Understanding damage symptoms and management of coconut pests

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Coconut provides livelihood security to millions of farmers in the country. Among the various production constraints, pest infestation is one of the key factors incurring considerable yield loss. Most of the major pests go unnoticed by farmers thereby incurring heavy production loss among the coconut producing farmers. Important damage symptoms of key pests and their management strategies are illustrated here under.

a) Rhinoceros beetle (*Oryctes rhinoceros*)

Damage symptoms

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 photosynthetic efficiency of the palms gets reduced as there is considerable reduction in functional area of young leaves which results in loss of vigour and reduction in yield. It is estimated that this pest on an average causes 10% loss in production of nuts. The damaged spathes will dry up causing complete loss of nuts in affected bunch. Attack in young seedlings and young palms results in stunted growth and delayed flowering and repeated attacks in growing point lead to the death of the seedlings. Emergence of elephant tusk-like damage symptoms is quite common when seedlings are attacked by black beetle. Petiole damage results in breaking of fronds

The pest breeds in decaying organic debris such as cattle dung, compost, dead and decaying palms. 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. Dwarfs and hybrid coconut varieties are more susceptible to this pest than tall varieties.

Pest management

- Prophylactic measures
  - ➢ Application of powdered oil cakes of neem (*Azadirachta indica* A. Juss.), or marotti (*Hydnocarpus wightiana* Bl.) @ 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 as a prophylactic measure
  - ➢ Placement of naphthalene balls in the leaf axil 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.
  - ➢ Filling of the top most three leaf axils around the spindle using a mixture chlorantraniliprole (Ferterra) or Chlorpyrifos (Chlori dust) @ 6.0g plus 250g sand.
- The dead and decaying coconut logs and other organic debris in the vicinity of coconut plantations may be properly disposed off, since these 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 has to be filled with a mixture of Mancozeb and sand @ 3g/ 1kg.
- Manure pits and other breeding sites are to be treated with entomopathogenic fungus, *Metarhizium anisopliae* @ 5 $x10^{11}$ spores/m^3. The pathogen is highly virulent and produces epizootics in the grub, pupae and adult population in the breeding material particularly during humid monsoon period.
- Incorporation of the weed plant *Clerodendron infortunatum* is also very effective in the control of the pest build up in the breeding sites causing transformational deformities during metamorphic moult.
- Release of *Oryctes rhinoceros* nudivirus (OrNV) infected beetles @ 10-12 beetles / ha. 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 on coconut palms.

- Installing pheromone traps (PVC pipe of dimension 11 cm diameter and 1.5 m height) using pheromone Oryctalure @ 1 trap / ha for collection of adult beetles.

Coconut eriophyid mite (*Aceria guerreronis*)

Damage symptoms

The nut infesting eriophyid mite, *A. guerreronis* is one of the most serious pests of coconut causing significant reduction in yield. In coconut, mite infest the developing young buttons after pollination and are confined in the floral bracts and the soft meristematic portions beneath the perianth. Entry of the mite into the developing nut takes place during the early phase of the development immediately after fertilization. The mite thus gaining entry into the nuts multiply and form active colonies containing various stages of development *viz.*, eggs, nymphs and adults. Usually in a developing nut, the coconut mite colonies are seen as 2 or 3 congregations on the meristematic regions of the buttons below the perianth. Under favourable conditions, the high reproductive potential and shorter life cycle of the mite result in the enormous multiplication of the colonies. When colony size becomes substantially increased, mite comes out of the interspaces between the tepals of the developing nut for dispersal. The dispersal of the pest takes place mainly through wind. Honeybees and other insects visiting inflorescence of coconut also act as agents for dispersal.

The mite infestation symptoms are observed approximately one month after the initial colonization of the mite inside the fertilized buttons. Appearance of elongated white streaks below the perianth is the first external visual symptom on young buttons. In many cases, an yellow halo develops around the perianth. Within a few days this halo develops into yellow triangular patch pointing towards the distal end of the button. This can be clearly seen in 2-3 month old buttons. In a short time the yellow patch turns into brown and show necrotic patches on the periphery of the perianth.

Survey undertaken during 2009, 2010 in different districts of south India and Lakshadweep Islands revealed average mite incidence ranging from 4.06–57.5% in different regions *viz.*, Hassan (44.7%), Tumkur (41.8%), Coimbatore (27.6%), Thanjavur (41.4%), Ratnagiri (46.1%), Trivandrum (4.06%), Minicoy (17.9%), Kalpeni (23.2%) and Kavaratti (57.5%). Survey undertaken in Andhra Pradesh during 2011 indicated 29-39% mite incidence in West Godavari and East Godavari Districts.

Pest management

An integrated management strategy with need based application of botanical pesticides either by spraying or root feeding and adequate nutrient management of affected palms is currently recommended for the management of the pest.

- Phytosanitary measures like crown cleaning and plantation sanitation.
- Spraying 2-6 month old nuts with 2% neem oil-garlic-soap emulsion / neem formulation containing azadirachtin 10000 ppm (0.004%) thrice a year during January, April and September
- Root feeding of neem based pesticides [Azadirachtin 50000 ppm (7.5 ml + 7.5 ml water) / Azadirachtin 10000 ppm (10 ml + 10 ml water)] thrice a year during January, April and September
- Spraying of palm oil (200 ml) sulphur (5g) emulsion in one litre water along with detergent (10-15 gms) on mite infested nuts after pollination was found effective in suppression of mite population.
- The nutritional status of the palm plays a significant role in the management of the pests. The nutrient management package consists of balanced application of NPK fertilizers at recommended doses in two splits (Urea 1.0 kg, rock phosphate 1.5 kg, muriate of potash 1.8 kg), recycling of organic biomass in coconut ecosystem using *in situ* vermicomposting or growing of green manure crops like cow pea or sun hemp and its incorporation in coconut basin and conservation of soil moisture by appropriate mulching methods
- The current emphasis is given

for biocontrol strategies as it is safe and eco-friendly and therefore vital in sustainable management of the pest. The potential of the acaropathogenic fungus, *Hirsutella thompsonii* as an effective biocontrol agent against mite is currently investigated in the field.

c) Red palm weevil (*Rhynchophorus ferrugineus*)

Damage symptoms

Red palm weevil infests palms of 5-20 years age. 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 and gnawing sound produced by feeding grubs enable the detection of pest infestation. Entry of the pest through the crown is the most common and most fatal 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. Dwarf cultivars especially CGD variety is more susceptible than tall variety. It is estimated that 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.

Pest management

- Scouting and monitoring the damage by close examination and routine checkup for red palm weevil infestation is a must on young coconut plantations
- 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 attract 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.
- Curative treatment with 1% carbaryl is currently recommended. 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.
- Current investigations on the effect of new molecules for the curative treatment of red palm weevil have given promising results. Molecules *viz.*, imidacloprid (Confidor 200% SL) @ 0.01%, Spinosad @ 0.013% (Success 2.5% SC) and Indoxacarb @ 0.04% (Avaunt 14.5% SC) when field tested against red palm weevil have given more than 80% recovery of infested palms.
- Synergistic interaction of imidachlorprid @ 0.001% along with entomopathogenic nematodes (*Heterorhabditis indica*) @ 1.5 lakhs IJ was found to suppress red palm weevil damage.
- Trapping of red weevil using aggregation pheromone lures "Ferrugineol" in food baited bucket traps forms an important component of the IPM strategy.
- Prophylactic leaf axil filling with any one of the repellents (Neem cake/ marotti cake/ chlorantraniliprole / naphthalene balls) recommended for O. *rhinoceros* is essential for keeping away red palm weevil.

d) Black headed caterpillar (*Opisina arenosella*)

Damage symptoms

Diagnostic symptoms of infestation are the presence of galleries on the lower surface with live or dead stages of the pest and the upper epidermis intact. The pest periodically assumes severe proportions in coastal and backwater areas in vicinity of water bodies in the interior parts of peninsular India. Caterpillars construct galleries of silken webs reinforced with excreta and scrapes of leaf bits. Hiding in these galleries they feed on the 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 the 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. A crop loss of 40% in yield has been recorded in the endemic areas of the pest infestation.

Pest management

A biointensive IPM is recommended for management of *O. arenosella*

- Cutting and burning the heavily infested and fully dried outermost 2-3 leaves removes the pupae and other pest stages in case of severe infestation.
- 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 3rd 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. Parasitoids are to be released at fortnightly intervals. 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 0.05% dichlorvos or 0.002% chlorantraniliprole on under surface of leaves can be done to bring down the population. If insecticide spraying is undertaken, waiting period of 21 days has to be observed for release of parasitoids.
- Proper irrigation and adequate fertilizer application should be done to rejuvenate the pest-affected palms.

e) White grub (*Leucopholis coneophora*)

Damage symptoms

White grubs are major pests of coconut palm mostly found in sandy loam soil tracts of Kerala and Karnataka. Grubs feed on roots of coconut palm as well as other intercrops like tubers, rhizomes, vegetables *etc.* Adult beetles are chestnut brown coloured and they emerge out of soil after 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 and reduction in yield. Peak grub population is seen in the coconut basin during September-October

Pest management

- Deep ploughing and digging of the soil during pre and post monsoon periods for exposing grubs to predators
- Collection and destruction of adult beetles during emergence period (May-June) was found superior than light trapping.
- Drenching the palm basin with chlorpyriphos @ 0.1% (7ml/litre) @ 14 litre/palm) during June and September and incorporation of neem cake @ 5 kg/palm/year.

f) Coreid bug (*Paradasynus rostratus*)

Coreid bug sucks sap from female flowers and developing young buttons and causes button shedding and immature nut fall. The infested nuts develop into undersized / crinkled nuts.

- Spraying the pest infested palms with neem oil (0.5%) or carbaryl (0.1%) on female flowers and young bunches (up to fifth month old) two times a year during May and September in endemic areas.

g) Scales and Mealy bugs

In coconut, four species of armoured scales *viz., Aonidiella orientalis, Aspidiotus destructor, Lepidosaphes megregori, Chionaspis* sp. and three species of soft scales *viz., Ceroplastes floridensis, Coccus hesperidum, Vinsonia stellifera* were commonly observed. Young coconut palms aged 10-15 years are more vulnerable to coconut scale damage. The scale infests mainly on the undersurface of leaves, but occasionally they attack frond stalks, flower clusters and young fruits. On the leaves, the crawlers of *A. destructor* settle and develop into scales with yellow spots. Entire leaves may turn yellow to brown and fall, Heavy infestation results in stunting of new leaves, reduction of crop yield or complete crop failure. Attack on fruits causes shriveling of nuts leading to premature nut fall. In extreme cases, the leaves dry out, entire fronds drop off and palm dies. Infestation is most severe in areas where the rainfall is high and the palms are closely planted; neglected palms grown in dense and

semi-wild vegetation are particularly susceptible. In general, palms grown in well managed plantations exposed to the prevailing winds are not severely infested.

Mealy bugs are soft-bodied, sap feeding insects with white, powdery to granular waxy filaments protruding from margins and tail end. Nymphs and adult mealybugs suck the sap by inserting their long and thin stylets into the epidermis. Growing points of palms like spindle leaves, floral parts, leaflets and roots are primarily infested by mealybugs. They are mostly aggregated, feed continuously at the same site for a longer period of time and remain sedentary in most cases to disturbances due to slow retraction of stylets. Feeding symptoms include chlorosis, stunting of seedlings, leaf deformation, early fruit drop, heavy build up of honey dew and severe infestation leads to death of seedlings. Ants are routinely attracted by honey dew which also aid in phoretic movement of crawlers of mealybug from plant to plant. Mealy bugs provide sugary secretion as food to ants and in turn ants help in spreading of mealybugs. Furthermore, ants provide protection to mealybugs from predatory lady beetles and other natural enemies.

Pest management

Scales

Scale insects are suppressed by the natural enemies present in the ecosystem when predators and parasitoid activities are not disrupted by ants or application of broad spectrum insecticides. Spot application of Insecticides viz., carbaryl (0.05%) and dimethoate (0.05%) can be used in case of severe out break

Mealy bugs

- Destruction of highly infested plant parts and removal of alternate weed hosts in the immediate vicinity.
- Management strategies need to be initiated at the initial stages of infestation.
- Locate ant colonies during summer ploughing and destroy.
- Conservation of coccinellid lady beetles in the ecosystem
- Regular monitoring and spot application twice with dimethoate 0.05% at 20 days interval during summer to avoid further spread of mealy bugs from infested fields.

h) Slug caterpillar *Conthyla rotunda* H., *Latoia lepida* Cram., *Macroplectra nararia* Moore

Early-instar caterpillar feeds from undersurface of coconut leaflets by scrapping the surface tissues giving a glistening appearance on the feeding area. Leaf spot-like black halo marking develops on the feeding areas which later coalesce and form bigger lesions. During heavy infestation caterpillars feed on the entire leaflet sparing only the midrib. These caterpillars are covered with tiny spines that cause severe irritation on contact.

Pest management

Establishment of light traps in endemic tracts proved effective in monitoring the pest incidence well in advance. Cutting and burning infested leaflets prevent the spread of the pest. In case of severe damage, spray lower side of the leaves with carbaryl 0.1%.

i)Termites, *Odontotermes obesus* Ramb.

Termites generally attack secdlings in the nursery especially in the laterite areas preferring the husk of nuts. Invasion is either through the base of the seednut or at the collar region. Wilting of the central shoot is usually the first visible symptom of attack followed by death of the seedlings. Infestation also continues in the transplanted field causing poor establishment.

Pest management

Remove and destruct all wood or timber in advance of planting seednuts. Regular watering reduces damage by termites. Apply chlorpyrifos dust 5 kg / ha or fipronil 3 kg / ha to the soil of the coconut nursery before sowing of seednuts.

j) Rodents

Rodents pose a major threat to coconut palms especially in the island ecosystem and water logged lowland tracts. In Lakshadweep 40% of the 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 the gerbil, *Tatera indica* makes extensive burrows in soils and damages the coconut seedlings by eating away the cabbage portions.

Pest management

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 the management of black rat. For control of bandicoots and gerbils poison bating with PVC trap is very effective. A community approach is highly essential for achieving the desired results in the management of rodents.

k) Alien Invasive pest

Coconut leaf beetle, *Brontispa longissima*

The recent incidence of coconut leaf beetle (CLB), *Brontispa longissima* Gestro (Chrysomelidae : Coleoptera) in Maldives and Union of Myanmar, attacking the tender leaves of young coconut palms and its possible entry poses an imminent threat to coconut industry in India. The countries to the West of Myanmar, Bangladesh and India are at a very high level of risk, since the beetle will not be stopped at land borders. For a country like India, where coconut and coconut based industries support millions of people, the pest incursion would be catastrophic. Grubs and adult spiny beetles inhabit the developing unopened leaves of the palm and feed on leaf tissues. As the pest continuously affects developing leaves, the inner whorl of leaves totally dry up. Severe attack results in complete defoliation of the palm. Prolonged attack particularly to young palms or those which are in poor growing conditions may result in death of palm. The productivity of the palms are drastically affected due to sub lethal attack by the pest. The whole life cycle of the pest is completed on coconut palm itself and takes about 5-7 weeks. Regular and periodic surveillance surveys since 2007 by Central Plantation Crops Research Institute (CPCRI), Regional Station, Kayamkulam have not revealed the incidence of *B. longissima* in any close proximal air port regions of Thiruvananthapuram, Kochi, Chennai, Kolkatta, Mumbai, Rajmundry, Vijayawada as well as seaport regions of Kochi, Vishakapatnam and Tuticorin during the past three years. Surveys conducted in North-East region *viz.*, Assam and Meghalaya, Lakshadweep and Bay Island could not be intercepted with this pest so far.

Pest management

Entry of CLB in new areas can be possibly checked through mechanical blockading, need based application of insecticides and augmentative release of natural enemies. Two parasitoids of coconut leaf beetle *viz.*, *Tetrastichus brontispae* Ferriere (Hymenoptera: Eulophidae), a pupal parasitoid and *Asecodes hispinarum* Boucek (Hymenoptera: Eulophidae), a larval parasitoid have been successfully used in several countries to control the beetle. Use of entomopathogenic fungus, *Metarhizium anisopliae* against the pest is also effective.

Strict quarantine laws curbing the movement of all types of coconut materials and other host palms particularly ornamental palms from CLB infested countries should be enforced.

Passengers travelling from beetle-infested countries should be encouraged to examine their baggage for the presence of the beetle / eggs / larvae to avoid accidental introduction of the pest.

Organizing seminars, sensitization campaigns, emergency preparedness, pest alert notifications, presentation of bulletins on *B. longissima* are also would be helpful in building up an awareness and vigilance on the pest. Awareness creation and capacity building through training programmes is essential to contain the problem at this point of time. The possible ports of entry in South and North-East part of the country must exert strict measures on these aspects.

Conclusion

An orderly and compatible integration of these management techniques is found to be the key factor for the sustainable management of major coconut pests. Biological pest suppression was developed and being practiced for two major pests *viz.*, black beetle and black headed caterpillar. Need based application of insecticides is also employed in the effective management of red palm weevil and root grubs. The continuous and homestead nature of coconut and the flight range of insect pests necessitate adoption of various technologies on a group approach mode as it will reduce the cost of operation and can produce sustainable results. The spread of these insects usually occur through transport of infested plants or plant parts. Hence, surveillance should be strictly enforced on curbing the movement of planting materials so as to avoid spread of insect pests across the transcontinental borders.