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# Effect of Frego Bract on the Incidence of Cotton Boll Rot[1]

Jack E. Jones and John A. Andries[2]


## ABSTRACT

**Near-isogenic populations of frego and normal bract biotypes on each of three varieties of *Gossypium hirsutum* L. were compared for relative incidence of boll rot in replicated field experiments for three years at several locations in Louisiana. The frego bract biotype of each variety in each year and at each location had significantly less boll rot than its related normal bract strain. The association of frego bract with reduced incidence of boll rot was consistent with the varieties tested at all locations where comparisons were made.**


***Additional index words:*** ***Gossypium hirsutum*** **L., resistance to boll rot, Bract shape, Isogenic lines.**

LOSSES from boll rot in Louisiana and other Gulf Coast states have been quite severe in past years (2, 3). The development of adpated cotton strains that resist or escape damage from boll rot would be expected to have beneificial effects on yield, yearly fluctuations in yield, and production cost. The effectiveness of the okra leaf and super okra leaf characters in reducing losses from this disease complex was recently reported (1, 6). This paper is a report on the influence of the frego bract character on boll rot.

Frego bract is a mutant character in cotton. The bracts are long, narrow, twisted, and tend to curl outward, leaving the flower buds and subsequent bolls well exposed. This is in contrast to the flat, triangular bracts of normal cotton that more or less enclose the flower buds (Fig. 1) and the lower half of cotton bolls (Fig. 2). Some tendency for parallel veination in the leaves of plants that have reached the fruiting stage of development (Fig. 3) is usually associated with the modified bracts. Frego bract (fg) is inherited as a simple recessive character (4) and is reported to be a member of linkage group VI (8).

The possible economic importance of frego bract was recognized several years ago when this trait was discovered to be associated with an important degree of boll weevil nonpreference (5, 7). A breeding program was begun to transfer the genetic factor for frego bract from a genetic marker line ('Frego Stoneville,' S. A. 201) to several adapted varieties of cotton.

Recent studies by Luke and Pinckard (9) indicated that bracts served as important sites through which certain boll rot organisms gained entry into the cotton boll. The removal of bracts from normal cotton bolls was effective in reducing the incidence of boll rot, both in the field and in moist chambers in the laboratory. They suggested that some modification of the bract may reduce boll rot losses. The possibility that frego bract may have an effect on the incidence of boll rot was investigated in replicated field experiments that were also being used to study the effects of this trait on yield, plant characters and fiber prop-

**Fig. 1. Immature flower buds of frego bract (left) and normal bract biotypes.**

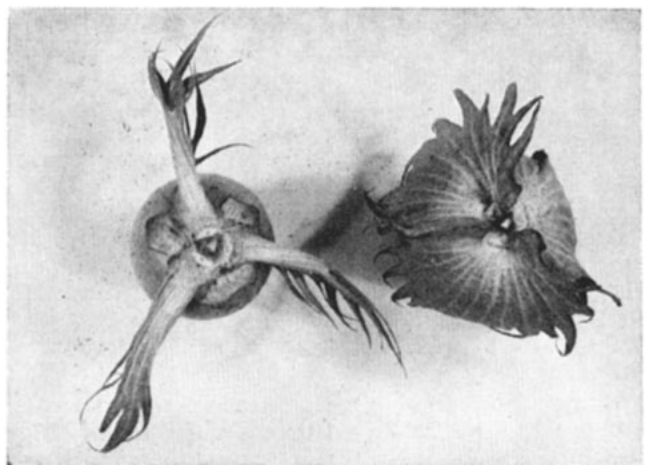

**Fig. 2. Unopened bolls of frego bract (left) and normal bract biotypes.**

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[2] Professor and former Associate (now Assistant Agronomist, Mississippi State University, State College, Miss.), Department of Agronomy, Louisiana State University, Baton Rouge, La., 70803.

erties. Only the boll rot phase of the study is reported here.

## MATERIALS AND METHODS

The materials used in this study consisted of two bract types, frego and normal, on each of three varietal backgrounds—'Bayou', 'Stoneville 7A', and 'Deltapine Smooth Leaf'—established after the third backcross to each. Bayou is a locally developed experimental variety of *G. hirsutum* L.; Stoneville 7A and Deltapine Smooth Leaf are adapted commercial varieties of this species. These varietal backgrounds are hereafter referred to as La. 1, La. 2, and La. 3, respectively. The seed of each biotype was increased in semi-isolated plots and used to plant replicated tests at several locations in Louisiana.

Comparisons were made between the frego bract and normal bract biotypes extracted from the same segregating population of each variety. No selection other than that for bract type was made in establishing the biotypes of each variety. The base population in each case was considered adequate for a representative sample. Thus, differences associated with the two bract types could be attributed to the genetic factor for bract type or to other genetic factors closely linked with it. The contrasting bract types were considered to be near-isogenic populations.

Data on boll rot were collected from one experiment in 1966, three experiments in 1967, and four experiments in 1968. The 1966 experiment was conducted at Baton Rouge and consisted of a comparison of frego with normal bract biotypes from the Bayou variety only. Single row plots, 30.5 m long, in a randomized block design with 10 replications were used. The test was planted on May 10 and a uniform stand of three plants per 30 cm was obtained. Plots were fertilized with 67-67-90 kg/ha of N-P-K. Weeds and insects were controlled throughout the growing season. Conditions were favorable for good plant growth (1.5 to 2.2 m) and moderately high lint yields (avg 989 kg/ha).

The 1967 experiments were conducted at Baton Rouge, St. Joseph, and Winnsboro, and consisted of a comparison of frego with normal bract biotypes from each of the three varieties. The experiment at each location was arranged in a randomized block, split-plot design. There were four replications at Baton Rouge and Winnsboro and five replications at St. Joseph. The three varieties were assigned to the main plots, and the two bract types were assigned to the subplots. Plots were two rows, 15 m long, at Baton Rouge and St. Joseph and two rows, 20 m long, at Winnsboro. The tests were planted on April 25, April 21, and April 13 at the respective locations. They were later thinned to a uniform stand of 3 to 4 plants per hill, 30 cm apart. Plots were fertilized at the respective locations with 72-67-101, 81-0-0, and 101-67-67 kg/ha of N-P-K. Weeds and insects were controlled throughout the season. Adequate moisture resulted in large plants and high lint yields. Frequent showers during late August and early September plus the rank vegetative growth resulted in an environment conducive to boll rot.

The 1968 experiments were conducted at Alexandria, Baton Rouge, St. Joseph, and Winnsboro. The entries and experimental design were the same as those used in 1967 except that four-row plots and three replications were used at all locations. Plots at the respective locations were 13.7, 18.0, 19.8, and 16.8 m in length. Rows were 102 cm apart at all locations but Baton Rouge where 107-cm width rows were used. The tests were planted May 7, April 26, April 23, and May 6, respectively. A uniform stand of 3 to 4 plants per hill, 30 cm apart, was obtained at all locations except at St. Joseph where a plant population of 4 to 6 plants/30 cm occurred. Plots were fertilized at the respective locations with 90-45-45, 85-90-90, 90-0-0, and 85-73-73 kg/ha of N-P-K. Damaging insects were controlled except for the occurrence of a high population of *Lygus* plant bugs in July at Alexandria and a temporary outbreak of boll weevils during late July at Baton Rouge. Average plant heights at maturity at the respective locations were approximately 1.7 to 2.0, 1.2 to 1.5, 1.7 to 2.0 and 1.0 to 1.2 m. The environment was conducive to the development of boll rot at all locations except Winnsboro.

The incidence of boll rot was determined in each test by counting the rotten bolls from a representative section of row from near the center of each plot shortly before the first harvest. Only the bolls which, in the opinion of the authors, were so deteriorated from rot that they would not have been picked with a mechanical picker were counted. The counts were made from a 3.05-m length of row in 1966. This was increased to a 6.1-m length of row in the 1967 and 1968 tests. The amount of rotten lint cotton per hectare was estimated for the two bract types by multiplying the number of rotten bolls per hectare by the appropriate boll weight and lint percentage. The percentage of total crop lost from boll rot was calculated for each bract type by dividing the estimated amount of rotten lint per hectare by the total production of lint (harvested lint plus rotten lint) $\times$ 100.

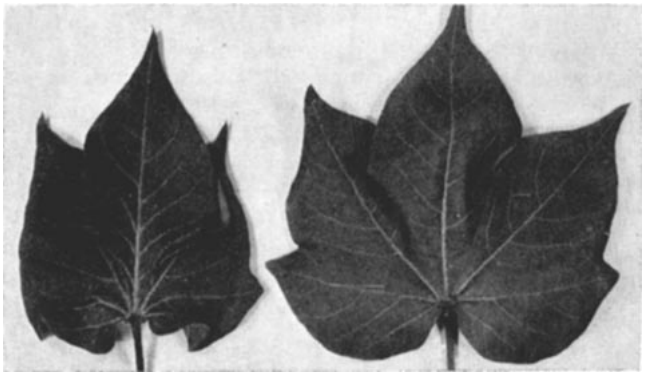

**Fig. 3. Typical leaves of frego bract (left) and normal bract biotypes.**

## RESULTS

The incidence of boll rot from the 10 paired plots of La. 1 Frego and La. 1 Normal at Baton Rouge in 1966 is given in Table 1. The frego bract plots averaged 17 rotten bolls per 3.05 m of row as compared with 25 rotten bolls for the same distance in the normal bract plots. Although the variation from plot to plot was substantial, the average difference was significant at the 5% level of probability. The estimated percentage of the total crop lost from boll rot was 9.2% for the frego bract strain as compared with 13.6% for the normal bract strain. This represents a difference of about one-third of the loss observed for the normal bract strain.

The incidence of boll rot as affected by bract type on the three varietal backgrounds at the three test locations in 1967 is summarized in Table 2. The frego bract biotype of each variety at each location had considerably less boll rot than its normal bract strain. The reduction in boll rot associated with frego bract was statistically highly significant at each location and in the analysis combining locations. The frego bract biotypes at the three locations averaged from 42 to 65% less boll rot than their related normal bract strains. The overall average reduction was 50%.

The incidence of boll rot as affected by bract type on the three varietal backgrounds at the four test

**Table 1. Number of rotten bolls per 3.05 meters of row as influenced by bract type on the Bayou variety of cotton at Baton Rouge in 1966.**

| Replication | Biotype | | Difference |
|---|---|---|---|
| | La. 1 Frego | La. 1 Normal | (Frego-Normal) |
| 1 | 12 | 10 | + 2 |
| 2 | 9 | 19 | -10 |
| 3 | 13 | 11 | + 2 |
| 4 | 8 | 18 | -10 |
| 5 | 7 | 23 | -16 |
| 6 | 21 | 26 | - 5 |
| 7 | 13 | 44 | -31 |
| 8 | 33 | 29 | + 4 |
| 9 | 30 | 33 | - 3 |
| 10 | 22 | 41 | -19 |
| Average | 17 | 25 | - 8* |

* Significant at the 5% level of probability.

**Table 2. The incidence of boll rot as influenced by bract type on three varieties of cotton at three locations in Louisiana in 1967.**

| Biotype | Locations | | | |
|---|---|---|---|---|
| | Baton Rouge | St. Joseph | Winnsboro | Avg |
| | Number rotten bolls per 6.1 m of row | | | |
| La. 1 Frego | 19† | 38‡ | 35‡ | 31 |
| La. 1 Normal | 45 | 92 | 94 | 77 |
| La. 2 Frego | 11 | 57 | 48 | 39 |
| La. 2 Normal | 28 | 104 | 66 | 66 |
| La. 3 Frego | 14 | 73 | 40 | 42 |
| La. 3 Normal | 44 | 85 | 62 | 64 |
| Avg. Frego | 15 | 56 | 41 | 37 |
| Avg. Normal | 39 | 94 | 74 | 69 |
| Diff. (F-N) | -24** | -38** | -33** | -32** |
| | Estimated kg of rotten lint per hectare | | | |
| Avg. Frego | 53 | 184 | 159 | 131 |
| Avg. Normal | 147 | 320 | 302 | 256 |
| Diff. (F-N) | -94 | -136 | -143 | -125 |
| | Estimated percentage of crop lost from rot§ | | | |
| Avg. Frego | 4.9 | 11.1 | 11.7 | 9.2 |
| Avg. Normal | 14.1 | 19.2 | 22.0 | 18.4 |
| Diff. (% of N) | 65.2 | 42.2 | 46.8 | 50.0 |

† Average of four replications. ‡ Average of five replications. ** Significant at the 1% level of probability. § Average harvested yields of lint over all varieties for the Frego and Normal biotypes at Baton Rouge, St. Joseph, and Winnsboro were 1,044, 900; 1,453, 1,345; and 1,196, 1,067 kg/ha, respectively.

**Table 3. The incidence of boll rot as influenced by bract type on three varieties of cotton at four locations in Louisiana in 1968.**

| Biotype | Locations† | | | | |
|---|---|---|---|---|---|
| | Alexandria | Baton Rouge | St. Joseph | Winnsboro | Avg |
| | Number rotton bolls per 6.1 m of row | | | | |
| La. 1 Frego | 14 | 17 | 46 | 6 | 21 |
| La. 1 Normal | 50 | 32 | 80 | 13 | 44 |
| La. 2 Frego | 13 | 13 | 33 | 5 | 16 |
| La. 2 Normal | 54 | 29 | 89 | 8 | 45 |
| La. 3 Frego | 10 | 20 | 25 | 6 | 15 |
| La. 3 Normal | 36 | 41 | 92 | 11 | 45 |
| Avg. Frego | 12 | 17 | 35 | 6 | 17 |
| Avg. Normal | 47 | 34 | 87 | 11 | 45 |
| Diff. (F-N) | -35** | -17* | -52** | - 5 | -28** |
| | Estimated kg of rotten lint per hectare | | | | |
| Avg. Frego | 43 | 53 | 133 | 18 | 62 |
| Avg. Normal | 183 | 114 | 357 | 38 | 173 |
| Diff. (F-N) | -140 | -61 | -224 | -20 | -111 |
| | Estimated percentage of crop lost from rot§ | | | | |
| Avg. Frego | 4.6 | 5.0 | 7.3 | 2.4 | 4.8 |
| Avg. Normal | 15.0 | 11.8 | 17.9 | 4.6 | 12.3 |
| Diff. (% of N) | 69.3 | 57.6 | 59.2 | 47.8 | 61.0 |

* Significant at the 5% level of probability. † Average of three replications. ** Significant at the 1% level of probability. § Average harvested yields of lint over all varieties for the Frego and Normal biotypes at Alexandria, Baton Rouge, St. Joseph, and Winnsboro were 876, 1,038; 1,004, 856; 1,687, 1,642; and 829, 894 kg/ha; respectively.

locations in 1968 is summarized in Table 3. As was the case in 1967, the frego bract strains averaged appreciably fewer rotten bolls than their near-isogenic normal bract strains at each location. The difference was statistically significant at all locations but Winnsboro, where it approached, but did not equal, the requirements for significance at the 5% level of probability. The frego bract biotypes at the four locations averaged from 48 to 69% less loss from boll rot than their near-isogenic normal bract strains. The overall average reduction was a highly significant 61%.

The interaction of variety × bract type was nonsignificant at each location and in the combined analysis of variance for both the 1967 and 1968 tests. This indicates that the influence of bract type on the incidence of boll rot was consistent with the varietal backgrounds tested.

The interaction of location × bract type was not significant in the combined analysis of variance of the 1967 tests, but it was significant in the combined analysis of the 1968 tests. The significant interaction in 1968 was due to a relative difference in suppressing effects of frego bract on the incidence of boll rot among locations rather than to a negative response, or the absence of a response, to bract type at one or more locations.

As illustrated in Fig. 2, the bracts of frego cotton are narrow, twisted, and generally stand away from the boll, leaving the boll well exposed. The open exposure of a frego bract boll may be expected to provide a microclimate less favorable for the deevlopment of fungi causing boll rot than that of a normal bract boll by lowering the relative humidity around the boll and shortening the periods of contact with free moisture. However, it should be pointed out that plants with the frego bract character generally set their bolls slightly later in the season and higher than plants with normal bract. This factor, too, could have been important in lowering the incidence of boll rot in these experiments. There is also the possibility that frego bract may have reduced the incidence of boll rot by increasing the difficulty of penetration of certain boll rot organisms through the bracts without regard to the effects on microclimate.

The substantial reductions in the incidence of boll rot associated with frego bract plus a potential value of this trait in insect control recommend frego bract as a highly desirable character to incorporate into adapted cotton varieties. The potential value of frego bract as an economically important character will depend on whether or not it is associated with any deleterious effects on yield, fiber quality, or important plant characters.

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