INSECTICIDAL MANAGEMENT OF *LYGUS* AND RELATIVE BOLL DAMAGE IN TEXAS HIGH PLAINS

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Abstract

Carbine at 2.3 oz, Ammo at 5.1 fl-oz, Orthene 97 at 0.75 lbs, Vydate at 17 fl-oz, Centric at 2.5 oz and Diamond at 10.5 fl-oz were evaluated for their efficacy to *Lygus* in late-season cotton in Hockley County, TX. Diamond and Carbine, as expected since being an IGR and anti-feedent, respectively, were somewhat slow acting, but by 6 DAT (days after treatment) the total number of *Lygus* were statistically equivalent and lower than the untreated for all the insecticides. However, the Centric plots had more adults than the other insecticides except Diamond. At 6 DAT, the untreated plots were averaging about 48% of the bolls with external *Lygus* feeding damage, and about 30% of the bolls with internal feeding damage. Bolls from all of the insecticide treatments had fewer external feeding marks than the check. External feeding damage was similar among the insecticides except Centric had more damage than Ammo. Results were similar for the percentage of bolls with internal damage, but Centric did not differ from the check.

Introduction

Lygus hesperus in the Texas High Plains has the potential to cause serious boll damage in late season cotton, resulting in reduced yield and fiber quality. *Lygus* ranked second to bollworm/budworm complex in terms of pest losses in cotton in 2007 (Williams 2008). The feeding of *Lygus* on cotton bolls is characterized by dark necrotic spots of about 2-mm width with a sunken center. The injury to the bolls may be external (superficial) or internal depending on the maturity/age of the bolls and feeding intensity of the insect. Cotton bolls that are 150-200 HU (heat units; >60 ^{0}F) old are most susceptible to *Lygus* damage while bolls attaining 350 HU are considered relatively safe from economic damage (Cranmer et al. 2005). Feeding injury results in increased shedding of immature squares and damage to bolls leading to a reduction in yield. Tugwell et al. (1976) reported an approximate 10% reduction in yield due to tarnished plant bugs feeding on bolls. For management of *Lygus* spp., the most important method to date is the use of broad spectrum insecticides (Nordlund 2000).

The objectives of this study were to evaluate the efficacy of six selected insecticides in controlling late season infestations of *Lygus*, and to quantify external and internal damage on bolls.

Materials and Methods

The field trial was conducted in southeastern Hockley County, TX. The cotton field had adjacent vegetation of alfalfa, cotton, weeds and trees. The alfalfa had high numbers of *Lygus* which acted as a source for *Lygus* in the cotton. The experiment was a randomized complete block design with seven treatments and four replications. The selected cotton variety, FiberMax 9063B2F, was planted on 40-inch rows in experimental plots measuring 4 rows x 60 ft. The field was irrigated using a sub-surface drip irrigation system. The insecticides evaluated are listed below (Table 1) and the control plots were untreated. During the experiment, cotton was approximately 8 nodes above white flower stage.

The *Lygus* population was estimated by drop cloth method (3 ft x 2 ft) and expressed as mean density/6-ft row. Bolls of approximately 10-15 mm dia. (~150-200 HU maturity) were collected at random from the plots for damage assessment. Pre-treatment observations on *Lygus* densities and boll samples were taken on Aug 20, 2008.

Table 1. Insecticides and rate of application.

Insecticide	Active Ingredient	Rate (per acre)	Category	Mode of Action
Carbine 50 WG	Flonicamid	2.3 oz	Flonicamid	Feeding blocker
Ammo 2.5 EC	Cypermethrin	10.5 fl-oz	Pyrethroid	Sodium channel modulator
Orthene 97S	Acephate	0.75 lbs	Organophosphate	Acetylcholine esterase inhibitor
Vydate C-LV 77	Oxamyl	17 fl-oz	Carbamate	Acetylcholine esterase inhibitor
Centric 40 WG	Thiamethoxam	2.5 fl-oz	Neonicotinoid	Nicotinic acetyl choline receptor agonist
Diamond 0.83 EC	Novaluron	10.5 fl-oz	Benzoylureas	Chitin biosynthesis inhibitor

For the pre-treatment damage assessment, approximately 30 bolls were collected from each plot to evaluate the external and internal boll damage. The samples were collected in Ziploc® bags and stored in a refrigerator until damage observations were recorded. The insecticide applications were made on Aug 23 using a four nozzle CO_2 pressurized hand boom sprayer with a discharge rate of 10 gallons/acre. Population counts were made at 3, 6 and 13 DAT, and boll samples were collected at 6 and 13 DAT. These post-treatment boll samples consisted of 20 bolls/plot. The external damage assessment was made by counting the number of feeding punctures using a 10x magnifying lens. For internal damage, bolls were cut cross sectional with two cuts, one at about one third and next at two thirds from the tip. The number of locules damaged were counted and recorded as internal damage. The plots were harvested on Nov 11 using a custom made 'HB' hand stripper. A 1/1000th acre section was harvested from of the middle two rows of each plot. Samples were ginned at Texas AgriLife Research ginning facility in Lubbock.

Data were analyzed using SAS PROC MIXED and means separated using protected LSD ($P \leq 0.05$) for all except for yield where a $P \leq 0.1$ was used for comparison (SAS Institute 2003). Both internal and external damage were expressed in % number of bolls affected.

Results and Discussion

Pre-treatment counts of *Lygus* by drop cloth method showed no significant differences among treatments (Figure 1). Population densities (*Lygus* nymphs and adults) were above treatment threshold (4 *Lygus*/6-ft row) in all plots. Post-treatment observations (3, 6 and 13 DAT) showed a sharp decline in *Lygus* densities across all treated plots, while the densities increased in untreated plots. The population in untreated plots remained above threshold through 13 DAT. Ammo, Vydate, Orthene and Carbine were able to reduce *Lygus* populations below threshold at 3 DAT, after which the population continued to remain low through 13 DAT. Centric and Diamond reduced the population below threshold at 6 DAT. The results clearly indicate that *Lygus* population in the Texas High Plains could be suppressed effectively by insecticidal application and that softer insecticides like Carbine 50 WG, Centric 40 WG and Diamond 0.83 EC could be utilized.

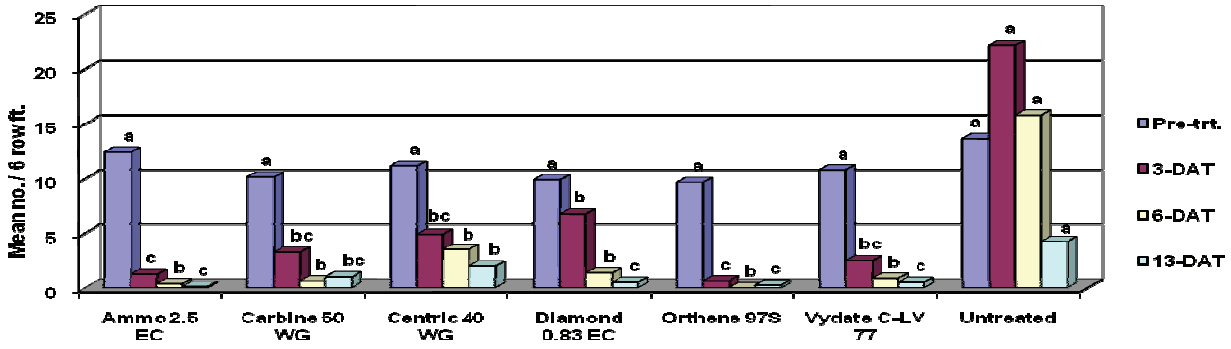

Figure 1. Mean *Lygus* population / 6 ft. row (drop cloth method) at pre-treatment and 3, 6 and 9 days after treatment.

Boll damage based on % bolls with external and internal injury/damaged locules did not differ among plots in pre-treatment observations (Figures 2 and 3). At 6 DAT, the percentage of bolls with external and internal injury decreased in all treated plots, whereas damage in untreated plots increased. Plots treated with Ammo (cypermethrin) had the least damage which may be due to its longer residual effect. Cardwell et al. (2000) reported that in spite of resistance development, growers continued to use pyrethroids for *Lygus* control, due to its longer residual action. Among the treatments, only the 6 DAT sample had significant differences among treatments for both internal and external injury, whereas the 13 DAT sample did not show differences between treatments. Of the treatments, Centric, Vydate and Diamond demonstrated the least amount of boll protection although they had significantly less damaged bolls than in untreated plots.

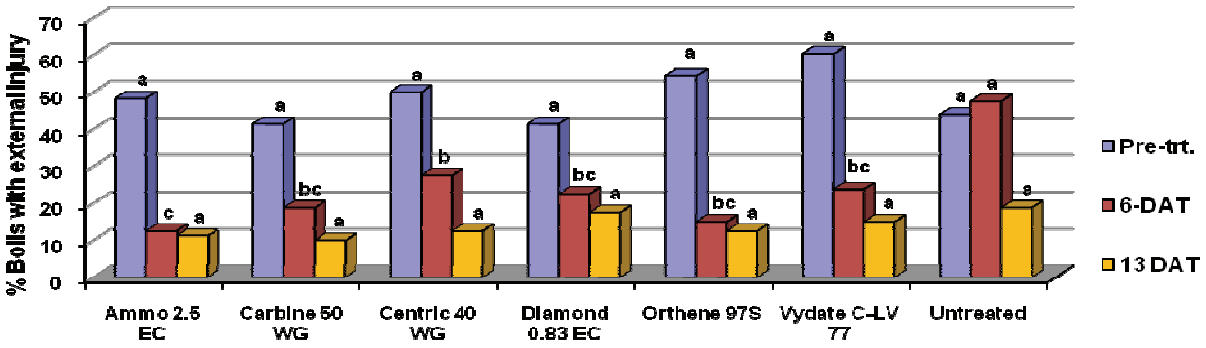

Figure 2. Percent bolls with external injury (n>80/trt.) at pre-treatment, and 6 and 13 days after treatment.

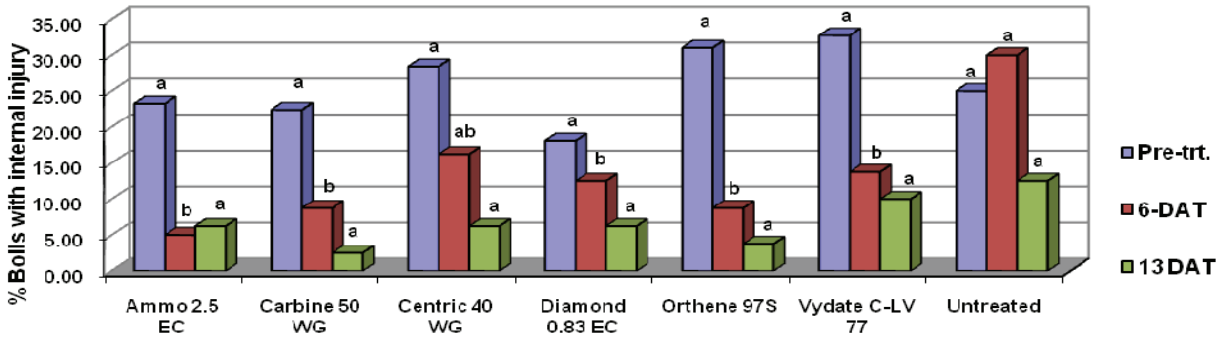

Figure 3. Percent bolls with internal injury/damaged locules (n>80/trt.) at pre-treatment, and 6 and 13 days after treatment.

Significant yield differences were observed among treatments (Figure 4). Orthene 97S recorded the highest lint yield (958 lbs/acre). The lowest yields were recorded in the Centric and untreated plots at 687 and 720 lbs/acre, respectively.

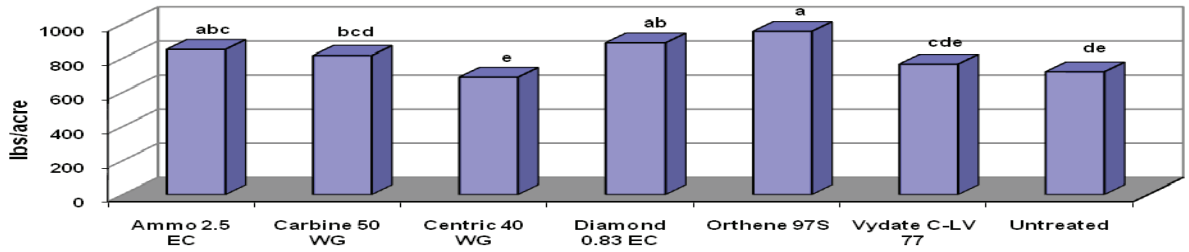

Figure 4. Total lint yield (lbs/acre).

The external and internal injury on the bolls showed a linear relationship. A simple linear regression of % bolls with external injury and % bolls with internal injury demonstrated a strong positive relationship ($R^2 = 0.97$, $P < 0.0001$) (Figure 5). Results indicated that approximately 50% of the bolls with external damage had internal damage. Simple linear regression analysis also demonstrated a good relationship between *Lygus* density and external injury (R^2=0.82, P<0.0001) (Figure 6). At a threshold of 4 *Lygus*/6 row ft., the % bolls with external injury would be around 25%. A sigmoidal 3 parameter Chapman simple linear regression analysis indicated a significant correlation between *Lygus*/6 ft-row and yield (lbs-lint/acre); $R^2 = 0.48$ ($P < 0.0004$) (Figure 7). A threshold of 4 *Lygus*/6 ft-row appears to be well situated to prevent the steepest portion of the curve toward yield reduction.

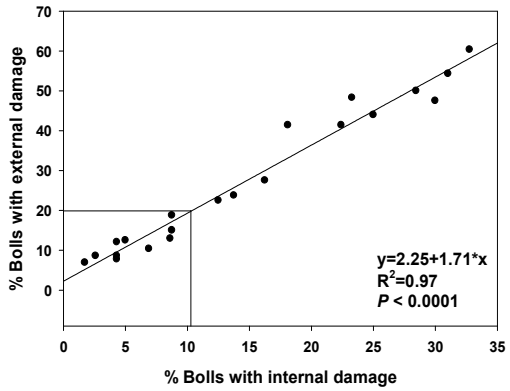

Figure 5. Relation between external and internal injury on bolls.

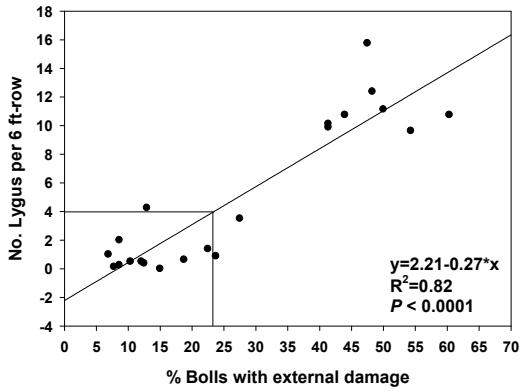

Figure 6. Relation between *Lygus* population and external injury on bolls.

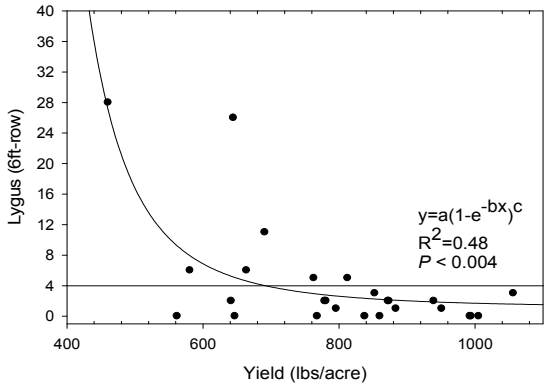

Figure 7. Relation between *Lygus* field population and lint yield/acre.

Summary

In the Texas High Plains, wherever alfalfa – cotton systems exists, there is high chance of an infestation of *Lygus*. Being a highly mobile insect, *Lygus* exhibits back and forth movement between alfalfa and cotton depending on phenological stage of the crop. Since our study was conducted in such a system where the adjacent field of alfalfa acted as the major source of *Lygus*, even in late season of cotton, it was evident that yield could be affected, if not managed in time. All insecticides except Centric and Diamond had a significant impact in reducing *Lygus* populations below threshold at 3 DAT, continuing until 13 DAT. Centric and Diamond showed activity at 6 DAT. Percentage of bolls (at 150-200 HU maturity) with external and internal injury did not vary among insecticides initially, but after treatment showed a sharp decline relative to the untreated beginning at 6 DAT. Ammo 2.5 EC recorded the least amount of *Lygus* injury to the bolls. The currently recommended threshold of 4 *Lygus*/6 ft-row appears to follow the yield response curve. With further evaluation, an action threshold of 25% bolls with external injury could be used as a scouting measure for the population threshold of 4 *Lygus*/6 ft-row. Approximately 50% of the bolls with external injury had internal injuries at 150-200 HU. Orthene 97S proved to be the best insecticide considering the lint yield, overall effect in reducing the *Lygus* population, and injury to bolls.

Acknowledgements

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