



**UNIVERSITI PUTRA MALAYSIA**

**EFFECT OF PARTIAL ROOT DRYING ON YIELD AND FRUIT QUALITY  
OF MELONS (*CUCUMIS MELON. L. VAR. GLAMOUR*)**

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

**EFFECT OF PARTIAL ROOT DRYING ON YIELD AND FRUIT QUALITY OF MELONS (*CUCUMIS MELON*. L. VAR. GLAMOUR)**

By

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**February 2010**

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Growth, productivity and fruit quality of melons are closely linked to media water availability. Withholding of water for any length of time results in slowed growth. If drought continues yield may be lost. Melon plants can be manipulated to stimulate early defense mechanism by decreasing media water availability. By using an irrigation technique, which allows for separate zones with different media moisture status, it is possible to stimulate response mechanisms of the root system which are normally related to water stress. The difficulty of separating 'wet' and 'dry' zones was initially overcome by using split-root plant with root systems divided between two containers.

Such experiments on split-root model plant resulted in the development of an irrigation technique termed *partial root drying* (PRD).

The main objective of the study was to determine the effects of partial root drying (PRD) on the growth and physiological responses of melon plants. It was hypothesized that PRD-exposed plants would enhance their quality and water use efficiency. In this study, three experiments were conducted to meet the following objectives,

- 1) to investigate the effects of PRD interval and deficit irrigation (DI) on plant yield and quality.
- 2) to study the effects of different PRD irrigation and nutrient levels on growth, leaf gas exchange, macro and micro nutrients status of melons and
- 3) to examine the effects of PRD fertigation deficiency on growth and yield of plants.

In experiment one, melon plants were exposed to different PRD interval viz full irrigation (control), deficit irrigation (50% of full irrigation), PRD 2, 4, 6, 8 and 10 days interval. Results showed that deficit irrigation had the most reduction in yield when compared to PRD and fully irrigated treatments. When the shifting time in PRD treatments increased to 8 and 10 days, the fruit yield was significantly reduced compared to the control and PRD 2, 4, 6 days interval. Total number of flower in full irrigation treatments was significantly higher than PRD and DI plants. There was no significant difference in number of flowers between PRD 2, 4 and 6. Total soluble solids (TSS) of PRD 8 and 10 days interval was the highest among the PRD, DI and control treatments.

In the second experiment, melon plants were subjected to different irrigation and nutrient levels viz PRD 100%, 80%, 70% and 60% of full irrigation (FI), PRD 70% and 100% of full nutrients (FN). Results showed that there was a significant difference

between media volumetric moisture amounts of irrigation levels during experiment. There was no significant difference between RWC of different irrigation levels, although the RWC amount of PRD 80%, 70% and 60% of FI was numerically less than control plants. By reducing the amount of water, LAI value significantly declined in different levels of PRD irrigation treatments. Total leaf nitrogen (N) was significantly ( $p \leq 0.01$ ) declined in PRD 80%, 70% and 60% of FI, compared to control plants. However, there was no significant difference between PRD 70% and 60% of FI. There was a significant interaction between irrigation and nutrient levels on photosynthesis rates ( $P_n$ ). Stomata conductance value of FI was the highest and PRD 60% of FI were the lowest value compared to PRD 70% and 80% of FI.

There was a significant interaction between irrigation and nutrient levels on water use efficiency (WUE). There was a significant interaction between irrigation and nutrient levels on yield. The highest amount of TSS was observed in PRD 60% of FI.

In the third experiment, plants were exposed to PRD fertigation deficit viz: PRD 100% of FI (control), PRD 90%, 80%, 70% and 60% of FI. The treatments were arranged in RCBD and replicated four times. The results showed that there was a significant difference between the root to shoot ratio of PRD 100%, 90%, 80%, 70% and 60% of FI in 10, 20, 30 and 40 days after treatment. There was a significant relationship between NAR and  $P_n$  in PRD 80% and 100% of FI ( $p \leq 0.01$ ). The results also indicated that the fruit fresh weight of PRD 90%, 80%, 70% and 60% of FI were 5%, 4%, 10% and 18% less than control plants, respectively. In conclusion, PRD two days interval with 80 % of

FI and 100 % of FN could improve melon fruit quality with a little adverse effect on yield compared to control.



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

**KESAN PENGERINGAN SEPARA AKAR TERHADAP HASIL DAN KUALITI BUAH  
TANAMAN MELONS (*CUCUMIS MELON* L. VAR. GLAMOUR)**

Oleh

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**Februari 2010**

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Tumbesaran, produktiviti dan kualiti buah melon adalah berkait rapat dengan media ketersediaan air. Penahanan air pada bila-bila masa menghasilkan tumbesaran yang perlahan. Di samping itu, hasil akan berkurangan jika berlaku kemarau secara berterusan. Tanaman melon boleh dimanipulasi untuk merangsang mekanisme ketahanan awal melalui pemberhentian media ketersediaan air. Melalui penggunaan teknik pengairan yang membenarkan zon berasingan dengan media yang berstatus kelembapan berbeza-beza mungkin dapat merangsang mekanisme tindakbalas sistem pengakaran yang kerap berkait rapat dengan ketegasan air. Kesukaran mengasingkan zon 'basah' dan 'kering' di peringkat awal telah diatasi dengan menggunakan pengasingan akar tanaman melalui pembahagian sistem akar di antara dua bekas.

Seperti mana dalam kajian terhadap model pengasingan akar tanaman telah menunjukkan peningkatan terhadap teknik pengairan yang dikenali sebagai pengeringan separa akar (PRD).

Objektif utama dalam kajian ini adalah untuk menentukan kesan pengeringan separa akar (PRD) terhadap tumbesaran dan tindakbalas fisiologi tanaman melon. Hipotesis

kajian ini ialah tanaman yang mendapat PRD akan meningkatkan kualiti dan kecekapan penggunaan air. Dalam kajian ini, terdapat tiga eksperimen yang akan dijalankan bagi mencapai objektif berikut:

- 1) Untuk menyelidik kesan selang aplikasi PRD dan kekurangan pengairan (DI) terhadap hasil dan kualiti tanaman.
- 2) Untuk mengkaji kesan pengairan PRD yang berbeza-beza dan tahap fertigasi terhadap tumbesaran, pertukaran gas daun, status kandungan mikro dan makro nutrient dalam melon.
- 3) Untuk memeriksa kesan kekurangan fertigasi PRD terhadap tumbesaran dan hasil tanaman.

Dalam eksperimen pertama, tanaman melon didedahkan kepada beberapa selang aplikasi pengeringan separa akar (PRD) dengan pengairan penuh sebagai kawalan, pengurangan pengairan (50% pengairan penuh), selang aplikasi PRD sebanyak 2, 4, 6, 8 dan 10 hari. Keputusan menunjukkan bahawa kekurangan pengairan akan memberikan hasil yang paling rendah jika dibandingkan dengan rawatan PRD dan pengairan penuh. Apabila selang aplikasi ditingkatkan kepada 8 dan 10 hari, hasil tanaman buah menurun secara signifikan berbanding dengan tanaman kawalan dan selang aplikasi 2, 4 dan 6 hari secara PRD. Jumlah bilangan bunga dalam kajian pengairan penuh adalah lebih signifikan berbanding PRD dan tanaman DI. Manakala tiada perbezaan yang signifikan dalam bilangan bunga antara 2, 4 dan 6 hari secara

PRD. Jumlah pepejal terlarut (TSS) bagi selang aplikasi 8 dan 10 hari untuk PRD adalah yang paling tinggi di antara rawatan PRD, DI dan kawalan.

Dalam eksperimen kedua, tanaman melon telah dilibatkan kepada pengairan dan tahap nutrien yang berbeza-beza iaitu PRD 100%, 80%, 70% dan 60% dengan pengairan penuh (FI), PRD 70% dan 100% dengan nutrient penuh (FN). Keputusan menunjukkan bahawa terdapat perbezaan yang signifikan di antara jumlah isipadu kelembapan media pada tahap pengairan semasa eksperimen. Tiada terdapat perbezaan yang signifikan di antara tahap pengairan RWC yang berbeza-beza walaupun jumlah RWC pada PRD 80%, 70% dan 60% dari FI adalah kurang berbanding tanaman kawalan. Dengan mengurangkan jumlah air, nilai LAI berkurangan secara signifikan pada tahap pengairan PRD yang berbeza-beza. Jumlah nitrogen (N) dalam daun menurun secara signifikan ( $p \leq 0.01$ ) pada PRD 80%, 70% dan 60% FI berbanding tanaman kawalan. Walau bagaimanapun, tidak terdapat perbezaan signifikan di antara PRD 70% dan 60% FI. Terdapat interaksi signifikan antara pengairan dan kadar nutrient ke atas kadar fotosintesis ( $P_n$ ). Nilai pembukaan liang stomata dalam FI merupakan yang tertinggi dan PRD 60% FI adalah terendah jika dibandingkan dengan PRD 70% dan 80% FI.

Terdapat interaksi yang signifikan di antara pengairan dan kadar nutrient terhadap kecekapan penggunaan air (WUE). Terdapat interaksi signifikan antara pengairan dan kadar nutrient ke atas hasil. Jumlah TSS yang tertinggi telah dikenalpasti dalam PRD 60% FI.



Dalam eksperimen ketiga tanaman didedahkan kepada kekurangan fertigasi PRD iaitu PRD 100% FI sebagai kawalan, PRD 90%, 80%, 70% dan 60% FI. Reka bentuk kajian yang dijalankan adalah RCBD dan mengandungi empat kali ulangan. Keputusan menunjukkan terdapat perbezaan yang signifikan di antara nisbah nilai akar ke pucuk pada PRD 100%, 90%, 80%, 70%, dan 60% FI dalam 10, 20, 30 dan 40 hari selepas rawatan. Terdapat hubung kait yang signifikan di antara NAR dan Pn dalam PRD 80% dan 100% FI ( $p \leq 0.01$ ). Keputusan juga menunjukkan berat basah buah pada PRD 90%, 80%, 70% dan 60% bagi FI adalah berkurangan sebanyak 5%, 4%, 10% dan 18% berbanding tanaman kawalan.

Sebagai kesimpulan, rawatan PRD selang aplikasi selama dua hari dengan 80% FI dan 100% FN dapat meningkatkan kualiti buah melon dengan sedikit kesan kekurangan ke atas hasil berbanding dengan kawalan.

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I certify that a Thesis Examination Committee has met on (**4 February 2010**) to conduct the final examination of (Vahid Aldin Fatahian) on his thesis entitled "**Effect of partial root drying on yield and fruit quality of Melons (*Cucumis melon L., Var. Glamour*)**" 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 relevant degree.

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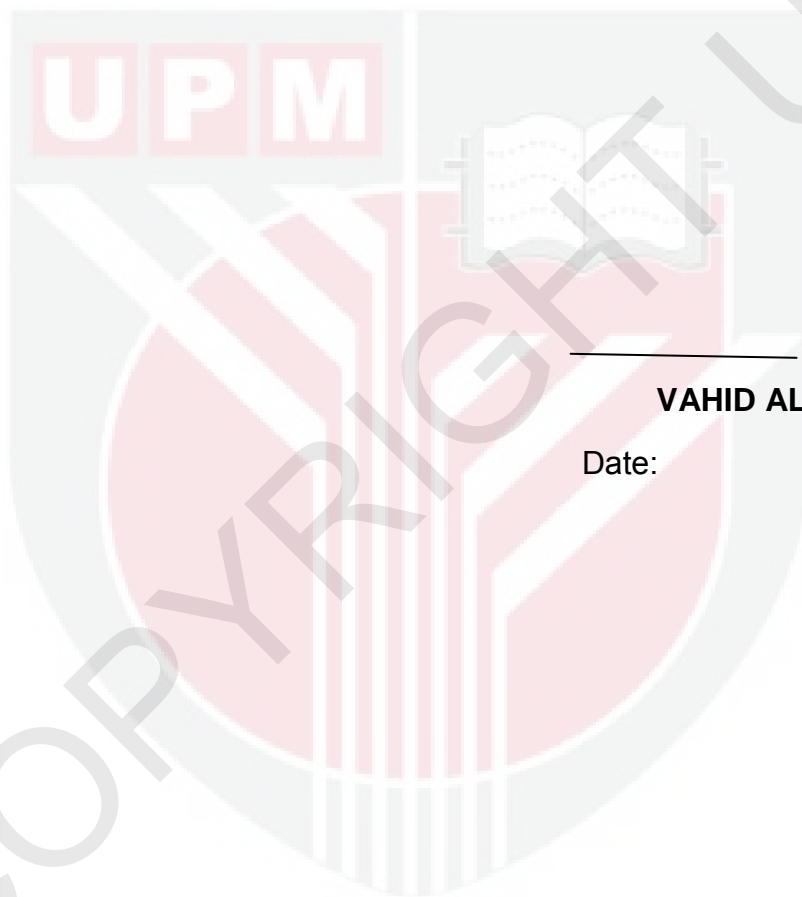
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## DECLARATION

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 Universiti Putra Malaysia or other institutions.



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