UNIVERSITI PUTRA MALAYSIA

ASSOCIATION OF SNP MARKERS WITH HEIGHT INCREMENT IN TWO MPOB-ANGOLA OIL PALM POPULATIONS, MALAYSIA

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By

ONG PEI WEN

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the Degree of Master of Science

ASSOCIATION OF SNP MARKERS WITH HEIGHT INCREMENT IN TWO MPOB-ANGOLA OIL PALM POPULATIONS, MALAYSIA

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June 2012

Chairman : Nur Ashikin Psyquay Abdullah, PhD

Faculty : Faculty of Agriculture

Low height increment is a desired trait in oil palm (*Elaeis guineensis*) breeding. Palms with low height increment have the advantage of facilitating fruit harvesting and extending the economic life of the oil palm. The natural oil palm germplasm collected from Angola has high genetic variation in height increment and therefore invaluable for oil palm improvement and breeding programmes. Single nucleotide polymorphism (SNP) based cleaved amplified polymorphic sequence (CAPS) marker assay is simple and reliable for SNP detection. This approach has widely been used in plant genetics and breeding. In this marker-trait association study, a total of 219 palms from two MPOB Angola oil palm germplasm populations namely AGO01 and AGO08, were successfully genotyped with nine informative SNP markers. These markers include three random SNPs and six candidate gene SNPs which were converted into CAPS

marker. Molecular data revealed a high level of genetic diversity among the MPOB-Angola populations when compared with the advanced breeding population. The dendrogram constructed did not group the oil palm according to the populations and families. The palms included in the study could have originated from other provinces due to human migration during the civil war in Angola. AMOVA analysis indicated the main contribution to the total genetic variation was due to variation within populations (99%) and remaining 1% was explained by variation between populations. The population structure analysis indicated K = 2 which suggested that the samples was made up of two main genetic groups. Association analysis between SNP markers and height increment was analyzed with four different models in TASSEL software. The incorporation of population structure and kinship correction factors into the association models had reduced the number of significant markers detected. Marker SNPG00006_*Fat*I was found to be significantly associated with height increment trait for all the TASSEL models tested. The results from SAS analysis further supported the significant association of this marker (SNPG00006_*Fat*I) with height increment. This indicated the potential application of SNPs in identifying molecular markers associated with height increment and other traits in oil palm.

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

PERKAITAN PENANDA SNP DENGAN PENAMBAHAN KETINGGIAN DALAM DUA POPULASI KELAPA SAWIT MPOB-ANGOLA, MALAYSIA

Oleh

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Pengerusi : Nur Ashikin Psyquay Abdullah, PhD

Fakulti : Fakulti Pertanian

Kadar penambahan ketinggian yang rendah merupakan ciri yang diinginkan dalam pembiakbakaan kelapa sawit (*Elaeis guineensis* Jacq.). Pokok sawit yang mempunyai kadar penambahan ketinggian yang rendah memudahkan penuaian buah sawit dan memanjangkan hayat ekonomi pokok tersebut. Germplasma kelapa sawit semulajadi yang dikumpulkan dari Angola mempunyai variasi genetik yang tinggi dari segi penambahan ketinggian dan oleh kerana itu amat bernilai untuk program penambahbaikan dan pembiakbakaan kelapa sawit. Pengasaian penanda polimorfisme nukleotida tunggal (SNP) berasaskan jujukan polimorfisme teramplifikasi terpotong (CAPS) untuk pengesanan SNP adalah mudah dan boleh dipercayai. Kaedah ini telah digunakan secara meluas dalam bidang genetik dan pembiakbakaan tumbuhan. Dalam kajian perkaitan antara penanda SNP dan ciri kalapa sawit ini, sebanyak 219 pokok sawit dari dua populasi germplasma kelapa sawit MPOB-Angola iaitu AGO01 dan

AGO08 telah berjaya digenotipkan menggunakan sembilan penanda SNP yang informatif. Penanda ini merangkumi tiga SNPs rawak dan enam SNPs spesifik berdasarkan gen ketinggian tumbuhan yang telah ditukar menjadi penanda CAPS. Analisis ke atas data molekul menunjukkan tahap kepelbagaian genetik yang tinggi di kalangan populasi yang disaring dibandingkan dengan populasi biakbaka termaju. Dendrogram yang dibangunkan tidak mengelaskan kelapa sawit berdasarkan kepada populasi dan famili. Pokok sawit yang digunakan dalam kajian ini mungkin berasal daripada wilayah berlainan yang dipindahkan akibat dari penghijrahan manusia semasa peperangan sivil di Angola. Analisis AMOVA menunjukkan sumbangan utama kepada jumlah variasi genetik adalah dari variasi genetik di kalangan populasi (99%) manakala yang selebihnya adalah dari variasi antara populasi (1%). Analisis struktur populasi menunjukkan K = 2, mencadangkan bahawa sampel yang disaring terdiri daripada dua kumpulan genetik utama. Analisis perkaitan antara penanda SNP dengan ciri penambahan ketinggian dijalankan dengan menggunakan empat model yang berbeza dalam perisian TASSEL. Faktor pembetulan struktur populasi dan perhubungan kekeluargaan telah mengurangkan bilangan penanda yang signifikan. Penanda SNPG00006_*Fat*I menunjukkan perkaitan yang signifikan dengan penambahan ketinggian bagi kesemua model TASSEL yang diuji. Keputusan hasil kajian ini seterusnya disokong oleh analisis SAS yang juga menunjukkan perkaitan signifikan antara penanda tersebut (SNPG00006_*Fat*I) dengan ciri penambahan ketinggian. Ini menunjukkan penanda SNP berpotensi untuk diaplikasi dalam pengenalpastian penanda molekul yang berhubung kait dengan penambahan ketinggian dan ciri lain dalam kelapa sawit.

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I certify that a Thesis Examination Committee has met on 29 June 2012 to conduct the final examination of ONG PEI WEN on his thesis entitled "Association of SNP Markers with Height Increment in Two MPOB-Angola Oil Palm Populations, Malaysia" in accordance with her 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:

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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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Date: 13 September 2012

DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that is 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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ONG PEI WEN

Date: 29 June 2012

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