



**EFFECTS OF DIFFERENT FERTILIZER REGIMES ON THE GROWTH  
OF 'MERAHAN SIPUT JANTAN' (*HOPEA ODORATA* ROXB.) FOR  
URBAN LANDSCAPE**

**AHMAD AZARUDDIN MOHD. NOOR**

**FRSB 2007 6**



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**By**

**AHMAD AZARUDDIN MOHD. NOOR**

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

**July 2007**



## DEDICATION

*This work is dedicated to*

*My beloved family*

*and*

*The 1<sup>st</sup> batch of Certified Arborist in Malaysia*



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

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**July 2007**

**Chairman: Professor Mustafa Kamal Mohd. Shariff, PhD**

**Faculty: Design and Architecture**

Fertilizer application is fundamental in providing adequate nutrients to landscape trees planted in and around urban areas. However, little information is available on the nutrient requirements of urban landscape trees especially on forest species planted for landscaping in Malaysia. An observation was carried out to examine the growth and nutrient status of *Hopea odorata* planted for urban landscape at the New Klang Valley Expressway (NKVE) on disturbed and undisturbed soils. Significant ( $p < 0.05$ ) difference in total tree height, foliar nitrogen content and relative chlorophyll content was found between trees planted on disturbed and undisturbed soil. Limited availability of nitrogen (N) due to poor soil condition could be one of the reasons for the unsatisfactory growth of *H. odorata* on disturbed and cut soil.

A fertilizer experiment was carried out to determine the effect of different fertilizer regimes as remedial treatment on *H. odorata* on cut and disturbed soil at the study site. The experiment employed a factorial design plus control in Randomized



Complete Block Design (RCBD). The treatments comprised of two types of fertilizer, two nitrogen rates in the form of compound fertilizer, two frequencies of application and a control. Result after twelve months of treatment indicated that types of fertilizer, nitrogen rates and frequencies of application affected the growth of *H. odorata* at the study site.

Organic fertilizer Avanti™ (3.5 N : 4.5 P : 2.5 K : 1.0 Mg) gave significantly ( $p < 0.05$ ) higher height and crown diameter increments, specific leaf area (SLA), net photosynthesis (Pn), apparent quantum yield (Qn) water use efficiency (WUE) and light use efficiency (LUE) than inorganic fertilizer Nitrophoska Yellow™ (15 N : 15 P : 6 K : 4 Mg). Fertilizer combinations with higher N rate at 150 g N/year (1000 g Nitrophoska Yellow™ and 4286 g Avanti™) was found to give significantly ( $p < 0.05$ ) higher height and crown diameter increments, SLA, leaf area index (LAI), foliar nitrogen (N) content, relative chlorophyll content and net photosynthesis (Pn) regardless of types of fertilizer and frequencies of application. The study showed that application of fertilizer at 4 times per year gave significant effect ( $p < 0.05$ ) on total height increment and foliar N of *H. odorata*. All fertilizer combinations were found to give no significant effect ( $p < 0.05$ ) on foliar phosphorus (P) as well as foliar potassium (K) content of *H. odorata*.

The results further indicated that treatment combination of organic fertilizer with 150 g N (4286 g Avanti™) applied 4 times per year gave the best response where significant ( $p < 0.05$ ) difference with unfertilized control plot were observed in growth parameters of *H. odorata* with the exception of stem diameter (dbh)



increment. It was also found to give significantly ( $p < 0.05$ ) higher foliar N content, relative chlorophyll content, LAI, Pn, maximum assimilation ( $A_{\max}$ ) Qn and LUE than control.



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

**KESAN REJIM PEMBAJAAN YANG BERBEZA TERHADAP  
TUMBESARAN MERAWAN SIPUT JANTAN (*HOPEA ODORATA* ROXB.)  
UNTUK LANDSKAP BANDAR**

Oleh

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Pemberian baja merupakan asas untuk membekalkan nutrien yang mencukupi kepada pokok landskap yang ditanam di dalam dan di sekitar kawasan bandar. Walaubagaimanapun, maklumat tentang keperluan nutrien pokok di bandar khususnya spesies hutan yang ditanam untuk landskap di Malaysia adalah terhad. Pemerhatian telah dilakukan untuk melihat pertumbuhan dan status kandungan nutrien bagi pokok *Hopea odorata* yang ditanam sebagai pokok landskap di Lebuhraya Baru Lembah Klang (NKVE) iaitu di kawasan tanah yang telah diganggu dan kawasan tanah yang tidak diganggu. Perbezaan yang bererti ( $p < 0.05$ ) telah didapati untuk ketinggian pokok keseluruhan, kandungan nitrogen (N) daun dan kandungan relatif klorofil daun antara pokok yang ditanam di kawasan tanah yang terganggu dan kawasan tanah yang tidak diganggu. Kandungan N yang terhad disebabkan keadaan tanah yang bermasalah dicadangkan sebagai salah satu punca pertumbuhan *H. odorata* yang tidak memuaskan di kawasan tanah yang dipotong dan diganggu.



Kajian pembajaan telah dijalankan untuk menentukan kesan rejim pembajaan berbeza sebagai rawatan pemulihan ke atas pokok *H. odorata* di kawasan tanah yang dipotong dan diganggu di tapak kajian. Rawatan melibatkan dua jenis baja, dua kadar N didalam baja sebatian, dua kekerapan pembajaan serta satu kawalan. Kajian ini menggunakan eskperimen faktorial dan kawalan dalam reka bentuk blok rawak penuh. Keputusan 12 bulan selepas rawatan menunjukkan bahawa jenis baja, kadar N serta kekerapan pembajaan mempengaruhi pertumbuhan *H. odorata* di tapak kajian.

Baja organik Avanti<sup>TM</sup> (3.5 N : 4.5 P : 2.5 K : 1.0 Mg) didapati meningkatkan secara bererti ( $p < 0.05$ ) ketinggian pokok keseluruhan dan garis pusat silara, luas daun spesifik (SLA), fotosintesis bersih (Pn), asimilasi maksimum ( $A_{max}$ ), hasil kuantum ketara (Qn), kecekapan penggunaan air (WUE) dan kecekapan penggunaan cahaya (LUE) berbanding baja bukan organik Nitrophoska Yellow<sup>TM</sup> (15 N : 15 P : 6 K : 4 Mg). Kombinasi baja dengan N pada kadar 150 g setahun (1000 g Nitrophoska Yellow<sup>TM</sup> & 4286 g Avanti<sup>TM</sup>) didapati meningkatkan ketinggian pokok keseluruhan, garis pusat silara, indeks luas daun (LAI), kandungan N daun, kandungan relatif klorofil dan Pn secara bererti ( $p < 0.05$ ) tanpa mengira jenis baja dan kekerapan pembajaan. Kajian menunjukkan bahawa kekerapan pembajaan sebanyak 4 kali setahun memberikan kesan bererti ( $p < 0.05$ ) ke atas peningkatan ketinggian pokok dan kandungan N daun *H. odorata*. Kesemua kombinasi baja didapati tidak memberikan kesan yang bererti ( $p < 0.05$ ) terhadap kandungan fosforus (P) dan kalium (K) daun *H. odorata*.





Keputusan seterusnya menunjukkan kombinasi rawatan baja organik dengan 150 g N (4286 g Avanti™) dengan pembajaan 4 kali setahun memberikan tindak balas yang terbaik di mana didapati peningkatan secara bererti ( $p < 0.05$ ) untuk semua parameter pertumbuhan kecuali garis pusat batang (dbh) berbanding kawalan. Ia juga menunjukkan peningkatan kandungan N daun, kandungan relatif klorofil, Pn, LAI,  $A_{\max}$  Qn dan LUE secara bererti ( $p < 0.05$ ) berbanding kawalan.



## ACKNOWLEDGEMENTS

Alhamdulillah, praise to Allah Almighty for giving me strength and courage that finally enable me to accomplish my graduate study.

It is of great pleasure to extend my deepest appreciation and sincere thanks to Professor Dr. Mustafa Kamal Mohd. Shariff, chairman of my supervisory committee who has contributed so much effort in guiding me through the entire course of this study. Special thanks and appreciation are also extended to the supervisory committee members, Associate Professor Dr. Mohd. Fauzi Ramlan and Associate Professor Dr. Anuar Abdul Rahim for the invaluable and constructive criticisms and comments, encouragement and support of which made this study a success.

I am also greatly indebted to the Director General of FRIM, YBhg. Datuk Dr. Abdul Razak Mohd. Ali for the support and financial assistance during my study. My acknowledgement is also extended to Senior Director of Biodiversity and Environment Division of FRIM, Dr. Abdul Rahim Nik and Director of Ecotourism and Urban Forestry Program of FRIM, Dr. Noor Azlin Yahya for their encouragement and support.

I am also grateful to Adnan Mohamad, Dr. Adzmi Yaacob, Dr. Ab. Rasip Ab. Gani and Dr. Aminah Hamzah who have lent support, guidance and assistance for me to complete this study.



I also like to extend my sincere thanks to Ahmad Zahir Mansor, Zulfadli Mat Yasin, Samsol Bohari, Mazli Abd. Wahab, Azrina Yahya, Syamsurina Arshad and other individuals from the Urban Forestry Unit of FRIM who had contributed in one way or another to this work. My thanks are also due to Mazlan Bangi, Azhar Othman, Tasnim Ghazali, Maslinda Mohd. Senon and other individuals from the Faculty of Agriculture, UPM, without which this research could not have been carried out successfully.

Last but not least, special appreciations are dedicated to my loved ones – my wife, my children and my parents for their patience and understanding through the entire period of this study.



I certify that an Examination Committee has met on 2<sup>nd</sup> July 2007 to conduct the final examination of Ahmad Azaruddin bin Mohd. Noor on his Master of Science thesis entitled “Effects of Different Fertilizer Regimes on the Growth of *Hopea odorata* Roxb. Planted for Urban Landscape” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded relevant degree. Members of the Examination Committee are as follows:

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## 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.

---

**AHMAD AZARUDDIN B. MOHD. NOOR**

Date: 28 September 2007



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## LIST OF ABBREVIATIONS/NOTATIONS/GLOSSARY OF TERMS

ANOVA	Analysis of Variance
$A_{\max}$	Maximum Assimilation
BRIS	Beach Ridges Intersperse with Swales
Ca	Calcium
CO <sub>2</sub>	Carbon Dioxide
dbh	Diameter at Breast Height
E	Transpiration rate
HSD	Honesty Significant Different
$I_l$	Light radiation beneath tree canopy
$I_o$	Light radiation in the open
K	Potassium
LAI	Leaf Area Index
LUE	Light Use Efficiency
Mg	Magnesium
N	Nitrogen
NH <sub>4</sub> <sup>+</sup>	Ammonium
NO <sub>3</sub> <sup>-</sup>	Nitrate
NPK	Nitrogen – Phosphorus - Potassium
NKVE	New Klang Valley Expressway
P	Phosphorus
PCA	Plant Canopy Analyzer
PLUS	Projek Lebuhraya Utara Selatan



Pn	Photosynthesis
Qn	Quantum Yield
RCBD	Randomised Completed Block Design
RLI	Relative Light Intensity
SLA	Specific Leaf Area
SPAD	Soil – Plant Analysis Development
WUE	Water Use Efficiency



# CHAPTER 1

## INTRODUCTION

### 1.1 General Background

Landscaping and urban tree planting has now become an important industry in Malaysia with the government's vision in making Malaysia as a Garden City. This created demand for high quality trees which aid in creating a high quality landscape. Landscape management and tree maintenance will play an important role to achieve this goal. Present and future emphasis will be on how to effectively manage and maintain urban trees so that they will perform in a harsh urban environment. Efforts on tree planting and landscaping were often not followed by proper management and maintenance programme due to lack of knowledge and application of effective maintenance practices. The diversity of landscape plants especially with the introduction of many new forest species for urban planting make it more challenging to maintenance as each species have different cultural requirements.

One of the important aspects in landscape management and maintenance is the fertilization programme. Effective fertilization program is vital to feed the landscape plants with adequate and balance nutrition. Fertilization is fundamental in providing adequate nutrient to trees planted in and around urban areas as the availability of urban soil nutrient is limited due to the poor soil condition and the absent of nutrient cycling. Thus, fertilization programme is a very important aspect in landscape





maintenance especially in the early establishment of landscape trees. However, effective results are difficult to accomplish from the fertilization program due to the lack of understanding on what and how much the plants actually need. Little information is available on the nutrient requirements of urban landscape trees. There is no information on the nutrient status, actual nutrient requirements and the effects of fertilizer application on the establishment of landscape trees especially on forest species planted for landscaping in Malaysia.

Urban areas are well known for their limited nutrient availability of soil nutrient as compared to natural forested areas. Under natural forest conditions, decayed leaves and dead plants replace mineral elements and nutrients, which are then taken up by living plants. The mineral substance in trees are returned to the soil in the form of organic matter and absorbed by the roots (Pirone *et al.*, 1988). However, in urban setting the situation is reversed. Fallen leaves and dead branches are usually removed during maintenance (Sieghardt *et al.*, 2005) resulting in loss of available nutrients. There is an interruption in the cycling of nutrient substances in the urban ecosystem (Craul, 1992). Despite this fact, landscape maintenance programmes ignore urban tree requirements for nutrient. The tree may survive but will not develop into a fine specimen as is found in its natural environment (Hamilton, 1981). The soils in urban areas are also known for their poor nutrients availability and nitrogen is frequently limited (Pirone *et al.*, 1988; Craul, 1992; Harris *et al.*, 1999; Sieghardt *et al.*, 2005). Therefore, the need to fertilize urban trees is very obvious. Fertilization encourages rapid plant growth, influences vigour, leaf size and colour as well as influence susceptibility to pest and disease (Harris *et al.*, 1999). It

