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THE REGIONAL FIELD EXPERIMENTAL PROGRAMME —AN APPROACH TO SOIL FERTILITY INVESTIGATIONS

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BACKGROUND

The Regional Research Centre of the University of the West Indies, has during the past twenty years, been engaged in doing a Soil Survey of the territories that make up the former British Caribbean. In these West Indian Islands, the location and extent of various soils have been identified and mapped in terms of their parent material and origin, their depth, texture, structure and colour. Slopes and erosion classes are also mapped. It has been assumed that these characteristics, when identified and described, will give the basis for a planned Land Use Programme.

On the basis of this information, there is no doubt that soils so described can be grouped into broad Land Use classes. In Jamaica, extensive use has been made of such a system, in which the land is classified on the basis of its soil type, slope and degree of erosion (10). Land is thereby grouped into seven classes. Class (I) is ideal land for agricultural cultivation, Class (II) is less suitable than class (I) because of a limiting factor. This limiting factor may be any of the following:—

(a) susceptibility to erosion;
(b) danger of water logging;
(c) inherent soil factors;
(d) unfavourable climate.

Land may thus be classed progressively lower and lower, the lowest class (class VII) consists of land not suitable for agricultural enterprise of any kind.

This type of information is of valuable use in agricultural development programmes and in the planned use of land in Jamaica. It permits the easy recognition of alternative cropping programmes which are suitable for the various areas.

In Tobago, the recent completion of the work on the Land Capability Survey (3), and the present Land Capability Survey being done in Trinidad both add to the systematic study of land use in these areas.

In Jamaica, the specific Land Use recommendations have been collected, in a series of information sheets called Technical Guide Sheets (11). These Technical Guide Sheets, attempt to set out the management conditions which ought to be practised for the different types of land described. For example, a certain soil because of its poor internal drainage, may require to be well drained before its utilisation can be profitable, or in other areas the danger of erosion may be a constant disadvantage. In general, a range of crops can be recommended on the basis of the soil survey data and Land Capability assessment.

In addition to all these recommendations a most important consideration must be the level of fertiliser which should be applied to give optimum return in terms of yield. Some of this work has already been done (6). For some of the better organized export crops, like sugar (7), (8), detailed information on crop response is known. Because of the relatively minor role root crop production has played in the past, little is known of responses to sweet potatoes and similar crops.

REGIONAL FIELD EXPERIMENTAL PROGRAMME

This Programme, was organised at the University of the West Indies Regional Research Centre, in order to study the crop responses to the main fertiliser nutrients on the major soils of the region and in particular to study the response of the main food crops of the region. Traditionally, the production of root crops, tubers and vegetables in the West Indies has been mainly on a subsistence scale, and by methods which involve low capital inputs and hence low returns.

These crops are labour intensive crops, in many cases, and the rising costs of labour make it necessary to attempt to maximise yields if these crops are to be competitive on the market, or if they are to be considered as substitutes for imported foodstuffs.

There appears to be two general approaches to this problem. On the one hand a number of field experiments, could be laid out to assess the wide range of crops over a wide range of soil and climatic conditions, or an alternative approach could be to select a single crop as an indicator of soil fertility, and test the responses of this indicator to fertiliser treatments on a wide range of soil types. This latter method was proposed by Cunningham (5) in the Regional Field Experimental Programme, as the technique to attack the problem. This method has the advantage that once a suitable indicator can be obtained, a number of routine experiments can be performed over a wide area with relatively untrained staff. This method estimates in general terms the nutrient status of the soil. For this purpose a grass crop (maize) has been chosen as being the most appropriate. A similar type of approach has been reported by Boyd in an F.A.O. publication dealing with a series of experiments done under the Freedom from Hunger Campaign (9).

ORGANISATION

For the organisation of the field work, the group of ten (10) islands under investigation has been divided into (4) areas viz:—

(I) Jamaica
(II) Antigua, Montserrat, St. Kitts, Dominica
(III) Barbados, St. Vincent, St. Lucia, Grenada
(IV) Trinidad and Tobago—the co-ordinating centre.

An Area Agronomist is in control of each group with the bead of the programme, the Senior Agronomist, based at the University of the West Indies at St. Augustine. The department is attached to the Soils Department of the Faculty of Agriculture.

EXPERIMENTATION

In the first year of study, 1967, three soil types were chosen from each island on tbe basis of their present or potential importance in food crop production. For each soil type an experiment was laid down at three different sites. Altogether ninety-three experiments of this type were laid down in the 10 territories in 1967.

These experiments were statistically designed as part of a central composite, so that each site may be analysed separately. At each site the design is basically a 2^3 factorial with some additional treatment combinations with some replications of the centre point. Tbe design comprises 17 treatments and an additional treatment with no fertiliser added. This gives a total of 18 plots and an assessment of response at five different levels of each nutrient.

Each plot consists of six rows of corn 3′ apart and 25′ long, spaced 15″ within the row (population 11,600 per acre). The corn was planted two seeds per hole and subsequently thinned to one. Fertiliser treatments were applied when the corn was four weeks old. It was considered that a single application would simplify the procedure, and the timing was chosen to take full advantage of the nitrogen.

Plots were kept free of weeds by chemical or mechanical means and insect pest control was effected through routine spraying with insecticides. At maturity, plants were allowed to dry and ears were harvested when they were field dry. Moisture content of the grain was taken by an electric Moisture Meter. The weights of yield of corn on the cob and the yield of grain, were recorded from each plot after the border rows were eliminated.

Data recorded was then partially processed for a computerised analysis. The analysis is being undertaken with the co-operation of staff of the Rothamsted Experimental Station in England until these facilities become available at St. Augustine.

It is hoped that the number of locations under study in any one year will be increased by the participation of the local departments of agriculture. If additional experiments of this standard design are put down they can all be included in the overall analysis and tbereby increase the rate of progress of the programme. A similar type of programme was evolved in the F.A.O. Fertiliser Programme reported on by H. L. Richardson (9). Our programme differs from this in that little emphasis is being placed here on the demonstration aspect of the programme, and that the experimental aspect is dominant.

When a large amount of data has been accumulated it is expected that these will be analysed according to soil types to determine the responses to the three fertiliser nutrients investigated, and also to study the effects of environmental factors like soil moisture on nutrient responses. It is clearly evident in many cases that rainfall is a dominant factor in yield, as compared to fertiliser responses. A large number of sites in varying rainfall regimes will therefore allow some grouping of sites as to rainfall. Comparisons by islands and by years will also be attempted. So many variables in environmental conditions occur, that the choice of a single crop as an indicator will inevitably simplify the study of the responses, although of course one must accept the contention that responses of the indicator crop are not necesssarily transferable to other crops without further study.

INDICATOR CROP

The indicator crop chosen should be easy to grow on a field scale, easy to establish in uniform stand, and easy to measure in terms of responses or performance. The analysis of foliar samples should give reliable indications of the nutrient status of the soils, and predictions of the behaviour of other crops under similar conditions should be possible from a study of the indicator crop.

No single crop meets all these requirements ideally, but the grass crops in general and corn (*Zea mays*) in particular offer many advantages and hence the selection of corn for the initiation of this programme.

The concept of an indicator crop and a standardised type of experiment raises many problems which cannot be ignored. For example the crop should ideally be grown under the optimum agronomic management, which will obviously vary from place to place and a set of uniform treatments is therefore at best a compromise. This compromise can be accepted where it is considered that the factors limiting yield do not seriously upset the response pattern. Thus, where the population density chosen is thought to be a factor masking or exaggerating a response to, say, nitrogen or any other nutrient, then to use this density is erroneous. This means then that a number of subsidiary investigations with the crop are necessary where the ideal management of the crop is not practised, in order to assess the effect of field practice on response, if any. For example, experimental work in Trinidad, with some corn varieties suggest a spacing within the row of 12 inches apart (4), but the spacing considered for investigation in these trials with corn is 15 inches within rows. It is therefore necessary to make comparisons of these factors.

SPACING

A small investigation was therefore laid down to test the differences in yield between corn grown at four different spacings viz: 9 inches, 12 inches, 15 inches, 18 inches within the row and with rows 3 feet apart. The variety used was X 304. When plants were 4 weeks old a fertiliser mixture was applied to all plots at the rate of 20 lb. nitrogen, 16 lb. $P_2 0_5$, 27 lb. $K_2 0$ per acre. Table (I) shows the yields obtained at different spacings in lb. corn on the cob per plot at 21.6 per cent moisture.

TABLE I

Yield of Corn in Spacing Trial.

Plot Yield in lbs. Corn on the cob (21% moisture)

Treatment	Distance within rows	Population per acre	Rep. I	Rep. II	Rep. III	Total	Mean
A	9″	19360	67.5	56.5	65.5	189.5	63.2
B	12″	14520	48.5	50.5	50.0	149.0	49.7
C	15″	11616	52.5	37.0	34.0	123.5	41.2
D	18″	9680	41.5	39.5	25.5	106.5	35.5
			210.0	183.5	175.0	568.5	47.4
Rep Mean			52.5	45.9	43.7	—	—

TABLE II

Showing Analysis of Variance for experiment comparing spacings of corn at University Field Station.

Source	S.S.	D.F.	M.S.	Var. ratio
Total	1722.96	11	—	—
Between Treatment ...	1302.56	3	434.19	10.29**
Between Replications ...	167	2	83.5	1.98
Error	253	6	42.2	—

These results indicate a significant difference between treatments and it appears that yield increases with increases in population from 9,680 plants per acre and that at 19,360 plants per acre the maximum yields are not yet achieved.

VARIETY TRIAL

For the same reason a simple trial was laid down to make comparisons of varieties which are considered suitable for growing in Trinidad. This trial indicated that X 304 was as good as or better than other varieties considered. The trial was planted at the University Field Station in May, 1967 on River Estate Loam and included the following six varieties.

(1) X 304 (Pioneer)
(2) PT 66 (Poey)
(3) S.A.S. (Trinidad)
(4) E.B.S. (Trinidad)
(5) Tunapuny (Venezuela)
(6) Seguida merjores (Venezuela)

Each variety was replicated four times. Grass plot size was 25 feet x 18 feet with seeds planted in rows 3 feet apart and 1 foot within the row. Population was 14,520 plants. per acre. A basic fertiliser dressing was applied to all plots four weeks after planting

The germination of the seed of varieties (5) and (6) was unsatisfactory and these varieties Tunapuny and Sequida Merjores cannot be considered as having been established. The quality of the seed was questionable. However the mean yields of the other varieties indicated that X 304 was a satisfactory variety for growing under Trinidad conditions. General field observations indicated that it tended to lodge less and did not grow as tall as PT 66.

TABLE III

Showing Yield of Corn in lbs. per plot in Variety Trial grown on River Estate Loam.

REPLICATIONS

Treatment	I	II	III	IV	Total	Mean
1	28.5	25.0	32.5	29.0	115.0	28.8
2	29.5	23.5	25.0	24.5	102.5	25.5
3	28.5	29.5	25.5	30.0	113.5	28.4
4	29.0	26.5	21.5	40.5	117.5	29.4
	115.5	104.5	104.5	124.0	448.5	—
Mean	28.9	26.1	26.1	31.0	28.0	—

TABLE IV

Analysis of Variance of Variety Trial on River Estate Loam.

Source	S.S.	D.F.	M.S. (Variance)	Variance ratio
Total	288.74	15	—	—
Between Treatments	32.92	3	10.97	.523
Reps	67.17	3	22.39	1.067
Error	188.85	9	20.98	—

There was no significant difference between treatments. It is accepted that the variety X 304 will yield satisfactorily at the Field Station, and is satisfactory as an indicator plant for this series in Trinidad.

The results of the 1967 Corn Indicator Trials (12) are being analysed by computer at Rothamsted. Preliminary inspection suggests that a number of responses will be indicated. A second series (1968) is now being planted with minor modifications. The 1967 series has indicated a fairly high coefficient of variation. This variability is considered to be an inherent part of the system being studied. For instance the variability in many of the soils is high and the situations in which they occur are often subject to microclimatic variations. Slopes and aspect are not always uniform. An important consideration therefore is to obtain differences of a magnitude which can be determined as clear responses in the circumstances where the co-efficient of variation is high.

The success of this type of evaluation is important to the establishment of a sound and usefnl fertiliser advisory service.

These experiments are being done in close collaboration with Walmsley and Cornforth, Soil Chemists in the Faculty of Agriculture, U.W.I. who are studying different methods of chemical analysis for the main fertiliser nutrients. Corn is grown under greenhouse conditions and the uptake of nutrients and the status of the soil is measured by several analytical methods. These methods will be correlated with the yield response in the field experiments and will enable the selection of a particular analytical method as being the one most suitable for the prediction of responses. These two joint programmes are considered to be the tool which will enable a better and more efficient use of fertilisers in crop production particularly for food crops in the area.

The project is ambitious and long term but the results will justify the effort if, as we expect, food production in the areas served is to be made more efficient and more profitable.

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