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Variation in phenotypic characteristics of ASD Costa Rica hybrids of oil palm in India

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ABSTRACT

Eighteen Costa Rican (C65711, C11067, C11239, C11225, C11143, C11146, C65635, C11044, C11076, C11053, C65893, C11142, C65758, C11169, C11163, C11189, C11092 and C11075) and two Palode (65*D* × 111*P* and 120*D* × 111*P*) hybrids of representative palms were evaluated for phenotypic characteristics by nut component analysis. No Dura contamination is reported in any of the hybrids. The analysis revealed that the variation was high for shell weight (57.7%) followed by kernel weight (40.3%) and nut weight (39.8%). Mean highest kernel weight was recorded in C65711 of ASD Costa Rica and single dry kernel weight showed a range from 0.48 (C11075) to 1.35 g (C65711) while single nut ranged from 1.57 g (C65635) to 3.97 g (Palode). The individual palm analysis indicated that the hybrids of ASD Costa Rica namely, C11146, C 65635, C11044, C65758, C11092 and C11075 had very thin shell and palm number 112 (C65711) and 78 (C11189) had high kernel weight. The present investigation revealed a good potential for improving palm kernel utilizing promising hybrids of ASD Costa Rica by hybridization or introgression to generate desirable segregates that posses large kernels.

Key words: Oil palm hybrids, phenotypic characteristics, nut components, kernel.

INTRODUCTION

Diversity in genetic makeup of oil palm (*Elaeis guineensis* Jacq.) parents induces wide variation in yield and growth among families (Ataga, 1). Hartley (4) emphasized the kernel in selection programme and opined that kernel content seldom been a positive objective in breeding. Variation in kernel oil composition of oil palm has received little attention (Corley and Timker, 3). According to Hartley (4), 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. In general, high heritability values were estimated for nut characters such as shell to fruit and kernel components (Kushiari *et al*., 5). In view of the above, phenotypic variations with special emphasis to nut and kernel characteristics of ASD Costa Rican hybrids were assessed with an objective to identify materials with desired characteristics.

MATERIALS AND METHODS

The fresh fruit bunches were harvested from two representative palms each of eighteen of ASD Costa Rica and two Palode hybrids from the experimental field laid out during 1993 at Directorate of Oil Palm Research (Formerly, National Research Centre for Oil Palm), Regional Station, Palode. Representative palms presenting ripe bunches were harvested, weighed and fruits were sampled for nut component analysis in the laboratory. Fruits were de-pulped and the nuts were surface dried for three days and cracked before the kernels were recovered. The phenotypic characteristics namely single fruit, nut, kernel, shell, kernel oil content and shell thickness were estimated from the fruits and mean and palm characteristics value were expressed. Kernel oil content was estimated by the solvent Soxhlet extraction system. The shell thickness was measured using digimatic Vernier callipers (Mitutoyo - Japan). The total variation of each character was determined by calculating the average, minimum and maximum value, standard deviation and coefficient of variation of each.

RESULTS AND DISCUSSION

The co-efficient of variation for different characteristics ranged from 19.2 to 57.7%. The total phenotypic variation for the fruit and nut characteristics studied are showed in Table 1. The co-efficient of variation found in this study was lower than African *dura* germplasm materials and hybrids from various sources planted at Directorate of Oil Palm Research, Pedavegi, Andhra Pradesh (Murugeson *et al*., 7). The co-efficient of variation ranged from 3.7 to 27.2% among the populations of the *dura* fruit form and 1.6 to 35.8% in the *tenera* fruit form (Corley and Tinker, 3). Generally, the variation appears to be higher in the *tenera* than *dura* populations although the mean values were higher in the *dura* populations (1).

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Table 1. Phenotypic variation of fruit and nut characteristics of ASD Costa and Palode hybrids.

Characteristic	Mean	Min.	Max.	CV (%)	Standard deviation
Bunch weight (kg)	11.90	4.78	23.12	19.19	5.07
Single fruit weight (g)	10.76	6.76	17.33	24.83	3.23
Single nut weight (g)	2.27	1.39	3.97	39.83	0.93
Kernel weight (g)	0.80	0.48	1.35	40.28	0.33
Shell weight (g)	1.09	0.43	2.34	57.69	0.64
Shell thickness (mm)	1.84	1.26	2.67	28.21	0.52
Kernel oil to kernel (%)	44	23	56	28.98	0.11

Different hybrid mean values of phenotypic characteristics are presented in Table 2. Mean bunch weight varies from 5.83 to 19.8 kg and highest value of 19.8 kg was found in C11146 hybrid. For nut weight, the mean values range from 1.39 to 3.97 g and the highest value was found in Palode *tenera* followed by C11189 of Costa Rica (3.13 g). Fruit weight variation of 2 to 23 g, 1.2 to 15.4 g for *dura* and *tenera* were reported in Nigerian germplasm by Rajanaidu (10). The undesirable trait of a large shell mass (2.34 g) and thickness (2.67 mm) were also high in one cross combination of Palode which was followed by C11239 (1.57 g and 2.25 mm). Work at NIFOR, Nigeria indicated that fertile *pisiferas* when used for hybridization resultant progeny may have thick shells and hence sterile *pisifera* is recommended for producing hybrids with thin shells (Menendez and Bloak, 6). Since observed mean value for shell thickness showed no significant difference and moreover this was contributed by few palms to the mean value, result conclusion was mostly derived from analysis from individual representative palms. Minimum shell thickness was recorded in C65758 (1.26 mm) followed by C11146 (1.31 mm) with a corresponding low shell weight of 0.63 and 0.43 g. Some of the ASD palms taken for study recorded very low shell thickness when compared to Cameroon and Zaire materials (1.37 and 1.88 mm) reported by Rajanaidu (10) during the expedition to these countries. The shell thickness gene has major effects on bunch composition with *teneras* typically having 30% more mesocarp and 30% higher oil content in bunches than *duras*. There is also continuous variation in shell thickness within the fruit types presumably controlled by minor genes. In general *tenera* has 0.5 to 3 mm shell thickness and all the hybrids of ASD Costa Rica and Palode studied in the present investigation have less shell thickness and shell weight except two palms *viz.,* 129 of Palode and 70 (C65893) of Costa Rica which had high shell weight and shell thickness. Corley and Tinker (3) reported shell thickness of more than 3 mm in *tenera* and less than 3 mm in *dura*. Kernel mass was significantly greater (1.35 g) in C65711 followed by C11189 (1.07 g). The latter one also recorded (0.56 g) high oil to kernel content. Other *teneras* from ASD and Palode showed very low weight of kernel mass with a range from 0.48 to 0.99 g. The lowest oil to kernel (0.23 g) was recorded in C11163 which had comparatively high (2.12 mm) shell thickness.

Palm to palm variation in bunch, fruit and nut weights of ASD Costa Rica and Palode hybrids are presented in Fig. 1 and shell, kernel weights and shell thickness of the hybrids are presented in Fig. 2. Significant variation has been observed for bunch weight, which varied between 4.3 to 23.12 kg. Highest bunch weight (26 kg) was recorded in palm number 134 from C11189 of ASD Costa Rica followed by 24 (21.6 kg) of C11146. Palm number 129 from Palode recorded highest single fruit weight (18.52 kg), nut (5.6 g), shell weight (3.9 g) and shell thickness (3.4 mm). Out of 36 palms, 29 palms recorded less than 1 g kernel weight, and remaining palms recorded kernel weight range from 1 to 1.38 g. Only one palm 112 from C65711 registered the highest weight of 2.09 g. A change in kernel size will have a greater relative effect on shell to fruit in *tenera* palms than in *duras* if the shell thickness remains the same. Van der Vossen (11) reported that parents having varied kernel size tend to produce progeny with low kernel/fruit and lower shell/fruit and it was postulated by Okwuagwu (9) that existence of kernel–inhibiting and shell inhibiting factors transmitted by the *tenera* or *pisifera* parent to its *tenera* offspring. In the present investigation kernel weight was high with moderate shell weight and thickness in palm number 112 followed by 78 of C11189 and 138 of C65758. The hybrids of ASD Costa Rica namely, C11146, C 65635, C11044, C65758, C11092 and C11075 had very thin shell. Based on this study, it is proposed to conduct hybridization (*Tenera* × *Tenera* or *Dura* × *Tenera*) or introgression utilizing the palms

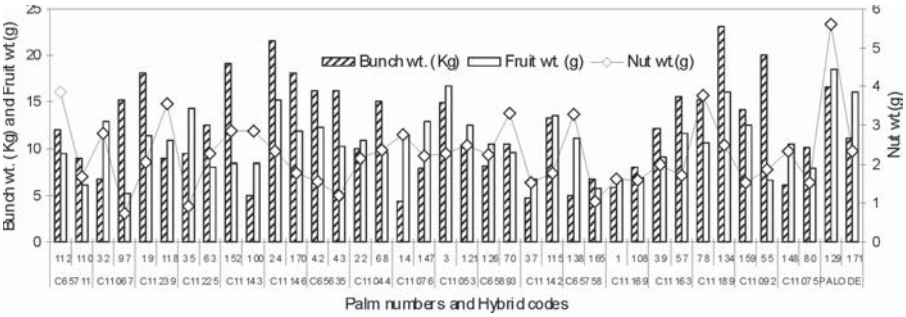

Fig. 1. Palm to palm variation in bunch, fruit and nut weights of ASD Costa Rica and Palode hybrids.

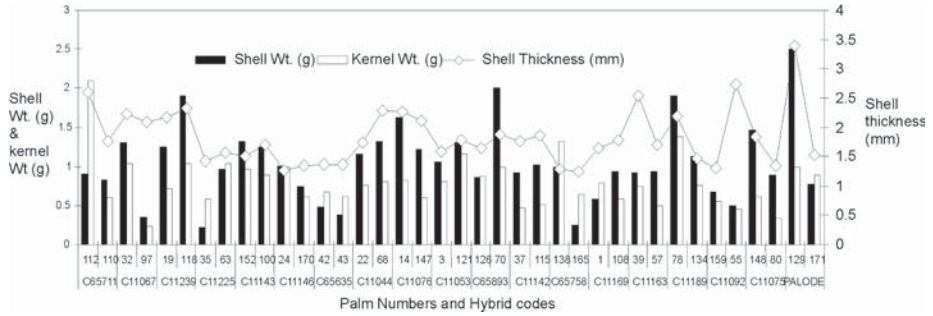

Fig. 2. Palm to palm variation in shell, kernel weights and shell thickness of ASD Costa Rica and Palode hybrids.

Table 2. Mean nut components of ASD Costa Rica and Palode hybrids.

Hybrid source	Bunch wt. (kg)	Single fruit wt. (g)	Single nut (g)	Shell wt. (g)	Kernel wt. (g)	Kernel/ fruit	Dry shell/ fruit	Kernel oil/ fruit	Shell thickness (mm)
					ASD Costa Rica				
C65711	10.44	7.77	2.77	0.88	1.35	16.04	11.73	7.43	2.18
C11067	10.98	9.04	1.77	0.83	0.64	6.26	8.37	3.35	2.16
C11239	13.53	11.12	2.80	1.57	0.88	7.92	14.56	4.08	2.25
C11225	10.935	11.18	1.60	0.60	0.81	8.56	11.10	4.35	1.50
C11143	12.06	8.47	2.86	1.29	0.93	9.77	11.0	3.42	1.60
C11146	19.88	13.53	2.06	0.88	0.81	5.91	6.46	2.93	1.31
C65635	16.17	11.20	1.39	0.43	0.64	5.48	3.98	1.87	1.37
C11044	12.45	10.25	2.26	1.24	0.78	4.70	6.14	1.93	2.02
C11076	6.13	12.09	2.48	1.42	0.71	4.70	11.86	2.45	2.19
C11053	12.64	14.59	2.38	1.18	0.99	7.05	8.40	3.18	1.68
C65893	9.29	10.02	2.77	1.44	0.94	9.47	14.63	5.27	1.76
C11142	9.05	10.14	1.65	0.97	0.49	5.37	10.22	1.80	1.80
C65758	5.83	8.43	2.17	0.63	0.98	11.59	6.65	5.15	1.26
C11169	6.94	6.76	1.60	0.76	0.69	10.19	11.26	3.92	1.71
C11163	13.82	10.37	1.85	0.93	0.62	4.09	7.80	0.91	2.12
C11189	19.12	13.39	3.13	1.51	1.07	8.87	12.38	5.20	1.83
C11092	17.11	9.59	1.69	0.59	0.51	13.32	8.52	3.59	2.02
C11075	8.10	9.18	1.94	1.18	0.48	5.06	13.72	1.74	1.59
					Palode				
Palode	13.90	17.33	3.97	2.34	0.95	5.45	14.26	2.83	2.67
$CD_{0.05}$	NS	NS	NS	NS	NS	NS	NS	NS	NS

with high kernel content to generate desirable segregates that posses large kernels. Okwuagwu and Ataga (8) had proposed similar crossing programme at NIFOR, Nigeria

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