

# MANGO



## Major insect pests

### Mango hopper (*Idioscopus clypealis*, *I. nitidulus* and *Amirtodus atkinsoni*)

It is most serious of all the mango pests and prevalent all over the country causing heavy damage to mango crop. Though hopper population exists throughout the year in mango orchards but occasionally it advances during January to April on flowering flush. Also noticed during June-August on vegetative flush. Old, neglected and closely planted orchards that are shady and with high humid conditions favour their multiplication.

### Symptoms

- Piercing and sap sucking of tender parts by nymphs and adults causing reduction of vigour that leads to shedding of flower buds, flowers and young fruits.
- Development of sooty mould due to honey dew secretion on leaves gives blackish appearance.
- Hoppers hibernate in the crevices of the barks on the tree.
- During higher infestation periods, characteristic clicking sounds of leaf hoppers can be heard.
- Warm, humid and cloudy climate is most congenial.



### Pest identification

- **Eggs** - Cigar-shaped, creamy-yellow in colour. Size: 0.9–1 mm in length.
- **Nymph** - Nymphs greenish with black or brown markings, resemble small adults but without wings. They are very active and hide in flower rachis.
- **Adult** – Golden brown or dark brown resembling to bark colour wedge-shaped. Size: 4–5 mm in length.
  1. *Idioscopus niveoparsus*: dark with wavy lines on wings and three spots on scutellum.
  2. *Idioscopus clypealis*: small, light brown with dark spots on the vertex and two spots on scutellum.
  3. *Amirtodus atkinsoni*: large, light brown with two spots on scutellum.



Mango hopper

## Biology of pest

Leafhoppers will breed all year round if tender flush is available. The female hoppers insert 100-200 eggs on mid rib of tender leaves, buds and inflorescence. Eggs hatch in two to three days and nymphs develop between 12 to 20 days. The nymphs develop faster during the flowering and fruiting period. The total life cycle occupies 2-3 weeks. They complete 2-3 generations in flowering period itself.

## Management practices

- Avoid dense planting, maintain clean orchards, prune overlapping branches and infested shoots.
- Neem based sprays can be utilized at initial stage of hopper population (Azadirachtin 3000 ppm@2ml/l).
- Protecting and encouraging biocontrol agents like predators, *Mallada boninensis*, *Chrysopa lacciperda*, egg parasite, *Polynema* spp. *Gonatocerus* sp. *Tetrastichus* sp. and fungus, *Verticillium lecanii*.
- Application of bio-agents, *Metarhizium anisopliae* @  $1 \times 10^8$  cfu/ml or *Beauveria bassiana* @  $10^8$  cfu /ml on tree trunk once during off season and twice at 7 days interval during flowering season.
- Three to five sprays depending on pest intensity, first spray before flowering with 0.007 % cypermethrin, second at panicle intition satge with 0.07 % quinalphos or 0.1 % carbaryl, subsequent sprays with imidacloprid (0.0053%), thiomithaxam (0.005%) or dimethoate (0.03%).

## Mealybug (*Drosicha mangiferae*)

In India, it is widely distributed along the Indo-gangetic plains and found in Punjab, Uttar Pradesh, Bihar and Delhi caused severe damage to mango crop. It attacks almost all the plant parts.

## Symptoms

- Pinkish nymphs and adult mealy bugs are present on leaves, inflorescence, branches, fruits and fruit stalk.
- The nymphs of this pest suck sap from leaves and inflorescence causing dryness leading to flower drop and negligible fruit set.
- They also secrete honey dew which gives rise to sooty mold attack.



Mango mealybug

## Pest identification

- **Nymph** – They are flat in shape and pink to brown in colour.
- **Adult** – The adult male is small and winged while the female is bigger and wingless. The females can be identified by their flat shape, covered with white flocculent wax covering.

## Biology of pest

They complete one generation each year. Females mate and crawl down the tree during the month of April-May and lays egg in the soil in large numbers sheathed in an egg sac. The eggs lie in diapause state in the soil till the return of the favourable conditions in the month of November - December. First instars move to the leaves and molt three times to become adults. Just after hatching the nymphs crawl up the tree. They are considered more important because of their activeness and infestation during the flowering season.

## Management practices

- Proper orchard maintenance by removal of weeds that harbor mealy bugs.
- Ploughing of the orchard during November-December.
- Flooding of orchard with water and raking of soil around tree trunk exposes the eggs to sun and natural enemies thereby destroying them.
- Banding of tree trunk with polythene sheets (400 gauge) 30 cm above ground level and just below the junction of branching to obstruct the ascent of the nymphs. Banding should be done well in advance before the hatching of eggs, i.e., around November - December.
- Application of *Beauveria bassiana* product (2g/L) or 5% NSKE around the tree trunk.
- Release of predators, *Menochilus sexmaculatus*, *Rodolia fumida*, *Sumnius renardi* and Australian ladybird beetle, *Cryptolaemus montrouzieri* @ 10-15 No./tree are effective in controlling the nymphs of the mealy bug.
- Application of Methyl Parathion dust 2% @ 250 g per tree in the soil around the trunk during 3<sup>rd</sup> or 4<sup>th</sup> week of December.
- Early instar nymphs of the mealy bug can be controlled by spraying of 0.05 % carbaryl from January to March.

## Leaf webber (*Orthaga euadrusalis*)

It is a pest that is attaining serious proportions mainly in North India especially in old, crowded orchards where there is excessive shade. Pest infestation begins from the month of April and continues up to December. The species *Orthaga exvinacea* is found commonly throughout the plains of South India.

## Symptoms

- Infestations of leaf webber may begin as early as seedling stage and persist even during flowering and fruiting.
- Webbing of terminal leaves and tender shoots with several caterpillars found inside.
- Caterpillars initially scrap and feed on the terminal leaves within the web and give burnt appearance to leaves.



*Leaf webber damage*

## Pest identification

- **Larva** - Pale greenish with brown head and prothoracic shield.
- **Adult** - Brown moth with wavy lines on fore wings.

## Biology of pest

The life-cycle completes in 3-4 weeks. Eggs are laid in clusters of about ten on buds and young leaves. After hatching the larvae forms a web around the leaflets and feed on the tender leaves. Pupation takes place inside the webs in silken cocoons. The last generation pupates in the soil around December-January.



*Adult, pupa & larvae of leaf webber [courtesy internet]*

## Management practices

- Webbed leaves should be removed mechanically along with larva and pupa and destroyed.
- Pruning of overcrowded branches and proper orchard maintenance.
- Encourage the activity of predators, carabid beetle *Panera lacticineta*, reduvid *Oecama sp*
- Spray carbaryl at 50 WP @ 0.1%, or quinalphos @0.05% when initial infestation is observed.

## Thrips (*Caliothrips indicus*, *Rhipiphorothrips cruentatus*, *Scirtothrips dorsalis*)

Thrips are polyphagous in nature and are widely distributed around mango growing regions.

## Symptoms

- Laceration of leaf tissues as a result of sucking of the cell sap by nymphs and adults.
- Silvery sheen on affected leaves bearing small spots of faecal matter.

- *C. indicus* and *R. cruentatus* feed on leaves and causes stippling on leaves.
- *S. dorsalis* mainly feed on inflorescences and fruits which show discoloured tissues that subsequently turn brown.



*Thrip damage to foliage & fruit*

*C. indicus* – Larvae are tiny, wingless and pale. Adults are blackish brown with brown and white banded forewings. The eggs are oval and duration of egg instar is slightly longer i.e. 7-10 days. Males are shorter than females.

*R. cruentatus* – Dark brown body, antennae, legs and fore wing pale with the veins and all basically being yellow. Head with complex irregular sculpture, with a transverse ridge near posterior and basal reticulate collar; cheeks sharply incut behind eyes and constricted to basal neck.

*S. dorsalis* – Yellow coloured with dark antennae and dark striping on the lower abdomen, small in size (under a millimeter in length). Duration of egg incubation period is 6-8 days, of larval instars 6-7 days and pre-pupal and pupal stages 2-4 days.

### Biology of the pest

*S. dorsalis* can complete a life cycle in 14 - 20 days and is capable of reproducing both sexually and parthenogenetically. It typically has 4 - 8 generations per year. Female lays eggs within leaves, flowers or fruits. The larva emerges from eggs deposited on the host plant and feeds during its first two larval stages which then enter a pre-pupal stage and later a pupal stage during which it does not feed.

*Thrips hawaiiensis* and *Thrips flavous* have recently become serious in Konkan region of Maharashtra causing discoloration of fruit rind and fruits become brown.

### Management practices

- Monitor for thrip infestation by placing sticky traps at regular intervals.
- Neem based pesticides control young nymphs effectively, inhibit growth of older nymphs and reduce the egg-laying ability of adults.
- Control thrips by spraying spinosad 0.0112%
- Promoting natural enemies that include predatory thrips, predatory mites (e.g. *Amblyseius* spp.) anthocorid bugs or minute pirate bugs (*Orius* spp.), ground beetles, lacewings, hoverflies, and spiders.
- If the infestation is severe, spray with either dimethoate (0.15%) or spinosad (0.0112%) or thiamethoxam (0.05%) when incidence noticed.

## Stem borer (*Batocera rufomaculata*)

This pest is widely distributed in India and attacks not only mango but also other varieties of fruits.

### Symptoms

- Grubs feed inside the stem boring upward making irregular tunnels which results in interruption of nutrient and water transport in the tissue.
- Drying of terminal shoot in early stages and severe symptoms causes wilting of branches or entire tree.



Damaged stem

Stem borer grub

### Pest identification

- **Grub** - Full grown grubs are cream coloured, fleshy and apodous with dark brown head and measure 90 x 20 mm in size.
- **Adult** - Beetle is dark with a fine grayish vestiture and 2 kidney-shaped orange yellow spots on pronotum.



Adult beetle

### Biology of the pest

Eggs covered with a viscous fluid are laid in incisions cut in the bark by females. Full grown grubs are cream coloured with dark brown head and 90 x 20 mm in size. Pupation takes place within the stem. Beetle emerges in July-August. There is only one generation of the pest in a year.

### Management practices

- Maintain healthy orchard by destroying affected branches along with grubs and pupae.
- Exclude alternate hosts around the vicinity of mango orchards.
- Block the tunnel hole by cleaning and inserting cotton wool soaked in emulsion of DDVP (0.05%) or kerosene/ petrol and pack them with mud.
- Carbaryl 0.1% can be swabbed at bimonthly intervals.

## Shoot borer (*Chlumetia transversa*)

This pest can be found throughout India and is serious in seedlings and young trees.

### Symptoms

- Tunneling from top-down wards of the tender terminal shoots.

- Stunting of seedlings with terminal bunched appearance.
- Larvae of this moth bore into the young shoot resulting in dropping of leaves and wilting.
- Similar symptoms also noticed on panicles.

### Pest identification

- **Caterpillar**-Young caterpillars are yellowish orange with dark brown pro-thoracic shield. Full grown caterpillars (20-24mm) are dark pink with dirty spots.
- **Adult**- Adult moths are stout grayish brown in colour with wings having wavy lines and measure about 17.5 mm at expanded wings. Hind wings are light in colour



Terminal shoot damage



Adult male      Adult female

### Biology of the pest

Female moths lay eggs on tender leaves. Young larvae after hatching enter the midrib of leaves and then enter into young shoots through the growing points by tunnelling downwards. Four overlapping generations of the pest are found in a year and it overwinters in pupal stage.

### Management practices

- Attacked shoots should be clipped off and destroyed.
- Effective control of the pest can be attained by spraying carbaryl (0.2%) or quinalphos (0.05%) at fortnightly intervals from the commencement of new flush.
- Two sprays at three weeks interval commencing from initiation of new flush of leaves may be required.

## Scale insect (*Chloropulvinaria polygonata*, *Aspidiotus destructor*)

In India mango is attacked by several species of scale insects, the predominant ones being *Chloropulvinaria polygonata*, *Aspidiotus destructor*, *Parlatoria pergandii*, *P.cinerea* and *Lepidosaphes gloverii*.

### Symptoms

- The vigour of the plants is reduced as both nymphs and adult scales suck the sap of the leaves and other tender parts.
- Secretes honeydew which encourages the development of sooty mould on leaves and other tender parts of the mango plant.
- Flower spikes and fruits may also be infested.

- Severe scale infestation tends to adversely affect the growth and fruit bearing capacity of the tree.

### Pest identification

- Two species of scale insect are most serious in India.

*Chionaspis vitis* - White elongate hard scale.

*Chloropulvinaria psidii* - Females with white ovisac.

- Adult - White, elongate, hard scale. Male smaller than female. Female scale is oval in shape having transparent skin coat.



Adult scales on leaf

### Biology of the pest

Life cycle is completed in 31-35 days with around ten generations in a year. A large number of eggs are produced by the females and some species also directly give birth to crawlers. Eggs hatch into young nymphs, which resemble mealy bugs and disperse over the plant to new feeding sites on leaves or stems where they attach themselves. Once a feeding site has been selected the scale will not move losing their legs and secreting wax like coating under which they hide.



Sooty mould

### Management practices

- Prune heavily infested plant parts and destroy them immediately.
- Spray imidacloprid 17.8SL (.005%) 2 times (0.04%) or dimethoate (0.06%) at 21 days interval.
- Elimination of ants may allow natural enemies to control the insect.

## Termites (*Odontotermes* sp.)

Several species of them are found almost in all states of India viz. *Odontotermes obsesus* Ramb., *Microtermes obesi* Hilmgr., *O. assuthi* Hilmgr., *O. feae* Wasmann., *Trinervitermes beimi* Wasmann., *Coptotermes reimi* Wasmann., *Heterotermes indicola* Wasmann., and *Nevbevares gardneri* Synder.

### Symptoms

- The worker termites feed on roots, shoots and trunks of the mango tree moving upward making the tunnels.
- Mud galleries on tree trunk which when nudged shows the damage caused due to feeding of tissues inside.



## Pest Identification

- Termites are white in colour, prefer darkness and remain underground.
- They feed on root or move upward making the tunnels with the construction of mud galleries on tree.

## Biology of the pest

The larvae having hatched from the eggs turn into nymphs that then develop into one of three adult phases: reproductive adults, workers or soldiers. The queen of a colony can lay up to 1,000 eggs per day.

## Management practices

- Orchards should be kept clean and free of all refuse vegetation all the dead and decaying wood should be regularly removed.
- Knock down the mud galleries on trunk and dust with 2% methyl parathion or spray the trunk with Malathion (1.5 ml/l).
- Application of finely ground mahua cake, followed by irrigation, helps to drive away the termites.
- For the control of termites, dusting with 2% methyl parathion at 22 to 27 kg/ ha in soil around the infested plants, and raking it into the soil has proved effective.
- Drench the soil with chlorpyriphos (1ml/l) at the base of the tree.



*Termite damage on stem*



*Termite & Termite mud galleries*

[Courtesy internet]

## Shoot gall psylla (*Apsylla cistellata*)

It is a serious pest of North India and particularly reported from Uttar Pradesh, Bihar and Terrai regions of northern India. The pest is active from August onwards with the nymphs emerging from eggs during August- September and crawling to the adjacent buds to suck cell sap. As a result of feeding, the buds develop into hard conical green galls which are usually seen during September-October.

## Symptoms

- Terminal shoots affected.
- Formation of green conical galls in leaf axis in response to egg-laying by adult insects or feeding by nymphs.
- Development of the green galls results in no flowering and fruit setting.



*Conical gall formation in leaf axis*

## Pest Identification

- **Nymphs:** Freshly hatched nymphs are yellowish in colour, but change in size and colour with time
- **Adults:** 3-4 mm long with black head and thorax and light brown abdomen. Membranous wings.



Shoot gall psylla nymph

## Biology of the pest

It has a single generation per year. Adult females lay eggs into the midrib of leaves in March-April. Eggs hatch in the last week of August. Five nymphal instars are present and nymphal period is 140 days. Second instar nymph migrates to the already formed gall. Adults may live up to 30-72 h.

## Management practices

- Galls with nymphs should be collected and destroyed.
- Spray thiomithoxam (0.05%) or quinalphos (0.05%) at fortnightly interval starting from the middle of August.
- New mango orchard in humid region need to be discouraged.

## Midge (*Erosomyia indica*, *Dasineura amraramanjarae*, *Procystiphora mangiferae* and *Procontarinia matteriana*)

There are four species of midges prevalent in India with three species attacking blossoms while one attacks the leaf. The inflorescence midge is becoming serious in some pockets of Uttar Pradesh, as well as Maharashtra.

### A] Leaf gall Midge (*Procontarinia matteriana*)

#### Symptoms

- Wart-like galls produced on leaves that reduce photosynthetic activity leading to leaf drop and lowered fruit production.
- Infested plant material and wind currents are responsible for its spread.



Midge galls on mango leaves

### B] Inflorescence midge (*Erosomyia indica*)

#### Symptoms

- Attacks at flower bud burst stage and fruit set stage during January and May.
- Appearance of black spots on the inflorescence.

## Pest Identification

- **Larva** – A maggot light yellowish in colour and moults three times
- **Adult** – a. *Erosomyia indica*: Yellowish fly  
b. *Procytiphora mangiferae*: Light orange fly  
c. *Dasineura amaramanjarae*: Orange red fly



Midge damage on inflorescence

## Biology of the pest

Midge flies are very small 1-2 mm in length. Female laying eggs into the tissue of young leaves leaving a small reddish spot. The leaf tissue under the red spot becomes swollen and soft. Within seven days gall formation begins and reaches a maximum diameter of 3-4 mm. From the underside of the leaf adults usually emerge leaving the pupal skin sticking out from the emergence hole.

## Management practices

- Deep ploughing of orchard exposing pupae and diapausing larvae to sun's heat kills them.
- Monitor of larval population and follow effective control measures based on population.
- Spray thiomithoxam (0.05%) or dimethoate (0.05%) at bud burst stage.

## Bark-eating caterpillar (*Indarbela quadrinotata*)

This pest is found damaging varieties of trees all over India. Three species of this pest have been recorded in India, viz., *Indarbela quadrinotata* Wlk., *I.tetraonis* M.o. and *I.idea* Swinhoe. *I. quadrinotata* is found in Uttar Pradesh, Maharashtra and Madhya Pradesh.

## Symptoms

- Characteristic presence of long-winding, thick, blackish or brownish ribbon-like masses composed of small chips of wood and excreta.
- Larvae also make shelter tunnels inside where they rest. Continuous devouring of the tissues by caterpillars weakens the stem, resulting in drying of the branches and finally of the tree itself.



Damaged bark



Larva tunneling  
[courtesy internet]

## Pest Identification

- **Larvae:** The full grown caterpillar is dirty brown in colour and is about 35-45 mm in length.
- **Adult:** The moth is light grey in colour with dark brown dots and measures about 35-40 mm with expanded wings.

## Biology of the pest

Female lays egg below the bark or in between cracks. Eggs hatch in about 8-10 days and the larvae bore into the tree feeding on the bark for 9 – 11 months. There is only one generation per year.

## Management practices

- Maintain a healthy orchard.
- Clean hole and put emulsion of monocrotophos (0.05%) in each hole and plug them with mud.

## Fruit fly (*Bactrocera dorsalis*)

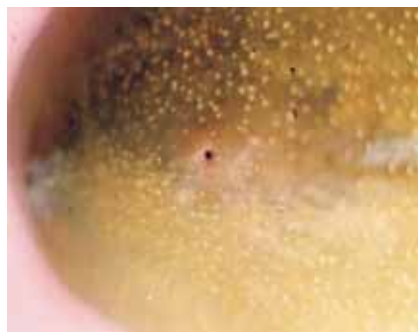
In India, eight species of genus *Bactrocera* are identified among quarantine pests with the oriental fruit fly *B. dorsalis* Hendel being the most destructive fruit fly of mango, followed by Peach fruit fly *B. zonata* Saunders and Guava fruit fly *B. correcta* Bezzi. The flies attack fruits at different stages of maturity but damage is more obvious at harvest period.

## Symptoms

- Sting marks and bruising to the fruit skin constitute the external damage that later turn to brownish rotten patches.
- Injury to fruit occurs through oviposition punctures by females and subsequent larval tunneling.
- Ripening fruits are more likely to be attacked.

## Pest Identification

- **Larva** – creamish yellow apodous maggots with a black tooth-like feeding mouthpart.
- **Pupa** – ranges in color from dull red or brownish yellow.
- **Adult** – Reddish brown with transparent wing and with prominent yellow and dark brown to black markings on the thorax.



*Fruit fly damage on mango*



*Maggots in fruits*



*Adult fruit fly*

## Biology of the pest

Females lay clusters of 6–10 eggs just under the skin of the fruit. After 1–2 days larvae hatch from the eggs and take 6–8 days to mature. Larvae feed upon the pulp of fruit. The larvae pupate in soil (5–10 cm) and flies start emerging from April onwards with maximum population during May to July which coincides with fruit maturity. The adults emerge after 10–12 days and may live for a few months.

## Management practices

- Affected fruits should be collected and destroyed.
- Rake up the soil below the tree and drench with chlorpyrifos 20 EC @ 2.5 ml/ L.
- Setting up of methyl eugenol traps to lure the males in the orchard @ 10/Ha.
- Spraying malathion @ 2 ml + Jaggery @ 10 g/ L or Carbaryl @ 4 g + Jaggery @ 10 g/ L at ripening stage.

## Major Diseases

### Powdery mildew (*Oidium mangiferae*)

This mango disease is widespread around the world, and in India it is most destructive in the states of Uttar Pradesh, Maharashtra and Karnataka.

### Symptoms

- White powdery growth of fungus observed on the leaves, inflorescence and young fruits.
- Severe fungal attack eventually leads to dry leaves, resulting in its shedding.
- Young fruits covered by mildew become misshapened, turn yellow, remain undersized and drop-off pre maturely at pea size stage.



*P. mildew on leaf*   *P. mildew on inflorescence*

### Pathogen dissemination

The fungal spores are wind-borne and spread from other affected trees or within the same tree. This fungus attacks only the mango crop.

### Management practices

- Prune plants regularly so as to improve air circulation in the canopy.
- Remove diseased leaves, severely infected panicles and destroy them.
- After the occurrence of high humidity and low temperature for 4–5 days in disease

prone areas, two sprays with wettable sulphur WP @ 0.2%, tridemorph EC @ 0.1% or penconazole @ 0.05%/ hexaconazole @ 0.05% at 15 days interval, could combat the disease very effectively.

## **Anthracnose (*Colletotrichum gloeosporioides*)**

This disease is reported from all mango growing tracks in India particularly in several districts of Punjab.

### **Symptoms**

- Almost all plant parts *viz.*, the young leaves, branches, inflorescence and fruits are affected causing leaf spot/leaf blight, wither tip, blossom blight and fruit rots.
- On leaves, characteristic oval or irregular lesions start as small, angular, brown to black spots that shows ‘shot hole’ symptoms when disease advances.
- Appearance of small black spots on panicles and flowers coalesce progressively leading to the death and shedding of flowers.
- The pathogen also produces black necrotic areas on twigs and tip drying of young branches is observed.
- On fruits it is seen as slightly depressed grey-black areas in the skin on ripening fruit



*Anthracnose on (A) Leaf, (B) twig and (C) Fruits*

### **Pathogen dissemination**

During the dry season, rain and humidity favours disease development. Conidia get dispersed by splashing rains or irrigation water. Spores landing on infection site penetrate into the tissues. Between seasons, the pathogens survive on the infected branches or older leaves.

### **Management practices**

- Wider plant spacing, yearly pruning of trees and proper disposal of diseased leaves, twigs and fruits.
- Foliar infection can be controlled by spraying of copper oxychloride (0.3%)/ bordeaux mixture (1%) / carbendazim (0.1%) / methyl thiophenate (0.1%)
- Spraying of carbendazim (0.1%) at 15 days interval can effectively control blossom infection.

## Bacterial leaf blight/ spot/ canker (*Xanthomonas campestris* pv. *mangiferae-indicae*)

It is prevalent in several mango growing regions including Andhra Pradesh, Maharashtra, Karnataka, Kerala, Tamil Nadu, U.P., Bihar, Delhi, Haryana and Madhya Pradesh.

### Symptoms

- Emerges as tiny black, irregular and dark raised spots with/ without yellow halo. Also found on petioles, twigs and branches that becomes black and leads to tip-dieback.
- Lesions on fruits are black and star-shaped cracks appears which usually burst open with exudation of gummy ooze containing bacteria.



*Bacterial leaf blight*

### Pathogen dissemination

Unseasonable wet situations favour the disease development and the bacteria are harboured in stem cankers or crack which spread to the fruits later on.

### Management practices

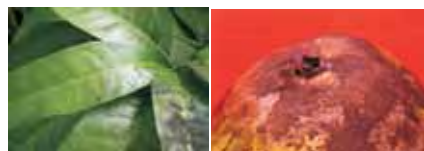
- Maintain clean orchards and use only certified seedlings
- On visual observation of disease, spraying with Streptomycin (100 ppm) or Agrimycin-100 (100 ppm) thrice at 10 days interval

## Sooty mould (*Capnodium mangiferae/ Meliola mangiferae*)

Disease commonly found in India where mango orchards are mismanaged and infested with sucking pests such as hoppers, mealy bug etc.

### Symptoms

- The honey dew secreted by some insects encourages mould growth on them giving a black velvety sooty look.
- The fungus being saprophytic causes no harm by itself but its presence on the leaf surface adversely affects the photosynthetic activity



*Sooty mould on leaves*    *Sooty mould on fruit*

### Pathogen dissemination

Air currents or splashing rains bear and spread the causal fungi. The fungi survive saprophytically as mycelium or spores on plant debris. Cool, moist, humid conditions favor some sooty molds.

## Management practices

- Preventing the spread of the disease by pruning of affected branches and their timely destruction.
- Due elimination of sucking pests secreting honeydew.
- Effective control by spraying of 2 % starch.
- Spraying of wettable sulphur + methyl parathion + gum Acacia@ 0.2 + 0.1+ 0.3%

## Mango malformation (different species of *Fusarium*)

Mango malformation is a serious disease in tropical and subtropical areas of the world and has been attributed to various *Fusarium* spp. Mango malformation disease is caused by one or more species of the fungus *Fusarium*. The disease spreads on a tree very slowly, but if left unchecked, can reduce yields in orchards. Mango is the only known host of the disease. It is a result of hormonal imbalance in the trees, induced by the *Fusarium* infections and associated with bud mite (*Aceria mangiferae*) infestations.

## Symptoms

- Deformation of vegetative and floral tissues.
- Growing tips produce distorted shoots with short internodes and affected leaves smaller than normal leaves giving a compact and bunched-top appearance while the flowers are sterile and don't bear fruits.
- Both normal and malformed growth can be present on the plant at the same time.



*Mango vegetative malformation*

## Pathogen dissemination

The fungus, *Fusarium mangiferae* produces both macro and micro spores which are the infective propagules. The main spread of mango malformation disease to new areas is by infected pruning equipment or grafted planting material. The bud mite, *Aceria mangiferae* is also shown to spread the disease within a tree and not between trees.



*Mango floral malformation*

## Management practices

- Orchards may be kept in good hygienic conditions and disease free planting material be used for planting.
- Regular pruning of malformed panicles and parts along with affected shoots.
- Simple, effective and eco-friendly control can be attained by using leaf extracts of



neem tree and common weeds namely *Datura stramonium*, *Calotropis gigantea* etc.

- Since this disease is the result of various agencies, an assortment of management practices are followed as – application of pesticides, plant growth regulators, nutrients, phenolics etc along with pruning, de-blossoming.

### Dieback / Gummosis (*Lasiodiplodia theobromae*)

The disease is observed all year round but is most evident during June, July and August and low during cool months from November to February. Disease is accompanied by damage caused by trunk borers Resembling *Batocera reformaculata*. It is a common soil-borne saprophyte or wound parasite, distributed throughout the tropics and subtropics.

#### Symptoms

- Characteristic leaf drooping and drying that leads to defoliation lending a scorched look to the tree.
- Trees exude gummy stuff from the bark of their trunks or branches and vascular tissues are discolored.



*Dieback of mango*

#### Pathogen dissemination

Main spread is through diseased plant parts, contaminated equipment and inoculum present in the field.

#### Management practices

- Use of disease free propagating material.
- Pruning and disinfection of infected branches.
- Avoid planting alternate host trees in the vicinity of orchards.
- Application of cowdung or copper oxychloride paste on pruned ends.
- Proper disposal and burning of affected branches
- Two foliar sprays with topsin-M (Thiophanate-methyl) @1 g/ L or foliar spray with carbendazim @ 0.1%, or chlorothalonil @ 0.2% at fortnightly interval



*Mango gummosis*

### Phoma blight (*Phoma glomerata*)

This disease is more prevalent in and around Lucknow region.

#### Symptoms

- Mainly older leaves show the symptoms of the disease.

- Small irregular lesions yellow to light brown found scattered over the leaf lamina at initial stage.
- Enlarged lesions are characterized by dark margins and dull grey necrotic centres and under severity defoliation occurs.



*Phoma blight*

### Management practices

- At initial stage of disease, spray benomyl (0.2%).
- The disease can be effectively controlled by spraying copper oxychloride (0.3%) at fortnightly interval.

## Red rust (*Cephaleuros virescens*)

### Symptoms

- Disease caused by algae whose attack on leaves cause reduction of photosynthetic activity thereby lowering the vitality of plant.
- Greenish grey spots, velvety in texture found on leaves which later turn reddish brown.
- Disease found commonly in closely planted orchards.



*Red rust of mango*

### Pathogen dissemination

Poor nutrition, poor growing conditions and other stresses. Dense canopy and wet humid environment are some of the pre disposing factors of the diseases.

### Management practices

- Balanced nutrient supply reduces the disease.
- Two to three sprays of copper oxychloride (0.3%) is effective in controlling the disease.
- Use of Bordeaux mixture (1%).
- Cut badly infected branches from the tree.

## Black banded disease (*Rhinoctadium corticolum*)

### Symptoms

- Black velvety fungal growth on midribs, twigs and branches of mango tree forming black bands

## Management practices

- Removal of black growth by rubbing.
- Application of Bordeaux paste/ Copper oxychloride paste and spraying of Bordeaux mixture (1%)/ Copper oxychloride (0.3%).



*Black banded disease*

## Physiological Disorders

### Black tip

#### Symptoms

- Found in orchards in the vicinity of brick kilns.
- Coal fumes from brick kiln releasing gases like carbon monoxide, sulphur dioxide and ethylene are responsible for black tip.
- Characteristic depressed spots leading to yellowing tissues of the distal end of the fruit that turn black finally.



*Black tip of mango*

#### Management practices

- Planting of mango orchards away from the brick kilns may reduce incidence
- Spray 1% borax at the time of fruit set, followed by two more sprays at 10 days
- Sprays of washing soda (0.5%) and caustic soda (0.8%) are good in minimizing the disorder.

### Red nose (cause not known)

#### Symptoms

- This problem is prominent in late maturing select varieties like Neelam and Mallika when they are harvested late resulting in considerable loss.
- Fruits with red nose are unfit for marketing and steadily become soft and rot.

#### Management practices

- Harvesting of fruits at appropriate time.
- Provision of proper plant nutrient.



*Mango Red nose*

## Woody stem gall (cause not known)

### Symptoms

- Woody galls sized 10-15 inches found on branches and are more prone in select varieties

### Management practices

- Sawing out the galls and applying Bordeaux paste to cut surface

## Nutritional Disorders

### Potassium deficiency

#### Symptoms

- Leaf margins have a scorched look which starts from tip downwards lending a burnt look to the foliage and subsequently affecting fruit quality.



*Scorched look of leaf margins due to potassium deficiency*

#### Management practices

- Deficiency can be overcome by application of 1Kg muriate of potash along with 2 Kg urea and 6 Kg super phosphate.

### Zinc deficiency

#### Symptoms

- Young leaves are usually the most affected and are small, narrow, chlorotic and often rosetted due to significant shortening of inter-nodal length.
- Typical zinc deficient leaves show pale interveinal areas and green veins.
- Bloom spikes are small, distorted and drooping.
- Zinc deficient trees do not grow well and the yield, size and quality of the fruits are affected.
- Alkaline, saline and sandy soils are more prone to be zinc deficiency.



*Narrow, chlorotic and rosette leaves due to zinc deficiency*

## Management practices

- By spraying twice a mixture of zinc sulphate (5 g) + urea (10g) / L water, one at the time of flowering and the other at one month after the first spray, zinc deficiency can be overcome.

## Iron deficiency

### Symptoms

- Leaves look bleached losing their natural colour, luster and with reduced size.
- Leaves have a mesh of green veins contrasting with the yellow of the lamina.
- Leaves dry from tip downwards, in severe cases of iron deficiency
- The deficiency is widespread in soils with high calcium content.
- Excessive amounts of manganese in poorly drained soils can induce iron deficiency in plants.



*Iron deficient leaves*

### Management practices

Two sprays of ferrous sulphate (2.5 g/ L) at fortnightly interval.

## Boron deficiency

### Symptoms

- Small leaves of pale green colour on shortened internodes.
- Causes death of the apical bud, resulting in excessive number of lateral buds.
- The floral panicles are smaller and have fewer hermaphroditic flowers.
- Fruit cracking is a characteristic symptom of boron deficiency and develop prominent brown areas in yellow fruit pulp.



*Fruit cracking due to boron deficiency*

## Management practices

- Two foliar sprays of borax (1%) at pea stage at 15 days interval or 100 g borax/ boric acid per tree.
- Application of boron @250 g/ tree (10-15 year old) around the tree basin with recommended dose of manures.



*Browning of fruit pulp*

## Copper deficiency

### Symptoms

- Occur frequently on young trees due to heavy nitrogenous fertilization.
- Tip burning of old leaves with grey brown patches is the typical symptom.
- Terminal shoots appear weak followed by defoliation and die back of branches.
- Causes long, tender and 'S' shaped branches and leaves with downward curls.
- Boil-like eruptions are caused on the branches.

### Management practices

- Spraying of 0.3% copper sulphate checks the disorder effectively.
- Spraying of Fe (0.1 %) and Cu (0.1%) reduced spongy tissue in mango

## Salt injury / toxicity

### Symptoms

- Due to excess salt in soil or irrigation water the leaves are scorched and turn bronze losing their natural colour.
- Severe cases of salt injury results in tip burning.

### Management practices

- Adequate application of FYM and compost every year.
- During tree bearing years intercropping with dhaincha as green manure crop in the orchard during onset of monsoon and their incorporation into the soil after one month growth.
- Gypsum filled gunny bag if kept in flowing irrigation water will reduce salt effect.



*Scorched, bronzed and tip burning of leaves due to salt injury*

