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University of Nebraska Cooperative Extension Circular EC98-1876-C

# Foliar and Fruit Diseases of Cucurbits

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Members of the cucurbit family are well adapted to Nebraska's weather conditions and are grown in both gardens and commercial fields. Cucurbits include cucumbers, squash, melons, gourds, gherkin, vegetable marrow, and pumpkins. They are susceptible to varying degrees to diseases caused by fungi, bacteria and viruses. Accurate disease diagnosis is an essential part of crop management and can help growers attain maximum yields.

## Powdery Mildew

All cucurbits are susceptible to this perennial problem. Two fungi, *Sphaerotheca fuliginea* and *Erysiphe cichoracearum*, infect plants in the field and in greenhouses. The two fungi have different physical characteristics (visible with the aid of a microscope) and temperatures of optimum growth but produce identical symptoms on host plants.

The most common sign of powdery mildew is the appearance of a powdery white talc-like coating on aerial plant parts (*Figure 1*). Infection occurs on leaves, stems and petioles but rarely on fruits. Initial infection most often starts on the underside of older leaves. Small areas of the leaf are affected first and then the entire leaf becomes covered with fungal growth. Eventually both leaf surfaces are covered with the talc-like coating. Affected leaves and vines become chlorotic before turning brown and dying. Reduction of fruit quality occurs when vines die prematurely. Fruit on infected vines matures prematurely, is sunburned, and has a poor texture, color, and flavor, a result of decreased sugar content. In addition, winter squash produced on infected vines does not store well.

**Figure 1. Powdery mildew on summer squash leaves. (Courtesy of J. Watkins, University of Nebraska)**

**Figure 2. Anthracnose lesions on muskmelon fruit. (Courtesy of J. Watkins, University of Nebraska)**

Powdery mildew occurs over a wide range of temperatures and humidities. The fungus is spread by windblown spores that can travel long distances. It is not seedborne. Cucurbit varieties resistant to powdery mildew should be used if possible. This disease can not be successfully managed through cultural practices. Fungicide treatments available for control are listed in *Table I*.

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**Figure 3. Anthracnose lesions on cucumber leaves. (Courtesy of L. Hodges, University of Nebraska)**

**Figure 4. Downy mildew on cucumber leaf, upper surface. (Courtesy of Seminis Vegetable Seeds)**

## Anthracnose

The fungus that causes anthracnose, *Colletotrichum lagenarium*, infects leaves, petioles, stems and fruit. Cucurbits that are often severely affected are cucumber, gherkin, muskmelon, watermelon, and gourd. Squash and pumpkins are rarely infected. Initial symptoms are small, water-soaked or yellow leaf spots, occurring near the veins (*Figure 3*). Spots enlarge and become brown and tattered; centers may drop out, producing a shot hole appearance. Watermelon leaf spots are black rather than brown. Stem and petiole infections, especially those on melons, are dark, elongated and produce a red exudate. Sunken cankers with dark borders develop on infected fruit (*Figure 2*). A pink ooze develops within the fruit cankers when humid weather prevails. Young watermelon fruit may have black spots. Fruit infected during early stages of development may be aborted or malformed.

*C. lagenarium* survives between growing seasons on infected debris. The fungus is also carried on seed harvested from infected fruit. Spores which act as inoculum are spread from plant to plant by wind, splashing rain, garden tools or gardeners. Wet, humid weather is necessary for disease development.

Anthracnose can be managed by using resistant varieties, clean seed, sanitation, and fungicides (*Table I*).

## Downy Mildew

Downy mildew can occur on almost all cucurbits, affecting both field and greenhouse plants. It is caused by the fungus *Pseudoperonospora cubensis*. Spores produced by the fungus are windborne from plant to plant. Infection may spread to nearby fields or be transported from southern growing regions to northern regions by airborne spores. During the growing season spores are spread by wind and splashing rain and on tools, hands and clothing of field workers. Disease development is favored by warm, wet weather. A film of free water on the leaves is necessary for infection. The free water may be produced by heavy dew and needs only to remain on the leaves for a short time to facilitate infection.

Infection is limited almost exclusively to the leaves. Symptoms may vary somewhat with the host but are generally seen as angular yellow areas on the upper leaf surface (*Figure 4*) with corresponding white to purplish gray to black areas of spore production on the lower leaf surface (*Figure 5*). Older leaves at the center of the hill are affected first and the disease progresses outward to younger leaves. Infected leaves eventually turn brown and die. Fruit infections are rare but fruit quality is poor due to premature leaf death.

Downy mildew can be effectively managed with a combination of cultural practices, resistant varieties, and fungicide applications (*Table I*). Cultural practices used to reduce downy mildew include maximizing

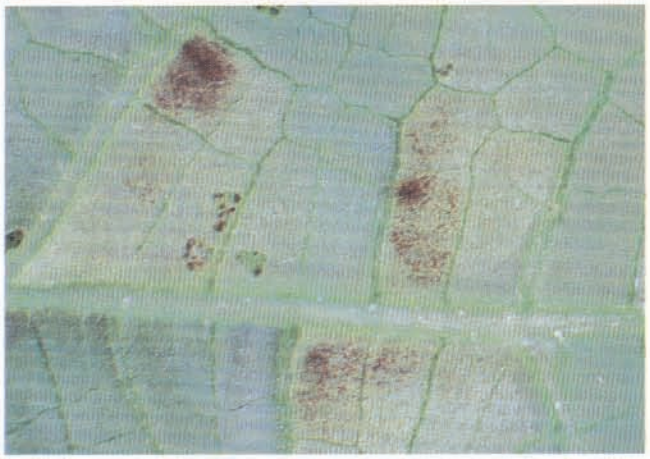

**Figure 5. Downy mildew on cucumber leaf, lower surface. (Courtesy of Seminis Vegetable Seeds)**

**Figure 6. Alternaria leaf spot on cantaloupe. (Courtesy of J.R. Hartman, University of Kentucky)**

**Figure 7. Angular leaf spot on cucumber leaf. (Courtesy of Seminis Vegetable Seeds)**

the distance from potential sources of inoculum, increasing plant spacing and avoiding overhead irrigation.

## Alternaria Leaf Spot

This disease, also known as Alternaria leaf blight, is most common on netted melons (cantaloupe and muskmelon) and watermelon, but also affects cucumber, pumpkin and squash. It is caused by the fungus *Alternaria cucumerina*. As the common name implies, this is primarily a disease of the foliage, however, fruit infections can occur. Symptoms begin as small water-soaked spots on older foliage near the crown. These spots are yellowish brown with a light green or yellow halo. The spots enlarge and turn light brown (dark brown or black on watermelon) (*Figure 6*). A pattern of concentric rings in the spot is visible on the upper leaf surface. Heavily infected leaves curl, wither and die. Exposed fruit is susceptible to sunburn, reducing the quality and quantity of marketable produce.

**Figure 8. Angular leaf spot lesions on cucumber fruit. (Courtesy of Seminis Vegetable Seeds)**

The fungus overwinters in plant debris up to two years. Windblown or splashed spores serve as primary and secondary inoculum. The disease is favored by wet weather as a film of free water on the leaf is necessary for infection.

Disease control is achieved by sanitation, crop rotation and fungicide application (*Table I*). Resistant varieties are available but the type of resistance available may not hold up to heavy disease pressure (ideal weather conditions and heavy inoculum). In this case, the combination of resistance and fungicide application may be necessary.

## Angular Leaf Spot

This disease is caused by the bacterium *Pseudomonas syringae* pv. *lachrymans*. Leaf infections occurring on cucumber, gherkin, muskmelon, pumpkin, squash, vegetable marrow and watermelon appear as vein limited, angular spots. The spots begin as small water-soaked areas that expand into gray spots (*Figure 7*). Diseased tissue may tear away from healthy tissue leaving holes in the leaves. A milky white bacterial exudate may be present on the underside of leaf lesions and on petioles and stems. Fruit infections appear as circular water-soaked spots with a tan center that eventually dries and cracks (*Figure 8*). Secondary infections from other bacteria and fungi along with *P. syringae* pv. *lachrymans* cause the fruit to rot. Infected fruit may not rot until after it is harvested, in transit or storage.

The bacterium overwinters in seed and infected plant debris, which are the sources of primary inoculum. *P. syringae* pv. *lachrymans* also can survive and be disseminated in irrigation or drainage water during the season. Disease development is favored by wet, humid conditions. The bacterium is spread by splashing water, insects, humans or implements and enters the plant through natural openings and wounds.

**Figure 9. Cercospora leaf spot on muskmelon leaf. (Courtesy of D. Wysong, University of Nebraska)**

**Figure 10. Scab on cucumber fruit. (Courtesy of P. Williams, University of Wisconsin)**

Angular leaf spot is managed by the use of resistant varieties (available primarily for cucumbers), copper fungicides *(Table I)*, use of clean seed, and sanitation.

## Cercospora Leaf Spot

This disease is most common in tropical and subtropical regions but does occur in temperate areas. It is caused by the fungus *Cercospora citrullina*. Infection occurs primarily on leaves and occasionally on petioles and stems. Fruits are not susceptible. Common hosts are cucumber, melon, squash and watermelon. Leaf spots are circular, light brown to tan and often have a purple or black margin (*Figure 9*). A yellow halo may surround the spot. Symptoms appear first on older leaves, except on watermelon where they appear first on younger leaves. Spots enlarge, covering the entire leaf. Severely infected leaves are shed from the plant.

The fungus overwinters on crop debris and weedy cucurbit hosts and is spread by windblown spores. Disease development is favored by warm, wet weather. Free moisture on the leaf surface is necessary for infection.

The disease is managed through sanitation, crop rotation and fungicides (*Table I*).

## Scab

Scab, caused by *Cladosporium cucumerinum*, occurs on cucumber, gherkin, cantaloupe, muskmelon, honeydew melon, squash, pumpkin and watermelon. This disease is also referred to as gummosis. Unlike most cucurbit diseases, it occurs after mid-season during periods of cool, wet weather. The pathogen infects all above ground plant parts but is most damaging on fruits. Leaf, petiole and stem symptoms begin as pale green water-soaked areas that eventually dry and turn white or gray. Infected tissues become cracked, giving leaves a tattered appearance. Characteristics of fruit lesions are variable depending on the host. In general fruit infections begin as small (1/8 inch) areas that are slightly sunken. A gummy exudate is present in the depressed area, especially on fleshy fruit like cucumbers (*Figure 10*). As the spots age the depressions darken and cavities are formed when host tissue collapses. A mat of dark green fungal spores forms in the cavity when moist conditions prevail. Spots in close proximity may merge, creating pits that are 1/2 inch or more in diameter. Soft rotting bacteria may enter the pits and produce a foul smell. Fruit lesions on cucumber are corky while those on pumpkin are sunken, resembling anthracnose lesions, and may cause the fruit to be misshapen. Fruit spots on resistant varieties are small, blister-like lesions which do not penetrate very far into host tissue.

The fungus overwinters in the soil, on vine debris and is seedborne. Spores (conidiospores) which are windblown great distances in wet weather are responsible for the spread of scab. These spores also can be disseminated by insects and on clothing and tools.

Scab can be managed by using resistant varieties (available primarily for cucumber), crop rotation, sanitation, clean seed, and fungicides (*Table I*).

## Gummy Stem Blight and Black Rot

This disease problem could easily be called "one fungus, two diseases". Mycologists (people who study fungi) can't quite agree on the name of the fungus and accept two scientific names: *Didymella bryoniae* and *Mycosphaerella melonis* (anamorph:*Phoma cucurbitacearum*). Two distinctly different types of symptoms occur, depending on the host. Most cucurbits are susceptible to this disease. The list of hosts exhibiting

**Figure 11. Gummy stem blight on watermelon stem. (Courtesy of D. Egel, Purdue University)**

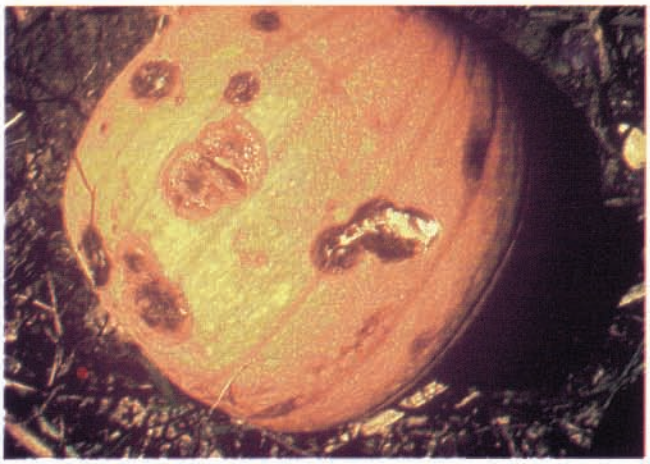

**Figure 12. Black rot lesions on fruit. (Courtesy of J.R. Hartman, University of Kentucky)**

both foliar and fruit symptoms includes cucumbers, summer and winter squash, pumpkins and watermelon. Muskmelon and gourd are also susceptible hosts. Infections beginning early in the season result in seed decay or seedling blight. Leaf spots may develop on seedlings or older plants and appear as circular lesions. Spots on cotyledons are watersoaked and dark and may extend to the hypocotyl (stem). Lesions on older leaves are light brown or grayish green on most hosts. Watermelon leaf spots are initially light then turn dark brown. Spots usually are seen first at the leaf margin and enlarge with age. Tiny black fungal fruiting structures (pycnidia or perithecia) form in lesions on leaves and all other infected plant parts including seed. Infected leaves on older plants turn yellow and die. The classic gummy stem symptoms begin as spots or streaks on the stem. These spots enlarge and exude a brown gummy substance (*Figure 11*). Infected vines commonly wilt and eventually die after mid-season. Black rot symptoms develop on fruit and are variable in size, depth and exudate production depending on the host. Symptoms may develop in the field, during transit and in storage. Fruit infections are first seen as circular spots that are light green or yellow. Spots enlarge, become sunken and darken in color when pycnidia or perithecia are produced (*Figure 12*). A whitish fungal growth also may be present in infected areas. In severe cases the fungus invades the rind, resulting in dry rot. The same gummy exudate produced with the stem blight stage also may be present with black rot but is less common. When the disease develops on immature cucumbers an area of discolored decay is evident near the blossom end of the fruit.

The causal fungus overwinters on infected crop debris and is seedborne. The disease is spread by windblown spores and develops during wet, humid weather.

Gummy stem blight and black rot can be managed by crop rotation, the use of disease-free or treated seed and fungicide application (*Table I*).

**Figure 13. Belly rot on cucumber. (Courtesy of Seminis Vegetable Seeds)**

## Belly Rot

This disease is caused by the soil-borne fungus *Rhizoctonia solani. R. solani* can infect a wide range of plants including members of the cucurbit family. All cucurbits are affected, but cucumbers suffer the most damage. Infection can occur on most plant organs but is most common on fruit. Symptoms appear as irregular, water-soaked, tan to brown lesions. They develop near the blossom end on the underside of the fruit where it is in contact with the soil. As the lesions enlarge, they become sunken and dry, resembling those of scab (*Figure 13*).

Disease development can occur over a wide range of temperatures, however the optimum is 80°F. Lush plant growth and high humidity near the soil surface also encourage disease development. One of the most effective disease management practices is to mulch

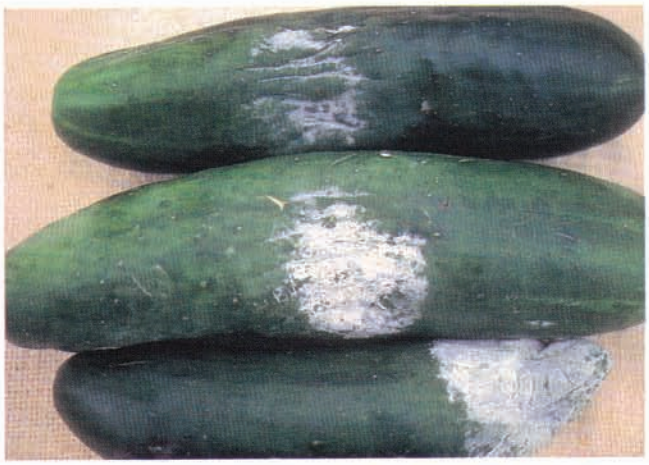

**Figure 14. Cottony leak on cucumber. (Courtesy of Seminis Vegetable Seeds)**

**Figure 15. Cucumber mosaic on melon leaves. (Courtesy of J. Steadman, University of Nebraska)**

plants with natural or synthetic materials to keep fruit from contacting the soil. The fungicide chlorothalonil is labeled for belly rot control, but only on cucumber (*Table I*).

## Cottony Leak

This disease is also known as Pythium fruit rot and is caused by several species of *Pythium*. Cucumber, melons, pumpkin and watermelon are all hosts, but the disease is most damaging to cucumber.

*Pythium*, like *Rhizoctonia*, is a common fungal soil inhabitant that is spread plant to plant by running water and infested implements. *Pythium* can infect the plant at any stage, but the name cottony leak refers to invasion of the fruit. Soft rotted spots that have a watery texture form where fruits contact the soil. These spots enlarge and become covered with a white cottony fungal growth when humidity is high (*Figure 14*). Cucumber infections begin as liquid-filled blisters that are replaced by soft rotted areas. Cottony leak occurs at an optimum temperature of 82°F and is most common in heavy, poorly drained soils.

The disease is difficult to control so planting into sandy or sandy loam soils that afford better drainage than heavy clay soils is an important part of disease management. Another cultural practice that will help manage this disease is mulching to keep the fruit from contacting the soil. Systemic fungicides also will control cottony leak (*Table I*).

## Virus Diseases

Cucurbits serve as hosts to several virus diseases. The three most common virus problems found in Nebraska are cucumber mosaic virus (CMV), squash mosaic virus (SqMV) and zucchini yellows mosaic virus (ZYMV). Symptoms associated with each virus are similar, making them difficult to differentiate based on field symptoms. In general affected plants show a mosaic pattern on fruit and foliage. Mosaic patterns consist of light green or yellow patterns interspersed with the normal green (*Figure 15*). Leaves may be dwarfed, curled or puckered and fruit can be warty looking (*Figures 16* and *17*).

All three viruses can be transmitted by physical contact between infected and noninfected plants and by workers and implements moving from infected plants to noninfected plants. The viruses also are transmitted by insects. Aphids transmit cucumber mosaic virus and zucchini yellows mosaic virus while cucumber beetles transmit squash mosaic virus. Seed transmission occurs with squash mosaic virus on some hosts and has been implicated but not proven in the spread of zucchini yellows mosaic virus. It is not a means of transmission for cucumber mosaic virus.

The virus diseases of cucurbits are difficult to manage. Resistant varieties are available for cucumber mosaic virus, but are not widely available for the

**Figure 16. Distorted zucchini squash leaves linfected with squash mosaic virus. (Courtesy of J. Christensen, University of Nebraska)**

**Figure 17. Distorted zucchini, yellow straight neck and butternut squash infected with squash mosaic virus. (Courtesy of J. Christensen, University of Nebraska)**

**Figure 18. Bacterial Blotch on watermelon fruit. (Courtesy of B. Bruton, USDA-ARS)**

other two virus problems. Many other garden crops and weeds also are susceptible to these diseases, particularly cucumber mosaic virus, and serve as reservoirs of inoculum. Removal of infected plants and good weed control helps reduce the amount of inoculum. Insect control is recommended but does not afford consistent, long-term control.

## Bacterial Blotch of Watermelon

Bacterial fruit blotch is caused by the bacterium *Acidovorax avena* sub sp. *citrulli* and is primarily a problem on watermelon; however, other cultivated cucurbits are susceptible. Two- to three-week old fruits are most susceptible to infection. Symptoms begin as small, watersoaked spots which expand rapidly and may cover the top surface of the fruit within 7-10 days. As the disease progresses, these lesions may turn red-brown and develop cracks (*Figure 18*). During wet weather a white bacterial ooze may form within the lesion. This is often followed by a general fruit rot. The pathogen is seedborne, making seedling stage identification of the disease important. The initial symptom on seedlings is a water-soaked area on the underside of the cotyledons. As the cotyledons expand, the lesion becomes necrotic and extends along the length of the midrib. Other symptoms on seedlings are small, dark-brown spots with chlorotic halos on the first true leaves.

The best control can be achieved by using disease-free transplants or clean seed; however, there is no way to ensure that seed is not contaminated. When the disease is detected, rotate out of cucurbits for three years and control volunteer watermelon plants to reduce disease inoculum. Prevent disease spread by avoiding sprinkler irrigation and not working in fields with wet foliage. Normally this disease does not warrant control; however growers can initiate a copper spray at flowering followed by two to three additional sprays on a 14-day schedule when disease management is necessary.

## Other Cucurbit Diseases

Fruit and foliar diseases are common on cucurbits but they are not the only types of diseases found on these crops. Vascular wilts including Fusarium and bacterial wilts are also common and quite damaging. These diseases and management strategies are described in *Wilts of Cucurbits*, NebGuide G74-108 (Revised October 1994).

## Cucurbit Disease Management

Inoculum for many cucurbit diseases overwinters in crop debris, making sanitation and crop rotation important tools in plant health management. Many of these diseases also can be controlled by using resistant varieties. A list of vegetable varieties and their resistance is available in the publication *Selected Vegetable Cultivars for Nebraska*, NebFact 92-69 (Revised March 1996). Resistance information is also available in mail order seed catalogs or by contacting seed companies directly. Several fungicides are labeled for control of cucurbit diseases. *Table I* provides a list of available fungicides, their labeled crops, and disease control information. If fungicides are used regularly, growers should alternate chemicals to avoid fungicide resistance. Certain restrictions may apply to individual chemicals and applicators should always read the label carefully before application. It is also important to be aware of the time limits between fungicide treatment and harvest.

**Table I. Fungicides[1] labeled for control of cucurbit diseases.**

| *Fungicide[2]* | *Diseases Controlled* | *Crops* | *Delay to Harvest (days)* |
|---|---|---|---|
| **aluminum tris** (Aliette WDG) | Downy mildew | Cucumber, gherkin, gourd, muskmelon, pumpkin, squash (winter & summer), watermelon | 0 |
| **aluminum tris + maneb** (Aliette/Maneb 2+2) | Alternaria leaf spot, angular leaf spot, anthracnose, downy mildew, Pythium fruit rot (cottony leak) | Cucumber | 5 |
| | Alternaria leaf spot, anthracnose, Cercospora leaf spot, gummy stem blight, downy mildew | Melons: cantaloupe, casaba, crenshaw, honeydew, watermelon | 5 |
| | Angular leaf spot, downy mildew | Pumpkin | 5 |
| | Anthracnose, downy mildew | Squash, summer and winter | 5 |
| **benomyl*** (Benlate) | Anthracnose, gummy stem blight, powdery mildew | Cucumber, melon, pumpkin, squash | 1 |
| **chlorothalonil*** (Bravo, Daconil 2787, Pennington Multipurpose Fungicide, Supranil 720) | Anthracnose, downy mildew, leaf blight[3], scab, Cercospora leaf spot, powdery mildew[4], belly rot[5] | Cucumber, cantaloupe, honeydew, muskmelon, watermelon, pumpkin, squash | 0 |
| **chlorothalonil + triadimefon** (Reach) | Powdery mildew | Cucumber, cantaloupe, muskmelon, honeydew, squash, pumpkin | 0 |
| **copper*** (Bonide Liquid Copper Fungicide 4F, Dragon Copper Fungicide, Copper Z 4/4, Recover Flowable Copper Fungicide) | Downy mildew, powdery mildew, Alternaria blight, scab, angular leaf spot[6] | Cantaloupe, muskmelon, watermelon, squash, pumpkin, cucumber | 0 |
| **maneb*** (Earl May Tomato and Vegetable Dust, Maneb 80, Maneb 75) | Alternaria leaf spot, angular leaf spot, anthracnose, downy mildew, Pythium fruit rot (cottony leak) | Cucumber | 5 |
| | Alternaria leaf spot, anthracnose, Cercospora leaf spot, downy mildew, gummy stem blight | Melons: cantaloupe, casaba, crenshaw, honeydew, watermelon | 5 |
| | Angular leaf spot, downy mildew | Pumpkin | 5 |
| | Anthracnose, downy mildew | Squash (winter and summer) | 5 |
| **mancozeb*** (Bonide mancozeb, Dragon Mancozeb Disease Control, Maneb Plus, Manzate 200 DF and Penncozeb) | Alternaria leaf spot, angular leaf spot, anthracnose, downy mildew, Pythium fruit rot, (Cercospora leaf spot and scab on Bonide and Dragon label) | Cucumber | 5 |
| | Alternaria leaf spot, anthracnose, Cercospora leaf spot, downy mildew, gummy stem blight | Melons: cantaloupe, casaba, crenshaw, honeydew, watermelon | 5 |
| | Anthracnose, downy mildew | Squash (winter and summer | 5 |
| **metalaxyl** (Ridomil) | *Pythium* spp. | Cucumber, gherkin, edible gourds, cantaloupe, casaba, crenshaw, honeydew, muskmelon, pumpkin, squash (summer & winter), watermelon | Pre-plant or preemergence applications. Do not apply in greenhouses. |
| **metalaxyl + chlorothalonil** (Ridomil Gold Bravo) | Downy mildew, anthracnose, Cercosporea leaf spot, gummy stem blight (black rot), leaf blight, scab | Cucumber, cantaloupe, casaba, crenshaw, honeydew, muskmelon, watermelon, pumpkin, squash (summer and winter) | 5 |
| **metalaxyl + copper** (Ridomil Copper) | Downy mildew | Cucurbit vegetables | 5 |
| **metalaxyl + mancozeb** (Ridomil MZ72) | Downy mildew | Cucumber, cantaloupe, casaba, crenshaw, honeydew, watermelon, summer squash | 5 |
| **sulfur, wettable** (Microthiol) | Powdery mildew | Cucumber, squash | 0 |
| **thiophanate-methyl** (Topsin M) | Anthracnose, gummy stem blight, powdery mildew | Cucumber, melons, pumpkin, summer and winter squash | 0 |
| **triadimefon** (Bayleton) | Powdery mildew | Cucumber, gherkin, gourds, edible melons, pumpkin, squash (summer & winter), watermelon | 0 |

[1]This list is presented for information only and no endorsement is intended for products listed nor criticism meant for products not listed.
[2]Active ingredient is labeled for use on specific crops, but certain products containing the active ingredient may **not** be labeled for all crops listed in this table. **Read the label carefully before making any applications.**
[3]Leaf blight is synonymous with Alternaria leaf spot when it occurs on labels in relation to cucurbit diseases.
[4]Labeled for powdery mildew control on cantaloupe, muskmelon and honeydew only.
[5]Belly rot control on cucumber only.
[6]Angular leaf spot control on cucumber only.
*This fungicide is available for home garden use.