SOME OBSERVATIONS ON THE MOISTURE AND AIR RELATIONS OF SUGAR-CANE SOILS IN THE NORTHERN PLAIN OF TRINIDAD

INTRODUCTION

The present average sugar-cane yields in Trinidad are low when compared with other sugar-producing countries (6). For example, the average yields in Queensland are 35 tons cane per acre and 70 tons per acre is the average yield in Hawaii. The average estate yield in Trinidad approximates to 20-25 tons of sugar-cane per acre. In the investigations described in the following pages the average yield of the experimental fields for the period 1923-43 was 20.5 tons cane per acre.

Several reasons for such low yields may be suggested; for example:-

1. Unsuitable cultivation and tillage methods; e.g. improper depth and time of ploughing; failure to maintain tilth, inefficient cropping practices, etc.
2. Poor and unsuitable drainage, leading to lack of aeration and water-logging of the soil.
3. Weather effects, especially rainfall distribution and intensity, temperature, etc., which are outside of man's control.
4. Loss of topsoil, and hence loss of a large amount of humus, by erosion, especially over undulating areas.
5. Unsuitable soil-type and variety of sugar-cane grown on it.
6. Inadequate porosity of the soils in their present condition.

For satisfactory plant growth, a suitable nutrient status, moisture status and aeration status of the soil are essential. The nutrient supply may be kept up by judicious manuring. The moisture content of the soil varies with the meteorological conditions, e.g. rainfall, temperature, humidity. Sugar-cane is very susceptible to soil waterlogging and where the drainage system is unable to cope with excess of water after heavy rainfalls the crop is bound to suffer (28). Other factors affecting soil moisture content are "cracking area", especially in clay soils, and the nature of

the topsoil, i.e. loose and granular and easily penetrable by rain, or hard and rather impervious to rain. The amount of air and water in a soil depends on the soil particle arrangement, that is, on soil structure. Lack of suitable soil structure results in a shortage of oxygen and respiration processes are retarded; hence normal plant growth is upset.

The importance of soil structure is now being recognised in many parts of the world. Unlike soil texture, the structure of the soil may be modified by cultural methods. A soil of good structure is one allowing full root development in the crop. With improved structure, roots extend, water penetration increases and the plant can obtain the necessary nutrients and water which it needs without being so dependent on fluctuating rainfall. Optimum crumb size may be defined as that which best secures adequate supplies of air and water for plant growth (26).

A good soil structure facilitates the entry and penetration of rainfall and this in turn improves the aeration of the soil. Too much moisture in the soil, due often to bad drainage, hinders proper plant growth. Naturally the moisture content depends first and foremost on the amount of rainfall over an area, so that there is probably a close relationship between soil moisture, aeration and porosity, soil structure, soil cracking and rainfall.

In the investigations described in the following pages special attention was paid to such physical aspects of the soil as are concerned with the fate of the rainfall and its ultimate utilisation by the crop; e.g. soil structure, soil cracking and water percolation. It was thought that, in working from such a view-point as "what happens to the rain", some new conclusions regarding the causes of the low yields of sugar-cane in the area investigated might be arrived at. It was attempted particularly to demonstrate some connection between cracking, aeration and moisture status of the soil.

The investigations were all carried out in Frederick Section of Caroni Sugar Estate lying to the south of Caroni River in the Northern Plain of Trinidad. Geologically, this plain consists mainly of clays of estuarine or marine origin which have largely been derived from erosion products of the metamorphic rocks comprising the Northern Range. In more

recent geological times many of these clays have been covered to varying depths and breadths with river alluvium. The area is more-or-less flat having once been occupied by lagoons and swamps; consequently surface drainage is poor.

Certain fields, nine in number, were chosen in the first instance on the manager's classification of "light" and "heavy" soils, i.e. sandy and clayey soil-types. According to Charter (29), the soils of the chosen fields belong to Washington Fasc which contains "soils having seasonally-"impeded drainage and a seasonally high water-table developed under a "tropical climate in which the humid element predominates, but which also "comprises a well-defined dry season".

The fields finally selected and marked on the map (attached) were (1) F. 116; (2) F. 164; (3) F. 119; (4) F. 122 as "heavy" types, and (5) F. 79; (6) F. 85; (7) F. 86; (8) F. 72 as "light" types. In addition, Field F. 88 (9) was included under both heads, since the eastern jib of this field consists of "light" soil and the western part of "heavy" soil. This field contained the original contrasted "good" and "bad" ecological plots that were systematically studied during the period of the Froghopper Investigations (1926 to 1930) by the Chemistry Department of the College (23).

Subsequent to the selection of the fields for detailed observation, a soil-map of Caroni Estate has been prepared by Dr. E.M.Chenery of the Trinidad Department of Agriculture and parts of it have been reproduced in the accompanying plan which indicates the broad classification of the soil-types.

It is proposed first to consider the large amount of soil moisture data obtained during the Froghopper Investigation which have been filed in the records of the Chemistry Department, and to attempt an interpretation thereof in the light of experience gained of new methods of dealing with soil moisture data that have been evolved in the Chemistry Department in more recent years in connection with cacao problems (13).