Pepper is an important commercial vegetable crop in Florida. During the months of November through May, the country is dependent on Florida for its supply of domestic fresh peppers. Sweet bell pepper is produced in the highest quantity; however, specialty peppers such as hot jalapenos, cubanelle, and mini sweets in addition to other hot pepper types are also produced.

Production of pepper in our state is often severely limited by one or more disease problems. This fact sheet describes the symptoms of several commonly observed diseases and provides recommendations for control. Since pesticide registrations and varieties change frequently, consult your local UF/IFAS Extension office or the Vegetable and Small Fruit Production Handbook of Florida (http://edis.ifas.ufl.edu/features/handbooks/vegetableguide.html) for current, specific pesticide recommendations.

**Bacterial Spot**

Bacterial Spot, caused by *Xanthomonas euvesicatoria* (formerly referred to as *X. campestris pv. vesicatoria*), is the most common and serious foliar disease problem facing Florida pepper growers. It is especially destructive when the weather is warm and there are frequent episodes of wind-driven rain. In southern Florida, we have observed most serious outbreaks in the months of August through November.

All plant parts above ground are susceptible. Initial foliar symptoms consist of watersoaked spots on the lower leaf surface, which develop within 3–4 days of infection. Within another 2–3 days, the lesions become tan to brown, greasy spots on the upper leaf surface. These leaf spots sometimes are the center for a spreading yellowing of leaves. The lobed or angular lesions often are aggregated. Leaf spots may expand and coalesce to form large areas of yellow and brown tissue with a characteristic, greasy appearance (Figure 1). Meanwhile on the lower leaf surface, the spots remain water-soaked and greasy, with the development of brown areas, especially in the lesion centers (Figure 2). In some cases, leaf margins become scorched, probably as a result of invasion of hydathodes by the bacteria. Infected leaves often drop prematurely, even when only moderate damage from bacterial spot has occurred.

Figure 1. Underside of pepper leaf exhibiting greasy, watersoaked margins of lesions of bacterial spot.
Credits: Chelsea Hardin, CC BY 2.0
Lesions in fruit appear initially as small, raised pimples that are a slightly lighter green than the normal fruit color. They enlarge and turn brown to black and appear as raised warts or scabs (Figure 3). Under humid conditions, other microbes may enter the fruit at the bacterial spot lesions and cause massive fruit decay.

Bacterial spot is most severe when night temperatures are above 65°F, but the bacteria can be active below that temperature. An integrated management approach, which uses several tactics in concert, is needed to manage this disease. While all pepper varieties are susceptible to one or more races of the bacteria, differences in the degree of susceptibility exist. Please see the Vegetable and Small Fruit Production Handbook of Florida (http://edis.ifas.ufl.edu/features/handbooks/vegetableguide.html) for a description of currently available pepper cultivars. There is some evidence that the pathogen can be transmitted in pepper seed. Pepper and tomato volunteers should be destroyed well before the next cropping season. Transplants should be disease-free. Overhead irrigation should be avoided whenever possible. Workers and farm equipment should be kept out of fields when fields are wet. This organism is readily spread through fields when contact is made with wet foliage. Avoid unnecessary use of magnesium as foliar or soil applications. Limited control may be obtained with copper sprays. However, the effectiveness of copper bactericides is limited, because of the widespread occurrence in Florida of copper tolerance among strains of X. euvesicatoria. It is recommended that any copper bactericide be combined with a dithiocarbamate fungicide, such as mancozeb, which has been shown to enhance the bactericidal activity of copper. While the exact mode of action is still unknown, the addition of dithiocarbamate fungicides does increase copper solubility which may account for the increased bactericidal activity. Numerous biopesticides are also labeled for the control of bacterial spot on pepper, but the efficacy of these products is limited. Best results are observed when biopesticides are used to augment the activity of standard copper-maneb applications. However, they do not represent a viable replacement for the use of copper or the dithiocarbamate partner, especially for the control of copper-tolerant isolates of X. euvesicatoria.

**Phytophthora Blight**

Phytophthora blight, caused by the fungal-like oomycete Phytophthora capsici, can cause major losses when conditions are conducive for the disease, especially in the fall crop. All parts of the pepper plant can be infected by P. capsici. The first symptom noted, in many cases, is a general wilting of pepper plants (Figure 4). The wilt, however, occurs only after the development of lesions at any point on the stem. The stem lesions start as dark green, watersoaked spots or streaks, that later become dark brown (Figure 5). Wilting is seen above lesions that girdle side shoots or the main stem.
Some Common Diseases of Pepper in Florida

Fruit infection is common. The pathogen usually first grows through the fruit stalk. Fruits are then invaded with the development of a soft, mushy rot. The white growth of the pathogen is often evident on the surface of lesions. Fruits eventually shrivel up but remain on the plant for considerable periods of time.

*P. capsici* is often referred to as a water-mold. Other water-mold fungi include *P. infestans* that causes late blight of tomato and potato and *Pythium* spp. which cause damping-off in many crops. *P. capsici* forms lemon-shaped spores (sporangia) among the mass of white mycelia that can subsequently produce many, smaller zoospores that are motile in water. These can be seen by growers, agents, scouts, and others with access to a reasonably good compound microscope. Special resting spores with thick walls, called oospores, are formed which enable the pathogen to survive long periods of adverse conditions.

The pathogen has been reported to survive in seed as well as in soil as oospores. The lemon-shaped spores produced by the actively growing pathogen are readily spread by splashing rain and in water-saturated soils.

*P. capsici* can be active during moist conditions in temperatures ranging from 46–91°F but optimum temperatures for activity range from 68–86°F. Heavy rains during warm periods are highly favorable for development of this disease.

This disease is not easy to control. Use of soil fumigation to reduce soil populations of the pathogen helps. Plastic mulch can reduce actual contact of soil populations of the pathogen with plants. Plant only on well-drained soil. Fungicides may provide some control. As noted previously, please confer with the Vegetable and Small Fruit Production Handbook of Florida ([http://edis.ifas.ufl.edu/features/handbooks/vegetableguide.html](http://edis.ifas.ufl.edu/features/handbooks/vegetableguide.html)) for current fungicide recommendations.

### Wet Rot (Choanephora Blight)

Wet rot or Choanephora blight has become increasingly more common and more severe in recent years. As early fall plantings of pepper continue to increase, we may expect to see more damage from this disease.

The causal agent is the fungus *Choanephora cucurbitarum*. This fungus is ordinarily thought of as a “weak” pathogen; it colonizes dead or dying tissue before it actively invades living pepper tissue. Most of the time, it seems to start in senescing flower petals. Once established, entire flowers are overgrown, resulting in a brown to black mass of soft tissue. Flower stalks, buds, and leaves may subsequently be invaded. Spore production can occur between 77–86°F. Diagnosis of wet rot in the field is based on the appearance of a silvery mass of fungus growth topped with a black ball made of great numbers of spores (Figure 6). The growth looks like whiskers growing out of the affected pepper tissue. The disease is not easily managed although reducing field conditions that favor moist conditions such as using drip irrigation may help. Fungicides labeled for pepper for other fungal diseases may help with this disease.

### Cercospora Leaf Spot

Cercospora leaf spot, sometimes known as frogeye leaf spot, is common in northern Florida during the summer. It is rare in production areas south of Orlando. Symptoms may occur in leaves, stems, petioles, and fruit stalks. However, the leaf lesions are very distinctive and allow one to readily recognize the disease in the field. Spots are circular to oval,
with light tan centers and dark red borders (Figure 7). Under conditions of high moisture, the fungus *Cercospora capsici* may be observed growing in the middle of the spot, especially if a good hand lens is used. Under a microscope, one can observe many long, thin, colorless, multicelled spores, characteristic of *Cercospora* fungi.

The fungus can survive in northern Florida on crop debris. The spores are readily transmitted via wind. The disease is usually most severe during warm, wet weather.

Prompt destruction of abandoned pepper crops and crop rotation are non-chemical methods of control. Fungicides can control the disease.

**Southern Blight (White Mold)**

Pepper is included in the wide host range of the southern blight fungus, *Sclerotium rolfsii*. This disease has been more of a problem in the northern part of the state. The major symptom is a rapid wilting of plants (Figure 8). Internal and external lower stem tissue is infected and discolored by this fungus. The disease can be definitively diagnosed by finding small, mustard seed sized resting structures called sclerotia at the base of stems. Sclerotia will begin as white structures and later darken to shades of orange to dark brown. Southern blight is favored by high temperatures (80–95°F).

Control is achieved by crop rotation with non-susceptible crops such as grasses. However, because the sclerotia are so resistant to adverse conditions, long rotations of several years are best. Care must be taken not to transmit sclerotia within or between fields on farm equipment or shoes of workers. Sclerotia may also be transmitted in runoff from rain or irrigation. Turning soil with a moldboard plow rather than disking prior to planting is preferred. Some control may be obtained from the use of broad-spectrum soil fumigants. These are usually applied when the full-bed, plastic mulch system is used for the production of pepper.

**Blossom End Rot**

Blossom end rot is an abiotic problem meaning that a living microorganism does not initiate this disease. Damage is confined to the fruit. Symptoms begin as water-soaked spots at the blossom end or side wall of the fruit (Figure 9). Damaged areas expand and become sunken, tan to brown in color, and dry, with a papery or leathery feel. Quite commonly, the affected fruit areas become covered with saprophytic fungi, which appear as black, felt-like growth on the fruit (Figure 10). It is important to know that these dark-colored fungi are not the cause of blossom end rot, but merely colonize damaged fruit tissue. This disorder is directly related to a calcium deficiency in the developing fruit. A low calcium level in fruit can be the direct result of insufficient calcium in the soil also be an indirect result of competition from high levels of ions such as magnesium. Severe fluctuations in the water status of plants (as when drought-stress occurs among plants) accentuate calcium deficiency in fruit. Control is based on proper calcium nutrition of the crop and optimum irrigation scheduling.
Some Common Diseases of Pepper in Florida

Tobacco Mosaic Virus

Tobacco mosaic virus (TMV) is one of the oldest known virus pathogens affecting pepper. TMV has not been a major problem in peppers in Florida. Many strains of the virus exist, and symptoms of the disease vary depending on the particular strain of virus and cultivar of pepper. TMV is active over a broad range of temperatures, light regimes, and nutrient situations.

Symptoms of TMV infection are more or less typical of those associated with virus infections of a great number of crops. Leaves are mottled and distorted. Plants are often stunted. Fruits may also be distorted in shape and show mottling. Systemic symptoms occur in many strain/cultivar combinations. In these cases, plants may wilt, exhibit extensive yellowing, and die.

TMV may be introduced into fields, in transplants, in crop debris, and on hands and clothing of workers, as well as on contaminated tools and machinery. Workers can get TMV-laden sap from infected plants on their hands and readily transmit the virus from plant to plant down the row. Some tobacco products used by workers can be a very important source of TMV.

TMV control centers on reduction of initial inoculum. Use of clean transplants and crop rotation are important. Cultural practices should be designed to minimize manipulation of plants. Workers should wash hands and use suggested practices for tools as described in Disinfection of Horticultural Tools at http://edis.ifas.ufl.edu/ep380.

There are differences in resistance to TMV among pepper varieties.

Aphid-Transmitted Viruses

Pepper mottle virus (PeMoV), potato virus Y (PVY), tobacco etch virus (TEV) are aphid-transmitted viruses that have caused serious problems throughout Florida. Cucumber mosaic (CMV) is an aphid-transmitted virus that is more common in the southern part of the state. It is very difficult to specifically diagnose which virus or viruses are in a plant based on field symptoms alone. Seek assistance from county agents, who can enlist the aid of plant disease clinic personnel in making a firm identification. Symptoms can be similar for all these viruses. A mosaic pattern (blends of light and dark green-yellow areas) with distortion is common in leaves of plants infected with PeMoV, PVY, or TEV. The small leaves at the top of the plant may be crinkled. Plants may be stunted. Veins in leaves may be banded a darker green than the background tissue (Figure 11). Fruit mottling, distortion, and uneven ripening are not uncommon. PeMoV can cause mild or severe distortion of fruit and leaves. CMV-infected plants may show large yellow ringspots and oak-leaf patterns.
All these viruses are transmitted by aphids in a “non-persistent” manner; i.e., the viruses are not taken up into the aphid, but remain on the outside of the insect’s feeding probe. Transmission or acquisition of the virus by feeding is accomplished in seconds. Therefore, insecticides provide little control. Aphids lose the ability to effectively transmit these viruses by one hour after acquisition. The aphids acquire the virus by feeding on infected weed or crop plants. Disease occurrence parallels closely the fluctuations in aphid populations. Traditionally, these viral diseases have been worse in the cooler and drier months of winter and early spring when aphids abound.

Numerous tactics have been identified to help manage these diseases. Source plants of these viruses include abandoned pepper crops and the weeds black nightshade and ground cherry. They should be identified and destroyed. Reflective mulches (also referred to as metalized mulches) have been shown to repel aphids. Repeated sprays of light petroleum oil (e.g., JMS stylet oil) reduce infection by coating the foliage with a layer of material that inactivates the virus. Resistant varieties can be used. In southern Florida, earlier fall plantings tend to avoid peak aphid flights. However, such plantings are likely to incur more damage from bacterial spot. Growers in northern Florida are encouraged to purchase disease-free transplants.

**Tomato Spotted Wilt Virus (TSWV)**

TSWV is spread primarily by thrips. Mechanical transmission is also possible. TSWV can kill plants or cause symptoms such as stunting, mosaics in leaves and fruit, or necrosis (browning) (Figure 12 and 13). TSWV has caused severe damage in tobacco, tomato, and many other field, vegetable, fruit, and ornamental crop species. An intensive control program is necessary for reducing this severe disease.