Comparing in-season external and internal signs of feeding caused by sucking bugs to damage at harvest, with emphasis on *Creontiades signatus*

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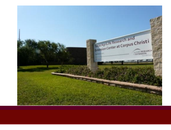


Introduction

Sucking bug management in cotton has increased in importance, now with less pressure from boll weevil and boll-feeding worms. Of the sucking bugs, boll-feeding stink bugs have been shown to cause cotton injury: boll abscission, lint staining and loss, and seed loss (Willrich et al. 2004). Loss is magnified when cotton boll rot is introduced during feeding (Medrano et al. 2007). In-season internal signs of green boll feeding (carpel wall feeding probe marks and stained lint and seed) are a good indicator of damage at harvest and useful for decision-making. External feeding probe marks may also be useful for decision-making (Toews et al. 2009).

A green plant bug, *Creontiades signatus,* is an emerging sucking bug threat, especially along the Coastal Bend of Texas. Much like stink bugs, it is able to injure young to mid-sized cotton bolls. Successful feeding results in lint and seed staining and loss, and possible transmission of cotton boll rot (Armstrong et al. 2009ab). To complement boll-age specific feeding tests (Armstrong, supported by Texas State Support Committee, Cotton Inc), we consider whether in-season green boll inspection for external and internal signs of feeding are good indicators of damage at harvest, and if feeding by *C. signatus* is associated with cotton boll rot in the field.

Photo credits: D. Fromme (Texas AgriLife Extension), S. Armstrong, (USDA ARS), R. Parker and B. Dress (Texas AgriLife Extension< http://insects.tamu.edu/fieldguide)

Green plant bug, *C. signatus* adult (left) and nymph (right)

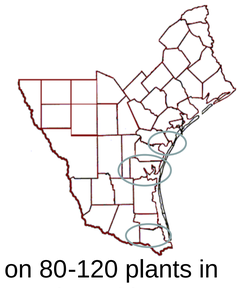
Other sucking bugs encountered along the Texas Coastal Bend in 2010 (left to right):

Cotton fleahopper, Lygus, Rice stink bug. Southern green stink bug

Experimental Question and Approach

Are signs of in-season sucking bug feeding on green bolls well linked to damage at harvest, and is the green plant bug *Creontiades signatus* associated with cotton boll rot in the field?

A replicated grower field survey was done to capture a range of sucking bug species and intensities occurring in the Coastal Bend of Texas, from Port Lavaca down to the Rio Grande Valley.



This survey was paired with a controlled field cage experiment to isolate the effects of *C. signatus*, an emerging pest of cotton along the Texas Coastal Bend.

For the replicated field survey, we collected and identified sucking bugs on 80-120 plants in each of 26 fields (half coastal and half inland) using a beat bucket during early and late bloom. Approaching harvest but before bolls opened, we inspected150 green bolls in the harvestable portion of the plant for external and internal signs of feeding and signs of boll rot, associated with sucking bugs (13 of the original 26 fields were visited along the upper coast that had signs of sucking bug activity). Near harvest, we scored 150 open bolls in these fields using a 0-4 scale and noted if boll rot was present.

External (left) and internal (right) signs of boll feeding

Open boll damage and scoring, from Lei et al. 2003

For the controlled field cage experiment, we exposed cotton plants (12 per cage, FiberMax 835 LLB2) at peak bloom to *C. signatus* (recently molted adults from a laboratory colony were used). Rates of infestation were 0 (control), 0.25, 0.5, 1, and 2 *C. signatus* per plant, replicated six times in a RCB design. Half the replications were sprayed through the cages and half were not sprayed after 7 days (a short residue pyrethroid was used pre-infestation as well). We destructively sampled half the plants per cage during late bloom, examining green bolls for signs of feeding and boll rot as in the field survey. Bolls from selected treatments were sent to the USDA ARS Cotton Pathology unit in College Station for boll rot confirmation and identification (Medrano et al. 2007, in progress), and harvest data were taken on the remaining half of plants per cage (in progress).

One of 26 field survey locations (left) and the caged *C. signatus* experiment (right)

Here we present the species composition and green and open boll data taken from the replicated field survey, and the in-season green boll data taken in the replicated field experiment for the unsprayed replications.

Summary

Cotton along the Texas Coastal Bend experienced loss to boll-feeding sucking bugs during 2010, especially in fields near the coast. This loss was magnified due to boll rot. *C. signatus* was the dominate species, and it was associated with boll rot in past lab work (Armstrong et al. 2009b) and now in the field. For monitoring purposes, harvest risk was well correlated with in-season field monitoring by inspecting green bolls for internal signs of feeding (cracking bolls to check for probe markings on the internal carpel wall and/or stained lint and seed). External signs of feeding were very common, but not useful as in-season indicators of damage at harvest.

Results

Sucking bug species composition: *Creontiades signatus* was the most common boll-feeding sucking bug in 2010. It occurred during late bloom onward, especially in fields that were located near the coast (within 5 miles of sea water). Cotton fleahopper was also common, it damages squares.

Species	Early bloom		Late bloom	
	% Coast	% Inland	% Coast	% Inland
Cotton fleahopper	99.6	99.4	34.4	52.1
Green plant bug	0	0	64.3	45.8
Lygus	0	0	1.0	0
Rice stink bug	0.4	0.5	0.1	2.1
S. green stink bug	0	0.1	0.2	0
Total insects collected *	80	456	2,795	328

* Collections using the beat bucket on 80 to 120 plants per site, 26 fields sampled, half inland and half coastal

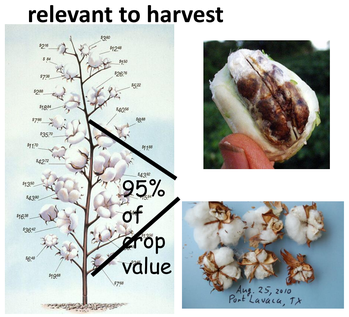
Damage and boll rot at harvest: There was a strong relationship of damage at harvest to boll rot presence (graph **A**). Cotton boll rot was found on up to 25% of the open bolls inspected (graph **A**, proportion of open bolls with rot). It was most common along coastal areas. Damage was mostly seen on bolls on the upper and outer portion of the plant, which is consistent with the presence of *C. signatus* feeding on small to mid-sized bolls during late bloom. (Pearson correlation test for the hypothesis r=0).

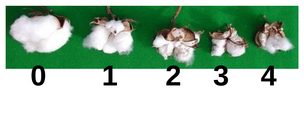
Possible in-season indicators of harvest damage

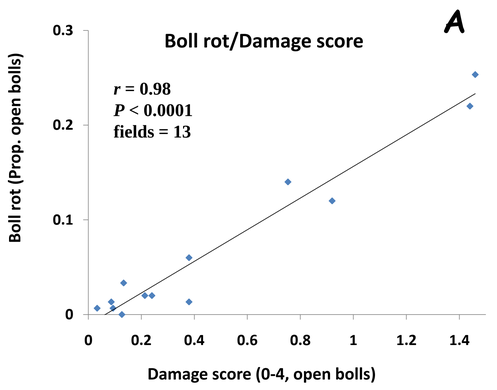
Boll-feeding sucking bug *C. signatus*

External (top) and internal (bottom) signs of boll feeding

Score damage and boll rot relevant to harvest

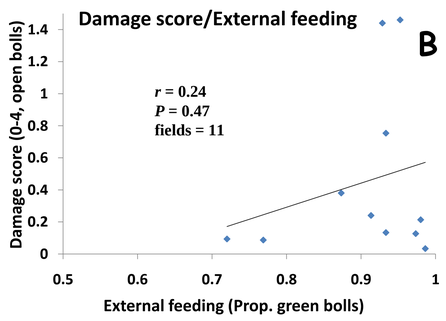


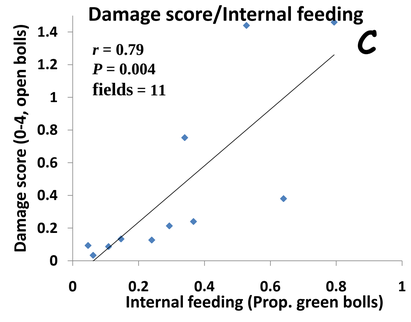


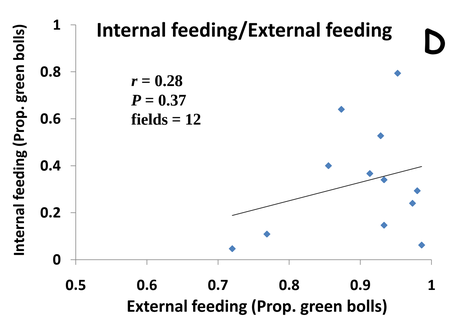


In the field cage experiment, internal signs of feeding occurred on 57% of the green bolls in the 2 *C. signatus* per plant treatment, while at 0.5 *C. signatus* per plant or lower internal signs of feeding was significantly lower, not exceeding 17% (P<0.05, equality test of proportions). Cotton boll rot occurred in at least 18% of the bolls infested with 2 *C. signatus* per plant by visual inspection (confirmation and identification of the boll rot organism is pending).

Linkage of In-season signs of feeding to damage at harvest. In the field survey, signs of external boll feeding was very common in all fields (>70% of bolls), but external feeding was not well linked to damage of open bolls near harvest (graph **B**). Whereas, signs of internal feeding was well linked to damage of open bolls near harvest (graph **C**). Internal signs of feeding are closely associated with successful feeding that results in lint and seed staining and loss, and possible transmission of cotton boll rot (graphs **C** and **A**) . External signs of feeding are feeding probes that may or may not penetrate internally; therefore external feeding signs are not well associated with internal feeding signs (graph **D**) and subsequent harvest damage (graph **B**). (Pearson correlation tests for the hypothesis r=0).







Literature. Armstrong et al. 2009a. Beltwide Cotton Conferences, San Antonio, p. 717-720.; Armstrong et al. 2009b. Beltwide Cotton Conferences, San Antonio, p. 712-716; Lei et al. 2003. In Proc. World Cotton Research Conf.. Agric. Res.Council – Institute for Industrial Crops, pp. 1338-1344 ; Medrano et al. 2007. J. Applied Microbio. 103: 436-444; Toews et al. 2009. J. Econ. Entomol. 102: 1344-135; Willrich et al. 2004. J. Econ. Entomol. 7: 924-933.