

Disease of Apple and Their Management

(* Amit Mandlik¹, Santosh Watpade² and Meenakshi Rana¹)

¹Department of Plant Pathology, Lovely Professional University, Punjab, Pin-144411

²Indian Agriculture Research Institute Regional Station, Shimla, Pin-171004

*Corresponding Author's email: amitmandlik25@gmail.com

In current scenarios there are too many problems for agriculture sector like so much pollution, shortage of water, global warming etc. Because of them there are plenty of diseases which are spoiling the crop grown by farmers. Apple (*Malus × domestica* Borkh.) belongs to family Rosaceae and it is the most important fruit crop grown extensively in temperate regions of the world. The major fungal diseases include scab, Alternaria leaf blotch, powdery mildew, collar rot, root rot, sooty blotch, fly speck etc. In the present paper, results on its symptom and their management are described.

Scab of Apple

Causal Organisms - *Venturia inaequalis*.

Importance - Apple scab occurs throughout the world where apples are grown, except in very dry or warm climates. The scab fungus has two kinds of spores, which are microscopic and seed-like bodies. One kind of spores called conidia, is produced at the surface of the scab spots from short, erect, thread-like branches of the fungus. Ascospores produced in these leaves start the disease in spring. Conidia produced from scab spots of the current season then continue spread of the disease.

Symptom

- Scab may occur on both surfaces of the leaf blade and on the midrib and petiole. It often appears first on the under surface, because it is exposed to infection as the buds break and the leaves unfold.
- The scab spot-lesion usually appears first as small, olive-colored areas, which increase in size and may darken with age.
- They often take on a velvety appearance on account of the abundant production of spores on the end of short, erect, thread-like branches of the fungus.
- The earliest lesions are largest, sometime one-half inch or more in diameter. Later lesions tend to be smaller, because resistance to the disease increases with the age of the leaf.
- The large scab spots, especially on the upper surface of the leaf, may become brown, except at the margins.
- Very thin cork layer is commonly formed in the apple tissue beneath the fungus, especially when fruit is young.



- Fruit approaches maturity, it becomes more resistant and the scab lesions develop very slowly. Infection lesions develop very slowly. Infection may occur too late in the season to cause visible lesions by harvest time. Small dark scab spot may then develop during the storage periods.

Management

- Cleaning leaf litter from the base of previously-infected trees, as well as removing infected woody material from the canopy when performing annual pruning.
- Doing so will reduce the amount of primary inoculum in the spring and subsequently delay the establishment of the disease.
- Furthermore, regular pruning will improve air flow and light penetration in the canopy, which ultimately inhibits the development and spread of disease.
- Another aspect of cultural control is water management. As water triggers ascospore release and promotes germination on vulnerable tissue, growers are advised to monitor watering periods and avoid using overhead watering systems. Doing so may ultimately aid in reducing infection periods caused by natural precipitation.
- Growers commonly use copper- or sulfur-based protectant sprays to reduce the efficacy of primary inoculum.
- Although these sprays will be among the earliest methods of preventing the development of apple scab, they do little to manage pre-existing infections and application may significantly damage the foliage of treated trees.

Rust of Apple

Causal Organisms - *Gymnosporangium juniperi-virginianae*

Importance- Rust diseases may cause serious losses within orchards. Leaf infections weaken trees and result in a reduction in fruit size and quality of the current crop, as well as reduced bloom the following year. Heavy infections occurring over several consecutive years result in stunting, increased susceptibility to winter injury, and failure to produce fruit. These stresses may result in tree death. Infected fruit may drop prematurely, while those that remain on trees until harvest have reduced market value.

Symptom

- Cedar-apple rust infections begin as small, pale yellow spots on upper leaf surfaces in mid- to late spring. Spots gradually enlarge (up to ¼ inch in diameter), become bright yellow-orange, and are frequently surrounded by a reddish border.
- Fungus continues to colonize infected leaves, yellow spots develop on lower leaf surfaces and tissue becomes noticeably thickened.
- Infected leaves may turn yellow and drop, especially as trees become stressed.
- Rust causes fruit to become puckered at the blossom end (calyx) if infection occurs when fruit are an inch or less in diameter. Later, sunken, dark green spots develop.
- Fruit flesh underneath surface lesions dies and becomes brown and spongy, often all the way to the core.



- Cedar-apple rust seldom affects apple twigs. Cedar-quince rust causes infected hawthorn and crabapple twigs to become swollen; tissue above infected sites dies as twigs are girdled.

Management

- Select and grow apple or juniper cultivars that are resistant or immune to rust.
- Resistance may vary among localities, depending upon the specific races of the rust species present in the area.
- Destroy nearby unmanaged, abandoned, or wild apple, crabapple, cedar, or juniper trees. When practical, prune and destroy cedar apples found on ornamental junipers and cedars.
- Follow a recommended fungicide management program for apple. Early protection beginning at the pink-bud stage is especially important for management since most infections occur within the first 30 days after bloom.

Powdery mildew

Causal Organisms - *Podosphaera leucotricha*

Importance - Powdery mildew attacks the leaves, twigs, blossoms and fruit of apple. Usually the mildew found on cherries is a closely related species (*P. oxyacanthae*) which is reported now and then on apples. The fungus that causes mildew grows on the surface but it send long suckers (haustoria) into the leaf cells. The fungus produced enormous numbers spores in chains on the fungus threads. wind carries the spores great distances. The spores require little moisture to germinate the dew in irrigated orchards is enough to allow the fungus to develop in dry regions.

Symptom

- Powdery mildew first forms off- white or pale-gray, felt like patches on the margins of leaves, usually on the underside .
- The fungus then gradually spreads until it covers the whole leaf surface and all the leaves in a terminal cluster.
- The mildew grows down the twig, which it covers with a gray felt. Dark- gray or black patches later form on the gray felt after the many tiny, globe-shaped winter Fruiting body of the fungus develop in the summer.
- Young infected leaves become somewhat narrowed and folded longitudinally, and their under sides are exposed. some become curled, crinkled, and stiffened. Many fall off before autumn.
- Terminals attacked early in the year often fail to survive or have tiny, dried remnants of leaves left on them at harvest.



Management

- Spray with 2.5 per cent concentrate 32° Baume lime-sulfur (2.5 gallon in 100 gallon of water) as the blossoms reach the pink stage, just before blooming; or use of dried sodium polysulfide at the rate of 3 pounds to 100 gallons of water
- Spray with 2.0 per cent lime-sulfur after 75 per cent of the petals have fallen; or use 2.5 pounds of the dried sodium polysulfide to 100 gallon of water
- Spray with 2 to 4 pounds of wettable sulfur 2 weeks later. micronized sulfur has given adequate control at 2 pounds to 100 gallon.
- In Orchard sprayed with lime-sulfur or with sulfur, the mildew is held down to 5 to 20 per cent until July.

Sooty blotch and flyspeck

Causal Organisms - **Sooty blotch** - (*Peltaster fructicola*) / **flyspeck** - (*Zygophiala jamaicensis*)

Importance - Sooty blotch and flyspeck are two of the most common diseases of apple that often occur on fruit at the same time. Sooty blotch is a disease complex caused by the fungi *Peltaster fructicola*, *Geastrumia polystigmatis*, and *Leptodontium elatius*. Flyspeck is caused by the fungus *Zygophiala jamaicensis*. These diseases are wide spread in the Midwest. Because the fungi causing sooty blotch and flyspeck grow superficially on the surface of the fruit, losses are primarily through lowered fruit quality. Infections are much more obvious on yellow-skinned apple cultivars.

Symptom

- Sooty blotch appears as sooty or cloudy blotches on the surface of the fruit. The blotches are olive green with an indefinite outline
- The blotches are usually one fourth of an inch in diameter or larger, and may coalesce to cover much of the fruit.
- The “smudge” appearance results from the presence of hundreds of minute, dark pycnidia that are interconnected by a mass of loose, interwoven dark hyphae
- The sooty blotch fungus is generally restricted to the outer surface of the cuticle and can be removed by vigorous rubbing or bleaching. In rare cases, the hyphae penetrate between the epidermal cell walls and the cuticle.
- Groups of a few to 50 or more slightly raised, black and shiny round dots that resemble fly excreta, appear on the apple fruit.
- The individual “fly specks” are more widely scattered and much larger than the pycnidia of the sooty blotch fungus.
- The flyspecks are sexual fruiting bodies (pseudothecia) of the fungus, and are interconnected by very fine hyphae. The blemishes can be removed by vigorous rubbing or bleaching.



Management

- A properly pruned tree will slow the development of sooty blotch/flyspeck. Annual pruning will allow better and faster drying of fruit after rain or dew.
- Sooty blotch/flyspeck fungi require periods of wetness in order to grow, so keeping the surface of the fruit as dry as possible can reduce diseases.
- Although there are no apple varieties resistant to sooty blotch/flyspeck, some cultivars have physiological characteristics that may reduce risk of sooty blotch/flyspeck damage. For example, only early-maturing cultivars may show less damage because sooty blotch/flyspeck fungi have less time to multiply on the apple surface.
- Potassium bicarbonate (KHCO₃) is a new, moderately effective fungicide for control of sooty blotch/flyspeck. Potassium bicarbonate is more effective treatment for control of apple diseases, particularly powdery mildew in organic orchards.

Apple mosaic virus

Causal Organisms

Importance - Apple mosaic disease is an economically important disease, which is prevalent throughout the world, where apple is being cultivated and poses a severe threat to the apple industry. The disease was first reported from Europe during 1930. The net photosynthetic rate of infected leaves can reduce from 2.93% - 45.83% and decrease fruit yield by as much as 30% - 50%. Trees with symptomatic leaves throughout the tree lack vigor and growth.

Symptom

- The symptoms differ in expression on different host plants with different virus strains. Leaves of apple trees infected with mosaic disease develop bright pale-yellow, bright cream colored irregular chlorotic spots, which expand during spring.
- Chlorosis can develop along leaf veins, creating a reticulated appearance or, in other cases, can manifest as large, amorphous chlorotic areas between leaf veins.
- Lesions may change to necrotic spots in the affected leaves after exposure to summer sun heat and leaves may drop prematurely.
- The distribution of symptomatic leaves may be erratic throughout individual trees or limited to a single limb. The number and severity of symptomatic leaves directly correlate with temperature, with more severe symptoms in years with moderate spring temperatures.



Management

- The most efficient way to manage the disease is through preventative measures and avoid planting contaminated material.

- Since these viruses cannot be directly removed from the plant itself, the most practical technique to manage ApMV is to plant certified trees obtained from Plant Improvement Organizations
- Because ApMV can be asymptomatic for quite a while, it is also best to test for the pathogen using high sensitivity and high specificity detection methods such as ELISA .
- The various techniques for production of virus free planting material include thermotherapy, tissue culture, etc. Thermotherapy is an efficient technique to eliminate viruses from infected plants and the combination with shoot-tip grafting can increase the efficiency of virus elimination.
- Thermotherapy performed on the infected apple trees did not show any symptoms in the following year, although symptoms can be present on trees that were the sources of the buds described that complete ApMV inhibition was observed with hot water treatment of wood scions at 47°C for 30 minutes and 50°C for 15 minutes. also reported that exposure to 50°C for 8 to 12 minutes was completely effective in deactivating ApMV.

Alternaria leaf blotch / Spot

Causal Organisms - *Alternaria alternata*

Importance - Alternaria leaf blotch (ALB) and alternaria fruit spot can cause significant impact to apples. In Australia, ALB, is believed to be caused by several *Alternaria* species including *A. mali*, *A. arborescens*, *A. alternata* and *A. tenuissima* and *A. longpipes*. The symptoms can vary from State to State with some regions experiencing very severe infections.

Symptom

- Symptoms on leaves appear as brown to purplish irregular spots surrounded by a black border. They can become necrotic and defoliation can occur.
- Fruit develops light brown sunken spots on the skin, which can be confused with other disorders, such as alternaria core rot (*Alternaria alternata*).
- Pre harvest spots stop growing when fruit is placed in cold storage, however upon removal spots become bigger and new ones can form, providing an entry point for other diseases.
- Trees affected by ALB can also suffer from premature defoliation which can lead to long-term reduction in tree vigor and yield.



Management

- Effective control of diseases is possible by using resistant cultivars. To date, no resistance gene has been identified. Few studies have investigated resistance to Alternaria leaf blotch .

- The ALFS outbreak could be controlled by combination of fungicidal spray, mite treatments and proper cultural practices. Main source of inoculum is leaf residue on the orchard floor and spores reside on twigs and buds during winter.
- Therefore it is crucial to reduce the leaf residue from the orchard floor. Maintenance of hygiene in orchards and chop or degradation of fallen apple leaves and other debris to minimize *Alternaria* leaf blotch fungi and mite eggs from overwintering in the debris.
- Application of urea on fallen leaves, mulching, removal of weeds, discarding fallen apple litter from orchards, application of lime sulphur, covering the plastic foil, manual removal of leaf residues could reduce the source of inoculum in orchards.
- Spores also resided on twigs and buds during the winter season. Protective spray of copper based fungicide is recommended prior to development of new leaves during the end of autumn or early spring.
- Selective pruning of canopy also reduces inoculum present in twigs and buds in the orchards. Fungicide sprays could aid in the reduction of infections with correct timing of the application.
- Leaf blotch incidence should be monitored and if by 70-90 DAB the incidence is more than 15%, fungicide application may need to be applied to prevent fruit spot infection. List of chemicals recommended and registered for control of apple leaf and fruit blotch.

Marssonina leaf blotch (pre mature leaf fall)

Causal Organisms - *Marssonina coronaria*

Importance - Marssonina blotch of apple was first reported in Japan in 1907. The disease was first detected in Connecticut in late summer 2016. Severe epidemics of the disease can cause extensive early defoliation before harvest, which affect fruit size, color, and yield as well as tree vigor and fruit bearing capacity.

Symptom

- Marssonina blotch can affect leaves and fruit. The initial symptom on leaves appears dark green circular patches, and then leaf tissue necrosis results in dark brown spots. Many lesions coalesce to form large brown blotches on leaves.
- Surrounding brown lesions and along veins is a characteristic symptom of this disease. The fungus forms acervuli (fungal fruiting bodies) on the upper surface of leaves.
- In wet and highly humid weather conditions, fungal spores ooze out of acervuli on infected leaves and serve as secondary inoculum for epidemics of the disease in field during a season.
- Fruit symptom appears as brown to black sunken circular spots where black acervuli may be noticed, which affects fruit quality.



Management

- Differences in resistance to marssonina blotch were report among apple varieties. almost all cultivars of apple are susceptible to the disease.
- Developing and planting resistant cultivar is an economic , reliable, and effective way to control disease.
- Collect all disperse fallen leaves and fruit by burning or burying them. prune trees properly to improve air circulation in the canopies.
- Mancozeb have been used to control marssonina blotch of apple. Fungicide application may protect leaves from the disease and may suppress spore production on infected leaves.