



Host Mulberry and Pest Management

(*Trilekha D¹, Debashree Sarangi², Anjali Verma² and K Phani Kumar³)

¹M.Sc. Sericulture, Department of Sericulture, UAS, GKVK, Bangalore

²M.Sc. Plant Pathology, Department of Plant Pathology, SHUATS

³M.Sc. Entomology, Department of Entomology, SHUATS

*Corresponding Author's email: trilekhareddydurga@gmail.com

Mulberry is prone to attack by several pests and they cause abrupt reduction in leaf yield and deteriorate its quality. Feeding such leaves to silkworms results in adverse effect on the cocoon yield and silk quality. The insect pests of mulberry are grouped into sap suckers, defoliators and borers based on their mode of feeding.

1. Sap Suckers

1.1. Pink Mealy bug, *Maconellicoccus hirsutus* (Green)

Occurrence: Pink mealy bug occurs on mulberry throughout the year, but the incidence is high in summer months (March to August).

Damage and symptoms:

- The affected apical shoots show bunchy appearance due to curling of leaves, shortening of internodes and thickening of stem, commonly referred to as 'Tukra' in India.
- In advance stages of infestation black sooty mould is developed in the affected area due to fungal growth on the honeydew secreted by the meal bug.
- It makes both quantitative and qualitative loss in mulberry production due to retarded growth of plants and depletion in nutritional value of the leaves.

Management practices:

- Clip off infested apical shoots and destroy by burning or dipping in soap solution.
- Do not grow alternate host plants of the mealybug in the vicinity of mulberry gardens.
- Spray 0.05% Dimethoate (36 % EC) 12-15 days after pruning. Safe period to silkworm is 20-25 days.
- During summer, second dose of 0.2% DDVP (76% EC) 10 days after first spray is essential to avoid recurrence of the pest during growing phase of mulberry plants. Safe period is 15-17 days.
- Release predatory ladybird beetles *Cryptolaemus montrouzieri* @ 250 adults or *Scymnus coccivora* @ 500 adults /acre/ year in two split doses at an interval of six months.

1.2. Papaya mealy bug, *Paracoccus marginatus*

Occurrence: Occurs throughout the year, but the severity is higher in summer months.

Damage and symptoms:

- It feeds on phloem sap of mulberry both from stem and leaf resulting in loss of moisture and decline in nutritional values.
- Chlorosis (yellowing), deformation (curling), pre mature drop, stunted growth followed by death of plants.

- Growth of dense black sooty mould on leaves over the honeydew excreted by the pest reduces the photosynthetic efficiency of the plants as well as pollutes entire mulberry garden in case of severe infestation.

Management practices:

- Clipping off the infested twigs and leaves and burning during early stage of infestation is the most effective way to eliminate the pest.
- Clearing all crop residues in the affected garden that harbour mealybug populations and burning them is crucial.
- Water jetting applies physical force to dislodge and wash away the insects from infested plant parts, ensuring a mealybug-free mulberry garden.

1.3. Thrips, *Pseudodendrothrips mori*

Occurrence: Occurs throughout the year, but incidence is severe in summer months (April – May) and least in rainy season (October-November).

Damage and symptoms:

- White streaks in the early stages followed by silvery blotches which are mixed with small black spots of thrips faeces.
- As the leaf tissue dries beneath the epidermis the silvery patches turn brown and become depressed.
- In acute cases serious drying of the leaf tissues results in leaf curl and these leaves shrink harden and fall.
- Stunting, leaf curling and deformation are observed in severely affected gardens.

Management practices:

- After harvest, ensure thorough cleaning of the mulberry field by removing side branches, dead leaves and weeds to eliminate any thrips developmental stages.
- Periodical ploughing and digging of mulberry field help in exposing the thrips pupae to hot sun and natural enemies.
- Water jetting or sprinkler irrigation is effective in reducing thrips population.
- Spray of 0.1% Dimethoate 30% EC (3ml/litre) 15 days after pruning. Safe period is 20-25 days.
- Release of *S. coccivora* @ five hundred adults or *Chrysoperla* @ one thousand eggs / acre, a week after the insecticide spray

1.4. White fly, *Dialeuropora decempuncta*

Occurrence: Whiteflies persist year-round, peaking in summer (March-June) and dwindling in winter (October-January). Their population correlates positively with temperature and negatively with humidity.

Damage and symptoms:

- Speckling, upward curling, yellowing of leaves, premature fall and retardation of growth.
- As the plant grows, bottom leaves accumulate a blue powdery substance from the blue filamentous covering of nymphal stages on the ventral side of the mulberry leaf.
- Honeydew excreted by the insect leads to the development of sooty mould on the mulberry leaves.

Management practices:

- Remove and destroy the infested leaves and install yellow sticky traps @ seventy-five per acre.
- Water jetting or sprinkler irrigation is effective in reducing pest population.
- Spray 0.05% Dimethoate 30% EC (1.5 ml/litre) on 15 days after pruning and second spray with 0.15% DDVP 76% EC (2 ml/litre) one week after first spray (safe period 20-25 days).
- Release *S. coccivora* beetles or *Micraspis discolor* @ five hundred adults / acre.

- Two aphelinid parasitoids *Encarsia haitiensis* and *E. meritoria* are most promising to control whiteflies population.

1.5. Jassids, *Empoasca flavescens*

Occurrence: The insect remains active year-round, with peak population occurring from November to January, during the winter season.

Damage and symptoms:

- Early symptoms include yellowing or brown patches at leaf margins, followed by vein distortion.
- Leaves then curl upward, forming cup shapes, with brown, dry margins that wither prematurely, a condition known as "Hopper burn."

Management practices:

- Set up light traps and yellow sticky traps to destroy adult population.
- Sprinkler irrigation is effective in controlling the pest.
- Spray neem oil (3%) with fish oil rosin soap (2%). Safe period is 10-12 days.
- Spray of a strong jet of water in the affected mulberry garden help to reduce the pest population below the economic injury level.
- Cultivation of cluster bean, cowpea, black gram or groundnut as intercrops in mulberry encourage to buildup natural enemies like coccinellids and spiders.
- Spray 0.1% Dimethoate 30% EC (3ml/litre). Safe period is 25 days.

1.6. Black Scale insect, *Saissetia nigra*

Occurrence: Though it is a minor pest, occurs throughout the year, but severe during summer months.

Damage and symptoms:

- Both nymphs and adults suck sap from leaves and tender stem portions, causing yellowing, stunted growth and drying shoots.
- Their honeydew excretion fosters sooty molds, limiting photosynthesis and leaf nutrition.
- Severe infestation pollutes the garden with black molds, rendering leaves unsuitable for silkworms. Ant activity is also observed on infested plants.

Management practices:

- Scraping the stem, swabbing with diesel oil and soap emulsion and cutting and burning infested parts.
- Spraying a strong jet of water can wash out crawlers and clean sooty molds.
- Additionally, spraying with 0.05% Dimethoate 30% EC (1.5 ml/litre) or 0.15% DDVP 76% EC (2 ml/litre) at safe intervals of 12 and 15 days, respectively, is effective.
- *Metaphycus helvolus* is a reported effective parasitoid of *S. nigra*.

1.7. Soft scale insect, *Megapulvinaria maxima* (Green)

Occurrence: This pest typically infests mulberry gardens from August to February, with peak incidence in October and November. It is more prevalent in hilly regions.

Damage and symptoms:

- Soft scale insects infest both leaves and twigs, identifiable by white scabs on *M. maxima*.
- Nymphs and adult females deplete leaf nutrient value by ingesting plant sap with threadlike mouthparts.
- Honeydew secretion fosters fungal growth, forming black sooty mold on leaves, disrupting photosynthesis, and reducing plant vigour.

Management practices:

- Pruning and burning infested shoots, washing out crawlers and cleaning sooty molds with water jets.
- Apply 0.05% Dimethoate 30% EC (1.5 ml/litre) or 0.15% DDVP 76% EC (2 ml/litre) at safe intervals of 12 and 15 days, respectively.
- Predators like coccinellids and *Chrysoperla* effectively control this coccid.

2. Defoliators

2.1. Mulberry Leaf roller, *Diaphania pulverulentalis*

Occurrence: Infestation begins with the onset of monsoon in June and persists until February, peaking from November to February.

Damage and symptoms:

- The larva binds mulberry leaf blades in the tender shoot portion with silken threads, devouring soft green tissues.
- Mature caterpillars feed voraciously on tender leaves, leaving their feces on lower leaves. This damages the apical shoot portion, adversely affecting plant growth and leaf production.

Management practices:

- Clipping off infested portions and larvae into polythene bags, burning or dipping in 0.5% soap solution.
- Burn dry leaves to destroy pupae and install light traps at 1-2 traps/acre to attract and destroy adult moths.
- Deep ploughing exposes pupae to sunlight and natural enemies, while flood irrigation helps kill pupae.
- Spray 0.076% DDVP 76% EC 12-15 days after pruning or leaf harvest, with a safe period of 15 days.
- Release *Trichogramma chilonis* egg parasitoids from 5 days after chemical spray at 1 Trichocard/acre/week for 4 weeks.
- Additionally, release two hundred adult wasps of the larval parasitoid *Bracon brevicornis* and one pouch/acre of the pupal parasitoid *Tetrastichus howardii*. After releasing these parasitoids, avoid insecticide spraying in the garden.

2.2. Cutworm, *Spodoptera litura*

Occurrence: The cutworm incidence occurs from August to February, in winter season.

Damage and symptoms:

- Cutworm caterpillars attack young mulberry shoots.
- The cut portion of the shoot dries up and falls off.
- They also voraciously feed on mulberry leaves, often leaving heavily infested gardens with bare plants or dried leaves.

Management Practices:

- Collect and destroy egg masses and young caterpillars.
- Deep plough infested gardens to expose pupae to sunlight and predators.
- Install light traps to attract and kill adult moths or use Spodolure pheromone traps twice at a 15-day interval from the 25th day after pruning to target male moths.
- Spray 0.15% DDVP 76% EC during evening hours, 20 days after pruning, with a safe period of 15 days.
- Utilize natural enemies like the egg parasitoid *T. chilonis* for effective control.

2.3. Bihar Hairy Caterpillar

Occurrence: It infests mulberry with the onset of monsoon and persists year-round in certain areas. Peak infestation occurs during March to April and July to November.

Damage and symptoms:

- Gregarious young caterpillars primarily feed on the chlorophyll layer, mostly on the leaf underside, skeletonizing leaves.
- In later stages, they become voracious feeders, consuming entire leaves and causing defoliation. Severe cases may result in only stems remaining.

Management practices:

- Collect and destroy egg masses, caterpillars and affected leaves by dipping in 0.5% soap solution or burning.
- Deep ploughing exposes pupae to predatory birds and sunlight, while flood irrigation aids in pupal destruction.
- Install light traps to attract and kill adult moths.
- Apply 0.1% Dimethoate 30% EC (safe period 20 days) or 0.15% DDVP 76% EC 20 days after pruning (safe period 15 days).
- Release *T. chilonis* at 4 cards per acre a week after insecticide spray, avoiding further insecticide application.

2.4. Tussock caterpillar, *Euproctis fraterna*

Occurrence: The pest is active year-round, with reduced activity in winter.

Damage and symptoms:

- Neonate caterpillars initially skeletonize leaves by feeding on the epidermal tissues and chlorophyll content.
- Later, they progress to consuming entire leaves. Severe infestations can lead to complete defoliation, leaving branches bare.

Management practices:

- Collect the caterpillars along with affected leaves and destroy by burning.
- Install light traps to attract and kill adult moths.
- Apply 0.1% Dimethoate 30% EC (safe period 20 days) or 0.15% DDVP 76% EC 20 days after pruning (safe period 15 days).

2.5. Moringa hairy caterpillar, *Eupterote mollifera*

Occurrence: Occur generally during August to February.

Damage and symptoms:

- Larvae gather in groups on stems, gregariously feeding by scraping bark and gnawing foliage.
- Severe infestation results in plant defoliation, with branches left bare in the garden.

Management practices

- Collect and destroy egg masses and caterpillars.
- Set up light trap @ 1trap / ha to attract and kill adults immediately after rain.
- Use burning torch to kill congregating larvae on the trunk.
- Spray of 0.1% Dimethoate 30% EC (safe period 20 days) or 0.15% DDVP 76% EC, 20 days after pruning (safe period 15 days)

2.6. Wingless (short-horned) grasshopper, *Neorthacris acuticeps nilgirensis*

Occurrence: This pest appears with the onset of the monsoon and persists until the post-monsoon period. Peak infestation is in October, declining thereafter, with no occurrence from January until the next monsoon onset.

Damage and symptoms: Both nymphs and adults voraciously feed on sprouting buds and leaves of mulberry, occasionally targeting green bark. Severe infestations leave affected plant branches without leaves in the mulberry garden.

Management practices:

- Collect and destroy during early morning when less active.
- Deep plough after monsoon onset to expose egg masses.
- Maintain field sanitation by removing weeds, alternate host plants.
- Apply 0.076% DDVP 76 % EC (1 ml/litre) on mulberry foliage, with a second spray 10 days later if severe. Safe period is 15 days.
- When spraying, ensure pests do not escape to neighbouring gardens by spraying in concentric circles to trap them.

2.7. May-June beetle, *Holotrichia serrata*

Occurrence: Their infestation coincides with the onset of monsoon and an occasional pest to mulberry crop in south India.

Damage and symptoms.

- Early hatched grubs first feed on organic matter, then move on to roots, damaging host plants.
- Adult beetles feed on foliage, often swarming into mulberry gardens at night, voraciously consuming foliage and leaving only stems behind, resembling cow grazing, with small black faecal pellets accumulating below plants.

Management practices:

- Monitor mulberry garden for adult beetles after the first monsoon.
- Collect and destroy beetles by immersing them in kerosene solution.
- Use light traps at night and collect beetles in kerosene mixed water.
- Tie fresh neem branches to attract adults for collection and destruction.
- Plough before the monsoon to expose pests to natural enemies.
- Apply 0.2% DDVP76% EC spray (2.5 ml/litre) with a 15-day safe period, preferably in the evening.
- Drench soil with 0.2% Chlorpyrifos 20% EC to kill grubs.

2.8. Green weevil, *Myllocerus viridanus*

Occurrence: The weevils are found throughout the year but are more prevalent during summer.

Damage and symptoms.

- Adults feed on leaves and buds, while grubs feed on underground plant parts.
- Severe attacks lead to wilting and drying of plants. Leaves exhibit irregular serrated margins from adult feeding.

Management practices:

- Ploughing exposes weevil life stages to sun and predators.
- Flood irrigation post-ploughing kills eggs, grubs and pupae.
- Apply Neem cake at 500 kg/ha during mulberry plant pruning.
- Drench soil with Chlorpyrifos 20% EC (2 ml/litre) at root zone to reduce population and damage.
- Maintain weed-free mulberry gardens, as weeds can serve as alternate host plants.

3. Borers

3.1. Mulberry longhorn beetle, *Apriona germari*

Occurrence: They occur throughout the year.

Damage and symptoms:

- During egg laying, stem tissues are partially damaged, making twigs susceptible to breaking in the wind.
- Grubs tunnel along branches beneath the bark or in the wood, leaving visible frass expulsion holes along the main gallery. Severely attacked plants may die.

Management practices:

- Remove and burn infested shoots.
- Inject 0.1% DDVP 76% EC into frass holes to kill grubs.
- Swab trunk and branches with a paste of 0.1% malathion 50% EC to prevent egg laying.

3.2. Mango stem borer, *Batocera rufomaculata*

Occurrence: Damage of this borer on mulberry is noticed throughout the year.

Damage and symptoms:

- Once grubs enter shoots, they voraciously feed, creating upward-boring tunnels up to 2-3 cm.

- These tunnels disrupt sap flow, initially affecting foliage yield, leading to shoot wilting and eventual plant death.
- Symptoms resemble root rot, but occasional frass ejection may occur.
- Grubs require stem girth of at least 6-7cm to develop into adults, making them more prevalent in older mulberry gardens.
- In severely affected gardens, adult exit holes are visible near ground level.

Management Practices:

- Maintain cleanliness and follow recommended practices in the mulberry garden.
- Exclude alternate host plants near the mulberry garden.
- Monitor adult beetle presence in summer and monsoon seasons, collecting and destroying them before egg laying, and using light traps.
- Collect and destroy exposed grubs during weeding or ploughing.
- Mechanically remove grubs from infested trunk holes using wire or hook.
- Prune and destroy affected branches, pasting cut ends with 5% Copper Oxychloride.
- Clean holes, insert cotton wicks soaked in 0.5% DDVP 76% EC solution and seal with mud to fumigate and kill grubs inside.
- Apply two trunk sprays of 0.04% Chlorpyrifos 20% EC at fortnightly intervals with monsoon onset, especially in mulberry gardens near mango orchards in summer (May-June).

3.3. Stem girdler, *Sthenias grisator*

Occurrence: It is noticed throughout the year.

Damage and symptoms!

- Main symptoms of infestation include girdling of young or green stems, followed by wilting.
- Affected stems dry up, allowing grubs to tunnel into the dry wood, leading to branch death.

Management Practices:

- Cutting and burning affected branches.
- Swabbing trunk and branches with a paste of 0.1% malathion 50% EC to prevent egg laying.

4. Soil Inhabiting Insect Pests**4.1. Termites, *Odontotermes sp***

Occurrence: They occur from October until the onset of monsoon rains, following the recession of rain.

Damage and symptoms:

- Termite damage is mainly observed in rainfed gardens. I
- n mulberry nurseries and new plantations, they attack below-ground portions, feeding on bark and hard wood.
- This leads to cuttings drying up with no sprouting. In old plantations, they first infest dry twigs before moving to live ones, forming foraging galleries inside the main stem and extending underground.
- On pruned plants, they form sheaths around twigs, affecting sprouting buds.

Management practices:

- Remove dead and dried twigs and leaves.
- Use flood irrigation to deter termites.
- Locate and destroy nearby termite mounds by breaking them and killing the queen, causing the colony to abandon.
- Prepare a solution of Chlorpyrifos 20% EC at 3ml/litre and pour into the mound, closing the hole with wet earth.

- In established plantations, practice soil drenching with 0.1% Chlorpyrifos 20% EC.
- Treat mulberry cuttings with a 0.1% Chlorpyrifos 20% EC solution before planting.

5. Non-Insect Pests

2.5.1. Giant African snail, *Achatina fulica*

Occurrence: Snail activity is observed from August to January, peaking from October to December, especially during the rainy season. Their occurrence is favoured by high humidity (>80%) and moderate temperatures (9 - 29°C), which promote population growth.

Damage and symptoms

- Giant African snails feed on tender leaves, bark and stems, causing circular holes in infested leaves.
- This damage leads to stunted mulberry growth and loss of leaf yield.
- Moreover, the mucus-like substance secreted by the pests on leaves affects silkworm consumption and cocoon production when fed leaves from infested gardens.

Management practices:

- Handpick snails at different stages and destroy by burning or immersing in a 25% salt solution.
- During the rainy season, place wet gunny sacks or papaya stem waste in the garden's hiding spots to attract snails for collection and destruction the next morning.
- Maintain garden cleanliness by removing debris and waste materials to prevent snail population buildup.
- Deep ploughing exposes snails and their egg masses to natural enemies, as snails avoid dry areas.
- Keep surrounding areas dry by spreading materials like sawdust or ash near hiding places.
- Use bran bait or snail-kill pellets (Metaldehyde) in alternate rows during the evening in the rainy season or after irrigation to attract and kill snails.
- Collect and destroy dead snails near pellets daily for about a week.
- Place Metaldehyde pellets near hiding places, compost pits, or dumping yards to suppress snail population. Approximately 2 kg of Metaldehyde pellets are needed per acre of mulberry garden, as it is non-toxic to silkworms.

5.2. Black Slug, *Laevicaulis alte*

Occurrence: Slugs are prevalent during rainy and winter seasons, especially in mulberry gardens near canals and swamps.

Damage and symptoms:

- The presence of mucus on plant parts due to slug activity affects foliage quality, while shot holes on leaves result from slug feeding.
- Additionally, drying of shoots occurs due to the scraping of stem bark by slugs.

Management practices: Applying lime powder to the soil (20kg/ac) dehydrates slugs, leading to mortality.

5.3. Millipede, *Phyllogonostreptus nigrolabiatus*

Occurrence: They occur throughout the year but common during rainy season.

Damage and symptoms:

- Superficial peeling of bark of mulberry plants.
- They feed on entire mulberry leaf leaving behind only petiole.

Management practices:

- Handpick and bury them deep in the soil.
- Dig trenches around the garden to trap millipedes.
- Collect and relocate them to nearby forest land or bury them deep in the soil.
- Note that millipedes are mostly harmless and only become pests under specific circumstances.

5.4. Red spider mite, *Tetranychus ludeni*

Occurrence: Although mites occur throughout the year, their incidence is severe during summer months. **Damage and symptoms:**

- Both nymphs and adults of the pest cause similar damage by sucking plant sap with their stylet mouthparts, resulting in affected parts turning greyish-white and withering.
- Infested leaves exhibit white speckles that develop into large patches, often covered in extensive fine webbing.
- Silken threads spun across the undersurface of leaves serve as habitats for crawling and egg-laying.

References

1. Kumari, V. N. (2014). Ecofriendly technologies for disease and pest management in mulberry-A review. *IOSR Journal of Agriculture and Veterinary Science*, 7(2), 1-6.
2. Singh, R. N., & Saratchandra, B. (2002). An integrated approach in the pest management in sericulture. *International Journal of Industrial Entomology*, 5(2), 141-151.
3. Singh, R. N., & Maheshwari, M. (2002). Biological control of pests of Non-mulberry silkworms and its host plants in India. *International Journal of Industrial Entomology*, 4(2), 83-91.