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Research Article

MORPHOLOGICAL CHARACTERIZATION AND IDENTIFICATION OF OIL PALM DURA MOTHER PALMS FOR YIELD AND DWARF TRAITS

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Abstract: African oil palm has the highest productivity amongst cultivated oil seeds crops. The Asian oil palm industry has developed at a great rate, and now leads the world. Indonesia became the global leader in palm oil. Nearly 90% of the world's oil palm seed production is based on Deli Dura, which originated from the four Bogor palms. African oil palm trees can reach up to 30 meters in height. There is no source of high yielding and short stature mother palms in India. Productivity and harvesting are the two major gaps in oil palm production in India. After eight years of palm age it is very difficult to harvest bunches manually by climbing palm due to its tall in stature. The present identified Palm No 33 has a highest yield (181.70 kg), a greater number of bunches (20.50) and less height increment (18 cm) in comparison to other progenies by taking moving average (Yield: 98.13 kg, No. of bunches: 13.38, Height increment: 32.48 cm) of the same cross. The mesocarp content of this accession also more (72.20%) when compared with the standard Dura's. Another palm selected (Palm N0: 47) has a highest yield (221.30 kg) and medium height increment (33.00cm) in comparison to other progenies by taking moving average (Yield: 103.77 kg, Height increment: 31.81 cm) of the same cross. The utilization of high-yielding genetic base as a planting material has been proven to be the most efficient and sustainable means of increasing the yield output of existing oil palm genetic base. This genetic stock recorded highest yield and short stature compared with other progenies. However, it can be used as a mother parent for the development of high yielding and dwarf oil palm hybrids.

Keywords: *Dura, Palm, Yield, Height increment*

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Introduction

The African oil palm (*Elaeis guineensis* Jacq.) is the most productive and versatile oil yielding crop, almost five times more oil per hectare than any other oil yielding crops. This crop produces about 4-6 Mt ha^{-1} $year^{-1}$ of crude palm oil (CPO) [1] as against 0.4 t ha^{-1} $year^{-1}$ of soybean oil and 0.6 t ha^{-1} $year^{-1}$ of rapeseed oil. Palm oil contributing 39% to world production of vegetable oils and is currently the most important vegetable oil commodity in the world [2]. The world population is expected to be over nine billion by 2050, and the demand for palm oil to be between 120 and 156 million tons [3]. Oil palm can be catalyst to meet global vegetable oil demand and nutritional security. Indonesia and Malaysia are the two countries contribute 85% of the global palm oil supply, which accounted for 34% of world vegetable oils consumption in 2018.

The FFB (fresh fruit bunch) yield is a major economic trait that determines the productivity of oil palms. For researchers it is critical to know the heritability estimates of bunch production, characters, the relationship between these components, and their contribution toward oil yield [4]. Oil palm plants respond and adapt differently to the selection pressures and environmental conditions imposed by distinct agro-climatic zones.

The Tenera is a heterozygous (Sh/sh) hybrid produced by crossing a thick-shelled female *Dura* (Sh/Sh) with a no-shell male *Pisifera* (sh/sh). Mostly Deli *Dura*'s are utilized as mother palms, since they assure for superior bunch and fruit characteristics. The Deli *Dura* × AVROS *Pisifera* (P) has been the common commercial planting material since late 1953. Plantations need compact and dwarf materials to maximize their land use and shorter stature makes harvesting easy and more efficient. The objective of the present paper is identification of high yielding and dwarf mother palms.

Materials and Methods

Dura material from two DxD crosses (selected for high yield and dwarfness) were evaluated during 2015-16, 2016-17, 2017-18 and 2018-19 the best performing palms with more yield and less height increment were selected based on the mean of two years. 100 progenies of exotic source material planted during 2009 at ICAR- Indian Institute of Oil Palm Research, Pedavegi, Andhra Pradesh were evaluated. Morpho-physiological parameters like girth, height, height increment, number of leaves, petiole width, petiole depth, number of leaflets, rachis length, leaflet length (LLL), leaflet width (LLW), leaf area (LA), leaf dry weight (LDW), and yield parameters like bunch number (BN), bunch weight (BW), average bunch weight (ABW), oil/bunch ratio were recorded as per [5]. Sixth year onwards observations were recorded for palm height (PH) measured from the ground level to the base of the 41stfrond; height increment (HI) was calculated according to Breure and Powell (1987) using the formula: height increment/year = (height at year t) / (t - 2), where t is the age of the palm; and stem girth (SG) recorded as circumference of the stem above 0.5m of the ground level. The dry matter parameters were calculated by using the formulae: Leaf Area (LA) in Sq cm=0.57 x NLL x LLL x LLW /100 /100; Leaf Dry Weight (LDW) in Kg = 0.1023 x (PW X PD) + 0.2062; Average Bunch Weight (ABW in kg) = Bunch Weight / Number of Bunches.

Results and Discussion

The observations for the present study carried out from 2016 to 2019 for its yield and growth parameters. Oil palm produce one leaf per month and each leaf end with either male or female inflorescence. The present study revealed that among the 100 progenies Palm No. 33 (IOPPV002964), Palm No. 47 (IOPPV002978) and

Table -1 *Three years average of yield and height for identified Dura palms*

Palm	Character	2016-17	2017-18	2018-19	AVG
Palm No.47	Bunch number	19.00	22.67	20.83	20.66
	Bunchweight(Kg/Palm/year)	206.15	236.39	221.3	221.28
	Height Increment (cm)	29	33	28	30
Palm No.33	Bunch number	18	23	20.50	20.50
	Bunch weight(Kg/Palm/year)	143.27	220.22	181.70	181.73
	Height Increment (cm)	19	18	18	18.33
Palm No.72	Bunch number	20	24	23	20.66
	Bunch weight (Kg/Palm/year)	145.55	202.42	211.70	230.08
	Height Increment (cm)	33	32	30	31.66

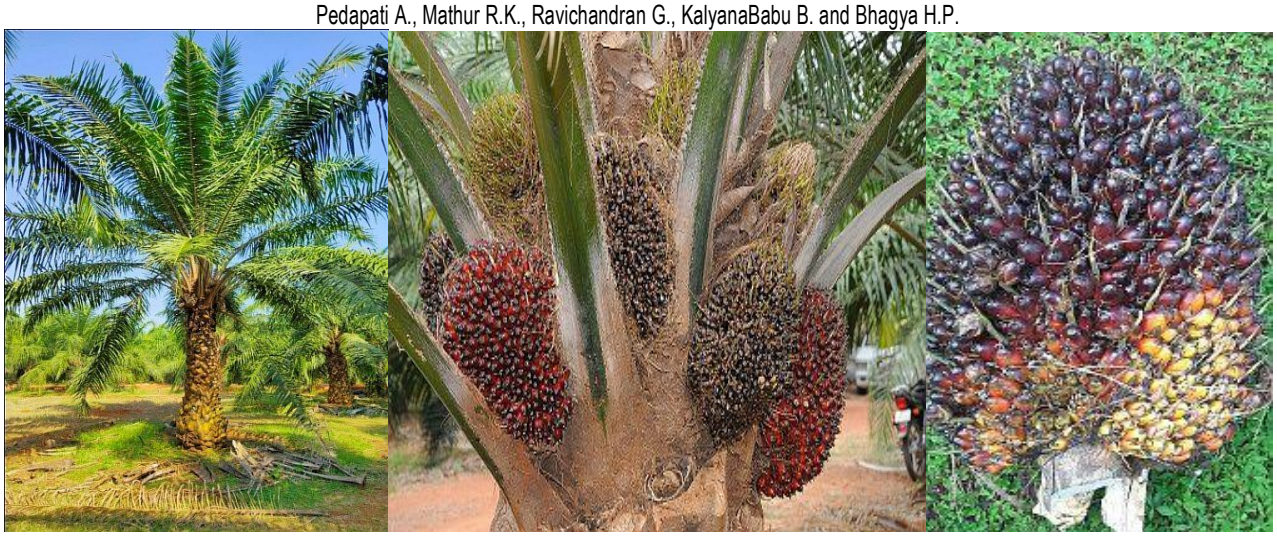
Table-2 *Characterization of promising oil palm Dura palms (Latest three years)*

Character	Palm No. 47			Palm No. 33			Palm No. 72		
	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
Flower colour	White	White	White	White	White	White	White	White	White
Fruit form	Dura (fertile)	Dura (fertile)	Dura (fertile)	Dura (fertile)	Dura (fertile)	Dura(fertile)	Dura(fertile)	Dura (fertile)	Dura (fertile)
Tree form	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Fruit colour	Nigrescence	Nigrescence	Nigrescence	Nigrescence	Nigrescence	Nigrescence	Nigrescence	Nigrescence	Nigrescence
Mesocarp pigmentation	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Girth (cm)	268	289	295	275	280	284.10	254	273	290
Height (cm)	237	248	250	204	211	230	192	219	240
Petiole Width(cm)	8.00	8.10	9.0	4.8	5.3	6.1	5.4	6.2	7.6
Petiole Depth (cm)	11.6	12.7	12.5	7.2	8.2	9.1	5.1	6.2	10.5
No. of Leaflets	120	147	304	138	144	288	142	155	312
Rachis Length(cm)	381	450	554	320	354	461	349	412	515
Leaflet Length (cm)	73.58	80.33	95.25	48.2	53.55	76.33	70.14	80.16	88.67
Leaflet Width (cm)	4.00	4.06	3.11	2.98	3.76	3.45	3.2	3.33	3.82
Leaf Area (sqcm)	1.80	2.73	5.46	1.01	1.65	4.32	1.62	2.35	6.02
Leaf Dry Weight (Kg)	9.69	10.72	7.09	3.74	4.65	5.88	3.02	4.13	8.37
Total no. of fruits	1024	1098	1284	1196	1358	1514	1068	986	1053
Fruit/Bunch	0.56	0.51	0.57	0.57	0.5	0.58	0.61	0.57	0.68
Oil/Bunch	13.25	12.99	13.5	15.24	14.68	17.72	12.65	12.97	14.63
Shell (%)	25.41	13.52	26.75	15.23	18.62	23.2	16.54	19.54	24.43
Mesocarp (%)	60.12	55.30	57.40	58.64	69.12	72.2	52.68	50.31	50.63

Table-3 *Selected promising palms for hybridization*

		2015-16			2016-17			Average of 2 years			
SN	PN	BN	BW	ABW	BN	BW	ABW	BN	BW	ABW	HI
Based on height and yield											
1	47	19	206.15	10.85	22.67	236.39	10.42	20.83	221.3	10.42	33
2	91	18	202.13	11.23	22.00	214.50	9.75	20.00	208.3	9.75	32
3	73	20	189.58	9.48	21.00	202.18	9.63	20.50	195.9	9.63	24
4	33	18	143.27	7.96	23.00	220.22	9.57	20.50	181.7	9.57	18
5	19	22	174.61	7.94	20.00	180.72	9.04	21.00	177.7	9.04	46
6	74	18	165.89	9.22	24.00	184.67	7.69	21.00	175.3	7.69	36
7	54	18	167.81	9.32	23.00	181.95	7.91	20.50	174.9	7.91	22
8	72	20	145.55	7.28	24.00	202.42	8.43	22.00	174.0	8.43	30
9	78	19	181.75	9.57	18.00	153.35	8.52	18.50	167.6	8.52	33
Based on morphological appearance											
10.	2	15	46.12	3.07	17.00	135.96	8.00	16.00	91.0	8.00	35
11.	10	16	101.65	6.35	22.00	144.80	6.58	19.00	123.2	6.58	18
12.	13	10	54.21	5.42	25.67	214.46	8.26	17.83	134.3	8.26	20
13.	38	6	38.95	6.49	16.00	110.04	6.88	11.00	74.5	6.88	21
14.	43	3	19.24	6.41	18.00	145.31	8.07	10.50	82.3	8.07	19

Palm No. 72 (IOPPV003003) are the promising in terms of its yield and height increment parameters. The maximum bunch weight (236.39 Kg/Palm/Year) with 22.67 bunches were seen in Palm No. 47 with less annual height increment (33cm) during 2017-18. The yield of the next consecutive year of this palm reduced due the utilization of the female inflorescences for hybridization purposes. The present identified Palm No.33 has a highest yield (181.70 kg), a greater number of bunches (20.50) and less height increment (18 cm) in comparison to other progenies by taking moving average (Yield: 98.13 kg, No. of bunches: 13.38, Height increment: 32.48 cm) of the same cross. The mesocarp content of this accession also more (72.20%) when compared with the standard *Dura*'s. Another palm selected (Palm No: 47) has a highest yield (221.30 kg) and medium height increment (33.00cm) in comparison to other progenies by taking moving average (Yield: 103.77 kg, Height increment: 31.81 cm) of the same cross. A medium height palm (Palm No: 72) having a greater number of bunches (22.00) with medium height increment (30 cm) in comparison to other progenies by taking moving average (No. of bunches: 15.40, Height increment: 31.56 cm) of the same cross [Table-1]. The flowers are white in colour with normal stature of tree, fruits are black (Nigrescence) with normal mesocarp for all the progenies of *Dura*. The girth and height were, on average, respectively of 284.10 cm and 230 cm in Palm No. 33. The leaf area of Palm No. 72 recorded very less (2.35 sqcm). Leaf area is one of the important parameters of dwarf palms. The other important morphological parameters are also superior to selected three palms. The oil/ bunch ratio was observed maximum in palm No. 33 (17.72) during 2018-19 followed by the same palm during 2016-17 (15.24) and minimum in Palm No. 72 (12.65) during 2016-17 [Table-2]. The highest mesocarp content was also found in Palm No. 33 (72.20) during 2018-19 and lowest in Palm No. 72 (50.31). The utilization of high-yielding genetic base as a planting material has been proven to be the most efficient and sustainable means of increasing the yield output of existing oil palm genetic base [6,7]. Total 14 palms with highest yield and less height increment were selected based on the mean of 2 years (2015- 16 and 2016-17). Palm No. 47 & 91 recorded highest yield (> 200 kg yield/ palm) [Table-3] and [Fig-1]. Selected high yielding palms of *Dura* are being utilized in the hybridization programme both for production of commercial planting material (DxP) and for production of advanced breeding material.



Palm No. 33

Palm No. 47

Palm No. 72

Fig-1 Identified dwarf Dura mother palms

Conclusion

The highyielding and dwarf genetic base can be used as a planting material for efficient and sustainable increase oil palm productivity. These identified *Dura*'s recorded as the highest yielding and short stature compared with the other progenies. Harvesting is the major problem in aged oil palm gardens, so development of dwarf palms is very useful to the farmers. However, it can be used as a mother parent for the development of high yielding and dwarf oil palm hybrids. Dwarf palms can improve yields, easy to harvest, maximize land use and improve palm oil sustainability. These genetic stocks recorded highest yield and short stature compared with other progenies. However, it can be used as a mother parent for the development of high yielding and dwarf oil palm hybrids

Application of research: The high yielding and low height increment *Dura* palms can be used as a mother parent for the development of high yielding and dwarf oil palm hybrids

Research Category: Oil palm breeding

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Study area / Sample Collection: ICAR-Indian Institute of Oil Plam Research, Pedavegi, West Godavari-534450, AP.

Cultivar / Variety / Breed name: *Dura*

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Ethical Committee Approval Number: Nil

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