# CLONAL PALM SERIES 4 (CPS4)

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Poor fruit set has been reported at specific sites by some oil palm plantations and is a growing concern, especially in peat areas. The malformed and parthenocarpic fruits, if severe, could eventually affect productivity especially oil yield. Insufficient pollen source due to the low numbers of male inflorescence (MI) and scant breeding sites for the pollinating insects leads to poor fruit set, resulting in lower fresh fruit bunch (FFB) and oil yield (Norman *et al*., 2018). Insufficient supply of viable pollens affects the pollination efficiency of *Elaiedobius kamerunicus*, the oil palm's natural pollinator. Planting highly productive DxP and clonal palms at high density in such areas further aggravates the situation. As a consequence, high number of parthenocarpic fruitlets and malformed bunches are observed in some cases (Harun and Noor, 2002), eventually affecting oil yield.

The discovery of clones that have higher MI production with lower abortion rate or a 'super male' character, offers much hope in overcoming the issues related to the poor fruit set phenomenon (Mohd Isa *et al.*, 2023). Oil palm trees that demonstrate a lower sex ratio can potentially improve pollination efficiency. Thus, to provide a balance between the production of good fruit sets and pollen supply, an oil palm clone namely CPS4, has been identified as an excellent pollen source to help improve pollination efficiency, especially in areas with palms recording high sex ratios.

## THE TECHNOLOGY

Over the past decade, the MPOB's Tissue Culture Program has generally focused on clonal propagation for yield improvement. However, as research and development continue towards this goal, the serendipitous discoveries of unique traits in clonal palms have encouraged MPOB to cast our net wider in the development of new variants, such as a 'super male' (Zamzuri, 2011).

CPS4 originates from a *dura* x *pisifera* (DxP) oil palm planted at the Hulu Paka MPOB Research Station in Terengganu. The palm with superior yield *i.e.* FFB of 195.07 kg palm$^{-1}$ yr$^{-1}$ and oil to bunch (O/B) of 31.78%, was cloned in 2002. Through a collaborative effort between MPOB and Johor Plantations Group Berhad (JPG), mass evaluation of the MPOB clones, including CPS4, was conducted since 2019 by JPG at Ladang Basir Ismail, Southern Johor to explore variants demonstrating male dominant character. This study involved 12 clones, two commercial DxPs, and a progeny of *dura*, *pisifera* and DxP standard cross, respectively.

The results recorded till 2023 led to the identification of CPS4 as a prospective male-dominant clone with low abortion rate, concurrently producing higher oil yield (50.8 kg palm$^{-1}$ yr$^{-1}$) compared to standard DxP (46.0 kg palm$^{-1}$ yr$^{-1}$) *Table 1*. The average MI recorded over four consecutive years for CPS4 was 12.6 MI palm$^{-1}$ yr$^{-1}$, compared to only 6.9 MI palm$^{-1}$ yr$^{-1}$ on average observed for the other clones. The female sterile *pisifera* produces 16.2 MI palm$^{-1}$ yr$^{-1}$, while DxPs produce 9.8 MI palm$^{-1}$ yr$^{-1}$ with significantly lower yield productivity than CPS4. Incorporation of this 'super male' palm in the cultivation of commercial clones at a specific density, would help to achieve better yields based solely on clones rather than relying on DxP as the pollen source. Studies are ongoing to continuously evaluate the effectiveness of the 'super male' CPS4 in assisting and enhancing the oil palm fruit set formation.

## NOVELTY OF CPS4

- CPS4 produce ~13 MI yr$^{-1}$ compared to the average of ~7 MI yr$^{-1}$ by other clones.
- Produces higher oil yield (50.8 kg palm$^{-1}$ yr$^{-1}$) as compared to 46.0 kg palm$^{-1}$ yr$^{-1}$ of the average DxP.

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**TABLE 1. MEAN OF SELECTED TRAITS FOR FFB, BUNCH COMPONENTS AND MI FROM TRIAL P15 (MOPC), BASIR ISMAIL ESTATE, JOHOR PLANTATIONS GROUP BERHAD (JPG), MALAYSIA**

| No | Code | N | FFB mean (2019-2023) | | | Bunch components | | | | | MI | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | MFFB | MBNO | MABW | O/B | K/B | OY | KY | TEP | 2020 | 2021 | 2022 | 2023 | Mean |
| 1 | CPS4 | 40 | 188.4$^{ab}$ | 16.2$^{bc}$ | 12.4$^{a}$ | 27.0$^{b}$ | 3.5$^{b}$ | 50.8$^{a}$ | 6.6$^{ab}$ | 54.8$^{a}$ | 8.2$^{bc}$ | 13.8$^{b}$ | 13.9$^{a}$ | 14.8$^{a}$ | 12.6$^{b}$ |
| 2 | Other clones | 213 | 196.3$^{a}$ | 19.3$^{a}$ | 10.7$^{c}$ | 26.9$^{b}$ | 3.1$^{b}$ | 52.7$^{a}$ | 6.2$^{ab}$ | 56.5$^{a}$ | 5.3$^{d}$ | 7.6$^{e}$ | 7.5$^{c}$ | 7.3$^{c}$ | 6.9$^{e}$ |
| 3 | DxP SC | 30 | 159.9$^{bc}$ | 14.3$^{c}$ | 11.9$^{ab}$ | 25.0$^{c}$ | 4.4$^{a}$ | 39.9$^{b}$ | 7.1$^{a}$ | 44.2$^{b}$ | 10.2$^{b}$ | 10.6$^{cd}$ | 11.6$^{b}$ | 10.9$^{b}$ | 10.8$^{c}$ |
| 4 | DxP Comm. 1 | 85 | 171.3$^{bc}$ | 16.6$^{b}$ | 10.9$^{bc}$ | 28.8$^{a}$ | 3.4$^{b}$ | 49.4$^{a}$ | 5.9$^{ab}$ | 52.9$^{a}$ | 7.9$^{c}$ | 8.8$^{de}$ | 10.0$^{b}$ | 10.8$^{b}$ | 9.3$^{d}$ |
| 5 | DxP Comm. 2 | 392 | 167.2$^{bcd}$ | 16.3$^{bc}$ | 10.8$^{c}$ | 29.1$^{a}$ | 3.3$^{b}$ | 48.7$^{a}$ | 5.6$^{b}$ | 52.1$^{a}$ | 8.0$^{c}$ | 8.3$^{de}$ | 10.0$^{b}$ | 10.9$^{b}$ | 9.3$^{d}$ |
| 6 | DxD | 11 | 147.3$^{d}$ | 17.2$^{b}$ | 9.5$^{d}$ | 22.1$^{d}$ | 3.6$^{b}$ | 32.3$^{c}$ | 5.3$^{b}$ | 35.6$^{c}$ | 4.1$^{d}$ | 13.8$^{bc}$ | 10.6$^{b}$ | 9.6$^{b}$ | 9.1$^{d}$ |
| 7 | PxP | 40 | 4.7$^{e}$ | 0.8$^{d}$ | 2.1$^{e}$ | na | na | na | na | na | 16.2$^{a}$ | 16.9$^{a}$ | 15.4$^{a}$ | 16.2$^{a}$ | 16.2$^{a}$ |
| Mean | | 811 | 167.7 | 16.3 | 10.5 | 28.1 | 3.3 | 49.4 | 5.9 | 53.0 | 7.7 | 9.0 | 9.9 | 10.4 | 9.2 |
| **Source of variation** | | **df** | **MS** | **MS** | **MS** | **MS** | **MS** | **MS** | **MS** | **MS** | **MS** | **MS** | **MS** | **MS** | **MS** |
| Between family | | 6 | 210 399.0* | 1 952.0* | 516.8* | 292.8* | 9.0* | 1 707.7* | 25.8* | 1 747.8* | 745.5* | 697.8* | 529.9* | 716.2* | 601.2* |
| Within family | | 804 | 1 009.1 | 8.6 | 1.9 | 6.6 | 0.8 | 105.7 | 4.4 | 120.4 | 8.6 | 13.1 | 9.8 | 5.4 | 3.5 |

Note: FFB = fresh fruit bunch (kg palm$^{-1}$ yr$^{-1}$); MI = male inflorescence; BNO = bunch number (no. palm$^{-1}$ yr$^{-1}$), ABW = average bunch weight (kg); O/B = oil to bunch (%); K/B = kernel to bunch (%), OY = oil yield (kg palm$^{-1}$ yr$^{-1}$); KY = kernel yield (kg palm$^{-1}$ yr$^{-1}$), TEP = total economic product (kg palm$^{-1}$ yr$^{-1}$); na = not available; ** = statistically significant; SC = standard cross; Comm. = commercial


*Figure 1. A CPS4 palm, planted in Basir Ismail Estate bearing a balanced number of bunches and male inflorescences to ensure good fruit set.*

*Figure 2. A male inflorescence at anthesis from a CPS4 palm producing pollen and hosting the pollinating weevils, Elaeidobius kamerunicus (insect).*

## BENEFITS AND ADVANTAGES

- Bearing a balanced number of bunches (BNO) and MI that supports good fruit set.
- Supports a 100% clonal field and thus helps to realise the full yield potential of clones.
- Additional pollen source for plantations, which need not solely depend on DxP.

## ECONOMIC ANALYSIS AND COMMERCIALISATION POTENTIAL

**TABLE 2. INDICATORS FOR ECONOMIC ANALYSIS**

| Indicator | Value |
|---|---|
| Net present value (NPV) @10% | RM787,036.00 |
| Internal rate of return (IRR) | 35.49% |
| Discounted payback period | 7 years |
| Discounted benefit: Cost ratio (B:C) | 1.3 |
| Return on investment (ROI) | 49.06% |

The CPS4 materials are available at MPOB and Johor Plantations Group Berhad (JPG).

## CONCLUSION

CPS4, a male-dominant clone, holds promises as a natural pollen donor, that has the potential to mitigate issues related to oil palm fruit set observed in areas planted with clones.

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