CLONAL PALM SERIES 2 (CPS2)

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The Malaysian oil palm industry recorded an average oil yield of 3.53 t ha^{-1} yr^{-1} in 2017 (MPOB, 2018). It was postulated that the oil palm has the genetic potential of attaining oil yield of up to 18.5 t ha^{-1} yr^{-1} (Corley, 1998). To narrow the yield gap, genetic gain through breeding and vegetative propagation could provide the much needed boost in yields (Kushairi *et al.*, 2010). Planting clonal oil palm under good agricultural practices (GAP) has proven to increase yields by at least 10%-15% (Soh, 1986). Despite its potential, less than 5% of oil palm plantings in Malaysia are derived from tissue culture.

Therefore, to improve productivity, planting of oil palm clones should be intensified. Following the discovery of KARMA (Ong-Abdullah *et al.*, 2015), a tool to screen clonal abnormality has provided added confidence for the industry to utilise clones in their fields (Ong-Abdullah *et al.*, 2016). Generally, the focus in clonal propagation of oil palm has been on production of high yielding materials (Zamzuri, 2011; Zulkifli *et al.*, 2017). In addition to producing high yield, materials have also been selected for compactness to improve productivity. Compact palms can be planted at higher density.

THE TECHNOLOGY

MPOB initiated a mass propagation programme for clonal planting materials named CPS1 (Clonal Palm Series 1) in 2017 (Tarmizi *et al.*, 2017). Subsequently, palm 0.150/2657 were selected and used as ortet for cloning. Its ramets were planted and evaluated in several locations including Kluang *(Table 1* and *Figure 1)* and Bagan Datuk (*Table 2*). At nine years after planting, CPS2 has the potential of achieving 35.7 t ha^{-1} yr^{-1} FFB with an oil yield of 10.8 t ha^{-1} yr^{-1} while planted at a density of 198 palms ha^{-1} (Zamzuri, 2011) as opposed to the 136 or 148 palms ha^{-1}. In addition, reclones of CPS2 showed almost zero mantling (*Figure 2*).

NOVELTY OF CPS2

1. Distinctive morphological traits:
   - Thin petiole cross section (PCS) of 15.7 cm^2 *vs.* 39.3 cm^2 of DxP standard cross.
   - Short rachis length (RL) of 4.5 m *vs.* 6.1 m of DxP standard cross.
   - Slow height increment (HT) of 24 cm yr^{-1} *vs.* 40 cm yr^{-1} of DxP standard cross.
   - High bunch index (BI) of 0.51 *vs* 0.30 of DxP standard cross.
2. Suitable for high density planting at 198 palms ha^{-1}.
3. Medium-sized bunches.

Figure 1. CPS2 planted at MPOB Research Station Kluang, a) Three-year-old palm with high bunch number and b) Ten year palms showing more space between fronds among adjacent palms planted at high density of 198 palms ha^{-1}.

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TABLE 1. VEGETATIVE PERFORMANCE OF CPS2 CLONE AT MPOB RESEARCH STATION KLUANG

Family Mean for Vegetative Measurement in Trial 0.462
Date Planted: November 2006 Material: CPS2 Breeding Design: Clonal

No.	Progeny Code	Pedigree	Mean 2014					2016
			n	PCS (cm^2)	RL (m)	HT (m)	LAI (m^2)	BI
1	TR 1	KLU 0.150/2657	19	17.69	4.71	1.50	4.18	0.49
2	TR 11	KLU 0.150/2657	21	14.89	4.39	1.41	3.85	0.54
3	TR 12	KLU 0.150/2657	20	13.38	4.27	1.49	3.38	0.53
4	TR 2	KLU 0.150/2657	20	16.27	4.56	1.53	3.98	0.48
5	TR 3	KLU 0.150/2657	20	15.92	4.55	1.22	4.00	0.46
6	TR 4	KLU 0.150/2657	10	18.34	4.72	1.54	4.43	0.56
7	TR 4 + (TR 13)	KLU 0.150/2657	4	15.34	4.42	1.23	4.18	0.44
8	TR 5	KLU 0.150/2657	20	15.03	4.63	1.42	3.82	0.52
9	TR 6	KLU 0.150/2657	20	15.80	4.55	1.61	3.96	0.5
10	TR 8	KLU 0.150/2657	10	15.91	4.47	1.30	3.69	0.54
11	DxP Std Cross	0.212/270 x 0.174/480	19	39.34	6.05	2.34	6.79	0.3
MEAN			**164**	**15.74**	**4.53**	**1.44**	**3.91**	**0.51**
SOURCE OF VARIATION			**df**	**MS**	**MS**	**MS**	**MS**	**MS**
Between family			9	31.55**	0.35**	0.26**	1.22**	0.02
Within family			154	7.60	0.06	0.04	0.39	0.00

Note: n= number of palms, PCS= petiole cross section, RL= rachis length, HT= height, LAI= leaf area index, BI= bunch index.

TABLE 2. YIELD PERFORMANCE OF CPS2 CLONE AT MPOB RESEARCH STATION BAGAN DATUK

Family Mean for Bunch Yield in Trial 0.473
Date Planted: December 2007 Material: CPS2 Breeding Design: Clonal

Materials	Year 4			Year 5			Year 6			Year 7			Year 8			Year 9		
	FFB	BNo	BWT	FFB	BNo	BWT	FFB	BNo	BWT	FFB	BNo	BWT	FFB	BNo	BWT	FFB	BNo	BWT
CPS2	95.7	29.0	3.4	133.2	30.0	4.4	167.5	27.0	6.2	175.9	24.0	7.3	160.3	22.0	7.2	164.4	18.0	9.2
DxP	89.0	20.0	4.0	100.6	18.0	5.6	134.5	17.0	7.7	164.6	19.0	8.6	192.3	19.0	9.9	167.9	13.0	9.9

Note: Year (no)= yield recording after planting, FFB= fresh fruit bunch (kg $palm^{-1}$ yr^{-1}), BNo= bunch number, BWT= average bunch weight (kg).

Figure 2. Cross-section of CPS2 fruits.

BENEFITS AND ADVANTAGES

- Can be planted at higher density (example 198 palms ha^{-1}).
- Higher density planting improves productivity per hectare.
- Potential of achieving 35.7 t ha^{-1} yr^{-1} FFB with an oil yield of 10.8 t ha^{-1} yr^{-1}.

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