



UNIVERSITI PUTRA MALAYSIA

***EFFECTS OF PACLOBUTRAZOL CONCENTRATION, APPLICATION
TECHNIQUES AND FREQUENCY ON GROWTH AND FLOWERING OF
Lagerstroemia indica (L.) Pers***

NYAN TAHIR MOHAMMED

FP 2016 26



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By

NYAN TAHIR MOHAMMED

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

June 2016

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DEDICATION

THIS THESIS IS DEDICATED TO
MY BELOVED HUSBAND RANJ SIRWAN NOORI
MY BEAUTIFUL DAUGHTER PRINCESS AYA
MY LOVELY PARENTS AND SIBLINGS
ALL MY KIND HEARTED TEACHERS, LECTURERS, AND FRIENDS



Abstracts of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

EFFECTS OF PACLOBUTRAZOL CONCENTRATION, APPLICATION TECHNIQUES AND FREQUENCY ON GROWTH AND FLOWERING OF *Lagerstroemia indica* (L.) Pers

By

NYAN TAHIR MOHAMMED

June 2016

Chairman : Associate Professor Yahya Bin Awang, PhD
Faculty : Agriculture

Lagerstroemia indica is an amazing flowering tree but the growth is very fast leading to the deformation of esthetical configurations in a short time. To minimize the problem, the plant can be treated with paclobutrazol (PBZ) to control the growth as previous studies have shown that PBZ can significantly reduce the plant height. The effects of PBZ, a growth retardant on the plant growth and flowering characteristics in *L.indica* were examined in two greenhouse experiments. In the first experiment, the effects of two application techniques (foliar spray and soil drenching) applied once at four concentrations (0, 1500, 3000 and 4500 mg/L) were evaluated. In the second experiment, the treatments involved application of PBZ delivered in two application frequencies (single and double application) given as soil drench with four concentrations (0, 500, 1000 and 1500 mg/L). Compared to the control plant, PBZ foliar spray and soil drenching reduced plant height by 75% and 90%, respectively. PBZ at 1500 mg/L with double application reduced plant height by 30% of those received single application. PBZ at 3000 mg/L in foliar spray increased the number of flowers by 21%, while PBZ at 1500 mg/L in soil drenching increased the number of flowers by 25% compared to the control plants. In addition, at 3000 mg/L, foliar sprayed-plant produced 49% more leaves compared to the control. Increasing PBZ from 0 to 1500 mg/L via soil drenching with either single or double application increased leaf number by 23%. PBZ application also produced significant effects on chlorophyll a content, total chlorophyll, photosynthesis and transpiration. PBZ at 1500 mg/L with single and double application increased chlorophyll a and total chlorophyll rate by 41% and 34%, respectively, compared to the non-treated plants. The rate of photosynthesis was reduced from 11.11 $\mu\text{molCO}_2\text{m}^{-2}\text{s}^{-1}$ to 10.80, 9.30 and 8.86 $\mu\text{molCO}_2\text{m}^{-2}\text{s}^{-1}$ as the concentration of PBZ increased from 0 to 1500, 3000 and 4500 mg/L. PBZ was also found to increase the activity of superoxide dismutase (SOD) and catalase (CAT) enzymes by 79% and 360%, respectively when the concentration of PBZ increasing from 0 to 1500 mg/L. PBZ did not affect stomata conductance, leaf mineral contents and peroxidase activity (POD). Overall, results of the present study show that PBZ

application produced some positive effects on the growth and flowering of *L. indica*. PBZ, applied as soil drenching with double application were more effective compared to the foliar spray and single application. Moreover, high PBZ concentration (4500 mg/L) given as soil drenching caused deformation of shoots, buds and delayed formation of the flower buds and reduced the number of flowers.



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

**KESAN KEPEKATAN PAKLOBUTRAZOL, TEKNIK DAN KEKERAPAN
PENGUNAAN TERHADAP PERTUMBUHAN DAN PERBUNGAAN
*Lagerstroemia indica***

Oleh

NYAN TAHIR MOHAMMED

Jun 2016

Pengerusi : Professor Madya Yahya B.Awang, PhD
Fakulti : Pertanian

Lagerstroemia indica adalah sejenis tumbuhan berbunga yang menakjubkan dengan pertumbuhan pantas yang boleh menjejaskan nilai estetikanya dalam masa yang singkat. Untuk mengurangkan masalah tersebut, tumbuhan ini boleh dirawat menggunakan paclobutrazol (PBZ) untuk mengawal pertumbuhannya memandangkan kajian lepas menunjukkan PBZ berupaya mengurangkan ketinggian pokok secara signifikan. Kesan-kesan PBZ sebagai perencat pertumbuhan dan pembungaan pada *L.indica* telah dikaji dalam dua buah eksperimen rumah hijau. Dalam eksperimen pertama, kesan dua teknik aplikasi (semburan daun dan siraman tanah), diberikan sekali pada empat kepekatan (0, 1500, 3000 dan 4500 mg/L) telah dinilai. Dalam eksperimen kedua, rawatan yang terlibat adalah aplikasi PBZ menggunakan dua frekuensi aplikasi (aplikasi tunggal dan berganda) telah diberikan secara siraman tanah dengan empat kepekatan (0, 500, 1000 dan 1500 mg/L). Berbanding dengan tumbuhan kawalan, semburan daun dan siraman tanah PBZ telah mengurangkan ketinggian tumbuhan masing-masing sehingga 75% dan 90%. PBZ pada 500 mg/L dengan aplikasi berganda telah mengurangkan ketinggian tumbuhan sehingga 30% berbanding tumbuhan yang menerima aplikasi tunggal. PBZ pada 3000 mg/L dan menggunakan aplikasi semburan daun telah meningkatkan jumlah bunga sehingga 21% sementara PBZ pada 1500 mg/L dan menggunakan aplikasi siraman tanah telah meningkatkan bilangan bunga sehingga 25% berbanding tumbuhan kawalan. Tambahan lagi, pada 3000 mg/L, tumbuhan yang telah diaplikasikan semburan daun menghasilkan lebih 49% daun berbanding tumbuhan kawalan. Peningkatan PBZ dari 0 kepada 1500 mg/L menggunakan siraman tanah; samada secara tunggal atau berganda telah meningkatkan bilangan daun sehingga 23%. Aplikasi PBZ juga telah menghasilkan kesan signifikan pada kandungan klorofil a, jumlah keseluruhan klorofil, fotosintesis dan transpirasi. Berbanding dengan tumbuhan kawalan, PBZ pada 1500 mg/L dengan aplikasi tunggal dan berganda telah meningkatkan klorofil a dan kadar jumlah keseluruhan klorofil masing-masing sehingga 41% dan 34%. Kadar fotosintesis telah berkurang dari 11.11 $\mu\text{molCO}_2\text{m}^{-2}\text{s}^{-1}$ kepada 10.80, 9.30 dan 8.86 $\mu\text{molCO}_2\text{m}^{-2}\text{s}^{-1}$ apabila kepekatan

PBZ meningkat dari 0, 1500, 3000 dan 4500 mg/L. PBZ juga didapati telah meningkatkan aktiviti superoxidase dismutase (SOD) dan enzim catalase (CAT) masing-masing sehingga 79% dan 360% apabila kepekatan PBZ meningkat dari 0 kepada 1500 mg/L. PBZ tidak menjejaskan aktiviti stomata, kandungan mineral daun dan aktiviti peroxidase (POD).

Secara keseluruhannya, hasil daripada kajian menunjukkan aplikasi PBZ menghasilkan kesan-kesan positif terhadap pertumbuhan dan pembungaan *L.indica*. PBZ, apabila diberikan secara siraman tanah dengan aplikasi berganda adalah lebih efektif berbanding pemberian secara semburan daun dan aplikasi tunggal. Selain itu, kepekatan PBZ yang tinggi (4500 mg/L) dan diberikan secara siraman tanah telah menyebabkan kecacatan pada pucuk, tunas dan melambatkan pembentukan tunas bunga selain mengurangkan bilangan daun.

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I certify that a Thesis Examination Committee has met on 28 June 2016 to conduct the final examination of Nyan Tahir Mohammed on her thesis entitled "Effects of Paclobutrazol Concentration, Application Techniques and Frequency on Growth and Flowering of *Lagerstroemia indica* (L.) Pers." in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

Members of the Thesis Examination Committee were as follows:

Mohamad bin Osman, PhD

Senior Lecturer
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Mohd Ridzwan bin Abd Halim, PhD

Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Internal Examiner)

Tsan Fui Ying, PhD

Associate Professor
Universiti Teknologi MARA
Malaysia
(External Examiner)



ZULKARNAIN ZAINAL, PhD

Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 23 August 2016

This thesis was 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 were as follows:

Yahya Bin Awang, PhD

Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Izham Bin Ahmad, PhD

Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

BUJANG BIN KIM HUAT, PhD

Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

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Signature: _____
Name of
Chairman of
Supervisory Associate Professor
Committee: Dr. Yahya Bin Awang

Signature: _____
Name of
Member of
Supervisory Associate Professor
Committee: Dr. Izham Bin Ahmad

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LIST OF ABBREVIATIONS

| | |
|---|--|
| PBZ | Paclobutrazol |
| mL | Millilitre |
| mg/L | Milligram per litre |
| % | Percentage |
| °C | degree Celsius |
| SOD | Superoxide dismutase |
| CAT | Catalase |
| POD | Peroxidase activity |
| APX | Ascorbate peroxidase |
| cm | Centimetre |
| cm ² | Square centimetre |
| IAA | Indoleacetic acid |
| Gas | Gibberellins |
| ppm | Part per million |
| GGPP | Geranylgeranyl pyrophosphate |
| N | Nitrogen |
| P | Phosphorus |
| K | Potassium |
| Mg | Magnesium |
| g | Gram |
| mg | Milligram |
| Kg | Kilogram |
| kg/ha | Kilogram per hectare |
| $\mu\text{molCO}_2 \text{ m}^{-2} \text{ s}^{-1}$ | Photosynthesis rate |
| $\text{mol m}^{-2} \text{ s}^{-1}$ | Stomatal conductance |
| $\text{m mol m}^{-2} \text{ s}^{-1}$ | Transpiration rate |
| RCBD | Randomize complete block design |
| $\text{mg g}^{-1} \text{ FW}$ | Chlorophyll unit |
| pH | Measurement for hydrogen ion concentration |
| μmole | Micromole |
| nmole | Nanomole |
| min | Minute |

CHAPTER 1

INTRODUCTION

Shrubs are a woody plant that has multiple stems and matures to a maximum height of 4-9 meter. Planting trees and shrubs is important in gardens or cities because they give considerable advantages such as environmental and economic benefits. Their roots help to filter out excess sediment and stop soil erosion, pollutants, and nutrients from stormwater runoff. Moreover, they enhance air quality by bringing down the temperature and removing airborne pollutants, their tissues store carbon dioxide, serving to neutralize to counteract global warming. In addition, trees are important for filtering noise, which is of vital importance for the livability of current urban communities and the well-being of urban residents (Fraser and Kenney, 2000; Chiesura, 2004). Studies in Malaysia showed that places covered by trees have the air temperature that could be 4°C lower than in uncovered space (Kuchelmeister, 1998). In addition, no landscaping project is complete without trees and shrubs. Shrubs are essential for landscaping because they can provide protection from the wind, provide privacy and add a dark green tone of landscaping design. Furthermore, flowering trees that bloom throughout the year can make a significant addition to the landscape design. Planning to use shrubs for landscape is important so that selecting the right type of shrubs will complement the landscape (Maddox, 2012).

Lagerstroemia indica is an attractive, blossoming bush, usually known as crape myrtle. It is a member of the Lythraceae, which is otherwise, called the Loosestrife family (Dou *et al.*, 2005; Esfahani *et al.*, 2014). *Lagerstroemia indica* is a fast-growing, upright shrub with a height up to 8 m tall. Most cultivars of *L.indica* are vigorous growers under some suitable nursery conditions. In the four season weather conditions, a few cultivars start their blooming time as in early summer and proceed into the fall (Knox, 2013). This early flowering can suppress vegetative growth, especially the height. Production of the plants ordinarily takes place in the full sun where blooming is profuse which is frequently exacerbated by heavy fruit, set later in the growing season (Morrison *et al.*, 2003). Crape myrtle is one of the most flexible landscape plants for sunny areas. The plants can be pruned and trained to become medium or small trees, bushes, ground covers, container plants, large perennial bedding plants and hanging baskets (Appleton *et al.*, 2009).

Pacllobutrazol (PBZ) is one of the chemicals used for controlling plant growth. PBZ may produce several positive effects and physiological advantages on woody shrubs, tree and ornamental plants. In addition, plants treated with PBZ have dark green color leaves because of high chlorophyll content (Chany, 2005). *Consolida orientalis* treated with pacllobutrazol at 125, 250 and 500 mg/L as foliar spray had darker violet flowers and deeper green leaves compared to the untreated plants (Mansuroglu *et al.*, 2009). According to the previous study, pacllobutrazol can significantly reduce the plant height, leaf area and internode length and increase the number of flowers, leaves and

branches (Matysiak, 2002; Ghosh *et al.*, 2010; Ahmad Nazarudin *et al.*, 2014; Suradinata and Hamdani, 2015).

The growth of *Lagerstroemia indica* is very fast during the growing season leading to the deformation of esthetical configurations in a short time. It needs frequent pruning on a regular basis, two to three times during active growing months (Ventura, 2009).

Maintenance of the plants that grow in area such as in close vicinity to power lines, slopes and right-of-ways is frequently more difficult especially to establish and keep up than their counterparts in parks due to lack of planting space and high expenses of individual maintenance of trees. Furthermore, pruning plant formation and preservation of esthetic features of plants take time and need skilled workers (Kuchelmeister, 1998; Ventura, 2009). Moreover, pruning is also necessary to advance the growth required for flowering (Knox and Gilman, 2009).

In this study, we focus on the use of growth retardant, paclobutrazol to reduce the rate of growth of *L. indica*, in view of its utilization to reduce the need for pruning, enhance flowering and plant configuration which could lessen the cost of pruning and shaping the plants to be the landscape plant.

1.1 Objective of study

- **Overall objective**

To evaluate the effects of paclobutrazol on vegetative growth, physiological processes and flowering of *Lagerstroemia indica*

- **Specific Objectives:**

1. To determine response of *Lagerstroemia indica* to four concentration of paclobutrazol
2. To compare effects of different application techniques (foliar spray and soil drenching) on vegetative growth, physiological processes and flowering of *Lagerstroemia indica*
3. To compare effect of different frequency (single and double application) of paclobutrazol on growth and physiological processes.

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