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Have coconuts without pest infection

About 547 species of insects and mites attack the palm during different phases of growth and incur substantial crop loss. The annual loss due to the pest complex in Kerala alone has been estimated to be 618.50 million nuts. Constantly changing cropping systems and adoption of agro-technologies for higher productivity without looking into the ecological balance of nature resulted in instability in biotic and abiotic components of the ecosystem. Such disruptions have created instances of minor pests emerging as major pests and also resulted in large-scale spread of major pests to newer areas. In India, pest control strategies in coconut were initially developed with more orientation towards use of insecticides. But increased awareness on the side effects caused by indiscriminate use of chemical pesticides had made integrated pest management (IPM) the need of the present era.

THE IPM is a pest population management system utilizing all suitable technologies in a compatible manner to maintain the pest population below the economic injury level. It is a holistic approach aimed to minimize pest impact and to maintain the integrity of ecosystem. During the past two decades considerable efforts have been made to develop IPM strategies for combating major pests of coconut palm.

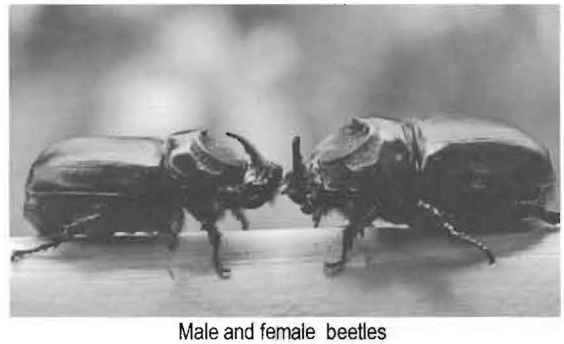
MANAGEMENT OF PESTS

Rhinoceros Beetle (*Oryctes rhinoceros*)

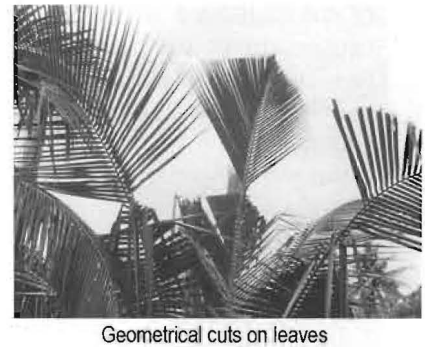
The adult beetle bores into the unopened spindle leaves and spathe, causing characteristic "V" shaped geometric cuts on leaves and round to oblong holes on spathes. The pest breeds in decaying organic debris such as cattle dung, compost, dead and decaying palms *etc.* Black beetle infestation has to be considered serious as the damage done by this pest provides egg laying sites for another lethal pest, *viz.* red palm weevil and for entry of fungal pathogens.

The photosynthetic efficiency of palms is reduced as there is considerable reduction in functional area of young leaves resulting loss of vigour and reduction in yield. On an average, it causes 10% loss in production of nuts. The damaged spathes dry up, causing complete loss of nuts. Attack on young seedlings and young palms results in stunted growth and delayed flowering and repeated attacks in growing point lead to death of seedlings. Petiole damage results in breaking of fronds.

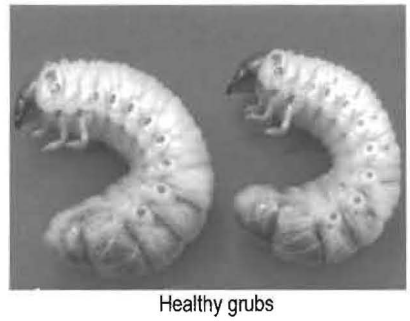
Rhinoceros beetle



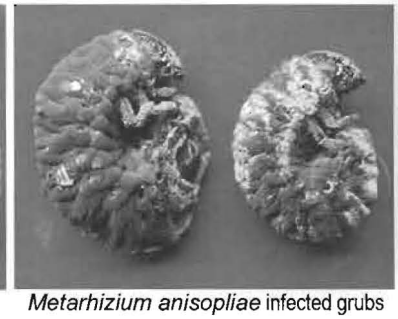
Male and female beetles



Geometrical cuts on leaves



Healthy grubs



Metarhizium anisopliae infected grubs

PVC Pheromone trap

IPM

- The dead and decaying coconut logs and other organic debris in the vicinity of coconut plantations may be properly disposed off, since this act as prolific breeding grounds of the beetle.
- Hook out beetles from crown during peak periods of pest infestation (June- September) and the bore hole shall be filled with a mixture of Mancozeb and sand @ 3g/1kg.
- Application of powdered oil cakes of neem, or marotti (*Hydnocarpus wightiana*) @ 250g mixed with equal volume of sand, into the top most three leaf axils around the spindle leaf thrice a year during May, September and December is recommended. Placement of naphthalene balls in the leaf axils at the base of spindle leaf @ 12g/ palm (3-4 numbers) and covering them with sand to prevent quick evaporation provide good protection against the pest for 45-60 days.
- Manure pits and other breeding sites are to be treated with the entomopathogenic fungus, *Metarhizium anisopliae* @ 5 x 10^{11} spores/m^3. The pathogen is highly virulent and produces epizootics in the grub population in the breeding material. All stages of the host excepting the eggs are mycosed. Incorporation of the weed plant *Clerodendron infortunatum* is also very effective in the control of the pest build up in the breeding sites. Treatment of breeding sites with Carbaryl 0.01% is recommended.
- Release of *Oryctes rhinoceros* virus infected beetles @ 10-12 beetles/ha is recommended. The virus infects both adults and grubs. The pathogen kills the grubs in 15-20 days and reduces the longevity and fecundity of beetles by 45 and 95%, respectively. Introduction of the pathogen in the natural habitat of the pest causes epizootics in pest population and leads to significant reduction in the larval population in breeding sites and resultant reduction in beetle damage.
- Instal pheromone traps using pheromone "Oryctalure" (Ethyl, 4-methyl Octonate) @ 5 traps/25 ha for collection and destruction of adult beetles. The collected beetles can also be used for virus inoculation and re-release to the pest infested areas.

Eriophyid Mite (*Aceria guerreronis*)

The nut infesting eriophyid mite *(A. guerreronis)* is one of the most serious pests of coconut causing significant reduction in yield. Mite infests coconut buttons during early stages of growth soon after pollination. Developing nuts harbour a large population of mite under their perianth. Symptoms appear approximately one month after initial colonization of mites inside the fertilized buttons as white longitudinal patches or triangular yellow patches near the perianth. As nuts grow, these patches turn brown and longitudinal fissures and wartings appear on the nut surface. Drying and shedding of buttons and young nuts are experienced in severe infestation. Dispersal of mites occurs through wind and population of mite reaches high from March to May.

The yield loss in South India recorded an average crop loss (30.94% in copra and 41.74% in husk production) in the initial years of pest damage. Mite damage also causes significant reduction in fibre length and tensile strength. The fibres from moderately to severely infested nuts suffere 26-53% reduction in length. In recent surveys the loss in terms of copra in South India ranged from 8 to12%, showing a remarkable reduction in yield loss as compared to initial years of occurrence.

IPM

- Phytosanitary measures like crown cleaning and plantation sanitation.
- Spraying of 2% neem oil-garlic-soap emulsion or azadirachtin 10000 ppm @ 0.004% on young bunches/ root feeding of neem based pesticides containing Azadirachtin 5% (7.5 ml + 7.5 ml water) or azadirachtin 1% (10 ml + 10 ml water) thrice a year during January, April and September
- Recycling of organic biomass in coconut ecosystem using *in situ* vermicomposting, raising of suitable green manure crop in coconut basin and its incorporation, application of NPK fertilizers as per recommendation and soil moisture conservation measures.
- Conservation of predatory mites especially the phytoseiid mite, *Neosieulus baraki* which is predominantly found along with the mite colonies in all pest infested areas.

Presently, emphasis is given for development of biocontrol strategies as they are safe and eco-friendly and vital in sustainable management of the pest. The fungal pathogen, *Hirsutella thompsonii,* has received considerable attention throughout the world as the most effective natural enemy of eriophyid mite of coconut. This acaropathogenic fungus could be collected from all major coconut-growing tracts of the country along with mite colonies and a total of 42 indigenous isolates are currently maintained.

Red Palm Weevil (*Rhynchophorus ferrugineus*)

Red palm weevil is a fatal enemy of coconut palm. The infestation of the pest is predominant on palms of younger age group ranging from 5-20 years. Feeding on the growing point by grubs results in death of the palm. The weevils are attracted to the rotting smell and the pest incidence is quite severe in areas where palms are infected with bud rot/ leaf rot or infested by rhinoceros beetle. The presence of holes on the stem, oozing out of brown viscous fluid through holes, extrusion of frass, wilting of inner leaves, splitting of leaf bases are the visual symptoms

of pest attack. The gnawing sound produced by feeding grubs is audible when closely monitored with ears on the infested stem. Entry of the pest through the crown is the most common and vulnerable type of infestation. The grubs in such cases stay very close to the cabbage portion (growing point) of the palm and results in drying of the young heart leaves. About 5-10% of the palms in the age-group of 5-20 years are lost annually due to the pest attack in different parts of the country.

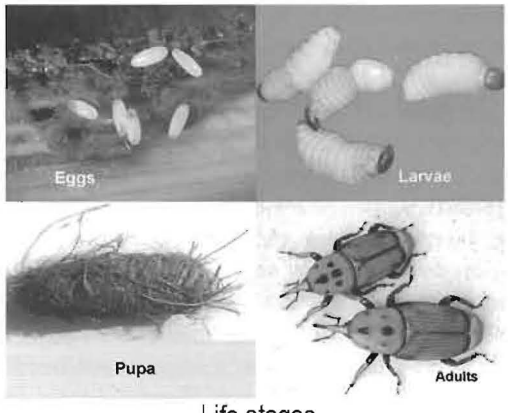
IPM

- Maintenance of field sanitation by removal, splitting and burning of dead palms, which harbour various stages of the pest, helps a lot in reducing fresh incidence and hence should be considered as an important step in IPM.
- Prevention of pest entry into the palm is the major step to be adopted in the IPM package. Fermenting smell emanating from the injured portions of the palm attracts the weevils for egg laying. This can be prevented by avoiding injuries on the palm and by treating the wounds, if any, with coal tar + carbaryl. Prophylactic leaf axil treatment for *O. rhinoceros* keeps away red weevil also. Whenever leaves are cut, a petiole length of 1.2 m should be retained on the palm to prevent the entry of the pest into the trunk through the cut petiole. Timely fungicidal treatment for bud rot and leaf rot also is essential.
- For infested palms, curative treatment with 1.0% Carbaryl / 0.1% Endosulfan (use of Endosulfan is banned in Kerala) is recommended as stem injection method or crown pouring. In stem injection method, after plugging all the holes on the lower part of the palm the insecticide solution is administered into the palm with a funnel through the uppermost hole.
- Root feeding of monocrotophos (10 ml + 10 ml water) for seedlings and non-bearing palms.
- Trapping of red palm weevil using aggregation pheromone lures "Ferrugineol" (4-methyl, 5-nonanol) in food baited bucket traps forms an important component of the IPM strategy. Pheromone trappping @ 1 trap/ ha for monitoring and mass trapping of adults with adequate servicing of trap baits is recommended. Usually, the traps are serviced once a week and the food bait is replaced. Food bait includes 200 g ripened banana / pine apple plus 5 g yeast and 5 g carbaryl mixed with one litre of water.

Black Headed Caterpillar (*Opisina arenosella*)

The pest periodically assumes severe proportions in coastal and backwater areas and also in the vicinity of water bodies in the interior parts of peninsular India.

Red palm weevil



Life stages


Leaf axil entry


Crown toppled dwarf palm


Pheromone (CPCRI)


Pheromone trap

Caterpillars construct galleries of silken webs reinforced with excreta and scrapes of leaf bits. Hiding in these galleries they feed on chlorophyll containing parenchymatous tissues. These affected portions get dried presenting a scorched up appearance. Damage results in drying of outer and middle whorls of leaves. Damage to leaves affect the photosynthetic efficiency of the palm, which leads to severe decline in yield and in addition renders the leaves unsuitable for other purposes also. Diagnostic symptom of infestation is the presence of galleries on the lower surface with live or dead stages of the pest. Damage results in drying of outer and middle whorl of leaves and such infested palms exhibit a scorched / burnt appearance from distance. A crop loss extending up to 40% loss in yield has been recorded in the endemic areas of the pest infestation.

IPM

- Cutting and burning the heavily infested and fully dried outermost 2-3 leaves removes the pupae and other life stages of the pest.
- Release of larval / pupal parasitoids such as *Bracon brevicornis*, *Goniozus nephantidis* and *Brachymeria nosatoi*. The larval parasitoid *Goniozus nephantidis* (Bethylidae) is released if the pest is at third larval stage or above @ 20 parasitoid /palm and *Bracon brevicornis* (Braconidae) @ 30 parasitoid/palm. The pre-pupal parasite *Elasmus nephantidis* Rohw. (Elasmidae) and the pupal parasite *Brachymeria nosatoi* Habu.(Chalcididae) are also very effective in managing the pest. They are released @ 49 and 32% respectively for every 100 pre- pupae, pupae estimated to be present on the palm. Before field releasing, the parasitoids should be fed with honey and newly emerged parasitoid can be released after 3 days of emergence.
- In severe sporadic outbreaks, spraying of 0.05% Diclorvos on under surface of leaves is recommended.
- Proper irrigation and adequate fertilizer application should be provided to rejuvenate severely pest-affected palms.

White Grub (*Leucopholis coneophora*)

White grubs are major pests of coconut palm mostly confined to sandy loam soil tracts of Kerala and Karnataka. Grubs feed on roots of coconut palm as well as other intercrops like cassava, yams, banana, vegetables *etc.* Adult beetles are chestnut-brown coloured and they emerge out of soil after a few rains during pre-monsoon showers in May-June.

In nursery, seedlings the grubs feed on tender roots and also tunnel into the bole and collar regions resulting in the drying of the spindle leaves followed by gradual death of the seedlings. In older coconut plantations continuous infestations by the grubs results in yellowing of leaves, premature nut fall, delayed flowering, retardation of growth, tapering of crown and reduction in yield. Peak grub population is seen in the coconut basin during September-October

IPM

- Deep ploughing and digging of the soil during pre and post-monsoon periods for exposing grubs to predators
- Trapping of adult beetles through light traps during the emergence period (May-June) and their destruction.
- Soil application of Phorate 10G @ 100g/palm or drenching the basin with chlorpyriphos @ 0.05% during June and September. The insecticide has to be applied in the active root zone of the palm evenly leaving a distance of 60 cm from base of the trunk.

MINOR PESTS

Coreid Bug (*Paradasynus rostratus* Dist.)

Adults and nymphs feed on the buttons and young nuts causing shedding of buttons and malformation of mature nuts. In many cases, the infested nuts show crinkling, gummosis and become barren. In addition to coconut, the pest also attacks guava, cashew, neem and cocoa. The pest is active in the field from June to February with peak population during September-October. Control of the pest is achieved by insecticidal spraying with 0.1% Carbaryl on young bunches or placement of Phorate 10G @ 5 g per palm in two polythene sachets at the stalk regions of youngest two bunches close to the leaf axils.

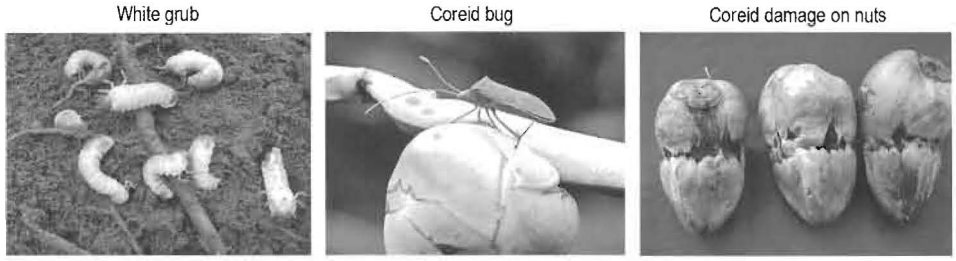
Slug Caterpillars

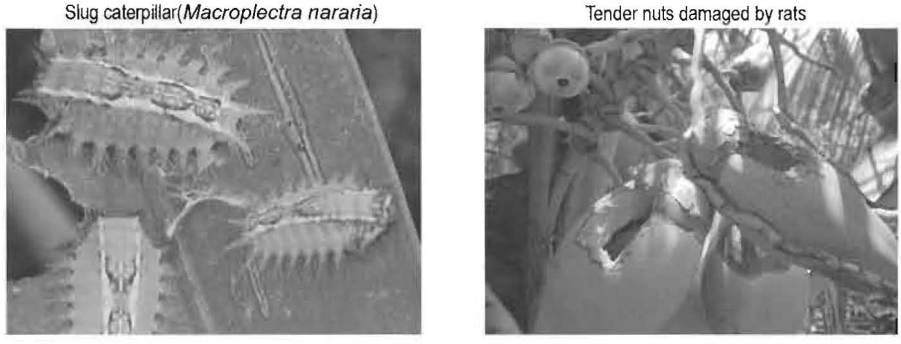
The slug caterpillars are sporadic pests on coconut. Their infestation becomes very severe during summer and post-monsoon months. The caterpillar voraciously feeds on the lamina, leaving only the midrib. These are polyphagous insects and hence the management becomes a problem at times. *Contheyla rotunda* Harm., *Latoia lepida* Cram. and *Macroplectra nararia* M. are reported from coconut in India. *C. rotunda* is more common in the coastal tracts of West Coast of India whereas the spiny slug, *M. nararia* is predominantly seen in East Coast of India. For the management of the pest during the out break season chemical control using Carbaryl 0.1% is recommended. Light trapping of adult moths is suggested as an effective monitoring tool and a feasible mechanical control strategy of the pest.

Mealybugs

Important species of mealybugs affecting coconut are *Palmiculter palmarum, Pseudococcus coccotis* and *Pseudococcus*

longispinus. They colonize on tender parts like spear leaves, spadix, inflorescence and inside perianth of nuts. Mealybug infestation results in poor nut set, shedding of buttons and drying up of spadix in adult palms. In seedlings, failure of heart leaf development and in severe cases the death of seedlings are reported. Management of pest is accomplished by spraying of Dimethoate or Monocrotophos at 0.05%. In the field, natural enemies especially coccinellids and lygaeids exert a good control of the pest.





Other pests

Scale Insects

Scale insects are usually found in colonies of dense masses on lower surface of leaf, petioles, peduncles and nuts. *Aspidiotus destructor, Aonidiella orientalis, Lepidosaphes megregori* are important species of scales infesting coconut palms. The pest incidence is at its peak during summer months. The predators especially coccinellid beetles exert natural control of the pest in the field. In case of severe infestation spraying with 0.1% Fenthion, 0.05% Dimethoate or Monocrotophos is recommended for the management of the pest.

Termites

Termites (*Odontotermes obesus*) occasionally causes serious damage to nursery seedlings and adult palms. They feed on collar region of seedlings and result in wilting of central shoot. In adult palms, attack is observed on bark. Drenching nursery with 0.05% Chlorpyriphos twice at 20-25 days interval manages the pest effectively. In older palms affected trunks are to be swabbed with the chemical.

Whiteflies

Two species of whiteflies, *viz.* areca whitefly *Aleurocanthus arecae* and spiralling whitefly *(Aleurodicus dispersus)* are found infesting leaves of middle and lower whorls of young palms. They inhabit on lower surface of leaflets and the presence can be visualized by development of sooty mould on upper surface of leaflets. These insects are naturally controlled by parasitoids and predators present in ecosystem.

Rodents

Rodents pose a major threat to coconut palms especially in the island ecosystem and waterlogged lowland tracts. In Lakshadweep, 40% of nuts are lost due to rat damage alone. The arboreal black rat, *Rattus rattus wroughtonii* is the major rat species. This vertebrate pest lives on the crown of the palm and feeds on the inner contents of tender nuts of 3-6 months maturity resulting in shedding of nuts. The burrowing rodents, *viz. Bandicota bengalensis, Bandicota indica* and gerbil, *Tatera indica* makes extensive burrows in soils and damages the coconut seedlings by eating away the cabbage portions.

An integrated approach consisting of adequate spacing, mechanical barriers, farm sanitation, trapping and chemical methods are generally followed for rodent management. Poison bating using single dose anticoagulant rodenticide bromodialone (0.005%) is effective in management of black rat.

SUMMARY

Effective IPM strategies have been developed against major pests of coconut but there is a scope for refining these technologies further for making them cost-effective, ecologically-safe and farmer-friendly. Emphasis should be given for popularization of biocontrol intensive integrated technologies among farming community though Farmer Field Schools. In depth studies are required for developing feasible biocontrol strategy against coconut eriophyid mite and red palm weevil. Contiguous and homestead nature of coconut gardens and long flight range of various insect pests warrant the necessity for adoption of IPM technologies on a group approach mode.

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