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EFFECTS OF PLANTING DENSITY ON GROWTH AND YIELD OF THREE DIFFERENT CLONES OF RUBBER

(*Hevea brasiliensis* Muell. Arg.)

by

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Candidate's Declaration

The work described in this thesis was carried out by me under the supervision of Dr V.H.L. Rodrigo of the Rubber Research Institute of Sri Lanka and Dr. S.M.C.U.P. Subasinghe of the University of Sri Jayewardenepura. This has been based on the independent work carried out by me and a report on this has not been submitted in whole or in part to any University or any other institution for another Degree/Diploma.

T.U.K. Silva

Supervisor's Certification

We certify that this thesis meets the required standard for the degree of Master of Philosophy.

23/6/08

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Dedication

To my father, Edmond Silva and mother, Thilaka Silva

who

guide and energize me to face every challenge of the life

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AI	Actual tapping intensity
BT	Bark thickness
BCR	Benefit – cost ratio
B45	Girth below 45
COP	Cost of production
ct	Collecting time within tree
ct'	Walking time per tree when collecting
CTB	Collecting time per task
ct + ct'	total collecting time per tree
D	Total walking distance of the plot
d/2	Once in two days
d/3	Once in three days
% d	Percentage of the actual density
d_b	Bottom diameter
d_m	Mid diameter
Dp	Days in period concerned
d_t	Top diameter
DIS	Average walking distance of the plot
DRC	% Dry rubber content
g/t/t	Grams per tree per tapping
IRR	Internal rate of return
L	Length of the section of tree
LA	Land area

LAI	Leaf area index
Lc	Length of cut
LPH	Labour amount per hectare
LSD	Least significant different
MLA	Mean leaf area
N	Number of trees in relevant planting density
NPV	Net present value
N_t	Number of tappings
NTL	Number of total leaves
PBP	Pay back period
PD	Partially dried trees
RRISL	Rubber Research Institute of Sri Lanka
½ S	Half spiral cut
t	Tapping time per tree
t'	Walking time per tree
T	Time taken to tap a sampling plot
TB	Total tapping time per task
TD	Totally dried trees
TG	Tappable girth
TIT	Trees in tapping
TIT_{ha}	Trees in tapping per hectare
TPD	Tapping panel dryness
t + t'	Total tapping time per tree
V_f	Volume of final section

$\mathbf{V_{int}}$	Volume between the cone and minimal diameter point
$\mathbf{V_L}$	Volume of latex
$\mathbf{V_m}$	Merchantable volume per hectare
$\mathbf{v_m}$	Merchantable volume per tree
$\mathbf{V_S}$	Timber volume of any section
$\mathbf{v_t}$	Stem volume per tree
$\mathbf{V_t}$	Total volume per hectare
YAP	Years after planting
YPH	Yield per hectare

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ABSTRACT

As for any crop, planting density of rubber (*Hevea brasiliensis*) appeared to be a primary factor which determines the ultimate yield and profitability. Previous studies have shown that the optimum density of planting rubber depend on the genotype, the purpose of planting and socio economic factors. Therefore, the present study was conducted with the objective of identifying the suitable planting densities of rubber with respect to both latex and timber production for major genotypes planted in Sri Lanka.

The experiment was set up in Ratnapura district of Sri Lanka in 1992. Three genotypes (clones), i.e. RRIC 100, RRIC 110 and RRIC 121 were planted in three high densities, i.e. 600, 700, 800 trees per hectare, with the presently recommended level of 500 trees per hectare. The statistical design of split plots was used where the planting densities were laid as the main plots whilst the clones were in sub plots. Growth and yield parameters of rubber in terms of girth, bark thickness, the incidences of tapping panel dryness, latex volume, % dry rubber content, number of trees in tapping were assessed throughout the study. In addition, the leaf area index, volume of timber and time taken for different activities of tapping operation were assessed in 10^{th}, 11^{th} and 12^{th} year after planting, respectively. A financial analysis was also performed with the data gathered for 14 years and extrapolated values up to the 30^{th} year.

Increasing planting density over presently recommended level, i.e., 500 trees per hectare resulted in reduction in the plant growth, hence low percentage of tappable trees. Nevertheless, the high planting densities led to greater number of tappable trees per hectare. With reduced growth, latex yield per tree was less in high densities. However,

there was an increase in yield per hectare with the increase in the planting density due to the corresponding increase in number of tappable trees. Reduction in tree growth reduced the timber value of the rubber tree in high densities, however high level of income from rubber trees could be expected at the end of the life cycle due to the increase in number of trees per hectare in high densities.

The percentage of trees affected by tapping panel dryness was not significantly affected by the planting density. There was no possibility to increase the tapping task within the generally used time frame in high planting densities because the average distance (DIS) between two productive trees in all densities was comparable due to lower percentage of trees in tapping in higher densities.

Irrespective of the density, the clone RRIC 121 outperformed the two other clones (i.e. RRIC 100 and RRIC110) tested with respect to growth hence timber production and latex yield. The poor performance of RRIC 110 was particularly due to the infection of *Corynespora* leaf fall disease.

Based on the financial assessments in terms of NPV, BCR and IRR, the planting density of RRIC 100 could be increased up to 600 trees per hectare whilst investment on higher densities above 500 trees per hectare in the clone RRIC 121 was not worthwhile. In order to derive suitable planting densities under sub optimal conditions and at different management conditions, adaptive research trials are to be carried out in those conditions and social factors influencing the parameters of financial analyses are to be taken into consideration.