Decision Guide for Late Season Management of Tarnished Plant Bug (*Lygus lineolaris* Palisot de Beauvois) in Arkansas Cotton using the COTMAN™ Crop Monitoring System

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Objective

The COTMAN insecticide termination rule for fruit-feeding insects was developed and validated in the Midsouth for the Heliothine caterpillars (*Heliocoverpa zea* and *Heliothis virescens*) and cotton boll weevil (*Anthonomus grandis*). The objective of this study was to compile results from insecticide termination trials in Arkansas conducted with tarnished plant bug (*Lygus lineolaris*).

COTMAN Insecticide Termination

Monitor the crop to identify the last effective boll population (cutout). Physiological cutout is signaled when field average Nodes-Above-White-Flower equals five. Accumulate daily heat units (DD60's) starting at cutout.

Stop insecticide applications for bollworm, tobacco budworm and boll weevil infestations that occur after bolls have accumulated 350 heat units.

Review of Previous Research

Insect Control Termination -- The question of when a cotton crop is safe from late season insect pests has been the focus of intense Cotton Incorporated sponsored crop monitoring research for over 25 years (Berhnart et al 1986, Bagwell et al 1992, Bourland et al 1992). These efforts have yielded a simple procedure to define the final stage of crop susceptibility for major boll feeding insect pests -- when the crop is no longer susceptible to new infestations, when thresholds become irrelevant, when additional insecticide applications are uneconomical (Pedigo et al 1986). The COTMAN system allows the user to determine the flowering date of the last effective boll population and to define when those bolls have reached the final stage of susceptibility (Danforth and O'Leary 1998). Extensive small plot and on-farm research has shown that at 350 heat units (DD60s) after physiological cutout (NAWF=5), bolls are safe from new infestations of bollworm, tobacco budworm, and boll weevil (O'Leary et al. 1996, Harris et al. 1997, Cochran et al. 1999).

No Choice Cage Tests: In Mississippi, Horn et al. (1999) examined the incidence and severity of plant bug feeding in no-choice cage studies. By confining adult bugs on bolls of different ages for 48 hrs, they determined that bolls which had accumulated 250 DD60s were relatively safe from tarnished plant bug injury. The authors proposed a conservative recommendation of establishing 300 DD60s after cutout as the point to terminate insecticides (i.e. insecticide sprays to control future infestations of plant bugs would be unnecessary). In similar no-choice cage tests in Louisiana, Russell et al. (1999) evaluated retention of bolls after 72 hrs exposure to 2 TPB adults. They found that TPB did not sufficiently penetrate the boll wall to result in boll abscission if the boll had accumulated > 300 DD60s.

Field Trials with Western Plant Bug: Ellsworth and Barkley (2003) reported changes in crop tolerance to field populations of western plant bug (*Lygus hesperus*) in Arizona cotton. They observed a yield penalty from terminating late season sprays 2 weeks prior to cutout at NAWF=7.2, but additional insecticide applications made 1, 2 and 3 weeks after cutout provided no yield benefit. Maximum yields and maximum profits were gained where insecticide applications for Lygus were continued up to 1 week prior to cutout.

Arkansas Termination Research

Small Plot Studies Augmenting Plant Bug Infestations after Cutout -- In open choice, field trials in commercial fields in NE Arkansas, we augmented natural infestations of TPB by releasing field collected or lab reared plant bug nymphs in small plots at different times after NAWF=5. Yield and quality from those treatment plots were compared to untreated cotton and cotton receiving protective insecticide sprays. In the 2001 and 2002 trials, 3 to 5 nymphs (2nd and 3rd instar) were released per plant starting at about 1 week after physiological cutout (NAWF=5 + 80 to 150 DD60s). Additional infestations were made in subsequent weeks such that plants were infested at cutout + 1, 2 and 3 wks, cutout + 2 and 3 wks and cutout + 3 wks. The final release date occurred after final bolls are considered safe -- cutout +350 DD60s, the COTMAN guideline. Plant monitoring results indicated significant feeding injury to upper canopy bolls, but we found no significant yield penalty associated with plant bug infestations compared to untreated or protected controls in either year. Mean yields ranging from 1180 to 1250 lbs/acre in 2001 and 1034 and 1150 lbs in 2002. Results of the 2001 study are summarized by Teague et al (2002). In 2002, yield was 1074 lb lint/acre for the treatment with 3 bug releases after cutout compared to the untreated check yields of 1089. Yields did not differ significantly from sprayed plots despite a late season boll weevil infestation.

Small Plot Studies Augmenting Plant Bug Infestations at Cutout -- Infestation timing was moved forward one week in the 2004 trial, and nymphs were released in drip irrigated cotton during the week of physiological cutout (Teague 2005). Infestations were made 1 time at 2 different levels: 1 bug per plant (=3 bug/ft) and 3 bugs per plant (=9 bugs/ft). Yields from these treatments were compared to untreated and sprayed cotton. In this high yielding year, we saw no differences in mean lint yield between untreated and sprayed treatments (1723 and 1721 lbs lint/ac, respectively); however, yields were significantly reduced in cotton infested with at 1 nymph/ft (13% reduction, 1496 lb lint/ac) and 9 bugs/ft (23% reduction, 1391 lb lint/ac).

Infestation timing was similar in a 2005 study, but plant bug infestation levels were reduced to 1 and 3 nymphs/ft. An additional factor, irrigation, was added. Plant bug treatments were made in either furrow irrigated (season long) or non-irrigated cotton. Plot yields ranged from a low of 1428 lbs lint/ac in the non-irrigated, 3 bugs/ft treatment compared to 1742 lbs in irrigated, sprayed treatments. Mean yield of irrigation main plot treatments was 1700 lbs compared to 1550 for dryland treatments. Yields were extremely variable across the experiment. Neither plant bug treatments nor irrigation effects resulted in statistically significant yield reductions, but mean yields tended to be lower in the non-irrigated 3 bugs/ft infestation compared to untreated and sprayed treatments. These results indicate that the high yielding cotton remains susceptible to economic damage by tarnished plant bugs at the time of physiological cutout.

Timing final furrow irrigation and terminating insect control -- The study was conducted at the UA Cotton Branch Experiment Station at Marianna, in the Central Delta region of the state. Natural plant bug population densities were above state recommended action thresholds in late season for both 2 years of the study. The 2004 season was characterized by high population densities of plant bugs and dry conditions in late season. Mean yields ranged from 1012 to 1258 lbs lint/ac. Termination of insecticide and irrigation prior to physiological cutout resulted in significant yield penalties compared to later termination dates (Teague and Danforth 2005). Extending insecticide sprays past 240 DD60 after physiological cutout to 450 DD60s or irrigation beyond 350 DD60s to 580 DD60s after NAWF=5 did not significantly improve yields. Late irrigations delayed boll opening. In the 2nd year, rains in late August confounded irrigation treatments, and there were no significant irrigation effects (Teague et al 2006). Mean yields ranged from 1150 to 1450 lbs lint/ac for all treatments. Plant bug numbers late season were at low to moderate levels but did exceed state recommended action thresholds. Late season insecticide sprays extending out to NAWF=5 + 413 DD60s reduced bug numbers in protected treatments, but sprays did not result in significant yield benefits compared to early terminated (NAWF=7) treatments. There were no significant irrigation*insecticide interactions observed with lint yield in either year. Results from these Central Eastern Arkansas and previous other NE Arkansas trials (see Vories et al. 2006) indicate that timing of final irrigation in furrow systems appears to be similar to that for terminating insect control –- NAWF=5 + 350 DD60s.

Conclusions

Results from Arkansas small plot research indicate that the high yielding cotton remains susceptible to high densities of tarnished plant bugs up to physiological cutout, and then becomes increasingly resistant. The insect control termination guide in COTMAN that has been in use for heliothine caterpillars and boll weevils (NAWF=5 +350 DD60s) is very conservative **and more than sufficient** for effective end-of-season plant bug management.

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