

- Parasitoid wasp, *Anagyrus lopezi* is effective against *Phenacoccus manihoti*.

### c. Bioformulations/chemical methods

- Soaking of planting materials (cassava setts) in dimethoate 30 EC @ 1% for 30 minutes to disinfect the mealybugs before planting in the main field.
- Regular monitoring of the crop for mealybug infestation and its natural enemies.
- Use of botanical insecticides such as neem oil @ 1 to 2% or neem seed kernel extract (NSKE) @ 5% or *Shreya* @ 1.5% followed by *Nanma* @ 1% (developed by ICAR-CTCRI).
- Application of insecticides is advised if the mealybug incidence above ETL (economic threshold level). Spraying any one of the insecticides viz., thiomethoxam 25 WG @ 0.6 g/litre and imidacloprid 17.8 SL @ 0.6 ml/litre to cover the lower surface of the leaves/ infested portions of the plants.
- Drenching of chlorpyrifos 20 EC @ 2 ml/litre for destruction of ant colonies/ preventing the movement of crawlers of mealybug.

### Calendar of Operations for the Management of Mealybug

#### April-May

- Summer ploughing/preparation of land for planting.
- Selection of healthy, pest and disease-free planting materials of high yielding varieties.
- Soaking of planting materials (cassava setts) in dimethoate 30 EC @ 1% for 30 minutes to disinfect the mealybugs before planting in the main field.
- Planting of cassava with recommended spacing and application of organic manures.
- Application of 1/3 dose of N and K fertilizers and full P fertilizer as basal dose.
- Monitoring and scouting to detect presence of the mealybug.
- Use of botanical insecticides such as neem oil @ 1 to 2% or neem seed kernel extract (NSKE) @ 5%

or *Shreya* @ 1.5% followed by *Nanma* @ 1% (developed by ICAR-CTCRI).

#### June - July

- Providing drainage facilities to avoid water stagnation.
- Weeding once in a month (removal of weeds/alternate host plants like *Hibiscus*, *Parthenium* etc. in and around cassava fields).
- Monitoring and scouting to detect presence of the mealybug.
- Pruning of infested branches and burning them.
- Application of insecticides is advised if the mealybug incidence above ETL (economic threshold level). Spray of any one of the insecticides viz., thiamethoxam 25WG @ 0.6 g/litre and imidacloprid 17.8 SL @ 0.6 ml/litre to cover the lower surface of the leaves/ infested portions of the plants.

#### August - September

- Apply 2/3 dose of N and K fertilizers at the time of intercultural operations.
- Providing drainage facilities.
- Weeding once in a month.
- Monitoring and scouting to detect presence of the mealybug.

#### October-November

- Irrigation once in two weeks or depending on the soil moisture.
- Weeding once in a month.
- Monitoring and scouting to detect presence of the mealybug.

#### December-January

- Harvesting of the crop after attaining full maturity.
- Selection of good quality planting materials after harvesting.
- Storage of planting materials: Stems can be stored vertically under artificial shade up to 4 months and water can be sprinkled to reduce drying of stems. Care should be taken to keep the materials free from pests and diseases.



## STANDARD OPERATING PROCEDURE FOR MANAGEMENT OF MEALYBUGS IN CASSAVA



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## Introduction

Cassava is one of the most produced food materials and constitutes the major energy source for about 1000 million people worldwide. Mealybug infestations have been reported as one of the serious issues in cassava production for the past few years in all the major growing ecosystems of India, viz., Tamil Nadu, Kerala and Andhra Pradesh.



## Infestation of mealybugs in cassava

Mealybugs are white and soft bodied insects covered with mealy or waxy secretions equipped with piercing/sucking mouth parts to suck the cell sap from plant tissue. They secrete large amounts of honeydew which attracts black fungus called sooty mould. Also, this notorious and polyphagous insect pest has wide range of alternate host plants including weeds and cause reduction in plant growth and considerable yield loss.

Globally, mealybugs are the major pests of cassava and out of the different species infesting cassava, *Ferrisia virgata*, *Paracoccus marginatus* and *Phenacoccus manihoti* are severely affecting the crop in our country.



*Ferrisia virgata*



*Paracoccus marginatus*



*Phenacoccus manihoti*

**Striped mealybug, *Ferrisia virgata* Cockerell:** One of the most highly polyphagous mealybugs known, attacking plant species belonging to 203 genera in 77 families, preferably on the host species belong to the families, Fabaceae and Euphorbiaceae. The striped mealybug has achieved economic significance as a pest of several agricultural crops, including cassava.

**Papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink:** A native of Central America/ Mexico, it infests more than 60

species of plants spread over 50 countries. In 2002, it was reported from the Pacific Islands, subsequently from Indonesia, India, and Sri Lanka. In India, it was first reported from Tamil Nadu in 2008, infesting papaya, cassava and a wide list of agricultural and horticultural crops. In the cassava growing area, particularly in Tamil Nadu and Andhra Pradesh, management of this pest by chemical measures poses a challenge; however, its menace could be successfully managed by releasing the parasitoid *Acerophagus papayae* which was imported by ICAR-NBAIR from Puerto Rico during 2010.

**Cassava mealybug, *Phenacoccus manihoti* Matile-Ferrero:** It was first reported in Asia from Thailand in the year 2008, since then it quickly spread throughout the cassava-growing regions of Thailand and neighbouring countries. Several non-preferred host species supports *P. manihoti* reproduction, but only cassava is known to experience significant damage by this insect. In India the pest was first reported by ICAR-NBAIR in May, 2020 from Thrissur, Kerala and subsequently from Salem, Tamil Nadu. For its management, ICAR-NBAIR has imported a highly host specific parasitoid wasp, *Anagyrus lopezi* from IITA, Republic of Benin and successfully released in many cassava growing tracts, which was found very effective in suppressing the pest.

## Life cycle of mealybug

Total life cycle is between one and two months depending on the season and weather factors. Adult males are smaller (0.9 to 1.7 mm long) with two wings which live only a short period of time and do not feed, they exist only to reproduce. Adult females are 1.5 to 2.7 mm long with flattened oval body covered with mealy wax. The secretion of this waxy material helps to protect their eggs and nymphs. Female lays 100-600 eggs in an ovisac over a period of one to two weeks. Egg hatching occur in 10 days and nymph or crawlers begin to actively search for feeding sites. Female crawlers have three instars. Populations of the mealybug build up during the dry season and decline with the onset of monsoon.

## Mode of spread

Mealybug infestation in cassava is influenced by various factors like use of infested planting materials, varieties, vicinity of infested gardens and lack of proper management practices. Spread occurs when crawlers move by themselves over short distances, or longer when carried by wind currents, vehicles,

animals, birds, on clothing, and during exchange or distribution of cassava stem cuttings.

## Symptoms

Mealybug destroys the cassava plant by sucking sap from all parts of the plant and injecting a toxic chemical into the shoot tips, lower surface of leaves and stems, causing them to wilt, fall and dieback. Deformation of terminal shoots, which become stunted resulting in compression of terminal leaves into 'bunchy tops' and reduction in internodal length and distortion of stems. Honey dew secretion and the associated black sooty mould formation impairs photosynthetic efficiency of the affected plants, stunted plant growth and yield loss up to 60-80 per cent. Heavy infestation resulting in plant stunting, chlorosis, dropping of newly emerged leaves and fruits, leaf deformation, a heavy production of honeydew and death of the host plant.



Distortion of terminal shoot



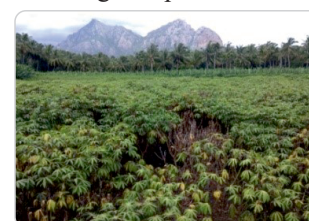
Bunchy top of leaves



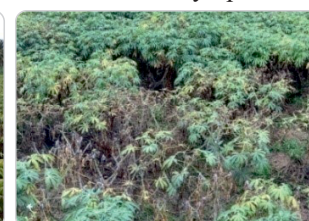
Wilting of apical shoot



Die back symptom



Mealybug infested cassava fields



## Management practices

Integrated pest management practices are recommended for managing mealybug as described below.

### a. Cultural and mechanical methods

#### Monitoring

- Monitoring and scouting to detect early presence of the mealybug.

- Destruction of ant colonies to prevent the spread of mealybug.

### High yielding varieties

- Use of high yielding improved varieties to realize the potential yield (35-40 tons per hectare). Local varieties are to be replaced with high yielding varieties as local varieties are not only susceptible to pests and diseases but also low yielding.

### Planting material

- Use of good quality, pest and disease-free planting materials. Planting materials are to be replaced once in three years in order to realize the true genetic potential of the variety.
- Stem cuttings free from pests and diseases; 7-10 months old, 2-3 cm thickness, 15-20 cm long.

### Agronomic practices

- Crop rotation with cereals and legumes to maintain the soil fertility.
- Weeding and earthing up 1.5-2 months after planting and again one month later.
- Provision of proper irrigation and drainage facilities.
- Summer ploughing and maintenance of field hygiene.
- Pruning of infested branches and burning them.
- Application of organic inputs like farmyard manure, neem cake, biofertilizers, biocontrol agents, green manuring etc. to maintain the soil fertility status.
- Removal of weeds/alternate host plants like *Hibiscus*, *Parthenium* etc. in and around cassava fields.
- Avoiding flood irrigation/water stagnation.
- Sanitization of farm equipments and implements to prevent the spread of mealybug.
- Timely harvest and proper storage of planting materials.

### b. Biological methods

- Conservation of natural enemies for reducing the mealybug population. Natural enemies include hymenopteran parasitoid *Acerophagus papayae* and predators viz., *Cryptolaemus montrouzieri*, the commercially available mealybug destroyer, lady bird beetles, lacewings, hover flies and *Scymnus* sp. are effective in managing the mealybug.