

## A Series on Diseases in the Florida Vegetable Garden: Squash<sup>1</sup>

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### Disease-causing organisms in the Florida Vegetable Garden

Many Floridians delight in maintaining a vegetable garden in their backyard. Others keep several pots of popular vegetables on patios or similar residential sites. Our long growing season and generally mild climate are ideal for the gardening enthusiast. Furthermore, the health benefits of moderate gardening activity are well documented, and the supply of wholesome garden-fresh vegetables and fruits adds to our quality of life in the Sunshine State.

Sometimes pest problems interfere with our gardening pursuits. Some problems, such as weeds and certain insects, are relatively easy to identify as causing damage. However, another group of maladies, plant diseases, can cause serious damage and are underappreciated and not as well understood by many homeowners.

The majority of plant health problems categorized as plant diseases are caused by

microorganisms. As the name implies, these are extremely tiny disease-causing agents that ordinarily require a microscope to be seen. The very minute size of these disease-causing pathogens accounts for the mystery that often surrounds their presence and impact in the garden.

The pathogenic microorganisms that attack garden vegetables, including squash, can be classified into three major groups: fungi, bacteria, and viruses.

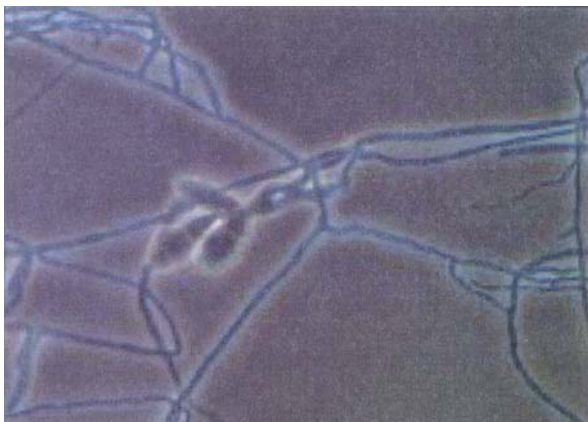
### Fungi

Fungi are seen (100-400x magnification) as threads (hyphae) that absorb food and water from their host (Fig. 1). Many of these fungi reproduce by forming thousands and thousands of spores that are readily blown about by even light winds. These spores can alight on your plants and eventually cause disease. Some fungi have the capacity to survive very long periods of time (10 or more years) in soil in the absence of a host. Once seeds are planted in infested soil, these resting fungal structures can become viable

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again and attack plant roots, causing disease. The majority of diseases you are likely to find in your home garden are caused by fungi.



**Figure 1.** Microscopic threads (hyphae) and spores of a typical plant-pathogenic fungus.

### Bacteria

Bacteria are even smaller than fungi (you need a 1000x magnification with a special light microscope to see them) (Fig. 2). They consist of only one cell and do not form the airborne spores that fungi do. Rather than being blown by the wind, bacteria are usually spread by splashing water, as in rainstorms or overhead sprinkler irrigation. They can also be spread by gardeners who touch diseased plants and healthy plants in succession without thoroughly washing their hands in-between.



**Figure 2.** A bacterial cell. Credits: Photo courtesy of J. B. Jones

### Viruses

Viruses are most strange indeed (Fig. 3). They are not "organisms" in the sense of the fungi and bacteria. They are very large molecular structures

consisting of a nucleic acid (DNA or RNA) wrapped in a protective coating of protein. Once inside squash cells, they take over the host cellular machinery and use it to produce more viruses. Most of the important viruses are transmitted to garden plants by insects such as aphids, whiteflies, or thrips.



**Figure 3.** Typical rod shaped virus as seen through a powerful electron microscope. Credits: Photo courtesy of Scott Adkins, USDA

### Specific Common Squash Diseases

The following diseases are a few of the ones, in our experience, that are most likely to appear on your garden squash. This is not by any means an exhaustive list of squash diseases, but the ones we feel occur most often in Florida home gardens. If you have a problem that you think might be a disease not covered in this publication, search the EDIS database or that of the Department of Plant Pathology web site of IFAS University of Florida for information on additional squash diseases.

An accurate diagnosis of any plant problem is a pre-requisite for solving the problem, which may or may not be related to a biotic cause. An accurate identification is necessary for proper treatment of the disorder. Legal uses and effectiveness of plant disease control chemicals change with time. You are strongly advised to consult you local UF IFAS Cooperative Extension office for current disease management recommendations.

### Angular Leaf Spot

Angular leaf spot is not a common disease in squash in Florida. Infections are found in the leaves, stems, and fruit. Spots in the leaves are angular, and

water-soaked. Free moisture allows bacteria to ooze from the spots which dry later leaving a white residue. These spots of dead tissue will occasionally drop away from the healthy tissue leaving holes in the leaves. This is a cool, wet weather disease.

The spots on the fruit are generally smaller and nearly circular. The dead spots on the fruit turn white and the tissue may crack open. The bacterium is seedborne and dispersed by rain or irrigation water. Control of this disease is through the planting of disease-free seed. Since the bacteria will spread readily from the ooze, do not handle diseased plants when they are wet. Consult with the UF IFAS Cooperative Extension Service for recommended copper bactericides.

### Damping-off

Seed fails to germinate due to rapid colonization of seed by soilborne fungi. Excavated seed will be rotted and soft, often with evidence of fungal mycelium. Young, newly emerged seedlings often collapse at soil line and crown. The stems may exhibit an obvious discoloration ranging in color from a reddish-brown to black and may be dry or mushy to the touch depending on the soil fungus involved. See Plant Pathology Fact Sheet PP-1: "Rhizoctinia Seedling Blights of Vegetables and Agronomic Crops" (<http://plantpath.ifas.ufl.edu/takextpub/FactSheets/pp0001.pdf>) for additional information. Avoid planting seed when soil moisture, soil preparation, temperature or planting depth do not favor rapid emergence. Plant in well tilled soil where old crop debris has been destroyed 30 days previously.

### Downy Mildew

Symptoms appear on the foliage as pale-green to yellow, angular spots, with gray-tinged spore masses on the undersides of these spots. Severely infected leaves become chlorotic, turn brown, and shrivel. The fruits are rarely affected directly, but fail to color properly and are usually sunburned and tasteless. Spores are readily wind dispersed. Prior to planting, choose a variety with resistance to this disease. Consult with the UF IFAS Cooperative Extension Service for recommended fungicides. See Plant Pathology Fact Sheet PP-2: "Downy Mildew of

Cucurbits"

(<http://plantpath.ifas.ufl.edu/takextpub/FactSheets/pp0002.pdf>).



Figure 4. Downy mildew spots on upperside of a leaf



Figure 5. Early symptoms of downy mildew on cucumber leaf

### Gummy Stem Blight

This fungus can cause damping-off, crown and stem rot, leaf spots and fruit rot on winter squash. Infection can begin on seed leaves but usually occurs



**Figure 6.** Advanced symptoms of downy mildew on cucumber leaf

on the older leaves close to the soil line. Lesions are round to irregular, brown and sometimes concentrically zoned. In Florida, this disease is found in fruit as black surface lesions. Stem or vine lesions are brown, often splitting open and turning light colored with age. The black, speck-like fruiting structures (pycnidia) can often be seen in these stem or vine cankers. Lesion enlargement may girdle the stem or vine, causing death. The pathogen can be seedborne but often survives in previous crop debris. Spread is achieved by rain splashing and strong winds. See Plant Pathology Fact Sheet PP-27: "Gummy Stem Blight of Cucurbits" (<http://plantpath.ifas.ufl.edu/takextpub/FactSheets/pp0027.pdf>). Prior to planting, choose a variety with resistance to this disease. Avoid watering from above the plant as this can splash spores around. Consult with the UF IFAS Cooperative Extension Service for recommended fungicides.

### Phytophthora Blight

The disease can occur on the plant at any stage causing damping-off, seedling blight, foliar blight, and plant death preceded by wilting. Symptoms on mature plants are seen as dark, water-soaked areas in the crown. Leaf spots are rapidly expanding, water-soaked lesions. Infection of the plant, particularly summer squash, leads to rapid death. Sunken, brown, water-soaked areas appear in infected fruit. A white growth may cover the lesion and sporangia can be readily recovered. Spores are



**Figure 7.** Gummy stem blight Lesions on butternut squash fruit

rain-splashed dispersed or by moving infested soil or contaminated equipment. Surface moisture is required by the swimming zoospores for infections. Standing water in gardens is an ideal situation for occurrence of this disease if inoculum is present in the soil. To avoid this disease, plant in well-drained soils and avoid waterlogged conditions. Avoid planting in sites known to have had this disease, because the pathogen can survive for many years in the soil. Consult with the UF IFAS Cooperative Extension Service for recommended fungicides.



**Figure 8.** Squash plant killed by Phytophthora blight

### Powdery Mildew

This disease affects the leaves and stems, first appearing as round whitish spots on the upper or lower leaf surfaces. The spots increase in number and size, coalesce, and appear on the upper surface as a white, powdery growth. Severely affected leaves lose their normal dark-green color and become pale yellow-green, then brown and shriveled. Also, the young stems are killed. Fruits on infected vines ripen prematurely, are of poor quality, and often sunburn.



**Figure 9.** Squash at bottom showing symptoms of Phytophthora blight

Spores are readily wind-dispersed over long distances. Prior to planting, choose a variety with resistance to this disease. This disease is almost impossible to avoid in south Florida on squash and is very often observed in home gardens. Consult with the UF IFAS Cooperative Extension Service for recommended fungicides.



**Figure 10.** Squash leaf showing signs of powdery mildew

**Viruses (*Cucumber mosaic virus*[CMV], *Papaya ringspot virus Type W*[PRSV-W], *Watermelon mosaic virus 2* [WMV2], and *Zucchini yellow mosaic virus*[ZYMV])**

Symptoms of viruses on young infected plants are prominent vein clearing, chlorotic spotting and a mosaic on leaves. Older plants may exhibit stunting with varying degrees of mottling, leaf blistering and malformation and vein extension along leaf borders depending on the strain of virus, age of infection and possibly other factors.

Yellow squash varieties will exhibit varying degrees of fruit greening in a striped or mottled

pattern, sometimes with raised yellow blisters. Green-fruited squash may lighten or mottle in color as well as blister. Fruit distortion can be severe across squash types.

Many viruses are spread by aphids from weed hosts within Florida. Common weed hosts include the creeping cucumber or melonette (*Melothria pendula*) in south Florida and alyce clover (*Alysicarpus* sp.) farther north in the State. Dayflower (*Commelina* sp.) is a major host for cucumber mosaic virus. See Plant Pathology Circular 1184: "Aphid-Transmitted Viruses of Cucurbits in Florida"

(<http://plantpath.ifas.ufl.edu/takextpub/FactSheets/circ1184.pdf>). To control virus diseases, do not grow squash behind or adjacent to other cucurbit crops since these viral diseases affect all cucurbits. Isolation of squash from other plants may prevent aphid populations from building up. Certain varieties of yellow summer squash and zucchini squash have resistance to some of these viruses.



**Figure 11.** Mosaic in squash leaf and fruit (ZYMV)



**Figure 12.** CMV-inoculated resistant and susceptible squash



**Figure 13.** Necrosis and rugosity in pumpkin leaf (WMV2 and PRSV-W)



**Figure 14.** Ringspotting in immature pumpkin fruit (WMV2 and PRSV-W)



**Figure 15.** Vein banding in leaf and mottling in leaf and fruit (ZYMV)



**Figure 16.** Ringspotting in mature pumpkin fruit (WMV2 and PRSV-W)



**Figure 17.** Mottling in squash fruit



**Figure 18.** Greening and bumps in squash fruit (ZYMV)



**Figure 19.** Mottling in acorn squash fruit



**Figure 20.** Mottling in yellow squash fruit

**Silverleaf**

Silverleaf was first observed in squash in Israel in 1963. It was then described as a distinct disorder differing from the genetically controlled leaf silvering that is common in zucchini-type summer squash. Although observed in Florida, and the cause of squash silverleaf is not known, but does not appear likely that drought stress causes the condition, as reported in Israel. However, stress induced by other factors may be related to the disorder. Extremely high populations of the sweetpotato whitefly are frequently noted in association with severe silverleaf. Therefore, it is thought that this insect may cause a physiological imbalance that leads to silverleaf symptoms by (a) direct feeding, (b) introduction of a toxin of some sort, or (c) by vectoring a heretofore unknown disease. No other biotic or environmental factor has been consistently related to the occurrence of silverleaf.

Silverleaf symptoms appear first at the leaf veins, as opposed to interveinal silvering that is genetically controlled, and is common in many zucchini cultivars. Symptoms develop in the interveinal area so that the entire upper leaf surface is distinctively silver. Symptoms do not occur on the leaf underside.

Fruit symptoms are not noticeable in cases of mild leaf silvering, but when leaf silvering is severe, fruit color is lighter than normal. Yellow summer squash is very pale-colored, zucchini squash is light-green to yellowish-green, acorn squash is mottled green to yellow, and golden acorn squash is white. Yield reductions and poor fruit quality are usually associated with leaf silvering.

Silverleaf symptoms have been noted on all types of squash but have not been observed in muskmelons, cucumbers, or watermelons.

### **Wet Rot (Blossom Rot)**

This disease affects the blossoms and fruit. The infected part rapidly becomes covered with a mass of whisker-like, white-stalked, black-headed fruiting bodies of the causal fungus. The tissue beneath this mass of fungus becomes water-soaked and rotted. During dry periods, fruit may rot back from the blossom-end without the characteristic fungus growth present. See Plant Pathology Fact Sheet PP-11. Occurrence of blossom-end rot may predispose fruits



**Figure 21.** Silverleaf on squash (foreground) and normal squash (back) Credits: Photo by P. Gilreath

to invasion by this weak pathogen. Use of fungicides in the control of other diseases may aid in the control of wet rot. Minimize crowding of plants and control weeds; these practices enhance air circulation. Removing the spent corolla (flower) after successful pollination will control this fungal disease on those fruit. Consult with the UF IFAS Cooperative Extension Service for recommended varieties and fungicides.



**Figure 22.** Yellow squash fruit rot Credits: Photo by P. Gilreath

Some tips on disease prevention for squash:

1. Purchase new western-grown seeds.
2. Plant as early as possible to avoid large aphid populations (spray if necessary).
3. Treat for nematodes, if needed.
4. Control powdery mildew.
5. Do not follow cucurbit crops (i.e., cucumber, cantaloupe, watermelon, and etc) with another cucurbit.
6. Destroy litter from previous crop and deep bury.

7. Do not over- or under- water plants and give adequate but not excessive fertilizer.
8. Examine plants frequently for appearance of plant disease symptoms and treat as quickly as possible.