Pest and Disease Free Coconut

P. Chowdappa, Vinayaka Hegde, Chandrika Mohan, A. Josephrajkumar and MerinBabu
Central Plantation Crops Research Institute Kasaragod and Regional Station, Kayamkulam

1. Introduction

Integrated Pest and Disease Management (IPDM) in coconut is a holistic concept wherein all components of management strategies are integrated in as compatible manner as possible so as to prevent the insect population/diseases attaining action threshold. While ensuring the pest and disease incidence under tolerant level, IPDM maintains a quality environment for the use by next generation. Adoption of IPDM practices enable sustainability of ecosystem which is extremely important in economic productivity in agriculture. It considers whole production system and always leaves a pest residue for the natural enemies to sustain. Coconut is affected by a wide array of insects, mites, rodents and lethal / debilitating diseases. The IPDM tools for a united convergence for sustainable pest/ disease management tactics will be discussed hereunder. With the formation of Coconut Producer's Societies and Federations throughout the coconut growing tracts of the country, community-mode in extension outreach of pest/disease management options are wide open and many a time successfully accomplished through farmer-participatory approach.

2. Approaches in Pest and Disease Management

2.1. Cultural Approaches: Simple adoption of good agricultural and agronomic practices will be handy for pest avoidance as prevention is always better than cure. Planting coconut seedlings with correct spacing and fully exposed to sun light and libidum are the best agronomic practices to avoid infestation by rhinoceros beetle, red palm weevil and rodents. Shallow planting leads to heavy incidence by red palm weevil and pits of size 1 m3 are recommended for seedling planting. Coconut seedlings planted in shallow pits show exposed bole region and proliferating roots that invite bole entry of red palm weevil. Never mulch seedlings with coconut leaves during the early stage of establishment. Poorly-drained soil is unsuitable for coconut planting and seedlings in water logged condition would invite skipper butterfly attack and root grub incidence. Timely crown cleaning

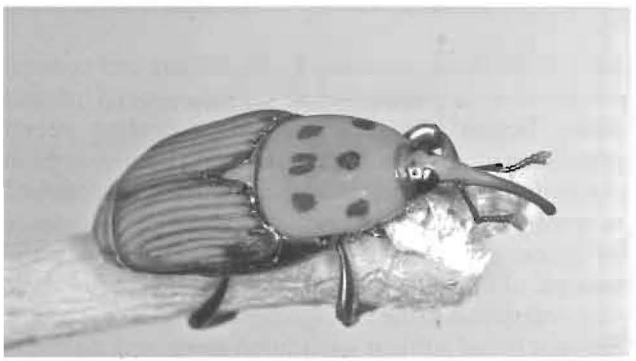
reduces the damage caused by coreid bug and coconut eriophyid mite. Destruction of red palm weevil infested palms, beyond recovery reduces the floating weevil population quite considerably. Avoiding injuries to palm and cutting petiole beyond 1.2 m from trunk is advised to ward off red palm weevil attack. Avoid succulence by excess application of nutrients. Farm hygiene and removal of breeding grounds of rhinoceros beetle is the foremost option in the management of rhinoceros beetle. Soil-test based nutrient application along with dolomite and in situ biomass recycling through raising cow pea in palm basin and incorporation during flowering are sound techniques to improve the palm health after invasion by coconut eriophyid mite and leaf eating caterpillars. Removal and destruction of heavily infested leaves are sound options in the management of black headed caterpillar and slug caterpillars. Summer ploughing exposes the white grubs for avian predators. Mulching of palm residues around the basin, raising green manure crops as well as providing summer irrigation improves the health of the palm significantly.

For a perennial crop like coconut, cultural practices form an important component of integrated disease management (IDM). Phytosanitation plays a vital role in the management of crown diseases viz., bud rot, leaf rot and grey leaf spot of coconut. Removal of the infected tissues eliminates or reduces the amount of inoculum facilitating the effective management of the disease by biological/chemical means. Moreover, rotten/fermented tissues in palms with leaf rot and bud rot diseases produce a spectrum of odorants that elicit stronger attraction in red palm weevil. The attracted weevils lay eggs on the moist rotten tissues in the disease affected portions of the palm. These diseased tissues serve as the point of entry/ breeding site of the pest. In bud rot endemic areas, priority has to be given to the removal and destruction of severely affected or dead palms as they may serve as inoculum reservoirs of the pathogen. Removal of inoculum/ infected tissues help to bring down the possibility of recurrent infection and prevent greater losses incurred from the spread of the disease. Providing proper irrigation and drainage in the field plays a critical role in the incidence and spread of bud rot, stem bleeding and basal stem rot diseases. Since wounds on the trunks predispose the palms to infection by stem bleeding pathogen, care should be taken not to injure the stem base while ploughing and avoid trash burning near the base of the palm. Isolation of diseased palms from healthy ones by digging a trench (60 cm deep and 30 cm wide) around the affected palm (1.2 m away from the base of the trunk) and avoiding flood irrigation or ploughing reduce/check the spread of the basal stem rot disease. Application of farm yard manure, neem cake, recommended dose of nutrients and moisture conservation by coconut husk burial enhances the health of the palm and reduce the severity of disease in root (wilt) disease (RWD) affected palms.

2.2. Use of Mechanical Tools: Use of mechanical devices and direct involvement of mankind are grouped under this category which is quite compatible with all techniques. Collection of emerging adult beetle of white grubs during June-July and use of light traps in monitoring the pest reduces the incidence of white grub. Mechanical hooking of rhinoceros beetle is perhaps the

best method of management that a marginal farmer can adopt. Banding the palm trunks using polythene sheets or metal bands avoids climbing of rodents to crown. Tying fertilizer gunny bags on the crown as well as baiting with traps are sound techniques in rodent management. Establishment of light traps could help both in monitoring and reducing the population of the slug caterpillar moths in endemic tracts of Andhra Pradesh and Kerala.

2.3. Biological Suppression: Biological pest suppression is the most ecologically sound and environmental-friendly approach that acts slowly with long-term effect. Some of the classical examples in coconut pest management come under this category. Application of an entomopathogenic green muscardine fungus, Metarhizium anisopliae on the breeding pits @ 5 x 1011 spores / m3 is an effective low cost farmer friendly technology in the sustainable management of rhinoceros beetle. This has been successfully implemented though farmer participatory mode by the Institute. Oryctes rhinoceros nudivirus is utilized for bio-suppression of rhinoceros beetle. Release of 10-12 virosed beetles/ha reduced rhinoceros beetle incidence. Placement of three filter paper sachets containing 12-15 Heterorhabditis indica-infected Galleria mellonella cadavers on the leaf axils after application of 0.002% imidacloprid suppressed the grubs of red palm weevil. Augmentative release of stage-specific parasitoids viz., the larval parasitoids Goniozusnephantidis (Bethylidae) @ 20 parasitoids/ palm, Braconbrevicornis (Braconidae) @ 30 parasitoids/ palm, the pre-pupal parasitoid, Elasmusnephantidis (Elasmidae) @49%/100 pre-pupae, and the pupal parasitoid Brachymerianosatoi (Chalcididae) @32%/100 pupae at the appropriate time was found effective in the sustainable management of black headed caterpillar. This technology also has been validated in large area demonstrations by ICAR-CPCRI. Application of talc based preparation of Hirsutellathompsonii @ 20 g / 1/ palm containing 1.6 x 108cfu with a frequency of three sprayings per year significantly reduced eriophyid mite population on coconut. Drenching aqua suspension of EPNs Steinernema carpocapsae in the interspaces of palms at 5-10 cm depth with a dosage of 40 - 50 lakh



infective juveniles/5 liter of water suppressed white grub incidence. The application of EPN shall be repeated as and when needed based on the grub population. Coccinellid beetles, Chilocorus nigritus, Cryptognatha nodiceps, Pseudoscymnus anomalus, Pseudoscymnus dwipakalpa, Scymnus luteus, Rhyzobius spp. and Telsimianitida suppress the scales and mealy bug population by predation. Hence, chemical pesticides in management of these sucking pests have to be judiciously used.

Management of disease using bioagents is an ecofriendly and sustainable component of IDM in coconut. Use of antagonistic microbes with biocontrol potential has been proved to be an effective tool in the management of leaf rot, stem bleeding and basal stem rot diseases. Application of 10% solution of talc based formulation of Pseudomonas fluorescensl Bacillus subtilis/consortium of these microbes(50 g talc based formulation in 500 ml water) to the spindle leaf axils twice in a year can be adopted as a prophylactic measure during April-May and October-November in leaf rot disease endemic areas. Placement of Trichoderma coir pith cakes (2 nos.) in the inner most leaf axils protects the palms from bud rot. For stem bleeding affected palms, smearing of a paste of talc based formulation of Trichoderma harzianum (CPCRI TD 28) on bleeding patches along with the basin application of neem cake (5 kg) enriched with T harzianum per palm during

September-October effectively manages the disease. Basin application of neem cake (5 kg) fortified with T harzianum (CPCRI TD 28) manages basal stem rot disease.

2.4. Use of Botanicals: Botanicals constitute yet another biorational approach in coconut pest management. Since time immemorial, use of botanicals has been leading from the front in sustainable pest management in coconut. Incorporation of the common weed plant, *Clerodendron infortunatum* on the manure pits to induce larval-pupal abnormalities in feeding grubs is an easily adoptable practice against rhinoceros beetle. Filling up top most leaf axils with 250 g neem cake/ maroti cake / pongamia cake along with equal volume of sand in palms reduced rhinoceros beetle attack. Spraying 2% neem oil-garlic mixture or 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 three times during March-April, October-November and December-January is recommended for the management of the coconut eriophyid mite. Placement of tablet-mode botanical cake on the leaf axils was found effective in the management of rhinoceros beetle. Spraying of azadirachtin 300 ppm (Nimbecidene) @ 0.0004% (13 ml / 1) reduced the coreid bug incidence at the highest level. Two rounds of azadirachtin spray on young 1-5 months old coconut bunches during May-June and September-October are quite essential for satisfactory control of coreid bug in the field.

2.5. Host plant resistance: The most effective, at the same-time a very difficult and time-consuming approach in perennial crop system is the development of tolerant cultivars against biotic stresses. Kalpaharitha (a selection of Kulasekaram Tall) recorded the lowest mite incidence in the field and could be a preferred choice in endemic zones. Dwarf genotypes such as CGD, MGD and Gangabondam are relatively more susceptible to red palm weevil attack than Tall genotypes.

Disease resistant/tolerant varieties are the cheapest and effective means of disease management especially in a perennial crop which remains in the field for many years. Use of a resistant genotype reduces the cost involved in plant protection and is of utmost importance in the management of phytoplasmal diseases which are not cured by any known chemical/ biocontrol measures. Use of disease free quality seedling is recommended for planting in disease endemic areas as this will help in the better initial establishment. ICAR-CPCRI has released two resistant/tolerant varieties viz., Kalparaksha (selection from Malayan Green Dwarf), Kalpasree (selection from Chowghat Green Dwarf) and a hybrid Kalpasankara (Chowghat Green Dwarf X West Coast Tall) for RWD endemic tracts.

2.6. Behaviour modulation tactics: Volatile chemistry is the buzz word in innovative pest management approach and uses of semiochemicals has been very successful in monitoring as well as trap and kill strategy. Use of PVC pheromone traps `Oryctalure [ethyl 4 methyoctonoate]' and field delivery using nanomatrix @1 trap / ha is an innovative method in pest suppression. Avoid installation of traps in gardens with juvenile palms. Installation of pheromone traps with ferrugineol embedded on nanoporous matrix @ 1 trap / ha was found effective in mass trapping of weevils. Impregnation of kairomonal blends containing host-induced volatiles enhanced the weevil catches substantially. Timely

servicing of traps with fresh food baits once in 6 days and avoiding placement of traps in gardens with juvenile palms or palms intercropped with tall intercrops (banana) are essential in successful adoption of the technology. A farmer-participatory community approach would be the key factor in successful field realization. Pheromone lures to attract Opisinaarenosella moths are available in the market. It is dispensed in the field in sticky traps and a trap density of 40 traps/ ha is recommended along with parasitoid release for pest management. Olfactory conditioning of parasitoids using the volatiles from larval frass enhanced the host searching ability and swift recognition of the host, *O. arenosella* by the parasitoid.

2.7. Agro-ecosystem based approach: The stimulo-deterrant approach rather push-pull strategy is emerging as an important pest management component in perennial cropping system. ICAR-CPCRI has developed a crop habitat diversification strategy in the management of rhinoceros beetle and red palm weevil through volatile confusion and disorientation of pest through diverse-cropping techniques. Habitat manipulation with crop diversity (nutmeg, rambutan, papaya, banana, glyricirdia, curry leaf, coral vine, and sunflower) along with coconut subdued rhinoceros beetle attack to 53.2%.

Disease management needs in inter/mixed cropping system differ from those in pure stands. With the increase in crop diversity due to multi-species cultivation the incidence and intensity of diseases may increase or decrease. The intercrop should not serve as an alternate/ collateral host of the pathogens affecting coconut. Growing non host crops helps to check the spread of soil borne diseases like basal stem rot.

2.8. Chemical control: This is the most powerful technique that needs to be judiciously used only on a need based manner. Residual toxicity need to be studied before recommendation of a chemical pesticide. Application of imidacloprid 18.5 SL 0.02% (1 ml per 1 of water) or spinosad 2.5 SC 0.013% (5 ml per 1 of water) or indoxacarb 14.5 EC 0.04% (2.5 ml per 1 of water) was found effective in the suppression of red palm weevil with no residue detectable for imidacloprid in nut meat, water and leaves. Drenching the root zone with chlorpyrifos 20EC @ 2.5ml/lit or imidacloprid @ 240 g ai /ha or bifenthrin @ 4.0 kg ai/ha during May-June and September-October is recommended for management of white grubs.Spraying lambda cyhalothrin @ 1ml/l on the pollinated bunches was found effective in the management of coreid bug. In coconut, application of 10 g Bromadiolone (0.005%) blocks two times at an interval of 12 days on the crown of one palm out of every five palms is recommended for effective control of rat. This method is highly cost-effective. If the damage is restricted to certain palms, only such palms require baiting.

Use of plant protection chemicals in disease management gained momentum with the discovery and development of Bordeaux mixture by PA Millardet. The introduction of fungicides revolutionized the entire concept of disease management and became the most widely adopted and accepted component of IDM. Crown application of 300 ml of fungicidal solution containing 2 ml of hexaconazole 5 EC in the cavity around the base of the spindle is recommended as prophylactic (April-May and October-November) and curative treatment in disease endemic areas. Crown cleaning and application of Bordeaux mixture (1%) to palms in disease endemic areas before the onset of monsoon preferably during the first week of June protect the palm from bud rot disease. Bordeaux paste (10%) is recommended for the curative treatment of bud rot affected palms. Root feeding of hexaconazole SEC 2% (100 ml solution per palm) and soil drenching with hexaconazole 5EC @ 0.2% or Bordeaux mixture @ 1% (40 1 solution per palm) at quarterly intervals are recommended for the management of basal stem rot disease.

2.9. Legislative mode: The most needed one but the least emphasized tool in pest and disease management is the legislative component. Sustained surveillance, scouting and sensitization programme have already been made in the look out of the invasive pest, coconut leaf beetle, Brontispalongissima which has not so far entered our country due to strict quarantine programme. However, this needs to be further strengthened with the formation of an incursion management team for tackling the disaster upon accidental entry. The diseases prevalent in other countries viz., cadangcadang, lethal yellowing and foliar decay virus are the major biosecurity threats to coconut sector in India. Domestic quarantine stations with diagnostic labs have to be equipped to prevent the spread of RWD to non endemic areas. The upsurge in the report of new diseases on coconut in recent years from other coconut growing countries warrants the strengthening of the disease surveillance, diagnostics and management techniques.

3. Conclusion

Judicious integration of all aforesaid techniques in a need based manner with sustained scouting and surveillance are key factors accomplishing plant health management for enhancing productivity in coconut. A social outreach programme through these tools would be realistic for sustainable coconut production which has redefined its position through product diversification and creating demand among public. Integration of IPDM practices along with other crop management components for a cost effective productivity of the crop is essential in making the farmer more competitive to face the challenges of the changing agricultural scenario. ■

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