UNIVERSITI PUTRA MALAYSIA

COMBINING ABILITY, HERITABILITY, HETEROSIS, AND STABILITY ANALYSES OF WATERMELON HYBRIDS

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By

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

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Abstract of thesis presented to the senate of University Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

COMBINING ABILITY, HERITABILITY, HETEROSIS, AND STABILITY ANALYSES OF WATERMELON HYBRIDS

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Chairman: **Associate Professor Mohd Rafii bin Yusop, PhD**

Faculty: **Agriculture**

An evaluation on watermelon hybrids derived from a complete 4 x 4 diallel crosses were conducted at two locations, MARDI Bukit Tangga Research Station, Kedah and MARDI Seberang Perai Research Station, Penang with two planting seasons at each location. Objectives of the study were to identify the superior and highly stable F_1 watermelon hybrid for yield and fruit quality, to estimate the combining ability of inbred lines in a complete diallel cross, to determine the genetic control and heritability of important traits in the watermelon population and to quantify and determine the level of heterosis revealed by the F_1 hybrids. Results from evaluation across environments of the watermelon genotypes showed that inbred line CS-19 had longest vine length, thickest rind and heaviest fruit weight among all genotypes, whereas inbred line BL-14 was earliest in flowering and inbred CH-8 was best for the earliest in days to fruit maturity. Meanwhile hybrid CH-8 x CS-19 had the highest fruit yield per plant compared to other genotypes. Analysis of combining ability among the four watermelon inbred lines showed the presence of both additive and non-additive gene effects in each environment as well as across environments. However, the additive

gene effects are more important than non-additive gene effects since the mean squares for general combining ability (GCA) were greater than the mean squares for specific combining ability (SCA). Inbred line CS-19 was the best general combiner ability for vine length, fruit yield, fruit weight and number of fruits, while inbred line BL-14 was the best general combiner for days to flower and days to fruit maturity. Inbred line 6372-4 was best general combiner for flesh colour, while inbred line CH-8 was the best general combiner for total soluble solid contents. The hybrids that showed significant SCA effect were BL-14 x 6372-4 for rind thickness, fruit yield and fruit weight, CS-19 x CH-8 for days to flower, flesh colour and fruit weight; CS-19 x 6372-4 only for fruit weight and BL-14 x CH-8 only for flesh colour. The environment has a significant influence on the magnitude of correlation coefficients for some of the traits studied. In hybrid populations, fruit yield was highly correlated with vine length, rind thickness and fruit weight at all environments. In general, the hybrids exhibited low to moderate heterosis values for most of the traits. However none of the hybrids had heterosis over better-parent for days to flower, days to fruit maturity and flesh colour traits. Hybrid 6372-4 x BL-14 had moderate heterosis over mid and better-parent for fruit yield. The estimates of broad- and narrow-sense heritability values were generally low at each environment as well as across environments. Days to fruit maturity showed moderate broad-sense (30%) and narrow-sense heritability (33%) estimates compared to other traits. Through combined used of the five stability statistics, hybrid BL-14 x 6372-4 was identified to be highly stable for vine length, days to flower, days to fruit maturity, total soluble solids content and fruit yield, while hybrid CS-19 x 6372-4 was highly stable for fruit weight. These superior hybrids will be recommended for commercial cultivation after multi-location trials and large scale evaluations have been done in the future.

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

KEUPAYAAN BERGABUNG, KEBOLEHWARISAN, HETEROSIS, DAN ANALISIS KESTABILAN KE ATAS TEMBIKAI HIBRID

Oleh

BAHARI BIN MOHD MASARUDDIN

Mac 2012

Pengerusi: **Profesor Madya Mohd Rafii bin Yusop, PhD**

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Satu penilaian ke atas hibrid tembikai yang dihasilkan daripada kacukan diallel 4 x 4 lengkap dijalankan dalam dua musim penanaman di dua lokasi iaitu Stesen Penyelidikan MARDI Bukit Tangga dan Stesen Penyelidikan MARDI Seberang Prai. Objektif kajian ini adalah untuk mengenalpasti tembikai hibrid F_1 yang stabil serta berhasil dan berkualiti tinggi, menganggar keupayaan bergabung titisan tulen tersebut di dalam kacukan diallel lengkap untuk menentu pengawalan genetik dan kebolehwarisan bagi beberapa ciri yang penting dalam populasi tembikai tersebut dan untuk menggangarkan tahap heterosis dalam hibrid F_1. Hasil penilaian ke atas hibrid tembikai di pelbagai persekitaran menunjukkan titisan tulen CS-19 mempunyai jalar yang terpanjang, kulit yang paling tebal dan buah yang terberat berbanding di kalangan semua genotip. Manakala titisan tulen BL-14 memberikan bilangan hari berbunga yang terawal dan titisan tulen CH-8 pula menunjukkan bilangan hari buah matang yang tersingkat. Sementara itu hibrid CH-8 x CS-19 menghasilkan hasil buah per pokok yang tertinggi berbanding dengan genotip yang lain. Analisis keupayaan bergabung

dikalangan empat titisan tulen tembikai menunjukkan wujudnya kesan kedua-dua gen aditif dan bukan-aditif di setiap persekitaran dan juga merentasi persekitaran. Walaubagaimanapun kesan gen aditif adalah lebih penting berbandingan kesan gen bukan aditif berdasarkan min kuasadua untuk keupayaan bergabung am (GCA) adalah lebih besar berbanding mean kuasadua untuk keupayaan bergabung khusus (SCA). Titisan tulen CS-19 memberikan keupayaan am terbaik untuk panjang jalar, hasil buah, berat buah dan bilangan buah, manakala titisan tulen BL-14 untuk sifat bilangan hari berbunga dan bilangan hari buah matang. Sementara itu titisan tulen 6372-4 adalah terbaik untuk warna isi, dan titisan tulen CH-8 adalah keupayaan bergabung am terbaik untuk jumlah pepejal terlarut. Hibrid yang menunjukkan kesan SCA yang bererti adalah BL-14 x 6372-4 untuk hasil buah dan berat buah, CS-19 x CH-8 untuk bilangan hari berbunga, berat buah dan warna isi, manakala CS-19 x 6372-4 untuk berat buah dan BL-14 x CH-8 untuk warna isi. Persekitaran mengakibatkan pengaruh yang bererti ke atas magnitud pekali korelasi untuk sebahagian ciri yang dikaji. Di dalam populasi hibrid ini, hasil buah adalah sangat berkorelasi dengan panjang jalar, ketebalan kulit dan berat buah di semua persekitaran. Secara umumnya hibrid tersebut memberikan nilai heterosis yang rendah hingga sederhana bagi kebanyakan ciri-ciri tersebut. Sementara itu tiada hibrid yang mempunyai nilai heterosis berdasarkan nilai induk terbaik untuk bilangan hari berbunga betina, bilangan hari buah matang dan warna isi. Walaubagaimanapun didapati hibrid 6372-4 x BL-14 mempunyai nilai sederhana bagi heterosis berdasarkan purata dan induk terbaik untuk ciri hasil buah. Nilai kebolehwarisan luas dan sempit, secara umumnya adalah rendah di setiap persekitaran dan juga merentasi persekitaran. Ciri bilangan hari buah matang menunjukkan kebolehwarisan luas (30%) dan sempit (33%) yang sederhana berbanding dengan ciri-ciri yang lain. Menerusi penggunaan kombinasi lima kaedah statistik kestabilan, hibrid

BL-14 x 6372-4 dikenalpasti sangat stabil untuk panjang jalar, bilangan hari berbunga, bilangan hari buah matang, jumlah pepejal terlarut dan hasil buah, manakala hibrid CS-19 x 6372-4 pula untuk berat buah. Hibrid yang unggul ini adalah disyorkan untuk ditanam secara komersial setelah penilaian berskala besar dijalankan di masa akan datang.

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I certify that an Examination Committee has met on 12 March, 2012 to conduct the final examination of Bahari bin Mohd Masaruddin on his Master of Science thesis entitled "Combining Ability, Heritability, Heterosis and Stability of Watermelon Hybrids" in accordance with the Universities and University College Act 1971 and 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.

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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:

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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 University Putra Malaysia or at any other institution.

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BAHARI MOHD MASARUDIN

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