

Plantation crops

Coconut

- Identification and documentation of four exotic whiteflies, viz., Rugose spiralling whitefly, *Aleurodicus rugioperculatus*, nesting whiteflies, *Paraleyrodes bondari*, *Paraleyrodes minei* and palm infesting whitefly, *Aleurotrachelus atratus* infesting coconut and many other host plants was done for the first time through regular survey and surveillance programme.
- Identification and documentation of several natural enemies such as *Pseudomallada* (= *Dichochrysa*) *astur*, *Jauravia pallidula*, *Encarsia guadeloupeae* and *E. dispersa*) and entomopathogens (*Isaria fumosorosea* and *Simplicillium* sp.) of invasive whiteflies was done.
- Augmentation and conservation of potential parasitoid, *Encarsia guadeloupeae* in coconut and other host plants through re-distribution, growing of intercrop/refuge (*Canna indica*/banana as banker plant), reduced use of insecticides and continuous awareness programme. The parasitoid population increased in the released garden and was significantly conserved which resulted in 72-88% reduction in pest population.
- Economic analysis of the impact of conservation and augmentation of *E. guadeloupeae* for management of RSW in Tamil Nadu and Karnataka indicated the saving of Rs 9500/ha and 900 ml of pesticides/ha. .
- Validation of potential entomopathogenic fungus *Isaria fumosorosea* (strain ICAR-NBAIR pfu-5) for the management of *A. rugioperculatus* in coconut and oil palm was done in Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, West Bengal and Maharashtra. The fungus was effective in suppressing all the life stages of the pest. The egg and early instar nymphal mortality was up to 91% and the late nymphal instars and pupal mortality was up to 80%.
- Developed different formulation such as talc, rice grain and oil based formulations with long shelf life. Due to its high field efficacy there is a huge demand for this biocontrol agent from the coconut farming community.

- Farmer-participatory bio-suppression strategies for rhinoceros beetle (*Oryctes rhinoceros*) was developed and demonstrated in different coconut belts in Kerala (1500 ha) which reduced pest incidence by 80% and improved nut yield by 13%.
- Documentation of natural occurrence of *Oryctes rhinoceros* nudivirus in different parts of the country and enhanced susceptibility of the nudivirus against grubs of *O. rhinoceros* was observed during laboratory bioassays indicating the absence of Guam strain in the country.
- Augmentative release of *Goniozus nephantidis* and *Bracon brevicornis* reduced the *Opisina arenosella* incidence in different parts of the country in coconut. *Steinernema hermaphroditum* that sustained more than nine-months in distilled water was reported and was found effective against red palm weevil, *Rhynchophorus ferrugineus*.
- Application of *Heterorhabditis bacteriophora*, *H. indica*, *Steinernema carpocapsae* and *S. abbasi* @ 1500 IJs /grub infective juvenile were found effective and induced 92.5% mortality of red palm weevil grubs while *H. bacteriophora* caused only 65% mortality in coconut. Besides developed delivery method i.e placement of three filter paper sachets containing 12-15 *H. indica* infected *G. mellonella* cadavers on the leaf axils after application of 0.002% imidacloprid could recover 60% of infested palms.
- Release of larval parasitoids, *Goniozus nephantidis* and *Bracon brevicornis* @ 20 parasitoid/palm reduced the coconut leaf eating caterpillar (*Opisina arenosella*) from 74.4% leaf damage to 16.7% over a period of nine months. Similar demonstration on integrated management of *O. arenosella* at Arsikere, Karnataka revealed significant recovery of palms.
- Conducted large area demonstration of integrated biocontrol technology against coconut pests by using *M. anisopliae* packets were supplied to famers for applying in breeding sites. Pheromone traps recorded an average collection of 5.8 beetle/trap/months. The population of *Opisina arenosella* reduced significantly after six releases of *Cardiastethus exiguus* @ 50 numbers / palm made at the crown region. Monitoring and release of stage-specific parasitoids viz, *G. nephantidis* and *Bracon brevicornis* could reduced leaf damage to the tune of 63% and population of *O. arenosella* to the tune of 91.3% in a period of eight months.
- In a pilot programme in Edava Panchayat of Trivandrum district, a community based participatory management methodology was followed to scale up the adoption of

Metarhizium anisopliae among small and marginal coconut farmers (520 ac). Farm level production technology was facilitated in the area through educated rural women farmers.

- Scaling up and utilization of *M. anisopliae* through technology transfer for the management practices for rhinoceros beetle was evolved and implemented in 520 ha covering more than 5500 farmers' plots and about 1 lakh palms in Kerala through area wide community adoption strategy.
- The technology of treating breeding sites of *Oryctes rhinoceros* with *M. anisopliae* was integrated with other ecofriendly IPM practices viz., incorporation of *Clerodendron infortunatum* in the breeding sites, phytosanitation and prophylactic leaf axil filling of juvenile and young palms with botanicals admixed with sand.
- The impact analysis indicated reduction of pest incidence in all the clusters proving the effectiveness of community adoption against this ubiquitous pest. The leaf cuts (typical major symptom of rhinoceros beetle infestation) reduced by 55.2%.
- The knowledge and skill of farmers also improved by more than 60%. Farmer to farmer technology dissemination achieved through trainings (18 trainings), sharing of experience, media publicity and providing *M. anisopliae* at low cost for farmer groups of other locations (four districts, 5000 packets).
- Identified sooty mould scavenging beetle, *Leiochrinus nilgirianus* Kaszab (Coleoptera : Tenebrionidae) was reported from coconut palms infested by RSW in Kerala, India. Scavenging action of *L. nilgirianus* and its immature stages on sooty mould deposits on coconut palms is very conspicuous and significant. Adult beetles, averaging 2.07 ± 0.9 / leaflet, with a maximum of five beetles per leaflet, and immature stages were generally confined to the abaxial of the palm.
- Developed three liquid formulations of coleopteran specific *Bacillus thuringiensis* (Bt) were tested on red palm weevil grubs under laboratory conditions. The formulation BTAN4 induced 8% mortality of grubs at 48h after treatment and attained maximum of 36% at 10 days after treatment whereas the formulation 4AT2 effected a maximum of 34% grub mortality at 10 days after treatment.

Tea

- *Beauveria bassiana* (NBAIR-Bb5a) treatment reduced the red spider mite population, which was at par with azadirachtin 10000 ppm and yield recorded was 4.57qt/ha and 3.92qt/ha, respectively.