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Qualitative analysis of interspecific hybrids of oil palm for bunch components and fatty acid composition

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Abstract

Elaeis oleifera or the American oil palm produces more liquid oil due to higher unsaturated fatty acid content compared to the commercial species *Elaeis guineensis*. However, due to erratic and poor yield, *E. oleifera* is not cultivated commercially. Interspecific hybrids are having the potentiality of combining yield and quality in the oil. Seven interspecific crosses were made involving six *E. guineensis* and five *E. oleifera* palms. These were evaluated for their bunch component and oil quality in terms of fatty acid composition along with control *E. guineensis* tenera (D X P) hybrids and *E. oleifera* parental palms. Bunch component analysis showed intermediate values for bunch weight as well as bunch related parameters including proportion of parthenocarpic fruits. However, the oil/mesocarp and oil/bunch were lower than those of the parents. Fatty acid composition showed intermediate value between the two parental species for all the fatty acids. Wide variability in fatty acid composition was found in progenies of two specific interspecific crosses. No correlation was observed between any two fatty acids. Out of seven interspecific crosses, three were found to be on par with the better performing *E. oleifera* parental palms with respect to fatty acids. Since performance of each palm is different, individual interspecific hybrid palm was assessed based on total unsaturated fatty acids and oleic acid content and 20 superior palms were selected, which could be employed for further back crossing programme to combine the quality of palm oil and yield.

Keywords: Bunch analysis, fatty acid composition, interspecific hybrid, oil palm

Introduction

Commercially grown species of oil palm *Elaeis guineensis* is known as African oil palm. Another species of oil palm *Elaeis oleifera* is drawing attention because of some desirable agronomic characters like lesser height increment, resistance to diseases and more liquidity of oil due to higher percentage of oleic acid (C18:1) in the oil. However, it has major disadvantages of unpredictable and inconsistent yield and low oil content (Hartley, 1988). These two species have frequently been hybridized on an experimental scale and it is reported that some of the morphological characters of the interspecific hybrids deviate from either of the parents, whereas most characters have intermediate values between the two (Corley and Tinker, 2003). Selection of the palms on the basis of oil quality (fatty acid composition) is the main objective of evaluation for improving the quality of edible palm oil. The inheritance of bunch characters in hybrid palms is of interest mainly because it indicates the oil content in the mesocarp as well as oil/bunch ratio. More number of parthenocarpic fruits has been reported in the interspecific hybrids, which is a trait of *E. oleifera* (Vallejo and Cassalett, 1975). The parthenocarpic fruits are reported to have less oil content (Vallejo and Cassalett, 1975; Mandal *et al*., 2007). In India, 23 *E. oleifera* palms are available at NRCOP, Palode, Kerala. Seven crosses were made involving six *E. oleifera* palms and five *E. guineensis* palms and planted in the field at NRCOP, Palode, Kerala and NRCOP, Pedavegi, Andhra Pradesh during 1998. These interspecific hybrid palms along with tenera hybrids (dura X pisifera) and open pollinated *E. oleifera* palms were studied for their oil quality on the basis of fatty acid composition (FAC) for selection of hybrids for further backcrossing. Two of the interspecific hybrid progenies were studied in detail for their segregating pattern. Bunch component analysis of the interspecific hybrids were carried out and compared with the controlled crosses (D X P) and parental *E. oleifera*. No report on evaluation of the interspecific hybrid from India is available so far, and this result would

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help in for the development of commercial interspecific hybrid.

Materials and Methods

Fully ripe bunches from 59 interspecific hybrid palms (three bunches from each palm) from seven crosses (12 Eo x 82 Eg, 15 Eo x 18 Eg, 16 Eo x 18 Eg, 16 Eo x 81 Eg, 19 Eo x 81 Eg, 360 D x 13 Eo and 361 D x 11 Eo), eight tenera hybrids (control) of *E. guineensis* (dura x pisifera) and two palms from the open progeny of *E. oleifera* (Eo-11) were sampled for the study. Of the total palms, 49 palms were from NRCOP, Pedavegi including four control palms (D x P) and 20 palms were from NRCOP (RS), Palode including four control (D x P) and two open pollinated *E. oleifera* (Eo-10). All the 69 palms were planted during 1998 and the study was carried out during the year 2005-06.

Bunch analysis

Bunch analysis (three bunches from each palm) of ten interspecific hybrid palms from four cross combinations (12 Eo x 82 Eg, 16 Eo x 18 Eg, 361 D x 11 Eo and 15 Eo x 18 Eg), four *E. guineensis* (D x P) hybrid palms and the parental *E. oleifera* palms were carried out following the modified method of Hartley (1988). Total bunch weight, stalk weight and spikelets weight were measured from each bunch. Fruits were separated from the spikelet and mesocarp was separated from nuts by scraping and moisture and oil content in the mesocarp were estimated, subsequently. Unlike the standard method, parthenocarpic and seeded fruits were separately weighed. The whole bunches were analyzed in all the cases, instead of representative samples. Fruit samples were collected from each bunch and the mesocarp was scraped out. Mesocarp samples were dried under hot air oven and moisture content was estimated by standard weight reduction method. Oil content in the dried mesocarp was estimated as per the method developed by Mandal and Gayathridevi (2005).

Analysis of fatty acid composition

The oil sample from the dried mesocarp samples was derivatised to fatty acid methyl esters (FAME) (Morrison and Smith, 1964) before analyzing them in Gas Chromatography (GC). Dried mesocarp samples (500 mg) was ground with 5 ml of sodium methoxide in methanol (0.5N) and transferred to a screw capped test tube and heated in a boiling water bath at 60-70^{o} C for 15 min. The tube was cooled to room temp. and one drop of BF_3–methanol complex was added to it. It was heated again for 5 min at 60-70^{o} C and allowed to cool to room temperature. Hexane (2 ml) was added to it, shaken and a few drops of water was added for hexane layer to get separated. The upper (hexane) layer was pipetted out into a micro fuge tube and moisture was removed by adding a pinch of anhydrous sodium sulphate.

Fatty acid methyl esters of oil samples were analysed by using a SIMADZU 17A GC. SGE make BPX-70 Capillary column of 60 m length, 0.25 mm ID and 0.25µ thickness with Flame Ionized Detector (FID) was used for the analysis. Helium was the carrier gas and different parameters of the isothermic method was set as: 180^{o} C oven temperature, 230^{o} C injector temperature, 250^{o} C detector temperature, 1.5 ml/min flow rate, 137 kpa column pressure and 50 split ratio. Standard FAMEs were injected to identify the retention time of different FAME and accordingly the fatty acid composition of the samples were derived.

Data was analyzed using SPSS V 14.0 and MSTATC V 2.1 software. Duncan's Multiple Range Test (DMRT) was performed to derive the ranges among different treatments.

Results and Discussion

Interspecific hybrids between *E. oleifera* and *E. guineensis* have generated much interest among oil palm breeders and the two species have frequently been hybridized on an experimental scale. The significance of the cross lies in selection and breeding for superior oil quality. The characteristics of the *E. oleifera* palm as regards height increment, falling leaf bases, persistent spathes, parthenocarpy, fruit shape and colour are retained in the hybrid. The perceived advantages of interspecific hybrids are much slower height growth, more liquid oil and resistance to fatal yellowing and marchitez sorpresiva (Corley and Tinker, 2003).

Bunch analysis

In general, the bunch production in interspecific hybrids were erratic and many of the palms did not produce bunch over the years. Overall size of the bunches was less than that of *E. oleifera* as well as *E. guineensis* D x P hybrids. This was reflected in stalk weight, spikelet weight as well as total fruit weight (Table 1).

Though it is reported that the bunch weight of *E. oleifera* palms are less (Ooi *et al*., 1981), the *E. oleifera* palms available at NRCOP Palode were on an average having higher bunch weight. It was also found that the bunch weight was significantly higher than that of both interspecific hybrids as well as tenera (D x P) hybrids. The average bunch weight of mature tenera palms from Palode are much higher than that from the four palms under study (Mandal *et al*., 2002). In the present study,

Table 1. Different parameters of bunch component analysis of interspecific hybrids along with D x P hybrids and E. *oleifera* parents

Bunch components	ISH	Control (D x P)	E. *oleifera*
Bunch wt. (kg)	14.10a	12.00b	23.41a
Stalk wt. (kg)	1.72b	1.00b	3.13a
Spikelet wt. (kg)	11.65b	9.79b	20.29a
Parthenocarpic fruit/Bunch (%)	43.13a	19.08b	53.59a
Seeded fruit/Bunch (%)	56.87b	80.92a	46.41b
Fruit/Bunch (%)	42.24b	51.92ab	55.81a
No. of fruits/Bunch	1648.90b	1206.29b	3429.33a
Av. wt.of parthenocarpic fruit (g)	2.27a	1.86a	2.38a
Av. wt.of seeded fruit (g)	16.12a	9.82a	11.41a
Av. fruit wt. (g)	6.05a	6.39a	3.77a
Mesocarp/Fruit (%)	82.79a	77.99a	73.15a
Mesocarp /Bunch (%)	34.28a	40.03a	40.96a
Moisture in mesocarp (%)	58.65a	33.98b	51.72a
Oil/Mesocarp (%)	30.00b	46.47a	31.57ab
Oil/ Bunch (%)	10.56b	18.61a	13.40a

ISH: Interspecific hybrid

Note: For each parameter, same letter (a, b, c etc.) mentioned in the superscript after each value of different treatments indicate they are not significantly different

the average bunch weight of interspecific hybrids was significantly less than the *E. oleifera* palms, but on par with the D x P hybrids. Same trend of significantly lower stalk, spikelet and total fruit weight in the interspecific hybrids was observed compared to that of *E. oleifera* parent but were on par with the D x P hybrids (Table 1).

Parthenocarpy is observed mostly in *E. oleifera* and this character was found in the interspecific hybrids also with 43% fruits being parthenocarpic, which was on par. However, parthenocarpy was significantly higher than the D x P hybrids. Fruit to bunch % was found to be lowest in the interspecific hybrids and was on par with D x P hybrids. But it was significantly higher in *E. oleifera* (Table 1). Number of fruits per bunch was also more in the *E. oleifera* bunches than that of interspecific hybrids and D x P hybrids mainly due to larger size of bunches. Though the latter two were on par, the average number of fruits per bunch was more in interspecific hybrids than that of D x P hybrids due to higher number of parthenocarpic fruits of smaller size. No differences in average fruit weight were observed. As the oil content is reported to be lesser in the parthenocarpic fruits (Vallejo and Cassalett, 1975), higher moisture content and lower oil content in the mesocarp was expected in interspecific hybrids from other bunch component data. Moisture content in mesocarp was the highest in interspecific hybrid, which was on par with the *E. oleifera* palms and significantly higher than that of D x P hybrids. It was just reverse in case of oil content in the mesocarp, with the lowest content in interspecific hybrids. This result is marginally different from the report by Hardon (1969) that oil-to-mesocarp in interspecific hybrid was intermediate between that of the parent species. Oil/ bunch % was the highest in the D x P hybrids and the least in interspecific hybrids. It is reported that during pollen grain formation, pollen viability and germination percentage in the interspecific hybrids are low (Hardon and Tan, 1969). Partly as a result of this, fruit set in the hybrids is usually poor. A second probable cause for poor fruit set is that the hybrid inflorescences appear to be less attractive to *Elaeidobius kamerunicus,* the pollinating weevil (Tan, 1985). Reasonable fruit set is sometimes observed in trials with hybrids, but it appears that this may be brought about by *E. guineensis* pollen from neighbouring plots.

In interspecific hybrid crosses with *dura,* mesocarp-to-fruit varies from under 40 to over 50 %, but fruit from *tenera* and *pisifera* crosses has given mesocarp percentages of 58-74 (Obasola, 1973; Vallejo and Cassalett, 1975). With parthenocarpic fruit, mesocarp percentage depends on the degree of parthenocarpy. In a Malaysian trial, large parthenocarpic fruit had 75 % mesocarp while the small type had 89 % mesocarp. In the present study, the result observed is similar (82.79 %) with regard to mesocarp/fruit per centage.

Fatty acid composition of oil

Palm oil of *E. oleifera* has more unsaturated fatty acids than *E. guineensis* and is quite similar to olive oil in composition (Corley and Tinker, 2003). Early work indicated that the oil of the interspecific hybrid was intermediate (Hardon, 1969), indicating additive inheritance, and this was confirmed by Meunier and Boutin (1975) and Ong *et al.* (1981).

The present study showed that the average fatty acid composition was either on par with the two species or intermediate (Table 2). Myristic acid (C14:0) and Linoleic acid (C18:2) were found on par with D x P hybrid as well as *E. oleifera* palms. Palmitic acid (C16:0), Stearic acid (C18:0), Oleic acid (C18:1), Linolenic acid (C18:3), total saturated fatty acids as well as unsaturated fatty acids showed intermediate values; though in all the cases, the values were on par either with *E. oleifera* or D x P hybrids. The data was analyzed separately for Palode and Pedavegi and the same trend was observed in both the locations. The result of the present study supports the additive inheritance of quantitative characters for overall performance of the hybrids. Moreover, the bunch component may vary from intermediate values in interspecific hybrids due to external factors like pollination, fruit set, parthenocarpy etc., but once the fruit

Table 2. Fatty acid composition of interspecific hybrids along with D x P hybrids and E. *oleifera* parents

Fatty acid (%)	ISH	Control (D x P)	E. *oleifera*	MSEM
C14:0	1.04a	0.91a	0.99a	0.19
C16:0	39.42ab	41.27a	38.04b	21.91
C18:0	3.73a	4.27a	1.81b	2.08
C18:1	42.39ab	41.03b	46.99a	16.95
C18:2	12.69a	11.74a	11.61a	7.14
C18:3	0.72ab	0.78a	0.57b	0.12
TSFA	44.51a	46.45a	40.83b	34.68
TUFA	55.49b	53.55b	59.17a	34.68

ISH: Interspecific hybrid; MSEM: Mean Squire Error

Note: For each parameter, same letter (a, b, c etc.) mentioned in the superscript after each value of different treatments indicate they are not significantly different

is set, the oil formation and FAC would be mostly directed by genetic factors.

FAC of individual hybrid progeny

The segregating patterns of FAC of individual interspecific hybrid palms derived from two different interspecific crosses (360 D x 13 Eo and 361 D x 11 Eo) were studied in detail. The values were not intermediate in all the cases of interspecific hybrids. Careful observations had projected the extent of variation and segregation among the hybrids. Most of the parameters were varying significantly from the *E. oleifera* parent and control (D x P). C18:1 (Oleic acid) and total unsaturated fatty acids were of interest because interspecific hybrids were developed for improving upon the total unsaturated fatty acid content. In the case of 361 D x 11 Eo, Oleic acid ranged from 35.35-43.57 %, much below the *E. oleifera* parent (52.13 %). Total unsaturated fatty acid ranged from 46.33 to 57.87 %, which were also below the level of *E. oleifera* parent (Table 3). However, many hybrid palms showed improvement over the parents. But the performance of the hybrid developed from Eo 13 (360D x 13Eo) was different. The oleic acid (C18:1 ranged from 36.13 to 48.66 %) and TUFA content was varying from 35.71 to 64.45 %), which were significantly lower and also higher than *E. oleifera* parent and control (Table 3). This indicated that the inheritance of oil quality is not simple additive when individual palms are considered, however, the average performance of them might be intermediate as indicated earlier (Table 2). This can happen in oil palm because of heterozygous nature of each palm, which segregates in the next generation. But when a large population of interspecific hybrid is averaged, the intermediate nature of the hybrid can be observed.

Correlation between the fatty acids showed their synthesis was independent, however, the significant

Table 3. Qualitative performance of interspecific hybrid palms from two specific crosses

Interspecific hybrid palms from 361 D x 11 Eo Cross									Interspecific hybrid palms from 361 D x 11 Eo Cross								
Palm no.	C14:0	C16:0	C18:0	TSFA	C18:1	C18:2	C18:3	TUFA	Palm no.	C14:0	C16:0	C18:0	TSFA	C18:1	C18:2	C18:3	TUFA
PD-45	0.86	38.22	3.06	42.13	42.55	14.50	0.83	57.87	PD-21	1.75	37.18	2.64	41.56	44.97	12.29	1.18	58.44
PD-55	1.36	36.45	4.46	42.27	43.52	13.72	0.50	57.73	PD-80	0.75	36.13	4.94	41.83	47.09	10.54	0.54	58.17
PD-32	0.70	38.75	4.04	43.50	43.57	12.25	0.67	56.50	PD-81	0.65	36.79	4.66	42.09	46.52	11.05	0.34	57.91
PL-35	1.26	39.30	3.11	43.67	42.25	13.36	0.72	56.33	PD-84	0.66	36.84	4.67	42.17	45.26	11.54	1.03	57.83
PL-47	0.93	38.96	3.93	43.82	42.29	13.23	0.66	56.18	PD-77	0.95	39.65	2.19	42.78	42.23	13.66	1.33	57.22
PD-37	1.21	40.32	2.71	44.24	43.07	12.02	0.66	55.76	PD-78	0.88	38.64	3.55	43.07	43.26	12.87	0.79	56.93
PD-42	1.17	40.65	3.16	44.98	41.13	13.14	0.74	55.02	PD-85	0.63	37.98	4.56	43.18	46.12	10.16	0.54	56.82
PD-66	1.65	40.31	3.09	45.05	40.68	13.59	0.68	54.95	PD-7	0.87	38.62	3.76	43.26	40.69	15.39	0.66	56.74
PD-31	0.79	40.25	4.86	45.90	39.27	14.14	0.69	54.10	PD-13	1.32	39.76	2.30	43.38	41.06	14.47	1.10	56.62
PD-30	0.97	40.60	5.32	46.90	37.44	15.16	0.50	53.10	PD-19	1.48	37.95	4.60	44.03	39.08	15.55	1.34	55.97
PD-39	0.76	42.54	3.87	47.17	39.22	13.19	0.43	52.83	PD-4	1.22	39.88	3.13	44.24	43.35	12.04	0.37	55.76
PD-29	1.16	41.78	4.50	47.44	39.07	12.77	0.72	52.56	PD-12	0.98	38.20	5.34	44.51	42.73	11.67	1.09	55.49
PD-14	0.87	43.31	3.42	47.60	37.87	14.32	0.21	52.40	PD-22	2.10	38.93	3.73	44.77	42.88	11.55	0.80	55.23
PL-4	0.78	41.88	5.10	47.75	42.10	9.90	0.25	52.25	PD-20	1.29	41.34	2.52	45.14	44.22	9.83	0.81	54.86
PD-35	1.33	42.53	4.13	48.00	41.23	10.42	0.35	52.00	PD-3	1.44	41.53	2.60	45.57	41.47	11.91	1.05	54.43
PD-58	1.38	42.24	4.44	48.06	37.95	13.51	0.48	51.94	PL-7	0.68	42.55	2.92	46.15	38.99	12.75	0.48	52.21
PL-12	1.04	42.33	4.94	48.31	41.29	9.65	0.76	51.69	PD-1	1.09	43.79	2.91	47.79	44.53	8.84	0.48	53.85
PD-33	0.75	45.15	3.05	48.95	37.51	12.88	0.66	51.05	PD-24	0.90	42.57	4.44	47.92	41.41	10.07	0.59	52.08
PD-44	1.49	44.15	3.59	49.23	37.97	12.27	0.53	50.77	PD-27	2.01	45.04	3.69	50.73	36.13	12.63	0.50	49.27
PD-60	1.20	45.06	3.90	50.15	37.89	11.40	0.56	49.85	PD-25	1.32	46.13	3.97	51.42	37.51	10.79	0.28	48.58
PD-46	1.18	47.86	4.63	53.67	35.34	10.28	0.71	46.33	PD-79	1.01	39.99	4.77	64.29	41.65	11.60	0.98	35.71
Eo-11	0.46	32.24	1.92	34.62	52.13	12.67	0.58	65.38	Eo-13	1.44	40.46	1.63	43.53	37.51	12.05	0.71	56.47
D x P	0.96	40.58	4.95	46.49	41.52	11.24	0.75	53.51	D x P	0.96	40.58	4.95	46.49	43.71	11.24	0.75	53.51

correlation between the TSFA with palmitic acid, and TUFA with oleic acid is observed in all the cases (Table 4) as the contribution of these two fatty acids determines mainly the degree of total saturation and unsaturation.

Table 4. Correlation coefficient between any two fatty acids of interspecific hybrid oil palm

	C14:0	C16:0	C18:0	C18:1	C18:2	C18:3	TSFA	TUFA
C14:0	1.000							
C16:0	0.234	1.000						
C18:0	-0.038	0.017	1.000					
C18:1	-0.361**	-0.863**	-0.170	1.000				
C18:2	0.032	-0.332**	-0.229	0.100	1.000			
C18:3	0.077	-0.353**	-0.105	0.206	0.194	1.000		
TSFA	0.260*	0.807**	0.292*	-0.754**	-0.334**	-0.230	1.000	
TUFA	-0.260*	-0.807**	-0.292*	0.754**	0.334**	0.230	-1.000**	1.000

**Significant at 0.01 level *Significant at 0.05 level

hybrid combinations in terms of total unsaturated fatty acids and C18:1, and another *E. oleifera* palm (Eo-19) was also on par with it. Among the interspecific crosses, three crosses namely 12 Eo x 82 Eg, 15 Eo x 18 Eg and 19 Eo x 81 Eg were on par with the two *E. oleifera* palms in terms of total unsaturated fatty acids. Considering the C18:1, C18:2 and total unsaturated fatty acid, these three combinations seems to be better than others (Table 5).

Keeping the two fatty acids (C18:1 and C18:2) as well as total unsaturated fatty acids percentage under consideration, 20 best palms were selected from the study (Table 6). Combining the quality of oil with other important attributes like much slower growth and resistance to diseases, a few superior palms could be selected and further employed in back crossing programme. All these palms were on par with respect to total unsaturated fatty acids. Though most of the palms also showed higher amount of C18:1 content, the highest value is exhibited by palm no. PL-36 (49.36 %) from Palode, which was significantly higher than that of palm nos. PD-15, PL-28, PL-11, PL-23, PD-45 and PD-55. However, further improvement by back crossing can gradually produce the hybrid with suitable oil quality and desirable yield. Selection of individual palms is important and it is suggested to clone the best individuals from back crosses (Corley and Tinker, 2003). Since it is not possible to generalize the exact trend of fatty acid composition in an interspecific hybrid due to the factors discussed above, the individual palm performance is most important as recorded in the present study.

Table 5. Fatty acid composition (%) of different interspecific crosses, D x P hybrids and E. *oleifera*

Crosses	C14:0	C16:0	C18:0	C18:1	C18:2	C18:3	TSFA	TUFA
115 D x 175 P	0.96^{abcd}	40.58^{abcd}	4.95^{a}	41.52^{cde}	11.24^{a}	0.75^{a}	46.49^{a}	53.51^{c}
12 Eo x 82 Eg	0.64^{bcd}	36.86^{cde}	3.39^{abc}	46.54^{bc}	11.75^{a}	0.82^{a}	40.89^{abc}	59.11^{abc}
15 Eo x 18 Eg	1.29^{abcd}	37.17^{bcde}	2.46^{bc}	46.39^{bc}	12.15^{a}	0.55^{a}	40.91^{abc}	59.09^{abc}
16 Eo x 18 Eg	0.35^{d}	45.71^{a}	2.46^{bc}	39.69^{e}	11.21^{a}	0.57^{a}	48.52^{a}	51.48^{c}
16 Eo x 81 Eg	0.93^{abcd}	40.38^{abcd}	3.79^{abc}	42.50^{bcde}	11.62^{a}	0.77^{a}	45.11^{ab}	54.89^{bc}
19 Eo x 81 Eg	1.06^{abc}	36.76^{cde}	3.65^{abc}	44.09^{bcde}	13.73^{a}	0.72^{a}	41.47^{abc}	58.53^{abc}
360 D x 13 Eo	1.03^{bc}	38.70^{bcde}	3.61^{abc}	43.45^{bcde}	12.43^{a}	0.78^{a}	43.96^{ab}	56.04^{bc}
361 D x 11 Eo	1.14^{ab}	40.85^{abc}	4.14^{ab}	39.83^{e}	13.41^{a}	0.64^{a}	46.12^{a}	53.88^{c}
D x P Palode	0.85^{abcd}	41.97^{abc}	3.59^{abc}	40.54^{de}	12.24^{a}	0.81^{a}	46.41^{a}	53.59^{c}
Eo - 10 Open	0.87^{abcd}	40.34^{abcd}	3.58^{abc}	41.86^{cde}	12.59^{a}	0.76^{a}	44.79^{ab}	55.21^{bc}
Eo-11	0.46^{cd}	32.24^{e}	1.92^{c}	52.13^{a}	12.67^{a}	0.58^{a}	34.62^{c}	65.38^{a}
Eo-12	1.37^{a}	39.89^{abcd}	1.83^{c}	45.57^{bcd}	10.67^{a}	0.66^{a}	43.10^{ab}	56.90^{bc}
Eo-13	1.44^{a}	40.46^{abcd}	1.63^{c}	43.71^{bcde}	12.05^{a}	0.71^{a}	43.53^{ab}	56.47^{bc}
Eo-15	1.25^{ab}	43.78^{ab}	1.59^{c}	40.19^{e}	12.66^{a}	0.54^{a}	46.62^{a}	53.38^{c}
Eo-16	0.96^{abcd}	37.92^{bcde}	1.87^{c}	47.47^{b}	11.34^{a}	0.44^{a}	40.75^{abc}	59.25^{abc}
Eo-19	0.43^{cd}	33.96^{de}	1.99^{bc}	52.87^{a}	10.24^{a}	0.50^{a}	36.38^{bc}	63.62^{ab}
MSE	0.17	19.35	1.98	12.14	7.02	0.12	32.17	32.17

Note: For each parameter, same letter (a, b, c etc.) mentioned in the superscript after each value of different crosses indicate they are not significantly different

Selection of superior interspecific cross combinations and hybrid palms

As the primary objective of the evaluation was to select interspecific hybrids with better fatty acid composition, main emphasis was on total unsaturated fatty acid which are contributed by oleic acid (C18:1) and linoleic acid (C18:2), the former is the mono unsaturated and the latter one is the polyunsaturated fatty acid.

The seven interspecific hybrid combinations were evaluated for FAC along with the D x P crosses and one open pollinated *E. oleifera* and other *E. oleifera* palms involved in the crosses. It was found that Eo-11 palm (*E. oleifera*) was distinctly superior than other palms or

Table 6. List of 20 superior interspecific hybrid oil palm and their fatty acid composition

Palm no.	Crosses	C14:0	C6:0	C18:0	TSFA	C18:1	C18:2	C18:3	TUFA
PD-26	360 D x 13 Eo	0.49	32.88	2.59	35.97	48.66	14.38	1.00	64.03
PD-2	360 D x 13 Eo	0.63	34.30	3.00	37.93	48.10	12.93	1.04	62.07
PL-10	15 Eo x 18 Eg	0.73	35.32	2.13	38.18	48.82	12.54	0.47	61.82
PD-8	360 D x 13 Eo	1.11	33.93	3.51	38.55	45.56	15.19	0.70	61.45
PD-11	360 D x 13 Eo	0.53	34.54	3.57	38.64	47.52	13.54	0.29	61.36
PD-72	360 D x 13 Eo	0.97	35.41	2.90	39.28	47.38	12.65	0.69	60.72
PL-36	12 Eo x 82 Eg	0.78	34.87	3.77	39.42	49.36	10.28	0.93	60.58
PD-16	360 D x 13 Eo	0.55	35.86	3.30	39.72	47.27	12.12	0.89	60.28
PD-15	360 D x 13 Eo	0.81	36.34	2.71	39.87	44.10	14.64	1.39	60.13
PL-28	12 Eo x 82 Eg	0.54	36.48	3.99	41.02	44.51	13.77	0.70	58.98
PD-6	360 D x 13 Eo	0.86	34.96	5.43	41.25	45.90	11.89	0.95	58.75
PL-11	19 Eo x 81 Eg	1.06	36.76	3.65	41.47	44.09	13.73	0.72	58.53
PD-21	360 D x 13 Eo	1.75	37.18	2.64	41.56	44.97	12.29	1.18	58.44
PD-80	360 D x 13 Eo	0.75	36.13	4.94	41.83	47.09	10.54	0.54	58.17
PD-81	360 D x 13 Eo	0.65	36.79	4.66	42.09	46.52	11.05	0.34	57.91
PL-23	16 Eo x 81 Eg	1.00	37.25	3.84	42.09	43.73	13.44	0.74	57.91
PD-45	361 D x 11 Eo	0.86	38.22	3.06	42.13	42.55	14.50	0.83	57.87
PD-84	360 D x 13 Eo	0.66	36.84	4.67	42.17	45.26	11.54	1.03	57.83
PL-26	12 Eo x 82 Eg	0.59	39.23	2.40	42.22	45.74	11.21	0.83	57.78
PD-55	361 D x 11 Eo	1.36	36.45	4.46	42.27	43.52	13.72	0.50	57.73
CD (P=0.05)	0.40	4.72	1.12	7.71	3.75	3.02	0.41	7.71	

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