

EFFECT OF IRRIGATION REGIMES ON INSECT POPULATIONS IN TEXAS HIGH PLAINS COTTON

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Abstract

Influence of irrigation application rates and irrigation application methods on cotton insect populations were studied in Texas High Plains during 2002. Cotton pests, including *Lygus* bugs and cotton fleahoppers, and beneficial arthropods were sampled. Three irrigation application rates, 50%, 75% and 100% evapotranspiration (ET) replacements, were evaluated. The two irrigation application methods evaluated were low energy precision application (LEPA) system and low elevation spray application (LESA) system. Four commercial cotton cultivars, ST2454R, PM2326RR, ST4793R and DP5415RR were evaluated. Insect populations were sampled using a vacuum sampler. Insect numbers were higher in LEPA irrigated plots than in LESA irrigated plots. Overall, insect numbers were higher at 75% ET replacement followed by 100% and 50%, respectively. The cultivar PM2326RR had the highest *Lygus* and fleahopper numbers and lowest predators compared with the other three cultivars.

Introduction

Texas High Plains is the world's most concentrated cotton producing region with over three million acres harvested and over three million bales of cotton lint produced per year. Texas State reported a cotton yield loss of 3.63% due to arthropods in the year 2001; *Lygus* and fleahoppers accounted for 0.21% and 0.13% of the total insect pest loss, respectively. Potential factors influencing the insect population abundance and activity in cotton include cotton cultivar, planting date, fertility rate and irrigation management. Generally, insect populations are greatest at higher plant densities and with more frequent irrigation (Leigh et al 1974). The influence of irrigation regimes on behavior and ecology of cotton arthropods has not been clearly understood. Lack of information on arthropod ecology as affected by cultural management practices has hindered the systems approach to cotton pest management. The overall objective of this study was to evaluate the influence of irrigation application rate, irrigation application method, and selected cotton cultivars on arthropod abundance patterns in cotton.

Materials and Methods

The study was conducted in 2002 at Western Peanut Growers Farm, Gaines County, Texas. The experimental design was a randomized block design with four replications. The plots were 16 rows wide with 36-inch row spacing. The study comprised of two main treatments in two spans (i.e. irrigation application rate and irrigation application method) under a quarter-mile center pivot system. In one span irrigation application rates targeting 50% (severe deficit), 75% (moderate deficit) and 100% (full irrigation) evapotranspiration replacement were applied through low energy precision application (LEPA) system. In the other span two irrigation application methods, low energy precision application (LEPA) system and low elevation spray application (LESA) system were used and the 75% evapotranspiration replacement was maintained throughout the span. Base irrigation treatment was a target of 75% crop evapotranspiration replacement, with approximately 1.5 to 1.7 inches per week, split into twice weekly applications. Four cotton cultivars ST2454R, PM2326RR, ST4793R and DP5415RR were evaluated under the 75% ET LEPA irrigation system, while cultivar PM2326RR was used to evaluate ET levels and irrigation methods. Cotton was planted on June 6, 2002. The field received 9.5 inches of pre-season irrigation. Fertilizer was applied at the rate of 80 lbs nitrogen per acre.

Arthropods were sampled using a 2-cycle backpack vacuum sampler (Model 1612, J. W. Hock Company, Gainesville, FL). Sample unit consisted of approximately 100 row ft sampled with a 30-second vacuum time per plot per week. Sampling was done weekly from July 10 to September 27, 2002. Vacuum sample counts were converted to numbers per acre. Data were analyzed using ANOVA and mean comparisons were performed with LSD (SAS system 2000).

Results and Discussion

Two pest species, *Lygus* and cotton fleahoppers, and beneficial arthropods including *Orius* sp., big eyed bug, assassin bug, ladybird beetle, green lacewing, *Collops* sp., hooded beetle and spiders were sampled from the field. Predaceous bugs including *Orius* sp., big-eyed bug, assassin bug and green lacewing were abundant throughout the season.

Influence of Irrigation Application Rate

The *Lygus* species complex included *Lygus hesperus* and *Lygus elisus* in approximately equal numbers. Therefore, we report the total number of *Lygus* combined over two species in this article. Overall, *Lygus* numbers were very low in the southern

Texas High Plains in 2002 (Table 1). Nevertheless, *Lygus* abundance varied with irrigation water levels. Average *Lygus* numbers were significantly higher in 75% and 100% ET replacement plots than in 50% ET replacement plots (Table 1). The cotton fleahopper numbers followed the same trend as *Lygus*. That is, average numbers of fleahoppers were higher in 75% and 100% ET replacement plots than in 50% ET replacement plots.

Abundance of predaceous bugs increased with increase in ET level. Green lacewing numbers were higher at 75% ET level, but the numbers were similar between 100% and 50% ET levels. Total beneficial arthropods (all predators combined) were also higher in 75 and 100% ET plots compared with that in 50% ET plots (Table 1).

Effect of Irrigation Application Method

Lygus abundance was significantly affected by irrigation method (Table 2), with LEPA irrigation method supporting significantly higher abundance of *Lygus* compared with the LESA irrigation method. We speculate that the overhead spray irrigation method (LESA) negatively affected the recolonization of *Lygus* on the upper canopy that resulted in lower vacuum sample counts; vacuum sampler generally samples the upper canopy of cotton. Cotton fleahoppers showed the same trend as *Lygus*. LEPA irrigated plots had more fleahoppers compared with that in LESA irrigated plots (Table 2). Abundance of total beneficial arthropods was higher in LEPA irrigated plots compared with that in LESA irrigated plots. The predaceous bugs and green lacewing dominated the trend of total predator abundance.

Influence of Cotton Cultivars

The cotton cultivar PM2326RR had the highest *Lygus* and fleahopper numbers and the lowest beneficial arthropod numbers compared with the other three cultivars, ST2454R, ST4793R and DP5415RR (Fig. 1-3). The higher abundance of plant bugs in PM2326RR could be attributed to the lowest amount of leaf trichomes in this cultivar compared with other three cultivars.

In summary, both the pest species and beneficial arthropods were more in LEPA irrigated plots compared with that in LESA irrigated plots indicating that overhead spray of water decreased insect colonization in cotton canopy (Table 2). Insect populations were higher at moderate and full irrigation plots compared with that in deficiently irrigated plots (Table 1).

Acknowledgement

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Table 1. Seasonal average numbers of *Lygus*, fleahopper and beneficial arthropod abundance at different irrigation application rates.

Insect Species	Different Evapotranspiration replacement levels		
	50%	75%	100%
<i>Lygus</i> spp	21	42	38
Fleahoppers	3515	4140	3710
Predaceous bugs	277	527	577
Green lacewing	595	1081	500
Beneficial arthropods	1168	1882	1317

Table 2. Seasonal average numbers of *Lygus*, fleahoppers and beneficial arthropods as affected by irrigation application methods.

Insect Species	Different irrigation application methods	
	LEPA	LESA
<i>Lygus</i> spp	42	12
Fleahoppers	4140	3151
Predaceous bugs	527	334
Green lacewing	1081	402
Beneficial arthropods	1883	987

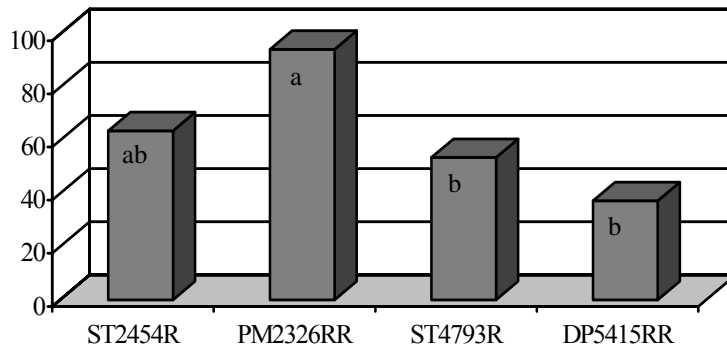


Figure 1. Influence of selected cotton cultivars on *Lygus* abundance.

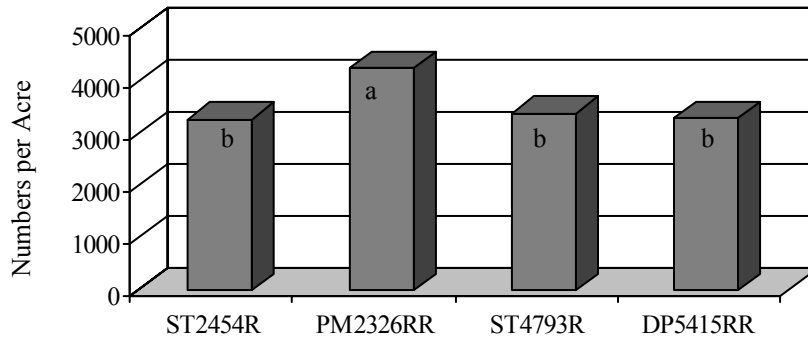


Figure 2. Influence of selected cotton cultivars on fleahopper abundance.

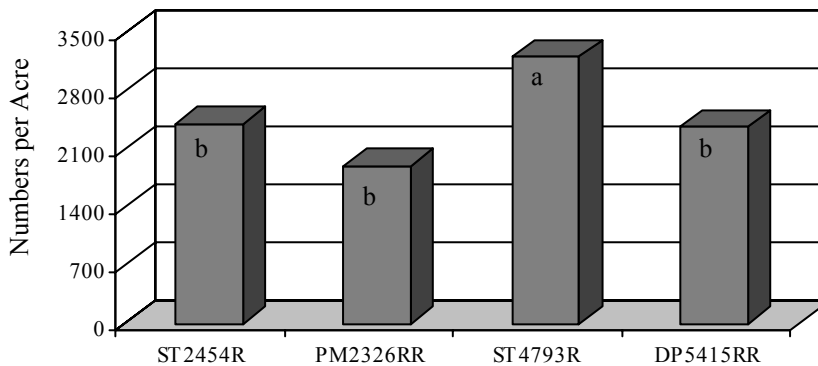


Figure 3. Influence of selected cotton cultivars on beneficial arthropod abundance.