# COTTON FLEAHOPPER DAMAGE ON WATER-STRESSED COTTON

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## Abstract

Cotton fleahopper, *Pseudatomoscelis seriatus*, can cause excessive loss of cotton squares, resulting in reduced yield and harvest delays. Field testing during drought conditions provided opportunity to assess insect activity in a high contrast of dryland and irrigated conditions. Plant water stress affected natural cotton fleahopper populations (South Texas study: increasing more in irrigated plots) and water stressed plants were more sensitive to equal cotton fleahopper pressure (High Plains study: lint loss and possibly boll load decreasing more in low irrigation plots). As seen last year, plant development stage at the time of initial cotton fleahopper infestation was crucial, with early squaring cotton having higher densities than cotton at early bloom in the infestation (South Texas study). For field application, detection of fleahoppers in early planted cotton may serve as early warning of cotton fleahoppers in later-planted cotton. As the infestation progresses, fleahoppers may persist better in cotton with low water stress. But the greatest potential for yield decline from cotton fleahopper was when cotton was water stressed and infestations occurred during pre-bloom squaring. Understanding how water stress contributes to cotton fleahopper fluctuations may allow better estimation of cotton risk from cotton fleahopper damage.

## Introduction

Cotton fleahopper, *Pseudatomoscelis seriatus* (Reuter) (Hemiptera: Miridae), has been documented to cause excessive loss of cotton squares in Texas and Oklahoma, resulting in reduced yield and harvest delays. Cotton fleahopper is also 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% (Williams 2000). A challenge to management is that square loss and subsequent yield loss to individual fields varies considerably as populations build.

This variability has been partly associated with cultivar differences and other host plant factors (Holtzer and Sterling 1980, Knutson et al. 2009, Barman et al. 2011), with the stage of cotton development when movement into the field occurs (Parajulee et al. 2006), and with environmental stressors, in particular plant water stress (Stewart and Sterling 1989). Even though foliar insecticide application may control the population, benefits to control may depend on these factors.

Understanding the degree to which these factors contribute to cotton fleahopper fluctuations and subsequent plant damage may allow better estimation of cotton risk from cotton fleahopper leading to improved in-season management (i.e., insecticides).

  

From left to right: cotton fleahopper, a blasted square (damage), and a healthy square. Photos provided by authors and Texas AgriLife Research, Lubbock and Corpus Christi.

## Materials and Methods

We hypothesize that plant water stress and plant vigor, and plant development at the time of infestation are main factors that affect cotton fleahopper population fluctuation and plant response/yield loss. These factors were considered in two studies, one in South Texas, and the second in the Texas High Plains.

Field testing in 2013 during drought conditions provided opportunity to assess insect activity in a high contrast of dryland (with supplemental irrigation due to severe drought) and irrigated (irrigation targeting 90% crop ET replacement) water regimes. The South Texas location focused on following a natural cotton fleahopper population and subsequent yield in a plot with two water regimes, two planting dates, two cultivars, and controlled with insecticide or not. The Texas High Plains location focused on plant response using an augmented population of cotton fleahopper under two water regimes. Details of the experimental layout at each location follow:

### South Texas - Corpus Christi - Texas A&M AgriLife Research & Extension Center

A split-split-split plot design was implemented with 5 replications. The main plot was two water regimes, 1) low irrigation during drought (6.1 acre-inch for the earlier planting, 7.9 acre-inch for the later planting) and 2) high irrigation during drought (10.4 acre-inch for the earlier planting, 13.8 acre-inch for the later planting). The 1$^{st}$ split was two planting dates; Earlier (May 6) and Later (May 31), with both planting dates being agronomically late for the region. The 2$^{nd}$ split was two cotton cultivars; PhytoGen 367 WRF (Dow AgroSciences) and Stoneville 5458 B2RF (Bayer CropScience). The 3$^{rd}$ split was insecticide treatment using Centric 40 WG (thiamethoxam, Syngenta Crop Protection) at a rate of 1.25 oz/acre on June 11, 1, July 3, and 15. Irrigation was delivered by above ground drip. Insect counts were made on a weekly basis for 9 weeks after fleahopper numbers exceeded 10 bugs per 100 plants using a beat bucket technique. A total of 20 plants were sampled per plot. Plant data included yield (lbs. lint/A) as well as boll load and plant height for the unsprayed plots.

### Texas High Plains - Lamesa

The plot design was a 2 by 2 factorial with 3 replications. The 1$^{st}$ factor was irrigation at 2 levels: a low rate in drought (4.5 acre-inch) and a high rate in drought (9.0 acre-inch). The 2$^{nd}$ factor was infestation rate: a control (no infestation) and 5 nymphs/plant at the 3$^{rd}$ week of squaring. Infestations were applied to uniform-sized plants. Plot size was 45 ft by 4 rows, and irrigation was by center pivot. Because cotton fleahopper populations were very low, the infestation was augmented with a specific and acute insect feeding pressure of 5 nymphs/plant at the 3$^{rd}$ week of squaring. Plant data included yield (lbs. of lint/A) and boll load (bolls/plant).

All measurements were analyzed with ANOVA, conforming to a split-split-split plot design in Corpus Christi, and a 2 by 2 factorial in Lamesa. Count data were transformed by the square root of the count + 0.5.

## Results

### South Texas

Fleahoppers exceeded an ET of 15% of plants infested. More cotton fleahoppers were seen on earlier planted cotton ($P < 0.0001$), especially early in the infestation (June 27 when the earlier planted cotton was at 3rd week of squaring and the later planted cotton was at the 1st week of squaring). Cotton fleahopper density did not differ between dryland and irrigated plots at the beginning of the infestation (June 27, $P = 0.24$) (Fig. 1), but as the infestation progressed more fleahoppers were detected in irrigated plots on July 3 ($P = 0.04$) (Fig. 2) and on irrigated plots of the earlier planted cotton on July 11 ($P = 0.009$) (Fig. 3). Cultivar differences were also detected, supporting historical claims of cultivar effects ($P = 0.005$) (Figs. 1-3). The insecticide Centric controlled fleahopper well across most conditions ($P < 0.0001$) (Figs. 1-3), including the very high populations found on June 27 in the earlier planting during the 3rd week of squaring (Fig. 1).

There was a good yield response with the best yields seen under irrigation for both cultivars, planting dates, and with or without insecticide protection ($P = 0.0008$) (Fig. 4). The benefits of good soil moisture were seen on unsprayed plots, which had higher bolls loads (Fig. 5) on taller plants (Fig. 6). Yield also increased when plots were sprayed, but to a much smaller degree ($P = 0.05$), and the later planted cotton (which had fewer cotton fleahoppers) had higher yield than earlier planted cotton ($P = 0.006$) (Fig. 4).

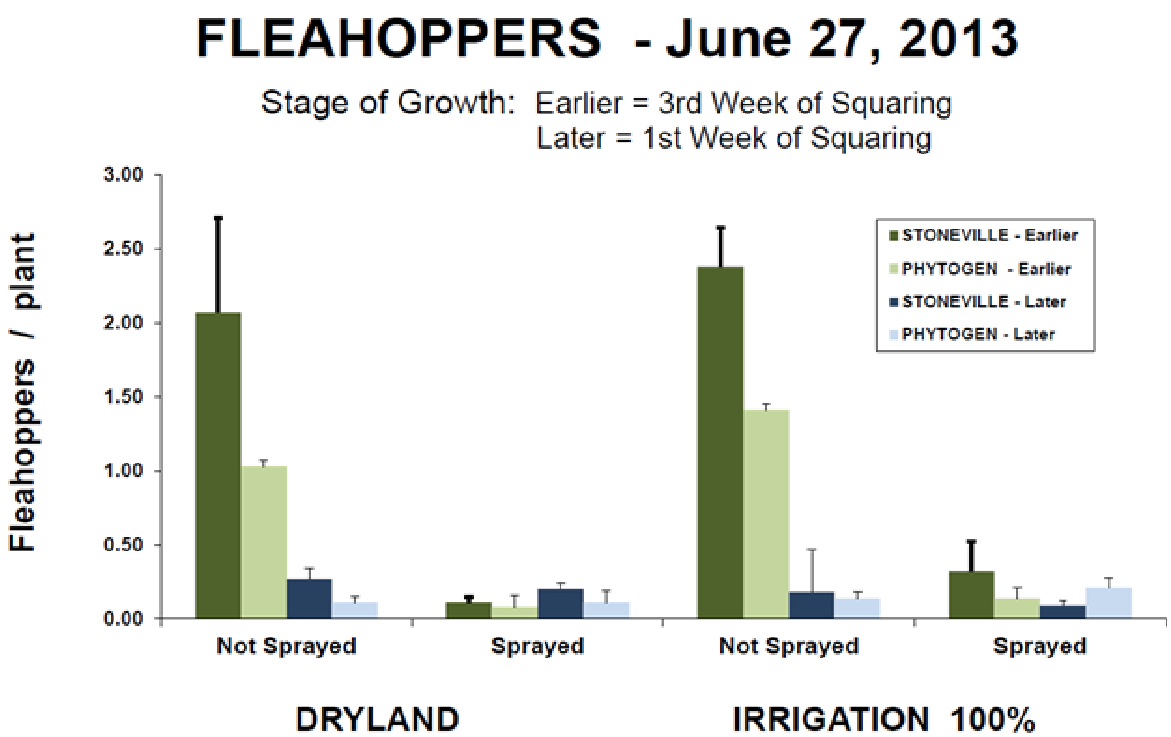


Figure 1. Number of cotton fleahoppers per plant for two sprayed and not sprayed cotton cutivars under two water regimes and two planting dates on June 27, 2013, Texas A&M AgriLife Research and Extension Center, Corpus Christi, Texas, 2013.

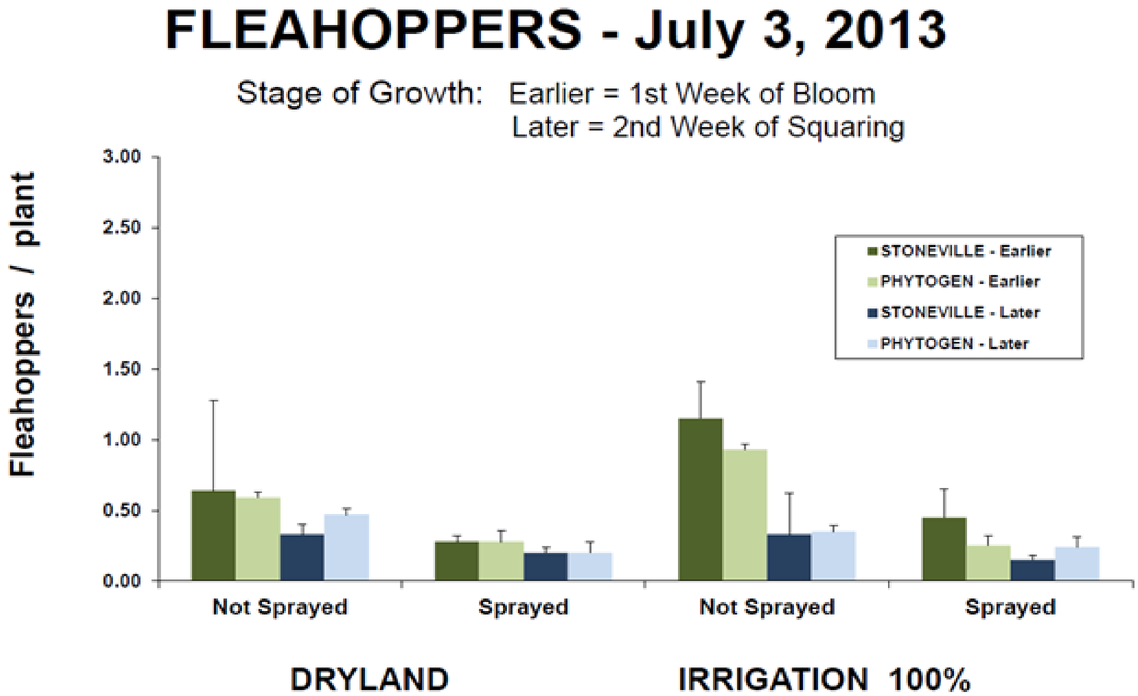


Figure 2. Number of cotton fleahoppers per plant for two sprayed and not sprayed cotton cutivars under two water regimes and two planting dates on July 3, 2013, Texas A&M AgriLife Research and Extension Center, Corpus Christi, Texas, 2013.

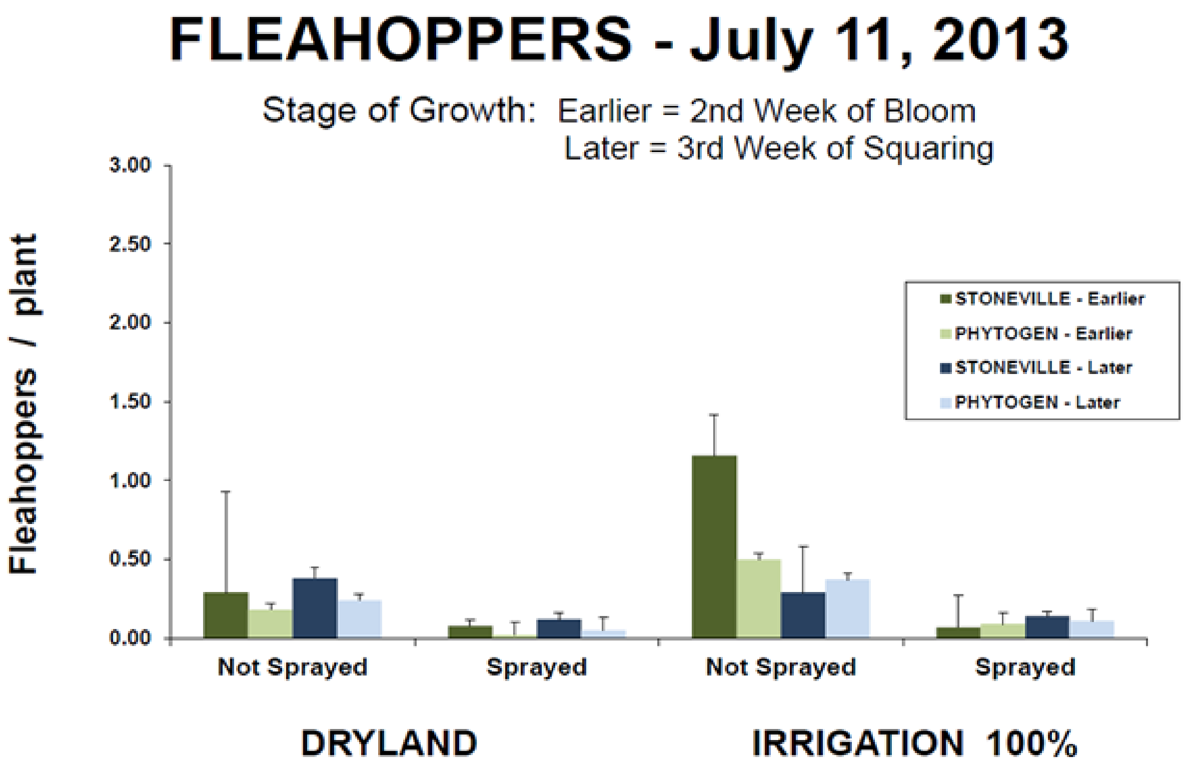


Figure 3. Number of cotton fleahoppers per plant for two sprayed and not sprayed cotton cutivars under two water regimes and two planting dates on July 11, 2013, Texas A&M AgriLife Research and Extension Center, Corpus Christi, Texas, 2013.

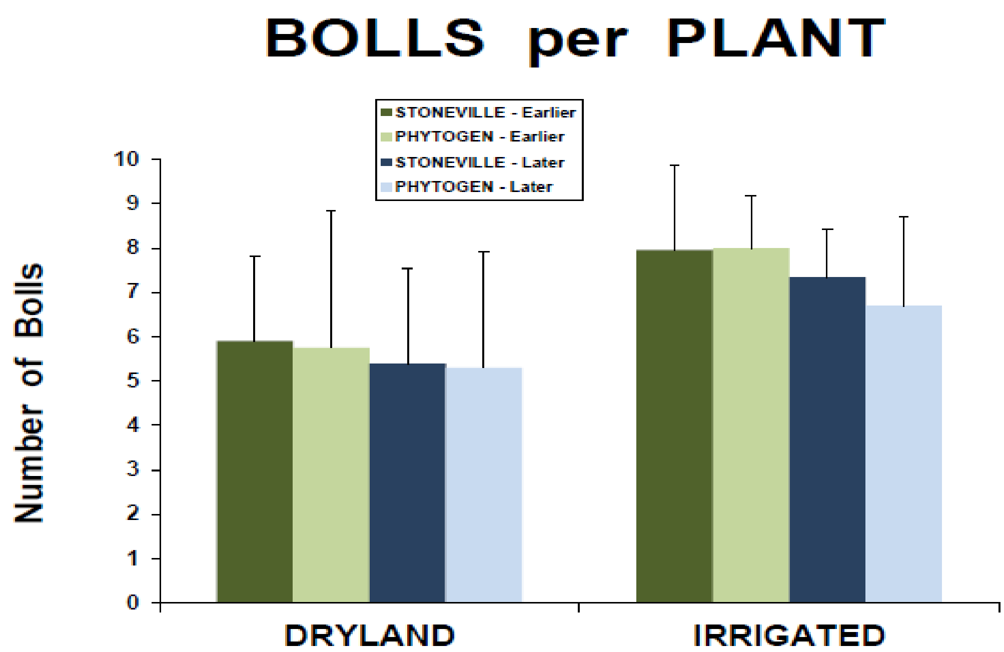


Figure 4. Number of bolls per plant for cotton cutivars under two water regimes, two planting dates, and not sprayed with insecticide, Texas A&M AgriLife Research and Extension Center, Corpus Christi, Texas, 2013.

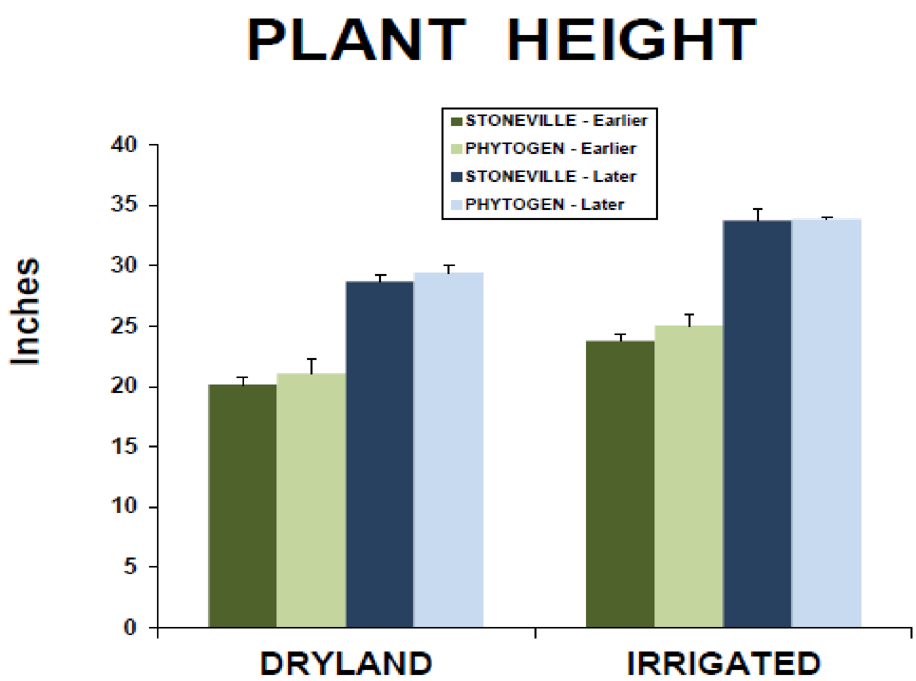


Figure 5. Plant height of two cotton cutivars under two water regimes and two planting dates, and not sprayed with insecticide, Texas A&M AgriLife Research and Extension Center, Corpus Christi, Texas, 2013.

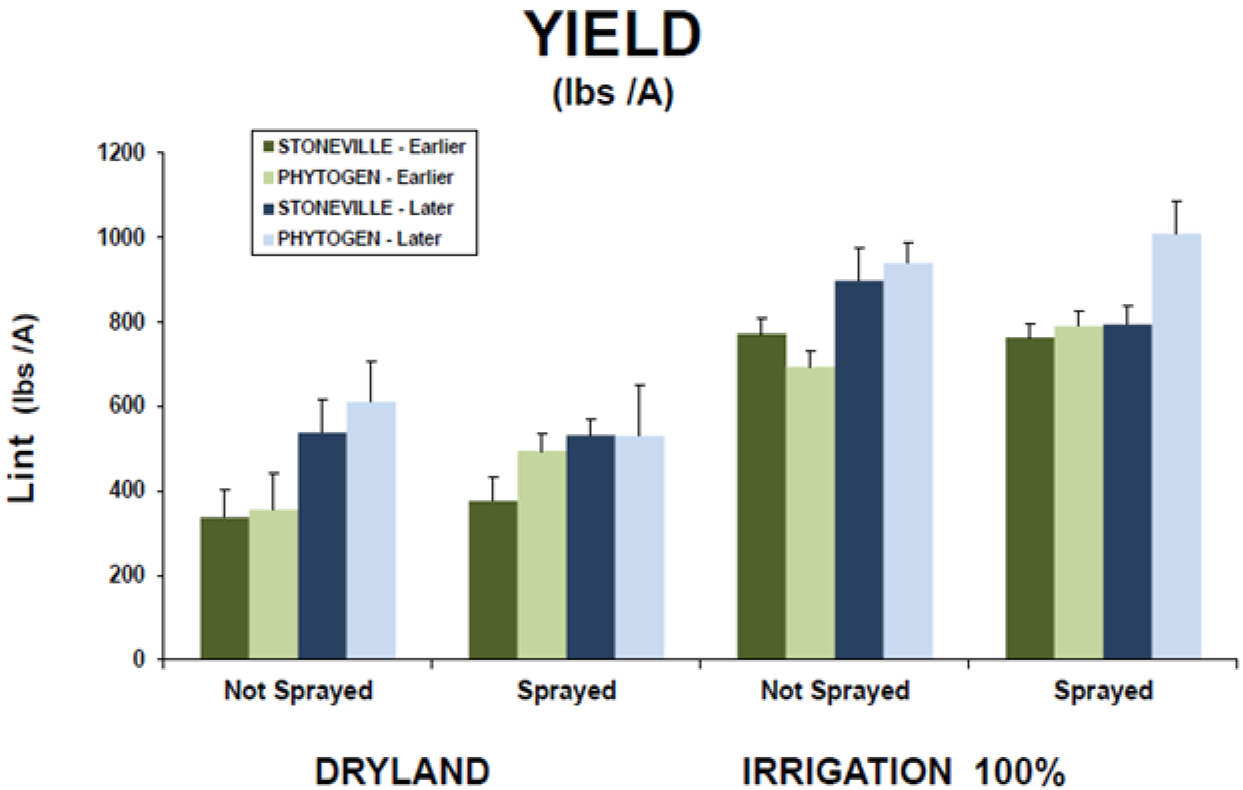


Figure 6. Yield (lbs. of lint/acre) for two sprayed and not sprayed cotton cutivars under two water regimes and two planting dates, Texas A&M AgriLife Research and Extension Center, Corpus Christi, Texas, 2013.

**Texas High Plains**

Natural populations of cotton fleahopper were low at this site which allowed field comparison of plant response to a specific and acute cotton fleahopper insect feeding pressure of 5 nymphs/plant at the 3rd week of squaring (fleahopper augmented) and a control (no augmentation of cotton fleahopper). This plant growth stage has been shown to host cotton fleahopper well. When plants were not water stressed (high irrigation), there was no effect of cotton fleahopper pressure based on boll load (Fig. 7) and lint yield (Fig. 8). But under water stress (low irrigation during a drought year), there was yield loss due to cotton fleahopper pressure ($P < 0.05$) (Fig. 8), which was also reflected in reduced boll load (although not significantly different) (Fig. 7).

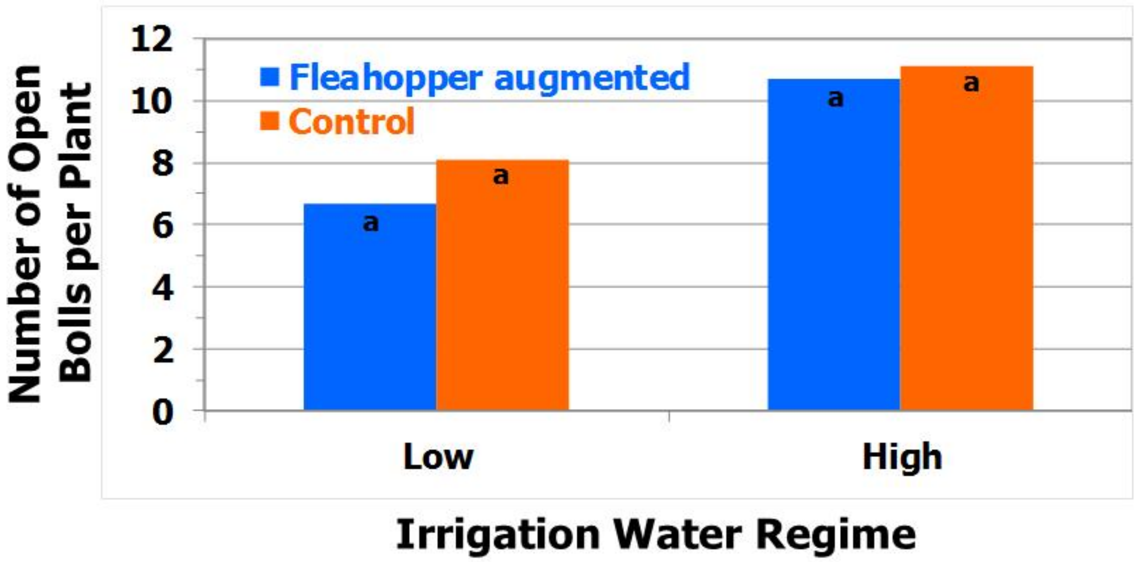


Figure 7. Number of open bolls per plant under low and high irrigation with and without (control) an augmented population of cotton fleahopper (fleahopper augmented) of 5 nymphs/plant released at the 3rd week of squaring, Texas A&M AgiLife Research, Lamesa, Texas, 2013.

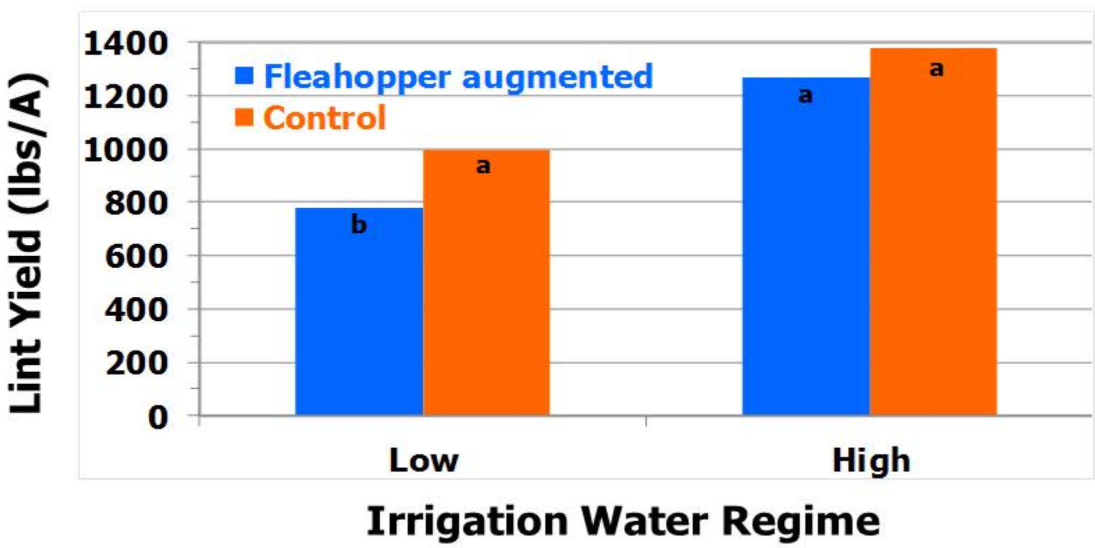


Figure 8. Yield (lbs. of lint/acre) under low and high irrigation with and without (control) an augmented fleahopper population (fleahopper augmented) of 5 nymphs/plant released at 3rd week of squaring, Texas A&M AgiLife Research, Lamesa, Texas, 2013.

## Conclusions

We live in a climate that produces highly variable weather, as seen in drought conditions in Texas the last two years. Plant water stress affects natural cotton fleahopper populations (South Texas study: increasing more in irrigated plots) and water stressed plants are more sensitive to equal cotton fleahopper pressure (High Plains study: lint loss and possibly boll load decreasing more in low irrigation plots). As seen last year, plant development stage at the time of initial cotton fleahopper infestation is crucial, with early squaring cotton having higher densities than cotton at early bloom in the infestation (South Texas study). For field application, detection of fleahoppers in early planted cotton may serve as early warning of cotton fleahoppers in later-planted cotton. As the infestation progresses, fleahoppers may persist better in cotton with low water stress. But the greatest potential for yield decline from cotton fleahopper was when cotton was water stressed and infestations occurred during pre-bloom squaring.

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