

Reducing pest incidence for quality coconut

A planned and holistic programme through awareness creation, capacity building on incursion management and strict quarantine are essentially warranted to combat invasions due to such biosecurity threats. Creation of an incursion management team comprising of experts from all disciplines as well as an emergency preparedness module would be the need of the hour to tackle accidental introduction of invasive pests into the country. With the impact of climate change and modulation in pest dynamics, a salubrious approach is very critical for effective implementation of IPM strategy. Farmer-participatory community mode would be given the top most priority for successful translation of technologies and field reality.

THE coconut palm, a versatile crop of food and vegetable oil is intimately associated with social and cultural heritage of people in Asia and Oceania. It is also eulogized as “*Kalpavriksha*” for being an icon of prosperity, peace, and productiveness. As a food cum health crop, coconut is an imperative source for industry and tourism ensuring livelihood security. Worldwide, coconut is infested by at least 830 insect and mite species, 173 fungi and 78 species of nematodes drastically affecting the productivity. Crop loss as high as 30% was reported ranging from diseases to damage by insect pests in palms. The major pests infesting coconut are rhinoceros beetle (*Oryctes rhinoceros* Linn.), red palm weevil (*Rhynchophorus ferrugineus* Oliv.), black headed caterpillar (*Opisina arenosella* Wlk.), coconut eriophyid mite (*Aceria guerreronis* Keif.), white grub (*Leucopholis coneophora* Burm.), rat (*Rattus rattus wroughtonii*) and the potential invasive pest (*Brontispa longissima* Gest.)

MANAGEMENT OF PESTS

Rhinoceros Beetle

Rhinoceros beetle (*O. rhinoceros*) is a cosmopolitan pest endemic to all coconut-growing regions. A loss in yield of 5.5-9.1% due to beetle attack in coconut as estimated in Kerala. The robust adult beetles cause damage to palms of all age groups by boring into the unopened spear leaves and spathes and chew-off the soft internal tissues after imbibing the juice. The damage to inflorescence is seen as oblong holes on the spathes which soon dry up resulting in complete loss of nuts in the affected bunch. Attack on juvenile palms results in stunted growth and delayed flowering. In the recent past, entry of rhinoceros beetle through collar region of the freshly transplanted coconut seedlings and eating away the growing spear leaf was observed resulting in wilting as well as improper establishment of seedlings.

Management

- Obtain seedlings from accredited nurseries such as CPCRI, Kasaragod, Kerala Agricultural University, Coconut Development Board etc., as planting weak seedlings fail to establish during initial stages leading to enhanced pest attack.
- Never mulch the seedlings with coconut leaves during initial phase of establishment as the decaying smell attract rhinoceros beetles. Planting two turmeric rhizomes on either side of the seedlings was found to reduce pest attack.
- Planting at correct spacing (Tall and hybrids 7.5 × 7.5 m; Dwarfs 7 × 7 m) with adequate sunlight helps for judicial release of volatile cues from palms and reduce beetle attack.
- Regular monitoring and look out for any damage on the spindle region of the seedlings or at collar region.
- Hooking out of the beetle if any chewed up fibre is observed on the collar regions or any leaf axils.
- Introduce coconut based cropping system by sequential intercrops inducing greater environmental heterogeneity, high species diversity and less host density reducing rhinoceros beetle attack on palms.
- Filling up top most leaf axils with 250 g neem cake/marotit cake/pongamia cake along with equal volume of sand in adult palms.
- Placement of two naphthalene balls on top-most two leaf axils (@ 12g/palm) to repel of the pest.
- Target delivery of two perforated sachets containing chlorantraniliprole (3 g) or fipronil (3 g) or botanical cake developed by ICAR-CPCRI on top most spear leaf during monsoon period.
- Incorporation of weed, *Clerodendron infortunatum* on the manure/compost pits has induced larval-pupal abnormalities affecting normal development of adult beetle through hormonal interferences.
- ICAR-CPCRI has developed a low-cost farmer-friendly approach of application of an



Female and Male beetles



Damage symptom as geometrical cut on leaves



Damage on juvenile palms



Hooking out beetle



Metarhizium anisopliae infected grub



Clerodendron infortunatum (inset- malformed adult)



Leaf axil placement of naphthalene ball

entomopathogenic green muscardine fungus, *Metarhizium anisopliae* on the breeding pits @ 5×10^{11} spores/m³ for the effective suppression of immature stages of the pest. Currently, *M. anisopliae* is multiplied on semi-cooked rice-based media for field application in organic manure as well as vermicompost pits @ 100 g per cubic metre. This technology through farmer-participatory and women group approach has created a great impact on the long-term bio-suppression of the pest in community-mode.

- Release of *Oryctes rhinoceros* nudivirus infected beetles @ 12/ha to suppress population build up of the pest.

Red Palm Weevil

Red palm beetle (*R. ferrugineus*) is most destructive and lethal pest of coconut palm. It is estimated 0.5% of the palms are attacked by the pest every year in Kerala alone. Due to the lethal nature of the pest and high value of the crops involved the assumed action threshold for red palm weevil (RPW) in coconut and date palm is 1% infested palms. In the recent past, incidence of red palm weevil has been quite predominant, inflicting loss as high as 3-5% in certain pockets of Kerala particularly in regions prevalent with root (wilt) disease. The major symptoms include splitting of petiole at the base of trunk due to pest entry and subsequent feeding, abnormal un-gripping of leaf petiole from the trunk surrounding the base of the bunch, abrupt yellowing of leaves around mid-whorl

region, choking and drying of spear leaf region, presence of bore holes and oozing fluid from the trunk and gnawing sound of grubs when heard through the trunk. Dwarf varieties and juvenile palms aged between 5-15 years are found more susceptible.

Management

- Close scrutiny and regular inspection of palms at all vulnerable points of entry (crown, leaf axil and bole region of palm) for early diagnosis. Practice clean cultivation by cutting and removing palms already damaged and the decaying stumps in the garden.
- Maintaining appropriate crop density and allowing proper sunlight is very critical for adequate growth and pest repulsion.
 - Avoid physical injuries on palms as the pest lay eggs in these wounds. While cutting leaves, retain at least 1m of petiole.
 - Constant vigil and prophylactic treatment for rhinoceros beetle damage, leaf rot and bud rot diseases is preferable.
- A pest suppressive coconut-based agro-ecosystem could be designed through ecological infrastructure within the cropping system such as defenders, volatile cue repulsion, refuge site, predatory birds etc. Such crop-habitat diversification approach could avoid pest entry into the system through stimulo-deterrent diversionary strategy. Growing intercrops such as nutmeg, rambutan, curry leaf, papaya, banana etc distracts weevils from egg laying in coconut due to



Adult weevils



Egg laid on rotten tissue



Grub



Pupal cocoon



RPW-infested crown
toppled palm



EPN Cadavers for
leaf axil placement



Damage symptom
on leaf axil

up to 45% nut yield loss from infested palms was reported in succeeding year of severe pest infestation. Caterpillars construct galleries of silken webs reinforced with excreta and scrapes of leaf bits on the abaxial side of leaflets. Hiding in these galleries they feed on the chlorophyll containing parenchymatous tissue leaving the thin upper epidermis. Severe pest damage results in complete drying of middle to inner whorl of fronds also. From a distance the crown of such palms appears burnt. The pest infests coconut palms of all age groups round the year from mild to medium intensities.

Management

- Early to mild stages of infestation can be reduced by cutting and burning the badly affected fronds / leaflets. In case of very severe infestation also, removal and burning of fully dried 2-3 outer whorl of fronds helps in removing the pupae and other pest stages.

- In case of very severe outbreaks, one spray of Chlorantraniliprole (0.3 ml/litre water) drenching larval galleries on lower side of leaves was found effective in reducing pest population.
- Augmentative release of larval parasitoids viz., *Goniozus nephantidis* (Bethyridae) @ 20 parasitoid / palm and *Bracon brevicornis* (Braconidae) @ 30 parasitoid/palm at fortnightly intervals was very effective in suppressing pest population and sustains for long-period. The pre-pupal parasitoid *Elasmus nephantidis* Rohw. (Elasmidae) and the pupal parasitoid *Brachymeria nosatoi* Habu. (Chalcididae) are also very effective in managing the pest.
- Feeding the parasitoids with honey and exposing the newly emerged parasitoid before field release to the host odours (odour plumes of the injured *O. arenosella* larvae and gallery volatiles) was found to improve the host searching efficiency of *G. nephantidis* through olfactory conditioning.

volatile confusion in host location.

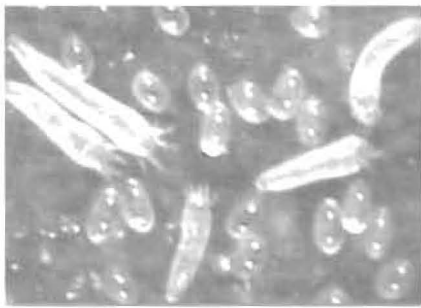
- Spot application of imidacloprid 0.02% (1ml/litre) or indoxacarb 0.04% (2.5 ml/litre) was found effective in pest suppression on infested palms and the infested growing point recovered swiftly. Residue of imidacloprid was not detectable in nut water and nut meat up to 30 days.
- Prophylactic delivery of filter paper sachets containing 10 *Heterorhabditis indica*-infected *Galleria mellonella* cadavers in combination with botanical cake on the leaf axils shielded palms from red palm weevil invasion during monsoon period.
- Pheromone traps @ 1 trap / ha could catch more weevils when installed in community mode under strict precautionary measure and should not be attempted by individual farmer. Care should be taken for timely servicing of food baits and traps are to be placed at the corners of the field preferably on separate poles. In plantations of uniform age, it can be recommended as a component of IPM but never advised as a sole mode of management. Palms adjacent to the pheromone traps need to be meticulously monitored for pest attack.

Black Head Caterpillar

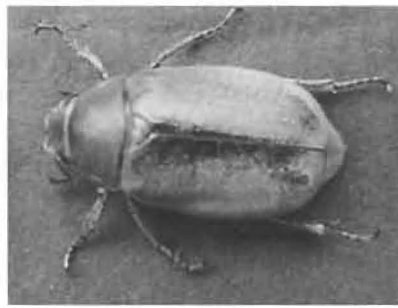
Black head caterpillar (*O. arenosella*) infests coconut along coastal and backwater areas and in the vicinity of water bodies in the inlands of peninsular India. The pest appears in several locations in discontinuous manner; but under favourable conditions it multiplies very rapidly resulting in sporadic outbreaks. A crop decline extending

Coconut Eriophyid Mite

Coconut eriophyid mite (*A. guerreronis*) is the most destructive invasive pest among the various species of eriophyid mites affecting coconut palm. Reported in India for the first time by ICAR-CPCRI during 1998, the mite had spread rapidly to all major coconut growing regions of the country including Lakshadweep and Bay Islands within a short span of time. Coconut mite is a microscopic creamy white, vermiform organism measuring 200-250 μ in length and 36-52 μ in breadth. In coconut, *A. guerreronis* infests the



Coconut eriophyid mite



White grub adult
(*Leucopholis coneophora*)



Black headed caterpillar



Eriophyid mite infestation
symptom on coconut bunch



L. coneophora - grubs



Black headed caterpillar
infested coconut plantation

developing young buttons after pollination and are seen in the floral bracts (tepals) and the soft meristematic portions beneath the perianth. Entry of the mite into the developing nuts takes place during the early phase of the development immediately after fertilization. Appearance of white longitudinal patches just below the perianth and their development to triangular yellow patches are the early symptoms of pest infestation. As the nut grows these patches turn brown and longitudinal fissures and warts appear on the nut surface. Drying and shedding of buttons and young nuts are also experienced.

Management

- Timely cleaning of palm crown and destruction of fallen mite-infested buttons reduces population build up.
- Spraying of neem oil garlic mixture (2%) or commercial botanical pesticides containing Azadirachtin 10,000 ppm @ 0.004% or root feeding with neem formulations containing Azadirachtin 50,000 ppm at 7.5 ml or Azadirachtin 10,000 ppm at 10 ml with equal volume of water is recommended for managing the pest.
- Three sprayings of palm oil (200 ml) and sulphur (5 g) emulsion along with 10 g soap powder in 800 ml of water on the terminal five pollinated coconut bunches during January-February, April-May and October-November reduced mite incidence.
- Application of talc-based preparation of the acaropathogenic fungus, *Hirsutella thompsonii* @20 g/litre of water/palm containing 1.6×10^8 cfu with a

frequency of three spraying per year suppressed mite attack.

- The high-yielding tall palm variety selection from Kulasekharam coconut population (*Kalpa Haritha*) recorded lesser mite infestation at field level at ICAR-CPCRI and was advised in mite-endemic zones.
- In addition to this IPM package, adoption of integrated nutrient management package including application of NPK fertilizer as per recommended levels, recycling of biomass or raising and incorporation of green manure crops in coconut basins, summer irrigation and adoption of appropriate soil conservation measures were also recommended for the management of the pest.

White Grubs

The grubs of cockchafer beetle *L. coneophora* feed on the roots of coconut palm. They occur in sandy loam soils and also feed on tubers, rhizomes and vegetables, which are grown as intercrops in coconut gardens. Continuous feeding by the grubs on mature palms results in yellowing of leaves, premature nut fall, tapering of stem, delayed flowering, retardation of growth and reduction in yield.

Management

- Mechanical capture and destruction of cockchafers during peak period of adult emergence (soon after pre-monsoon showers between 6.35 to 7.15 PM) for two-three weeks.
- Summer ploughing to expose the immature stages to predators and repeated ploughing envisaged during peak grub incidence (September-November).

- * Soil application of bifenthrin 10 EC @ 20 litre/500 L of water/ha during July-August (plains) and September (hills) was found effective in suppressing root grub population.
- Drenching aqua suspension of *Steinernema carpocapsae* @ 1.5 IJ/ha during September -October and repeated during November -December.
- Second round need based root zone application of chlorpyrifos 20 EC @ 7ml / palm after 45 days of first round insecticide application was also found effective.

Rats

Rat (*R. wroughtonii*) is the major and threatening mammalian pest of coconut in the Island ecosystem both in Lakshadweep and Bay Islands. In Lakshadweep Islands nut loss as high as 50% could be recorded. Colonies of rats are found on the crowns of the coconut palm feeding on nut. In closely planted coconut gardens, rats move from tree to tree. Not all palms are invaded by the rats and selected palms that yield sweet nut water and pulp

Potential Invasive Pests

The spread of Alien Invasive Species (AIS) is now recognized as one of the greatest threats to the ecological and economical well being of the country. Invasions by alien species imbalance native ecosystems and are likely to breed profusely in the absence of natural enemies in the new environment and cause upsets in biodiversity out-competing native species. Coconut leaf beetle, *Brontispa longissima* Gestro and the armoured scale insect, *Aspidiotus rigidus* ravaging Maldives and Philippines, respectively are impending dangers at our door steps which had caused serious threats to the income generation from tourism industry as well as food security in South-Asian countries.

Adult *B. longissima* beetles measure 7.5-10.0 mm long and 1.5-2.0 mm wide, with a conspicuous orange to reddish pronotum. Grubs and adult beetles inhabit the developing unopened still folded heart leaves of coconut palm and feed on leaf tissues causing severe drying. Hard scale, *A. rigidus*, is a close relative of the minor pest *Aspidiotus destructor* which is reported from coconut growing tracts of the country. Although *A. destructor* is under check by natural enemies, *A. rigidus* is reported to be a ravaging pest in The Philippines incurring huge loss to coconut growers in that country. The mobile stage being the crawlers and males are easily drifted away by wind or passively carried through any inert packaging materials, nuts, leaflets, dried spathes, etc.

are highly preferred. Not only the nuts are preferred even the emerging spathes are very badly eaten by the rats in the Island. Brooding nests are also constructed on palm crown if not managed properly.

Management

- Maintain adequate palm density as well as regular crown cleaning will avoid brooding of rats.
- Traditional practices such as hanging a fertilizer bag on the petiole could reduce rat damage in isolated trees in the main land.
- Placement of protection barriers such as tin sheets or polythene sheets to prevent climbing of rats
- Placement of Bromadiolone cake (0.005%), (two pieces of cake each weighing 10g/palm) on the crown of those rat-preferred palms was found to reduce the rat damage to a greater extent.

For further infraction, please write to:
Drs Chandrika Mohan and A Joseph Rajkumar (Scientists), CPCRI Regional Station, Kayamkulam, Kerala 690 533.

INDIAN HORTICULTURE Subscription Order Form

To start a renew a subscription to Indian Horticulture fill in your name and address below:

Mail along with remittance by Money Order or Draft to: Business Manager, Directorate of Knowledge Management in Agriculture, Indian Council of Agricultural Research, Krishi Anusandhan Bhavan, Pusa, New Delhi 110 012.

Subscription for 6 issues: 1 year from: onwards.

India: ₹150.00 Overseas: \$30.00

SUBSCRIPTION

RENEWAL (Subscription No.)

Name.....

Name.....

(In Block Letters)..... (In Block Letters).....

Address.....

Address.....

..... Pin code Pin code

A total remittance of is enclosed herewith.