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Taming insect pests in coconut

Biological suppression of two key pests of the coconut palm : the rhinoceros beetle and black-headed caterpillar has been achieved through natural enemies—parasitoids, predators and pathogens. Baculovirus of Oryctes *introduced into Minicoy and Androth (Lakshadweep) in 1983 and 1988 reduced the population density of rhinoceros beetle and its incidence on coconut palms remarkably. While, a number of spiders are major natural enemies of the black-headed caterpillar.*

A large number of insect pests during different stages of growth and development affect the coconut. Eventhough nearly one hundred species of insects are now known to be pests on the coconut in India, biological control has been developed and practised against only two : the rhinoceros beetle (*Oryctes rhinoceros* Linn.) and the black-headed caterpillar (*Opisina arenosella* Wlk.).

Rhinoceros beetle (*Oryctes rhinoceros* Linn.)

The adult beetle bores through the tender unopened fronds and inflorescence (spathes) and causes damage. Insect fauna associated with different breeding sites of rhinoceros beetle such as cattle dung, compost, decaying coconut logs and stumps and other accumulations of decomposing organic debris in different coconut-growing tracts of the country, including Lakshadweep and Andamans have shown the presence of a number of insect predators like *Santalus parallelus* Payk, *Scarites* sp., *Harpalus* sp., *Pheropsophus* spp. and *Agryonus* sp. Their adults and immature stages feed on the eggs and early stage larvae of rhinoceros beetle. The suppression of the pest is quite meagre compared with its multiplication rate. The pest is a prolific breeder multiplying on accumulated decaying organic debris while the host being a perennial palm provides abundant food material to the pest all through the year. Conservation of the indigenous predators alone is advocated.

The exotic predator *Platymerus laevicollis* Distant has been introduced from Zanzibar for the biological suppression of rhinoceros beetle. This reduvid bug sucks the body fluid of adult beetles and is capable of numerically reducing the pest population. It is also quite amenable to laboratory rearing. The predator has been multiplied and released in rhinoceros beetle- infested fields at regular intervals. At Androth (Lakshadweep), Pandalam (Kerala) and Vittal (Karnataka), with regular predator releases, the beetle incidence on palms could be significantly lowered. Also dead beetles on the crowns of pest-infected palms indicate the efficacy of the predator in suppressing the rhinoceros beetle population.

An entomogenous fungus, *Metarhizium anisopliae* (Metch.) produces green muscardine disease in rhinoceros beetle, when the temperature is low and relative humidity high.

The fungus may be mass-multiplied at laboratory-scale using locally available cassava chips and rice-bran, supplemented with waste fish meal extract or urea as a source of nitrogen in specially designed large aluminium vessels. The fungal spores cultured in the laboratory may be applied to the breeding sites of the pest. In fact the fungus on the breeding stuff of the pest survived longer. Favourable weather for disease prevalence is of much importance.

Coconut water, at present a waste from copra-making industry, is an ideal medium for mass-culturing of the entomopathogen. Higher mycelial weight and spore count has been recorded in coconut water medium than in conventional potato dextrose broth.

A baculovirus disease also occurs naturally in *O. rhinoceros* in Kerala. The symptoms conform to the baculovirus disease the pest suffers in Malaysia, first reported in 1966 and subsequently the baculovirus was introduced into several South Pacific Islands for the biological suppression of the rhinoceros beetle. The biological control was impressively successful and created a landmark.

The visual symptoms of baculovirus disease are : the midgut of the diseased beetle or grub are white, swollen and filled with a mucoid milky fluid in contrast to the very thin, brown midgut of the healthy beetles that contain very little brownish-fluid. Giesma-stained smears of gut aspirate of diseased beetles contain large clumps of cells and purple-stained hypertrophied nuclei and sparse blue cytoplasm. The infected nucleus is hypertrophied containing a homogenously stained deep-pink circular band along the periphery of the nucleus and a central core of deeply stained cytoplasm. The infected larvae are translucent, the healthy transparent. Immunosomophoresis, bioassay and electron microscopic examination confirm the natural incidence of baculovirus disease infection in the natural population of beetles collected from different tracts of Kerala. The percentage being 54.2. Beetles collected from Karnataka, Tamil Nadu, Andhra Pradesh, and Maharashtra also show the presence of baculovirus disease in their natural population.

Beetles and grubs collected from Minicoy, Lakshadweep are free of the baculovirus. Baculovirus may hence be introduced into the island for biological suppression of the pest. A hundred and thirty beetles collected from the Island had been infected with the baculovirus and released in April 1983. The pre-release observations of 10 per cent sample palms had 56.6 per cent leaf damage, 31.1 per cent spathe damage and 39.2 per cent fresh incidence on spindles. Subsequently the disease had spread to the natural population of the pest in the entire island. There was a drastic decline in the pest, crop damage and a dramatic fall in the site occupancy of the pest in its breeding places. Post- release data collected in December 1988 exposed 7.0 per cent leaf damage, negligible spathe and spindle damage (only 4-5 recorded per 2,000 palms). Sixty-two per cent of the natural population of the pest manifested the baculovirus.

Ubiquitous in all coconut-growing countries and foraging on other palms as well, the rhinoceros beetle is probably the most damaging on the coconut, its preferred palm, cutting and chewing the tender unopened leaves and inflorescences. The helpless leaves look fan-like with leaflets symmetrically damaged on either side.

Baculovirus of *Oryctes* was also introduced in the Androth island in April 1988 and results repeated. The Directorate of Agriculture, Union Territory of Lakshadweep has already taken up the task of introducing the baculovirus to all islands of the Union Territory for guarding the palm against the rhinoceros attack.

In the Andamans too baculovirus of *Oryctes* introduced in May 1987 voraciously fed on the pest population.

Leaf-eating caterpillar

The leaf-eating caterpillar, *Opisina arenosella* Wlk., damages the coconut palms mostly in the coasts and backwater. The caterpillars remain in the silken galleries on the lower surface of leaves and feed on the chlorophyll-containing tissues. They are particularly destructive during the summer. *O. arenosella* is attacked by parasites, predators and pathogens in different stages of its development. Bioagents therefore come handy in reducing the caterpillars to a naught.

The larval parasites *Apanteles tamagamae* Vier., *Bracon brevicornis* Wesm, *Bracon hebetor* Say. (*Braconidae*), *Goniozus nephantidis* (Bethylidae), *Elasmus nephantidis* Gahan (Elasmidae), *Brachymeria nosatoi* Habu. *B. nephantidis* Gahan, *B. himeatteviae Joseph, B. lasus* Walk., *Antrocephalus* sp. (Chalcididae), and *Xanthopimpla*

punctara Fb. (Ichneumonidae) and predators *Parena nigrolineata, Calleida splendidula, Sphaedanolestes aurescens* and *Cardiastethus* sp. besides a number of spiders form the major natural enemies of the pest. The bacterial pathogen *Serratia marcescens* takes a heavy toll of caterpillars during the monsoon.

Among the indigenous larval parasitoids the bethylid *Gonizous nephantidis* and the prepupal parasitoid *Elasmus nephantidis* are more potent in suppressing the pest population. Techniques have been developed for mass multiplication of *E. nephantidis*, a highly host- and stage-specific parasite. For maintaining laboratory culture of the larval parasitoid a regular and adequate supply of prepupal caterpillars of *O. arenosella* has to be ensured.

Of the different pupal parasitoids the chalcidid *Brachymeria nosatoi* is the most efficient biocontrol agent. It is very sturdy, prevalent almost throughout the year. The natural incidence is quite high (up to 38.8 per cent) in some tracts even during the summer when the pest population is at its peak. There is always preponderance of females. They have greater searching ability and can locate and parasitise host pupae remaining inside the cocoons in silken galleries. Their appetite is wholesome, each capable of gobbling numerous host pupae during its long life span of more than 3 months. The parasitoid can also be cultured in the laboratory.

Xanthopimpla punctata, another sturdy pupal parasitoid, is a voracious eater in some tracts of Kerala and interior Tamil Nadu. Glass chimney method can be adopted for multiplication of this parasitoid using *Opisina* and *Anadevidia* pupae as hosts.

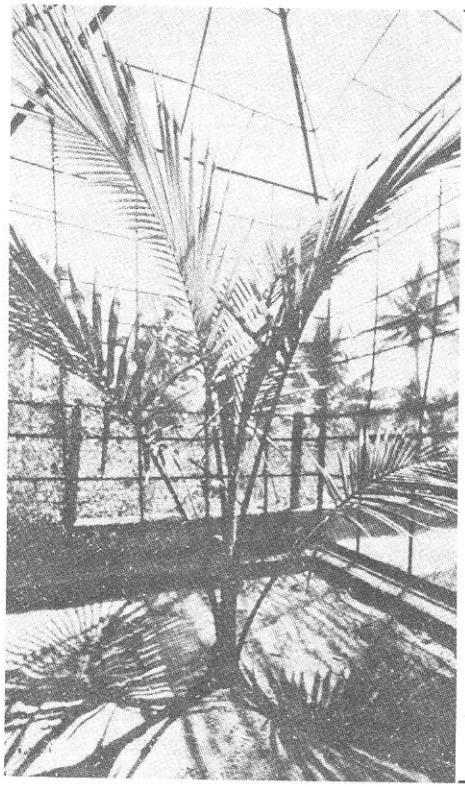
For monitoring the pest population of *O. arenosella* and its natural enemy complex a sampling procedure has been developed. The larvae, pupae, parasites or predators present in 40-60 per cent of leaflets of the lowest 20 per cent leaves are counted and from this data the estimates of the pest : natural enemy population can be assessed. The quantum of the bioagent to be released hence can be modulated. *G. nephantidis, E. nephantidis* and *B. nosatoi* doses have been standardized for target stages of the pest population.

For assessing the intensity of natural parasitism of pupae, in addition to recording the emergence of parasites from live pupae, a method of examination of emergence holes present in empty pupal cases has also been developed. The method is useful in assessing the aggregate natural pupal parasitism during the entire pest generation.

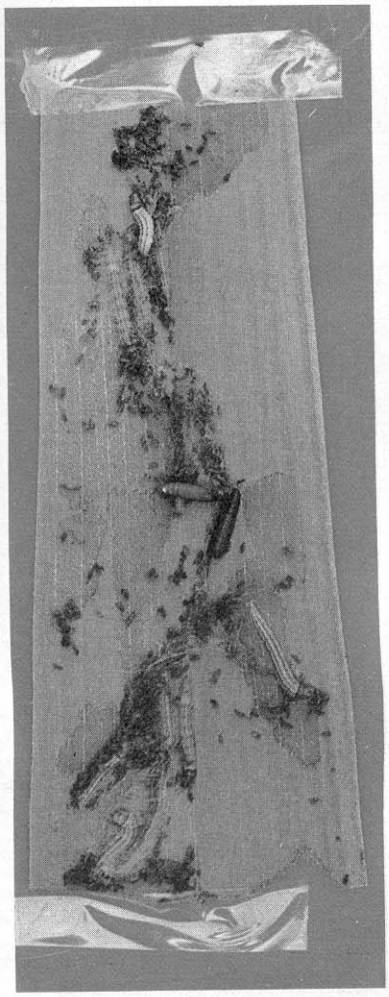
Adults and grubs of the carabid predators *Parena nigrolineata* and *Calleida splendidula* feed on *Opisina* caterpillars. Twenty-two species of spiders belonging to 12 genera and 6 families have been recorded from coconut ecosystem. Feeding potential among spiders *Cheiracenthium* sp., *Rhene indicus* and *Sparassus* sp. is maximum and they are capable of exerting considerable check on the pest population in the field.

Hyperparasitism occurring in nature is one of the major problems in biological pest suppression. The important species of hyperparasitoids recorded on coconut caterpillar include *Eurytoma albotibialis* and *Pediobius* sp. Sometimes the primary parasites of the pest may behave as hyperparasitoid. For example, *B. nephantidis* acts as a hyperparasite on *Eriborus trochanteratus* in the field.

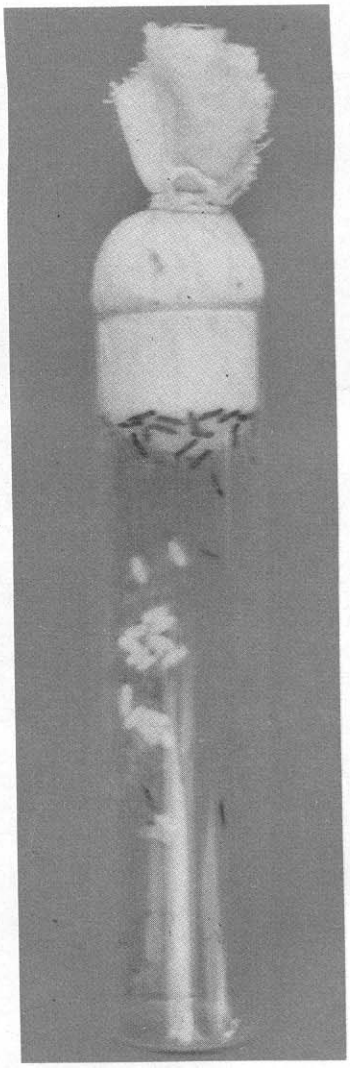
Another serious problem in biological pest suppression is the toxic hazards of insecticides to the beneficial natural enemy fauna. In several cases, the chemical insecticides applied do more harm to the non-target organisms like natural enemies of pests than to pests themselves, against which they are applied. In absence of adequate population of natural enemies in the field the pests may assume severe proportions that may be

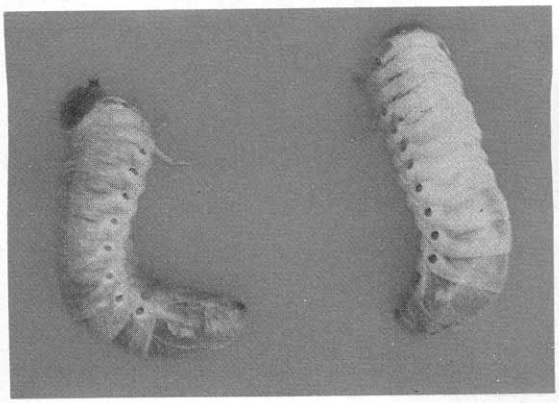


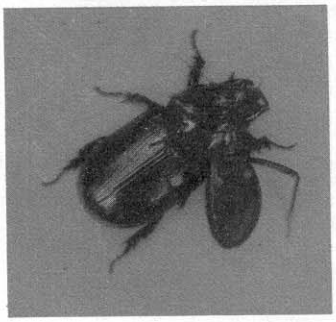
Pathogenecity experiment on transmission of Mycoplasma-like organisms from diseased to healthy plants in insect-proof cages deploying doddar, a weed parasite, and lace-wing bug (Stephanitis typica) as insect vector. It confirms Mycoplasma-like organisms to be responsible for the root-wilt in coconut.



From extreme left clockwise: Coconut leaf infested by the black-headed caterpillar, *Opisina arenosella;* pupae of chalcidid parasitoid *Brachymeria nosatoi;* baculovirus-infected rhinoceros beetle grub (translucent) and healthy counterpart (transparent); larvae of bethylid parasitoid *Goniozus nephantidis* and exotic reduvid predator *Platymeris laevicollis* attacking the rhinoceros beetle.







overcome by judicious use of less harmful pesticides on the beneficial natural enemies. Integrated pest management would thus be an ideal way of containing pests on the coconut.

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