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Bract Size in Relation to Bollworm Damage in Upland Cotton Varieties

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Abstract: Larger and wider floral bracts provide good shelter to bollworms to safely feed-upon cotton bolls whereas smaller, narrower and twisted bracts provide less protection to bollworms. Variation in normal bract size and their relationship with bollworm damage was studied in several upland cotton varieties. Our results suggest that generally varieties with larger bracts sustained more damage as compared to varieties with smaller bracts. However, in some cases where varieties with even smaller bracts received more damage due to close fruit bearing behaviour of particular varieties that probably favoured bollworms to easily reach the bolls to feed-upon.

Key words: Bract size, bollworm damage, upland cotton

Introduction

Floral bract modification from normal to frego bract is conditioned to simple recessive mutant gene (Green, 1955). The mutant plant possesses narrow, elongated and twisted bracts, therefore are reflexed away from flower buds or bolls. Frego bract cottons were recognized to confer resistance to boll weevils, boll rot and bollworms. Hunter *et al.* (1965) noted that reflexed bracts provide less protection for adult bollworms, consequently inhibit their feeding as well as oviposition. Thus, several times more insecticide was recovered on frego bract flower buds as compared to those with normal bracts (Parrott *et al.*, 1973). Reed (1974) observed that frego bract cottons were least attacked by *Earias* spp. and gave good results in Tanzania (Nyambo, 1985). Ahuja *et al.* (1998) specifically noted that cotton lines stable for yield were unstable for bollworm damage with the exception of frego bract morphotypes. Variety CRI33 was first frego bract variety released in China for bollworm tolerance. Li-Feng *et al.* (1997) determined morphological resistance of cotton lines to *Helicoverpa armigera* L. and their results showed that accumulation of eggs decreased by 36.0% in frego bract cottons, whereas mean larvae decreased by 28.4% and square plus boll damage per plant by 34.0%. Bhatnager and Sharma (1993), while studying the relationship of Pink bollworm damage to phenological traits of isogeneic lines of *hirsutum* cotton reported lower percentage of bollworm attach in lines with frego bract, okra leaf and red plant colour. Calhoun *et al.* (1992) compared four new *G. hirsutum* L. lines for yield and bollworm damage. It was observed that two varieties with frego bracts sustained less than half as much damage as for other two varieties.

Frego bract cottons, on the contrary possess some undesirable features also. There are some reports that Lygus and Fleahopper prefer frego bracts and inflict greater damage on it than normal bract varieties. In addition, frego bract varieties were late maturing (Waddle, 1972). It seems that both the extremes of bracts, either frego bracts or larger bracts are undesirable in the sense that frego bract cotton is late maturing and lower yielding whereas larger bracts provide good shelter to the bollworms. Our personal observation also suggests that there is large variation in even normal bract cotton. Some covering the bolls halfway, others 3/2 of the boll size, and some overlap the bolls completely. It would therefore be an important aspect of research to determine the existence of genetic variation in normal bract's size of cotton varieties, consequently to figure-out bract size variation attributable to bollworm damage.

Materials and Methods

Twenty five commercial varieties were grown in the crossing block of the crop year, 2000. Twelve varieties that apparently showed variation in floral bract size were selected. Care was taken not to select varieties with high gossypol glands that otherwise would have imposed confounding effect on bollworm damage. Five rows of each variety, (50.0 feet long) were grown. Ten randomly tagged plants from each variety were used for observations. Five bolls from each plant, thus total of 50 bolls were brought in the laboratory to collect information on bract and boll sizes. Total area of bolls and bracts was calculated by multiplying length x breadth = area. Bollworm damage was determined by counting the damaged bolls out of total bolls per plant calculated in percentage. Single classification ANOVA as adapted by Sokal and Rohlf (1981) was used for determining the significance of variance. Whereas LSD (P = 0.05) was used to separate the mean differences.

Results and Discussion

Floral bracts are small green leafy structures that can cover the bolls halfway, more than halfway or completely depending upon their sizes. Thus larger and wider bracts provide good shelter to the bollworms to safely feed on the bolls. A smaller bract on the other hand exposes the bolls not only to the sunlight but also helps in having good penetration of insecticides to the bolls.

Present studies were carried-out to determine the variation in bract size of several upland cotton varieties in relation to bollworm damage. Statistically significant variation was noted in bract size, boll size and bollworm damage (Table 1). The results summarized in Table 2 suggest that bolls were covered by their bracts in the range of 54.8 to 117.3% of the area. The smaller bracts, however were observed in Karishma (54.8% of boll area was covered by their bracts) and larger bracts were noted in CRIS-121 (117.3% of the boll area was covered by their bracts). The boll length and bract length, nevertheless, were longer than their corresponding widths in all the varieties.

Generally, varieties with larger bracts sustained more bollworm damage than varieties with smaller bracts. Varieties Karishma and CRIS-220, which had minimum boll area covered by their bracts, 54.8 and 65.6% received less bollworm damage of 6.5 and 7.0% respectively. In some varieties, in addition to bract size, other factors such as close fruit bearing in FH-901 and more pubescent in CIM-443

Table 1: Mean squares from analysis of variance for bollworm damage in relation to cotton bract size.

Source of variation	Degrees of freedom	Mean Squares		
		Bract size	Boll size	Bollworm damage
Among varieties	11	1021174.2**	253625.6**	52.28**
Within varieties (error)	108	43401.5	24103.3	12.36

**Significant at 1% probability level.

Table 2: Cotton bolls and floral bracts size in relation to bollworm damage in Upland cotton varieties.

Varieties	Boll Size		Bract Size		Boll Area* (mm)	Bract Area* (mm)	Bolls Covered by bracts (%)	Bollworm Damage (%)
	Length (mm)	Width (mm)	Length (mm)	Width (mm)				
CRIS-121	42.2	32.4	51.1	31.4	1367.3	1604.5	117.3	10.8
CRIS-134	39.8	31.6	38.0	26.8	1257.7	1018.4	80.9	7.6
CRIS-168	42.2	33.2	47.8	32.4	1401.0	1548.7	110.5	10.3
CRIS-206	48.4	34.8	44.5	29.8	1684.3	1326.2	78.7	9.7
CRIS-220	40.4	32.4	36.4	23.6	1309.0	859.0	65.6	7.0
Karishma	42.4	32.8	37.0	21.6	1390.7	799.2	54.8	6.5
FH-901	43.4	39.1	42.0	28.6	1696.9	1201.2	70.8	10.0
DNH-49	44.0	34.6	46.0	32.4	1522.4	1490.4	97.9	9.7
CIM-443	39.0	35.2	43.0	30.2	1372.8	1298.6	94.6	15.5
Mono-25	46.8	36.0	48.4	34.2	1684.8	1655.3	98.3	9.8
Cyto-51	41.2	38.4	36.0	27.4	1582.1	986.4	62.4	7.5
F1 (CRIS-121 x CIM-443)	43.2	37.8	52.0	32.6	1633.0	1695.2	103.8	13.2
LSD (0.05)	-	-	-		137.5	184.2	-	3.1

*Boll and bract area were calculated by multiplying length with their respective width.

exaggerated the bollworm damage. Thus, it can easily be observed from Table 2 that there is discrepancy in bracts size and bollworm damage of varieties FH-901 and CIM-443 against other varieties in that, these varieties received comparatively high bollworm damage of 10.0 and 15.5% respectively against their relatively smaller bracts size.

A lot of literature indicate that morphological characters also called genetic markers (mutant genes) have strong genetic linkages with wrecker genes. These wrecker genes thus inflict deleterious or negative effects on agronomic traits. Thus if smaller bracts still significantly suppress cotton bollworm, then there is no need to incorporate frego bract character in our high yielding varieties, which is linked with many deleterious genes.

Though the effect of frego bract on bollworm damage was not the aim of this study, yet we treated frego bracts as synonymous to smaller bract cotton. Because of scarcity of references on variation in normal bract's size, we used the references related to frego bracts. Ahuja *et al.* (1998) reported that cotton lines stable for yield were unstable for bollworm damage with the exception of the frego bract morphotype. The morphological resistance of cotton lines to *Helicoverpa armigera* L. was analyzed by Li-Feng *et al.* (1997) and reported that accumulation of eggs decreased by 36% in frego bract cotton whereas square plus boll damage per 100 plants decreased by 34%. Other researchers, Zhang and Zhang (1998), Bhatnager and Sharma (1993) and Colhoun *et al.* (1992) also noted significant impact of frego bract cotton on bollworm damage.

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