UNIVERSITI PUTRA MALAYSIA

EFFECT OF LIGHT LEVEL ON GROWTH AND SHOOT DEVELOPMENT OF FIVE SPECIES OF TROPICAL SAPLINGS

TONG PEI SIN

EFFECT OF LIGHT LEVEL ON GROWTH AND SHOOT DEVELOPMENT OF FIVE SPECIES OF TROPICAL SAPLINGS

By

TONG PEI SIN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia in Fulfilment of the Requirement for the Degree of Master of Science

April 2006

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

EFFECT OF LIGHT LEVEL ON GROWTH AND SHOOT DEVELOPMENT FOR FIVE SPECIES OF TROPICAL SAPLINGS

By

TONG PEI SIN

April 2006

Chairman: Jamaluddin Basharuddin, PhD

Faculty: Forestry

Saplings of *Acacia mangium, Shorea roxburghii, Dyera costulata, Eusideroxylon zwageri* and *Cinnamomum iners* were grown at 4%, 7%, 25%, 50% and 100% relative light intensities (RLIs) and their growth was monitored by rate of increment of height and diameter, rate of production of new leaves and leaf life span. Leaves were analysed for their content of nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg), calcium (Ca), chlorine (Cl), sulphur (S), boron (B), manganese (Mn), copper (Cu) and zinc (Zn). For each RLI, two samples of leaves were taken for analysis: young fully expanded leaves and old about-to-shed leaves. From these analyses, the fate of nutrients was determined.

Acacia mangium and *Cinnamomum iners* were found to grow best at 100% RLI, *Shorea roxburghii* at 50% RLI and, *Dyera costulata* and *Eusideroxylon zwageri* at 25% RLI. *Acacia mangium* at 100% RLI had the highest weekly height and diameter increment of 16.15 cm and 0.77 cm respectively. This is 4 times higher than the second best growth species, *Shorea roxburghii* at

50% RLI and 21 times higher than the slowest growth species, *Eusideroxylon zwageri* at 25% RLI.

Acacia mangium at 100% RLI had the highest mean leaf production rate per week on leaders and branches, of 1.70 and 1.60 leaves respectively. This is 3 times higher than the second best species, *Shorea roxburghii* at 50% RLI and 17 times higher than the slowest growing species, *Eusideroxylon zwageri* at 25% RLI.

At 100% RLI, *Acacia mangium* had the shortest average leaf life span, of 130 days on leaders and 124 days on branches. In general, average leaf life span increased with reduction in RLI for all species.

A fast-growing plant is associated with higher height increment, higher diameter increment, higher mean leaf production and shorter leaf life span.

The level of NPK for these species in this study shared a similar range with major agricultural crops in Malaysia. The highest rate of NPK incorporation (g per week) was found in *Acacia mangium,* followed by *Dyera costulata*, and it was relatively low for other species.

The levels of NPK were higher in young leaves than the old leaves for all species at all RLIs. *Dyera costulata* seems to withdraw more than 60% of NPK and *Shorea roxburghii* more than 60% of P from old leaves before they shed. All species did not withdraw Mn and Zn.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KESAN CAHAYA KEATAS PERTUMBUHAN DAN PERKEMBANGAN POKOK UNTUK LIMA SPECIES POKOK KECIL

Oleh

TONG PEI SIN

April 2006

Pengerusi: Jamaluddin Basharuddin, PhD

Fakulti: Perhutanan

Anak pokok *Acacia mangium, Shorea roxburghii, Dyera costulata, Eusidexylon zwageri* dan *Cinnamomum iners* didedah pada kadar penerimaan cahaya (RLI) 4%, 7%, 25%, 50% and 100%. Pertumbuhan mereka dikawal dengan kadar pertumbuhan dalam ketinggian and garis pusat, kadar pertumbuhan daun baru dan umur daun. Daun-daun dianalisis untuk nitrogen (N), fosforus (P), kaliam (K), magnesiam (Mg), kalsiam (Ca), klorin (Cl), sulfur (S), boron (B), manganese (Mn), kuprum (Cu) dan zink (Zn). Untuk setiap kadar penerimaan cahaya, dua sampel daun diambil untuk analisis: daun muda yang penuh berkembang and daun tua yang akan gugur. Daripada analisis ini, nutrien dalam daun akan ditentukan.

Tumbuhan tumbuh paling baik di bawah kadar penerimaan cahaya yang tertentu. *Acacia mangium* and *Cinnamomum iners* tumbuh paling baik pada 100% RLI, *Shorea roxburghii* pada 50% RLI dan, *Dyera costulata* dan *Eusideroxylon zwageri* pada 25% RLI. *Acacia mangium* pada 100% RLI mempunyai pertumbuhan ketinggian dan garis pusat mingguan yang paling

baik, iaitu 16.15 sm dan 0.77 sm masing-masing. Ini adalah 4 kali lebih tinggi dari *Shorea roxburghii* yang bertumbuh kedua paling baik pada 50% RLI dan 21 kali lebih tinggi dari *Eusideroxylon zwageri* yang paling lambat pertumbuhan pada 25% RLI.

Acacia mangium mempunyai umur daun yang paling pendek, iaitu 130 hari atas pucuk dan 124 hari atas batang. Umur daun bertambah dengan kadar penerimaan cahaya yang rendah. Sebahagian species belum gugur daun mereka lagi pada kadar penerimaan cahaya yang rendah.

Pokok yang cepat tumbuh biasanya dikaitkan dengan pertambahan ketinggian yang lebih tinggi, pertambahan garis pusat yang lebih tinggi, kadar pertambahan daun baru yang lebih tinggi dan jangka hayat daun yang pendek.

Kadar NPK adalah lebih tinggi di dalam daun muda daripada daun yang akan gugur untuk semua species pada semua kadar penerimaan cahaya. Juga didapati bahawa kadar NPK dalam eksperimen ini hampir sama dengan pokok dalam pertanian di Malaysia. Kadar NPK yang paling tinggi (g seminggu) untuk 100 pucuk yang sedang tumbuh ialah *Acacia mangium,* diikuti oleh *Dyera costulata* dan kadar rendah untuk species lain. *Shorea roxburghii* menarik balik 60% P dan *Dyera costulata* menarik balik lebih dari 60% NPK sebelum daun gugur dan jatuh. Semua species tidak menarik balik Mn dan Zn.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to all those who continued in an enormous manner in making this study of mine a success.

I am most grateful to my supervisor, Dr. Jamaluddin Basharuddin, for his invaluable contributions and advice throughout the study. I am deeply indebted to Dr. Francis Ng whose stimulating suggestions and encouragement have tremendously helped me in the research and writing components. Without him, the scientific value of the study would have diminished greatly. The effort and assistance offered by Dr. Lim Meng Tsai, Dr. Ahmad Ainuddin Nuruddin and Dr. Daniel Baskaran Krishnapillay are also much appreciated.

I would also like to acknowledge the financial support provided by the Forest Research Institute Malaysia (FRIM). My heartfelt thanks go to Bandar Utama City Centre (BUCC) Sdn. Bhd. for their permission to use their study site and light meter equipment. Additionally, I would like to thank Fujisawa Scholarship awarded through Kajang Rotary Club.

The episode of acknowledgement would not be complete without the mention of a number of individuals: Dato' Dr. Hj. Wan Razali Wan Mohd., Dr. Hoi Why Kong, Dr. Gary William Theseira and my family members, whose unfailing support, direct or otherwise, has enabled me to complete my thesis in time.

Last but not least, my friends and colleagues who have provided much inspiration and motivation over the past several years. Their contribution may have been less academic but no less important to me. For that, I truly cherish their presence in my life.

I certify that an Examination Committee met on 28/08/06 to conduct the final examination of Tong Pei Sin on her degree thesis entitled “Effect of Light Level on Growth and Shoot Development of Five Species of Tropical Saplings” in accordance with the Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Committee are as follows:

Chairman, PhD
Associate Professor Azmy Hj. Mohamed
Faculty of Forestry
University Putra Malaysia
(Chairman)

Examiner 1, PhD
Professor Noraini Binti Ab Shukor
Faculty of Forestry
University Putra Malaysia
(Member)

Examiner 2, PhD
Associate Professor Mohd Fauzi Bin Ramlan
Faculty of Agriculture
University Putra Malaysia
(Member)

External Examiner, PhD
Mohd Haniff Harun
Malaysian Palm Oil Board
(Independent Examiner)

_____

HASANAH MOHD. GHAZALI, PhD
Professor/Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 22nd Nov 2006

This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee are as follows:

Jamaluddin Basharuddin , PhD
Lecturer
Faculty of Forestry
Universiti Putra Malaysia
(Chairman)

Ahmad Ainuddin Nuruddin, PhD
Associate Professor
Faculty of Forestry
Universiti Putra Malaysia
(Member)

Francis Ng, PhD
Forest Research Institute of Malaysia (FRIM)
Kuala Lumpur
(Member)

Danieal Baskaran Krishnapillay, PhD
Forest Research Institute of Malaysia (FRIM)
Kuala Lumpur
(Member)

_____
AINI IDERIS, PhD
Professor/Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

_____

TONG PEI SIN

Date: 20th April 2006

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES