Florida Crop/Pest Management Profile: Eggplant

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Production Facts

- In 2007, approximately 1,800 acres of eggplant were planted and harvested in Florida. Florida was ranked second nationally in the annual production of eggplant (1).
- The ten-year experimental production mean for eggplant is 762 bushels per acre (2). Eggplant production in 2007 was estimated to total 1,600,000 bushels or nearly 50 million pounds (1). Eggplant is sold over an approximate ten-month period throughout the year, with 25 percent harvested in winter (January through March), 40 percent harvested in the spring (April through mid-July), and 35 percent harvested in the fall (mid-September through December) (3).
- At a price of $10 per bushel of eggplant (10-year average), the value of Florida eggplant in 2007 was approximately $16 million (1,3).

Production Regions

The southeastern part of Florida is its main region for eggplant production. About half of Florida's harvested eggplant acreage is in Palm Beach County, 20 percent is in Miami-Dade County, and five percent each in Manatee, Collier, Lee, and Hillsborough Counties. The remainder of production is distributed throughout the state, mostly in the northern region (1).

Production Practices

Eggplant are normally planted in August and again in February to March in North Florida, in August to September and January to February in Central Florida, and between August and February in South Florida (4).

Eggplant can be grown year-round and are often double-cropped with pepper or cucumber following eggplant harvest. The vegetable crop that follows eggplant in a double-cropping production system depends upon prevailing environmental and economic factors. Growers in Florida often put eggplant in as an extra crop, and grow okra, squash, or cucumbers after the eggplant has been harvested (4). Because of the extended harvest period in Palm Beach County, however, double-cropping with eggplant is not as common a practice there as it is for pepper or tomato. A spring crop of eggplant may follow as a second crop after a fall crop of pepper or tomato.

Eggplant does best on well-drained, fertile, sandy-loam soils at a pH of 6.0–6.5. Poorly drained soils may result in slow plant growth, reduced root systems, and low yields.
Eggplant requires a long, warm, frost-free growing season, usually of 14–16 weeks. Cold temperatures below 50°F injure this crop. The best temperatures are between 80°F and 90°F during the day, and 70°F–80°F during the night; plant growth is curtailed at temperatures below 60°F. Additionally, soil temperature below 60°F restricts germination. However, most eggplant is started in the field from transplants (4).

Eggplant production practices are similar to those of tomato production. In the Palm Beach area, production is usually by the full-bed mulch system with seepage irrigation. The field is plowed and disced to turn under old crop residue, and then shaping the bed, fumigating, and fertilizing are done prior to plastic application. Advantages in the use of plastic include increased weed control, moisture retention, and reduced leaching of fertilizer. Irrigation should be maintained approximately 15–18 inches below soil surface to ensure seepage into the root zone. Maintaining a moist environment creates a nutritional concentration gradient. This gradient allows the banded nitrogen and potassium to diffuse into the soil and replace those nutrients lost to the plant. Plastic mulch also helps retain nutrients by preventing leaching by natural rainfall.

Methyl bromide is often used in the full-bed mulch process. Until 1999, the chemical formulation primarily used was 98 percent methyl bromide and two percent chloropicrin. Since then, growers have been forced to use formulations with lower concentrations of methyl bromide and higher amounts of chloropicrin, due to the phase-out schedule of methyl bromide. Aside from the cost increases, this formulation change is currently not viewed by conventional growers as detrimental to their operations, as eggplant production areas often have high fungal infection pressure, and chloropicrin is highly effective as a fungicide.

Eggplant is usually forced-air cooled, with cold air blown over the fruit. If eggplant is room-cooled, cooling occurs more slowly. Eggplant is not hydro-cooled because the skin is susceptible to damage if suspended in water (5). The larger portion of this crop is generally shipped by truck out of Florida to other states and to Canada (1).

**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. Eggplant is almost always planted as transplants. After several weeks, transplanting crews (approximately 14 people) set transplants, usually using a setting aid. These workers can cover about 10–15 acres a day. Stakes are placed in the rows when plants are 2–3 weeks old, and plants are “sandwiched” between two lines of plastic twine that are wrapped around each stake. This procedure is usually done by workers 3–4 times during the growth of the plant. Approximately 90 percent of eggplant grown in southeastern Florida is staked, either next to every plant or next to every other plant within the row. Ten to eleven weeks after transplanting comes the beginning of harvesting. Twelve to 100 people may be in a field for harvest, depending on field size. The plant may be picked two or three times at 10–14 day intervals. After the final harvest, plants may be killed with an herbicide such as paraquat or glyphosate. Some growers may remove old vegetation by mowing, without the use of herbicides. If the price that eggplant receives is still appealing at the end of the growing season, a grower may hand-cut the old vegetation and ratoon the mature plants. Stakes are removed by hand (4).

**Insect/Mite Management**

Major insect pests of eggplant include mites, armyworms, whitefly, leafminer, aphids, tomato pinworm, and thrips.

**Mites (Polyphagotarsonemus latus, Tetranychus urticae)**

The broad mite, *Polyphagotarsonemus latus*, is a major pest of eggplant and often drives the spray program. Additionally, the two-spotted spider mite, *Tetranychus urticae*, is a sporadic problem. Broad mites are cosmopolitan in distribution. They feed by piercing plant cells and sucking the sap that leaks from the wound. Photosynthesis is reduced, and water balance is affected. Additionally, the terminal leaves and flower buds develop in a deformed manner. Blooms abort, leaves become discolored and thickened, and young foliage or fruit are often malformed and rust-colored. The life cycle from egg to adult lasts 4–6 days. Eggs are oval, approximately 0.7 mm long, and hatch in 2–3 days. The larvae feed for 1–3 days, and then go into the resting pupal stage. Adults are very small (1.5 mm) and difficult to see without a hand lens. Females may live as long as 10 days and lay an average of 2–5 eggs per day (totaling 20–50 eggs over a lifetime). Unfertilized eggs develop into males. The broad mite may be dispersed by climbing onto the legs and bodies of adult whiteflies (6).

Spider mites differ from broad mites in that they are larger and they construct webbing in the plant canopy, but the feeding signs of both of these pests can be quite similar. Spider mites in particular are resistant to many insecticides/miticides (7).
**Silverleaf Whitefly (Bemisia argentifolii)**
Silverleaf 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 (8,9).

Whiteflies attack over 500 species of plants, and have been observed to reproduce on at least 15 crops and 20 weed species in Florida. Capable of laying from 50 eggs up to 400, averaging around 160 over the course of a lifetime, females deposit their eggs on the underside of leaves. Attached by a stalk to the leaf, the tiny (0.2 mm long) eggs are smooth and whitish yellow in color until turning brown just before hatching in about 5–7 days. After hatching, the nymph, also 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) features conspicuous red eyes and a convex body (10).

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 pin-hook 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; furthermore, doing so 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, both of which disturb the foliage and cause whitefly adults to fly.

**Armyworms (Spodoptera spp.)**
Beet and, occasionally, southern armyworms are minor pests of eggplant that may occur throughout the growing season. Populations in Florida peak from June through September. Adult beet armyworm moths lay a mass of 50–75 eggs covered with fuzzy brown or light-colored scales. Newly hatched larvae aggregate on the underside of the foliage, where they scrape away everything but the clear cuticle, giving the leaf a “window pane” look. They also spin a loose webbing. Older larvae disperse, and may enter the fruits of crop. When full-sized, they reach 1–1.5 inches in length. Generation time is about 25–35 days, depending on temperature. Southern armyworm larvae feed on a number of weed species, such as pigweed (Amaranthus spp.), from which they move to a wide range of crop plants (11).

**American Serpentine Leafminer (Liriomyza trifolii)**
These insects are present throughout the growing season, and have a very broad host range that includes eggplant, celery, spinach, lettuce, melons, cucumber, pumpkin, okra, tomato, pepper, potato, and carrot. The adult is a tiny black and yellow fly which deposits eggs within leaf tissue that then hatch within a few days. The larva is yellow, 3 mm long, and feeds within the leaf, where it forms a serpentine mine. Mature larvae generally emerge from inside the leaf and drop to the soil where they pupate. Egg-to-adult life cycle is less than three weeks under optimum conditions, thus many generations may occur within a year. Young plants are most susceptible to damage. Parasitic wasps manage leafminers in most circumstances, but these beneficial wasps may be killed by spraying non-selective insecticides. A decrease in natural enemies may lead to a large outbreak of leafminers (12).

**Aphids (Myzus persicae, Aphis gossypii)**
Aphids, a minor pest, normally appear at the end of the season when growers are not actively spraying (4). Aphids feed by injecting their sharp, hollow mouthparts into plant tissue, and sucking out phloem exudate. Female aphids reproduce asexually, giving birth to live young that develop...
rapidly. Undisturbed, adults remain sedentary, continuing to give birth to more asexually reproducing adults. When populations become crowded, winged, sexually-reproductive forms are produced that disperse, and their dispersal may spread plant viruses. Aphids that can affect eggplant production in Florida include *Myzus persicae* and *Aphis gossypii* (13,14).

Aphids have a number of natural enemies, including ladybird beetles, aphid lions, hover flies, and parasitic wasps. If these natural enemies are present in sufficient numbers, before aphid populations expand, they can keep aphids under control. If foliar sprays are needed to manage aphids, thorough coverage of all the plant surfaces is essential, as aphids tend to prefer the underside of leaves. Because aphids do not lay eggs, a life stage often protected from insecticides, a single, well-delivered spray will usually kill all aphids on a crop until winged individuals migrate.

**Melon Thrips (Thrips palmi)**

Thrips are small insects (usually less than 2 mm in length) that attack a number of crops. Eggs are deposited on plant tissues, and usually hatch in two weeks or more, with nymphs becoming mature in another two weeks. Females lay fertilized and unfertilized eggs, the unfertilized eggs developing into males. These insects can produce several generations in a year. Damage to the plant is caused by the feeding of both adults and larvae on leaves, stems, flowers, and fruit, removing sap with their rasping mouthparts. In eggplant, they are more abundant on leaves (15).

Melon thrips are present in South Florida during the entire growing season, but are most abundant between December and April. Each female produces an average of 50 eggs, which are deposited in slits she makes in host leaf tissue. In eggplant, infestation appears first on the older leaves (particularly near the midrib and veins) at the bottom of the plant. Populations move upward to the younger leaves as food reserves in the older leaves are exhausted. Consequently, larvae are found first on the older leaves (4). After passing through two larval instar stages in about 4–5 days (at 79°F–90°F), the larva drops to the ground, where it passes the prepupal and pupal stages in a soil chamber it has constructed. After 3–4 days, the adult emerges and seeks new host-plant leaves on which to feed. Direct feeding damage from thrips degrades the quality of the fruit by either discoloring the calyx or causing scab formation. Leaf feeding can cause serious defoliation (15).

The relationship between early damage from thrips and eggplant yield has not been determined. However, levels of fruit damage may result in economic crop loss at a density of one larva per fruit. Melon thrips are resistant to many insecticides. In addition, the use of broad-spectrum insecticides may increase populations of melon thrips by killing their natural enemies (particularly pirate bugs of the genus *Orius*), which contribute to thrips management in the field (15).

**Tomato Pinworm (Keferialyocopersicella)**

The tomato pinworm, a small, moth larva, is a serious pest in warmer climates. It is common in Florida tomato-producing regions along the coast south of Tampa and Ft. Pierce. The egg-to-adult development time averages 67 days, but may be as short as 28 days. Eggs are laid singly, or in twos or threes, on host-plant foliage. First instar larvae spin a silk tent before tunneling into the leaf where they make a blotch-like mine. Third and fourth instar stages feed either from within folded or rolled portions of the leaf, or they may enter the stem. Pupation occurs in the soil. Adults emerge in 2–4 weeks. Seven or eight generations of pinworm may occur in some seasons (16).

Damage results from the larvae feeding on leaves, stems, and fruit. The initial injury, a small leaf mine, is not readily noticeable. Later injury is more apparent in leaf folding caused by the older larvae. Leaf folding often hinders the effectiveness of insecticides against this pest. Other damage may then result from pathogenic infections. Pinworms are often seen on eggplant when growers use non-selective insecticides (for management of whitefly) that reduce beneficial organism populations (16).

**Chemical Control**

Historically, eggplant fields were fumigated with methyl bromide/chloropicrin (98:2). However, loss of this fumigant has led some to discontinue the process (approximately 20 percent), while the others are using the remaining methyl bromide. Fumigation has historically been used as the main method of insect control in the production of Florida eggplant.

As eggplant is included in the fruiting vegetable crop group, many of the insecticides and miticides available to tomato growers are available for eggplant as well. Insecticides and miticides labeled for use in eggplant and registered for use in Florida as of 2009 include: abamectin, acetamiprid, azadirachtin, bifenazate, bifenthrin, buprofezin, B.t., car-baryl, chlorantraniliprole, cryolite, cyfluthrin, cyhalothrin, cypermethrin, deltamethrin, dinotefuran, emamectin, endosulfan, esfenvalerate, fenbutatin, fenpyroximate, fenpropathrin, flonicamid, flubendiamide, imidacloprid,
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Indoxacarb, kaolin, malathion, methomyl, methoprene, methoxyfenozide, naled, oil, oxydemeton, permethrin, pymetrozine, pyrethrins, pyriproxyfen, soap, spinetoram, spinosad, spiromesifen, spiracetram, sulfur, tebufenozide, and thiamethoxam. Many of these are selective materials recently registered from 2005 to 2009.

As stated previously, broad mites determine the spray schedule, with organic acreage (which comprises at least ten percent of the current Florida eggplant acreage) receiving sulfur and azadirachtin (neem oil) applications twice weekly. These same materials may be used for conventional crops, in addition to abamectin and spiromesifen for mites (both broad and spider).

Whiteflies are generally treated for based upon aforementioned guidelines. After the seedling nicotinoid treatment has faded, materials used for this pest include spiromesifen, dinotefuran, buprofezin, endosulfan, and soaps.

Although most of the whitefly materials address aphids, some aphid-specific materials are used, such as pymetrozine and flonicamid.

For lepidoptera larvae, product selection depends on how early in the season pressure becomes actionable. Both organic and conventional growers employ B.t. compounds early in the season, but eggplant price drives selection later in the season. If prices are still good, materials such as spinosad, spinetoram, chlorantraniliprole, indoxacarb, or methoxy/tebufenozide may be used to extend the season with low impacts to non-target pests. If prices are down, cheaper non-selective materials are used to clean up the field prior to destruction.

Cultural Control
The only cultural insect/mite management practice reported by eggplant growers in Florida is that of removing host plants (either crop or weed) from the fields.

Disease Management
There are not many disease problems on eggplant in Florida, but a few are significant. The warm, moist climate in the state contributes to the disease problems that do have the opportunity to become established.

Phytophthora Blight (Phytophthora capsici)
Since the late 1990s, Phytophthora blight has been a consistent pest when conditions are favorable. The disease can spread rapidly, causing serious losses to eggplant (17). Phytophthora infestations are more prevalent in the winter, but outbreaks can occur anytime. During February to April 1998, Florida experienced a severe epidemic of this fungus that affected a number of vegetable crops. Disease incidence in eggplant ranged from 16 to 25 percent (17,18).

Phytophthora causes seed rot and seedling blight (damping-off) in many solanaceous crops such as eggplant, pepper, and tomato. In eggplant, the entire plant may be susceptible to the disease, but fruit rot is the primary symptom. This disease begins as a round, dark brown area on the fruit, which can occur at any stage of maturity. A light tan area quickly expands around the initial lesion. A white-to-gray colored fungal growth may appear during wet, humid times, beginning on the more mature part of the lesion. The concentric patterns and dark fruiting structures indicative of Phomopsis rot are lacking in Phytophthora fruit rot (17).

Phytophthora capsici can survive in and on both seeds and plant debris in the soil because of its thick-walled spores (oospores). The fungus may also be spread by wind and water in the form of sporangia, microscopic fungal strands (hyphae), in infected transplants, and on contaminated soil and equipment. Diseases caused by this organism are most abundant during warm, wet weather (80°F–90°F), and in the lowest parts of fields that are often water-logged. Signs of the disease may occur 3–4 days after infection, and entire fields may be rapidly infected (17,19).

Phytophthora blight can be very serious, especially when there has been a damp, moist winter. These weather conditions can produce high infection rates. In fields near Boca Raton, crops have suffered up to 75 percent infection rates. This disease is one of the most destructive, and there are few control measures. Fumigation provides some measure of control. Some growers try not to plant on land that was previously cropped in pepper. However, this practice may be difficult for growers who plant only pepper and eggplant. Rotation is not always practical if a grower has invested so much in their equipment that they must continue to plant only high-value crops. Resistance or insensitivity to mefenoxam has been reported for other Phytophthora species, and has been demonstrated in the laboratory for P. capsici (17). Chemical control of Phytophthora is difficult due to the rapid rate of development of the disease, especially under optimal weather conditions. In Florida in 1993, field-testing found many isolates that varied in sensitivity to mefenoxam (18,19).
**Phomopsis Blight (Phomopsis vexans)**

Another disease of significant importance to eggplant production in Florida is Phomopsis blight, which occurs on fruit and, occasionally, on leaves or stems. Once present, the disease is difficult to manage because the slippery skin of the fruit does not allow good adhesion of sprays, but there are several eggplant varieties that have demonstrated good resistance to Phomopsis blight.

Seedlings that are infected with Phomopsis blight, however, exhibit dark brown lesions that turn gray in the center just above the soil line. Eventually these lesions girdle the stem and kill the plant. On older plants, round or oval spots develop on the leaf and stem, which enlarge and become more irregular. Infection of foliage is less important than fruit infection. This pathogen forms indentations on the fruit. Fungal fruiting bodies form in concentric circles inside the fruit, reducing the grade of the eggplant (20).

**Alternaria Leaf Spot (Alternaria cucumerina)**

The causal fungus infects the leaves only. Lesions are usually round to irregular, dark brown or black, and frequently occur with concentric rings. The pathogen over-seasons on old, diseased plant debris. It can survive on or in crop debris, especially debris on the soil surface, where wind can readily disperse its spores. Volunteer cucurbit plants and weeds may also serve as reservoirs of infection. Wind is the main dispersal agent for spores, but rain splash and mechanical transmission are also factors in the spread of this disease. While spore release from plants occurs mostly under dry conditions, spores require moisture to germinate and enter the leaf tissue. The optimum temperature for infection is 68°F. Within 3–12 days of spore penetration, the next group of spores is released. Disease development is most rapid when nighttime temperatures are close to the optimum (20,21).

**Bacterial Disease**

The largest concern with regard to bacterial diseases is that of bacterial soft rot. Although this is generally a post-harvest disease, it may be observed in the field. Most growers in Florida use copper-based products for bacterial diseases (4).

**Chemical Control**

Fumigation with methyl bromide/chloropicrin in some combination is still performed on the majority of eggplant acreage. Growers rely on this method to control soil-borne fungal diseases. However, disease problems not eliminated by fumigation do exist, with the vast majority of these treated with some type of fungicide during the season. The fungicides most commonly applied are azoxystrobin, maneb, sulfur, and copper hydroxide.

Other fungicides registered for use in Florida eggplant production in 2009 include acibenzolar, azadirachtin, boscalid, chlorothalonil, copper sulfate/octanoate/oxychloride, dimethomorph, fenamidone, fludioxonil (seed treatment only), fluopicolide, fluoxastrobin, mandipropamidine, mfenoxam, myclobutanil, plant oils, potassium phosphate, polyoxin-D, pyraclostrobin, extract of *Reynoutria sachalinensis*, thiram, and trifloxystrobin. Peroxyacetic acid has also been registered for post-harvest fungus control.

**Cultural Control**

Planting in well-drained soils and avoiding planting in fields with large amounts of decomposed plant debris are recommended as cultural controls for damping-off. Most research on alternative controls for disease has been done on tomato, and growers are likely to adapt those findings to eggplant. Tomato was the first crop to be grown under full-bed mulch culture; consequently, progress in tomato pest management will likely be applied to related crops.

Management practices for Phytophthora in transplant production areas include the use of pathogen-free and fungicide-treated seeds and sterile potting media. Flats, plug trays, benches, seeding equipment, and plant house structures should be disinfected using a sodium hypochlorite solution or other disinfectant. Steam sterilization of flats and plug trays may also be useful. Transplant trays with infected plants should be removed immediately from production sites. Workers should disinfect their hands after contact with infected plants. Planting sites should be well-drained and free of low-lying areas. The drainage area of the field should be kept free of weeds and volunteer crop plants, particularly those in the solanaceous and cucurbitaceous groups. If practical, and if disease incidence is low and plants are dry, infected fruit and plants with roots should be rogued and destroyed to prevent the spread of spores (17,19). Alternatively, pulling all infected plants, and subsequent drying and burning rather than discing is recommended.

Florida Market and Florida Beauty varieties are resistant to the “tip over” stage of seedling Phomopsis blight. However, these strains are still susceptible to leaf and stem blight and the fruit rot stages of this disease (20).
Biological Control

There have been a number of biological organisms labeled for use as fungicides. *Streptomyces lydicus*, *Gliocladium virens*, *Bacillus pumilus*, *Bacillus subtilis*, and *Trichoderma harzianum* are registered for fungal control in eggplant.

Nematode Management

Nematodes are small, microscopic, unsegmented worms that live in the soil and attack the roots of plants. Nematode problems in eggplant are similar to those in tomato and pepper, where root damage leads to reduced rooting volume, and reduced water and nutrient uptake. Several different species of nematode attack eggplant. The root-knot nematode is prevalent in sand-, muck-, and rock-based soils, such as those found in many Florida counties. Stubby-root nematode is found in sand and muck soils, and sting nematode is present in sandy soils (22). Since most growers have used fumigants under plastic mulch, nematodes have not been considered serious pests on eggplant.

Root-Knot Nematode (*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 lays hundreds to several thousand eggs that are released into the soil. Low temperatures or dry soil conditions may slow the hatching of eggs (23,24). Root deformation results in symptoms that include stunting, wilting, chlorosis, and yield loss. Additionally, the gall tissue is rendered more susceptible to secondary infections such as root rot (23).

Stubby-Root Nematodes (*Trichodorus* spp.)

Stubby-root nematodes feed externally on the root surface and remain in the soil throughout their life cycle. The primary effect on roots from the nematode’s feeding is cessation of root growth at the root tip. Nematode feeding may also cause abnormal growth of lateral roots. In combination with the lack of root tip growth, the result can be a short, stubby root system with swollen root branches. Populations of this pest build up quickly in the presence of a suitable host, and decrease quickly when a host is no longer available (25,26).

Sting Nematode (*Belonolaimus* spp.)

These nematodes are also ectoparasites, like stubby-root nematodes, 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 first turn yellow and later become 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 (23,25–27).

Cultural Control

Clean fallowing during the off-season is probably the single-most important and effective cultural control measure available for nematodes in Florida eggplant production. When food sources are no longer readily available, soil population densities of nematodes gradually decline, with death occurring as a result of starvation. Due to the wide host range of many nematode species, weeds and crop volunteers must be controlled during the fallow period to prevent nematode reproduction and further population increase. At least two discing operations are generally required to maintain clean, fallow soil conditions during the interim period between crops. Fallowing by use of herbicides to deplete nematode populations is a much slower process because the soil is not disturbed, thereby subjecting nematodes from deeper soil layers to the drying action of sun and wind. The unfavorable effects of fallowing on soil organic matter and soil structure are usually more than compensated for by the level of nematode control achieved and the resulting increase in crop productivity (23).

Chemical Control

Although both fumigant (dichloropropene, methyl bromide, chloropicrin, metam) and non-fumigant (oxamyl) options are available for use in eggplant, the vast majority of growers use fumigation as the method to reduce nematode pressure. Approximately three quarters of eggplant growers employ fumigation prior to planting. These fumigants must diffuse through soil as gases to be effective. The most effective fumigations occur when the soil is well drained, in seedbed condition, and at temperatures above 60°F. Fumigant treatments are most effective in controlling root-knot nematode when residues of the previous crop are either removed or allowed to decay (23).
Weed Management
The most common weeds found in eggplant production in Florida are nightshade (Solanum spp.), eclipta (Eclipta alba), goosegrass (Eleusine indica), crabgrass (Digitaria spp.), Bermuda grass (Cynodon dactylon), yellow nutsedge (Cyperus esculentus), pigweed (Amaranthus spp.), and morning glory (Ipomoea spp.).

Chemical Control
Fumigants such as methyl bromide serve to control weeds in raised bed production, but others such as dichloropropane and metam affect weed populations minimally, and must be supplemented with herbicide use. 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.

Historical herbicide use in eggplant reflects mostly use of paraquat to control row-middle weeds post-emergent. Other herbicides registered for use with eggplant in Florida include bensulide, carfentrazone, clethodim, dacthal, glyphosate, halosulfuron, napropamide, oxyfluorfen, pelargonic acid, pyraflufen, sethoxydim, and trifluralin. Flumioxazin, lactofen, and metolachlor are available through special local-needs registrations (28).

Cultural Control
Methods of cultural control include using plastic mulches, planting grass in row middles, or planting cover crops during the off-season. Cover crops can be used to manage populations of undesirable plants. Mechanical weed control includes turning the weeds under by cultivation using a disk or plow to reduce weed infestation during the off-season or while the crop is growing.

Contact
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