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CHARACTERIZING THE DAMAGE AND OVIPOSITION OF A CREONTIADES PLANT BUG TO SOUTH TEXAS COTTON

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Abstract

A plant bug only recently identified as *Creontiades signatus* (Hempitera: Miridae) has been infesting cotton in the Coastal Bend and South Texas growing regions in high enough densities that insecticide treatments have been applied to reduce feeding damage, even though an economic threshold has not been established. Our research focused on characterizing the damage caused by this plant bug in field plots by infesting cotton bolls and comparing this to a simulated damage of injecting cotton bolls with 1µl dilutions of pectinase in distilled water. *C. signatus* that were enclosed on 8 d old cotton bolls significantly reduced seed cotton, lint, and seed weights, and had significantly higher injury scores, number of damaged seeds, and growths on the carpal wall when compared to the control (enclosed but not infested bolls). In 2005, 10% pectinase injections were not as injurious to cotton bolls as the *C. signatus* infestations, nor were there significant differences detected for seed cotton, lint, and seed weights compared to the control. In 2006, when 5% and 15% pectinase injections treatments were added to the Creontiades, 10% pectinase and control treatments, the injury score, injured seeds and growths on the carpal wall all separated out significantly (control< all pectinase injections < *C. signatus*). However, the *C. signatus* infestations were not significantly different from any of the pectinase injections in terms of seed cotton weight, lint weight, and seed weight in 2006 partially because of drought conditions where any form of injury was magnified by drought stress. A greenhouse study revealed that FiberMax 832 had over 2 times the mean number of eggs laid per plant when compared to Stoneville 4554. Most eggs (> 90%) were found on leaf petioles; similar to that reported for *Lygus hesperus* Knight and *Creontiades dilutus* (Stål).

Introduction

Lygus spp. are not an economic problem in cotton in the Lower Rio Grande Valley (LRGV) of Texas, but a green mirid *Creontiades signatus* has been considered an annual pest of some importance in the LRGV, Coastal Bend, and Beaumont, TX area for at least the last ten years. This green colored mirid looks very similar to the principal plant bug pest of cotton in Australia *Creontiades dilutus* (Stal), known as the green mirid (Foley and Pyke 1985). There has been no research conducted to determine standard sampling methods, action thresholds, or insecticide recommendations for this *C. signatus* infesting cotton in south Texas, and the current recommendations for management are listed as the same for *Lygus* spp. (Cattaneo and Sansone 2006). This plant bug may become more of a concern as insecticide use for boll weevil and lepidopteran pests decreases, particularly as the South Texas Eradication Zone nears completion of boll weevil eradication, and more acreage is planted to Bt transgenic cottons. These two factors have been associated with the elevated pest status of other heteropteran species (tarnished plant bug, *Lygus lineolaris* [Palisot de Beavois,], and the stink bug complex) in the southeastern, mid-south and Texas High Plains cotton producing regions (Layton 2000; Armstrong and Camelo 2003; Turnipseed et al. 2004). One of our objectives was to characterize the damage caused by *Creontiades* by infesting cotton bolls in the field and compare the actual feeding damage to a simulated damage technique. If a comparable feeding injury technique were developed for this mirid pest, it would expedite the knowledge base and decision support system for management applications. Damage simulation could also reduce the need for labor and time required to rear the mirids for actual infestation studies. Another objective was to conduct a preliminary greenhouse study to investigate where this mirid oviposits on the cotton plant.

Materials and Methods

Field Studies. A *C. signatus* colony was maintained on pods of "Texas Pinkeye" cowpea (*Vigna unguiculata* (L.) for feeding and oviposition and reared in ventilated Tupperware® containers held in environmental chambers at 27° C and a 14:10 h light:dark phase. A few rows of a larger block of cotton at the USDA, ARS North Farm were used to infest or artificial inject for both years of study. On 14 June 2005, 150 bolls with day-old blooms manually removed and inspected to ensure no insect or damage presence, then enclosed in an 8 oz. bottomless styrofoam cup that was covered with nylon hosiery (Greene et al. 1999). The hosiery sleeve was secured to the boll peduncle and at the cage top with a twist-tie. Three treatments were applied to bolls that were enclosed at eight days of age post-bloom: introduction of one *C. signatus* 5th instar, injection of 1 µl of 10% pectinase (Sigma-Aldrich, St Louis MO) solution diluted in distilled water via a 50 µl Hamilton (Reno, NV) syringe in each of two opposite boll locks with a 0.41 mm needle, or untreated controls (no bugs or injections). In 2006 the same procedures were followed with the addition of 5 and 15 % pectinase injection treatments. Each treatment was represented in a randomized block of 1-m cotton row. After the cotton reached harvestable maturity, all bolls were noted as present or abscised and taken to the laboratory where a damage rating score (Lei et al. 2004) was made for individual locks, and each lock was individually weighed to determine seed cotton weight. Each lock was manually delinted and lint was weighed. Seed weight and percent lint were calculated. Seeds were rated as good, bad (deformed), or as unfertilized ovules. Treatment variables were subjected to analysis of variance using the PROC GLM (SAS 2001), and treatment means were discriminated using the Ryan-Einot-Gabriel-Welsch multiple range test (Westfall et al. 2003).

Greenhouse Oviposition Study. Two cotton varieties representing an okra leaf (Fibermax 832) and a more conventional leaf architecture (Stoneville 4554) were planted with 4 seeds to a 4.6 L pot in potting soil (Sunshine mix, Bellevue, WA) and maintained in the greenhouse until attaining 9-10 nodes. The plants were enclosed with insect netting and wire hoop to keep the netting off of the plant and secured at the base of the pot. Two *C. signatus* females were enclosed for each plant in the pot and left in the greenhouse for 5 d. The number of eggs laid in the cotton tissue, and the location of the eggs were recorded on a mapped template of a cotton plant. The number of eggs/ plant was analyzed by PROC GLM and mean number of eggs from each variety was differentiated by Ryan-Einot-Gabriel-Welsch multiple range test (Westfall et al. 2003).

Results and Discussion

Field Studies. The overall model was significant (F = 73.9; df = 2,63; $P < 0.001$) for 2005 where *C. signatus* were enclosed with bolls, bolls were injected with 10% pectinase and the control (Table1) and in 2006 (F = 14.1; df = 4,92; $P < 0.001$) where the 5% and 15% pectinase treatments were included (Table 2). In 2005, injury score, number of injured seeds, and growths on the carpal wall were all significant from one another, with the *C. signatus* infestation having the highest means, followed by the 10% pectinase and controls respectfully. Seed cotton weight, lint weight and seed weights were significantly higher for the *C. signatus* infestation when compared to the 10% pectinase and controls in 2005. In 2006, the controls had significantly lower mean injury score, injured seeds, growths on the carpal wall, and significantly higher means for seed cotton weight, lint weight and seed weight, when compared to all other treatments (Table 1). The 2006 *C. signatus* infestation had the highest injury score, injured seeds, growths on the carpal wall, but was not different from any pectinase treatment in terms of seed cotton weight, lint weight or seed weight. The *C. signatus* infestations and 10% pectinase injections means were higher in 2006 compared to those of 2005. This can be partially explained by increased drought stress in 2006. The test area should have been irrigated one more time and damage caused by plant bugs can be amplified under drought stress (Armstrong and Camelo 2005).

Greenhouse Oviposition Study. FiberMax 832 had over 2 times the mean number of eggs laid per plant when compared to Stoneville 4554 (F = 19.1; df = 1,28; $P < 0.001$) (Table 2). Greater than 90% of the eggs were deposited on leaf petioles, with the remainder deposited on the main stem. This distribution of ovipostion is similar to that of *Lygus hesperus* Knight on glanded and glandless cotton varieties in the United States (Benedict et al. 1981) and for *Creontiades dilutus* (Stål) and *Creontiades pacificus* (Stål) infesting cotton in Australia (Khan et al. 2004). We did not check egg eclosion and subsequent nymphal survival in this experiment but have confirmed that *C. signatus* eggs do survive when oviposited in cotton by collecting tissue from the field and rearing *C. signatus* in the laboratory.

Table 1. Boll and yield damage parameters associated with Creontiades infestations and pectinase injections to 8d old cotton bolls at the time of injection/infestation, 2005 & 2006.

Treatment	Injury Score	Seed cotton weight (g)	# Injured seeds	# Growths on carpal wall	Lint weight (g)	Seed weight (g)
Boll injury parameters 2005						
Control	0.0 ± 0.00 c	5.1 ± 0.20 a	0.0 ± 0.0 c	0.0 ± 0.0 c	2.0 ± 0.08 a	3.0 ± 0.12 a
Creontiades	1.8 ± 0.15 a	3.6 ± 0.23 b	9.9 ± 0.34 a	6.5 ± 0.94 a	1.3 ± 0.09 b	2.3 ± 0.14 b
10% pectin.	0.7 ± 0.06 b	4.7 ± 0.19 a	2.9 ± 0.57 b	2.0 ± 0.04 b	1.8 ± 0.8 a	2.9 ± 0.12 a
Boll injury parameters 2006						
Control	0.0 ± 0.00 c	4.2 ± 0.28 a	0.0 ± 0.0 c	0.0 ± 0.0 c	1.55 ± 0.1 a	2.61 ± 0.18 a
Creontiades	2.4 ± 0.28 a	2.0 ± 0.30 b	13.27 ± 1.9a	8.47 ± 1.4 a	0.74 ± 0.0 b	1.26 ± 0.20 b
5% pectin.	1.3 ± 0.24 b	2.5 ± 0.23 b	7.89 ± 0.9 b	2.88 ± 0.4 b	0.92 ± 0.1 b	1.59 ± 0.13 b
10% pectin.	2.0 ± 0.27 ab	2.2 ± 0.23 b	7.38 ± 1.0 b	2.69 ± 0.4 b	0.79 ± 0.1 b	1.37 ± 0.15 b
15% pectin.	2.0 ±0.31 ab	2.1 ± 0.26 b	8.86 ± 1.0 b	3.21 ± 0.4 b	0.80 ± 0.0 b	1.32 ± 0.11 b

Column means within year of study followed by the same small letter are not significantly different, while those followed by a different letter are significantly different Ryan-Einot-Gabriel-Welsch, ($P < 0.05$).

Table 2. Oviposition of *Creontiades* on cotton plants (9-10 nodes, n = 16) maintained in the greenhouse, 2006.

	Mean #	Percentage of total eggs laid on plant parts			
Variety	eggs/plant[a]	Petioles[b]	Main Stem	Peduncle	Fruit
Stoneville 4554	8.0 ± 0.00 b	97.6	2.4	0	0
FiberMax 832	18.1 ± 0.15 a	90.1	9.9	0	0

[a] Eggs/plant column means followed by the same small letter are not significantly different, while those followed by a different letter are significantly different Ryan-Einot-Gabriel-Welsch, ($P < 0.05$).
[b] Petioles were monopodial and sympodial combined, most were monopodial.

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