B. Sc. (Ag). 3rd Year, IInd Semester
Course Title: Diseases of Field & Horticultural Crops and their Management-II
Topic: diseases of cucurbits and Citrus

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Downy mildew of Cucurbits

Introduction:
- Downy mildew is an important disease of cultivated Cucurbits, specifically sponge gourd, ridge gourd, Muskmelon and Cucumber.

Symptoms:
- The first symptoms on the leaves resemble those of mosaic mottling.
- The pale green areas are separated by is lands of darker green.
- Soon the spots become well-defined. They are angular, yellow and often restricted by veins on the upper surface.
- On the lower side of those spots a purplish colour is lacking and the lower side of the spots looks white to almost black.
- The entire leaf quickly dies. Usually, the central leaves are attacked first and are followed by other leaves until the entire plant is wilted or weakened.

Causal organism: Pseudoperonospora cubensis
- The mycelium is coenocytic and intercellular with small, ovate haustorea which sometimes develop finger-like branches.
- The sporangiophores arise singly or in groups of 2-5 through the stomata.
- The upper third of the sporangiophore is branched dichotomously or intermediate between dichotomous and trichotomous branching habit.
- The sporangia are grayish to olivaceous purple, ovoid to elliptical, thin walled and with a papilla at the distal end, 21-39 X 14-23 μ in size.
The germination of sporangia occurs by production of biflagellate zoospores which are 10-13 microns in diameter when in resting stage.
The zoospores are spherical, rarely obovoid to ellipsoid, light yellow, and smooth walled. They measure 19-22 microns in diameter.

Sporangia of *Pseudoperonospora cubensis*

Disease cycle:

- The great diversity of climate and season in different parts of India and the abundance of wild Cucurbits hosts would probably ensure continuous supply of primary inoculums of the fungus.
- In areas where oospores are found these may be an important source of survival and primary inoculums for initiation of the disease.
- Dispersal of sporangia starts as soon as they are mature and detached. They are carried away mainly by wind or are dispersed by raindrop splashes and then carried by wind.
- Spotted Cucumber beetles also transport the sporangia.
- Contact between diseased and healthy leaves also causes local spread.

Favorable environment:

- Free moisture on leaf surface is essential for germination of sporangia.
- The optimum temperature for germination and zoospores production lies between 15 and 20°C.
- Low relative humidity favors dispersal of sporangia.

Control:

- Some of the cultural practices that help in reducing losses from the downy mildew are early sowing, destruction of weed hosts, proper nutrition and reducing the amount of moisture among the vines.
The spraying of some protectant fungicides like Mancozeb, Zineb and Tricop-50 (tribasic copper sulphate) @ 0.2-0.3 % at 5-7 days intervals.

Other fungicides that have been used are Difolatan & chlorothalonil.

Ridomil (Metalaxyl + Mancozeb) @ 0.2 % is more effective in controlling the disease.

Use of resistant variety. (LC-8 and PPDMR-4 were identified as resistant to downy mildew).

**Powdery mildew of Cucurbits**

**Introduction:**

Powdery mildew is sometimes a destructive disease of cucurbits especially Pumpkin and Bottle gourd.

**Symptoms:**

- On cultivated Cucurbits the first symptoms are tiny, white to dirty grey spots (sometimes with reddish brown tinge) on leaves and stems.
- Most extensive development of the mildew occurs on the upper surface of the leaf. After sometimes, these spots enlarge the superficial powdery mass may ultimately cover the entire host surface.
- Black point bodies, representing the ascigerous stage of the fungus, appear rarely late in the season. They have been found in India only during the winter months.
- The effect of severe infection may be premature defoliation of the plant.
- The diseased fruits remain undersized and are often deformed.

![Symptoms of powdery mildew on cucurbits leaf](image)
**Causal organism:** *Erysiphe cichoracearum & Sphaerotheca fuliginea*

- Khan & Khan (1970) had stated that *E. cichoracearum* may be responsible for Cucurbit powdery mildew in other countries, not in India.
- Siradhana and Chadhari (1972) reported the occurrence of both species on Cucurbits at Udaipur (Rajasthan).

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<tr>
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<th><em>Erysiphe cichoracearum</em></th>
<th><em>Sphaerotheca fuliginea</em></th>
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<tbody>
<tr>
<td><strong>Mycelium:</strong></td>
<td>Hyaline well developed, evanescent but sometimes persistent and effused.</td>
<td>Hyaline, occasionally brown when old, usually evanescent but sometimes persistent.</td>
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<tr>
<td><strong>Conidia:</strong></td>
<td>Produces in long chains, ellipsoidal or barrel-shaped, 24x14-36 μ in size.</td>
<td>In long chains, often with distinct sib rosin bodies, ellipsoidal to barrel shaped 27-31x15-18 μ in size.</td>
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<tr>
<td><strong>Cleistothecia:</strong></td>
<td>Gregarious or scattered, globose, becoming depressed or irregular, 90-135 μ in diameter contain 10-25 asci.</td>
<td>Cleistothecia are rare, scattered to density gregarious, 6698 μ in diameter and contain one ascus.</td>
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<tr>
<td><strong>Appendages:</strong></td>
<td>Numerous, basally inserted, myeloid, interwoven with the mycelium and hyaline to dark brown, 1-4 times as long as the diameter of the cleistothecium.</td>
<td>Variable in number, usually as long as the diameter of the cleistothecium, myeloid, tortuous, brown, interwoven, with the mycelium but sometimes long nearly straight but dark brown.</td>
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<tr>
<td><strong>Ascus:</strong></td>
<td>Ovate to broadly ovate, rarely subglobose, more or less stalked, 60-90X25-50 μ size.</td>
<td>Broadly elliptical to subglobose and 50-80X3060 μ in size.</td>
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<tr>
<td><strong>Ascospores:</strong></td>
<td>Tow per ascus rarely three, measure 20-30X12-18 μ.</td>
<td>Each ascus contains 8 ascospores which are ellipsoid to nearly spherical and measure 17-22X12-20 μ.</td>
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Various structures of *Erysiphe cichoracearum & Sphaerotheca fuliginea*
Disease cycle:
- There are many possible means of survival of these fungi between two crop seasons.
- Where cleistothecia are formed they can explain the mode of perennation from one crop season to the next.
- In India these sexual fruit bodies develop on left over Cucurbit crops during winter in isolated areas or in the sub-mountainous areas in North.
- These may initiate the disease in the local hosts and from there the primary inoculums in the form of conidia might be blown by wind to the main crop in the plains.

Favorable environment:
- The fungi can sporulate and cause infection in a very dry as well as wet atmosphere but infection increases the atmospheric humidity increases, heavy dew deposits favoring the penetration by germ tubes.
- The temperature range 26-28°C with high relative humidity (< 95 %) and reduced sunshine hours significantly help in disease development.

Control:
- The Cucurbit weed hosts should not be allowed to grow near the cultivated fields. The diseased crop debris should be burnt.
- One to three sprays of any one fungicide like Sulfex (0.2%), Calixin (0.1%), Karathane (0.05-0.2%), Bavistin (0.1%) at 10-12 days intervals are required.
- The mycoparasite *Ampelomyces quisqualis* is a biocontrol agent against powdery mildew caused by *Erysipe* and *sphaerotheca*.
- *Verticillium lecanii*, as a biocontrol agent, is another Valuable alternative to current management strategies for powdery mildew.
- Use of disease resistant variety (In muskmelon, cultivars diguria and Haragola are reported to be immune to the disease).
Citrus canker

Introduction:

- Canker was recognized as a new disease in citrus in 1913 in Florida as it was earlier confused with citrus scab (Elsinoe fawcetti).
- The disease become so severe in USA that mass eradication of diseased plants was undertaken to prevent its spread.
- In India citrus canker was first reported from Punjab in 1940 (Luthra & Sattar). The disease is now occurs in all citrus growing areas of the country.
- The disease is presently prevalent in Africa, Asia, Australia and South America.
- The disease causes heavy losses when the infection occurs at the early stage.

Symptoms:

- The symptom of the disease are observed on all the aerial parts including leaves, twigs and fruits as necrotic brown spots having a coarse raised surface.
- On young leaves, the lesion appear as small white specks at the very early stage later, on these lesions develop in to brown necrotic spots (1-2 mm).
- The lesions further enlarge and become white or grayish which give a rough, corky, and crater like appearance. These lesions surrounded by a yellowish helo.
- The cankers are irregular, rough and more prominent on twigs and branches.
- The fruit lesions are quite rough, raised brown to dark brown in colour.
- The presence of many lesions on the fruit may result in small and misshapen fruits especially when the infection is early.

Canker symptoms on fruit

Causal organism: Xanthomonas axonopodis pv. Citri

- The bacterial cells are rod shaped, 1.5-2.0 X 0.5-0.75 µ in size & Gram negative.
- It forms chains and capsule but no spores and motile by one polar flagellum.
- Colonies on beef agar are circular, straw yellow to amber yellow, slightly raised and glistening.
Disease cycle:

- Since citrus is a perennial plant, there is no problem for the survival of the bacterium, which easily over-winters on cankered lesions on the leaves, twigs and fruits.
- The bacteria enter the plant tissue through stomata on leaves or small wounds.
- The bacterial cells start multiplying inside the tissue during the onset of spring and ooze out in large numbers.
- The cells are splashed on to young tissues through rain water.
- The dissemination of the bacteria through leaf minor (*Phyllocnismistis citrella*).
- The long distance dissemination is through the transfer of diseased planting bacterial.

Favorable environment:

- The disease is favored by mild temperatures and wet weather.
- Temperatures between 20 and 30°C with good evenly distributed rains are most suitable for disease development.
- Presence of free moisture on the host surface for at least 20 minutes is essential for successful infection.

Control:

- In canker free citrus producing areas, strict quarantine measures are practiced to exclude the pathogen.
- Raising canker free nursery plants is the first essential steps in citrus canker management.
- The infected plant parts should be pruned out and destroyed.
- Foliar sprays of Streptocycline (100 ppm) + Copper Oxychloride (0.1%) at 7 or 15 days interval have been found effective.
- Two pruning’s, along with four sprays of Copper Oxychloride (0.5%) or 1% Bordeaux mixture (5:5:50) were found effective against the disease.
- Application of Neem cake (80 kg/ acre) is highly effective against citrus canker as well as leaf miners.
- Some biological control against like *Pseudomonas syringae*, *Bacillus subtilis*, *Bacillus polymyxa*, *P. fluorescens*, *Aspergillus terreus*, *Trichoderma viride* and *T. harzianum* have been reported to be effective against the disease.
- Use of resistant variety seedless lime is reported as a resistant variety against citrus canker.