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Thesis Summaries

Nitrogen in *Hevea brasiliensis* Cultivation – Some Aspects of Its Sources and Transformation Processes in Soils of Peninsular Malaysia

A mixed leguminous cover of *Pueraria phaseoloides* and *Calopogonium caeruleum* returned 694 kg of leaf litter nitrogen per hectare from the third to the eighth year of growth. *C. caeruleum* was the main contributor. Annual leaf litter N addition from mature rubber *(Hevea brasiliensis)* was between 42 kg and 53 kg per hectare. Glasshouse studies showed leaf litter N of the two legumes was available to rubber seedlings. Among the various fertiliser N sources, ammonium sulphate was the most effective in promoting rubber growth on Serdang series soil.

Decomposition of the three types of leaf litter in the field was rapid but only N content in leaf litter of the legumes declined during the process. Incubation of soil with leguminous leaf litter resulted in net mineralisation. Rubber leaf litter caused immobilisation of soil inorganic N. During twelve weeks of incubation, between 3% and 7% of total N were mineralised from native organic N in the twenty soils from rubber-growing areas in Peninsular Malaysia. Nitrate-N was produced in some soils by presumably heterotrophs because of the absence or scarcity of autotrophic nitrifiers. Mineralisation was related to some soil properties (sand, clay, total N, total P and organic C) and it was enhanced by the addition of lime or phosphate. Generally, most of the soils appeared not being able to nitrify or fix the applied ammonium-N. Native fixed ammonium-N accounted for less than 3% of total N in most soils.

Denitrification studies in the laboratory showed differences in denitrification capacity were related to organic/mineralisable C contents of soils. Denitrification was accelerated by liming but not affected by initial nitrate-N content. Addition of sucrose increased denitrification only in soils of low organic C status. The gaseous N produced during denitrification followed the sequence of initial formation of predominantly N_2O which was subsequently reduced to N_2. The rate of biological reduction depended on denitrifying capacity and level of nitrate-N in soil.

The level of urease activity in these soils was generally lower than in other tropical soils. The non-buffer method of assaying urease activity could provide an index of the soil's ability to hydrolyse urea. Urea hydrolysis was affected by soil type, soil moisture and rate of urea and it was effectively retarded by urease inhibitors (p-benzoquinone and hydroquinone). Ammonia volatilisation of surface broadcast urea was influenceed by the cation exchange capacity of the soil. Maximum volatilisation was at 25% WHC. Increasing the rate of urea and application on moist leaf litter mulch increased volatilisation. Mixing or placement of urea in soil, application with triple superphosphate or with urease inhibitors reduced volatilisation losses.

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Cytotaxonomic Investigations of the Genus *Hevea*

The karyotypes, meiosis, pollen viability, crossing affinities and several morphological, bark, anatomical, yield and girth characters and rubber properties of seven species of genus *Hevea (H. benthamiana, H. brasiliensis, H. guianensis, H. nitida, H. pauciflora, H. rigidifolia* and *H. spruceana)* were studied. Karyotype analysis showed a somatic chromosome number of 2n = 36 for all the seven species. The seven species differed in their mitotic karyotypes. Five chromosome pairs were very similar in all the seven species. In the other chromosome pairs, varying degrees of differences were present among species. In all seven species, a certain amount of similarities existed between chromosome pairs within the complements permitting the grouping of pairs of chromosomes into sets of two.

The degree of relationship of the seven species with respect to karyotypes varied widely and the order is *H. brasiliensis – H. nitida – H. rigidifolia – H. pauciflora – H. spruceana – H. guianensis – H. benthamiana.* The degree of asymmetry of karyotypes of seven species varied considerably and the order is *H. brasiliensis > H. benthamiana > H. rigidifolia > H. spruceana > H. nitida > H. pauciflora > H. guianensis.*

Meiotic analysis showed that, except for the occurrence of rare quadrivalents, it was normal in all seven species and the two interspecific hybrids studied.

Crossability studies showed that *H. brasiliensis* and *H. spruceana* crossed easily with all other species while the other five species, in particular, *H. rigidifolia* showed low intercrossability.

Studies of morphological and other characters showed that the seven species have diverged with respect to all characters except bark, anatomical, girth, yield and rubber properties. The cultivated species, *H. brasiliensis* showed marked differences even in these characters.

Analysis of the relationships of the seven species using forty-seven quantitative characters showed the following order of relationships *H. pauciflora – H. spruceana – H. benthamiana – H. brasiliensis – H. nitida – H. guianensis– H. rigidifolia.*

The implications of these results in the probable mode of origin, evolution and diversification of the genus *Hevea* and the practical implications in breeding and improvement of genus *Hevea* were also discussed.

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Studies on Endogenous Growth Substances in Relation to Flowering in Seedlings of *Betula pendula*, Roth.

The main objective of this work was to determine the role of growth substances in catkin formation in *Betula pendula*, Roth. In the early part of the work, it was found that girdling stimulated catkin initiation in seedlings of different ages and sizes. Application of GA_3, GA_9 and $GA_{4/7}$ inhibited catkin initiation in girdled seedlings and prevented catkin formation in non-girdled plants. The inhibitory effect was also shown with application of partially purified gibberellin extracts obtained from birch bark tissues. Applied

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CCC, an antigibberellin, on the other hand was shown to promote catkin initiation in girdled seedlings but applied AMO 1618 inhibited it. These results tend to suggest that the amount of endogenous gibberellins in non-girdled trees was at a level beyond which catkin initiation was inhibited. Girdling and CCC might have reduced the level sufficiently to cause flower initiation.

Another approach to establish the role of growth substances was undertaken by extracting gibberellin-like substances and abscisic acid (ABA) from various tissues of vegetative and reproductive plants. In non-girdled seedlings it was found that the levels of gibberellins in bark tissues were higher in the basal than the middle or terminal regions, of the main stem. The levels in mature leaves were higher than in young leaves; the mature leaves in the distal region contained higher levels of gibberellin-like substances than the basal region of the plants. The endogenous gibberellins in both leaves and bark tissues were qualitatively similar and appeared to co-chromatograph with GA_3.

Girdling resulted in increased gibberellin levels in bark tissues above the girdle and a reduction below the girdle. Application of CCC, an anti gibberellins, raised the levels of bark gibberellins in both girdled and non-girdled seedlings even when catkin initiation was stimulated in girdled seedlings. This suggests that endogenous gibberellin is not the only growth substance involved in catkin initiation of birch seedlings. Initiation appears also to involve ABA, since its application stimulates catkin initiation. The ABA content was therefore determined and it was found that girdling increased ABA content, especially in buds and bark of branches above the girdle. Application of CCC further raised ABA content in both these tissues, suggesting a direct involvement of ABA in catkin initiation.

A series of experiments was carried out to determine the source and the movement of bark gibberellins. Disbudding or defoliation did not appear to alter the levels of endogenous gibberellins in either girdled or non-girdled seedlings indicating that buds and leaves are not the likely source. Results from derooting experiments appeared conflicting and hence not possible to indicate the root as the source. Nevertheless, decapitation reduced the levels of accumulated bark gibberellins above the girdle and raised the levels in bark of the branches. Application of IAA to decapitated girdled seedlings restored these levels comparable to those in girdled control. These results tend to suggest that the bark gibberellins are synthesised in the green bark tissues of the branches and may be transported basipetally into the main stem to be accumulated in bark tissues above the girdles. This movement may be induced by IAA produced in the shoot apices.

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