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Thesis Summaries

Effect of Manganese and Aluminium on the Survival of Selected *Rhizobium phaseoli* Strains

The effects of Mn and Al on selected *Rhizobium phaseoli* strains in solution culture and in soil were investigated. In solution culture, responses to high Mn (320 μg per millilitre) and Al (50-100 μM) varied among the seventeen strains of *R. phaseoli* tested. Four (about 24%) of the tested *R. phaseoli* strains were tolerant, seven (41%) were moderately tolerant and six (35%) were sensitive to high Mn concentration. Four strains were tolerant to high Al (100 μM), four (about 24%) were moderately tolerant and nine (53%) were sensitive to even 50 μM Al. In most cases, the extra-cellular polysaccharide production of the tolerant strains increased with increasing concentrations of Mn or Al. The comparative growth response studies indicated that the tolerant strains had the highest growth ratio followed by the moderate and the sensitive strains.

In soils, survival of the tolerant and the sensitive strains was not adversely affected by the high extractable Mn in Rossmoyne series soil and the high exchangeable Al in Bom Jesus series soil. The cell decline of the strains in these soils (Rossmoyne, Bom Jesus, Santa Angelo and Senai series) provides evidence for the establishment of the strains in these soils at populations large enough to initiate nodule formation in field beans *(Phaseolus vulgaris)*.

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Studies on the Lysozyme and Components of Microhelices of *Hevea brasiliensis* Latex

The protein contents of the rubber fraction, serum fraction and bottom fraction of ultracentrifuged latex from *Hevea brasiliensis* were determined by a modified colorimetric method. The average total protein content of eighteen latex samples was 0.95% (weight/volume) using the isolated proteins of latex as standards. The protein distribution was: rubber – 27.2%; serum – 47.5% and bottom fraction – 25.3%. If bovine serum albumin was used as the standard, the apparent total protein content was 1.57% but the distribution figures were not much affected.

Dialysis of B serum (obtained by lysis of bottom fraction) against water precipitated some minor glycoproteins accounting for approximately 2.5% of the total proteins; two of these combined in a certain ratio to give microhelical structures. These proteins were of molecular weights 160 000 (termed 'assembly factor') and 22 000 ('pro-helical protein'). A third protein (molecular weight 5000) appeared to promote the combination of single microhelices into bundles. The lack of formation of microhelices with latices of certain clones was found to be due to a deficiency of the pro-helical protein.

Two basic proteins in B serum which account for about 4% of the total proteins in latex, were found to have lysozyme as well as chitinase activities. The major basic protein was crystallised and its enzyme kinetics and a partial amino acid sequence were elucidated. This sequence was completely different from those of lysozymes from hen egg, duck egg, baboon milk and T4-phage. Many similarities were observed in respect of pH

optimum, isoelectric point and amino acid composition when the *Hevea* lysozyme was compared with lysozyme from fig and papaya.

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Contribution Towards a Better Appreciation of Soils from South-east Johore, Peninsular Malaysia

A semi-detailed soil survey of areas under rubber in South-east Johore established twenty-eight soil series with eleven names of newly proposed soil series. The demarcated soil units are presented in three soil maps at the scale of 1 : 50 000. Soil series were differentiated on soil criteria used in the family category of *Soil Taxonomy* (Soil Survey Staff, 1975). Four soil sequences comprising fourteen pedons on various parent materials namely: acid plutonics; acid volcanics; metasediments and sandstone; and older alluvium were selected for detailed characterisation of their morphological, physico-chemical, mineralogical and micromorphological properties. Based on the established soil characteristics, various hypotheses were developed to explain the distribution, genesis and mineral associations together with their associated soil properties of the selected soils. The soils were then classified according to *Soil Taxonomy* and the FAO soil legend for the *Soil Map of the World* (UNESCO/FAO, 1974). Relationships between various soil parameters such as CEC with respect to free iron and aluminium and CEC determined by various methods were also studied.

Considering the soil forming factors, climate and parent materials are the prime determinants of soil properties. The high temperature (+ 26°C) and heavy rainfall (about 3000 mm per year) result in ferrallitic weathering. Weathering of parent rocks was inferred to start from Tertiary age. Ferrallitic soils in the studied area are characterised by soil pH of 4.5 to 5.5, low base saturation (less than 10%) but high aluminium saturation (more than 80%), low CEC (less than 16 m-equiv. per 100 g clay) and are dominated by kaolin minerals with oxides and hydroxides of Al, Fe and Si. Gibbsite is noted only in soils derived from acid plutonics. Soils derived from acid volcanics, metasediments and sandstone which the relatively less weathered compared to those developed on acid plutonics and on older aluvium have comparatively a higher silt/clay ratio, stronger dispersibility characteristics of the clay and the presence of important amounts of mica and mica-vermiculite. Exchangeable aluminium is always more than 6 m-equiv. per 100 g clay in the former soils which have been classified as either Dystropepts or Tropudults. The latter soils are either Paleudults or Haplorthox. Generally, Dystropepts and Tropudults occur on steep to very steep topography while Paleudults and Haplorthox are found on undulating to rolling topography. Topography is noted to have a modifying influence in soil development.

The amount of free iron in ferrallitic soils is due mainly to the mineralogical composition of parent materials and the developmental stage of the soils. The state of free iron rather than the amount is more important in influencing soil colour. The cation exchange capacity of soils is strongly related to clay mineralogical composition in subsoils and to organic matter in topsoils. The natural chemical fertility of ferrallitic soils is largely dependent on the quality and quantity of organic matter in surface horizons. Effective CEC (sum of exchangeable

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bases by neutral 1*N* NH_4OAc plus extractable alluminium by 1*N* KCl) was found to be a convenient parameter to estimate the CEC of soils with variable charges; indeed 16 m-equiv. per 100 g clay by neutral 1*N* NH_4OAc is equivalent to 9.3 m-equiv. per 100 g clay by ECEC while 24 m-equiv. per 100 g clay by NH_4OAc is equivalent to an ECEC of 16.3 m-equiv. per 100 g clay. Paleudults and Haplorthox have a higher PDC/PC ratio suggesting that in ferrallitic weathering the clays develop more pH-dependent charges (PDC) because of the formation of low activity clays and oxides/hydroxides of iron. Gibbsite aggregates in soils were found to arise from pseudomorphic alteration of feldspars and crystallisation from soil solutions in a free draining soil micro-environment. Clay illuviation is significantly observed in Tropudults and not very distinct in Paleudults. Soils developed on older alluvium are distinguished from those on granite (s.l.) by particle-size distribution, absence of gibbsite and the presence of runiquartz.

The soil series units identified in the soil survey were evaluated to assess their suitability for the cultivation of rubber, oil palm and cocoa using three evaluation systems such as FAO's 'a framework of land evaluation' (following the methodology of Sys, 1978), soil-crop suitability classification of Wong (1974) and the fertility-capability classification of Buol *et al.* (1974). Based on the limitations of the identified soils, the optimum use was suggested.

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