Seasonal, sampler, and time to sample variability in sampling strategies for cotton fleahopper and a green plant bug, *Creontiades signatus*

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Goal

Identify one sampling method to estimate insect density that can be effectively used by pest scouts of varying experience, from cotton squaring to late-bloom when cotton fleahopper and a green plant bug, *C. signatus*, threaten cotton.

Introduction

In the southern US, visual inspection of cotton squares and bolls has been the standard method for boll weevil and worm damage and presence. Now with less pressure from these pests (due to increase Bt-cotton use and success of boll weevil eradication), sampling is being revisited with a focus on sucking bugs. In South Texas, two economically-relevant sucking bugs species are the cotton fleahopper (feeding damage to squares and most important from squaring to early bloom cotton) and a green plant bug, *Creontiades signatus* (feeding damage to young bolls and becomes numerous late-bloom). Presence of these bugs can be detected using a variety of methods and can help attribute square loss and signs of boll injury to sucking bug activity. But because of these insects' good mobility, visual inspection for density estimation for decision-making is challenging and alternative sampling methods have been sought (Pyke et al 1980, Parajulee et al. 2006).

If one method can be found for both bugs, quantifying insect density is a very good complement to can help verify in-season square loss and boll injury thought to be associated with sucking bug activity (Pyke et al. 1980, Musser et al. 2007, Toews et al. 2009, Reay-Jones et al. 2010).

Cotton fleahopper adult and nymph

Green plant bug, *C. signatus* adult and nymph

External and internal signs of boll feeding caused by *C. signatus*

KISS

Visual

Beat cloth

Beat bucket

Sweep net

Experimental Question and Approach

What sampling method is optimal, detecting the most cotton fleahopper and green plant bug with the least variation in the least time:

Among 5 methods common to insect sampling:

KISS, Visual, Beat cloth, Beat bucket, Sweep net

For scouts with varying experience levels:

No previous sampling work, 30 minutes of training

Previous professional work in insect sampling

During periods of cotton growth when damage occurs:

Squaring (Pre-bloom), Early bloom, Late bloom

We measured number of these bugs collected and time needed to sample on a 10-plant basis, across the treatments described above in 26 cotton fields located along the Texas Coastal Bend,

from Port Lavaca

to Corpus Christi,

to the Rio Grande Valley.

Cotton fleahopper was found during all plant growth periods, and *C. signatus* only during late bloom. Therefore, the Anova for cotton fleahopper and time needed to sample conformed to a replicated split – split plot design, allowing testing of the interactions between cotton growth periods (3), experience levels (2), and methods (5). For *C. signatus*, the Anova defaulted to a split-plot, allowing testing of the interaction between experience levels and methods. Coefficents of variation (CV as a % of mean) were also calculated.

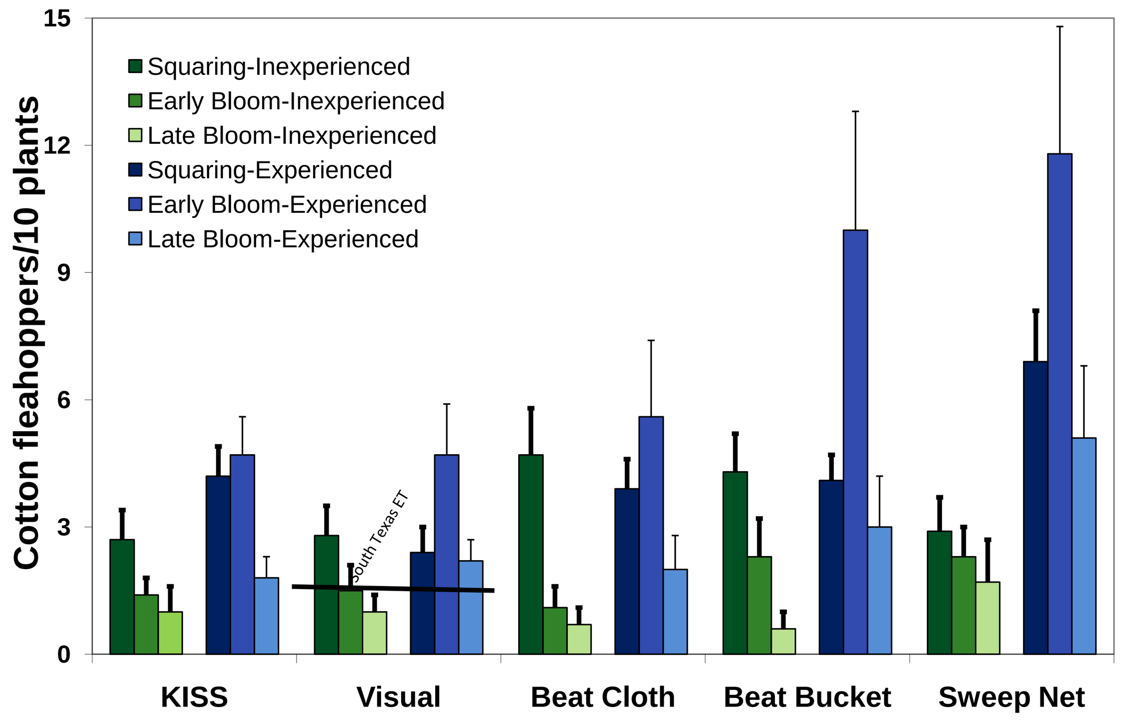
Conclusions and Future Plans

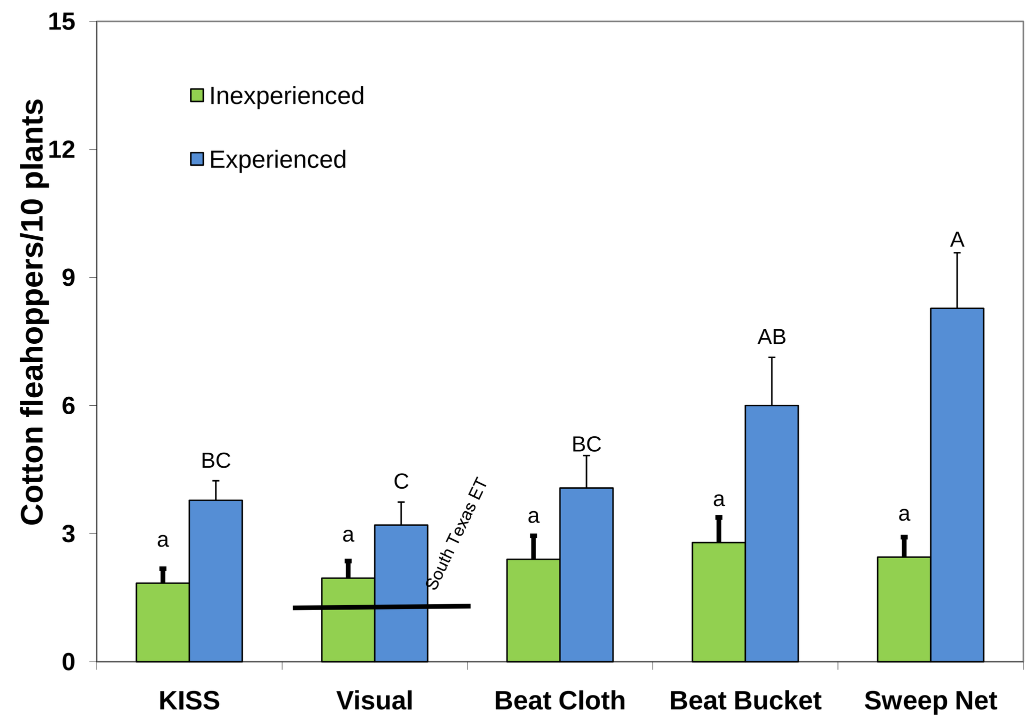
The beat bucket is an efficient and effective alternative to the more laborious visual method, as long as experienced (or well trained and supervised) samplers do the work (see Results). The beat bucket method is flexible. It is also effective in sampling cotton natural enemies (Knutson et al. 2008) and is used for sampling headworms in sorghum (a rotational crop with cotton in south Texas). Future work should include 1) training procedures for inexperienced samplers, 2) testing a 2x conversion of the cotton fleahopper thresholds based on visual inspection for use with the beat bucket, 3) determination of minimal sample sizes for decision-making, and 4) assessing the association of boll rot to green plant bug feeding (Medrano et al. 2007, 2009) to determine the threshold level needed to prevent economic loss.

Results

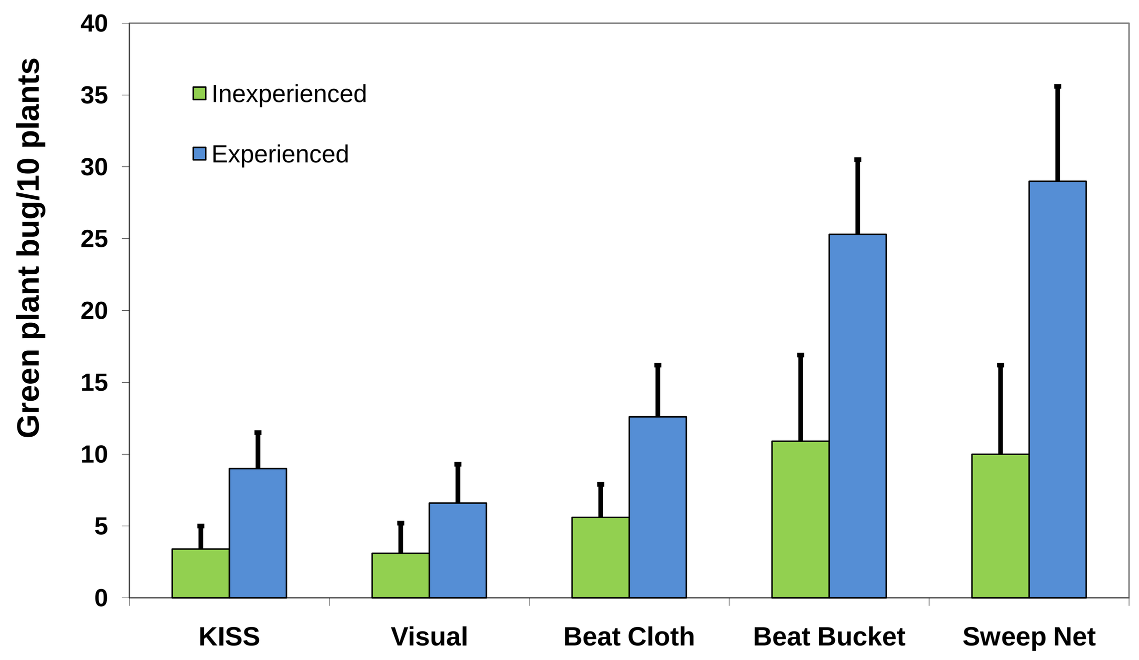
Background: We were working with good population levels, often exceeding the current south Texas economic threshold of 1.5 cotton fleahoppers per 10 plants. The green plant bug occurred during late bloom, with populations especially high in fields near the coast.

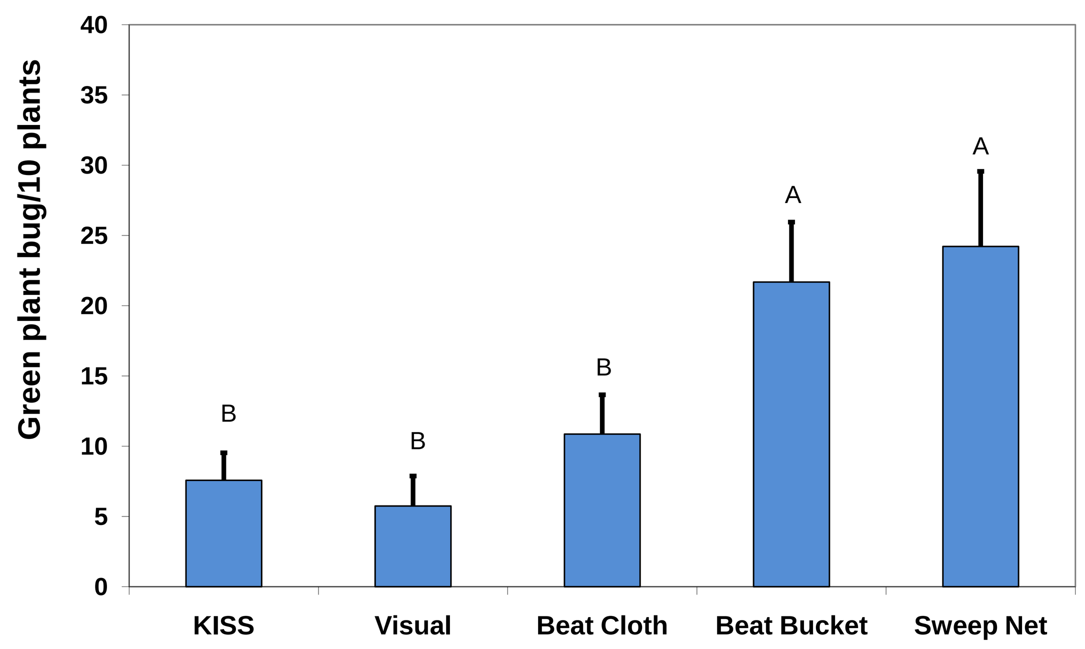
Cotton fleahopper: The 3-way interaction (top left graph) between growth stage, experience level, and sampling method was not significant (P = 0.83). One 2-way interaction was significant between experience level and sampling method (F = 2.58; df = 4, 264; P = 0.04) (top right graph). For experienced samplers, twice as many bugs were captured with the beat bucket and sweep net than with the visual method. Variation about the means (CVs) were similar, but regularly above 100%. (Means separation using the Tukey test was done for the 2-way interaction slicing by experience level: lower case letters for Inexperienced and upper case letters for Experienced samplers).





Green plant bug (*C. signatus*): The 2-way interaction between experience level and sampling method was not significant (P = 0.28) (middle left graph). Averaging across experience, there were more than twice as many bugs captured with the beat bucket and sweep net than observed with the other methods (F = 9.98; df 4, 28; P < 0.0001) (middle right graph). CV trends were similar to those above. (Means separation using the Tukey test was done for the significant Method main effect).





Time to sample: The 3-way interaction (bottom left graph) between growth stage, experience level, and sampling method was significant (F = 2.12; df = 8, 212; P = 0.04). The greatest contribution to variation was in the 2-way experience level by sampling method interaction (F = 40.8; df = 4, 212; P < 0.0001) (bottom right graph). It took nearly twice the time for experienced sampling to visually inspect plants, especially the older plants, than when using the beat cloth, beat bucket, and sweep net. (Means separation using the Tukey test was done for the 2-way interaction slicing by experience level: lower case letters for Inexperienced and upper case letters for Experienced samplers. Means separation was not done for the less significant and more complex 3-way interaction).