Managing Foliar Diseases of Cucurbits in Indiana

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The purpose of this presentation is to familiarize the audience with some of the highlights of disease management in cucurbit crops in Indiana. It is assumed that the disease management decisions that most of the members of the audience will be involved in will be fungicide applications. Therefore, an emphasis will be placed on those diseases that will require fungicide applications.

The largest acreages of cucurbits in Indiana are, from most to least, watermelon, muskmelon (i.e., cantaloupe), and pumpkin. The largest acreages of watermelon and muskmelon are in the southwestern portion of the state, while pumpkin acreages are scattered around the state.

Watermelon

The most important foliar disease of watermelon in Indiana is gummy stem blight. The earliest symptom of gummy stem blight is often a lesion of indefinite shape on leaves and/or stems (Figure 1). A close inspection of these lesions with a 10X hand lens may reveal the dark fungal structures (pycnidia) that are diagnostic for this disease. The fungus that causes gummy stem blight survives on crop residue in the soil and can be transmitted on seed.

Anthracnose is much less common than gummy stem blight in Indiana. However, this disease can be severe because it may affect the fruit directly. On leaves, lesions are typically angular since veins often limit lesion growth. The center of larger lesions may fall out giving the lesion a shot-hole appearance. Fruit lesions are sunken, round and may have an orange or salmon colored appearance. The fungus that causes anthracnose survives on crop residue in the soil and can be transmitted on seed.

Downy mildew is not observed on watermelon in Indiana as frequently as it is on pumpkin. See the pumpkin section for more information.

Bacterial fruit blotch is perhaps the only serious bacterial disease of watermelon in Indiana. While bacterial fruit blotch causes devastating symptoms on fruit, the symptoms on foliage are not important economically and often go unnoticed. The lesions on fruit are often large and water-soaked. The most frequent mode entry for this disease into a field situation is through contaminated seed or transplants.

Watermelon Disease Management

Fall/Winter — Fall tillage and crop rotations of at least 3 years without a cucurbit crop will help to reduce crop residue and thus help to manage gummy stem blight, anthracnose, and bacterial fruit blotch. Downy mildew is unaffected by crop rotation.

Greenhouse — Anthracnose, gummy stem blight, and bacterial fruit blotch may be transmitted on seed; growers should inspect transplant seedlings for this disease upon delivery. Greenhouses should be inspected regularly for symptoms of these diseases. Poor sanitation can lead to the

survival of these disease organisms from year to year. Do not apply fungicides in the greenhouse unless labeled specifically for greenhouse use.

Vine-Touch — The preventative application of contact and/or systemic fungicides is usually necessary for the successful management of anthracnose and gummy stem blight. Contact fungicides effective against anthracnose and gummy stem blight include chlorothalonil (e.g., Bravo®, Echo®, Equus®) and mancozeb (e.g., Dithane®, Manzate®, Penncozeb®). Several formulations of systemic strobilurin fungicides (including Amistar®, Cabrio®, Pristine®, and Quadris®) can also be effective against these diseases. Apply fungicides every 7 to 14 days or use the Purdue University MELCAST system. MELCAST is a weather-based disease forecasting system that helps growers to apply fungicides when the weather is most conducive to disease (see below). Working in watermelon fields that are wet from rain or dew may increase disease spread.

Many copper products are labeled for disease suppression for bacterial fruit blotch. Applications are most effective if started before the symptoms are observed on the fruit.

Harvest — Fungicide applications are not necessary within 2 to 3 weeks of the final harvest. Do not save seed from fields where anthracnose, gummy stem blight or bacterial fruit blotch have been observed.

Muskmelon

All of the diseases described above for watermelon can also affect muskmelon. However, the order of importance is different for muskmelon than for watermelon. There are some additional diseases that affect muskmelon.

Bacterial wilt is perhaps the most frequently observed disease of muskmelon plants in Indiana. This disease, which is never observed on watermelon, causes muskmelon to wilt and die (Figure 2). The roots of affected plants appear healthy, but the sap may appear “stringy.” This disease may be best managed by controlling the striped and/or spotted cucumber beetle that spread the causal bacterium.

The most frequently observed foliar disease of muskmelon observed in Indiana is Alternaria leaf blight. Typical lesions are round with “bull’s-eye” rings in the necrotic interior. Multiple lesions on a single leaf may coalesce to form a large necrotic area with a “shot-hole” appearance. The fungus that causes Alternaria leaf blight survives on crop residue.

Lesions of gummy stem blight on muskmelon are similar to those observed on watermelon. However, this disease is less common on muskmelon than on watermelon in Indiana. This may be due to the relatively short season of muskmelon compared to watermelon.

Bacterial fruit blotch affects muskmelon as well as watermelon; however, the lesions are less than 1 centimeter in diameter, corky, and water-soaked. This disease is more often observed on watermelon than on muskmelon.

Muskmelon Disease Management

Fall/Winter — Fall tillage and crop rotations of at least 3 years without a cucurbit crop are critical for the management of all the diseases described above with the exception of bacterial wilt.

Vine-Touch — The preventative application of contact and/or systemic fungicides is usually necessary for the successful management of Alternaria leaf blight, anthracnose, and gummy stem blight. Note that the same fungicides that are effective against gummy stem blight are effective against Alternaria leaf blight. Contact fungicides effective against Alternaria leaf blight include chlorothalonil (e.g., Bravo®, Echo®, Equus®) and mancozeb (e.g., Dithane®, Manzate®, Penncozeb®). Several formulations of systemic strobilurin fungicides (including Amistar®, Cabrio®, Flint®, Pristine®, and Quadris®) are also effective against Alternaria leaf blight. Apply fungicides every 7 to 14 days or use the Purdue University MELCAST system. MELCAST is a weather-based disease forecasting system that helps growers to apply fungicides when the weather is most conducive to disease (see below).

Harvest — Fungicide applications are not necessary within 2 to 3 weeks of the final harvest. Do not save seed from fields where anthracnose, gummy stem blight or bacterial fruit blotch have been observed.

Pumpkin

The fungal disease powdery mildew is common to most pumpkin patches by midsummer. This disease is easily recognized by the white talcum-like appearance on leaves (Figure 3). Powdery mildew can reduce the vigor of vines and yield if susceptible plants are left untreated.

Other diseases common to most pumpkin patches in Indiana are one or more virus diseases. These diseases cause a variety of symptoms including leaf mosaics, leaf strapping, misshapen fruit, and stunting. The most common virus diseases are spread by aphids. However, applying insecticides for the aphids will not stop the spread of the disease. Such applications may cause outbreaks of secondary insects pests such as spider mites.

Downy mildew is often a more serious threat on pumpkin than watermelon or muskmelon since pumpkin is a late crop. The fungus that causes downy mildew must overwinter on green tissue; it does not survive in crop residue or soil in Indiana. Therefore, the presence of downy mildew in Indiana depends on whether the spores of the fungus are blown up from the southeast United States. If the disease arrives in Indiana, it is more likely in August and September than in the early season. Downy mildew can be recognized by the chlorotic, angular lesions and the dark growth of the fungus on the underside of the leaves.

Bacterial fruit spot of pumpkin causes a pimple-like lesion on the surface of the pumpkin fruit. Angular, necrotic leaf lesions are important for recognizing the disease early, but do not cause economic damage. Bacterial fruit spot is a serious disease, but its occurrence is sporadic.

Pumpkin Disease Management

Fall/Winter — Fall tillage and crop rotation are critical for management of bacterial spot and powdery mildew. When placing seed orders, remember that several pumpkin cultivars have partial resistance to powdery mildew.

Planting — It is recommended that growers plant pumpkins by the third week of June so that pumpkin fruit are set before virus disease pressure becomes severe.

First True Leaves Appear — Starting at the first true leaf stage, scout pumpkin plants for leaf symptoms of bacterial spot. If symptoms appear on leaves, fixed copper products should be applied at 7 to 14 day intervals. These applications may be combined with contact/systemic fungicides as appropriate.

Bush State[[STAGE?]]/Softball Stage Fruit — This stage of pumpkin growth is reached once the plant has grown vertically as high as it will reach, but before the plant begins to vine. Depending on planting date/variety, this stage is reached about mid-July. Systemic fungicides for powdery mildew control should be applied at approximately this stage. A typical schedule would be to apply systemic fungicides every 2 to 3 weeks from bush stage through September (for 3 to 5 applications), depending on harvest date. Always alternate systemic fungicides with different modes of action. Some systemic fungicides are labeled for additional foliar diseases. It is often advantageous to tank mix systemic and contact fungicides to increase the number of diseases controlled and to lessen the opportunity for resistance to form in the fungi which cause disease.

Fungicides effective against powdery mildew of pumpkin include thiophanate-methyl (Topsin®), myclobutanil (Nova®), and triflumizole (Procure®). Most of the strobilurin fungicides are effective against powdery mildew plus additional diseases. These include azoxystrobin (Amistar®, Quadris®), kresoxim-methyl (Sovran®), pyraclostrobin (Cabrio®), trifloxystrobin (Flint®), and pyraclostrobin/boscalid (Pristine®). Azoxystrobin and chlorothalonil are available as a pre-mix in Quadris Opti®.

Apply fixed copper solutions if bacterial spot threatens — that is, if the field has a history of bacterial spot, the disease has been introduced to the field, or symptoms of the disease have been observed. Apply fixed copper solutions every 7 to 14 days until most of the fruit that one expects to harvest have matured beyond “softball” size. Since overhead irrigation may facilitate the survival and spread of the pathogen, avoid late afternoon and evening irrigations that will lengthen the dew period.

Foliar Disease Control Using MELCAST

MELCAST is a weather-based spray advisory program for the control of foliar diseases of muskmelon and watermelon. The MELCAST program was developed by Dr. Richard Latin, Department of Botany and Plant Pathology, Purdue University.

The primary foliar diseases of muskmelon and watermelon can be managed with information provided by MELCAST. These diseases are: Alternaria leaf blight, gummy stem blight and anthracnose.

Reasons for using MELCAST include saving money on fungicide applications and better disease control. In most years, MELCAST will save growers two to three fungicide applications per season. In all years, MELCAST recommends fungicide applications when they are most needed for disease control.

MELCAST can be used to assess the risk of disease activity. The severity of the foliar diseases of muskmelon and watermelon mentioned above are correlated with weather. The MELCAST system calculates the weather-related risk for you and converts the data into Environmental Favorability Index (EFI) values. The more rapidly EFI values accumulate, the more likely disease will occur and the more frequently fungicides will have to be applied.

A wide variety of fungicides have been tested for use with MELCAST. Contact fungicides include chlorothalonil products (e.g., Bravo®, Echo®, Equus®) and mancozeb products (e.g., Dithane®, Manzate®, Penncozeb®). Systemic fungicides include the strobilurin fungicide Quadris®.

MELCAST is available for most muskmelon- and watermelon-growing locations within Indiana. Contact Dan Egel for more information about the availability of MELCAST in your area. More information about how to use MELCAST can be found in the Purdue Extension publication BP-67, *Foliar Disease Control Using MELCAST*, www.ces.purdue.edu/extmedia/BP/BP-67.pdf.

Fungicide Resistance Management

Disease-causing fungi may become resistant to fungicides if label precautions are not followed carefully. This table, adapted from the *Midwest Vegetable Production Guide for Commercial Growers 2008*, is designed to help growers alternate applications between fungicides with different modes of action to avoid or delay development of fungicide resistance in fungi. Many product labels use the same letters and numbers as those listed in the MOA Code column below. This list is not exhaustive, but does contain many of the fungicides used in the Midwest.

Trade Names	Common Name	Risk of Resistance	MOA Code[1]
Acrobat®	dimethomorph	medium	15
Actigard®	acibenzolar-S-methyl	none-low	P[2]
Aliette®	fosetyl-Al	Low	33
Amistar®	azoxystrobin	high	11[3]
Bravo®	chlorothalonil	none-low	M[4]
Cabrio®	pyraclostrobin	high	11
Copper	copper	none-low	M[4]
Curzate®	cymoxanil	medium-high	27
Dithane®	mancozeb/maneb	none-low	M[4]
Echo®	chlorothalonil	none-low	M[4]
Endura®	boscalid	medium	7
Equus®	chlorothalonil	none-low	M[4]
Flint®	trifloxystrobin	high	11
Forum®	dimethomorph	medium	15
Gavel®	mancozeb (M) + zoxamide (22)	low-medium	M[4], 22
Gem®	trifloxystrobin	high	11
Headline®	pyraclostrobin	high	11
Manex®	mancozeb/maneb	none-low	M[4]
Manzate®	mancozeb/maneb	none-low	M[4]
Messenger®	harpin	none-low	NA[5]
Microthiol®	sulfur	none-low	M[4]
Nova®	myclobutanil	medium	3

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Fungicide Resistance Management (continued)

Trade Names	Common Name	Risk of Resistance	MOA Code[1]
Penncozeb®/Maneb®	mancozeb/maneb	none-low	M[4]
Pristine®	boscalid (7) + pyraclostrobin (11)	medium-high	7, 11
Procure®	triflumizole	medium	3
Propimax®	propamocarb	low-medium	28
Quadris®	azoxystrobin	high	11[3]
Ranman®	cyazofamid	medium-high	21
Reason®	fenamidone	high	11
Ridomil®	mefenoxam	high	4
Royral®	ipridione	medium	2
Scala®	pyrimethanil	medium	9
Sovran®	kresoxim-methyl	high	11
Switch®	cyprodinil (9) + fludioxonil (12)	low-medium	9, 12
Tanos®	cymoxanil (27) + famoxadone (11)	high	27, 11
Thiolux Jet®	sulfur	none-low	M[4]
Tilt®	propiconazole	medium	3
Topsin M®	thiophanate-methyl	high	1
Ziram®	ziram	none-low	M[4]

[1] MOA=mode of action, or FRAC code
[2] P=host plant defense inducers
[3] Fungicides with a numbered MOA code have very specific activity sites and may cause resistance to develop in fungi. These fungicides should be alternated with fungicides with different MOA codes. Read product labels to determine resistance management strategies.
[4] M=multi-site activity. Fungicides with mode of action code "M" are contact fungicides. It is not necessary to alternate these fungicides for resistance management.
[5] NA=not available

Photographs of Important Foliar Diseases of Cucurbits in Indiana

Figure 1. Gummy stem blight on watermelon leaves causes dark brown lesions of indefinite shape (above left). On stems, gummy stem blight can be recognized by the small, dark fungal structures produced (above right). The latter photograph is enlarged about 3 times. Gummy stem blight is managed by a combination of crop rotation, fall tillage, and timely fungicide applications.

Figure 2. Muskmelon vines that have wilted due to bacterial wilt. Management of this disease is accomplished through controlling the striped or spotted cucumber beetle that spreads this disease. Watermelon is unaffected by bacterial wilt.

Figure 3. Powdery mildew is perhaps the most common disease of pumpkins in Indiana. This disease can be recognized by the talcum-like appearance of the fungus on the upper and lower surfaces of the leaves. Several cultivars are available that have partial resistance to powdery mildew. Most growers find it necessary to use systemic fungicides to control powdery mildew.