

Thesis Summaries

Canopy Modification and its Effect on the Growth and Yield of *Hevea brasiliensis* Muell. Arg.

This study describes the influences of the cultural practices of plant density, pruning and clones on canopy characters, growth and productivity of *Hevea brasiliensis* Muell. Arg. Canopy characters were described in terms of crown length and width and their derivatives such as crown fullness ratio, crown area and volume. In addition, leaf area index and canopy light penetration were used in the description of the canopy. These two parameters were calculated from hemispherical pictures and various methods to decode the pictures were investigated. Growth was described in terms of tree girth and height as well as percentage tappability. Productivity was measured in terms of dry matter and latex production. By correlation studies, an attempt was made to explain the relationship between canopy characters and growth and productivity.

The main findings are as follows:

- Good correlation was obtained between leaf area index obtained from hemispherical pictures and leaf area index obtained from *in situ* leaf litter collection.
- Good correlation was obtained between canopy light penetration obtained from hemispherical pictures and actual field measurement of diffuse radiation.
- Plant density, pruning and clones significantly affected canopy size, shape, leaf area index and canopy light penetration.
- Plant density, pruning and clones significantly affected growth and productivity.
- Regression equations of plant girth, dry matter production and yield on various crown characters showed that the most significant and useful variables were crown width, crown cross-sectional area, crown surface area and crown volume.
- Large-crowned plants were favoured to small-crowned plants for better growth and productivity.

LEONG WING

Awarded the degree of Doctor in Agricultural Sciences by the University of Ghent, Belgium, 1980

Soil Genesis on the Coastal Plain of Perak (Peninsular Malaysia)

The coastal alluvial soils in Perak Plain, covering an area of over 40 000 ha were surveyed and mapped at scale 1:25 000. Subsequently, fifteen pedons comprising four sequences of soils were studied to determine their attributes and to evaluate their genesis. All the above soils were characterised by physical, chemical, mineralogical and micromorphological techniques.

The effects of the soil forming factors on the pedogenesis of alluvial soils in the Perak Plain have been investigated. Parent material seems to be the most important soil forming factor which today differentiates the soils of the Perak Plain. The

soils in Perak Plain are grouped into two categories: soils developed on marine clay; and soils developed on riverine deposits.

Soils derived from marine clay contain a high amount of S^{--} in the form of insoluble Fe^{++} compounds (sulfidic material). If this layer occurs at a shallow depth, the soil exhibits all the acid sulphate characteristics — such as yellow jarosite mottles, peculiar smell of H_2S and a sharp drop in pH (from 4.5 to 2.0) on drying the soil. Soils derived from marine clay are further subdivided into two categories: 'fresh water acid-sulphate soil; and saline acid-sulphate soil. The saline acid-sulphate soils contain a high amount of free salts, and the conventional method used for the charge characteristics determination of these soils was found to be very unreliable. A new method based on the successive extractions with H_2O , 1N KCl, 1N NH_4Cl and 1N NH_4OAC has been developed and it is giving more satisfactory results.

Micromorphological study indicates that sponge spicules and diatoms, genus *Coscindodiscus* are prominent features in marine clay, but absent in soils formed on riverine materials. Their presence are now employed as indicators of the marine origin.

Clay mineralogical studies indicate that there is a distinct difference between the mineralogy of marine sediments and riverine sediments; the former being smectitic whereas the latter are kaolinitic. The smectite present in marine clay are mainly of the beidellite type, a dioctahedral smectite with the deficit of charges in the tetrahedral layer. The phyllosilicates are characteristically rich in Al^{+++} .

The second most important soil forming factor affecting the attributes of these soils is the physiographic position. The position by itself is not the determining factor but rather the differences in the water regime resulting from the physiography. The pedogenetic properties of the soils are heavily dependent on the position as well as the quality of the groundwater table. In marine sediments, the composition of the ground water is of utmost importance. The soils are distinctly high in 'soluble salt' if the recharging water is sea water and low in 'soluble salt' if the recharging water is fresh water.

All the above soils are classified according to Soil Taxonomy and the FAO/UNESCO Soil Legend. Considerable problem arises in the classification of these soils. The criteria used in the Soil Taxonomy for the classification of acid sulphates have been found to be inadequate. There is an urgent need to reconsider the criteria used to identify the 'sulfuric horizon' and the 'sulphidic material'. Several suggestions have been forwarded for the improvement. Several new subgroups are proposed to be introduced into the Great Groups of Sulfaquents. The new proposals include the 'Hydraquentic' subgroup in the Sulfaquents, and the 'Umbric' subgroup in the Sulfaquents.

The prospects of reclamation of acid sulphate soils are also discussed. The basic problems for agriculture are toxicities and acute acidity when such soils are used in the water-logged state or when drained. When the soils are drained the S^{--} compounds are oxidised into SO_4^{--} and Fe^{++} is oxidised into Fe^{+++} . A tremendous amount of acidity is released in the soil

system causing detrimental effects to plant growth. It is suggested that phyllosilicates rich in Mg^{++} , Ca^{++} , Na^+ and K^+ but low in Al^{+++} and Fe^{+++} may favourably be used to neutralise the acute acidity in acid sulphate soils. Field trials to test this theoretical findings are recommended.

Finally, several established systems are used to evaluate the suitability of these soils, and a new system based on the actual yields and the actual soil attributes are proposed. The new method gives a more reliable result, and consequently the optimum use of these soils is suggested.

NOORDIN WAN DAUD

Awarded the degree of D.Sc. (Soil Science) by the University of Ghent, Belgium, 1980

The Role of Carbohydrates in the Exploitation and Latex Flow of *Hevea*

In the unexploited *Hevea* tree, neither a bark carbohydrate gradient in the trunk nor the influence of diurnal effects on bark carbohydrates has been demonstrated unequivocally. However, with the commencement of exploitation, a bark starch gradient decreasing from the top of the tree to the tapping panel was formed. Compared to an unexploited region like the opposite untapped panel or a region above the exploited area like 2 m height, exploitation resulted in a general depletion of bark starch at the tapping panel. Compared to the controls, the extent of depression of bark starch did not appear to show a linear relationship with the percentage of intensity of exploitation. However, the percentage of bark starch at the tapping panel to that at 2 m height

appeared to be more closely correlated with the intensity of exploitation. In contrast to bark starch, a general increase in bark sugars with exploitation was observed. Possible reasons for the increase are suggested and discussed.

The effects of varying lengths of tapping cut, microtapping and different intensities of exploitation on the latex and bark carbohydrates were investigated. The sucrose content of latex decreased with increasing length of tapping cut, but latex obtained from microtapping appeared to contain less sucrose than S/2. d/2 controls. A preliminary investigation on the influence of crown budding on the sucrose content of latices from the crown and trunk panels was also carried out.

The effects of ethephon stimulation on latex carbohydrates from previously unexploited and unstimulated trees were also studied. The influence of repeated ethephon stimulation on the latex and bark carbohydrates of trees after 1 year, 3–4 years and 9–10 years of repeated ethephon stimulation was examined and compared. The earliest detectable effect of ethephon stimulation on the carbohydrate status of previously unstimulated virgin *Hevea* trees appeared to be a depression of the sucrose content in latex. This is followed by a lowering of bark starch content and then a decrease in the total cyclitol concentration in latex. The depression of latex sucrose level and bark starch content appeared to persist throughout the period of ethephon stimulation, since these were detected in trees which were continuously stimulated for 3–4 years as well as 9–10 years. Stimulation rest seemed to increase the latex sucrose levels in some clones even before an improvement in latex yield was evident. The depletion of bark carbohy-

drates in the exploited panel with ethephon stimulation was demonstrated and the benefits of changing to a new panel containing a higher carbohydrate content in bark were shown. It has been suggested that the response to ethephon stimulation as well as the ability to sustain the positive yield response to ethephon stimulation (which varied with clones) was related to the percentage of starch at the tapping panel to that at 2 m height.

Invertase activity was enhanced with ethephon stimulation, but the enhancement was not permanent. Unlike other plant invertases, *Hevea* invertase did not result in multiple isoenzyme formation with stimulation. Phosphoglucomutase activity was studied under various intensities of exploitation and its activity was compared and discussed in relation with invertase activity. As far as the present studies were concerned, invertase activity did not appear to be correlated with latex yield.

Total sucrose output was shown to be directly related to dry rubber production for the various exploitation systems

studied. The total sucrose output was inversely related to the dry matter production (expressed as shoot dry weight production). These studies have implied that the intensities of exploitation of a particular exploitation system should be estimated in terms of the total sucrose output through latex of that exploitation system, rather than the conventional mode of calculation of intensity.

The changes in latex carbohydrate content during latex flow were investigated and the findings were discussed in relation to the role of these carbohydrates in latex flow. The influence of various exploitation systems on bursting, plugging and micro plugging indices was investigated. Comparisons of micro plugging index measurements at the tapping panel with that at 2 m height suggested that the effects of ethephon stimulation were not confined to the tapping panel but were extended to even 2 m height.

CHONG FEE-CHON

Awarded the degree of D. Sc. (Agric.) by the University of Ghent, Belgium, 1981