



Disease Control for Squash in Florida¹

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Summer and winter squash are grown commercially throughout the state of Florida. In the middle of the winter, southern Florida is the primary supplier of fresh squash for the produce departments of supermarkets all over the nation. In 1997-1998, squash was harvested from 12,500 acres in the state with a total value of \$54.5 million.

Several diseases must be controlled successfully if squash is to be grown commercially in our subtropical environment. Even though many growers have been combating these diseases for many years, substantial losses sometimes still occur. A sequential disease control program is presented in this pointer as a guide for commercial growers. If followed, disease losses should be minimized for the majority of plantings.

Characteristics of Pathogens that Cause Disease of Squash

The great majority of plant health problems that we call diseases are caused by microorganisms. These extremely tiny disease agents cause losses in squash in two basic ways. Fruit may be attacked directly, rendering them unfit for consumption or reducing their cosmetic appeal. The pathogens may attack plant parts other than the fruit. In these cases, plant vigor and

carbohydrate production may be reduced, with subsequent losses in yield.

The pathogenic microorganisms attacking squash may be classified into three major groups: fungi, bacteria, and viruses.

Fungi are microscopic organisms that we often call molds in everyday language. In the past, they were commonly classified as plants. However, they are sufficiently different from plants that most experts now classify fungi in a unique kingdom by themselves. They have no true roots, stem, or leaves. Instead, they grow as hyphae (microscopic threads of living matter) that absorb food and water directly into their cells. Although fungi have cell walls, the chemical composition of the wall material is often drastically different chemically from the cellulose wall material we find in higher plants. Fungi also do not have chlorophyll; therefore, they must depend on outside sources of food, including living plants.

Many of the fungi which attack squash reproduce by developing and releasing large numbers of spores. Some spores (e.g., those of the powdery mildew fungus) are readily spread by wind. Others require splashing rain or irrigation for dispersal. Some fungi, particularly those that cause root and stem diseases,

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have specialized spores that can survive many years in the soil in the absence of squash. Fungi may enter plants through wounds or natural openings (e.g., stomates). Certain fungi are capable of penetrating directly into host cells by pushing through and/or dissolving the cuticle and cell walls.

Bacteria are smaller than fungi and are not at all plant-like. All bacteria are just one cell, and they lack chlorophyll. The ones that cause plant disease do not form spores. The major type of reproduction for plant pathogenic bacteria is by simple cell division. Bacteria never enter plants directly. They must have a wound or a natural opening to get inside a potential host plant.

Viruses probably shouldn't be considered "organisms." They are nothing more than very large molecules of nucleic acid (RNA or DNA) with a wrapping or "coat" of protein. There are no cellular structures. New virus particles can only be reproduced inside of living cells. They are much smaller than bacteria, and normally require sophisticated techniques such as electron microscopes and polymerase chain reaction to be studied. Viruses probably spread from infected weed hosts to squash. Aphids are usually responsible for spread of virus particles on their feeding probe (stylet). Healthy plants then may become infected on subsequent feedings.

It must be remembered that the development of disease is dependent on the proper combination of factors in the so-called disease triangle: a susceptible host, a virulent strain of the pathogen, and weather conditions favorable for a given disease. If any of these conditions is absent, plants will not become diseased.

Effective control of diseases of squash is based on a sound understanding of the biology of both the host and the pathogen. It is essential that the disease is correctly diagnosed. Selecting cultivars with minimal susceptibility to key diseases can reduce dependence on other types of control. Knowing the weather conditions that enhance development of certain diseases can lead to more informed control strategies. A brief outline of the characteristics of the major diseases of squash in Florida given in Table 1.

With this important background information, we can proceed to a reasonable sequential disease control program for squash grown commercially in Florida.

I. Seed Treatment

Squash is generally susceptible to a group of fungi in the soil that cause damping off. Damping-off is a term to describe the death of plants before or soon after emergence from the ground. Fungi in the soil, particularly *Pythium* and *Rhizoctonia*, are responsible for damping-off. In order to minimize damping-off damage, most commercial seed is treated with fungicide prior to purchase. If the seed is not treated, a general-purpose seed treatment is desirable.

II. Preplant Treatments

A. Mefenoxam

Mefenoxam treatments can be applied preplant for control of *Pythium*, a soilborne fungus. This may be helpful in fields that have a history of *Pythium* or *Phytophthora* damage. Historically, *Pythium* has been most damaging during warm, rainy weather.

1. Ridomil Gold EC can be applied at the rate of 1-2 pt/treated acre as a preplant incorporated application or as a soil surface spray in a 7-inch band after planting. See the label and Plant Protection Pointer No. 6 for details.

B. Fumigants

In some parts of the state, particularly the Palm Beach coastal area, squash is grown on raised, plastic-mulched beds that have been fumigated prior to planting. These fumigants include methyl bromide + chloropicrin and, more recently, Telone® + chloropicrin. They have a wide range of activity against many soilborne pests including soil insects, nematodes, and weed seed. When using fumigants, it is important that crop or weed residues be worked thoroughly into the soil and allowed to decompose 4-6 weeks before application. The plastic mulch itself probably helps reduce wet rot damage of fruit by serving as a barrier between fruit and the soil.

III. Application of Foliar Fungicides

Periodic application of foliar fungicides is important in an overall program to control a number of foliar diseases in Florida. Failure to do so limits the production of squash on a commercial scale. Aircraft or ground application is used, but the latter is preferred because of superior coverage, especially of the lower surfaces of leaves.

The method of application is as important as the choice of material if adequate results are to be achieved. A typical planting of squash would be sprayed with a tractor-mounted boom sprayer at 200-250 psi and 100 gal finished spray per acre. Equipment should be properly calibrated to a tractor speed of 3 miles/hr. At this speed an observer should be able to walk behind the tractor at a comfortable pace. When these calibration guidelines are followed, most disease problems should be adequately controlled on a 5-7 day spray schedule.

Thorough coverage is absolutely essential. Addition of drop nozzles will enhance coverage of larger plants, especially the lower surfaces of leaves. The air inside the squash canopy must be completely displaced by a fine mist of fungicidal spray in order to prevent hard-to-detect disease outbreaks.

Fungicides are primarily preventative; that is, they must be applied before pathogens penetrate plant surfaces in order to be effective. Timing of applications is very important. If fungicides are applied after a disease is first found in a field, it may be impossible to prevent serious losses from occurring.

Chlorothalonil (Ridomil Gold®, Bravo®, Bravo Weatherstik, etc.) will control a number of foliar diseases of squash, including the serious disease downy mildew. It also provides some control of powdery mildew. A number of maneb/mancozeb compounds are also registered on squash for control of downy mildew. Aliette® is used for the downy mildew fungus and *Phytophthora* spp.

Powdery mildew control may require additional fungicide applications aimed specifically at this disease. Flint, Benlate, Quadris, and Topsin are labeled for *Erysiphe* but only the latter three are for

use against *Sphaerotheca*. Laboratory examination of the spores of the powdery mildew fungus is necessary to confirm which of the two powdery mildew fungi exists in a field.

Phytophthora blight has rapidly become a limiting disease in squash production in southern Florida. The disease causes substantial losses regardless of control methods if environmental conditions are conducive to disease development. Copper compounds are labeled for the foliar phase of this disease. Water management and avoidance of previously infected field may help to manage this disease.

Copper compounds may be needed if angular leaf spot is found. Benomyl and chlorothalonil are the registered compounds of choice when gummy stem blight threatens (primarily a problem on winter squash).

Sprays of stilet oil have been shown to be helpful in the management of aphid-vectored viruses in squash if applied early enough. Widespread and destructive outbreaks of papaya ringspot and other viruses have occurred on squash in previous years. Applications of oil may reduce outbreaks; however, very specific use directions must be followed for best results. The oil must be applied with a ground rig at a pressure of 400 pounds per square inch. TX5 SS nozzles must be used. These special requirements often dictate that a rig or rigs be dedicated to oil applications.

Readers are urged to consult the Florida Plant Disease Control Guide or their county extension agent for current, specific fungicide recommendations. In addition, Plant Protection Pointer No. 6 presents an excellent summary of fungicide recommendations for all commercial vegetables. This pointer is available on request from your county extension office. The plant pathology fact sheets listed in Appendix I can be used to aid in diagnosis of some of the diseases discussed in this pointer.

Appendix

1. Kucharek, T. Rhizoctonia seedling blights of vegetables and field crops. Plant Path. Fact Sheet No. PP-1.

2. Kucharek, T. Downy mildew of cucurbits. Plant Path. Fact Sheet No. PP-2.
3. Kucharek, T. Alternaria leafspot of cucurbits. Plant Path. Fact Sheet No. PP-32.
4. Kucharek, T., and Simone, G. Wet rot of vegetable crops. Plant Path. Fact Sheet No. PP-11.
5. Pohronezny, K., and Stall, W.M. Powdery mildew of vegetables. Plant Path. Fact Sheet No. PP-14.
6. Kucharek, K., and Schenck, N. Gummy stem blight of cucurbits. Plant Path. Fact Sheet No. PP-27.
7. Perenezny, K., and Simone, G.W. Target spot of several vegetable crops. Plant Path. Fact Sheet No. PP-39.

Table 1. Characteristics of major squash diseases in Florida.¹

Disease	Pathogen(s)	Type of Organism	Seed Transmission	Soil Survival	Insect Transmission	Favorable ² Conditions	Areas Most Likely to Occur
Angular leaf spot	<i>Pseudomonas syringae</i> pv. <i>lachrymans</i>	bacterium	+	+	-	C, wet	NF, CF
Downy mildew	<i>Pseudoperonospora cubensis</i>	fungus	-	-	-	W, wet	All
Powdery mildew	<i>Sphaerotheca fuliginea</i>	fungus	-	-	-	C	All
Powdery mildew	<i>Erysiphe cichoracearum</i>	fungus	-	-	-	C	All
Wet rot	<i>Choanephora cucurbitarum</i>	fungus	-	++	+	W, wet	All
Gummy stem blight	<i>Didymella bryoniae</i>	fungus	+	++	-	W, wet	All (winter squash, primarily)
Pythium crown rot	<i>Pythium</i> spp.	fungus	-	++	-	wet	All

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Phytophthora blight	<i>Phytophthora capsici</i>	fungus	-	++	-	C, W, wet	SF, All
Alternaria leaf spot	<i>Alternaria cucumerina</i>	fungus	-	+	-	W, wet	All
Papaya ringspot virus (Watermelon mosaic virus race 1)	PRSV (WMV-1)	virus	-	-	++	C	SF
Watermelon mosaic virus	ZYMV	virus	-	-	++	C	CF, NF
Target spot	<i>Corynespora cassicola</i>	fungus	-	-	-	C, heavy dews	All (primarily on cucumber)

¹ = may occur occasionally, maybe of some importance.
++ = occurs often, important to know for proper disease control.
-- = not known to occur or relatively unimportant.
²W = warm weather.
C = Cool weather.
³NF = North Florida.
CF = Central Florida.
SF = South Florida.