

# Oil Palm Clones: Productivity Enhancement for the Future

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**Mass reproduction of high yielding palms is a major objective of oil palm tissue culturists. Developing plantlets from tissue of selected *tenera* palms is seen as the most promising technique towards more uniformity and higher efficiency in oil palm plantations.**

Clonal oil palm offers the potential for greater productivity because it is possible to establish uniform tree stands comprising identical copies (clones) of a limited number of highly productive oil palms (**Figure 1**). In addition, improved standards of field agronomy have a greater effect on productivity.

Cloning is a process in which identical or true-to-type 'photocopies' of a selected palm (ortet) are reproduced by developing plantlets from the leaf tissue of *tenera* oil palms with desirable characteristics (e.g., large yields...t palm products/ha...precocity, disease resistance, drought tolerance, and small height increment). Unfortunately, tissue culture sometimes accentuates the expression of defects in oil palm, particularly when embryogenesis is induced in a particular callus for prolonged periods. However, when suitable cloning protocols are used, the incidence of abnormalities (mantle fruitlets) is small whilst other defective traits that occur in DxP *tenera* palms (e.g., androgyny, hermaphroditism, parthenocarpy, sterility, chimera, collar snap, genetic orange spotting, etc.) are eliminated. In order to overcome problems related to genetic conformity, genetic identification (DNA finger printing) and the registration of proven clones have been proposed as preliminary steps towards controlled mass clone production (Khaw et al., 1999).



The greatest potential for increased productivity of oil palm is with properly prepared clones grown with balanced fertilization.

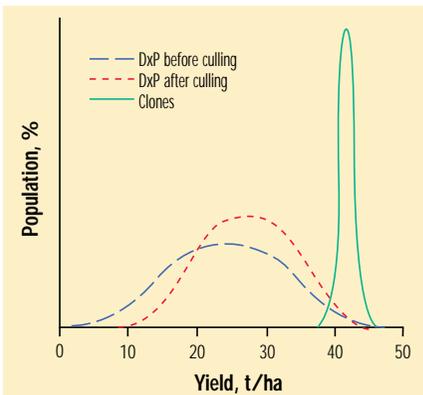


Figure 1. Diagram representing the distribution of palms in unselected DxP, culled DxP and clonal oil palm populations.

The cloning process involves the following steps:

- Selection of palms (ortets) with desirable characteristics.
- Removal of physiologically young leaf tissues (explants) from close to the growing point of the selected ortets.
- Development of callus on explants raised on a nutrient medium in culture tubes.
- Initiation of embryoids on callus (embryogenesis).
- Removal of embryoids from the callus and development of plantlets with functioning roots and shoots.
- Transplanting of plantlets and preliminary “hardening off”.
- Transfer of plantlets to the field nursery for adaptation to ambient climatic conditions.
- Conventional nursery phase. Planting takes place after 12 to 15 months.

The whole process from initial tissue culture to the development of mature, field-tested clones takes about 10 years.

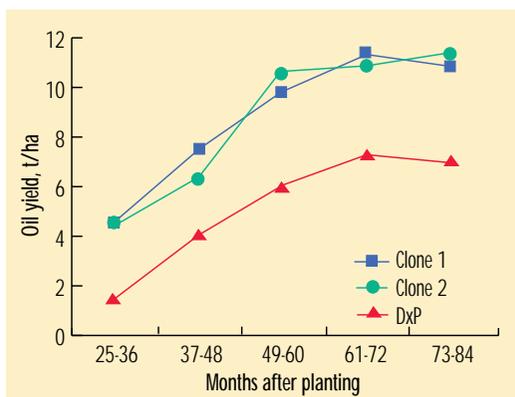
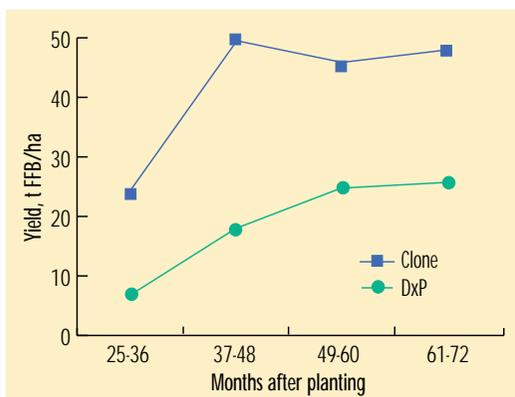
Only 30 to 40 percent of ortets are developed into viable clones. Therefore, a clone production facility requires a large resource base of elite palms...more than 10,000 per year...from which ortets are selected. A variable, but generally small number of plantlets (100 to 10,000) can be produced from a single ortet, and each ortet can only be harvested for leaf explants once in 3 to 5 years.

After the enthusiasm for clonal oil palm generated in the 1970s and the setbacks incurred in the 1980s, several thousand hectares have been planted successfully in Southeast Asia with clonal oil palms. A Malaysian group with nearly 100,000 mature clones in the field has met the most stringent criteria of success. This has been achieved by maintaining a near 100 percent level of key fruit and bunch trait replication and a very small incidence of abnormalities (less than 1 percent). Yield was 30 percent higher in the clones compared with DxP material grown in commercial size polyclonal test plots.

Greater amounts of fertilizer nutrient inputs are required to sustain higher yields in clonal oil palm, but clonal oil palms also use fertilizer nutrients more efficiently than DxP seedlings, **Table 1** (Woo et al., 1994). Clones yielded 9 to 11 t oil/ha from the third year of production onwards (**Figure 2**), and a world record fruit yield of 50 t fresh fruit

**Table 1.** Efficiency of K fertilizer use by clonal and DxP oil palm seedlings in Malaysia (Woo et al., 1994).

| Planting material | Cumulative (6 years) |                                    | Efficiency                 |     |
|-------------------|----------------------|------------------------------------|----------------------------|-----|
|                   | Oil yield t/ha       | K <sub>2</sub> O requirement kg/ha | kg oil/kg K <sub>2</sub> O | %   |
| Clones            | 31.3                 | 1,865                              | 16.8                       | 146 |
| DxP               | 19.4                 | 1,687                              | 11.5                       | 100 |



bunches (FFB)/ha was recorded in the second year after the start of harvest (**Figure 3**). Therefore, in spite of the greater cost of clones compared with DxP material and their greater fertilizer requirements, clones offer a large economic advantage over DxP material. **BCI**

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## References

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Figure 2. (At left) Fresh fruit bunch (FFB) yield of oil palm clone AGK19 and DxP seedlings during years 2 to 6 after planting on soils (Bukit Lanchu series) in Sarawak, Malaysia (Khaw et al., 1999).

Figure 3. (At right) Oil yields of oil palm clones and DxP seedlings during years 2 to 7 after planting on coastal soils (Carey series) of Malaysia (after Agrocom, 1998).

## Oil Palm in Southeast Asia, 1998

Oil palm continues to be Southeast Asia's most rapidly expanding crop. These data for 1998 summarize production and nutrient use for four countries.

| Country   |                 | Indonesia | Malaysia | Philippines | Thailand |
|---|-----------------|-----------|----------|-------------|----------|
| Area harvested                                    | thousand ha     | 1,980     | 2,320    | 19          | 143      |
| Immature area                                     | "               | 800       | 650      | 10          | 45       |
| Total   | "               | 2,700     | 2,970    | 29          | 188      |
| Likely expansion                                  | "               | 4,500     | 1,000    | 30          | 100      |
| Production FFB                                    | thousand tonnes | 29,510    | 43,700   | 273         | 2,300    |
| Prod. crude palm oil (CPO)                        | "               | 5,900     | 8,370    | 40          | 380      |
| Prod. palm kernels (PK)                           | "               | 1,300     | 1,650    | 8           | 90       |
| N, P, K, Mg fertilizer nutrient use               | kg/ha/year      |           |          |             |          |
| Average N application                             | "               | 60        | 95       | 50          | 55       |
| Average P <sub>2</sub> O <sub>5</sub> application | "               | 25        | 45       | 25          | 35       |
| Average K <sub>2</sub> O application              | "               | 10        | 170      | 70          | 120      |
| Average MgO application                           | "               | 5         | 30       | 1           | 3        |

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