How Process Coco Husk Materials to Substrates as Propagation Medias
Coconut Tree

- Scientific Name – *Cocos nucifera*
- Large palm, growing up to 30 m (98 Ft) tall
- Generally, having two types
  - Tall
  - Dwarf

- Produce their 1st fruit in 6 to 10 years – under proper care and growing conditions
- Coconut palm tree can yield up to 75 fruits / year in a fertile soil
Composition of Coconut Fruit

**THE COCONUT FRUIT**

Average weight = 1.2 kg  
Average Copra Recovery = 25%  
Oil and fat = 63.65%  
Copra Cake = 35.35%

Fibrous drupe  
Outer skin exocarp covers the thick fibrous husk  
Nut consists of  
Shell (Endocarp)  
Seed coat (in between shell and the meat)  
Oil bearing meat  
Liquid milk

HUSK, 35%  
Fiber = 30%  
Coco pith = 70%

Meat Kernel, 28%  
Oil = 40%  
Water = 43%  
Non-fatty Dry Matter = 17%

Nut Water, 25%  
Water = 91.15%  
Nitrogen = 0.05%  
Phosphoric Acid = 0.56%  
Calcium Oxide = 0.69%  
Potassium Oxide = 0.60%  
Magnesium Oxide = 0.59%  
Chlorine = 0.35%

Shell, 12%  
Cellulose = 33.01%  
Lignin = 36.51%  
Pentosans = 29.27%  
Ash = 0.01%

Outer cover of the fruit  
Husk contains cellulose, lignin, tar, tannin, potassium, gas, etc.
Coconut Industry in Sri Lanka
Key Coconut Products

- **Coconut Kernel Products** - Desiccated Coconut, Edible Copra, Fresh Coconut, Coconut water/King Coconut water, Virgin Coconut Oil, RBD Coconut Oil, Coconut Flour, Coconut Butter, Liquid Coconut Milk, Coconut Milk Powder, Coconut Cream, Vinegar, Defatted Coconut, Poonac and Coconut base Arrack etc.

- **Coconut Shell Products** - Charcoal Briquettes, Activated Carbon, Coconut Shell Charcoal, Coconut shell pieces, Coconut shell powder.

- **Coconut Fiber Products** - Coir Twines, Geo Textiles, Rubberized coir products for horticultural and Agricultural Industry, Rubberized Coir Mattresses, Coco Peat and Fiber Pith, Twisted Fiber, Bristle Fiber, Mattress Fiber, Molded coir products, Coconut Husk Chips, Coir Yarn, Coir mats and Rugs, Rubberized coir pads, Brooms and Brushes, etc.

- **Coconut Husk Products** - Let’s discuss in the next slides
Coir Substrates as a Plant Propagation Media
**Coco Pith**

- By product from a coir fiber processing industry
- Non-fibrous material in the coconut husk
- Contributes to 50-70% in the husk
- Spongy material that binds coir fiber in the husk
- Compressible material

**Coconut Husk Chips**

- Cut pieces from the outer layer of the husk of the coconut nut
- Consists of long fibers and sponge-like pith particles
- Having the highest air to water ratio

**Coir Fiber**

- Adding coir fiber to the medium aids to add air pockets
  - Negative impact is that these fibers are made out of cellulose and they break down easily and collapsing of air pockets may happen
## Chemical Composition of Coco Pith

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Un retted CP</th>
<th>Retted CP</th>
<th>RHP Standard limits for CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lignin ( % w/w )</td>
<td>30.0</td>
<td>28.5</td>
<td></td>
</tr>
<tr>
<td>Cellulose ( % w/w )</td>
<td>26.4</td>
<td>25.8</td>
<td></td>
</tr>
<tr>
<td>Organic carbon ( % )</td>
<td>29.5</td>
<td>29.0</td>
<td></td>
</tr>
<tr>
<td>Nitrogen ( % )</td>
<td>0.24</td>
<td>0.26</td>
<td>0.8 mmol/l</td>
</tr>
<tr>
<td>Phosphorus ( % )</td>
<td>0.01</td>
<td>0.01</td>
<td>0.2 mmol/l</td>
</tr>
<tr>
<td>Potassium (%)</td>
<td>0.71</td>
<td>0.76</td>
<td>0.6 mmol/l</td>
</tr>
<tr>
<td>C : N Ratio</td>
<td>123:1</td>
<td>112:1</td>
<td></td>
</tr>
<tr>
<td>Calcium ( % )</td>
<td>0.40</td>
<td>0.47</td>
<td></td>
</tr>
<tr>
<td>Magnesium ( % )</td>
<td>0.36</td>
<td>0.41</td>
<td></td>
</tr>
<tr>
<td>Moisture ( % )</td>
<td>20 - 30</td>
<td>60 - 80</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>5.4 - 5.8</td>
<td>5.60 – 6.0</td>
<td>6.5</td>
</tr>
<tr>
<td>EC ( mS/cm)</td>
<td>0.60 - 1.20</td>
<td>0.30 – 0.60</td>
<td>0.3</td>
</tr>
<tr>
<td>Salinity</td>
<td>1</td>
<td>2 - 4</td>
<td></td>
</tr>
<tr>
<td>CEC ( Meq / 100 g of sample)</td>
<td>15 - 20</td>
<td>20 - 30</td>
<td></td>
</tr>
</tbody>
</table>
Properties of Coco Pith

- Varies depending on several factors
  - Maturity of the coconut
  - Method of extraction and disposal
  - Period between extraction and use
  - Environmental factors

- For all growing media there should have two key properties
  - Physical Properties
  - Chemical properties

- It’s same for coir substrates as well
Properties of Coco Pith

**Chemical Properties**
- Very high moisture retention capacity (600 – 800 % and can be up to 1100 in dry weight)
- High in K+ content and low in bulk density (0.18 g/ ml) and particle density (0.8 g/ ml)
- High CEC which varies from 20 – 30 meq / 100 g
- EC level (Salt Content) 2-6 mS/cm which is far too high for a growing medium
- Has fixed carbon, low fat, Ash and sulfur
- All these properties enables it to use a mulch and a soil amendment

**Physical properties**
- Water holding capacity (WHC)
- Porosity
  - Air filled porosity (AFP)
  - Total porosity
- Bulk Density (BD)

Combination of different particle sizes manipulate these properties in Cocos.

Increase smaller particles = WHC = AFP = BD
and vise versa
Specialty in Coco Substrate

- 100% Renewable resource (by product from coir fiber industry)
- Helps to reduce the destruction of ecologically fragile peat bogs
- Neutral pH level and easier to amend with nutrients
- Easy to handle
- Absorb 30% more water than peat
- Create soil – air pockets (holds 22% air even when fully saturated
- Maintains root health prevents root rot)
Coir Pith and Husk Chips Production Process

Harvesting

De husking of the ripe coconuts

Slice coconut husks into desired pieces (7 mm, 10 mm)

Husk Cutting Machine

Retting of the coconut husks

De fibering of coco. Pulp (Decorticating)

Husk Chips

Coir Pith
Coir Pith and Husk Chips Processing Process at JSL

1. **Raw Material Storage Bunkers**
   - Husk Chips
     - Buffering and Washing
     - Material Squeezing
     - Sun Drying
   - Coco. Pith
     - Aging
     - Buffering and Washing
     - Material Squeezing
     - Sun Drying
     - Sieving

2. **Water Source**
   - Production Storage Bin
     - Material Blending & Fertilizer Addition
     - Pressing
     - Packing and Palletizing
     - Finished Goods Storage

3. **Finished Goods Storage**

4. **Dispatch**
✓ Fresh CP contains lignin, cellulose, hemicellulose and some degradable carbohydrate fractions.
✓ Main component is lignin (30% +) surrounded by cellulose (28% +) that gives the stability to the coir.
✓ But, in fresh CP as it contains degradable carbohydrates cannot get the stability as it tend to degrade over the short period of time.
✓ Lignin and cellulose gets years that to happen.
✓ Aging means the natural degradation of this organic component.
✓ When the material gets aged we get the stability which contributes to the expansion as well.
Material Aging

- Method - Stored in bunkers for stabilization for 3 months
- Objective - to gain matured coco pith by removing last remaining fibers.
  - to change the pH from acidic to neutral
  - to achieve more favorable C:N ratio
  - to reduce the salt content
- Two stages are in the process
  - Physical Stage (coir absorbs water, cells and tissues well, substances (carbohydrates, glucoside, tannins. Etc.) leached out of the tissues)
  - Biological Stage (Activation of microbes to secrete substances to decompose pectin, hemicellulose and phenolic compounds this’ll loosen the fibers)
Coir Pith and Husk chips Processing Process at JSL

Why Buffering?

✓ Process to achieve the chemical stability of materials
✓ CP and HC are naturally consist of high levels of Na⁺, K⁺, salts and tannin (a phenolic compounds)
✓ These levels are natural requirement of coconut growing
✓ But, as a growing medium these levels are at a toxic level for plant propagation
✓ Though, salts and tannin are dissolved in water Na⁺ and K⁺ can be only replaced by cation exchange action by replacing monovalent by bivalent introducing Ca²⁺
✓ This process is known as treating/ buffering
Buffering Process at JSL

**Buffering (Treating the materials)**

**Method** –

1. Calculate the \( \text{Ca(NO}_3\text{)}_2 \) requirement
2. Fill the tank barrel / tank with water up to the mark
3. Split the required \( \text{Ca(NO}_3\text{)}_2 \) into half and dissolve in the barrel
4. Add the 1\(^{st}\) half through the sprinklers to the tank
5. Allowed to drain and apply clean water
6. Add the 2\(^{nd}\) half to the tank through sprinklers
7. Check the \( \text{K}^+ \) and \( \text{Na}^+ \) content for the random sampled raw materials

**Objective** – to reduce the concentration of;

- \( \text{K}^+ \) level < 2 mmol/L and \( \text{Na}^+ \) level < 1 mmol/L
Coir Pith and Husk chips Processing Process at JSL

Why Washing?

✓ Process of washing with fresh water after buffering with calcium nitrate
✓ By washing can remove the excess salts and tannin
✓ Thus, reduces the EC (electrical conductivity) of the material for some extent
Coir Pith and Husk chips Processing Process at JSL

**Material Squeezing**

**Method**
- Squeeze the material using squeezer machine.
- Maintains the squeezer pressure for 80bar

**Objective** - To reduce the water level to accelerate the drying process

**Material Drying**

**Method**
- Clean the drying yards (don’t allow any foreign matters)
- Spread buffered material on the drying floor batch wise
- Mixed the material for proper drying (use properly cleaned motor bikes)
- Check moisture level using portable moisture meter (should be 18% or below)
Thank You !!!