EFFECTS OF VARIOUS DATES AND LEVELS OF SQUARE REMOVAL OF TAMCOT 788 COTTON

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CHAPTER I

INTRODUCTION

The use of insecticides produces many undesirable side-effects such as hazard to man, injuring non-target animals like beneficial arthropods, and producing outbreaks of minor pests. Certain insecticides cause the development of resistance of target pest and increase environmental pollution. In spite of these problems, in many cases the applications of insecticides is still the most effective prevention to the losses of crop yields caused by insect pests.

Concerning works on cotton, Adkisson, et al. (1964b), who studied the damaged fruit index of bollworms (Heliothis spp.), suggested that the survey of larval densities of these pests prior to insecticidal application would be useful.

As mentioned in the literature review, many workers have found that the loss of cotton fruit during certain stages of plant development did not reduce the final yields. These instances showed that early season insect control is often not needed. However, many of these works were limited and incomplete. Different varieties of cottons in various locations exhibit much variation in their ability to compensate for fruit losses (Pate and Young, 1971), thus more or less affecting the final yield.

Local studies on simulated fruit damage to particular varieties of cotton were still needed to form a basis of economic fruit loss thresholds for cotton pests.

The objectives of this study were to obtain preliminary fruit loss effects from simulation square damage to Tamcot 788 cotton at two levels in each of three weekly periods in early season and at five levels, with a weekly repeat, in late season.

Hopefully, any information obtained from this study will aid in establishing the economic threshold levels of square damage for the said variety of cotton and will also be useful as a basis for future related research.

CHAPTER II

LITERATURE REVIEW

Hamner (1941) carried out studies in Mississippi from 1936 to 1939 to determine whether cotton could overcome the loss of young squares early in the season. The damage was simulated by removing all the squares from six sets of plants 1-6 times at weekly intervals. The first picking was made four days after half the plant had visible squares. This date varied with the year from June 17 to July 8. The potential ability of the plant to grow new squares showed that the total numbers of squares removed in four or more pickings were greater than the number of blooms produced on untreated plants. The treated plants tended to have shorter blooming and fruiting periods and produced more blooms and bolls than the untreated. They were taller and had longer branches. There was a slight decrease in the size of the bolls and the staple length. The yield of seed cotton was not directly associated with the number of flowers or bolls produced. The complete loss of squares up to the end of the third week in July did not cause a significant reduction in yield when the plants were protected from pests and diseases. Plants that have lost all their squares for five or six weeks may become top-heavy and fall over.

The same author conducted research on boll weevil damage of cotton in Mississippi between 1939 and 1942 (Hamner, 1943). The squares were removed at weekly intervals throughout the fruiting period of 8 weeks.

It was found that the percentages of flowers which gave rise to mature bolls were always higher on the treated plants than on the controls, even when the percentage of squares removed each week was as low as 10 percent. The total number of flowers produced each year in treated plants decreased as the percentage of squares removed was increased. The bolls produced by treated plants were heavier than those produced by the controls, and the number of bolls per pound of seed cotton was reduced by nine or more on plots from which all squares were removed after the seventh week of square production. In 1939, the highest average yield was obtained from plots in which the percentage of squares removed in successive weeks were 10, 20, 30, 40, 50, 50, 50 and 50. The highest loss in yield from this treatment in any of the three years was 5.5 percent. The yields from plots in which the percentages of squares removed in successive weeks were 10, 20, 30, 40, 40, 40, 40 and 40 were higher than from the control in the first two years and were lower, only 0.9 percent, in the third year.

Dunnam, et al. (1943) conducted experiments at Stoneville, Mississippi, in 1939, 1940 and 1941, to determine the influence on yield of upland cotton by removing squares by hand. All squares over 6 or 7 days old were removed at weekly intervals for 1-9 weeks. At weekly intervals for 7-11 weeks, 10-50 percent of the squares were removed. They indicated that the square removal would result in a reduction of yield.

It was found by [Graham, et al. (1972)], Blackwell and Buie (1929), Eaton (1931), Ludwig (1939) and Smith (1922) that early square removal actually increases yield. The compensation for losses of squares during the early portion of the fruiting cycle enables a cotton plant to withstand relatively large Heliothis spp. populations without significant yield losses. However, in mid-season, when the majority of bolls are susceptible, the larvae can be much more damaging with little time left for the plant to produce new bolls. Again, late in the season when most of the crop has reached the hard or open boll stage, control measures may be unnecessary even though large numbers of larvae develop on new plant growth.

Kincade, et al. (1970) referred to their studies 1965-67 on simulating the damage of squares and bolls caused by the Heliothis zea (Boddie) and Heliothis virescens (Fabricius) larvae in 2 different areas in Mississippi. They used insect-free plots 72 ft. long to determine the effects of various infestation levels at different times of the season on cotton yield. The authors used the index of 2,541 and 5,082 larvae per acre in early, mid, and late season removal. For early season, they picked off 1 pinhead square and 3 small squares to represent the damage of 1 larva in the first week and 10 large squares for 1 larva a week later. For mid and late season, they also used a cork borer of 1/4 inch core to drill holes in the bolls, instead of picking them off a week later. They concluded that no single infestation of Heliothis spp. larvae of these magnitudes at any one time in early, mid and late season reduced cotton yield. However, they found that a season-long infestation greater than 5,082 larvae/acre (4 larvae/10 ft. of row) significantly reduced the yield below that of treated cotton. Their study indicated that relatively heavy infestations in mid and late season were required for yield reductions.

For boll weevil damage simulation, Coakley, et al. (1969) in Mississippi studied the result of the injection of water homogenates of the larvae to the square. They found that the injection of the said solution

(1 larval equivalent) of the second and third instarts into the squares caused abscission in 60 and 43 hours, respectively. Implantation of the second instar larvae into squares also caused abscission. However, the injection of water homogenates of eggs of various ages or of the first instar larvae showed no abscission.

Effects of increasing, constant, and fluctuating patterns of square removal (averaging 45 percent for 8 weeks) on fruiting characteristics, early date, and yield of Coker 100 W cotton were investigated by Mistric and Covington (1968) in North Carolina between 1957 and 1959 in an area protected from boll weevils. They concluded that plants compensated for each pattern of square removal by increasing square production, the percentage of bolls set, and the average weight of bolls. However, the extent to which each of these plant responses contributed to the total compensation varied with the patterns of square removal. The increasing pattern of square removal increased square production the least, the constant pattern increased average boll weight the least, and the fluctuating pattern increased the percentage of bolls set the least. Effects of the different patterns of square removal on yield were not significant, but effects on early date of production and harvest were significant and of practical importance. The fluctuation pattern of square removal delayed total production 10 days and total harvest 15 days. Both production and harvest were delayed an additional 2 weeks by the constant pattern of square removal and 3 weeks by the increasing pattern. The fluctuating pattern of square removal more nearly approximates weevil infestations in North Carolina, and it is potentially less detrimental to cotton production than the constant and increasing patterns. The effect of boll weevil square infestation on the yield of treated cotton was similar to the effect of square removal on the yield of protected cotton; that is, up to 45 percent (8-week average) square infestation or removal had no significant effect on yield. At about this level of square infestation, the yield of untreated cotton was reduced 50-60 percent, principally because of boll damage and boll abscission caused by weevil attack. Thus within this level of square infestation, protection of the yield was mostly a matter of protecting bolls. Three treatment schedules are described which protected the yield at square infestation levels, ranging from about 10 to 45 percent.

In 1905, Quaintance and Brues (according to Graham, et al., 1972) found that the average consumption of the bollworm, Heliothis zea (Boddie), during their larval period on the cotton plant was 8 squares, 1 flower, and 1-2/3 bolls per larva, but the variation among larval individuals was great. They concluded that 7 or 8 larvae completing their development on a cotton plant could almost destroy its fruit. They suggested that the amount of injury was the best method to estimate the number of larvae present. Similar observation was made on cotton by Kincade, et al. (1967) in Mississippi. The average consumption of tobacco budworm, Heliothis virescens (Fabricius) was found to be about 10 squares, 1.2 blooms, and 2.1 bolls per larva.

Adkisson, et al. (1964a) in Texas in 1961 and 1962 compared the yield and quality of cotton exposed in big cages to 3 levels of infestation of bollworms during the first week of flowering. They concluded that a season-long infestation of 8-10 larvae/100 plants or more than 2/10 ft. of row caused significant damage with loss in yield. They found significant losses in yield when an average of more than 3 percent of squares or bolls was damaged in a season. They also found that 23.2

larvae/100 plants or 7.1 larvae/10 ft. of row caused a heavy loss of 12.6 percent bolls in 1962 and reduced the yield 836 lbs./acre.

In simultaneous field tests, the same workers attempted to establish different levels of infestation of Heliothis spp. by applying insecticides with different degrees of effectiveness and compared damage to the crop in these treatments (Adkisson, et al., 1964b). Their results showed a seasonal average of 3.8 damaged squares/larva in 1961 and 5.7 in 1962 in the untreated plots. Statistical analysis indicated the yields among insecticides and check treatments were not significantly different in 1961, though the untreated check had a seasonal average of 1,977 larvae/acre, which was significantly higher than the 432/acre in the best insecticide treatment. The seasonal range in larval population was 0-5,750/acre in the check and 0-1,250 in the best insecticide treatment.

In 1962, however, greater populations of Heliothis caused significant yield reductions among insecticide treatments and check. The best insecticide treatment had a seasonal average of 977 larvae/acre with 7.8 and 4.0 percent damaged squares and bolls, respectively, while the untreated check had a seasonal average of 3,636 larvae/acre with 16.7 and 9.2 percent damaged squares and bolls, all of which were significantly higher than those in the best insecticide treatment. Yields were reduced significantly in the check plot, with a reduction in mean yield of 925 lbs. seed cotton from that of the best treatment. Another insecticide treated plot had larval populations and percentages of damaged fruit similar to the check, though its yield was significantly higher than the check. Based on these results, these workers concluded that 2,000-2,500 larvae/acre (1.5-2.0/10 ft. of row) would constitute a damaging population. Using damaged fruit as an index, they stated that with 6-8 percent or more damaged bolls, significant losses in yield would occur. Also, they suggested that larval counts based on unit area were more valid for the purpose of determining when to apply insecticides than those based on larvae per plant. Ridgway (according to Graham, et al., 1972) agreed with their economic threshold of infestations of 2,000-2,500 larvae/acre for central Texas, but he pointed out that this was based on a seasonal average and higher populations could be tolerated at times, depending on local conditions.

CHAPTER III

MATERIALS AND METHODS

Field experiments were conducted near Tipton, in southwestern Oklahoma, during the summer of 1972. The total area of the plots was 1.10 acres.

The plots were planted on May 23, with 15 pounds of Tamcot 788 seed per acre. The cotton was irrigated 3 times during the growing season. Four row plots 60 ft. long replicated 5 times (completely randomized-block design), were used. Twelve treatments were involved. Six treatments consisted of early season square removal, 5 treatments of late season square removal and a check.

Treatment 1: Fifty percent of the squares were hand picked and counted after the first week of fruiting (June 30).

Treatment 2: One hundred percent of the squares were picked and counted after the first week of squaring (June 30).

Treatment 3: Fifty percent of the squares were picked and counted after 2 weeks of squaring (July 7).

Treatment 4: One hundred percent of the squares were picked and counted after 2 weeks of squaring (July 7).

Treatment 5: Fifty percent of the squares were picked and counted after 3 weeks of squaring (July 14).

Treatment 6: One hundred percent of the squares were picked and counted after 3 weeks of squaring (July 14).

Treatments 7, 8, 9, 10 and 11: Five, ten, twenty, thirty and forty percent of squares were picked, respectively, after 5 weeks of squaring (July 26) and repeated again at the same percentages for the following week (August 3). To make these percentages of square removal in each plot, squares were checked through the plot and squares were picked off at intervals that produced the percentage desired. For example, when picking 10 percent of the squares off the plot, one square was picked at every interval of ten squares checked. However, this method was not practical and was changed after the first square picking. In the new method, the squares were randomly counted on all plants in a 10 ft. distance of each row in the plots. These were calculated to the percentages desired for each specific plot and then picked off randomly through the whole of each plot. Later, the sampling distance on each row was changed to 5 ft. instead of 10 ft. This was begun with the second replication during the second square removal (August 3).

Treatment 12 (check): Squares were left naturally.

To obtain data: For treatments 1-6 (early season square removal), the numbers of squares on July 14 and 20 were randomly counted on the whole plants in 10 ft. of each row. This was begun 2 weeks after the squares were picked off of each plot and continued weekly until the eighth week of squaring (August 16). However, to facilitate the works, the sampling distance on each row was changed to 5 ft. This was begun with the second replication during the sixth week of squaring (August 3).

For treatments 7-11 (late season square removal), the squares, blooms and bolls were randomly counted on the whole plants in 10 ft. of each row in the plots. This was started a week after the first square removal and continued weekly, 3 times, until the eighth week of squaring

(August 16). Also the sampling distance was changed to 5 ft., beginning with the second replication of the sixth week of squaring (August 3).

For treatment 12 (check), the numbers of squares, blooms and bolls were randomly counted, on all plants in 10 ft. of each row of the plot. This was started the fifth week of squaring (July 26) and continued weekly, 4 times, until the eighth week of squaring (August 16). Again, the sampling distance was changed to 5 ft. from the same replication and same date as all treatments above.

All the data obtained above were calculated to find the average numbers of squares, blooms, bolls and total fruits of each plot.

Yields (cotton in burr) were harvested manually from the first row of every plot and weighed separately on October 16. The data were subjected to analysis of variance and L.S.D. test was applied to treatment means to determine the differences between the check and each treatment.

CHAPTER IV

RESULTS AND DISCUSSION

Normal Fruit Production of Tamcot 788 Cotton

The squares from Tamcot 788 cotton were first counted and removed on June 30, from 2 treatments of early season square removal (treatments 1 and 2) presented in Table I. The cotton had been fruiting approximately one week. The average numbers of squares per plot were 336.8 to 416.8 in a 240 ft. row. The cotton had been planted 39 days. Also the square production during the following two weeks, July 7 and 14, was assumed, from treatments 3, 4 and 5, 6 of the same table. The averages ranged from 729.2 to 837.8 and 1710.0 to 1885.4 per plot, respectively. On July 20, one week later, the squares considered as normal production of the plants were not counted. On July 26, August 3, 8 and 16 the normal square production was obtained again from check plots as shown in Table I. They averaged 2857.2, 3375.6, 2205.6 and 2112.0 squares per plot, respectively. Normal bloom and boll production was also obtained from check plots as shown in Table I. They averaged 252.0, 249.6, 405.6 and 163.2 blooms per plot and 307.6, 1861.2, 2539.2 and 3508.8 bolls per plot on July 26, August 3, 8 and 16, respectively. Thus total fruit production which included squares, blooms and bolls in the check plot of the same table is 3916.8, 5486.4, 5150.4 and 5784.0 as average numbers per plot on July 26, August 3, 8 and 16, respectively.

Patterns of Fruit Production of Tamcot 788 Cotton After Early Season Square Removal

Patterns of fruit production of Tamcot 788 starting 2 weeks after square removal in early season in each treatment were studied until August 16 or 85 days after planting. These were shown separately as squares, blooms, bolls and total fruits. Figures 1-4 are graphics derived from parts of Table I.

The peaks of square production were found on August 3 (Figure 1) for 6 treatments of early season square removal plus the check. The 100 percent third week square removal plot showed the highest peak on the said date after 2 treatments. The 50 percent second week square removal and the 50 percent third week square removal, showed lower peaks than the check. The last survey on August 16 showed that the square production was still highest in the 100 percent third week square removal plot. The 50 percent second week square removal plot was still lower than the check while the 50 percent first week square removal plot showed square production below the check on this date. However, from August 3 to 8 and from August 8 to 16 all plots showed a decline in square production.

Bloom production of all early season square removal treatments plus the check reached peaks on August 8 (Figure 2). Two peaks were higher than the check. These were the 100 percent first week square removal plot, the highest, and the 100 percent second week square removal plot. The lowest peak was the 50 percent second week square removal plot. The last survey on August 16 showed that bloom production of the 100 percent first week square removal plot was still highest and the 100 percent second week square removal plot was still higher than the check. But the 50 percent first week square removal plot was the only one that was lower than the check.

Boll production of all treatments of early season square removal and check is shown in Figure 3. The 100 percent first week square removal plot showed a pronounced reduction in the transformation from blooms to bolls from August 8 to 16. This was compared with the other plots which showed almost steady inclined patterns. The 100 percent second week square removal plot exhibited highest boll production on the last studied date, August 16. No treatment showed any decline during the studied period.

Fruit production (including squares, bolls and blooms) from early season square removal plots and the check is shown in Figure 4. The treatment of 50 percent first week square removal reached a peak on August 3 while the treatment of 50 percent second week square removal reached a peak on August 8. The other treatments exhibited their highest production of fruits on August 16.

Patterns of Fruit Production of Tamcot 788

Cotton After Late Season Square Removal

Patterns of fruit production of Tamcot 788 starting from August 3, about a week after first square removal in late season to August 16 or 85 days after planting were studied. These are shown separately as squares, blooms, bolls and total fruits, in Figures 5-8 which were graphically derived from parts of Table I.

Among 5 treatments of late season square removal plus the check (Figure 5), all patterns of square production declined on August 8. On August 16 treatments of 20, 30 and 40 percent square removal showed slight incline patterns while treatments of 5 and 10 percent square removal plus the check still showed declined patterns even though squares were diminishing.

Bloom production of late season square removal treatments and check (Figure 6) showed inclined patterns from August 3, a week after first square removal, to August 8 where bloom production peaked. These were especially pronounced in the check and the 20 percent square removal plot. The treatments of 30 percent square removal showed a slight decline pattern during the same period of time. Then the patterns of all treatments declined toward August 16.

Boll production of late season square removal treatments and the check is shown in Figure 7. The 30 percent square removal plot showed more diminishing inclined pattern toward August 16 than any of the other treatments. All treatments showed boll production below the check on August 16 even though 3 treatments, 5, 10 and 30 percent square removal plots showed higher production than check on August 3 which was about a week after first square removal. Only the 5 percent square removal plot remained higher on August 8.

Fruit production of late season square removal treatments and the check is shown in Figure 8. Only one treatment, the 20 percent square removal, showed an inclined pattern of fruit production from August 3 to August 8. Other treatments and the check exhibited declined patterns during the same period of time. This was very pronounced in the 10 percent square removal plot, and only the treatment of 5 percent square removal showed a slight declined pattern from August 8 to August 16. The last survey for fruit production on August 16 showed that all treatments of late square removal were still far below the check. This was especially evident in the 30 percent square removed plot. This indicates that the cotton could not compensate the fruit to the normal level within a period of 2 weeks after a second square removal in late season.

Effects of Various Dates and Levels of Square Removal on Late Fruit Production of Tamcot 788 Cotton

The average numbers of fruits (including squares, blooms and bolls) per plot of 240 ft. row obtained from the last count on August 16, 85 days after planting or 8 weeks after squaring, in each of the treatments were studied to determine the effects of different combinations of square removal. A conclusive study from the analysis of variance (Table II) is shown in Table IV. The data show that the late fruit production in all treatments ranged from 6902.4, 6364.8, 6326.4, 6302.4, 5784.0 (check), 5020.8, 4929.6, 4867.2, 4821.6, 4804.8, 4512.0 and 4228.8 in treatments 6, 2, 5, 4, 12 (check), 3, 1, 11, 9, 7, 8 and 10, respectively. From these, only the treatment of 30 percent square removal in late season showed significant reduction in late fruit production. The other treatments showed no statistical differences from the check and this was also evident when only late season treatments were considered separately. Among early season treatments, late fruit production of the 100 percent square removal plots was apparently higher than the 50 percent square removal plots of the same dates during square removal. This was statistically valid between 2 plots of first week square removal as shown in treatments 1 and 2.

Effects of Various Dates and Levels of Square Removal on Harvest Yields of Tamcot 788 Cotton

Yields of Tamcot 788 harvested on October 16, or 146 days after planting are shown in Table V. The yields ranged from 15.552, 15.456, 14.88, 14.784 (check), 14.40, 13.536, 13.44, 13.344, 12.096, 12.096, 11.328 and 11.04 pounds of cotton lint per plot (240 ft. row) in treatments 2, 5, 4, 12 (check), 1, 7, 8, 3, (6) and (10), 9 and 11, respectively. Average yields as pounds of cotton in burr per 60 ft. row in all the experimental plots were statistically analyzed. The analysis of variance in Table III showed that the differences within experimental replications and treatments were both highly significant. Conclusive studies from Table V showed that there were only 4 treatments, including 3 treatments of late season square removal and 1 treatment of early season square removal, which exhibited statistical reduction in yields. The 20 and 40 percent square removal plots in late season showed a highly significant yield reduction while the 30 percent square removal plot in late season showed significant yield reduction. The 100 percent third week square removal plot in early season also showed significant yield reduction.

Correlation Study Between Late Fruit Production and Harvest Yields of Tamcot 788 Cotton

Late fruit production obtained from the last count on August 16, 85 days after planting or 8 weeks after squaring, and yield as cotton in burr harvested on October 16, 146 days after planting, as mentioned above were statistically studied to determine whether or not they were correlated. A simple method of analysis using the formula:

$$r = \sum X \cdot Y - \frac{(\sum X)(\sum Y)}{n} \div \sqrt{\sum X^2 - \frac{(\sum X)^2}{n} \cdot \sum Y^2 - \frac{(\sum Y)^2}{n}}$$

where r = correlation coefficient,

X = late fruit production,

Y = harvest yield, and

n = numbers of treatments,

showed no correlation between late fruit production on the said date and harvest yield of Tamcot 788; the calculated r value (0.4578) was below the table r value (0.576) at .05 level of probability. From the results in Tables IV and V, in treatment 6, where 100 percent square removal took place the third week, produced the highest numbers of fruits on August 16 but gave a poor yield. This was significantly lower than the check. This might be due to the differences in compensation of fruit production such as fruit shedding, boll weight, maturity period of fruit and/or other unknown factors that occurred during the period of 61 days after the last count on August 16. In future research, sampling techniques and sampling dates should be exploited further.

CHAPTER V

SUMMARY AND CONCLUSIONS

Eleven combinations of dates and levels of manual square removal and a check were compared, using Tamcot 788 cotton, to determine the effects on fruiting patterns and harvest yields of cotton plants in field experiments. The test was conducted near Tipton, in southwestern Oklahoma, during the summer of 1972.

The differences in patterns of fruit production were found during 2 periods of fruitings. These periods were from August 3-8, when 50 percent of the fruit was removed during the second week, 50 percent the third week, 100 percent the first week and 100 percent the third week during early season. The 20 percent square removal plot in late season showed inclined patterns of fruit production while normal plant (check) and other treatments showed a decline. From August 8-16, the 50 percent first week and second week square removal plots in early season and the 5 percent square removal plot in late season showed declined patterns while normal plant (check) and others showed an incline in fruit production. Single square removal of Tamcot 788 in first, second and third week of fruiting (early season) and repeated square removal up to 40 percent in the fifth and sixth weeks of fruiting (late season) showed no reduction in late fruit production on August 16 or 85 days after planting by statistical analysis, except one treatment, the 30 percent square removal in late season.

Four treatments showed the effects in yield reduction. These were the 20, 30 and 40 percent square removal plots in late season and the 100 percent third week square removal plots in early season.

Harvest yield of all treatments showed no correlation with fruit production on August 16 or 85 days after planting.

LITERATURE CITED

Adkisson, P. L., C. F. Bailey, and R. L. Hanna. 1964a. Effect of the Bollworm, *Heliothis zea*, on Yield and Quality of Cotton. *J. Econ. Entomol.* 57(4): 448-50.

Adkisson, P. L., R. L. Hanna, and C. F. Bailey. 1964b. Estimates of the Number of Heliothis Larvae per Acre in Cotton and Their Relation to the Fruiting Cycle and Yield of the Host. *J. Econ. Entomol.* 57(5): 657-63.

Coakley, J. M., F. G. Maxwell, and J. N. Jenkins. 1969. Influences of Feeding, Oviposition, and Egg and Larval Development of the Boll Weevil on Abscission of Cotton Squares. *J. Econ. Entomol.* 62(1): 244-45.

Dunnam, E. W., J. C. Clark, and S. L. Calhoun. 1943. Effect of the Removal of Squares on Yield of Upland Cotton. *J. Econ. Entomol.* 36(6): 896-900.

Hamner, A. L. 1941. Fruiting of Cotton in Relation to Cotton Fleahopper and Other Insects Which do Similar Damage to Squares. *Bull. Miss. Agric. Exp. Sta.* 360: 11.

Hamner, A. L. 1943. The Effect of Boll Weevil Infestations at Different Levels on Cotton Yield. *Bull. Miss. Agric. Exp. Sta.* 389: 11.

Graham, H. M., P. D. Lingren, Charles Lincoln, and P. L. Adkisson. 1972. The Economic Threshold of Infestations for *Heliothis* spp. on Cotton. *So. Coop. Ser. Bull.* 169: 8-14.

Kincade, R. T., M. L. Laster, and J. R. Brazzel. 1970. Effect on Cotton Yield of Various Levels of Simulated *Heliothis* Damage to Squares and Bolls. *J. Econ. Entomol.* 63(2): 613-15.

Mistric, W. J., Jr., and B. M. Covington. 1968. Effects of Square Removal on Cotton Production With Reference to Boll Weevil Damage. *J. Econ. Entomol.* 61(4): 1060-67.

Pate, T. L., and E. F. Young, Jr. 1971. Effects of Simulated Insect Damage to Squares on Yields of Several Varieties of Cotton, El Paso Valley. Consolidated PR-3002-3009 on Research in Far West Texas, Tex. A & M Univ. 7-9.

APPENDIX

TABLES AND FIGURES

TABLE I

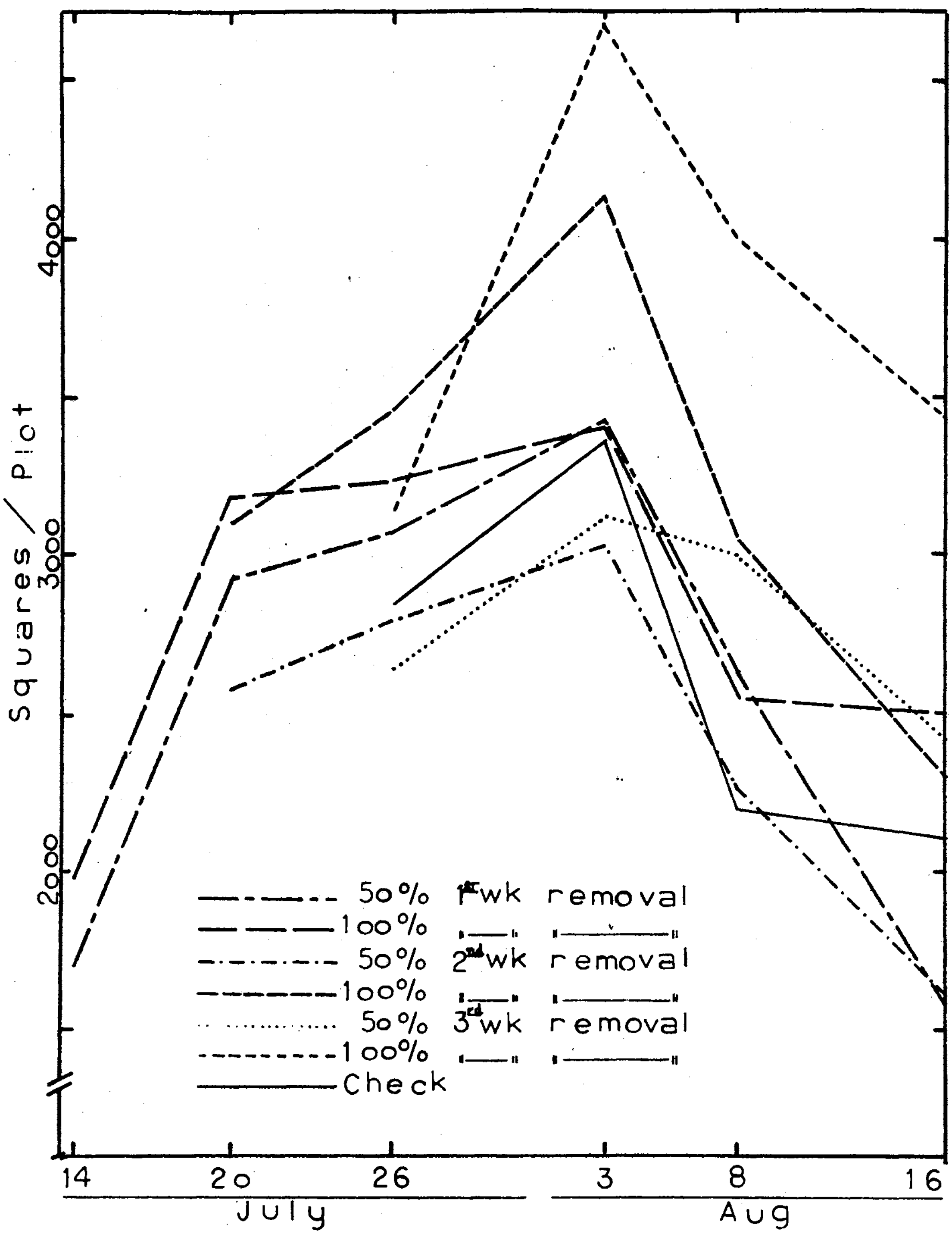
AVERAGE NUMBERS OF SQUARES, BLOOMS, BOLLS AND TOTAL FRUITS PER PLOT OF TAMCOT 788 COTTON IN EACH OF 12 TREATMENTS (INCLUDING CHECK) IN THE EXPERIMENT ON SQUARE REMOVAL, TIPTON, OKLAHOMA 1972

Treatment No.	Week of Square Removal	Percent of Square Removal	Dates Counted	Squares	Blooms	Bolls	Total Fruits
1	1	50	June 30	336.8	-	-	336.8
			July 7	-	-	-	-
			July 14	1713.6	-	30.0	1743.6
			July 20	2930.4	-	220.0	3152.4
			July 26	3081.6	331.2	775.2	4188.0
			Aug. 3	3433.2	252.0	1830.0	5515.2
			Aug. 8	2640.0	360.0	2328.0	5328.0
			Aug. 16	1598.0	148.8	3182.4	4929.6
2	1	100	June 30	416.8	-	-	416.8
			July 7	-	-	-	-
			July 14	1983.2	-	1.2	1984.4
			July 20	3192.0	-	142.8	3334.8
			July 26	3243.0	309.0	621.0	4173.0
			Aug. 3	3416.4	256.8	1965.6	4638.8
			Aug. 8	2577.6	381.6	2606.4	5564.6
			Aug. 16	2508.0	211.2	3645.6	6364.8
3	2	50	July 7	729.2	-	-	729.2
			July 14	-	-	-	-
			July 20	2588.4	-	182.4	2770.8
			July 26	2800.8	280.8	424.8	3506.4
			Aug. 3	3040.8	238.8	1634.4	4914.0
			Aug. 8	2272.8	352.8	2474.4	5100.0
			Aug. 16	1612.8	165.6	3242.4	5020.8
4	2	100	July 7	837.8	-	-	837.8
			July 14	-	-	-	-
			July 20	3112.8	-	12.0	3124.8
			July 26	3477.6	276.0	196.8	3950.4
			Aug. 3	4147.2	266.4	1449.6	5863.2
			Aug. 8	3069.6	468.0	2258.4	5796.0
			Aug. 16	2308.8	283.2	3710.4	6302.4
5	3	50	July 14	1710.0	-	-	-
			July 20	-	-	-	-
			July 26	2655.6	163.2	523.2	3342.0
			Aug. 3	3136.8	222.0	1428.0	4786.8
			Aug. 8	3004.8	367.2	2215.2	5587.2
			Aug. 16	2421.6	256.8	3648.0	6326.4

TABLE I (Continued)

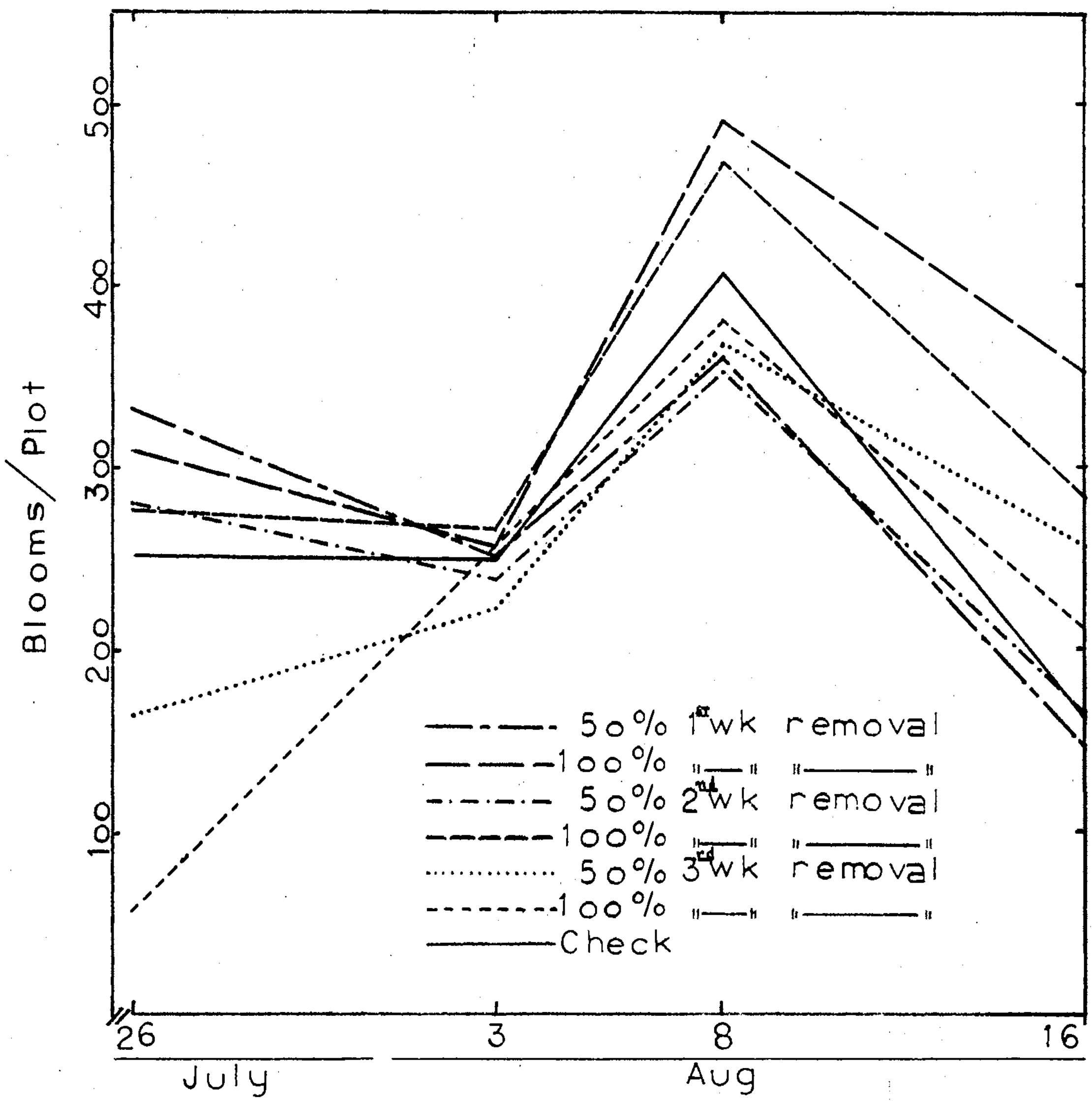
Treatment No.	Week of Square Removal	Percent of Square Removal	Dates Counted	Squares	Blooms	Bolls	Total Fruits
6	3	100	July 14	1885.4	-	-	-
			July 20	-	-	-	-
			July 26	3150.0	56.4	127.2	3333.6
			Aug. 3	4690.8	252.0	675.6	5618.4
			Aug. 8	4017.6	480.0	1536.0	6033.6
			Aug. 16	3441.6	352.8	3108.0	6902.4
7	5,6	5	July 26	2432.0	-	-	-
			Aug. 3	2797.2	237.6	2134.8	5169.6
			Aug. 8	1785.6	254.4	2786.4	4826.4
			Aug. 16	1334.4	134.4	3336.0	4804.8
8	5,6	10	July 26	2944.0	-	-	-
			Aug. 3	3166.8	220.8	2043.6	5431.2
			Aug. 8	1514.4	285.6	2304.0	4104.0
			Aug. 16	1168.8	108.0	3235.2	4512.0
9	5,6	20	July 26	3123.0	-	-	-
			Aug. 3	1935.6	139.2	1671.6	3746.4
			Aug. 8	1718.4	247.2	2100.0	4065.6
			Aug. 16	2104.8	112.8	2604.0	4821.6
10	5,6	30	July 26	2584.0	-	-	-
			Aug. 3	1891.2	174.0	2040.0	4105.2
			Aug. 8	1569.6	168.0	2316.0	4053.6
			Aug. 16	1644.0	84.0	2500.8	4228.8
11	5,6	40	July 26	3088.0	-	-	-
			Aug. 3	2554.8	171.6	1627.2	4353.6
			Aug. 8	1905.6	177.6	2054.4	4137.6
			Aug. 16	2224.8	112.8	2529.6	4867.2
12 (check)	-	0	July 26	2857.2	252.0	807.6	3916.8
			Aug. 3	3375.6	249.6	1861.2	5486.4
			Aug. 8	2205.6	405.6	2539.2	5150.4
			Aug. 16	2112.0	163.2	3508.8	5784.0

Figure 1. Patterns of Square Production of Tamcot 788 Cotton in Each Treatment of Early Season Square Removal (Including Check) Represented by Average Numbers of Squares per Plot (240 ft. row) Starting 2 Weeks After Square Removal to August 16, Tipton, Oklahoma, 1972



Squares / Plot
4000
3000
2000
50% 1st wk removal
100% " "
50% 2nd wk removal
100% " "
50% 3rd wk removal
100% " "
Check
14
20
26
3
8
16
July
Aug

Figure 2. Patterns of Bloom Production of Tamcot 788 Cotton in Each Treatment of Early Season Square Removal (Including Check) Represented by Average Numbers of Blooms per Plot (240 ft. row) Starting July 26 to August 16, Tipton, Oklahoma, 1972



Blooms/Plot
500
400
300
200
100
26
3
8
16
July
Aug
50% 1st wk removal
100% " "
50% 2nd wk removal
100% " "
50% 3rd wk removal
100% " "
Check

Figure 3. Patterns of Boll Production of Tamcot 788 Cotton in Each Treatment of Early Season Square Removal (Including Check) Represented by Average Numbers of Bolls per Plot (240 ft. row) Starting 2 Weeks After Square Removal to August 16, Tipton, Oklahoma, 1972

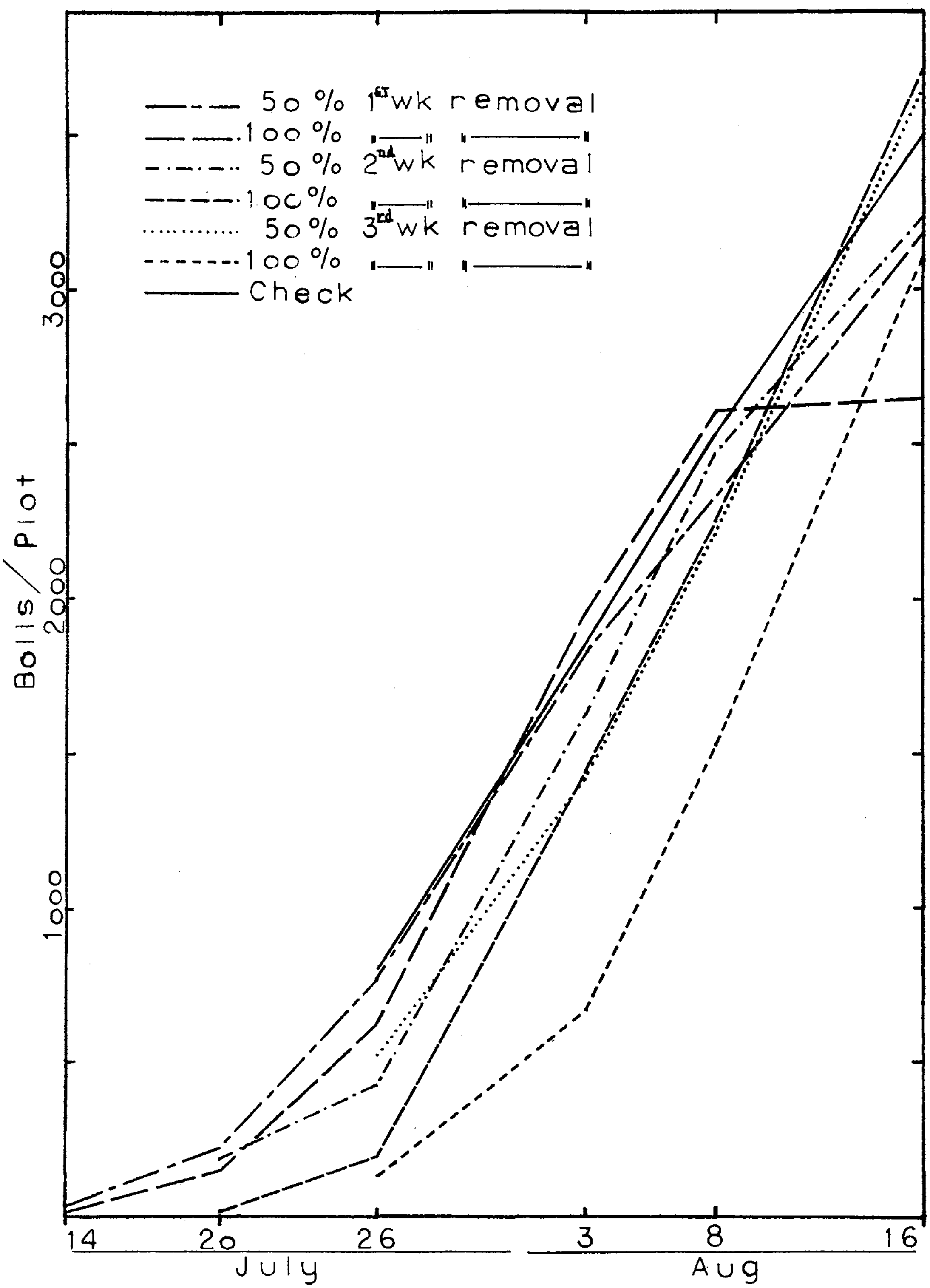
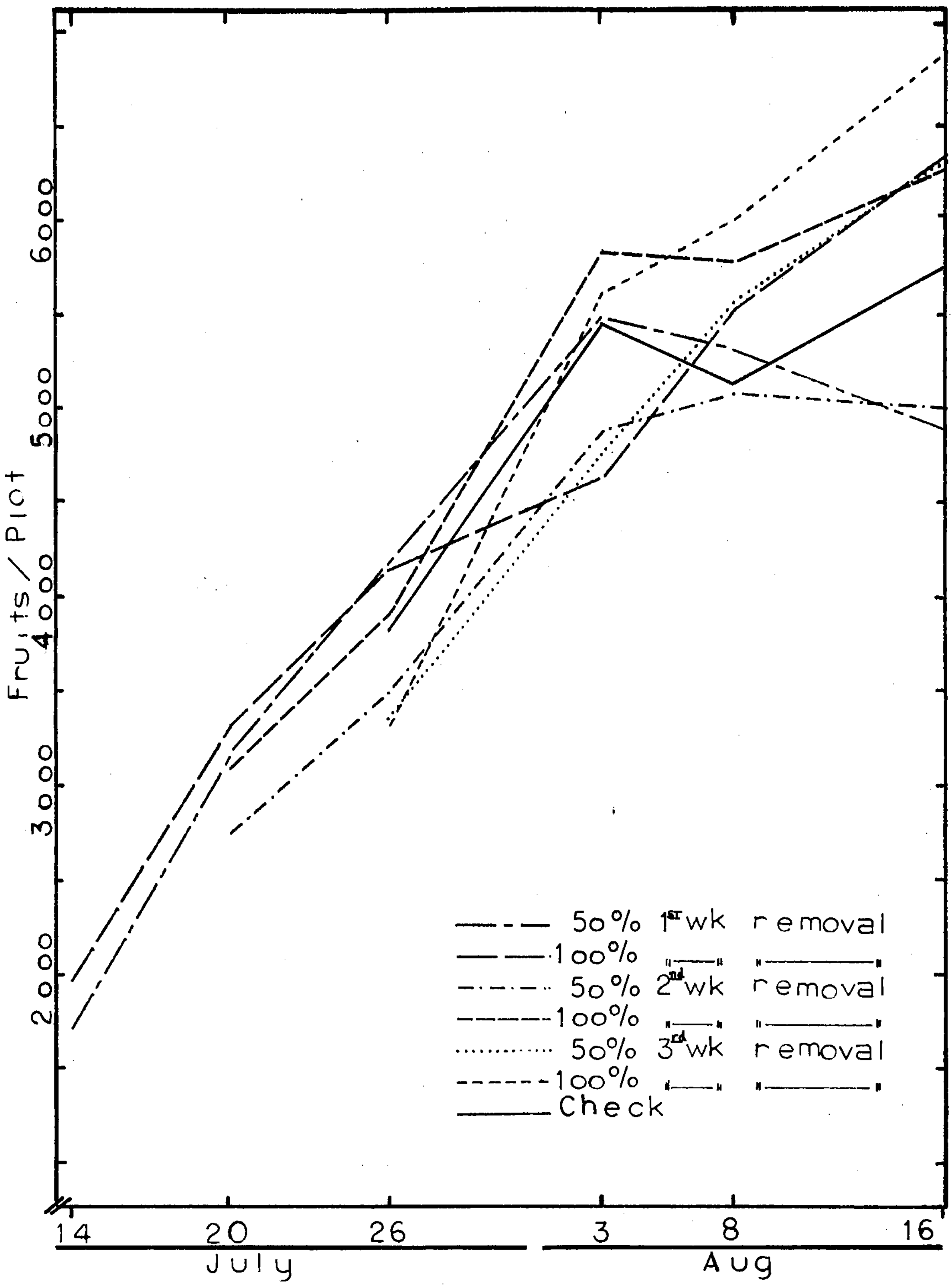

50 % 1st wk removal
100 % " "
50 % 2nd wk removal
100 % " "
50 % 3rd wk removal
100 % " "
Check
Bolls/Plot
1000
2000
3000
14
20
26
3
8
16
July
Aug

Figure 4. Patterns of Fruit Production of Tamcot 788 Cotton in Each Treatment of Early Season Square Removal (Including Check) Represented by Average Numbers of Total Fruits per Plot (240 ft. row) Starting 2 Weeks After Square Removal to August 16, Tipton, Oklahoma, 1972



Fruits / Plot
2000
3000
4000
5000
6000
50% 1st wk removal
100% " "
50% 2nd wk removal
100% " "
50% 3rd wk removal
100% " "
Check
14
20
26
3
8
16
July
Aug

Figure 5. Patterns of Square Production of Tamcot 788 Cotton in Each Treatment of Late Season Square Removal (Including Check) Represented by Average Numbers of Squares per Plot (240 ft. row) Starting 1 Week After First Square Removal to August 16, Tipton, Oklahoma, 1972

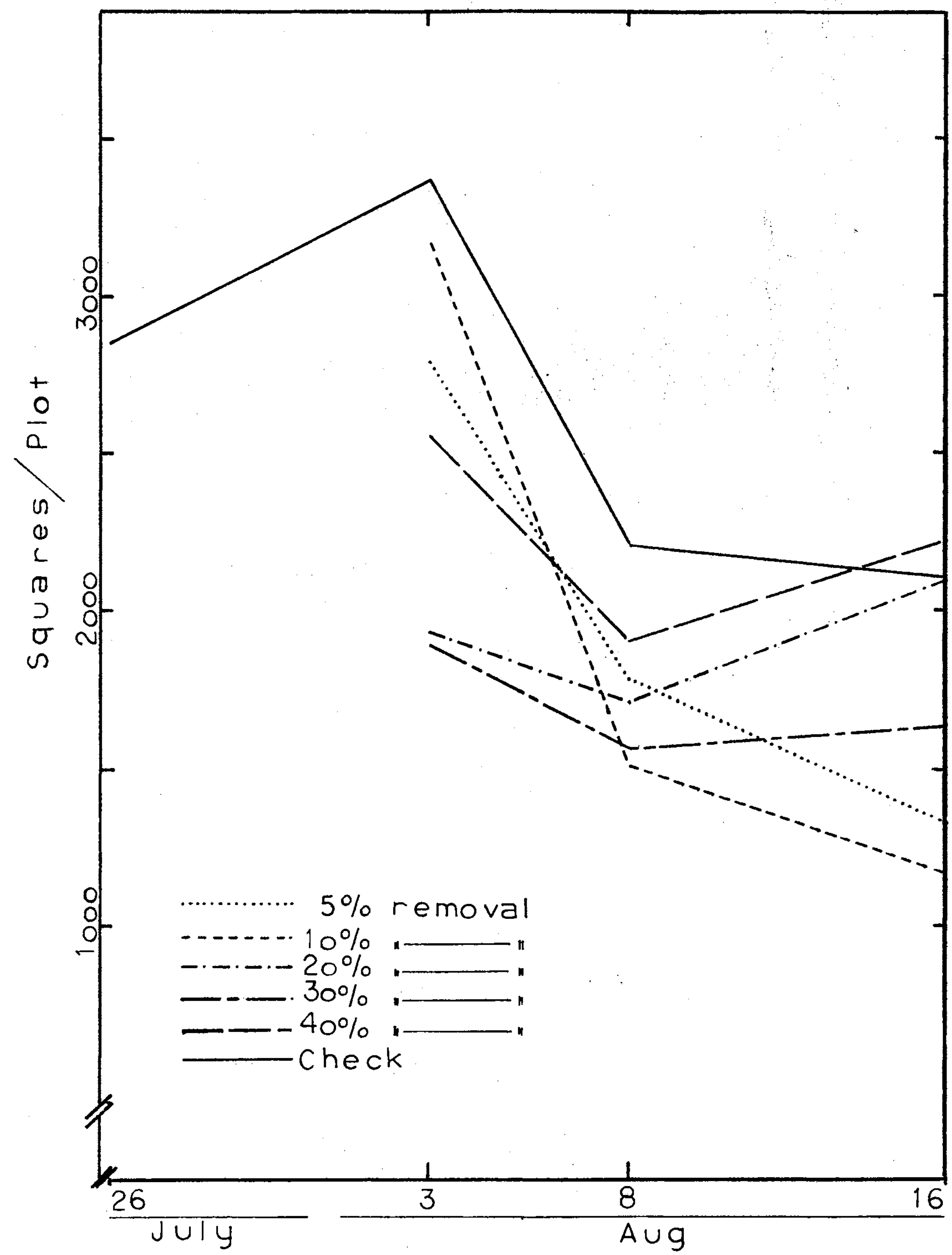

Squares/Plot
3000
2000
1000
26
3
8
16
July
Aug
5% removal
10% "
20% "
30% "
40% "
Check

Figure 6. Patterns of Bloom Production of Tamcot 788 Cotton in Each Treatment of Late Season Square Removal (Including Check) Represented by Average Numbers of Blooms per Plot (240 ft. row) Starting 1 Week After First Square Removal to August 16, Tipton, Oklahoma, 1972

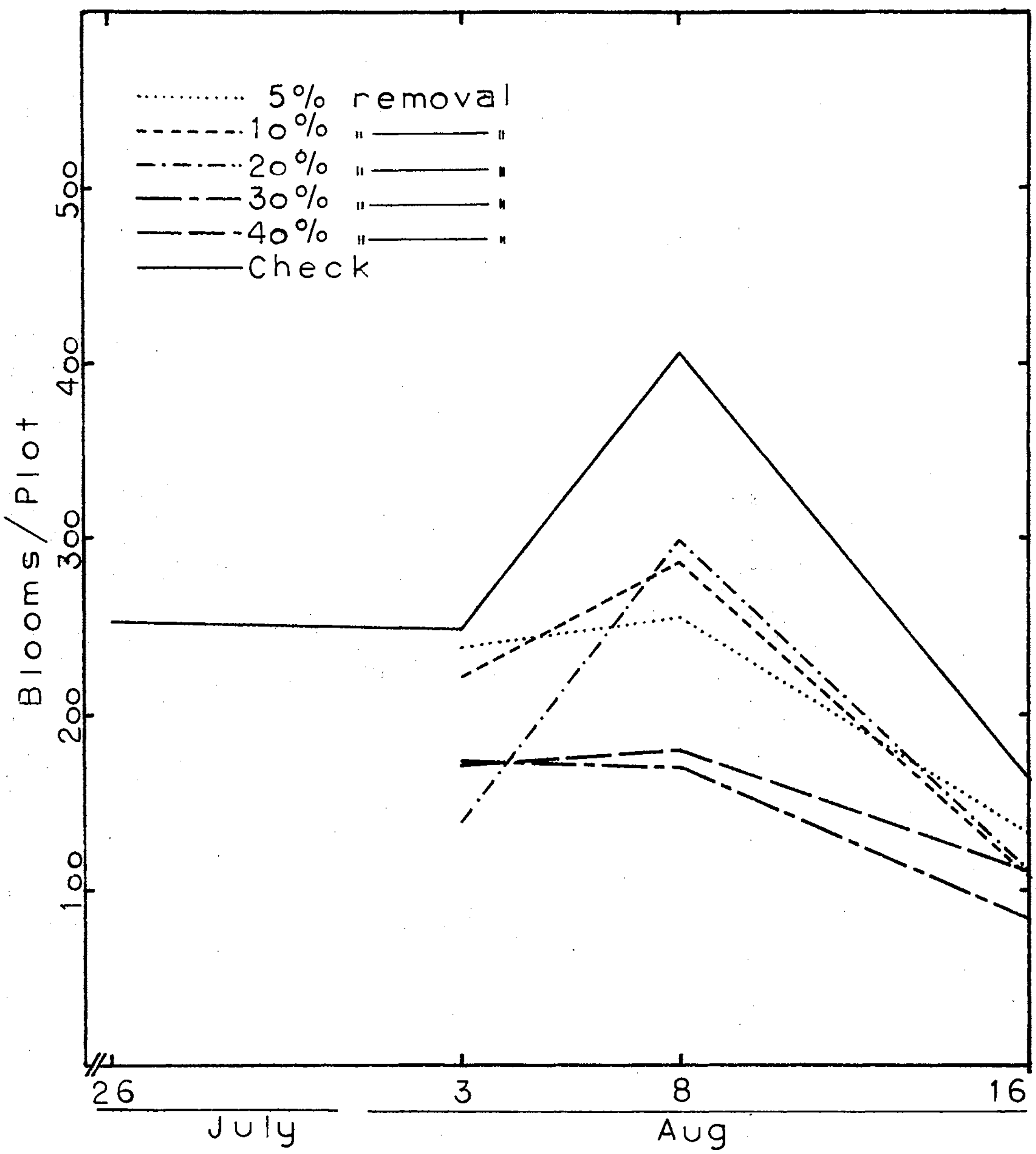

5% removal
10% " "
20% " "
30% " "
40% " "
Check
Blooms/Plot
500
400
300
200
100
26
3
8
16
July
Aug

Figure 7. Patterns of Boll Production of Tamcot 788 Cotton in Each Treatment of Late Season Square Removal (Including Check) Represented by Average Numbers of Bolls per Plot (240 ft. row) Starting 1 Week After First Square Removal to August 16, Tipton, Oklahoma, 1972

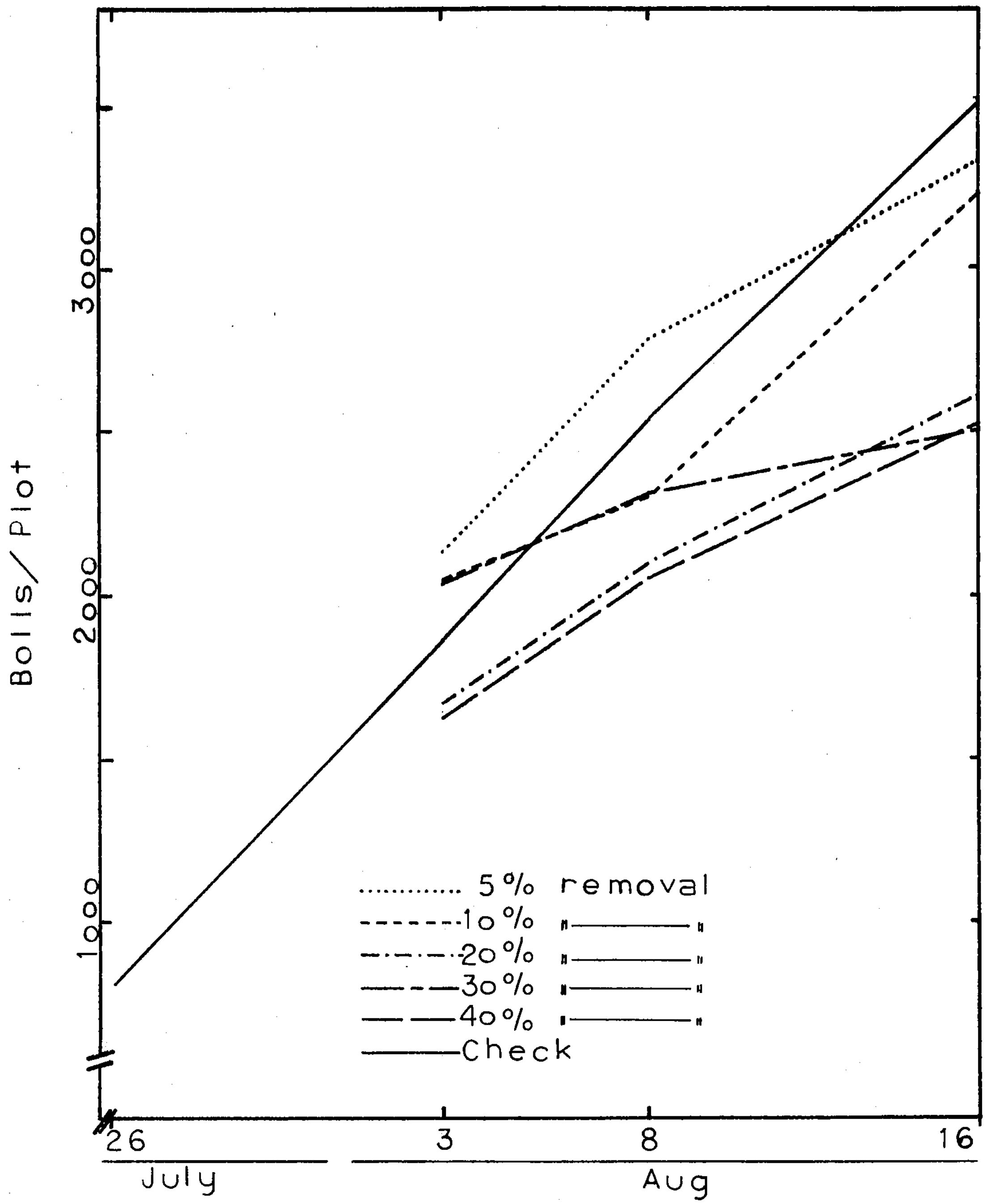

Bolls/ Plot
3000
2000
1000
5% removal
10% " "
20% " "
30% " "
40% " "
Check
26
3
8
16
July
Aug

Figure 8. Patterns of Fruit Production of Tamcot 788 Cotton in Each Treatment of Late Season Square Removal (Including Check) Represented by Average Numbers of Total Fruits per Plot (240 ft. row) Starting 1 Week After First Square Removal to August 16, Tipton, Oklahoma, 1972

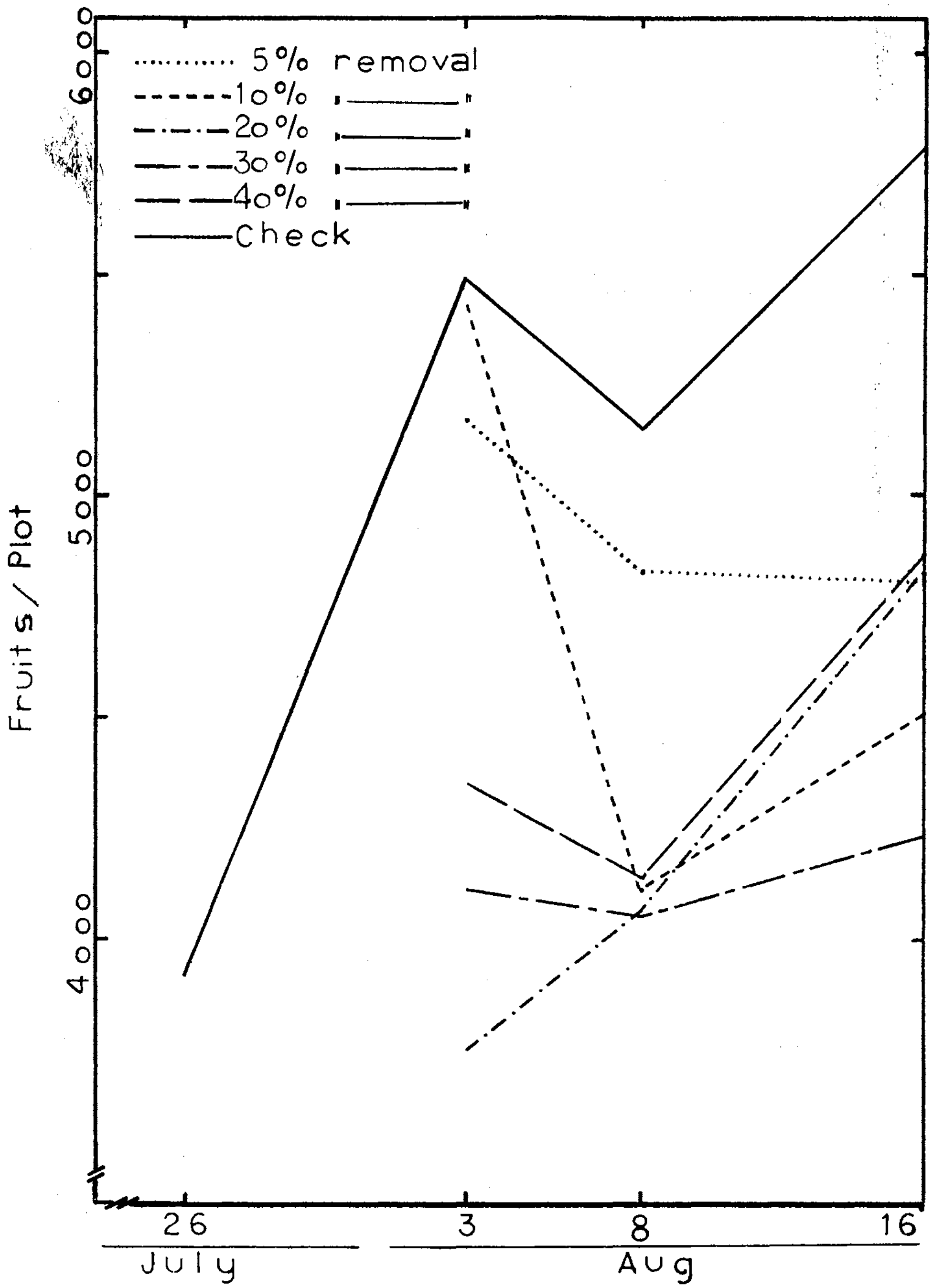

5% removal
10% "
20% "
30% "
40% "
Check
Fruits/Plot
6000
5000
4000
26
3
8
16
July
Aug

TABLE II

ANALYSIS OF VARIANCE IN COMPARING THE AVERAGE NUMBERS OF COTTON FRUITS IN THE LAST COUNT ON AUGUST 16, TIPTON, OKLAHOMA 1972

Source of Variation	df	SS	MS	F cal	F tab (.05)	F tab (.01)
Total	59	857904.85				
Replications	4	225839.76	56459.94			
Treatments	11	297336.85	27030.62	3.553	2.01	2.68
Error	44	334728.24	7607.46			

$$\text{L.S.D. } 5\% = 2.016 \times \sqrt{\frac{(2 \times 7607.46)}{5}} = 111.2086$$

$$\text{L.S.D. } 1\% = 2.693 \times \sqrt{\frac{(2 \times 7607.46)}{5}} = 148.554$$

TABLE III

ANALYSIS OF VARIANCE IN COMPARING THE AVERAGE WEIGHTS OF COTTON YIELDS HARVESTED ON OCTOBER 16, TIPTON, OKLAHOMA 1972

Source of Variation	df	SS	MS	F cal	F tab (.05)	F tab (.01)
Total	59	388.80				
Replications	4	66.44	16.61			
Treatments	11	147.25	13.38	3.36	2.01	2.68
Error	44	175.11	3.98			

$$\text{L.S.D. } 5\% = 2.016 \text{ X } \sqrt{\frac{(2 \text{ X } 3.98)}{5}} = 2.544$$

$$\text{L.S.D. } 1\% = 2.693 \text{ X } \sqrt{\frac{(2 \text{ X } 3.98)}{5}} = 3.3978$$

TABLE IV

COMPARISON BETWEEN AVERAGE NUMBERS OF COTTON FRUITS IN EACH TREATMENT WITH CHECK IN THE LAST COUNT ON AUGUST 16 OR 85 DAYS AFTER PLANTING, TIPTON, OKLAHOMA 1972

Treatment No.	Week of Square Removal	Percent of Square Removal	Average No. of Fruits/Plot	Average No. of Fruits/20 ft. Row: Mean	Average No. of Fruits/20 ft. Row: Differences From Check	N.B.
1	1	50	4929.6	410.8	71.2 lower	unsignificant
2	1	100	6364.8	530.4	48.4 higher	"
3	2	50	5020.8	418.4	63.6 lower	"
4	2	100	6302.4	525.2	43.2 higher	"
5	3	50	6326.4	527.2	45.2 higher	"
6	3	100	6902.4	575.2	93.2 higher	"
7	5,6	5	4804.8	400.4	81.6 lower	"
8	5,6	10	4512.0	376.0	106.0 lower	"
9	5,6	20	4821.6	401.8	80.2 lower	"
10	5,6	30	4228.8	352.4	129.6 lower	significant
11	5,6	40	4867.2	405.6	76.4 lower	unsignificant
12 (check)	-	0	5784.0	482.0	0 -	-

L.S.D. 5% = 111.2086; 1% = 148.554

TABLE V

COMPARISON BETWEEN AVERAGE WEIGHTS OF COTTON YIELDS IN EACH TREATMENT WITH CHECK, HARVESTING DATE OCTOBER 16 OR 146 DAYS AFTER PLANTING, TIPTON, OKLAHOMA 1972

Treatment No.	Week of Square Removal	Percent of Square Removal	Average Yields of Cotton Lint lbs./plot	Average Yields of Cotton in Burr lbs./60 ft. row		N.B.
				Mean	Differences From Check	
1	1	50	14.40	15.0	0.4 lower	unsignificant
2	1	100	15.552	16.2	0.8 higher	"
3	2	50	13.344	13.9	1.5 lower	"
4	2	100	14.88	15.5	0.1 higher	"
5	3	50	15.456	16.1	0.7 higher	"
6	3	100	12.096	12.6	2.8 lower	significant
7	5,6	5	13.536	14.1	1.3 lower	unsignificant
8	5,6	10	13.44	14.0	1.4 lower	"
9	5,6	20	11.328	11.8	3.6 lower	highly significant
10	5,6	30	12.096	12.6	2.8 lower	significant
11	5,6	40	11.04	11.5	3.9 lower	highly significant
12 (check)	-	0	14.784	15.4	0 -	-

L.S.D. 5% = 2.544; 1% = 3.3978

VITA

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