INFLUENCE OF CROP CULTIVATION ON COTTON PHYSIOLOGY

W. E. Hart[1], F. D. Tompkins[1], M. S. Palmer[1], and J. F. Bradley[2]
Agricultural Engineers[1]
and Experiment Station Superintendent[2]
Tennessee Agricultural Experiment Station
The University of Tennessee
Knoxville, TN

Abstract

Effects of tillage practices and application of the growth regulator Pix on cotton physiological properties and yield were evaluated in a three-year study, the last year of which was 1995. Tillage practices included no-till and conventional seedbed preparation with three levels of post emergence cultivation (single, double, and triple) employed during the production season. DPL-20 variety was grown in West Tennessee using 30-inch row spacing. Yield performance was shown to be affected by tillage system. In particular, conventionally prepared seedbeds with post emergence cultivation resulted in significantly higher yields than no-tillage planting. However, the number of post emergence cultivations, either one, two, or three, was not a significant factor in predicting yield of the plots with conventionally prepared seedbeds. The effect of tillage treatment was generally consistent, in that in only one year was tillage treatment not shown to be a significant factor in predicting yield.

Application of the growth regulator Pix had no significant effect upon mean crop yield over three years. Only in 1995 did the application of Pix result in a significant yield advantage. Any yield advantage associated with the application of Pix to this particular cotton variety grown in 30-inch rows appears to be dependent upon the nature of the growing season. The 1995 yield advantage associated with the application of Pix corresponded to greater numbers of green bolls observed on Pix-treated plants.

Physiological development of cotton produced using no-tillage was similar to that of cotton planted in conventionally prepared seedbeds. In particular, activity at fruiting sites as indicated by frequency counts of squares, aborts, green bolls, and open bolls over the growing season were similar regardless of tillage treatment. Further, tillage treatment did not have a discernible effect upon the maximum number of nodes, plant height, or main stem diameter.

Sequential applications of Pix were effective in controlling vegetative growth as indicted by plant height. For instance, Pix-treated plants were, on the average, about five inches shorter than untreated plants at harvest maturity in 1995. Plant maturity or earliness as indicated by the percentage of the total crop collected during the first picking was affected by neither tillage treatment nor application of the growth regulator Pix.

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Introduction

Research involving cotton production in narrow rows, that is, in rows spaced closer than the traditional 38 to 40 inches, spans at least four decades. For example, Waddle et al. issued a report in 1956 highlighting the results of Arkansas studies involving row spacings ranging from 18 to 48 inches and noted that the greatest yields were produced in 18-inch rows. In trials conducted by researchers in five states between 1984 and 1988, narrow rows were shown to increase yields in comparison to 40-inch rows by one to 20 percent (Cotton Physiology Today, 1990). Narrow rows apparently resulted in greater or more efficient use of one or more of the crop production inputs, including such things as available water, nutrients, and solar energy. However, narrow rows did not always result in increased yields. In a three-year Tennessee study involving production in 30- and 40-inch rows, the nature of the growing season was shown to be a critical factor in determining which row spacing resulted in greatest yields (Hart et al., 1995).

The physiological development of cotton grown in narrow rows has also been shown to differ somewhat from that of cotton planted in 40-inch rows. For example, McCarty et al. (1993) reported that cotton in 30-inch rows tended to accumulate more of its total yield on the lower fruiting nodes than cotton grown in 40-inch rows. Plant growth and fruiting characteristics may also be influenced by other factors including tillage and cropping management strategies. In a South Carolina study involving monocrop and double crop production systems with various levels of tillage, Porter et al. (1992) found that the position of boll set varied among the cultural practices. In particular, over 15 percent of the bolls were formed on or below the fifth node in the monocropped cotton, while less than six percent of the bolls on the double cropped cotton were set on or below the fifth node. Hake et al. noted that plant density tends to influence the node at which the first fruiting branch forms. High density plantings tend to have the first fruiting branch up to one node higher than low density stands. Thus, narrow row crops might be expected to begin fruiting somewhat higher than plantings in conventionally spaced rows.

Application of the plant growth regulator mepiquat chloride (Pix) primarily serves to affect internode elongation, thereby controlling vegetative growth. When applied at adequate rates, Pix always has the effect of shortening internode length (Hickey, 1995). However, there is not always a positive effect on yield. In fact, Hake (1990) noted that application of Pix could be detrimental to cotton under certain conditions. On the basis of many studies, cotton plant yield responses to growth regulators generally have been variable and inconsistent (Oosterhuis et al., 1995). Pix was much more effective in enhancing yields of cotton in 40-inch rows than in 30-inch rows in a 3-year study in West Tennessee (Hart et al., 1995).

Clearly, a great many complex and sometimes interrelated factors contribute to the environmental milieu in which a given cotton crop is grown. To this milieu, add the cotton plant itself, a plant which has perhaps the most complex structure of any major field crop (Mauney, 1986). The resulting physiological response typically presents a formidable challenge to analytic description. Consequently, a variety of field experiments conducted over a range of conditions become essential to the process of creating a pool of data which may reveal significant general relationships between environmental stimulus and crop response. A three-year Tennessee study was initiated in 1993 to investigate the physiological response of cotton grown in 30-inch rows to various levels of tillage and to application of the growth regulator mepiquat chloride (Pix). Results of the 1995 field tests along with a summary of the 3-year yield performance are contained herein.

Methods and Procedures

Yield Performance Tests

Production Systems. Eight production systems were compared to evaluate tillage effects on physiological growth and maturity of 30-inch narrow-row cotton grown in West Tennessee. Production systems included a comparison of no-tillage versus conventional tillage with three levels of post emergence cultivation and treatment versus non-treatment with the plant growth regulator Pix (mepiquat chloride). First, second, and third cultivations in the conventional plots were scheduled to occur when plant heights reached approximately 6, 12, and 18 inches, respectively (third cultivation scheduled for early bloom).

Experimental Design and Plot Layout. A Latin square experimental design was used to arrange the plots for the eight treatments, four levels of cultivation plus application or no application of the growth regulator Pix. Experimental plots consisted of eight rows per treatment. Rows were 30 feet in length. The eight treatments were replicated four times. Treatments within a replication were contiguous with no border or alleyway. Replications were separated with 20-foot alleyways.

Plot Description and Preparation. Test plot areas were planted in the same field as the 1993 and 1994 crops. Previous cropping history for the plot area included soybeans in 1990, wheat/no-till soybeans double cropped in 1991, and cotton in 1992, 1993, and 1994. Predominant surface soil is a Memphis silt loam with 0-2 percent slope. Fertilization, chemical applications, and field operations were typical of cotton production in West Tennessee.

Tillage systems in the study included no-tillage and conventional tillage cultural practices. The no-till system consisted of planting with a no-till row-crop planter and applying pesticides in liquid form with broadcast application equipment. Conventional tillage consisted of preparation of a well tilled seedbed using two passes with a tandem disk harrow, plus a single pass with a cultimulcher, followed by planting with a row-crop planter. A pto-driven rotary tiller was used to prepare conventionally tilled plots during the 1993 and 1994 seasons of the experiment. Pesticides were applied with broadcast application equipment. The same pesticide application equipment and broadcast application equipment for soil fertility amendments were used in both no-tillage and conventional tillage systems.

Plot Seeding. Test plots were planted on May 9, 1995. A John Deere 7100 row-crop planter was used to plant all treatments. The planter was equipped with 4 row-planting units. Specific adjustments (planter down tension springs, ballast, presswheel pressure, etc.) were made on each planter unit to allow for planting in conventional and no-tillage plots. The planter was operated at a travel speed of approximately five miles per hour. Planting depth was maintained at approximately one inch. Delta Pine and Land Company DPL-20 acid delinted, triple-treated seeds were planted at a seeding rate of 14.9 pounds seed per acre.

Description of Plot Cultivation. A Buffalo 4-row minimum till cultivator (Model 63000430) was used to cultivate all conventional tillage treatments. The cultivator was equipped with two 13-inch smooth concave disks positioned on either side of the plant row, plus a single 17-inch smooth straight disk and a 16-inch sweep in each row middle. The cultivator was operated at a depth of approximately 4 inches with a travel speed of three miles per hour during the first cultivation (31 days after planting). Second and third cultivations were performed at a depth of approximately two inches with a travel speed of 5.5 miles per hour (50 and 62 days after planting).

Growth Regulator Application. The experimental test plots designated to receive the growth regulator Pix were treated twice during the 1995 production season using a 50-50 split application. Plots were treated using a total application rate of 16 ounces of formulation per acre, or 20 grams of active ingredient per acre. The first application was made 59 days after planting, with the second application 10 days later (69 days after planting). Growth regulator applications included a tank mixture of Pix, X-77 surfactant, and water such that the application rate was 20 gallons of solution (Pix plus surfactant @ 0.25% v/v plus water) per acre. The Pix solutions were broadcast applied with a John Deere 6000, high-clearance sprayer equipped with flat fan nozzles spaced 20 inches apart.

Harvest Procedure. Chemical defoliant was applied when the cotton plants had matured to the point that about 60 percent of the bolls were open. Plant defoliant and boll opener agents were applied 17 days prior to harvest (126 days after planting). Experimental plots were harvested September 29, 1995 (first pick - 143 days after planting) and October 17 (second pick - 161 days after planting). A Case IH 2155 four-row spindle picker was used to pick experimental plots. Picker travel speed was maintained at approximately two miles per hour while harvesting experimental plots.

Data Acquisition

Plant Density. Stand establishment was determined by collecting samples from the four center rows of each experimental plot. Samples consisted of measuring 10-foot random segments along each row and counting the number of plants present. Values from the four samples were averaged to determine mean plant density for each treatment plot.

Plant Canopy Closure. Plant canopy was routinely monitored for each experimental plot. Daily visual observation of the plots were used to establish the time of canopy closure. Crop canopy closure was considered established when 50 percent of the plants in a given plot were either touching or overlapping plants in adjacent rows.

Plant Physiological Properties. Plant physiological properties were measured throughout the production season. Two plants representative of each plot (a total of 64 plants - 16 no-till and 16 for each of the three conventional cultivation systems) were randomly selected and tagged so that physiological growth could be monitored throughout the growing season. Fruiting sites were mapped for each of these plants throughout the production season. In addition to mapping fruiting sites (i.e. squares, nodes, aborts, green bolls, and open bolls), plant heights and stem diameters were also monitored. Plant height was measured from the soil surface to the canopy top and terminal bud. Stem diameters were measured at a location immediately above the cotyledons. A dial caliper was used for the stem diameter measurement. Two measurements were collected at each site, and the values were averaged to obtain a mean stem diameter. All physiological data was recorded in the field electronically using a PSION HC120 hand held computer.

Yield and Quality Determination. The four center rows of each 8-row experimental unit were harvested and weighed to determine treatment seed cotton yields. Grab samples, weighing approximately 2.5 to 5 pounds each, were collected from the second and fourth replications for each treatment. These grab samples were combined to generate approximately 5- to 10-pound samples for use in determining percentage gin turnout. Samples were ginned at The University of Tennessee West Tennessee Experiment Station, Jackson. Additional grab samples were collected in a similar manner for use in establishing fiber properties and classifying cotton color grades. Cotton quality analyses were performed at the cotton classification laboratory located at the USDA AMS Cotton Division, Memphis, Tennessee.

Results and Discussion

Production Season Observations

Stand Establishment. Plant stand densities were measured during the week of June 12. No-till plots averaged 3.1 plants per foot of row and conventionally tilled plots averaged 2.9 plants per foot of row. Cotton plants were, at the time, in the 3-4 true leaf stage.

Plant Canopy Closure. Tillage treatment, no-tillage and conventional tillage with cultivation, significantly affected ($p>0.0003$) the time required to establish closure of the crop canopy. At the time of canopy closure, all cultivation treatments had been performed on the conventionally tilled plots, with the third cultivation occurring 62 days after planting. Average number of days required for crop canopy closure are presented in Table 1. No-till plots established canopy closure an average of 73.5 days after planting, while conventionally tilled plots averaged 65.8, 69.0, and 70.5 days for one, two, and three cultivations, respectively.

Application of the growth regulator Pix did not have a significant effect ($p>0.99$) upon the average number of days required to establish closure of the crop canopy for the various treatment combinations. At the time of canopy closure, both portions of the split application of Pix had been applied to the appropriate experimental plots (first application 59 days after planting and second application 69 days after planting). Average number of days required to establish crop canopy closure was 69.7 days after planting, for both treated and untreated plots.

Plant Fruiting Patterns and Physiological Properties

Plant Fruiting Patterns. Plant fruiting patterns and physiological properties were measured eleven times during the production season (45, 52, 58, 65, 73, 86, 93, 101, 114, 128, and 142 days after planting). Recall that two plants representative of each plot (a total of 64 plants - 16 no-till and 16 for each of the three conventional cultivation practices) were randomly selected and tagged so that physiological growth and fruiting patterns could be monitored throughout the growing season. In addition to mapping fruiting sites (i.e. squares, nodes, aborts, green bolls and open bolls), plant heights and stem diameters were also measured. Frequency counts of squares, bolls, open bolls, and aborts for the various treatments during the 1995 season are shown graphically in Figures 1, 2, 3, and 4. Frequency counts represent eight plants per treatment (two plants per treatment combination times four replications). Square loading activity was first noted on the first mapping date (45 days after planting) and continued through 114 days after planting. The highest loading rate was observed between mapping dates 52 and 93 days after planting. The first occurrence of fruiting site aborts was noted 52 days after planting and continued through the last mapping date (142 days after planting). The highest frequency of fruiting site aborts occurred between mapping dates 93 and 142 days after planting. The presence of green bolls was first noted 73 days after planting and continued to the last mapping date (142 days after planting). The highest loading rates for green bolls were observed between mapping dates 93 and 114 days after planting. Open bolls were first observed 114 days after planting and continued through the last mapping date 142, days after planting. As one might expect, the last mapping date had the highest frequency of plants with open bolls.

Frequency counts of squares, bolls, open bolls, and aborts for the eight treatments were analyzed by plant section. Section number refers to the node location on the plant main stem; that is, section 0, section 1, section 2, and section 3 refer to nodes 1-3, nodes 4-10, nodes 11-17, and nodes 18-24, respectively). Most of the fruiting activity for square loading occurred in sections 1 and 2, with little activity observed in section 3. Predictably, fruiting site patterns for green bolls were similar to those associated with square loading. Almost all of the open bolls were located in section 1, with a rather insignificant level of activity in section 2. Frequency of fruiting site aborts was most concentrated in sections 1 and 2, with at least a noticeable level of activity in section 3.

Analyses of variance indicated that differences observed over the growing season for the average number of squares per plant for the various treatments were not statistically significant for either tillage treatment ($p>0.46$) or application of the growth regulator Pix ($p>0.19$). The average number of squares for the various treatments did change in a consistent manner as the plants matured over the growing season. There were large changes in the average number of squares between mapping dates ($p<0.0001$), an observation which is fully expected as a natural consequence of plant growth and aging. Due to the natural order of performing cultivations to the conventionally tilled plots and application of the growth regulator Pix , data were pooled to analyze the effects of cultivation and application of the growth regulator at selected mapping dates. For example, at the mapping date 45 days after planting, all conventionally tilled plots had been cultivated one time with no applications of Pix. At the mapping date 58 days after planting, the second cultivation had occurred eight days before at 50 days after planting and no Pix had been applied. At the mapping date 73 days after planting, the final cultivation had occurred 11 days previously at 62 days after planting and the first application of Pix had been made 14 days before at 59 days after planting. Analyses of variance indicated that differences observed for the specified dates for the average number of squares per plant for the various treatments were not statistically significant for either tillage treatment or application of the growth regulator Pix.

Analyses of variance indicated that differences observed over the selected mapping dates for the average number of fruiting site aborts per plant for the various treatments were not statistically significant for either tillage treatment ($p>0.78$) or application of the growth regulator Pix ($p>0.81$). Average number of fruiting site aborts for the various treatments changed in a consistent manner as the plants matured over the growing season. There were large changes in the average number of fruiting site aborts which occurred between mapping dates ($p<0.0001$). Again this was an observation which is fully expected as a natural consequence of plant growth and aging.

Analyses of variance indicated that differences observed over the selected mapping dates for the average number of green bolls per plant for the various treatments were not statistically different for the various tillage treatments ($p>0.50$). However, there was a significant difference ($p<0.023$) in the average number of green bolls per plant for the various treatments involving application of the growth regulator Pix. Plots treated with Pix averaged 5.0 green bolls per plant over the selected mapping dates while untreated plots averaged 4.5 green bolls per plant. This observation is consistent with that reported by Livingston and Parker (1994), when they noted that the capacity of Pix to enhance yields was associated with its ability to produce a greater number of bolls per acre. Average number of green bolls for the various treatments did change in a consistent and predictable manner as the plants matured over the growing season. Large changes in the average number of green bolls were observed between the various mapping dates ($p<0.0001$) as was fully expected as a natural consequence of plant growth and aging.

Analyses of variance indicated that differences observed over the growing season for the average number of open bolls per plant for the various treatments followed the same pattern as was noted with green bolls. Tillage treatment did not have a significant effect ($p>0.62$) on the average number of open bolls over the selected mapping period. However, as observed with the average number of green bolls per plant, there was a significant difference ($p<0.0022$) in the average number of open bolls per plant which was associated with the application of the growth regulator Pix. Plots treated with Pix averaged 3.4 open bolls per plant over the selected mapping dates, while untreated plots averaged 2.6 open bolls per plant. Average number of open bolls for the various treatments changed in a consistent and predictable manner as the plants matured over the growing season.

Plant Physiological Properties. Data defining plant terminal heights, main stem diameters, and maximum numbers of nodes were subjected to analyses of variance. These analyses indicated that plant height differences observed over the growing season among tillage treatments (no-till or conventional tillage with cultivation) were not statistically significant ($p>0.13$). However, similar analyses did indicate a significant difference ($p<0.0001$) in the average plant height for the various treatments involving application or no application of the growth regulator Pix. Average plant heights for plots treated with the growth regulator Pix were 27.4 inches over the growing season while untreated plots averaged 30.6 inches in height. Average plant heights measured at the final mapping date (142 days after planting) for plots treated with Pix were 31.4 inches while the plants in untreated plots grew to an average height of 36.6 inches. The interaction among the main treatment effects, tillage treatment and application of the growth regulator Pix was not statistically significant ($p>0.23$). However, analysis of variance did indicate a significant difference ($p<0.0001$) in plant heights due to the interaction of the application Pix and mapping dates. This interaction is graphically presented in Figure 5. As one might reasonably expect, plant heights among the various treatments where similar prior to the first application of Pix (59 days after planting). After treatment with Pix plants grew in height at a slower rate.

Differences over the growing season among treatments involving the application of the growth regulator (No-Pix or Pix) were not statistically significant either for plant main stem diameter ($p>0.11$) or maximum number of nodes ($p>0.43$). Likewise, tillage significantly affected neither main stem diameter ($p>0.75$) or maximum number of nodes ($p>0.92$). Interactions among the main treatment effects, tillage treatment and application of the growth regulator, were not statistically significant for either main stem diameter ($p>0.60$) or maximum number of nodes ($p>0.25$). These observations indicate that the physiological behavior of the cotton plants subjected to the several treatments included in this field study was similar for main stem diameters and maximum node numbers. There were large changes in main stem diameter and number of nodes per plant between mapping intervals (all p-values <0.0001) which, as indicated previously, are natural consequences of plant growth and maturity.

Plant Maturity

The percentage of total seed cotton harvested during the first picking was taken as an indication of plant maturity at harvest time. Tillage treatment (no-till versus conventional till with cultivation) did not significantly affect ($p>0.24$) plant maturity. There were no statistical differences among treatments in maturity or earliness (refer to Table 2).

Application of the growth regulator Pix also did not significantly affect ($p>0.99$) the percentage of seed cotton harvested during the first pick across the various tillage treatment combinations. Experimental plots treated with the growth regulator Pix yielded an average of 81.7 percent of their total crop during first harvest, with non-treated plots producing the same percentage.

Seed Cotton Yield

Average gin turnout for the various treatment combinations in 1995 was 33.4 percent. However, since gin turnout estimates where obtained by grab samples from only the second and fourth replications of each experimental treatment and due to some inconsistencies in gin turnout values, yield data are presented on the basis of harvested seed cotton. Average seed cotton yields and estimated lint yields for the various treatment combinations are presented in Table 3.

Average seed cotton yields for the tillage treatments in 1995 are shown in Table 4. No-tillage plots yielded an average of 2915 pounds seed cotton per acre while conventionally tilled plots yielded averages of 2974, 3044, and 3038 pounds per acre for single, double, and triple cultivations, respectively. Based upon these data, tillage treatment did not significantly ($p>0.30$) affect seed cotton yield (refer to Appendix P). Likewise, yield in the conventionally prepared plots was not significantly ($p>0.05$) affected by the number of post emergence cultivations.

Application of the growth regulator Pix did significantly affect ($p<0.0034$) seed cotton yields observed across the various tillage treatment combinations. Plots treated with Pix yielded an average of 3082 pounds of seed cotton per acre while plots receiving no growth regulator produced an average of 2903 pounds of seed cotton per acre. Thus, plots treated with Pix produced an average yield advantage of 179 pounds of seed cotton per acre, or about 60 pounds of lint per acre.

Seed Cotton Yield -- Three Year Summary

Average seed cotton yields and estimated lint yields for the three-year study are shown in Table 5 to provide an overall comparison of the production seasons. Note that estimated lint yields were computed using the average gin turnout for each production year.

Tillage treatment (no-till versus conventional till with cultivation) significantly affected ($p<0.0001$) the average seed cotton yield over the three-year experiment. Average seed cotton yields and estimated lint yields for the four tillage treatments for each production year are shown in Tables 6 and 7, respectively. Conventionally tilled plots produced an average yield of 3474 pounds of seed cotton per acre, while no-till plots yielded an average of 3155 pounds of seed cotton per acre. Specifically, conventionally prepared plots with cultivation produced an average yield advantage of 318 pounds of seed cotton per acre during the three-year experiment. In two of the three years, tillage treatment had a significant effect upon yield. Only in 1995 was tillage treatment shown not to be a significant factor in predicting yield. There was not a statistically significant ($p>0.07$) interaction between tillage treatment and the production year, denoting that conventional tillage tended to consistently produce greater yields year to year (refer to Tables 6 and 7).

Application of the growth regulator Pix did not have a significant effect ($p>0.15$) upon the average seed cotton yields observed across the various treatment combinations over the three-year experiment. Average seed cotton yields and estimated lint yields for the two growth regulator treatments (treated and non-treated) for each production year are shown in Tables 8 and 9. Plots treated with Pix yielded an average of 3429 pounds of seed cotton per acre, while plots receiving no application of the growth regulator produced an average of 3359 pounds of seed cotton per acre over the duration of the experiment. Thus, plots treated with Pix produced an average yield advantage of 70 pounds of seed cotton per acre. However, as indicated previously, this yield advantage was not statistically significant. Note that Pix had a significant effect upon yield in only one year out of three and that was in 1995. Further note that the numerical yield advantage associated with application of Pix was not always positive. For example, Pix tended to reduce yield in 1994, though the magnitude of the reduction was not statistically significant. Recall that Hake (1990) reported that application of Pix could be detrimental to yield under certain conditions. Moreover, in an adjacent study involving production in 30- and 40-inch rows, Hart et al. (1995) had observed that the positive yield advantage of applying Pix was much more pronounced in 40-inch rows than in 30-inch rows. That experiment was conducted using a different variety (DPL-50) than that used in the current study (DPL-20). Results of these studies suggest that there are questions as to whether using Pix in 30-inch rows may be truly advantageous.

Clearly, the advantage of Pix is dependent upon the production season. The interaction between application of the growth regulator Pix and the production year had a significant effect ($p<0.038$) on average seed cotton yields (refer to Table 8).

Conclusions

Based upon analyses of the pooled data set comprised of measurements taken over the entire three-year period, 1993 through 1995, in the specific field study described above, the following can be concluded:

1. Yield performance of cotton was affected by tillage system. In particular, conventionally prepared seedbeds with post emergence cultivation resulted in significantly higher yields than no-tillage planting. However, the number of post emergence cultivations, either one, two, or three, was not a significant factor in predicting yield of the plots with conventionally prepared seedbeds. The effect of tillage treatment was generally consistent, in that in only one year was tillage treatment not shown to be a significant factor in predicting yield.

2. Application of the growth regulator Pix had no significant effect upon mean crop yield over three years. Only in 1995 did the application of Pix result in a significant yield advantage. Any yield advantage associated with the application of Pix to this particular cotton variety grown in 30-inch rows appears to be dependent upon the nature of the growing season.

3. Physiological development of cotton produced using no-tillage was similar to that of cotton planted in conventionally prepared seedbeds. In particular, activity at fruiting sites as indicated by frequency counts of squares, aborts, green bolls, and open bolls over the growing season were similar regardless of tillage treatment. Further, tillage treatment did not have a discernible effect upon the maximum number of nodes, plant height, or main stem diameter.

4. Sequential applications of Pix were effective in controlling vegetative growth as indicted by plant height. For instance, Pix-treated plants were, on the average, about five inches shorter than untreated plants at harvest maturity in 1995. In the one year when Pix-treated plants out-yielded the untreated cotton, a significantly greater number of green bolls were observed on the plants treated with Pix as compared to those not treated.

5. Plant maturity or earliness as indicated by the percentage of the total crop collected during the first picking was affected by neither tillage treatment nor application of the growth regulator Pix.

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Table 1. Average number of days required to establish crop canopy closure for four tillage treatment combinations.

Tillage Treatment	Mean Number of Days for Canopy Closure[1]
No-Till	73.5a
Conventionally Tilled - 1 Cultivation	65.8b
Conventionally Tilled - 2 Cultivation	69.0c
Conventionally Tilled - 3 Cultivation	70.5c

[1]Means followed by the same letter are not significantly different (p>0.05)

Table 2. Average percentage of seed cotton yield harvested during the first pick for four tillage treatments.

Treatment Description	Mean Percent Seed Cotton Yield for First Picking[1]
No-Till	83.6a
Conventionally Tilled - 1 Cultivation	81.9a
Conventionally Tilled - 2 Cultivation	79.3a
Conventionally Tilled - 3 Cultivation	82.1a

[1]Means followed by the same letter are not significantly different (p>0.05)

Table 3. Average seed cotton yields for the eight tillage/cultural practice combinations for the 1995 crop.

Treatment Description	Mean Seed Cotton Yield (lbs/ac)	Est. Mean[1] Lint Yield (lbs/ac)
No-Till	2744	916
Conventionally Tilled - 1 Cult	3044	1017
Conventionally Tilled - 2 Cult	2847	951
Conventionally Tilled - 3 Cult	2977	994
No-Till - Pix application	3087	1031
Conventionally Tilled - 1 Cult - Pix	2903	970
Conventionally Tilled - 2 Cult - Pix	3242	1081
Conventionally Tilled - 3 Cult - Pix	3099	1035

[1]Lint yields are estimates computed from an average gin turnout of 33.4 percent.

Table 4. Average seed cotton yields for tillage treatments, no-till and conventionally tilled plots with different number of cultivations for the 1995 crop.

Treatment Description	Mean Seed Cotton Yield[1] (lbs/ac)
No-Till	2915a
Conventionally Tilled - 1 Cultivation	2974a
Conventionally Tilled - 2 Cultivations	3044a
Conventionally Tilled - 3 Cultivations	3038a

[1]Means followed by the same letter are not significantly different (p>0.05)

Table 5. Average seed cotton and lint yields observed over the three-year study.

Average Cotton Yields[1]	Production Year 1993	1994	1995
	(pounds per acre)		
Seed Cotton	2744	4446	2992
Lint	936	1672	1000

[1]Estimated lint yields were computed using average gin turnouts of 34.1, 37.6, and 33.4 percent for production years 1993, 1994, and 1995, respectively.

Table 6. Average seed cotton yields for the four tillage practices observed over the three-year study.

Tillage Practice	Production Year 1993	1994	1995	Mean[1]
	(pounds of seed cotton per acre)			
No-till	2456a	4095a	2915a	3155a
Conv till, 1 cult	2940b	4608b	2974a	3507b
Conv till, 2 cult	2674ab	4516b	3044a	3411b
Conv till, 3 cult	2904b	4565b	3038a	3502b

[1]Means in the same column followed by the same letter are not significantly different (p>0.05)

Table 7. Estimated lint yields for the four tillage practices observed over the three-year study.

Tillage Practice	Production Year 1993	1994	1995	Mean[1]
	(estimated pounds of lint per acre[2])			
No-till	837	1540	974	1117a
Conv till, 1 cult	1003	1734	993	1243b
Conv till, 2 cult	912	1698	1017	1209b
Conv till, 3 cult	990	1716	1015	1240b

[1]Means followed by the same letter are not significantly different (p>0.05)
[2]Estimated lint yields were computed using average gin turnouts of 34.1, 37.6, and 33.4 percent for production years 1993, 1994, and 1995, respectively.

Table 8. Average seed cotton yields for two growth regulator treatments (treated and non treated) observed over the three-year study.

Application of Growth Regulator	Prouction Year 1993	1994	1995	Man[1]
	(pounds of seed cotton per acre)			
No Pix	2673	4501	2903	359a
Pix	2814	4390	3082	3429a
Difference	141(ns)	111(ns)	179(s)	70

[1]Means followed by the same letter are not significantly different (p>0.05)

Table 9. Estimated lint yields for the two growth regulator treatments (treated and non treated) observed over the three-year study.

Application of Growth Regulator	Production Year 1993	1994	1995	Mean[1]
	(estimated pounds of lint per acre[2])			
No Pix	911	1692	970	1191a
Pix	960	1651	1030	1213a
Difference	49(ns)	41(ns)	60(s)	22

[1]Means followed by the same letter are not significantly different (p>0.05)
[2]Estimated lint yields were computed using average gin turnouts of 34.1, 37.6, and 33.4 percent for production years 1993, 1994, and 1995, respectively.

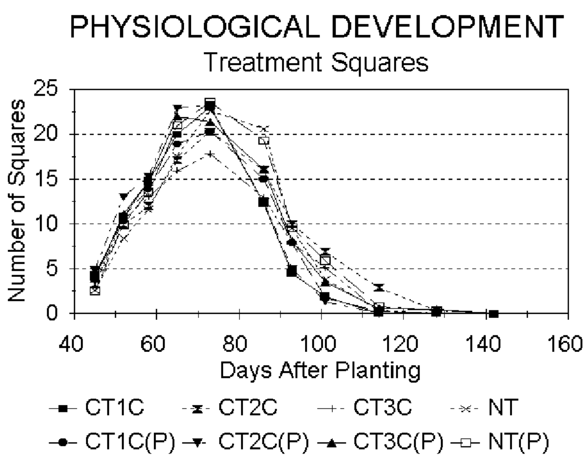

Figure 1. Average number of squares per plant for the various tillage and growth regulator treatment combinations.

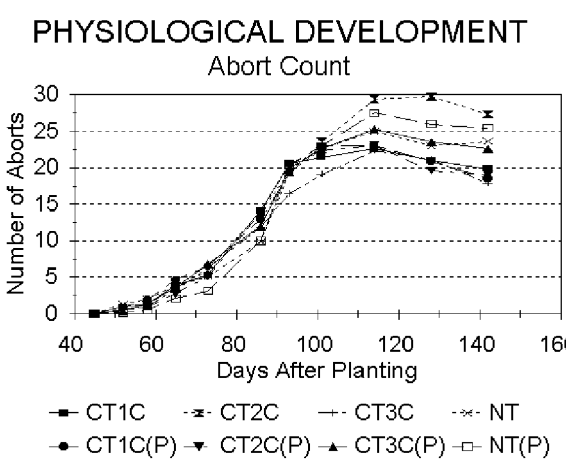

Figure 2. Average number of aborts per plant for the various tillage and growth regulator treatment combinations.

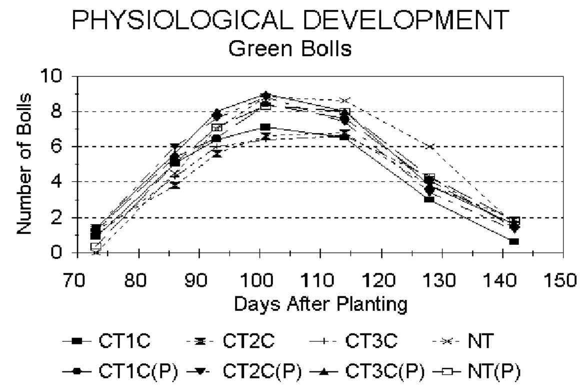

Figure 3. Average number of green bolls per plant for the various tillage and growth regulator treatment combinations.

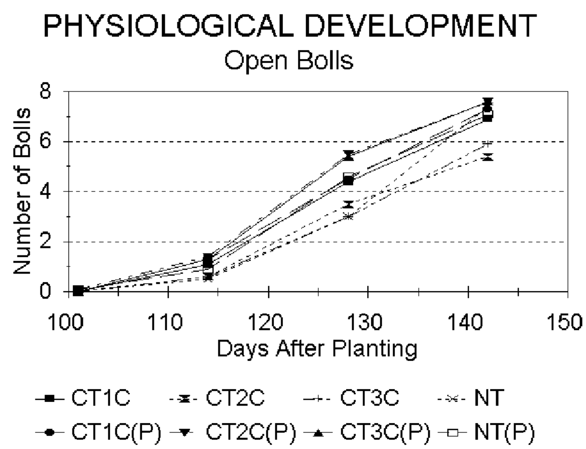

Figure 4. Average number of open bolls per plant for the various tillage and growth regulator treatment combinations.

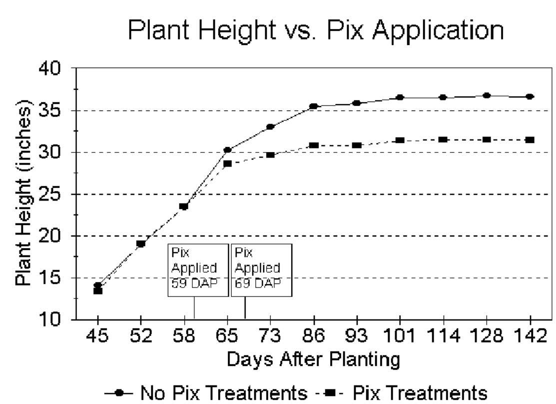

Figure 5. Plant height response to application of the growth regulator Pix.