MANAGING EARLY-SEASON INSECT PESTS IN DRYLAND COTTON

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Abstract

A multi-year study has been initiated in the Texas High Plains to quantify the impact of single (thrips or cotton fleahoppers) versus multiple (thrips and cotton fleahoppers sequentially) pest infestations on cotton lint yield and fiber quality under two irrigation water regimes. The scope of this work entails integrating production practices and pest management options under numerous cotton management scenarios. Thrips and cotton fleahoppers were evaluated with five combinations of single versus sequential infestations under two water-deficit (near-zero deficit or full irrigation and high deficit or dryland) regimes, replicated four times. Thrips and cotton fleahopper augmentations and resulting colonization were compromised due to uncharacteristic rain and storm events. Plant growth parameters such as plant height, leaf area and dry leaf biomass were significantly higher in full irrigation plots than dryland plots. Water deficit conditions and insect infestations impacted crop growth profile as well as lint yield. Lint yield was similar across all five treatment combinations under dryland conditions while cotton fleahopper significantly reduced the lint yield compared to control under high irrigated condition.

Introduction

The Texas High Plains (THP) has been facing some significant unpredictable drought conditions in recent years. THP is a semi-arid region with characteristic low rainfall, with production agriculture supported by limited irrigation or rain-fed. As a result, the cropping system in this region is largely low-input and the producer decision-making in economically profitable input use is a challenge. Since 2007, water-deficit cotton production situation has worsened in THP and dryland:irrigated cotton production has shifted from 40:60 to 60:40 in recent years. Unpredictability of limited rainfall has been a challenge for cotton farmers in their production decision-making. Increased input costs and decreased availability of water have forced growers to move toward reorganizing available input resources to sustain their production enterprise.

Drought has direct and indirect effects on cotton, but the information on the effect of drought stress on cotton insect pest dynamics, feeding potential, and plant's response to insect injury under drought-stressed conditions are limited. Predicting pest populations under water-deficit cropping production scenarios and understanding how these conditions influence those populations to impact crop production risks are critically important components for implementing pest management strategies as crop cultivars and other input variables continue to change. The objective of this study was to quantify the impact of early-season pests on cotton lint yield and fiber quality under dryland and high irrigation water regimes.

Materials and Methods

Irrigation water level treatments

Two irrigation water levels (dryland and full irrigation) were evaluated in this study. A high-water treatment maintained >90% evapotranspiration replenishment through subsurface drip irrigation throughout the crop growing season whereas the dryland treatment received pre-planting irrigation to facilitate proper seed germination and no additional irrigation. Cotton cultivar DP 1646B2XF (seed with no insecticide or fungicide seed treatment) was planted on 14 May 2019.

Insect infestation treatments

Two key early-season insect-pest species (thrips and cotton fleahoppers) impacting cotton production risks were evaluated with five combinations of single versus sequential infestations under two water-deficit (zero versus high) regimes, including sprayed control and unsprayed control, replicated four times (total 40 experimental plots). Targeted insect management options were achieved via artificial infestation of insect pests as our experiment was designed to infest our treatments at the most vulnerable stage of crop for the species infested.

Insect augmentation

Thrips. Thrips were released to seedling cotton on 7 June 2019 when the crop was at 1-2 true leaf stage. Thrips infested alfalfa terminals were excised from a healthy alfalfa patch and these terminals were laid at the base of young cotton seedlings. Thrips were expected to move onto the cotton seedlings as excised alfalfa sections began to dry. Approximately 6 thrips per seedling were released to two 5 row-ft sections (approximately 12 plants per section) per plot (approximately 140 thrips per thrips-augmented plot), with 20% expected survivorship of released thrips.

Cotton fleahoppers. Woolly croton, with embedded overwintering cotton fleahopper eggs, was harvested from rangeland sites near College Station, Texas, in early February 2019 and then placed into cold storage. Eighty 1-gallon sheet metal cans, each containing 4 oz of dry croton twigs per can, were initiated to generate the required number of cotton fleahopper nymphs for the experiment. Conditions conducive to cotton fleahopper emergence were simulated in a laboratory environment in order to induce hatching of overwintered eggs embedded in the croton stems, and emerged cotton fleahopper nymphs were subsequently reared on fresh green beans. The single release of nymphal cotton fleahoppers (2^{nd} instars) was timed to simulate the acute heavy infestation of cotton fleahoppers (4-5 days of feeding) while cotton was highly vulnerable to the fleahopper injury (1^{st} week of squaring). The release was accomplished on 4 July by transferring second-instar fleahopper nymphs from the laboratory colony into 15 cm x 10 cm plastic containers, then cautiously depositing them onto the terminals of plants in each treatment plot at the rate of 5 nymphs per plant. Immediately after cotton fleahoppers were released onto the fleahopper-augmentation plots, control plots were sprayed with Orthene® 97.

Parameters measured

The flowering profile was monitored from all 40 experimental plots for eight sample dates to determine the effect of insect infestation and water-deficit condition on fruiting delays and/or flowering patterns. Five plants from each plot were removed to record plant height, leaf area, and dry leaf biomass. Hand harvesting was done on 4 November 2019 from flagged area and cotton was ginned on 12 November 2019. Lint samples were sent to Cotton Incorporated for fiber analysis.

Results and Discussion

No significant differences were observed in thrips numbers between control-spray treatments and thrips-released treatments due to recurring storm events preventing thrips from effectively colonizing on the cotton seedlings. Plant parameters such as plant height, leaf area, and dry leaf biomass were significantly influenced by the irrigation water level, with greater plant height, larger leaf, and greater biomass in full irrigation plots compared to that in dryland plots (Figs. 1-2). As expected, lint yield was significantly higher in full irrigation treatments than dryland treatments. No significant differences in lint yield was observed amongst treatments in dryland plots; however, in irrigated plots, significantly higher lint yield was recorded from unsprayed control plots compared to that in fleahopper augmented plots (Fig. 3).

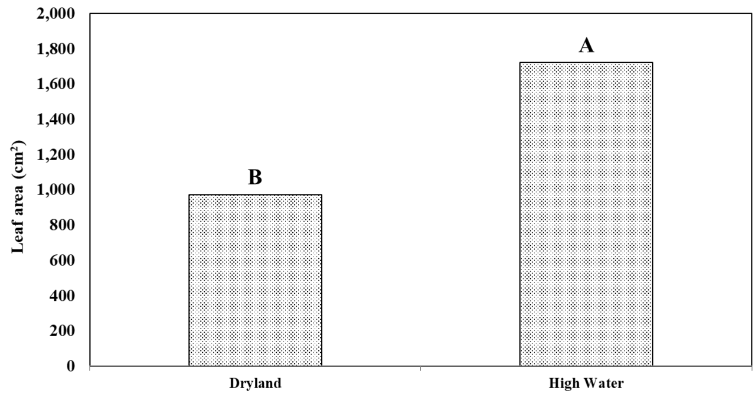

Figure 1. Leaf area recorded from dryland and high irrigation treatment plots, Lubbock, Texas, 2019. Different letters indicate treatment means were significantly different from each other.

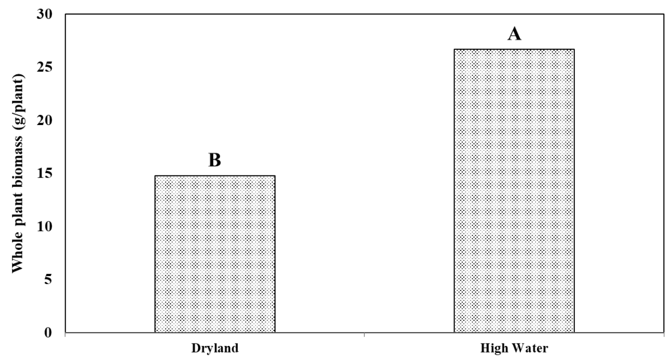

Figure 2. Plant dry biomass (peak-flowering stage) recorded from dryland and irrigation treatment plots, Lubbock, Texas, 2019. Different letters indicate treatment means were significantly different from each other.

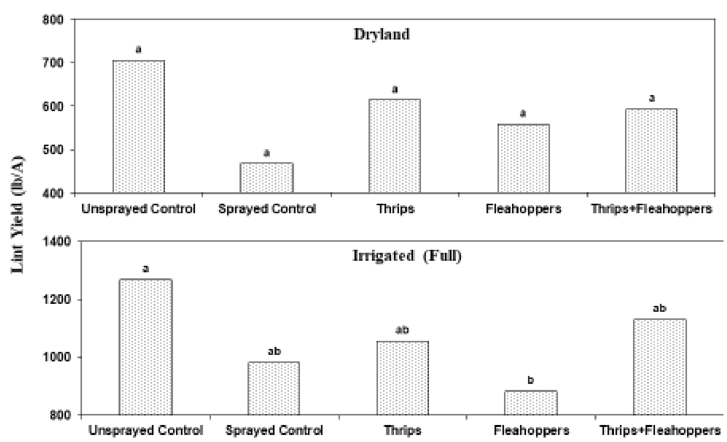

Figure 3. Cotton lint yield losses due to thrips and cotton fleahopper infestations under dryland versus irrigated production conditions, Lubbock, Texas, 2019. Average values were compared across five treatments within irrigation main treatment; same lowercase letters indicate treatment means were not significantly different from each other.

As noted previously, the 2019 crop season in the Texas High Plains was marked with uncharacteristic rain and thunderstorms which compromised our irrigation treatments. There was no evidence of thrips colonization nor any thrips-induced injury in our experimental plots. Cotton fleahoppers were also dislodged by heavy storms and probably did not cause injury to the growing squares as expected, but the plant mapping 10 days after cotton fleahopper release indicated significant square loss in fleahopper augmented plots. While no significant treatment differences were observed under dryland regime, cotton fleahopper augmented plots resulted in lowest yield under irrigated system. However, the yield was highly variable across treatments; thus, the results of the 2019 study are inconclusive. This study will be repeated for three additional years.

Acknowledgements

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