THE EFFECTS OF DIFFERENT ROW SPACINGS IN COTTON ON INSECT NUMBERS IN SOUTHWESTERN OKLAHOMA

By

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CHAPTER I

INTRODUCTION

The restriction on the use of many insecticides has caused scientists to look for other means of controlling cotton pests. Both biological and agronomical methods have been considered. Narrow row planting of cotton has been a suggested agronomical method of reducing cotton insect damage.

There are advantages that narrow row cotton production systems offer over standard 40-inch rows in pest management. Narrow row cotton allows a shorter growing season with earlier maturity of the fruits. Early maturing determinate cotton eliminates young fruits preventing late season pests such as the boll weevil and bollworm. The rapid fruiting period of the narrow row system would also serve to reduce the number of generations of some insects developing in one season.

Another advantage of a shorter growing season is that there is less productivity inputs resulting in lower costs. (Ray and Hudspeth, 1966).

The primary objective of this study was to plant cotton in four different row spacings and determine what effect row spacing had on insect populations, damage and yield.

Both beneficial and destructive insects were collected and the data recorded. The beneficial insects that were reported in this study were lady beetle, Hippodamis spp; green lacewings, Chrysopa spp;

nabids, Nabis spp; soft-winged flower beetles, Collops spp; hooded beetles, Notoxus spp; big-eye bug, Geocoris spp; and several species of spiders.

The cotton fleahopper, Psallus seriatus (Reuter) and the black fleahopper complex, Spanogonicus albofasciatus (Reuter) and Rhinacloa forticornis (Reuter), which occur in southwest Oklahoma (Robinson et al., 1972) were collected and recorded in this study.

The cotton bollworm complex, Heliothis zea (Boddie) and Heliothis virescens (Fabricus) usually cause economic damage to cotton but during this study the populations were too low to evaluate.

The boll weevil, Anthonomus grandis (Boheman), appeared to be the most important pest in cotton during this study.

CHAPTER II

LITERATURE REVIEW

Research work on narrow row planted cotton is limited. Most research work with narrow row cotton has been concerned with yield.

Pimentel (1970) worked with vegetables planted in close spacing to see the effect on insect populations. He found that planting crops more densely reduced insect numbers per plant and could be a safe means of limiting insect damage.

Bottrell (1970) found that on a per plant basis the number of insects were about the same for all row spacings. When converted to a per acre basis there were more insects present in the 10-inch row cotton than in the 40-inch row cotton.

As early as 1897 (Pittuck), spacing of cotton plants to increase yield was being investigated. These early studies were concerned with varying the space between plants within 40-inch rows. Pittuck and Henry (1898) and Welburn in 1908 found that there was no significant difference in yield when the plant population varies from 12 to 18 inches within 40-inch rows.

Investigations of row widths were made at Mississippi (Brown, 1916), Arkansas (Ayres, 1918), South Carolina (Hamilton and Pritchard, 1936) and Alabama (Mayton, 1937). The results of these studies have shown that yield per acre increased consistently as row width decreased.

In a five-year study at Lubbock, Texas, Wanjura and Hudspeth (1963) found a 10 per cent increase in yield in closely spaced rows compared to conventional 40-inch rows.

In 1966, Wilkes and Hobgood found the opposite results when comparing broadcast cotton with 40-inch cotton. They found that yields were significantly lower from broadcast cotton compared with 40-inch row cotton.

CHAPTER III

METHODS AND MATERIALS

During the 1972 growing season tests were conducted near Tipton in southwestern Oklahoma. The field size was 240 feet long and 134 feet wide.

Blanco 3363 cotton was first planted at a rate of 28 pounds per acre on May 26, but due to a poor stand was replanted on June 23. The cotton was irrigated on July 17, 25, and August 3.

There were four treatments replicated three times in a randomized block design. The four treatments were 10, 20, 30 and 40 inch row spacings. Each plot was 75 feet long and approximately 33 feet wide. The plots with 10-inch row spacings contained 40 rows and the 20-inch row spacings contained 20 rows. The 30-inch row spacing plots had 13 rows and the 40-inch row spacing had 10 rows.

The thrips population was determined by taking 10 plants from each plot. The plants were put in ice cream cartons and taken to the laboratory. Each sample was placed in a Berlese funnel for one hour, the thrips counted and the data recorded. Due to low populations, thrips counts were made for only two weeks.

Beginning on July 24, samples of arthropods were collected weekly for four weeks with a back-pack D-VAC vacuum sweeper. Two rows in each plot were randomly selected to be sampled. The collecting net was removed from the machine and put in a quart container. Ethyl acetate was squirted into the carton to kill the insects. The containers were taken to the laboratory and the insect counts were made and recorded.

At the beginning of fruiting season and continuing weekly for six weeks, 25 squares per plot were randomly collected. From these squares the number of bollworm (*Heliothis zea*) and boll weevil (*Anthonomous grandis*) damage was determined and recorded.

The plant density for each treatment was found by counting the number of plants in 5 feet of row. Plants were counted in 6 rows of 40-inch spaced cotton, 8 rows of 30-inch row spacing, 12 rows of 20-inch spaced cotton and 24 rows of 10-inch row spaced cotton. The total means of the three replications for each treatment were converted to the number of plants per acre.

Cotton bolls were manually harvested from the middle 20 feet of each plot on February 21 and 28 to determine the yield. The pounds of lint cotton was calculated by using the conversion factor of 0.23 multiplied times the pounds of cotton bolls. An analysis of variances was used to determine if there was a significant difference due to treatments.

CHAPTER IV

RESULTS AND DISCUSSION

The number of plants per acre for the 10, 20, 30 and 40-inch row spacings was 188,352; 96,792; 66,315; and 47,088 respectively. The plant density was probably higher than in most fields because plots were planted manually. The plants grew at an extremely fast rate due to an abundance of soil moisture throughout the growing season. The plants continued to produce vegetative growth and flowers until late season.

Thrips populations were very light for the two sampling dates (Table I). Table I shows that all four row spacings had about the same number of thrips. The low population was probably due to the planting date. When a satisfactory stand of cotton was reached, the thrips population had left the surrounding cotton and moved to other host plants.

The total number of arthropods collected from each treatment are listed in Tables II-V. Results showed fleahoppers were the most abundant arthropod collected. No individual spacing was consistently high or low for all sampling dates. Figure 1 illustrates that the 40-inch row spacing had the greatest number of fleahoppers for the first two weeks, but in the third week, the 40-inch had the lowest population of the four treatments. In the fourth week of sampling the 40-inch spacing had the second highest population. On the third sampling date, the 30-inch row spacing had the highest population of fleahoppers, but on the fourth date, this spacing had the lowest population. On the second date, the 10-inch row spacing had the lowest population of fleahoppers, but on the fourth date it had the greatest number. Only on the first date did the 20-inch row spacing have the lowest population. Total fleahopper populations over the four sampling dates were higher in the 40-inch row spacings and lowest in the 10-inch row spacings. In analyzing this data, there was no significant difference between treatments. The only significant difference at the 0.05 level of confidence was between sampling dates.

Table VI shows the total population of beneficial arthropods collected in the four row spacings at four sampling dates. As Figure 2 illustrates, no individual spacing had the highest or lowest population of beneficials for all four sampling dates. The 20-inch row spacing had the highest population of beneficials for the second, third and fourth sampling dates, but had the lowest population on the first sampling date. The 10-inch row spacing had the highest population of beneficials the first week, but had the lowest population for the second and fourth weeks. On the third sampling date, the 40-inch row spacing had the lowest population of beneficial arthropods. When the total number of beneficials for all four sampling dates is examined, the 10 and 40-inch row spacings had the lowest populations and the 20 and 30-inch the highest populations. The data shows that there was no significant difference between treatments, only between sampling dates at the 0.05 level of confidence.

Spiders were the most abundant and lady beetles were the least abundant beneficial arthropods collected. Results from Tables II-V show Collops populations higher in the 10-inch row spacing and lower in the 40-inch spacing. The lady beetle and flower beetle populations were higher in the 40-inch row spacing and low in the 10-inch spacing. The 20 and 30-inch row spacings had the highest population of lacewings and nabids and the 40-inch spacing had the lowest populations of the two insects. Spiders were most abundant in the 30-inch row spacing and least abundant in the 10-inch spacing. The big-eye bug had the highest population in the 20-inch row spacing and the lowest in the 40-inch spacing.

The bollworm damage during the growing season was very low (Table VIII). As the table shows, there was no damaged squares collected from any of the 10-inch row spacings. The 30 and 40-inch row spacing had one damaged square each from 450 squares collected from each treatment over six sampling dates. The 20-inch row spacing had four damaged squares from 450 squares collected which is less than 1% damage. An analysis of variance was run, but there was no significant difference at the 0.05 level of confidence.

The number of squares damaged by the boll weevil increased weekly. Table VII shows the number of damaged squares found in 75 squares collected weekly from each treatment for six sampling dates for a season total of 450 squares. As Figure 3 illustrates, no individual spacing had the greatest or fewest number of damaged squares for all six sampling dates. There is an indication of a direct relationship between damage and the row width, but there was no signficant difference between treatments at the 0.05 level of confidence. The 10-inch row spacing had the greatest number of damaged squares on the second, fourth and fifth sampling dates. On the first and third sampling dates the 40-inch row spacing had the greatest number of damaged squares.

The 20-inch row spacing had the greatest number of damaged squares on the sixth sampling date. When comparing the different row spacings as to the least amount of square damage, the 10-inch row spacing had the least amount of damage on the third sampling date. The 20 and 30-inch row spacing had no damaged squares on the first and second dates (Table VII). The 30-inch row spacing had the least number of damaged squares on the fourth sampling date. For the final two sampling dates the 40-inch row spacing had the least amount of damage. Overall the 10 and 20-inch row spacings had the greatest number of damaged squares and the 30 and 40-inch row spacings had the fewest number of damaged squares.

The yield data indicated that there was no significant difference due to row spacing, but there was a significant difference at the 0.05 level due to replication (Table IX). This difference was probably due to the amount of water that the first replication received. The first replication received more water than the other two replications. This meant a reduction in the number of squares that were set on the plants during this period. Overall, the 10 and 40-inch row spacing produced the least amount of lint cotton per acre. The 30-inch spacing produced the largest yield followed by the 20-inch spacing.

Results from this research indicated that further studies on narrow row cotton should be done in larger fields using different sampling techniques. The sampling techniques should be designed so that data can be analyzed on a per acre basis and a correlation could be made between insect populations and yield.

SUMMARY AND CONCLUSIONS

Thrips populations were very light, less than one per plant. There was very little difference between treatments.

Fleahopper data shows that populations were higher in 20, 30, and 40-inch row spacings. Results showed a fluctuation of fleahoppers in the wide row spacings, whereas in the 20-inch row spacing, populations were more uniform.

Total beneficial insect populations were slightly higher in the 20 and 30-inch treatments compared to the 10 and 40-inch row spacings. However, the difference is not great nor is it consistent from week to week. There was no significant difference between the number of beneficial arthropods present in the different row spacings.

Bollworm damaged fruits were very (less than 1%) and were not a significant factor in this experiment.

The boll weevil damage increased in all treatments over the collecting dates. The 10 and 20-inch row spacings had the greatest number of damaged squares while the 30 and 40-inch spacings had the least amount of damage. There was no significant difference between the number of damaged squares due to row spacing.

The 20 and 30-inch row spacings had the highest yield of lint cotton. There was no significant difference in yield due to row spacing, but there was a significant difference at the 0.05 level due to replication. This difference was probably due to the amount of water that the first replication received.

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APPENDIX

TABLE I

Thrips populations collected in different row spacings, Tipton, Oklahoma 1972[1/]

Row Spacings (inch	Sampling Dates July 7	12	Total
10	2	3	5
20	6	1	7
30	5	1	6
40	2	1	3

[1/]Numbers represent the total thrips found on 10 plants in three reps for each spacing.

TABLE II

Arthropod populations collected in 10 inch row spacings from 450 feet of row, Tipton, Oklahoma 1972[1/]

Sampling Dates	Fleahopper Complex	Collops	Lady beetles	Flower beetles	Lacewings	Spider	Nabids	Big-eye bugs
7-24	32	4	1	1	2	4	0	6
7-31	23	6	0	2	0	3	3	2
8-7	55	2	0	0	2	6	1	2
8-14	43	1	0	0	2	2	1	0
Total	153	13	1	3	6	15	5	10

[1/]Numbers represent the total from three reps at each sampling date.

TABLE III

Arthropod populations collected in 20 inch row spacings from 450 feet of row, Tipton, Oklahoma 1972[1/]

Sampling Dates	Fleahopper Complex	Collops	Lady beetles	Flower beetles	Lacewings	Spiders	Nabids	Big-eye bugs
7-24	17	5	1	0	0	3	0	2
7-31	50	13	3	0	0	4	3	3
8-7	91	1	1	1	4	9	2	9
8-14	34	2	0	0	5	4	2	0
Total	192	21	5	1	9	20	7	14

[1/] Numbers represent the total from three reps at each sampling date.

TABLE IV

Arthropod populations collected in 30 inch row spacings from 450 feet of row, Tipton, Oklahoma 1972[1/]

Sampling Dates	Fleahopper Complex	Collops	Lady beetles	Flower beetles	Lacewings	Spiders	Nabids	Big-eye bugs
7-24	20	4	1	0	0	4	4	4
7-31	61	5	1	2	1	7	1	6
8-7	104	1	0	2	5	5	2	2
8-14	27	1	1	1	3	5	0	0
Total	212	11	3	5	9	21	7	12

[1/]Numbers represent the total from three reps at each sampling date.

TABLE V

Arthropod populations collected in 40 inch row spacings from 450 feet of row, Tipton, Oklahoma 1972[1/]

Sampling Dates	Fleahopper Complex	*Collops*	Lady beetles	Flower beetles	Lacewings	Spiders	Nabids	Big-eye bugs
7-24	51	2	2	6	0	3	0	0
7-31	91	2	6	6	2	7	1	0
8-7	39	0	0	4	0	2	0	0
8-14	36	2	0	0	0	2	0	6
Total	217	6	8	16	2	14	1	6

[1/] Numbers represent the total from three reps at each sampling date.

TABLE VI

The total number of beneficial arthropods collected in different row spacings from July 24th to August 14th, Tipton, Oklahoma 1972

Row Spacing (inch)	Sampling Dates 7-24	7-31	8-7	8-14	Seasonal Total
10	18	16	13	6	53
20	11	26	27	13	77
30	17	23	17	11	68
40	13	24	6	10	53

TABLE VII

Total number of fruits damaged by the boll weevil in different row spacings Tipton, Oklahoma 1972[1/] [2/] [3/]

Row Spacings (Inch)	Sampling Dates August 11	18	24	31	September 7	14	Total
10	1	1	8	20	33	41	104
20	0	0	13	19	25	43	100
30	0	0	12	16	28	32	88
40	4	1	15	18	23	27	88

[1/]Numbers represent total from three reps for each date.

[2/]75 squares collected from each treatment.

[3/]No significant difference at 5% level.

TABLE VIII

Total number of fruits damaged by the bollworm in different spacings, Tipton, Oklahoma 1972[1/2/3/]

Row Spacings (inch)	Sampling Dates August 11	18	24	31	September 7	14	Total
10	0	0	0	0	0	0	0
20	1	2	1	0	0	0	4
30	0	1	0	0	0	0	1
40	0	1	0	0	0	0	1

[1/]Numbers represent total from three reps for each date.

[2/]75 squares collected from each treatment.

[3/]No significant difference at 5% level.

TABLE IX

Total Pounds of Lint Cotton Harvested From Four Different Row Spacings, Tipton, Oklahoma 1972

	Pounds of Lint Cotton Per Acre			
	Row Spacing (inch)			
REP	10	20	30	40
1	234	367	347	314
2	414	361	454	381
3	434	441	448	387
MEANS [a/]	361	390	416	361

[a/] There was not a significant difference between means at the 5% level of probability.

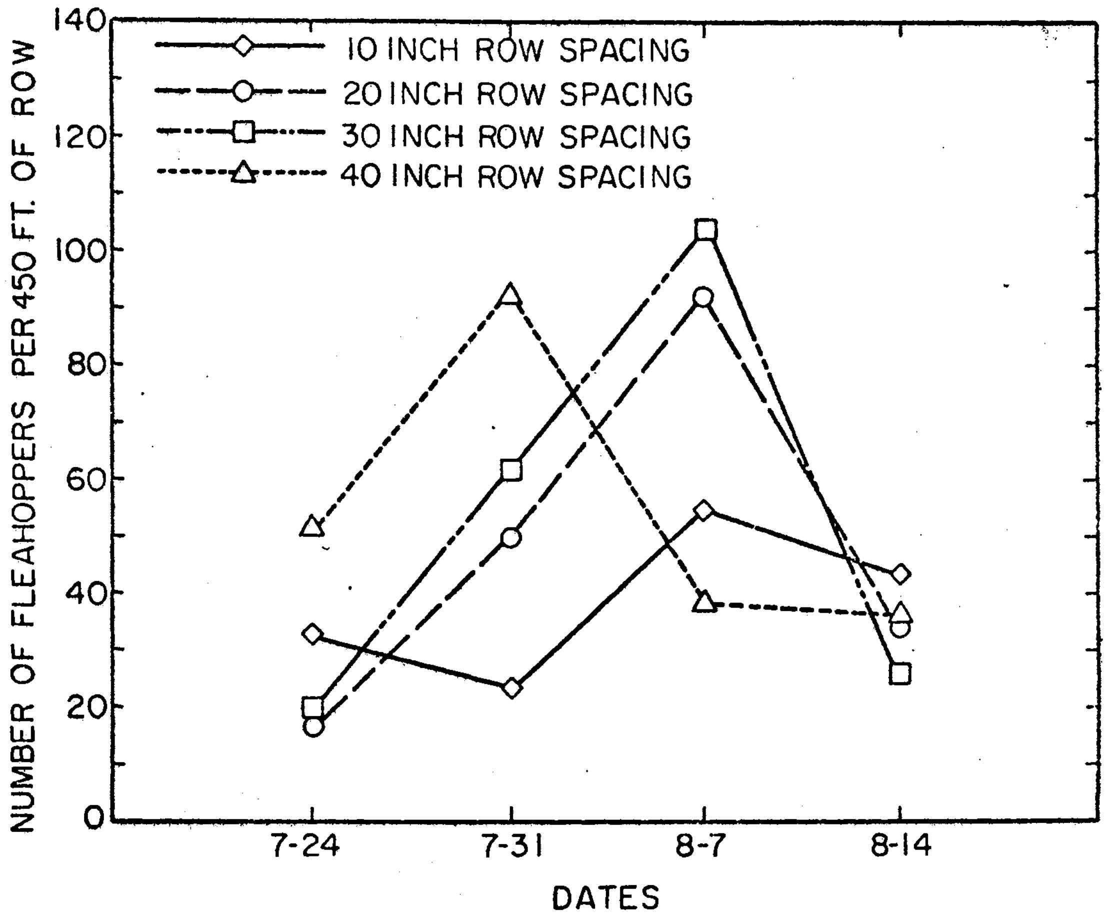

FIGURE 1. Total Number of Fleahoppers Collected on 450 Feet of Row at Four Sampling Dates

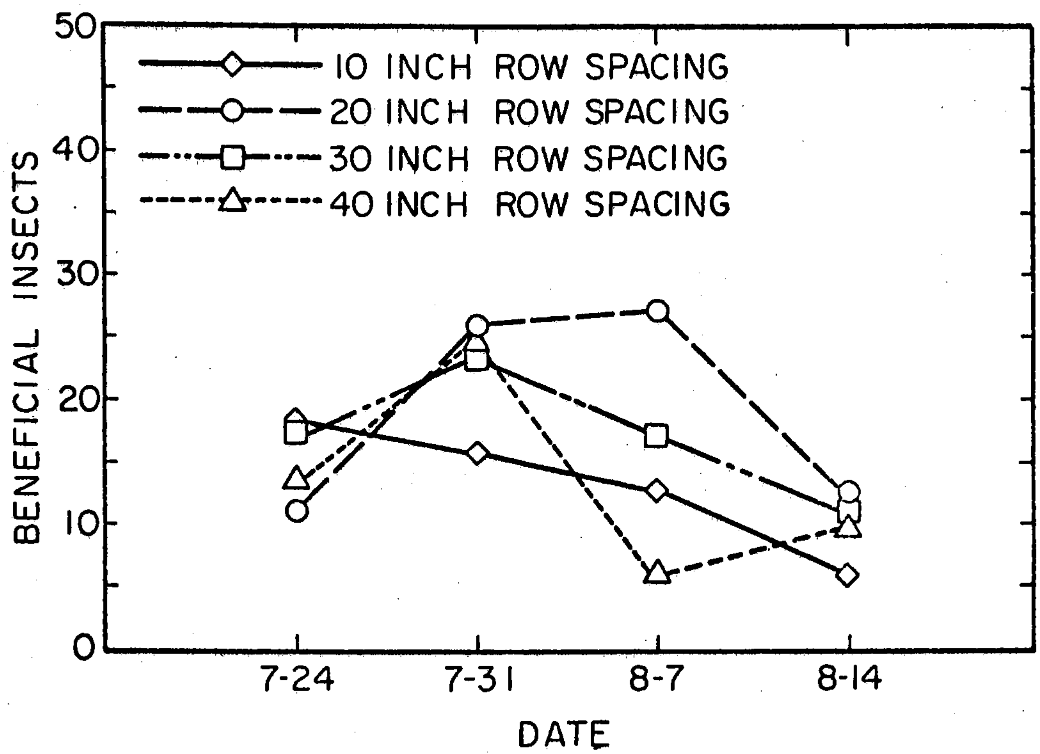

FIGURE 2. Total Number of Beneficial Arthropods Collected on 450 Feet of Row at Four Sampling Dates.

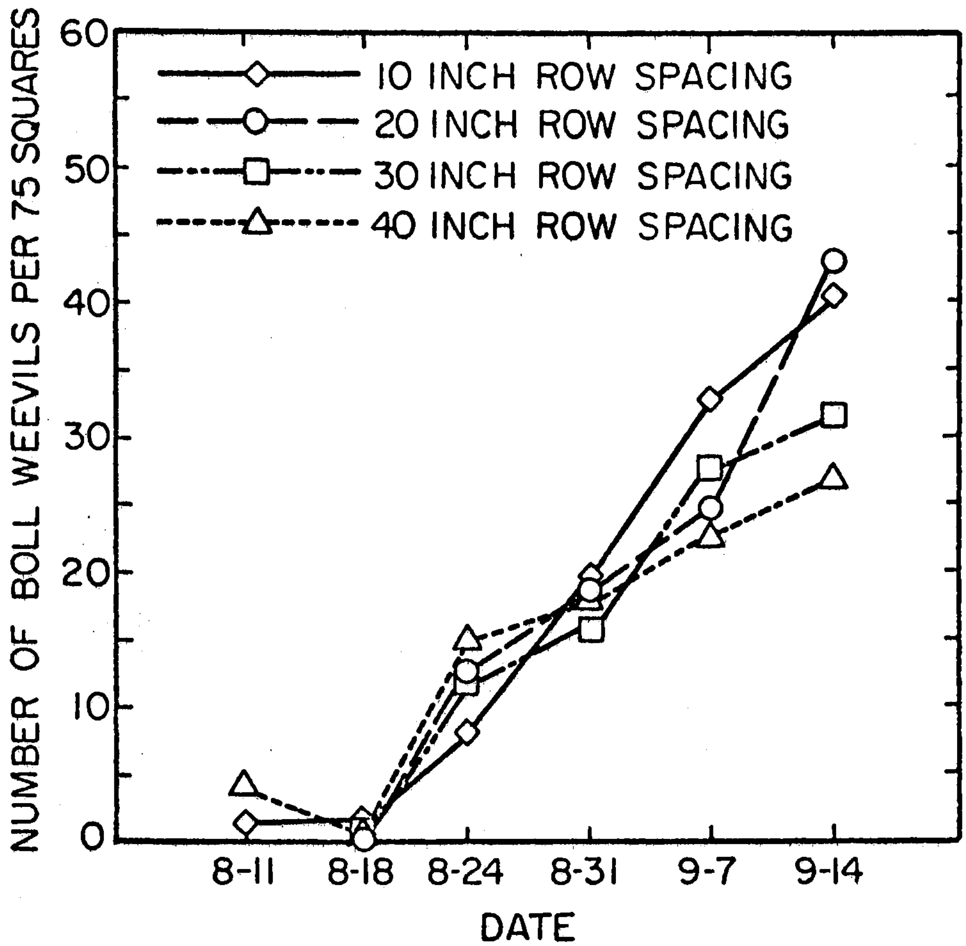

FIGURE 3. Total Number of Fruits Damaged by Boll Weevils at Each Sampling Date

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