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**DISEASE CONTROL PROGRAM FOR WATERMELON
by Tom Kucharek and Pam Roberts**

Introduction

Watermelons are grown on a commercial basis in many of Florida's 67 counties. Moreover, the geographical distribution of watermelon plantings is such that plantings exist from the Naples-Immokalee area all the way up the peninsula and west through the panhandle. Because of the northward, continual succession of watermelon plantings in Florida plus Florida's moist, warm climate, an ideal situation for plant disease development in watermelons has been created. Moreover, because of natural climatic differences between southern watermelon areas and our northern watermelon areas, differences in plant disease intensity exist within the state. Differences exist in degree of vigor incorporated in the disease control programs by growers in different areas within the state. Disease control efforts have also interacted with market prices typical of an area. For example, southern growers normally get higher prices because of early marketing but without these higher prices they could not afford to practice the intensive disease control program necessary for that area. Northern growers, on the other hand, usually get lower prices for melons because of market conditions but, fortunately, they do not need as intensive of a spray program as do the growers in south Florida.

Summer-planted watermelons that are harvested in the fall will require the best possible disease control program.

Watermelon diseases reduce yields and monetary returns. They do so by retarding desirable plant development and by detracting from buyer appeal or preference. Most watermelon diseases are obvious but some, such as rind necrosis, may not be obvious until buyer's begin to inspect fruit. Post harvest rots in transit can occur but in recent years losses of this type presumably have been minor in relation to field diseases.

Watermelon diseases are caused by fungi, bacteria or viruses. Fungi cause most diseases that occur in watermelons in Florida but diseases caused by viruses can cause equal devastation.

FUNGI are organisms that have no true roots, leaves, stems or chlorophyll. Instead, they have hyphae (microscopic threads) of various types which can grow in the soil or in a host plant. These threads absorb food from the plant or organic material in the soil. Fungi can not make certain necessary food materials, so they must live on food products manufactured by other organisms. Fungi reproduce by various methods. They produce different types of spores (microscopic seeds). Some spores are spread by air currents and others by contact or rain splash. Fungi that cause leaf spots, downy mildew and gummy stem blight produce hundreds

and even thousands of these spores in one spot on a leaf or stem.

Many of the fungi causing seedling blights, root rots, wilts and certain fruit rots produce "heavy duty" spores (resting spores) that are able to survive in the soil for many years. *Fusarium* spp. produce chlamydospores and *Pythium* spp. produce oospores. This situation plus the lack of convenient and economical fungicides for use in the soil make it difficult to control this group of soilborne fungi. Other fungi produce visible resting structures called sclerotia. Southern stem rot, caused by *Sclerotium rolfsii*, produces mustard seed-sized sclerotia. Many diseases can be controlled over a period of time by using crop rotation because even heavy duty spores and sclerotia are diminished in number by other microorganisms and certain environmental conditions in the soil over time.

As you might expect, a longer interval, in years, between watermelon plantings on the same land is more effective for disease control than a shorter interval.

When pathogenic fungi come into contact with a watermelon plant, they grow on it and eventually enter the plant. Some penetrate directly, while others gain entrance only when an opening or a wound is present. Plants have natural openings through which fungi can grow into the plant.

BACTERIA are microscopic one-celled organisms which increase by division. Bacteria enter plants only through wounds or natural plant openings. Currently, angular leaf spot, bacterial fruit blotch, a foliar disease with a fruit rot phase, rind necrosis, and a soft rot of fruit, are the watermelon diseases caused by bacteria in Florida. None of these bacterial diseases are common in Florida, but bacterial fruit blotch was devastating in some fields from 1989 through 1996. In 2000, bacterial fruit blotch occurred in commercially produced cantaloupe in Florida.

Most **VIRUSES** are particles composed by a nucleic acid core and a protein coat. No cellular structure is present and viruses reproduce in living cells only. Viruses are so small they can not be seen with the best light microscopes; an electron microscope is necessary to visualize these particles. At the present time, papaya ring spot virus type W (PRSV-W), watermelon mosaic virus 2 (WMV 2), and zucchini yellow mosaic virus (ZYMV) occur in watermelon, cantaloupe, and other cucurbits in Florida. PRSV-W, formerly known as watermelon mosaic virus one, predominates in south Florida and is found in wild cucurbits such as the wild balsam apple and creeping cucumber. WMV-2, which predominates in central and northern Florida, can occur in 160 different hosts (e.g. Hibiscus, lupine, showy croton, alfalfa, citron, hairy indigo, clovers) but none have been demonstrated to be associated with epidemics or occurrences of WMV-2 in Florida. Zucchini yellow mosaic virus (ZYMV) also occurs in watermelon and squash in Florida. Aphids are the main vectors for transmitting PRSV-W, WMV-2, and ZYMV. Tomato spotted wilt virus was found in watermelon in one field in 1987. It is transmitted by thrips.

A SUMMARY OF WATERMELON DISEASE-CAUSING ORGANISMS AND THEIR HABITATS ARE PRESENTED IN TABLE 1.

With the basic information at hand, it becomes understandable that no one control measure will be totally effective in controlling all watermelon diseases. Instead, a coordinated sequential program of several methods should be used.

SEQUENTIAL DISEASE CONTROL PROGRAM FOR WATERMELONS

Before Planting

STEP 1. CROP ROTATION.

The use of new land had been the backbone for production of watermelons in many areas of Florida and it is effective in reducing plant diseases. However, land availability has become critical in Florida because of urban sprawl and land use programs directed by governmental programs. As a grower you must begin a rotation plan now. Crop rotation is more essential now than ever before. An interval of no less than 4-5 years or more between watermelon crops is best even if varieties resistant to Fusarium wilt are used. Moreover, crop rotation plans should be incorporated in your farm plans as a routine and not as a result of necessity. Never plant watermelons on the same land two years in a row. In general, it is best to rotate grass crops such as corn, pasture grasses, etc. with watermelons. Root-infecting diseases, such as Fusarium wilt and Phytophthora blight, are the general targets for crop rotation but crop rotation will minimize exposure of a crop to inocula of leaf- and stem-infecting fungi causing gummy stem blight, anthracnose, and leaf spots.

STEP 2. SITE SELECTION.

When preparing a rotation plan for your farm, consider planting watermelons as far away as possible from fields of squash, cucumbers, and other cucurbits because these crops are susceptible to some of the same diseases (Table 1). For example, the major viral diseases of watermelon occur commonly in squash in Florida. Phytophthora blight occurs in other cucurbits, tomatoes, peppers, and eggplant and thus, locating watermelon plantings away from these other crops may aid in the minimization of exposure to inoculum from this pathogen. Spores of *Phytophthora capsici* can be spread by water movement from one field to another or wind-borne rain. Phytophthora blight has been an increasing problem in Florida and other areas in the United States, particularly during seasons with above average rainfall or irrigation. For these reasons, watermelons should be planted on well drained land that minimizes standing water during intense periods.

If aerial applications of chemicals are to be used, it is best to select fields that are void of power lines and trees. Aerially sprayed fields should be away from residential dwellings and areas where people gather. Aerial applicators will not deposit spray on watermelons next to hazards for the pilots. Fungicides perform best when spore numbers are minimized throughout the vicinity.

The incidence of watermelon mosaic virus 2 has tended to be less in large fields when compared to small fields.

STEP 3. DEEP PLOWING.

Deep plowing refers to the use of bottom plows and not discs. Burial of plant debris is an effective disease control measure and within a geographical area, the more farmers that use this practice the more effective it becomes for every one. Primary inoculum (early season) for gummy stem blight survives on debris of previously infected crops. Ascospores are ejected into wind currents which can carry them from one field to another. If plant debris with inoculum is buried, primary inoculum is reduced.

Deep plowing is effective in reducing other diseases such as southern blight and leaf spots because burial of these organisms, as opposed to leaving them on the surface, places them in competition with soil organisms and mechanically inhibits their movement.

STEP 4. WEED CONTROL.

Two phases of weed control should be considered in relation to plant disease control for watermelons. First, eliminate weeds such as citron, balsam apple, creeping cucumber and volunteer cucurbits near watermelon fields because they harbor organisms that cause watermelon diseases (Table 1). This is especially important for reducing papaya ring spot in southern Florida, where wild balsam apple and creeping cucumber are the known wild hosts this virus. Citron is a host plant for the bacterial fruit blotch bacterium. Solanaceous weeds such as nightshades are likely hosts for *Phytophthora capsici*, the causal agent of Phytophthora blight. It is understood that elimination of these weeds may be impossible but attempts in this direction will reduce disease problems.

The second phase is overall control of weeds within the field themselves. Besides weeds causing direct losses in yield, their presence aids in moisture retention on leaves and stems which gives fungi a distinct advantage because moisture is necessary for spore germination. Also, the presence of weeds interferes with deposition of fungicides on watermelon leaves and stems.

STEP 5. USE DISEASE RESISTANT VARIETIES.

Fusarium wilt is a major limiting factor for watermelon production in Florida. As a result, you should use a variety resistant to this disease. Up to recent years, nearly all contemporary varieties have had some degree of resistance to Fusarium wilt and anthracnose. However, many of the contemporary seedless varieties do not appear to have an adequate level of resistance to Fusarium wilt. More Fusarium wilt has occurred in Florida with the advent of intense plantings of seedless varieties.

It should be understood that resistance to these diseases is not complete; some plants within a population are susceptible. Crimson sweet has had the least amount of Fusarium wilt compared to other varieties when planted on the same Fusarium wilt-infested land after four or more years of continuous cropping. Commercially usable resistance to downy mildew, gummy stem blight, Phytophthora blight, or the viral diseases is not available. Crimson sweet has been quite susceptible to rind necrosis (internal rind discoloration). Dark-skinned watermelons and dark tissues in striped melons are less susceptible to bacterial fruit blotch than lighter-skinned types.

STEP 6. PURCHASE SEEDS THAT HAVE BEEN INDEXED FREE OF INOCULUM FOR BACTERIAL FRUIT BLOTCH.

The bacterium, *Acidovorax avenae* subsp. *citrulli* that causes bacterial fruit blotch can be seedborne. However, most seed companies are indexing seed with either seedling grow outs or PCR (polymerase chain reaction) techniques.

STEP 7. SEED AND SEEDLING PROTECTION.

Use of transplants minimizes seedling blight in the field.

For direct seeding, seed treatment increases the original stand by partially protecting seeds and young seedlings from decay caused by fungi. Most seed treatment materials used on watermelon are not systemic and their period of protection should not be expected to extend beyond emergence. Ridomil Gold EC may be applied as a 7 to 12" band along the row center at seeding. Use a rate of 1-2 pints/treated acre, respectively. This treatment will reduce *Pythium* seedling blight.

When watermelon seed are planted in cool soils, you can expect a higher incidence of seedling blight. Slow emerging seedlings are more likely to be infected by pathogenic fungi (e.g. *Rhizoctonia solani*, *Pythium*, spp. etc.) than fast emerging seedlings.

CAUTION: DO NOT FEED TREATED SEED TO MAN OR BEAST UNDER ANY CIRCUMSTANCES.

STEP 8. HEALTHY TRANSPLANTS.

If transplants are used, purchase or grow disease-free plants. Producers in Florida should purchase plants from within Florida that are inspected by the Division of Plant Industry. Plant production systems should not be near production fields. Avoid exposure of plants to production fields (past or present) during transit by using covers on transport vehicles. See Plant Protection Pointer No. 25 for details on producing healthy transplants. Also, avoid deep setting of plants during the transplant operation. The transplants you purchase should be inspected and issued a phytosanitary certificate before acceptance. Even though the transplants you purchase or grow may have been inspected, you should examine each flat for defective plants. Do not use plants in transplant trays that have infected or suspect plants. Transplants are susceptible to ALL diseases mentioned in this publication and have been the source of inoculum for *Phytophthora* blight, gummy stem blight, downy mildew, and others.

STEP 9. PROPER PLANTING DEPTH AND FIELD PLAN.

Planting excessively deep will offset benefits from seed treatments. The longer it takes for a seedling to emerge, the longer the entire plant is exposed to soil-borne fungi. The recommended planting depth is 1/2 to 2 inches depending upon soil surface moisture levels.

If a ground sprayer (airblast or hydraulic) is to be used, allow enough space in alleys to accommodate tractor and spray equipment. Alleys will be of benefit during harvest operations. Distance between alleys should be established based on the spray swath of either the airblast distance or boom width.

After Planting

STEP 10. USE DRIP IRRIGATION

Drip irrigation will minimize spread of certain diseases compared to overhead irrigation. Spread of bacterial fruit blotch and gummy stem blight are likely to be less severe with drip irrigation compared to overhead irrigation. Also, minimization of leaf wetness with drip irrigation, compared to overhead irrigation, will aid in suppressing Phytophthora blight and other diseases during periods that have low to modest rainfall.

STEP 11. OBSERVATION.

Periodically walk through representative portions and low and wet areas of your fields looking for disease. Don't wait until you can see diseased plants through a windshield. The county agent can help you identify diseases. The best time to attempt diagnoses of bacterial fruit blotch is on seedlings in the transplant house or in the field.

STEP 12. WORK IN FIELDS WHEN THEY ARE DRY.

Working in wet fields is likely to spread certain plant pathogens (e.g. gummy stem blight, bacterial fruit blotch, Phytophthora blight). Also, teach workers about sanitation and how it can minimize movement of pathogens from one field to another or one area of a field to another.

STEP 13. DELAYED THINNING.

Delay thinning in direct-seeded fields to the extent possible so that you cull more of the plants susceptible to Fusarium wilt.

STEP 14. FOLIAR APPLICATIONS OF FUNGICIDES.

Materials.

This control measure is directed at downy mildew, gummy stem blight, anthracnose, Cercospora leaf spot, Alternaria leaf spot, Phytophthora blight, and bacterial fruit blotch. Fungicides and rates for controlling these diseases are listed in Table 2. All foliar fungicides used on watermelons need constant agitation in the tank to keep them in suspension. Bacterial leaf spots, if they appear, can be controlled by using a copper fungicide (e.g. Champ, Champion, Basicop, Kocide 101). Copper fungicides can stunt or burn watermelon foliage; thus, use a copper fungicide only when needed. Bacterial fruit blotch can be reduced by use of copper sprays. If a spray program for bacterial fruit blotch is needed, it should begin at first flower or earlier and continue till fruit have a thick, waxy cuticle. Use copper fungicides at the highest labeled rate on a biweekly interval or at one half the highest rate on a weekly interval (see Table 2). Bacterial fruit blotch has not been a problem in Florida in the past few years. It occurred sporadically from 1989 till 1996.

Initiation of spray program for fungal diseases.

Fungicides act as protectants primarily; that is, they protect the plant from infection. Except for Ridomil/Bravo 81W and Ridomil MZ which are effective for downy mildew control, fungicides are not highly therapeutic. If fungicide sprays are delayed until disease severity is

visible through a windshield of a car or pickup truck, it is difficult to minimize diseases such as Phytophthora blight, downy mildew or gummy stem blight. These diseases will begin as just a few spots on the leaves or stems but after a period of time their severity increases rapidly. If your spray program begins after the appearance of disease with a non-therapeutic fungicide, you can expect an increase of visible disease up to 7-10 days later because of infections already present.

Because of the differences in climate and disease severity within the state of Florida, no one spray schedule or plant can be suggested. Rather it may be more practical to divide the state into areas and offer suggestions based on data and experiences from those areas. Four areas are designated:

Area I Immokalee - Naples

Area II Leesburg - Wildwood - Ocala

Area III Levy, Alachua and Gilchrist Counties

Area IV North Florida (Including the Panhandle)

Generally, disease intensity is greatest in Area I and least in Area IV, with areas II and III being intermediate.

In Area I, downy mildew and other diseases can occur throughout the year on crops, weeds and volunteer plants in the field and ditch banks. If a freeze does not destroy these plants, inocula (spores) are present all year. Gummy stem blight also produces, inocula on old vines when allowed to remain on the soil surface. Area I, then, should be on a continual alert from emergence through harvest every year. It may become necessary to spray twice each week to maintain spray on new foliage. When temperatures drop below 60 F and dew periods are reduced, weekly spray schedules may be adequate because the rate of disease progress decreases and plant growth is reduced. Generally, downy mildew and gummy stem blight appear to be most intense from February to harvest in this area but control is difficult while either disease is ravaging a crop. Rather, control is most effective when the level of disease is maintained at a low level with a full-season spray program.

In Area II, downy mildew and gummy stem blight are potentially devastating every year, but some years they may not be a problem. For example, between 1931 and 1959 either gummy stem blight or downy mildew occurred in epidemic proportions in 16 out of the 29 years within Area II. The following factors are known to be conducive of gummy stem blight and downy mildew:

1. Mild or "warm" winters;
2. Above average rainfall from February to June;
3. Short or no crop rotation plans;
4. Failure to bury old vine debris and volunteers after harvest (even in other fields);
5. Use of infected transplants;
6. Starting spray program late.

In Area II, growers should monitor their fields closely after emergence for symptoms of disease. Proper identifications should be made promptly and if downy mildew or gummy stem blight appears, spray programs should be started immediately. **If downy mildew occurs in**

your area, even if in someone else's field, start spraying immediately. Downy mildew increases fast and knows no boundaries. Spraying watermelons with non-therapeutic fungicides or therapeutic fungicides (eg. Ridomil/Bravo 81W or Ridomil MZ) prior to the first appearance of downy mildew in your field will be most effective.

In Area III, growers should keep in touch with county Extension personnel about the occurrence of these diseases in their area. The same guidelines are true for Area III as well as Area II. Generally, downy mildew will not be a problem in Area III if it is not a problem in Area II that same year as this pathogen moves up the peninsula. For example, downy mildew has been significant in 2 out of 6 watermelon seasons (1970-1975) in this area. Sometimes, downy mildew is introduced into Areas II and III early in the season with infected transplants. In such situations, earlier and extremely intense spray programs are required to minimize disease progress. Gummy stem blight can occur in any area every year. Powdery mildew has recently become a major problem in this area on watermelons.

In Area IV, the need for spraying is reduced if proper rotations and debris burial are carried out. Within Area IV downy mildew has been epidemic in one of six seasons; (e.g. 1970-1975) but gummy stem blight has occurred within this area in most seasons. Like Area III, powdery mildew has become a major problem in recent years. Growers in Area IV should maintain constant contact with county extension staff about the occurrence of watermelon diseases in their area as well as Area III. Suspicious-looking disorders in watermelon plants should be properly and promptly identified. Profit margins in this area are the least of all areas and thus spraying should be done only when needed.

It is imperative that watermelon diseases are diagnosed early in all areas. Identification of watermelon diseases can be made by:

1. Local County Extension staff
2. Agricultural Research Centers
3. Plant Disease Clinics.
4. Some consulting organizations.

Spray intervals.

Once a spray program has been initiated, subsequent applications should be no longer than 7 days apart. The addition of a **spreader-sticker** will aid in holding some wettable powder fungicides on the leaves and stems during rains, but they are **not recommended** for liquid formulations.

Application of fungicides.

Fungicide sprays may be applied by ground equipment or by aircraft. Ground equipment includes boom sprayers (hydraulic sprayers) or air assist sprayers.

With respect to equipment, little data, if any, has been developed to prove one type being definitely better than another. All methods have been effective and each method has advantages and disadvantages depending on various considerations.

Advantages of ground equipment:

1. Coverage of foliage is good when adequate gallonage and proper nozzle arrangements are used.

2. Small fields and fields bordered by trees and power lines are most accessible by ground equipment.
3. Especially with boom equipment, there is less drift of the spray away from the target.

Advantages of aerial application:

1. No soil compaction or plant damage by equipment occurs.
2. Applications can be made over the entire acreage when needed, even if the field is too wet for ground equipment.
3. Growers have less handling tasks.
4. Fewer hours of labor are required by the grower's enterprise to operate and maintain equipment.

The cost of using aerial application versus ground equipment is dependent upon the acreage involved, cost of maintaining equipment, labor costs (if any) and life expectancy of equipment. The grower should consider all these factors in relation to his own enterprise.

When using boom equipment, align the nozzles so that the spray pattern of each nozzle slightly overlaps the adjacent pattern at the top of the foliage canopy. **Complete coverage along a band 4' wide, along the row center, is imperative for best control of gummy stem blight.** Penetration of foliage and leaf coverage is best with this type of spray pattern. Consult with an equipment dealer on what sizes of nozzles are needed for various gallonage-pressure combinations at a given tractor speed. Direct nozzles of boom sprayers to cover the foliage not the soil.

When using airblast sprayers, don't try to stretch the distance between swaths. Adjust nozzles to deliver an even distribution across the canopy. Consult the equipment manual for determining the capability of your machine. Remember to do this before planting so alley distances can be established prior to planting.

Minimum days to harvest after fungicide use.

Fungicides vary as to the time interval after their use on watermelon before harvests are allowed. Intervals vary from 0-7 days; therefore, check each label for this information.

STEP 15. PLOW DOWN OLD DEBRIS AFTER HARVEST.

Debris allowed to remain on the soil surface will serve as a source of inoculum for gummy stem blight for next years crop even for surrounding fields. Therefore, bury old debris after harvest as soon as possible. This may seem to be an uncomfortable and an unnecessary step but the fact remains that it does reduce primary inocula for gummy stem blight and other watermelon diseases for the following crops.

Table 1. Habitats of organisms causing plant diseases in watermelon.

ORGANISM	DISEASES	PATHOGEN TYPE	CARRIED IN OR ON SEED	SURVIVES IN SOIL ³	SURVIVES IN WEEDS	TRANSMITTED BY INSECTS	MOVED BY WIND OR RAIN	SOME OTHER HOST PLANTS
<i>Pythium spp.</i>	Seedling blight, fruit rot	Fungus	-1	++	+	-	+/-	Most other crops
<i>Rhizoctonia spp.</i>	Seedling blight	Fungus	-	++	+	-	+/-	Most other crops
<i>Fusarium oxysporum f. sp. niveum</i>	Fusarium wilt	Fungus	-	++	+	-	?	Citron, balsam apple, squash
<i>Didymella bryoniae</i>	Gummy stem blight	Fungus	+	++	+	+	+	Cantaloupe, squash, pumpkin, citron, cucumber, chayote, balsam apple
<i>Pseudoperonospora cubensis</i> ²	Downy mildew	Fungus	-	-	+	-	+	Cantaloupe, cucumber, squash, pumpkin, citron ²
<i>Colletotrichum lagenarium</i>	Anthracnose	Fungus	++	++	+	+	+	Same as downy mildew
<i>Alternaria cucumerina</i>	Alternaria leaf spot	Fungus	++	++	++	-	+	Cantaloupe, squash, cucumber
<i>Cercospora citrullina</i>	Cercospora leaf spot	Fungus	-	++	++	-	+	Cantaloupe, cucumber, squash, pumpkin, chayote, balsam apple
<i>Phytophthora capsici</i>	Fruit rot, leaf blight, stem rot	Fungus	?	++	+	-	+	Pepper, squash, eggplant, cucumber, tomato, papaya, cantaloupe, marigold, pumpkin, others
<i>Sclerotium rolfsii</i>	Stem rot, fruit rot	Fungus	-	++	+	-	-	Many non-grass plants
<i>Sphaerotheca sp. continued</i>	Powdery mildew	Fungus	-	?	?	-	+	Other cucurbits

ORGANISM	DISEASES	PATHOGEN TYPE	CARRIED IN OR ON SEED	SURVIVES IN SOIL ³	SURVIVES IN WEEDS	TRANSMITTED BY INSECTS	MOVED BY WIND OR RAIN	SOME OTHER HOST PLANTS
<i>Pseudomonas lachrymans</i> <i>Table 1 continued</i>	Angular leaf spot, fruit rot	Bacterium	?	-	++	-	+	Cantaloupe, squash, cucumber, citron, creeping cucumber
<i>Acidovorax avenae subsp. citrulli</i>	Fruit blotch, leaf spot, seedling blight	Bacterium	++	++	+	?	+	Citron, squash, honeydews, cantaloupe, and others
<i>Erwinia spp. & others?</i>	Rind necrosis	Bacterium	?	?	?	?	?	?
<i>Papaya ringspot virus type W (formally watermelon mosaic virus 1)</i>	Leaf and fruit mosaics	Virus	-	-	++	++ aphids	-	Cantaloupe, cucumber, pumpkin, creeping cucumber, balsam apple, citron, squash
<i>Watermelon mosaic virus 2</i>	Leaf and fruit mosaics	Virus	-	-	++	++ aphids	-	Cantaloupe, pumpkin, cucumber, citron, hibiscus, lupines, squash crotalaria, hairy indigo, clovers, alfalfa, & others
<i>Zucchini yellow mosaic virus</i>	Leaf and fruit mosaics	Virus	?	-	?	++ aphids	-	Cantaloupe, squash, cucumber, pumpkin
<i>Tomato spotted wilt virus⁴</i>	Leaf mosaic	Virus	-	?	+	thrips ++	-	Many crops & weeds.

¹ -- = not known to occur; + = occurs; ++ = occurs commonly.

² Often cucurbits other than watermelon will have downy mildew and watermelons will not. The strain of the fungus on watermelon appears to be different than those on other cucurbits.

³ Includes survival on old watermelon debris or volunteers or both.

⁴ Seen only a couple of times in watermelon in Florida.

Table 2. Foliar fungicides for watermelon diseases. Alternate fungicide types when possible to enhance resistance management.

FUNGICIDE ²	MAXIMUM RATE/ ACRE/ APPL	Disease								
		SEEDLING BLIGHT	FUSARIUM WILT	DOWNY MILDEW	GUMMY STEM BLIGHT	ANTHRACNOSE	ALTERNARIA LEAF SPOT	CERCOSPORA LEAF SPOT	POWDERY MILDEW	BACTERIAL LEAF SPOTS
Aliette 80 WDG	5 lbs.	0 ¹	0	+	0	0	0	0	0	0
Cuprofix Disperss 36.9 DF	2.5 lbs.	0	0	+	+	+	+	+	0	+
Equus 720 or Echo 720, 6 FLs ^{5, 10}	3 pts	0	0	++	++	+	+	++	++	0
Bravo Ultrex 82.5 WDG ^{5,15}	2.7 lbs.	0	0	++	++	+	+	++	++	0
Champ Formula 2 4.6 FL or Kocide 4.5 LF	1 1/3 pts.	0	0	+	+	+	+	+	0	+
Dithane F45 or Manex II FLs ⁶	2.4 qts	0	0	++	+	+	+	+	+	0
Kocide 101, or Champion 77 WPs	3.0 lbs.	0	0	+	+	+	+	+	0	+
ManKocide 61DF ⁸	2.66 lbs.	0	0	++	+	+	+	+	+	+
Penncozeb, Dithane M-45, Manzate 80 WPs, or Dithane, Manzate, or Penncozeb 75 DFs ⁷	3 lbs.	0	0	++	+	+	+	+	+	0
Equus 82.5 or Echo 90 DFs	2.5 lbs	0	0	++	++	+	+	++	++	0
Ridomil-Bravo 81W ^{4,5}	3 lbs.	0	0	++	+	+	+	++	+	0
Ridomil MZ WP ⁴	2.5 lbs.	0	0	++	+	+	+	+	+	0
Topsin M 70WP ³	2 lbs.	0	0	0	++ ³	+	0	+	0	0
Basicop 53 WP	2 lbs	0	0	+	+	+	+	+	0	+
Acrobat 50 WP ¹⁷	6.4 ozs..	0	0	++	0	0	0	0	0	0
Kocide 2000 53.8 DF	1.5 lbs.	0	0	+	+	+	+	+	0	+
Champ 57.6 DP	1 1/3 lbs..	0	0	+	+	+	+	+	0	+

Table 2 continued

FUNGICIDE ²	MAXIMUM RATE/ ACRE/ APPL	Disease								
		SEEDLING BLIGHT	FUSARIUM WILT	DOWNY MILDEW	GUMMY STEM BLIGHT	ANTHRACNOSE	ALTERNARIA LEAF SPOT	CERCOSPORA LEAF SPOT	POWDERY MILDEW	BACTERIAL LEAF SPOTS
Table 2 continued										
Nova 40 W ¹²	5.0 ozs.	0	0	0	0	0	0	0	++	0
Pristine 38 WG ²⁰	18.5 ozs.	0	0	++	++	+	+	+	+	0
Bravo Weatherstik ⁵	1 ½ -3 pts.	0	0	++	++	+	+	++	++	0
Gavel 75 DF	2lbs	0	0	+	0	0	+	0	0	0
Amistar 80 DF	5 oz	+	0	++	++ ³	++	++	++	++	0
Quadris 2.09 FL	3.2 pts	0	0	+	++ ³	++	++	++	++	0
Cabrio 2.09 FL ¹⁴	16 fl oz	0	0	++	++ ³	++	++	++	++	0
Flint 50 WDG ^{4,19}	4 oz	0	0	+ / 0	0	?	?	?	++	0
Maneb 75 DF ¹¹	2 lbs.	0	0	+	+	+	+	+	+	0
Manex 4F ¹³	1.6 qts.	0	0	+	+	+	+	+	+	0
Tanos 50 DF ^{4,21}	8 ozs.	0	0	++	?	?	?	?	?	?
Topsin 4.5 FL	10 fl ozs.	0	0	0	++ ³	+	0	+	0	0

Footnotes for Table 2 are on next page.

Table 2 continued with footnotes

¹++ = highly effective, + = may be effective; 0 = not effective.

²Minimum days to harvest from last use varies among different fungicides (e.g. coppers-1 day; Amistar-1 day; EBDC types - 5 days; chlorothalonil - 12 hrs to 7days depending on availability of eyewash equipment; Flint, Pristine, & Nova-0 days). Read the label.

³Not for routine disease control because numerous isolates of the gummy stem blight pathogen are resistant to this type of active ingredient.

⁴Limit is 4 appl./crop.

⁵Avoid applications during cloudless days, particularly after fruit have set.

⁶Limit is 19.2 qts./acre/crop.

⁷Limit is 24 lb./acre/crop (limit is 25.6 lbs./acre/crop for Dithane Rainshield DF).

⁸Limit is 128 lbs/acre/crop.

⁹Limit is 20 ozs./acre/crop

¹⁰ Limit is 21 pts./acre/crop.

¹¹ Limit is 17.1 lbs/acre/crop.

¹² Limit is 1.5 lbs./acre/crop

¹³ Limit is 12.8 qts/acre/crop

¹⁴Limit is 64 fl oz/crop

¹⁵ Limit is 19.1 lbs/acre/crop

¹⁶ Limit is 17.5 lbs/acre/crop

¹⁷ Limit is 32 ozs./acre/crop

¹⁸ Limit is 35 lbs/acre/crop

¹⁹ Limit is 8 ozs./acre/crop

²⁰ Limit is 74 ozs./acre/crop

²¹ Limit is 32 oz/acre/crop