EFFECT OF SOIL TYPE, SOIL COMPACTION AND WATER STRESS ON ESTABLISHMENT OF COCONUT (*Cocos nucifera* L.) SEEDLINGS

By

NAINANAYAKE PATHIRANNAHELAGE
ATHULA DHARMAPRIYA NAINANAYAKE

Thesis

Submitted in partial fulfilment of the requirements

for the degree of

MASTER OF PHILOSOPHY

in the

POSTGRADUATE INSTITUTE OF AGRICULTURE

of the

UNIVERSITY OF PERADENIYA

SRI LANKA

March, 2000

ABSTRACT

The recent changes in weather pattern seriously affected the National Replanting Programme (NRP) of coconut that has been progressing since the 1960's for gradual replacement of senile palms to maintain the sustainability of the crop (Fernando, 1996). The requirement of coconut seedlings for the NRP was estimated to be around 1.45 million per year to maintain the existing coconut population in the country. However, the actual demand was over 3 million due to extremely high mortality of coconut seedlings during field establishment. Hence, it is important to study the physiological aspects in coconut seedlings in their first few months of establishment in commonly available soil series in coconut growing areas. Such a study specially under water deficit conditions would obviously help to develop possible measures to rectify the problem.

Performance of open pollinated six month old CRIC 60 (*Tall x Tall*) coconut seedlings grown under *Weliketiya*, *Wilpattu* and *Mavillu* soil series at two different compaction levels was evaluated imposing water stress by withholding water. Soils were selected from Puttalam District. Soils were filled into large galvanized iron pots having a capacity of 0.067 m^3 (2.375 cubic feet) per pot, up to a height of 75 cm, in order to create two bulk densities of 1.3 and 1.6 $g.cm^{-3}$. After allowing coconut seedlings to establish in pots in the glass house environment for 6 weeks, they were subjected to an 8-week stress period by withholding water. There were 12 treatment

combinations (Water levels [2] x Soil series [3] x Soil compaction levels [2]) with six replicates per treatment. Physiological, anatomical, biochemical and vegetative growth parameters were studied at weekly intervals. Gypsum resistance blocks were used to monitor soil moisture depletion during the study.

The reduction in vegetative growth occurred because of the reduced cell expansion and photosynthetic rate in seedlings grown under water deficit in different soil series. This was resulted due to different nutrient contents, different water holding capacities resulted from varied organic carbon contents and different cation exchange capacities attributed to each soil series. The high nutrient content (N, P, K and Mg), high cation exchange capacity and high organic carbon content in *Wilpattu* series soil were the main factors that contributed to a better seedling growth compared to what observed in other soils. Therefore, the improvement of other soils with respect to the soil parameters would help in arresting the reduction in vegetative growth occurred through reduced cell expansion and photosynthetic rate in seedlings grown in such soils. The prominent stomatal regulation coupled with the enhanced root growth contributed to the maintenance of internal water status as high as possible in coconut seedlings. However, the osmotic adjustment in this regard has only marginal contribution in coconut seedlings. Stomatal diffusive resistance was proved undoubtedly as the best indicator for identifying the stress development in coconut seedlings.

The availability of more nutrients per unit volume of soil and physical obstruction in high soil compaction have resulted a reduced and unspread coconut root system. However, some sturdy roots have succeeded in penetrating hardy soil, mainly in *Wilpattu* series that contained some stored water in deeper layers. The resulted coconut seedling with large canopy supported by a small, unspread root system is more vulnerable in subsequent drought.