CONSTRUCTION OF RFLP AND AFLP GENETIC LINKAGE MAPS FOR OIL PALM (*ELAEIS GUINEENSIS* JACQ.) USING A DELI *DURA* X YANGAMBI *PISIFERA* CROSS

By

CHUA KIA LING

Thesis Submitted to the School of Graduate Studies, University Putra Malaysia, in Fulfillment of the Requirement for the Degree of Master Science

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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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Chairman: Professor Tan Soon Guan, PhD

Faculty: Science

Conventional oil palm improvement using traditional breeding is a slow and expensive process. If markers linked to a useful trait, such as yield, shell thickness and embryogenesis rate, can be identified, marker-assisted selection (MAS) can be carried out, which can reduce the time taken for conventional breeding. Generating a linkage map is the first step towards marker-assisted selection. In this study, two oil palm maps were generated based on 87 F_1 progeny of a controlled cross (Deli *dura* x Yangambi *pisifera*). A total of 106 RFLP markers and 171 AFLP markers were identified and scored. Of the 277 markers scored, 28 markers (10.1%) were deviated from expected Mendelian ratio ($p<0.05$). *Pseudo*-testcross strategy was used to generate two parental maps. The dura map consisted of 18 linkage groups and covered a total map distance of 584.1cM. The pisifera map resolved into 19 linkage groups and covered a total map distance of 1099.3cM. Of all the markers analyzed, 16.9% of the *dura* markers and 25.1% of the *pisifera*

markers remained unlinked. RFLP marker although difficult to develop, proved very useful because only a small fraction is deviated from the expected Mendelian ratio. Furthermore, about 80% of the RFLP markers can be mapped on both parental maps. More markers will be needed to reduce the number of linkage groups of both parental maps to the haploid chromosome number of oil palm (n=16). Five homologous regions between the *dura* and the *pisifera* maps were identified by comparing the co-dominant RFLP markers. The orders of the homologous markers were conserved and the overall distances were nearly the same in both varieties, although a small difference was observed in one homologous region on linkage group D3 and P5. This difference might be due to unequal recombinations that occurred at that particular region.

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

PENJANAAN PETA GENETIK BERDASARKAN RFLP DAN AFLP BAGI KELAPA SAWIT (*ELAEIS GUINEENSIS* JACQ.) DENGAN MENGGUNAKAN KACUKAN DELI *DURA* X YANGAMBI *PISIFERA*

Oleh

CHUA KIA LING

Februari 2006

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Pembaikan ciri-ciri penting kelapa sawit melalui kaedah pembiakbakaan konvensional adalah proses yang memakan masa dan mahal. Sekiranya penanda yang berkaitan dengan ciri-ciri penting seperti hasil yang tinggi, ketebalan tempurung buah dan kadar embriogenesis yang tinggi dapat dikenalpasti, maka pemilihan berasaskan penanda dapat dijalankan dan ini dapat menjimatkan masa yang diperlukan dalam pembiakbakaan konvensional. Langkah pertama ke arah merealisasikan penggunaan kaedah pemilihan berasaskan penanda adalanh melalui penghasilan peta genetik. Di dalam kajian ini, dua peta genetik kelapa sawit telah dihasilkan berdasarkan maklumat yang diperolehi daripada 87 progeni F_1 bagi kacukan terkawal *(*Deli *dura x* Yangambi *pisifera).* Sejumlah 106 penanda RFLP dan 171 penanda AFLP telah dikenalpasti. Daripada jumlah ini, 28 penanda (10.1%) didapati tersisih daripada nisbah Mendel ($p<0.05$). Untuk penghasilan peta genetik, strategi 'pseudo-testcross' telah digunakan. Peta dura terdiri daripada 18

lingkaran genetik dan meliputi jarak peta sebanyak 584.1cM. Manakala peta pisifera pula mengandungi 19 lingkaran genetik dan meliputi jarak peta sebanyak 1099.3cM. Berdasarkan semua penanda yang telah dianalisis, didapati sebanyak 16.9% penanda dura dan 25.1% penanda pisifera tidak dapat dipetakan. Walaupun penanda RFLP sukar untuk dibangunkan, namun ianya lebih berguna memandangkan hanya sebilangan kecil daripada penanda ini tersisih daripada nisbah Mendel. Tambahan pula, sejumlah 80% penanda RFLP telah berjaya dipetakan ke atas peta genetik. Untuk mengurangkan bilangan lingkaran genetik di atas peta genetik agar sejajar dengan bilangan kromosom haploid kelapa sawit (n=16), lebih banyak penanda diperlukan. Lima bahagian homologi antara peta dura dan pisifera telah dikenalpastikan dengan membuat perbandingan dengan menggunakan penanda-penanda RFLP yang bersifat co-dominant. Jujukan penanda di semua bahagian homologi adalah terpelihara dan jarak antara satu sama lagi juga terperlihara antara dua variety ini. Jujukan penanda antara linkaran D3 dan P5 telah didapati berbeza sedikit antara satu sama lain. Perbezaan ini mungkin disebabkan oleh ketidaksamaan rekombinasi yang telah berlaku di bahagian itu.

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I certify that an Examination Committee has met on 20.02.2006 to conduct the final examination of Chua Kia Ling on his Master thesis entitled "Construction of RFLP and AFLP Genetic Linkage Maps for Oil Palm (*Elaeis Guineensis* Jacq.) Using Deli *Dura* x Yangambi *Pisifera* Cross" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis 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 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.

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CHUA KIA LING

Date: 10th May 2006

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