COTTON PEST MANAGEMENT IN DEFICIT IRRIGATION PRODUCTION SYSTEMS

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Abstract

The Texas High Plains is a semi-arid region 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 objective of this study was 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 three irrigation water regimes (water-deficit treatments). In 2018-2019, thrips and fleahoppers were evaluated single versus sequential infestations each under two water-deficit (full irrigation and dryland) regimes, and three water regimes in 2020-2021, replicated four times. Water deficit conditions and insect infestations impacted crop growth profile as well as lint yield and fiber quality. In 2018 and 2019, lint yield was similar across all four treatment combinations under dryland condition while the sequential infestation of two pests (2018) and cotton fleahopper augmentation (2019) significantly reduced the lint yield compared to uninfested control under irrigated condition. In 2020, thrips and cotton fleahoppers significantly reduced lint yield in dryland and numerically lower yields were observed in irrigated treatments compared to uninfested control treatment. In 2021, thrips and thrips+fleahopper treatments significantly reduced lint yield compared to only fleahopper treatments in dryland, however, lint yield was similar across all insect treatments in low water and high water treatments, 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, 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 current trend of increasing dryland acreage has altered our input resources, cultivars, and management practices to minimize the production risks. 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 (Dhakal et al. 2019, Lascano et al. 2020). 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 study were to: 1) Quantify the impact of single versus sequential infestations of two major insects (thrips and cotton fleahoppers) on cotton lint yield and fiber quality under three irrigation water regimes (full irrigation, low irrigation, and dryland), 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.

Materials and Methods

A four-year study was conducted on a five-acre subsurface drip irrigation cotton field located at the Texas A&M AgriLife Research farm (Lubbock County, TX). Three irrigation water levels (dryland, supplemental irrigation, and full irrigation) simulated three water-deficit production conditions, including high water-deficit (dryland condition), limited water condition, and no water deficit. A high-water treatment maintained >90% evapotranspiration

replenishment through subsurface drip irrigation throughout the crop growing season, supplemental irrigation maintained about 40% ET replenishment, and the dryland treatment received pre-planting irrigation to facilitate proper seed germination and no additional irrigation. Cotton cultivar DP 1646 B2XF (2018-2019) and DP1820B3XF (2020-2021), with no insecticide or fungicide seed treatment, was planted in mid- to late May, but the first planting of 2021 test was lost to a hailstorm and the test was replanted in mid-June. Two key insect-pest species (thrips and cotton fleahoppers) impacting cotton production risks were evaluated with five combinations of single versus sequential infestations. Targeted insect management options were achieved via natural colonization and/or artificial augmentation of insect pests. Insect management treatments included 1) all insects suppressed (no insect infestation) (sprayed control), 2) thrips occurring at 1-2 true leaf stage, 3) cotton fleahoppers occurring during the first week of squaring, and 4) thrips and cotton fleahoppers infested sequentially. Various plant growth and reproductive parameters were recorded including final lint yield and fiber quality parameters.

Results and Discussion

In 2018 and 2019, lint yields were significantly higher in irrigated cotton compared to that in dryland cotton across all four treatment combinations (Fig. 1). This suggests that the dryland plots were sufficiently water-stressed during the growing season. In 2018, the highest lint yield under irrigation treatment was observed in the untreated control treatment while the lowest was recorded in the thrips+fleahopper sequential infestation treatment. Lint yield did not significantly vary across insect management treatments under dryland condition. Yield response in 2019 was similar to that for 2018 under dryland condition, but the cotton fleahopper treatment reduced the yield under irrigated condition (Brewer et al. 2016).

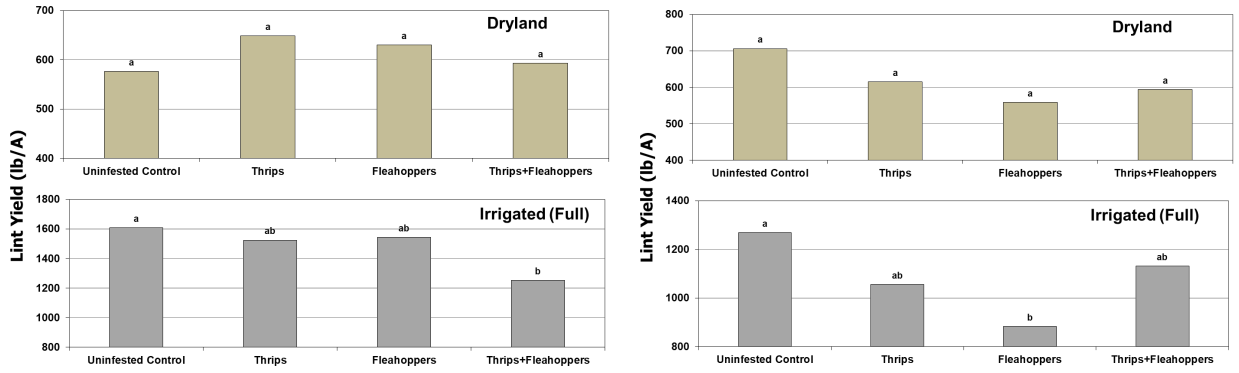

Figure 1. Lint yield (lb./acre) as affected by thrips and fleahopper infestations under dryland versus irrigated production conditions, Lubbock, Texas, 2018 (left) and 2019 (right). Average values were compared across insect management treatments within each irrigation treatment; same lowercase letters indicate treatment means were not significantly different from each other.

In 2020, lint yield varied with irrigation treatments. Lint yield was significantly higher in irrigated cotton (High irrigation: 1623 lb./acre; Low irrigation: 1350 lb./acre) compared to that in dryland (1046 lb./acre) cotton across all four treatment combinations (Fig. 2). This suggests that the dryland plots were sufficiently water-stressed during the growing season as in previous two years. The highest lint yield under full irrigation treatment was observed in the uninfested control treatment, while the lowest were recorded in the thrips and thrips+fleahopper infestation treatments. Overall, thrips+fleahopper treatment resulted in the lowest yield across all three irrigation treatments, although statistically significant only under dryland condition. The lack of statistical significance across sub-treatments under irrigated treatments can be attributed to a large variation in data. In 2021, lint yield was similar across irrigation treatments as well as insect management treatments, except for the lowest yield in thrips+cotton fleahopper treatment in dryland condition (Fig. 2). Also, thrips and thrips+fleahopper treatments significantly reduced lint yield compared to only fleahopper treatments in dryland, however, lint yield was similar across all insect treatments in low water and high-water treatments, indicating the impact of drought conditions on modulating the effect of insect pests as well as the plant's compensatory ability (Barman and Parajulee 2013). The overall low yield in 2021 is primarily attributed to replanting (late-planted crop for the Texas High Plains region). Averaged over four years, there was a clear trend

that sequential infestations of thrips and fleahoppers reduced the lint yield across all irrigation treatments, but detailed economic analyses are pending.

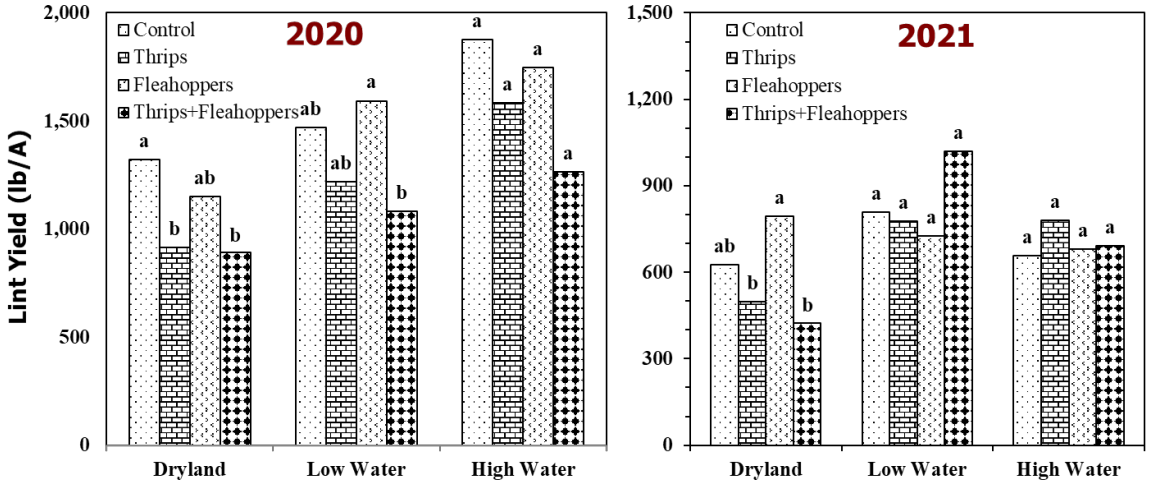

Figure 2. Lint yield (lb./acre) as affected by thrips and fleahopper infestations under dryland versus irrigated production conditions, Lubbock, Texas, 2020-2021. Values were compared across insect management treatments within each irrigation treatment; same lowercase letters indicate treatment means were not significantly different from each other.

Acknowledgments

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