LATE SEASON *LYGUS HESPERUS* MANAGEMENT IN TEXAS COTTON

Megha N. Parajulee
Abdul Hakeem
Stanley C. Carroll
Texas A&M AgriLife Research and Extension Center
Lubbock, TX

Abstract

A three-year field cage study was conducted to characterize the density-dependent boll feeding potential of *Lygus hesperus* in Texas High Plains cotton. *Lygus* damage to cotton bolls at various *Lygus* densities was determined. Individually caged cotton plants were exposed to 4 levels of *Lygus* (0, 1, 2 and 4 or 6 adults per cage) for one week when plants were at two selected boll development stages (350 and 550 HU >60 °F after first flower). When the crop matured from 350 HU to 550 HU after first flower, the percentage of bolls vulnerable to *Lygus* feeding damage was reduced from 50% to 30%. Averaged over three years, artificial augmentation of 1, 2, 4, and 6 *Lygus* per plant at 350 HU after first flower reduced the cotton lint yield by 137, 313, 422, and 516 lb/acre, respectively, whereas the yield reduction values for the same *Lygus* densities were 66, 191, 213, and 415 lb/acre during the late season (550 HU from first flower). Thus, the *Lygus* yield reduction potential decreased by 52, 39, 50, and 20% for 1, 2, 4, and 6 *Lygus* per plant infestation when cotton matured from 350 HU to 550 HU. A detailed understanding of *Lygus* boll feeding biology and behavior will be highly valuable in improving *Lygus* management decisions during the different boll developmental stages.

Introduction

Cotton, *Gossypium hirsutum* L., is a major cash crop in the U.S. and worldwide. The U.S. is the world's third largest cotton producer and the U.S. cotton industry is valued at more than $25 billion per year. In Texas, approximately six million acres of cotton have been planted annually in recent years, and Texas is the largest cotton producing state (Williams 2013). *Lygus hesperus* is an important economic pest of cotton in some regions of the United States and it is an emerging pest of Texas High Plains cotton. In Texas, over 2 million acres of cotton were infested by *Lygus* in 2012 (Williams 2013). *Lygus* can cause severe cotton square loss, anther damage, and seed damage depending upon the crop growth stage the infestation occurs. Both adult and nymphal stages of *Lygus* can inflict damage to cotton fruiting structures. *Lygus* late-instar nymphs are capable of inflicting greater internal damage to maturing bolls than are adults, and this was especially true for 1-2 week old (150-250 HU) bolls (Jubb and Carruth 1971, Parajulee *et al.* 2011). In the Texas High Plains region, *Lygus* generally infest cotton fields during the latter part of the cropping season, thus causing damage primarily to the cotton bolls. Following the introduction of *Bt*-technology (Bollgard® cotton), outbreaks of lepidopteran pests have been drastically reduced, and in recent years, secondary piercing-sucking pests such as *Lygus* are of increasing concern to Texas High Plains producers (Parajulee *et al.* 2008).

Cotton boll profiles change as the crop matures, and as a result, the number of *Lygus* susceptible and/or tolerant bolls to *Lygus* damage also change. As boll maturity profiles change, *Lygus* boll selection and feeding behavior may also change which can result in different levels of crop injury and yield loss. There is a strong relationship between boll maturity and *Lygus* feeding damage, thus understanding the boll maturation profile and characterizing *Lygus* damage risk dynamics is important. The objective of this study was to quantify the yield loss caused by 4 different levels of *Lygus* infestations (0, 1, 2 and 4 or 6 *Lygus* adults per plant). The overall goal is to better understand the boll feeding biology and behavior of *Lygus hesperus* in order to further develop a dynamic economic threshold for improved *Lygus* management in Texas High Plains cotton.

Materials and Methods

A field study was conducted to quantify the effect of *Lygus* density and infestation timing on cotton yield and fiber quality. Cotton cultivar ST 5458B2RF was planted on May 18 (2012), May 22 (2013), and May 15 (2014) in a drip-irrigated field with 40-inch row spacing at the Texas A&M AgriLife Research farm located near Lubbock, Texas. The targeted seeding rate was 56,000 seeds per acre. On June 2, the 2012 study was treated with Orthene® 97S for thrips at a rate of 3.0 oz per acre and with Cornerstone Plus® herbicide (41% glyphosate) at 32 oz per acre for weed management, whereas the 2013 and 2014 study plots did not receive insecticide interventions for thrips control and weeds were removed via cultivation and hand-hoeing.

The field study was laid out in a split-plot randomized block design with three replications, two main plot factors [two cotton boll developmental stages (early boll development and late boll development)], and four subplot factors [four levels of *Lygus* infestation (control or zero bugs, one bug/plant, two bugs/plant, and four or six bugs/plant)]. There were a total of 24 experimental units. Each experimental unit had 8 cotton plants as subsamples (3 used for damage assessment and 5 for yield and quality assessment). A total of 192 whole-plant sleeve-caged cotton plants (three blocks x two cotton boll stages x four *Lygus* densities x eight subsamples) were used for this study (Fig. 1).

Figure 1. Field deployment of whole-plant cages for *Lygus* threshold study, Lubbock, TX, 2012-2014.

The cotton field study site was closely monitored and kept virtually arthropod pest-free until cages were deployed on July 24, July 29, and July 28 in 2012, 2013, and 2014, respectively. When the cotton plants reached the target maturity level (350 HU after first flower on August 7, August 13, and August 17 in 2012, 2013, and 2014, respectively, and 550 HU after first flower on August 21, August 29, and August 27 in 2012, 2013, and 2014, respectively), lab-reared *Lygus* were released into the whole-plant sleeve-cages at the rates of 0, 1, 2, and 4 bugs/plant in 2012 and 2013; the infestation densities were changed to 0, 2, 4, and 6 bugs/plant in 2014 to increase the damage intensity. *Lygus* adults were collected from nearby alfalfa field or from alfalfa in adjacent counties and acclimatize in the laboratory for 48 hours before using them for the boll feeding experiment. Cotton plants were exposed to the *Lygus* adults for ~7 days, after which time, the insects were killed via a pesticide application. Three randomly selected cotton plants from each plot were cut and brought to the laboratory on August 13, August 19, and August 27 for the 350 HU and August 29, September 2, and September 5 for the 550 HU plots in 2012, 2013, and 2014, respectively. The cotton crop was defoliated by spraying FOLEX® 6EC (12 oz per acre) and a boll opener (Ethephon® 6; 32 oz per acre) in a tank mix in all three years of the study. After the crop was ready to harvest, the remaining 5 caged plants from each plot, which had been maintained pest-free, were harvested manually to evaluate the lint yields and fiber quality. Harvested single-plant samples were ginned individually via table-top gin and samples were analyzed for fiber quality (HVI) parameters at Cotton Incorporated. Data from the whole-plant cage study were summarized by calculating average and standard errors. ANOVA, GLM model (SAS Institute 2010) was used to evaluate the treatment effects (α=0.1) and treatment means were compared by LSMEAN procedure.

Results and Discussion

In general, as expected, *Lygus* augmentation reduced the lint yield compared to that in uninfested control cages (Figs. 2-4). However, the damaging effect of *Lygus* was more pronounced during mid-season (350 HU from first flower) compared to that in late season (550 HU from first flower) for all three years of the study. Although year-to-year variation existed, *Lygus* augmentation of 1 adult per cage did not significantly decrease the lint yield, but the higher densities reduced the yield significantly compared to that in uninfested cages.

In 2012, artificial augmentation of 1, 2, and 4 *Lygus* bugs per plant at 350 HU after first flower reduced the cotton lint yield by 116, 425, and 580 lb/acre, respectively, whereas the yield reductions for the same *Lygus* densities were 125, 149, and 185 lb/acre during the late season (550 HU from first flower) (Fig. 2).

In 2013, cotton lint yields in mid-season plots (cages) were much lower than in 2012, but the augmentation of 1, 2, and 4 *Lygus* bugs per plant reduced the cotton lint yield by 157, 106, and 281 lb/acre, respectively (Fig. 3). While these lint yield reduction values were not statistically significant, owing to greater variation in data, the trend was convincingly supportive of a clear influence of *Lygus* augmentation on yield reduction and the data trend was similar to that in 2012. Overall, lint yield was higher in late-season test plants compared to that in mid-season test plants, but

the augmentation of 1 *Lygus* per plant did not result in significant yield reduction, whereas 2 and 4 *Lygus* per plant reduced 143 and 159 lb/acre, respectively (Fig. 3).

In 2014, augmentation of 2, 4, and 6 *Lygus* per plant at 350 HU after first flower reduced the cotton lint yield by 407, 406, and 516 lb/acre, respectively, whereas the yield reductions for the same *Lygus* densities were 282, 295, and 415 lb/acre during the late season (550 HU from first flower) (Fig. 4). Overall yield in 2014 was higher than in 2012 and 2013, but the damage inflicted by 2 and 4 *Lygus* per plant on mid-season cotton was comparable to that for 2012, whereas the damage inflicted in late season cotton was higher in 2014 compared to that in 2012 or 2013.

Lygus-induced lint yield reduction for a given *Lygus* density was lower for late season compared to that for mid-season infestation in all three years of the study (Figs. 2-4). These data clearly suggest that the maturing bolls are more tolerant to *Lygus* injury when the plant attains 550 HU from first flower. It is also possible that *Lygus* bugs may choose to feed on superfluous bolls or squares and the yield contributing fruits may not be significantly impacted by such late infestation. Because potential yield loss risks due to certain *Lygus* density infestations vary with boll maturation profile, the *Lygus* management economic threshold should be optimized for a dynamic ET to accommodate for within-plant fruit maturity profiles.

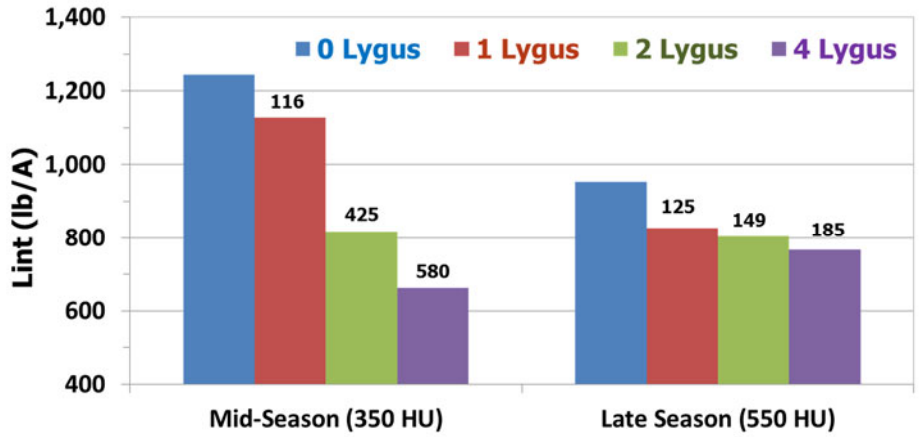

Figure 2. Influence (pounds of yield reduction) of varying levels of *Lygus* infestations on lint yield at two crop phenological stages, Lubbock County, TX, 2012.

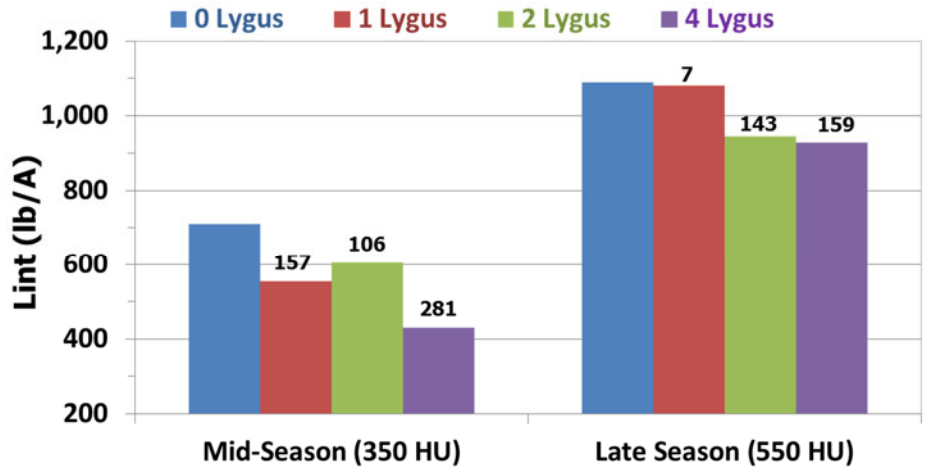

Figure 3. Influence (pounds of yield reduction) of varying levels of *Lygus* infestations on lint yield at two crop phenological stages, Lubbock County, TX, 2013.

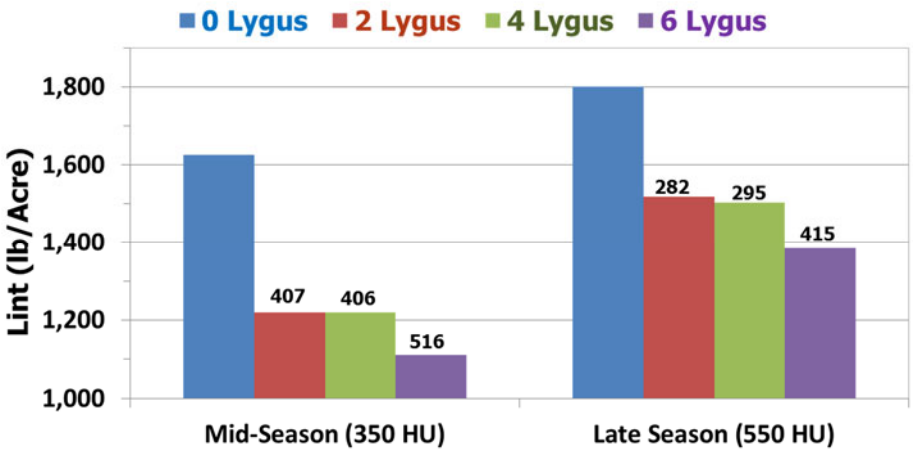

Figure 4. Influence (pounds of yield reduction) of varying levels of *Lygus* infestations on lint yield at two crop phenological stages, Lubbock County, TX, 2014.

Averaged over three years, artificial augmentation of 1, 2, 4, and 6 *Lygus* per plant at 350 HU after first flower reduced the cotton lint yield by 137, 313, 422, and 516 lb/acre, respectively, whereas the yield reduction values for the same *Lygus* densities were 66, 191, 213, and 415 lb/acre during the late season (550 HU from first flower). Thus, the *Lygus* yield reduction potential decreased by 52, 39, 50, and 20% for 1, 2, 4, and 6 *Lygus* per plant infestation when cotton matured from 350 HU to 550 HU. Late season *Lygus* management program may consider decreasing *Lygus* damage potential as season progresses and adjust the economic threshold (ET) accordingly. We are currently developing dynamic ET for *Lygus* management in the Texas High Plains.

Acknowledgements

We thank the Cotton Incorporated Texas State Support Committee and Plains Cotton Growers, Inc. for funding of this research. The authors also are indebted to Richard Norman, Jeffrey Drymalla, Betsy Perafan, Sydnee Woodman, Christy Hogue, and Jason Saiz, whose technical assistance in the field was invaluable.

References

Jubb, Jr. G. L., and L. A. Carruth. 1971. Growth and yield of caged cotton plants infested with nymphs and adults of *Lygus hesperus*. J. Econ. Entomol. 64: 1229-1236.

Parajulee, M. N., R. B. Shrestha, A. K. Barman, and S. C. Carroll. 2008. Ecologically intensive pest management in cotton agroecosystems: *Lygus hesperus* as a model system. Egyptian Journal of Agricultural Research 86: 57-81.

Parajulee, M. N., M. B. Adhikari, D. L. Kerns, R. B., Shrestha, and S. C. Carroll. 2011. Insecticide termination rule for western tarnished plant bug in the Texas High Plains, pp. 1204-1208. *In* Proceedings, Beltwide Cotton Conferences, National Cotton Council, Memphis, TN.

Williams, M. R. 2013. Cotton insect losses-2012, pp. 546-586. *In* Proceedings, Beltwide Cotton Conf., National Cotton Council, Memphis, TN.