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Mealybugs and their management



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Mealybugs infesting *Parthenium*

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Mealybugs and their management

INTRODUCTION

Mealybugs (Homoptera: Pseudococcidae) are cottony in appearance, small oval, soft-bodied sucking insects. Adult mealybugs are found on leaves, stems and roots and are covered with white mealy wax, which makes them difficult to eradicate. They form colonies on stems and leaves developing into dense, waxy, white masses. They suck a large amount of sap from leaves and stems with

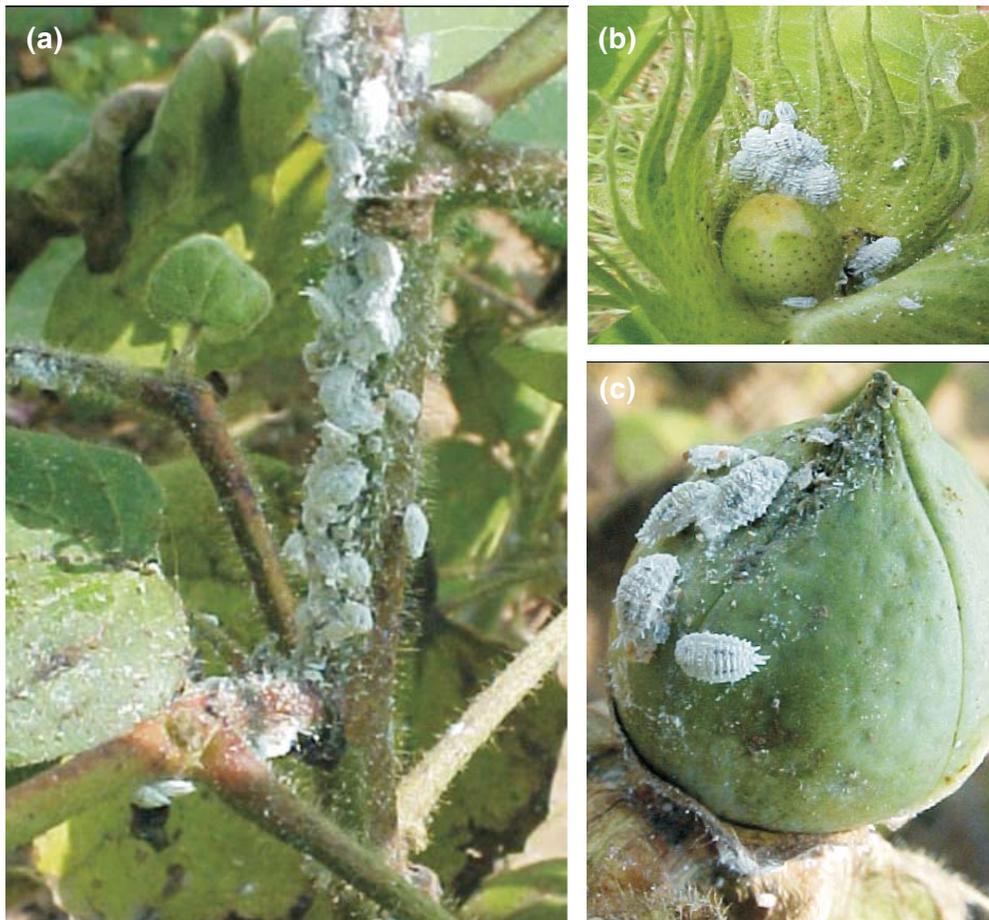


Fig. 1. Mealybugs infesting cotton (a) Plant; (b) Square; (c) Green boll



the help of piercing/sucking mouth parts, depriving plants of essential nutrients. The excess sap is excreted as honeydew which attracts **ants** and develops **sooty mould** inhibiting the plant's ability to manufacture food.

In the current decade, the trend of increased build up of various mealybug species in crop plants and in the wild is observed mainly due to certain abiotic changes in climate and environment. During the last few years mealybugs, which were considered to be minor pests in many crops have acquired the status of major pests especially in cotton, vegetables and fruits. Recently in India the cotton crop in Punjab, Rajasthan, Maharashtra and Gujarat is being seriously infested with mealybug (Fig. 1). During 2005, the sudden appearance of the pest in cotton in Multan, Sanghar, Mirpurkhas and Tando Allahyar of Pakistan destroyed the entire crop within a few days.

HOSTS

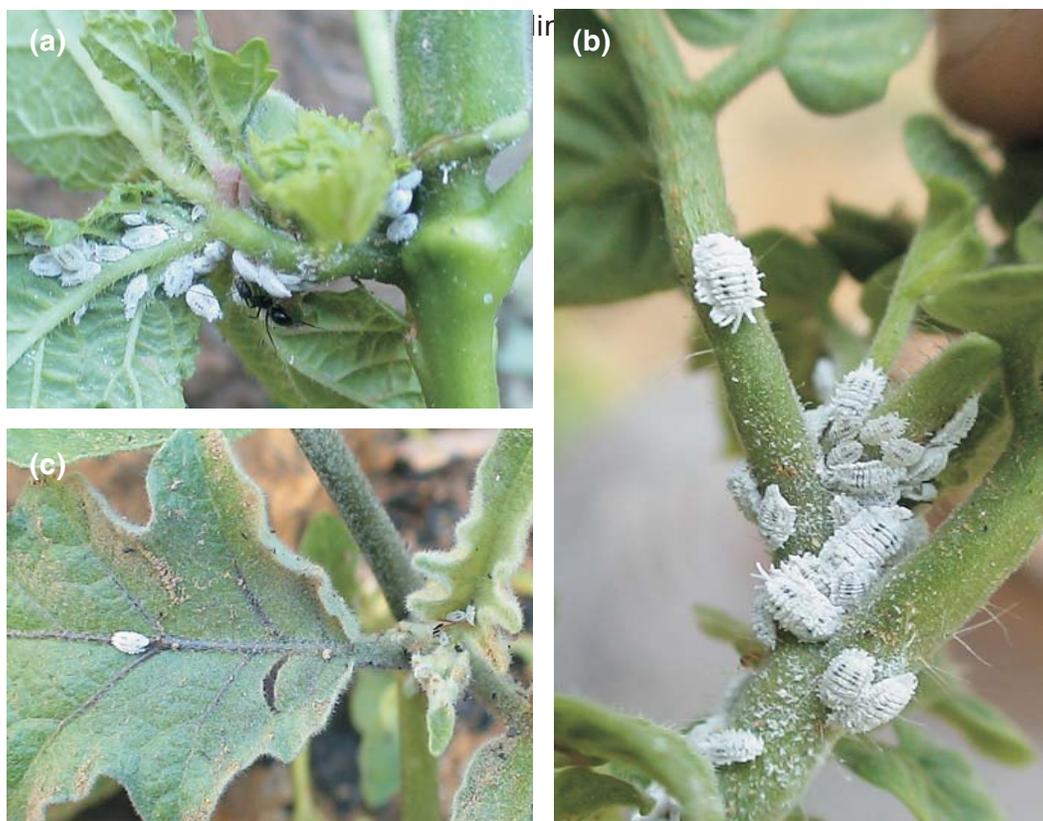


Fig. 2. Mealybugs infesting vegetables (a) Okra; (b) Tomato; (c) Brinjal

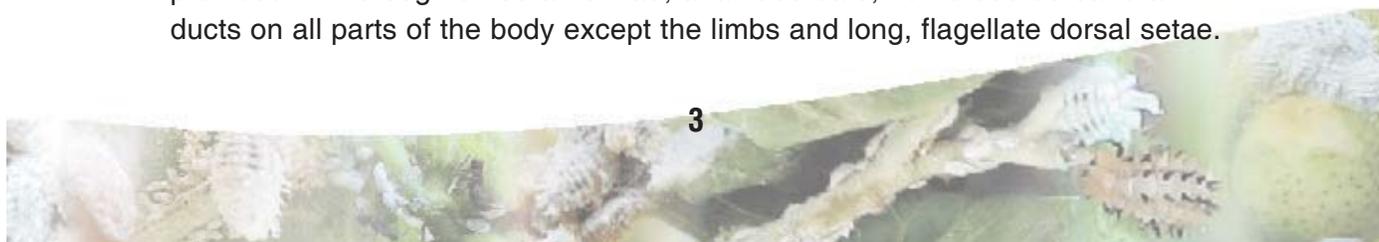
Malvaceae, Solanaceae and Leguminaceae. The host range of the mealybugs includes grape, fig, date palm, apple, avocado, banana, citrus, okra, tomato, brinjal (Fig. 2), cotton and a few ornamentals. *Hibiscus rosa-sinensis* is a typical host which is frequently attacked by *Maconellicoccus hirsutus* (Fig. 3). Host records of *M. hirsutus* extend to 76 families and over 200 genera, including beans, *Chrysanthemum*, citrus, coconut, coffee, cotton, corn, *Croton*, cucumber, grape, guava, *Hibiscus*, peanuts, pumpkin, rose, and mulberry.



Fig. 3. Mealybugs infesting *Hibiscus rosa-sinensis*

MORPHOLOGY

Mealybugs are white to pink in colour and measure 3–4 mm in length. In case of *M. hirsutus*, eggs as well as crawlers are pink in colour. The crawlers measure 0.3 mm in length. Immature females and newly matured females are greyish-pink which are dusted with mealy white wax. Adult females are 2.5–4.0 mm long, soft-bodied, elongate oval and slightly flattened. Females are provided with 9-segmented antennae, anal lobe bars, numerous dorsal oral rim ducts on all parts of the body except the limbs and long, flagellate dorsal setae.



Males have one pair of very simple wings, long antennae and white wax filaments projecting posteriorly with no mouthparts.

IDENTIFICATION OF IMPORTANT SPECIES

Striped mealybug (*Ferrisia virgata*): Species is associated with aerial portion of host plant. The body is grey in colour, covered with very long waxy filaments and is provided with long tails. Two dark stripes are present on dorsum and body fluid is light color. This species produces egg mass or ovisac.

Longtail mealybug (*Pseudococcus longispinus*): Anal wax filaments are as long as body and appear as long tails; 2nd to last pair of wax filaments are also long; dorsal median stripe is present on abdomen.

Citrus mealybug (*Planococcus citri*): Body is yellow to pink in colour, covered with medium sized slightly curved waxy filaments and is not pyramid shaped. One dorsal median stripe is present on the back in adults and body fluid is clear. Anal filaments are less than one-eighth the length of the body. This species produces an egg mass or ovisac which is irregular and remains under body of female.

Solanum mealybug (*Phenacoccus solani*): The body is covered with very short waxy filaments. Long tails and stripes on the body are absent. This species does not produce an egg mass or ovisac.

Pink sugarcane mealybug (*Saccharicoccus sacchari*): The mealybug (Fig. 4) is light pink in colour and occurs underneath leaf sheaths on sugarcane. Adult females are provided with mobile legs.



Fig. 4. Pink sugarcane

Pineapple mealybug (*Dysmicoccus brevipes*): This species is associated with roots of host plants. Body colour is light pink to grey and is provided with 17 pair of wax filaments.

Pink mealybug (*Maconellicoccus hirsutus*; synonyms - *Phenacoccus hirsutus*): Mealybug colonies contain immature as well as mature females. Larger mealybugs are darker in color and covered with significantly more white waxy material. The body is



edge, no stripes and this mealybug produces an egg mass. Ovisac is irregular and remains beneath the body. When squashed a pink to red fluid is observed.

Solenopsis mealybug (*Phenacoccus solenopsis*): The insect is provided with short to medium sized waxy filaments around the body, anal filaments about one-fourth the length of the body and the two dark stripes on either side of the middle “ridge” of the body. Long glassy rods are present on back. This species produces an egg mass or ovisac.

Mango Mealybug (*Drosicha mangiferae*): The females can be identified by their flat shape, covered with white mealy powder.

BIOLOGY

- Reproduction is mostly parthenogenetic but some species such as *M. hirsutus* are bi-parental.
- The mature female lays eggs in an egg sac of white wax, usually in clusters on the twigs, branches, or bark of the host plant but sometimes on the plant’s leaves and terminal ends. Each egg sac may contain as many as 600 eggs, majority of which are female resulting in explosive outbreak. Some species such as *D. brevipes* are ovoviviparous i.e. the eggs hatch within the female and give births live larvae.
- Eggs are minute, varying from 0.3 to 0.4 mm in length. Egg development takes between 3 and 9 days.
- Eggs hatch into nymphs called crawlers (Fig. 5) and are very mobile. In appearance, nymphs of both sexes resemble female adults. There are three nymphal instars in female and four in males which lasts for 22–25 days. The last instar of the male is an inactive stage with wing buds within a cocoon of mealy wax.
- Individual mealybugs may take as long as 30 days to grow through all the nymphal stages under normal conditions.
- There may be as many as 15 generations per year.



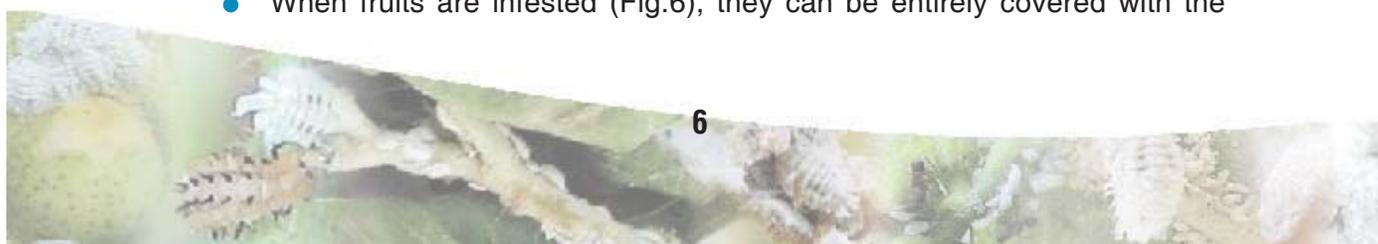
- The species survives cold conditions as eggs or other stages, both on the host plant and in the soil. In warm climates, the insects stay active and reproduce round the year.

MODE OF TRANSPORT

Non-infected plants can be infected from infected plants as juvenile mealybugs can crawl from an infected plant to another plant. Small 'crawlers' are readily transported by wind, rain, birds, ants, clothing and vehicle and may settle in cracks and crevices, usually on new plants. The wax, which sticks to each egg, also facilitates passive transport by equipments, animals or people. The female mealybug is not active and unable to fly. In fact, humans are great friends helping in transport of mealybugs. As the infested plant back the colonies of mealybugs migrate from shoot tips to twigs, branches and finally down the trunk. Long-distance movement is most probable through carrying infested planting material and fresh fruit and vegetables across the country or even from one end of a farm to the other. Ants, attracted by the honeydew, have been seen carrying mealybugs from plant to plant.

NATURE OF DAMAGE

- Infested growing points become stunted and swollen which may vary depending upon the susceptibility of each host species.
- Heavy clustering of mealybugs can be seen under leaf surface giving the appearance of a thick mat with waxy secretion. Severe infestations resemble patches of cotton all over the plant.
- They excrete copious amount of honey dew that attracts ants and help in development of black sooty mould which inhibits the plants ability to manufacture food.
- Both nymphs and adults suck the sap from leaves causing withering and yellowing of leaves. Fruit may drop prematurely on crop plants. Heavy infestation can cause defoliation and even death of the plant.
- Mealybugs also affect the development of flowers and stems (especially in succulents with fleshy stems).
- When fruits are infested (Fig.6), they can be entirely covered with the



white, waxy coating of the mealybug. Infestation can lead to fruit drop, or fruit may remain on the host in a dried and shriveled condition. Mealybug infected fruits are unfit for marketing.

- In cotton serious attack results in retarded growth and late opening of bolls, affecting the yield badly. It feeds on soft tissues and injects saliva that causes curling and contortion of leaves.
- Citrus mealybug (*P. citri*), commonly found associated with black pepper (*Piper nigrum*) plants in India was shown to transmit *Badnavirus* associated with stunted disease.
- Feeding of *Dysmicoccus* species on pineapple produces a toxic effect called mealybug stripe, expressed as green or black striped areas. The most predominant symptom is wilting of leaves, commencing from leaf tips. Reddish-yellow colour develops in the wilting areas and finally the plants rot and develop decaying.



Fig. 6. Mealybugs infesting okra fruit

ECONOMIC IMPACT

In its native range, *M. hirsutus* has been recorded causing economic damage to many crops. In India, losses have been reported for cotton; the fibre crops *Hibiscus sabdariffa*, *Hibiscus cannabinus* and *Boehmeria nivea*; grapevine; mulberry; pigeonpea; *Zizyphus mauritiana*. Presumably, many ornamental woody plants are also affected, but populations and damage may be limited by natural enemies. In India, it is a major pest of grapes, reducing yields 50 to 100 per cent. Yield losses on other crops, such as jute and mesta range up to 75 per cent.

ASSOCIATION OF ANTS AND MEALYBUGS

Mealybugs are known to bribe ants (Fig.7) with their sugary secretion (honeydew) and in return ants help in spreading of mealybugs and provide protection from predator ladybird beetle, parasites and other natural enemies. Ants also keep their colony clean from detritus that accumulate in the secreted

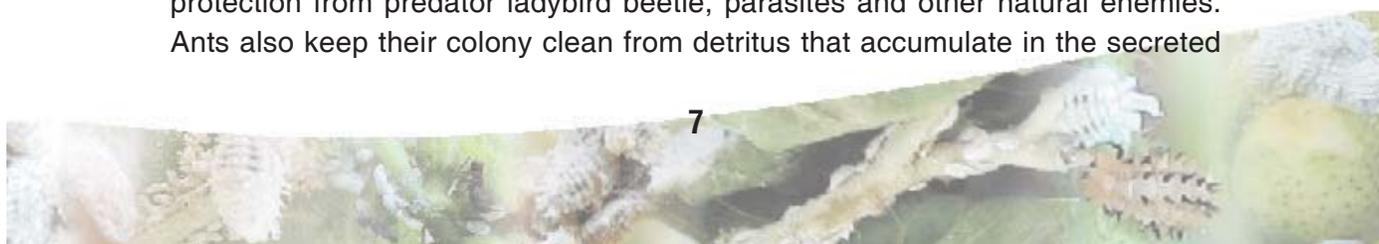




Fig. 7. Association of ants and mealybugs

honeydew, which may be harmful to the colony. Species of ants such as *Oecophylla smaragdina*, *Crematogaster* sp. and *Anoplolepis gracilipes* have been found attending mealybug, *P. citri* while feeding on honeydew on *Hibiscus*.

MANAGEMENT

Mealybug control often involves the control of caretaking ants that are important for the proper development of mealybugs. Without the ants, mealybug populations are small and slow to invade new areas and the field would be free of a serious mealybug infestation. Therefore, management of mealybugs often includes the control of ant species.

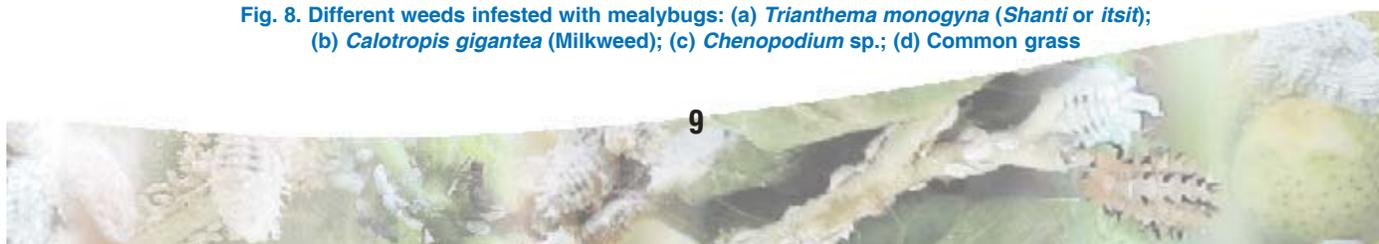
For management of mealybugs, it is important to know the species present as management programs for the various mealybugs may differ. Plant protection products are of limited effectiveness against mealybugs because of their habit of hiding in crevices and the presence of waxy covering of its body. Management of mealybugs involves the following tactics:

Cultural and mechanical Control

- Physical barriers such as ant fences can be applied parallel to the field periphery to keep ants away from field, and subsequently help in controlling mealybug populations.
- All crop residues in previously infested fields should be removed and burnt. Crop residues and grass left in the field may harbor mealybug populations which may invade the new crop.
- Field borders should be free from weeds and debris that may support mealybugs (Fig. 8) between plantings. Weeds also provide alternative host for ant populations between periods where mealybug infestations are small.



Fig. 8. Different weeds infested with mealybugs: (a) *Trianthema monogyna* (Shanti or itsit); (b) *Calotropis gigantea* (Milkweed); (c) *Chenopodium* sp.; (d) Common grass



- Remove alternate host plants like *Hibiscus*, okra, custard apple, guava, etc. in and nearby crop.
- Equipments should be sanitized before moving to uninfested portions in a crop.
- Manual picking of bugs can be done in plants that are not severely infested in small conservatory or kitchen gardens or apply strong jet of water to remove bugs (avoid the damage to plants).
- In case of perennial crop remove loose bark to expose hiding population of mealybugs and swab stem and arms with dichlorvos 76 EC @ 2 ml + 2 g of fish oil resin soap in a litre of water.
- Apply sticky bands like 'Track-trap' or 'Bird Tangle Foot' on arms or on main stem to prevent crawlers of mealybugs reaching the bunch.
- Destroy ant colonies during land preparation because their nests are located near the soil surface.

Biological Control

Biological control is considered the most effective long-term solution to the mealybug infestation because the parasites and predators (Fig. 9) are self-perpetuating, persist even when the mealybug is at low population densities,

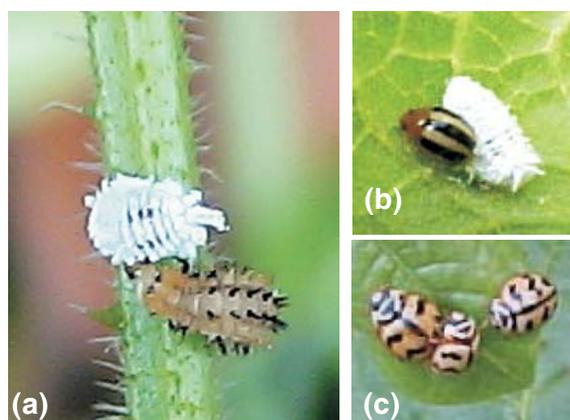


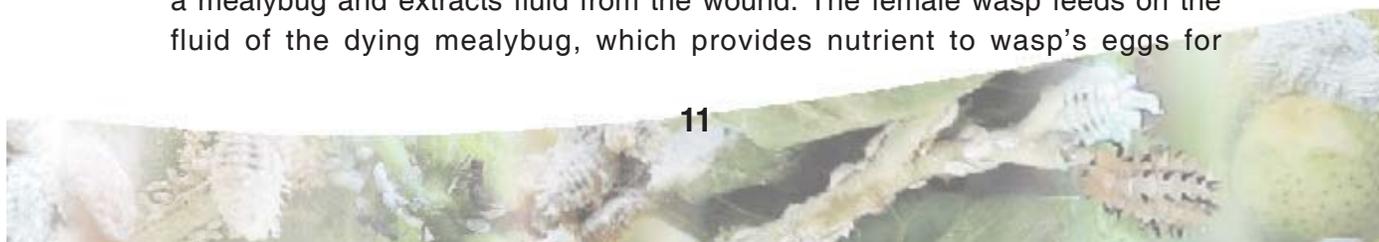
Fig. 9. Coccinellid predators:
(a) Coccinellid larvae feeding on mealybug;
(b) *Brumus suturalis* near mealybug;
(c) *Cheilomenes sexmaculata*

and they continue to attack the mealybugs, keeping populations below economic-injury levels. The coccinellid beetles such as *Cheilomenes sexmaculata*, *Rodolia fumida*, *Scymnus coccivora* and *Nephus regularis* are important predators of mealybug nymphs. Biological control by release of natural enemies has proved very successful. Among the biological control agents introduction of *Cryptolaemus montrouzieri* (Australian Ladybird), *Anagyrus pseudococci*, *Leptomastix dactylopii*, *Hypoaspis* sp., *Verticillium lecanii* and *Beauveria bassiana* are effective in managing the infestation. *Hypoaspis* is a small mite that feeds on crawlers.

Coccinellids generally respond positively to some extent to the increasing densities of mealybugs; at the initial level a sigmoidal increase may be seen whereas in the later stage it may exhibit negative density dependence due to satiation. Therefore, the entire population of mealybugs may not be suppressed by coccinellids. There is a need to integrate other control tactics along with conservation and augmentation of coccinellids to manage mealybugs.

***Cryptolaemus montrouzieri*:** *Cryptolaemus montrouzieri*, commonly called the redheaded ladybird beetle or the mealybug destroyer, is a black lady beetle. *C. montrouzieri* has been used successfully in Karnataka to reduce large populations of *M. hirsutus*. It is considered a predator of citrus and long-tailed mealybug in greenhouses and interior plantscapes and has already been introduced in a biocontrol program to control pink mealybug. The adult female beetle lays an egg among the cottony egg sac of an adult female mealybug. The larvae of the beetle grow up to 1.3 cm in length and have wooly appendages of wax, which makes them superficially resemble the mealybug. The larvae feed on mealybug eggs and young crawlers. The lifespan of the *C. montrouzieri* is two months. During this time, the mealybug destroyer can lay up to 400 eggs. It is capable of eating 3,000–5,000 mealybugs in various life stages. Biological control in grapes includes one to three releases of *C. montrouzieri* at 10 per tree or @ 5,000 beetles/ha, two times in a season especially during August–September and December–January. It is better to release a mixed population of grubs and adults rather than only adults.

***Anagyrus kamali*:** *Anagyrus kamali* is a parasite from China and is being currently used to manage pink mealybug. It has also been recorded in India on mulberry plant. It attacks the mealybugs in two ways. The adult wasp punctures a mealybug and extracts fluid from the wound. The female wasp feeds on the fluid of the dying mealybug, which provides nutrient to wasp's eggs for



development. The female wasp also lays an egg inside mealybug, which hatches and feeds internally, killing the mealybug. Fully developed adult wasp comes out of the “mummy” of the mealybug by cutting a circular hole in the end of the mummy and crawls out. The process can take place in half the time it takes for the entire life cycle of the mealybug. *A. kamali* typically has a 15-day life cycle in tropical climates. During its lifetime, a female wasp can lay single eggs inside 40–60 mealybugs.

***Verticillium lecanii*/Beauveria bassiana:** Foliar spray of *Verticillium lecanii* or *Beauveria bassiana* (2×10^8 cfu/ml) @ 5 g/ml per litre of water is effective during high humid months in reducing the population of mealybugs.

Chemical Control

Any insecticide used against *M. hirsutus* should be carefully selected to avoid injury to its natural enemies. IPM using both coccinellid beetle predators and insecticides has been achieved on grapevine.

- Plant protection products are of limited effectiveness against mealybug because of its habit of hiding in crevices, and the waxy covering of its body. Most granular insecticides are ineffective, therefore, systemic insecticides are used to control heavy infestations.
- Locate ant colonies and destroy them with drenching of chlorpyrifos 20 EC @ 2.5 ml/l or apply 5% malathion dust @ 25 kg/ha as the ants provide them protection from parasitoids and predators and also helps in spreading the crawlers to non-infested plants.
- Inorganic oil emulsion sprays gave good control of *M. hirsutus* on guava. IPM using both coccinellid beetle predators and insecticides (dichlorvos and chlorpyrifos) has been achieved on grapevine.
- Spray dichlorvos 76 EC 2 ml/l, monocrotophos 36 WSC 1.5 ml/l, methyl demeton 25 EC 2 ml/l, chlorpyrifos 20 EC 2 ml/l, imidacloprid 200 SL 1ml/l or malathion 2.5ml/l of water at 15 days intervals.
- Use dichlorvos (0.2%) in combination with fish oil rosin soap (25 g/l) as spray or for dipping the fruits for two minutes.



Phytosanitary measures

It is relatively easy to detect mealybugs by inspection, so the basic requirement that imported consignments of plants for planting should be free from the pest can be fulfilled by inspection. Monitoring the movement of fresh farm produce, including flowers, between countries as well as between states of our country is the first step in controlling any spread within the region. This applies to both the import/export trade and to passenger traffic. *M. hirsutus* was added in 2003 to the European and Mediterranean Plant Protection Organization (EPPO) A1 Action List, and endangered EPPO member countries have recommended regulating it as a quarantine pest.

TIPS & WARNINGS

- Do not move any plant material with suspected mealybugs. Moving infested plants is the fastest way to spread the pest.
- After pruning the cuttings infested shrubs or trees lying around must be immediately burnt.
- Do not shake or scatter the infested material.
- Do not spray any chemical insecticide unless mealybug infestation is confirmed; unnecessary spraying may destroy natural enemies which keep mealybug populations under control.
- Follow the waiting period of 2–3 weeks after the last spray to release the mealybug destroyers.
- Water an infested plant well before releasing mealybug destroyers.
- Predator beetles should be released in spots having adequate mealybug population to ensure the best effectiveness.
- Apply safer pesticides like dichlorvos, chlorpyrifos, fish oil rosin soap, azadirachtin, buprofezin etc. during the activity of ladybird beetle.
- If you choose a chemical control, always wear protective clothing and safety gear.

INTEGRATED PEST MANAGEMENT FOR MANGO MEALYBUGS

- Flooding of orchards with water in October kills the eggs.
- Ploughing the orchards in November exposes the eggs to sun's heat.



- Fasten 400 gauge alkathene sheet of 25 cm width to the tree trunk besides raking the soil around the tree trunk and mixing of 2 per cent methyl parathion dust or 1.5% chlorpyrifos dust @ 250 gm per tree in the middle of December.
- Sprinkle the recommended insecticide dust below the alkathene band on the tree to kill the congregated nymphs below the band.
- Spray 0.04% monocrotophos or 0.06% dimethoate if nymphs have already ascended the tree.
- Spray of neem products and soil application of the spores of the fungus, *B. bassiana* will ensure further reduction of the pest population.

INTEGRATED PEST MANAGEMENT FOR GRAPE MEALYBUGS

IPM in grapes has been achieved successfully in grapevine by involving both coccinellid beetle predators and insecticides. IPM includes the following practices after forward pruning (October–April):

- Collection and proper destruction of the pruned material from mealybug infested grape garden.
- Removal and destruction of loose bark after pruning and swabbing of stem and arms with 2 ml of dichlorvos 76 EC + 2 g of fish oil resin soap in a litre of water to expose hiding population of mealybugs and destroy them.
- Application of sticky bands like 'Track-trap' or 'Bird Tangle Foot' on arms or on main stem before appearance of mealybugs on canes or bunches to prevent crawlers of mealybugs reaching the bunch and also to prevent movement of ants.
- Removal of weeds and alternate host plants like *Hibiscus*, okra, custard apple, guava etc in and nearby vineyards which harbor mealybugs.
- Locating of ant colonies and destroy them with drenching of chlorpyrifos 20 EC @ 2.5 ml/l of water or by application of 5% malathion dust @ 25 kg/ha. This operation can be carried out round the year.
- Soil drenching with imidacloprid 200 SL @ 1.5 ml/l of water/plant on the base of the plant around the trunk.



- Foliar spray of dichlorvos 76% EC @ 2 ml/l of water after 30–45 of days pruning.
- Spraying of buprofezin 25 SC @ 1,000–1,125 ml/ha after 45–60 days of pruning.
- Release of Australian lady beetle adult/grub *C. montrouzieri* @ 5,000 beetles/ha, two times in a season especially during August–September and December–January.
- Foliar spray of *V. lecanii/B. bassiana* (2×10^8 cfu/ml) @ 5 g/ml/l of water after 90–105 days of pruning during high humid months to reduce the population of mealybugs.
- Spraying of buprofezin 25 SC @ 1,000–1,125 ml/ha after 105–120 days of pruning.
- Foliar spray of azadirachtin 1% @ 2 ml/l or 5% @ 1 ml/l of water after 120–135 days of pruning.

INTEGRATED PEST MANAGEMENT FOR COTTON MEALYBUGS

- Prepare the land thoroughly so that eggs may be destroyed.
- Host plants like congress grass, *guputna*, *bhakhra* and *itsit* act as carrier for mealybugs, therefore weeding in and around fields should be done on time.
- Locating of ant colonies and destroy them with drenching of chlorpyrifos 20 EC @ 2.5 ml/l of water or by application of 5% malathion dust @ 25 kg/ha. This operation can be carried out round the year.
- Mealybugs at initial stage appear in small pockets, therefore, recommended insecticide are applied only in the infested spot, not in the entire crop.
- Recommended doses of insecticides of carbamate (carbaryl 50 WP @ 2.5 kg/ha or thiodicarb 75 WP @ 625 gm/ha) and organophosphate (profenofos 50 EC @ 1,250 ml/ha, quinalphos 25 EC @ 2,000 ml/ha, acephate 75 SP @ 2,000 gm/ha or chlorpyrifos 25 EC @ 5l/ha) could be sprayed rotation-wise in consecutive sprays.
- Sufficient quantity of water should be used for spray so as to drench the whole plant.
- Soil around the stem must be sprayed.



- Use of soap oil or fish oil resin soap twice at an interval of 15–20 days.
- Most affected plants should be uprooted and burnt.
- This pest mostly spreads in other areas of field during the picking time, therefore, cotton pickers should be guided accordingly.
- Encourage the activity of predators like *C. sexmaculata*, *B. suturalis*, *S. coccivora* and *C. montrouzieri*.

IMPORTANT REFERENCES

- Package of practices for managing major diseases and insect pests on grapes, *Technical Bulletin 8*, National Research Centre for grapes, Pune, India.
- Management of mealybugs on grapes, *Extension Folder 11*, National Research Centre for grapes, Pune, India.
- Field Key to Common Mealybugs or Scales Mistaken for Mealybugs in Florida, Greg Hodges, FDACS-DPI.
- Mango Integrated Insect Pest management, *Extension Bulletin 7*, Central Institute for Subtropical Horticulture, Lucknow.

