

**EARLY-SEASON INSECT MANAGEMENT IN DRYLAND COTTON IN THE
TEXAS HIGH PLAINS**

**Abdul Hakeem
Megha Parajulee
Katie Lewis
Suhas Vyavhare**

**Texas A&M AgriLife Research and Extension Center
Lubbock, TX**

Abstract

The Texas High Plains (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. The shift in cotton production system due to devastating droughts in an already semi-arid region has altered our input resources, cultivars, and management practices. Low cotton market price, increased nitrogen fertilizer prices, and reduced water availability have forced farmers to move toward reorganizing available input resources to sustain their production enterprise. Thus, transitioning to the new crop production reality via developing economic data-based input management practices has become our priority to sustain producer profitability.

The objectives of this project were to quantify the impact of single versus multiple pest infestations on cotton lint yield and fiber quality under two irrigation water regimes. Thus, the scope of this proposed work entails integrating production practices and pest management options under numerous cotton management scenarios and the management options would be developed based on breakeven value and net return of each option for farmers to choose depending on the availability of water resources on their farms.

In 2018, thrips and fleahoppers impacting cotton production risks were evaluated with five combinations of single versus sequential infestations under two water-deficit regimes, and replicated four times. Water deficit conditions and insect infestations impacted crop growth profile as well as lint yield. For example, fleahopper infestation resulted in increased apical growth of the plants in water-deficit conditions, whereas sequential infestation of two insect pests increased the plant apical growth in irrigated plots. Lint yield was similar across all five treatment combinations under dryland conditions, while the sequential infestation of two pests significantly reduced the lint yield under irrigated condition, indicating the impact of drought conditions on modulating the effect of insect pests as well as the plant's compensatory ability.

Introduction

The Texas High Plains (THP) is a semi-arid region with characteristic low rainfall (average annual rainfall of 15-18 in.), 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. THP has been facing some significant drought conditions in recent years, including the drought of 2011 that claimed much of the Texas production agriculture, reducing total cotton yield that year by 55%. Drought conditions ensued the next 3 years that disproportionately depleted the underground water, significantly shifting the cotton production outlook in THP to even more low-input with dryland acreage reaching to about 70%. The shift in cotton production system due to devastating droughts in an already semi-arid region has altered our input resources, cultivars, and management practices. Low cotton market price, increased nitrogen fertilizer price, and reduced water availability have forced farmers to move toward reorganizing available input resources to sustain their production enterprise. While the drought and heat conditions are unpredictable, the anticipated changes in global climate patterns may exacerbate the water-deficit conditions further in the THP. Thus, transitioning to the new crop production reality via developing economic data-based input management practices has become our priority to sustain producer profitability and for future success of the U.S. cotton industry.

Much has been reported on direct and indirect effects of drought stress on cotton, but 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. In addition, the paucity of information on integration of pest management decisions and crop production decisions has hindered producers' ability to predict economic risks of optimizing limiting input resources. Predicting pest populations under different water-deficit crop 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. Reduced water availability, low rainfall, higher pumping cost of limited water, and increased input cost may result in lower yields and correspondingly lower profit margins, warranting for higher water use efficiency in our crop production. Therefore, cotton producers must carefully consider costs of pest management options against potential benefits to overall net profit margin of the crop production enterprise. The objectives of this project are to: 1) Quantify the impact of five combinations of single versus sequential infestations of two major insects (thrips and cotton fleahoppers) on cotton lint yield and fiber quality under two irrigation water regimes (water-deficit treatments – near dryland versus full irrigation), and 2) Develop a dynamic optimization economic model that maximizes the net returns from management of single versus sequential pest infestations under water-deficit crop production conditions. Thus, the goal of this project aims to integrate production practices and pest management options under numerous cotton management scenarios (10 total scenarios) and the management options will be developed based on breakeven value and net return of each option for farmers to choose depending on the availability of water resource on their farms.

Materials and Methods

A multi-year study was initiated in 2018 on a five-acre subsurface drip irrigation cotton field located at Texas A&M AgriLife Research farm, Lubbock, TX.

Irrigation Water Level Treatments

Two irrigation water levels (dryland and full irrigation) simulated two water-deficit production conditions, including high water-deficit (dryland condition) and no water deficit. 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 1646 B2XF (seed with no insecticide or fungicide seed treatment) was planted on 31 May 2018.

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, replicated four times (total of 40 experimental plots). Targeted insect management options were achieved via artificial infestation of insect pests. Because Texas High Plains cropping conditions rarely warrant more than a single insecticide application to suppress either of the two major insect pest groups (thrips at seedling stage and cotton fleahopper at early squaring stage), 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 19 June 2018 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). Thrips were released on all 16 thrips-augmentation plots (treatments #2 and #4 x 2 water levels x 4 replications) on the same day. Thrips were released on four additional plots to estimate thrips movement onto the cotton seedling via absolute sampling of seedlings and washing of thrips 3 days post-release. Data showed that the seedlings received an average of 1.2 live thrips per seedling which is the threshold density for 1-2 leaf stage seedling cotton.

Uncharacteristic high daytime temperatures for the next 7 days following the thrips release (103-107 °F) contributed to low thrips feeding performance and perhaps high thrips mortality after the thrips moved to the seedlings. Consequently, no visible signs of thrips-feeding effect were observed in thrips-augmented plots.

Cotton Fleahoppers

Woolly croton, with embedded overwintering fleahopper eggs, was harvested from rangeland sites near College Station, Texas, in early February 2018 and then placed into cold storage. Eighty 1-gallon sheet metal cans, each containing 4 ounces 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 fleahoppers were subsequently reared on fresh green beans. The single release of nymphal cotton fleahoppers (2nd 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 (1st week of squaring). The release was accomplished on 10 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 (treatments #3 and #4; total 16 plots), control plots were sprayed with Orthene® 97. All treatment plots, except treatment #1, were sprayed with Orthene® 97 on 17 July and kept insect-free for the remainder of the study to isolate the effect of various treatments.

Parameters Measured

The flowering profile was monitored from all 40 experimental plots for five sample dates (31 July, 6 August, 9 August, 15 August and 28 August 2018) to determine the effect of insect infestation and water deficit condition on fruiting delays and/or flowering patterns. Plant height was also recorded from all plots at the time of harvest. Hand harvesting was done on 16 November from flagged area and cotton was ginned on 17 December 2018. Lint will be sent to Cotton Incorporated for fiber analysis.

Results and Discussion

Extremely high temperatures during the seedling stage complicated the study in 2018, especially the released thrips failed to exert the desired significant infestation on the young cotton seedlings. As a result, thrips damage to seedlings was not apparent on visual observation. Cotton fleahoppers caused about 20% square loss overall across all experimental plots. Because cotton fleahoppers were released when plants had 2-3 total squares (all were fleahopper susceptible squares), the effect was not apparent immediately and plants outgrew the effect of early season fleahopper-induced square loss. Nevertheless, insect injury manifested some noticeable effect on flowering patterns, plant height, and lint yield.

Untreated control plots showed slightly higher flower densities in irrigated versus dryland cotton effect all throughout the month-long monitoring period, with significantly higher flower densities in late August. Contrasting to this phenomenon, the flowering patterns were near identical between irrigated and dryland plots when cotton fleahoppers were infested singly or sequentially with thrips infestation. The average flower abundance was significantly lower in dryland compared to that in irrigated cotton only at untreated control plots while all other treatments were not significantly different between the two irrigation regimes. These data suggest that the insect infestation during pre-flower stage exerts some significant physiological response to cotton during the flowering stage. Multi-year data will hopefully add more insights into this phenomenon.

Lint yield was significantly higher in irrigated cotton compared to that in dryland cotton across all five treatment combinations (Fig. 1). This suggests that the dryland plots were sufficiently water-stressed during the growing season, despite several rainfall events during the crop maturation phase in late September - early October. The highest lint yield under irrigation treatment was observed in the untreated control treatment (1,607 lb/acre), while the lowest (1,253 lb/acre) was recorded in the thrips+fleahopper sequential infestation treatment (Figure 1). Lint yield in other treatments (spray control, thrips only, and fleahoppers only) did significantly differ from the untreated control or thrips+fleahopper sequential treatments (Fig. 1). Lint yield did not significantly vary across five insecticide augmentation treatments. As expected, the yield threshold in dryland cotton is much lower than that for irrigated cotton and thus the lower yield across all treatments can be partially attributed for lack of insecticide treatment effect on lint yield.

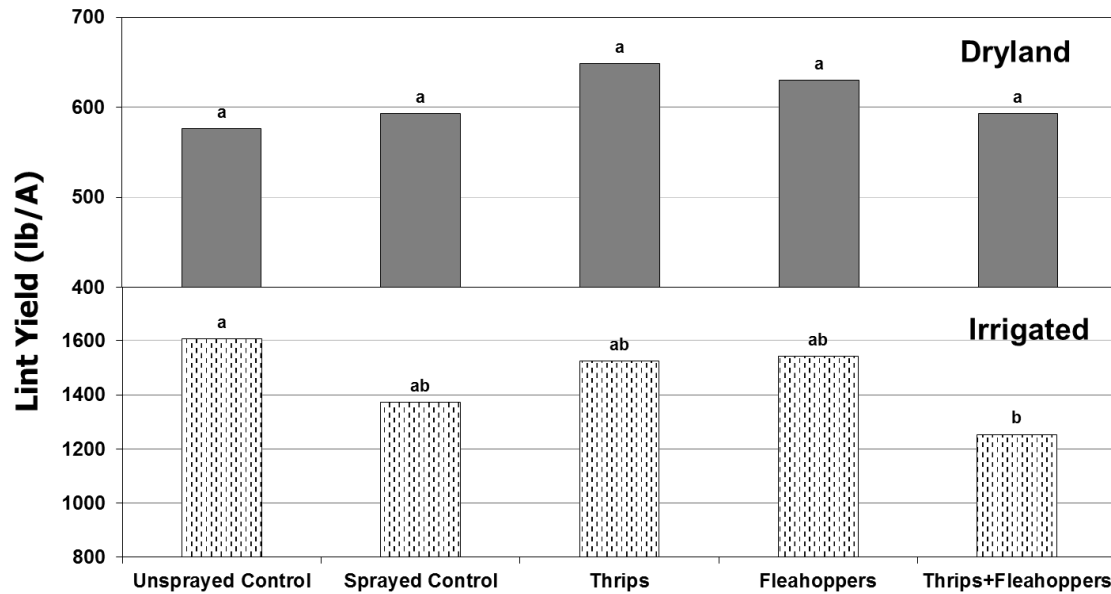


Figure 1. Cotton lint yield losses due to thrips and fleahopper infestations under dryland versus irrigated production conditions, Lubbock, Texas, 2018. Average values were compared across five treatments within each irrigation treatment; same lowercase letters indicate treatment means were not significantly different from each other.

References

- Parajulee, M. N., R. B. Shrestha, and J. F. Leser. 2006. Influence of tillage, planting date, and *Bt* cultivar on seasonal abundance and within-plant distribution patterns of thrips and cotton fleahoppers in cotton. *International Journal of Pest Management* 52: 249-260.
- Rummel, D. R., and M. D. Arnold. 1989. Estimating thrips populations in cotton with conventional sampling and a plant washing technique. *Southwestern Entomologist* 14: 279-285.
- Slosser, J. E., C. L. Cole, E. P. Boring, M. N. Parajulee, and G. B. Idol. 2005. Thrips species associated with cotton in the northern Texas Rolling Plains. *Southwestern Entomologist* 30: 1-7.