DETERMINING THE RELATIONSHIP BETWEEN BOLL AGE AND GREEN PLANT BUG FEEDING INJURY TO SOUTH TEXAS COTTON

J. Scott Armstrong
John J. Adamczyk
Randy J. Coleman
USDA-ARS, Beneficial Insect Research Unit
Weslaco, TX

Abstract

Our objectives are to define the relationship of feeding-injury of the green plant bug *Creontiades signatus* (Stahl) to cotton boll age to provide a degree-day based threshold that determines when economic damage no longer occurs so that management (i.e. insecticides applications) can be justifiably terminated. *Creontiades signatus* (Stahl) (Heteroptera: Miridae) has been infesting cotton in the Coastal Bend and the Lower Rio Grande Valley of Texas in high enough densities that insecticide treatments have been applied to reduce feeding damage, even though an economic threshold has not been established. Accumulated heat units (daily max – min/2 minus 60 F) are commonly used and available from different sources where crop managers could easily determine the threshold. We tagged cotton blooms in the summer of 2008, and infested them with a single green plant bug when accumulated DD's reached from between 100 and 500 heat units. The bolls were collected at maturity where seed-cotton weight, lint weight and seed weight were recorded. Regression analysis was performed on the heat unit accumulations (independent variables) and the yield parameters (dependant variables) to define relationships, and identify the number of DD's required before feeding injury will no longer occur. Analysis of variance and repeated measures analysis will be performed on the damage score, seed-cotton weight, lint weight and seed weight, and the number of damaged and undamaged ovules to determine if significant differences occur across accumulated DD's.

Introduction

True bugs, including mirids and stink bugs, have increased in importance as significant pests of cotton in most areas of the cotton belt over the last fifteen years. The adoption of transgenic cotton varieties that effectively control lepidoperous pests, along with the development and use of more target specific insecticides has resulted in an overall reduction in broad spectrum insecticides that previously controlled heteropteran species. The Lower Rio Grande Valley (LRGV) and Coastal Bend region of south Texas has been challenged with a unique mirid species identified as *Creontiades signatus* (Stahl) (Coleman et al. 2008, Armstrong and Coleman 2008). Observations on this pest over the last ten years have indicated that infestations occur later in the cotton season with cotton bolls being the most susceptible to feeding injury. Over the last ten years, consultants and crop protection personnel working in south Texas cotton have been concerned about when a cotton boll may be mature enough that feeding injury from *Creontiades signatus* (Stahl) will cease to reduce the yield in lint or seedcotton values. The determination or "threshold" that defines when a cotton boll has reached a point of maturity that insects can no longer caused abscission, or reduce the lint or seed values has been reported for the tarnished plant bug, *Lygus lineolaris* [Palisot de Beavois], (Russell 1999) and the stink bug southern green stink bug, *Nezara viridula* (L.), (Bommireddy et al 2007) with the use of accumulated degree-days >60 ^{0}F from the time of white flower (Bagwell & Tugwell 1992). Our objectives for this study are define the relationship of boll feeding injury of the green plant bug, *Creontiades signatus,* to cotton boll-age as defined by degree-days accumulated past white flower to determine when economic damage no longer occurs, and management strategies (i.e. insecticides applications) can be justifiably terminated.

Materials and Methods

Green plant bugs used to infest cotton bolls at varying degree-days were collected from cowpeas "Texas Pinkeye" (*Vigna unguiculata* (L.) planted at the USDA-ARS research farm just south of Weslaco, TX and from surrounding redroot pigweed, *Amaranthus retroflexus,* (L.) one day before being used to infest cotton bolls. The insects were kept in plexi-glass cages overnight on their respective host plants with the addition of some store purchased green beans *Phaseolus vulgaris* (L.). Pesticide residues from the store purchased green beans were minimized by soaking in water and baking soda for 5 m, followed by rinsing three times with RO water. Only healthy adults, with all appendages intact, were used for infesting cotton bolls. The cotton genotype (Stoneville 4357BGIIRF) was planted under a field cage (20'w x 40'l) covered in 50 mesh screening to prevent interference from boll weevil eradication. The cotton was irrigated by drip lines (t-tape) and weeds were controlled by hoeing. Two applications of N-42

fertilizer was applied at 60 lbs total N per acre through the drip system on 15 April and 19 May. Two rows of cotton were planted on 40 inch centers, followed by a skip row on March 5, 2008. One 2-row section of cotton that measured 10 m in length was considered a replicate, and within each replicate and over the course of the cotton fruiting period, a total of about 40 white-blooms exhibiting anthesis were tagged and dated. White blooms were tagged with aluminum tags (Pittsburgh Tag CO., Pittsburg, PA) secured with cotton strings placed around the main stem and pedicle of first position white-blooms every 2 - 4 d starting May 13th to July 16th. Cotton bolls were infested by enclosing one adult green plant bug on the tagged bolls by using a 15 x 11.5 cm nylon bag (Armstrong and Camelo 2005). The bugs, and controls with no bug enclosed, were left on the plants for 72 h before being removed. No determination of sex of the experimental insects was made. After the cotton reached harvestable maturity, all bolls were noted as present or abscised and taken to the laboratory where the seed cotton was removed from each boll. The lint and seed were hand separated and weighed. Linear regression analysis (PROC REG, SAS 2001) were be performed on the heat unit accumulations (independent variables) and the yield parameters (dependant variables) to determine the relationships of feeding injury to accumulated degree-days.

Results and Discussion

Younger cotton bolls that accumulated fewer DD's were more susceptible to abscission than older cotton bolls (Figure 1). The data indicate that bolls less than 100 DD's or up to 4 days of age, are most susceptible to abscission, followed by moderate abscission up 200 DD's or 8 days of age, and no abscission > 300 DD's or 13 days of age. This trend follows all other studies for plant bugs in that the younger the cotton boll, the more susceptible to abscission (Greene et al. 1999, Russell 1999, Layton 2000).

Both lint and seed yield from cotton bolls infested with green plant bugs were affected by the age of the boll as determined by degree-day accumulations (Figures 2 & 3 respectively). Lint yield varied widely at 100 DD's, steadily increasing up to 250 – 300 DD's where it seemed to be more stable and equalized (Figure 2). It appears that even when abscission was greatly reduced or had ceased up 200 DD's, some loss in lint yield still occurred. Seed yield response from green plant bug feeding mirrored the lint yield loss in that at 100 DD's, a wide variation in seed yield was detected, but by 250 DD's there was no seed yield loss (Figure 3). From our observations of *Creontiades signatus* temporal distribution over several growing seasons, we have never observed cotton infestations before bolls are starting to form. Our data indicates that as soon as bolls are present, they are susceptible to green plant bug attack. We report these preliminary findings of green plant bug injury to cotton based on boll age. Our intention is to conduct this study for a minimum of at least one more year.

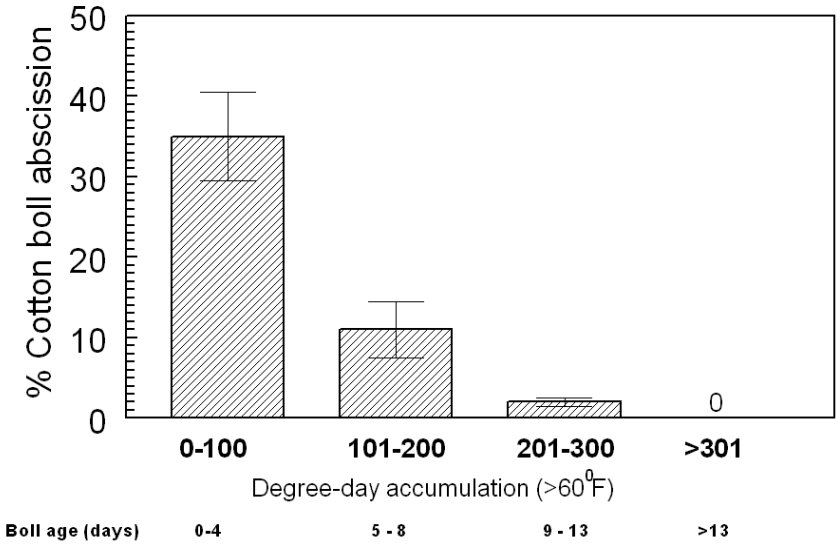

Figure 1. Boll abscission of Stoneville '4357BGIIRF' bolls infested with an adult green plant bug, *Creontiades signatus* (Stahl) (Heteroptera: Miridae), at various degree-days (maximum + minimum)/ 2 – 60^{0}F) accumulated summer 2008.

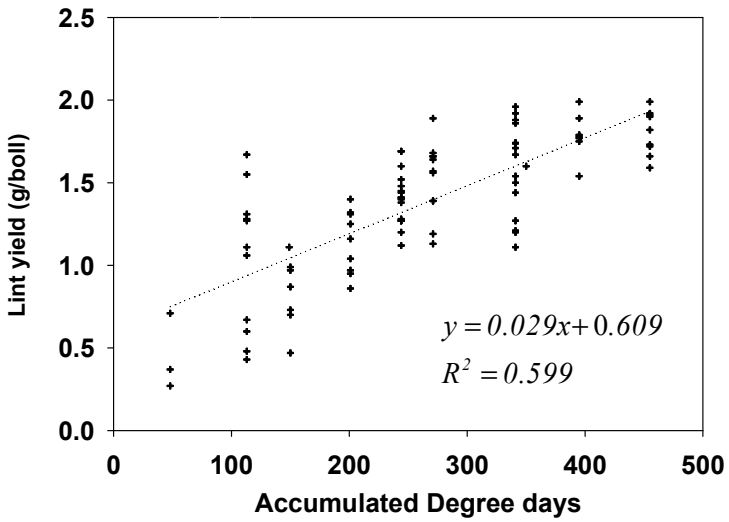

Figure 2. Lint yield from Stoneville '4357BGIIRF' cotton bolls infested with an adult green plant bug at various degree-day (maximum + minimum)/ 2 – 60^{0}F) accumulated during the summer 2008.

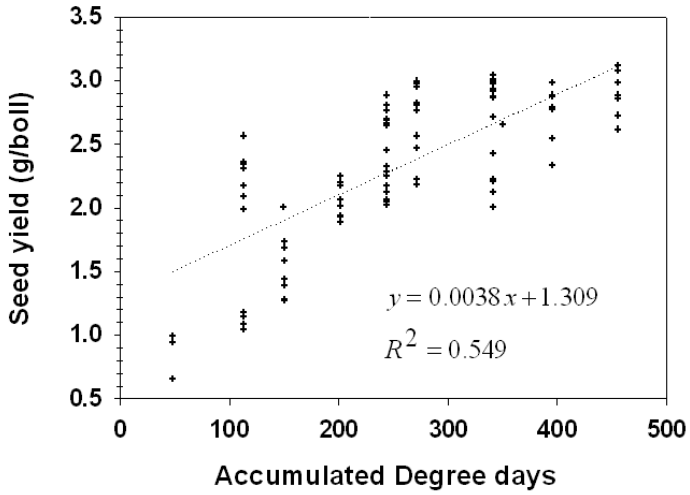

Figure 3. Seed Stoneville '4357BGIIRF' cotton bolls infested with an adult green plant bug at various degree-day (maximum + minimum)/ 2 –60 ^{0}F) accumulated during the summer 2008.

References

Armstrong, J. S. and L. D. Camelo. 2005. A comparison of feeding damage from *Lygus hesperus* and *Lygus elisus* to pre-bloom cotton. J. of Entomol. Sci. 40:143-148.

Armstrong, J. S., R. J. Coleman and M. Setamou. 2008. Oviposition patterns of *Creontiades signatus* (Hemiptera: Miridae) on okra-leaf and normal-leaf Cotton. (Accepted, Annals of the ESA).

Bommireddy, P. L., B. R. Leonard, and J. H. Temple. 2007. Influence of *Nezara viridula* feeding on cotton yield, fiber quality, and seed germination. J. Econ. Entomol. 100: 1560-1568.

Bagwell, R. D., N. P. Tugwell. 1992. Defining the period of boll susceptibility to insect damage in heat units from flower. 1992 Proceedings Beltwide Cotton Conf., National Cotton Council, Memphis, TN. p. 767-768.

Coleman, R. J., J. P., Hereward, P. J. De Barro, D. R., Frohlich, J. J. Adamczyk Jr., and J. A. Goolsby. 2008. Molecular comparison of *Creontiades* plant bugs from south Texas and Australia. Southwest. Entomol. .

Greene J. K., Turnipseed S. G., Sulivan M. J., and Herzog G. A. 1999. Boll damage by southern green stink bug (Hemiptera: Pentatomidae) and tarnished plant bug (Hemiptera: Miridae) caged on transgenic *Bacillus thuringiensis* cotton. J. Econ. Entomol. . 92:941–944 1999.
Layton, M. B. 2000. Biology and damage of the tarnished plant bug, *Lygus lineolaris*, in cotton. Southwest. Entomol. 23:7-20.

Russell, J. S., B. R. Leonard, J. Gore and G. E. Church. 1999. Cotton Boll Abscission Influenced by Tarnished Plant Bug Feeding. Proc. Beltwide Cotton Prod. Res. Conf., National Cotton Council, Memphis, TN. pp. 1046-104

SAS Institute. 2001. SAS/STAT user's guide, release 8.02 ed. SAS Institute, Cary, NC.