

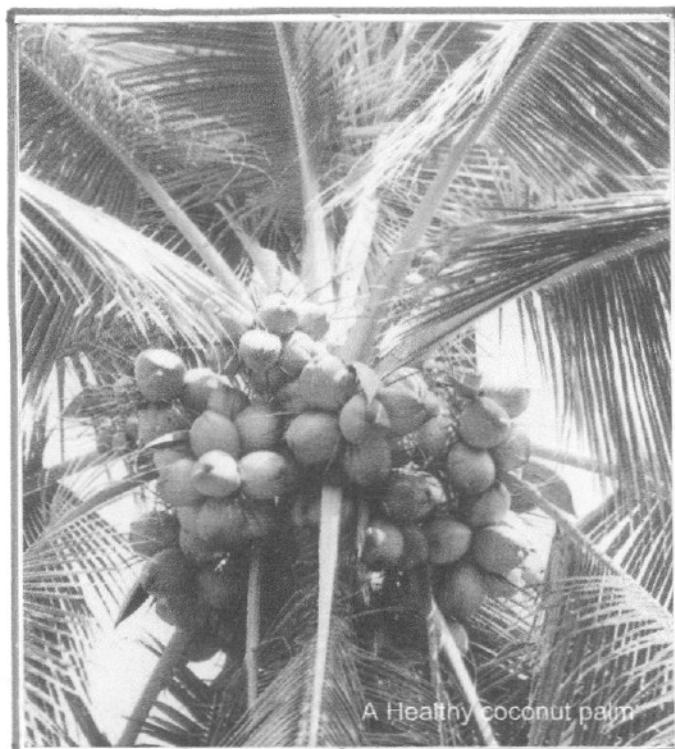


IPM PACKAGE NO. 42



# INTEGRATED PEST MANAGEMENT PACKAGE

## FOR COCONUT



Government of India  
Ministry of Agriculture  
Department of Agriculture & Cooperation  
**Directorate of Plant Protection, Quarantine & Storage**  
N. H. IV, Faridabad - 121 001.

## IPM PACKAGE FOR COCONUT

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Grams : 'PROTECTION'



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## FORWARD

Integrated Pest Management (IPM) approach has been globally accepted for achieving sustainability in agriculture. It has become more relevant due to a number of advantages like safety to environment, pesticide-free food commodities; low input cost based Crop Production Programme etc. Though IPM approach has been taken up since 1981, its impact has not been felt until 1994. Human Resource Development has helped to sensitize extension functionaries and farmers about the usefulness of IPM.

For successful implementation of IPM, gathering of the scattered information on various components of this eco-friendly approach in the form of package is basic necessity. In this direction, initial attempts were made in 1992 to harmonize the IPM Package of Practices of various crops. Subsequently, concerted efforts were made in 1998, 2001, 2002 and 2003 to update and develop IPM Package of Practices for agricultural and horticultural crops. Keeping in view, the development of resistance and attainment of pest status by certain insects, updating of IPM modules in five crops (Cotton, Rice, Sugarcane, Groundnut & Coconut) was done in 9<sup>th</sup> National Workshop held at CIL, Faridabad during 22<sup>nd</sup>-23<sup>rd</sup> December, 2003.

(P. S. Chandurkar)

31<sup>st</sup> December, 2003

(IPM Package for Coconut)

## P R E F A C E

In order to minimize the indiscriminate and injudicious use of chemical pesticides, INTEGRATED PEST MANAGEMENT (IPM) has been enshrined as cardinal principle of Plant Protection in the overall Crop Protection Programme under the National Agricultural Policy of the Govt. of India. IPM is an eco-friendly approach for managing pest and disease problems encompassing available methods and techniques of pest control such as cultural, mechanical, biological and chemical in a compatible and scientific manner. The greater emphasis has been given on biological control including use of biopesticides.

With a view to provide technical knowledge to the extension functionaries and farmers in the States, first National Workshop on IPM for harmonization of Package of Practices was organized at National Plant Protection Training Institute (NPPTI), Hyderabad during June 29-30, 1992. Subsequently workshops were organized on April 15-17, 1998 and Nov. 5-6, 1998 at the Directorate of Plant Protection, Quarantine & Storage, Faridabad and IPM Package of Practices for 20 crops were finalized on rice, cotton, vegetables, pulses and oilseeds. In this series, two National Workshops on IPM have been conducted at NPPTI, Hyderabad and Dte. of PPQ&S, Faridabad during May 14-17, 2001 and February 20-22, 2002 respectively to update 20 available IPM Packages and developed 31 new IPM Packages especially for horticultural crops. Sixth and Seventh National Workshops held at Central Insecticides Laboratory, Faridabad on 4<sup>th</sup>-5<sup>th</sup> July, 2002 and 9<sup>th</sup>-10<sup>th</sup> January, 2003 respectively for 18 IPM Packages and Eighth National Workshop was held at NPPTI, Hyderabad on 28<sup>th</sup>-29<sup>th</sup> May, 2003 for 8 IPM Packages. In these Workshops, 77 IPM Package of Practices for cereal crops (Rice, Wheat, Maize, Sorghum, Millets), commercial crops (Cotton, Sugarcane, Tobacco, Tea, Betelvine, Saffron), pulse crops (Pigeonpea, Gram, Black gram/Green gram, Peas, Rajma), oilseeds (Groundnut, Soybean, Rapeseed/Mustard, Sesame, Olive, Safflower, Castor, Sunflower, Oilpalm), vegetables (Potato, Onion, Tomato, Brinjal, Okra, Chillies, Cruciferous vegetables, Leguminous vegetables, Cucurbitaceous vegetables, Broccoli, Spinach, Lablab bean, Garlic), fruits (Citrus, Banana, Apple, Mango, Guava, Grapes, Jackfruit, Pineapple, Sapota, Pomegranate, Litchi, Papaya, Apricot, Peach, Pear, Cherry, Walnut, Ber, Amla, Loquat, Strawberry, Watermelon, Fig, Phalsa, Persimmon, Custard apple, Raspberry, Kiwi, Passion fruit), spice and plantation crops (Small Cardamom, Large Cardamom, Black Pepper, Ginger, Coriander, Cumin, Fennel, Coconut, Cashew and Areca nut) have been finalized. Moreover, 9<sup>th</sup> National Workshop for Review/Upgradation of IPM Package of Rice, Cotton, Sugarcane, Coconut and Groundnut crops was held during 22<sup>nd</sup> -23<sup>rd</sup> December, 2003 at CIL, Faridabad. Latest research developments, pest problems and their management practices have been incorporated in these IPM packages.

IPM technology manages the pest population in such a manner that economic loss is avoided and adverse side effects of chemical pesticides are minimized. The IPM packages encompass various management strategies for containing the pest and disease problems. Pest monitoring is one of the important components of IPM to take proper decision to manage any pest problem. It can be done through Agro-Ecosystem Analysis (AES), field scouting, light, pheromone, sticky/yellow pan traps. The economic threshold levels (ETL) of important pests and diseases are also given in the packages to take appropriate control measures when pest population crosses ETL.

These IPM packages developed with the technical inputs from experts from the various Institutes of Indian Council of Agricultural Research, State Agricultural Universities, Central Directorate of Plant Protection, Pesticide Industries and State Departments of Agriculture/Horticulture will provide technical backup in the management of pests, diseases, weeds, nematodes and rodents in the agriculture and horticulture. These will also be useful in reducing the pesticide residues in agricultural commodities and would also help in the management of pests/diseases/weeds/nematodes which may get inadvertently introduced in the country.

IPM Package of Practices for agricultural and horticultural crops will be helpful to minimize the ill-effects of chemical pesticides to promote the IPM for sustainable production. These IPM packages will be useful for the researchers, extension workers and farmers alike who are engaged in the agricultural practices.

31<sup>st</sup> December, 2003

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(IPM Package for Coconut)

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- |   |  |
|---|--|
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(- PM Package for coconut)

## IPM PACKAGE FOR COCONUT

The coconut palm (*Cocos nucifera L.*), Kalpavriksha(the tree of heaven) is one of the most important palms that provides a variety of useful products like food, fuel, and timber. India ranks third in production( 12822 million nuts) from an area of 1.89 millions ha. and contributing to to 26.06% share of total coconut production from different coconut producing countries of the world. Kerala contributes 34.4% of national production by producing 5744 million nuts from 939 500 ha. area.

### I. MAJOR PESTS.

#### A. PEST OF NATIONAL SIGNIFICANCE

##### 1. INSECT PESTS

- 1.1 Rhinoceros beetle (*Oryctes rhinoceros*)
- 1.2 Red palm weevil (*Rhynchophorus ferrugineus*)
- 1.3 Black headed caterpillar (*Opisina arenosella*)

##### 2. OTHER ARTHROPODS

- 2.1 Mite (*Aceria guerreronis*)

##### 3. DISEASES

- 3.1 Bud rot (*Phytophthora palmivora*)
- 3.2 Stem bleeding (*Thielaviopsis paradoxa*)
- 3.3 Leaf rot (*Exserohilum rostratum* and *Colletotrichum gleosporioides*)

##### 4 RODENTS

- 4.1 Rattus rattus
- 4.2 *Tatera indica* (nursery/seedling)
- 4.3 *Bandicota bengalensis*

##### 5. WEEDS

- 5.1 Crofton weed (*Eupatorium odoratum*)
- 5.2 Congo grass (*Imperta cylindria*)
- 5.3 Goose grass (*Elousine indica*)
- 5.4 Purple nut sedge (*Cyperus rotundus*)
- 5.5 Burmuda grass (*Cynodon dactylon*)

#### B. PEST AND DISEASES OF REGIONAL IMPORTANCE

- 1. Cockchafer beetle (*Leucopholis coneophora*)
- 2. Thanjavur wilt (*Ganoderma lucidum*)
- 3. Coreid bug (*Paradasynus rostratus*)
- 4. Root wilt (*Phytoplasma sp.*)
- 5. Spurge (*Euphorbia hirta*)
- 6. Pig weed (*Amaranthus gracilis*)
- 7. Morning glory (*Ipomoea triloba*)
- 8. Beggar stick (*Bidens pilosa*)
- 9. Niruri (*Phyllanthus niruri*)

## II. PEST MONITORING

The objective of pest monitoring is to monitor the initial development of pest and diseases in the field. Field scouting for pest/disease and biocontrol fauna/flora by extension agencies and farmers once in a fortnight should be undertaken to assess increasing/decreasing trend in the pest/disease incidence and availability of biocontrol potential. The plant protection measures are required to be taken only when pests and diseases cross economic threshold level (ETL) as per the result of field scouting.

**1. Rapid Roving Survey.(RRS):** In the beginning of crop season, survey routes are required to be identified in the pest and disease endemic areas to undertake Rapid Roving Survey (RRS). During survey the observations are to be made at every 5 -10 KM. distance in the pre-selected route at 10 – 15 days intervals depending upon pest and disease situation. Record the incidence of pest, disease and defender population at each spot in 5 plants at random and 12 spots per ha.

**2. Field Scouting.** Based on the observation of RRS the farmers at village level are to be mobilized to undertake field scouting. During field scouting farmers may record pest, disease and defenders populations once in 10-15 days in their own fields as per Agro-Ecosystem Analysis (AES) approach. The State Department of Agriculture should make all possible efforts by using different media, mode and publicity to inform the farmers the need for the field scouting in the specific crop areas having indication of pest or disease build up.

**3. Agro-ecosystem Analysis (AES).** AES is an approach, which can be gainfully employed by extension functionaries and farmers to analyse field situation with regard to pest, defenders, soil conditions, plant health, the influence of climatic factors and their interrelationship for growing healthy crop. Such critical analysis of the field situation will help in taking appropriate decision on management practices.

The basic components of AESA are :

- 1) Plant health.
- 2) Pest and defender population dynamics.
- 3) Soil conditions.
- 4) Climatic factors.
- 5) Farmers past experience.

### III. INTEGRATED PEST MANAGEMENT(IPM) STRATEGIES

#### 1. CULTURAL PRACTICES

- 1.1 Seed nuts must be selected from 20 years mother palms which yields more than 80 nuts per annum carries at least 12 bunches, has nut weighing not less than 600 grams.,
- 1.2 Collect seed nuts between February and May
- 1.3 Prepare beds of 1.3 metres width of convenient length
- 1.4 Timely sowing (May-June), proper irrigation.
- 1.5 Mulch the nursery beds after the monsoon
- 1.6 Timely planting (APRIL-If irrigation facility exists or May following the receipt of pre-monsoon showers but in low lying areas in September after the cessation of the heavy rain)
- 1.7 Prepare proper soil pit as per soil type:  
 Sandy soil: 0.75 x0.75x0.75 metre (fill the pit with mixture of top soil and wood ash or Farm yard manure or any organic manure to a height of 40 cm)  
 Loamy soil with low water table: 1x 1x 1 metre. Laterite soil with under lying rock : 1.2x 1.2x 1.2 metre ( 2Kg common salt may be applied on the floor of the pit to improve the soil condition about six months prior to planting).  
 Low lying area : shallow pit  
 ( as the plant grows, raise the ground level by adding silt and sand to cover the entire bole i.e.; root producing region of palm.
- 1.8 Maintain proper spacing  
 Square system: 7.6 to 9 metre(123 to 173 palm/ha)  
 Triangular system: 7.6 to 9 metre (143 to 200 palm/ha)  
 Single hedge system: 5 to 9 metre (222 palm/ha)  
 Double hedge system: 5 to 5 metre (286 palm/ha)
- 1.9 INM for coconut mite affected palm with 50 kg FYM, 1.3 kg urea, 2 kg super phosphate, 3.5 kg murate of potash, 1 kg gypsum and 50 gm of Borax.
- 1.10 Intercropping with cocoa, pepper, arecanut, pineapple, guava, vanilla and other crops suited to different agro climatic condition.
- 1.11 Field sanitation by promptly removing the disposing organic matters will reduce the rhinoceros beetle, red palm beetle attack and termites infestation.
- 1.12 Provide shade, irrigation, manure, fertilizer, drainage, weeding, mulching and interculture timely to have healthy plant stand.
- 1.13 Smothering of weeds by using mulching with straw/plastic sheets.
- 1.14 Grow intercrop/green manure crop/concern crop in coconut plantation to suppress the weed growth.

#### 2. MECHANICAL CONTROL

- 2.1 Take out and kill the Rhinoceros beetle from the attacked palms using a beetle hook

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- 2.2 Close the opening on the trunk with clay or cement to check red weevil.
- 2.3 Cut and burn one or two severely infested leaves of lower whorl affected by black headed caterpillar.
- 2.4 Cut and burn disease affected portion of palms.
- 2.5 Chisel out the affected tissues and dress the wound with hot coal tar to manage stem bleeding and Thanjavur wilt.
- 2.6 Use pheromone trap for Red palm weevil and Rhinoceros beetle @ 20 number/ha for mass control.
- 2.7 When fronds are to be removed from the palm, it should be cut leaving a petiole length of 120 cm. This will avoid entry of red weevil into the trunk portion
- 2.8 Log trapping with toddy for Red palm weevil-Fresh coconut logs 50 cm long, split longitudinally and cut surfaces smeared with fresh toddy fermented with yeast or acetic acid are effective in attracting the weevils. The traps are set in such a way that the two split halves are placed one above other with their cut surfaces facing each other
- 2.9 Pieces of fresh coconut petiole smeared with fermented toddy and kept in pots also serve as a weevil trap. Such traps should be kept in the evening and the weevils can be collected and destroyed next day morning
- 2.10 Mud pots containing Sugarcane molasses 2.5 kg/toddy 2.5 litre + acetic acid 5 ml.+ yeast 5 gm.+ longitudinally split tender coconut stem/leg of green petioles of leaves, 75 number in one ha. are effective in trapping Red palm weevils in large number
- 2.11 Collection and destruction of the adult beetles of white grub during the peak period of emergence in May-June
- 2.12 Setting up light trap to attract beetle of white grub.
- 2.13 Destruction of Rhinoceros grubs from breeding sites such as cow dung, compost pit etc
- 2.14 Trunk banding with aluminum sheet of 30 cm width at 5 ft. height of the palm prevents rat climbing to the crowns of the palm.
- 2.15 Searching for the Queen in termitorium and killing them will check the population of termites.
- 2.16 Use power/bullock/hand operated implements for controlling weeds as and when needed.

### **3. BIOLOGICAL CONTROL**

- 3.1 Conserve the natural enemies given in Annexure-I
- 3.2 Release *Goniozus nephantidis* (larval parasite), @ 10 nos. per plant at 15 days interval for 4 times *Bracon hebator* and *Bracon brevicornis* @ 20 number per 100 larvae at 15 days intervals for 4 times, *Elasmus nephantidis* (pre-pupal) and *Brachymeria nosatoi* (pupal) @ one per plant against *Opisina arenosella*.
- 3.3 Release *Baculovirus Oryctes* against *Oryctes rhinoceros* @ 10-15 virus infected beetles/ha.
- 3.4 *Metarhizium anisopliae* could be mass cultured in coconut water or on cassava chips and rice bran supplemented with a nitrogen source during

monsoon season against Rhinoceros beetle @  $5 \times 10^6$  spore/m<sup>3</sup> of breeding area.

- 3.5 Incorporation of the weed plant, *Clerodendron infertunatum* in the breeding sites of *O.rhinoceros* disrupts larval development.

#### **4. CHEMICAL CONTROL**

- 4.1 Drenching the nursery with 0.05% chloropyriphos twice at 20-25 days interval against termites.
- 4.2 Spray Neem oil + Garlic+ Soap (20ml+20g+5g) /lit against *Aceria guerreronis*
- 4.3 Spray Azadirachtin 1500 PPM, 4 ml/lit. of water against Eriophyid mite.
- 4.4 Inject the attacked palm with\*Carbaryl 1% as curative control for Red palm weevil.
- 4.5 Treat breeding site of Rhinoceros beetle with \* Carbaryl 0.01%.
- 4.6 Spray \*Carbaryl 0.1% on the bunches against Coreid bug
- 4.7 Remove the infected tissue and apply Bordeaux paste (10%) to the wound of the bud rot affected palm.
- 4.8 After removing the infected portion of the spindle leaf pour Contaf (Hexaconazole) 2 ml. or Indofil M-45 (Mancozeb) 3gm in 300 ml water around the well of the spindle against leaf rot.
- 4.9 To protect the young palm from rhinoceros beetle the innermost 2-3 leaf axils may be filled with a mixture of Sevidol 8g (25 g) + fine sand (200gm) per palm during May, Sept., and Dec. or leaf axil filling with neem cake 200 g + equal volume of sand or leaf axil filling with 12 gm of naphthalene balls covered with sand at 45 days interval is also effective.
- 4.10 Setting up of breeding traps using decaying organic derbies treated with 0.1% \*Carbaryl 3-4 times a year.
- 4.11 Spray the bunches (2-6 months old) with Azadirachtin 0.004% against *Aceria guerreronis*.
- 4.12 The single dose anticoagulant Bromadiolone in ready- to- use form may be used on the crown of the palms @ 30 bait points / ha.
- 4.13 Root feeding of Monocrotophos 36 WSC-10 ml + 10 ml water in polythene bag against Black headed caterpillar and Eriophyid mites. Harvesting of nuts should be done minimum 45 days after treatment.
- 4.14 Soil drenching with 0.1% calaxin @ 2.25 litres per tree for Tanjavur wilt.

\*Not as per the approved usage under Insecticide Act, 1968.

#### IV. CROP STAGE WISE IPM PRACTICES

Pre-sowing stage	Cultural practices	<ul style="list-style-type: none"> <li>-Select good mother palm i.e. must be of 20 years of age, yield more than 80 nuts/anum, etc.</li> <li>-Prepare beds of 1.3 metre width and of convenient length.</li> <li>-Timely sowing (May-June).</li> </ul>
Nursery stage	Cultural practices	<ul style="list-style-type: none"> <li>-Provide proper shade, irrigation and drainage.</li> <li>-Rogue out diseased seedling.</li> <li>-Employ locally made rat traps.</li> </ul>
	Chemical practices	<ul style="list-style-type: none"> <li>-Drenching the nursery with 0.05% Chlorpyriphos twice at 20-25 days interval against termites.</li> </ul>
Pre-planting stage	Cultural practices	<ul style="list-style-type: none"> <li>-Prepare proper pits.</li> <li>-Timely planting.</li> <li>-Maintain proper spacing.</li> <li>-Fill the pit with recommended soil mixture.</li> </ul>
	Cultural practices	<ul style="list-style-type: none"> <li>-Provide irrigation, organic manure, fertilizer as per the recommended dose, drainage, weeding, mulching, interculture timely.</li> <li>-Cut and burn disease affected portion of palms.</li> <li>-INM for coconut mite affected plants with 50 kg FYM, 1.3 kg ha, 2 kg SSP, 3.5 kg MOP, 1 kg gypsum &amp; 50 gm of Borax.</li> </ul>
Growth stage	Mechanical practices	<ul style="list-style-type: none"> <li>-Take out and kill the Rhinoceros beetle from the attacked palms using a beetle hook.</li> <li>-The hole is needed to be filled with a mixture of 3gm. Mancozeb + 1 kg sand.</li> <li>-Close the opening on the trunk with clay or cement to check red palm weevil.</li> <li>-Chisel out the affected tissues and dress the wound with hot coal tar to manage stem bleeding and Thanjavur wilt.</li> <li>-Use pheromone trap for Red palm weevil @ 10 traps/ha.</li> <li>-When fronds are to be removed from the palm, it should be cut leaving a petiole length of 120 cm. This will avoid entry of Red palm weevil in to the trunk portion.</li> <li>-Log trapping with toddy for Red palm weevil- Fresh coconut logs 50 cm long, split</li> </ul>

	<p>longitudinally and cut surfaces smeared with fresh toddy fermented with yeast or acetic acid are effective in attracting the weevils. The traps are set in such a way that the two split halves are placed one above other with their cut surfaces facing each other.</p> <p>-Pieces of fresh coconut petiole smeared with fermented toddy and kept in pots also serve as weevil trap. Such traps should be kept in the evening and the weevils can be collected and destroyed next day morning.</p> <p>-Mud pots containing sugarcane molasses 2.5 Kg /toddy 2.5 litre + acetic acid 5 ml + yeast 5 gm + longitudinally split tender coconut stem/ log of green petioles of leaves, 75 number in one ha are effective in trapping Red palm weevils in large number.</p> <p>-Collection and destruction of the adult beetles of white grub during the peak period of emergence in May-June.</p> <p>-Setting of light traps to attract beetles of white grubs.</p> <p>-Destruction of Rhinoceros grub from breeding sites such as cow dung, compost pit etc.</p> <p>-Conserve natural enemies.</p> <p>-Release <i>Goniozus nephantidis</i>, <i>Elasmus nephantidis</i> and <i>Brachymeria nosatoi</i> at the recommended dosages against the target pest stage of <i>Opisina arenosella</i>.</p> <p>-Release <i>Baculovirus</i> infested beetles against <i>Oryctes rhinoceros</i> (10 to 15 beetles/ha.)</p> <p>-<i>Metarhizium anisopliae</i> could be mass cultured in coconut water or on cassava chips and rice bran supplemented with a nitrogen source during monsoon season against Rhinoceros beetle.</p> <p>-Inject the red palm weevil attacked palm with Carbaryl (1%).</p> <p>-Treat breeding site of Rhinoceros beetle with Carbaryl (1%).</p> <p>-Spray Carbaryl (0.1%) on the bunches against Coreid bug.</p> <p>-Remove the infected tissue and apply Bordeaux paste (10%) to the wound of the bud rot affected palm.</p> <p>-After removing the infected portion of the spindle leaf, pour Contaf (Hexaconazole) 2 ml or Indofil M-45 (Mancozeb) 3 gm in 300 ml water around the well of the spindle against leaf rot.</p>
Biological control	
Chemical control	

Mature palm	Mechanical practices	<p>-To protect the young palm from Rhinoceros beetle the innermost 2-3 leaf axils may be filled with a mixture of Sevidol 8G (25 gm) + fine sand(200gm) per palm during May, Sept. and Dec. or leaf axil filling with 12 gm of naphthalene balls covered with sand at 45 days interval is also effective.</p> <p>-Setting up of breeding traps using decaying organic debrises treated with 0.1% Carbaryl 3-4 times a year.</p>
	Chemical practices	<p>-Trunk banding with aluminium sheet of 30 cm width may be done to prevent rats harboring the trees.</p> <p>-All methods will be same as of growth stage except following:</p> <ul style="list-style-type: none"> <li>-Spray Neem oil + Garlic + Soap mixture or Azadirachtin 0.004% against <i>Aceria guerreronis</i>.</li> <li>-Spray Azarachtin 1500 ppm @ 4 ml/lit. of water agansit mites.</li> <li>- Root feeling of Monocrotophos 36 WSC-10 ml+10 ml water in polythene bags against BHC &amp; mites.</li> <li>- Root treatment with 5% Azarachtin (7.5 ml mixed with equal quantity of water in polythene bags).</li> <li>-Spray Carbaryl (0.1%) on the bunches against Coreid bug.</li> <li>-Place Bromodiolone(0.005%) ready to use form @ 30 bait points/ha. Repeat the treatment after 12 days on those palms showing fresh damage. The placement should be done at 1:5 ratio of infested trees. Infestation of rodents can be diagnosed based on fallen rat-damaged nuts at the base of the trees.</li> </ul>

## V. DO'S AND DON'TS IN COCONUT IPM

DO'S	DONT'S
<ol style="list-style-type: none"> <li>1. Select the good mother palm i.e. .must be of 20 years of age yield more than 80 nuts/annum, has 30 to 40 fully opened leaves in the crown, carries at least 12 bunches of nuts, has nut weighted not less than 600 gm/nut.</li> <li>2. Collect mature nuts (11 to 12 month old) from selected mother palm between Feb. and May.</li> <li>3. Store the seed nuts with the stalk end up over a layer of sand in a shed or pit. Up to 5 layers of nuts can be arranged one over the other for a period of 60 days or till the husk is well dried before sowing.</li> <li>4. Prepare seed bed of 1.3 m width and of convenient length.</li> <li>5. Sow the seed nut during the May-June with the commencement of S.M.Monsoon.</li> <li>6. Sow the seed nut vertically with stalk end-up with spacing of 30 cm</li> <li>7. Provide adequate shade to the nursery during summer months.</li> <li>8. Remove seed nut that have not germinated within 5 months.</li> <li>9. Do weeding, irrigation timely.</li> <li>10. Transplant 9-12 months old seedling in main field during April if irrigation facility earliest otherwise during May following the receipt of pre-monsoon showers maintaining proper spacing.</li> <li>11. Irrigate @45 litre water per seedling once in four days during summer months and 200 litre water once in 4 days for adult palms. Through drip irrigation apply 30-35</li> </ol>	<ol style="list-style-type: none"> <li>1. Don't collect seed nuts from palms with long, thin and pendulous inflorescence stalk, which provide long, narrow, small sized or barren fruits, which shed immature nuts in large numbers which are alternate bearers.</li> <li>2. Don't collect immature nuts as a seed nut.</li> <li>3. Avoid overcrowding in storage.</li> <li>4. Don't prepare too wider seed bed.</li> <li>5. Avoid planting before Sept. in low lying area.</li> <li>6. Avoid horizontal sowing and too close/wide planting.</li> <li>7. Avoid raising nursery in open area.</li> <li>8. Avoid ungerminated seed nut of the seedbed.</li> <li>9. Avoid untimely excess or low irrigation.</li> <li>10. Don't transplant seedlings below 9 months and after 12 months old.</li> <li>11. Irrigation should not be excessive</li> </ol>

<p>litre water/palm/day.</p> <p>12. Remove soil accumulating at the collar region of the seedlings during rain.</p> <p>13. Keep the pits weed free.</p> <p>14. Fill up seedling pit with soil gradually every year by cutting from the sides as the seedling grows.</p> <p>15. Apply balanced manure and fertilizers.</p> <p>16. Make regular monitoring.</p> <p>17. Take out and kill Rhinoceros beetle from the attacked palm using a beetle hook.</p> <p>18. Mulch the coconut basin with green/dry leaves or with husk at the close of N.E.Monsoon.</p> <p>19. Bunches may be stalked with bamboo splits or coconut leaf stalks or secured with strong ropes.</p> <p>20. Conserve natural enemies.</p> <p>21. Use pheromone trap against red palm weevil.</p> <p>22. Release <i>Bracon brevicornis</i> and <i>Goniozus nephantidis</i> to control Black headed caterpillar.</p> <p>23. Release <i>Baculovirus</i> against Rhinoceros beetle.</p> <p>24. Use neem oil and garlic juice against mite.</p> <p>25. Adopt various mechanical methods to control pest problem.</p> <p>26. Ready to use block of anti-coagulant rodenticide Bromadiolone should be placed at the base of the affected bunches on the crown.</p>	<p>12 Avoid soils accumulating at the collar region of the seedling.</p> <p>13. Avoid weeds in the pits</p> <p>14. Avoid soil erosion.</p> <p>15. Avoid non-judicious use of fertilizer as more K application induces Magnesium deficiency. More Ca induces B deficiency.</p> <p>16. Avoid calendar based and non judicious application of pesticides.</p> <p>17. Dead rats located after anticoagulant application should be buried in soil.</p>
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## VI. POTENTIAL BIOAGENTS OF COCONUT PALM

Sl.no.	Bioagent	Nature	Host	Stage attacked
<b>Hymenopterans:</b>				
1.	<i>Apanteles taragamae</i>	Parasitic	<i>O. arenosella</i>	Early larvae
2.	<i>Goniozus nephantidis</i>	Parasitic	-do-	Larvae
3.	<i>Bracon brevicornis</i>	Parasitic	-do-	Larvae
4.	<i>Eriborus trochanteratus</i>	Parasitic	-do-	Larvae
5.	<i>Elasmus nephantidis</i>	Parasitic	-do-	Pre pupal stage
6.	<i>Brachymeria nephantidis</i>	Parasitic	-do-	Pupal stage
7.	<i>Brachymeria nosatoi</i>	Parasitic	-do-	Pupal stage
8.	<i>Xanthopimpla sp.</i>	Parasitic	-do-	Pupal stage
9.	<i>Campsomeriella collaris</i>	Parasitic	White grub	Grub
10.	<b>Carabids:</b> <i>Parena nigrolineata</i> <i>Calleida splendidula</i>	Predatory	<i>O.arenosella</i>	larvae
11.	<b>Anthocoreid bug:</b> ( <i>Cardiastethus sp.</i> )	Predatory	<i>O.arenosella</i>	Egg and neonatal stage
12.	<b>Reduviid bug (Exotic):</b> <i>Platymeris laevicollis</i>	Predatory	Rhinoceros beetle	Adult
13.	<b>Spiders:</b> <i>Cheiracanthium sp.</i> <i>C. melanostoma</i> <i>Rhene indicus</i> <i>Marpissa tigrina</i> <i>Phidippus bengalensis</i> <i>Sparassus sp.</i> <i>Tetragnathes andamanensis</i>	Predatory	All insects	All stages

14.	<i>Santallus parallelus</i> <i>Pherosophus occipitalis</i> <i>P. lissoderus</i> <i>Harpalus indus</i> <i>Scaritus sp.</i> <i>Agrypnus sp.</i> <i>Oxycetonia versicolor</i>	Predatory	Rhinoceros beetle	Eggs and larvae
15.	<b>Pathogens:</b> <i>Baculovirus oryctes</i>	Pathogenic	Rhinoceros beetle	Grub and adult
16.	<i>Metarhizum anisopliae</i>	Pathogenic	Rhinoceros beetle and White grub	Grub
17.	<i>Pseudomonas aeruginosa</i>	Pathogenic	Red palm weevil	Grub
18.	Nuclear Polyhedrosis Virus	Pathogenic	Red palm weevil	Grub
19.	Cytoplasmic Virus	Pathogenic	Red palm weevil	Grub
20.	<i>Beauveria bassina</i>	Pathogenic	White grub	Grub
21.	<i>Beauveria brogniartii</i>	Pathogenic	White grub	Grub
22.	<b>Nematodes:</b> <i>Heterorhabditis indica</i> <i>Steinernema glaseri</i> <i>Steinernema sp</i>	Parasitic	Rhinoceros beetle, Red palm weevil and White grub	Grub

## VII. SAFETY PARAMETERS IN PESTICIDES USAGE

S. No	Name of pesticide	Classification as per Insecticides Rules, 1971	Colour of Toxicity Triangle	WHO classification by hazard	First aid measures	Symptoms of poisoning	Treatment of poisoning	Waiting period (No. of days)
<b>INSECTICIDES</b>								
<b>CARBAMATES</b>								
1.	Carbaryl	Highly toxic	Yellow	Class II - Moderately hazardous		Constriction of pupils, salivation, profuse sweating, lassitude, muscle incoordination, nausea, vomiting, diarrhoea, epigastric pain, tightness in chest.	<ul style="list-style-type: none"> <li>- Atropine injection 1 to 4 mg. Repeat 2 mg when toxic symptoms begin to recur (15-60 minute intervals). Excessive salivation - good sign, more atropine needed.</li> <li>- Keep airway open. Aspirate, use oxygen, insert endotracheal tube. Do tracheotomy and give artificial respiration as needed.</li> <li>- For ingestion, lavage stomach with 5% sodium bicarbonate, if not vomiting. For skin contact wash with soap and water (eyes - wash with isotonic saline). Wear rubber gloves while washing contact area.</li> <li>- Oxygen</li> <li>- Morphine, if needed.</li> </ul> <p>Avoid theophyllin and aminophyllin or barbiturates. 2-PAM and other oximes</p>	

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							are not harmful and in fact contra indicated for routine usatge.	
							Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.	
<b>FUNGICIDES</b>								
2.	Copper oxychloride	Slightly toxic	Blue	Class III - Slightly hazardous		Headache, palpitation, nausea, vomiting, flushed face, irritation of nose, throat eyes and skin etc.,	No specific antidote. Treatment is essentially symptomatic.	
3.	Mancozeb		Green	Table 5 - Unlikely to present acute hazard in normal use.				
4.	Sevidol							
<b>RODENTICIDES</b>								
5.	Bromodiolone	Extremely toxic	Bright red	Class I a - Extremely hazardous		Bleeding from nose, gums and into conjunctiva, urine and stool & coma  Possible polar and petechial rash, late-massive ecchymoses or hematoma of skin, joints, brain hemorrhage	<ul style="list-style-type: none"> <li>- Give Vitamin K1 15-25 mg for adults; 5-10 mg. for children orally;</li> <li>- Transfuse with fresh blood if bleeding is severe or until anemia is corrected.</li> <li>- Iron (Ferros sulfate) by mouth for correction of secondary anemia, 0.3 gm t.i.d.</li> </ul>	

## BASIC PRECAUTIONS IN PESTICIDE USAGES

### A. Purchase

1. Purchase only JUST required quantity e.g. 100, 250, 500 or 1000 gm/ ml for single application in specified area.
2. Do not purchase leaking containers, loose, unsealed or torn bags.
3. Do not purchase pesticides without proper / approved LABELS.

### B. Storage

1. Avoid storage of pesticides in the house premises.
2. Keep only in original container with intact seal.
3. Do not transfer pesticides to other container.
4. Never keep them together with food or feed / fodder.
5. Keep away from the reach of children and livestock.
6. Do not expose to Sun-light or rain water.
7. Do not store weedicides along with other pesticides.

### C. Handling

1. Never carry / transport pesticides along with food materials.
2. Avoid carrying bulk pesticides (dusts / granules) on head, shoulders or on the back.

### D. Precautions for Preparing Spray Solution

1. Use clean water.
2. Always protect your NOSE, EYES, MOUTH, EARS and HANDS.
3. Use hand gloves, face mask and cover head with cap.
4. Use polythene bags as hand gloves, handkerchiefs or piece of clean cloth as mask and a cap or towel to cover the head (Do not use polythene bag contaminated with pesticides).
5. Read the label on the container before preparing spray solution.
6. Prepare spray solution as per requirement.

7. Do not mix granules with water.
8. Concentrated pesticides must not fall on hands etc., while opening sealed containers. Do not smell the sprayer tank.
9. Avoid spilling of pesticide solution while filling the sprayer tank.
10. Do not eat, drink, smoke or chew while preparing solution.

**E. Equipment**

1. Select right kind of equipment
2. Do not use leaky, defective equipment
3. Select right kind of nozzle.
4. Don't blow / clean clogged-nozzle with mouth. Use old toothbrushes tied with the sprayer and clean with water.
5. Do not use same sprayer for weedicide and insecticide.

**F. Precautions for applying pesticides**

1. Apply only at recommended doses and dilution.
2. Do not apply on hot sunny day or strong windy condition.
3. Do not apply just before the rains and also after the rains.
4. Do not apply against the wind direction.
5. Emulsifiable concentrate formulations should not be used for spraying with battery operated ULV sprayer.
6. Wash the sprayer and bucket etc. with soap water after spraying.
7. Containers, buckets etc., used for mixing pesticides should not be used for domestic purposes.
8. Avoid entry of animals and workers in the fields immediately after the spraying.

**G. Disposal**

1. Left over spray solution should not be drained in ponds or water lines etc. Throw it in barren isolated area, if possible.
2. The used / empty containers should be crushed with a stone / stick and buried deep into soil away from water source.
3. Never re-use empty pesticide container for any purpose.