THE RELATIONSHIP OF INSECTS ON COTTON PLANT FRUITING CHARACTERISTICS DURING THE FIRST NODES OF FRUITING

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Abstract

Two years data on tarnished plant bug, Lygus lineolaris (Palisot de Beauvois), populations occurring during the time a cotton crop grew its first 5 fruiting nodes are presented. These populations were correlated to percent square set when cotton plants were approximately 10 nodes tall. Plant bug populations were described using *"Lygus* days". These data were collected on Sure-grow 125 cotton and DPL NuCotn 33B. The data collected from NuCotn 33B in a production setting allowed the authors to examine the early season relationship between percent fruit set and plant bugs without interference from bollworms, Helicoverpa zea (Boddie), and tobacco budworms, Heliothis virescens F. The difference between years was significant; however, the relationship between plant bug populations and percent set were similar. A combined analysis was used to refine the relationship between "*Lygus* days" and percent fruit set.

Introduction

Jenkins and McCarty (1995) showed through end of season plant mapping, that early maturing cotton such as DES 119 produced 41% of its crop on the first five main stem fruiting nodes. These same authors showed that DP 5415 produced approximately 27% of its crop on the first five mainstem fruiting nodes. These boll map data show that a large percentage of the crop is produced from a limited number of squares on the first five nodes of the cotton plant stimulated the interest to see how insects interact with these early fruiting positions. Jenking and McCarty (1995) did not present mapping data for Sure-grow 125 cotton, the variety which Phelps et. al. (1996) collected data on Lygus days and fruit set. The boll map data from DES 119 was presented here to represent an early maturing variety and is a parent of Sure-grow 125. DP 5415 is a parent of NuCotn 33B and the terminal boll maps should be similiar between these varieties.

Phelps et. al. (1996) correlated Heliothine and *Lygus* days to square set in a 1995 field study. *Lygus* days were significantly correlated to percent square set and squares per plant. Heliothine days were significantly correlated to percent damaged terminals.. The interaction of Heliothine days and *Lygus* days on percent square set was examined; however, only plant bugs, *Lygus lineolaris (Palisot de Beauvois),* was significantly correlated to percent square set and squares per plant.

A demonstration in 1996 was designed to examine the effects of early season insecticide applications on insect populations and the fruiting characteristics of cotton. The demonstration was carried out on NuCotn 33B cotton which essentially removed bollworms, Helicoverpa zea (Boddie), and Heliothis virescens F. from the demonstration. Over 4000 terminals were examined, only 10 eggs and no larvae of Heliolthines were found in all the plots during the entire 12 day sample period. These data should add to the data base for economic thresholds for early season insects.

Materials and Methods

Two fields of NuCotn 33B cotton were used for this demonstration. The demonstration was designed as a randomized complete block with one replication in one field and three replications in the second field. Each block contained 7 treatments randomly arranged. Each plot was 53.3 ft wide (sixteen, 40" rows, the swath width of the Melrose Spray Coupe utilized to apply insecticide to the plots) and the length of the field. The field where the first replication was located was rectangular in shape and rows were approximately the same length. The field where the remaining three replications were located had rows which varied in length. Both fields had one side which was relatively straight and to which rows ran perpendicular. All sampling was conducted within 400 feet from that side of the field.

Sampling on 24 May 1996 (Table 1), indicated that the seedling cotton plants were approaching an average height of 5 nodes (i. e. the fifth mainstem leaf had unfurled). The following day (25 May 1996) all plots were treated with the following insecticide treatments: (1.) Provado 0.047 lbs AI/acre. (2.) Baythroid 0.036 lb AI/acre. (3.) Karate 0.033 lb AI/acre. (4.) Orthene 0.33 lb AI/acre. (5) Vydate 0.25 lb AI/acre plus Lannate 0.22 lb AI/acre. The Karate and Baythroid treatments were applied to 2 plots in each block. The protocol called for all plots to be treated a second time as they reached threshold levels for plantbugs but before the 10th leaf stage of the cotton. At the 10th leaf stage the test was terminated. The second Karate and Baythroid plot was to be treated automatically 8 days after the first treatment. Because of rapid growth and a rain delay, the second treatment was not applied. Therefore, the demonstration that was treated was a randomized block design with five treatments and unequal replications. Two of the treatments had eight replications and three treatments had four replications. Ruscoe (1997) will report on insecticide efficacy and duration of the treatments.

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Sampling of the 28 plots produced information on insect populations. Sweepnet samples consisting of fifty sweeps of a 15 inch sweep net were taken on row nine in each plot. The contents of the sweepnet were aenesthized with ether and transferred from the sweepnet to a paper bag. Sweepnet samples were killed by placing the paper bag into a five gallon bucket containing a cotton wick saturated with ethyl acetate. The bags of insects were later opened, identified, and counted under laboratory conditions. At each sweepnet sample site, 25 plants were selected from row 8 and examined for node height, heliothine eggs, heliothine larvae, damaged terminals and black flags (dead leaves caused by damage to the petiole). The plant selection was done by choosing the first sample plant for observation, then sequentially examining each 5th plant down the row until 25 plants were examined. However, if the 5th plant was severely damaged or stunted the next plant was selected. Insect data from sweepnet and whole plant examinations were taken on 24, 26, 29, and 31 May, and 2 and 4 June.

On June 25, a final plant mapping produced plant characteristics on which correlations could be conducted. The selection of 25 plants in all 28 plots was similar to the selection of plants for whole plant examination, but no plants were rejected. Data recorded from these plants were total number of nodes (cotyledonary node as 0), mainstem node of first fruiting site, total number of fruiting sites on the plant, damaged terminals, and total number of squares on the plant. From these mapping data percent square set was calculated.

The only phytophagous insect which consistantly occurred in the sweepnet samples in numbers high enough was the tarnished plant bug. *Lygus* days were calculated as described by Phelps (1996) to quantify the plantbug population over the sample period. Utilizing PROC. GLM (SAS Institute 1989-1993) correlations were run. Dependent variables were total nodes, node of first fruiting site, total sites, total squares, damaged terminals, and percent square set. *Lygus* days, treatments, replications, and interactions of these independent variables were examined.

Results and Discussion

Only one significant correlation resulted from all of the regression analyses. The relationship between percent square set and *Lygus* days was significant ($F=8.28$ $P>F=.0079$)(Fig. 1). Square set in all plots (Fig. 2) was extremely good. The worse square set was 78% and the overall mean for all plots was 91.56%. The lack of a significant correlation of *Lygus* days with squares/plant which was significant in 1995 (Phelps et. al. 1996) could be due to the lack of damage. The regression slope indicates that the average cotton plant loses -0.323 percent of its squares for each *Lygus* day (one *Lygus* bug per 100 sweeps per day). The standard error of the slope's estimate is ± 0.112 percent square set. This standard error is almost twice the standard error of 0.068 percent square set reported by Phelps et. al. (1996). The lack of damage and the clumping of the data points above the eighty percent level account for this increase in the error in the 1996 data.

Percent set and corresponding *Lygus* days collected from Sure-grow 125 cotton in the 1995 season and reported by Phelps et. al. (1996) were combined with the 1996 data (Fig. 2). Regression analysis on the combined data set both years and *Lygus* days were correlated to percent square set. After removal of the effect of years, *Lygus* days were significantly correlated to percent square set ($F=16.25$, $P>F=0.0002$) for 1995 and 1996 plants . The slope of the regression equation of the combined data for the two years was 0.223 (SE±0.0554) percent square set per *Lygus* day. The average intercept for the two years is 85.559. The average intercept for the two years means little to the analysis but may be important to understanding of square loss at this time.

These data point to several considerations involved with defining a early season economic threshold. Jenkins and McCarty (1995) showed that early maturing varieties of cotton set a larger portion of their crop during the first five nodes of growth. It is quite possible that maturity and yield of different varieties could be affected differently by early season square loss. The relationship between square loss and *Lygus* bugs seemed to be similar for Sure-grow 125 and NuCotn 33B.

Calculating a treatment threshold from the data is possible and practical. To grow the first five nodes, it takes about two weeks. If a percent square set of 80 or greater is what is desired at the end of the two week period, 20 percent square loss divided by the average percent loss per *Lygus* day of -0.223 is 90 *Lygus* days. An average daily capture of 6.43 tarnished plant bugs per 100 sweeps per day would be required to accumulate 90 *Lygus* days in 14 days. To give the producer some time to spray and allow for scouting intervals, the threshold would have to be lowered accordingly.

These data point to one of the most important but much neglected considerations when thresholds are derived, i.e. the interaction of two or more factors acting on the crop. The intercepts of the regression equations for percent square set on *Lygus* days were below 100 percent both years. This means something removed squares besides tarnished plant bugs. In 1996, the intercept of the percent square set and *Lygus* day equation indicates that some other factor removed 4.64 percent of the squares from the plants. This percent square loss could be error of the measurement or physiological square loss. Phelps et. al. (1996) presented a similar equation which indicated that 15.3 per cent of the squares were lost to something besides tarnished plant bugs from data collected in 1995 on Sure-grow 125 cotton. There is a high probability that this square loss was not due only to physiological factors or errors. The most probable factor was Heliothines since a positive correlation between terminal damage and bollworm larvae was presented in the 1995 data.

If we assume that the intercepts for both years are correct and some other factor was also removing fruit, the plantbug threshold required to reduce the crop to 80 per cent set was 4.92 tarnished plant bugs per 100 sweeps per day for 14 days in 1996 on NuCotn 33B cotton and 1.5 tarnished plant bugs per 100 sweeps per day for 14 days in 1995 on Suregrow 125 cotton. It is not uncommon for tarnished plant bug populations to increase at a rate of 16 *Lygus* days in 4 days. Populations have been observed which increased from four tarnished plant bugs per 100 sweeps to 22 bugs per 100 sweeps in 4 days. Such a population would accumulate 52 plantbug days in 4 days.

Lygus days by definition includes the element of time. The rate of growth of the cotton plant will effect the tarnished plant bug threshold. The rate of growth is unknow to a decision maker attempting to maintain a square set. Data on plant growth were not available for the 1995 crop reported by Phelps (1995). The average number of fruiting sites on the 1995 crop was 4.54 and this same measurement for the 1996 crop was 3.32. The node of first average fruit set was 5.7 in the 1995 crop and 6.0 in the 1996 crop. There was at most only a node difference in the two crops but it took 12 days to grow the four nodes of the 1996 crop and 18 days to grow the approximated five nodes of the 1995 crop. An examination of the degree days from both years show less that 20 degree days difference in the first 12 days form 25 may when the test was started in both years. Temperature before 25 may in 1996 was warmer and may havae contributed to better early root developement before the 5th node.

To maintain an 80 percent square set when a cotton plant is growing its first five fruiting nodes will probably require close scouting and a quick application by the producer once thresholds are reached during this early fruiting period. Mixed populations such as *Lygus* bugs, bollworms, and boll weevils may account for some cotton fields having low square set or possibly crazy cotton when no individula insect thresholds were exceeded.

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Table 1. Average node height for cotton plants sampled on the indicated date.

Cotton Plant Growth by Nodes	
Date	Nodes per Plant
5/24	4.92
5/26	5.88
5/29	6.83
5/31	7.77
6/2	8.43
6/4	9.17

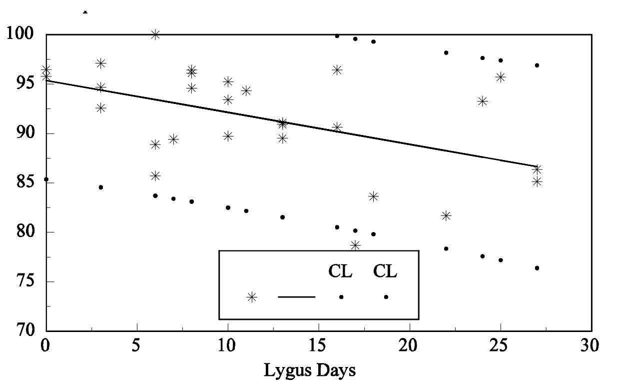

Figure 1. A graphical representation of the regression equation: percent square set= -0.3227* *Lygus* day+ 95.36, F=8.28, P>F=.0079, and SE (b)=0.112.

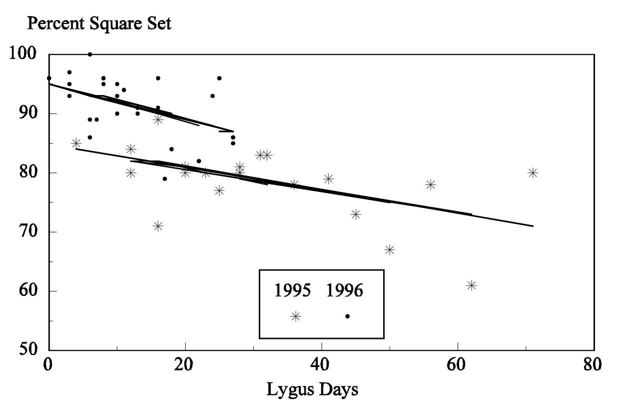

Figure 2 A graphical representation of the data collected in 1996 and 1995 with the regression lines from both years.