Crop Profile for Muskmelon in Florida

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Production Facts

- The melon referred to as “cantaloupe” is actually named muskmelon (*Cucumis melo*, var. *reticulatus*). The term “cantaloupe” is a misnomer that has been used widely in the vegetable industry as a synonym for muskmelon. True cantaloupe (*C. melo*, var. *cantalupensis*) is grown in Europe and is a small fruit with a hard, scaly, or warty skin.

- Florida-grown muskmelon comprises approximately four percent of national muskmelon acreage (1,2). The national reported planting acreage in 2009 for cantaloupe (muskmelon) was 77,460 acres (1).

- In 2007, Florida muskmelon production occurred on 2,795 acres and 138 farms were involved with the production of this crop (2).

- Hybrid muskmelon varieties recommended for Florida planting include Odyssey, Vienna, Athena, and Eclipse (3).

- While the state average is 80 hundredweight (cwt.) per acre, new hybrids that should be selected by farmers provide approximately 150 cwt. per acre, and 300 cwt. per acre has been achieved in some trials (3,4). Similarly, gross returns for wholesale melons average $1,500 per acre, but could reach as high as $3,000 per acre. Estimated production cost is $750 an acre ($1,500 with the use of plastic mulch and drip irrigation). Break-even price ranges from less than $3.00 per cwt. to over $9.00 per cwt. depending on expected yield (4).

- At a price of $18/cwt., the average Florida production value for muskmelon in 2009 was slightly over four million dollars (1).

Production Regions

Muskmelon is produced throughout the state of Florida, but the majority is planted in the central area of the state. In 2007, 25 percent of Florida's farms and 6 percent of the muskmelon acreage was located in western Florida (Holmes, Jackson, Jefferson, Okaloosa, Walton, and Washington counties). Northern Florida (Alachua, Bradford, Gilchrist, Levy, and Suwannee counties) accounted for 28 percent of the state's muskmelon producing farms and 11 percent of total acreage in 2007. Twenty-one percent of the state's muskmelon-producing farms and 50 percent

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of total acreage was located in west-central Florida (Hillsborough and Hardee counties) in 2007. The remainder of production (26 percent of farms and 33 percent of acreage) was distributed throughout the state (2).

Production Practices

Muskmelon is a warm season species that is adapted to dry conditions, but requires consistent moisture for acceptable yield. The plant needs a frost-free season with plenty of sunshine and heat, and relatively low humidity (4). This melon is prone to cracking and rotting in wet climates. Not surprisingly, most muskmelons are grown in the desert west. Generally, muskmelons in Florida are planted after the threat of frost has passed. Retarded growth and reduced yields result if the seedlings are subject to any lengthy periods at 55EF (13EC) or lower.

Muskmelon grows best in a fertile, well-drained slightly acidic sandy or silt loam soil with a pH between 6.0 and 6.5. The soils present in Florida muskmelon production areas generally fulfill this requirement once the fertility of the soil has been balanced. Excessive levels of nutrients, especially nitrogen, may delay maturity and reduce fruit quality (4).

Muskmelon can be either directly seeded or transplanted. The use of transplants has increased since farmers can harvest the melons from seven to ten days earlier than with directly-seeded plants. The earliest harvested melons command top market prices. From 25 to 50 percent of the muskmelon is grown using plastic mulch and most of this is irrigated with drip irrigation. However, approximately 90 percent of muskmelon growers used full-bed plastic mulch system, often with muskmelon following a high-value crop such as tomato, pepper, or strawberry. The general trend is for mulch and drip irrigation for the central Florida production, and direct seeding on plastic in the northern and western parts of the state.

Muskmelon is planted in Florida between mid-December and mid-April, depending on latitude. Growers in south Florida plant anytime from mid-December to March, while in central and north Florida, planting occurs during the first two months of the year or between mid-February and mid-April, respectively (3). The hybrid varieties employed by Florida growers require 70 to 90 days from transplant to maturity (85 to 110 days from seed), and are planted at a depth of 0.5 to 1.0 inch (1.3 to 2.5 cm). The rows are spaced 60 to 72 inches apart (150 to 180 cm) and plants are spaced from 24 to 36 inches apart (60 to 90 cm). Plant population under closest spacing is 4,356 plants per acre, which requires from one to two pounds of seed per acre (3). Muskmelon requires approximately one inch (2.5 cm) of water weekly, either from rain or irrigation (4).

Cucurbits have separate female and male flowers, with the male flowers appearing prior to female flowering. For the female flowers to produce fruit, pollen from the male flower must be transferred to the female flower by insects. Generally, satisfactory pollination occurs when one strong beehive is present for every two acres of muskmelon. Flowers of muskmelon and other cucurbits open just after sunrise and close in the late afternoon or early evening. Therefore,

applications of insecticide during flowering must be made before sunrise or at dusk/after dark to avoid negatively affecting bee activity (3).

Melons may be harvested at full slip (melon easily separates from stem) or at half to three-quarters slip. The full slip melons are fully mature and are channeled to local fresh market, while the other melons are often trucked to areas such as the Midwest (3). Based on weather, pests, and economics, melons are generally hand-harvested no more than four times within a crop, separated by one or two weeks. As a general practice, muskmelon is picked and packed directly into containers without rinsing. To prevent cracking, the melons should be hydrocooled or forced-air cooled. Florida muskmelon is often packed in 40-pound, two-layer boxes and can be held for approximately two weeks at temperatures from 36 to 41EF (2 to 5EC) at the three quarter slip stage. The melons can be held at even slightly cooler temperature at full maturity.

Worker Activities In-field activities commence with fumigation if employed. Ten to 15 people are required to help seal bed ends and cut shovel ditches in the mulch. After several weeks, transplanting crews (approximately 14 people) set transplants, usually using a setting aid. These workers can cover about ten to 15 acres a day. Ten to eleven weeks after transplanting comes the beginning of harvesting. Growers in Florida harvest muskmelon from mid-March through June, with the most active time of harvest occurring from mid-April through May. After the single harvest, plants may be killed with a herbicide such as paraquat or glyphosate. Some growers may remove old vegetation by mowing, without the use of herbicides.

Insect/Mite Management

Insect/Mite Pests

The principal pests on muskmelon in Florida are the silverleaf whitefly, pickleworm, melonworm, melon thrips, leafminers, and aphids. Minor and occasional pests include squash bug, stink bugs, squash vine borer, southern armyworm, banded cucumber beetle, and twospotted spider mite. Insects and mites that may occasionally be seen on muskmelon but are not economically damaging include garden fleahoppers, fruit flies, spotted cucumber beetle, striped cucumber beetle, potato leafhopper, broad mite, leaffooted bug, western flower thrips, sweetpotato whitefly, greenhouse whitefly, cutworms, ants, cabbage looper, field crickets, other armyworms (fall armyworm, beet armyworm, yellowstriped armyworm), flea beetles, grasshoppers, lygus bugs, saltmarsh caterpillar, squash beetle, tobacco budworm, and wireworms (5).

SILVERLEAF WHITEFLY (*Bemisia argentifolii*)

Silverfleaf whitefly is a significant pest of eggplant, cucumber, squash, succulent bean, tomato, and sweet potato in Florida. This pest is most abundant between December and May (4), although it may be seen over the whole season. Whitefly infestations may also result in sooty mold formation from the accumulation of honeydew on leaves. This fungus is more commonly seen on leaves, but can also occur on fruit, discoloring them as well. As the whitefly migrates

from crop to crop throughout the year, populations commonly peak on the state's crops at the time of harvest. In south-central Florida, populations build on fall vegetables and move directly to overlapping spring crops (6,7).

Whiteflies attack over 500 species of plants, and have been observed to reproduce on at least 15 crops and 20 weed species in Florida. Females deposit eggs on the underside of leaves and are capable of laying from 50 to 400 eggs, averaging around 160. The tiny (0.2 mm long) eggs are attached by a stalk to the leaf and are smooth and whitish yellow, but turn brown just before hatching in about 5 to 7 days. After hatching, the nymph, called a crawler, moves a short distance. Later nymphal stages are sedentary. They pierce the plant with their mouthparts and remain in place, sucking the plant juices. These nymphs are found on the underside of the leaf and may even cover the entire surface. This insect goes through four instar stages, appearing thin, flat, and greenish-yellow. The pre-adult stage (pupa) has conspicuous red eyes and a convex body (8).

Cultural control begins with field hygiene, which is a high priority and should be included as an integral part of the overall strategy for managing whitefly populations and insecticide resistance. These practices will help reduce the onset of the initial infestation of whitefly, both biotype B and biotype Q (if present), and lower the initial infestation level during the cropping period.

The first practice includes establishing a minimum two-month crop free period during the summer, preferably from at least mid-June to mid-August. This is paired with use of a correct crop destruction technique, which includes destruction of existing whitefly populations in addition to the physical destruction of the crop. The fields should then be monitored for germination of tomato seedlings and, if present, they should be controlled by mowing or with herbicides. Growers should also avoid U-pick or pinhooking operations unless effective whitefly control measures are continued. With respect to chemical use around fields, insecticides should not be applied to weeds on field perimeters because this can kill natural enemies, thus interfering with biological control, and because this can select for biotype Q, if present, which is more resistant to many insecticides than biotype B. Growers should also try to keep abreast of operations in upwind fields, especially harvesting and crop destruction, which both disturb the foliage and cause whitefly adults to fly.

PICKLEWORM (*Diaphania nitidalis*)

Pickleworm is a tropical moth that is capable of overwintering in south Florida during normal conditions and may overwinter as far north as Orlando when winters are mild. However, pickleworm is highly dispersive, infesting much of the Southeast each summer. The moths commence flying between three and five hours after sundown, with peak activity around midnight.

Pickleworm can complete a life cycle in approximately 30 days, and up to four generations per season have been documented in Georgia. The wingspan is about 3 cm, with the central portion of the front and hind wings a transparent yellow, bordered by dark brown. The adult moths are not found in the field during the day, instead residing in woods or weedy areas. Female moths

lay eggs (0.8 mm in length) in clusters at points of active plant growth. The eggs are initially white but turn yellow after 24 hours and hatching occurs in four days.

The larvae go through five instars with a development time of two weeks and may reach a length of 2.5 cm in the fifth instar. The first four instars are white-colored with black or gray spots. The spots are lost at the final instar, with color dictated by diet. Pupation often occurs in a leaf fold, and no cocoon is apparent.

Although pickleworm larvae often attack cucurbit fruit, muskmelon is not a preferred host. However, pickleworm larvae sometimes burrow into the melon but more often feed on the surface, causing Arindworm@ damage (9).

MELONWORM (*Diaphania hyalinata*)
Melonworm is another tropical moth that is capable of overwintering in south Florida, and it also infests much of the Southeast each summer. Melonworm can complete a life cycle in approximately 30 days, and up to three generations per season have been documented. The wingspan is about 2.5 cm, pearly white centrally and slightly iridescent, with a broad band of dark brown around the perimeter. Unlike the pickleworm, melonworm moths are found in the field during the day, and will fly short distances when disturbed. Female moths lay eggs (0.7 mm in length) in clusters of two to six. The eggs are initially white or greenish, but turn yellow shortly after laying, and hatch in three or four days.

The larvae go through five instars with a development time of two weeks and may reach a length of 1.6 cm in the fifth instar. The first instar is colorless, but by the second instar, the larvae assume a pale yellow-green color and construct a loose silken structure under leaves which serves to shelter them during the daylight hours. At the fifth instar, two lateral white stripes appear which run the length of the larvae. These stripes disappear just prior to pupation, when the larva spins a loose cocoon on the host plant, often folding a leaf over for added shelter.

Melonworm feeding is restricted to cucurbits. The preferred genus is *Cucurbita* (squash and pumpkin) but *Cucumis* species (muskmelon and cucumber) are also attacked. The larvae preferentially feed upon foliage of favored plants, leaving the veins and creating a lace-like appearance. For less favored hosts such as muskmelon, the larvae may burrow into the melon or feed on the rind - causing Arindworm@ damage (10).

MELON THRIPS (*Thrips palmi*)
The melon thrips is a Southeast-Asian flying insect that is capable of reproducing in greenhouses throughout the southeastern United States, but can be a field pest south of Orlando. Melon thrips can complete a life cycle in approximately 20 days at 30EC, and the insect has a preference for young vegetation (of the cucurbit or solanaceous family), thus creating problems for spring and fall vegetable growers. As one crop matures, thrips move to other crops which are just emerging.

The adult is about 1 mm long, and pale yellow or whitish in color with a black line running down the back. Numerous setae cover the body. Female thrips lay an average of 50 eggs, which are pale white and bean shaped, in slits which it has made in leaf tissue. One end of the egg protrudes from the slit. Hatching at 32EC occurs in about four days.

The larvae go through two instars with a development time of four days at 32EC. Unlike the adults, larvae feed in groups on older plant tissue, particularly along the leaf midrib and veins. Pupation consists of prepupal and pupal stages, which take place in the dirt or leaf litter, and this process takes about three days at 32EC.

Since melon thrips prefer leaves, these structures are generally the most affected, progressing from chlorosis through necrosis, and ending with abscission of the leaves. If infestations are high enough, the crop may have a bronzed appearance in the field. Although there is a preference for leaves, fruit scarring, deformation, and abortion have been observed (11).

APHIDS (*Aphis gossypii*, *Myzus persicae*, *Aphis craccivora*, others)
Aphids common in vegetable production areas vary in color and size (1-2 mm), but have in common the ability to reproduce rapidly (one generation per week under optimum conditions). In Florida, sexual reproduction is not required for population increases as the female aphid reproduces asexually. Adults are often wingless, but nymphs develop into winged adults if the plant condition deteriorates or if it becomes overcrowded.

In addition to the damage caused by direct feeding in the phloem, and the potential for mold growth on honeydew, aphids can transmit viruses. Several viruses common to cucurbit plants are cucumber mosaic virus, watermelon mosaic virus 2, and zucchini yellow mosaic virus. The three aphids named are capable of growth and reproduction on cucurbit plants, but other species may serve as virus transmitters as well in crops such as muskmelon. This process may only take seconds, as the aphid probes the plant to determine suitability. Consequently, insecticides may have little effect on virus transmission.

In addition to virus transmission, aphid feeding does cause direct plant damage. The saliva injected during feeding may cause the foliage to become twisted, curled, or cupped downward. A large aphid infestation may cause plants to gradually wilt, turn yellow or brown, and die.

Aphids in Florida are naturally controlled by parasitic wasps, ladybird beetle larvae, and syrphid fly larvae. However, if non-selective insecticides are used, these predators may be killed, thus leaving surviving populations to expand unchecked. Since aphids feed on new growth and the underside of leaves, insecticidal sprays often do not penetrate to the location of the infestation. Additionally, resistance to the major insecticide groups (chlorinated hydrocarbon, organophosphate, carbamate, and pyrethroid) has been documented for some species, probably as a result of the short generation time for these insects (5,12).

LEAFMINERS (*Liriomyza trifolii, Liriomyza sativae*)
Agromyzid flies of the genus *Liriomyza* in Florida are small (1.5-2.0 mm long) and mostly shiny black expect for yellow markings on portions of the head and abdomen. The adult female fly punctures upper leaf surfaces with its ovipositor, and deposits eggs in the tissue. The yellow maggots grow to a length of 3 mm, feeding on leaf tissue and making serpentine mines in the upper leaf surface. After two weeks of feeding, the larvae cut through the leaf cuticle and drop to the soil surface to pupate. The life cycle in Florida may be as short as 18 days (5,13). Historically, leafminers in Florida were naturally controlled by parasitic wasps. However, if non-selective insecticides are used, predatory wasps may be killed, thus leaving leafminer populations to expand unchecked. Consequently, infestations are often more severe late in the season. Signs indicative of heavy infestation include leaves covered with tunnels (mines) and defoliation (5).

Chemical Control
Historically, some muskmelon fields received soil sterilant. The cost and availability of fumigants has greatly reduced this practice; however, plastic mulch is still employed for various reasons. With warm and moist spring weather, most all Florida growers treat muskmelon for insects.

As muskmelon is included in the cucurbit vegetable crop group, many of the insecticides and miticides available to that group are available for muskmelon as well. Insecticides and miticides labeled for use in muskmelon and registered for use in Florida as of 2010 include: abamectin, acetamiprid, azadirachtin, bifenazate, bifenthrin, buprofezin, B.t., carbaryl, chlorantraniliprole, cryolite, cyfluthrin, cyhalothrin, cypermethrin, cyromazine, diazinon, deltamethrin, dicofol, dimethoate, dinotefuran, endosulfan, esfenvalerate, etoxazole, fenpyroximate, fenpropathrin, flonicamid, flubendiamide, imidacloprid, indoxacarb, kaolin, malathion, methomyl, methoprene, methoxyfenozide, naled, oil, oxydemeton, permethrin, pymetrozine, pyrethrins, pyriproxyfen, soap, spinetoram, spinosad, spiromesifen, sulfur, and thiamethoxam. Many of these are selective materials recently registered from 2005 to 2009.

Most all muskmelon growers scout and monitor while performing routine tasks in the field. Half of the growers conduct scouting activities on a scheduled basis (generally once a week for insects and diseases, every two or three weeks for weeds, and monthly for nematodes).

Cultural Control
Historically, a small number of Florida growers reported modifying planting dates, adjusting fertilizer rates to avoid favorable insect conditions and using insect-resistant varieties. Nearly two-thirds identified/ conserved beneficial insects and managed pests in ditch banks and non-crop area. Most growers destroy crop residues and use rotational/ alternate crops.

Weed Management

Weed Pests

Weeds can reduce muskmelon yields by competing for light, water and nutrients. This effect is greatest early in the season (the first month of growth after emergence), at which time weed management is most critical. Late season weeds will generally not reduce melon yields, but may reduce efficiency of harvest operations (14,15). Weeds are a greater problem in open-grown muskmelon than in mulched bed production, where fumigation may have occurred in previous crops.

Individual weed species will vary from year to year and from region to region within the state. Pigweeds (*Amaranthus* spp.) and grasses are generally the major weed problems in muskmelon production. Florida pusley, purslane and nutsedges (yellow and purple) are also common weeds in muskmelon production.

GOOSEGRASS (*Eleusine indica)*

Goosegrass is a summer annual that is found throughout the state. The grass is consequently a potential weed in all of Florida muskmelon production.

SOUTHERN CRABGRASS (*Digitaria ciliaris*)

Southern crabgrass is a summer annual that poses problems largely in the northern parts of Florida.

AMARANTHS (*Amaranthus* spp).

In the southern region of the state (Dade County) smooth amaranth (*Amaranthus hybridus*) and spiny amaranth (*Amaranthus spinosus*) are the principal amaranth (pigweed) species. Livid amaranth (*Amaranthus lividus*) occurs in other parts of the state.

FLORIDA PUSLEY (*Richardia scabra*)

This summer annual has a prostrate growth pattern and weak stems. It is ubiquitous throughout the state, and consequently a potential weed in melon production.

PURSLANE (*Portulaca oleracea*)

This summer annual also has a prostrate growth pattern and fleshy, succulent leaves. Distribution and potential are similar to Florida pusley.

NUTSEDGES (*Cyperus esculentus, Cyperus rotundus*)

Both yellow *C. esculentus*) and purple *C. rotundus*) nutsedge are potential problems in muskmelon production. These plants are able to penetrate through plastic mulch and compete with melon plants for nutrients, light, and water.

Chemical Control

Non-selective herbicides are used to manage weeds such as eclipta and nightshade in row middles. However, selective herbicides must be used in the raised beds so that crop plants will not be injured. Selective pre-plant herbicides may be used prior to setting transplants and selective post-emergent herbicides are used for over-the-top weed control once the plants have been set or seeded.

Herbicides labeled for muskmelon in Florida in 2010 include bensulide, carfentrazone, clethodim, clomazone, dacthal, ethalfluralin, flumioxazin, glyphosate, halosulfuron, naptalam, oxyfluorfen, paraquat, pelargonic acid, pyraflufen, sethoxydim, and trifluralin.

Cultural Control

Historically, the majority of muskmelon growers establish healthy plants that shade and out-compete weeds as a cultural control method. Growers also use plastic mulch to reduce weed growth and cultivate row middles.

Disease Management

Disease Pathogens

The principal diseases affecting muskmelon production in Florida include viruses (cucumber mosaic virus, papaya ringspot virus type W, watermelon mosaic virus 2, zucchini yellow mosaic virus) and bacterial/fungal diseases such as gummy stem blight, and downy mildew. Diseases with potential for sporadic outbreaks include *Phytophthora* blight, *Alternaria* leaf spot, angular leaf spot, anthracnose, and powdery mildew. *Cercospora* leaf spot, *Fusarium* wilt, bacterial soft rot (caused by *Erwinia carotovora*), target leaf spot (caused by *Corynespora cassiicola*), scab (caused by *Cladosporium cucumerinum*), and southern blight (caused by *Sclerotium rolfsii*) may also affect production occasionally (16).

VIRUSES

Papaya ringspot virus Type W (PRSVW) was formerly known as watermelon mosaic virus 1. It is more prevalent in south and central Florida. While it does not occur every year, it may be widespread in some years. Its occurrence also depends on the presence of wild cucurbit species such as creeping cucumber (*Melothria pendula*), balsam apple (*Clusia rosea*), and ivy gourd (*Coccinea grandis*) that serve as the primary hosts. The virus occurs later in north Florida, during the summer and fall, particularly during the principal watermelon season. PRSVW is not seed-borne, and is transmitted primarily by aphids and to some extent by leafminers. These insects can spread PRSVW from other cucurbit crops (watermelon, squash, and cucumber), as well as weed hosts (17,18).

Watermelon mosaic virus 2 is generally more prevalent in the north central part of Florida. In contrast to PRSVW, the primary source of this virus in unknown, although it has a wide range of hosts. Aphids are the principal vectors of watermelon mosaic virus, although mechanical

transmission by plant sap and transmission by leafminers can also occur. The virus is spread to muskmelon from other cucurbit crops and from weed hosts. Alyceclover (*Alysicarpus vaginalis*) is an important host, particularly in north Florida. In addition, lupine (*Lupinus* spp.), hairy indigo (*Indigofera hirsuta*), and English pea (*Pisum sativum*) can all harbor watermelon mosaic virus in Florida (17,18).

Zucchini yellow mosaic virus, a disease that infected cucurbit crops in the entire state in 1983, now occurs sporadically. Signs can be similar to those of PRSVW or watermelon mosaic virus 2. Although zucchini yellow mosaic virus is transmitted mechanically by plant sap, aphids are the primary vector. The wild cucurbit creeping cucumber (*M. pendula*) is an important host and may be a reservoir of the virus (17,19).

Aphids transmit these viruses in a stylet-borne, non-persistent manner, meaning that an aphid can pick up virus particles on its stylet from an infected plant and transfer them to a healthy plant without the virus entering the aphid's body. There is little delay time from when the aphid acquires the virus to when it transmits it, and the aphid is able to transmit the virus for only a short period of time. This type of transmission can occur within seconds, and knock-down adulticide insecticides are therefore ineffective in preventing virus spread. The use of reflective mulches to disrupt visual landing cues can substantially delay or reduce the incidence of viral diseases by repelling insect vectors.

GUMMY STEM BLIGHT (caused by *Didymella bryoniae/Phoma cucurbitacearum*)
Muskmelon is frequently infected by gummy stem blight, which is more prevalent during wet crop seasons. The infection may occur at any stage of growth and can occur on all plant parts, except the roots. Signs first appear as brown spots on leaves, or as a light to dark brown sometimes gummy lesion on the main stem. The tissue may also appear watersoaked. Wilting and death may ensue if the infection is severe. Both sexual (ascospore) and asexual (pycnidiospore) spore stages are produced after the initial infection. The ascospores have the ability to serve as wind-borne primary sources of inoculum, while the pycnidiospores function in secondary spread. The fungus can be spread through infected transplants or from wild cucurbits (16).

DOWNY MILDEW (caused by *Pseudoperonospora cubensis*)
Downy mildew is another important disease of muskmelon in Florida. The disease reduces yield and fruit quality and can kill plants if they are infected early. The first signs of downy mildew on leaves appear as pale green or yellowish spots on the upper surface, with grayish spore masses on the corresponding lesion on the lower surface. The spots, which are generally angular, become brighter yellow as time progresses. A downy fungal growth, ranging in color from whitish to grayish to light blue, can be seen on the lower leaf surface at each spot when the leaf is wet. Spores are produced primarily within that growth. As the disease progresses, leaves that are severely infected will turn brown and die. The fungus does not occur directly on the melons, but improper coloration and reduced sugar content may reduce the price of the fruit. Optimal conditions for disease development include nighttime temperatures from 55 to 75EF (13 to 24EC) and relative humidity greater than 90 percent. In south Florida, downy mildew is less

severe during winter plantings than during fall and spring plantings, when infection may occur very early in the season. In north Florida, downy mildew epidemics do not usually occur until the flowering period because of cool nighttime temperatures during the spring months (16).

PHYTOPHTHORA FOLIAR BLIGHT/FRUIT ROT (caused by *Phytophthora capsici*)
Phytophthora blight historically occurred sporadically in Florida, but during wet years, it can become the limiting factor in vegetable production in general. During the wet spring growing season in 1998, reductions in muskmelon production in Lee, Hendry, Collier, and Manatee county ranged from 3 to 60 percent (20). The first sign is the development of water-soaked lesions, which expand quickly on the leaves. Dieback of shoot tips, wilting, and shoot rot can be followed by rapid death of the plant. Fruits may develop dark, water-soaked areas and may be covered with the white growth of the fungus. Disease development can be very rapid under favorable conditions, resulting in extensive losses when the disease occurs (21). The fungus survives in the soil, on host plant debris, or on seed. Production of thick-walled spores (oospores) help it to survive unfavorable periods in the soil, while production of a more mobile type of spore (zoospores) helps it to spread by wind and water. Dissemination may also occur by contaminated soil or equipment. When surface moisture is present, zoospores landing on host plants can invade the plant's tissue. Signs may be present in three to four days after infection, under ideal conditions, which include warm, wet weather (21).

ALTERNARIA LEAF SPOT (caused by *Alternaria cucumerina*)
Muskmelon is sensitive to *Alternaria* leaf spot, and quality and sweetness may be affected if the fungus is not controlled. Leaf spots begin as small pale to bright yellow or tan flecks on the upper leaf surface. The spots may be surrounded by light green or yellow halos. Concentric rings appear in the spots as they enlarge, giving a Atarget spot@ appearance. A greasy or watersoaked perimeter may also surround the spots. The spots enlarge to 1- to 2-cm lesions which are somewhat circular to irregularly-lobed and light brown-black in color. The dark areas contain small spores which are easily dispersed by wind. If the disease becomes severe, leaf curling, defoliation, premature ripening, lower yields, and fruit deformity may result. Overripe and sunscalded fruit are especially susceptible to infection. Sunken spots up to 3-cm in length with a greenish-black color are typical signs of fruit rot. Dew period is critical for the establishment of *Alternaria* leaf spot, with very high rates of spore penetration after 10 to 24 hours of wetness. Infection can occur from 41 to 95EF (5 to 35EC) with the optimum for infection being a nighttime temperature of 68EF (20EC) (16).

POWDERY MILDEW
In cucurbits, powdery mildew is caused by three fungal species, *Podosphaera xanthii* (syn. *Sphaerotheca fuliginea*), *Golovinomyces cucurbitacearum* (syn. *Erysiphe cichoracearum*), and *Golovinomyces orontii* (syn. *Erysiphe cichoracearum*. However, *P. xanthii* is more widespread than the other two species. Within each fungal species that causes powdery mildew disease, different races have been described. These powdery mildew races have the potential to attack several powdery-mildew-tolerant or -resistant cucurbit crops if specific environmental conditions are favorable for fungal infection and spread. Consequently, powdery mildew occurs to some extent every year on Florida muskmelon (22).

The disease usually does not appear until later in the season, and older leaves and stems are most affected. Premature loss of foliage can result in yield loss, which is proportional to the severity of the disease and the length of time that plants are infected. This loss of foliage usually results in lower fruit sugar with subsequent reduction in quality. The first sign of powdery mildew is the presence of small, white spots on older leaves. As the disease progresses, the spots merge and large areas of white, powdery fungal growth appear on the upper leaf surface. Spores from the powdery masses are carried by wind to nearby plants. Severely infected leaves eventually turn yellow, then brown, and may die, leaving fruits exposed to sunburn. Powdery mildew is most severe under conditions of greater humidity, particularly during periods of heavy dew. However, the fungus can also reproduce under dry conditions, making it a potential disease during the drier winter and spring months in Florida (22).

ANGULAR LEAF SPOT (caused by *Pseudomonas syringae* pv. lachrymans)
This disease can affect muskmelon leaves, stems, and fruit when the conditions are cooler than normal. Spots on the leaves are irregular in shape, angular, and watersoaked. Free moisture allows the bacteria to ooze from the spots which, upon drying, leaves a white residue. These spots of dead tissue will occasionally drop away from the healthy tissue leaving irregular holes in the leaves (16).

Chemical Control
Over the past decade, a large number of fungicides and bactericides have been registered for use in cucurbits and consequently muskmelon. While the crop is grown in the spring in hopes of minimal insect and disease pressure, nearly all muskmelon produced in Florida will be treated with some type of fungicide, if only as a seed treatment. Historic records indicate foliar applications for over three-quarters of the crop. Weather conditions often guide the types of diseases observed in the field, and growers respond with materials specific for fungal/bacterial and root/foliar diseases. Accordingly, cost has increased for highly-efficacious treatment of specific diseases, while non-specific materials with lesser efficacy for any single disease have remained lower. Consequently, compounds such as coppers, chlorothalonil, sulfur, and thiophanate are widely employed as are the strobilurins (azoxystrobin, pyraclostrobin, trifloxystrobin).

Other disease mediating materials registered for Florida muskmelon production in 2010 include acibenzolar, *Bacillus pumilus*, *Bacillus subtilis*, bicarbonate, boscalid, cyazofamid, cyprodinil, cymoxanil, dimethomorph, famoxadone, fenamidone, fludioxonil, fluopicolide, fosetyl, *Gliocladium virens*, kresoxim, mandipropamide, mefenoxam, plant oils, potassium phosphite, polyoxin-D, propamocarb, quinoxyfen, extract of *Reynoutria sachalinensis*, *Streptomyces lydicus*, tebuconazole, triflumizole, and zoxamide.

Cultural Control
Some growers rogue virus-infected plants and adjust spacing, while nearly half plant as far from other cucurbit crops as possible. Half of the growers use disease-resistant varieties and manage ditch bank and non-crop land pests. Three-quarters of growers use rotational/alternate crops and crop residue management.

Post-harvest Control
Careful handling during and after harvest, removal of infected muskmelon during grading, and adequate temperature maintenance can all aid in minimizing losses from post-harvest decays.

Nematode Management

Nematode Pests
Plant-parasitic nematodes are microscopic roundworms, found in soils, which primarily attack plant roots. General signs of nematode damage include stunting, premature wilting, leaf yellowing, root malformation, and related symptoms characteristic of nutrient deficiencies. Stunting and poor stand development tend to occur in patches throughout the field as a result of the irregular distribution of nematodes within the soil. Root-knot nematodes are the principal nematode pest of muskmelon. Sting nematodes can also be a problem (23).

ROOT-KNOT NEMATODES (*Meloidogyne* spp.)
Root-knot nematodes enter the host plant as second stage juveniles and settle within the root to establish a feeding site. At the feeding site, secretions from the nematode cause the surrounding plant cells to enlarge and multiply, producing the characteristic galls associated with root-knot attack. The female develops within the root, living for as long as several months, and laying hundreds to several thousand eggs that are released into the soil. Low temperatures or dry soil conditions may slow the hatching of eggs. Root deformation results in signs that include stunting, wilting, chlorosis, and yield loss. Additionally, the gall tissue is more susceptible to secondary infections such as root rot (23).

STING NEMATODES (*Belonolaimus* spp.)
These nematodes are ectoparasites, remaining outside the plant root and feeding superficially at or near the root tip by penetrating the root with a long stylet. Affected root tips turn yellow and later necrotic, with cavities forming and the root tip swelling slightly. Damage from feeding inhibits root elongation and causes roots to form tight mats and appear swollen, resulting in a stubby or coarse root appearance. Under severe infestations, new root growth is killed in a way that resembles fertilizer salt burn (23).

Chemical Control
Fumigant nematicides registered for use on muskmelon include 1,3-dichloropropene+/-chloropicrin and methyl iodide. Non-fumigant nematicides include oxamyl and metam sodium. Usually, growers prefer to produce muskmelon under plastic mulch after a first crop of peppers, eggplant, or tomato which have been fumigated, the effect of which carries through the melon crop, which grows quickly.

Cultural Control

A few muskmelon growers use solar sterilization. Others use other non-chemical methods (flooding or deep sub-soiling) as nematode management practices. Many growers use crop rotation as the main form of cultural nematode control.

Contact

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