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HYBRID MAIZE PERFORMANCE IN SOME EASTERN CARIBBEAN ISLANDS*

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Maize is widely grown in the Eastern Caribbean islands, mainly as a subsistence crop in mixed stand with sweet potato (*Ipomoea batatas* Lam.), pigeon peas (*Cajanus indicus*. Spreng) or peanuts (*Arachis hypogea*. L.) in the Windward Islands and in vacant land between sugar cane crops in Barbados. Yields are, as a rule low, and farmers therefore consider the crop's production uneconomic. Two major constraints to improved yields are, the unavailability of planting seed of varieties with high yield potential under Eastern Caribbean conditions and the lack of rational chemical fertilizer use.

Attempts in the past to import seed from abroad have not been successful, largely because of the absence of sustained activity. It is well known that maize is usually location specific, and past importation in the area have suffered severely from the rigors of weather, disease, and insect pests. Thus, it is customary to hold over seed from year to year, so that, in fact, some form of mass selection is practised. The local corn is quite variable in plant and grain characteristics. While, one St-Vincent selection was seen to mature in about 80 days, a selection of St-Lucia corn required about 130 days for maturity. Grain types vary from flints to dents and from deep red to light yellow. Clearly, this unconscious selection has produced types which are resistant or tolerant to local major disease and insect pests, however, it is apparent that the yield potential is quite low.

This paper was inspired by the increase in interest in maize production in the area and by the fact that considerable quantities of maize and maize products are imported. Over 6 Mil. pounds of maize and maize products were imported into Barbados, Grenada, St-Vincent and St-Lucia in 1966 (3). The prospects for the future are an increasing demand for maize, with an ever increasing human population and a growing demand for livestock feed. Further there seems to be some debate, as to the value of hybrid corn, relative to local selections, having regard to the record of performance of importations in the past. The author conducted over 60 fertilizer experiments in Barbados, Grenada,

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St-Vincent and St-Lucia, using maize hybrid variety X304 produced by Pioneer Seed Company in Jamaica, on a range of soils and climatic conditions. In addition, local selections were compared with hybrid varieties from Pioneer on three of the four islands. This paper therefore, attempts to draw attention to the high yield potential of hybrid corn in the area based on performance over a range of ecological conditions, and the need for extended research activity.

MATERIAL AND METHODS

Two sets of field experiments will be briefly described, namely, the Maize Fertilizer Series and the Maize Varietal Series.

a — *Maize Fertilizer Series*

These experiments were designed as part of the R. F. E. P. soil calibration exercises during 1967 and 1968. A central composite design, which allowed 18 plots on each site was employed through-out, with individual plot size at 1/96.8 acres. All plots were seeded with hybrid variety X304 at a plant density of about 11,500 plants per acre, during the planting season, May to August in each year.

Three soil types were selected in each of the four islands as indicated in Table I, and three separate sites were seeded for each soil type each year, except for Grenada where only two soil types were seeded during the 1967 season.

The Barbados soils are calcareous clays ranging from pH 7.6 to 7.9, and the sites were at a mean elevation of 200 feet above sea level for the Black soils, 350 feet above sea level for the Grey Browns, while the Yellow Browns were 650 feet above sea level (4).

The other soils on which sites were located were all of volcanic origin, with a range in pH from 5.5 -- for Capitol Clay Loam in Grenada to 6.7 for Woburn Clay Loam in Grenada (Table I). These soils also included a recent volcanic sand, Soufriere Cindery Bouldery Sand in St-Vincent, and two alluvial soils, Latille Clay and Raveneau Clay in St-Lucia (4, 5, 6, 7). Site elevations ranged from 50 feet above sea level on Latille Clay and Raveneau Clay to 600 feet above sea level in Grenada on Capitol Clay Loams. Fertility ratings were in the main medium to low, with only two soils, Belmont Clay Loam and Raveneau Clay, described as being high (4, 5, 6, 7).

Fertilizer rates used were as follows :

- 1) Sulphate of ammonia 0-80 lbs. N per acre.
- 2) Phosphate source, single superphosphate in 1967 and triple superphosphate during 1968, 0-54 lbs P_2O_5 per acre.
- 3) Muriate of potash 0-110 lbs K_2O per acre.

Fertilizers were applied as a side dressing four weeks after seeding during 1967, and at seeding time during 1968.

Moisture source was by precipitation only, of which the means for soil types over two years were recorded (Table I).

TABLE I

Brief description of soils on which Maize Fertilizer Experiments were sited during 1967 and 1968

Island	Soil type	Soil pH	Soil Fertility rating	Mean Rainfall for crop	Mean Elevation of sites (ft. above sea level)
<i>Barbados</i>	Black soils	7.9	medium	24.6	200
	Grey Brown soils	7.7	—		350
	Yellow Brown soils	7.6	—	26.4	650
<i>St-Vincent</i>	Soufriere Cindery	5.8	low nitrogen	23.1	200
	Bouldery Sand				
	Bellevue Sandy Loam	6.4	medium low	28.5	250
<i>St-Lucia</i>	Akers Sandy Loam	6.4	medium low	22.8	250
	Balembouche Gritty Clay Loam	6.4	medium to low	22.2	150
	Latille Clay Loam	5.7	medium	20.2	50
<i>Grenada</i>	Raveneau Clay	5.6	High	20.2	50
	Capitol Clay Loam	5.5	medium	31.7	600
	Belmont Clay Loam	5.8	medium	34.8	150
	Woburn Clay	6.7	high to high medium	20.8	250

b — Maize Varietal Series

Three maize varietal experiments were seeded during 1968, one each on a Black soil at Waterford, Barbados, Balembouche Gritty Clay Loam at Balembouche in St-Lucia, and on Akers Sandy Loam at Carapan in St-Vincent.

Varieties compared were :

- (a) X304
- (b) X332A
- (c) X336A
- (d) Farmers' corn from each island.

Experimental designs used were randomized complete blocks, replicated four times, with individual plots of 1/96.8 acre. Plant density was about 11,500 plants per acre, and a basal fertilizer dressing of 200 lbs. Sulphate of ammonia, 60 lbs. Triple superphosphate and 90 lbs. Muriate of potash per acre, was applied to all plots at seeding time. Routine weed control was done with the use of atrazine as pre-emergence spray supplemented by hand weeding. Good insect pest control was achieved by regular spraying with sevin or malathion. No irrigation was done, and the rainfall experienced was 25.4 inches, 27.1 inches and 16.8 inches at Balembouche, Carapan and Waterford respectively.

RESULTS

a — Maize Fertilizer Series

For this paper, the highest plot yield from each site for each year was abstracted and used to calculate the mean maximum grain yield for each soil type. Typically, therefore, this mean was derived from six separate experiments over the two year

period. In Grenada, the Woburn Clay Loams is for 1968 only, while the yields on Latille Clay in St-Lucia are from three sites and that from Raveneau Clay from four sites (Table II). Experiments were lost as a result of extreme dry weather, praedial larceny or by hurricane Beulah in 1967.

The highest mean maximum yields were observed in St-Vincent where Soufriere Cindery Bouldery Sand and Akers Sandy Loam supported over 4,000 lbs grain (15.5 % moisture) per acre. The lowest yields were noted in Grenada which experienced unseasonal dry periods during the conduct of the experiments.

The maximum grain yield (Table II) is self explanatory and attempts to demonstrate the sort of yields possible in the area, the highest, 5,326 lbs grain (15.5 % moisture) being recorded in St-Vincent.

TABLE II

Mean Grain yields (lbs per acre 15.5 % moisture) recorded during 1967 and 1968 on six sites from each soil type

Island	Soil type	Maximum Mean grain yield	Maximum grain yield
<i>Barbados</i>	Black soils	2 650	3 737
	Grey Brown soils	3 387	3 871
	Yellow Brown soils	3 737	4 437
<i>St-Vincent</i>	Soufriere Cindery Bouldery Sand	4 660	5 326
	Bellevue Sandy Loam	3 411	3 873
	Akers Sandy Loam	4 302	5 321
	Balembouche Gritty Clay	3 647	4 523
<i>St-Lucia</i>	Latille Clay Loam	3 709	4 310
	Raveneau Clay	3 450	3 830
	Capitol Clay Loam	2 646	3 198
<i>Grenada</i>	Belmont Clay Loam	2 709	4 633
	Woburn Clay	2 434	3 450

b — *Maize Varietal Series*

Extremely dry conditions at Waterford, Barbados lead to very low yields, thus, the data from this experiment is not presented.

In St-Vincent and St-Lucia significant yield differences were evident between the local selections and the hybrids, however, there was no statistically significant difference between hybrids (Table III).

In St-Vincent the hybrids all outyielded the local corn by 1 500-2 000 lbs of dry grain per acre, and X332A gave the highest yield of 5 068 lbs dry grain per acre (Table III). In St-Lucia, the difference between the local corn and the hybrids was even more dramatic. X332A produced 4 542 lbs dry grain as compared with local, 2 192 ; that is to say, the highest yielding hybrid produced more than twice as much dry grain as the local.

Shelling % was variable among varieties, ranging from 69.8 % to 79.5 %, and although yields were generally lower in St-Lucia than in St-Vincent, shelling % in the former island tended to be higher than in the latter (Table IV). There were no serious differences between the ratio of grain weights to ear weights.

Variety X332A produced the largest ears, 9.58 and 9.42 ounces in St-Vincent and St-Lucia respectively (Table V). Statistically, the mean ear weights of all three hybrids can be regarded as similar, however, ears produced on local selections were distinctly inferior in size and weight.

TABLE III
Mean Grain yields (lbs 15.5 % moisture) of varieties,
under test in St-Vincent and St-Lucia

St-Vincent		St-Lucia	
Variety	Yields	Variety	Yields
X332A	5 068	X332A	4 542
X336A	4 528	X304	4 120
X304	4 524	X336	3 594
Local	3 099	Local	2 192
S. E.	195		446
C. V.	4.5 %		12.8 %

Line indicates common sub-sets within which there are no significant differences at the 5 % level as indicated by Duncan's Multiple Range Test.

TABLE IV
Mean Shelling % of Varieties tested in St-Vincent and St-Lucia

St-Vincent		St-Lucia	
Variety	Shelling %	Variety	Shelling %
Local	73.9	X304	79.5
X332A	72.7	X336A	78.5
X336A	72.0	X332A	77.8
X304	69.8	Local	77.0
S. E.	2.0		3.2
C. V.	2.7 %		4.0

No significant differences observed.

TABLE V
Mean Ear Weights (ozs.) of Varieties tested in St-Vincent and St-Lucia

St-Vincent		St-Lucia	
Variety	Mean Ear Wt.	Variety	Mean Ear Wt. %
X332A	9.58	X332A	9.42
X336	8.67	X336A	7.71
X304	8.57	X304	7.56
Local	5.83	Local	4.52
S. E.	0.367		0.69
C. V.	4.5 %		9.4

Line indicates common sub-sets within which there are no significant differences at the 5 % level as indicated by Duncan's Multiple Range Test.

DISCUSSION

The fluctuations in mean maximum grain yields from island to island and within islands, appear to be most strongly influenced by rainfall and soil type. In Barbados, for example, the Black soils occur in areas of lower rainfall than the Yellow Brown soils, and in St-Vincent, the Bellevue Sandy Loam supported the lowest yield there, despite the fact that it received the highest rainfall. This last fact, however, is not surprising since Bellevue Sandy Loam is a rather excessively leached and impoverished soil. Extensive rainfall could only adversely affect yield.

The dramatic differences observed between local selections and imported hybrid varieties, stem from the obvious disparity in vigour between the two groups. The hybrids germinated more quickly and elongated at a faster rate, and was usually more lush vegetatively. While plants of the local selection in St-Lucia were large and later maturing, the St-Vincent local was much shorter than the hybrids and matured very much earlier. It is clear from the data and field observations, that a major contributing factor to the yield superiority of the hybrids, was their comparatively large ear size. Shelling % was disappointing, as one would expect a larger out-turn of grain per unit of ear weight from high producing maize.

The results of the two series of field experiments described above indicate that the new hybrids are well adapted and capable of high yields under conditions in the Eastern Caribbean. This is underscored by the fact that comparatively low plant densities were employed and that the chemical fertilizers used were not necessarily optimal. Clearly, the results are encouraging enough to demand research on maize on a continuing basis with increasing efforts to provide germ plasm capable of higher grain yields under these conditions. It is also evident that the dynamics of nutrient and moisture supply, variety and plant density, need thorough investigation if the crop is ever to be developed as an important one in the region.

SUMMARY

Two series of field Experiments in which hybrid corn was used, were reported.

The first series, a soil fertility calibration programme, involved the growing of hybrid variety X304 on 12 soil types in Barbados, Grenada, St-Vincent and St-Lucia during the 1967 and 1968 wet seasons. Soil types ranged from the calcareous clays of Barbados to the markedly acid sands of St-Vincent, and site elevations varied from 50 to 650 feet above sea level. Rainfall during the crops' life varied from 20.8 inches to 31.7 inches.

Mean maxima grain yields were calculated for each soil type and were as low as 2.434 lbs dry grain, 15.5% moisture, and as high as 4.460 lbs dry grain per acre. The lowest mean maximum yield was at least twice as large as average farmers yields in the islands.

The second series described two varietal experiments in which local maize selections were critically compared with three imported hybrid varieties, X304, X336A and X332A, over one season, in two islands. Variety X332A outyielded all other entries to give mean yields of 5.068 and 4.542 lbs per acre, dry grain (15.5% moisture) in St-Vincent and St-Lucia respectively. Of particular importance was the fact that the local selections were very much poorer in production than the hybrids; the local in St-Lucia producing less than half the yield of the best hybrid there.

Attention was called to the comparatively high yield potential of currently available hybrid material and the need for more intensive research in such matters as the economics of fertilizer use and insect pest control, and a continued search for higher yielding varieties, was stressed.

RÉSUMÉ

AGRONOMIE ET PRODUCTIVITÉ DE MAIS HYBRIDES DANS CERTAINES DES ILES AU VENT

Deux séries d'expérimentations au champ ont été étudiées.

La première série qui consiste en tests d'évaluation de la fertilité basée sur la culture de la variété X304 sur 12 types de sols (Barbade, Grenade, Saint-Vincent, Sainte-Lucie) allant des sols sur calcaire de Barbade aux sols sableux très acides de Saint-Vincent correspondant à des milieux très variés : altitudes variant de 15 à 200 m. Ces cultures, conduites pendant la saison humide ont reçu un total de pluie variant de 50 à 80 mm. La production de grain a été mesurée et représente des rendements variant de 2 700 kg/ha, à 5 000 kg/ha (% humidité : 15,5). Les rendements les plus bas obtenus représentent au moins le double de la moyenne obtenue par les cultivateurs de ces îles.

La seconde série compare des sélections locales de maïs à trois hybrides importés : X304, X336A, X332A. La variété X332A a été la meilleure en donnant des rendements en grains secs (humidité 15,5) 5 600 et 5 050 kg/ha respectivement à Saint-Vincent et Sainte-Lucie. Dans tous les cas le rendement des variétés locales est très inférieur.

Il convient d'insister sur l'intérêt présenté par les possibilités de rendement de ces hybrides déjà disponibles sur le marché des semences et sur le besoin d'accroître les recherches notamment en fertilisation et en lutte contre les ennemis des cultures, tout en poursuivant l'amélioration variétale.

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