains under field conditions. Since nectariless has been shown to impart some resistance to tarnished plant bugs, which normally damage early flower buds, we could expect increased earliness where plant bugs were present and resistance from nectariless was effective. However, because insect damage varies both in amount and sensitivity of host plant response, programs to develop cottons with specific fruiting characteristics should include at least some evaluations in an insect-free situation.

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