COMPENSATION OF LYGUS-INDUCED FRUIT LOSS IN DRIP-IRRIGATED COTTON

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Abstract

Previous Texas High Plains research on the cotton plant's ability to compensate for early fruit loss indicated that 40-50% pre-flower square loss achieved through manual removal of pinhead squares could be fully compensated for lint yield and quality. Recent research also indicated that insect-induced early fruit loss could also be compensated, but at a much lower level than that for manual removal. However, the plant's ability to compensate insect-induced fruit loss may depend on soil moisture, other input variables, and overall plant vigor. The objective of this study was to quantify the compensatory ability of cotton to insect-induced fruit loss in a high input production system utilizing subsurface drip irrigation. Experiment consisted of four *Lygus* augmentation treatments [3 *Lygus* bugs per plant (3PP), 1 *Lygus* per plant (1PP), natural control or untreated control (UC), and spray control with no *Lygus* augmentation (SC)] to generate four levels of fruit loss during pre-flower and early flower stages, and all potential plant growth and reproductive parameters were measured. Preliminary results of the study suggested that the plant could compensate pre-flower square loss slightly better (25-30%) than the early flower fruit loss (20-25%) when environmental conditions were favorable. If conditions were not favorable, 25-30% of the fruit will be shed physiologically, therefore an insecticide intervention to save early squares may not be necessary. Consequently, it is important to consider plant compensation potential, input variables (fertility, moisture), and environmental stress while making insect management decisions. However, control costs and efforts to protect less than a 30% and 20% fruit shed during early squaring and during early flowering, respectively, may not be necessary under full irrigation production in the Texas High Plains region.

Introduction

A three-year study evaluating the compensation capacity of cotton grown in the southern Texas High Plains using manual square removal treatments ranging from 0-100% indicated irrigated cotton could lose 100% of first position squares with no loss in yield or fiber quality (Leser et al. 2004). Dryland cotton could lose 50% with no significant impact on yield or fiber quality. The current recommended pre-flower management approach places an emphasis on early square protection with a cumulative retention level of 75% after three weeks. Clearly this is higher than what the compensation study indicated. If cotton plants can truly compensate for loss levels exceeding 25% during the first three weeks of squaring, then action thresholds could potentially to be elevated based on the study of Leser et al. (2004). However, the plant's response to mechanical injury is expected to be different from that of insect-induced injury. Barman et al. (2007) reported that cotton was unable to fully compensate a 30% *Lygus*-induced pre-flower square loss under limited irrigation production in the Texas Southern High Plains, whereas they showed that the plants fully compensated a 25% fruit loss that occurred during the early flowering stage of cotton. Further research in our program clearly demonstrated that the efforts to protect less than a 30% and 25% fruit shed during early squaring and during early flowering, respectively, may not be necessary in the Texas High Plains region (Parajulee 2008). The objective of this study was to evaluate the compensation of *Lygus*-induced fruit loss in a high input, full-irrigation production system in the Texas Southern High Plains.

Materials and Methods

The experiment was conducted at the Texas AgriLife Research farm north of Lubbock, Texas during 2006 and 2007. Cotton cultivar ST 4554B2RF was planted in a drip irrigated field on 15 May 2006 and 6 June 2007. Irrigation schedule for the growing season was set to follow the standard drip irrigation management for the Texas High Plains. Over a period of time, liquid 32-0-0 (N-P-K) fertilizer was fed through the irrigation system until a cumulative 150 lb/acre of nitrogen was applied. Experimental plots were 8 rows wide x 50 ft long with a 2-row buffer and 5 ft alleys separating the plots. The two center rows were selected in each plot for *Lygus* bug treatments, plant monitoring and harvesting.

The study consisted of two experimental blocks in which two different phenological stages of cotton (one per block) including pre-bloom (first three weeks of squaring) and early-bloom (first three weeks of blooming) were exposed to augmentative *Lygus* bug releases in order to inflict fruit loss. There were four treatments: 1) Sprayed control (SC), plots were sprayed at regular intervals with Intruder at 0.6 oz/acre to exclude naturally infesting bugs; 2) Untreated control (UC), plots were not sprayed and no bugs were released; 3) Plots receiving 1 bug per plant (1PP) per release; and 4) Plots receiving 3 bugs per plant (3PP) per release. The four different treatments (SC, UC, 1PP and 3PP) were assigned randomly to plots with four replications. Three consecutive releases were made for each phenological stage of the crop. Detailed plant monitoring was conducted, using the SQUAREMAN component of the COTMAN plant monitoring program, prior to each release and one week following the final release. Data on plant height, number of nodes, yield and fiber quality parameters were recorded and subjected to statistical analysis (SAS Institute 2003).

Results and Discussion

Pre-Flower *Lygus* Release. Average fruit retention in the "bug free" SC treatment was >90% first week into the bloom stage (Fig. 1). Overall, bug-augmented plots had higher fruit shed rate compared with SC or NC plots, with significantly higher fruit shed rate in 3PP followed by 1PP and the lowest shed rate in control plots (Fig. 1). After three consecutive releases of *Lygus,* we achieved 25, 15, 9, and 7% (2006) and 33, 29, 14, and 9% (2007) square loss in 3PP, 1PP, UC, and SC treatments, respectively (Fig. 1). Final plant mapping showed no significant differences in the number of harvestable bolls per plant across the four treatments in 2006 while the 3PP treatment had marginally fewer harvestable bolls than the control plots in 2007, indicating that the 33% pre-flower fruit loss in 3PP treatment was severe enough that plants were unable to fully compensate the loss (Fig. 2). The harvestable boll load per plant generally corresponded with the total lint yield across treatments, with no significant yield variation among treatments in 2006 and lower total lint yield in 3PP plots compared with other treatments in 2007 (Fig. 3).

Early Flower *Lygus* Release. Fruit retention was around 95% across all treatments until the initiation of the first flower. Weekly spray applications maintained this level of fruit retention in SC plots four weeks into flowering. One week after the three weeks of consecutive bug release events, plant mapping showed 20, 16, 8, and 5% (2006) and 26, 20, 13, and 8% (2007) of the fruit loss in 3PP, 1PP, UC, and SC treatments, respectively (Fig. 4). Despite a significant variation in shed rates four weeks into flowering, pre-harvest boll loads (number of harvestable bolls per plant) were statistically similar across treatments in both years (Fig. 5). Nevertheless, the pre-harvest boll load numerically declined with increased in-season fruit loss (SC, UC, and 1PP in that order) and then increased for 3PP (Fig. 5), suggesting a possible "overcompensation" response of the plant at the most severe treatment of 3PP. Total lint yield showed a pattern identical to that for pre-harvest fruit profile (Figs. 5 and 6). In 2006, 3PP treatment numerically out-yielded all other treatments whereas it produced 180 lb/acre less than that for SC in 2007. Based on these two years of data, it may be suggested that at least 20% of the fruit loss during the early flower period could be compensated when soil moisture is not a limiting factor.

While additional years of continuing research are planned, current data suggest that the plants are able to compensate up to 30% fruit loss 4 weeks into squaring and 20% fruit loss 4 weeks into flowering under favorable environmental conditions. Therefore, protection of 25-30% of the fruit loss during early squaring and 20% of the fruit loss during early flowering may not be necessary in our region.

Acknowledgments

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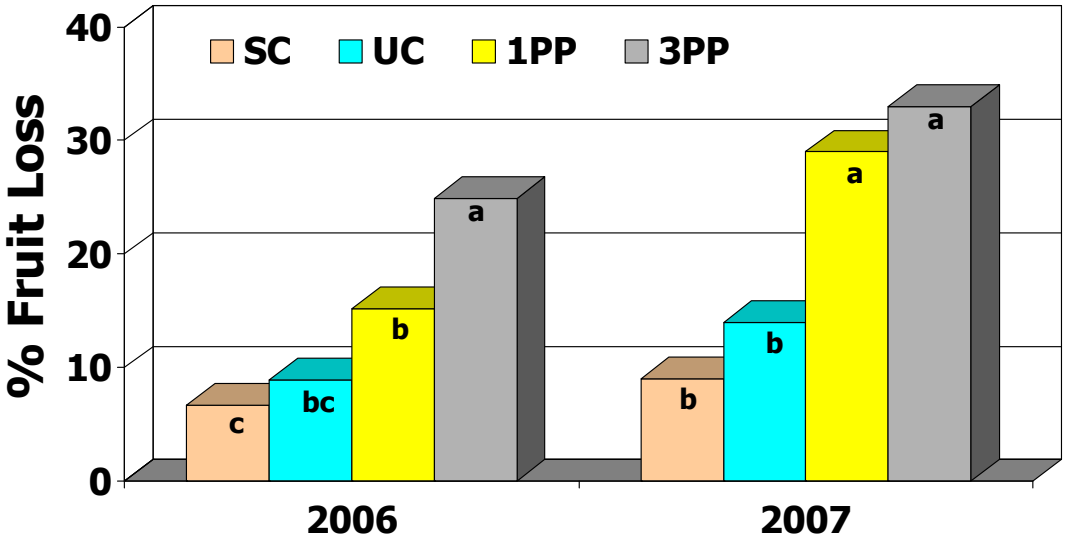

Figure 1. Percent fruit loss in cotton plots receiving various levels of *Lygus* bug releases during the pre-bloom fruiting period, Lubbock, TX, 2006-2007. Bars within year with different letters are statistically different (P<0.10).

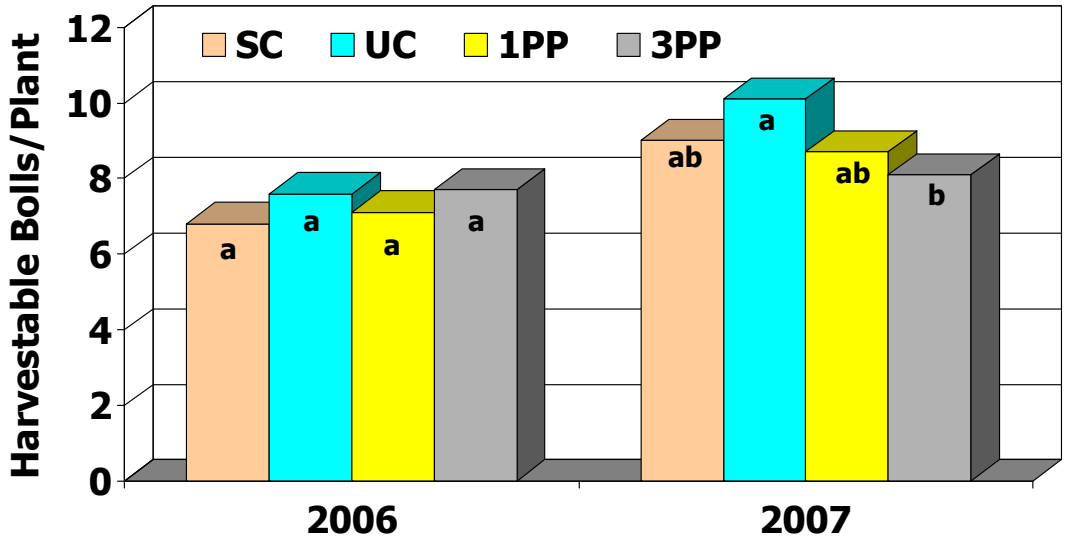

Figure 2. Number of harvestable (open) bolls per plant in cotton plots receiving various levels of *Lygus* bug releases during the pre-bloom fruiting period, Lubbock, TX, 2006-2007. Bars within year with different letters are statistically different (P<0.10).

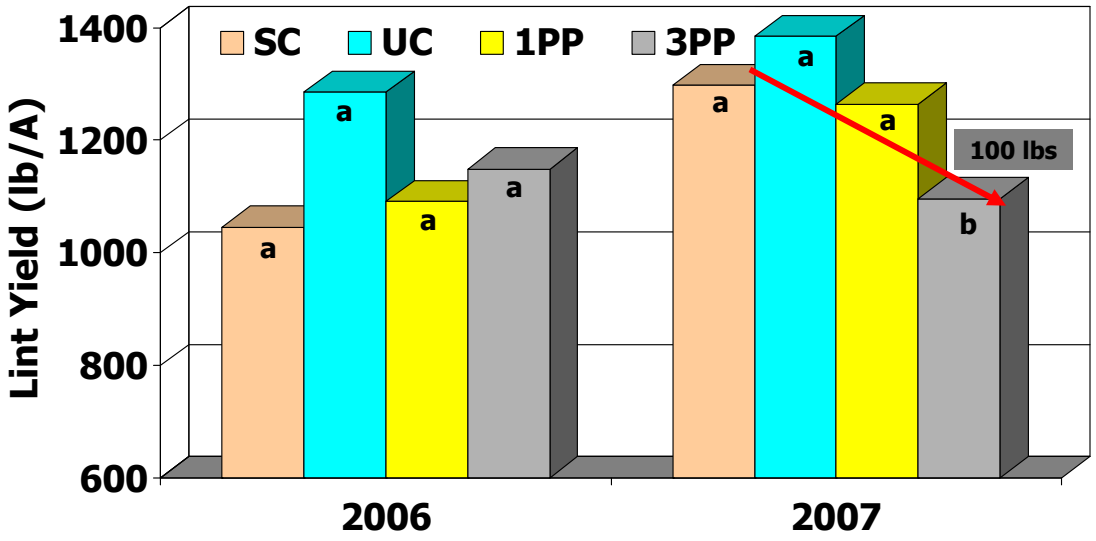

Figure 3. Total lint yield (lb/A) in cotton plots receiving various levels of *Lygus* bug releases during the pre-bloom fruiting period, Lubbock, TX, 2006-2007. Bars within year with different letters are statistically different (P<0.10).

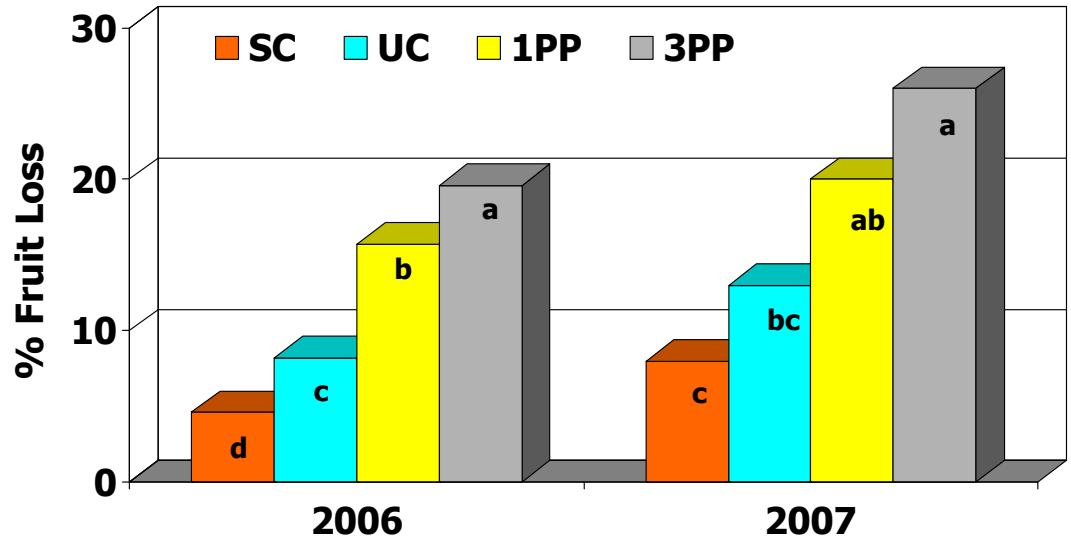

Figure 4. Percent fruit loss in cotton plots receiving various levels of *Lygus* bug releases during the early bloom fruiting period, Lubbock, TX, 2006-2007. Bars within year with different letters are statistically different (P<0.10).

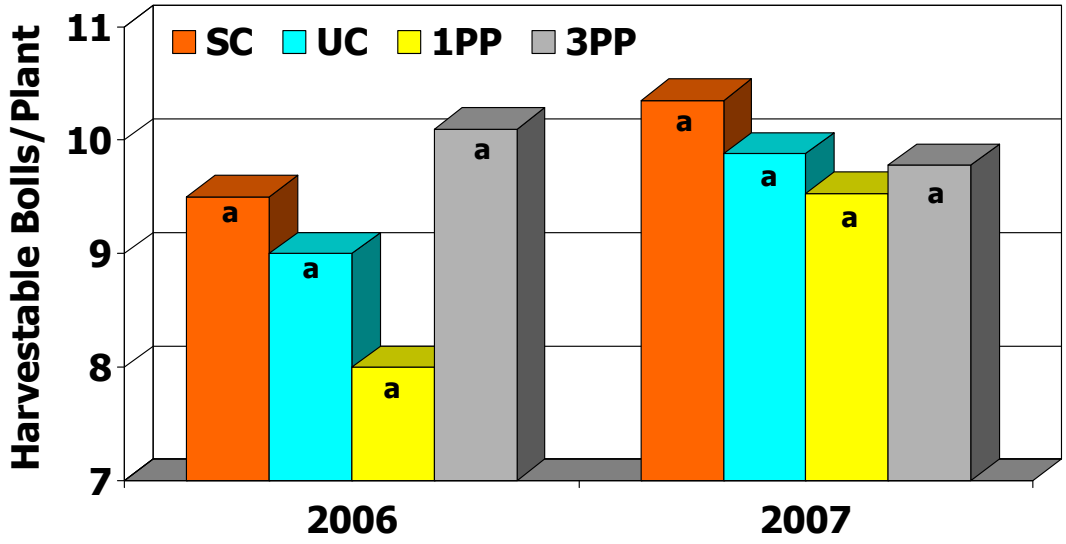

Figure 5. Number of harvestable (open) bolls per plant in cotton plots receiving various levels of *Lygus* bug releases during the early bloom fruiting period, Lubbock, TX, 2006-2007. Bars within year with different letters are statistically different (P<0.10).

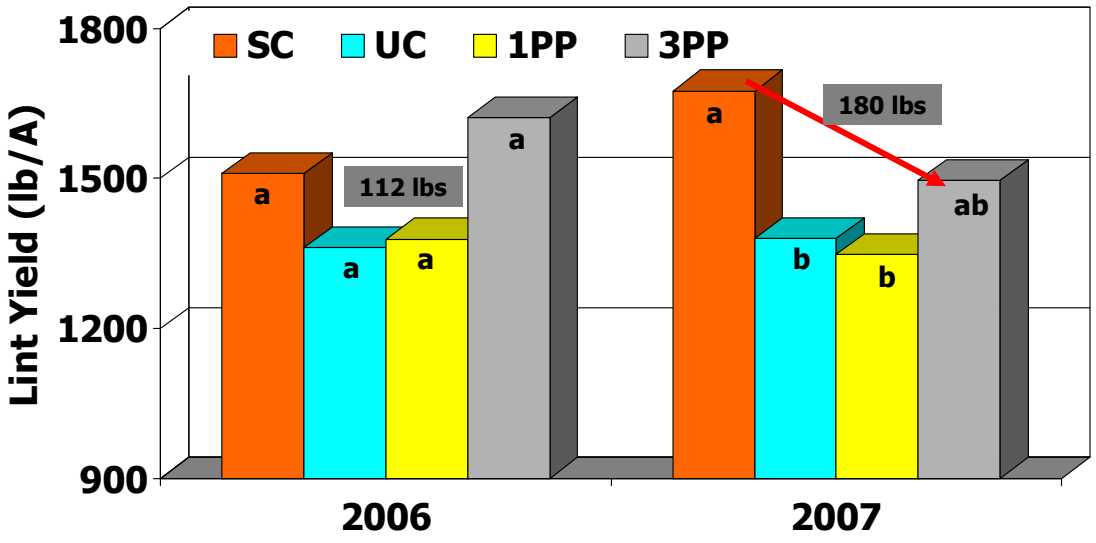

Figure 6. Total lint yield (lb/A) in cotton plots receiving various levels of *Lygus* bug releases during the early bloom fruiting period, Lubbock, TX, 2006-2007. Bars within year with different letters are statistically different (P<0.10).