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A BOLL DIAMETER-BASED, DYNAMIC ACTION THRESHOLD FOR MANAGING STINK BUGS

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Abstract

In 2002 and 2003, as part of an effort to evaluate the potential use of dynamic, crop maturity-based threshold adjustments for stink bug damage to bolls, the maximum outside diameters tagged bolls under different circumstances which affect boll growth were taken during the boll production period at the Upper Coastal Plain Research Station near Rocky Mount, NC. Boll diameters at the "bug-safe" age of 3.5 wk. varied by variety, plant position, and time of anthesis, averaging 1.25 inches for 1st position early bolls and approximately 1.15 inches for 2nd position or late 1st position bolls. In 2004, the diameters of cohorts of 100 bolls each of DP 555 BG/RR, FM 989 R (Rocky Mount, NC) and BG II 958 BR (Grantham, NC) were monitored throughout the season. In the boll cohort study, regressions of mean boll size, and thus the proportion of bolls over or under a given size, were linear with a high R^2 value, although the point at which half the number of bolls exceeded a predetermined size varied somewhat by variety and growing conditions. We propose that a simple "boll-sizing" template with either a fixed diameter of approximately 1.25 inches for general crop growth conditions, or a template with different diameters for high or low boll growth conditions, can be used by scouts to quickly separate a very high proportion of the boll population in a cotton field into "stink bug safe" and stink bug-susceptible bolls. Stink bug thresholds can then be raised during the boll production period according to the ratio of safe vs. susceptible bolls. This approach should offer a reliable alternative to the static, inherently biased thresholds now in place throughout the cotton belt.

Introduction

Presently, all post-bloom stink bug thresholds recommended by cotton entomologists in the US are static- they remain unchanged during the boll production period (SC, GA, FL, AL, TN, MS, LA, AR, etc.). These static thresholds, generally in the range of 15 to 20% internal boll damage, remain constant from the time of anthesis through the growing season or until a given number of degree days (DD-60's) beyond cutout is reached. Because bolls reach a "stink bug-safe" state at approximately 21 to 25 days after anthesis, an increasingly greater proportion of the boll population in a cotton field becomes resistant to stink bug damage during the boll production period. Unfortunately, a threshold that may be viable 4 weeks after anthesis is probably not valid later in the season when most bolls are too mature (or large) to be damaged. This preliminary research evaluated the concept of using a "boll-sizing" approach as the basis for quickly and reliably adjusting stink bug damaged boll thresholds upward during the season to account for a maturing (and less susceptible) boll population.

Methods

In 2002, maximum diameters of twenty 1st and 2nd position tagged bolls of 12 cotton varieties, suggested by NCSU cotton breeder Daryl Bowman (personal comm.) to show a variety of boll sizes, were tagged individually and measured at 2, 3, 4 and 5 weeks after anthesis, both early and late in the boll production period at the Upper Coastal Plain Research Station (UCPRS) near Rocky Mount, NC. In 2003, maximum diameters of fifty 1st and fifty 2nd position bolls were again measured weekly for FM 989 R and DP 555 BG/RR, both early and late in the boll production period at UCPRS. A digital caliper was used for the measurements (Forestry Suppliers, Jackson, MS). Degree-day 60's accumulations were also calculated for each boll cohort for the various measuring intervals. In 2004, cohorts of the first 25 bolls encountered from a flagged position in each of 4 replications for DP 555 BGRR and FM 989 R (UCPRS), and DP 960 BGIIR (Grantham, NC) were measured weekly from the onset of anthesis through approximately 3 wk. past cutout.

Results

Bolls generally reached their maximum diameters at 3 wk. Under the drought conditions of 2002, mean boll diameters at the "bug-safe" age of approximately 3.5 wk. (DD-60's = 506.1) were very close to 1.25 inches for 1st position fruit tagged as white flowers 2 wk. after plant anthesis, although the 12 varieties assessed showed a mean boll diameter range of 1.161 to 1.305 inches (Table 1). Under the wet conditions of 2003, mean diameters of 1st

position bolls tagged early 1.42 and 1.32 inches for FM 989 R and DP 555 BG/RR, respectively, at 3 wk. and 471.2 $DD_{60's}$ (Table 2). First position bolls tagged late had mean diameters of 1.20 and 1.17 inches for FM 989 R and for DP 555 BG/RR, respectively, while 2nd position bolls tagged late had mean diameters in the 1.12 and 1.09 for the respective varieties at 3 wk. and 475.8 $DD_{60's}$.

Table 1: Mean Diameters for 3.5 Week-Old Bolls, Rocky Mount, NC, 2002

Variety	Mean Boll Diameter (inches) @ 3.5 Weeks* Bug-Safe Stage	
	1st Position	2nd Position
Stoneville 474R	1.30	1.22
SureGrow 521R	1.29	1.24
Phytogen 355	1.21	1.20
Phytogen GA161	1.26	1.16
Fibermax 989	1.31	1.19
Fibermax 966	1.28	1.05
Fibermax 989R	1.29	1.04
DeltaPine 555 BG/RR	1.19	1.17
DeltaPine Delta Pearl	1.16	1.09
DeltaPine 565	1.22	1.10
DeltaPine NuCotn 33B	1.27	1.16
DeltaPine 491	1.23	1.11
Means	**1.25**	**1.14**

Table 2: Mean Diameters of 3.5 Week-Old Bolls by Fruiting Position and Bloom Period, Rocky Mount, NC 2003

FM 989 R	1st	Early	1.42
		Late	1.20
	2nd	Late	1.12
DP 555 BG/RR	1st	Early	1.32
		Late	1.17
	2nd	Late	1.09

Early = 471.2 $DD_{60's}$ Late = 475.8 $DD_{60's}$

Table 3: Suggested Damaged Boll Thresholds for Stink Bugs*

Boll Ratio		Threshold (%)
Susceptible "quarter size"	"Safe" (too large)**	
1	0	10
1	0.5	15
1	1	20
1	1.5	25
1	2	30
1	2.5	35

* A Boll Sizer may be helpful in determining ratios.
** Boll diameter approximately 1.25 inches or larger.

In Figures 1, 2 and 3, the proportion of bolls over 1.2, 1.25 and 1.3 inches in diameter is shown for DP 555 BG/RR, FM 989 R and DP 960 BGII R. As can be seen in the figures, the proportion of bolls over a given diameter occurs later for DP 555 BG/RR than for the other varieties. This can more easily be shown by comparing the proportion of the 3 varieties over a given diameter, for example 1.25 inches (Fig. 4). In looking at a single variety, in this case DP 960 BG II R, one can see that using either a boll diameter of 1.2, 1.25 or 1.3 inches makes approximately a 1 wk. difference in ½ of the bolls reaching the given "boll safe" stage (Fig. 5). When half of the boll population reaches the "bug safe" stage, presumably, the threshold can be doubled (Fig. 6).

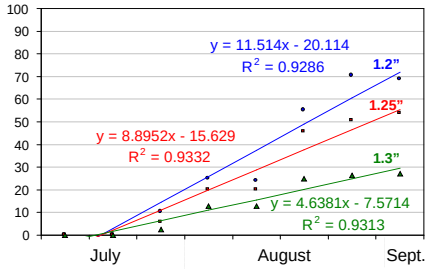

Fig. 1: Percentages of Bolls > Selected Sizes, DP 555 BG/RR, Rocky Mount, 2004

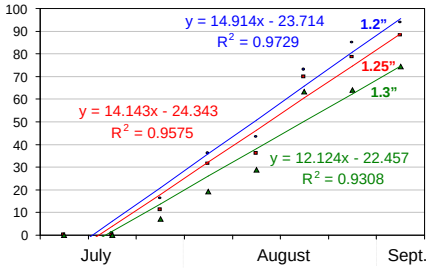

Fig. 2: Percentages of Bolls > Selected Sizes, DP 989 R, Rocky Mount, 2004

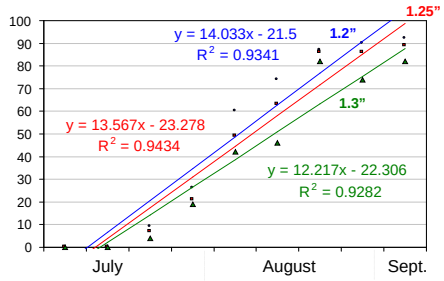

Fig. 3: Percentages of Bolls > Selected Sizes, FM 960 BGIIR, Grantham, 2004

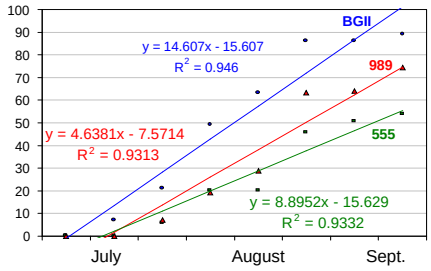

Fig. 4: Percentages of Bolls > 1.25 inches, for 3 Varieties, 2004

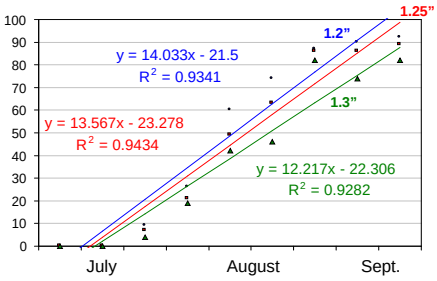

Fig. 5: Percentages of Bolls > Selected Sizes, FM 960 BGII R, Grantham, 2004

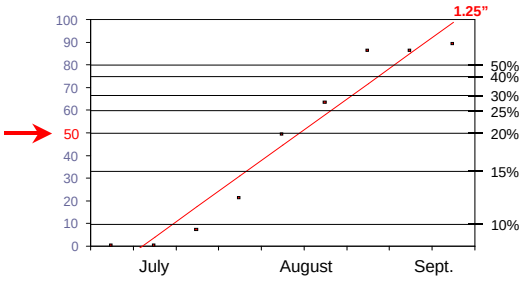

Fig. 6: Percentages of Bolls > 1.25 Inches, FM 960 BGII R, Grantham, 2004

By directly comparing the static 20% plus cutout threshold to a 10% boll maturity based adjustable threshold, one can see the adjustable threshold is triggered more readily early in boll production period and less often later in the boll production period (Fig. 7). Possible threshold adjustments based on the proportion of "bug safe" bolls is presented in Table 3. Note that the table provided assumes an initial threshold of 10% internally damaged bolls. The same approach could also be used for initial thresholds of 15 or 20%.

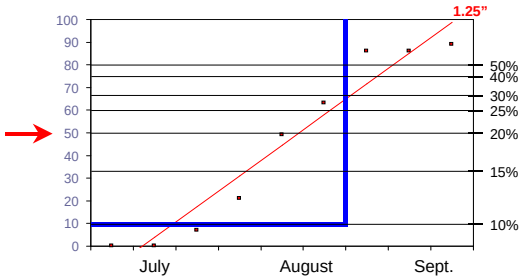

Fig. 7: Percentages of Bolls > 1.25 Inches, FM 960 BGII R, Grantham, 2004

Conclusions

Presently recommended thresholds are both static and rely on the internal inspection of quarter-sized "target" bolls. However, the proportion of larger, stink bug-resistant bolls increases during the boll production period is not taken into consideration. Therefore, static stink bug thresholds may result in over treatment later in the boll production period when the proportion of "bug safe" boll is high. Our data suggest that a "Boll-Checking" or "Boll-Sizing" template could be used by cotton scouts to sort bolls into stink bug susceptible (less than a given diameter) and stink bug resistant (more than that diameter) groupings, and thus provide the basis for adjusting threshold accordingly. Because the size at which a boll would be safe from stink bug damage could be expected to vary according to variety, position, time interval from anthesis, and perhaps moisture availability and other factors, a boll sizing

template would probably need to offer scout several diameters to account for different varieties and growth factors (Fig. 8).

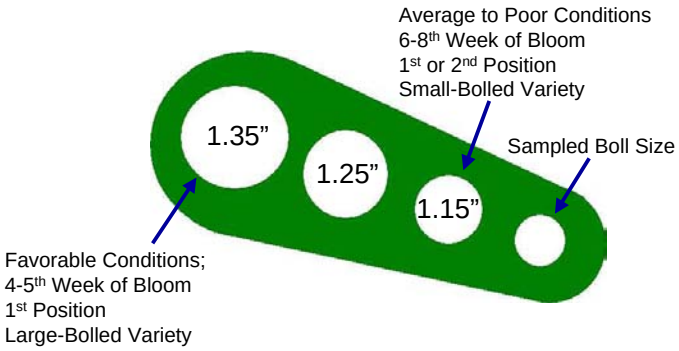

Fig. 8 - Schematic of boll sizer template with diameter to account for different conditions.

References

Greene, J.K., and G.A. Herzog. 2001. Damage potential of southern green stink bug and effect of boll age on feeding ability and yield. UGA/CPES Res.-Ext. Pub. No. 4. March.

Greene, J.K., G.A. Herzog, and P.M. Roberts. 2001. Management decisions for stink bugs. *In*, Proceedings, 2004 Beltwide Cotton Conferences, pp. 913-917. National Cotton Council, Memphis, TN.

Emfinger, K.D., B.R. Leonard, M.M. Willrich, J.D. Siebert, J.H. Fife, and J.S. Russell. 2004. Defining boll and yield tolerance to late season cotton pests in LA. *In*, Proceedings, 2004 Beltwide Cotton Conferences, pp. 1744-1746. National Cotton Council, Memphis, TN.

Willrich, M.M., D.R. Cook, J.H. Temple, and B.R. Leonard. 2003. When does brown stink bug, *Euschistus servus* (Say) begin to injure cotton? . *In*, Proceedings, 2003 Beltwide Cotton Conferences, pp. 1528-1532. National Cotton Council, Memphis, TN.

Willrich, M.M., R.H. Gamble, J.H. Temple, and B.R. Leonard. 2004. Defining a preferred cohort for brown stink bug, *Euschistus servus* (Say). *In*, Proceeding, 2004 Beltwide Cotton Conferences, National Cotton Conferences, Memphis, TN.