



**UNIVERSITI PUTRA MALAYSIA**

**RESPONSES OF *Platyserium coronarium* (Koenig.) Desv. AND  
*Platyserium bifurcatum* (Cav.) C. Chr. TO LIGHT AND WATER  
STRESS IN NURSERY ENVIRONMENT**

**RUZANA ADIBAH BINTI MOHD SANUSI**

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**By**

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**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in  
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**Faculty: Faculty of Forestry**

Environmental changes have enormous effects especially on plants physiology and growth. These changes will have significant impact on the growth and survival of plants in the changing of future climates. Canopy plants especially epiphytes which live in the forest canopy play an important role to their surroundings. Thus, this study was conducted to evaluate the growth and physiological response of *Platynerium coronarium* and *Platynerium bifurcatum* towards light and water stress.

In light stress study, both species were grown under four treatments namely  $20 \mu\text{mol m}^{-2}\text{s}^{-1}$  (T1),  $70 \mu\text{mol m}^{-2}\text{s}^{-1}$  (T2),  $200 \mu\text{mol m}^{-2}\text{s}^{-1}$  (T3) and  $1500 \mu\text{mol m}^{-2}\text{s}^{-1}$  (T4). In water stress study, they were divided into five treatments which were watered once everyday (T1), watered to field capacity (T2), watered once in two weeks (T3), watered once in three weeks (T4) and not watered (T5). Growth responses were evaluated through the

leaf length measurement, leaf area, sporotrophophyll weight, cover leaves weight, total dry weight and total leaf water content. Physiological responses were quantified by leaf gas exchange, chlorophyll fluorescence and whole plant transpiration rate. All measurements were carried out weekly for twelve weeks. Two experiments were conducted to determine whether both species were CAM plants by determining their leaf acidity and carbon 13 isotope ( $\delta^{13}\text{C}$ ) ratio.

In light stress treatment, leaf length and leaf area of *P. coronarium*, was statistically different between treatments ( $p \leq 0.05$ ). However, T1 had the lowest value in all growth parameters. Lowest light intensity reduces growth for this species. For *P. bifurcatum*, total leaf length was significantly different between treatments ( $p \leq 0.05$ ). Higher light intensity treatment causes reduction in leaf length for this species. All leaf gas exchange parameters for *P. coronarium* were statistically different except for  $C_i$  ( $p \leq 0.05$ ). However, highest light intensity (T4) reduces the  $A_{net}$ ,  $D$  and  $WUE$  value. All treatments also had the value of  $F_v/F_m$  of healthy plant in the range from 0.82 to 0.84. *P. coronarium* were moderately affected in its physiological activity. For *P. bifurcatum*, significant differences were found for  $A_{net}$ ,  $E_L$  and  $WUE$  ( $p \leq 0.05$ ). Highest light intensity (T4) showed lowest value in  $A_{net}$ .  $F_v/F_m$  in T3 and T4 were below 0.8 indicating that there was a sign of stress. *P. bifurcatum* was affected under high light intensity. Both species had no higher accumulation of acids at dusk compared to early morning and  $\delta^{13}\text{C}$  showed both species are  $C_3$  plant thus suggesting that both species did not initiate CAM.

In water stress treatments, total leaf length and leaf water content of *P. coronarium*, were significantly different for all treatments ( $p \leq 0.05$ ). While for *P. bifurcatum*,

significant differences were found in total leaf length, leaf area and leaf water content ( $p \leq 0.05$ ). Higher water stress treatment (T5) reduced growth performance of both species.  $A_{net}$ ,  $g_s$ ,  $E_L$ ,  $D$  and  $WUE$  were significantly different in all treatments of *P. coronarium* ( $p \leq 0.05$ ). For *P. bifurcatum*, significant differences were found in  $A_{net}$ ,  $g_s$ ,  $E_L$  and  $D$  ( $p \leq 0.05$ ). T5 reduced  $A_{net}$ ,  $g_s$  and  $E_L$ , however its  $F_v/F_m$  value was above 0.8 in both species. Both species were moderately affected by water stress. Higher acid accumulation was observed in early morning compared to dusk samples and all treatments were found to have  $C_3$  photosynthesis for both species. Therefore this indicates that water stress did not alter physiological pathway for both species.

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

**TINDAKBALAS *Platyserium coronarium* (Koenig.) Desv. DAN *Platyserium bifurcatum* (Cav.) C. Chr. TERHADAP TEKANAN CAHAYA DAN AIR DALAM PERSEKITARAN TAPAK SEMAIAN**

Oleh

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Perubahan persekitaran mempunyai kesan yang besar terutamanya kepada fisiologi tumbuhan dan pertumbuhannya. Perubahan-perubahan ini akan memberikan implikasi terhadap pertumbuhan dan kelangsungan kemandirian hidup di dalam perubahan iklim di masa hadapan. Tanaman kanopi khususnya epifit yang hidup di kanopi hutan memegang peranan penting kepada persekitaran mereka. Oleh yang demikian, kajian ini dilakukan untuk menilai tindak balas pertumbuhan dan fisiologi dari *Platyserium coronarium* dan *Platyserium bifurcatum* terhadap tekanan cahaya dan air.

Dalam kajian tekanan cahaya, kedua-dua spesies ini ditanam di bawah empat rawatan yang berbeza iaitu  $20 \mu\text{mol m}^{-2}\text{s}^{-1}$  (T1),  $70 \mu\text{mol m}^{-2}\text{s}^{-1}$  (T2),  $200 \mu\text{mol m}^{-2}\text{s}^{-1}$  (T3) dan  $1500 \mu\text{mol m}^{-2}\text{s}^{-1}$  (T4). Dalam kajian tekanan air, mereka dibahagikan kepada lima

rawatan iaitu disiram setiap hari (T1), disiram dalam kapasiti lapangan (T2), disiram sekali dalam dua minggu (T3), disiram sekali dalam tiga minggu (T4) dan tidak disiram (T5). Tindakbalas pertumbuhan dinilai melalui pengukuran panjang daun, luas daun, berat sporotrophophyll, berat daun penutup, berat kering keseluruhan dan kadar keseluruhan air dalam daun. Tindak balas fisiologi di nilai dari segi pertukaran gas daun, pendafluoran klorofil dan kadar transpirasi keseluruhan pokok. Semua pengukuran dilakukan secara mingguan selama dua belas minggu. Untuk menilai samada spesies ini boleh megubah proses fisiologinya kepada “Crassulacean Acid Metabolism” (CAM) selepas dua belas minggu didalam rawatan tekanan, ada Dua ujikaji telah dijalankan untuk menilai samada kedua-dua spesies ini adalah tumbuhan jenis CAM melalui penentuan keasidan daun dan nisbah isotop carbon 13 ( $\delta^{13}C$ ).

Dalam kajian tekanan cahaya, panjang daun keseluruhan dan keseluruhan luas daun bagi *P. coronarium* menunjukkan perbezaan yang nyata antara rawatan-rawatan ( $p \leq 0.05$ ) Bagaimanapun, T1 menerima bacaan yang paling rendah bagi setiap parameter pertumbuhan. Pada keamatan cahaya rendah, ia mengurangkan pertumbuhan bagi spesies ini. Untuk *P. bifurcatum*, panjang daun keseluruhan menunjukkan perbezaan yang nyata antara rawatan-rawatan ( $p \leq 0.05$ ). Keamatan cahaya yang tinggi mengurangkan panjang daun keseluruhan bagi spesis ini. Semua parameter pertukaran gas daun bagi *P. coronarium* menunjukkan perbezaan yang nyata antara rawatan-rawatan kecuali  $C_i$  ( $p \leq 0.05$ ). Bagaimanapun, rawatan keamatan cahaya yang tertinggi (T4) merendahkan nilai  $A_{net}$ ,  $D$  dan  $WUE$ . Semua rawatan mempunyai nilai  $F_v/F_m$  didalam keadaan tumbuhan yang sihat di dalam nilai lingkungan 0.82 hingga 0.84. *P. coronarium* adalah sederhana terjejas di dalam aktiviti fisiologinya. Bagi *P.*

*bifurcatum*, perbezaan yang nyata di dapati pada  $A_{net}$ ,  $E_L$  dan WUE ( $p \leq 0.05$ ). Rawatan keamatan cahaya yang tertinggi (T4) menunjukkan nilai  $A_{net}$  terendah dengan  $1.797 \mu\text{m CO}_2 \text{ m}^{-2} \text{ s}^{-1}$ . Nilai  $F_v/F_m$  bagi T3 dan T4 di bawah 0.8 menunjukkan bahawa ada tanda tekanan berlaku. *P. bifurcatum* terjejas oleh keamatan cahaya yang tinggi. Kedua-dua spesies tiada pengumpulan asid yang lebih tinggi pada waktu senja berbanding pada awal pagi dan  $\delta^{13} \text{C}$  menunjukkan bahawa spesies ini adalah tumbuhan  $\text{C}_3$ . Ini menunjukkan kedua-dua species ini tidak menjalani CAM.

Dalam rawatan tekanan air, panjang keseluruhan daun dan kadar keseluruhan air daun bagi *P. coronarium* menunjukkan perbezaan yang nyata antara rawatan-rawatan ( $p \leq 0.05$ ). Manakala bagi *P. bifurcatum*, perbezaan yang nyata antara rawatan-rawatan di dapati pada panjang daun keseluruhan, luas daun dan kadar keseluruhan air ( $p \leq 0.05$ ). Tekanan air yang tinggi mengurangkan pertumbuhan bagi kedua-dua spesies.  $A_{net}$ ,  $g_s$ ,  $E_L$ ,  $D$  and  $WUE$  menunjukkan perbezaan yang nyata antara rawatan-rawatan bagi *P. coronarium* ( $p \leq 0.05$ ). Bagi *P. bifurcatum*, perbezaan yang nyata antara rawatan-rawatan di dapati pada  $A_{net}$ ,  $g_s$ ,  $E_L$  and  $D$  ( $p \leq 0.05$ ). T5 menyebabkan penurunan pada  $g_s$  dan  $A_{net}$  dan  $E_L$  namun, nilai  $F_v/F_m$  adalah di atas nilai 0.8 bagi kedua-dua spesies.. Kedua-dua spesies adalah sederhana terjejas oleh tekanan air. Pengumpulan asid yang tinggi dilihat pada awal pagi berbanding waktu senja dan semua kumpulan rawatan menjalani proses fotosintesis  $\text{C}_3$  bagi kedua-dua spesies. Oleh itu menunjukkan tekanan air tidak mengubah laluan fotosintesis bagi kedua-dua spesies.



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I certify that an Examination Committee has met on 3<sup>rd</sup> August 2011 to conduct the final examination of Ruzana Adibah Mohd Sanusi on her Master of Science thesis entitled "Responses of *Platyserium coronarium* (Koenig.) Desv. and *Platyserium bifurcatum* (Cav.) C. Chr. to Light and Water Stress in Nursery Environment" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the student be awarded the degree Master of Science.

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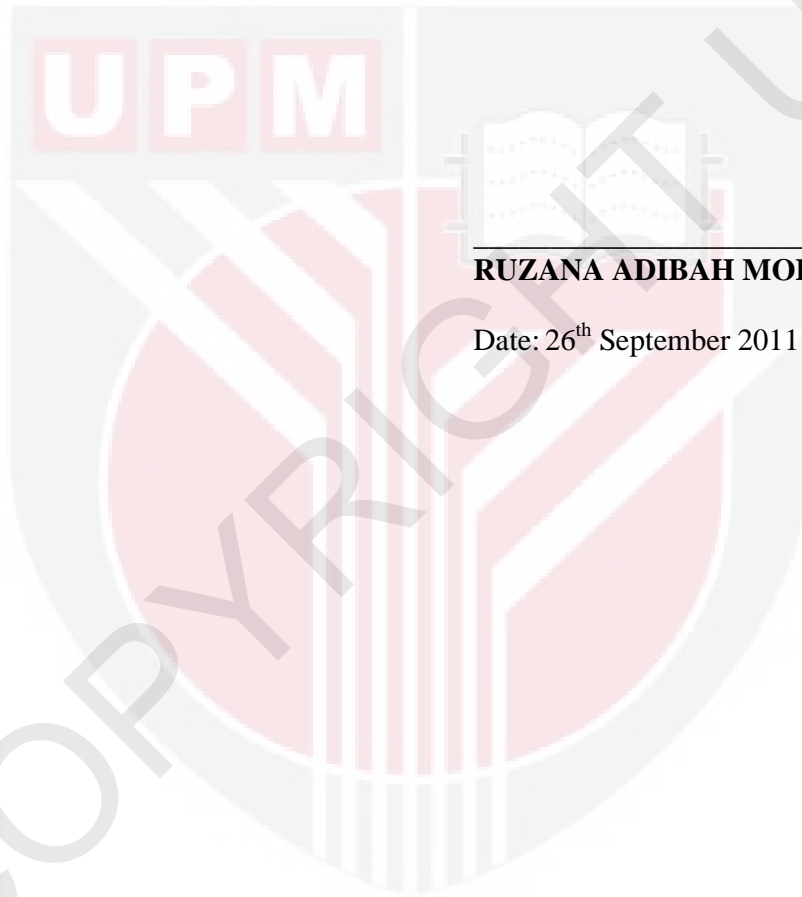
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## DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.



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**RUZANA ADIBAH MOHD SANUSI**

Date: 26<sup>th</sup> September 2011

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