Breeding for Sustainable High Yielding Oil Palm (Elaeis guineensis Jacq.) at P.T. Socfindo
By

Introduction
Talking about P.T. Socfindo

- Located in North Sumatra and D.I. Aceh
- 37,000 ha of oil palm plantations
- 10,000 ha of rubber plantations
- 9 oil palm mills
- 1 refinery
- 3 latex processing units
Talking about Cirad-CP

- Department of a French public organisation specialised in tropical and sub-tropical areas agronomy
- in charge of research projects concerning cacao, coconut, coffee, oil palm and rubber
Two genetic blocks implemented by the Company

- Aek Kwasan Genetic Block (1975 - 1978)

Fully connected to the other RRS team-mates headed by Cirad
Oil Palm Improvement at PT Socfindo
Scheme of RRS Program

- **Introduction**
  - Group A Initial Population
  - Introduce
  - Selected Individuals
  - Recombination
    - Group A Improved Population

- **Introduction**
  - Group B Initial Population
  - Introduce
  - Selected Individuals
  - Recombination
    - Group B Improved Population

- **Progenies A x B**
  - GCA – SCA Tests
  - Recombination

Breeding History at P.T. Socfindo

- 1920s: 17 Dura Deli and 8 Tenera Kuala Krapuh
- 1927 – 1943: Three generations of mass selection
- 1933 – 1934: First genetic field planted at Bangun Bandar
- 1970: Introduction of the RRS concept at P.T. Socfindo
- 1973 – 1978: First cycle trials at Bangun Bandar
- 1975 – 1979: Aek Kwasan Genetic Block
- 1979 – 1994: Second cycle trials at Bangun Bandar
Since 1970, 51 trials testing

- 1061 D*T, T*D and D*P progenies for its mainstream
The Aek Loba Timur Project

- Improving the Socfindo planting material for palm oil / ha
- Following on the breeding work started with Aek Kwasan Block
- Establishing RRS genetic blocks testing Pobé and PSBB parental material
The project

- Comprises 25 progeny trials and 3 clonal tests
- Covers 489 ha and 5 years of planting
- Tests 482 different D*T, T*D and D*P crosses
- Tests 45 clones
The project is divided into 3 parts:

- 18 trials testing SRPH Pobé second cycle parents
- 7 trials testing PSBB second cycle parents
- 3 clonal tests
Group A Grandparents:

D Socfindo: BB126D, BB129D, BB150D, BB177D, BB206D

D Socfin: LM269D, LM404D

D Dabou: DA3D, DA5D, DA10D, DA115D, DA128D, DA300D, DA551D, DA767D

Deli*Angola: LM5448T
<table>
<thead>
<tr>
<th>Group</th>
<th>Markers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kuala Krapuh</td>
<td>BB20T, BB85T</td>
</tr>
<tr>
<td>Nigeria</td>
<td>PO1876T, PO1879T</td>
</tr>
<tr>
<td>Ya / Si</td>
<td>LM238T, LM511P, LM718T</td>
</tr>
</tbody>
</table>
Control network:

- Between the ALT trials: 55 progenies and 1 clone
- With other RRS trials:
  - LM2T*DA10D
  - LM2T*DA115D
Example: link by 4 common progenies
Breeding for the Ganoderma tolerance
Aim of the programme:

- First step: developing a less susceptible planting material to BSR
- Second step: developing Ganoderma tolerant planting material
The scheme:

• SP01: Search of possible sources of tolerance in the third germplasm recombination
• SP02: Search of possible sources of tolerance in the current hybrids produced for commercial seeds
• SP03: Search of possible sources of tolerance in some genotypes tested at ALT
The current situation:

- 300 hectares
- 4 years of planting (2002-2005)
- 3 estates:
  - Bangun Bandar
  - Mata Pao
  - Tanah Gambus
- BRS prevalence exceeding 60%
Marker-assisted Breeding

Construction and exploitation of high density DNA marker and physical maps in the perennial tropical oil crops coconut and oil palm.
Objectives of the programme:

- Construct an oil palm high-density reference map and a multi-parent consensus linkage map
- Detect and analyse worthwhile genes of vegetative characters and production quality
- Define and recommend a MAB strategy for oil palm
• **Plant oil palm methodological trials**
• **Integrate the results of the project into current oil palm breeding programmes**
Current situation:

- All field observations and oil analyses required have been completed and sent to Cirad for the first research on QTLs.
- Plantation of the first methodological trial testing multi-parent F1-like progenies. Some parents are suspected or known to present genetic tolerance factors to BSR or Wilt Disease.
Choice criteria and statistical design
Evaluation of the hybrids:

- Estimate the genetic value of both parents
- Estimate the average value of the type of progeny
- Rank the progenies within the types of progeny
Criteria:

- Total oil production and precocity
- Height increment
- Disease tolerance
- Oil quality
Statistical designs

- Equilibrated lattice design
  - 4*4 (16 treatments)
  - 5*5 (25 treatments)
- Fisher blocks
Trial results:
All our results are corrected:

- FFB (t / ha) = FFB (kg) per tree * 135 / 1000
- \%OER = \%O/B * 0.855
- \%KER = \%K/B * 0.5 * 0.855
- \%TER = \%OER + \%KER
<table>
<thead>
<tr>
<th></th>
<th>%O/B</th>
<th>%OER</th>
<th>%KER</th>
<th>%TER</th>
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<tbody>
<tr>
<td>LM2T self</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LM2T partner</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DA10D self</td>
<td>24.14</td>
<td>22.41</td>
<td>1.98</td>
<td>24.39</td>
</tr>
<tr>
<td>DA10D*DA3D</td>
<td>28.29</td>
<td>24.22</td>
<td>2.11</td>
<td>26.33</td>
</tr>
<tr>
<td>DA5D*DA3D</td>
<td>28.31</td>
<td>24.26</td>
<td>1.84</td>
<td>26.10</td>
</tr>
<tr>
<td>DA115D self</td>
<td>29.91</td>
<td>25.62</td>
<td>1.96</td>
<td>27.58</td>
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<tr>
<td>LM404D self</td>
<td>32.09</td>
<td>27.47</td>
<td>1.44</td>
<td>28.91</td>
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<tr>
<td>LM404D*DA10D</td>
<td>29.61</td>
<td>25.37</td>
<td>1.62</td>
<td>27.00</td>
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## Yield at adult stage at Aek Kwasan (t/ha)

<table>
<thead>
<tr>
<th>LM2T self partner</th>
<th>FFB</th>
<th>CPO</th>
<th>Total Oil</th>
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<tbody>
<tr>
<td>DA10D self</td>
<td>26.9</td>
<td>6.03</td>
<td>6.56</td>
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<tr>
<td>DA10D*DA3D</td>
<td>26.2</td>
<td>6.39</td>
<td>6.94</td>
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<tr>
<td>DA5D*DA3D</td>
<td>28.5</td>
<td>7.00</td>
<td>7.48</td>
</tr>
<tr>
<td>DA115D self</td>
<td>26.1</td>
<td>6.75</td>
<td>7.26</td>
</tr>
<tr>
<td>LM404D self</td>
<td>25.0</td>
<td>6.81</td>
<td>7.17</td>
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<td>LM404D*DA10D</td>
<td>26.3</td>
<td>6.56</td>
<td>7.00</td>
</tr>
</tbody>
</table>
Height Increment

LM2T self partner Cm/year
DA10D self 48.2
DA5D*DA3D 46.4
DA115D self 44.1
LM404D self 52.1
LM404D*DA10D 52.6
Aek Loba Timur Project
Variability in 1995 common progenies

<table>
<thead>
<tr>
<th>OER (%)</th>
<th>FFB Kg/tree</th>
<th>CPO T/ha</th>
<th>Total Oil T/ha</th>
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<tbody>
<tr>
<td>Mean</td>
<td>25.64</td>
<td>226.7</td>
<td>7.836</td>
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<td>C.I. (%)</td>
<td>0.28</td>
<td>4.18</td>
<td>0.110</td>
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**Best three crosses in 1995 planting (5 - 7 yr)**

<table>
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<tr>
<th>Cross</th>
<th>OER</th>
<th>FFB</th>
<th>CPO</th>
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<tbody>
<tr>
<td>(DA5D*DA3D)*LM</td>
<td>27.4</td>
<td>31.6</td>
<td>8.6</td>
</tr>
<tr>
<td>(DA128D*LM269D)*YA</td>
<td>28.2</td>
<td>31.7</td>
<td>8.9</td>
</tr>
<tr>
<td>(DA3D*DA115D)*LM</td>
<td>29.5</td>
<td>30.8</td>
<td>9.1</td>
</tr>
<tr>
<td>(DA10D*DA115D)*LM</td>
<td>26.9</td>
<td>32.3</td>
<td>8.8</td>
</tr>
<tr>
<td>DE*LM Clones</td>
<td>28.3</td>
<td>31.8</td>
<td>8.9</td>
</tr>
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</table>
## 1997 planting (3 - 5 yr)

<table>
<thead>
<tr>
<th></th>
<th>OER</th>
<th>FFB</th>
<th>CPO</th>
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<tbody>
<tr>
<td>GP06 to 10</td>
<td>27.7</td>
<td>23.3</td>
<td>6.4</td>
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<tr>
<td>LM2T*DA10D</td>
<td>23.0</td>
<td>22.4</td>
<td>5.1</td>
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<tr>
<td>LM2T*DA115D</td>
<td>24.9</td>
<td>22.5</td>
<td>5.6</td>
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<tr>
<td>GP11 to 17</td>
<td>26.0</td>
<td>19.3</td>
<td>5.0</td>
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<tr>
<td>LM2T*DA10D</td>
<td>23.7</td>
<td>17.4</td>
<td>4.1</td>
</tr>
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</table>
Commercial scale
Deli * La Mé planting material at Aek Loba

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Age
Total Oil t/ha
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- Div.II
- Div.III
- Div.IV
- Div.V
The best progenies produces from 8.6 to 9.1 tons oil / ha

Some genitors confirm excellent bunch quality (up to 27% OER)

probable complex interactions between the genotype, the pests, the physiology and the behaviour of the oil palm
• Commercial yield of 7 to 9 tons total oil / ha / year

The Company’s 37,000 ha of oil palms are the best tool to cross-check the quality of the work undertaken and a large exciting field of investigation for both team-mates engaged on the sustainability of oil palm along the way.
Thanks for your attention