

Yield, bunch quality and vegetative traits of American oil palm (*Elaeis oleifera*, HBK) population in India

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ABSTRACT

The wild American species, *Elaeis oleifera* (HBK) is a promising genetic resource for slow trunk growth, disease resistance and desired oil quality. Yield, bunch quality and vegetative traits of *E. oleifera* planted during 1992 were evaluated in a trial with an aim to produce inter-specific hybrids. Four palms (palm Nos. 6, 8, 11 and 21) were screened based on yield performance, bunch quality and vegetative characteristics. The results of the evaluation indicated that *oleifera* population had slow vertical growth. The highest mean Fresh Fruit Bunch (FFB) yield recorded was 158.66 kg per palm per annum, number of bunches was 7.44 per palm per annum, oil to bunch ratio was the highest at 18.31% and height increment was lowest at 0.08 m per annum. No single palm possessed all the desirable traits except palm No. 6 that performed well for majority of the desirable traits studied.

Key words: *Elaeis oleifera*, yield, bunch components, vegetative traits, selection.

INTRODUCTION

Oil palm is cultivated mainly in Andhra Pradesh, Kerala, Karnataka, Tamil Nadu, Orissa, Gujarat, Goa, Assam, Tripura and Mizoram in India. An area of 2,06,000 ha has been planted under Oil Palm Development Programme (OPDP) up to 2011-12 (Anon, 1). Height has negative correlation with Fresh Fruit Bunch (FFB) yield in *Elaeis guineensis* and generally high yielding palm populations possess high vertical elongation (Murugesan *et al.*, 8). The wild American oil palm species, *Elaeis oleifera* (HBK) is a promising genetic resource for slow trunk growth, disease resistance and oil quality. The desirable traits in *E. oleifera* are introgressed gradually into existing breeding material through hybridization (Moretzsohn *et al.*, 7). *Oleifera* population, with narrow genetic base was evaluated with an aim to produce inter-specific hybrids to retain slow growth of *oleiferas* in the planting material to be developed using promising palms of *E. guineensis*.

MATERIALS AND METHODS

Twenty three palms of *oleifera* population of two accessions (DOPR G 23 and 24) planted during 1992 at Directorate of Oil Palm Research (DOPR) Research Centre, Palode were evaluated for vegetative, yield and bunch quality traits as per the standard procedure. The palm numbers from 1 to 21 are accessions of "DOPR G 23, 22 and 23 are registered as "DOPR G 24". Recording of yield and its components were commenced from fifth year after planting and continued for ten years. The bunch number and bunch weight

of harvested fruit bunches from each palm were recorded once in seven to ten day harvest intervals. During the period from 2008-09 to 2010-11, individual fruit bunches of uniform maturity were analyzed in the laboratory to determine the bunch quality components (bunch weight, fruit weight, parthenocarpic fruit weight, nut weight, oil to bunch, fruit to bunch, mesocarp to fruit, oil to wet mesocarp and shell to fruit). Vegetative traits measured in the individual palms of *oleifera* are height increment, frond fresh weight, frond dry weight, rachis length, leaflet width, leaflet length and leaflet number. Bunch analysis in Palm No. 23 could not be done due to bud rot incidence during the evaluation period. The bunch analysis technique adopted was that developed by Blaak *et al.* (2) and vegetative traits were measured during November 2011, adopting methods recommended by Corley *et al.* (3) with necessary modifications.

RESULTS AND DISCUSSION

Overall mean obtained from 23 palms of two accessions was 106.4 kg/ palm per year for FFB yield with 5.43 numbers of fruit bunches. With regard to ten years average, palm No. 6 had the highest FFB (158.66 kg/ palm per year) and bunch numbers (7.44 bunches/ palm per year), which also found to produce FFB throughout the evaluation period, whereas palm No. 3 had lowest FFB (63.4 kg/ palm year) with 3.4 bunches and no bunch production for three years out of ten. Other promising palms with notable mean FFB yields and bunch numbers were 4 (139.05 kg FFB and 7.10 bunches), 21 (143.45 kg FFB and 6.10 bunches) and 16 (136.88 kg FFB and 6.4 bunches).

During 2004-05, palm No.18 had highest FFB yield of 295 kg with 11 bunches. In all the observations, bunch numbers had lower standard deviation than FFB. Reverse trend was noticed in case of percent co-efficient of variation and FFB had lower variation than bunch number (Fig. 1). Ten years data of individual palms on bunch weight and bunch numbers are not given in this article and entire database is available at DOPR. Bunch weight of the palms taken for bunch analysis showed significant variation with a range of 16 to 53 kg bunch⁻¹. Parthenocarpic fruits weighed a mean value of 3.2 g, whereas, fertile fruit weighed at 9.88 g. The maximum and minimum values recorded for parthenocarpic fruits were 3.84 and 2.11 g, whereas, fertile fruits had 5.96 and 14.54 g. Parthenocarpic fruits showed low (0.55) values of standard deviation followed by nut weight (1.59). Fruit to bunch was found to be low in majority of the palms, seven palms recorded less than 50% and rest had > 50%, whereas, highest (81.3%) was recorded in palm No. 6. The *oleifera*s were generally thick-shelled with the shell to fruit ranging from 43.3 to 61.1% (Mohd Din *et al.*, 6). The present population had as high as 52.58% of shell to fruit in palm No. 15 followed by palm No. 6 (49.19%). Highest (18.31%) oil to bunch was observed in palm No. 13, which had lowest shell to fruit content of 12.04% (Table 1). The presence of relatively high proportion of normal and parthenocarpic fruits on a bunch affects the total percentage of mesocarp per bunch and therefore the amount of oil to bunch. Since, the bunch production, fruit set and other related ratios are appear to be erratic, selection exclusively on the basis of bunch components could be avoided in the *oleifera* population and yield and other vegetative traits could be combined for selection as recommended by Escobar (5). For vegetative traits, among the 23 *oleifera* palms, the minimum values of

height (3.40 m), height increment (0.08 m) and rachis length (5.34 m) were obtained in the palm numbers, viz., 3, 3 and 6, respectively. Whereas, palm numbers 4, 13 and 15 had maximum values for height (5.8, 0.73 and 7.55 m). Though palm No. 3 had low values for vegetative characteristics, yield performance was lowest among all the palms. Other promising palms which recorded lower values for height increment, rachis length were Nos. 8, 22, 20, 12 and 17. However, they performed poorly with respect to other important traits and hence may not be considered for selection. This population had mean leaf fresh and dry weight of 17.22 and 4.38 kg with maximum values of 22.25 and 5.78 kg, respectively. The mean values recorded for rachis length (6.64 m), leaflet width (7.87 cm), leaflet length (122.97 cm) and leaflet number (151.83) have confirmed hybrid nature of present *oleifera* stand and clearly indicate undesirable qualities of vigorous vegetative growth (Table 2). The results obtained by Oboh and Fakorede (9) confirmed that individual data were comparable to progeny mean data for selection of palms. It is necessary to reduce the number of desirable traits to be used as criteria for selection in case of *oleifera*, which is primarily utilized to produce short stem palms. Accordingly, all the 23 palms were given ranking based on important desirable traits which are relevant to compact palm evaluation (Table 3). This is an important aspect in view of inherent nature of excessively long leaves of the interspecific hybrids (Escobar, 4). With respect to parameters of vegetative traits, palm No. 6 showed lowest values for rachis length and height increment (second lowest). Economically, height increment is of considerable interest since height of the palms affects cost of harvesting. The rachis length and compact characteristics are deciding traits for planting density and spacing. Considering the above results, some

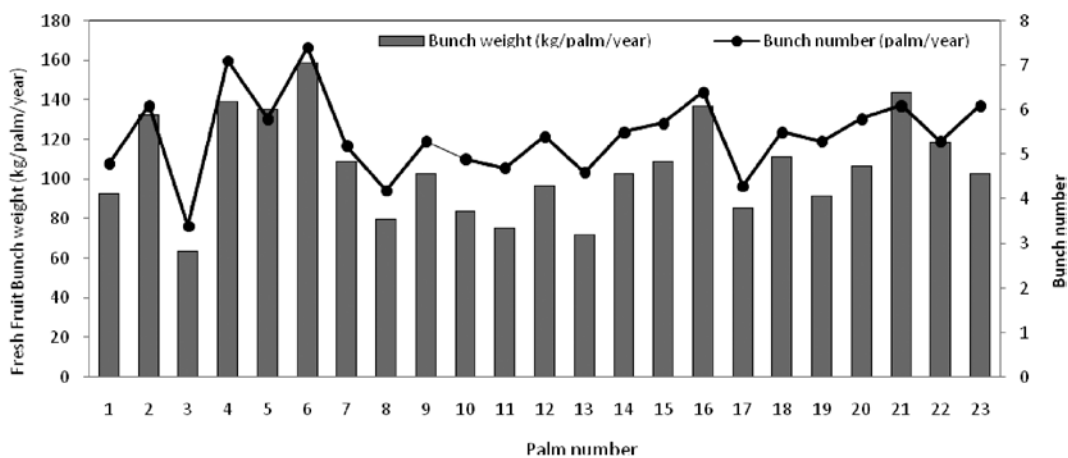


Fig. 1. Mean fresh fruit bunch weight and bunch number (10 years average) in *Elaeis oleifera* palms.

Table 1. Bunch quality components of *Elaeis oleifera* palms.

Palm No.	BW (kg)	FW (g)	PFW (g)	NW (g)	OB (%)	FB (%)	MF (%)	OWM (%)	SF (%)
1	26.00	10.20	3.51	3.55	9.7	60.35	65.12	24.21	32.75
2	23.00	8.73	3.84	1.33	9.12	33.57	77.19	35.22	15.43
3	22.00	6.87	2.58	2.42	6.52	65.45	43.93	14.97	18.26
4	28.54	8.48	3.33	3.35	9.37	53.19	60.46	31.20	29.36
5	44.10	5.96	2.11	3.21	4.88	45.35	67.90	16.68	22.66
6	53.00	12.37	3.55	6.37	13.80	81.13	66.61	38.71	49.19
7	28.36	6.26	2.35	3.38	5.40	30.11	60.80	33.41	29.56
8	33.00	9.76	3.64	4.11	9.61	65.15	61.35	24.05	28.10
9	32.64	9.57	3.63	2.43	9.41	56.37	77.17	22.86	15.11
10	19.80	13.29	3.82	7.34	5.43	37.47	42.77	39.16	47.85
11	23.56	11.36	3.42	4.35	15.43	74.28	56.47	39.01	35.02
12	34.50	8.35	3.07	2.89	8.11	60.00	57.75	24.58	30.69
13	18.00	9.86	3.58	1.97	18.31	77.22	76.78	30.88	12.04
14	25.00	10.92	3.50	5.45	9.41	52.56	61.88	31.32	26.40
15	30.00	11.97	3.19	6.08	10.06	76.33	37.98	34.71	52.58
16	29.80	11.50	2.39	5.79	5.85	62.08	51.38	19.39	37.09
17	16.00	14.54	3.57	3.51	7.99	27.13	69.15	42.59	21.05
18	30.48	12.03	3.61	5.85	6.52	60.70	41.55	27.33	47.97
19	16.00	9.89	3.52	3.86	3.94	36.38	59.03	22.14	31.45
20	29.00	8.81	3.24	3.36	6.22	38.97	57.64	30.38	34.54
21	34.50	10.16	2.74	5.34	13.75	68.12	48.77	43.25	40.93
22	20.00	6.44	2.17	2.85	14.47	56.60	61.77	41.40	29.36
Mean	28.06	9.88	3.20	4.04	9.24	55.39	59.25	30.34	31.25
Max.	53.00	14.54	3.84	7.34	18.31	81.13	77.19	43.25	52.58
Min.	16.00	5.96	2.11	1.33	3.94	27.13	37.98	14.97	12.04
SD	8.85	2.30	0.55	1.59	3.81	16.03	11.32	8.46	11.46
CV (%)	31.52	23.26	17.18	39.29	41.23	28.94	19.10	27.87	36.67

BW = Bunch wt., FW = Fruit wt., PFW = Parthenocarpic fruit weight, NW = Nut wt., OB = Oil to bunch, FB = Fruit to bunch, MF = Mesocarp to fruit, OWM = Oil to wet mesocarp, SF = Shell to fruit.

Table 2. Important vegetative traits of *Elaeis oleifera* palms.

Palm No.	HI (m)	FFW (kg)	FDW (kg)	RL (m)	LLW (cm)	LLL (cm)	LLN
1	0.25	11.25	2.60	6.61	8.83	115.33	164.33
2	0.20	15.50	4.43	6.85	7.88	129.50	162.00
3	0.08	10.75	4.17	6.73	7.82	107.17	156.00
4	0.35	16.00	3.78	6.70	7.95	125.00	148.00
5	0.40	15.75	3.84	6.15	8.15	128.67	147.66
6	0.13	17.25	4.36	5.34	6.83	121.50	146.00
7	0.15	17.50	4.67	6.74	8.15	131.17	160.00

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Palm No.	HI (m)	FFW (kg)	FDW (kg)	RL (m)	LLW (cm)	LLL (cm)	LLN
8	0.18	17.75	4.17	5.60	7.47	129.00	140.00
9	0.35	19.25	5.30	7.27	8.03	120.83	160.10
10	0.20	20.25	4.84	6.73	8.37	114.17	176.30
11	0.15	18.50	4.66	5.93	8.10	114.83	142.00
12	0.13	17.25	3.89	7.44	8.13	105.67	164.20
13	0.73	15.00	3.96	6.86	7.68	108.83	172.00
14	0.18	22.00	5.78	6.96	7.77	126.50	144.00
15	0.30	21.25	5.55	7.55	7.87	132.67	152.80
16	0.18	16.75	4.58	6.95	7.80	112.33	164.00
17	0.13	19.00	4.63	6.95	7.32	150.83	154.40
18	0.20	17.75	4.27	7.10	8.03	115.00	154.00
19	0.25	22.25	5.02	6.55	9.38	122.33	120.30
20	0.21	16.50	5.18	5.85	7.47	116.83	98.00
21	0.20	20.75	4.85	6.90	8.55	118.17	158.00
22	0.30	19.00	4.31	5.65	7.27	133.00	160.10
23	0.37	8.75	1.93	7.20	6.10	149.00	150.30
Mean	0.25	17.22	4.38	6.64	7.87	122.97	151.83
Max	0.73	22.25	5.78	7.55	9.38	150.83	176.00
Min	0.08	8.75	1.93	5.34	6.10	105.67	98.00
SD	0.14	3.44	0.86	0.60	0.66	11.75	16.62
CV (%)	55.38	19.98	19.63	9.09	8.35	9.56	10.95

HI = Height increment, FFW = Frond Fr. wt., FDW = Frond Dry wt., RL = Rachis length, LLW = Leaflet width, LLL = Leaflet length, and LLN = Leaflet No.

Table 3. Ranking of *Elaeis oleifera* palms based on yield, bunch and vegetative characteristics.

Palm No.	Ranking numbers based on important traits					
	Mean FFB yield	Bunch No.	Fruit to bunch	Oil to bunch	Height increment	Rachis length
1	16	13	10	7	15	8
2	6	16	20	12	10	13
3*	23	17	6	15	1	10
4	3	11	14	11	19	9
5	5	2	16	21	22	6
6	1	1	1	3	2	1
7	10	12	21	20	5	12
8	20	5	7	8	7	2
9	14	6	13	9	20	21
10	19	19	18	19	11	11
11	21	15	4	2	6	5
12	15	3	11	13	3	22
13	22	20	2	1	23	14

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Palm No.	Ranking numbers based on important traits					
	Mean FFB yield	Bunch No.	Fruit to bunch	Oil to bunch	Height increment	Rachis length
14	13	14	15	10	8	18
15	9	8	3	6	17	23
16	4	9	8	18	9	16
17	18	21	22	14	4	17
18	8	7	9	16	12	19
19	17	22	19	22	16	7
20	11	10	17	17	14	4
21	2	4	5	5	13	15
22	7	18	12	4	18	3
23	12	NA	NA	NA	21	20

*Palm No. 3 showed dried leaves throughout evaluation period and undesirable.

NA : Data not included due to non-availability bunches (bud rot affected but recovered fully).

palms could be provisionally screened (palm Nos. 6, 8, 11 and 21) based on various attributes, viz., yield performance, bunch quality characteristics, height increment and other vegetative characteristics. Palm No. 6 which recorded highest FFB yield and possessed compact characteristics was ultimately selected for producing interspecific hybrids and further breeding for dwarf palms.

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