Lecture 24
Tropical Oil Palms

Palm family = Palmae = Arecales
Over 4000 species

Oil palm, *Elaeis guineensis*
Originates to west and central Africa

Tree
An unbranched monoecious palm; 40–50 leaves (24/year), 10–11m at 25 to 35 years.

Fruit
A drupe with fleshy mesocarp and hard endocarp which surround 1, usually 2, and occasionally 3 seeds.

The oil of the mesocarp is orange red = palm oil. This is the most important product.
The oil of the seed is colorless = palm kernel oil.
Ratio of palm oil to palm kernel oil is about 10:1, 90% of all palm oil is used for food.
Palm kernel oil, similar to coconut oil is fractionated or hydrogenated for use in confectionery.
Also used for industrial purposes either as an alternative to coconut oil in the manufacture of high-quality soaps or as a source of short chain and medium chain fatty acids.
These are used as intermediates in the manufacture of fatty alcohols, esters, amines, amides, and more sophisticated chemicals which have a multitude of end-uses.
In Brazil palm oil is known as dende and is slightly red; imparts a special flavor to cooking.

Fruit bunches contain 500–4000 fruits (up to 30 g/fruit). Fruits take 5–6 months to mature. Palm oil is 70–75% oil, source of glycerin. Residue is used for cattle feed. The shell is used as fuels for the mill.

From 1968 to 1978 production increased 10% per year, 94% came from Malaysia and Indonesia.

Staminate inflorescence at anthesis.

Receptive pistillate inflorescence.

Four year old palm harvested with a chisel.
Fatty Acid Composition of Palm Oils

<table>
<thead>
<tr>
<th>Fatty acid</th>
<th>No. of carbons</th>
<th>Composition (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>caprylic</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>capric</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>lauric</td>
<td>12</td>
<td>50</td>
</tr>
<tr>
<td>myristic</td>
<td>14</td>
<td>1 16</td>
</tr>
<tr>
<td>palmitic</td>
<td>16</td>
<td>50 6</td>
</tr>
<tr>
<td>stearic</td>
<td>18</td>
<td>3 1</td>
</tr>
<tr>
<td>oleic</td>
<td>18:1</td>
<td>40 17</td>
</tr>
<tr>
<td>linoleic</td>
<td>18:2</td>
<td>6 1</td>
</tr>
</tbody>
</table>

Oil Palm Production (2001)

<table>
<thead>
<tr>
<th>Continent</th>
<th>1000 tonnes</th>
<th>Palm</th>
<th>Oil</th>
<th>Chief countries (palm oil)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Kernel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>World</td>
<td>4,353</td>
<td>118,794</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Africa</td>
<td>723</td>
<td>15,080</td>
<td></td>
<td>Nigeria (8,000), Ivory Coast (1,771), Ghana (1,050)</td>
</tr>
<tr>
<td>North America</td>
<td>52</td>
<td>1,854</td>
<td></td>
<td>Costa Rica (650), Honduras (620), Guatemala (295)</td>
</tr>
<tr>
<td>South America</td>
<td>356</td>
<td>5,159</td>
<td></td>
<td>Columbia (2,550), Ecuador (1,540), Brazil (388)</td>
</tr>
<tr>
<td>Asia</td>
<td>3,149</td>
<td>95,543</td>
<td></td>
<td>Malaysia (56,000), Indonesia (34,750), Thailand (3,443)</td>
</tr>
<tr>
<td>Oceania</td>
<td>72</td>
<td>1,158</td>
<td></td>
<td>Papua New Guinea (1,830), Solomon (128)</td>
</tr>
</tbody>
</table>

Ecology

Requires 24–28°C; lowland equatorial, to 500 m. Moisture must be sufficient to insure the absence of stress.
Propagation

Seed propagation—nut is enclosed in polyethylene and exposed to 38–40°C; Modern plantations use hybrid seed.

Tissue culture—asexual embryos form from roots and allows clonal propagation but there have been problems with somaclonal variation.

Fruit Types

A particular feature of the oil palm with considerable economic consequences is the occurrence of three natural fruit types under monogenic control, which form also the basis for the classification of oil palm.

Dura

Homozygous (Sh Sh) for a relatively thick endocarp (shell 2–8 mm), 25–55% of fruit

- Mesocarp = 35–65%
- Kernel = 7–20%
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**Tenera**

Heterozygous ($Sh sh$) with a relatively thin endocarp (0.5–4 mm), 1–32%
- Mesocarp = 60–95%
- Kernel = 3–15%

**Pisifera**

Homozygous ($sh sh$) for the absence of an endocarp; is sterile.
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Thick mesocarp, high oil bearing fruits of a clonal palm

Thick shelled dura as seed parent × shell-less pisifera as pollen parent produces thin shelled tenera

\[ Sh \, Sh \times sh \, sh \rightarrow Sh \, sh \]

Oil yields can be very high, up to 4.5 t/ha (2 tons/acre) —now 4.8–7.0 t/ha oil

Planting

160 trees/ha (8.5 × 8.5 m in triangular pattern). No pruning except removal of dead leaves for sanitary reasons.
Harvest
Throughout the year after the 3rd year. Cut by hand. Production is usually 30 t/ha of bunches.

Uses
The mesocarp produces one product, palm oil. The palm kernel produces both oil and high protein cake (used as feed stock). The future is bright for palm oil because it is the highest yielding oil crop. Potential energy crop if oil yields of 12 t/ha/year can be achieved. The only problem at present is that high saturation of palm oil makes it “unhealthy” compared to such alternatives as canola oil produced in temperate areas. However palm oil is much cheaper and is still widely used.
African oil palm

Precocious high yielding clonal palm or ramet
Babassu