

## Lecture 12 - Diseases of Cucurbits (2 Lectures)

### Cucumber and squash

**Vascular Wilt:** *Erwinia tracheiphila*

#### Symptoms



Symptoms of the disease first appear on a single leaf which suddenly wilts and becomes dull green. The wilting symptoms spread up and down the runner sometimes as a recurring wilt on hot, dry days. Soon infected runners and leaves turn brown and die. The bacteria spread through the xylem vessels of the infected runner to the main stem, then to other runners. Eventually the entire plant shrivels and dies.

Less susceptible plants, such as certain squash varieties, may show dwarfing of growth before the wilt symptoms become apparent.

Creamy white bacterial ooze consisting of thousands of microscopic, rod-shaped bacteria may sometimes be seen in the xylem vascular bundles of an affected stem if it is cut crosswise near the ground and squeezed. This bacterial ooze will string out forming fine, shiny threads (like a spider's web) if a knife blade or finger is pressed firmly against the cut surface, then slowly drawn away about 1 cm.

Two cut stem ends can also be put together, squeezed, then separated to look for shiny strands of bacteria. The sap of a healthy plant is watery and will not string. Sometimes it helps to wait several minutes after cutting to perform the test. This technique is useful in field diagnosis to separate this disease from other vascular wilts. Beware, however, that the technique may not always work (i.e., no bacterial strings occur yet the plant is still infected). The test works better

for cucumbers than for muskmelons. Fruit may also show symptoms. Small water-soaked patches form on the surface. These patches eventually turn into shiny decayed spots on the fruit.

### **Pathogen**

It is a motile rod with 4 – 8 peritrichous flagella and capsulated. Agar colonies are small, circular, smooth, glistening white and viscid.

### **Mode of spread and survival**

The bacteria apparently overwinter in cucumber beetles and they appear to multiply in the beetle. The bacterium is not seed borne or soil borne. Bacteria in stems can survive for one month. Beetles prefer to feed on plants with bacterial symptoms than on healthy plants. Beetle can remain infective for atleast three weeks. Striped cucumber beetle and the 12- spotted cucumber beetle help in the spread of the bacterium.

### **Management**

Larger plantings must be protected by insecticides. Some carbaryl (Sevin), malathion, or rotenone insecticides or combination products are registered to treat cucumber beetles. They will provide control of the beetles if applied when beetles first appear in the spring. Early control, beginning as soon as the plants emerge, is most important as a single beetle can introduce the bacteria. One to four generations of the beetle may occur on unprotected plants and applications of these insecticides at weekly intervals may become necessary. Apply a light even coating of the insecticide over the entire plant, especially where the stem emerges from the soil (that is where the beetles often congregate).

**Scab:** *Cladosporium cucumerinum*

### **Symptoms**



Scab lesions appear on all parts of the vine that are above ground. The first symptoms appear as light water soaked or pale green spots on the leaves. These spots are numerous and appear on and between veins. Similar elongated spots develop on petioles and stems. Gradually, the spots turn grey to white and become angular.

The affected leaves near the tip of the vine may be stippled with dead and yellowish spots, stunted and crinkled. Fruits are infected at all stages of growth but is most susceptible while young. Fruit spots are grey, slightly sunken and about 2.0mm in dia.

### **Pathogen**

Conidia are oblong, dark, mostly aseptate.

### **Mode of spread and survival**

The fungus probably survives in old cucumber refuse or soil in cracks and on seed. It is disseminated by insects, clothings and tools.

### **Disease Cycle**

The scab organism survives in soil on squash, melon, and pumpkin vines and reportedly may grow extensively as a saprophyte. The fungus may also be seed borne. It is disseminated on clothing and equipment and by insects. The conidia can survive long-distance spread in moist air. The most favorable weather conditions for disease development are wet weather and temperatures near or below 21°C. At 17°C the growing tips of young plants are killed. Conidia germinate and enter susceptible tissue within 9 hr. A spot may appear on leaves within 3 days, and a new crop of spores is produced by the fourth day.

### **Management**

Crop rotation with corn once in 4 years. Grow resistant varieties like Highmoor and Maine no.2. Spray Mancozeb 0.2 %.

### **Musk melon and water melon**

### **Gummy Stem Blight - *Mycosphaerella melonis***

#### **Symptoms**



Infected stems first appear water-soaked and then become dry, coarse and tan. Older stem lesions (dead tissue) reveal small black fruiting bodies (pycnidia) within the affected tissues. Large lesions girdle stems and plants wilt in the heat of the day. Stem lesions on melons exude a gummy, red-brown substance which may be mistaken for a symptom of Fusarium wilt.

### **Mode of spread and survival**

The pathogen can be seed-borne and, thus, can spread by infected seedlings. The inoculum of the pathogen can also come from other cucurbitaceous host plants and weeds and infected plant debris in and around the facility. The pathogen produces two types of spores: asexually-produced pycniospores, and sexually-produced ascospores. Both types of spores are short-lived once they are released into the environment. However, the pathogen can survive up to 2 years as chlamydospores or mycelium on undecomposed, dry plant debris.

### **Disease Cycle**

The gummy stem blight fungus is both seed- and soil-borne. The pathogen may be carried in or on infested seed. In the absence of host plants, the fungus can over winter for a year and a half or more on infected crop residue. The exact length of survival in the Northeast is currently being studied. The fungus survives as dormant mycelium or as chlamydospores (thick-walled modifications of the mycelium). In northern areas of the country in the spring, pycnidia are produced, giving rise to conidia, which serve as the primary inoculum. Conidia are released through a pore (ostiole) in the pycnidia and if moisture is high, conidia exude as "spore horns" containing thousands of conidia. Conidia vary in size, are short and cylindrical, with usually one septum near the middle, or they may be unicellular. Under moist conditions, they are readily dispersed by splashing water.

Both temperature and moisture are critical for germination, sporulation, penetration of conidia, and subsequent symptom development, but moisture (relative humidity over 85 percent, rainfall and duration of leaf wetness from 1 to 10 hours) has the greatest influence. The optimal temperature for symptom development varies depending on the cucurbit for watermelon 75° F is optimal, for cucumber 75-77° F, and for muskmelon 65° F. The optimal temperature for muskmelon reportedly is lower because its resistance increases at high temperatures.

This can be significant to determine when early-season disease scouting should be initiated for future control. Penetration by conidia is probably direct and does not need to occur through stomata or wounds. Wounding, striped cucumber beetles, and aphid feeding, along with

powdery mildew infection, predispose plants to infection. The additional nutrients provided by such injuries enhance gummy stem blight infection.

## Management

Use of disease-free seed and transplants is essential to prevent serious crop losses. Periodic applications of fungicide like mancozeb @ 0.2% can help limit secondary infections, especially on fruits. Fall plowing and extended rotations with other crops can significantly reduce the amount of inoculum in infested fields.

### **Bacterial Wilt - *Erwinia tracheiphila***

#### Symptoms



On cucumber and melon, generally a distinct flagging of lateral and individual leaves occurs. Affected leaves turn a dull green. Sometimes wilting occurs on leaves that have been injured by cucumber beetles' feeding, but in many cases obvious feeding is not apparent. Leaves adjacent to the wilting leaves will also wilt, and eventually the entire lateral is affected. The wilt progresses as the bacteria move from the point of entry through the vascular system toward the main stem of the plant.

Eventually the entire plant wilts and dies. If you cut through the stem of an affected plant and squeeze both cut ends, a white, sticky exudate will often ooze from the water-conducting tissue of the stem. This exudate is composed of bacterial material that plugs the vascular system of the plant. Affected stems do not appear significantly discolored. Bacterial wilt is closely associated with either the striped or the spotted cucumber beetle. The bacteria over winter in the bodies of adult cucumber beetles. The beetles carry the bacteria when they emerge in the spring.

The bacteria are spread either through the feces of the beetle or from contaminated mouthparts. When the beetles feed on young leaves or cotyledons, they open entry points for the pathogen. Once inside the plant, the bacteria travel quickly through the vascular system, causing blockages that in turn result in wilting of the leaves. The disease progresses from plant to plant when a carrier beetle moves through the field or when clean beetles pick up the bacteria from a diseased plant and fly to healthy plants. Larvae are not known to carry the wilt organism.

### **Pathogen**

It is a motile rod with 4 – 8 peritrichous flagella and capsulated. Agar colonies are small, circular, smooth, glistening white and viscid.

### **Mode of spread and survival**

The bacteria apparently overwinter in cucumber beetles and they appear to multiply in the beetle. The bacterium is not seed borne or soil borne. Bacteria in stems can survive for one month. Beetles prefer to feed on plants with bacterial symptoms than on healthy plants. Beetle can remain infective for atleast three weeks. Striped cucumber beetle and the 12- spotted cucumber beetle help in the spread of the bacterium.

### **Management**

In general, more bacterial wilt is seen on the edges of fields where beetles first encounter plants. Larger plantings must be protected by insecticides. Carbaryl, Malathion or rotenone insecticides or combination products are registered to treat cucumber beetles. They will provide control of the beetles if applied when beetles first appear in the spring. Early control, beginning as soon as the plants emerge, is most important as a single beetle can introduce the bacteria. One to four generations of the beetle may occur on unprotected plants and applications of these insecticides at weekly intervals may become necessary. Apply a light even coating of the insecticide over the entire plant, especially where the stem emerges from the soil (where the beetles often congregate).

**Fusarium Wilt** - *Fusarium oxysporum* f. sp. *melonis* attacks muskmelon and *Fusarium oxysporum* f. sp. *niveum* attacks watermelon.

### **Symptoms**



Both fungi contribute to damping-off of seedlings, but most significant losses occur after young plants are infected in the field. Plants infected early in the season often produce no marketable fruits. Plants that begin to show wilt symptoms at or near maturity produce fewer and lower quality fruits. The first symptoms of *Fusarium* wilt are wilting and chlorosis (yellowing) of older leaves. The wilt is most evident during the heat of the day. Plants may appear to recover by morning, only to wilt again in the afternoon. Stem cracks and brown streaks often appear near the crown of the plant and are associated with a red-brown exudate. *Fusarium* wilt also causes vascular browning that is visible in stem cross-sections.

### **Mode of spread and survival**

The wilt fungus is introduced to new areas on seed. It spreads by wind, equipment and workers. It can survive long periods in soil as chlamydospores and in association with melon plant residue.

### **Management**

Planting resistant cultivars is the only reliable way to keep infested fields in production. Commercially acceptable resistant cultivars exist, but extremely high pathogen populations in the soil can overcome their resistance. Therefore, methods to reduce *Fusarium* populations in the soil also should be employed. These methods include extended rotations with crops other than cucurbits and fall plowing of severely infested fields.

### **Anthracnose *Colletotrichum orbiculare* (= *C. lagenarium*)**

#### **Symptoms**



The diagnostic features of anthracnose vary with the host. Sunken, elongated stem cankers are most prominent on muskmelon, though leaf and fruit lesions also occur. Large lesions girdle the stems and cause the vines to wilt. Stem cankers are less obvious on cucumbers,

but leaf lesions are very distinct. Watermelon foliage affected by anthracnose appears scorched; sunken fruit lesions are easy to recognize. The anthracnose fungus over winters on diseased crop residue. There also reported that the pathogen is carried in or on cucurbit seed. In wet conditions each spring, the fungus releases airborne spores that begin new infections on vines and foliage. Anthracnose usually becomes established in mid-season, after the crop canopy has fully developed.

### **Mode of spread and survival**

The fungus can infect muskmelon and watermelon in addition to cucumber. The pathogen survives the winter in infected plant residues. The fungus can also be associated with seed. As with most fungal diseases, long periods of leaf wetness favor disease development. Spores are splashed from leaf to leaf, and plant to plant, during irrigation or rain events. Several disease cycles can occur in a single growing season, resulting in defoliation of severely infected plants.

### **Management**

Seed treatment with Carbendazim 2g/kg of seed. Spray Mancozeb 2g or Carbendazim 0.5g/lit.

### **Sudden Wilt**

#### **Symptoms**



Unlike bacterial wilt, which can occur any time during the season, sudden wilt generally occurs late in the season and is closely associated with a heavy fruit load on the plant. Cucumbers and melons appear to be most sensitive to sudden wilt. Initial symptoms are a slight flagging of the plants in midday even when abundant moisture is present. This flagging will continue to worsen so that, by the third or fourth day, many of the plants are completely wilted. Disease progression is rapid, hence the name sudden wilt. After five to six days, all of the vines have melted down and only the immature fruits are left in the fields. Affected plants appear to lack feeder roots; other roots become slightly misshapen and thick. Currently it is thought that

sudden wilt is caused by a root rot complex involving *Pythium* sp., *Rhizoctonia solani* and *Fusarium* sp. that invade the roots and further colonize the root tissue. It is thought that stresses such as excess moisture and drought, prolonged periods of low temperatures (below 50 degrees F) and attack by the several viruses that commonly affect melons and/or cucumbers individually or in combination weaken plants so that soil-borne pathogens can rapidly colonize the root systems.

### **Management**

Good soil drainage and thin plant density reduces the incidence of disease. Destroy diseased plant debris. Soil application of *T. viride* @ 2.5 kg/ha with 50 kg FYM. Spray Mancozeb/ Copper Oxychloride at 2.5 g /lit or Carbendazim/ Thiophanate-methyl at 1 g /lit.

### **Powdery mildew - *Erysiphe cichoracearum***

#### **Symptoms**



It attacks muskmelons, squash, cucumbers, gourds, and pumpkins. It is evident as a superficial, powdery, grayish-white growth on upper leaf surfaces, petioles, and even main stems of infected plants. Affected areas turn yellow then brown and die. In dry seasons, powdery mildew can cause premature leaf drop and premature fruit ripening. Some early disease results from spores produced on over wintering cucurbit debris or weeds but the major source of disease inoculum is windblown spores from southern crops. Warm, dry weather conditions favor the development of powdery mildew.

#### **Pathogen**

The conidia measure 63.8 x 31.9 micron meter, the cleistothecia are globose which contain 10 – 15 asci. In each ascus, ascospores are two and are oval or sub cylindrical.

## Mode of spread and survival

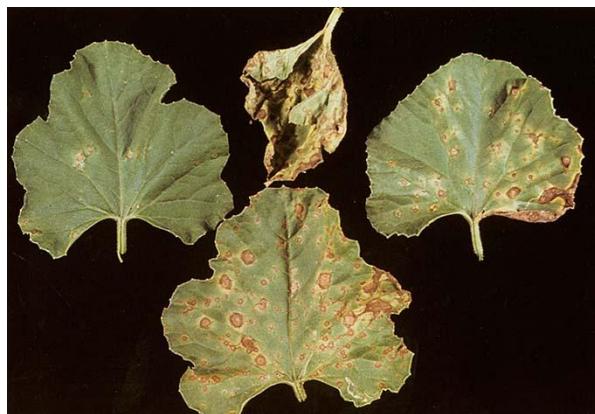
Perithecia developed on left over cucurbit crop in isolated areas serve as primary inoculum. Wild cucurbits harbour the conidial stage of the fungus and release conidia for primary infection to the spring or summer sown cucurbits. Conidia are spread by wind , thrips and other insects.

## Management

Powdery mildew can be controlled by application of Wetttable sulphur @ 0.2%.

## Alternaria Blight - *Alternaria cucumerina*

### Symptoms



It usually occurs on foliage during the middle of the growing season. The disease starts as small, yellow spots which enlarge to form concentric rings on the upper leaf surfaces. Muskmelons are more susceptible than other cucurbits to Alternaria blight.

Often muskmelon vines will be almost completely defoliated by this disease. The pathogen also may cause fruit injury. *Alternaria cucumerina* may be carried in and on seed and can also overwinter in diseased plant debris or cucurbit weeds. Spores produced on infected foliage are spread by wind, rain, people, tools, etc. Plants weakened by lack of proper fertilizer or poor soils are more likely to be attacked than young, vigorously growing plants. Warm, wet weather favors development of Alternaria blight.

### Pathogen

In water melon isolate, the conidia are 50.5 – 86.4 x 22.8 micron meter. Cross septa vary from 1 to 9 and longitudinal septa range from 1 to 4.

## Mode of spread and survival

The fungus can survive as mycelium in refuse from diseased plants at least for one season and possibly two years in dry conditions. Fungus spores can survive in dry warm conditions for several months. Conidia are air borne.

## Management

To control Alternaria blight, plant disease-free seed in fertile, well-drained soil, practice crop rotation with unrelated crops, destroy cucurbit weeds. Spray the crop with Mancozeb @ 2 g /lit.

### Downy mildew - *Pseudoperonospora cubensis*

#### Symptoms



It occurs on cucumbers, squash, muskmelons, and pumpkins and less frequently on watermelons. On cucurbits other than watermelons, small, yellowish areas occur on the upper leaf surface. Later a more brilliant yellow color develops with the center of the lesion turning brown. Usually spots are angular because they are restricted by leaf veins. When leaves are wet, a downy, white-gray-light blue fungus growth can be seen on the underside of individual lesions. On watermelons, yellow leaf spots may be angular to non-angular and turn brown to black. Spores produced on the lower leaf surface are readily spread by the wind. Rainy, humid weather favors the development of downy mildew.

#### Pathogen

It is an obligate parasite. The mycelium is coenocytic and intercellular with small ovate or finger like haustoria. One to five sporangiospores arise through the stomata. Sporangia are grayish to olivaceous purple, ovoid to ellipsoidal, thin walled with a distal papilla. Zoospores are 10 – 13 micron meter. Oospores are not common.

## **Mode of spread and survival**

The pathogen survives on the diseased plant debris. In warm and humid climates, transmission from old to younger crops takes place all the year round. Where warm and dry summers alternate with cooler and wet winters, year round survival is possible on summer irrigated crops. They may overwinter as thick walled oospores. Sporangia are disseminated by wind. Cucumber beetles are reported to carry the sporangia.

## **Disease cycle**

*Pseudoperonospora cubensis* is an obligate parasite requiring living host tissue to survive. It does not live in debris in the soil. Occasionally, under optimum environmental conditions, the pathogen may develop thick-walled spores called oospores that are resistant to low temperatures and dry conditions. This is rare and not considered an important source of inoculum. Infections in greenhouses likely originate from another type of spore (sporangia) that enters the facilities from the outside. Local field infections are usually established by spores carried by moist air currents blowing northwards from distant warmer regions where the fungus can over winter on plant material.

Moisture on the leaf surfaces is necessary for infection to occur. When spores land on a wet leaf surface, they can either germinate and infect through the breathing pores (stomates) on leaves or release many smaller spores, called zoospores, that swim in the film of water on leaves during humid or wet conditions, and enter and infect leaves through stomata. Optimum temperatures for infection range between 16°C and 22°C, with infection occurring more rapidly at the warmer temperatures. The periods of wetness needed for infection on cucumber leaves are about 12 hr at 10°C-15°C, 6 hr at 15°C-19°C, and 2 hr at 20°C. About 4-5 days after infection, new spores are produced and released into the air, primarily in the morning. Spores can quickly spread within the greenhouse via moist air currents, contaminated tools, equipment, fingers and clothing.

## **Management**

Spraying with Metalaxyl 500 g or Metalaxyl + Mancozeb 1 kg/ha or Mancozeb 1 kg/ha.

## Angular Leaf Spot - *Pseudomonas lachrymans*

### Symptoms



Symptoms of the disease firsts appear as small, angular, water-soaked lesions on the leaves. When moisture is present, bacteria ooze from the spot in tear like droplets that dry and form a white residue on the leaf surface. Water-soaked areas turn gray or tan, die, and may tear away leaving irregular holes. Water-soaked spots may also appear on the fruit and are frequently followed by soft rot bacteria.

### Pathogen

The bacterium is a rod with 1 – 5 polar flagella and forms capsule and a green fluorescent pigment in culture. The colonies on beef – peptone agar are circular, smooth, glistening, transparent and white.

### Mode of spread and survival

Infected seeds may harbour the bacterium. They survive in soil or debris from diseased plants for two years. They spread by irrigation water.

### Management

Angular leaf spot may be controlled by planting disease-free seed. Rotating with unrelated crops, keeping workers out of fields when foliage is wet and Spray 400ppm Streptomycin sulphate.

### Gourds

## Downy mildew: *Pseudoperonospora cubensis*

### Symptoms



Symptoms resembling mosaic viz, pale green areas separated by dark green areas appear on upper surface of leaf. During wet season, corresponding lower surface is covered with faint purplish fungal growth. The entire leaf dries up quickly.

### **Pathogen**

It is an obligate parasite. The mycelium is coenocytic and intercellular with small ovate or finger like haustoria. One to five sporangiospores arise through the stomata. Sporangia are grayish to olivaceous purple, ovoid to ellipsoidal, thin walled with a distal papilla. Zoospores are 10 – 13 micron meter. Oospores are not common.

### **Mode of spread and survival**

The pathogen survives on the diseased plant debris. In warm and humid climates, transmission from old to younger crops takes place all the year round. Where warm and dry summers alternate with cooler and wet winters, year round survival is possible on summer irrigated crops. They may overwinter as thick walled oospores. Sporangia are disseminated by wind. Cucumber beetles are reported to carry the sporangia.

### **Management**

Use of bed system with wide spacing with good drainage and air movement and exposure to sun help to check the disease development. Spray with Moncozeb 0.2 % or Chlorothalonil 0.2% or Difolaton 0.2% or Ridomil MZ 72 0.1% Seed treatment with Apron SD 35 @ 2 g./kg. followed by spraying with Mancozeb 0.2% is effective in reducing the disease.

### **Powdery mildew: *Erysiphe cichoracearum***

#### **Symptoms**



Powdery mildew, is especially prevalent in hot dry conditions. White or brown mealy growth will be found on upper and lower surfaces and stems. Under severe infestations, the plant will be weakened and stunted.

## **Pathogen**

The conidia measure 63.8 x 31.9 micron meter, the cleistothecia are globose which contain 10 – 15 asci. In each ascus, ascospores are two and are oval or sub cylindrical.

## **Mode of spread and survival**

Perithecia developed on left over cucurbit crop in isolated areas serve as primary inoculum. Wild cucurbits harbour the conidial stage of the fungus and release conidia for primary infection to the spring or summer sown cucurbits. Conidia are spread by wind , thrips and other insects.

## **Management**

The disease can be controlled by spraying Wettable sulphur 0.1%.

### **Mosaic: PRSV/CMV**

#### **Symptoms:**



A virus distributed world wide, affecting most cucurbits but rarely affecting watermelon. New growth is cupped downward, and leaves are severely mottled with alternating light green and dark green patches. Plants are stunted, and fruits are covered with bumpy protrusions. Severely affected cucumber fruit may be almost entirely white.

## **Mode of spread and survival**

It is transmitted by mechanical inoculation and by insect vectors, *Aphis gossypii* and *Myzus persicae*.

## **Management**

The virus is readily transferred by aphids and survives on a wide variety of plants. Varietal resistance is the primary management tool, and eliminating weeds and infected

perennial ornamentals that may harbor the virus is critical. Spray with any one of the systemic insecticide.



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