B. Diseases

1. Citrus Black Spot

Citrus Black Spot is a fungal disease caused by *Phyllosticta citricarpa* (formerly *Guignardia citricarpa*), which affects citrus plants like oranges, lemons, and grapefruits. Citrus Black Spot thrives in warm, humid environments, making it a significant threat in tropical and subtropical citrus-growing regions.

Symptoms:

Affected fruits show reddish and dark depressed spots with brown margins. These lesions spread and coalesce, especially on fallen and harvested fruit. Severely affected fruit ripen prematurely and drops. In some cases, infected fruit that are asymptomatic at harvest may develop the symptoms in transport or storage. When severe symptoms develop before maturity, fruit often drop resulting in significant yield loss.

[https://www.hortifresh.org/wp-content/uploads/CitrusProductionManual_2022_online.pdf]

Causes:

Citrus Black Spot is a fungal disease caused by *Phyllosticta citricarpa* (formerly *Guignardia citricarpa*), which affects citrus plants like oranges, lemons, and grapefruits.

Prevention:

- Remove and destroy fallen leaves, infected fruits, and other plant debris where the fungus can survive and spread.
- Prune trees to improve airflow and reduce moisture, which can help slow fungal growth.
- Use disease-free, certified nursery plants when establishing new orchards.
- Avoid planting citrus trees in low-lying areas with poor drainage, as excessive moisture can promote fungal growth.
- Regularly inspect plants for early signs of infection, especially after periods of rain or high humidity.
- Quarantine new plants until they have been inspected and confirmed disease-free.

Treatment Option:

- Apply fungicides, such as copper-based products or strobilurins, following local guidelines and recommendations to prevent the disease from spreading.
- Start fungicide treatments at early fruit development and continue as needed, especially in high-risk, humid areas.

Impact on fruit quality

The disease leaves fruit speckled and lesioned but does not affect the internal quality of the infected fruit. It can lead to blemishes, premature fruit drop, and lower fruit quality, affecting both the yield and market value.

2. Citrus Canker

This is a bacterial disease. It appears as brownish-yellow spots on the leaves, stems, and fruits. When spots form on the fruits, the quality of the fruit deteriorates. This disease starts spreading before the rainy season and spreads rapidly during it. The disease can be transmitted by leaf-miner insects, which carry the bacteria into the plant through wounds or damage caused by insects or other factors. Additionally, the disease can spread through pruning tools as well.

Symptoms:

Disease begins as small pimple-like spots that are about 1 mm in diameter and yellow in color. As the spots enlarge, they become brown and corky with sunken centers and raised edges. Often each of these spots have a yellow ring surrounding them. [https://agriculture.vic.gov.au/biosecurity/plant-diseases/fruit-and-nut-diseases/citrus-canker#:~:text=Symptoms%20of%20citrus%20canker,-Figure%201%3A%20Fruit&text=Disease%20begins%20as%20small%20pimple,a%20yellow%20ring%20surrounding%20them.]

Transmission:

This disease starts spreading before the rainy season and spreads rapidly during it. The disease can be transmitted by leaf-miner insects, which carry the bacteria into the plant through wounds or damage caused by insects or other factors. Additionally, the disease can spread through pruning tools as well.

Prevention (Management practices):

- Obtain plants from a nursery free from disease; avoid plants from low-altitude areas.
- Prune and remove infected parts, and apply pesticide to the remaining healthy sections.
- During December–January, spray a 1% Bordeaux mixture or Copper Oxychloride at 2-3 grams per liter of water.

Treatment

- During December–January, spray a 1% Bordeaux mixture or Copper Oxychloride at 2-3 grams per liter of water.
- Mix 1 gram of Streptomycin Sulfate + Tetracycline Hydrochloride in 3-5 liters of water and spray, or
- Mix 2 ml of Kasugamycin (Kas-B) per liter of water and spray.

3. Huanglongbing (HLB / Citrus Greening Disease):

Early signs

Asian citrus psyllid

- Eggs are yellow-orange and almond-shaped. They are often tucked inside crevices and leaf folds.
- Nymphs are difficult to see, but leave behind waxy, white excretions on plants.
- Adult psyllids are gnat-sized, only about 1/8-inch long. When approached, they jump or fly.
- Adults have three abdominal colors: blue-green, gray-brown, or orange-yellow.
- Adults have mottled brown wings, and the last two segments of their antennae are black.

Citrus greening

- Once infected, a tree can remain asymptomatic, serving as a source of bacteria that infects other trees.
- Over time, an infected tree will start producing fewer fruit that are partially green, smaller, shaped irregularly, and taste bitter.
- Leaves may show asymmetrical, blotchy mottling.
- Trees may show twig dieback and premature fruit drop.

[https://www.aphis.usda.gov/plant-pests-diseases/citrus-diseases/citrus-greening-and-asian-citrus-psyllid]

Spread and Causes:

The primary carrier of this disease is the Asian citrus psyllid, an insect commonly found in warmer regions below 1100 meters in altitude. They first of all affect few trees and then spread throughout the orchard.

Preventive Measures of Citrus Greening Disease:

- Monitor and inspect the presence of citrus psyllid carriers in orchards located at altitudes below 1100 meters. Always obtain plants from nurseries located above 1100 meters.
- Avoid plants from infected nurseries. Use only healthy seedlings, destroy infected plants, maintain modern nursery practices, produce seedlings in screened houses, manage psyllid carriers, and apply pesticides as needed.
- Only plant certified budwood within screen houses. Use scratch tests and PCR methods to diagnose the disease.
- For integrated disease management, identify and survey affected areas, use scratch tests for disease detection, manage psyllid carriers and disease, and destroy infected plants as part of an internal control system.

Treatment:

There is no treatment or cure for citrus greening. Infected trees eventually die. The best way to prevent the introduction of citrus greening is to prevent the introduction of the Asian citrus psyllid.

4. Citrus Sooty Mold:

Identification

This disease spreads over the leaves, branches, and fruits of the plant, partially or completely covering them with a black layer. Since it is lightly attached, it can be scraped off by hand. By obstructing light absorption, it weakens the plant's health. The shoots and branches of the affected plant start to wither. The size of the affected fruits is also slightly smaller.

Primary hosts:

This disease is caused by pests like whiteflies and aphids.

Removal Methods:

The fungus is lightly attached, it can be scraped off by hand. Moreover, To remove the fungus from infected plants, mix 2 grams of Mancozeb (Dithane-45) per liter of water and spray.

Preventive Measures of Citrus Sooty Mold:

- This disease is caused by pests like whiteflies and aphids. To control these insects, use Dimethoate (Rogar) (डाईमेथोएट (रोगर) कीटनाशक) pesticide at 1–1.5 ml per liter of water or mix 5-7 ml of neem oil per liter of water and spray.
- Regular pruning, keeping the garden clean, and maintaining proper spacing reduce the chances of pest infestations, thereby decreasing the likelihood of this disease.
- Aphid populations tend to increase significantly from mid-May to August, which is also when this disease commonly appears. Therefore, regular inspection of the garden during this period is essential.

5. Citrus Scab

Symptoms and Carrier:

This disease is caused by mold named Elsinoe fawcetti. It has more effect on leaves and fruits. As its infestation increases, it spreads to the fruit. It damages most fruits. After being attacked by this disease, scabs with raised blisters appear on the peel of the fruit. Although this disease does not affect the plant immediately, it has a direct effect on the market price of the fruit.

Preventive Measures of Citrus Scab:

- Do not plant the crops produced in the diseased area and do not sell and distribute them elsewhere.
- Regularly spray 1 percent Bordeaux mixture 3 times a year in Poush-Magh,Baishak-Jestha and Bhadra-Ashoj. In addition, spray 1 gram benomyl or carbendazim mixed with water.

Healthy Plants:

Visual Indicators

The healthy plants have following characteristics:

- Fast Growth
- Healthy roots
- Healthy leaves characteristics
- Blooming
- No pests

Routine care tips (Seasonal care tips):

These activities should be implemented throughout the year to ensure the health and productivity of orange trees:

Poush-Magh (Flowering and Vegetative Growth Period)

- Remove weeds and other unnecessary plants.
- Prune dead, diseased, and damaged branches, as well as any parasitic plants. Apply Bordeaux paste to cut areas immediately after pruning.
- Soil Preparation and Fertilization:
    - Create a ring-shaped basin around the plant.
    - Add 30 kg of compost or manure, 450 g of urea, 250 g of DAP, 350 g of potash, and 100 g of agricultural lime to the basin.
    - Apply half the urea and other fertilizers (around 325 grams) now; reserve the remaining half of the urea for application in Jestha.
    - Cover the fertilizer with soil and irrigate thoroughly.

Baisakh-Jestha (Fruit Development Stage)

- Prepare and spray a mixture of zinc sulfate, copper sulfate, magnesium sulfate, and ferrous sulfate.
- Apply Bordeaux paste to areas affected by gummosis.
- At the banana-seed stage of fruit development, spray a 1% Bordeaux mixture in Baisakh, and repeat after 40 days.
- For plants affected by foot rot and root rot, mix Ridomil M-72 at a rate of 2.75 grams per liter of water and drench around the basin.
- If soil pH is below 4.5–5, apply 200 grams of dolomite lime per plant every 3 years.
- Use pesticide traps and protein baits to control fruit rot.

Ashah-Shrawan (Intensive Vegetative Growth and Secondary Growth Phase)

- Spray Rogar or Malathion (2 ml per liter of water) to control pests like Patero and Lahi.

- Use Servo Agro Spray (10 ml per liter of water) to manage cutworms and leaf-mining insects.
- Keep the garden clean and tidy.
- Ensure proper drainage if there is water accumulation.
- If borer damage is observed, place a cotton ball soaked in petrol or kerosene in the borehole and seal it.
- Support branches as necessary to prevent breakage.
- Apply Bordeaux paste and spray Bevishtin (2 ml per liter of water). Spray sulfur (2 grams per liter of water) to control fungal issues.
- During the rainy season, manage high temperatures and humidity, which may lead to scab disease, rot, and root rot. Apply Bordeaux mixture as needed and maintain garden cleanliness.

Bhadra-Kartik-Mangsir (Maturity Phase)

- Spray Rogar or Malathion (2 ml per liter of water) to manage pests.
- Use pheromone traps (methyl eugenol) for insect monitoring.
- Apply mulch (such as straw, wood dust, or dry leaves) around the plants to retain moisture and manage temperature changes.

Harvesting:

- Use pruning scissors for double clipping when harvesting fruits, keeping the button (head) on the fruit to prevent disease.

- Avoid bruising or rind wounds to ensure quality, especially for export or fresh sale.

- Use bags for harvesting to prevent fruits from falling to the ground; gently transfer fruits from bags to crates.

- Keep harvested fruits off the soil and always under shade to preserve vitamins and prevent spoilage.

- For processing, place fruits on tarpaulin or cut vegetation to avoid soil contact.

Post Harvesting

- Sorting of Fruits: Sorting involves removing debris (like leaves and twigs) and any damaged, bruised, immature, or spoiled fruits. This process helps prevent fruit deterioration and reduces transportation costs. During sorting, fruits are inspected, and unripe, undersized, damaged, or decayed ones are discarded.

- Grading of Fruits: Grading involves grouping fruits by similar size and color to enhance marketability. Uniformity in size, color, and lack of defects is essential as it boosts product presentation and value. This practice, often overlooked, especially for citrus, is crucial for creating a standard product that's easier to handle and more appealing to buyers.
- Packaging: Instead of traditional heaping, fruits can be packaged in boxes (10 kg, 20 kg, 50 kg, and 500 kg) designed to reduce postharvest loss. These boxes help determine yield per unit area and support easier handling and transport.
- Transport: Transporting fruits from the farm to market can lead to postharvest loss, especially if the vehicle is unreliable or overloaded. Using heavy vehicles and packing fruits in boxes helps prevent damage and loss during transit.

Common misdiagnosis:

Citrus Greening (HLB) vs. Nutrient Deficiency: Citrus greening, or Huanglongbing (HLB), often shows yellowing patterns in leaves that resemble zinc or iron deficiencies. Both conditions cause leaf chlorosis (yellowing), but HLB usually has asymmetrical blotching, while nutrient deficiencies display a more uniform yellowing.

Citrus Canker vs. Physical Damage or Sooty Mold: Citrus canker causes raised, corky lesions on leaves, stems, and fruit, which can be confused with physical damage from pests or abrasion. Additionally, sooty mold can look similar but is caused by fungal growth on honeydew excreted by pests, lacking the canker's distinct raised lesions.

Citrus Black Spot vs. Fungal Leaf Spots: Citrus black spot presents with dark lesions on the fruit rind that look like common fungal leaf spots, leading to misdiagnosis. Black spot lesions, however, are generally harder and more defined compared to other fungal spots.

Citrus Scab vs. Pest Damage: Citrus scab causes wart-like, raised lesions on fruit and leaves, which can be mistaken for pest damage from insects that create lumps or bumps. Scab lesions are typically more widespread and irregular compared to isolated pest bite marks.

[https://www.lsuagcenter.com/~/media/system/9/2/4/5/9245b6a15f86068840811a1b56359a59/a%20guide%20to%20citrus%20disease%20identificationpdf.pdf]

General Plant care:

1. Watering: Citrus trees require consistent watering, especially in the summer. Young trees need about 10-12 gallons of water daily during hot months. Establish a watering routine that keeps the soil consistently moist but not waterlogged.

2. Fertilization: Use a fertilizer specifically formulated for citrus trees. Apply it in three "meals" during the growing season (spring and summer) to provide essential nutrients like nitrogen, phosphorus, potassium, and trace minerals. Young trees should receive frequent, light doses, while mature trees should be fertilized four to five times a year.

3. Site Selection and Planting: Choose a sunny location with at least 15 feet of space between trees. When planting, ensure the root ball is at the same depth it was in the pot and create a basin around it to hold water.

4. Pruning: Remove suckers and any dead or damaged branches. Mature trees do not require heavy pruning, as excessive cutting can reduce fruit production.

5. Pest Management: Monitor for pests and diseases, and utilize integrated pest management (IPM) strategies, including biological and cultural controls.

6. Soil: Ensure the soil is slightly acidic to neutral (pH 6.0 to 7.0) for optimal nutrient uptake. Avoid letting grass or weeds grow around the tree base to prevent root rot.

[https://sfyl.ifas.ufl.edu/media/sfylifasufledu/baker/docs/pdf/horticulture/educator-resources/Citrus-Care-Basics.pdf]