



Farmers' participation in procurement and release of parasitoids

Strategy for biological control of papaya mealybug

1. Inoculative release of the exotic parasitoids *Acerophagus papayae*, *Anagyrus loecki* and *Pseudleptomastix mexicana* @ 100 or more of each species per village in mealybug infested areas.
2. Conservation of the released parasitoids and other natural enemies like *Spalgis* by avoiding chemical pesticide sprays.
3. Redistribution of the natural enemies to new areas infested by the mealybug.
4. Alternative hosts of papaya mealybug like tapioca, pineapple, *Parthenium hysterophorus*, *Plumeria alba* and *Acalypha indica* are very valuable reservoirs of parasitoids and hence should not be destroyed or sprayed with chemical pesticides.
5. Initial releases can be concentrated on gardens, producing organic papaya without the use of chemical pesticides as well as teak and mulberry plantations with heavy mealybug infestation.

Outcome

The introduction of exotic parasitoids has generated significant economic benefits in crops like papaya, mulberry, cassava and vegetables. More than two-thirds of the benefits were in cassava, which was heavily infested by the pest. It is estimated that an annual saving of ` 1,623 crores has accrued to the farmers in Tamil Nadu, Karnataka and Maharashtra because of this biocontrol programme. In addition, the indirect benefit has been the reduced exposure to hazardous pesticides, thus making the environment safe. The papain production, which has come down during the years of mealybug infestation has regained its productivity after biocontrol intervention. NBAIR is continuously monitoring the pest status and supplying the parasitoids regularly to farmers to keep the mealybug population under control.



The result

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Biocontrol Bears Fruit: Saving Papaya from the Mealybug



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Saving Papaya from the Mealybug

India is a leader in papaya production contributing to approximately 50% of the world production with 6 million tonnes of fruits. Papaya is cultivated in the states of Andhra Pradesh, Karnataka, Maharashtra, Gujarat, Odisha, West Bengal, Assam, Kerala, Tamil Nadu and Madhya Pradesh in around 1.34 lakh ha.

During July 2008, *Paracoccus marginatus*, a mealybug native to Mexico, was first reported on papaya in Coimbatore, Tamil Nadu, and soon it spread to neighboring districts infesting cassava (tapioca), mulberry, teak and more than 100 other plant species. The population build-up of mealybug was so high that it became a threat to papaya cultivation. Papain, sago and silk industries were significantly affected by this pest. Farmers were about to abandon the cultivation of papaya, cassava and mulberry. Several insecticides were recommended and used by the farmers for the management of mealybug, but could not contain the pest.



The problem: Papaya mealybug havoc

Importation of natural enemies

ICAR-NBAIR (then Project Directorate of Biological Control or PDBC) with help from the United States Department of Agriculture (USDA) imported three natural enemies of the papaya mealybug, namely, *Acerophagus papayae*, *Anagyrus loecki* and *Pseudleptomastix mexicana*, from the laboratory of Animal and Plant Health Inspection Services (APHIS) at Puerto Rico, complying the mandatory safety procedures and specificity tests in the quarantine facility.

Multiplication of the parasitoids

ICAR-NBAIR mass multiplied the imported parasitoids successfully in the laboratory on *Paracoccus marginatus* colonies grown on potato sprouts. Various stakeholders, entomologists of state Agricultural Universities, ICAR institutes, Krishi Vigyan Kendras, Central Integrated Pest Management centres, government biocontrol laboratories and Central Sericultural Research and Training Institutes from all over India were trained on the mass production, field release and conservation of the parasitoids.



The solution: *A. papayae* and *P. mexicana*

Biocontrol in action

Within a short time, the scientists of ICAR-NBAIR developed a large-scale production technology for each of these three exotic parasitoids. Once their safety to non-targets was confirmed, field-release permits were obtained from the Plant Protection Advisor to Government of India. In the 'National Consultation Meeting on Strategies for the Utilization of the Parasitoids', wherein more than 250 participants deliberated, a decision was taken to release *A. papayae*, which was found to be very effective against papaya mealybug, at all places of fresh incidence of the papaya mealybug across the country. The parasitoid was supplied free of cost to all the trained entomologists for multiplication in their respective laboratories, and further supply to papaya, cassava and mulberry farmers for field releases.

Awareness programmes were conducted all over India and brochures on biocontrol of the papaya mealybug were distributed in nine regional languages, along with live parasitoids. Within a period of six months, the papaya mealybug was controlled successfully by this biological control method and the farmers were encouraged to take up cultivation of papaya, cassava and mulberry, which they had abandoned earlier.

Present status

Surveys and surveillance carried out in papaya- and mulberry-growing areas in Tamil Nadu, Karnataka, Kerala, Maharashtra and Gujarat reveal that papaya mealybug has been under control with an average incidence of up to 7.5% in the last five years and 0-2% during 2017-18, emphasising the fact that the pest is managed by the parasitoid, *A. papayae*, which is being conserved in farmers' fields.