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IMPROVING CORN YIELDS IN BARBADOS

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INTRODUCTION

There is a large, and increasing, demand for Indian Corn (*Zea mays*) in Barbados. Some 2,000 to 2,500 acres are planted to corn annually, yielding about 1,700 tons, and in addition well over 3,500 tons are imported in various forms representing a drain in foreign currency of more than half a million dollars (E.C.C.). With the development of animal husbandry in Barbados this figure is rising rapidly.

The average yield of corn in Barbados is very low, being about 19 bushels (1,520 lbs) per acre. True, this is not low by tropical standards; for example published figures for certain tropical countries are as follows:—

South West Africa	270 lb./acre
Sierra Leone	540 lb./acre
Mexico	880 lb./acre
India	940 lb./acre
Brazil	1,300 lb./acre

In temperate climates average yields are much higher:—

Argentina	1,700 lb./acre
Western Germany	2,790 lb./acre
United States	3,220 lb./acre
Israel	4,500 lb./acre

However, there is no room for complacency and we know of no fundamental reason why corn yields should necessarily be low in the tropics; a glance at the way in which corn is grown in Barbados suggests that a very great deal could indeed be done to improve the situation.

In passing it is worthy of note that the figure for the U.S.A., as recently as 1962 was only 3,220 lbs. (40.5 bushels) per acre. Yields of well over 100 bushels are, of course, commonplace in the corn belt. There must be some exceedingly poor areas as well.

USUAL SYSTEM IN BARBADOS

On sugar plantations, which occupy some 70 per cent of the sugar cane. After the cane is reaped in the months of February to April the land is tilled, the cane trash and stumps being incorporated into the soil, ridged for the next crop of cane, the ridges being 5 feet 0 inch or 5 feet 6 inches apart, and the corn is planted on the ridges. Usually the corn is planted "2 chops per hole" i.e. two planting points per five foot length of row, chopped with a hoe, and 4 or 5 seeds per point. Average survival of the seeds is about 50 per cent so this gives a population of some 8,000 plants per acre in 3,500 clumps. Some farmers, following work done by the Ministry of Agriculture, apply 2 to 3 cwt. of sulphate of ammonia per acre; most do not. One may comment further that corn is among the food crops required to be planted by

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law, and it is frequently regarded as a no-profit crop being planted only to satisfy the law's demands.

In small-holdings corn is seldom planted in pure stands, but usually in conjunction with other crops such as yams, sweet potatoes, eddoes or pulses, widely spaced, and yields per acre in this context are meaningless.

RECENT EXPERIMENTS

As part of a major study on the more efficient use of the land by food crops now being undertaken in Barbados, some rather elementary investigations have been made on corn, and experiments have been carried out on spacing, fertilising, varieties, drying and cost of production. Time allows comment in this paper on only the first three.

1. Spacing: It was recognised that for some years hence it might be necessary to plant corn in land prepared for sugar cane, and so two series of experiments were carried out: one on corn at various spacings planted on the 5 feet 0 inch or 5 feet 6 inches ridges of "preparation land" the other on ridges 2 feet 6 inches apart. In each case replicated plot experiments were carried out at several localities in areas of different soil type and rainfall conditions. The results are briefly summarised below:—

(*a*) Corn planted in preparation land

Planting treatment were:—

(i) 2 "chops" per hole
(ii) 4 "chops" per hole
(iii) 6 "chops" per hole

In each case 3 to 4 seeds per "chop" were planted.

Land preparation was the usual heavy disc harrowing, incorporating the cane trash and stumps into the soil, followed by subsoiling and ridging.

Fertilisation was with 3 cwt. 15–15–15 per acre, applied as a side dressing when the plants were about 6 inches high.

Plots were large, in strip form, averaging 27 feet 6 inches × 290 feet. Each experiment occupied approximately 2 acres and it was through that this adequately represent true field conditions.

The experiments were carried out on six plantations: on one excessive rainfall led to heavy weed growth that could not be brought under control by the management and this experiment was discounted; the other five showed trends similar to one another The average overall figures are shown in Table 1.

TABLE I

Corn spacing trial in preparation land.

Treatment	No. of plants per acre	Yield per acre (lb)	Gain in Yield (lb)	% Increase in yield
I—2 chops per hole ...	5,600	1,518	—	—
II—4 chops per hole ...	9,400	2,448	930	61
III—6 chops per hole ...	12,250	2,328	810	56

All yields are relatively low: there was excessive rainfall during the year (1966), ranging from 31 to 59 inches on the different experimental sites during the period of the experiment, and there was waterlogging in several instances and poor germination. However, there was no doubt that increasing the density by planting at 4 "chops" to the hole gave a very substantial increase in yield, worth $55.80 (E.C.C.) per acre at the current price of corn of 6 cents per lb. on the cob.

(*b*) Corn planted as a crop in its own right

Land preparation and fertilising were as in the previous experiments, except that ridging was now at 2 feet 6 inches.

Relatively small plots were used, of dimensions 30 feet × 10 feet.

Planting was by hand at various distances along the ridges, followed by thinning out if necessary. Planting distances were:

Planting distances	No. of plants per acre
8 ins.	25,000
1 ft. 0 ins	17,400
1 ft. 4 ins.	13,800
1 ft. 8 ins	10,200
2 ft. 0 ins.	8,700
3 ft. 0 ins.	5,800

RESULTS

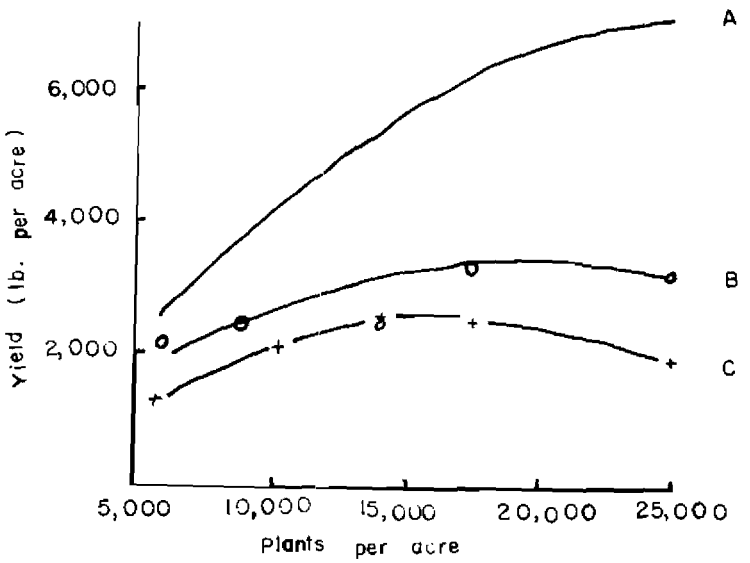
The year of the experiment (1965) was characterised by low rainfall over much of the island and one experiment was lost by drought; however, the remaining three gave valuable results as shown in Figure 1. It was found that astonishingly high yields could be obtained under favourable conditions: with 25,000 plants to the acre, 6,950 lb. (87 bushels) were achieved, and in the lower rainfall areas yields of 2,500 to 3,000 lb. were obtained—about twice the island's average.

The number of cobs per plant and average weight per cob were measured; these gave the usual pattern of reduction, both in number and size, as the population increased.

An attempt was also made to study the effect of rainfall distribution: again time does not allow us to go into detail, but the conclusion was that the quantity and intensity of rainfall during the first month after planting was extremely important; Hudson (2) has shown that direct daily evaporation from the soil ranges from 0.2 to 0.12 inches, in different parts of Barbados, and our analyses suggested that showers of less than these quantities were virtually useless in helping the crop to become established.

Commercial Development: As a consequence of these experiments a number of sugar plantations in Barbados have planted corn rather more closely than hitherto, using "4 chops per hole" of spacing at 6 to 8 inches along the 5 feet 6 inches ridges: yields ranging from 3,200 to 4,800 lb. per acre (40 to 60 bushels) have been reported. On two large plantations corn has been planted on ridges 2 feet 6 inches apart one obtained 5,440 lb. (68 bushels) and 5,760 lb. (72 bushels), the other 5,920 lb. (74 bushels) per acre. Results like these are, of course, most encouraging to the research

FIGURE 1. PLANT DENSITY AND FIELDS OF CORN IN BARBADOS (1965 EXPERIMENTS)



A = High rainfall area
B = Intermediate rainfall area
C = Low rainfall area

worker, and it is quite clear that attention to spacing can give yields in Barbados which are exceptionally high by tropical standards.

2. *Fertilising:* In the spacing experiments a 15–15–15 formulation, or equivalent, was used to give some 45 lb. N, 45 lb. P_2O_5 and 45 lb. K_2O per acre, following the general recommendations of Jacob and von Uexkull (3). In 1966 large scale experiments (1¼ acres each) were laid down on a number of localities in which four levels of fertilising were compared: 0, 2, 4 and 6 cwt. 15–15–15 per acre, applied as a side dressing when the corn was about 6 inches high (3 weeks approximately). Planting was at "4 chops per hole". Results are summarised in Table II (average for 6 plantations).

TABLE II

Corn Fertilising Experiment 1966

Treatment	Yield per acre (lb)	Gain in yield (lb)	% Increase in yield
No fertilizer	1,996	—	—
2 cwt/acre 15–15–15	2,560	564	28.5
4 cwt/acre 15–15–15	2,668	672	34.0
6 cwt/acre 15–15–15	2,688	692	34.7

It is clear that a very considerable gain in yield can be achieved by the use of 2 cwt. of 15–15–15 per acre, and some further increase with 4 and 6 cwt.; however it was calculated that the cost of the heavier applications was not covered by the gain in yield in 7 out of 12 instances.

In one locality there was, quite accidentally, a finding of considerable interest. Only part of the experimental field had sugar-cane as the preceding crop (Part A); the other part had sweet potatoes (Part B). Yields and response for these two sections of the field were dramatically different (Table III).

TABLE III

Yields of Corn after Sugarcane (A) and after Sweet Potatoes (B)

Treatment	Yield per acre (lb)		% Increase in Yield	
	A	B	A	B
No fertiliser	985	2,460	—	—
2 cwt/acre 15–15–15 ...	1,710	3,360	74	36
4 cwt/acre 15–15–15 ...	2,080	3,380	110	37
6 cwt/acre 15–15–15 ...	2,010	3,260	105	33

The extremely low yields in the plots where cane was planted were presumed to be due to the heavy demand for nitrogen associated with the microbiological decomposition of the cane trash and stumps: although the response to fertiliser was great, even the heaviest applications did not bring yields up to those of unfertilised plots which had not had trash incorporated into the soils.

One further observation is worthy of comment. In a series of experiments in 1965, not described here, in which low level and high level fertilising was applied, the higher level of fertilisation gave yield up to 1,000 lb./acre more than the lower level in those experiments which had high rainfall, but no increase in yield where rainfall was low: shortage of water could clearly be an absolutely limiting factor to the plant's development.

This is, of course, only the start of our examination of fertiliser use on corn in Barbados. We have no idea of the relative importance of nitrogen phosphorus and potash: we are currently setting up experiments to examine these factors. The Regional Field Experimental Programme of the University of the West Indies is also developing information on these problems.

3. *Variety Trials:* Frequently, when faced with the 19-bushel per acre yield of corn, the Barbadian farmer will say—"well, what do you expect from the ordinary Barbados corn?" Now, if we had some of these American varieties and have, of course, failed to produce a crop, not appreciating the long-day nature of the North American Plants.

In 1965 and 1966 observational trials were carried out on a number of tropical hybrid corns and selections—a total of 31 from Colombia, Mexico, Cuba, Rhodesia, Trinidad and Jamaica were compared with the Barbados "variety". None of the trials was at all satisfactory; poor germination or pests played havoc both in 1965 and 1966. However, despite this, the Jamaican hybrid X 304 appeared to be very promising, and worthy of further trial; Diacol V–351 from Colombia and the Mexican selection No. 1917 also seemed to have potentialities for high yields.

A very noticeable feature of these trials was the much more robust nature of the Barbados corn; it was a shorter and sturdier plant; the leaves appeared to suffer less attack from insects, the cobs had far less ear-worm attack, and the cob sheath was less liable to tearing by birds and bats. In one locality where bats caused heavy losses 35 per cent of the Barbados corn cobs showed damage, but in others the damage ranged from 44 per cent to 88 per cent. The conclusion can be drawn that over the centuries the Barbados corn has undergone a substantial degree of a selection which has enabled it to withstand to a high degree the local pests. Furthermore, as the 87 bushel yield in one experiment has shown, it is capable of high yields when the growing conditions are good. The potentialities may be higher than we appreciate at present. At least one plantation has, by selection of cobs, developed a "strain" which performs distinctly better than the "unselected" corn on his estate; no critical evaluation has been carried out but it would be surprising if, in as heterogeneous a population as the Barbados corn appears to be, careful selection could not lead to real improvement.

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