Watermelon Diseases

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Watermelons are an important vegetable crop in the cucurbit family grown both on commercial farms and in residential gardens in Oklahoma. Based on a long history of production in Oklahoma, open-pollenated, hybrid and seedless (triploid) varieties can be successfully grown in the state. Watermelons are generally well adapted to Oklahoma because, with adequate irrigation, high-quality melons can be produced under normal summer conditions. Early production for the Fourth of July market is generally started by transplanting into plastic mulch, while main and late-season production is typically direct seeded into warmer soils in May and June. Late-season production can extend until frost if vines are well maintained.

Diseases are frequent and can limit watermelon quality and yield. Diseases can occur any time during the crop production cycle and can affect all plant parts from roots to fruit. Diseases are most severe when vines are attacked and prematurely killed. However, diseases that attack leaves (foliar diseases) reduce fruit quality by exposing melons to sun-scald. Additionally, fruit sweetness and normal ripening are dependent on healthy foliage. When disease affects fruit, they are generally rendered unmarketable and prone to decay, resulting in losses during shipment and transit. Fortunately, it is normally possible to manage watermelon diseases and obtain consistent yield and quality.

Watermelon diseases are caused by microorganisms (pathogens) that include fungi, bacteria, viruses and nematodes. Abiotic disease are caused by environmental conditions, such as soil imbalances (nutrients or pH), soil moisture extremes and chemical injuries (herbicide drift, air pollution, etc.).

The purpose of this publication is to aid in the identification of important diseases of watermelons in Oklahoma and to provide general guidelines for their management. Correct disease identification is the first step in effective management. Incorrect identification can lead to the implementation of an ineffective management practice and crop failure. For example, diseases caused by bacteria or viruses are not controlled with most fungicides. Furthermore, select fungicides or resistant varieties may control one disease but not another. Watermelon growers should learn to recognize the more common diseases by their symptoms and have sufficient knowledge of disease development to select appropriate management practices. Some diseases are easy to identify in the field, while others are more difficult. The OSU Plant Disease and Insect Diagnostic Laboratory offers disease diagnosis as a service to commercial growers and residential gardeners. Samples can be submitted to the laboratory through local county OSU Extension offices.

Oklahoma Cooperative Extension Fact Sheets are also available on our website at:
extension.okstate.edu

Disease Management Strategies

Integrated pest management (IPM) involves the use of several different strategies and the judicious use of pesticides for management of disease and other cucurbit pests. Better and more economical control is usually achieved when IPM is practiced, compared to reliance on a single management practice such as pesticide applications. Management strategies that are components of an effective IPM system include:

Crop rotation: Fungi, bacteria and nematodes, which cause soilborne and foliar disease, often survive in the soil or in crop debris between watermelon crops and build up to damaging population levels with repeated cropping. To reduce pathogen survival and disease carryover, a three- to four-year rotation with non-cucurbit crops is recommended.

Site selection: Watermelons are best grown on sandy loam soils, with good drainage and a slightly acid pH of 6.0 to 6.8. When planted in heavy soils, plants may develop slowly; be more susceptible to root, crown and fruit rots; and have inferior fruit size and quality. Late plantings should not be situated adjacent to early plantings because the older field may serve as a source of disease pathogens.

Sanitation: Crop debris, where many plant pathogens overwinter and survive between crops, should be removed or incorporated into the soil to hasten their decomposition as soon as possible after harvest. Care should be taken to avoid contaminating planting areas by importing soil, diseased culls or diseased plants.

Disease-resistant varieties: Disease-resistant varieties are available for a limited number of diseases such as anthracnose and Fusarium wilt and should be planted where possible. Resistance is the most effective and economical means of disease control. Unfortunately, genetic resistance has not been developed for other diseases and there are many varieties and hybrids with no resistance.

Grafting: Grafting watermelon varieties onto disease-resistant rootstocks is an effective way to manage soilborne diseases such as Fusarium wilt. Bottle gourd (*Lagenaria siceraria*) and interspecific winter squash hybrids (*Cucurbita*

maxima x *Cucurbita moschata*) are the two main types of rootstocks used. The bottle gourd varieties include Coloso, Emphasis, Macis, Skopje, FR Gold, Jingxinzhen No. 1, WMXP 3938 and WMXP 3945 provide resistance to Fusarium wilt and chilling tolerance. Their root systems are less vigorous but they promote earlier maturity. The interspecific hybrids P360, Marathon, RS 841, Shintosa, Shintosa Camel, Strong Tosa, Carnivor and Qingyanzhen No.1 provide resistance to Fusarium wilt and chilling tolerance. However, inter-specific hybrids increase root vigor, which may delay maturity and affect fruit quality. Growers should test various rootstock and scion combination on a few plants before committing to large-scale grafted production.

Pathogen-free seed and transplants: Some diseases, such as bacterial fruit blotch may be seedborne or introduced into fields on infected transplants. Efforts should be taken to obtain high-quality seed tested for fruit blotch and only transplants that appear healthy should be used.

Irrigation: Frequent applications of sprinkler irrigation with small amounts of water favor the spread and development of many diseases. Drip irrigation helps reduce diseases because drip systems do not wet foliage, a condition that favors infection. Drip irrigation also reduces the spread of plant pathogens moved by splashing water or runoff.

Chemical control: Spray programs with fungicides or bactericides (copper compounds) may be needed for effective management of foliar diseases. Consult the latest edition of the OSU Extension Agent's Handbook of Insect, Plant Disease and Weed Control for a list of suggested treatments for specific diseases. Generally, spray programs are most effective when applied on a regular (7- to 14-day) preventive schedule.

Scouting: Plantings should be scouted regularly (at least once per week) for insect pests and diseases. Scouting allows for early pest detection so that timely management practices can be implemented.

Anthracnose (*Colletotrichum obiculare*)

Anthracnose is a common foliar disease of watermelon in Oklahoma. It affects all aboveground parts of the plant including leaves, stems, and fruit. The fruit lesions are particularly damaging because they can develop from small, easily overlooked spots on the fruit at harvest into decayed and leaky melons during shipping. As a result, USDA grade standards specifically state that US Fancy, US #1 and US #2 watermelons be free of anthracnose.

Symptoms: Foliage spots first appear as small brown spots that are circular to angular in shape (Figure 1). Leaf spots enlarge, coalesce and crack. Elongated, tan-colored lesions also appear on stems and petioles (Figure 1). Entire vines may be killed by combined leaf and stem infections. Fruit spots are circular and typically range from ¼ to ½ inch in diameter (Figure 2). Fruit spots crack and become sunken and the decay extends into the flesh.

Disease biology: Anthracnose is favored by extended periods of warm and rainy weather. The anthracnose fungus overwinters on infected debris from previous crops, on volunteers from seed of diseased melons left in the field, and may be seedborne in commercial seed. Spores produced on the debris and volunteers are spread to plants by splashing rain, sprinkler irrigation or surface runoff. Thereafter, disease

Figure 1. Anthracnose leaf spots and stem lesions.

Figure 2. Anthracnose fruit spots.

increase is a result of infection by spores produced on new lesions, which are spread in the same manner.

Management: Anthracnose is managed by crop rotation, resistant varieties and fungicide sprays. Some watermelon varieties or hybrids are classified as resistant to anthracnose race 1. Unfortunately, most race 1 isolates are from cucumber and cantaloupe, while race 2 is confined to watermelon. As a result, resistant varieties can become severely diseased, albeit at a lower rate than those with no resistance. Fungicide spray programs consisting of preventive sprays on 7- to 14-day intervals beginning at bloom and early fruit set have been effective in managing anthracnose.

Bacterial fruit blotch (*Acidovorax citrulli*)

Bacterial fruit blotch is a sporadic disease of watermelon in Oklahoma. It has been more severe where crops are initiated with transplants compared to direct seeding. The disease is of minor concern on the foliage, but severely affects fruit and renders them unmarketable. Yield losses up to 50 percent have been reported.

Symptoms: Early symptoms of fruit blotch on foliage are useful in diagnosis. Small, water-soaked areas (a few millimeters in diameter) on cotyledons or leaves may develop, but they are easily overlooked. These later turn brown, but they

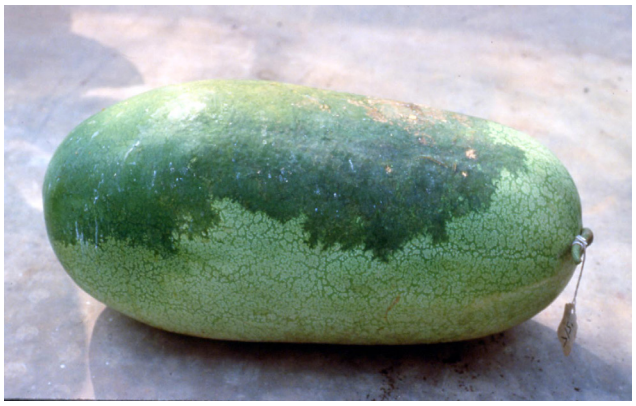

Figure 3. Bacterial fruit blotch.

remain small and do not severely damage leaves. However, the leaf spots serve as a source of the pathogen to infect fruit. Fruit infections first appear as small, water-soaked areas on the upper surface of melons. As the melons mature, the water-soaking area rapidly expand to cover a large portion of the fruit surface (Figure 3). Initially, the blotches do not extend into the rind, but affected rinds eventually crack and become invaded by secondary pathogens.

Disease biology: The bacterium survives in seed and seedborne inoculum is thought to be the source of most epidemics. The bacterium may persist in diseased rinds left in the field and on volunteer seedlings from contaminated seed left in the field from diseased melons. The disease is favored by warm humid conditions, splashing water and overhead irrigation. Transplant production greenhouses, crowded plants, sprinkler irrigation and warm temperatures favor transplant infection and disease spread.

Management: Control of bacterial fruit blotch centers on planting pathogen-free seed and transplants. The seed industry has adopted seed testing, seedling grow-outs and inspection of seed production fields to limit the sale and use of contaminated seed lots. Crop rotation, plowing under crop residue and control of volunteers should be practiced by growers to limit field carryover of the pathogen.

Cercospora leaf spot (*Cercospora citrullina*)

Cercospora leaf spot is a fungal disease that is generally of minor importance but can cause defoliation and yield loss, particularly in eastern Oklahoma where humidity is highest. Vine defoliation can reduce yield and fruit quality where it becomes severe.

Symptoms: The disease is mostly confined to leaves, but stems and petioles may become diseased. The disease does not directly affect fruit. Leaf spots first appear on younger leaves as circular dark brown to purple spots about ¼ inch in diameter (Figure 4). As spots enlarge, the centers usually become tan to grey in color, but they retain their dark margins. Leaves are killed when enlarging spots coalesce.

Disease biology: The fungus overwinters on crop debris, where it produces airborne spores that initiate disease development. Infection is favored by warm temperatures (80 to 90 F) and extended periods of leaf wetness. Older leaf spots serve as a source of spores for new infections.

Figure 4. Cercospora leaf spot.

Management: Crop rotation, incorporation of old crop residue into the soil and crop rotation with non-cucurbit crops for three years are effective in limiting carryover of the pathogen. Fungicide spray programs are very effective on Cercospora leaf spot.

Downy mildew (*Pseudoperonospora cubensis*)

Downy mildew is a sporadic but damaging disease of watermelons in Oklahoma. The disease can rapidly defoliate vines reducing yield, fruit quality and exposing fruit to sunscald. All cucurbit crops are affected, but in some areas, certain crops are affected more than others. In Oklahoma, cantaloupes and watermelons have been most susceptible.

Symptoms: Symptoms of downy mildew are confined to leaves. The oldest leaves are usually attacked first. Symptoms first appear as pale green to yellow blotches on leaves that develop into spots that are circular to irregular in shape and dark brown to black in color (Figure 5). Affected leaves curl

Figure 5. Downy mildew.

Figure 6. Inward curling of leaves with downy mildew.

inward, quickly die and remain attached to upright petioles (Figure 6). Severely infected foliage appears scorched. Petioles and stems remain intact for some time following defoliation. This is in contrast to anthracnose, which affects and kills stems and petioles as well as leaves.

Disease Biology: Downy mildew is caused by a water mold (oomycete), a fungal-like organism closely related to algae. The pathogen can only grow and survive on living plants. Therefore, the fungus does not overwinter locally, rather it spreads as airborne spores northward from plants in southern production areas as the season progresses. The disease is favored by periods of high humidity and leaf wetness. Unlike downy mildews that affect other crops, infection can occur when temperatures are warm (up to 80 F). Downy mildew spores also can tolerate several hot days and remain infective. Late crops are at most risk from downy mildew although the disease has occurred as early as July in Oklahoma.

Management: There are no watermelon varieties or hybrids resistant to downy mildew. Therefore, downy mildew control relies on preventive fungicide spray programs, i.e sprays before symptoms are seen. Fungicide selection for downy mildew is important because some fungicides used for control of other foliar diseases such as anthracnose and gummy stem blight may not be effective on downy mildew. In Oklahoma, protectant fungicides such as chlorothalonil and mancozeb have remained effective as long as they are applied on a preventive schedule. Numerous other fungicides are available with specific activity on downy mildews. Downy mildew forecasts, based on reported occurrences of the disease during the season that serve as sources of spores to infect new fields, are available at https://cdm.ipmpipe.org/. The forecast provides an assessment of the risk of losing a watermelon field to downy mildew.

Fusarium wilt (*Fusarium oxysporum f. sp. niveum*)

Fusarium wilt of watermelon is a soilborne fungus disease that occurs statewide. The disease can cause considerable damage where susceptible varieties are grown because entire plants are killed prior to harvest.

Symptoms: Plants may be affected early in crop development but symptoms most commonly develop later, beginning when vines begin to run through fruit set. Symptoms first appear dull, greyish green appearance to the foliage. Affected vines wilt, become dry, turn brown and die (Figure 7). Wilt symptoms are often one-sided in that individual vines are initially affected before the entire plant wilts. Elongated brown lesions (dead areas) may develop along stems near the crown. Spore masses, which appear as pink mold, also may appear on these lesions in wet weather. Affected vines and entire plants eventually wilt and die. A distinct reddish-brown discoloration of the central vascular core (xylem) is apparent in stems cut near the soil line (Figure 8). The xylem, which transports water from the roots through the leaves, becomes dysfunctional, resulting in the wilt symptom.

Figure 7. Fusarium wilt. (Photo courtesy Dan Egel, Purdue University)

Disease Biology: Fusarium species cause root rots and vascular wilts of many crops. They are persistent soilborne fungi that increase in soils repeatedly cropped to susceptible crops. The strain that attacks watermelon is different from those that attack cantaloupe or cucumber. The fungus produces resistant spores that can survive in the soil for many years. The presence of nearby roots stimulates spore

Figure 8. Brown discoloration of inner crown area (xylem) in lower stem caused by Fusarium wilt. (Photo courtesy Dan Egel, Purdue University)

germination and growth, followed by their penetration of roots through natural openings and wounds. The fungus then colonizes the vascular system of the plant, causing the wilt symptoms. There are strains (races) of the fungus that differ in their ability to infect different varieties. To date, there are four described races (0, 1, 2 and 3). Currently, race 1 is predominant in Oklahoma and only a few cases of race 2 have been identified.

Management: Fields with a known history of Fusarium wilt should be avoided if possible. Introduction of the pathogen into clean fields via infested soil clinging to equipment should also be avoided. Control is best achieved through the use of genetic resistance. Resistance to race 1 is widely available in varieties and hybrids, but seedless (triploid) watermelons are generally susceptible. Grafting onto resistant rootstocks is an effective alternative to planting susceptible watermelons. Long crop rotations (six-year minimum) may reduce levels of the wilt fungi. Shorter crop rotations help limit increase of the fungus and development of races capable of attacking resistant varieties. Cover crops such as hairy vetch and crimson clover have reduced Fusarium wilt in some environments.

Gummy stem blight (*Stagonosporopsis cucurbitacearum*)

Gummy stem blight is a damaging foliar disease of watermelon that is difficult to control. It is mainly a problem in southeastern Oklahoma, but has been a periodic problem in other parts of the state. Defoliation of vines causes reduced yields and fruit quality.

Symptoms: Gummy stem blight refers to the stem phase of this disease, which is more common on cantaloupes. On watermelon, the disease is mainly confined to the foliage (leaves and petioles), although seedling blight and fruit rot occasionally occur. Leaf spots are circular to irregular in shape, large (up to ¾ inch in diameter) and dark brown to black in color (Figure 9). The spots often develop at the leaf margins, which is unusual for most foliar diseases. Heavily spotted leaves are killed and affected foliage does not remain erect like downy mildew. Fruiting bodies of the fungus may be visible on affected petioles as tiny black specks (Figure 10).

Figure 9. Gummy stem blight on leaf.

Figure 10. Gummy stem blight on leaf petiole with fruiting bodies.

Disease Biology: The fungus survives on infested crop residue and on contaminated seed. The disease is favored by cool to warm rainy weather, high humidity and wet soils. Fruiting bodies of the fungus on crop debris produce two types of spores. Asexual spores are spread short distance by splashing rain and water runoff. Sexual spores are airborne and are capable of spreading longer distances. Spores require only brief periods of leaf wetness for infection to occur.

Management: Control of gummy stem blight is achieved primarily with fungicides and crop rotation. Crop rotation for a minimum of two years is required for infested crop debris to completely decompose and new fields should be separated from old infested fields by at least 1,000 feet to reduce exposure to spores. The gummy stem blight fungus has developed resistance to several classes of fungicides and it is important to alternate applications of fungicides with different modes of action in preventive spray programs.

Powdery mildew (*Podosphaera xanthii*)

Powdery mildew is a foliar disease that is a more obvious on other cucurbits, such as squash and pumpkins. However, the disease has increased in importance on watermelon, particularly on late plantings. The disease can cause premature defoliation that reduces plant productivity and fruit quality.

Symptoms: Powdery mildew first appears on the oldest leaves as yellow areas on the upper leaf surface. The white mildew on the underside of the leaf often can only be seen with the aid of a hand lens. As the disease increases, the areas of whitish, powdery growth become more apparent (Figure 11) and can cover both upper and lower leaf surfaces. Affected leaves eventually wither and die and defoliation can become extensive. Fruit may also develop mildew symptoms.

Disease biology: Powdery mildew outbreaks begin from airborne spores deposited onto plants. The disease generally appears after flowering in dense plant canopies. The disease is favored by cloudy weather, warm to hot temperatures and high humidity; although the fungus can infect leaves at relative humidity as low as 46%. Rainy weather is not necessary

Figure 11. Powdery mildew.

for powdery mildew development. Numerous spores are produced by the fungus, resulting in rapid disease increase once the disease becomes established. The fungus grows and survives only on living cucurbit plants.

Management: Because watermelon varieties and hybrids are all susceptible to powdery mildew, fungicide sprays are required to control this disease. Preventive spray programs with fungicides can be effective, but the fungus readily develops fungicide resistance, often within a single season. Therefore, spray programs should utilize fungicides with different modes of action. Sulfur is effective on powdery mildew and is permitted in organic production.

Virus diseases (PRSV, WMV and ZYMV)

Several types of viruses affect watermelons in Oklahoma. Most belong to the potato virus Y group of viruses, called potyviruses. These include papaya ringspot virus (PRSV), watermelon mosaic virus (WMV) and zucchini yellow mosaic virus (ZYMV). Losses result from stunted plant growth, reduced fruit set and abnormal fruit development. Plants infected early in crop development are generally most severely affected. Other viruses can occur, but their biology and management are similar.

Symptoms: Symptoms caused by the different viruses are usually similar and more than one virus may be present in plants exhibiting symptoms. Plants can be infected at any stage of growth. Symptoms are most striking on the new growth of young, rapidly growing plants. Leaves are dwarfed, misshapen, puckered, pale green in color and exhibit mosaic patterns of light and dark green color (Figure 12). Infected plants re-main stunted throughout the season and may fail to set fruit or it will be small in size and poor in quality. Virus infection of older plants usually results in less dramatic symptom development and damage. Sometimes the vine terminals of infected plants become erect and hover over the canopy (Figure 13).

Disease biology: The viruses are usually spread by aphids, but they also may be spread mechanically or by cucumber beetles. Aphids acquire the virus by feeding on virus-infected crops or weeds that act as virus reservoirs. Aphids then migrate to cucurbit crops and rapidly infect plants during their probing and feeding activities. Aphids other than the melon aphid, a significant cucurbit pest itself, are usually responsible for initial infection in fields. Generally, only a few plants are initially infected from aphids moving from field to field. Melon aphid activity within fields then accounts for secondary spread, which can be extensive. Aphid numbers in an area increase as the growing season progresses, making late-season plantings particularly vulnerable.

Management: Control of viral diseases of watermelon is difficult because there are no virus-resistant varieties. Planting early to avoid late-season aphid build-up can be an effective way to escape virus disease. Aphid control with insecticides is not effective because insecticides do not kill aphids before they infect plants. Reflective plastic mulches that repel aphids are partially effective. Weed management should be practiced in and around cucurbit fields because weeds may harbor aphids and/or cucurbit viruses. Watermelon plantings, particularly those planted late in the season, should not be situated near or downwind of other fields or areas with virus symptoms. Planting alternating strips of grain sorghum or another short-statured summer grass with watermelons may be effective in reducing virus disease by acting as a 'virus sieve'. Aphids intercepted by the grassy boarder may loose infectivity as they taste or 'probe' the grass crop.

Figure 12. Mosaic virus.

Figure 13. Upright vine growth from severe mosaic virus.

Yellow vine (squash bug (*Anasa tristis*) and *Serratia marcescens*)

While less susceptible than pumpkins and squash, yellow vine is a significant problem on watermelons in Oklahoma and kills plants prior to harvest.

Symptoms: Affected plants are often most numerous near edges of fields and appear in patches. Plants turn yellow and die back (Figure 14). Numerous squash bugs may be present or there will evidence of their prior feeding. When basal stems of affected plants are cross-sectioned, a ring of light brown discoloration is evident around the outer part (phloem) of the vascular core (Figure 15). The phloem—a part for the vascular system of the plant that transports sugars and nutrients downward from the leaves—becomes dysfunctional resulting in the yellowed foliage.

Disease Biology: Squash bugs overwinter as adults in brushy field perimeters and lay groups of shiny bronze-colored eggs on the undersides of leaves. Emerging nymphs and adults feed on basal stems and cause a range of yellowing and wilting symptoms historically called 'Anasa wilt'. It was originally thought that yellow vine was caused by a toxin injected by the squash bug, however no toxin has ever been identified. The bacterium *Serratia marcescens* has recently been implicated as a plant pathogen vectored by the squash bug. However, only a small percentage of plants inoculated with *S. marcescens* develop yellow vine symptoms.

Figure 14. Yellow vine. (Photo courtesy Ed Sikora, Auburn University, Bugwood.org)

Figure 15. Light-brown discoloration of outer crown area (phloem) in lower stem is an internal symptom of yellow vine.

Management: Management of yellow vine should focus on the control of squash bugs and effective control of this insect pest is important for successful watermelon production. This can be achieved by mechanical removal, insecticide application and physical exclusion by using row covers. A novel approach to squash bug management is to plant nearby strips of summer squash which is highly attractive to squash bugs. The insect pest in the trap crop is then sprayed to kill the squash bugs thus avoiding treatment of the main watermelon crop.

Root-knot nematode (*Meloidogyne* spp.)

Nematodes are microscopic round worms that live in soil. Plant parasitic nematodes feed on roots and can reduce plant growth when they reach high levels. Root-knot nematodes cause roots to swell and produce galls. Severe root galling disrupts normal root function. There are several species of root-knot nematode that attack a wide range of crop plants, including watermelons. In small vegetable farms and gardens, the southern root-knot nematode (*M. incognita*) is most common. However, northern root-knot (*M. hapla*) and peanut root-knot (*M. arenaria*) nematodes sometimes occur in commercial production fields.

Symptoms: Aboveground, plants affected by root-knot nematode appear yellowed, stunted or generally unthrifty. Affected areas often occur as patchy areas in a field or along a row of plants. Uprooting affected plants is required to accurately determine that it is root-knot and not one of a number of other causes of poor plant development. Affected roots are

Figure 16. Root-knot nematode. (Photo courtesy Clemson University, Bugwood.org)

disfigured, swollen and stubby in appearance (Figure 16). The galls formed on roots range in size from ¼ inch to more than ½ inch in diameter, depending on the species present and the degree of infestation.

Disease biology: The nematodes survive as eggs or juvenile larvae in soil. Eggs remain dormant in soil in the absence of plant roots. Compounds from roots cause the eggs to hatch and form larvae, which move into roots and use a rigid straw-like mouth-part called a stylet to pierce cells and remove nutrients. Female larvae eventually become sedentary and form feeding sites, which become swollen and produce the characteristic root galls. Large numbers of eggs are produced in the galled roots, then released into the soil upon root decomposition, where they are available for infecting future crops. Several cycles of nematode feeding and reproduction may occur during a single growing season. The degree of root galling and damage is proportional to levels of nematode in the soil.

Management: Root-knot nematode is difficult to manage once soil is infested. Therefore, its best to prevent nematode introduction into fields and gardens. Avoid carrying infested soil on tools, equipment, transplants or other plant material and accompanying soil. Rotation with a non-host crop is a way to reduce levels of root-knot nematodes and to prevent their buildup in soil. In theory, crop rotation with non-host crops results in egg hatch, but resulting larvae cannot feed or reproduce and die. Several crop cycles with non-hosts is required to reduce nematode to non-damaging levels. However, the southern root-knot nematode has a wide host range including most broadleaf vegetable crops, including corn. Genetic resistance to root-knot nematodes is currently unavailable in watermelon. Soil solarization—the heating of soil by capturing solar radiation—is beneficial for reducing nematodes and some other soil-borne plant pathogens. A drawback of solarization is that crops cannot be grown during the summer while the solarization is ongoing. Because nematodes thrive in course, sandy soils low in organic matter, adding organic matter or using soil management practices that favor organic matter accumulation in soil may help reduce nematode levels. Grafting watermelon varieties onto citron melon 'Ojakkyo' rootstock provides resistance to root-knot nematode, but not Fusarium wilt. Where nematodes have been a problem in previous crop production, soil should be tested for nematode levels prior to planting susceptible crops, including watermelon.

Verticillium wilt (*Verticillium dahliae*)

Verticillium wilt occurs in southwestern Oklahoma, where the disease also affects cotton and peanuts. It appears similar to Fusarium wilt and damages the crop by killing plants prior to harvest and/or exposing mature fruit to sunscald.

Symptoms: The disease generally appears after vines have set fruit. Symptoms first appear as yellowed wedge-shaped areas (Figure 17) on older leaves, which eventually develop brown sectors. Crown leaves collapse and wilt extends along individual vines. Wilt symptoms often are one sided, in that individual vines wilt before the entire plant dies. A tan to light brown discoloration is apparent in the vascular core (xylem) of affected plants at the base of stems near the soil line. The discoloration is lighter in color than for Fusarium wilt and appears in streaks when the stem is cut at an angle. Vines later wilt and die.

Figure 17. Early foliar symptoms of Verticillium wilt.

Disease biology: Verticillium is a soilborne fungus that forms resistant survival structures called microsclerotia that persist in soil for many years. Microsclerotia germinate and infect roots during cool and wet conditions. Populations of the fungus increases in the presence of susceptible crops, such as cotton, peanuts and potatoes. While infection of new plants may be limited by hot temperatures, plants already infected likely will continue to develop symptoms.

Management: Verticillium wilt is difficult to manage and should not be introduced into clean fields with soil movement on implements. Sites with a history of Verticillium wilt should be avoided. Practice crop rotation, but avoid rotating watermelons with cotton, peanuts and potatoes. Grafting watermelon varieties onto 'Super Shintosa,' 'Tetsukabuto' or 'Just' rootstocks reduces Verticillium wilt.

Related Extension Publications

EPP-7677, Phytophthora Blight of Cucurbits and Peppers
EPP-7336, Pumpkin and Squash Diseases
HLA-6236, Watermelon Production
EPP-7640, Soil Solarization for Control of Soilborne Diseases
E-832, OSU Extension Agent's Handbook of Insect, Plant Disease and Weed Control (available at the local county Extension office)

FS100E Vegetable Grafting: Watermelon. Washington State University Extension

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