CHEMOMETRIC ANALYSIS OF OIL PALM (*Elaeis guineensis* Jacq.) GERMPLASM FROM SENEGAL AND GAMBIA

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AUTHOR DECLARATION

I hereby declare that the work in this dissertation is my own except for quotations and summaries which have been duly acknowledged.

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ABSTRAK

Anggaran kepelbagaian genetik dan menentukan hubungan antara koleksi adalah strategi yang penting untuk memastikan pengumpulan dan penggunaan germplasma yang cekap. Bahan germplasma sawit yang dikutip dari Senegal dan Gambia yang ditanam di Stesen Kluang MPOB telah dicirikan mengikut kepelbagaian genetik. Sebanyak 44 ciri - ciri agronomi germplasma sawit ini telah dinilai melalui statistik yang mudah untuk menilai kepelbagaian genetik; dan dua teknik kemometrik (PCA dan analisis Kluster) untuk mengenal pasti sifat - sifat yang menyumbang kepada perubahan keseluruhan dan mengklasifikasikan bahan-bahan itu berdasarkan persamaan. Keputusan profil kepelbagaian itu menunjukkan bahawa germplasma kelapa sawit Senegal dan Gambia mempunyai kebole hubahan yang rendah kepada tinggi untuk pelbagai ciri. Sembilan komponen utama dengan nilai eigen > 1 bersamaan dengan 88% daripada jumlah variasi dengan majoriti variasi itu dikuasai oleh PC1. Kebanyakan ciri-ciri, khususnya, BTS, ABW, BWT, MFW, P / B, M / F, OY, TEP, TDM, BDM, e, S / F, K / F, O / B dan K / B menyumbang kepada kepelbagaian di antara dan dalam germplasma, yang mana menunjukkan bahawa variasi yang luas wujud dalam bahan germplasma yang telah dikaji. Analisis kumpulan Ward adalah berdasarkan keputusan - keputusan PCA yang telah dikumpulkan untuk aksesi 42 minyak kelapa sawit kepada enam kelompok, dan kelompok-VI mempunyai bilangan tertinggi ahli. Tambahan pula, ia tiada kaitan antara kepelbagaian genetik dan asal geografi. Purata ciri-ciri agronomi setiap kelompok menunjukkan bahawa kelompok-III mempunyai nilai purata tertinggi pada sifat hasilnya. Selain itu, kumpulan - kumpulan kelompok yang mempunyai nilai purata yang tinggi bagi ciri-ciri yang diingini boleh dipilih untuk ciri-ciri setiap satu. Pengaksesan ini boleh digunakan untuk menghasilkan bahan-bahan kelapa sawit yang berhasil tinggi.

Kata kunci: Kelapa sawit, germplasma, kepelbagaian genetik, kimometrik, analisis komponen utama, analisis kelompok.

ABSTRACT

Estimation of genetic diversity and determination of the relationships between collections are useful strategies for ensuring efficient germplasm collection and utilization. Oil palm germplasm materials collected from Senegal and Gambia maintained at the MPOB Kluang Station were characterized for genetic diversity. A total of 44 agronomic traits of these oil palm materials were subjected to simple statistics to evaluate the genetic variability; and two chemometric techniques (PCA and Cluster analysis) to identify the characters contributing to the overall variation and classify the materials based on similarity. Results of the variability profile showed that the Senegal and Gambia oil palm germplasm exhibited low to high variability for the various traits. Nine principal components with eigenvalue >1 accounted for 88 % of the total variation with PC1 capturing majority of the variation. Most of the traits especially, FFB, ABW, BWT, MFW, P/B, M/F, OY, TEP, TDM, BDM, *e*, S/F, K/F, O/B and K/B contributed to divergence between and within the germplasm, indicating that wide variation exists in the germplasm materials studied. Ward's cluster analysis based on the PCA results grouped the 42 oil palm accessions into six clusters with cluster-VI having the highest number of members. Furthermore, there was no association between genetic diversity and geographical origin. Means of the agronomic traits of each cluster showed that cluster-III had the highest mean value of yield traits. Also, the cluster groups having high mean values for desired traits could be selected for the traits per se. These accessions could be used to produce high yielding oil palm materials.

Keywords: Oil palm, germplasm, genetic diversity, chemometrics, principal component analysis, cluster analysis.

ملخص البحث

تقدير التنوع الوراثي وتحديد العلاقات بين المجموعات هي استراتيجيات مفيدة لضمان جمع المادة الوراثية والاستفادة منها. تميزت مواد الأصول الوراثية لنخيل الزيت التي تم جمعها من السنغال وغامبيا من محطة MPOB Kluang في الحفاظ علي التنوع الجيني. وتعرض 44 من الصفات الزراعية لزيت النخيل لإحصاءات بسيطة لتقييم التباين الوراثي. وتقنيات تحليل المكون الرئيسي (PCA) والتحليل العنقودي (CA) للتعرف على الشخصيات المساهمة في الاختلاف الكلي وتصنيف المواد على أساس التشابه. وأظهرت نتائج تحليل المكون الرئيسي (PCA) أن الأصول الوراثية لنخيل الزيت من السنغال وغامبيا عرضت تفاوت كبير لمختلف الصفات. تسعة عناصر رئيسية مع القيمة الذاتية > 1 تمثل 88٪ من التباين الكلي وأغلب الاختلاف منPC1. ساهم معظم الصفات خاصة، MFW, BWT, ABW, FFB K / B وO / B, K / F, S / F, BDM, TDM, TE,P OY, M /, F P / B, إلى الاختلاف بين المادة الوراثية، مشيرا إلى أن تباين واسع موجود في مواد الأصول الوراثية المدروسة. التحليل العنقودي (CA) وارد بناء على نتائج تحليل المكون الرئيسي (PCA) حيث تم تقسيم 42 من نخيل الزيت الي ست مجموعات. كتلة 5 تميزت بوجود أكبر عدد من الأعضاء. وعلاوة على ذلك لم يكن هناك ارتباط بين التنوع الجيني والأصل الجغرافي. وأظهرت الصفات الزراعية أن الكتلة 3 تميزت بوجود أعلى قيمة لمتوسط العائد من الصفات أيضا. ويمكن استخدام هذه المجموعات لإنتاج زيت النخيل ذات بعوائد عالية.

الكلمات المفتاحية للبحث : الأصول الوراثية لزيت النخيل ،التنوع الجيني، chemometrics، تحليل المكون الرئيسي و التحليل العنقودي.

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ABBREVIATION

ABW	average bunch weight
BNO	bunch number
BWT	bunch weight
BDM	bunch dry matter
BI	bunch index
C12:0	lauric acid
C14:0	myristic acid
C16:0	palmitic acid
C16:1	palmitoleic acid
C18:0	stearic acid
C18:1	oleic acid
C18:2	linoleic acid
C18:3	linolenic acid
C20:0	arichidic acid
DIAM	diameter of trunk
e	radiation conversion efficiency
f	fractional interception of radiation
F/B	fruit/bunch
FFB	fresh fruit bunch
FP	frond production
GAM	Gambia
HT	height
IV	iodine value
K/B	kernel/bunch
K/F	kernel/fruit
KY	kernel yield
LA	leaf area

LAI	leaf area index
LL	leaflet length
LN	number of leaflet
LW	leaf width
MARDI	Malaysian agricultural research and development institute
M/F	mesocarp/fruit
MFW	mean fruit weight
MNW	mean nut weight
MPOB	Malaysian palm oil board
NAR	net area ratio
NIFOR	Nigerian institute for oil palm research
O/B	oil/bunch
O/DM	oil/dry mass
O/WM	oil/wet mass
OY	oil yield
P/B	parthenocarpic fruit/bunch
PCA	principal component analysis
PC(s)	principal component(s)
PCS	petiole cross section
PORIM	palm oil research institute of Malaysia
RL	rachis length
RRS	reciprocal recurrent selection
SEN	Senegal
S/F	shell/fruit
TEP	total economic product
TDM	total dry mass
UPGMA	unpair weighted group method using arithmetic averages
VDM	vegetative dry mass
WHCA	Ward's hierarchical clustering analysis