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Identifying Factors Affecting Population Abundance of *Lygus* species in Texas High Plains Cotton

Submitted by:

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Project Summary

This is a geographically specific research project that was conducted in the Texas southern High Plains. The overall objective of this project was to identify biological and cultural factors influencing the populations of *Lygus* bugs in Texas High Plains cotton. The major factors influencing the population dynamics of *Lygus* species include diversity of cultivated and wild hosts which support *Lygus* populations when cotton is not available, variation in cotton cultivars (leaf smoothness, timing of maturity, and plant height), the geographic gradient within the Texas High Plains, planting date, and irrigation management. To develop a knowledgebase on several biotic and abiotic factors that affect population dynamics of *Lygus* species, this project was initiated to examine the effects of known and potential factors on *Lygus* population dynamics. Specifically, this project was designed to quantify *Lygus* population abundance as affected by cotton cultivars, irrigation regimes, and planting date window in the Texas High Plains. The experiments were conducted at two Texas Agricultural Experiment Station farms that represent the northern and southern areas of the Texas High Plains. The study in the northern region was conducted at Halfway (Hale County) and the study in the southern region was conducted near Denver City (Gaines County). *Lygus* bugs, fleahoppers, and total predators were monitored at both locations.

Halfway Site: cotton was planted on May 7 (timely planted) and June 6 (late planted) as part of planting date study. Within each planting date, four commercial varieties of cotton were planted, including Paymaster 2145RR, Paymaster 2167RR, Paymaster 2326RR and Stoneville 2454R. Seasonal average *Lygus* and fleahopper numbers varied significantly with cotton cultivar. Paymaster 2326RR supported significantly higher number of *Lygus* and fleahopper when compared with the other three cultivars evaluated. There was no significant difference in seasonal predator numbers when comparing cultivars. Planting date significantly affected total seasonal numbers of both *Lygus* and fleahoppers in our study. Late planted cotton had significantly higher numbers of both fleahoppers and *Lygus* compared with timely planted cotton. Planting date had no significant effect on total seasonal numbers of predators. Sampling methods varied in their efficiency to monitor fleahoppers, *Lygus,* and predators. The beat bucket method captured the greatest numbers of *Lygus* and predators. The visual method accounted for the most fleahoppers compared with other sampling methods.

Denver City Site: Four commercial varieties of cotton were planted on June 6, including Stoneville 4793R, Deltapine 5415RR, Paymaster 2326RR, and Stoneville 2454R. Irrigation treatments of 50, 75, and 100% ET were applied to one of the four varieties, PM 2326RR. The cotton cultivar PM2326RR had the highest *Lygus* and fleahopper numbers and the lowest beneficial arthropod numbers compared with the other three cultivars, ST2454R, ST4793R and DP5415RR. The higher abundance of plant bugs in PM2326RR could be attributed to the lowest amount of leaf trichomes in this cultivar compared with other three cultivars. Both the pest species and beneficial arthropods were more at moderate and full irrigation plots compared with that in deficiently irrigated plots. These studies will be repeated in 2003 supported by other funding sources.

Introduction and Project Justification

This is a geographically specific research project that was conducted in the Texas southern High Plains. The overall objective of this project was to identify biological and cultural factors influencing the populations of *Lygus* bugs in Texas High Plains cotton. The tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), and western tarnished plant bug, *L. hesperus* Knight, have been known to be key pests of cotton in several states in the Cotton Belt. In addition to these two species, a third species, *Lygus elisus* Van Duzee, has been identified to be an equally prevalent species of *Lygus* in the Texas High Plains. However, no biological information on *Lygus* bugs was available for the Texas High Plains.

The major factors influencing the population dynamics of *Lygus* species include diversity of cultivated and wild hosts which support *Lygus* populations when cotton is not available, variation in cotton cultivars (leaf smoothness, timing of maturity, and plant height), the geographic gradient within the Texas High Plains, planting date, and irrigation management. To develop a knowledgebase on several biotic and abiotic factors that affect population dynamics of *Lygus* species, this project was initiated to examine the effects of known and potential factors on *Lygus* population dynamics. Specifically, this project was designed to quantify *Lygus* population abundance as affected by cotton cultivars, irrigation regimes, and planting date window in the Texas High Plains.

Materials and Methods

The experiments were conducted at two Texas Agricultural Experiment Station farms that represent the northern and southern areas of the Texas High Plains. The study in the northern region was conducted at Halfway (Hale County) and the study in the southern region was conducted near Denver City (Gaines County).

Halfway Site: The treatments consisted of four commercial cotton cultivars and two planting dates in a randomized complete block design with four replications for a total of 32 plots. Cotton cultivars included Stoneville 2454R, Paymaster 2324RR, Paymaster 2145RR, and Paymaster 2167RR. The cultivar selection was based on plant architecture, leaf smoothness, and adaptability of the cultivar to the region. Planting date treatments included an optimum planting date (recommended for the southern High Plains), hereinafter referred to as timely planting, and a late planting date that mimics the replanting cut-off date for the region. Timely planting and late planting dates for this study were May 7 and June 6, respectively. Insect sampling began on June 17 and continued throughout the growing season on a weekly basis. A vacuum sampler (2-cycle backpack aspirator) was used to monitor populations of both fleahoppers and *Lygus* in all 32 plots. Five different sampling methods (Fig. 1) were used to sample only the cultivar PM 2326RR to evaluate the efficacy of sampling methods for plant bug monitoring. Sampling methods included vacuum sampler (30 second vacuum time/plot), sweepnet (100 sweeps/plot), beat bucket (8 plants/plot), dropcloth (48 plants/plot), and visual inspection (10 plants/plot). Sample units for each sampling method varied, but the sample counts were converted to numbers per acre. Data were subjected to analysis of variance with cultivar, planting date, and cultivar x planting date as sources of variability; treatment means were compared with the least significant difference. Data for sampling method comparison were also subjected to the ANOVA with sampling method as source of variability and LSD was used for mean comparison.

Denver City Site: The experimental design was a randomized block design with four replications. The plots were 16 rows wide with 36-inch row spacing. Cotton was planted on June

6, 2002. The study comprised of two main treatments in two spans (i.e. irrigation application rate and irrigation application method) under a quarter-mile center pivot system. In one span irrigation application rates targeting 50% (severe deficit), 75% (moderate deficit) and 100% (full irrigation) evapotranspiration replacement were applied through low energy precision application (LEPA) system. Base irrigation treatment was a target of 75% crop evapotranspiration replacement, with approximately 1.5 to 1.7 inches per week, split into twice weekly applications. Four cotton cultivars ST2454R, PM2326RR, ST4793R and DP5415RR were evaluated under the 75% ET LEPA irrigation system, while cultivar PM2326RR was used to evaluate ET levels. Arthropods were sampled using a vacuum sampler. Sample unit consisted of approximately 100 row ft sampled with a 30-second vacuum time per plot per week. Sampling was done weekly from July 10 to September 27, 2002. Vacuum sample counts were converted to numbers per acre. Data were analyzed using ANOVA and mean comparisons were performed with LSD.

Results and Discussion

Halfway Site: The *Lygus* spp. complex included *Lygus hesperus* and *Lygus elisus* in approximately a 2:1 ratio in the northern part of the Texas High Plains (Fig. 2). However, for this report, data are presented as total combined *Lygus* numbers. Seasonal average *Lygus* and fleahopper numbers varied significantly with cotton cultivar. Paymaster 2326RR supported significantly higher number of *Lygus* compared with the other three cultivars evaluated (Fig. 3). PM 2326RR, ST 2454R, PM 2145RR, and PM 2167RR supported 588, 282, 314, and 204 *Lygus* per acre per season, respectively. Paymaster 2326RR supported significantly higher number of fleahoppers compared with the other three cultivars evaluated. PM 2326RR, ST 2454R, PM 2145RR, and PM 2167RR supported 2761, 778, 1242, and 946 fleahoppers per acre per season, respectively. Among the four cultivars, PM 2326RR and PM 2167RR are semi-smooth cultivars, whereas PM 2145RR is a hairy leaf cultivar and ST 2454R is a smooth leaf cultivar. The difference in abundance between PM 2326RR and other cultivars is large, especially when compared with the two semi-smooth leaf cultivars. This observation would indicate that the leaf hairiness is not entirely responsible for variation observed in *Lygus*/fleahopper abundance among these cultivars.

Planting date significantly affected total seasonal number of both *Lygus* and fleahoppers in our study. Late planted cotton had significantly higher numbers of both fleahoppers and *Lygus* compared with timely planted cotton. Average numbers of fleahoppers and *Lygus* in late planted cotton plots were 2169 and 535 per acre, respectively, whereas numbers in timely planted plots were 1420 and 291 per acre, respectively. Significantly higher abundance of these plant bugs in late planted cotton compared with that in timely planted cotton could be attributed to the interaction between plant bugs and plant phenology. Late-planted cotton may have been more attractive to plant bugs than timely planted cotton during the period when plant bugs were moving into cotton fields from other hosts because of the greater abundance of squares present at that time in the late planted cotton.

Sampling methods varied in their efficiency to monitor fleahoppers and *Lygus*. The beat bucket method captured the greatest numbers of *Lygus* (Fig. 4). The beat bucket, sweep net, drop cloth, vacuum, and visual methods estimated 2009, 383, 357, 113, and 102 *Lygus* per acre per season, respectively. The visual method accounted for the most fleahoppers compared with other sampling methods. The beat bucket, sweep net, drop cloth, vacuum, and visual methods estimated 4841, 1299, 934, 512, and 6717 fleahoppers per acre per season (Fig. 5), respectively.

Denver City Site: Two pest species, *Lygus* and cotton fleahoppers, and beneficial arthropods including *Orius* sp., bigeyed bug, assassin bug, lady beetle, green lacewing, *Collops* sp., hooded beetle and spiders were sampled from the field. Predaceous bugs including *Orius* sp., bigeyed bug, and assassin bug and green lacewing were abundant throughout the season. Unfortunately, *Lygus* activity was minimal at the Denver City location in 2002 cotton growing season. However, the study will be repeated in 2003.

Influence of Irrigation Application Rate: The *Lygus* species complex included *Lygus hesperus* and *Lygus elisus* in approximately equal numbers in the southern High Plains. For this report, data are presented as total combined *Lygus* numbers. Overall, *Lygus* numbers were very low in the southern Texas High Plains in 2002 (Table 1). Nevertheless, *Lygus* abundance varied with irrigation water levels. Average *Lygus* numbers were significantly higher in 75% and 100% ET replacement plots than in 50% ET replacement plots (Table 1). The cotton fleahopper numbers followed the same trend as *Lygus*. That is, average numbers of fleahoppers were higher in 75% and 100% ET replacement plots than in 50% ET replacement plots.

Abundance of predaceous bugs increased with increase in ET level. Green lacewing numbers were higher at 75% ET level, but the numbers were similar between 100% and 50% ET levels. Total beneficial arthropods (all predators combined) were also higher in 75 and 100% ET plots compared with that in 50% ET plots (Table 1).

Influence of Cotton Cultivars: The cotton cultivar PM2326RR had the highest *Lygus* and fleahopper numbers and the lowest beneficial arthropod numbers compared with the other three cultivars, ST2454R, ST4793R and DP5415RR (Figs. 6-8).

Table 1. Seasonal abundance (numbers per acre per week) of *Lygus* bugs, fleahoppers, and total arthropod predators at different irrigation application rates, Gaines County, Texas, 2002.

	Evapotranspiration Replacement Levels		
Insect Species	50%	75%	100%
Lygus spp.	21	42	38
Fleahoppers	3515	4140	3710
Predaceous bugs	277	527	577
Green lacewing	595	1081	500
Total predators	1168	1882	1317

Research Impact and Continuation of the Project

This research was timely and very important for cotton IPM program development and implementation for the Texas High Plains, particularly in light of boll weevil eradication. We have generated extensive amount of baseline data on biology and ecology of *Lygus* bugs, fleahoppers and associated arthropod predators. This project is continuing to accomplish several remaining project objectives that will require multi-year data. We continue to seek funding from several sources, including the TDA, to complete this challenging project.

Acknowledgment

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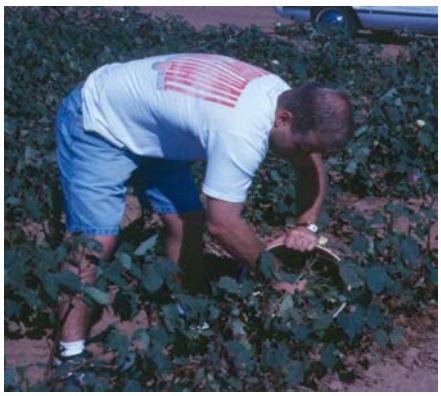
Vacuum Sampler



Beat Bucket

Drop Cloth

Visual

Sweepnet

Figure 1. Different sampling techniques used in arthropod sampling, Halfway and near Denver City, Texas, 2002.

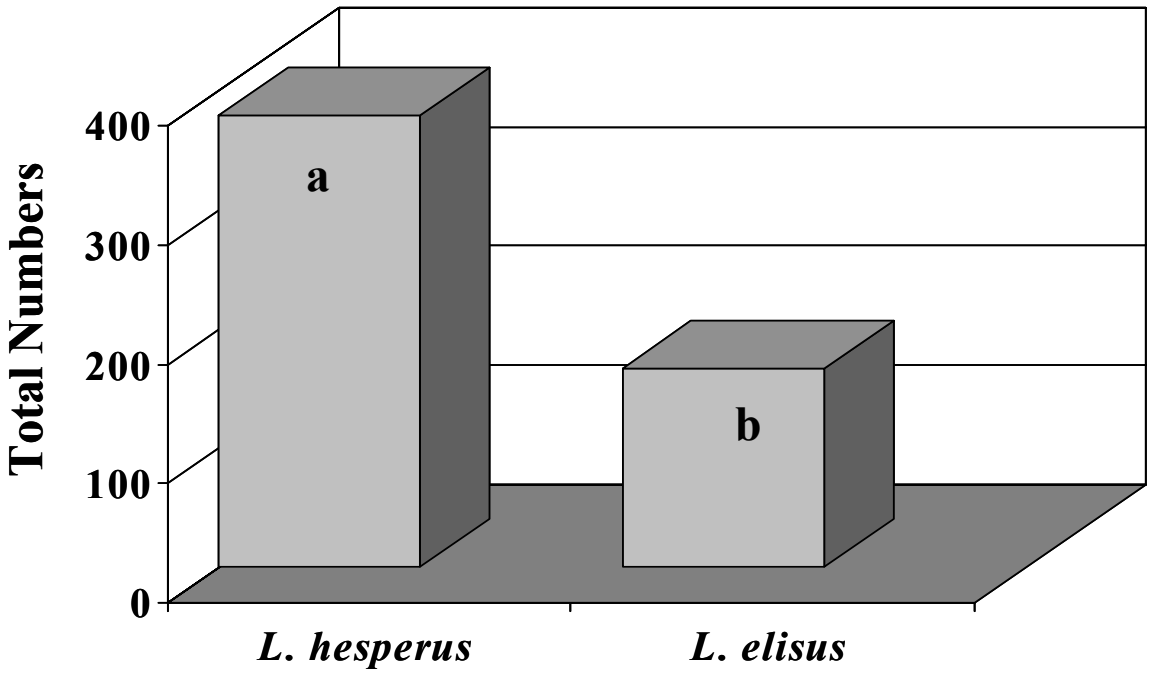


Figure 2. *Lygus* species collected from different cotton samples from 17 June to 8 October 2002, Halfway, Texas.

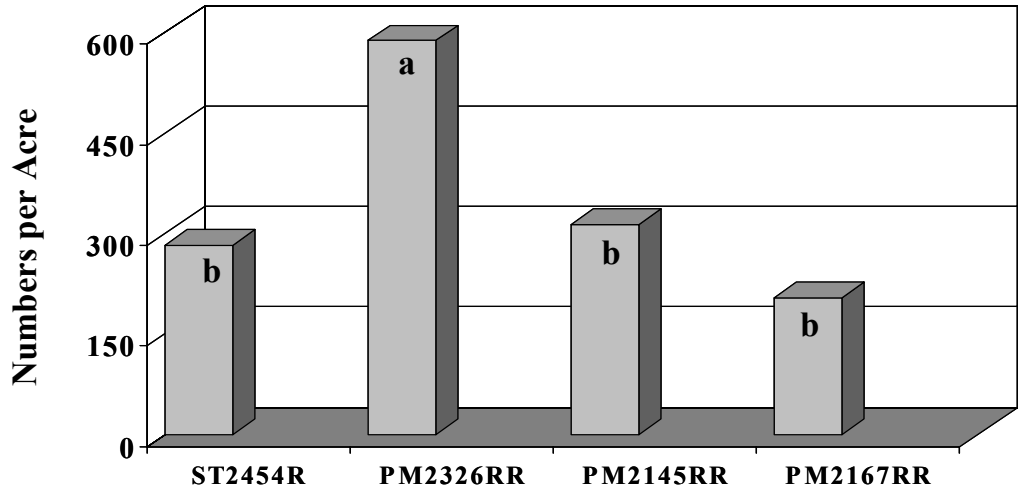


Figure 3. Seasonal average abundance of *Lygus* bugs detected by vacuum sampler in four selected cotton cultivars, 17 June to 8 October 2002, Halfway, Texas.

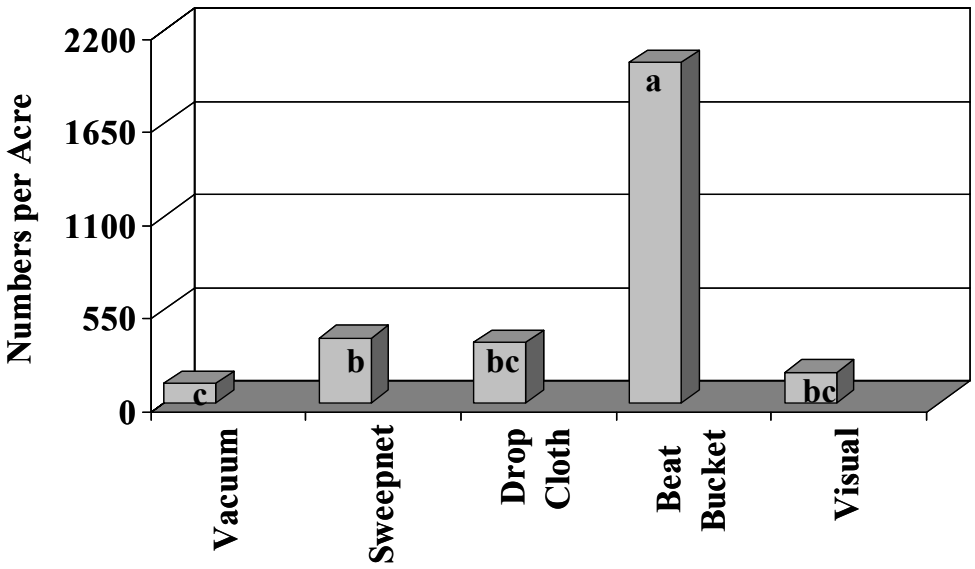


Figure 4. Seasonal average abundance of *Lygus* bugs detected by five different sampling methods, 17 June to 8 October 2002, Halfway, Texas.

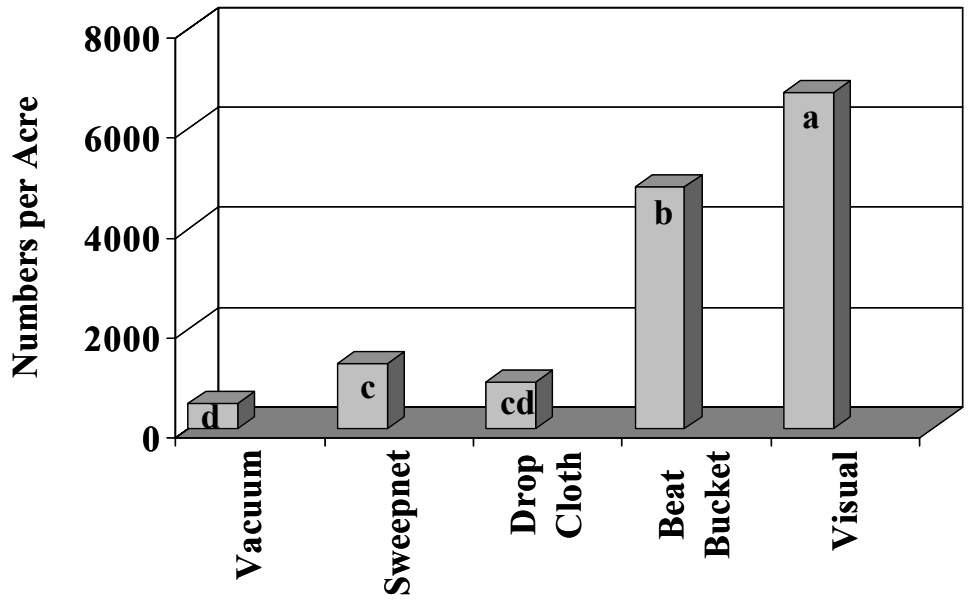


Figure 5. Seasonal average abundance of fleahoppers detected by five different sampling methods, 17 June to 8 October 2002, Halfway, Texas.

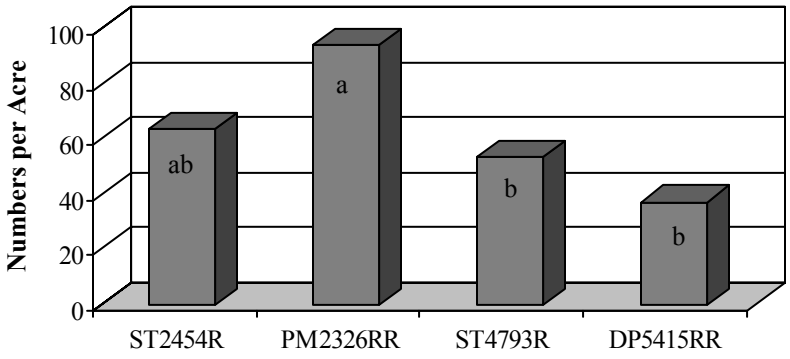


Figure 6. Influence of selected cotton cultivars on *Lygus* abundance near Denver City, Texas, 2002.

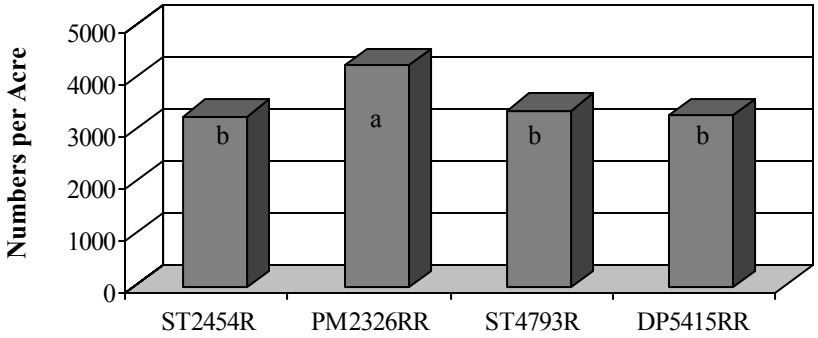


Figure 7. Influence of selected cotton cultivars on fleahopper abundance near Denver City, Texas, 2002.

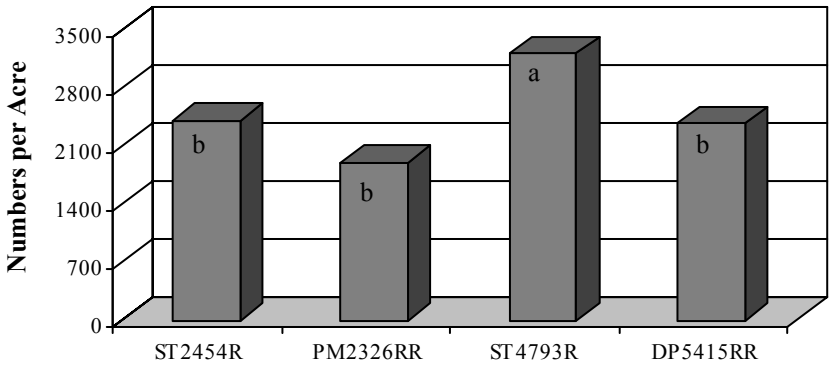


Figure 8. Influence of selected cotton cultivars on total arthropod predators near Denver City, Texas, 2002.