TEXAS A&M AGRILIFE RESEARCH & EXTENSION

COTTON ENTOMOLOGY
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TECHNICAL REPORT 25-4

TEXAS A&M AGRILIFE RESEARCH, CLIFF LAMB, DIRECTOR
THE TEXAS A&M UNIVERSITY SYSTEM, COLLEGE STATION, TEXAS

COTTON ENTOMOLOGY PROGRAM

RESEARCH ACTIVITY ANNUAL REPORT

2024

SUBMITTED TO:

PLAINS COTTON IMPROVEMENT COMMITTEE
PLAINS COTTON GROWERS, INC.

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Introduction

Plains Cotton Growers, Inc. (PCG) has been a strong and consistent supporter of cotton insect research and extension activities in west Texas. Most notably, PCG was instrumental in securing state funds for the Boll Weevil Research Facility at the Lubbock Center and provided both financial and political support to conduct boll weevil biology and ecology research even before the boll weevil became a significant economic pest of the High Plains region. After the initial entry of the boll weevil into the eastern edge of the High Plains, PCG promoted and along with USDA-APHIS administered the boll weevil diapause suppression program involving a team effort that continued to include Texas A&M University. PCG also supported Texas Cooperative Extension (now Texas A&M AgriLife Extension Service) efforts to annually evaluate the diapause suppression program, conduct applied research trials to develop boll weevil management practices that would enhance the diapause suppression program's efforts, and in the 1990s supported an annual survey of High Plains overwintering sites and grid trapping of cotton across the High Plains area. The team effort of PCG, Texas A&M AgriLife Research and AgriLife Extension Service over several decades resulted in a comprehensive understanding of boll weevil ecology and behavior. Under the strong and cooperative leadership of PCG, the boll weevil eradication program for the High Plains area progressed much more rapidly than anticipated. Now, the successful boll weevil eradication program has eliminated the boll weevil from this region for two decades.

With a successful boll weevil eradication program and increased adoption of the transgenic *Bt* technology (now >70%), the cotton insect research and extension program focus has changed considerably during the last 20+ years. Our current research/extension focus is on developing ecologically intensive strategies for cotton pest management, including crop phenology, cultivar, non-crop habitat, irrigation, and fertility management towards reducing insect pest pressure. Our research has demonstrated the need for continuing investigation of basic behavior and life patterns of insects while having strong field-based applied research to bridge the gap between basic, problem-solving science and producer-friendly management recommendations. We have assembled a strong group of people to work as a team to examine multiple disciplines within the broad theme of Cotton IPM. We invest considerable time and manpower resources in investigating the behavior and ecology of major cotton pests of the High Plains with the goal of developing management thresholds based on cotton production technology and economics, with particular focus on limited water production system. Our Program has successfully leveraged research funds based on the funding provided by PCIC to support our research effort. We are excited about and greatly value our Cotton Entomology research and extension partnerships with multidisciplinary scientists at the Texas A&M AgriLife Research Center in Lubbock and statewide field crop entomologists, together with area IPM agents in the region, to continue this partnership as we challenge ourselves to deliver the best cotton insect-pest management recommendations to our Texas High Plains producers. Together, we have maintained the Texas High Plains area as a characteristically low cotton insect-pest prevalence region in the U.S. cotton belt.

Texas A&M AgriLife Research & Extension Center at Lubbock

COTTON ENTOMOLOGY PROGRAM

Megha N. Parajulee, Ph.D.

Professor, Faculty Fellow, and Texas A&M Regents Fellow

PROGRAM OVERVIEW: The Cotton Entomology Program at Lubbock combines basic and applied research with strong outreach, industry, and grower partnerships to produce information to enhance the ability of the cotton industry in the Texas High Plains to mitigate cotton yield losses due to insect pests through the use of ecologically intensive integrated pest management. Selected projects of the Program are briefly highlighted in this exhibit.

EFFECT OF NITROGEN FERTILITY ON COTTON CROP RESPONSE TO INSECT DAMAGE

A long-term study investigating the effects of differential nitrogen fertility on cotton aphids and cotton fleahopper population dynamics in a typical drip-irrigation Texas High Plains cotton production system has been ongoing since 2002. Differential nitrogen fertility (0, 50, 100, 150, and 200 lbs N/acre) is being examined for its effect on cotton plant physiological parameters, thereby influencing cotton insect injury potential and plant compensation. Recent focus has been to examine the effect of residual nitrogen on crop response to simulated cotton fleahopper damage.

Cotton fleahopper augmentation in multi-plant cages to quantify the response of variable rates of N to FH injury

SEASONAL ABUNDANCE PATTERNS OF BOLLWORM AND TOBACCO BUDWORM MOTHS IN THE TEXAS HIGH PLAINS

A long-term study is investigating the seasonal moth flight activity patterns of bollworm and tobacco budworm in the Texas High Plains. The regional adoption of cotton and corn cultivars incorporating *Bt* technology has contributed to reduced level of these lepidopteran pests in recent years; however, constant threat of insect resistance to transgenic technology and diminishing underground water availability for irrigation is necessitating lower crop inputs, such as transgenic seed costs, for increasing dryland crop acreage, increasing the importance of these pests.

Texas Pheromone (TP) and “Bucket” traps used to monitor moths

COTTON FLEAHOPPER SUSCEPTIBILITY OF PRE-FLOWER COTTON UNDER LIMITED IRRIGATION PRODUCTION

The objective of this project is to investigate the growth and fruiting response of cotton after cotton fleahopper infestation at three discrete cotton fleahoper susceptible stages (prior to visible squares, 1-2 square, and 3-4 square stages) of cotton under three irrigation water levels. We also quantify cotton compensatory potential following cotton fleahopper induced square loss under phenological stage x irrigation treatments.

Cotton fleahopper augmentation at three crop phenological stages and inspection to determine insect colonization and crop injury

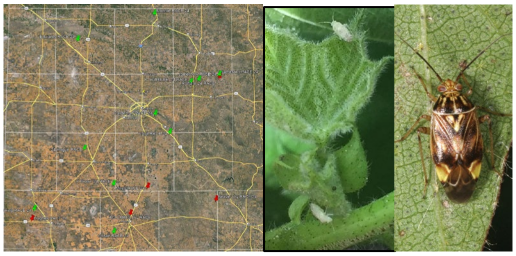
INTERACTIVE EFFECT OF COVER CROPS AND IRRIGATION ON COTTON AND INSECT-PEST MANAGEMENT

Reduced water availability, low rainfall coupled with wind erosion of topsoil, higher pumping cost of limited water, and increased input cost limit cotton productivity in the Texas High Plains and correspondingly lower profit margins, warranting for higher water use efficiency in our crop production. The study aims to: 1) quantify the impact of cover crops on early seedling growth and cotton susceptibility to thrips infestations across three irrigation water availability, and 2) evaluate the interactive effect of cover crop x irrigation water on seedling vigor, thrips infestations, and seasonal plant phenology impacting cotton lint yield and fiber quality. Two cover crops (terminated rye and wheat) and a control (no cover crop) will be deployed under three irrigation treatments (full irrigation, supplemental irrigation, and dryland). Two thrips infestation treatments (thrips augmented versus spray-control) will be deployed within each of the 9 main plot treatments (3 water levels x 3 cover crops x 2 thrips treatments = 18 treatment units), replicated four times (72 plots).

Terminated cover crops x Irrigation treatments affecting cotton phenology, early-season insect abundance, and crop compensation

COTTON FLEAHOPPER AND LYGUS RESPONSE TO NEWEST COTTON TECHNOLOGIES: MULTIDISCIPLINARY RESEARCH-EXTENSION COLLABORATION ON REPLICATED AGRONOMIC COTTON EVALUATION (RACE) TRIALS

The study will deploy a simulated cotton fleahopper-Lygus study in four counties – Crosby, Hale, Terry, and Gaines. This study utilizes the four selected farmers’ fields of the Texas A&M AgriLife Extension Replicated Agronomic Cotton Evaluation (RACE) trial. Cotton compensatory response to simulated fruit loss in relation to cultivar maturity and cotton production sites will be evaluated by overlaying this study on the existing large scale RACE trial in the Texas High Plains.



Cotton fleahopper and Lygus response to cotton cultivars across various irrigation management options

EFFECT OF NITROGEN FERTILITY ON COTTON CROP RESPONSE TO SIMULATED COTTON FLEAHOPPER AND LYGUS DAMAGE

Megha N. Parajulee, Raju Sapkota, Surendra Gautam, and Katie L. Lewis

Objective: Evaluate the effect of artificial removal of cotton squares and bolls mimicking cotton fleahopper and *Lygus* injury under five nitrogen application rates on cotton lint yield and quality.

Methodology: Cotton cultivar, DP1820B3XF, was planted on June 4, 2024. The experiment was laid out in a split-plot randomized block design with five nitrogen rate treatments (0, 50, 100, 150, and 200 lb N/acre) applied for 22 years as main plots (16-row plots) and four fruit loss treatments (artificial removal of cotton squares mimicking acute cotton fleahopper infestation, 20% boll removal treatment to mimic late-season Lygus infestation, simulated cotton fleahopper injury followed by late-season Lygus injury, and control) as sub-plots with four replications (80 plots). The main-plot treatments included pre-bloom applications of five rates of N augmentation using a soil applicator injection rig on July 10. Pre-treatment soil samples (two 0 to 12 and 12 to 24-inch depth soil cores) were collected from each of the 20 main plots on July 9. Ten leaves per plot were collected three times (July 17, August 17, September 17) for leaf dry weight and nitrogen analysis. Within each main plot, four 6.5-ft. sections of uniform cotton were flagged in the middle two rows, one section each receiving hand removal of 100% cotton squares three weeks into squaring (July 23), 20% bolls removed from top canopy of the plants at crop cut-out (August 23), square removal on July 23 followed by boll removal on August 23, and control (no square or boll removal). Treatment plots were hand-harvested on October 29 for lint yield.

Results: Lint yields were similar across the three lower N rates (0, 50, and 100 lb/A). The yield increased significantly at 150 lb/A treatment and then slightly declined at 200 lb/A (Fig. 1). Simulated insect infestation treatments showed inconsistent patterns across the range of N application rates. However, at high lint yield (150 lb/A N treatment) situation, removal of 100% squares at 1st flower stage significantly reduced lint yield. Interestingly, and somewhat expected, the late-stage boll removal slightly increased the lint yield due to the removal of young bolls at crop cut-out that allowed plants to allocate more energy on maturing harvestable bolls. The sequential removal of squares during the pre-flower stage and boll removal at crop cut-out resulted in reduced lint yield, indicating the stronger effect of pre-flower square loss than the late-season boll loss. Residual N and fiber quality data are pending which will be presented at the Plains Cotton Improvement Program annual meeting.

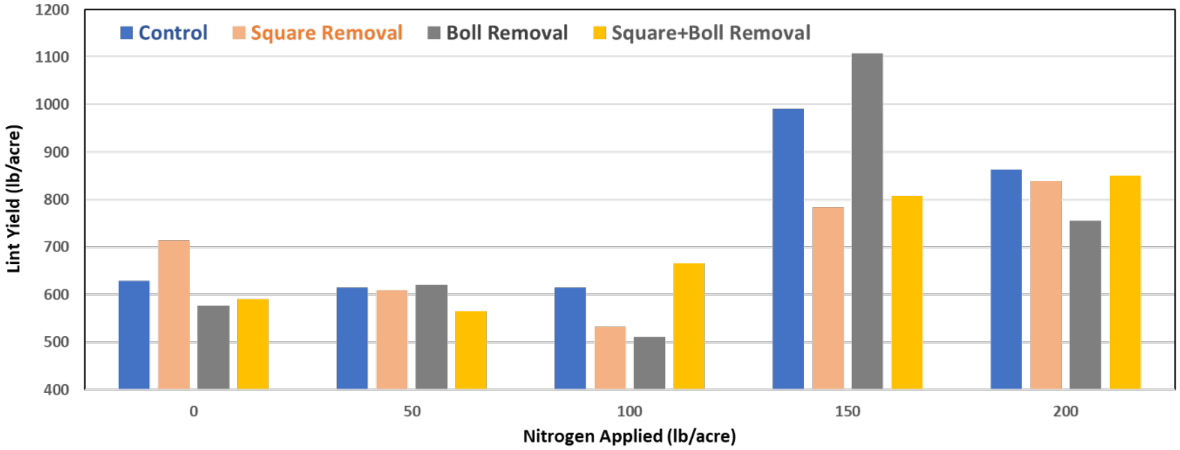


Fig. 1. Lint yield (lb/A) affected by simulated cotton fleahopper and Lygus damage across five variable N rates.

TITLE:

Cotton yield response to simulated cotton fleahopper and western tarnished plant bug infestations as influenced by irrigation level and cultivar treatments, Lamesa, TX, 2024.

AUTHORS:

Megha Parajulee – Professor, Faculty Fellow, and Regents Fellow
Surendra Gautam – Senior Research Associate
Raju Sapkota – Research Assistant
Wayne Keeling - Professor

MATERIALS AND METHODS:

Plot Size: 4 rows by 300-700 feet, 3 replications

Planting Date: May 16 (terminated rye cover)

Varieties: DP 2143NR B3XF
FM 2498 GLT

Herbicides:

Roundup 32 oz/A + Panther 2 oz/A	3/20/24
Roundup 32 oz/A	4/12/24
Caparol 48 oz/A	5/17/24
Roundup 32 oz/A + Liberty 43 oz/A + Warrant 48 oz/A	6/24/24
Roundup 32 oz/A + Liberty 43 oz/A	8/01/24

Fertilizer: 85-0-0

Irrigation:

	Low	Base	Base Plus
Preplant/Emergence	3.8”	3.8”	3.8”
In-season	5.6”	7.3”	9.4”
Total	9.4”	11.1”	13.2”

Treatments: Four insect simulation treatments included

1. Uninfested control
2. Fleahopper Simulated Damage
3. Lygus Simulated Damage
4. Fleahopper - Lygus Sequential Simulated Damage

Simulated damage consisted of manual removal of 100% squares three weeks into squaring (July 18) to time cotton fleahopper susceptible stage *(fleahopper simulation*), removal of 20% bolls (September 10) from the top 1/3rd of the plant when the crop was at near cut-out *(Lygus simulation),* and removal of pre-flower squares followed by removal of 20% small bolls near crop cut-out *(fleahopper - Lygus sequential simulation)*.

Harvest date: October 22 (hand-harvested)

Effect of manual removal of fruits at early-stage (cotton fleahopper simulation), late-stage (Lygus simulation), and early and late sequentially (fleahopper – Lygus sequential simulation) was evaluated on two cotton cultivars, DP2143NR B3XF and FM2498 GLT, as influenced by two irrigation (low and high) water levels. The 'low' and 'high' water treatments were set up as 'base'±2" with ~4" irrigation water discriminating the two water levels in the study. Thus, the experiment comprised of two water levels, two cultivars, and four simulated fruit loss events [control, pre-flower 100% square loss mimicking the cotton fleahopper injury-induced loss, 20% small bolls (<3 cm diameter) loss mimicking the Lygus boll injury-induced small fruit abortion at cut-out, and square removal followed by boll removal], replicated three times, totaling 48 plots. The test plots were monitored for the occurrence of any other insects, but no such occurrences were observed during the growing season.

RESULTS AND DISCUSSION:

Combined over two cultivars and three insect simulation treatments, significantly higher lint yield was recorded from 'high' water regime (333 lb/acre) compared to that in 'low' water regime (103 lb/acre). Lint yield was abnormally low in 2024 due to prolonged drought during the growing season. While both cultivars produced near identical lint yield under low irrigation regime (100 and 105 lb/A for FM2498 GLT and DP2143NR B3XF, respectively), FM2498 GLT performed slightly better under full irrigation production system (351 lb/A) compared to DP2143NR B3XF (314 lb/A) (Fig. 1). Nevertheless, the insect simulation treatments showed characteristic treatment differences, although the pattern was similar between low and high irrigation treatments (Fig. 2). That is, cotton fleahopper and Lygus simulations marginally reduced lint yield in both irrigation conditions but not significantly. The sequential infestations of cotton fleahoppers and Lygus reduced lint yield the most compared to cotton fleahopper or Lygus simulated treatment singly. The effect of insect simulation treatment was more pronounced under full irrigation production system (Fig. 2), indicating a greater pest risk at high irrigation production regime for sequential infestations of cotton fleahoppers and Lygus.

The effect of insect injury simulation was generally similar in both cultivars; however, DP2143NR B3XF (control: 263 lb/A vs FH-Lygus sequential simulated damage: 201 lb/A) appeared to be more tolerant to sequential infestation of cotton fleahopper and Lygus than FM2498 GLT [control: 263 lb/A vs FH-Lygus sequential simulated damage: 163 lb/A) (Fig. 3) and the effect was more pronounced under full irrigation production condition [control: 128 lb/A vs FH-Lygus sequential simulated damage: 62 lb/A) (Fig. 4). That is, DP2143NR B3XF significantly compensated for fruit loss due to sequential simulated insect infestations under high irrigation regime while FM2498 GLT suffered a significant lint yield loss under the same scenario. The simulated cotton fleahopper and Lygus sequential damage under low irrigation reduced 82 and 66 lb/A for FM2498 GLT and DP2143NR B3X, respectively, while the lint yield reduction under high irrigation regime was 135 and 40 lb/A, respectively, for the two cultivars. Nevertheless, both cultivars exhibited similar responses for single or sequential infestations under low irrigation regime (Fig. 4).

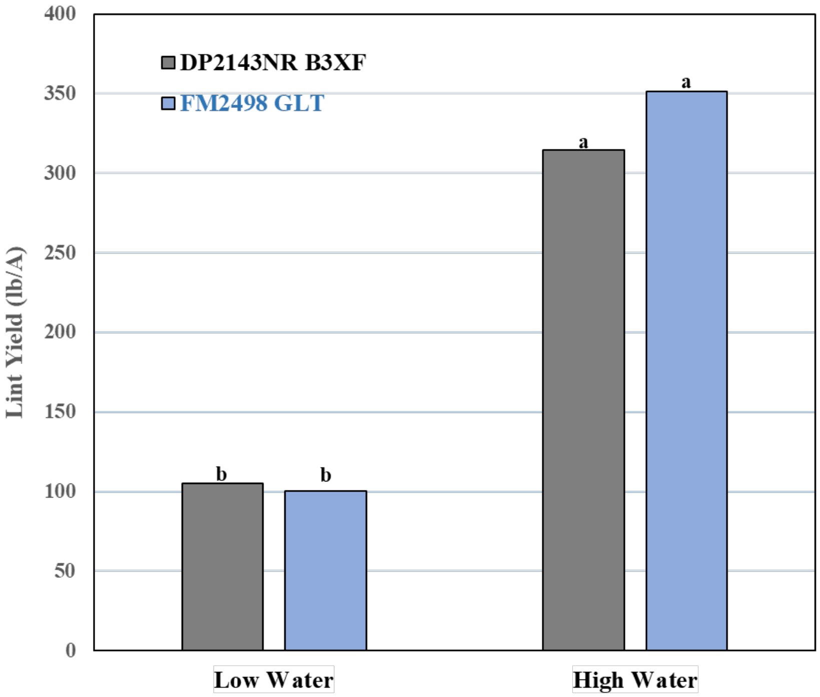


Figure 1. Average lint yield of DP2143NR B3XF and FM2498 GLT under low and high irrigation regimes, Lamesa, Texas, 2024.

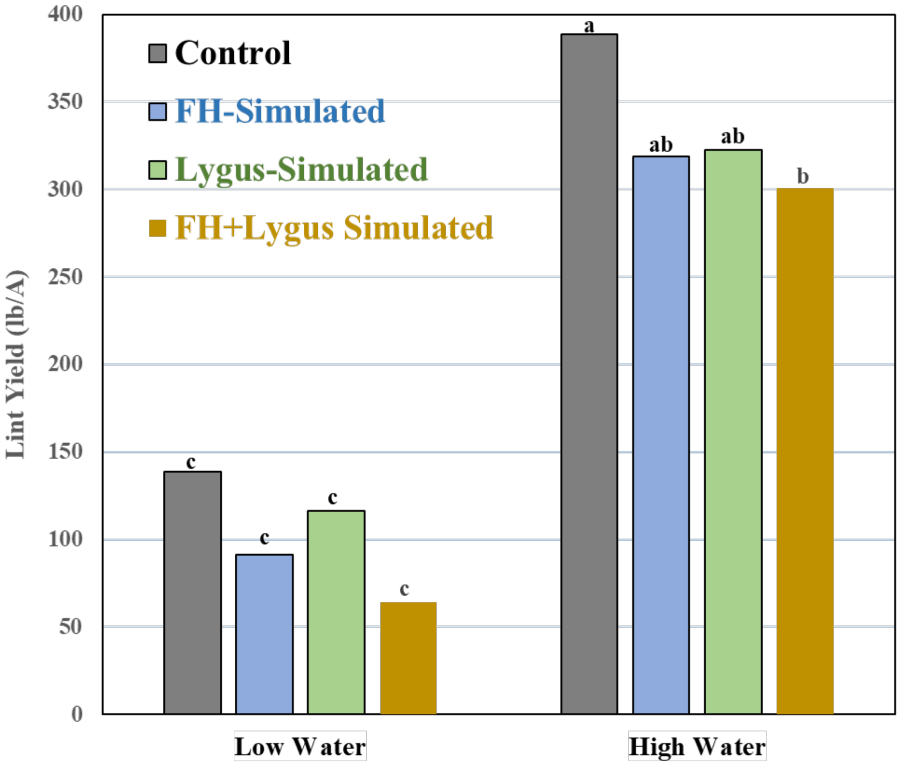


Figure 2. Average lint yield influenced by simulated cotton fleahopper versus *Lygus*-induced fruit removal in two cotton cultivars under low and high irrigation regimes, Lamesa, Texas, 2024.

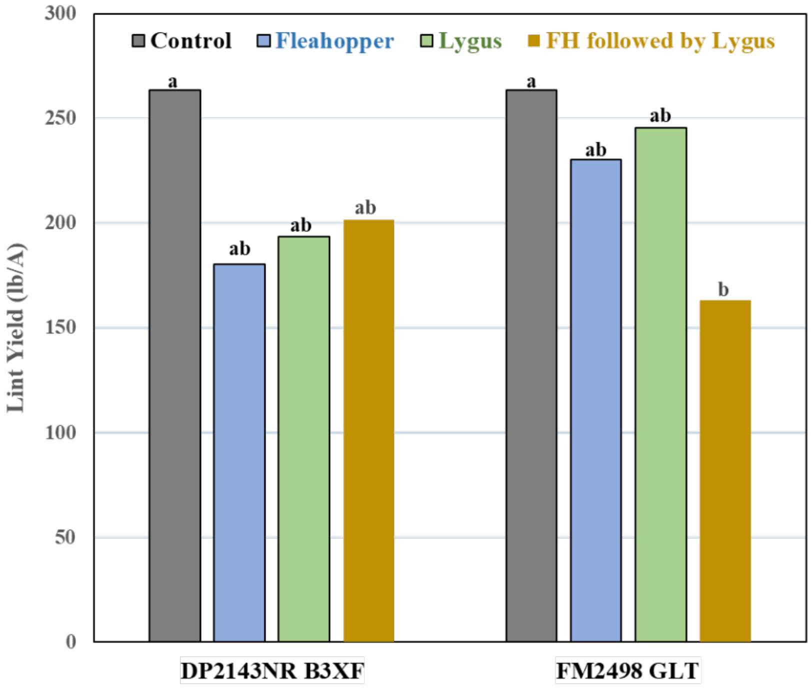


Figure 3. Average lint yield influenced by simulated cotton fleahopper versus *Lygus*-induced fruit removal in two cotton cultivars combined over two irrigation treatments, Lamesa, Texas, 2024.

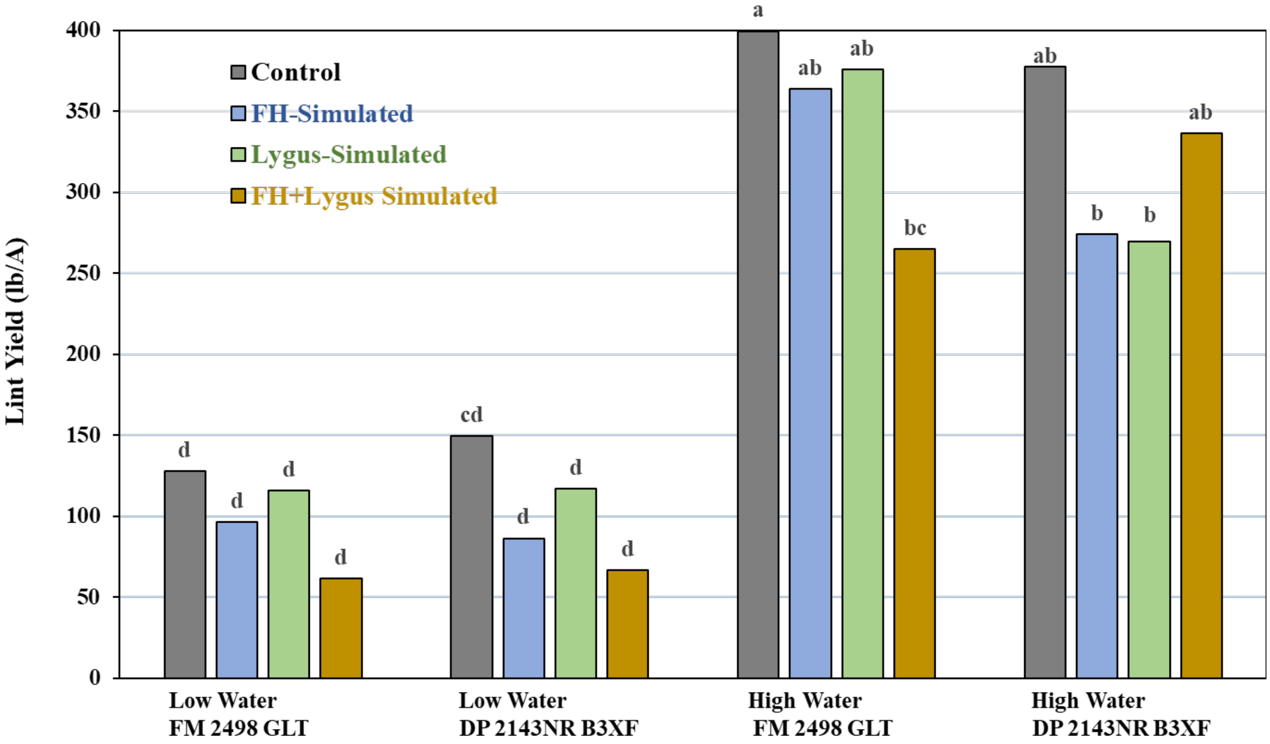


Figure 4. Average lint yield influenced by simulated cotton fleahopper versus *Lygus*-induced fruit removal in two cotton cultivars x two irrigation treatments, Lamesa, Texas, 2024.

Cover crop and insect-pest management in water-deficit cotton production

Cotton Incorporated **-** Texas State Support Committee

Project Number: 23-943TX
PI: Megha N. Parajulee
CO-PIs: Wayne Keeling, Suhas Vyavhare, and Donna McCallister

PROJECT SUMMARY

The Texas High Plains (THP) is a semi-arid region with characteristic low rainfall, with production agriculture supported by limited irrigation or solely 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. Recurring drought conditions have disproportionately depleted the underground water, significantly shifting the cotton production outlook in THP to even lower input with dryland acreage reaching 60-65%. The intrinsic value of cover crops in THP cotton production system has been well established, including soil conservation, early-season seedling protection from wind, and improved soil health. However, the use of cover crops has not been fully utilized, especially for the lack of sufficient information on the amount of water required to grow cover crops versus the value of terminated cover crop in decreasing evaporation from the soil surface, increased infiltration of rainwater and moisture storage, and increased water use efficiency. Also, the value of cover crop on insect management, particularly thrips population dynamics and the resulting effect on early crop vigor, needs to be examined to ensure that the effectiveness of the cover crop is maximized across various production options.

The objectives of this project were to: 1) quantify the impact of cover crops on early seedling growth and cotton susceptibility to thrips infestations across three irrigation water availability, 2) evaluate the interactive effect of cover crop, seedling vigor, and thrips infestations on cotton yield and fiber quality, and 3) develop a dynamic optimization economic model that maximizes the net returns from management of cover crops and thrips under water-deficit crop production conditions.

Two cover crops (rye and wheat) and a control (no cover crop) were deployed under three irrigation treatments (full irrigation, supplemental irrigation, and dryland). Cover crops were planted in early spring and terminated in late spring to ensure that they were at proper height but before heading for the best performance. Two thrips infestation treatments (thrips augmented versus spray-control) were deployed within each of the 9 main plot treatments (3 water levels x 3 cover crops x 2 thrips treatments = 18 treatment units), replicated four times (72 plots). Terminated rye and wheat cover did not significantly influence thrips colonization and the thrips densities were much below economic thresholds for both years. Irrigation and cover crops significantly influenced the cotton flowering patterns. Full irrigation produced the highest abundance of white flowers, followed by supplemental irrigation plots, and the lowest flower abundance was observed in dryland. Cover crops resulted in higher flower densities than no-cover (fallow) plots in 2023 but not in 2024. In-season plant parameters such as plant height and flowering patterns and flower densities correlated with lint yield, with highest lint yield under full irrigation, followed by supplemental irrigation, and the lowest yield in dryland for both years. Cover crops resulted in marginally greater yields while thrips augmentations marginally reduced the lint yield, but the data were not statistically significant. We plan to repeat this study in 2025 to capture the year-to-year variation in data.

Cover crop and insect-pest management in water-deficit cotton production

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 historic drought of 2011 that claimed much of the Texas production agriculture, reducing total cotton yield that year by 55%. Drought is a recurring issue for THP agriculture which has disproportionately depleted the underground water, significantly shifting the cotton production outlook to even lower input with dryland acreage reaching upward of 60%. 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 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 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.

In agricultural systems, vegetation structure associated with different agronomic practices may have potential implication for insect predation and natural pest suppression. Habitat management provides food for prey and shelter for adverse conditions which favors natural enemies and enhances biological control. Generally, cover crops provide refuge to beneficial insects. We have demonstrated at AGCARES research that the no-till cover crop system harbored twice the density of predatory arthropods in cotton than no-cover conventional tillage system. No-tillage plots and organically managed crops tend to have higher diversity of beneficial insects than non-organic crops and tillage plots. Long-term research at AGCARES farm has also shown that soil organic carbon was greatest in the no-tillage with cover crops at the 0-6" depth compared to the conventional tillage treatments prior to planting cotton. Profile soil water was greatest following the no-tillage cover cropping systems compared to the conventionally grown system. During the cropping season, soil moisture was greatest in the no-till treatments where greater soil cover provided by cover crop residue likely increased water capture and reduced evaporation losses. Organic matter and reduced tillage can improve soil structure increasing infiltration and percolation while decreasing evaporation from the soil surface. The no-till treatments were better able to respond to precipitation events possibly through increased infiltration and moisture storage.

Because limited information is available on the impact of cover crops on population abundance and diversity of arthropod natural enemies, especially across the range of irrigation water regimes, and on the value of terminated cover crop in enhancing seedling vigor and its tolerance to thrips injury, this project aimed to characterize the impact of cover crops x thrips infestation x irrigation water levels on crop health, soil health, and cotton yield and fiber quality and develop a dynamic economic model to determine the suitability of cover crops for the range of irrigation regimes in Texas High Plains cotton.

Predicting pest populations under different water-deficit crop production scenarios and understanding how these conditions influence pest 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. The use of cover crops has not been fully utilized in Texas High Plain cotton, especially for the lack of sufficient information on the amount of water required to grow cover crops versus value of terminated cover crop in decreasing evaporation from the soil surface, increased infiltration of rainwater and moisture storage, and increased water use efficiency. Therefore, cotton producers must carefully consider cost-benefit of cover crops across the range of water availability and its value to early seedling health and thrips population dynamics, in-season crop growth and earliness, and yield and fiber quality for overall net profit margin.

The objectives of this study were to:

1) Quantify the impact of terminated cover crops on cotton germination, seedling growth and cotton tolerance to thrips infestations across three irrigation water availability,
2) Evaluate the interactive effect of cover crop, seedling vigor, and thrips infestations on cotton yield and fiber quality, and
3) Develop a dynamic optimization economic model that maximizes the net returns from management of cover crops and thrips under water-deficit crop production conditions.

METHODOLOGY

A field study was conducted at Texas A&M AgriLife Research and Extension Center farm in Lubbock, Texas. The study consisted of two cover crops (rye and wheat) and a control (no cover crop) deployed under three irrigation treatments (full irrigation or high irrigation, supplemental irrigation or low irrigation, and dryland) and two thrips infestation treatments (thrips augmented versus spray-control) then deployed within each of the nine main plot treatments (3 cover crop x 3 irrigation), replicated four times (total 72 experimental plots) (Figure 1). Three irrigation water levels (near-dryland, limited irrigation or 30% ET replenishment, and full irrigation or 90% ET replenishment) achieved through subsurface drip irrigation simulated three water-deficit production conditions, including high (near-dryland condition), medium, and no water deficits (full irrigation). Two cover crops (rye and wheat) and a control (no cover crop) were sown on 8 February (2023) and 5 March (2024) under each of the three irrigation treatments (full irrigation, supplemental irrigation, and dryland). Cover crop planting was timed to ensure a reasonable height and biomass but before heading for the best performance (sufficient biomass but tolerance to lodging) by the time cotton was planted in mid-May (Figure 1). Cotton cultivar DP2020B3XF was planted on 18 May (2023) and DP1845B3XF on 20 May (2024). The 2023 crop germination was delayed, and the plant stand was compromised due to rain/hail event.

Figure 1. Randomized Complete Block Design (RCBD) layout with irrigation as main plot and cover crop as sub-plot treatments. Thrips augmentation treatment (treated control vs. thrips augmentation) was deployed as sub-sub-plot treatment indicated by two 6-ft sections (2023) or one 12-ft section (2024) with colored flags (left panel). Cover crop residues persisted through most of the crop growing season (right panel).

2023 Study

On 6 June 2023, two thrips infestation treatments (thrips augmented versus spray-control) were deployed within each of the 9 main plot treatments (3 water level x 3 cover crop x 2 thrips treatments = 18 treatment units), each treatment replicated four times (total 72 plots). Thrips sampling was done in all treatment plots on 6 June 2023. Natural colonization of thrips was expected to achieve threshold densities, but the actual densities were much lower than thrips thresholds (1 thrips per leaf). Thus, thrips were augmented on 7 June 2023 in all thrips-designated plots by placing excised alfalfa terminals with thrips at the base of the cotton seedlings to ensure a significant pest pressure in these plots and to achieve quantifiable infestations and seedling damage. No-thrips plots were kept insect-free via insecticide sprays. Thrips sampling was done again on 12 June and 19 June. Thrips damage ratings were done on 9, 20 and 26 June. Plant heights were taken at 1-week intervals on 3, 10, 17, 24, and 31 July and 7, 14, 21, and 28 August (9 sample dates).

Cotton flower monitoring (number of white flowers counted per 6-ft section treatment rows) was done for 18 sample dates, at 2-3 days intervals. Actual flower monitoring dates were 24, 26, 28, and 31 July, 2, 4, 7, 9, 11, 14, 16, 18, 21, 23, 25, 28, and 30 August, and 1 September 2023. Approximately 1-inch diameter size bolls (20 per plot) were collected from irrigation main-plot treatments at crop cut-out and measured for individual boll size, weight, and the pressure required to puncture the carpel wall of the boll using a penetrometer to determine the boll susceptibility to insect feeding as affected by irrigation treatments. Harvest-aid (a tank mix of Folex® 6 EC 16 oz/acre and Boll'd® 6SL 32 oz/acre) was applied on October 17 to terminate the crop. Test plots were hand-harvested on 2 November 2023. Hand-harvested yield samples were ginned, and the samples were sent to Cotton Incorporated for fiber analysis (HVI parameters).

2024 Study

Two thrips infestation treatments (thrips augmented versus spray-control or no-thrips) were deployed within each of the 9 main plot treatments (3 water level x 3 cover crop x 2 thrips treatments = 18 treatment units), each treatment replicated four times (total 72 plots). All no-thrips (control) plots were sprayed with Orthene 97 @ 5 g/l on 30 May 2024 to ensure that cotton seedlings were kept insect-free on control plots while thrips-augmented plots were allowed to receive thrips colonization. Pre-treatment thrips counts were done on 3 June 2024 and found that natural colonization of thrips was insignificant. Therefore, thrips densities were augmented by collecting thrips-infested alfalfa terminals from the adjacent field and releasing them at the base of the cotton seedlings to ensure a significant pest pressure in thrips-designated plots and to achieve quantifiable infestations and seedling damage. Thrips sampling was done again on June 12, 2024 (2-3 true leaf stage) and the control plots were sprayed with Orthene. Thrips damage rating was one on 14 June 2024. Thrips were sampled again on 18 June 2024 (4-5 true leaf stage) and the second damage rating was done on 21 June 2024. Plant heights were taken on 1, 8, and 15 July.

On 10 July 2024 (pre-flower stage), three plants per main treatment plot (3 water levels x 3 cover crop treatments x four replications) were pulled from the field along with the root and measured the root length, shoot length, and leaf area per plant. Individual plants were then dried to measure root, shoot, and leaf dry weight per plant. The residual soil nitrogen was measured at 0-6", 6-12", 12-18", and 18-24" depths using a soil applicator injection rig on 3 July 2024. The whole-plant biomass measurement was again done on 14 August 2024 (full-bloom stage), when plants entered boll maturation phase (7-8 bolls per plant), followed by the third whole-plant biomass measurement on 17 October (pre-harvest stage).

Cotton flower monitoring (number of white flowers counted per 6-ft section treatment rows) was done for 18 sample dates, at 2-3 days intervals. The actual flower monitoring dates were July 17, 19, 21, 23, 28, 30, August 3, 5, 7, 10, 12, 14, 17, 19, 21, 24, 26, 31. Plant heights were measured at weekly intervals for nine weeks (July 1, 9, 15, 22, 30, August 5, 12, 19, 26).

Harvest-aid (a tank mix of ETX® (Pyraflufen-ethyl) 1 oz/acre and Boll'd® 6SL 32 oz/acre) was applied on 22 October to terminate the crop, followed by Gramoxone® SL 2.0 @24 oz/acre on 30 October. Test plots were hand-harvested on 1 November 2024. Hand-harvested yield samples were ginned, and the samples were sent to Cotton Incorporated for fiber analysis (HVI parameters).

RESULTS

2023 Study

Harsh weather (excessive rain and sandstorms) during early season and extreme drought during the reproductive phase of cotton resulted in uncharacteristically low yield across all treatments in 2023. Thrips colonization was insignificant even with the augmentation of thrips during the seedling stage. Thrips densities remained <1 thrips per plant during the first four weeks of cotton growth stage. Thrips injury ranking was 1-3 (injury ranking at 1 to 5 scale, where 1 is cosmetic damage and 5 is plant terminal is completely dead) during the first 2-true leaf stage and 2-3 at 5-6 true-leaf stage. While not significant, dryland plots received more thrips injury compared to that on irrigated plots.

Plant growth was significantly influenced by irrigation treatment. Plants were taller in high irrigation plots throughout the growing season compared to that in dryland. While low irrigation plots had numerically shorter plants than in high irrigation plots, the heights between the two water treatments were not significant (Fig. 2). Cover crops did not significantly affect the plant height. Similarly, thrips augmentation did not impact on plant height. Because thrips densities were much below economic threshold, the injury they exerted was not expected to influence the plant height.

Irrigation treatments significantly impacted the flowering dynamics. The high irrigation plots began flowering earlier and greater number of flowers were observed in high irrigation plots until peak flowering stage (about second week of August). Flower initiation was delayed in dryland plots and the flower densities were the lowest of three irrigation treatments until crop reached the peak flowering stage (Fig. 3). Cover crops also influenced flowering patterns with fallow plots producing the lowest densities of flowers until the crop reached peak flowering stage and then the fallow plots produced the highest numbers (Fig. 3). This type of flowering pattern is a clear indicative of a lag in growth and reproductive phenology in fallow plots compared to that in terminated cover crop plots. While thrips densities and injury ratings were low, thrips augmentation plots showed slightly lower flower densities compared to no-thrips control plots.

As stated earlier, lint yields were low in 2023 and the variability in data was too high. Nevertheless, irrigation treatments showed a staircase effect on yield with increased lint yield for increased level of irrigation. On average, dryland, low irrigation and high irrigation plots produced 250, 511, and 626 lb/A lint, respectively (Fig. 4). The interaction of irrigation and cover crop treatments influenced the lint yield. Cover crops produced marginally higher yield in dryland compared to fallow plots, whereas fallow plots produced higher yield than cover crop plots under high irrigation. Thrips augmentation had no effect on lint yield.

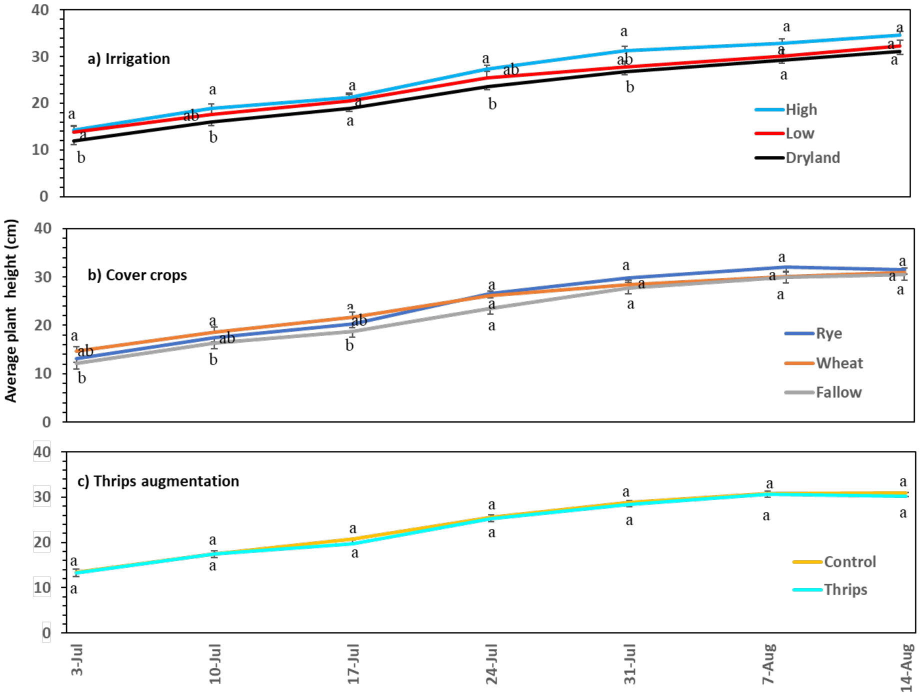


Figure 2. Temporal change in plant height (cm) as influenced by irrigation level, cover crop type, and thrips augmentation treatment ($p < 0.1$, LSD test), 2023.

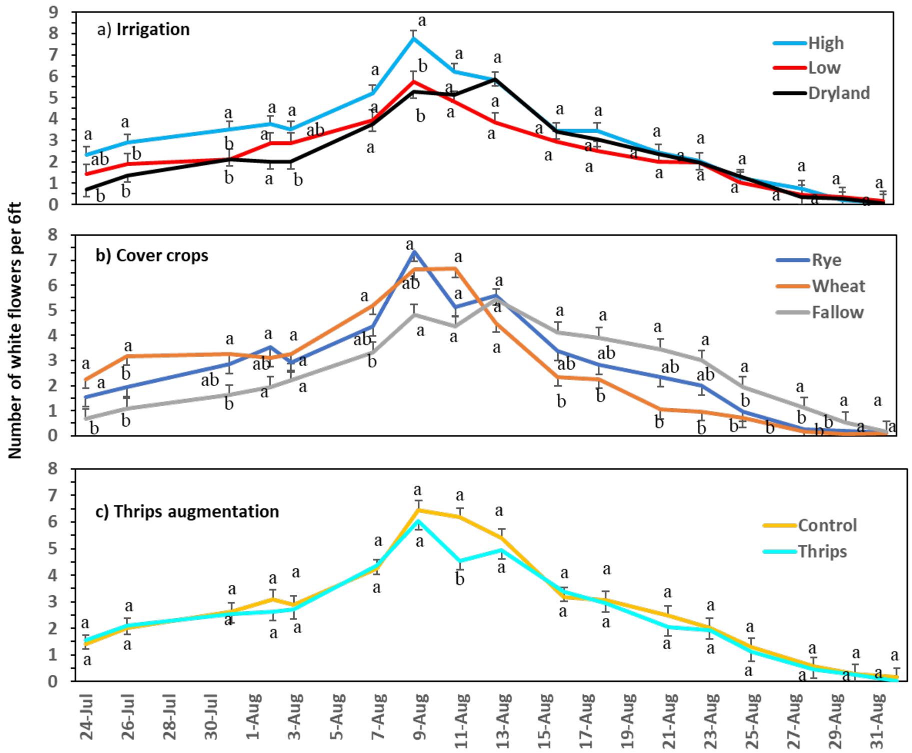


Figure 3. Average number of white flowers per 6-ft per sample date in cotton as influenced by irrigation level, cover crop type, and thrips augmentation treatment. Bars on the means are standard errors. Bars with different letters indicate a significant difference between treatments ($p < 0.05$, LSD test).

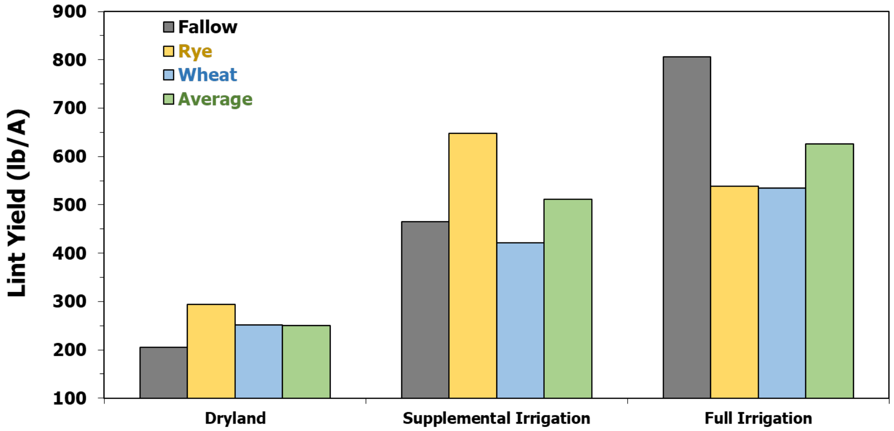


Figure 4. Average cotton lint yield (lb/A) as influenced by irrigation level and cover crop types, Lubbock, TX, 2023.

2024 Study

Natural thrips colonization was insignificant in 2024 crop season and the augmentation of thrips did not significantly increase the thrips abundance nor exerted the thrips-induced injury to the cotton seedlings. Thrips densities remained <1 thrips per plant during the first four weeks of cotton growth stage (cotyledon stage 0.6, 2-3 leaf stage 0.4, and 4-5 true leaf stage 0.6 thrips per 5-plant sample). While not significant, dryland plots received more thrips (0.8 thrips/sample) compared to that on irrigated plots (0.4 and 0.5 thrips/sample in low and high irrigation treatments, respectively). Cover crops also did not significantly influence the thrips colonization, but the fallow-planted cotton had more thrips nymphs (0.75 thrips per sample) compared to the two cover crop treatments (rye 0.58 and wheat 0.42 thrips per sample).

Plant growth was significantly influenced by irrigation treatment, but the frequent rain during the early growing season complicated the effect of irrigation treatments. As a result, the irrigation effect was more pronounced during the crop flowering stage and insignificant during the early growth stage of the crop. Similarly, the effect of irrigation became insignificant when plants matured to the harvest stage (Figs. 5-6).

The effects of different irrigation treatments (high, low, and dryland) on cotton growth across three growth stages: 5-6 square (pre-flowering), flowering, and pre-harvest stages indicated significant differences in some growth parameters while others showed no substantial variation.

Pre-flower (5-6 Square) Stage. At the 5-6 square stage (pre-flower stage), irrigation treatments showed no significant effect selected plant growth parameters as summarized below:

1. **Shoot Length**: The average shoot length was 16.34 cm with a low CV of 16.46%. ANOVA (F = 0.014, p = 0.986) revealed no significant effect of irrigation treatments on shoot length.
2. **Leaf Area**: The average leaf area was 240.36 cm² with a CV of 28.21%. ANOVA (F = 0.067, p = 0.935) showed no significant differences across irrigation treatments.
3. **Shoot Dry Weight**: Shoot weight averaged 0.99 g with a CV of 40.21%. ANOVA (F = 0.381, p = 0.686) showed no significant effect of irrigation treatments.
4. **Leaf Dry Weight**: The average leaf weight was 1.81 g with a CV of 28.42%. ANOVA (F = 0.533, p = 0.592) indicated no significant effect of irrigation treatments.
5. **Whole Plant Dry Weight**: The average whole plant weight was 3.62 g with a CV of 34.43%. ANOVA (F = 0.725, p = 0.492) showed no significant differences across treatments.

At pre-flowering stage, irrigation had significant effect on plant root growth. The dryland plots had significantly longer roots (18.6 cm) compared to that in low irrigation (17.4 cm) and full irrigation plots (16.2 cm) with a staircase effect of irrigation amount on root growth. The dryland plot seedlings appeared to invest more energy in root elongation in search of moisture while the roots were slenderer compared to that in irrigated plots. The similar root biomass, shoot length (plant height), and leaf area across three irrigation treatments during the pre-flower stage suggests that the irrigation onset during the early seedling stage is probably too early.

Flowering Stage. At the flowering stage, irrigation treatments had the most profound effect on plant height and leaf area growth while the plant biomass was not significantly influenced as summarized below:

1. **Shoot Length**: The average shoot length was 41.01 cm with a relatively low CV of 17.21%, indicating consistency across treatments. ANOVA results (F = 9.25, p = 0.000647)

showed a significant difference among the irrigation treatments, with the high irrigation treatment outperforming the low and dryland treatments.

2. **Leaf Area**: The average leaf area was 1143.16 cm² with a CV of 46.15%. ANOVA results (F = 3.465, p = 0.043) indicated a significant effect of irrigation treatments on leaf area, with high irrigation resulting in the largest leaf area.
3. **Shoot Weight**: The average shoot weight was 18.23 g with a high CV of 50.88%, suggesting variability among plants. ANOVA (F = 1.055, p = 0.359) indicated no significant differences in shoot weight across treatments.
4. **Leaf Weight**: Leaf weight averaged 13.14 g with a CV of 54.18%. ANOVA (F = 0.942, p = 0.4) showed no significant differences across treatments.
5. **Whole Plant Weight**: The average whole plant weight was 31.37 g with a CV of 45.17%. Similar to shoot and leaf weights, ANOVA (F = 1.204, p = 0.313) showed no significant effect of irrigation treatments.

Pre-harvest Stage. The effect of irrigation treatments became insignificant when the crop reached the pre-harvest stage.

1. **Shoot Length**: The average shoot length was 43.00 cm with a CV of 10.27%. ANOVA (F = 2.22, p = 0.125) showed no significant differences among the irrigation treatments.
2. **Leaf Area**: The average leaf area was 831.50 cm² with a CV of 38.37%. ANOVA (F = 1.014, p = 0.374) indicated no significant effect of irrigation treatments on leaf area.
3. **Shoot Weight**: The average shoot weight was 22.17 g with a CV of 36.35%. ANOVA (F = 0.231, p = 0.795) revealed no significant effect of irrigation treatments on shoot weight.
4. **Leaf Weight**: The average leaf weight was 10.72 g with a CV of 28.26%. ANOVA (F = 0.943, p = 0.4) indicated no significant differences in leaf weight.
5. **Whole Plant Weight**: The average whole plant weight was 32.89 g with a CV of 28.82%. ANOVA (F = 0.512, p = 0.604) showed no significant differences across treatments.

Irrigation treatments significantly impacted the flowering dynamics. The dryland plots began flowering earlier and greater number of flowers were observed in dryland plots until peak flowering stage (about second week of August). Flower initiation was delayed in dryland plots and the flower densities were the lowest of three irrigation treatments until crop reached the peak flowering stage (Fig. 7). This phenomenon is just the opposite of what we observed in 2023, a drier year. In 2024, frequent rain events during the early growing season likely water-logged the irrigated plots while the dryland plots had sufficient moisture to meet the water demand until plants entered the full reproductive phase (Fig. 7). After mid-August (coincided with the dry spell), irrigated plots increased flower production while the flowering activity declined in dryland plots. Cover crops also influenced flowering patterns with fallow plots producing the highest densities of flowers until the crop reached peak flowering stage and then the fallow plots produced the lowest numbers (Fig. 7). We suspect that the cover crop plots retained more rainwater and had an water-logged situation compared to that in fallow-planted cotton which slowed the reproductive activity until the dry spell returned in mid-August. At that time, cover crop plots produced significantly more flowers (fruits) than fallow-planted cotton. This type of flowering pattern is a clear indicative of a lag in growth and reproductive phenology due to crop growing conditions (cover crops, moisture, nitrogen, etc.). While thrips densities and injury ratings were low, thrips augmentation plots showed slightly lower flower densities compared to no-thrips control plots throughout the growing season.

Lint yields were lower than expected for the Southern High Plains. The lower lint yield was partly due to the incessant early rain events that delayed the seedling growth and compromised the plant stand. Nevertheless, irrigation treatments showed a staircase effect on yield with increased lint yield for increased level of irrigation. On average, dryland, low irrigation and high irrigation plots produced 275, 621, and 988 lb/A lint, respectively (Fig. 8). Cover crops marginally increased the lint yield but not significantly, with 565, 599, and 624 lb/A lint yield produced in fallow, wheat, and rye cover plots, respectively (Fig. 8). The interaction of irrigation and cover crop treatments influenced the lint yield (Fig. 9). There was much more variation in yield across various cover crop treatments in dryland and supplemental irrigation plots while the yield was more stabilized in full irrigation production regime (Fig. 9). Thrips augmentation had no significant yield reduction (thrips augmentation 584 lb/A and sprayed control 608 lb/A).

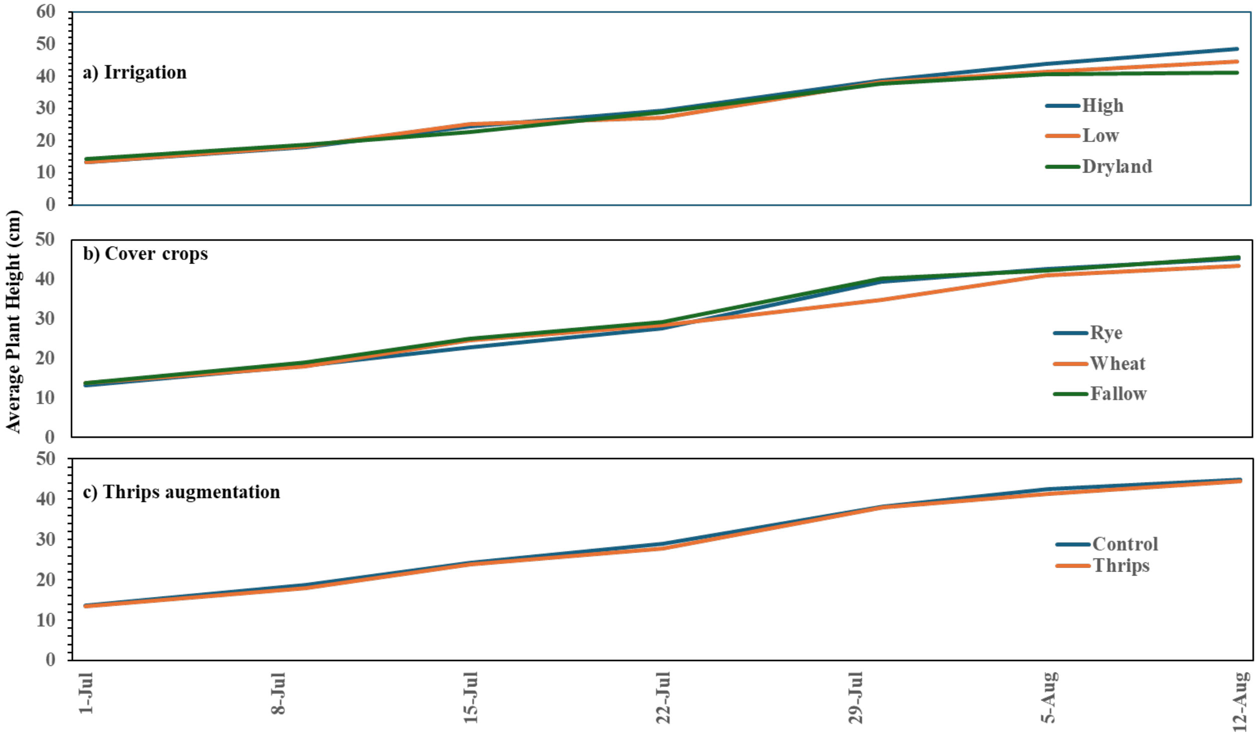


Figure 5. Temporal change in plant height (cm) as influenced by irrigation level, cover crop type, and thrips augmentation treatment, 2024.

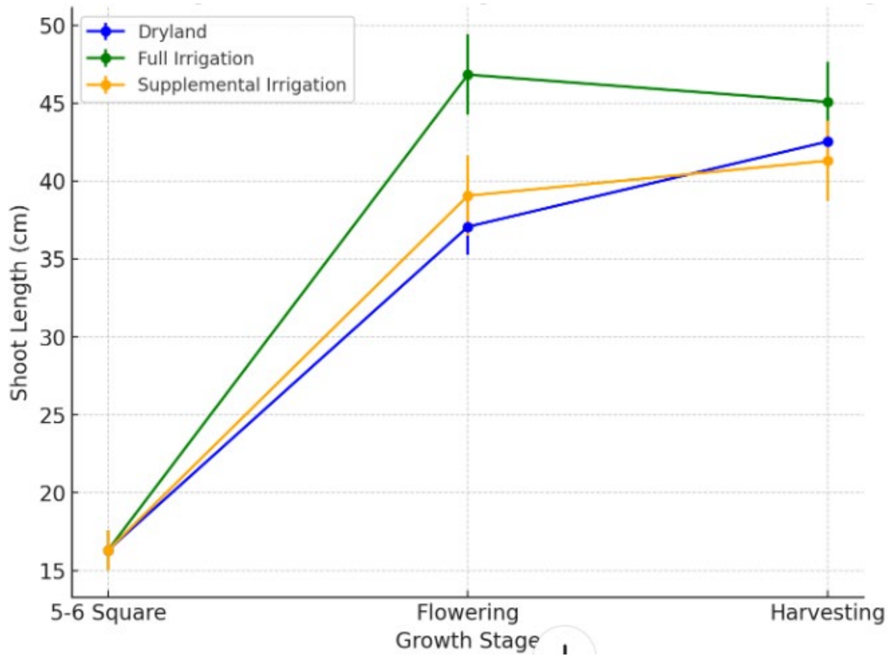


Figure 6. The effect of irrigation treatments (dryland, full irrigation, and supplemental irrigation) on plant height (shoot length) across different growth stages (5-6 square, flowering, pre-harvest).

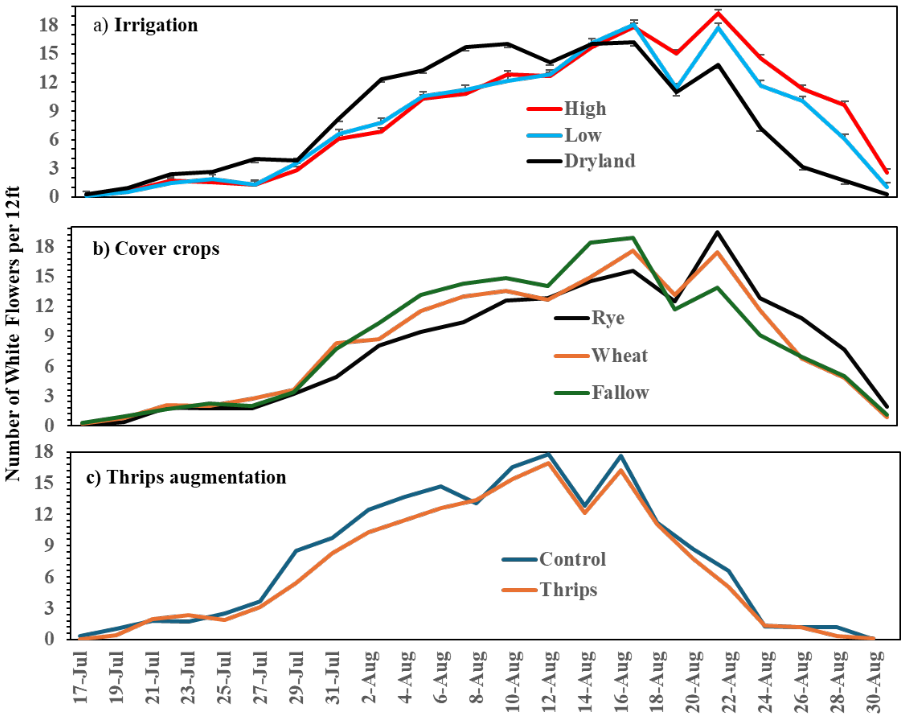


Figure 7. Average number of white flowers per 12-ft per sample date in cotton as influenced by irrigation level, cover crop type, and thrips augmentation treatment. Bars on the means are standard errors, where shown, 2024.

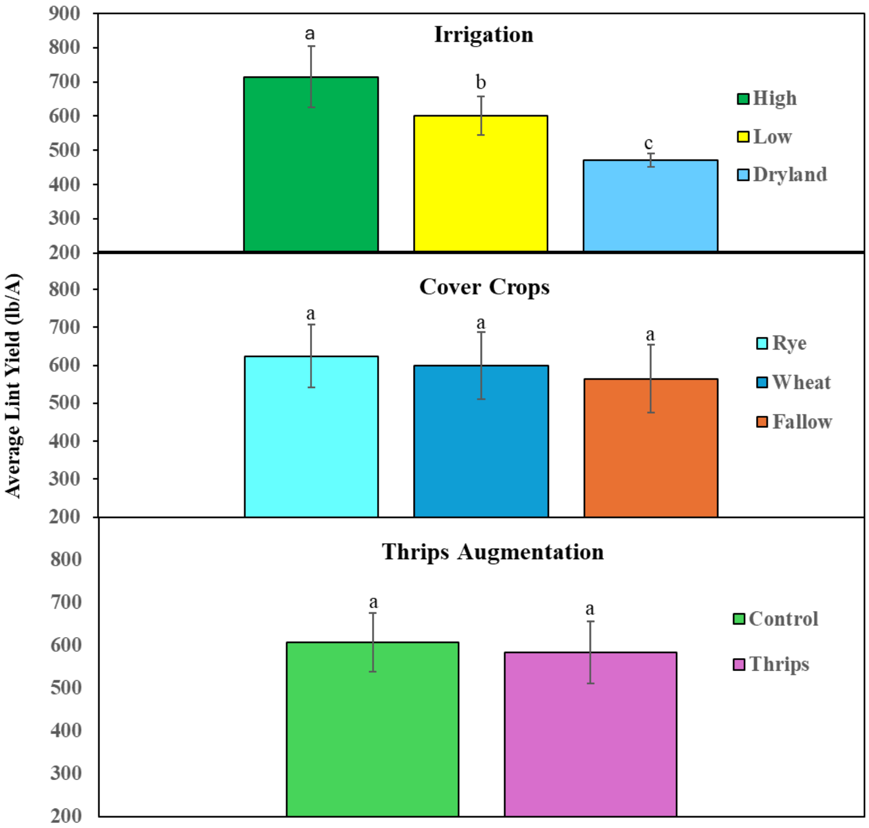


Figure 8. Average cotton lint yield (lb/A) as influenced by irrigation level, cover crop types, and thrips augmentation, Lubbock, TX, 2024.

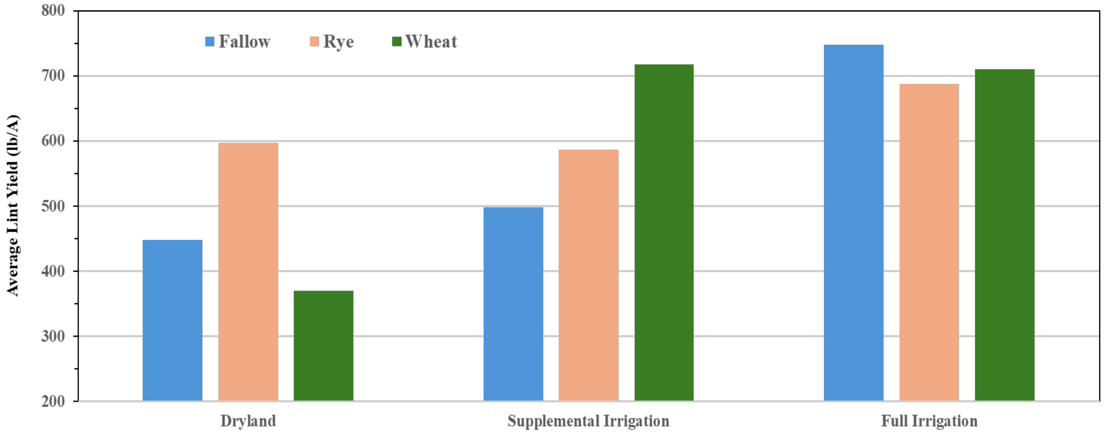


Figure 9. Average cotton lint yield (lb/A) as influenced by cover crop types within each of the three irrigation regimes, Lubbock, TX, 2024.

Acknowledgments

Research funding which facilitated this study came from Cotton Incorporated Texas State Support Committee. Raju Sapkota and Surendra Gautam provided technical help.

Cotton fleahopper overwintering host plants and spring emergence in the Texas High Plains

Cotton Incorporated – Core Program
Project Number: 24-131
PI: Megha N. Parajulee

PROJECT SUMMARY

The cotton fleahopper (CFH) is frequently encountered in cotton in most cotton-growing states, but it is considered a significant pest in Texas cotton. Injury by cotton fleahoppers to squaring cotton often causes excessive loss of small squares during the early fruiting period of plant development. Squares up to pinhead size are most susceptible to damage, and yield loss is most likely from feeding during the first three weeks of fruiting. CFH damage also delays crop maturity and thus increases the vulnerability of cotton to late season pests such as Heliothine caterpillars and *Lygus* bugs, particularly when natural enemies are destroyed by insecticides directed against CFH. At least 160 plant species in 35 families including pinkladies, prairie coneflowers, horsemint, silverleaf nightshade, and woolly croton are hosts for CFH. Large number of potential CFH host plants occur in the Texas High Plains agroecosystems, but information on the diversity, distribution, and abundance of these host plants in supporting CFH populations in the High Plains is lacking. Also, the timing of CFH emergence and the relationship between the prevalence of overwintering hosts in the region and the abundance of CFH colonization in Texas High Plains cotton are not clearly understood. The objectives of this study were to 1) Evaluate the diversity and abundance of potential cotton fleahopper overwintering host plants in the Texas High Plains, and 2) Identify cotton fleahopper risk areas within the Southern High Plains and establish relationship between overwintering host prevalence in the region and cotton fleahopper colonization risks in cotton.

The study began with a survey of potential CFH overwintering sites in Lubbock, Hockley, Hale, and Swisher counties. Potential CFH overwintering host plants were collected from a total of seven sites across these four counties and these host substrates were exposed to optimum moisture-temperature regime for CFH egg hatch and nymphal emergence if these host plants supported the CFH overwintering. Unfortunately, none of the host substrates resulted in any CFH nymphal emergence. Periodic monitoring of possible CFH activities in the areas where potential overwintering plants had been collected did not result in any CFH. Except for Swisher and Hale County locations, CFH were not observed in cotton adjacent to those host substrate collected sites. It is speculated that the 2023 summer in Texas being the second hottest summer in history was responsible for the lack of CFH overwintering hosts in the fall of 2023 that resulted in insignificant CFH activities in 2024 crop season. We expect improved CFH host availability and CFH activity in 2025.

In addition, we conducted CFH simulated studies in four counties – Hale, Crosby, Terry, and Gaines – that covered the most diverse cotton production regions within the Texas High Plains. Here, we evaluated 3-4 cultivars at each location with simulated CFH and Lygus injury and cotton response to the simulated injury. The first-year results are quite interesting and impactful for producers. For 2025, I plan to add this as the third objective of the study on the project.

Project Description

Cotton fleahopper overwintering host plants and spring emergence in the Texas High Plains

Megha N. Parajulee
Texas A&M AgriLife Research and Extension Center, Lubbock, Texas

Introduction

The cotton fleahopper, *Pseudatomoscelis seriatus* (Reuter) is frequently encountered in cotton in most cotton-growing states, but it is considered pestiferous primarily in Texas. In Texas, the cotton fleahopper is more prevalent in the Coastal Bend and Brazos Valley but is an equally important economic pest on the Texas High Plains, Rolling Plains, and in the Trans-Pecos region. Injury by cotton fleahoppers to squaring cotton often causes excessive loss of small squares during the early fruiting period of plant development. Generally, cotton is affected by cotton fleahopper injury from about the fifth true leaf through the first week after initiation of flowering. Squares up to pinhead size are most susceptible to damage, and yield loss is most likely from feeding during the first three weeks of fruiting. Cotton fleahopper damage also delays crop maturity and thus increases the vulnerability of cotton to late season pests such as Heliothine caterpillars and *Lygus* bugs, particularly when natural enemies are destroyed by insecticides directed against cotton fleahoppers. While cotton fleahoppers can significantly reduce the cotton lint yield, timing of cotton fleahopper infestation and cotton cultivar and inputs (e.g., irrigation and fertility) could affect the severity of damage and the compensatory response of the plant to injury (Chen et al. 2007, Knutson et al. 2013). Several field research projects in our program elucidated the field ecology in relation to cotton cultivar, irrigation, and fertility and developed management strategies against the cotton fleahopper. We have also developed a successful rearing method to allow mass production of cotton fleahoppers for augmentative release studies or to facilitate screening of the large number of potential fleahopper overwintering host plants (Hakeem and Parajulee 2015).

At least 160 plant species in 35 families including pinkladies, *Oenothera speciosa* Nutt.; upright prairie coneflower, *Ratibida columnifera* (Nutt.) Woot. & Standl.; horsemint, *Monarda punctata* L.; silverleaf nightshade, *Solanum elaeagnifolium* Cavanilles; and woolly croton, *Croton capitatus* Michx. are hosts for the cotton fleahopper (Snodgrass et al. 1984, Esquivel and Esquivel 2009). In central Texas, woolly croton is a host of cotton fleahoppers throughout the growing season and for overwintering eggs (Almand 1974). In late fall, cotton fleahoppers lay eggs that overwinter on host plants until early spring. Warm temperatures and spring rainfall events activate diapaused eggs to emerge as nymphs. In a laboratory, Saunders (1983) terminated diapause by controlled temperature, light, and moisture. Despite its intriguing overwintering biology and host-associated differentiation (Barman et al. 2012), information is limited on the ecology of cotton fleahopper overwintering in a semi-arid environment such as the Texas High Plains. Large number of potential cotton fleahopper host plants occur in the Texas High Plains agroecosystems, but information on the diversity, distribution, and abundance of these host plants in supporting cotton feahopper populations in the High Plains is lacking. Also, the timing of cotton fleahopper emergence and the relationship between the prevalence of overwintering hosts in the region and the abundance of cotton fleahopper colonization in Texas High Plains cotton are not clearly understood.

The recent increase in limited-irrigation cotton production in the Texas High Plains has demanded development of pest management strategies at low-input production system. Cotton fleahoppers can be injurious to cotton during 3-weeks of squaring until about the appearance of first flower. Our recent Cotton Inc. funded project characterized that the impact of cotton fleahoppers on pre-squaring stage, especially when fleahoppers migrate to cotton prior to the occurrence of visible squares, is significant. Therefore, understanding the prevalence of cotton fleahopper host source risks and colonization potential of cotton fleahoppers in pre-square cotton prior to visible squares can be highly valuable information for our cotton producers. This project aims to investigate the potential cotton fleahopper host source, cotton fleahopper emergence from overwintered hosts, and the cotton fleahopper colonization risks in cotton. The outcome of this project should provide useful information for producers and consultants in cotton fleahopper management. Specific objectives of this project were to: 1) Evaluate the diversity and abundance of potential cotton fleahopper overwintering host plants in the Texas High Plains, and 2) Identify cotton fleahopper risk areas within the Southern High Plains and establish relationship between overwintering host prevalence in the region and cotton fleahopper colonization risks in cotton.

Methodology and Results

Objective 1. Evaluate the diversity and abundance of potential cotton fleahopper overwintering host plants in the Texas High Plains. The study consisted of surveying potential cotton fleahopper overwintering host plants in Lubbock, Hockley and Hale counties in the Texas Southern High Plains. In each County, 4-5 most prevalent species of cotton fleahooper host plant substrates were identified, and 8-10 lb. of clean, dry substrate material for each host plant were collected around mid-March and stored at 4ºC in a walk-in cooler for 3-4 months. On July 1, collected substrates (4 oz. per unit) were placed in cylindrical 1-gallon tin metal containers. Both ends of the rearing container were covered with coarse-mesh aluminum window screen to hold the substrate in place yet allowed newly emerged cotton fleahopper nymphs to exit from the rearing substrate. Another layer of muslin cloth was placed on top of the first screen and secured by a rubber band to enclose newly emerged fleahopper nymphs until shaking to dislodge them from the substrate. The moisture regime used to terminate diapause and facilitate the nymphal emergence from the substrate consisted of 2-hour initial soaking followed by 30-minute soaking for the next 7 days and thereafter mist spraying daily. The rearing room was maintained between average daily cool and warm temperatures of 25 and 34ºC and a photoperiod of 12:12 light:dark hours to mimic ambient temperature fluctuation during late spring/early summer in the Texas High Plains. Temporarily removing the muslin cloth and shaking the rearing cans allowed dislodging the emerging nymphs from the substrate and was continued the experiment until no new nymphs emerged from the can for three consecutive days (about four weeks). If the nymphs did not emerge from any of the samples, they were kept for 3 weeks for possible delayed emergence. Rearing cans were shaken daily by beating the sides of the cans 12 times at 2-second intervals to dislodge nymphs onto a white poster board. The protocol for dislodged nymphs would be to count and transfer into small plastic containers and feed green beans, but no emergence occurred in our study in 2024.

Objective 2. Identify cotton fleahopper risk areas within the Southern High Plains and establish relationship between overwintering host prevalence in the region and cotton fleahopper colonization risks in cotton. Visual samplings were conducted to determine CFH densities in cotton at four historically CFH prevalence sites within each county at 7-10 days intervals (2-3 samples per site per season) during CFH susceptible stage of cotton (4-7 weeks from cotton germination; late June to mid-July). A simultaneous survey was conducted in late June to mid-July within a mile radius of each cotton fleahopper sampling sites within each county to determine the diversity and abundance of 5-6 prominent cotton fleahopper hosts that contributed to cotton fleahopper colonization in cotton.

Objective 3 (NEW). Evaluate the effect of single acute infestation of CFH and Lygus and a sequential infestation of CFH followed by Lygus via simulated studies across four potential CFH prevalent areas in the Texas High Plains. Because the 2024 study did not result in expected CFH activity in the field, we conducted a simulated CFH-Lygus study in four counties – Crosby, Hale, Terry, and Gaines (Fig. 1). This study utilized the four selected fields of the Texas A&M AgriLife Extension Replicated Agronomic Cotton Evaluation (RACE) trial. The four sites are indicated by bold blue-white arrows.

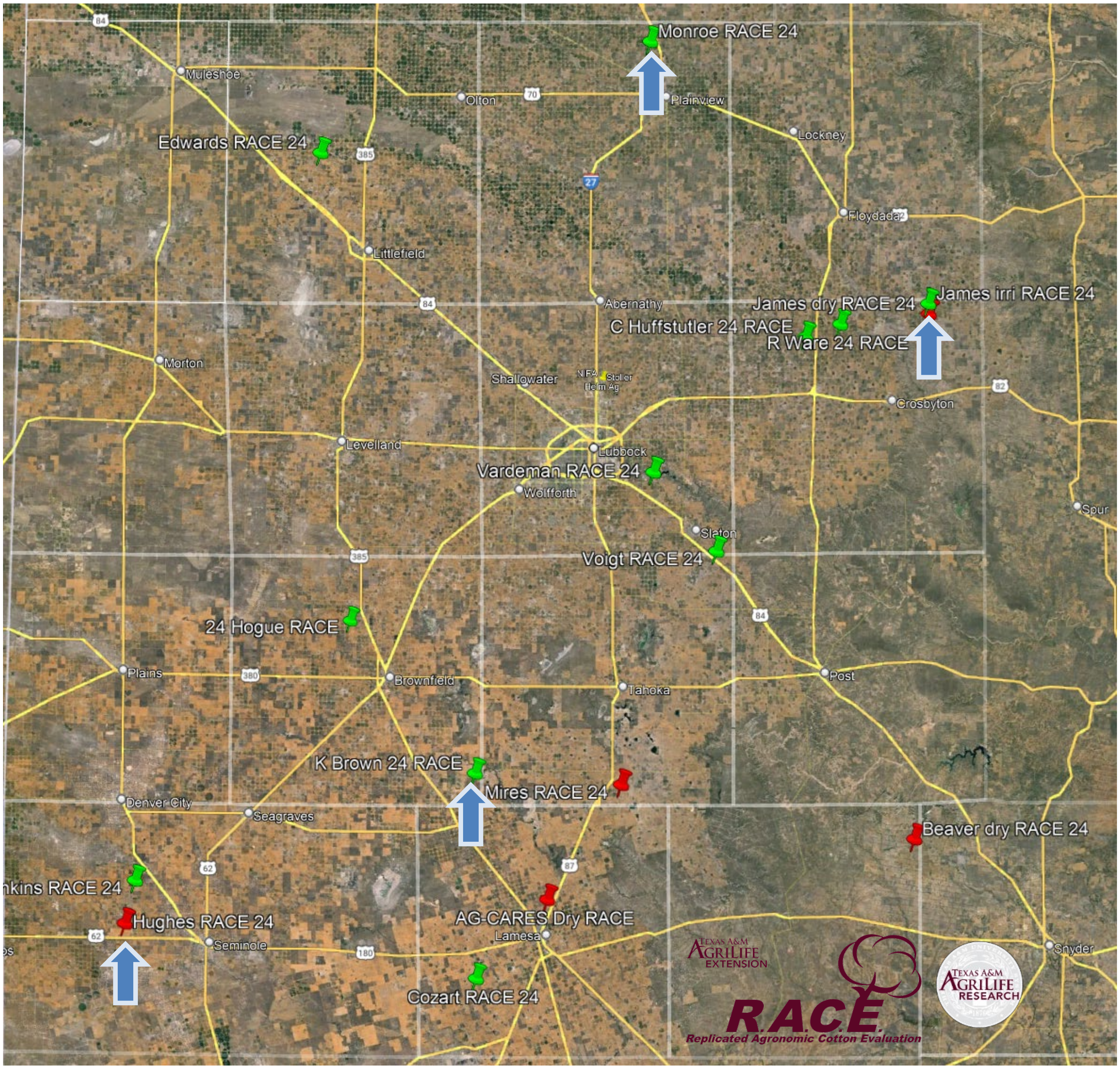


Fig. 1. Simulated cotton fleahopper and Lygus studies at four select sites in the Texas High Plains.

Cotton compensatory response to simulated fruit loss in relation to cultivar maturity and cotton production sites were evaluated by overlaying this study on the existing large scale RACE trial in the Texas High Plains. We selected four distinct locations to capture the site variation (soil fertility, soil type, irrigation, and varying management practices). We examined four cultivars in Crosby Co. (DP2335B3XF, FM765AX, FM868AXTP, PHY332W3FE) and three cultivars each in Terry Co. (DP2335B3XF, FM765AX, FM868AXTP), Hale Co. (DP2335B3XF, FM765AX, FM823AXTP), and Gaines Co. (PHY475W3FE, PHY443W3FE, PHY332W3FE). We tried to utilize the same or very similar cultivars at Crosby, Hale, and Terry counties to compare cultivar performance with respect to simulated injury by CFH and Lygus. However, Gaines Co. only had Phytogen cultivars, so we used Crosby Co. to compare selected Phytogen cultivars.

The experiment consisted of four simulated fruit loss events [1) control, 2) pre-flower 100% square removal mimicking the cotton fleahopper injury-induced loss, 3) 20% small fruit (<3 cm diameter) removal mimicking the Lygus boll injury-induced small fruit abortion right before cut-out, and 4) a sequential removal of 100% square removal at pre-flower stage mimicking the cotton fleahopper injury-induced loss followed by 20% small fruit (<3 cm diameter) removal mimicking the Lygus boll injury-induced small fruit abortion right before cut-out], replicated three times.

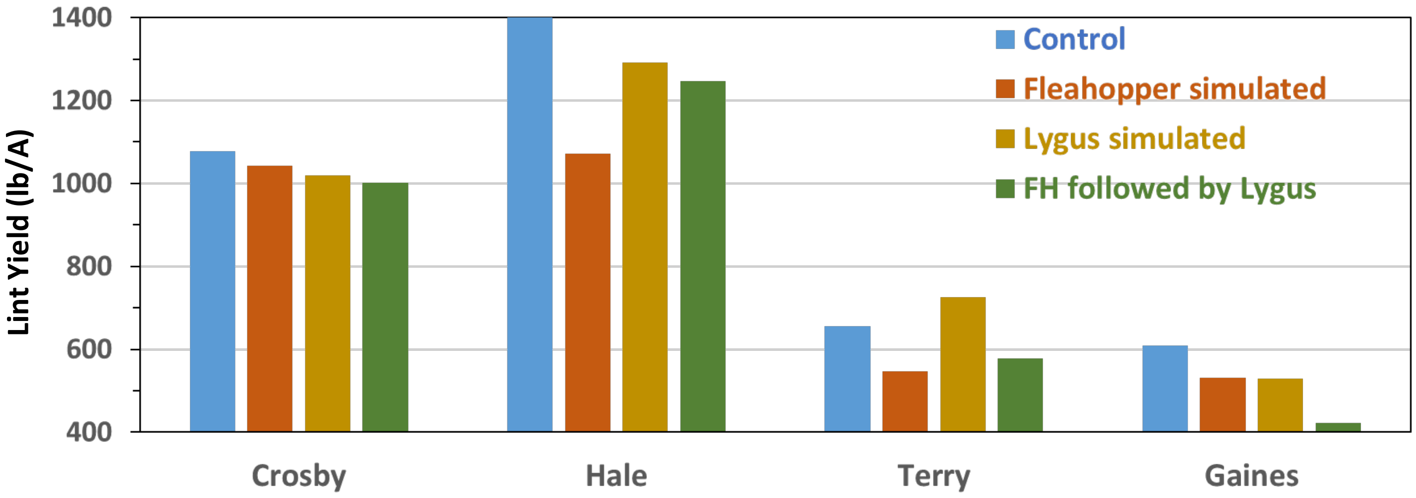


Fig. 2. Cotton response to simulated cotton fleahopper and Lygus damage across four Texas High Plains locations. These results are averaged over 3 or 4 cultivars. The cultivar differences are being analyzed and will be presented in next year's report.

Crosby County – Crosby Co. study was characterized as a moderate yield (1100 lb/A) location with good irrigation. Cotton compensated for single CFH and Lygus injury with insignificant reduction in lint yield, whereas the sequential simulated injury reduced ~100 lb/A lint yield.

Hale County – Hale County location is characterized as a high yield production system with high input drip irrigation system. The average production on this trial was 1400 lb/A. At high-yield condition, single acute infestation of CFH reduced lint yield significantly (>300 lb/A). Single episode of Lygus infestation that simulated the loss of 20% small bolls caused about 100 lb/A yield loss. However, the sequential simulated infestation of CFH and Lygus reduced the lint yield by about 150 lb/A. We argue that the massive square loss due to CFH simulation delayed the maturity of the compensatory fruits that resulted in a significant lint yield loss on CFH single injury event. However, the sequential simulation injury removed those immature fruits and allowed the yield to recover, thereby achieving a higher yield in sequential CFH-Lygus injury than on single CFH injury. We plan to repeat this study this year to ascertain our hypothesis.

Terry County – Terry County is a low production system with low fertilizer input and supplemental irrigation. The average yield was 650 lb/A. CFH was a significant yield reducer in a low yield production system. However, the late season pruning of small bolls resulted in overcompensation and increased the lint yield. The positive influence of Lygus is also reflected in the sequential simulated injury treatment.

Gaines County – This is another low yield production system with 600 lb/A average lint yield across the study location. Here, CFH and Lygus individually reduced some yield, but the sequential simulated injury significantly reduced lint yield (~200 lb/A). The yield level was similar between Terry and Gaines counties, but the cotton response to same sets of simulated injuries varied significantly. This phenomenon will be closely observed in 2025.