EFFECT OF VARIOUS LEVELS OF SIMULATED INSECT DAMAGE TO SQUARES ON YIELD OF STONEVILLE 213 COTTON

By

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CHAPTER I

INTRODUCTION

Cotton is one of the most important fibre crops of the world. Besides its utilization in textile industry, cotton seeds can be used for oil extraction and cotton-seed cake can also be used for animal feeds. As cotton is a highly useful product, much of the research in many countries aims at improving cotton production in order to obtain high yield. For example, in the United States, the average yield of cotton lint was 167.5 pound per acre in 1925, and 181.5 pound per acre in 1935 (Cotton Situation 1950). The average yield has increased substantially and in 1973 and 1974 the average yield was 520 and 443 pound per acre respectively (Cotton Situation 1975). To obtain a high yield of cotton requires a well prepared soil, high yielding variety, optimum quantity of fertilizer and irrigation practices, and good method of crop protection which includes weeds, diseases, and insects. Lacking of any one of these may be a cause of low yield.

For the cotton plants, insect infestation is a problem. The most injurious insects that infest the cotton plants are the thrips (*Frankliniella* spp.), the spider mites (*Tetranychus* spp.), the cotton fleahopper (*Pseudatomoscelis seriatus* Reuter), the boll weevil (*Anthonomus grandis* Boheman), the bollworms (*Heliothis zea* Boddie), the tobacco budworm (*H. virescens* F.), the lygus bugs (*Lygus* spp.) and the pink bollworm (*Pectinophora gossypiella*). These insects will either suck the sap from the plant or feed in the squares and bolls causing them to drop off from the plants. The damage usually begins at seedling stage and continues until boll maturity. Therefore, the field is usually sprayed with insecticides several times during the growing season. The amount of insecticides used in each spray is one of the most important factors in cotton production. When insecticides are sprayed several times, the amount of insecticides used is increased and so does the labor cost thereby, increasing the cost of production per acre. According to Farm Chemical and Crop Life, in 1971 the United States spent about $65 million on insecticides of cotton. The leading insecticides used on cotton were toxaphene, methyl parathion and DDT (Beltwide Cotton 1974).

The control of insects with insecticides has both advantages and disadvantages. The advantages are that they help by reducing insect infestations and provide crop protection for a period of time. One of the most important disadvantages is insecticides resistance.

Insect infestations are one of the problems in cotton production but they do not always cause a low yield. Other factors such as climatic factors, as well as agronomic practices, also play important roles in cotton production. Insect infestation may not cause an economic loss if that infestation is not beyond the capability of the plant to recover. A plant such as cotton can tolerate the loss of young squares and young bolls to some extent provided that the loss of the fruits is within a certain limit. In nature, cotton plants can also produce new squares to compensate for the loss. Thus, to protect the plants from insect damage by spraying insecticides may not be necessary especially in early season while the plant is growing. On the other hand, insect infestations may cause economic loss. This investigation is intended to study the amount and the extent of damage caused by cotton pest which will result in an economic loss to the crop by determining:

(1) Economic threshold of the cotton insects in terms of percentage of square removal per acre.

(2) The period at which control measures should be started so as to keep insect pest population below economic injury levels.

(3) That early season insect damage to squares does not reduce the yield and possibly increase the yield.

CHAPTER II

LITERATURE REVIEW

Experiments on artificial shedding as well as normal shedding of squares, blooms, and bolls of the cotton plant were studied extensively by various investigators. Lloyd (1921) observed the environmental effect upon boll shedding in Alabama. He found that cotton plants responded to boll shedding by producing new squares within a period of 36 hours to 10 days. He also observed that open flowers are rarely shed because anthesis seems to inhibit abcission.

Buie (1929), who studied the habit of the cotton plants in South Carolina, found that fruiting was continuous beginning about 7 weeks after planting and continued unless stopped by external factors. Cotton plants in nature produce more buds and flower than they could mature and if the environment was unfavorable for growth a considerable amount of fruits might be shed.

King (1930) observed the habit of Pima and Upland cotton. He found that cotton plants produced 2 types of branches: the vegetative branches and the fruiting branches. The vegetative branches do not produce flowers or bolls while the fruiting branches do. Two buds are formed at the base of each leaf: the axillary bud and extra axillary bud. If the extra axillary bud develops, it produces a vegetative branch. If, on the other hand, the axillary bud develops it produces a fruiting branch. The axillary bud on the fruiting branch usually remains dormant but can become active at any time during the growing season if the plants have previously thrown off a large number of extra axillary buds. He conducted an experiment to determine the influence of removing extra axillary buds on the axillary buds and found that extra axillary buds stimulated the axillary buds into development. The plants were taller and produced greater number of fruiting branches as compared to the normal plants.

Eaton (1931) reported on an investigation of delay boll setting in relation to yield in Acala and Pima cotton that when all previously set bolls were removed in the early season, growth and flowering were stimulated and the plants carried more bolls than the untreated plants. Removing all flowers from irrigated plants during the first 25 days of the flowering period resulted in large plants and a 20% increase in number of bolls.

Brown (1938) wrote that shedding of young squares and young bolls was either caused by insect, disease, or normal shedding which was produced by environmental and physiological conditions. Particularly important was the amount of available soil moisture which had an influence on food condition within the plant. In addition genetic factors were also important.

Kearny and Pebbles (1927) studied the rate of shedding of hybrid cotton variety and found that there was a highly significant negative correlation in shedding before and after anthesis in F_3 Pima Acala hybrid. They pointed out that if most buds were shed before anthesis, few would be left to shed after anthesis and vice versa.

Eaton (1955) studied the shedding of young squares and young bolls, and noted that without a protective mechanism of square and boll shedding cotton plants would be overfruited. He also added that in accordance with the behavior of many horticultural plants, cotton plant would produce smaller fruits with the probability of poor fibre if it was overfruited.

Adkisson et al. (1964) studied the yield as well as the quality of cotton when they were damaged by bollworms. This was accomplished by maintaining 3 infestation levels of the bollworm under screen cages. The infestation levels were termed as light, medium and heavy. Beginning the first week of flowering, first and second larval instar were placed on the plant terminals, in addition the adults were also released. The results were as follows: (1) loss to cotton from bollworm attack was more likely to be in the yield than in the quality (2) significant yield loss was caused when the infestation averaged 8-10 bollworm larvae/100 plants or more than 2 larvae/1 ft row (3) severe yield loss occurred when more than 5% of the bolls were damaged for a long period and significant yield loss did not occur until damage exceeded 3% of squares and of the bolls. The percentage of damaged bolls was probably more indicative of potential yield loss than the percentage of damage squares since a greater number of squares might be shed normally without affecting the yield.

Mistric (1968) removed the squares at 3 different patterns namely increasing, constant and fluctuating pattern, each with square removal averaging to about 45%. He found that there were no significant difference in yield in the 3 patterns. He also found that the plants normally fruited for 8 weeks after squaring, the peak of bloom and boll production occurred during the 3rd week of blooming or about 1 week later than the peak of squaring.

Kincade et al. (1970) simulated bollworm damage at 2 levels. At one level the damage was inflicted at 1 larva/5 ft (2541/acre) in the early season using 1 pin head square per larva in the first week, and pulling 10 large squares off the plant 7 days later. At the other levels, the damage was inflicted at 1 larva/2.5 ft (5082/acre) in the late season using 6 small to large squares per larva, and 3 bolls per larva 7 days later. No significant difference was found at two levels tested at different periods. This indicated that no single infestation of bollworm at any period during the growing season is likely to reduce the yield. However, a season long bollworm infestation heavier than 1 larva/2.5 ft row might reduce the yield significantly.

Covenberries and Pacheo (1970) simulated insect damage in the Mexican State of Sonora by removing squares manually at 3 levels. They were 33%, 66% and 100% levels. The squares were removed at weekly interval starting 3 weeks after the first squares appeared in the field. The result was that the yield was not reduced up to the 4th week of square removal. Square removal at 66% from the 5th week and 33% from the 9th week onward reduced the yield. The boll weight also decreased when the picking date was delayed.

Dale (1971) on studying of fruit shedding in cotton in relation to yield found no evidence of increased yield following early season crop loss. He also found that the late season insect attack might prevent crop production eventhough other factors might favor the growth. Shedding could cause reduction in yield under certain circumstances. Late season shedding of young buds and bolls would not usually reduce the yield to any significant extent if only the early season crop was held. If, on the other hand, the early crop was lost, then shedding late in the season would be important.

Wilson et al. (1972) conducted an experiment on the response of cotton to pest attacked at Ord River Station in Australia. He used Stoneville 7 A which tends to stop fruiting once the crop was set. The experiment consisted of 3 treatments. The first treatment was protected with a standard weekly insecticide schedule which started 8 weeks after sowing. The second and third treatment were delayed to 4 and 8 weeks respectively. They found that when no insecticide was applied, the squares were shed and no large bolls developed until after insecticide was applied. The rate of accumulation of square increased at first as the plant grew larger. As soon as large bolls appeared, the production of new squares declined, and the number of square and small bolls decreased rapidly. The result of the experiment suggested that once the bolls set it would inhibit further formation of the squares, and promote shedding of squares and small bolls. They concluded that with each delay of insecticide application the crop set later and accumulated more insect damage. Yet, there was no significant difference in the final number of bolls in each treatment. They had also developed a modification of the model to simulate the response of the cotton plants to the attack by Heliothis spp. The output from the model suggested that there was a theoretical maximum number of bolls produced by cotton varieties. To produce a maximum crop required a complete protection from Heliothis larvae but the period of protection could be minimized.

Singhaseni (1973) removed the squares at different levels and in 2 different periods. One period was in early season and another was in late season. In early season, squares were removed at the 50 and 100% level after the 1st, 2nd, and 3rd week of squaring starting from June 30 to August 16. In the late season the squares were removed at 5, 10, 20, 30 and 40% after the 5th week of squaring starting from July 26 to August 16. He found that significant reduction in yield occurred when 20, 30 and 40% level of squares were removed in the late season, and 100% square removal in the 3rd week of the early season. He also found that late fruit production showed no correlations with the harvest yield. Since the highest number of squares were recorded in the 3rd week at 100% level of square removal but this gave the lowest yield.

Wang (1974) simulated insect damage by removing squares up to 40% for 7 weeks. She found no statistical difference between the yields from the plots with different levels of square removal and the check plot where no squares were removed. However, square removal up to 40% in the first week increased the yield. The reduction in yield appeared when 20, 30, and 40% of squares were removed in the fourth, third and first week after squaring began respectively.

Dunnam et al. (1943) studied the effect of dusting schedule on cotton yield. He removed the squares from dusted and undusted plots at weekly interval and found that dusted check plot produced an average of 17.2% less seed cotton than the undusted plots. However, analysis of variance on the average yield over a 3 years of the experiments showed no significant difference in yield between the two plots. They further noticed that yield apparently depended more on rainfall during July, August, and September than any other factors. If rainfall is below normal reduction in yield occurred. If it was above normal the yield would be higher.

Gain et al. (1947) conducted an experiment on early and late season dusting schedules at College Station and Terril in Texas and found that a 50% square loss during the first 30 days of the fruiting period did not affect the yield provided that the plants were given adequate protection from the boll weevils and the bollworms. An average of 60% square loss did not greatly reduce the yield of the cotton plants. In 1948, they conducted the same experiment but this time was to determine the minimum number of the applications for the control of all cotton insects and yet maintain the maximum yield. They found that early application for thrips control and the pre square application did not increase the yield. The late season schedule containing 6 applications result in the yield as much as the plot dusted 8 to 11 times. This result, indicated that early season protection for squares from insect injury did not necessarily increase the total yield of cotton plants and it might be more profitable to dust cotton during the last three weeks of July and August which was the period when boll weevils and bollworms caused the most injury to the plants than to try to protect the fruits throughout the season.

CHAPTER III

METHODS AND MATERIALS

This experiment was conducted at the Altus Irrigation Research station in the summer of 1974. In this experiment, the squares were removed by hand from each treatment so that each plot would receive equal treatment. The design for the experiment was a complete randomized block design which consisted of 28 treatments and one control plot. Each treatment consisted of 5 replications with 4 different levels of square removal. Each treatment was one row wide and 30 ft. long making a total of 0.25 acre for the entire test.

The experiment was started about one week after the first square appeared in the field. The period of the experiment started on July 18 and continued until August 31, 1974. To simulate the insect damage the squares were removed by hand at 25, 50, 75, and 100% levels at weekly intervals. The procedure for removing the squares were as followed:

25% square removal	-	1 out of every 4 square were removed
50% square removal	-	2 out of every 4 square were removed
75% square removal	-	3 out of every 4 square were removed
100% square removal	-	all squares present on the plants were removed

and in the check plot no squares were removed.

In this experiment Stoneville 213 cotton variety was selected and was planted at the rate of 20 pounds per acre into a well prepared soil fertilized with 100 pounds of 16-48-0 fertilizer. The plants were irrigated 3 times. Three inches were used in the first and second application and 3.5 inches in the third application. Methyl parathion was applied once during growing season at the rate of 1.0 pound per acre to all treatment for pest control.

The cotton was harvested manually on December 18 and 19, 1974. The yield from each plot was recorded in Table II and the number of square removed was recorded in Table I.

CHAPTER IV

RESULT AND DISCUSSION

Due to unfavorable climatic conditions during the experiment, the yield obtained was lower than had previously reported by Wang (1974). The yield in the check plot was 1508.91 pound of burr cotton per acre as compared with 3000 pound per acre during the previous year. The highest yield was from the plot with 50% level of square removal in the 7th week and the lowest yield was from the plot with 100% level of square removal in the 4th week which was only 169 pound of burr cotton per acre. The highest square production occurred in the 5th week of square removing period and after this week the production of squares declined. When the yield (Table II) was analyzed, it was found that there was a significant difference in yield between the treatment plots and the check plots at 5% level of significance. Further statistical analysis indicated that 7 treatments were significantly different from the check (Table III). The yield from these treatments were much lower than the check plots ranging from 169 pound to 949.6 pound of burr cotton per acre. Other treatments had little effect on yield and did not result in significantly higher or significantly lower than the yield in the check plot.

Following are the results which are divided into 3 parts according to the yield obtained after different levels of squares were removed in the 7th week.

Effect of Square Removal at 4 Levels in the First and Second Week

Square removal in the 1st and 2nd week after squaring began resulted in 2 different patterns.

(1) Square removal at 25 and 50% level generally resulted in an increase in yield over the check plot.

(2) Square removal at 75 and 100% level generally resulted in yield lower than the check plot, but no significant yield loss occurred in these 2 weeks.

Square Removal at 25 and 50% Level Generally Resulted in an Increase in Yield Over the Check Plot

When the squares were removed in the 1st and 2nd week, the number of squares removed ranged from 9060 to 43298 squares per acre (Table I). These numbers were not great when compared with the number of square that the plants could produce in the 5th week (429501 square per acre) which represented the maximum number of squares produced by the cotton plants in all 7 weeks after squaring began. These squares, when removed in the early season, stimulated the plant to grow taller, produced more fruiting branches and increased the development of the reproductive structures. Removal of the squares at the beginning of the squaring season stimulated the plant to produce more fruits than the plant with no square removal provided that no damage to bolls occurred in the late season. The end result was an increase in yield over the check plot except for removal of the squares at the 50% level in the 2nd week which had a yield of slightly lower than the check but this did not cause any significant yield loss.

Square Removal at 75 and 100% Generally Resulted in a Reduction in Yield

Square removal at these 2 levels generally resulted in a slight reduction in yield, except in the 1st week with 100% level of square removal which produced the higher yield than that of the check plot. During this period, the number of squares removed ranged from 13677 to 9517 per acre. The number of squares were not great enough to cause the plants to suffer from this loss. At this stage, the plant made response for the loss of squares by producing new ones. The rate of production of new squares to compensate for loss of squares decreased as the season progressed.

Effect of Square Removal at 25, 50, 75 and 100% Levels on Yield in 3rd, 4th and 5th Week

Square removal in these 3 weeks was quite important since they resulted generally in low yield. Of the 12 treatments, only one where 50% of the squares were removed in the 3rd week had a higher yield than the check plot. Other plots had lower yield than the check plot. When the data were analyzed to see the effect of square removal from each treatment on yield it was found that:

(1) Removal of squares at 25% in the 3rd, 4th and 5th week and 50% in 3rd and 4th week did not have an effect on yield.

(2) Square removal at 75 and 100% levels in all 3 weeks and 50% in the 5th week caused a significant reduction in yield.

Removal of Squares at 25% in 3 Weeks and 50% in the 3rd and 4th Week

Removal of squares at these 2 levels did not have an effect on yield. During this stage the number of squares loss could still be compensated for by a later development of fruiting structures. In this experiment, the plant continued to square from the 11th of July and reached the maximum number of squares production (429501/A) in the 5th week. The number of squares removed ranging from 52097.76 to 166312.08 squares/A. The number of squares removed was great but the plants still had the ability to compensate for the loss. Although square removal at 25 and 50% in a 3 week (except 50% levels in 5th week) did not cause any reduction in yield. However, if agronomic practices are poor and unfavorable climatic condition occur during this period, significant yield reduction may occur.

Removal of Squares at 75 and 100% in the 3rd, 4th and 5th Week and 50% Square Removal in the 5th Week Caused a Significant Reduction in Yield

It is obvious that when the number of squares were removed was from 134600 to 429501 squares per acre reduction in yield occurred. Eaton (1955) studied physiology of the plant and found that square production in the cotton plant is progressive during the early season. Thus, flowering is progressive and more rapid as the plant grows. After flowering and bolling the growth of the plant and production of flower are checked and may stop. Stoneville 213 is an upland cotton and follows regular patterns of upland cotton under similar environmental conditions.

In early season, when cotton plants had just started squaring, removal of squares up to 100% did not cause any reduction in yield because production of squares was still in a progressive situation and also the plants were stimulated to produce more squares. But removal of 134600 to 429501 squares per acre seemed great even if the squares production continued and reached its maximum number in the 5th week. When large number of the squares were removed from the plant, the cotton plant made a response to square loss by producing new squares to compensate for but compensation rate declined after the 5th week of square removal. Also at this time there would be few squares left on the plant to form bloom and boll. Young bolls were also naturally shed. Therefore, few squares were left on the plant plus few squares formed after squares were removed. Consequently, few bolls were formed and left to be harvested and the end result was reduction in yield.

Effect of Square Removal at 4 Different Levels on Yield in 6th and 7th Week

Square removal in the 6th and 7th week generally resulted in yields lower than the check plot. Only 2 plots where 25 and 50% level of square removal in the 7th week resulted in higher yield than that of the check plot. The highest yield was from plot with 50% level square removal in the 7th week. Analysis of the data indicated that square removal in these 2 weeks did not have a significant effect on yield.

In the 6th week when 34935 squares per acre were removed from the plot with 25% squares removal, the plant was able to produce new squares to compensate for square loss, and the same is true for 50, 75 and 100% square removal. In the 7th week, however, the number of square removed at 75 and 100% level was large but no significant reduction in yield occurred. The possible answer for why no significant reduction in yield occurred in these 2 weeks would have been that the square production declined after reaching its maximum in the 5th week (Table I). Therefore, few squares were removed as compared with previous weeks, and also some blooms and small bolls had already been formed. The blooms are rarely shed but the young bolls will shed under normal condition. When the squares were removed, regardless of the number of the squares, the plant would produce new squares to compensate for those lost. But as the square production declined after the 5th week, thus few bolls were formed plus those bolls that were left after natural shedding, the result was reduction in yield. This indicated that square removal in the 6th and 7th week might have a very less effect on yield and there should be no relation between squares removal and the bolls reaching its maturity. Thus, during these weeks, insect damage to square at any level will not have a significant effect on yield. On the other hand, if damage is caused to bolls and blooms there will be a yield loss since few square will be formed after the damage and few bolls will be left to harvest. Therefore, a final reduction in the yield occurs.

CHAPTER V

SUMMARY AND CONCLUSIONS

Square removal at 25% levels in 7 week periods did not have any significant effect on yield because number of squares removed were so few as compared with total number of squares that the plant can produce during growing season. The yields were increased when the squares were removed at this level in the 1st, 2nd and 3rd week after the first square appeared in the field. At 50% level the yields were increased when the squares were removed in the 1st, 3rd and 7th week but slightly reduced when the squares were removed in the 2nd, 4th and 6th week. The yield was reduced significantly when the squares were removed at 50% level in the 5th week. Square removal at 75 and 100% levels generally resulted in low yield in all 7 weeks except first week with 100% level which increased the yield over the check plot. Significant yield loss occurred in the 3rd, 4th and 5th week of square removal indicating that insect control should be started so as to keep insect pest population below economic injury levels and to prevent crop loss.

From the result above, it is clear that square removal in first week at 4 different levels generally resulted in an increase in yield over the check plot indicating that early season protection may not be profitable. It is also clear that the number of squares removed at different levels and at different periods correlated in some way with the yield obtained but it should be a negative correlation since the more the squares removed in particular period, results in a lower yield. Yield loss is usually high when square removal is high during the mid-season period since the successful production of a crop depends upon favorable conditions in the latter part of the season - a situation which cannot be guaranteed. If the early crop is held, late season shedding of young squares and bolls will not usually reduce the yield to any significant extent. If, on the other hand, a large number of squares is lost, then shedding due to natural conditions or insect damage will be very important.

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APPENDIX

TABLES AND FIGURES

TABLE I

AVERAGE NUMBER OF SQUARES REMOVED AT 4 DIFFERENT PERCENTAGES
IN 7 WEEKS AT ALTUS, OKLAHOMA
MAY THROUGH DECEMBER 1974

Week and Percent Square Removal	Average No. of Squares Removed per 30 Ft. Row	Average No. of Squares Removed per Acre
1-25	20.8	9060.4
1-50	43.6	18992.2
1-75	31.4	13677.8
1-100	57.8	25177.7
2-25	75.0	32670.0
2-50	99.4	43298.6
2-75	160.2	69783.1
2-100	207.8	90517.7
3-25	119.6	52097.7
3-50	252.2	109858.3
3-75	309.0	134600.4
3-100	487.2	212224.3
4-25	189.8	82676.8
4-50	381.8	166312.0
4-75	670.4	292026.2
4-100	720.4	213806.2
5-25	284.6	128971.7
5-50	496.2	216144.7
5-75	728.4	317291.0
5-100	986.0	429501.6
6-25	80.2	34935.1
6-50	189.4	82502.6
6-75	242.6	105676.5
6-100	132.2	57586.3
7-25	109.6	47741.7
7-50	275.0	119790.0
7-75	503.4	219281.0
7-100	713.2	310669.9
Check	--	--

TABLE II

AVERAGE YIELD OF STONEVILLE 213 COTTON AT 4 DIFFERENT PERCENTAGES OF SQUARES REMOVED IN 7 WEEKS AT ALTUS, OKLAHOMA, MAY THROUGH DECEMBER, 1974

Week and Percent Square Removal	Average Yield in Pound Per 30 Ft. Row	Average Yield in Pound Per Acre
1-25	4.384	1909.67
1-50	4.036	1758.08
1-75	3.028	1318.99
1-100	4.604	2005.50
2-25	4.076	1775.50
2-50	3.422	1490.62
2-75	2.492	1085.51
2-100	2.664	1160.43
3-25	2.784	1212.71
3-50	3.646	1588.19
3-75	2.180	949.60
3-100	1.204	524.46
4-25	3.214	1400.01
4-50	2.436	1061.12
4-75	1.438	626.39
4-100	0.388	169.0
5-25	3.05	1328.58
5-50	1.68	731.80
5-75	2.004	872.94
5-100	1.03	448.66
6-25	3.392	1477.55
6-50	2.972	1294.60
6-75	3.016	1313.76
6-100	2.21	962.67
7-25	4.01	1746.76
7-50	5.172	2252.92
7-75	2.95	1285.02
7-100	2.60	1132.55
Check	3.464	1508.91

TABLE III

AVERAGE NUMBER OF SQUARES REMOVED AND AVERAGE YIELD* OF STONEVILLE 213 COTTON IN THE SIGNIFICANT TREATMENTS AS COMPARED WITH CHECK

Time of Square Removal	Percentage of Square Removal	Average Squares Removed Per Acre	Average Yield in Pound Per Acre
Third Week**	75	134600.4	946.6
	100	212224.3	524.4
Fourth Week***	75	292026.2	626.3
	100	313806.2	169.0
Fifth Week****	50	216144.7	731.8
	75	317291.0	872.9
	100	429501.6	448.6
Check	-	-	1508.9

* Yield of cotton in burr

** August 1, 1974

*** August 8, 1974

**** August 15, 1974

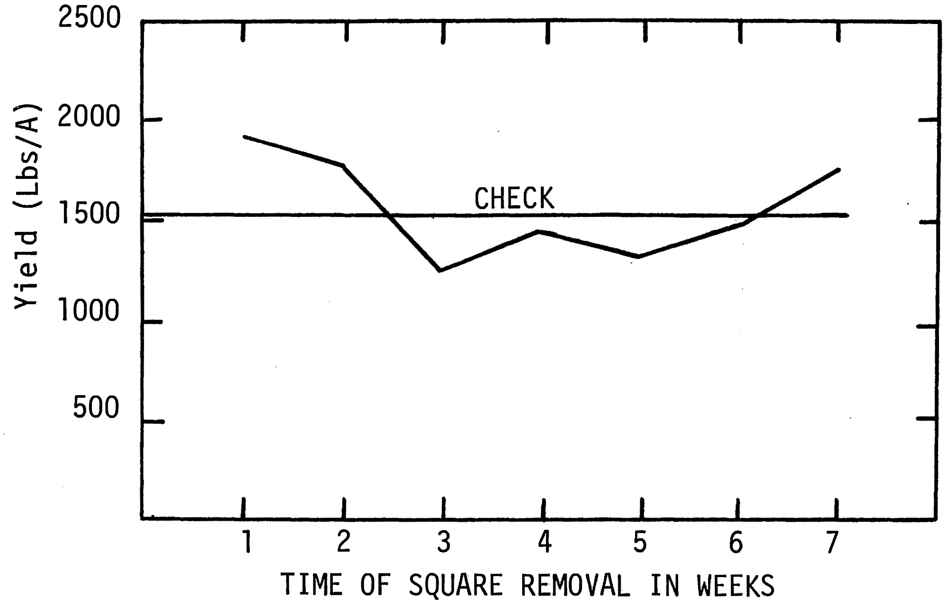

Figure 1. Average Yield of Stoneville 213 Cotton at 25% Level of Square Removal in 7 Weeks

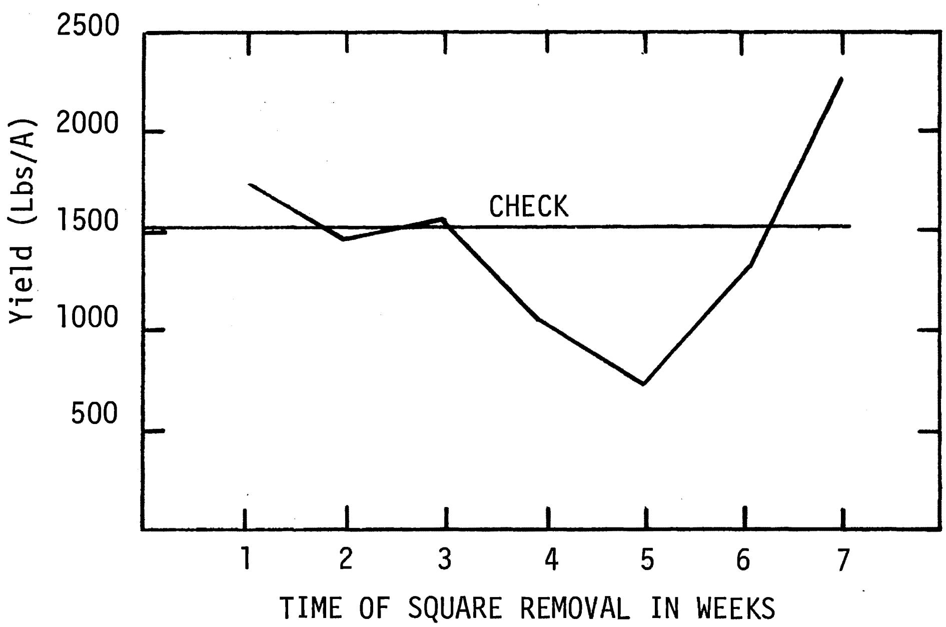

Figure 2. Average Yield of Stoneville 213 Cotton at 50% Level of Square Removal in 7 Weeks

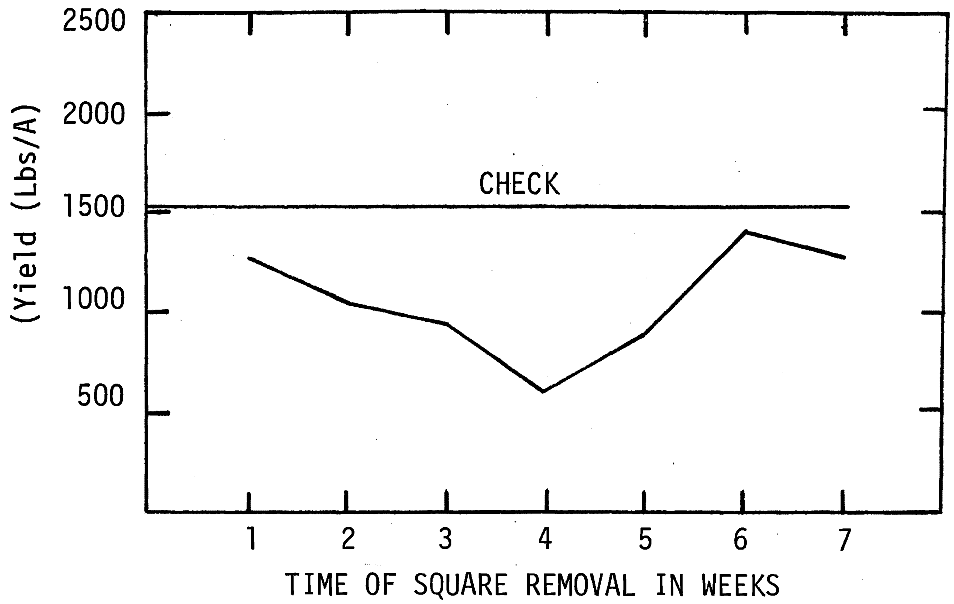

Figure 3. Average Yield of Stoneville 213 Cotton at 75% Level of Square Removal in 7 Weeks

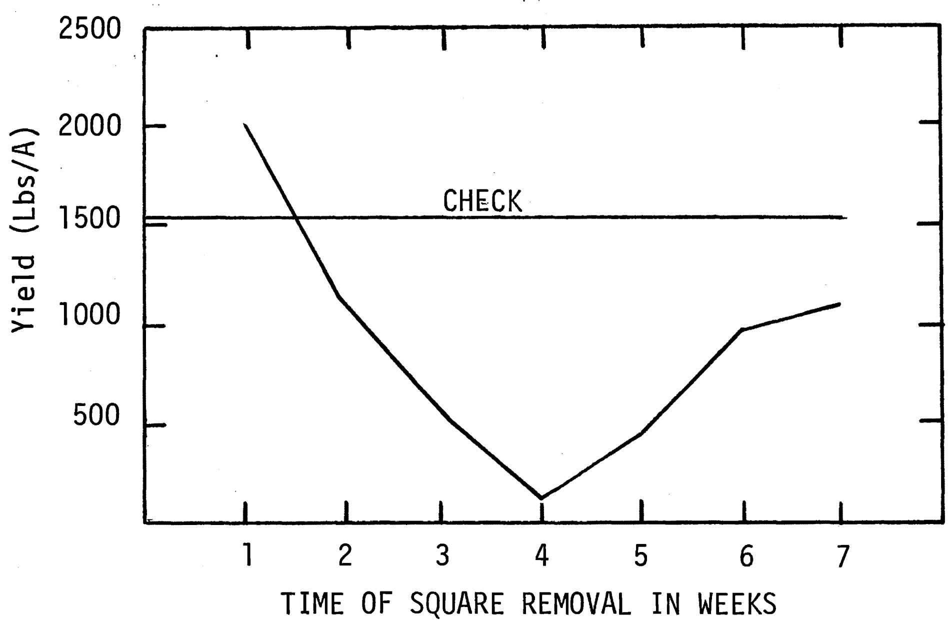

Figure 4. Average Yield of Stoneville 213 Cotton at 100% Level of Square Removal in 7 Weeks

VITA

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