

# **IDENTIFICATION AND MANAGEMENT OF INSECT PESTS AND DISEASES OF FORESTRY TREES**

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**GOVERNMENT OF PUNJAB  
DEPARTMENT OF FORESTS & WILDLIFE PRESERVATION  
PUNJAB**

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# *Introduction*

Agroforestry has emerged as one of the viable alternative for diversification to the existing rice-wheat rotation. There are many tree species that are grown as boundary and block plantations in various agroclimatic zones of the state. The selection of appropriate tree species, their quality planting material and remunerative crop combinations are needed for higher returns. Moreover, the productivity and economic returns from the agroforestry systems can be increased by protecting them from insect pests and diseases.

Trees are susceptible to insect damage just like agricultural crops. The extent of damage however depends on the stage at which they are infested and the nature of the insect/disease organism. Trees are usually attacked by leaf eaters, defoliators (insects and diseases), sap suckers, gall formers, stem borers, pod or fruit borers, seed infestors etc. Potential benefits of agroforestry can not be realized unless the insect-disease problems are tackled effectively. The extent of damage in an agro forestry system is determined firstly by the primary interaction between the plant species and secondly by the interaction among components (tree, crop, soil and environment) of the system. The interaction among the components of the system can have positive, negative or neutral effect on insect pests, diseases of trees and crops i.e. insect/ disease activity is enhanced, reduced or remains unaffected, respectively. Therefore, an important area of research in agroforest entomology and pathology is to study the effect of interaction among the components.

The management of insects and diseases can only be possible with its correct identification, biology, identifying most susceptible stage, peak activity period and its relationship with the environment. The correct identification of disease causing organisms and their relationship with environment also carries a lot of importance in its management. In the changing scenario of forestry operations and management systems, the pest control has acquired new dimensions, it has become more complex and requires services of specialists in different fields. In fact, the concept of integrated pest management has acquired more relevance today where different specialists work together as a team for solving insect pest problems in the field.

Technical details in this booklet have been kept to minimum and main emphasis has been given on the identification of pest, damage symptoms and practical control measures

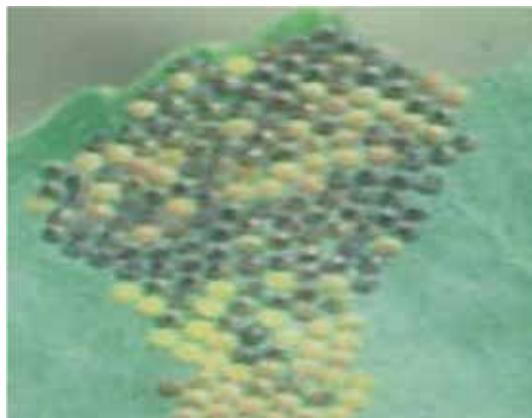
# Insect Pests

## POPLAR

In India, eight insect species have been identified as important pests of poplar in agro forestry systems. Three species, *Closter fulgurita*, *C. cupreata* and *Apriona cinerea* have been ranked as major pests and five species, *Ascotis sclearia*, *Eucosma glaciata*, *Phlantha phalantha*, *Nodostoma* and white grubs have been identified as potential pests of poplar.

In Punjab *C. fulgurita*, *C. cupreata*, *Asphadistis cryphomycha*, *Indarbela quadrinotata* are major pests. Whereas, *Apriona cinerea* (stem borer), leaf hopper (*Kusale salicis* - sporadic pest) are minor pests. The incidence of major and minor pests varied from 85 - 100 and 60-70 per cent, respectively (Sangha, 2007). There are three major leaf defoliators of poplar, two belonging to *Closter* genus i.e. *C. fulgurita* and *C. cupreata* and one leaf webber *Asphadistis cryphomycha*. All these defoliators belong to order Lepidopera of class Insecta and their life cycle is divided into 4 distinct stages i.e. egg, larva, pupa and adult

### Leaf Defoliators: *Closter fulgurita* and *Closter cupreata*



Eggs of *C. fulgurita*



Eggs of *C. cupreata*

#### Egg

Eggs of both *C. fulgurita* and *C. cupreata* are laid in clusters.

***Closter fulgurita:*** The eggs are spherical and light yellow coloured initially. Subsequently, these eggs turn into pinkish red in colour. Eggs are usually laid on the undersurface of leaf lamina and sometimes on the stem. After 4-5 days eggs turn pinkish red in colour.

***Closter cupreata:*** Freshly laid eggs are light green in colour which later on change to reddish brown due to longitudinal curved line originating from the centre of the egg. Eggs are usually laid on both sides of leaf lamina and sometimes on the stem.

The larvae emerge from the eggs leaving behind the empty egg-shells. This behaviour of the insects to lay eggs in groups or masses can be exploited in their management. Therefore, the mechanical control becomes a good option for the management of these defoliators.



Grown up larvae of *C. fulgurita*



Grown up larvae of *C. cupreata*



Larvae of *C. fulgurita* in clusters

## Larva

The newly emerged larvae are about 1-2 mm in length. The first three instars are gregarious; 4<sup>th</sup> and 5<sup>th</sup> instar larvae are solitary in nature and feed singly by moving in the tree canopy.

***C. fulgurita:*** The larvae of younger instars are dark brown to black in colour. The grown up larvae are pale brown which are sparsely covered with short hairs. The head is dark brown and hairy. The dorsal longitudinal lines are light brown with yellowish green tinge; the lateral sides are streaked dark brown. Two reddish tuft of hairs are present each on the mid dorsal region of 1<sup>st</sup> and 8<sup>th</sup> abdominal segment. The full grown up larva is about 30-35 mm long.

***C. cupreata:*** The larvae of younger instars are light brown with greenish mid dorsal portion. The head is light brown which is speckled with dark brown spots. There are two reddish tuft of hairs present on each mid dorsal region of 1<sup>st</sup> and 8<sup>th</sup> abdominal segment. The fully mature larva is about 25-28 mm long.

The gregarious feeding habit provides us an important weak link for the management of this insect pest. Plucking and destruction of skeletonised leaves particularly in nurseries is a good non-chemical management strategy.



Pupae of *C. fulgurita* in leaf fold



Pupae of *C. cupreata*



Adult (female) of *C. fulgurita*



Adult of *C. cupreata*

## Pupa

The pupa of insects belonging to *Closteria* spp. are dark reddish brown in colour. The pupae of *C. cupreata* are smaller than *C. fulgurita*. The pupa is the overwintering stage, as the leaf defoliators hibernate in this stage from December to March.

***C. fulgurita:*** The pupa is obtect type. The colour of pupa is reddish brown to dark brown in colour. It is elongated, cylindrical whose cephalic region is roundish and somewhat pointed on its posterior end.

***C. cupreata:*** The pupa is obtect type, elongate, cylindrical in shape with cephalic end rounded and the posterior end is pointed. Pupation takes place in leaf folds either on the tree or in the fallen leaf webs on the ground.

## Adult

***C. fulgurita:*** The moths are greyish brown with wing expanse of 36-46 mm. Forewings are grey brown with white irregular markings on the anterior half. The apical half is reddish brown with an indistinct series of submarginal black spots generally with some black suffusion near the inner margin.

***C. cupreata:*** The forewings are pale reddish brown with two pale oblique antemedian lines. The first line angled to medial nervate and the second curved near the inner margin. There is also a medial outwardly curved line joining a straight postmedial line at inner margin. Hindwings are paler than forewings. Male moths have characteristic anal tuft.

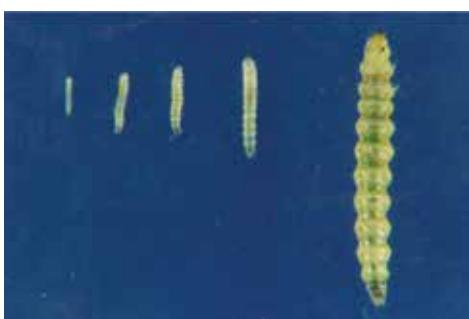
Female moths of the species have broader abdomen than male. Fecundity varies from 400-500 eggs in *C. fulgurita* and 250-300 eggs in *C. cupreata*.

# LEAF DEFOLIATORS

## Leaf Webber, *Asphadistis cryphomycha*



Eggs laid singly on leaf



1<sup>st</sup> to 5<sup>th</sup> larval instars



Fifth instar larva, pre pupa, pupa and adult



Adults

### Egg

Eggs are laid along the midrib. The eggs are elliptical or oval, creamy white to light yellow in colour. After 2-6 days, these eggs become reddish yellow with 4-5 red spots.

### Larva

There are five larval instars. Neonates are creamy white with shining black head. The 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> instar larvae have four black spots present on prothorax anteriorly and posteriorly. Anterior spots are more clear and large in size. The fifth instar larvae are greenish yellow with light brown head. A yellowish longitudinal streak is present on the mid dorsal surface of the larvae.

### Pre-Pupa

A prepupal stage is found in this pest. Prepupae are broad anteriorly and tapering posteriorly. This stage is light green initially and become yellow at later stages. This stage lasts for 90-110 days from November to March.

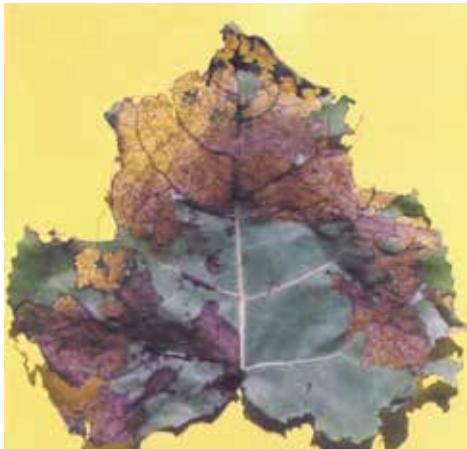
### Pupa

Pupa of both the male and female is broad anteriorly and tapering at caudal end. The Pupa is yellowish initially and dark brown finally. Compound eyes are prominent. Pupation occurs in the webbed leaves, fallen leaves on the ground or on trees.

### Adult

The moth is dusky brown. Forewings are light brown with irregular black spots dorsally and one black band on the ventral side. Wings are fringed with black hairs at the apical margins. Hind wings are silvery white with two black bands at apical margin and fringed with white hairs. The abdomen of males is narrow and pointed. Whereas, it is broad and round in females which is surrounded by a tuft of black colour hairs.

# MANAGEMENT OF LEAF DEFOLIATORS



**Damage of leaf defoliators**



**Defoliation of Poplar caused by  
*Closteria spp.***



**Damage of leaf webber**

## Peak Period of Activity

The peak period of activity of defoliators is from July to November. The adult moths start emerging from pupae in the month of March. Incidence of these defoliators can be seen from March to December.

## Nature of Damage

***Closteria spp.***: The first three instars are gregarious in nature and are voracious feeders. They scrap the leaf epidermis and skeletonize the leaves. The older larvae (4<sup>th</sup> and 5<sup>th</sup> instar) are solitary in nature and eat away all the tissues of the leaves leaving behind only the veins.

***Asphadistis cryphomycha*** : The young larvae web 2 or 3 leaves with silken threads and eat the epidermis resulting in drying of leaves. The webbed leaf folds give scorched appearance when seen from below. In severe cases 60 per cent of the leaves may be webbed.

## Control

1. The poplar clones (L 47/88 and L 48/89) are comparatively tolerant to the damage of defoliators in nursery and poplar plantations.
2. Collect the egg masses and destroy them by burning and crushing.
3. Plough the field 2-3 times in December to bury the overwintering pupae in soil debris.
4. Burn the fallen leaves which have been damaged by *A. cryphomycha*.
5. The insecticides such as Ekalux 25 EC (quinalphos) @ 4 ml or Curacron 50EC (profenofos) @ 2 ml in 1 litre of water should be sprayed in the affected fields in the evening to control the population of these defoliators.

# STEM BORER

## Poplar Stem Borer, *Apriona cinerea*



Larva feeding inside branch



Adult beetle



Damage of *A. cinerea*

### Egg

The eggs are dirty creamish white, oval, 7-8mm long and 3-3.2 mm wide.

### Grub

The grubs are creamy white in colour with elongated head of chestnut brown colour. The feeding of grubs starts during July and goes upto October. From October to February the grubs feed less and active feeding again starts in March.

### Adult

Beetle 35 to 50 mm long, ashy grey with numerous black tubercles at the base of elytra and antennae are longer than body.

### Peak Period

The peak activity period of this beetle is July-August. The grubs feed till October and remains quiescent during winter.

### Life Cycle

The life cycle of this beetle is completed in two years.

### Nature of damage

**Nursery:** The grubs bore through the stools and make circuitous galleries downwards reaching the roots.

**Older trees:** The grubs make 8-10 circuitous holes (for throwing out excreta and chewed wooden fibre) at an interval of 10-12 cm in the branches of main stem and reach to the trunk. The branches, stem and main trunk become hollow from inside. Ultimately the trees become weak and break in strong winds.

### Control

1. Prune the infested branches in August-September before the entry of grub in the main stem.
2. Figure out all ejection holes of live infestation in each tree and plug them with wet clay, leaving only the lowermost hole untouched. Inject 2 ml of Dursban 20 EC (chlorpyrifos) saturated in kerosene oil in the lowest hole.
3. Avoid planting of other collateral hosts like mulberry, apple in the vicinity of poplar plantations.

# Poplar Bark Eating Caterpillar, *Indarbela quadrinotata*



**Damage of *I. quadrinotata***



**L- shaped tunnel made by larva**



**Damaged plantation of poplar**

## Larva

The First instar larvae are dirty brown in colour and full-grown caterpillars (5-6 cm in length) have pale-brown to brown body with dark brown head capsule.

## Pupa

The pupa is formed inside the tunnel

## Peak Period of Activity

July to October.

## Nature of damage

The larvae feed on the bark while covering their body with web made of frass of wood and its faecal pellets. The damage is externally visible as thick, ribbon like, silken webs running on the bark of main stem and branches especially near the forks. The larvae also make L-shaped tunnels in the trunk usually at the junction of the branches. The repeated and severe attack by this insect for 2-3 years result in the complete death of plants.

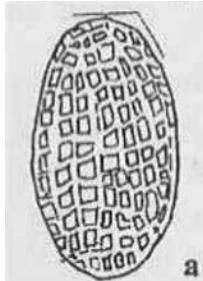
## Control

1. The block plantations need proper care and irrigation during summer months. The neglected block plantations that underwent water scarcity during summer are more prone to the attack.
2. Spray Dursban 20 EC (chlorpyrifos) or Ekalux 25 EC (quinalphos) at 0.05 per cent concentration. Dissolve 2.5 ml Dursban 20 EC per litre water or 2 ml Ekalux 25 EC per litre water to get the required concentration of the spray material.

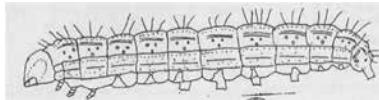
Spray can be done using a foot sprayer or power sprayer mounted on tractor trolley. If the problem persists even after 10-15 days after first spray, a second spray can be done using different insecticides. Only the trunk should be sprayed.

# TEAK

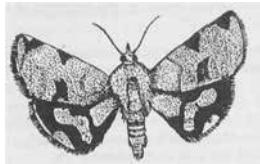
## Teak defoliator, *Hyblaea puera*



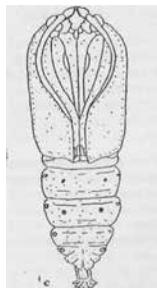
Egg (enlarged)



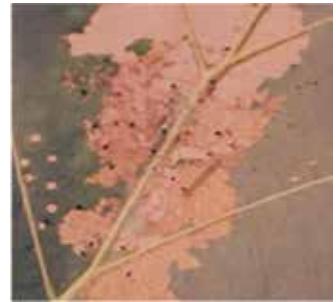
Larval stage



Adult moth



Pupal stage



Damage symptoms

### Eggs

The eggs are 1mm in size, white ovoid, laid singly on young foliage sticking to both sides of the leaf lamina. The fecundity of female varies from 500-600 eggs upto 1000.

### Larva

The first instar larvae are small, greenish yellow with black head and later instars are almost black or greyish green in colour.

### Pupa

The pupae are stout, shining and dark chesnet brown. The pupation occurs in green leaves, undergrowth, dead or fallen leaves or in soil litter. The mature larvae make triangular leaf fold cut and spun it strongly.

### Moth

The moths are small, greyish to reddish brown and abdomen is dark brown with orange segmental bands.

### Peak Period of Activity

(1) April to second week of June. (2) July to August (defoliation). (3) October (low number)

### Nature of Damage

The newly hatched larvae feed at night, under silk strands of young soft tissues of foliage by skeletonizing and making shallow depressions or trenches on the surface of the leaf. Later instars cut portion of the leaf in semi circular or rectangular flap at the edge and then fold it or roll over and fasten it with silken stands. The first and second instar larvae prefer young leaves. They consume completely the young leaves and skeletonise the older leaves. The later instar larvae feed by eating all the tissue leaving only the midrib and stiffer side veins.

### Control

Spray Curacron 50 EC (profenofos) @ 2 ml/ litre of water using foot sprayer

# **EUCALYPTUS**

## ***Eucalyptus* gall wasp, *Leptocybe invasa***



**Galls on leaves**



**Deformation of leaves due to galls**



**Drooping of *Eucalyptus* plants**



**Adult of *L. invasa***

In Punjab, this pest was recorded for the first time in 2009.

### **Incidence**

The incidence of *L. invasa* is found to be lesser in the dry regions than in the humid regions of Punjab. The farmers from Hoshiarpur district had to uproot and replace the clonal plants of *Eucalyptus* as all the plants were infested from this wasp.

### **Identification**

The presence of *Eucalyptus* gall wasp is indicated by bump shaped galls on leaf midrib, petioles, stem and leaves which are visible on both sides of the leaves.

### **Nature of Damage**

The wasp attacks nurseries, coppices and young plantations of *Eucalyptus*. Its infestation lead to presence of galls on the leaves, deformation and reduction in size of the leaves and multiple shoot formation in the canopy. The severly infested plants bend and droop to the ground. The plant remain stunted in growth and die in severe case.

### **Control**

1. The *Eucalyptus* clones such as C-413 and C-288 exhibit tolerance to the attack of gall wasp. These clonal plants can be procured from PAU, Ludhiana.
2. The systemic insecticides such as Pride 20 SP (acetamiprid) @ 0.2 g, Actara 25 WG (thiamethoxam) @ 0.3 g and Confidor 17.8 SL (imidacloprid) @ 0.5 ml per litre water show promising results in controlling this wasp. These insecticides can be repeated after 15 and 30 days to maintain gall free nursery.

## DEK

### Semilooper



Semilooper

It is a serious defoliator of dek in Punjab. The larvae feed on the leaves resulting in defoliation. High population of the pest in the nursery causes a severe damage due to denuding of plants. The larvae are green in colour and walk by making a loop as shown in the picture. The eggs of the semilooper are laid in groups. The initial instars feed gregariously and cause damage to individual leaves. The later instars feed on the leaf completely. If the attack is in nursery, the plants are denuded and may eventually dry up and die.

#### Control

The pest can be controlled by Curacron 50EC (profenofos) @ 2 ml per litre water.

## SHISHAM

### Shisham leaf roller, *Apoderus sissoo*



Damage of Shisham leaf roller

Female beetle rolls the leaf from the ends and then lays a single egg in the central whorl. The development of the grubs takes place in the rolled leafs and emerges as an adult beetle. The adult beetle and the grubs are serious defoliators of the shisham. The pest feeds on the leaf tissue resulting in severe damage to the foliage. The peak period of activity of this insect is June to October.

#### Control

The pest can be controlled by spraying Curacron 50 EC (profenofos) @ 1 ml per litre of water.

# TUN

## Tun Fruit and Shoot Borer, *Hypsipyla robusta*



Larva feeding inside stem



Infested tree

The tun fruit and shoot borer has five generations in Punjab. The larvae are known to damage flowers, fruits and shoots. The first generation during February, damages the flowers by binding them and as a result no fruits are formed. The fruit generation binds 2-3 fruits together and feeds on the internal contents of the fruits. The larvae then descend down and pupate in the cracks in the bark under silken web. Under severe attack the whole tree trunk is covered with web. The adults emerge to lay eggs on the young tender branches. The next 3-5 generations bore the shoots and cause the maximum damage to the tun plantations.

The damage due to the shoot generation result in forking of the main stem or alternatively lead to staggered heads resulting in poor economic returns at the time of harvesting. The larvae feed and bores the soft branches and shoots of the young plants. It ejects frass from the entrance holes. The shoot above the entrance hole dries up and dies. Sometimes due to strong winds, the shoot breaks at the junction point.

The extent of damage caused by this insect varies from 80-100 per cent in kandi region followed by 30-40 per cent in central and no damage has been observed in southwest agro climatic zone of Punjab.

The attack is more pronounced in nurseries and young trees (one year old) where it causes death of plants. Moreover, the neglected nurseries are more prone to the attack of this insect.

### Control

Identify the active holes from the frass and injecting the holes with 2 ml of Dursban 20EC (chlorpyrifos) or Curacron 50EC (profenofos) per hole results in good control of the borer.

# Termites



Termite eggs



Termite damage on trunk

Termite damage in forest nurseries and plantations is of widespread nature though the incidence and attack varies with species and locality. Subterranean damage to the root system of seedlings, tap roots and lateral roots of trees is very common. In nurseries it assumes serious proportions and often results in total loss. In nurseries, the affected plants show the signs of yellowing and wilting of apical leaves and ultimately death.

## Peak Period of Activity

March– October.

## Control

1. Drench the soil (around plants and before filling it in polythene bags) with Dursban 20 EC (chlorpyrifos) @ 5 ml / litre of water.
2. Destroy all the termitaria in the nursery or nearby areas.
3. Flood the termitaria with Dursban 20 EC (chlorpyrifos) using same dose as above.

## Prevention of Termite incidence in Stored Timber

1. Keep ground of the depot or timber yard as dry as possible.
2. Remove material (ends of timber, sawdust etc.) that attracts the termites.
3. Store timber at a place with Paved or brick or concrete flooring.
4. Make proper stacks with good aeration that reduces the chance of attack of termite.
5. Treatment of timber against termite - Impregnation of timber under pressure with coal tar creosote imparts resistance for a very long duration.

# Diseases

Spectrum of diseases varies considerably in different agroclimatic regions of Punjab. Diseases primarily infest the nurseries and subsequently the plantations. In the nurseries diseases caused by soil borne fungi such as *Pythium*, *Phytophthora*, *Fusarium*, *Botryodiplodia* etc. cause rotting, damping off and collar rot. Several fungi like *Alternaria* spp., *Myrothesium roridum*, *Cercospora populina* etc. later on infects the leaves of plants in nurseries and plantations, causing leaf spots. Leaf blight, stem rot, stem canker, stem blight are more prevalent in the plantations of Punjab State.

## POPLAR

**LEAF SPOTS:** The fungal pathogens cause different kinds of spots and the description of each one is as follows



**Myrothecium spots on leaf and close up of the spot showing sporodochia (Black dots)**



**Cercospora leaf spots giving blighted appearance**

### 1. Myrothecium Leaf spots (*Myrotheicum roridum*)

#### Symptoms

Spots appear on lower leaves as round to oblong or irregular in shape, which are light brown in the center with dark brown margins. The size of the spot varied from 5 to 20 mm in diameter. Spots coalesce to form bigger patches giving blight appearance. The sporodochia appear concentrically in the center of the spots as raised, rounded structures which were initially white and later turned olive green to black in colour, mostly on the upper leaf surface. The necrotic area is shed giving shot hole appearance. These spots cause premature defoliation. Its incidence in Punjab ranged from traces to 92 per cent with an average of 12.2 per cent.

### 2. Cercospora Leaf spots (*Cercospora populina*)

#### Symptoms

Brown to dark brown round spots of variable sizes appear on leaves, the centre of which contains a dark speck giving a dot like appearance. The colour of the spots is same on both the sides. The spots coalesce to form bigger patches, to give blighted appearance. The highly spotted leaf falls prematurely.



**Phaeoisariopsis Leaf spots**



**Drechslera leaf spots**



**Alternaria leaf spots**

### **3. Phaeoisariopsis Leaf Spots (*Phaeoisariopsis* sp.)**

#### **Symptoms**

Brown to dark brown round spots of variable sizes appear on leaves, the centre of which contains a dark speck giving a dot like appearance. The colour of the spots is same on both the sides. The spots coalesce to form bigger patches to give blightened appearance. The highly spotted leaf falls prematurely.

### **4. Drechslera Leaf Spots (*Drechslera maydis*)**

#### **Symptoms**

The disease starts as minute specks of light brown colour on lower leaves of the plant. These enlarge to form spots of size 0.4 –0.8mm. The spots are light brown with dark margins and may contain yellow halo. Medium to large sized spots have ring type pattern. Disease appears in rainy season and is more serious in nursery grown at the same place year after year. The incidence of the disease in Punjab varied from 55-90% with a mean incidence of 24.3%.

### **4. Alternaria Leaf Spots (*Alternaria* Spp.)**

#### **Symptoms**

The disease starts as minute spots of purplish-brown colour with dark margins. These spots merge with each other to form large irregular patches. A close observation of spots show ill defined concentric rings.

#### **Peak Period:** Rainy Season

The disease was recorded in Jalandhar, Ludhiana and Sangrur nurseries of the forest department. Maximum incidence of 90 per cent was recorded from Sangrur which had maximum severity of 35 per cent. The disease was in traces at Ludhiana nursery.

# CONTROL OF LEAF SPOTS OF POPLAR

1. Give 3-4 sprays with Dithane M-45 @ 3g per litre of water or Bavistin 50WP or Tilt 25EC @ 1g per litre of water or Bordeaux mixture (0.8%) starting from the onset of monsoon and subsequent sprays at fortnightly interval.
2. Avoid raising nursery on same place where infection was noticed in the previous year.
3. Burn or bury diseased leaves lying on floor.
4. Proper sanitation by ploughing the plantation helps, as it results in quick decomposition of the litter and disease inoculum.



**Cutting rot of poplar**

## 5. Cutting Rot (*Botryodiplodia spp.*)

### Symptoms

Cutting rot is a serious disease of nursery. On cuttings, the infection appears on bark as raised black bodies called pycnidia, which contain millions of spores of the fungus. Later on with the advancement of infection the part below the bark is also covered with black mass of the fungus. Ultimately the cuttings rot and bark appear as shredded fibers leading to the death of the plant. The problem has been found to aggravate with the attack of termites. Browning of the wood portion and rotting is common. The disease intensity increases with any damage to cutting. The incidence ranged from 20-50 per cent with mean state incidence of 20.3 per cent. Incidence was more in sub mountainous districts of Punjab.

### Peak Period

Late sown planting specially March when temperatures are high

### Control

1. Use cuttings made from healthy, disease free nursery plants only.
2. Treat the cuttings with Emisan-6 @ 0.5% by dipping them for 15 minutes before planting.
3. Drench the soil around the cuttings, if disease attacks the plant in nursery with Emisan-6 @ 0.2%
4. Avoid growing poplar in water logged areas.

# EUCALYPTUS



Cylindrocladium leaf spots



Cercospora leaf spots



Pink leaf spots

## 1. Cylindrocladium Leaf Spots (*Cylindrocladium scoparium*)

### Symptoms

This disease is a serious disease of nurseries. The disease is characterized by round to irregular spots brown in colour which start from margins. The spots coalesce to form bigger patches. The margins of the spots are expanding and clear. Under warm and humid conditions, the fungal growth on spots appears as white mycelium with millions of conidia in it. These conidia cause rapid disease spread. Its severe infection leads to complete defoliation.

### Peak Period

Rainy season

## 2. Cercospora Leaf Spots (*Cercospora eucalypti*)

### Symptoms

The disease is characterized by pale brown coloured round to irregular spots. The centre and margins of the spot is chocolate brown with diffusing margins.

### Peak period

Rainy season

## 3. Pink Leaf Spots (*Gleosporium Sp.*)

### Symptoms

The spots start as small pin head sized specks scattered all over leaf lamina. Spotting is characterized by purplish margins. The bigger spots become straw brown on both sides of the leaf.

### Peak Period

May- October

# CONTROL OF LEAF SPOTS OF *Eucalyptus*

1. The planting material should be disease free and from good progeny.
2. Maintain sanitation by disposing of diseased material.
3. Maintain high plant vigour through cultural practices.
4. Three to four sprays with Bavistin 50 WP @ 1 g of formulation per litre of water, starting with the onset of rains in end of June or July controls the *Cylindrocladium* and *Cercospora* leaf spot diseases.
5. In case of pink leaf spot disease, the plants should be sprayed with Dithane M-45 @ 3g per litre of water.



**Die back due to *Eucalyptus* stem blight**

## 4. *Eucalyptus* stem blight

(*Cryptosporiopsis eucalypti* associated with *Colletotrichum* spp. and *Diplodia* spp.)

### Incidence

Recently dying of *Eucalyptus* leaves and branches has been reported in the districts of Hoshairpur and Nawanshehar.

### Symptoms

*Eucalyptus* trees are rendered susceptible due to the infection caused by two leaf spot fungi viz. *Cylindrocladium scoparium* and *Cercospora eucalypti* during rainy season that result in severe leaf defoliation. Subsequently, *Cryptosporiopsis eucalypti* causes dieback followed by canker on the trunk. Further *Colletotrichum* spp. and *Diplodia* spp. have also been found to be associated with these cankers and die back in young plantations.

### Control

1. Procure the nursery from certified or reputed nursery growers.
2. This problem has been noticed particularly in nursery plants procured by farmers from Uttrakhand and Uttar Pradesh.
3. Procure plants from gall free nursery and preferably from state forest department or Punjab Agricultural University.
4. 2-3 sprays should be given with Bavistin 50 WP (1 g per litre of water) followed by Tilt 25 EC (1 ml per litre of water) at fortnightly interval starting from last week of June to avoid leaf spots.
5. Drenching with Bavistin 50 WP @ 0.2 per cent should be done using 25 litre of water per tree during second fortnight of August.

# DAMPING OFF IN NURSERIES

## (*Pythium* sp., *Phytophthora* sp., *Fusarium* sp. etc.)



Post-emergence damping off in pine

### Symptoms

Damping off is a serious disease of all the nursery plants raised from seed. It is of two types, pre-emergence and post-emergence. In pre-emergence damping off the young seedlings are killed before they reach the surface of the soil. The radicle and plumule rot completely, when they come out of seed. Since it happens under soil surface, it appears as if there is less germination of the seed.

In case of post emergence damping off, the seedlings are infected at or below ground level and the infected portion appears water soaked and soft. As the disease advances the stem becomes constricted at the base and the plant collapses. The seedling from infested soil escaping damping off dies very soon after transplanting.

### Control

1. Treat the seed with Captaf or Thiram @ 3 g per kg of seed, before sowing.
2. Disease incidence is heavy in wet soils, so during sprouting of seed watering should be minimum.
3. In case of disease appearing in young nursery, drenching with Captaf or Thiram @ 25-30 g/ sq. m. should be done.
4. Lowering of pH by acidifying soil with concentrated sulphuric acid (100-400 ml in 4.5 litre of water) or Ammonium sulphate (Fertilizer grade) (100-450 g) per sq. yard of nursery bed.
5. Soil solarization should be done in May and June by exposing the soil to high temperatures to kill the fungal infestation.
6. Maintain proper drainage by raised bed sowing and making furrow around the bed for irrigation. Give light but frequent irrigations.
7. In severely infested beds soil fumigation with formalin should be done with a 2 % solution [1 litre of formaline (40%) in 20 litre of water] using 4-5 litre/ sq.m. Drench the soil with the formaline solution so that top 10 cm of soil becomes wet. Cover the treated soil with polythene sheet for 24 hrs. Nursery should be planted at least 7 days after the treatment so that all the traces of formalin escape from the soil.
8. Use well decomposed FYM and sandy loam soil as potting mixture for filling polythene bags to raise nursery plants.

# DEK AND NEEM



Symptoms of Shoot blight



Seporia leaf spot

## 1. Shoot blight/ Canker (*Fusarium* spp.)

### Symptoms

It is serious disease in nursery. Symptoms appeared on tender shoots as depressed water soaked lesions in nursery plants, which later turned necrotic and lead to stem breakage at the point of infection.

### Peak Period

July- August

### Control

1. Three to four sprays with Bavistin @ 0.1% at appearance of broken apical portion or during rainy season.
2. Avoid excessive moisture and shade.

## 2. Septoria Leaf spot (*Septoria* spp.)

### Symptoms

These spots occur on both neem and Dek. The disease symptoms were characterized by spots, which were pale brown to grey with dark margins, and the pale portion had black coloured pycnidial bodies. Spots resulted in heavy premature defoliation.

### Peak Period

April- September

### Control

As mentioned in management of leaf spots of poplar.

# SHISHAM



**Ganoderma root rot**



**Fructing body of Ganoderma**

## 1. Ganoderma root rot (*Ganoderma lucidum*)

### Symptoms

This fungus destroys the root system completely. The foliage on infected tree is comparatively paler and canopy appears thin. The top most branches become completely defoliated giving the tree, a stag head appearance. The large sized fruiting bodies of the fungus, which are reddish brown in colour with shiny surface, appears around the tree trunk in the rainy season.

The infected roots that are left behind after clearing forest trees are a major source of its infection. The spread of the fungus can also occur from diseased to the healthy tree through root contact in soil.

### Peak Period

Rainy Season

### Control

1. Remove the infected trees along with all the diseased and rotting roots.
2. Trees should not be planted on freshly cleared forestlands, rather field crops should be grown for 2-3 years. The infected roots will get decomposed with time.
3. The infected tree in a plantation can be isolated from the healthy ones by digging trenches around it. Usually 2-3 ft. deep trenches are sufficient but care should be taken while digging so as not to spread the diseases soil/ debris in the plantation.
4. Avoid injury to the roots of adjoining healthy trees.



**Wilt of Shisham**

## 2. Wilt (*Fusarium solani*)

### Symptoms

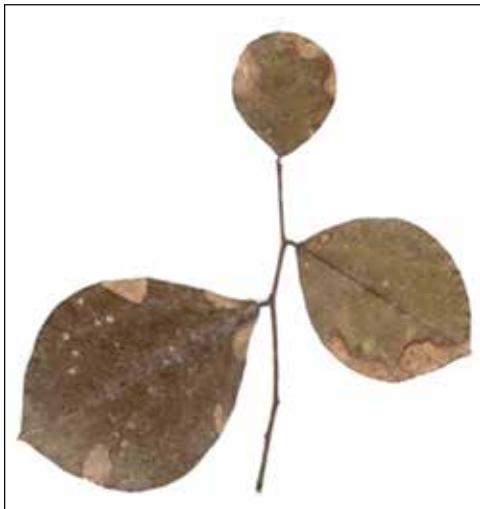
Wilt usually attacks older trees. The disease is characterized by yellowing of leaves from base of the trees upwards. Later on the leaves dry up and start to fall off leaving bare branches. The outer sap wood exhibits pink to reddish pink stain. Death of the tree occurs in a short span of few months.

### Peak Period

July – September.

## Control

1. Maintain plant vigor by application of irrigation water in dry season and proper fertilization.
2. Avoid shisham plantation in clayey soils with inadequate drainage.
3. Avoid water logging.
4. To avoid the spread of the pathogen through root contact, 3 feet deep trench should be dug around the infected tree.
5. The wilted tree should be removed along with the roots and the soil around it should be fumigated with formalin (commercial grade) as soil drench (200ml commercial grade in 4 litres of water per square meter of land).
6. Symptoms in wilting trees in initial stages (less than 10% chlorotic leaves) can be checked by applying systemic fungicides such as Bavistin @ 0.2% as soil drench.



**Myrothecium leaf spot**

## 3. Myrothecium leaf spot (*Myrothecium roridum*)

### Symptoms

The spots start from margin in most of the cases as light brown coloured lesion with broad dark chocolate brown border. Spots contain very minute dark green coloured sporodochia, which appear as raised dots.

### Peak Period

Rainy Season

## Control

As mentioned in management of leaf spots of poplar.



**Cercospora leaf spot**

#### **4. Cercospora leaf spot**

*(Cercospora sissoo)*

##### **Symptoms**

The attack is mostly on the lower side of leaf, where greyish-green discolouration is visible. The lesion under humid conditions are covered with greenish growth of saprophytic fungus. The affected portion of the leaf turns necrotic and dies giving a blightend appearance.

##### **Peak Period**

Rainy Season

#### **Control**

Follow control measures as mentioned in leaf spots of poplar.



**Rust pustules on lower side of leaf**

#### **5. Leaf rust (*Uredo sissoo*)**

##### **Symptoms**

This disease has been observed in nurseries of sub mountainous regions of Punjab. The main symptoms are produced on leaves and juvenile twigs. The disease is characterized by yellow to orange coloured pustules on the lower side of the leaf. The affected part is killed and die-back symptoms are produced. The disease is more pronounced in nurseries and young plants in the plantation.affected portion ultimately dies.

##### **Peak Period**

October - January

#### **Control**

1. Sow resistant/tolerant varieties.
2. In nursery sulphur fungicides @ 0.3% can be sprayed to manage the disease.

# CANKER OF FOREST TREES



**Water oozing out of tree trunk**



**Canker of eucalypts**



**Canker of poplar**

Abrupt climate changes in recent years have resulted in squeezed winters and delay in the onset of monsoon in Punjab. The increased spell of heat wave and prolonged dry weather induce physiological stress and heat induced cankers in trees. Poplar and eucalypt plantations have been seriously affected by this malady.

## Symptoms

The face of the tree trunk exposed to sun (southern side), develop water soaked patches. Soon these patches develop into cankers and water starts to ooze out from them. The weakened plant defenses and favourable conditions for pathogen development in the cankers result into secondary attack by several fungi, mostly saprophytes. The fungus infects the inner bark causing the outer bark to slough off. The portion of trunk having cankers later on rots, which ultimately affects the tree growth and timber yield. The injuries inflicted on tree trunk during cultural operations pre-dispose the trees to cankers.

## Peak Period

June-July

## Control

1. Avoid heat stress by giving adequate irrigation at regular intervals.
2. Maintain tree vigor by following recommended cultural practices.
3. Whitewash tree trunks in May to prevent heat damage.
4. Apply Bordeaux paint on cankers.

## Natural Enemies of the Leaf defoliators

Natural enemies are beneficial for the regulation of population the poplar leaf defoliators and the leaf webber. The poplar leaf defoliator larval parasitoid, *Aleiooides percurens* (Fig 1) results in 23 % parasitization of the defoliator larvae which are turned into mummified structures (Fig 2). In addition, the predatory bug, *Canthecona furcellata* (Fig 3) nymphs (in groups) and adults (singular) feed on the larvae by sucking body fluids. The poplar leaf webber population is regulated by a predatory beetle, *Cheracanthium sp.* (Fig 4), pupal parasitoid, *Brachymeria* sp (Fig 5) and a spider, *Crossoglossa latecincta* in the fields. These insects need to be preserved for natural control on these defoliators.





**Defoliation (100 per cent) caused by poplar leaf defoliators  
at Nurpur Bet, Distt. Ludhiana in October Month**

**Department of Forests and Wild Life Preservation, Punjab**

**Help Line No. 0172-2298098**

**All working days: From 6:00 am to 10:00 pm**

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