Available online at www.elixirpublishers.com (Elixir International Journal)

Agriculture

Elixir Agriculture 45 (2012) 7937-7939

ISSN: 2229-712X

Collection of Oil Palm (*Elaeis guineensis* Jacq.) Germplasm in the Central Region of Ghana

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ARTICLE INFO

Article history:

Received: 28 February 2012;

Received in revised form:

15 April 2012;

Accepted: 20 April 2012;

Keywords

Elaeis guineensis Jacq,

Germplasm,

Accessions,

Co-efficient of variation,

Breeding,

Extinction.

ABSTRACT

The need for intensive germplasm collection to broaden the genetic base of oil palm (*Elaeis guineensis* Jacq.) breeding to safeguard the vulnerability and the rate at which wild oil palm are becoming extinct as these wild oil palms are very imperative. The paper highlights oil palm accessions that were collected from the Central Region of Ghana. Thirty seven (37) accessions were collected from seven (7) locations in the Central Region. Data on stem height, bunch weight, bunch length, bunch breadth, bunch depth, stalk weight, weight of ten fruits, weight of ten nuts, mesocarp to fruit ratio, fruit length, fruit diameter, nut diameter, kernel diameter, shell thickness and other qualitative traits were examined. The mean, co-efficient of variation and range of the individual traits, were statistically analysed using standard procedures. Differences in the qualitative traits were recorded with most of the oil palm accessions having nigrescens fruits. The Tenera (T) type recorded the highest mesocarp to fruit ratio of 63.8%. These prospected germplasm accessions are being germinated and raised for future planting in the germplasm fields of the Council for Scientific and Industrial Research (C.S.I.R) - Oil Palm Research Institute (OPRI) to be introduced for breeding programmes.

Introduction

The oil palm (*Elaeis guineensis* Jacq.) has been projected to be the world's highest oil producing crop in 2020 (Wakker, 2000). It is common in almost all the political Regions of Ghana, especially the rainforest zone. In Ghana, besides the other regions, oil palm is endemic in the Eastern part. Oil palm (*Elaeis guineensis*) has three different forms including the Dura (D), Pisifera (P) and Tenera (T) distinguished on the basis of shell and mesocarp thickness (Muniran *et al.* 2008). The Tenera (T) form is a cross between the D×P and it is the commercially produced one which is normally supplied to farmers. In oil palm breeding, the D is the most imperative source of germplasm (Duke, 2007; Rajanaidu *et al.*1997) but only obtained from the wild. However as a result of felling of the oil palm trees through urbanization and tapping for palm wine in Ghana, has dwindle the oil palm germplasm (local accessions) base to almost a level of insignificance. Hence, the need for the Oil Palm Research Institute (OPRI), Ghana, to collect and conserve the oil palm genotypes Tenera (T) or Dura (D) as well as aid in assessing these germplasm to enhance the breeding research on oil palm in the country and also build up the capacity of exchanging germplasm with other interested countries.

Though germplasm are been collected from parts of Ghana, there has been the introduction of some of the oil palm types such as the Deli × Dura, *E. oleifera*, Angolan Dura, Pisifera and Dura forms from Costa Rica to broaden the germplasm base for improved breeding programmes. There is also the need to collect germplasm from parts of the country where there has not been any collection. This study will aid and reflect the phenotypic differences and similarities of the oil palms in the central region that have been collected to be conserved in the Oil Palm Research Institute (OPRI) fields.

Materials and methods

Area of study

The main area for the collection of the oil palm germplasm is in the coastal part of Ghana. Most of the locations were above sea level and the soil is slightly and mostly sandy, loamy but is highly heterogeneous. The vegetation is strictly forest zone. The sampling was dependant on the availability of the local or wild oil palms within every location. There were thirty seven (37) accessions collected from seven (7) locations. The areas in the Central region includes: Dunkwa on-Offin (Atakyem), Twifo Praso Ayiase, Twifo Praso Mensakrom, Mempasim Asokyeano Junction/barrier, Assin Kwaasa, Jukwa and Mfuom. The high lands were between 44-189 m above sea level.

Methodology

The sampling number for each location was neither more than seven (7) nor less than four (4). The sampling was done following the standard protocol of IBPGR (1987). The data was taken on the population density, location, population size, nature of stem, stem height and a fruit and bunch analysis was done on the fruit form, fruit colour, spine characteristics, bunch weight, bunch length, bunch depth, bunch breadth, stalk weight, weight of ten fruits, weight of ten nuts, mesocarp to fruit ratio, length of fruit, diameter of fruit, diameter of kernel and thickness of shell. The means, standard deviations, standard errors and co-efficient of variation (CV) were computed using standard statistical methods and presented in tables.

Results and Discussion

The results in Table 1 showed a wide range of qualitative trait differences occurring between the accessions that were collected from the seven areas in the Central region. The population density of the oil palms was mostly a mixture of dense, isolated and scattered for all the areas. There was no location where the population density followed one specific

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pattern of distribution. The nature of the stems of the oil palms that were collected was either smooth or rough. Only three localities namely Mempasim-Asokyeano Junction/barrier (MAJ/B), Jukwa (JK) and Mfuom (MF) had only oil palms with rough stem appearance as compared to the rest that were having different sampled oil palms with either smooth or rough stems existing in the same population. Okwuagwu *et al.* (2011) reported that, oil palms greater than 30 years of age normally have smooth stems. Therefore it is an indicator that oil palms in the named areas were below this age. Though there were Dura (D) and Tenera (T) oil palms in the different locations, the Dura (D) was predominant and this has been confirmed by Okwuagwu *et al.* (2011) who also recorded more of Dura (D) in the wild as compared to the Tenera (T) in Nigeria. Most of the fruit colours were nigrescens with only few virescens occurring in the areas. Most of the spines had similar characteristics for all the accessions that were collected. The results in table 2 showed the quantitative traits that were present for the entire oil palms collected in the various localities. The lowest stem height was recorded in the Assin Kwaase (AK) accessions and had the highest bunch weight because all the accessions collected from the area were Dura (D). The lowest shell thickness was found in MAJ/B and this was because it had Tenera (T) in the oil palms that were collected. The Tenera (T) types are known to have smaller shell thickness as compared to the Dura (D) type whiles the Pisifera as known is shell less. The highest mesocarp to fruit ratio (47%) was found in the oil palms that were collected from Twifo Praso Ayiase (TPA) though it had the highest (3.3mm) shell thickness. There was the need to assess the traits in the Dura (D) and Tenera (T) oil palm types that were collected. These results have been shown in tables 3 and 4. It was observed that the Tenera (T) types had a higher mean (2.9m) stem height than the Dura (D) contrary to what was reported by Okwuagwu *et al.* (2011) in Nigeria and this may be due to differences in locations, age and nutritional composition of the soil with the Tenera (T) recording a CV (59.19%) as compared to a CV (10.01%) for Dura (D). Almost all the quantitative traits found in the Dura (D) were below (10%) CV indicates that there are no significant differences among these accessions taking into consideration that particular parameter. The Dura (D) had the highest shell thickness and this is natural of them due to the nature of their shell as compared to the Tenera (T). In addition, the mean bunch weight of the Dura (D) proved the effect of the thick shell which normally is positively correlated to the weight which in turn causes a reduction in the (%M/F) ratio and was evident in the results as Dura (D) and Tenera (T) had a mean value of 38.65% and 63.8% respectively, an observation which has been confirmed by Breure and Corley (1992) and Okwuagwu *et al.* (2011).

Conclusion

The data that have been presented in the tables have the qualitative and quantitative traits of all the accessions that were collected in the Central Region from the seven locations. It is very evident that the Tenera (T) accessions are more diverse as compared to the Dura (D) taking into consideration the co-efficient of variation (CV) that was recorded for all the parameters. These accessions have been prepared for germination and further work need to be done to ascertain the differences at the genotypic level to confirm whether or not they are related.

Acknowledgement

The Authors thank Sumatra Biosciences for providing funds for the collection of the oil palm germplasm in collaboration with Council for Scientific and Industrial Research (CSIR)-Oil Palm Research Institute (OPRI) as well as the Director of CSIR-OPRI. We also want to thank all the Technicians at the Crop Improvement Division-OPRI who assisted in the collection of the oil palm germplasm.

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Table.1. Oil Palm Collection Sites and their Qualitative Traits

Location (CR)	Population size	Stem nature	Fruit form	Fruit colour	Spine characteristics
DOA	Dense/Scattered	Rough/smooth	D/T	NIG/VIR	Thin, Sparse, Short, Profuse, Numerous, Few, Slender, Stout.
TPA	Isolated/Scattered	Rough/smooth	D/T	NIG	Thin, Sparse, Short, Profuse, Numerous, Slender, Stout, Evenly Distributed, Few
TPM	Dense/Scattered	Rough/smooth	D/T	NIG	Thin, Sparse, Short, Profuse, Numerous, Slender, Stout, Evenly Distributed, Few
AK	Dense/Isolated	Rough/smooth	D	NIG/VIR	Thin, Sparse, Short, Profuse, Numerous, Slender, Stout, Evenly Distributed, Few
MAJ/B	Dense/Isolated	Rough	D	NIG	Thin, Sparse, Short, Profuse, Numerous, Slender, Stout, Evenly Distributed, Few
JK	Isolated/Dense	Rough	D	NIG	Thin, Sparse, Short, Profuse, Numerous, Slender, Stout, Evenly Distributed, Few
MF	Isolated/Scattered/Dense	Rough	D	NIG	Few, Short, Slender, Long, Profuse

*CR- Central Region, DOA- Dunkwa on-Offin (Atakyem), TPA- Twifo Praso Ayiase, TPM- Twifo Praso Mensakrom, AK-Assin Kwaasa, MAJ/B- Mempasim Asokyeano Junction/barrier, JK-, Jukwa, MF- Mfuom.

*D-Dura, T- Tenera

*NIG-Nigrescens, VIR-Virescens

Table.2. Oil Palm Collection Sites and their Quantitative traits

Location CR	SH (m)	BW (kg)	BL (cm)	BB (cm)	BD (cm)	STW (g)	WTF (g)	WTN (g)	M/F (%)	FL (cm)	FD (cm)	ND (cm)	KD (cm)	ST (mm)
DOA	3.6	13.0	42.9	41.2	26.1	1.2	65.7	35.6	44.9	3.1	1.8	1.3	0.9	2.1
TPA	3.8	10.5	37.8	34.6	24.6	1.4	65.0	34.1	47.0	2.8	2.0	1.6	1.1	3.3
TPM	1.9	5.7	32.0	26.3	19.1	0.6	60.7	34.9	42.0	3.1	1.8	1.5	1.3	2.5
AK	1.4	26.8	33.7	31.3	23.0	1.1	55.6	32.9	40.9	2.8	1.6	1.3	0.9	2.4
MAJ/B	2.6	7.5	31.3	29.4	20.7	0.7	51.7	34.5	33.3	2.9	1.7	1.5	1.0	2.0
JK	2.6	11.0	36.4	32.4	21.8	1.0	53.9	33.0	38.7	3.0	1.6	1.4	1.0	2.3
MF	1.7	8.2	32.4	27.6	20.9	0.7	67.4	39.5	41.5	3.0	1.9	1.6	1.1	2.8

*CR-Central Region, SH-Stem Height, BW- Bunch Weight, BL-Bunch Length, BB-Bunch Breadth, BD-Bunch Depth, STW-Stalk Weight, WTF-Weight of Ten Fruits, WTN-Weight of Ten Nuts, M/F (%)-Mesocarp to Fruit Ratio, LF- Fruit Length, DF- Fruit Diametre, DN-Nut Diametre, DK- Kernel Diametre, ST- Shell Thickness

*DOA- Dunkwa on-Offin (Atakyem), TPA- Twifo Praso Ayiase, TPM- Twifo Praso Mensakrom, AK- Assin Kwaasa, MAJ/B-Mempasim Asokye, JK- Jukwa and MF- Mfuom.

Table.3. Quantitative traits of Dura (D) fruit form

Traits	Range of Values	Mean	CV (%)
Stem Height (m)	0.5-5.3	2.00	10.01
Bunch Weight (kg)	4.0-34.0	8.97	11.87
Bunch Length (cm)	24.0-49.0	33.02	3.34
Bunch Length(cm)	18.0-54.5	29.63	4.18
Bunch Depth (cm)	16.5-34.0	21.30	3.54
Stalk Weight (g)	0.3-2.9	0.83	11.39
Fruit Weight (g)	33.7-108.1	57.46	5.30
Nut Weight (g)	22.1-67.5	35.04	5.33
Mesocarp to Fruit Ratio (%)	0.0-53.0	38.65	3.71
Shell (%)	9.50-44.90	22.40	35.50
Kernel (%)	4.30-15.60	8.35	29.34
Fruit Length (cm)	2.2-4.0	2.90	0.03
Fruit Dimetre (cm)	1.2-2.5	1.72	2.73
Nut Diameter (cm)	0.9-2.0	1.43	3.03
Kernel Diameter (cm)	0.7-1.7	1.04	3.49
Shell Thickness (mm)	1.0-5.0	2.40	5.78

Table.4. Quantitative traits of Tenera (T) fruit form

Traits	Range of values	Mean	CV (%)
Stem Height (m)	0.5-4.5	2.9	59.19
Bunch Weight (kg)	5.5-11.5	9.0	31.10
Bunch Length (cm)	31.0-43.0	39.3	14.47
Bunch Length (cm)	24.0-42.5	36.4	23.69
Bunch Depth (cm)	21.0-27.0	24.0	12.49
Stalk Weight (g)	0.4-1.4	1.0	41.56
Fruit Weight (g)	50.0-77.0	63.6	17.34
Nut Weight (g)	17.0-28.4	23.1	21.38
Mesocarp to Fruit Ratio (%)	60.3-66.0	63.8	4.18
Shell (%)	10.5-21.6	14.13	35.85
Kernel (%)	6.8-11.7	9.03	23.79
Fruit Length (cm)	2.5-3.5	3.2	14.32
Fruit Diametre (cm)	1.8-2.1	2.0	7.07
Nut Diametre (cm)	1.2-1.8	1.4	18.46
Kernel Diametre (cm)	0.9-1.5	1.1	23.38
Shell Thickness (mm)	1.0-2.0	1.7	28.64