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6. Diseases of Horticulture Crops and Their Management

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Abstract:

Plant diseases cause serious threats to the successful cultivation of horticultural crops, resulting in huge losses in their yields. These plant diseases are known to affect horticultural crops at various growth stages and reduce the yield as well as quality of fruits and vegetables.

Diseases also cause subsequent postharvest transit and storage losses. However, the diseases, if not managed on a war foot, it will result in drastic yield reduction and quality of the produces. Hence adoption of suitable management measures with low residue in the final produces. Plant diseases cause serious threats to the successful cultivation of horticultural crops, resulting in huge losses in their yields.

These plant diseases are known to affect horticultural crops at various growth stages and reduce the yield as well as quality of fruits and vegetables. The diseases causing most damage to horticultural crops like anthracnose, soft rot, powdery mildew, blight, virus, bacteria, storage fungus.

Keywords:

Fruits, Fungicides, Insecticides, Management, Symptoms.

6.1 Citrus:

A. Gummosis: *Phytophthora parasitica, P. palmivora,P. citrophthora:*

Symptoms:

- The symptoms appear as yellowing of leaves, followed by cracking of bark and profuse gumming on the surface.
- The main source of infection is infected planting material. As a result of severe gumming, the bark becomes completely rotten and the tree dries owing to girdling effect.
- Prior to death, the plant usually blossoms heavily and dies before the fruits mature. In such cases, the disease is called foot rot or collar-rot.

Pathogen: Aseptate, intercellular & intracellular hypha. Sporangia are ovoid or ellipsoid. Sporangium attached with the sporangium at the right angle's sporangia germinate to release zoospore.

Management:

- Preventive measures like selection of proper site with adequate drainage, use of resistant rootstocks and avoiding contact of water with the tree trunk by adopting ring method of irrigation are effective.
- Alternatively, the disease portions are scraped-out with a sharp knife and the cut surface is disinfected with Mercuric chloride (0.1%) or Potassium permanganate solution (1%) using a swab of cotton.
- Painting 1 m of the stem above the ground level with Bordeaux helps in controlling the disease.
- Also spraying and drenching with Ridomil MZ 72@ 2.75 g/l or Aliette (2.5 g/l) is effective in controllingthe disease.

B. Canker: *Xanthomonas campestris* pv *citri:*

Symptoms:

- Acid lime, lemon and grapefruit are affected. Rare on sweet oranges and mandarins. Affects leaf, twig and fruits.
- In canker, leaves are not distorted. Lesions aretypically circular with yellow halo; appear on both sides of leaf, severe in acid lime (difference from scab) When lesions are produced on twigs, they are girdled and die. Onfruits, canker lesions reduce market value.

Pathogen: It is Gram negative, non-spore forming, aerobic bacteria. It is rod shaped, forms chains and capsules and is motile by one polar flagellum.

Management:

- Streptomycin sulphate 500-1000 ppm; or Phytomycin 2500 ppm or Copper oxychloride 0.2% at fortnight intervals.
- Control leaf miner when young flush is produced.Prune badly infected twigs before the onset of monsoon.

C. Tristeza or quick decline: *Citrus tristeza virus*

Symptoms:

- Lime is susceptible both as seedling or buddling on anyroot stock. But mandarin and sweet orange seedlings or on rough lemon, trifoliate orange, citrange; Rangpur lime rootstocks tolerant; susceptible root stocks are grapefruit and sour orange.

- In sweet orange or mandarin on susceptible root stocks, leaves develop deficiency symptoms and absise. Roots decay, twigs die back. Fruit set diminishes; only skeleton remains.
- Fine pitting of inner face of bark of sour orange stock.Grapefruit and acid lime are susceptible irrespective of root stock.
- Acid lime leaves show large number of vein flecks (elongated translucent area).
- Tree stunted and dies yield very much reduced. Fruits are small in size.
- Use of infected bud wood and *Toxoptera citricida* (aphid) is the important vector.

Pathogen:

- Citrus tristeza virus is long, flexuous rod and measure 2000 x 12nm in size. Three strains viz., mild, severe and seedling yellow are reported.

Management:

- For sweet orange and mandarin, avoid susceptible root stocks. For acid lime, use seedling preimmunised with mild strain of tristeza.

D. Exocortis of Scaly Butt: *Viroid:*

Symptoms:

Affects only Rangpur lime, trifoliate orange and citrange root stocks. Verticalcracking and scaling of bark in the entire, root stock. Extreme stunting of plant.

Pathogen:

- Viroid is free RTVA without protein coat.

Management:

- Spray with any one of the systemic insecticides to control the aphid vector. Use virus-free certified bud wood; use tolerant stocks like rough lemon Periodically wash budding knife with disodium Phosphate solution.

E. Greening: *Liberobactor asiaticum* (Phloem limited bacteria):

Symptoms:

- This disease affects almost all citrus varieties irrespectiveof root stock. Stunting of leaf, sparse foliation, twig die back,poor crop of predominantly greened, worthless fruits. Sometimes only a portion of tree is affected.A diversity of foliar chlorosis.
- A type of mottling resembling zinc deficiency often predominates. Young leaves appear normal but soon assume on outright position, become leathery and develop prominant veins and dull olive green colour. Green circular dots on leaves.

- Many twigs become upright and produce smallerleaves. Fruits small, lopsided with curved columella. The side exposed to direct sunlight develops full orange colour but the other side remain dull olive green. Low in juice and soluble solids, high in acid. Worthless either as fresh fruit or for processing. Seeds poorlydeveloped, dark coloured.

Pathogen: Rickettsia like organisam

Management:

- Control psyllids with insecticides. Use pathogen free bud wood for propagation. 500 ppm tetracycline spray requires fortnightly application.

Pathogen:

- It is Gram negative, non-spore forming, aerobic bacteria. It is rod shaped, forms chains and capsules and is motile by one polar flagellum.

Management:

- Streptomycin sulphate 500-1000 ppm; or Phytomycin 2500 ppm or Copper oxychloride 0.2% at fortnight intervals.
- Control leaf miner when young flush is produced.Prune badly infected twigs before the onset of monsoon.

6.2 Mango:

A. Anthracnose: *Colletotrichum gloeosporioides:*

Symptoms:

- The disease appears on youngleaves, stem, inflorescence and fruits.Leaves show oval or irregular, greyish-brown spots which may coalesce to cover larger area of the leaf. The affected leaf tissues dry and shred.
- Leaves on infected petioles droop and fall. On young stem, grey-brown spots develop. These enlarge and cause girdling and drying of the affected area. The disease appears on young leaves, stem, inflorescence and fruits. Often, black necrotic areas develop on the twigs from the tip downwards causinga dieback.
- In humid weather, minute, black dots develop on the floral organs. Theinfected flower-parts ultimately shed resulting in partial or complete deblossoming. Latent infections of fruit are established before harvest.
- The ripening fruits show typical anthracnose. Black spots appearing on skin of the affected fruits gradually becomesunken and coalesce.

Pathogen:

- Mycelium septate and coloured. Conidia Single celled, hyaline, small and elongated.

Management:

- Spray *P. fluorescens* (FP 7) at 3 weeks interval commencing from October at 5g/like on flower branches. 5-7 sprays one to be given on flowers and bunches.
- Before storage, treat with hot water, (50-55°C) for 15 minutes or dip in Benomyl solution (500ppm) or Thiobendazole (1000ppm) for 5 minutes.

B. Powdery mildew: *Oidium mangiferae (Acrosporum mangiferae):*

Symptoms:

- Powdery mildew is one of the most serious diseases of mango affecting almost all the varieties. The characteristic symptom of thedisease is the white superficial powdery fungal growth on leaves, stalk of panicles, flowers and young fruits.
- The affected flowers and fruits drop pre-maturely reducing the crop load considerably or might even prevent the fruit set.
- Rains or mists accompanied by cooler nights duringflowering are congenial for the disease spread.

Pathogen:

- Mycelium is ectophytic. Conidiophores short, hyaline and conidia single celled barrel shaped, produced in chain. Fungus is odium type.

Management:

- Dusting the plants with fine sulphur (250-300 mesh) at the rate of 0.5 kg/tree. The first application may be soon after flowering, second 15 days later (or) spray with Wettable sulphur (0.2%), (or) Carbendazim (0.1%), (or) Tridemorph (0.1%), (or) Karathane (0.1%).

C. Mango malformation: *Fusarium moliliforme var. subglutinans:*

Symptoms:

- Three types of symptoms: bunchy top phase, floral malformation and vegetative malformation.
- In bunchy top phase in nursery bunching of thickened small shoots, bearing small rudimentally leaves.
- Shoots remain short and stunted giving a bunchy top appearance. In vegetative malformation, excessive vegetative branches of limited growth in seedlings. They are swollen with short internodes forming bunches of various size and the top of the seedlings shows bunchy top appearance.
- In malformation of inflorescens, shows variation in the panicle. Malformed head dries up in black mass and persist for long time.

- Secondary branches are transformed into numberof small leaves giving a witches broome appearance.

Pathogen: Micro conidia are one or 2 celled, oval to fusiform and produced from polyphialides. Macro conidia are rarely produced. They are 2 -3 celled and falcate. Chlamydospores are not produced.

Management:

- Diseased plants should be destroyed. Use of disease-free planting material. Incidence reduced by spraying 100-200 ppm NAA during October.
- Pruning of diseased parts along the basal 15-20 cm apparently healthy portions. This is followed by the spraying of Carbendazim (0.1%) or Captafol (0.2%).

D. Stem End Rot: *Diplodia natalensis:*

Symptoms:

- The dark epicarp around the base of the pedicel.In the initial stage the affected area enlarges to form a circular, black patch.
- Under humid atmosphere extends rapidly and turns the whole fruit completely black within two or three days.
- The pulp becomes brown andsomewhat softer. Dead twigs and bark of the trees, spreadby rains.

Pathogen:

- The fungus produces brown to black, globose to sub globose, pyriform, erumpent pycnidia that are ostiol. They are 120-155x370-465 micrometer.
- Two types ofconidia are produced within a pycnidium. One is hyaline, thin walled and unicellular. Another one is thick walled and bicelled with four to six longitudinal striations.
- Management
- Prune and destroy infected twigs and spray Carbendazim or ThiophanateMethyl (0.1%) or Chlorathalonil (0.2%) as fortnightly interval during rainy season.

6.3 Banana:

A. Panama disease: *Fusarium oxysporum* f. sp. *Cubense:*

Symptoms:

- Yellowing of the lower most leaves starting from margin tomidrib of the leaves. Yellowing extends upwards and finally heart leaf alone remains green for some time and it is also affected.

- The leaves break near the base and hang down around pseudostem. Longitudinal splitting of pseudostem. Discolouration of vascular vessels as red or brown streaks. The fungus spreads through use of infected rhizomes Continuous cultivation results in buildup of inoculum.

Pathogen:

- Mycelium is septate, hyaline and branched. Fungus produces micro, macro conidia and also chlamydospores. Micro conidia - Single celled or rarely one septate hyaline elliptical or oval. Macro conidia - Sickle shaped hyaline, 3-5 septate and tapering at both ends.
- Chalamydospores - Thick walled, spherical to oval, hyaline to slightly yellowish in colour.

Management:

- Avoid growing of susceptible cultivars *viz.,* Rasthali, Monthan, Red banana and Virupakshi. Grow resistant cultivar Poovan.
- Since nematode predispose the disease pairing and prolinage wit Carbofuran granules.
- Corm injection of 3 ml of 2% Carbendezim injected in the corm by making a hole to a depth of 10cm with 45^{o} angle on 5th and 7th month as mentioned earlier.

B. Moko disease: *Pseudomonas solanacearum / Burkholderia solanacearum*

Symptoms:

- Leaves become yellow and progress upwards. The petiole breaks and leaves hang. When it is cut open discolouration in vascular region with pale yellow to dark brown colour.
- Thediscolouration is in the central portion of the corm. Internal rot of fruits with dark brown discoloration. When the pseudostem is cut transversely bacterial ooze can be seen.

Pathogen: It is rod-shaped, gram-negative bacterium with one polar flagellum.

Management:

- Eradicate infected plant. Expose soil to direct sunlight. Use of clean planting material. Fallowing and crop rotation is advisable.
- Disinfection of pruning of tools. Providing good drainage.

C. Sigatoka disease: Mycosphaerella musicola (Cercospora musae**):**

Symptoms:

- On leaves small light yellow or brownish green narrow streaks appear.

- They enlarge in size becomes linear, oblong, brown to black spots with dark brown brand and yellow halo. Black specks of fungal fruitification appear in the affected leaves.
- Rapid drying and defoliation of the leaves.

Pathogen:

- Conidia are elongated, narrow and multi septate and measure 20 – 80 x 2-6micronmeter.
- Perithecia are dark brown to black and asci are oblong, clavate and measure 28.8-36.8x8.0-10.8 micro meter. Ascospores are one septate, hyaline, obtuse with upper cell slightly broader.

Management:

- Removal and destruction of the affected leaves. Spray Propiconazole + Carbendazim 0.1% or Chlorothalonil 0.25%. Add wetting agent such as teepol or sandovit added at the rate of 1ml/lit of water.

6.4 Potato:

A. Late blight of potato: *Phytopthora infestans:*

Symptom:

- It affects leaves, stems and tubers. Water-soaked spots appear onleaves, increase in size, turn purple brown& finally black colour White growth develops on under surface of leaves. This spreads to petioles, rachis& stems.
- It frequently develops at nodes. Stem breaks at these points and the plant topples over.
- In tubers, purplish brown spotsand spread to the entire surface on cutting, the affected tuber show rusty brown necrosis spreading from surface to the center.

Pathogen:

- The mycelium is endophytic, coenocytic and hyaline which are inter cellular with double club shaped haustoria type.
- Sporangiophores are hyaline, branched intermediate and thick walled. Sporangia are thin walled, hyaline, oval or pear shaped with a definite papilla at the apex.
- The sporangium may act as a conidium and germinate directly to forma germ tube. Zoospores are biflagellate possess fine hairs while the other does not.

Management:

- A regular spraying and dusting during the growing season give effective control. First spraying should be given before the commencement of the disease and subsequent should follow at requlr interval of 10 -15 days.

- Protective spraying with mancozeb or zineb 0.2 % should be done to prevent infection of tubers. Destruction of the foliage few days before harvest is beneficial and this is accomplished by spraying with suitable herbicide.
- Tuber contamination is minimized if injuries are avoided at harvest time and storing of visibly infected tubers before storage.
- The resistant varities recommended for cultivation are Kufri Naveen, Kufri Jeevan, Kufri Alenkar, Kufri Khasi Garo and Kufri Moti.

B. Early blight: *Alternaria solani:*

Symptoms:

- It is present in both hills & plains. Brown- black necrotic spot-angular, oval shape characterized by concentric rings. Several spots coalesce & spread all over the leaf. Shot holes on fruits.

Pathogen:

- Hyphae are light brown or olivaceous which become dark coloured with age. The hyphae are branched, septate and inter and intra cellular.
- The coniophores emerge through the stomata or between the epidermal cells. The conidia are club shaped with a long beak which is often half the long of the whole conidium.
- The lower part of the conidium is brown while the neck is colorless. The body of the conidium is divided by 5 – 10 transverse septa and there may or may not be a few longitudinal septa.

Management:

- Disease free seed tubers should be used for planting. Removal and destruction of infected plant debris should be done because the spores lying in the soil are the primary source of infection.
- Very early spraying with Zineb or captan 0.2% and repeating it for every 15 – 20 days gives effective control. The variety Kufri Sindhuri possesses a fair degree of resistance.

C. Black scurf: *R. solani:*

Symptoms:

- Black speck, black speck scab, russetscab on tubers. At the time of sprouting dark brown colour appear on the eyes.
- Affected Xylem tissue causes to wilting of plants. Infected tuber contains russeting of the skin.Hard dry rot with browning on internal tissue.
- Spongy mass appears on the infected tuber. Seed tubers are source of spread. Moderately cool, wet weather and temp 23 ℃ are the favourable for the development of disease.

Pathogen:

- The mycelium is hyaline when young and brown at maturity. Hyphae are septate and branched with a characteristic constriction at their junction with the main hyphae. The branches arise at a right angle to main axis.
- Sclerotia are black. A basidium bears four sterimata each with a basidiospore at the end. The basidiospores are hyaline, elliptical to obovate and thin walled. They are capable of forming secondarybasidiospores.

Management:

- Disease free seed tubers alone should be planted. If there is a slight infection ofblack scurf that can be controlled by treating seed tubers with mercuric chloride solution for 1.5 hr with acidulated mercuric chloride solution for 5 min.
- Treating the soil with pentachloroni trobenzene at the rate of 70 kg/ ha lowers the incidence of the disease, butit is too expensive and cumbersome.
- Well sporulated tubrs may be planted shallow to control disease. The disease severity is reduced in the land is left fallow for 2 years.

D. Common scab or corkey scab:

Streptomyces scabies:

Symptoms:

- Corkiness of the tuber periderm is the characteristics symptoms. 1/4 inch into the tuber surface are russette appearance. Slightly pitted on the infected tuber. Light brown to dark brown lesion appears on the infected tuber. Affected tissue will attract insects.

Pathogen:

- Aerial mycelium in pure culture has of prostrate branched threads. Sporogenous hyphae are spiral in form.
- Conidia are produced by the formation of septa at intervals along the hyphae, which contract to form narrow isthmuses between the cells.
- Conidiaare roughly cylindrical and hyaline. The conidia can germinate even at higher temperatures. The growth of the organisam is good in slightly alkaline medium and is checked at pH 5.2.

Management:

- Only scab free seed potatoes should be planted as this will help in checking the spread of the inoculum and infection to be subsequent crop.
- Infection of the seed tubers can be removed by 1.5hrs dip in mercuric chloride 0.1% solution or by 2h dip in 1 part formaldehyde in 240 parts of water. This disease can be reduced by soil application of PCNB at the time of planting.

- Four to six years crop roation with alfalfa satisfactory under irrigated conditions. The disease incidence can be effectively reduced by green manuring the fields before planting potatoes.
- Common scab is severe in alkaline soil and application of alkaline fertilizers like calcium ammonium nitrate should be avoided.

E. Brown rot or Bangle blight: *Ralstonia solanacearum:*

Symptoms:

- At the time tuber formation wilt is the main characteristic symptom. In leaf symptom - wilt, stunt and yellowing. Browning of xylem tissue. Eye buds are black in colour. Bacteria ooze coming on infected tuber surface and emits a foul odour.

Pathogen:

- Gram –ve, short rod, 1-4 flagella. Colonies are white to brown in colour

F. Soft rot: *Erwinia carotovora* subsp *caratovora:*

Symptoms:

- Infection at two phases are black leg and soft rot. Black lesions appear on the baseof the plant. Systemic and browning ofinfected tubers.
- Yellow appearance of the plant. Finally, the plants wilt and die. Lenticels (water-soaked brown rot). Rot and collapse of tubers. Soft, reddish or black ring appear on the infected tuber.

Pathogen:

- It is a gram-negative, rod-shaped bacterium with 1 to 6 peritrichous flagella.

Management:

- The pathogen is difficult to control because of long survival both on seed tubers and in soils. However, using disease free seed tubers could minimize the disease incidence. Before planting the seed, tubers are treated with Boric Acid (3% for 30 minutes) and driedin shade. The same treatment is repeated before the storage of the tubers.
- The disease can be reduced by soil application of PCNB (30 kg/ha) at the time of planting. Following crop rotations with wheat, pea, oats, barley, lupin, soybean, sorghum and bajra checks the disease development. In plains, treatment of the seed tubers with TBZ + acetic acid + 0.05% Zinc Sulphate solution or Carbendazim 1% for 15 minutes effectively controls the disease. Soaking of tubers in Mercuric chloride 0.1% formalin.

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