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# Identification and evaluation of bunch components of Nigerian source oil palms (*Elaeis guineensis* Jacq.) from Hut Bay, Little Andaman Island, India

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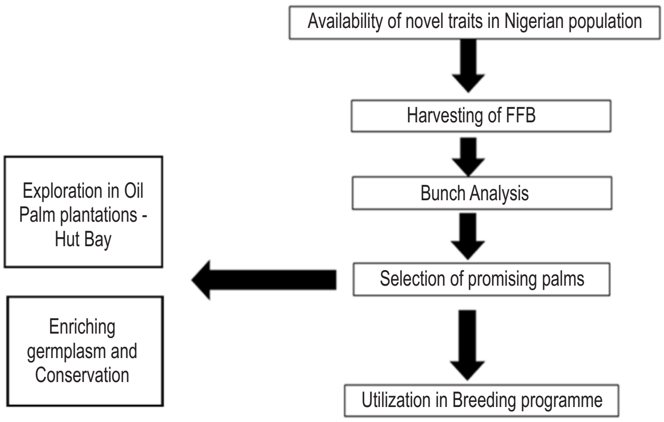
## Abstract

**Aim:** The present study was carried out with an aim to select promising individual oil palms from Nigerian source population at Hut Bay, Little Andaman Island for utilization in breeding programme, enrich germplasm assemblage and conservation in the field gene bank.

**Methodology:** The Nigerian source oil palm were subjected to fruit cut testing and evaluated for eleven bunch quality components of horticultural importance at Oil Palm Research Centre, Palode in Kerala.




**Results:** The maximum standard deviation was observed for total number of fruits followed by total number of spikelet and percentage of shell/fruit, whereas highest CV % was recorded for bunch weight followed by oil to bunch %, single fruit weight and single nut weight. The four identified palms had maximum values of bunch components viz, total number of spikelet, single fruit weight, total number of fruits, mesocarp tofruit and oil to bunch with 262, 15.79g, 2246, 73.79 % and 37.3 %, respectively. Principal Component Analysis of bunch components revealed that the first three principal components accounted for 79.1% of the variability observed with Eigen value more than one. The most important bunch components that contributed more to the diversity of the oil palms are fruit to bunch, single nut weight, single kernel weight, bunch weight, total number of spikelets, total number of fruits and shell thickness.

**Interpretation:** The significant genetic diversity observed among the individual palms of Nigerian source suggests that these palms are best donors of new genes for oil palm improvement as well as widening the genetic base.

**Key words:** Breeding programme, Bunch analysis, Little Andaman, Nigerian source, Oil palm

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## Introduction

Oil palm (*Elaeis guineensis* Jacq.) cultivation is expanding rapidly and is now the largest source of oils and fats in the world (Ong *et al*., 2020). This rapid development of oil palm industry in equatorial and adjoining regions of the tropics is mainly due to highest productivity and cheap cost of production of edible oil (Corley, 2009). Despite oil palm's inherent high productivity, its narrow genetic base is a barrier to the industry; because of stagnation and low fresh fruit bunch output (Zulkifli *et al.,* 2017). According to Rajanaidu *et al.* (2000), the deli duras which are descendants of four seedlings brought to Indonesia in 1848 is still utilized in the majority of the seed production centres of oil palm growing countries. This explains importance attached to breeding population of restricted origin (BPRO) and dependence on narrow genetic base. At the same time, there is an ever-growing need for genetic diversity which necessitates exploration from endemic and centres of origin (Rajanaidu *et al.,* 2013).

Little Andaman is famous for oil palm plantation which is spread across an area of 1593 hectares owned by Andaman and Nicobar Islands Forest and Plantation Development Corporation Limited (ANIFPDCL). The plantations established in Little Andaman consists exotic varieties introduced from Nigerian Institute for Oil Palm Research, Nigeria, Institut de Recherche pour Les Huiles et Oleagineux, France, Dami Oil Palm Research Station, Papua New Guinea, Harrison & Cross field, Malaysia, Federal Land Development Authority, Malaysia (Kumar, 2004). The highest allelic diversity was found among Nigerian palm populations, indicating the reflection of center of origin (Bakoumé *et al.,* 2015). Realising the importance of Nigerian materials, Malaysian Palm Oil Board had collected germplasm from Nigeria and released commercial varieties such as dwarf (PS1), high iodine value (PS2) and high kernel (PS3) (Rajanaidu *et al.,* 2000). High oleic acid breeding populations (PS12) were also obtained from the Nigerian germplasm (Isa *et al.,* 2006).

Oil palm growing countries including India are banking on exotic germplasm which are being either introduced or exchanged by all the major world oil palm breeding programmes. Oil Palms planted in Thodupuzha, Athirapilli and Kulathupuzha during 1960 to 1984 in Kerala by Plantation Corporation of Kerala Ltd. (subsequently taken over by Oil Palm India Ltd.). The efforts are in full swing to utilize exotic genetic resources planted in Kerala; whereas, the palms planted in the Little Andaman has received little attention with respect to collection, evaluation and conservation. As we aim to widen the genetic base, the Nigerian source population planted in the Little Andaman plantation is worth preposition for exploration and collection (Murugesan et al, 2020). Moreover, to exploit qualitative traits, study on bunch quality components is crucial to optimize the selection and further development of new hybrids. In the present study, identification of qualitative traits and bunch component evaluation of Nigerian source materials were carried out with an objective to assess the variability in individual palm(s).

## Materials and Methods

Exploration was undertaken in the Oil palm plantation (with different exotic sources of early introduced Oil palms) owned by Andaman Forest and Plantation Development Corporation Limited (ANIFPDCL) at Hut Bay, Little Andaman (situated between 10°30' to 10°54' North latitude and 92°21' to 92°37' East longitude) India during 2015-16 by targeting Nigerian source population, which were introduced from Nigerian Institute for Oil Palm Research (Latitude: 6°20' 21.0660'' N, Longitude 5° 37' 2.8092'' E and Altitude 88 M) and planted during 1975. During the exploration, a total of eleven individual palms with special qualitative traits were identified. The harvest and yield register maintained by management of ANIFPDCL was referred for confirming the identified traits. Moreover, these were identified with the help of experienced harvesters of Hut Bay estate and confirmed with harvest register maintained by Estate Manager.

The open pollinated fresh fruit bunches of eleven individual palms were evaluated for bunch components *viz.,* bunch weight, total number of spikelet, shell thickness, total No. of fruits, Oil/Dry mesocarp, Fruits/Bunch, Mesocarp/Fruits, Oil/Bunch and single fruit weight. Bunch analysis was done at ICAR-Indian Institute of Oil Palm Research, Regional Station Palode, Kerala, India by following the methodology of the NIFOR (Blaak *et al.,* 1963). The general qualitative characters of bunch and fruits of individual accessions were also recorded and documented in the passport data. The passport data has been prepared for 11 accessions and IC numbers were obtained from ICAR-National Bureau of Plant Genetic Resources. The data and mean values were reported after statistical analysis for the bunch components. The total variation of each characteristics was determined by calculating the average, minimum and maximum values, standard deviation and co-efficient of variation. Above data were subjected to Principal Component Analysis using SAS software hosted at ICAR-IASRI, New Delhi.

## Results and Discussion

The exploration undertaken in Little Andaman Islands-Oil palm plantation with different exotic sources yielded eleven individual palms of Nigerian source with desired qualitative traits which were assigned with Indigenous Collection (IC) numbers and Short Identification Numbers from ICAR- National Bureau of Plant Genetic Resources for germplasm cataloguing and conservation purposes. Collection Identification Numbers of identified palms were given based on harvest register maintained by ANIFPDCL for tracing palms for future study. In the present study, entire Oil palm plantations of Hut Bay were explored for unique qualitative traits and targeted Nigerian population. Two palms showed dwarf with small/medium fruits ( IC-0621172-P2 and IC-0621801-P11), another two had fruit bunches with low fruit shedding (IC-0621798-P8 and IC-0621799-P9) traits (long self-life) and rest one each had long spikelet thorn (IC-0621791-P1) (Fig. 1a), mantled fruit (IC-0621793-P3) (Fig. 1b), strong virescens fruit colour (IC-0621794-P4) (Fig. 1c), round shape


**Fig. 1:** Some qualitative traits of identified palms from Nigerian source of Hut Bay Oil palm plantations in Little Andamans.

bunches (IC-0621795-P5)(Fig.1d), dwarf stem (IC-0621996-P6) (Fig. 1e), lean unique tenera fruit (IC-0621797-P7) and short rachis (IC-0621800-P10). Fruit cut testing carried out revealed that all the palms are *tenera* except P 3 with mantled dura. According to, Corley and Tinker (2003), qualitative traits of heritable nature are preferred for germplasm collection during exploration and for practical purposes, individual palm selection is most suitable breeding approach in Oil palm in view of strong environmental influence on phenotypic characters in the family or population. Shape is one of the visual qualitative traits, primarily used for preliminary evaluation and characterisation of germplasm. There are three shapes available in case of fruit bunches namely heart, obovate and globular. The fruits also had varied shape from obovate, globular and obovoid (Corley and Tinker, 2003).

In the present study, unusual round shape bunch and lean fruits were observed in palm number 5 and palm number 7. Similarly, long spikelet thorn with blunt spine was recorded in

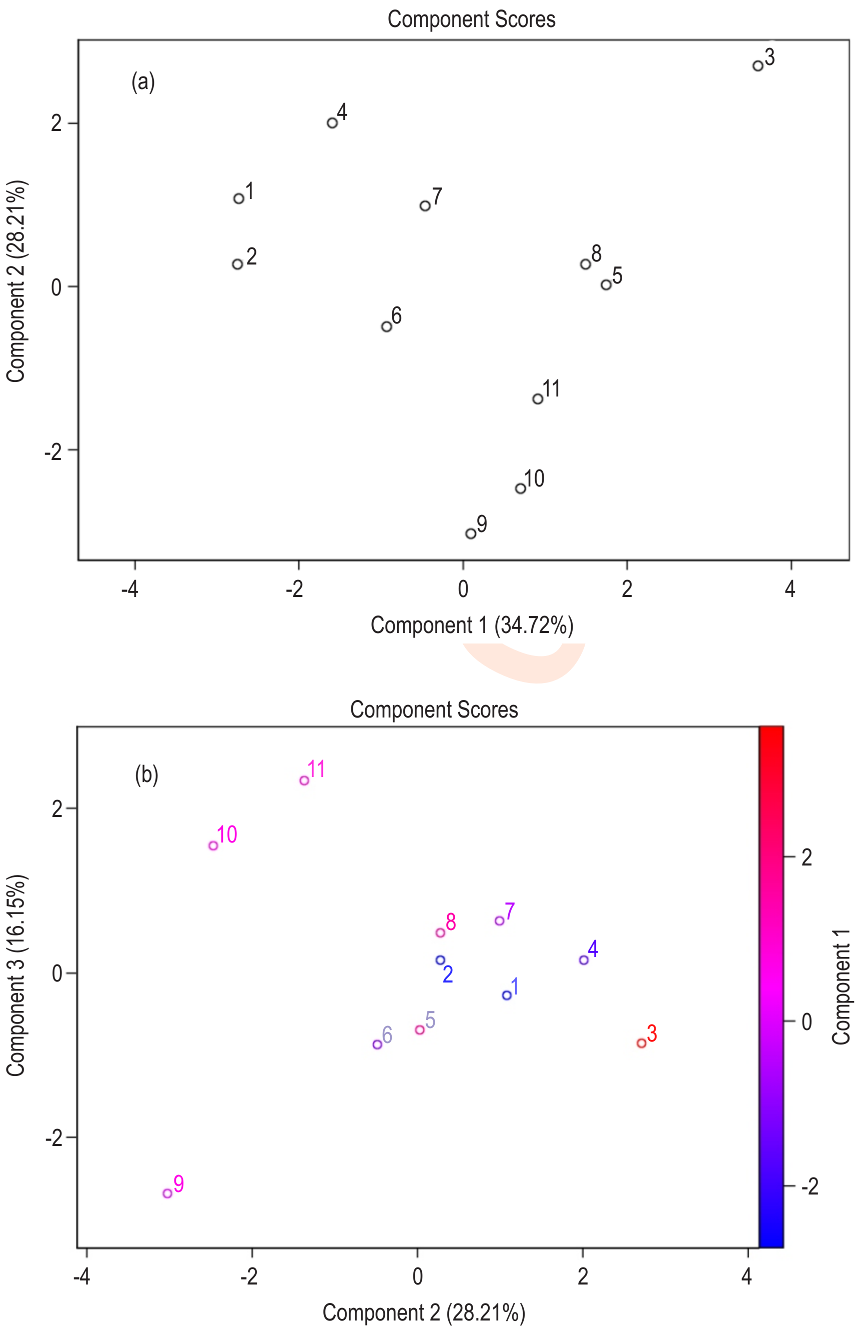


**Fig. 2:** (a) Two-dimensional scatter plot for the first two principal components and (b) Tri-plot of the first three principal components (Numbers 1-11 in the plot represent the individual palms of Nigerian source).

palm number 1. Hartley (1988) observed wide variation in spine length of spikelet of fruit bunches of original *tenera* population of Nigerian Institute of Oil Palm Research main station at Benin City. From utilisation point of view, the identified traits are relevant to crop improvement as they are used for characterisation, preliminary evaluation and initial screening. Yet other traits identified were dwarf palm (palm number 6) and short rachis (palm number 10). Dwarf palm with low stem height increment and other dumpy character such as short rachis had significant advantage of easy harvest by the farmers. Dumpy and dwarf palms are also useful for high density planting (Murugesan *et al.,* 2009). Namboothiri (1998) reported dwarf *tenera* in the year 1998 from 1981 planted *tenera* population at Palode. Generally, natural thinning takes place in most of the fruit crops where flowers and

**Table 1:** Bunch quality components of pre-selected individual palms of Nigerian source palms from resources planted in Little Andaman

| Collection ID/Statistics | BW (kg) | TNSP (No.) | ST (mm) | TNOF (No.) | O/DM (%) | F/B (%) | M/F (%) | O/B (%) | SFW (g) | SNW (g) | SKW (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PM/LA-VIII(BB): P1 | 11.38 | 262.00 | 1.02 | 1800.00 | 86.16 | 50.18 | 56.04 | 8.09 | 4.82 | 2.12 | 2.25 |
| PM/LA-VIII (98): P2 | 9.76 | 212.00 | 0.98 | 2940.00 | 78.08 | 60.96 | 69.31 | 9.24 | 4.96 | 1.52 | 2.14 |
| PM/LA-II (75-76): P3 | 9.00 | 149.00 | 2.44 | 662.00 | 81.87 | 62.89 | 63.59 | 15.12 | 15.79 | 5.75 | 3.78 |
| PM/LA-X (1496): P4 | 10.36 | 242.00 | 1.42 | 2246.00 | 83.65 | 69.11 | 63.43 | 10.65 | 7.15 | 2.61 | 2.89 |
| PM/LA-VIII (1079): P5 | 7.06 | 175.00 | 1.39 | 670.00 | 81.87 | 50.44 | 57.96 | 22.81 | 9.05 | 3.80 | 4.71 |
| PM/LA-VIII (NFT): P6 | 9.83 | 195.00 | 0.95 | 1590.00 | 80.33 | 42.32 | 59.17 | 14.90 | 5.80 | 2.37 | 3.58 |
| PM/LA-IX: P7 | 8.26 | 205.00 | 1.33 | 945.00 | 82.60 | 58.84 | 68.33 | 9.53 | 9.08 | 2.88 | 1.82 |
| PM/LA- VIII: P8 | 5.30 | 170.00 | 1.01 | 1380.00 | 83.98 | 56.60 | 64.71 | 25.20 | 11.18 | 3.95 | 4.17 |
| PM/LA- V (630): P9 | 3.74 | 180.00 | 1.23 | 1476.00 | 74.41 | 38.50 | 31.94 | 28.25 | 4.45 | 3.03 | 2.85 |
| PM/LA-VIII-(1099): P10 | 2.52 | 163.00 | 1.35 | 278.00 | 80.88 | 41.27 | 73.79 | 31.94 | 5.78 | 1.92 | 1.98 |
| PM/LA-VIII-(406): P11 | 3.12 | 148.00 | 0.94 | 1162.00 | 82.73 | 64.17 | 73.75 | 37.30 | 7.31 | 1.51 | 3.10 |
| Maximum | 11.38 | 262.00 | 2.44 | 2946.00 | 86.16 | 69.11 | 73.79 | 37.30 | 15.79 | 5.75 | 4.71 |
| Minimum | 2.52 | 148.00 | 0.94 | 278.00 | 74.41 | 38.50 | 31.94 | 8.09 | 4.45 | 1.51 | 1.82 |
| Std. Dev | 3.15 | 36.76 | 0.43 | 767.07 | 3.15 | 10.27 | 11.60 | 10.22 | 3.40 | 1.26 | 0.95 |
| Mean | 7.30 | 191.00 | 1.28 | 1377.00 | 81.50 | 54.12 | 62.00 | 19.37 | 7.76 | 2.86 | 3.03 |
| CV (%) | 43.16 | 0.19 | 0.34 | 0.26 | 0.04 | 0.19 | 0.19 | 0.53 | 0.44 | 0.44 | 0.31 |

BW: Bunch weight, TNSP: Total number of spikelet, ST: Shell thickness, TNOF: Total number. of fruits, O/DM: Oil/Dry mesocarp, F/B: Fruits/bunch, M/F: Mesocarp/fruits, O/B: Oil/Bunch, SFW: Single fruit weight; SNW: Single nut weight, SKW: Single kernel weight

immature fruitlets falls due to abscission influenced by nutritional status. (Osborne *et al.,* 1992) whereas, in Oil palm instead of immature flowers, ripe fruits are shed and become loose fruits which causes direct economic loss in the plantations. (Roongsathan *et al.,* 2012). The detached fallen and bruised fruits also showed increase free fatty acids. In the present study, team could locate two palms showing long fruit shelf life *viz.,* palm number 8 and palm number 9. A palm namely, mantled fruit dura (palm number 3) is economically important trait and possible donor as female parent in breeding cycle unlike other fruit forms of *pisifera* and *teneras*. Mantled fruit is governed by dominant gene and mostly occurs due to mutations. Mantled self and Mantled X ordinary palm cross resulted in 100% and 50% mantled palms progenies, respectively. This trait is desirable as more mesocarp to bunch is expected from such fruit bunches. Moreover, bunch with mantled fruits shows delayed abscission and low rate of loose fruits shedding which are important economic traits for Oil palm industry. (Zeven, 1973 and Hartley, 1988).

Next important trait is virescens colour fruit bunch observed in palm number 4 which is one of the notable identifications from Nigerian source. Palms with virescens fruit bunches can be harvested easily in view of very bright orange colour during maturity unlike other bunch characters such as short and thick stalks (Le Guen *et al.,* 1990). Due to ease of determining matured fruits as well as higher oil quality, virescens Oil palm type is recommended to be included in modern breeding programme. (Siregar *et al.,* 2020). The frequency of presence of virescens in Nigerian source is a notable observation which is believed to be due to the inheritance Calabar duras, 551.341 and 551.375 which were predominantly utilized for Nigerian *tenera* materials production. Human selection for attractive orange colour paved the way for persistence of palms with virescens fruit (Zeven, 1972) as in the case of present selection. It is indented to study genetic variability of the palms with above described traits to carry forward superior palms before going for hybridsation. Bunch analysis is one of the important aspects for oil palm selection and conventional breeding (Corley, 2018) and bunch analysis data is also used for studying the variability of bunch components (Okoye *et al.,* 2009). Genetic diversity in bunch components helps to introgress novel genes, widen the scope of selection and enhance quantitative character (Arolu *et al.,* 2017). Individual or palm population is selected based on bunch quality components (Murugesan *et al.,* 2011 and Murugesan and Shareef, 2014). According to Hartley (1988), selection for the more bunch quality components such as mesocarp to fruit and kernel to fruit may be more effective to improve the overall potential of the palms.

The bunch analysis of palms revealed that the maximum standard deviation for total number of fruits was followed by total number of spikelets and percentage of shell/fruit. A change in kernel size, if the shell thickness (in mm) remains the same, will have a greater relative effect on shell/fruit in tenera palms. The identified palms recorded mean values of 7.3, 191, 1.28, 2940, 81.5, 54.12, 62, 19.37,7.76, 2.86 and 3.03 for bunch complements *viz.,* BW, TNSP, ST, TNOF, O/DM, F/B, M/F, O/B, SFW, SNW and SKW, respectively. The range of minimum to maximum recorded for the above parameters are 2.52 to 11.38, 148 to 262, 0.94 to 2.44, 278 to 2946, 74.41 to 86.16, 38.50 to 69.11, 31.94 to 73.79, 8.09 to 37.30, 4.45 to 15.79, 1.51 to 5.75 and 1.82 to 4.71, respectively (Table 1). The Bunch weight and other components of Nigerian source materials reflect the performance of matured palms (planted during 1975 and age > 41

**Table 2:** Eigen vectors of principal component axes from PCA for the bunch traits of pre-selected individual palms of Nigerian source genetic resources planted in Little Andaman

| | Component | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | PC1 | PC2 | PC3 | PC4 | PC5 | PC6 | PC7 | PC8 | PC9 | PC10 | Pc11 |
| Character | Eigenvectors | | | | | | | | | | |
| Bunch weight | -0.253 | **0.443** | -0.209 | 0.023 | -0.101 | -0.359 | 0.192 | -0.072 | **-0.607** | 0.188 | 0.334 |
| Total number of spikelet | 0.011 | **0.400** | 0.326 | 0.093 | **0.523** | **0.433** | 0.120 | **-0.489** | -0.087 | -0.044 | -0.008 |
| Shell thickness | 0.028 | 0.158 | **0.672** | -0.110 | 0.076 | **-0.536** | 0.075 | 0.134 | 0.307 | -0.114 | 0.296 |
| Total No. of fruits | 0.273 | **-0.417** | 0.217 | 0.198 | 0.072 | 0.312 | 0.277 | 0.278 | -0.258 | 0.292 | **0.507** |
| Oil/Dry mesocarp | -0.004 | 0.338 | 0.390 | 0.272 | **-0.571** | 0.310 | -0.018 | 0.305 | -0.205 | -0.196 | -0.251 |
| Fruits/Bunch | **0.401** | 0.335 | 0.025 | -0.032 | 0.068 | -0.040 | **-0.445** | 0.152 | 0.063 | **0.690** | -0.131 |
| Mesocarp/Fruits | 0.317 | 0.088 | -0.203 | **0.720** | -0.012 | -0.276 | 0.388 | -0.127 | 0.260 | 0.025 | -0.146 |
| Oil/Bunch | 0.384 | 0.278 | -0.311 | 0.053 | 0.007 | 0.126 | -0.350 | 0.091 | 0.093 | **-0.492** | **0.528** |
| Single fruit weight | 0.323 | 0.274 | -0.182 | **-0.522** | 0.050 | 0.109 | **0.610** | 0.303 | 0.084 | -0.050 | -0.169 |
| Single nut weight | **-0.396** | 0.120 | -0.114 | 0.265 | **0.546** | 0.020 | -0.062 | **0.654** | 0.023 | -0.070 | -0.104 |
| Single kernel weight | **-0.437** | 0.209 | -0.123 | 0.018 | -0.270 | 0.313 | 0.141 | -0.033 | 0.578 | 0.315 | 0.353 |
| Eigen value (root) | 3.819 | 3.103 | 1.776 | 0.904 | 0.825 | 0.338 | 0.145 | 0.056 | 0.033 | 0.000 | 0.000 |
| Difference (Eigen value) | 0.716 | 1.327 | 0.872 | 0.079 | 0.486 | 0.194 | 0.089 | 0.023 | 0.032 | 0.000 | |
| Explained variation (%) | 0.347 | 0.282 | 0.162 | 0.082 | 0.075 | 0.031 | 0.013 | 0.005 | 0.003 | 0.000 | 0.000 |
| Cumulative explained variation (%) | 0.347 | 0.629 | 0.791 | 0.873 | 0.948 | 0.979 | 0.992 | 0.997 | 1.000 | 1.000 | 1.000 |

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years) under Little Andaman condition. It confirms with the general report of decline of bunch weight of matured palms after surpassing economic viable age of 25-30 years. The usual range for F/B is between 60 and 65%, but ratios below 60% are not uncommon. There is no doubt that the efficiency of pollination, an environmental factor, plays a significant part in determining fruit to bunch. High oil to bunch is one of the important selection criteria for *tenera* palms.

There was considerable variation in Oil to bunch, both between families and among individual palms. Dumortier *et al.* (1992) found family mean oil to bunch for *teneras* ranging from 14.2 to 26.8%. In a breeding trial in Malaysia, Rajanaidu *et al.* (2000) found O/B ranging from 4.2% to 38.2%. Comparatively high genetic diversity of populations from Nigeria (evidenced by high values for He and average number of alleles) also indicates significance of centre of diversity of oil palm (Zulkifli *et al.,* 2012). The results of total number of fruits, single fruit weight, single nut weight and single kernel weight reflected usual bunch characteristics of Nigerian source base breeding populations. Similarly, performance on Mesocarp/Fruits, oil to bunch and bunch weight showed the inherent characteristics of Nigerian materials which might have undergone less cycle of recurrent selection in the beginning of breeding programme. Similar results was reported for bunch components of Nigerian material and their progenies by Okoye *et al.* (2009) in introgressed Oil palm. In the present study, all the reported bunch components recorded low values of % coefficient of variation except bunch weight (43.16).

Among eleven accessions, P1 had highest Bunch weight (11.38 Kg) followed by P4 (10.36). The former also had long spikelet spine (Fig. 2a) and later had deep orange colour fruit (virescens). The palms *viz.,* P11, P6 and P2 recorded 0.94, 0.95 and 0.98 mm of shell thickness, respectively (Table 1). Mantled fruit accession (IC-0621793) (P3) had moderate bunch weight (9 kg), total number of spikelet (149), Fruits/Bunch (62.89), Mesocarp/Fruits (63.59) and Oil to bunch (15.12). Mesocarp content of the fruit is a major factor that can influence oil yield in bunch as 95% of palm oil is available only in this fruit structure (Corley, 2003). Consequently, preference would be given for selecting high mesocarp to fruit, considering the requirements of palm oil (Okoye *et al.,* 2009 and Henderson *et al.,* 2015). It is to be noted that P3 (mantled fruit) had 2.44 mm of shell thickness with maximum values for Single fruit weight, SNW and SKW (15.79 g, 5.75 g and 3.78g) with satisfactory oil to Bunch ratio of 15.12%. Similarly, P5 (round fruit bunch) also showed maximum SNW of 4.71 g. The very important bunch components which decides oil yield of individual palm *viz,* mesocarp to fruit and oil to bunch were high in P11 and P10, respectively; notably former also had lowest shell thickness of 0.94 mm.

The total number of fruits (2246) and Fruits/Bunch (69.11) were highest in P4 (strong viresens). Further, P1, P3, P4, P10 and P11 observed maximum values *viz.,* total number of spikelets, single fruit weight, total number of fruits, mesocarp to fruit and oil to bunch with 262, 15.79 g, 2246, 73.79% and 37.3%, respectively. Among above, P11 can be placed top in the list as it showed best performance for shell thickness (0.94 mm), Mesocarp/Fruits (73.79%), oil to bunch (37.30%) and single nut weight (1.51 g). (Table 1). Principal component analysis is mostly used to accomplish the task of pattern recognition or data reduction for multivariate data. Recently Singh *et al.* (2020) studied chilly germplasm and PCA was utilised to determine genetic variation. Principal component analysis was carried out to study correlations among the bunch traits and also to determine the characters more strongly contribute to the principal components. For each factor, a principal component loading of more than 0.40 was considered as being significant that indicated five components explaining 95% of the total variance and nine components explaining all the 100% variance (Table 2). Principal component 1 explained 34.7% of the variation between individuals while principal component 2 explained 28.2% of the variation among 11 palm entries. Therefore, the findings of the oil palm genotype grouping after PCA were mainly based on the first three PCs, which accounted for 79.1% of the variability observed with Eigen value more than one. Principal components 4 to 9 collectively explained only 20.9% of the variation with Eigen values <1 and have not been interpreted.

The most important variables integrated with strong correlation by PC1 were Fruits/Bunch, SNW and SKW. In the second component (PC2), bunch weight, total number of spikelet and total Number of fruits were the most significant variables whereas, PC3 representing 16.2% of the total variance was influenced only by shell thickness (Table 2). Balakrishna *et al.* (2017), Khadivi-Khub *et al.* (2015), Khadivi-Khub (2014), Khadivi-Khub and Anjam (2014) observed that fruit characters were important factors in differentiating and analyzing breeding materials dealing with the morphological characterization of oil palm, pomegranate, Persian walnut and *Prunus scoparia,* respectively. PCA bi-plot prepared based on PC1 and PC2 showed phenotypic variation among the pre-selected oil palm from Nigerian germplasm (Fig. 2a). Mantled fruit of palm number 3 was adjudged as most distinct from others when 11 palm bunch data were distributed into four sides of the bi-plot. Also, a tri-plot prepared according to PC1, PC2 and Pc3 reflected relationship among the genotypes in terms of phenotypic resemblance. The results of tri-plot supported the results of bi-plot and the genotypes were distributed in the side of the plot (Fig. 2b). Principal components analysis results revealed high amount of variability among different pre-selected oil palms of Nigerian genetic resources, according to different bunch characteristics. Similar observations were reported by Li-Hammeda *et al.* (2016) in Nigerian oil palm germplasm materials collection at Malaysian Palm Oil Board. Sapey *et al.* (2017) and Martinez *et al.* (2012) used PCA analysis to study the oil palm and pomegranate genotypes, respectively, and found considerable phenotypic diversity.

The most important traits that contributed more to the diversity of the pre-selected oil palms were Fruits/Bunch, single nut weight, single kernel weight, bunch weight, total number of spikelet, total Number of fruits and shell thickness (Table 2). Selections for the characters which had large positive significance such as Fruits/Bunch, bunch weight, total number of spikelet and shell thickness on the first three extracted PCs could possibly enhance oil palm improvement and can be utilized for hybridization between accessions having higher means for the desired traits. As, palm numbers, *viz.* 3 and 11 placed for away in two-dimensional and tri-dimensional scatter plots, respectively; confirms status of genetic variability as per PCA (Fig. 2). Many reports discussed above confirmed the desirable utilities and importance of Nigerian germplasm materials in view of variability in bunch quality performance and unique traits (Yue *et al.*, 2021). Representative palms of Nigerian source showed high variability for eleven components of bunch quality used in this study.

The significant genetic diversity observed among the individual palms of Nigerian source suggest that these palms are good source of new genes for introgression into improvement programme as well as widening the genetic base. Out of eleven palms, four individual palms have maximum values for desirable bunch components which are reported to contribute for high palm oil yield. The selected four palms namely, P1, P3, P4, P10 and P11 are potential genetic stocks of Nigerian population to be utilised for breeding programme. However, further confirmative study is required for influence of different qualitative traits on oil yield and other performance of progenies derived from selected genetic stocks.

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## Add-on Information

**Authors' contribution: P. Murugesan:** Conceptualization of research, design the experiment, experimental materials, data collection, interpretation and preparation of manuscript; **D. Ramajayam:** Statistical analysis, data interpretation and preparation of manuscript; **P. Preethi:** Manuscript prepared; **G. Ravichandran:** Lab experiments and data collection; **H.P. Bhagya, P. Anitha, G. Somasundaram:** Manuscript preparation; **R.K. Mathur, V. Damodaran:** Experimental materials; **V. Pandey:** Statistical analysis, interpretation.

**Research content:** The research content of manuscript is original and has not been published elsewhere.

**Ethical approval:** Not Applicable

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**Data from other sources:** Not Applicable

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