IMPACT OF LYGUS BUGS AND COTTON FLEAHOPPERS ON COTTON YIELD UNDER DROUGHT CONDITIONS

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Abstract

Multi-year field studies were conducted to determine the impact of plant bug infestations under a range of water levels on Texas High Plains cotton. Various densities of cotton fleahopper and *Lygus* bugs were released on cotton squares and mid-season bolls, respectively. In 2012, two *Lygus* densities (0 and 5 adults per plant) were released on cotton plants. From 2013-2015, three fleahopper densities (0, 2 and 5 fleahoppers per plant) were released on cotton squares. One week following the releases, plant bugs were removed and the test plants were sprayed with insecticides. Overall, significantly higher lint yield was recorded from control plots compared to cotton fleahopper released plots in all years. Additionally, cotton significantly compensated lint yield loss caused by cotton fleahopper feeding under high water regime. *Lygus* boll injury was observed 3rd to 4th week into flowering and significantly higher lint yield was recorded from control plots compared with *Lygus* released treatments. Impact of *Lygus* injury on cotton lint yield was significantly greater in dryland production compared to that in full irrigation system.

Introduction

United States is the third largest cotton producing country in the world. In 2015, cotton was grown on an area of 8.2 million acres in the United States. Texas planted approximately 55% (4.48 million acres) of the total U.S. cotton. Texas High Plains plays an important role in U.S. agriculture and significantly contributes to Texas cotton production. More than 65% of Texas cotton is produced in Texas High Plains. In 2015, arthropod pests caused 2.83% reduction in U.S. cotton lint yield. *Lygus* species ranked second while cotton fleahopper ranked 5th and caused 0.79% and 0.35% cotton fiber yield loss in the U.S., respectively (Williams 2016). Late-instar *Lygus* nymphs can cause greater damage to young bolls than adults (Jubb and Carruth 1971, Parajulee et al. 2011). In Texas High Plains, cotton generally compensates losses caused by early *Lygus* infestation, but a significant lint loss is possible if the infestation occurs around mid-season coinciding with the major boll developmental period (Hakeem et al. 2016). Plant health also contributes significantly to compensate for insect-induced fruit losses. Available nitrogen and water also play an important role in plant's compensatory performance. The objective of this study was to determine the impact of plant bug infestations under a range of water levels on Texas High Plains cotton.

Materials and Methods

Studies were conducted at the Texas A&M AgriLife Research Center farm, Lubbock, and Agricultural Complex for Advanced Research and Extension Systems, Lamesa, Texas, to determine the impact of plant bug infestations under a range of water levels on cotton lint yield. Two seasonal irrigation levels, High (11.05") and Low (8.05"), were evaluated for cotton fleahopper damage potential in cotton under a center pivot irrigation system (Lamesa location). Drought-stress treatments for *Lygus* study also included two irrigation levels (sufficient irrigation versus dryland) at the Lubbock location. Cotton fleahopper (incubated from overwintered eggs) and *Lygus* bugs (field collected) were released on cotton plants (two weeks into cotton squaring was timed for cotton fleahopper release while *Lygus* release was conducted at 2-3 weeks into the initiation of cotton flowering) and allowed to feed for a week (Hakeem and Parajulee 2015, Hakeem et al. 2016). One week after releases, plants were sprayed with Orthene® 97UP and the fields were kept insect pest free for the remainder of the growing season. Plant mappings were done two weeks after insect release and immediately before harvest. Cotton cultivars varied across the study years while the irrigation levels remained the same.

Figure 1. A) Cotton fleahopper adult, B) *Lygus* adult, C) fleahopper-infested cotton square, D) *Lygus* feeding injury on cotton boll in Lamesa, TX.

Figure 2. A and B) Multi-plant cages used to release fleahopper and *Lygus* bugs on cotton, C) Pre-harvest plant mapping and harvesting of the test plants.

Results and Discussion

Cotton fleahopper augmentation to squaring cotton resulted in significantly greater percentage of square abscission compared to that in control treatment. Pre-flower square abscissions due to cotton fleahopper injury generally resulted in lint yield. In 2013, lint yield values were 781 and 998 lbs per acre for 'Low' water regime and 1,271 and 1,380 lbs/acre for 'High' water regime in control and fleahopper augmented plots, respectively. Lint yield was significantly lower due to cotton fleahopper infestation under 'Low' water regime, but the effect was not as pronounced and not significant under 'high' water regime, indicating plants' ability to compensate for fleahopper-induced fruit loss under high irrigation production system.

In 2014, augmentation of fleahoppers caused significant injury to cotton squares and fruit abscission rates were 16% and 9% for 'Low' and 'High' water regimes, respectively. It is noteworthy that cotton fleahoppers caused higher levels of injury under 'Low' water regime compared to that under a 'High" water regime, suggesting that the ability of cotton fleahoppers to inflict injury to water-stressed plants is greater than that for fully water-turgid plants or the water-stressed plants may be more susceptible to cotton fleahopper injury. Lint yield was not significantly impacted by the cotton fleahopper augmentation treatment, but the yield was numerically lower in cotton fleahopper augmented plots compared to that in control plots. Lint yield values were 1,030 and 918 lbs per acre for 'Low' water regime and 1,638 and 1,579 lbs/acre for 'High' water regime in control and cotton fleahopper augmented plots, respectively. The effect of cotton fleahopper on lint yield was numerically more pronounced under 'Low' water regime compared to that for 'High' water regime as observed in 2013, indicating plants' greater ability to compensate for fleahopper-induced fruit loss under high irrigation production system. The effect of irrigation water treatment on cotton fleahopper injury and damage potential was similar across all three years of the study.

In 2015, significantly higher square loss was observed with increased fleahopper density as compared to control plots under both low and high irrigation regimes (Fig. 3). The staircase effect of insect-induced square loss trend was similar between low and high water regimes. The fleahopper-induced early-season square loss resulted in a significant reduction in lint yield, particularly under high water (full irrigation) production system, whereas lint yield did not vary significantly between uninfested and fleahopper-infested plots under low irrigation production system (Fig. 4). It is unclear why the full-irrigated treatment showed reduced lint yield.

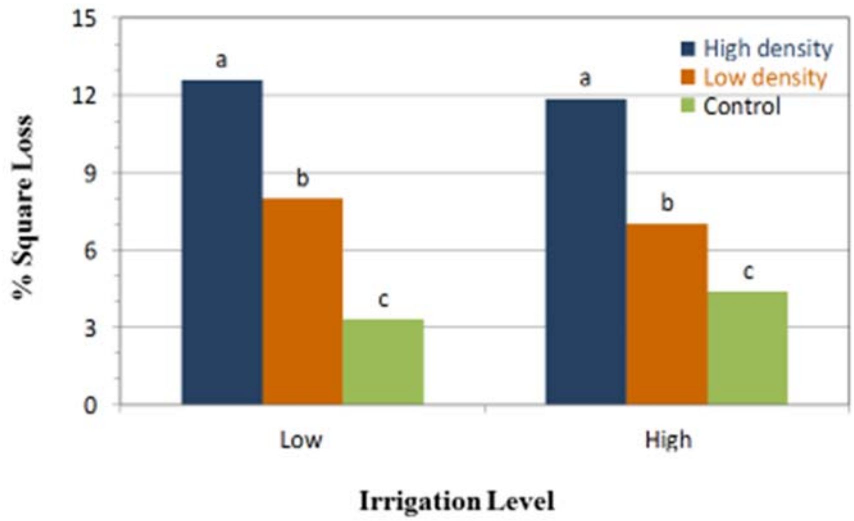

Figure 3. Percent square loss caused by cotton fleahopper infestations under high and low irrigation regimes, Lamesa, Texas, 2015.

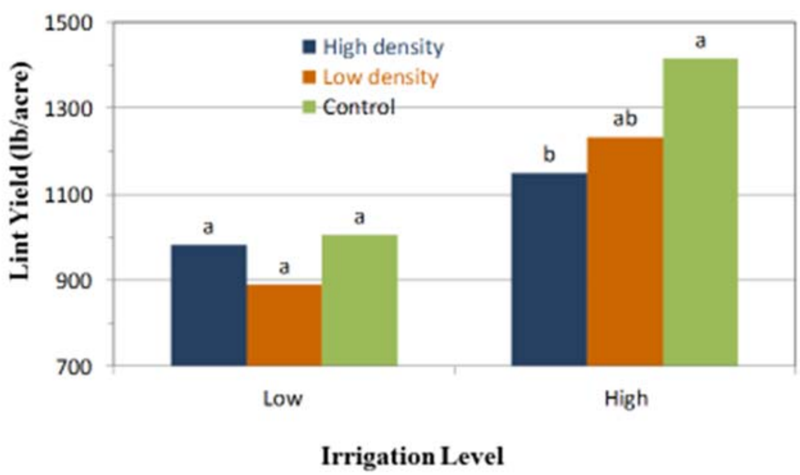

Figure 4. Impact of cotton fleahopper infestations on cotton lint yield under high and low irrigation regimes, Lamesa, Texas, 2015.

In 2016, drought-stress induced significantly greater impact of *Lygus* injury on cotton lint yield. *Lygus* injury caused 34.83% lint yield loss in dryland cotton compared to only 11.3% loss in irrigated cotton (Fig. 5, Coyle et al. 2016), suggesting a reduced *Lygus* injury sensitivity on full irrigated cotton compared to that in water-stressed production situation. The injury impact of *Lygus* on cotton lint yield in 2017 showed similar trend to that observed in 2016. That is, *Lygus* injury caused 41.1% lint yield loss in dryland cotton compared to 29.8% loss in irrigated cotton (Fig.

5), suggesting a reduced *Lygus* injury sensitivity on full irrigated cotton compared to that in water-stressed production situation.

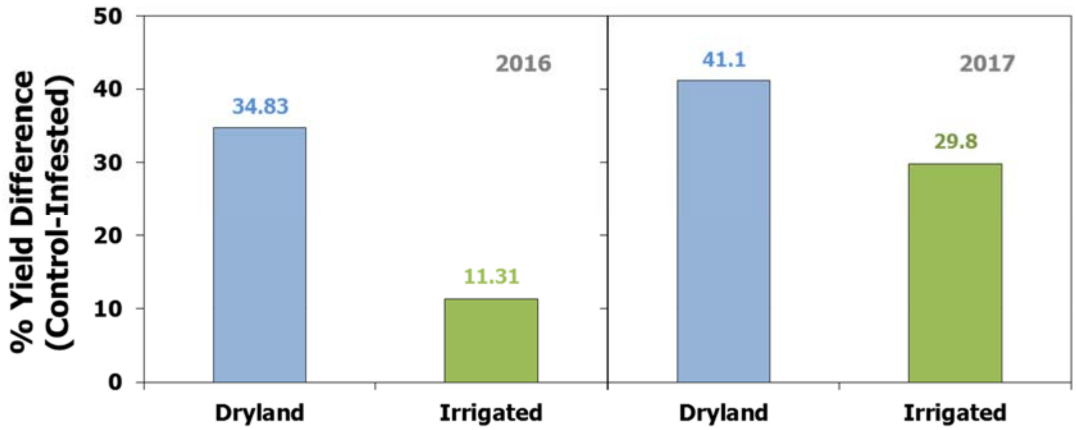

Figure 5. Effect of *Lygus* bugs on cotton lint yield (% lint yield reduction) under dryland and irrigated production conditions, Lubbock, TX, 2016-2017.

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