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A SPACING AND FERTILIZER TRIAL WITH OKRA

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The okra, *Hibiscus esculentus*, is not well known outside the tropical and sub-tropical regions. It is of particular interest in Trinidad and Tobago as it is a main constituent of a national dish, *Callaloo*, which is eaten by many families in Trinidad and Tobago for Sunday dinner. It is also eaten frequently alone or with meat or fish; *Coocoo*, made with okra and cornmeal, is popular in Barbados.

There is little information in the literature concerning the fertilizer requirements of okra. As regards spacing, it is recommended, USDA (1962), that dwarf varieties be planted at $3\frac{1}{2}' \times 1'$, and tall varieties at $4\frac{1}{2}' \times 2'$ or $1\frac{1}{2}'$, with about 1,000 lb/acre of 5:10:5 NPK fertilizer applied at planting. Woodroof (1927) and Shoemaker (1953) suggest similar spacings without mentioning fertilizer rates.

The experiment reported here was undertaken to investigate the effects of various spacing and fertilizer treatments on okra in Trinidad. The variety used was 'Six Weeks' and the site chosen was at the University Field Station on St. Joseph Sandy Loam with medium phosphate and potash contents.

MATERIALS AND METHODS

The experimental layout consisted of a 3×3 Latin square with split plots. The main plots were for spacing:

A. $3' \times 3'$ B. $3' \times 2'$ C. $3' \times 1'$

and sub-plots for fertilizer treatment:

(a) basic dressing of $2\frac{1}{2}$ cwt./acre 13:10:10 applied before sowing,
(b) basic dressing + $1\frac{1}{2}$ cwt./acre Calnitro 20% N 4 weeks after sowing,
(c) basic dressing + $1\frac{1}{2}$ cwt./acre Calnitro 20% N 8 weeks after sowing,
(d) basic dressing + $1\frac{1}{2}$ cwt./acre Calnitro 20% 4 weeks after sowing and again 8 weeks after sowing.

Each sub-plot covered an area $30' \times 18'$ and was surrounded by two guard rows; main plots were separated by two or more guard rows.

At each stand a simple plant was allowed to grow and, apart from the experimental treatments, the entire area was subjected to cultural practices regarded as standard. Harvesting was commenced $7\frac{1}{2}$ weeks after sowing and was continued at 2–4-day intervals over a period of 9 weeks; pods were picked at the stage when they were considered saleable, after they had attained a length of over 2 inches and before they become fibrous.

Plant heights and leaf numbers were recorded at 4, 8 and 12 weeks after planting. The purpose of these measurements was to obtain some measure of the vigour of the plant and its growth habit.

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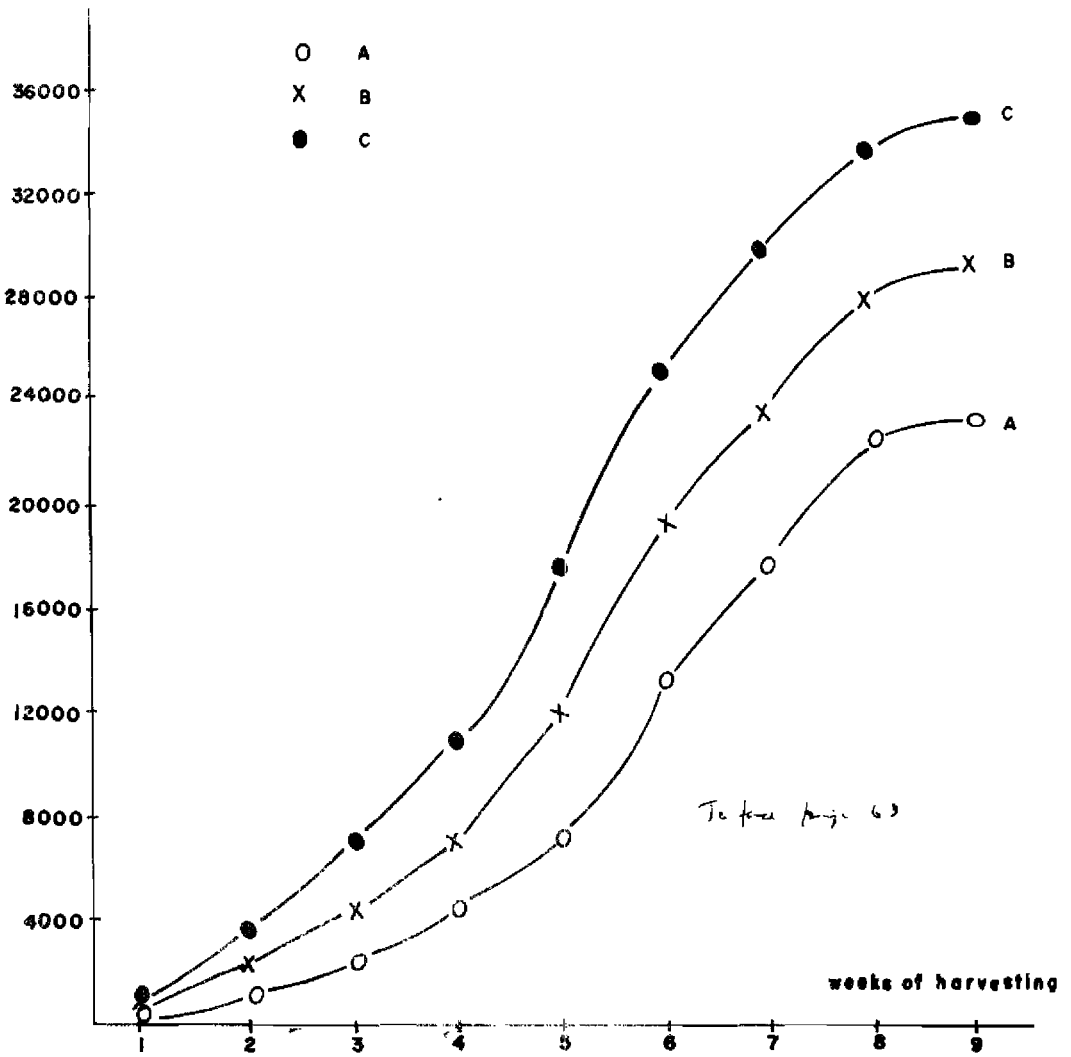
FIGURE I

Total number of pods picked (cumulative) — Spacing treatments



RESULTS

Plants at the closest spacing were difficult to harvest, as the leaves and pods became intertwined and required care to avoid breakage and other damage to the plants. Yield figures are presented in Table 1 figure 1.

TABLE 1

Total Plot Yields

Sub-plot	A		B		C		Total	
	No.	Wt./lb	No.	Wt./lb	No.	Wt./lb	No.	Wt./lb
a	6587	446.4	7247	499.0	8289	584.6	22023	1530.0
b	6141	377.0	7092	476.6	8599	572.2	21832	1425.8
c	5689	398.0	7863	560.2	8385	528.7	21937	1487.8
d	5350	354.3	6627	439.5	9772	672.8	21749	1466.5
Total	23667	1576.5	28829	1975.3	35045	2358.3	87541	5910.1

The analyses of variance for pod numbers and for yield were carried out by computer and are shown in Table 2. The spacing treatments gave yield and pod number differences that are significantly different at the 5% level. The differences between the A and B and the B and C treatments just fail to be significant at the 5 % level, but the difference between the A and C is. There are no significant differences among the fertilizer treatments.

TABLE 2

Analysis of Variance

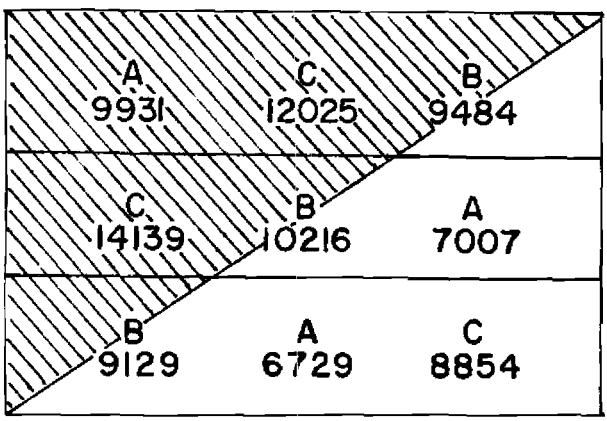
	Variance		DF	F	
	Weight	Number		Wt.	No.
Rows	5896.9	1296730.0	2	5.86	12.40
Columns	7398.4	1247930.0	2	7.36	11.94
Main Plots	12738.6	2704775.0	2	12.67*	25.88*
Sub-Plots	208.9	1593.3	3	.40	.01
Interaction	1187.9	162683.3	6	2.32	1.57
Error I	1004.7	104500.0	2		
Error II	510.3	102968.3	18		
Standard Error (Main) ...	12.9	132.0			
Standard Error (Sub-plots) ...	18.4	262.0			

*Significant at 5% level

Harvesting of pods reached a peak in the sixth week (Figures 2 and 3); numbers harvested from the different spacing treatments from sixth to the ninth week did not vary widely, although there were differences from the second to the fifth week—the closer spacings giving the higher yields. Slight differences only were recorded among the fertilizer treatments during the harvesting period.

DISCUSSION

Scrutiny of the plot yields indicates that there was wide variation in the number and weights of pods from the A and C plots, whereas the B plot yields were relatively uniform. In the following diagram of the plot layout it can be seen that the A and C plots shown shaded gave much higher yields than those shown unshaded (figures represent numbers of pods harvested). The cause may have been differences in soil, water drainage or aspect.



The interaction effects were not statistically significant. At the widest spacing, the best yields were obtained from the plots receiving basic fertilizers only, and the lowest from those receiving two additional applications. The basic application of fertilizer apparently provided adeqnate nutrients for plants at this spacing, and extra applications depressed the yield.

At the intermediate spacing, a single extra application of fertilizer at 8 weeks gave the highest yields, and plots with basic fertilizer only had second highest yield. At the closest spacing, however, two extra fertilizer applications were required to give the highest yields. It seems evident that increased plant density resulted in an increase in competition for nutrients from the soil, and extra fertilizer applications were advantageously effective. Plots receiving basic fertilizer only, gave the lowest number of pods at the wider spacing, but the yield in pounds weight was second highest.

FIGURE 2

Weekly harvests at the 3 spacings – pod number

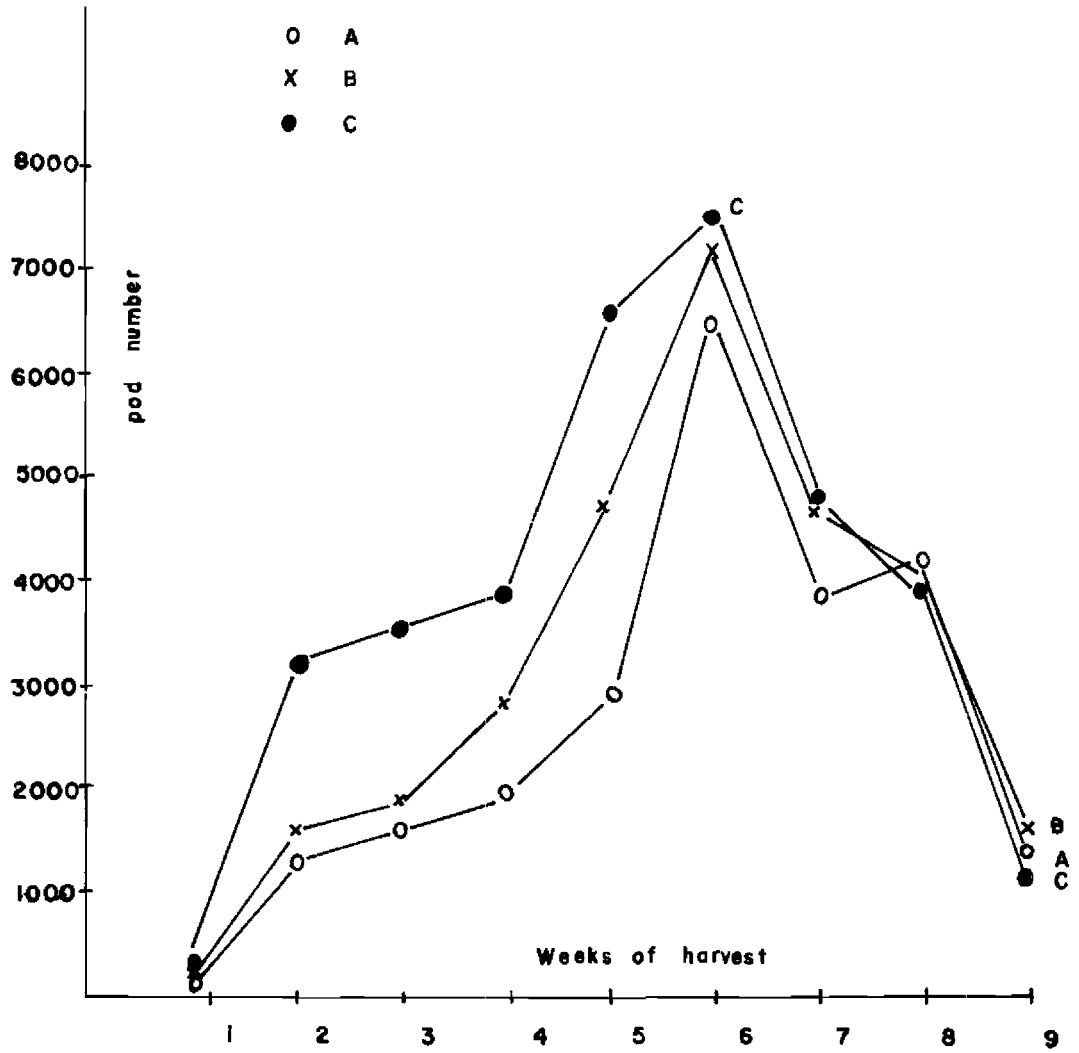
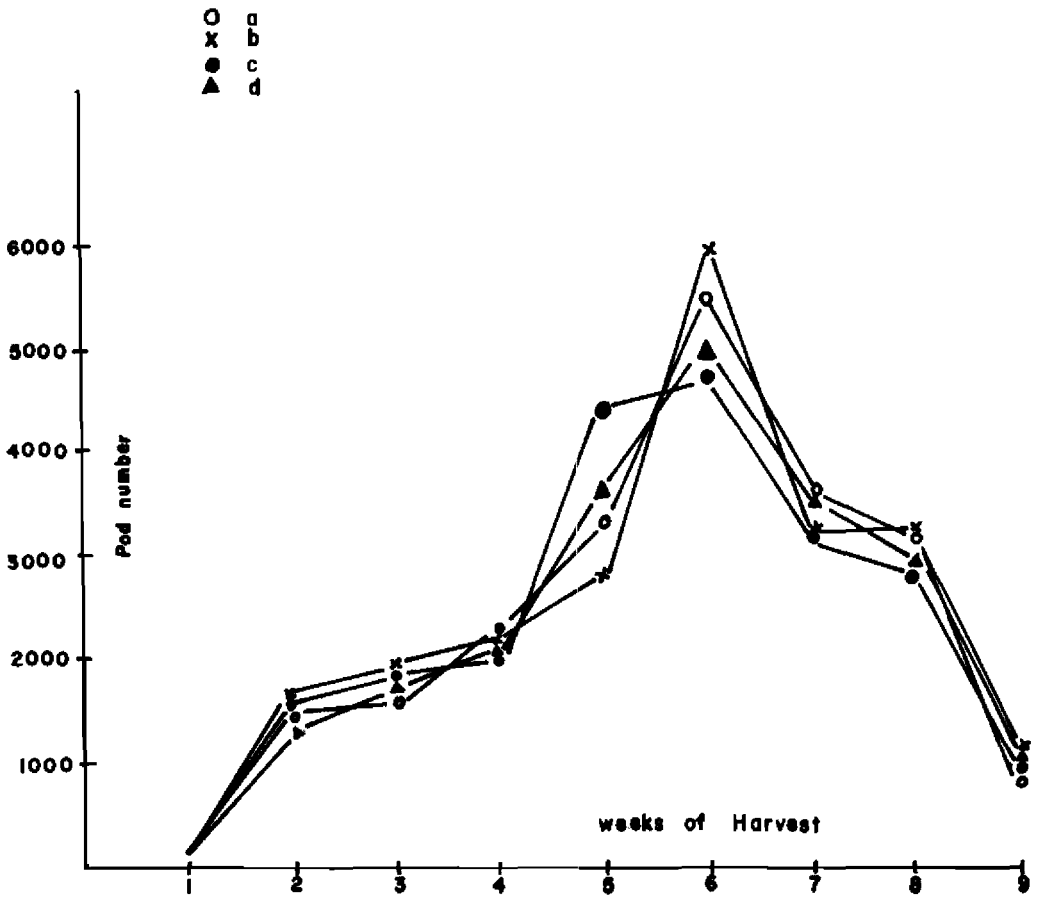


FIGURE 3

Weekly harvests at the 4 fertilizer levels - Pod Number



MEAN POD WEIGHT (TABLE 3)

In Trinidad markets, okra is sold by number of pods, not weight, so pod weight to the farmer, is of less economic importance. It was observed, however that the intermediate spacings gave the highest pod weight, but differences do not seem great as can be seen in Table 3.

TABLE 3

Mean Pod Weight (oz.)

Subject	A	B	C	General Mean
a	1.10	1.10	1.13	1.11
b	0.98	1.08	1.06	1.04
c	1.12	1.14	1.01	1.08
d	1.06	1.06	1.10	1.09
General mean	1.06	1.10	1.08	1.08

WEEKLY YIELDS

Considerably more pods were harvested from plots at the closest spacing than from the wider spacings in the first 6 weeks of harvest; subsequently there was little difference. This can be of importance to the grower when prices early in the season tend to be higher than later on.

MEAN HEIGHT AND LEAF NUMBER

As shown in Table 4, plants grown at the widest spacing had the largest number of leaves and were shorter than those grown at closer spacing (this was most noticeable from 8 weeks); plants grown at high density tended to be taller, most likely a phototropic response. The increased production of leaves in plants at the wider spacing may also be response to light.

TABLE 4

Mean Heights and Leaf Numbers of Plants

	4 weeks		8 weeks		12 weeks	
	Mean height	Leaf No.	Mean height	Leaf No.	Mean height	Leaf No.
A	8.55 ins	4.68	27.8 ins	31.8	58.7 ins	73.9
B	9.99 ins	5.33	29.6 ins	28.9	59.5 ins	65.1
C	9.69 ins	4.87	33.6 ins	21.8	62.5 ins	42.5

The difference in number of pods obtained at the various spacings is significant at the 5% level although the yields in pounds weight from the 3 spacing treatments are not significantly different. Since this crop is usually retailed in Trinidad and Tobago by the pod, the numbers of pods must be of greater economic significance than the actual weight.

The interaction effects are non-significant for both weight and pod numbers at the 5% level; they may be regarded, however, as not entirely negligible.

CONCLUSION

It is clear that the closest spaced plots receiving two extra applications of fertilizer gave the highest yield. It was noted, however, that there were difficulties in harvesting the crop from these plots due to intertwining of branches, leaves and pods. Loss due to damaged pods and plants or to the extra labour that would be required to pick these pods more slowly, made it advisable to consider the other spacing treatments. At intermediate spacing, the fertilizer treatments (two extra applications of fertilizer, at 4 weeks and at 8 weeks) give the largest number of pods. Here money and labour can be saved because of only one extra application of fertilizer, and harvesting is easier. This must be evaluated in the light of a 19% reduction in pod yield from the best performance at the closest spacing.

REFERENCES

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U.S.D.A. 1962. Leaflet. USDA Leaflet No. 449 1962.

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FIG. 1 SWEET POTATO

Total Fresh weight