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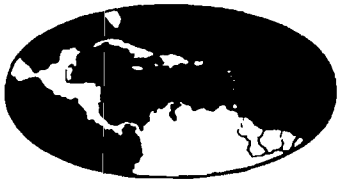

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5. Snedecor, G. W., Statistical Methods, first ed., Collegiate Press, Inc. Ames, Iowa, 1937.

6. Spencer, D., The effect of molybdate on the activity of tomato acid phosphatase, Australian J. Biol. Sci. 7:151-60, 1954.

7. Sumner, J. B., Dinitrosalicylic acid: A reagent for the estimation of sugar in normal and diabetic urine, J. Biol. Chem. 47:5-9, 1921.

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A REVIEW OF CURRENT RESEARCH ON FOOD, FIELD AND PHARMACEUTICAL CROPS AT THE TATE & LYLE CENTRAL AGRICULTURAL RESEARCH STATION

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INTRODUCTION

Imports of food into Trinidad and Tobago in 1962 were valued at $76,410,400. (1). Fruits, vegetables, cereals, and cereal preparations accounted for roughly 45 per cent of the food import bill. The enormity of this bill is one of the reasons why the Tate and Lyle Central Agricultural Research Station has devoted attention to research on food and field crops.

As the sugar industry becomes mechanized, and as yourger people are attracted to the cities, older employees in sugar are not always easily replaced. It is hoped that the research work on food and field crops will serve to motivate younger people to remain in agriculture and to grow a greater proportion of their own food. This would be of benefit to the nation, to the sugar industry, and to the agricultural community in general.

The importation and evaluation of new varieties of high quality food crops is an important facet of the research program. It is desirable that yields of vegetable and other crops be increased by growing more productive varieties. Accumulation of information on which varieties of a particular crop may best be grown in Trinidad at different times of the year, is also of great importance. Frequently, in the past, crops have not been grown successfully because the varieties were unsuited to the particular thermo- or photoperiods obtaining at different times of the year.

Research is also being undertaken on the growing of crops which are new to Trinidad. Seed or other forms of planting material of

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soybean, sorghum, etc., have been imported and the crops are currently being grown and evaluated.

Investigations are also in progress on determining the best systems for growing vegetable crops on the heavy clays, which represent the predominant soil type in Central Trinidad. Also we have looked into alternative methods of cultivating vegetables.

For example, the development of a new medium for the production of vegetable crops has been described by Davies and Vlitos (6). Briefly, the medium consists of coconut fibre waste to which are added various inorganic fertilizers together with ground limestone. Crops may be grown in the medium with a minimum of effort, provided that an adequate supply of water is available. The medium possesses none of the physical difficulties of the heavy clays and has been used successfully to grow a variety of crops.

While the medium is undoubtedly the best answer to the problem of food crops production on a small scale, the average Trinidadian does not appear to be very interested in using it. It is however being successfully used on an extensive scale by a commercial concern in the island for growing crops for eventual sale to supermarkets, hotels and other organizations requiring large quantities of high quality food crops regularly. Since the work is primarily directed towards the small-scale vegetable grower and not to large commercial enterprises, more emphasis has been placed during 1965 on growing crops on the heavy clays located in the vicinity of the Research Station. The methods used in the demonstration areas are those which the local farmer can afford to use and we have made an effort to avoid the use of heavy machinery and have relied primarily on hand labour. The demonstration plots are open to visits by peasant farmers and others. Information gained from this work is published and is freely available.

EXPERIMENTAL

Only about 1 3/4 acres of land has been utilized for the food crops program. The soil type has been described by Chenery (3) as Waterloo loam to clay. It is appropriate to quote extracts of Chenery's original description"

"The topsoil is very variable in texture and may be clay, silty clay, silty clay loam or loam; the heavier types are found on the seaward side. Since all the land has been cultivated at some time an undisturbed profile is never found but the general appearance is yellowish brown somewhat mottled on speckled with grey and orange. A thickly mottled yellowish grey and orange silty clay occurs at 12 to 24 inches from the surface. Below this is a broader horizon often 4 feet thick of compact light greenish grey clay, mottled crimson and bright red, fissures and root traces are heavily encrusted with orange rust. At about 5 feet a grey horizon is found which is blue grey clay, mottled and piped with yellowish brown loamy material. Deep ploughing and draining often brings the orange and grey subsoil to the surface and presents the silver and gold appearance described by

Charter (2). Concretions are rarely seen and manganese dioxide staining is not very prominent. The horizons are usually very sharply defined." Drainage in this soil is described as imperfect.

A chemical analysis of samples which had previously been planted with sugar cane follows:

TABLE 1

Results of chemical analysis of samples of Waterloo Loam and Clay Soil (1964)

% N	% P	% K	% Ca	pH
0.060	0.016	0.016	0.006	6.1

The area was divided into individual blocks for planting the vegetable crops. Within each block raised beds were formed 9 to 12 inches high and 36 inches wide. The beds were separated by pathways about 30 inches wide. Cultivation was carried out by hand forking and quantities of farmyard manure were thoroughly worked into the soil. Weeding was carried out by hand. During the dry season (January to May) water was applied by hand using perforated polyvinyl chloride hose and watering cans. With certain crops an attempt was made to reduce evaporation from the surface of the beds by mulching with bagasse.

Regular sprayings with specific insecticides and fungicides controlled pests and diseases.

RESULTS

Several crops have been grown successfuly in the heavy clays and some of the results obtained are given below:

Vegetable Crops

Bean (*Phaseolus vulgaris*)

Two varieties of bean were grown during December and January. Seed of the *Contender* variety of bush bean and the *Kentucky Wonder* variety of pole bean were planted at 9 inches intervals along rows 2 feet apart. Excellent germination took place about four days after planting. During the growth of the plants weekly spraying with a fungicide was carried out. The pole beans were staked with 8 feet high bamboo poles.

Harvesting the bush beans commenced some seven weeks after planting while the pole beans matured at about eight weeks. Harvesting of both varieties was completed within nine weeks after planting. The results are given in Table 2.

TABLE 2

Yield data of two varieties of bean grown in a clay soil

Variety	Area (sq. ft.)	Total weight Harvested (lb)	Average yield per plant (lb.)	Average yield per sq. ft. (lb)	Estimated yield per acre (lb.)
Contender	75	26.5	0.44	0.35	15,391
Kentucky Wonder	150	49.0	0.38	0.33	14,230

Lettuce (Lactuca sativa)

Seed of three varieties of lettuce were germinated in flats on a medium consisting of equal proportions of clay, coconut fibre waste (CFW) and rotted filter press mud. At about 12 days after germination the seedlings were planted in the field. The seedlings were planted on raised beds at intervals of 12 - 15 inches along the row. Growth was excellent in the heavy clay, and each of the varieties produced true heads during this time (December-January).

Harvesting began six weeks after planting and the yield data are presented in Table 3. Great Lakes 118 produced smaller heads than either Early Great Lakes or Mesa 659.

TABLE 3

Yield data of three lettuce varieties grown in a clay soil

	Area (sq. ft.)	No. of lettuce harvested	Average weight per plant (lb.)
Great Lakes 118	125	41	1.5
Early Great Lakes	125	46	1.0
Mesa 659	125	88	2.0

Cucumber (Cucumis sativus)

Two varieties of pickling cucumber, the seed of which were imprted from Canada, were evaluated under Trinidad conditions during December and January. The seed was sown in seedling boxes containing a mixture of soil, CFW and rotted filter press mud. About two weeks after germination the seedlings were transplanted into the field at intervals of 6 feet along the beds. During growth of the

crop it was sprayed at regular intervals with alternate treatments of copper and zinc fungicides.

Harvesting took place some eight weeks after planting. The variety Wisconsin SMR 18 produced smaller, more yellow fruit than the Windermoor Wonder variety. The yield data are presented in Table 4.

TABLE 4

Yield data of two cucumber varieties grown in a clay soil

	Area (sq. ft.)	No. of plants	Total weight of fruit (lb.)	Average yield per plant (lb.)	Approximate yield per acre (lb)
Windermoor Wonder	600	24	54	2.25	3,920
Wisconsin SMR 18	600	22	46	2.09	3,340

Rockmelon (Cucumis melo)

The seed of two varieties of rockmelon, imported from Australia, were planted directly into the beds at 6 feet intervals along the rows. Germination occurred about four days after planting. During growth the plants were sprayed regularly with a fungicide (Dithane). While the fruits were forming, sprays of Malathion were used to control insects. The fruits were harvested some nine weeks after planting. Yield data are presented in Table 5.

TABLE 5

Yield data of two rockmelon varieties grown in a clay soil

Variety	Total weight of fruit (lb)	Number of fruit	Average weight of fruit (lb)
Tardello	46.06	22	2.09
Conqueror	60.00	32	1.87

The Tardello variety produced fewer fruit than the Conqueror variety but the fruit were more uniform in size. Fruit of the latter variety varied in size between 1.0 to 3.5 lbs.

Pumpkin (Cucurbita pepo.)

The seeds of a local variety of pumpkin were planted in the soil at 8 feet intervals along the rows. Excellent germination was

followed by good growth of the vines. Alternate treatments with copper and zinc fungicides were carried out at weekly intervals. Fruits were harvested between the end of February and April 20, 1965. The yield data are presented in Table 6.

TABLE 6

Yield data of pumpkings grown in a clay soil

Number of plants	Number of fruit	Total weight of fruit (lb.)	Average weight per fruit (lb.)	Average weight per plant (lb.)
48	72	364.25	5.06	7.59

Jerusalem Artichoke (Helianthus annuus)

Tubers of Jerusalem Artichokes were imported and planted in a mixture of soil, CFW and rotted filter press mud in polythene bags in the greenhouse. Three varieties were evaluated and it was of particular interest to assess the performance of each variety under local conditions. An important aspect of the crop is to assess its potential for the production of fructose.

The two varieties Dagneutral and Silver Skin grew very well in compost contained in polythene bags, but the Spindel variety failed to germinate. Seedlings were transplanted in the clay soil at 2 feet spacing along the beds. Both varieties grew well and tuberization occurred notwithstanding the heavy clay soil. After approximately four months the tubers were harvested. Results are presented in Table 7.

TABLE 7

Yield data of Jerusalem Artichoke grown in a clay soil

Variety	Date planted	Area (sq. ft.)	No. of plants	Total yield of tubers (lb.)	Average weight per plant (lb.)	Estimated yield per acre (lb.)
Dagneutral	1/12/64	444	47	72	1.53	7,064
Silver Skin	12/ 2/65	1,050	96	189	1.97	7,841

Onion (Allium cepa)

Onion seed (var. Yates' Selection 608) was sown directly in the field in rows 6 inches apart on 14th December 1964. At two weeks after germination the seedlings were thinned to between 1 and 1 1/2

inches along the rows. The seedlings developed well and produced onions of reasonable size. The crop was harvested on May 6, 1965.

From an area of 375 sq. ft. a total yield of 28.5 lb. of onions was obtained.

Sweet Pepper (Capsicum frutescens.)

Seedlings of the sweet pepper variety (Californian Wonder) were transplanted into the clay soil on January 8, 1965. Harvesting commenced on February 22, 1965 and was completed on April 4, 1965. Yield data are given in Table 8.

TABLE 8

Yield data of Sweet Peppers grown in a clay soil

Variety	Number of plants	Total yield of fruit (lb.)	Average yield per plant (lb.)
California Wonder	20	35	1.75

Several other vegetable crops are being grown in the clay soil and results are not yet available. Crops such as head lettuce (L. sativa) are being planted at different times of the year in order to obtain information on the ability of different varieties viz. Mesa 659 and Early Great Lakes to produce true heads under different thermo- and photoperiods.

Artichoke (Cynara scolymus)

This is a new crop to the Research Station. Seed of the variety Green Globe was sown on a medium of equal parts of clay, CFW and rotted filter press mud. The seedlings were transplanted on March 24, 1965 into the clay soil at a distance of 18 inches along the rows.

The plants have made good vegetative growth in the soil but no flowering has occurred to date.

Tomato (Lycopersicon esculentum)

Four varieties of tomato are being evaluated in the clay soil. Seed of the varieties Indian River, Manalucie, College Challenger and Ace VF 55 were germinated in a medium containing clay, CFW and rotted filter press mud in the green house. The seedlings were transplanted into the soil between April 28 and May 11, 1965. Observations are being made on flowering, fruiting and vegetative

growth of the different varieties. Interest is particularly centred on their performance during the Trinidad wet season since this is the out of season for tomato production.

Cabbage (Brassica oleracea var. capitata)

Several varieties of cabbage are currently undergoing evaluation in the clay soil. Again particular attention is being paid to the performance of the different varieties at different periods of the year.

Field Crops

In addition to the work being carried out on vegetable crops research is also in progress on field crops. The crops being investigated so far as we are aware have not been grown on a large scale in Trinidad previously. Preliminary work on sweet corn was described previously by Davies and Vlitos (7). This crop is being evaluated further during 1965. Research is also being carried out on sorghum and soybeans.

Sweet Corn (Zea mays)

As a result of the investigations on sweet corn in 1964 (7, 8) the varieties Valleygold and Floribelle are being evaluated further in 1965. An area of about 2 acres, which had lain fallow for one year, was given a shallow cultivation and seed of the two varieties of sweet corn were planted between April 7 and April 10, 1965. The seeds were planted at 9 inches intervals along rows either 2 or 3 feet apart. A pre-emergence application of Atrazine (2-chloro-4-ethylamine-6-isopropylamino-s-triazine) at the rate of 2.5 lb. active ingredient per acre was given some two days after planting. At the same time a 10 per cent granular formulation of Diazinon (0,0-diethyl 0-(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothioate) was dusted lightly along the rows to control insects. Triple super phosphate at 2 cwt. per acre was applied in the holes at planting while sulphate of ammonia and muriate of potash were applied at the rate of 2 cwt. per acre each, some four weeks after planting. The plots were irrigated as necessary using Wright Rain equipment. Germination occurred within five days.

The first ears of corn appeared on May 24, 1965 and shortly thereafter a 1 per cent mixture of Sevin (1-naphthyl methylcarbamate) in Vapona oil was placed on the emerging silks. This treatment reduced the incidence of attack from corn earworm, Heliothis armigera.

Harvesting commenced on June 14, 1965 some 67 days after planting. Excellent yields are being obtained and kernel formation is very regular, particularly in the variety Valleygold.

The results obtained with sweet corn thus far in 1965 are encouraging and further work is planned for the remainder of the year. Seed will be planted at varying intervals to determine whether varieties are sensitive to photoperiod.

Sorghum (Sorghum vulgare)

Two sweet sorghum varieties were evaluated in trials conducted during 1964 (6). Seed of the varieties Mer.55-1 and Mer 57-1 received from the United States Department of Agriculture.

Both varieties were planted in Waterloo loam and clay soil on April 15, 1964. On August 4, 1964 the crop was harvested. Stalks were crushed by passing them through a cane sample mill and the juice thus extracted was analyzed. The results of the analysis are presented in Table 9.

TABLE 9

Results of analysis of juice of two sweet sorghum varieties

Analysis	Variety	
	Mer. 55-1	Mer. 57-1
Brix	17.9	13.75
Pol. % Juice	13.55	9.45
Purity	75.70	68.73
Sucrose % Juice	13.48	9.31
Invert Sugars	0.796	0.915

Seedlings of the two varieties were also transplanted into the loam and clay soil on April 28, 1964. Samples of the sorghum were cut at monthly intervals beginning on August 7, 1964. The stalks were shipped and then ground in a Wiley mill. Juice was extracted from the chipped and crushed stalks under pressure. The results of the analyses carried out during each month are presented in Table 10.

The variety Mer. 55-1 yielded juice of better quality than Mer. 57-1. In each case the brix, pol per cent juice and sucrose per cent juice were higher in the former variety and the invert sugar content was also lower.

At the present time work is in progress with several varieties of grain sorghum. These are being grown on a small scale and information on yields and crop duration under Trinidad conditions is being accumulated.

TABLE 10

Results of analysis of juice of two sweet sorghum varieties

Analysis	Variety			
	Mer. 55-1		Mer. 57-1	
	No. of days after planting			
	108	140	108	140
Brix	15.85	15.70	13.15	9.50
Pol. % Juice	11.69	11.18	8.63	4.73
Purity	73.75	71.21	65.63	49.79
Sucrose % Juice	11.69	-	8.65	-
Invert sugars	0.620	0.590	0.796	0.865
pH	-	5.1	-	4.8

Soybean (*Glycine max.*)

Four varieties of soybean are currently undergoing evaluation at the Research Station. Information is being accumulated on the growth of the varieties at different times of the year.

Pharmaceutical Crop

The growth of medicinal yams (*Dioscorea* sp.) is being evaluated at the Research Station (8). This crop is being studied in view of the need for large sources of precursors of the steroid drugs such as cortisone (4, 5). Three species (*Dioscorea floribunda*, *D. composita* and *D. spiculiflora*) are currently undergoing test. Tubers of different varieties of the three species are being grown in the clay soil. The vines are supported either by 9 feet high bamboo supports or by wires arranged between teak poles.

The yams are being grown for their diosgenin content and analysis of the *D. floribunda* and *D. composita* tubers has been carried out by Professor R. F. Dawson of Columbia University, N. Y.

The results of typical diosgenin assays are given in Table 11.

TABLE 11

Results of diosgenin assays of Dioscorea sp.

Sample Number	% Diosgenin
233 (internal control)	3.6
PI 199766 (floribunda)	2.8
PI 201783 (composita)	3.1
PI 264145 (floribunda)	4.4

Other Fruit and Orchard Crops

Several other crops are being grown on a small scale at the Research Station. These crops have only recently been introduced into the food crops programme and yield data are not available at time of writing.

Fig (Ficus carica)

Cuttings of the following varieties have recently been imported and are now growing in drums containing a medium made up of equal proportions of clay, CFW and rotted filter press mud. The varieties are Calimyrna, Brown Turkey and White Ischia.

Papaya (Carica papaya)

Plants of the Solo variety have recently been planted in the clay soil at the Research Station.

Barbados-Cherry or Acerola (Malpighia glabra)

A nursery of some 47 acerola trees has been established over the last 4 years. The trees have made excellent growth in the nursery and have yielded large quantities of fruit. Some of the fruit has been utilized for making jam and preserves.

Strawberry (Fragaria sp.)

Plants of varieties Surecrop, Armore, Vesper, Tennessee Beauty and Blakemore were recently imported and have been planted on raised beds in the clay soil. The plants are making good vegetative growth and fruiting is also taking place.

Apple (*Malus* sp.)

Ten tropical apple trees were imported from Queensland. The trees have now been established on raised hills in the clay soil are making good vegetative growth.

Macadamia (*Macadamia ternifolia*)

Several trees of the following varieties of *Macadamia* have been planted in the clay soil: *Stephenson*, *Pink*, *Keauhou No. 246*, *Ikaiki No. 333*, *Z 1* and *Kakea No. 508*. Growth of the trees appears satisfactory at present.

DISCUSSION

The limited experiments carried out here demonstrate that many new crops can be grown in Trinidad, even on the heaviest of the clays. Whether these crops can be grown economically in the face of competition from North America and Western Europe depends a good deal upon other factors. For example, adequate facilities must be provided for marketing fresh fruits and vegetables and for storing perishable commodities. Import duties on foreign products would assist local growers in the initial phases and, coupled with long-term credit, this would be a motivation to younger persons to enter agricultural careers. The research reported here is the first step, we feel, towards emphasizing the need to grow more local food in Trinidad and Tobago. It is also hoped that this type of research will indirectly assist the sugar estates to compete more effectively with overseas producers.

SUMMARY

Current research on food, field and pharmaceutical crops at the Tate and Lyle Central Agricultural Research Station is reviewed in some detail. Experiments are described where crops are being grown in a heavy clay soil which is difficult to work. The methods of cultivation and crop husbandry are designed to be acceptable to and feasible for use by the peasant farmer.

The importance of investigating the growth of different crops at different times of the year under Trinidad conditions has also been discussed. The evaluation of several different varieties of a given crop is another important facet of the research programme in Trinidad.

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LITERATURE CITED

1. Annual Statistical Digest. No. 12, Central Statistical Office. Govt. of Trinidad and Tobago. p. 171, 1962.

2. Charter, C. F., Soil types of sugar estates of Trinidad, Trinidad Govt. Printing Office, 1939.

3. Chenery, E. M., The soils of Central Trinidad. Trinidad Govt. Printing Office. pp. 43-44, 1949.

4. Correll, D. S., Schubert, B. G., Gentry, H. S. and Howley, W. O. The search for plant precursors of cortisone, Econ. Bot. 9, 307-375, 1955.

5. Cruzado, H. J., Delpin, H., and Roark, B. Effects of various vine supports and spacing distances on steroid production of Dioscorea composita, Trop. Agric. Trin. Vol. 41, 4: 345-349, 1964.

6. Davies, W. N. L. and Vlitos, A. J., Coconut fibre waste as a basic medium for the production of vegetable crops. Proc. 2nd Ann. Meeting of Caribbean Food Crops Society, 1964.

7. Davies, W. N. L. and Vlitos, A. J., Experimental production of several new sweet corn varieties for canning, and for fresh market use in Trinidad. Proc. 2nd Annual Meeting of Caribbean Food Crops Society, 1964.

8. Davies, W. N. L. Agronomy. Tate & Lyle C. A. R. S. Annual Report 1964. 262-267, 1965.