# MANAGE OFF-CAMPUS TRAINING MANUAL ON

# Integrated Pest And Disease Management In Coconut

# 24-28 April, 2018


**Published By**

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# ICAR-CENTRAL PLANTATION CROPS RESEARCH INSTITUTE (ICAR-CPCRI)
# KASARAGOD-671 124

## MANAGE Off-Campus Training programme on
## INTEGRATED PEST AND DISEASE MANAGEMENT IN COCONUT
## 24-28 April 2018

| | | |
|---|---|---|
| **Day - 1 : 24/4/2018 (Tuesday)** | | |
| 0830-0900 | Breakfast | |
| 0900-1015 | Registration/Pre-evaluation | V. H. Pratibha, Girija Chandran, Arati |
| 1015-1130 | Technologies of commercial importance | K. Muralidharan |
| 1130-1200 | Tea; Group Photo | |
| 1200-1315 | Advances in Health Management in Coconut | Vinayaka Hegde |
| 1315-1400 | Lunch | |
| 1400-1515 | Subduing Fungal Diseases in Palms | V.H. Prathibha |
| 1515-1530 | Tea | |
| 1530-1700 | Mass Production of Antagonistic Fungus- *Trichoderma* sp. | V.H. Prathibha |
| 1930-2000 | Dinner | |
| **Day - 2 : 25/4/2018 (Wednesday)** | | |
| 0830-0900 | Breakfast | |
| 0900-1015 | Biological Pest Suppression and GAP in Coconut | Chandrika Mohan |
| 1015-1130 | Technology Translation through Social Engineering | P. Anithakumari |
| 1130-1200 | Tea | |
| 1200-1315 | Success Stories on Area-wide Pest Suppression in Coconut | Chandrika Mohan |
| 1315-1400 | Lunch | |
| 1400-1515 | Nutrition and Palm Health | Ravi Bhat |
| 1515-1545 | Tea | |
| 1545-1700 | Advances in Coconut Farming/ Visit to Experimental Plots | P. Subramanian |
| 1930 – 2000 | Dinner | |

**Programme Director:** K. Muralidharan (9446169526)
**Course co-ordinators:** Vinayaka Hegde (9447245649)
Rajkumar (8848988319)

| Day - 3 : 26/4/2018 (Thursday) | | |
|---|---|---|
| 0830-0900 | Breakfast | |
| 0900-1015 | Global Scenario on Coconut Pests and Diseases | P. Chowdappa |
| 1015-1130 | Innovative Approaches in Pest Management | A. Joseph Rajkumar |
| 1130-1200 | Tea | |
| 1200-1315 | Overview on Coconut Phytoplasma : Diagnosis and Management | Merin Babu |
| 1315-1400 | Lunch | |
| 1400-1515 | Biodiversity and Bio-security Risks in Coconut | A. Joseph Rajkumar |
| 1515-1545 | Tea | |
| 1545-1700 | Mass Production of Entomophaga and Entomopathogens invading Coconut Pests | M. Sujithra /Rajkumar |
| 1930 -2000 | Dinner | |
| **Day - 4: 27/4/2018 (Friday)** | | |
| 0830-0900 | Breakfast | |
| 0900-1015 | Pest and Disease Management in Coconut Nursery | A. Joseph Rajkumar |
| 1015-1130 | Bio-priming Coconut Seedlings for Inducing Resistance | Dr. Murali Gopal |
| 1130-1200 | Tea | |
| 1200-1315 | Visit to APC and Collection of *Kalparasa* | Dr. K.B. Hebbar |
| 1315-1400 | Lunch | |
| 1400-1900 | Demonstration of disease management in farmers' field | Vinayaka Hegde |
| 1930 – 2000 | Dinner | |
| **Day - 5 : 28/4/2018 (Saturday)** | | |
| 0830-0900 | Breakfast | |
| 0900-1015 | Containing Palm Pests and diseases through Host Plant Resistance | Regi J. Thomas |
| 1015 -1045 | Quarantine and Diagnosis of Plant Pathogens in Palms | Dr. Vinayaka Hegde |
| 1045-1145 | Entomopathogenic Nematodes and Bio-suppression of Coconut Pests | Rajkumar |
| 1145-1200 | Tea | |
| 1200-1315 | Climate Change and Pest Outbreak in Palms | M. Sujithra |
| 1315-1400 | Lunch | |
| 1400-1515 | Biotechnological approaches in pest management | M. K. Rajesh |
| 1515-1545 | Tea | |
| 1545-1700 | Valedictory function | |
| 1930 – 2000 | Dinner | |

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# Nutrition and Palm Health

**Ravi Bhat, Selvamani, V. and Jeena Mathew**

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## Introduction

Green plants which are autotrophic require some inorganic mineral nutrients for their growth and development. As many as 92 elements / nutrients have been found, out of which 23 are essential nutrients *i.e.*, without them plants do not complete their life cycle. Out of these 23 essential nutrients, carbon, hydrogen and oxygen are derived from the atmosphere and soil water, and the rest are supplied either from soil minerals and soil organic matter or by organic or inorganic fertilizers. Arnon and Stout in 1939 laid down the following criteria for judging the essentiality of mineral nutrients to the plants. The nutrient must be absolutely essential for normal growth and development. The requirement of the nutrient must be specific and not replaceable by another nutrient *i.e.,* non-availability of the nutrient to the plant causes a deficiency symptom. As expression of abnormality through symptoms in plants arise due to several factors like pests, diseases, nutrient deficiency, toxicity *etc*., it becomes important to identify the exact reason. Nutrient deficiency/ toxicity symptom is due to inadequate / excessive application of fertilizers or nutrient sources. The actual disorder can be ascertained only with proper soil and tissue testing results that are obtained from soil and tissue testing laboratories. After identification of the actual deficient nutrient only, the management should be undertaken in the field**.** The fertilizers need to be applied based on the soil test data, to correct the deficiency as the supply of specific nutrient alone can correct it.

## Nutrient Deficiency Symptoms, Diagnosis and Remediation in Coconut

### ROLE OF NITROGEN (N)

- It promotes growth
- Facilitates better leaf production and chlorophyll production
- It encourages vegetative growth of plant and imparts deep green colour to the leaves
- Nitrogen is a constituent of amino acids, proteins and nucleic acids.

Nitrogen deficiency symptoms are commonly seen in light textured sandy soils poor in organic matter and also in water logged conditions. Nitrogen being mobile in the plant system deficiency symptoms first appears in the older leaves

**Deficiency symptoms**

- Loss of normal healthy green colour in the initial stage and becomes yellowish green and the whole foliage exhibits slight and continuous yellowing
- As the deficiency progresses, the older leaves develop a uniform golden yellow colour, whereas, the younger leaves turn pale green giving the leaflets a dull appearance
- Reduction in chlorophyll content with golden yellow colouration of older leaves near the petioles and light brown colour near the end, which later dries out
- Yellowing starts from the tip of the leaf and leaflets and progresses along the midrib
- Mid rib turns yellow
- The size of the leaves gradually gets reduced and the number of functioning leaves becomes less
- In advanced stage, the stem below the crown narrows down to a 'pencil point' with a few short leaves on the crown
- Abortion of inflorescences and fail to emerge. If emerges, it will be with little or very little female flowers. Growth virtually stops when N deficiency is very severe and the palm turns barren.

N deficiency can be confused with Fe or S deficiency, although the chlorosis in those deficiencies is typically most severe on the youngest leaves, whereas, the older leaves are affected in the case for N deficiency.

**Remediation**

The deficiency can be managed through the application of nitrogenous fertilizers depending on the soil test data.

**ROLE OF PHOSPHORUS (P)**

Phosphorus (P) is an important constituent of nucleic acid and is abundant in the young tissues. Initial flowering of young palms is greatly influenced by the supply of P. Phosphorus, essential macronutrient, is involved in photosynthesis, respiration, energy storage and transfer, cell division, and enlargement. Phosphorus promotes early root formation and

growth. The content of P in the leaves will be lower in summer indicating the minimum flux during such period.

P deficiency in coconut

P deficiency occurs in crops grown in the lateritic and poor sandy soils. But due to continuous application of chemical fertilizers, there will be build up of P in the soil which increases the availability in soils.

The deficiency symptoms are usually seen in palms grown in extremely acidic as well as in calcareous soils.

**Deficiency symptoms**

- Leaves become purple coloured, and in severe cases, leaves may turn yellow.
- Premature drying and shedding of leaves are also seen.
- The symptoms of slowing down of growth and shortening of fronds are found to be associated with P deficiency.

**Remediation**

Application of P fertilizers based on soil test value. Correction of P deficiency improves overall nutrition of the palm and produces beneficial effects on the number of nuts and yield of copra per nut.

**ROLE OF POTASSIUM (K)**

Potassium is required in relatively large amounts in palms and it facilitates several major functions. This nutrient is involved in photosynthesis, enzyme activation and osmoregulation. It plays vital role in the formation of amino acids and proteins and in the photosynthetic activities of the plant. It is essential for starch formation and the translocation of sugars and also in the development of chlorophyll. It increases leaf area, improves leaf angle and leaf colour which result in better utilisation of sunlight and ultimately causes increased number of fronds, inflorescences, female flowers, nut set and weight of copra per nut. It imparts resistance to pest and disease attack along with regulating water balance of the plant. It also

enables the plant to withstand drought. Osmoregulation affects the pressure within a plant cell: potassium controls the opening and closing of stomata. If potassium levels in soils are low, plant leaves develop symptoms of water stress. Palms may also become more susceptible to disease if important elements, including potassium, nitrogen, boron, and magnesium, are out of balance in soils.

K deficiency in coconut

The deficiency is common in light sandy soils as well as in laterite soils. High levels of calcium and magnesium in soil results in depletion of this nutrient from the root zone. Intercropping with potassium exhaustive crops such as tapioca, fodder grass, banana and pineapple without proper addition of fertilizers would also result in the depletion of potassium.

**Deficiency symptoms**

- Development of orangish yellow discoloration from the tip of the leaflets, progressing along the margin towards the base.
- If severe, tip of leaflets withers and become necrotic
- The midrib remains green and some leaves exhibit a scorched appearance
- Appearance of a green triangle with it's base in the lowest leaflets and apex towards the tip is a characteristic feature of potassium deficiency in coconut.
- Newly emerging leaves are short and chlorotic or yellow.
- Reduced growth, slender stem, short leaflets and reduction in inflorescences, nut set and nuts per bunch

**Remediation**

Application of K fertilizers based on soil test prevents K deficiency

## ROLE OF CALCIUM

Calcium (Ca) is an immobile element in plant. It is a constituent of cell walls and is essential for the growth of meristems, cell division, particularly for the growth and functioning of root tips, and bud formation. In coconut, apart from the role of a nutrient, it acts as a soil ameliorant, especially under acidic conditions. This is also involved in nitrogen metabolism, reduces plant respiration, aids in translocation of photosynthesis from leaves to fruiting organs and stimulates microbial activity

### Deficiency symptoms

Clear cases of Ca deficiency in coconut are not usually found. However, the deficiency symptoms first appear on the youngest leaves.

- Young leaves exhibit narrow white bands at margins. Later it gains a rusty appearance in leaf margin.
- Along with this there will be rolling up of leaves.
- Yellowing of leaflet tips with yellow to orange ring shaped spots spread on the leaflets, later turn necrotic and further drying up of leaf. These symptoms appear in the middle leaves earlier than in the older leaves. Severe distortion of leaflets and leaves also occur.

### Remediation

Regulated applications of Ca bearing fertilizers like rock phosphate, super phosphate, bone meal or soil application of lime or dolomite @ 1 kg per palm per year depending on the lime requirement of the soil is recommended.

## ROLE OF MAGNESIUM (Mg)

Magnesium (Mg) is the only metal constituent of chlorophyll, the green colouring matter of plants and hence has a definite role in the pigment system and affects the photosynthetic capacity of the plant. It plays an important role as a 'carrier' in the transport of P in plants. It also plays an important role in the production of carbohydrates, proteins and fats. Magnesium is the key element of chlorophyll production. It improves utilization and mobility of phosphorus and also acts as an activator and component of many plant enzymes. It facilitates increased iron utilization in plants.

### Deficiency symptoms

- Mg deficiency appears on the older leaves of palms
- Presence of broad chlorotic (yellow) bands along the margins
- Leaves in the lower half of the crown are bright yellow, while leaves on the upper half remain green

- Yellowing of the older leaves, which starts from the tip and extends towards the base and later the younger leaves also turns yellow
- Mg deficient leaves have distinctly green leaf centres and bright lemon yellow to orange coloured margins
- Yellowing occurs principally in those parts of the leaf which are exposed to sunlight, whereas, the shaded part remains green
- Bronzed appearance of older leaves which dry out later
- Necrosis of leaflets which turn reddish brown with translucent spots

Mg deficiency symptoms differ from those of K deficiency wherein, the symptom severity of discoloration in K deficient leaves is usually orange to bronze, shading gradually to green at the base of the leaf, whereas Mg deficient leaves have distinctly green leaf centres and bright lemon yellow to orange margins. Mg deficiency reduces coconut yield by about 40 %. Dwarf palms are more sensitive to Mg deficiency than tall and hybrids.

Mg deficiency symptom on coconut

**Remediation**

Application of dolomite @ 1 kg per palm, two weeks prior to fertilizer application, or magnesium sulphate @ 500 g per palm along with second dose of fertilizer application would help in managing the deficiency.

**ROLE OF SULPHUR**

Sulphur (S) is a constituent of protein and it aids in the formation of chlorophyll. It helps in the development of dark green leaves and an extensive root system.

**Diagnosis**

- Leaflets become yellowish - green or yellowish – orange
- Chlorosis and necrosis increase with the age of the leaves
- In severe cases, second or even the first leaf may show yellowing

- Drooping of the leaves as the stem becomes weak
- In older palms, leaf number and size are reduced
- The number of live fronds becomes fewer.
- In the advanced stage, the crown loses most of the leaves and severe necrosis is found on the older leaves.
- The yield of nuts is reduced and the nuts are usually small with normal kernel thickness.
- On drying, the kernel collapses into soft flexible and leathery copra, often brown in colour which is usually referred to as "***rubbery copra".***
- It has very poor physical and chemical characteristics, particularly with very low oil content.

**Remediation**

S deficiency in coconut can be prevented by the regular use of S containing fertilizers like Ammonium Sulphate, Super Phosphate, Magnesium Sulphate *etc*.

**ROLE OF IRON (Fe)**

Iron (Fe) is a catalyst for the formation of chlorophyll and is also a constituent of enzymes associated with respiration and oxidation systems. Usually appears on palms grown in poorly aerated soils or those that have been planted too deeply. Water logged soils and deep planting suffocate the roots and reduce their effectiveness in taking up nutrients such as Fe. Under acidic soil conditions, deficiency of Fe is usually not encountered.

**Deficiency symptoms**

- Uniform chlorosis *ie.*, a pale green or dark yellow discolouration occurs to all the leaves from the top of the crown to the base
- Gradual yellowing of the leaflets in longitudinal strips parallel to the veins
- In the advanced stages the leaf becomes completely yellow
- Shortening of the rachis and the leaflets
- Absence of necrosis in any part of the leaf is a characteristic symptom of iron deficiency.

Fe deficiency symptoms on coconut

**Remediation**

Application of $FeSO_4$ @ 0.25 to 0.5 kg / palm / year is recommended as the management practice for correcting the deficiency.

**ROLE OF MANGANESE (Mn)**

Visual symptoms may be sufficient to diagnose this disorder, but leaf nutrient analysis is also suggested, since symptoms of boron (B) deficiency can be similar. Mn deficiency is caused primarily by high soil pH and as in the case of Fe, deficiency of Mn occurs in alkaline and calcareous soils, where it gets immobilized in the coconut root zone.

**Deficiency symptoms**

- Newer leaves with chlorotic and longitudinal necrotic streaks
- As the deficiency progresses, newly emerging leaflets appear necrotic and withered on all except the basal portions of the leaflets
- This withering results in curling of the leaflets about the rachis giving the leaf a frizzled appearance (‘***frizzle top’***).
- In severely Mn - deficient palms, growth stops and newly emerging leaves consist solely of necrotic petiole stubs.


Mn deficiency in coconut

**Remediation**

Soil application of $MnSO_4$ @ 25kg/ha is recommended as the management practice for correcting the deficiency.

**ROLE OF COPPER**

Deficiency of copper (Cu) is seen in highly acid sandy soils and in heavy organic soils, highly calcareous and alkaline sols. Liming reduces the availability of copper in deficient soils.

**Deficiency symptoms**

- The deficiency symptoms are severe bending of the rachis of the youngest leaves accompanied by yellowing and desiccation of the leaf tip which is rimmed with brown and yellow and the central part remains green.
- As the symptoms develop, dried out part spreads and gives the palm a saggy appearance
- Most of the petioles will be in arc - shape, eventually losing turgidity
- The leaflets show premature dry up and necrosis of the tips and change in colour from dark green to yellow from the tips towards the leaf petiole

**ROLE OF ZINC (Zn)**

Zinc (Zn) catalyses oxidation in plant cells, is essential for the transformation of carbohydrates, helps in the formation of auxins, and promotes water absorption. Zn deficiency usually occurs in saline soils.

**Deficiency symptoms**

- Button shedding along with the shortening of the crown is the reported symptom of zinc
- Zinc deficiency is characterized by formation of small leaves wherein the leaf size gets reduced to 50 %
- Leaflets become chlorotic, narrow and reduced in length
- In acute deficiency, flowering is delayed

**Remediation**

Soil application of $ZnSO_4$ @ 25 kg / ha is recommended as the management practice for correcting the deficiency

**ROLE OF CHLORINE (Cl)**

Chlorine (Cl) has a role in the stomatal conductance and in the maintenance of water balance. The deficiency of Cl is seen the palms located in the inland areas. Chlorine is normally considered as a micronutrient element for higher plants. It's importance in the nutrition of coconut has been emphasized recently. Since Cl requirement of coconut is comparatively very high, it is considered as a major nutrient for the crop. It enhances the growth of young palms and increases the yield of bearing palms. The effect of Cl is manifested more on the thickness of the kernel and the copra out turn.

**Deficiency symptoms**

- Presence of abnormal leaves

- Reduced growth rate of the palms with reduction in size and number of nuts
- Drooping of leaves that indicates signs of moisture stress which may result in the breakage of fronds
- Stem cracking and frequent occurrence of stem bleeding
- Marked incidence of grey leaf blight is also reported
- The leaflets become susceptible to fungal attack and cause ***"leaf spots".***

**Remediation**

Sodium Chloride (NaCl: common salt) can be used for supplementing the Cl requirement of the palm, particularly in the case of plantations situated away from sea coast.

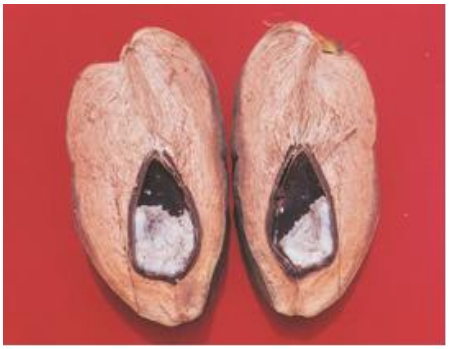
**ROLE OF BORON**

Boron is an essential micronutrient for coconut, which helps in the multiplication of meristematic tissues. It helps in the metabolism of protein, synthesis of pectin, maintenance of water relation, translocation of sugars, tissue respiration, fruiting process, growth of pollen tube and in the development of flowers and fruits. Wide spread deficiency of boron is noticed in the coconut growing areas, which may be attributed to the continuous removal through cropping and due to the non-replenishment of the same along with regular fertilizer application. The deficiency symptoms of boron are very much specific. Boron deficiency has been reported from different coconut growing countries of the world and the problem is commonly known as ***'crown rot / choking'*** disease of coconut. Since boron is an immobile element in plant, initial symptoms appear on the youngest leaf.

**Deficiency symptoms**

- Initial symptoms of boron deficiency are manifested by reduction in the elongation of young leaves.
- The leaflets, when unfolding, are crinkled and will be shorter than normal.
- In more advanced stages, terminal leaflets remain fused.
- The tips of these leaflets may be 'knife shaped', with or without a brown solution oozing out through the hook. This symptom is also called ***'hook leaf'***.
- The basal part of the petiole may be without leaflets.
- In adult palms, the deficiency leads to production of ***branched spikes***, premature death of inflorescence, and production of inflorescence with lesser female flowers, and shedding of buttons (female flowers).
- Other associated symptoms include '***Hen and Chick'*** symptom (a few under developed nuts / small sized nuts along with full developed nuts),
- Cracking of nuts externally /internally with meat protruding towards the mesocarp and barren nuts with partial/unevenly developed kernel having poor quality copra. Pollen production, pollen grain germination and pollen tube development will be affected.

- Often, the malformations may be exhibited either singly or by various combinations based on the intensity of the deficiency. Drought may aggravate boron deficiency and in some cases seasonal boron deficiency *i.e.*, the symptoms appearing in the dry season and disappearing in the wet season could be noticed.



Boron deficiency symptoms in coconut