Potential of Diamond Insecticide for Lygus Management in the Texas High Plains

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Introduction

Lygus hesperus in the Texas High Plains has the potential to cause significant boll damage in late season cotton resulting in reduced yield and fiber quality. 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. Cotton bolls that are < 200 heat units (>60 ºF) old are most susceptible to Lygus damage. The feeding injury also results in an increased boll abscission leading to reduction in yield.

Lygus infesting cotton in the Texas High Plains appear to be fairly susceptible to a number of commonly used insecticides. However, because the use of some insecticides increases the likelihood of secondary pest outbreaks such as aphids, there is much interest in identifying insecticides that are efficacious toward Lygus but relatively softer on natural enemies. Diamond (novaluron) is an insect growth regulator that acts by inhibiting formation of chitin during molting. Thus Diamond is only active toward immature Lygus. Fortunately in the Texas High Plains, most treatable Lygus infestations are comprised primarily of Lygus nymphs.

Objectives

The objectives of this study were to evaluate the efficacy of Diamond (novaluron) insecticide alone or mixed with adulticidal insecticides for managing late season infestations of Lygus, to quantify external and internal damage on bolls, and impact on yield.

Materials and Methods

This study was conducted west of Wolfforth, TX, in Hockley Co. Cotton 'FiberMax 9063B2F' was planted on May 15, 2009, and irrigated using sub-surface drip irrigation. The test was a RCB design with 4 replicates. Plots were 4 rows X 60 ft in length. Treatments are listed in Table 1.

The Lygus populations were estimated by drop cloth method (3 ft x 2 ft) and expressed as mean density/6 ft-row (Figure 1). Bolls of approximately 10 to 20-mm diameter. (~150 to 200 HU maturity) were collected at random from each plot for damage assessment.

Lygus population counts were made at 0, 7, 14 and 21 DAT, and boll samples were collected at 0 and 7 DAT.

Table 1. Insecticides evaluated, rates, classification and MOA.

Insecticide	Active Ingredient	Rate applied (per acre)	Classification	Mode of Action
Diamond 0.83 EC	Novaluron	6 fl-oz	Benzoylureas	Chitin biosynthesis inhibitor
Diamond 0.83 EC	Novaluron	9 fl-oz		
Diamond 0.83 EC	Novaluron	12fl-ox		
Carbine 50 WG	Flonicamid	1.7 oz	Flonicamid	Feeding blocker
Acephate 97	Acephate	0.75 lbs	Organophosphate	Acetylcholine esterase inhibitor
Diamond 0.83 EC + Carbine 50 WG	Novaluron + Flonicamid	6 fl-oz + 1.7 oz		
Diamond 0.83 EC + Acephate 97	Novaluron + Flonicamid	6 fl-oz + 0.75 lbs		

All treatments included Dyne-Amic non-ionic surfactant at 0.375% v/v

Materials and Methods (continued)

Figure 1. Sampling Lygus with a drop cloth.

Pre-treatment observations on Lygus densities and boll samples were taken on August 20, 2009. Fifteen bolls were collected from each plot to assess external and internal damage. The samples were collected in Ziploc bags and stored in a refrigerator until damage observations were recorded. The insecticide application was made on August 20 using a four nozzle CO_2 pressurized hand boom sprayer with a discharge rate of 10 gallons/acre.

The external damage assessment was made by counting the number of feeding punctures using a 10x magnifying lens (Figure 2a). For internal damage, bolls were cut cross sectional with two cuts, one at about one third and next at two thirds from the tip. (Figure 2b). The number of locules damaged were counted and recorded as internal damage.

Figure 2a. Boll (~150 HU) with external Lygus injury.

Figure 2b. Boll (~150 HU) cut open showing damaged locules due to Lygus feeding.

The plots were harvested on November 10 using an HB hand stripper. A 1/1000th acre section was harvested from the middle two rows of each plot. Samples were ginned at Texas AgriLife Ginning Facility in Lubbock.

Data were analyzed using PROC MIXED and means separated using protected LSD ($P \leq 0.05$) for all except for yield where a $P \leq 0.05$ was used for comparison.

The relationship between external damage, internal damage, and yield and external damage was made using linear regression analyses. Data from other Lygus tests were included in these analyses for a more robust data set.

Results

Pretreatment counts taken on August 21 (0 DAT) showed no significant differences among treatments in the Lygus populations (Figure 3a). At this time, Lygus were averaging 12.26 per 6 ft-row, well above the action threshold of 4 per 6 ft-row.

Post-treatment observations at 7 DAT showed a sharp decline in Lygus densities across all treated plots, while the densities increased in the untreated plots dropped to 4 per 6 ft-row (Figure 3b).

Results (continued)

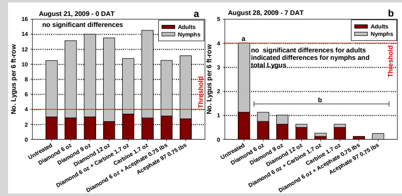

Figure 3. Lygus populations at 0 DAT (a) and 7 DAT (b).

Plots treated with Ammo had the least damage. 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.

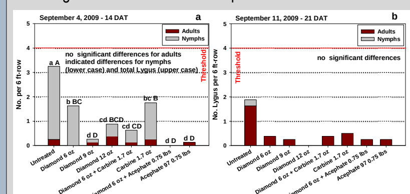

Figure 4. Lygus populations at 14 DAT (a) and 21 DAT (b).

The Lygus population continued to drop across all plots at 14 and 21 DAT indicating that the initial infestation was probably a solitary event originating from a nearby alfalfa field that had been recently cut (Figures 4a & b). At 14 DAT, all of the treatments had fewer Lygus than the untreated, but Diamond + Acephate was the only treatment that had no Lygus. However, Diamond + Acephate did not significantly differ from Acephate alone, Diamond + Carbine, or Diamond at 9 or 12 fl-oz. Carbine and Diamond at 6 fl-oz appeared weak, but the rate of Carbine tested (1.7 oz) is considerably lower than the recommended rate for Lygus (2.3 oz). The low rate was tested to determine if there was an additive effect when combined with a low rate of Diamond (6 fl-oz). These data suggest that combining the two low rates of Diamond and Carbine may be a viable strategy for managing mixed populations of adult and immature Lygus.

Based on external Lygus feeding stings, all of the treatments had fewer stings than the untreated 7 DAT (Figure 5a). Treatments containing Acephate had the fewest stings but did not statistically differ from Diamond at 9 fl-oz, Carbine or Diamond + Carbine. The damage relationships among treatments was similar for internal injury or the number of damaged locules per 100 bolls (Figure 5b). As expected there is a very close relationship between external stings and internal damage. Based on simple linear regression, when sampling dime sized bolls, one might expect to find about 17 damaged locules per 100 stings (Figure 6).

Results (continued)

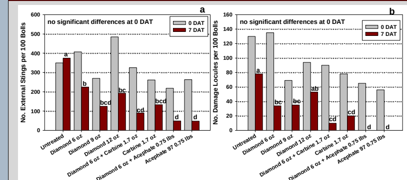

Figure 5. Impact of insecticides on preventing external Lygus stings (a) and internal damage (b) to bolls.

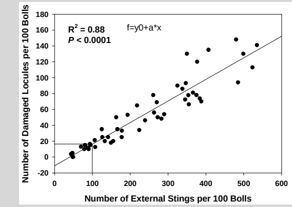

Figure 6. Relationship between the external and internal Lygus damage to dime sized (10-20 mm diameter) bolls.

Yield differences could not be detected in this test, possibly because of stand issues in some plots associated with hail events early in the season (Figure 7a).

However, when looking across several similar studies relationships between external damage and yield were evident. Although the R^2 was much lower than desired, it appears that notable yield reduction may occur when 100 bolls average 1 sting per boll (Figure 7b). This suggests that a Lygus treatment action threshold may be developed utilizing external damage as the determining factor. Based on Figure 7, 100 stings would equate to 16-17 damaged locules per 100 bolls.

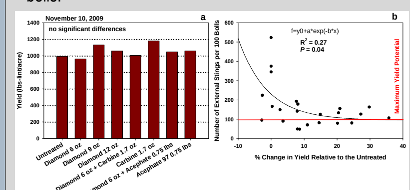

Figure 7. Yield (a) and the relationship between external damage and maximize yield through protection form Lygus (b).

Acknowledgements

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