COTTON FLEAHOPPER AND ITS DAMAGE TO COTTON AS AFFECTED BY PLANT WATER STRESS AND INSECT SEASONALITY

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Abstract

A set of paired experiments were implemented at Corpus Christi and Lubbock, Texas to evaluate the interaction of damage expressed in cotton from cotton fleahopper under the following variables: cultivar, planting date, and water (irrigation vs. dryland). At Corpus Christi the experiment involved 2 planting dates, 3 cultivars, and 3 water regimes. The paired experiment in Lubbock involved 1 cultivar and 1 planting date across 4 water regimes. At both locations the least negative plant response to cotton fleahopper was detected when the amount of water was increased as compared to cultivar and planting date. At Corpus Christi this positive response was measured in increased yield. At Lubbock the positive response measured was fruit set, fruit retention, boll size, and boll weight.

Introduction

Cotton fleahopper, *Pseudatomoscelis seriatus* (Reuter) (Hemiptera: Miridae), can cause excessive loss of cotton squares, resulting in reduced yield and harvest delays. Cotton fleahopper is a key insect pest of cotton in Texas and Oklahoma, and an occasional pest in New Mexico, Arkansas, Louisiana, and other mid-South states. Within Texas, regional average cotton fleahopper induced yield loss estimates vary, reaching up to 6% in Texas (Williams 2000). Damage to individual fields varies from none to extremely high square loss when heavy populations develop and are left uncontrolled.

How is this variability in cotton fleahopper damage explained? This variability is partly associated with cultivar differences and other host plant factors (Holtzer and Sterling 1980, Knutson *et al.* 2009, Barman *et al.* 2011), with timing and magnitude of cotton fleahopper movement from non cultivated weed hosts to cotton and the stage of cotton development when migration occurs (Parajulee *et al.* 2006), and with physical stressors in particular soil moisture (Stewart and Sterling 1989).

Understanding of these factors contributions to cotton fleahopper dynamics will allow better estimation of cotton risk from cotton fleahopper damage. Some of these factors are manageable. Our ultimate goal is to discern when in-season management (i.e., insecticides, irrigation) is most useful to reduce cotton fleahopper damage when it is expected to be severe.

Methods

We propose that plant water stress, insect seasonality, and plant sensitivity are interacting factors that result in damage differences attributable to cotton fleahopper feeding, which are currently difficult to predict.
Field testing initiated in 2011 at Corpus Christi and Lubbock, TX; drought conditions provided opportunity to assess insect activity in a high contrast of dryland and irrigated conditions (irrigation targeted as % ET replacement).

Corpus Christi

This location had a split-plot design with 5 replications. The main plot, the three water regimes were, dryland, medium irrigation (75%), and high irrigation (90%). Water regimes were applied by surface irrigation through drip tubes. The split plot was 2 planting dates (April 1 and 15) and 3 cultivars (Phytogen 367 WRF, Deltapine 1032 B2RF, and Stoneville 5458 B2RF). The plot size was 100 ft by four rows, with data taken from the inner two rows.

Half of the plot was utilized for in-season data collection and half of the plot was left undisturbed for harvest. Fleahopper counts (adults and nymphs) were made weekly over a period of 5 weeks after the population exceeded 0.1 fleahopper per plant using the beat bucket technique; visual counts were also made and correlated well with the beat bucket. Plant measurements included: yield, COTMAN (squareman and bollman), and complete plant mapping using PMAP.

Lubbock
Extremely dry conditions limited the experiment at Lubbock. The plot design was randomized complete block with 3 replications. Water treatment regimes were dryland, low irrigation (30%), medium irrigation (60%), and high irrigation (90%) applied via subsurface drip tubes. The cultivar planted in the test was Deltapline 1032 B2RF and the plot size was identical to Corpus Christi. Fleahopper counts were not taken as populations did not develop. Plant measurements were total fruit set, percent fruit retention, and boll size by weight taken at 250 DD 60's.

Drought conditions resulted in delays of cotton fleahopper occurrence in Corpus Christi, and in very low cotton fleahopper density in Lubbock season-long. Therefore, we have reported cotton fleahopper and harvest results from Corpus Christi and plant measurement results from Lubbock.

Results

Corpus Christi:
Insect Measurements. Cotton fleahoppers were detected late with good numbers first occurring June 9 (about 1 month late for the region), corresponding to peak bloom for the early planting (about 8 NAWF) and early bloom for the late planting (about 7 NAWF). There was no major pattern in the fleahopper populations related to the treatments (P>0.05 for treatments and interactions Fig 1). In 2 weeks, fleahopper populations increased on average 10-fold. They tended to be least abundant in the early planting (8NAWF) and in the high irrigation regime (P<0.05, Fig. 2).

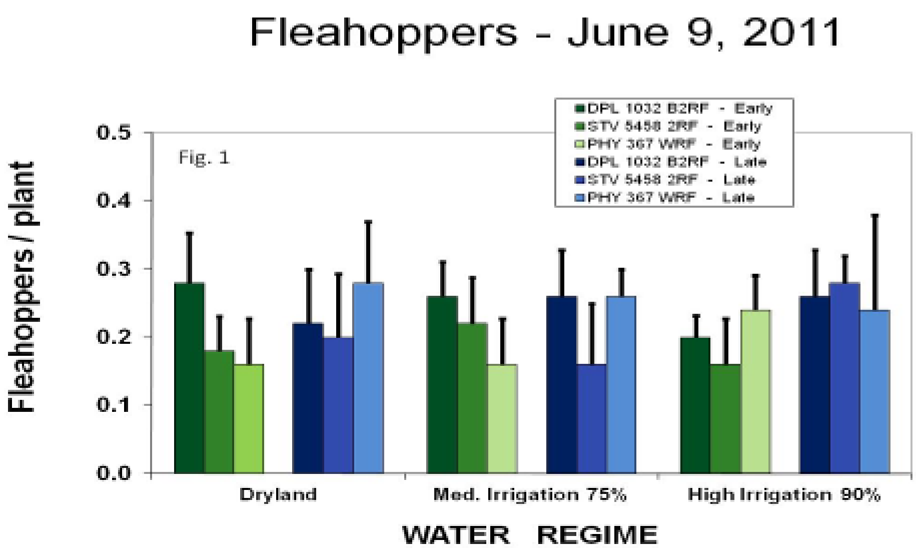

Figure 1. Total cotton fleahoppers (adults & nymphs) per plant on June 9, 2011 across three water regimes and 3 cotton cultivars, and 2 planting dates Corpus Christi, TX.

Plant Measurements. Lint yield was greatest in the high irrigation regime and in the early planting for all cultivars (P<0.05 for main effects, Fig. 3), where cotton fleahoppers also were less abundant (Fig. 2). Through season COTMAN data and at cutout complete plant mapping data are being processed. These data will be used to compare yield, fleahopper abundance, and cotton fruit set and retention.

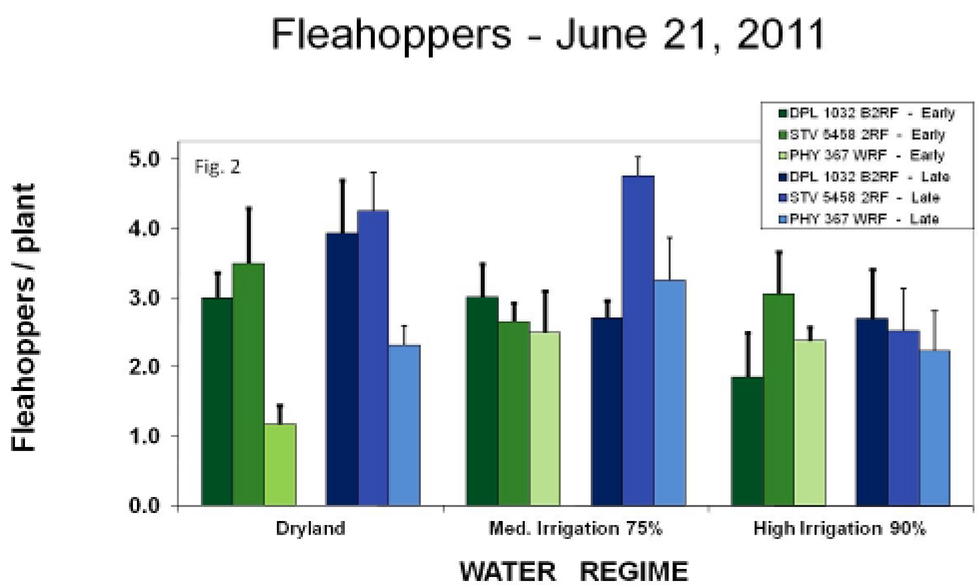

Figure 2. Total cotton fleahoppers (adults & nymphs) per plant on June 21, 2011 across three water regimes and 3 cotton cultivars, and 2 planting dates, Corpus Christi, TX.

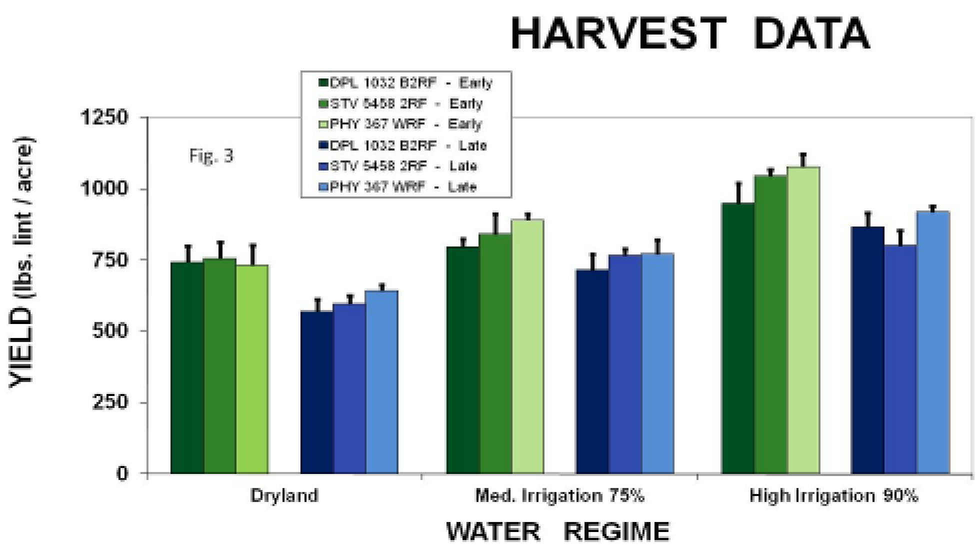

Figure 3. Lint yields (lbs/A) across 3 water regimes, 3cotton cultivars, and 2 planting dates, Corpus Christi, TX.

Lubbock: *Plant Measurements.* Total number of fruit set per plant increased with increasing irrigation, but fruit retention suffered only when irrigation was reduced (low irrigation and dryland) (Fig. 4, data taken from a complete plant mapping on August 3, 2011).

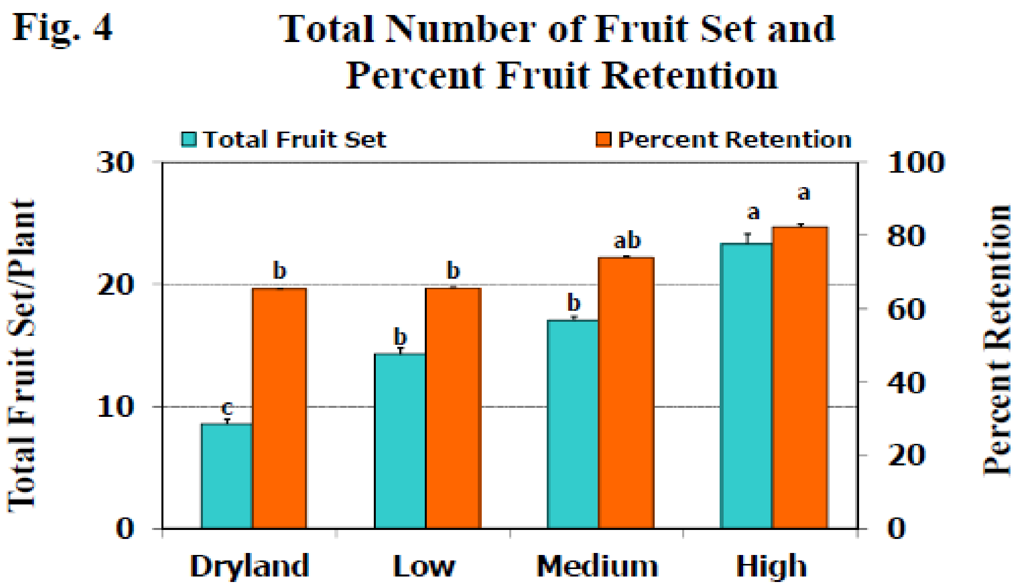

Figure 4. Fruit set and percent fruit retention across 4 water regimes on August 3, 2011, Lubbock, TX.

Irrigation level significantly influenced cotton fruit physiology, with larger and heavier bolls with harder carpel walls produced at high irrigation regimes compared to those at the low irrigation and dryland (Figs. 5 and 6).

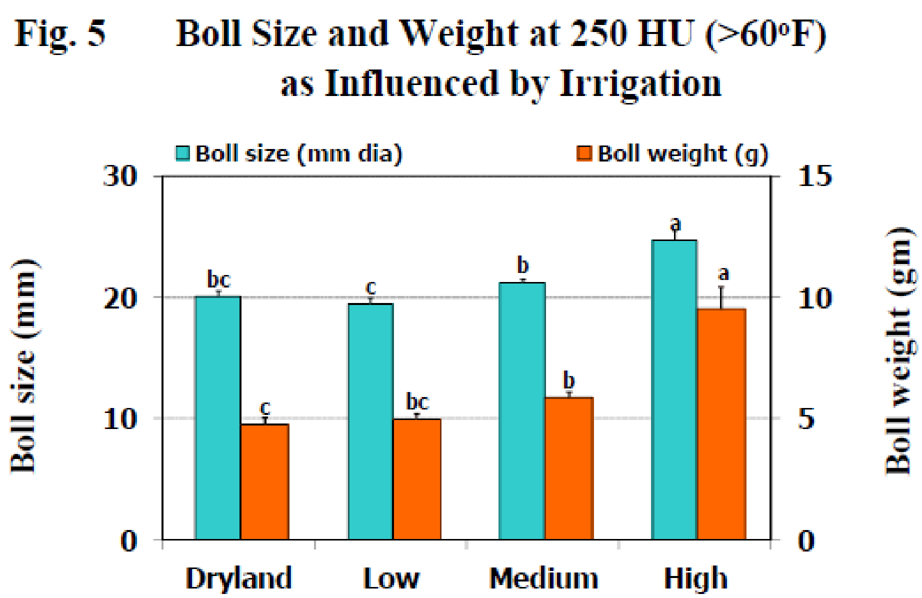

Figure 5. Boll size and weight at 250 heat units across 4 water regimes, Lubbock, TX.

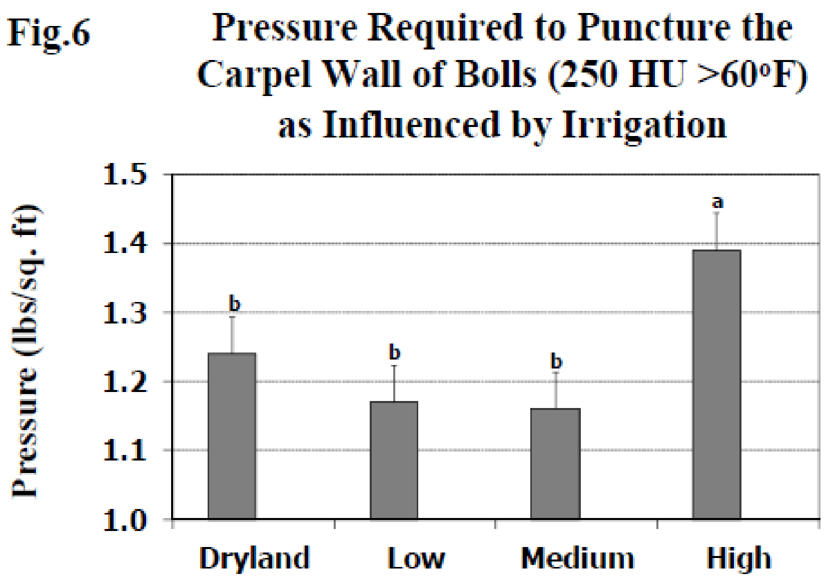

Figure 6. Pressure required to puncture the carpel wall of cotton bolls, 250 heat units post bloom across 4 water regimes, Lubbock, TX

Summary

We live in a climate that produces highly variable weather year to year and within-season in Texas. Across many plant/insect systems, such variability affects plant physiology, insect population growth, and their interactions. The first year of this experiment allowed us to simulate a broad range of water availability. Our data supported the hypotheses that water affects plant response positively (especially revealing in Lubbock), and may position the plant to withstand cotton fleahopper feeding or affect the insect's population growth across the season (especially revealing in Corpus). Additional study years and experiments will help us discern the interactions.

Acknowledgements

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