Good Agricultural Practices to Sustain Coconut Development

P. Subramanian
Principal scientist
ICAR CPCRI, Kasaragod, INDIA
• Good Agricultural/Manufacturing Practices are a set of principles, regulations and technical recommendations applicable to production, processing and food transport, addressing human health care, environment protection and improvement of worker conditions and their families. (FAO)
Global emphasis on Farming

2014-Family Farming

- Small scale farming linked to World food security
- Feeding the world and caring the earth
- Preserves traditional food products

2015-Soil

- Non-renewable resource
- Healthy soil for health life
- Where food begins

2016-Pulses

- Nutritional benefit of Pulses as part of Sustainable food production
- Utilize pulse-based proteins
- Food security nutrition and Innovation

2020-Plant Health

- Promote healthy Ecosystem for sustainable development
- Plant health to solve hunger, poverty and threat to environment
- Phytosanitary standards for International trade of plant and plant products
Why GAP is important for coconut

• Sustainable Development Goal
• Lot of degradation of natural resources over the period of time.
• Perennial – long life 60 to 80 years
• Safeguarding environment
• Reducing occupational hazard
• One Health Approach (includes plant, animal, environment and human health)
GAP in coconut

I Pedigree (Location specific)

II Production

III Protect

IV Process
My presentation includes

- Ideal site selection
- Production of planting materials
- Planting and after care
- Water management
- Nutrient management
- Soil and moisture conservation
- Cropping /farming system
- Pest and disease management
- Harvesting
- Processing
**Ideal site selection**

- **130-230cm** rainfall
- **27 °C +/- 5 °** temperature
- **>60 % RH** relative humidity
- **210 bright sunshine** h/month
- **6 to 7.5 pH** soil pH
- **1.5m to 2m depth** well drained soil
- **600 m MSL**
Suitable Varieties ....

- Wider adaptable varieties that are also tolerant to abiotic/biotic stress
- Tall varieties preferable under water deficit condition
- Cold tolerant varieties in low temperature zones
- Varieties delivering high biomass potential and harvest index
- Hybrids responsive for high inputs and resources
- Location specific varieties that tolerate pest and disease incidences
- Varieties amenable for product diversification requirement
Selection of good seedlings

One year old seedling

Possess 5 - 6 leaves

Higher collar girth

Early splitting of leaves

Profuse roots

short petiole

Polybag seedlings fortified with bioinoculants for early establishment and precocious bearing
LAND PREPARATION AND PLANTING

If the land is uneven and full of shrubs, the shrubs have to be cleared and land should be leveled before digging pits.

Sunlight and Geometry Viable intercrops for holistic system

Spacing

- Square system is ideal - 8.0m and above
- Wider spacing 10 x 10 m if perennial intercrops taken up simultaneously like multistreyyed cropping/HDMSCS
- Cyclone prone areas wider spacing is recommended.
PIT SIZE AND PLANTING

<table>
<thead>
<tr>
<th>Pit size</th>
<th>Normal soil – 1m³</th>
<th>Sandy soil – 0.6m³</th>
<th>Laterite – 1.2m³</th>
</tr>
</thead>
</table>

Pit making and Layering of coconut husk
Filling with top soil
Incorporation of organic manure
Baby pit for planting seedling

Water logging area
Mound method
Shading seedling to avoid sun scorching
WATER MANAGEMENT

Flood irrigation is not recommended
Basin irrigation through hose
Sprinkler irrigation for specific cropping system
**DRIP IRRIGATION** – Ideal method

**Why Drip is the ideal irrigation method?**
- Directly on to the root zone
- Delivered at crop-need based
- Water saving by 33 %
- Fertilizer economy and increase in yield
- Weed control
- About 90% efficient delivery & utilization
- Make non-suited regions productive

Drip irrigation with 4 dripping points
Mulching in the basin after laying drip system
INTER CULTIVATION

• Minimum tillage-Ploughing twice in a year –summer and post monsoon- at least 60 cm from trunk
• To control weeds aeration, conserve soil moisture
• Slash weeding and zero tillage approach
Points to be considered

- Analyze the soil and leaf once in three years and provide nutrients accordingly
- Integrated nutrient Management
- Liming in acid soil and gypsum in alkaline soil for buffering pH
- Always apply well decomposed organic manures (C:N <=12:1).
- Avoid rainy days/insufficient soil moisture during application of nutrients.
- In drip irrigated gardens adopt fertigation
- Organic manure once in a year
- Need based phosphorus
- Chemical fertilizer application – from 2 to 3 splits (rainfed)
- Irrigated- 4 splits- fertigation 7 to 10 splits in a year
RAINFED COCONUT GARDEN
FIRST DOSE SHOULD BE APPLIED IMMEDIATELY AFTER
THE RECEIPT OF MONSOON

Application of Lime/
Dolomite - Acidic
Gypsum – Alkaline
@1 kg/palm

Mix with soil

Apply chemical fertilizer

Cover with soil
Second dose of manuring under rainfed condition

Opening of basin

Dolomite application

Apply chemical fertilizer

Glyricidia application @ 30-50kg + 5kg neem cake and fortified with trichoderma

After 10 days apply biofertilizer and cover the soil
• In Irrigated conditions –
  
  -> Organic manure application along with 25% of the soil test based recommended chemical fertilizer towards the end of monsoon if basin irrigation is adopted.
  
  -> Remaining 75% of chemical fertilizer applied in three equal quantity in 3 months interval

• Fertigation at least monthly interval (7 to 10 months in a year) avoiding rainy days
Type of organic manure

- Green manure
- Green leaf manure
- FYM
- Bio gas slurry
- Vermicompost
- Goat manure
- Poultry manure
- Coir pith manure
- Dosage – 30 to 50 kg/palm/year
FYM OR POULTRY MANURE OR GOAT MANURE SHALL ALSO BE APPLIED
Leguminous crops

-> Easiest and most economical method - augment soil organic matter.
-> 100 g of legume seeds (cowpea/ sunhump/ daincha/ pureria/ calapagonium/ mimosa) immediately after the receipt of monsoon rain.
-> Towards the fag end of monsoon incorporate by biomass and apply chemical fertilizer and cover with soil.

ADVANTAGE

-> Prevention of soil erosion
-> Smothering of weeds
-> Organic matter addition - maintain soil structure
-> Improves soil aeration
-> Protects from excessive heat of sun
-> Soil fertility conservation - arrest leaching loss
-> Atmospheric N fixation - Leguminous crops
Recycling of biomass in coconut garden through vermicomposting

Coconut leaf + cow dung (10:1)

Eudrilus sp.

40-50% moisture

Coconut leaf vermicompost

From 1 ha - 5 to 8 tonnes of leaves
Insitu compost in the basin/ in the interspace /vermi composting tanks
- 1.8 % N, 0.21% P, 0.16% K
- Rich in humic acid, plant beneficial microorganisms and growth promoting substances
- Vermicomposting tank should be covered with nylon net to protect from rhinoceros beetle attack

Modern large scale vermicomposting units at CPCRI
# Diagnosis and Correction of Specific Nutrient Problems

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Deficiency symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium</td>
<td>older functional Leaves-yellowing of the leaflets with orange tinge, followed by necrosis. Severe case scorched appearance – decrease in nut production</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>uniform light green discoloration / yellowing (uniform chlorosis) of the oldest leaves.</td>
</tr>
<tr>
<td>Magnesium</td>
<td><strong>Oldest leaves</strong> - broad chlorotic (yellow) bands along the margins with the central portion of the leaves remaining distinctly green.</td>
</tr>
<tr>
<td>Copper</td>
<td>Coppery bluish leaf- Rolling of terminal leaves due to loss of turgor</td>
</tr>
<tr>
<td>Nutrient</td>
<td>Deficiency symptoms</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Boron</td>
<td>failure of the leaves to split, crown choke disorder, leaves have a serrated zigzag appearance, poor nut setting, increase in button shedding and immature nut fall. The inflorescence and nuts become necrotic leading to barren nuts.</td>
</tr>
<tr>
<td>Zinc</td>
<td>formation of small leaves –leaf size is reduced to 50%. button shedding- saline soils</td>
</tr>
</tbody>
</table>
SOIL AND MOISTURE CONSERVATION

MULCHING
Cover Crops

Cowpea
(Vigna unguiculata)
11 ton biomass
45 kg N, 47 kg K2 O

Sunn hemp
(Crotalria juncea)
12 ton biomass
53 kg N 49 kg N

Daincha
(Sesbania sp)
13 ton biomass
57 kg N
51 kg K

Mimosa

-> Protects soil from beating effect of rain
-> Helps in percolation of rain water
-> Helps in preventing soil and nutrient loss
Half moon bund with pineapple border

- Flat basin with a slight inward slope towards upstream is made by excavating soil from the upstream side and filling the excavated soil at the down stream.
- A bund of 30 cm height and with suitable width with excavated soil made at downstream end.
- Two layers of pineapple plans planted with a spacing of 20 cm x 20 cm on the bund.
- Collects runoff in the basin.

Runoff = 0.32 % (8.75\%)*
Soil loss = 0.305 t/ha (6.76 t/ha)
Water conserved = 30 m³/year
Increase in coconut yield was 37 %

* Values in parenthesis are of control (Mathew et al., 2018)
Contour trench filled with coconut husk

- Trenches - 50 cm width x 50 cm depth with convenient length between two rows of coconut
- Coconut husk with bottom layer facing up and top two layers facing down
- A bund of 30 cm height and with suitable width with excavated soil made at downstream end
- Collects surface runoff and allows to percolate
- Reinforce the bund with pineapple

Runoff = 0.11 % (8.75%)*
Soil loss = 0.075 t/ha (6.76 t/ha)
Water conserved = 27 m³/year
Coconut yield increase was 29 %
* Values in parenthesis are of control (Mathew et al., 2018)
Coastal sandy soil management through husk/coir pith burial and raising intercrops
Monocropping leads to
- Poor natural resource use
- Small holdings and low income
- Limited factor productivity

Coconut
- A natural companion for cropping system/farming system
- The unbranched trunk, Venetian structure and orientation of leaves
- 77.7% land area is not effectively utilized
- The intensity at ground level was always higher than 6,700 lux at all parts of the year
- Coconut canopy receives on an average only about 50% of the incident solar radiation.

Horizontal – 1.8m
Vertical – 30 to 60 cm
**Coconut based Cropping System**

**Cereals:** Rice, maize

**Pulses and oil seeds:** Groundnut, horse gram, cowpea, sunflower

**Fruits:** banana, papaya, pineapple, lime/lemon, orange, noni, mango, sapota

**Vegetables:** cowpea, coccinia, bhendi, chillies, cucurbits

**Tuber crops:** colocassia, cassava, yams, sweet potato

**Spices & condiments:** pepper, clove, nutmeg, cinnamon, ginger, turmeric

**Beverage crop:** Cocoa

**Floriculture:** Orchids, anthuriums, heliconia, jasmine, marigold, gomphrena

**Medicinal & aromatic plants:** Vetiver, Kacholam, Arrowroot, Chittadalodakam, Aloevera, Thippali, Neelayamari, Sathavari, Orila, Patchouli, Moovila, Karimkurinji, Nagadanthi
**Coconut + Cocoa mixed cropping system**

-> Increase in O.M content of soil through cocoa leaves shedding & prunnings

-> Amount of O.M added to soil (oven dry wt.)
   - SH 818 kg/ha/year
   - DH 1985 kg/ha/year

-> Nutrient conc. N-2.84%, P-0.26%, K-1.73%
   - 50 kg N, 11 kg P2O5, 35 kg K2O/ha/year

-> Intense activity of beneficial microbes: N fixing bacteria- *Beijerinckia*, P Solubiliser- 21 isolates of bacteria, *actinomycetes* and fungi identified (*Pseudomonas* sp. And *Aspergillus niger*)

-> Evaporation is 30% of that from the open area

-> Variation in mean monthly temperature is low

---

**High Density Multi Species Cropping System**

-> Better yield

-> Less input cost

-> Improved soil health & fertility

-> Less pest & disease damage

-> Moisture conservation

-> Weed suppression

-> Year round income

Two or more mutually beneficial plants to increase biodiversity of a cropping system
Coconut based integrated farming system

- Supplementing the entire requirement of phosphorus and > than 70 % requirement of Nitrogen and potassium and the system is sustainable
- Improve the microbial load
- Better soil nutrient status in the system
- Higher net income ($9587) over monocropping ($1400)
- Higher employment generation (900 man days per year) over monocropping (140 mandays)
PLANT PROTECTION IN COCONUT

> Follow safety measures while spraying

> The agro-chemicals you use must be admitted, that is, they must be registered in your country –

> Expired agro-chemicals or in bad state should not be used (verify due date)

> Children, pregnant women and old age people must not be near the area where agro-chemicals are applied

> Once the application is over, the worker should have a shower and wash the protection elements

> Compact area approach for plant protection measures-community action for effective pest and disease management
## Pest Management in Coconut

Safety standards and hygienic practices should be observed

<table>
<thead>
<tr>
<th>Pests</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coconut rhinoceros beetle</td>
<td>Regular hooking out of beetle</td>
</tr>
<tr>
<td></td>
<td>Prophylactic leaf axil filling with neem cake plus sand or naphthalene balls</td>
</tr>
<tr>
<td></td>
<td>-Nylon fish net wrapping of spear leaf</td>
</tr>
<tr>
<td></td>
<td>Incorporation of <em>Metarhizium majus</em> and <em>Clerodendroan infortunatum</em> in to breeding zone</td>
</tr>
<tr>
<td></td>
<td>-Release of nudivirosed beetle @ 12 per ha</td>
</tr>
<tr>
<td>Red palm weevil</td>
<td>Regular monitoring, sustained surveillance and destruction of crown toppled palms</td>
</tr>
<tr>
<td></td>
<td>-Cutting fronds at least 1.2 m from trunk</td>
</tr>
<tr>
<td></td>
<td>Spot application of imidacloprid 0.02%</td>
</tr>
<tr>
<td></td>
<td>Community trapping of weevils using pheromone lures</td>
</tr>
<tr>
<td>Coconut eriophyid mite</td>
<td>Spraying neem oil-garlic (2%) or palm oil-sulphur (0.5%)</td>
</tr>
<tr>
<td></td>
<td>Spraying of <em>Hirsutella thompsonii</em> (20 g/litre) thrice</td>
</tr>
<tr>
<td></td>
<td>Balanced application of nutrients</td>
</tr>
<tr>
<td>Black headed caterpillar</td>
<td>Removal and destruction of severely affected fronds -Release of parasitoids</td>
</tr>
<tr>
<td></td>
<td>(<em>Goniozus nephantidis</em> &amp; <em>Bracon brevicornis</em>) 100 per palm</td>
</tr>
<tr>
<td>Rugose spiralling whitefly</td>
<td>Pesticide holiday, conservation biological control of <em>Encarsia guadeloupe</em></td>
</tr>
<tr>
<td></td>
<td>and sooty mould scavenger beetle, <em>Leiochirus nilgirianus</em> –Yellow sticky trap</td>
</tr>
<tr>
<td></td>
<td>Ecological engineering with intercrops</td>
</tr>
</tbody>
</table>

Safety standards and hygienic practices should be observed.
## Disease Management in Coconut

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Management</th>
</tr>
</thead>
</table>
| Root (wilt) disease – Phytoplasma disease | Diagnosis and removal of advanced diseased plams  
Raising resistant varieties and tolerant hybrid (Kalpa sankara)  
Nutritional management |
| Leaf rot disease               | Phytosanitation and removal of diseased spear leaf  
Crown pouring of Talc-based preparation of Pseudomonas fluorescens and Bacillus subtilis @ 50 g / 500 ml water  
Application of hexaconazole (Contaf 5 EC) 2 ml / 300 ml water per palm |
| Basal stem rot                 | Complete destruction of infected palms at advanced stage  
Avoid flood irrigation  
Apply 50 kg bio-suppressive compost containing 500 g Trichoderma harzianum and 5 kg neem cake  
Root drenching with BM 1% @ 40 litres |
| Bud rot                        | Destroy all affected tissues in crown  
Spot application of 1% BM  
Placement of Trichoderma coir pith cake on the innermost leaf axils |
| Stem bleeding                  | Avoid flood irrigation  
Apply 50 kg bio-suppressive compost containing 500 g Trichoderma harzianum and 5 kg neem cake |
> Regular harvesting is must
> Harvesting should be done at 45-60 days interval
> Manual or mechanically harvesting can be done with proper safety measures.
POST HARVEST PROCESSING AND VALUE ADDITION

➢ Coconut- a small holder’s crop, farmers experience resource constraints
➢ Facilitate FPOs- community approach for production and marketing of value added products to enhance income
Mature coconut based products

VCO  Coconut chips  Milk powder  Frozen coconut delicacy  Milk powder

By-product utilization: Coconut Milk Residue

CMR based products

Extrudates  Biscuits  Rusk  Pasta  Fried snack

Instant coconut chutney
Inflorescence sap based products

Kapa nutri bar

Kalparasa®

Neera Honey

Kalpa sweets

Coconut jaggery

Kalpa bean to bite chocolates

Calpa Drinking chocolate

Kalpa Bar

Dark chocolate

Coconut sugar
VCO VALUE ADDITION

Tender coconut based products

Trimmed tendernuts

Snowball tendernuts

Carbonated tender coconut water
Adoption of a holistic approach by employing Good Agricultural Practices would enable to sustain the coconut productivity.
THANK YOU