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EFFECT OF INTERSTOCK ON GROWTH AND YIELD OF HEVEA BRASILIENSIS (MUELL. ARG.)

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EFFECT OF INTERSTOCK ON GROWTH AND YIELD OF HEVEA BRASILIENSIS (MUELL. ARG.)

BY

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GLOSSARY

ABA	abscisic acid
BT	bark thickness
^{14}C	radioactive carbon
CIRP	Christmas Island Rock Phosphate
CV	coefficient of variation
DRC	dry rubber content
E	Einstein
GA	gibberellic acid
GI	girth increment
g/t/t	gram per tree per tapping
^{3}H	radioactive hydrogen
illegitimate seedling	a plant raised from seed obtained from the free (natural) pollination of any seedling or clonal tree where the male parent is unknown.
IRGA	Infra-red gas analyser
LA	leaf area
LAR	leaf area ratio
LGC	length of guard cell
LSC	length of stomatal complex
LVR	latex vessel ring
LWP	leaf water potential
monoclonal seedling	a plant raised from seed obtained from the centre of an isolated block containing plants of a single clone.
NAR	net assimilation rate
nm	nanometre

PR	photosynthetic rate
RDI	relative diameter increment
RGR	relative growth rate
RRIM	Rubber Research Institute of Malaysia
1/2 S. d/2	half spiral tapping system tapped on alternate day.
1/2 S. d/3	half spiral tapping system tapped every three days.
SF	stomatal frequency

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By

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Supervisor : Dr. Wan Chee Keong
Faculty : Agriculture

This study explores the possibility of using interstock in vegetative propagation to improve the growth and yield of Hevea brasiliensis (Muell. Arg.).

The parameters investigated were growth and yield of young and mature trees. Other parameters studied included leaf and stomatal characters, photosynthetic rate and bark anatomy of scion with the objective of providing possible explanations for some of the interstock effect on scion growth and yield.

The various aspects of scion growth affected by interstock clones were scion height, girth and its increment, dry weights of various plant parts, mean relative growth rate and mean net assimilation rate, the distribution of dry matter into various plant parts, leaf area, leaf area ratio, photosynthetic rate, stomatal frequency and stomatal size. In general, it was shown

that the interstock influence on scion growth was related to the inherent vigour characteristic of the interstock clones. For instance, vigorous interstocks such as RRIM 613 and TR 3702 improved scion growth by about 4 to 9% compared to the control. There was also significant interaction effect between scion and interstock clone with respect to scion girth. The interaction effect was because interstock clone significantly influenced growth of RRIM 802 and PB 235 scion clones but growth of RRIM 600 scion was not similarly affected.

Yield of scion clone was generally found to be largely determined by the genetic make up of the scion clone and was not generally influenced by the yield potential of the interstock clone. Other characteristics of scion such as plugging index and dry rubber content did not appear to play important role in determining yield of scion clones. Vigorous interstocks (RRIM 613 and TR 3702) improved early vigour of scion clones thereby increasing the percentage tappability of the trees. Immature vigour also influenced markedly yield per tree and yield per hectare. RRIM 513, AVROS 427 and AVROS 1734 interstocks improved yield of RRIM 600 scion clone by causing a greater differentiation of latex vessel ring in the scion stem.

The results obtained in this study are discussed in relation to tree performance and the possible mechanism by which interstock influences growth and yield of Hevea trees.

Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi sebahagian daripada keperluan untuk Ijazah Doktor Falsafah.

KESAN BATANG PERANTARAAN KE ATAS PERTUMBUHAN DAN PENGHASILAN HEVEA BRASILIENSIS (MUELL. ARG.)

Oleh

BASTIAH BINTI AHMAD

MAC, 1990

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Penyelidikan ini mengkaji kemungkinan menggunakan batang perantaraan dalam pembiakan vegetatif untuk meningkatkan pertumbuhan dan penghasilan Hevea brasiliensis (Muel. Arg.).

Parameter-parameter yang diselidiki adalah pertumbuhan dan penghasilan pokok-pokok muda dan matang. Parameter-parameter lain seperti ciri-ciri daun dan stomata, kadar fotosintesis dan anatomi kulit juga diselidiki dengan tujuan mendapat penjelasan tentang beberapa kesan batang perantaraan ke atas pertumbuhan dan penghasilan sion.

Aspek-aspek pertumbuhan sion yang dipengaruhi oleh klon-klon batang perantaraan adalah ketinggian sion, ukuran lilitan batang dan peningkatannya, berat kering berbagai bahagian pokok, purata kadar pertumbuhan relatif dan purata kadar asimilasi bersih, taburan bahan kering di dalam berbagai bahagian pokok,

keluasan daun, nisbah keluasan daun, kadar fotosintesis, frekuensi stomata dan saiz stomata. Umumnya, didapati bahawa pengaruh batang perantaraan ke atas pertumbuhan sion mempunyai hubungkait dengan ciri kesuburan semulajadi klon-klon batang perantaraan. Mithalannya, batang perantaraan yang subur saperti RRIM 613 dan TR 3702 meningkatkan pertumbuhan sion dengan 4 hingga 9 %. Terdapat juga kesan saling tindak yang nyata di antara sion dan klon batang perantaraan dari segi ukuran lilitan batang sion. Kesan saling tindak itu adalah kerana batang perantaraan memberi kesan kepada pertumbuhan sion RRIM 802 dan PB 235 tetapi kesan itu tidak terdapat dengan sion RRIM 600.

Amnya didapati hasil klon sion dipengaruhi oleh sifat-sifat genetik klon sion dan pada keseluruhannya tidak dipengaruhi oleh potensi penghasilan klon batang perantaraan. Ciri-ciri sion yang lain seperti indeks palam dan kandungan getah kering tidak memainkan peranan yang penting dalam penentuan hasil klon sion. Batang-batang perantaraan yang subur (klon RRIM 613 dan TR 3702) meningkatkan kesuburan awal klon-klon sion dan dengan itu meningkatkan peratus pokok yang boleh ditoreh semasa dibuka. Kesuburan sebelum matang juga mempengaruhi dengan ketara hasil sepokok dan hasil sehektar. Batang-batang perantaraan RRIM 513, AVROS 427 dan AVROS 1734 meningkatkan hasil klon sion RRIM 600 dengan menambahkan pembentukan relang saluran lateks di dalam batang sion.

Hasil-hasil yang diperolehi dari kajian ini dibincangkan berhubung dengan prestasi pokok dan mekanisma yang menyebabkan batang perantaraan mempengaruhi pertumbuhan dan penghasilan pokok-pokok Hevea.

CHAPTER 1

INTRODUCTION

The quest to increase the yield and reduce the immaturity period of rubber (Hevea brasiliensis Muell. Arg.) tree has been the continuous task of researchers since the first rubber plantation of 16 hectares was established in 1898 (Wycherley, 1959). Over the years, research efforts made in plant breeding and selection by the Rubber Research Institute of Malaya have contributed much to raise the yield of the tree through the production of new clones. The seedling trees yielded rubber at the rate of approximately 500 kg per hectare per year in the 1920s whereas the pedigree clones developed in the 1950s raised the yield to 1500 kg, and those in the 1960s to more than 2,400 kg (Wycherley, 1969). Currently, the best clones are reported to yield more than 3500 kg per hectare annually (Tan, 1988). The yield of these clones can be increased further by 30 to 50 % by the use of a yield stimulant 2-chloroethyl phosphonic acid (ethrel) (Abraham et al. 1968; Abraham, 1970 and 1972; Abraham et al. 1972; Abraham and Manikam, 1973; Abraham et al. 1973; Ping et al. 1973; Abraham et al. 1975).

The rubber tree normally takes some 6 to 6 1/2 years to reach maturity when they would have attained the tappable girth of 46 cm at height of 152 cm from the first union. This lengthy immature and unproductive period of the tree has

remained a primary economic concern to the growers. Various attempts have been made by researchers at the Rubber Research Intitute of Malaysia (RRIM) to reduce the period of immaturity by the use of precocious clones (Ong *et al*. 1981 and 1989) and by horticultural manipulation of the tree (Yoon, 1973).

Research in propagation techniques have been shown to be another effective way to reduce further the immaturity period. The early method of propagating *Hevea* trees was by seeds which produced trees with variable characteristics. This was subsequently replaced by the vegetative propagation technique of brown budding in the 1930s followed by the green budding technique in the 1960s (Hurov, 1961). The conventional method of budgrafting 6 to 8 months old seedling trees by green budding technique has now been replaced by the young budding technique (Leong and Yoon, 1985). This allows for budding of young seedlings from 8 to 10 weeks old thereby reducing the preparation time in the nursery and the cost of production. The young budding technique produces vigorous trees which can reduce the period of immaturity of rubber.

Innovations such as the establishment of planting materials in the nursery as opposed to the budding operation being carried out in the field (Templeton, 1967) and the use of advanced planting materials as stumped budding, core stump, advanced buddings in soil core and large polybag and those produced by young budding technique in normal sized polybag have been reported to reduce considerably the immaturity period of the trees (Mainstone, 1962; Strivens, 1962; Shepherd, 1967; Sivanadyan *et al*. 1973 and 1975; Leong and Yoon, 1985; Yoon *et al*. 1989).