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Chapter 23.
Tomato Production in Florida

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BOTANY

Nomenclature

Family - Solanaceae
Tomato - *Solanum lycopersicum*

Origin

Tomato is a New World vegetable being native to the west coast of South America in the area of Peru and Ecuador.

Related Species

Potato, pepper, and eggplant are other important vegetables in the Solanaceae family. Tomatillo and pepino, of much less importance, are also in this family. In addition, many plants in this family are used as ornamentals. Some, like tobacco, contain powerful alkaloids which may be addictive, poisonous, or useful as pharmaceuticals.

VARIETIES

Variety selection, often made several months before planting, is one of the most important management decisions made by the grower. Failure to select the most suitable variety or varieties may lead to loss of yield or market acceptability.

The following characteristics should be considered in selection of tomato varieties for use in Florida.

* **Yield** - The variety selected should have the potential to produce crops at least equivalent to varieties already grown. The average yield in Florida is currently about 1400 25-pound cartons per acre. The potential yield of varieties in use should be much higher than average.

* **Disease Resistance** - Varieties selected for use in Florida must have resistance to Fusarium wilt, race 1 and race 2; Verticillium wilt (race 1); gray leaf spot; and some tolerance to bacterial soft rot. Available resistance to other diseases may be important in certain situations

* **Horticultural Quality** - Plant habit, stem type and fruit size, shape, color, smoothness and resistance to defects should all be considered in variety selection.

* **Adaptability** - Successful tomato varieties must perform well under the range of environmental conditions usually encountered in the district or on the individual farm.

* **Market Acceptability** - The tomato produced must have characteristics acceptable to the packer, shipper, wholesaler, retailer and consumer. Included among these qualities are pack out, fruit shape, ripening ability, firmness, and flavor.

TOMATO VARIETIES FOR COMMERCIAL PRODUCTION

The varieties listed have performed well in University of Florida trials conducted in various locations.

LARGE FRUITED VARIETIES (FIG. 23-1)

Amelia. Vigorous determinate, main season, jointed hybrid. Fruit are firm and aromatic suitable for green or vine ripe. Good crack resistance. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1, 2 and 3), root-knot nematode, gray leaf spot and Tomato spotted wilt.

Bella Rosa. Midseason maturity. Fruit are large to extra-large, deep globed shaped with firm, uniform green fruits well suited for mature green or vine-ripe production. Determinate, medium to tall vine. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2) Fusarium crown rot and root-knot nematode.

BHN 586. Midseason maturity. Fruit are large to extra-large, deep globed shaped with firm, uniform green fruits well suited for mature green or vine-ripe production. Determinate, medium to tall vine. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2) Fusarium crown rot and root-knot nematode.

BHN 602. Early-midseason maturity. Fruit are globe shape but larger than BHN 640, and green shouldered. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2,3) and Tomato spotted wilt.

BHN 640. Early-midseason maturity. Fruit are globe shape but tend to slightly elongate, and green shouldered. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2,3) and Tomato spotted wilt.

Crista. Midseason maturity. Large, deep globe fruit with tall robust plants. Does best with moderate pruning and high fertility. Good flavor, color and shelf-life. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2,3), Tomato spotted wilt and root-knot nematode.

Crown Jewel. Uniform fruit have a deep oblate shape with good firmness, quality and uniformly-colored shoulders. Determinate with medium-tall bush. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2) Fusarium crown rot, Alternaria stem canker and Gray leaf spot.

Fletcher. Midseason maturity. Large, globe to deep oblate fruit with compact plants. Does best with moderate pruning and high fertility. Good flavor, color and shelf-life. For vine ripe use only due to nipple characteristic on green fruit. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2,3), Tomato spotted wilt and root-knot nematode.

Flora-Lee. It was released for the premium tomato market. A midseason, determinate, jointed hybrid with moderate heat-tolerance. Fruit are uniform green with a high lycopene content and deep red interior color due to the crimson gene. Resistant: Fusarium wilt (race 1, 2, 3), Verticillium wilt (race 1), and Gray leaf spot. For Trial.

Florida 47. A late midseason, determinate, jointed hybrid. Uniform green, globe-shaped fruit. Resistant: Fusarium wilt (race 1 and 2), Verticillium wilt (race 1), Alternaria stem canker, and Gray leaf spot.

Florida 91. Uniform green fruit borne on jointed pedicels. Determinate plant. Good fruit setting ability under high temperatures. Resistant: Verticillium wilt (race 1), Fursarium wilt (race 1 and 2), Alternaria stem canker, and Gray leaf spot.

HA 3073. A midseason, determinate, jointed hybrid. Fruit are large, firm, slightly oblate and are uniformly green. Resistant: Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1 and 2), gray leaf spot, Tomato yellow leaf curl and Tomato mosaic.

Linda. Main season. Large round, smooth, uniform shouldered fruit with excellent firmness and a small blossom end scar. Strong determinate bush with good cover. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2), Alternaria stem canker and Gray leaf spot.

Phoenix. Early mid-season. Fruit are large to extra-large, high quality, firm, globe-shaped and are uniformly-colored. "Hot-set" variety. Determinate, vigorous vine with good leaf cover for fruit protection. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2), Alternaria stem canker and Gray leaf spot.

Quincy. Full season. Fruit are large to extra-large, excellent quality, firm, deep oblate shape and uniformly colored. Very strong determinate plant. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2), Alternaria stem canker, Tomato spotted wilt and Gray leaf spot.

RPT 6153. Main season. Fruit have good eating quality and fancy appearance in a large sturdy shipping tomato and are firm enough for vine-ripe. Large determinate plants. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2) and Gray leaf spot.

Sanibel. Main season. Large, firm, smooth fruit with light green shoulder and a tight blossom end. Large determinate bush. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2), root-knot nematodes, Alternaria stem canker and Gray leaf spot.

Sebring. A late midseason, determinate, jointed hybrid with smooth, deep oblate, firm, thick walled fruit. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1, 2 and 3) Fusarium crown rot, gray leaf spot.

Security 28. An early season determinate variety with a medium vine and good leaf cover adapted to different growing conditions. Produces extra large, round and firm fruit. Resistant: Alternaria stem canker, Fusarium wilt (race 1 and 2), Gray leaf spot, Tomato yellow leaf curl and Verticillium wilt (race 1).

Solar Fire. An early, determinate, jointed hybrid. Has good fruit setting ability under high temperatures. Fruit are large, flat-round, smooth, firm, light green shoulder and blossom scars are smooth. Resistant:Verticillium wilt (race 1), Fusarium wilt (race 1, 2 and 3), Gray leaf spot.

Solimar. A midseason hybrid producing globe-shaped, green shouldered fruit. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1 and 2), Alternaria stem canker, Gray leaf spot.

Soraya. Full season. Fruit are high quality, smooth and tend toward large to extra-large. Continuous set. Strong, large bush. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2,3), Fusarium crown rot and Gray leaf spot.

Talledega. Midseason. Fruit are large to extra-large, globe to deep globe shape. Determinate bush. Has some hot-set ability. Performs well with light to moderate pruning. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2), Tomato spotted wilt and Gray leaf spot.

Tygress. A midseason, jointed hybrid producing large, smooth firm fruit with good packouts. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1 and 2), Gray leaf spot, Tomato mosaic and Tomato yellow leaf curl.

PLUM TYPE VARIETIES

BHN 410. Midseason. Large, smooth, blocky, jointless fruit tolerant to weather cracking. Compact to small bush with concentrated high yield. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2), Bacterial speck (race 0) and Gray leaf spot.

BHN 411. Midseason. Large, smooth, jointless fruit is tolerant to weather cracks and has reduced tendency for graywall. Compact plant with concentrated fruit set. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2), Bacterial speck (race 0) and Gray leaf spot.

BHN 685. Midseason. Large to extra-large, deep blocky, globe shaped fruit. Determinate, vigorous bush with no pruning recommended. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2,3) and Tomato spotted wilt.

Marianna. Midseason. Fruit are predominately extra-large and extremely uniform in shape. Fruit wall is thick and external and internal color is very good with excellent firmness and shelf life. Determinate, small to medium sized plant with good fruit set. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2),root-knot nematode, Alternaria stem canker and tolerant to Gray leaf spot.

Monica. Midseason. Fruit are elongated, firm, extra-large and uniform green color. Vigorous bush with good cover. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2), Bacterial speck (race 0) and Gray leaf spot.

Plum Dandy. Medium to large determinate plants. Rectangular, blocky, defect-free fruit for fresh- market production. When grown in hot, wet conditions, it does not set fruit well and is susceptible to bacterial spot. For winter and spring production in Florida. Resistant: Verticillium wilt, Fusarium wilt (race 1), Early blight, and rain checking.

Spectrum 882. Blocky, uniform-green shoulder fruit are produced on medium-large determinate plants. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1 and 2), root-knot nematode, bacterial speck (race 0), Alternaria stem canker, and Gray leaf spot.

Sunoma. Main season. Fruit are medium-large, elongated and cylindrical. Plant maintains fruit size through multiple harvests. Determinate plant with good fruit cover. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2), Bacterial speck (race 0), root-knot nematodes, Tomato mosaic and Gray leaf spot.

CHERRY TYPE VARIETIES (FIG. 23-2)

BHN 268. Early. An extra firm cherry tomato that holds, packs and ships well. Determinate, small to medium bush with high yields. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1)

Camelia. Midseason. Deep globe, cocktail-cherry size with excellent firmness and long shelf life. Indeterminate bush. Outdoor or greenhouse production. Verticillium wilt (race 1), Fusarium wilt (race 1) and Tobacco mosaic.

Cherry Blossom. 70 days. Large cherry, holds and yields well. Determinate bush. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1,2), Bacterial speck (race 0), root-knot nematodes, Alternaria stem canker and Gray leaf spot.

Mountain Belle. Vigorous, determinate type plants. Fruit are round to slightly ovate with uniform green shoulders borne on jointless pedicels. Resistant: Fusarium wilt (race 1), Verticillium wilt (race 1).

Shiren. Compact plant with high yield potential and nice cluster. Resistant: Fusarium wilt (race 1,2), root-knot nematodes and Tomato mosaic.

Super Sweet 100 VF. Produces large clusters of round uniform fruit with high sugar levels. Fruit somewhat small and may crack during rainy weather. Indeterminate vine with high yield potential. Resistant: Verticillium wilt (race 1) and Fusarium wilt (race 1).

GRAPE TOMATOES

Grape tomatoes are elongated cherry tomatoes with very sweet fruit and fruit length about twice that of the diameter. The fruit usually weigh about 1/3 to 1/2 oz. The plant habit and fruit flavor are very similar to ‘Sweet 100’ and ‘Sweet Million’, two old indeterminate cherry varieties. These older varieties had limited commercial use due to plant growth habit and severe fruit cracking. The original "grape" tomato variety was ‘Santa’, a high quality, indeterminate variety. ‘Santa’ is a proprietary variety and has limited availability to growers. (Varieties are listed below.)

Brixmore. Very early. Indeterminate. Very uniform in shape and size, deep glossy red color with very high early and total yield. High brix and excellent firm flavor. Resistant: Verticillium wilt (race 1), root-knot nematodes and Tomato mosaic.

Cupid. Early. Vigorous, indeterminate bush. Oval-shaped fruit have an excellent red color and a sweet flavor. Resistant: Fusarium wilt (race 1,2), Bacterial speck (intermediate resistance race 0) and Gray leaf spot.

Jolly Elf. Early season. Determinate plant. Extended market life with firm, flavorful grape-shaped fruits. Average 10% brix. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 2) and cracking.

Red Grape. 68 days. Vigorous indeterminate bush. Firm excellent shaped fruit weighing 8-15 gms.

Santa. 75 days. Vigorous indeterminate bush. Firm elongated grape-shaped fruit with outstanding flavor and up to 50 fruits per truss. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1), root-knot nematodes and Tobacco mosaic.

St Nick. Mid-early season. Indeterminate bush. Oblong, grape-shaped fruit with brilliant red color and good flavor. Up to 10% brix.

Smarty. 69 days. Vigorous, indeterminate bush with short internodes. Plants are 25% shorter than Santa. Good flavor, sweet and excellent flavor.

Sweethearts. Indeterminate bush with intermediate internodes. Brilliant red, firm, elongated grape-shaped fruit. Matures between 70 and 75 days. Good flavor, crack-resistant and high brix. Resistant: Tobacco mosaic virus.

Tami G. Early season. Indeterminate, medium tall. Small fruits with nice shape.

Optimum in-row spacing is usually about 27 inches, closer spacing such as 24 inches crowds the plants and makes harvesting more difficult. Wider spacing such as 30 inches has resulted in incomplete canopy closure between plants and waste of space. Since most of the production is with the indeterminate varieties, tall stakes must be used. Most growers use 7 to 8-foot stakes placed between every plant. Fertility management would be similar to normal tomatoes on a daily basis, but end up with greater amounts due to the longer season.

Harvesting is usually done into buckets and then may be transferred to small field crates. Fruits must be handled carefully due to small size and tendency to split. The fruits are graded and separated into color groups. They are packed into pint containers, usually clamshells and placed into flats. There is also some bulk packing into 12 to 20 pound flats. The fruits must be harvested with color and the more color the better. The primary selling point has been the high sugar content of the fruit and growers have found that if they are picked green and gassed, the fruit are not very sweet.

Table 1. Seeding and planting information for tomato.

Planting dates	
North Florida	July - Aug 15 Feb - Apr 15
Central Florida	Aug - Sept Jan - Feb
South Florida	Aug - Feb
Seeding information	
Distance between rows (in)	48 - 72
Distance between plants (in)	12 - 32
Seed per acre, transplant (lb)	0.5 - 0.75
Days to maturity from transplant	70 - 90
Plant population (per acre)	3,630 to 4,356[1]

[1] Standard tomato spacing 24 inches in a row, 6-ft and 5-ft centers, respectively.

SEEDING AND PLANTING

Planting dates and seeding information are given in Table 1.

FERTILIZER AND LIME

For mulched crops with subsurface irrigation, broadcast or band all P_2O_5, micronutrients, and 20 to 25% of N and K_2O in the bed area. Banding P_2O_5 is preferred where only small amounts of P_2O_5, are needed. Band remaining N and K_2O in grooves 2 to 3 inches deep in shoulders of bed. Supplemental N and K_2O at 30 lb and 20 lb, respectively, can be applied by liquid fertilizer injection wheel to replace leached N and K_2O. Soil test and fertilizer recommendations for mineral soils are given in Table 2.

For staked, mulched and drip-irrigated crops, broadcast all P_2O_5, micronutrients, and 20 to 25% of N and K_2O in bed area (Fig. 23-3). Inject remaining N and K_2O through the tube using the schedule in Table 3.

PLANT TISSUE ANALYSIS

Plant tissue analysis information for tomato is given in Table 4. The analysis was done at first flower, using the most recently matured leaf.

PETIOLE SAP TESTING

Fresh sap can be pressed from leaf petioles and analyzed for nitrogen and potassium concentrations. Results can be used to make adjustments in the fertilization pro-

gram. Sufficiency ranges for sap testing for tomato (field) are presented in Table 5.

PRUNING

In most short-stake culture systems some pruning is usually done. Pruning is the removal of suckers (axillary shoots) and can vary from no pruning to removal of all suckers up to the first fork (sucker immediately below the first bloom cluster). The cost of pruning ranges from $0 to $40/acre and comprises a very small part of the total production costs, but this operation can have a very large effect on yield and quality.

The degree of pruning is variety dependent. With short determinate varieties such as Solar Set, Equinox and plum types, only minimal pruning is necessary. With these varieties only the ground suckers, (those that form at cotyledons) need to be removed or none at all. Heavier pruning especially to the fork with these varieties will result in significant yield losses and can lead to increased sunburn fruit, blossom end rot and catfacing. With more vigorous determinate varieties such as Quincy, Florida 91 and Florida 47, heavier pruning such as removal of ground suckers plus two additional suckers may result in increased yields and fruit size. Again, heavy pruning (removal to fork) has caused reduced yields. As new varieties are available, growers will need to experiment as to the proper pruning for each variety. It is important to remove suckers when they are small to minimize damage to the plants.

Sanitation is very important, the tomatoes should never be pruned when the plants are wet. Working wet plants is an excellent way to transmit foliar diseases such as bacterial leaf spot. Other disease such as bacterial wilt and tobacco mosaic virus may also be transmitted through pruning.

IRRIGATION

Initial water requirements (see Chapter 3, *Principles and Practices of Irrigation Management for Vegetables*, Tables 4 to 6) of staked tomato plants (transplants) range from 20% of ETo to 50% of ETo. Lower values are associated with drip irrigated plants on raised, plastic mulched beds. Higher values are associated with production systems that have wet or moist row middle conditions. Water requirements increase during rapid growth and development to range from 90% to 115% of ETo (see Chapter 3, *Principles and Practices of Irrigation Management for Vegetables*, Table 3). As fruit are harvested, water requirements will decrease to between 75% and 100% of ETo. Uniformly available soil moisture through proper irrigation management is essential to ensure high fruit quality and proper sizing of fruit.

WEED MANAGEMENT

Herbicides labeled for weed control in tomatoes are listed in Table 6.

DISEASE MANAGEMENT

Chemicals approved for disease management in tomato are listed in Table 7.

INSECT MANAGEMENT

Table 8 outlines the insecticides approved for use on insects attacking tomato.

PRODUCTION COSTS

Sample breakeven production costs for tomato crops grown in different parts of Florida are given in Table 9 through Table 11. The example year is 2005-2006.

Table 9 Dade County
Table 10 Manatee Ruskin, spring crop
Table 11 Southwest Florida

Table 2. Soil test and fertilizer recommendations for mineral soils for tomato on 6-foot centers.[1]

Target pH	N lb/A	VL	L	M	H	VH	VL	L	M	H	VH
		P_2O_5					K_2O				
		(lb/A/crop season)									
6.5	200	150	120	100	0	0	225	150	100	0	0

[1] See Chapter 2 section on supplemental fertilizer application and best management practices, pg 11.

Table 3. Fertilization recommendations for tomato grown in Florida on sandy soils testing very low in Mehlich-1 potassium (K_2O)

		Recommended-Base fertilization[z]							Recommended-Supplemental fertilization[z]		
				Injected[x] (lbs/A/day)							
Production system	Nutrient	Total (lbs/A)	Preplant[y] (lbs/A)	Weeks after transplanting[w] 1-2	3-4	5-11	12	13	Leaching rain[r,s]	Measured "low" plant nutrient content [u,s]	Extended harvest season[s]
Drip irrigation, raised beds, and polyethylene mulch (on deep sands or on soils with shallow impermeable layer)	N	200	0-70	1.5	2.0	2.5	2.0	1.5	n/a	1.5 to 2 lbs/A/day for 7 days[t]	1.5 to 2 lbs/A/day[p]
	K_2O	220	0-70	2.5	2.0	3.0	2.0	1.5	n/a	1.5 to 2 lbs/A/day for 7 days[t]	1.5 to 2 lbs/A/day[p]
Seepage irrigation, raised beds, and polyethylene mulch (on soils with shallow impermeable layer)	N	200	200[v]	0	0	0	0	0	30 lbs/A[q]	30 lbs/A[t]	30 lbs/A[p]
	K_2O	220	220[v]	0	0	0	0	0	20 lbs/A[q]	20 lbs/A[t]	20 lbs/A[p]

[z] A=7,260 linear bed feet per acre (6-ft bed spacing); for soils testing "very low" in Mehlich 1 potassium (K_2O) Seeds and transplants may benefit from applications of a starter solution at a rate no greater than 10 to 15 lbs/acre for N and P_2O_5, and applied through the plant hole or near the seeds.

[y] Applied using the modified broadcast method (fertilizer is broadcast where the beds will be formed only, and not over the entire field). Preplant fertilizer cannot be applied to double/triple crops because of the plastic mulch; hence, in these cases, all the fertilizer has to be injected.

[x] This fertigation schedule is applicable when no N and K_2O are applied preplant. Reduce schedule proportionally to the amount of N and K_2O applied preplant. Fertilizer injections may be done daily or weekly. Inject fertilizer at the end of the irrigation event and allow enough time for proper flushing afterwards.

[w] For standard 13 week-long, transplanted tomato crop.

[v] Some of the fertilizer may be applied with a fertilizer wheel though the plastic mulch during the tomato crop when only part of the recommended base rate is applied preplant. Rate may be reduced when a controlled-release fertilizer source is used.

[u] Plant nutritional status may be determined with tissue analysis or fresh petiole-sap testing, or any other calibrated method. The "low" diagnosis needs to be based on UF/IFAS interpretative thresholds.

[t] Plant nutritional status must be diagnosed every week to repeat supplemental fertilizer application.

[s] Supplemental fertilizer applications are allowed when irrigation is scheduled following a recommended method (see Chapter 3 on irrigation scheduling in Florida). Supplemental fertilizations is to be applied in addition to base fertilization when appropriate. Supplemental fertilization is not to be applied "in advance" with the preplant fertilizer.

[r] A leaching rain is defined as a rainfall amount of 3 inches in 3 days or 4 inches in 7 days.

[q] Supplemental amount for each leaching rain

[p] Plant nutritional status must be diagnosed after each harvest before repeating supplemental fertilizer application.

Table 4. Plant tissue analysis for tomato at first flower stage. Dry wt. basis.

	N	P	K	Ca	Mg	S	Fe	Mn	Zn	B	Cu	Mo
Status	Percent						Parts per million					
Deficient	<2.8	0.2	2.5	0.8	0.3	0.3	40	30	25	15	5	0.2
Adequate range	2.8 -4.0	0.2 -0.4	2.5 -4.0	0.8 -2.0	0.3 -0.5	0.3 -0.8	40 -100	30 - 100	25 -40	15 -30	5 - 10	0.2 - 0.6
High	>4.0	0.4	4.0	2.0	0.5	0.8	100	100	40	40	15	0.6
Toxic								>1500	>300	>250		

Table 5. Sufficiency ranges for petiole sap testing for tomato.

Crop development stage	Fresh petiole sap concentrations (ppm)	
	NO_3-N	K
First buds	1000-1200	3500-4000
First open flowers	600-800	3500-4000
Fruits one-inch diameter	400-600	3000-3500
Fruits two-inch diameter	400-600	3000-3500
First harvest	300-400	2500-3000
Second harvest	200-400	2000-2500

Table 6. Chemical weed controls: tomatoes.

Herbicide	Labeled crops	Time of application to crop	Rate (lbs. AI./Acre) Mineral	Muck
Carfentrazone (Aim)	(All)	Preplant Directed-hooded Row-middles	0.031	
Remarks: Aim may be applied as a preplant burndown treatment and/or as a post-directed hooded application to row middles for the burn-down of emerged broadleaf weeds. May be tank mixed with other registered herbicides. May be applied at up to 2 oz (0.031 lb ai). Use a quality spray adjuvant such as crop oil concentrate (coc) or non-ionic surfactant at recommended rates.				
Clethodem (Select 2 EC) (Arrow) (Select Max)	Tomato	Postemergence	0.09-0.25	
Remarks: Postemergence control of actively growing annual grasses. Apply at 6-16 fl oz/acre (Select, Arrow) or 9-16 fl oz/acre (Select Max). Higher rates are listed for perennial grasses. Use a crop oil concentrate for Select and Arrow, but a non-ionic surfactant may be used for Select Max. Do not apply within 20 days of harvest.				
DCPA (Dacthal W-75) (non-mulched)	Established Tomatoes	Posttransplanting after crop establishment	6.0-8.0	---
Remarks: Controls germinating annuals. Apply to weed-free soil 6 to 8 weeks after crop is established and growing rapidly or to moist soil in row middles after crop establishment. Note label precautions of replanting non-registered crops within 8 months.				
EPTC (Eptam 7E)	Tomatoes	Pretransplant	2.62-3.5	---
Remarks: Labeled for transplated tomatoes grown on plastic mulch. Apply 3-4 pints/A to the bed top and shoulders immediately prior to the installation of the mulch. Do not transplant the tomato plants for a minimum of 14 days following the application. A 24c special local needs label for Florida.				
Flumioxazin (Chateau)	Fruiting Vegetables Tomato	Directed Row-middles	0.125	---
Remarks: Chateau may be applied up to 4oz product/application to row middles of raised plastic-mulched beds that are at least 4 inches higher than the treated row middle and the mulched bed must be a minimum of a 24-inch bed width. Do not apply after crops are transplanted/seeded. All applications must be made with a shielded or hooded equipment. For control of emerged weeds, a burn down herbicide may be tank-mixed. Label is a Third-Party registration (TPR,Inc). Use without a signed authorization and waiver of liability is a misuse of the product.				
Glyphosate (Roundup, Durango Touchdown, Glyphomax)		Chemical fallow Preplant, pre emergence, Pre transplant	0.3 - 1.0	
Remarks: Roundup, Glyphomax and Touchdown have several formulations. Check the label of each for specific labeling directions.				

Table 6. Continued.

Herbicide	Labeled crops	Time of application to crop	Rate (lbs. AI./Acre) Mineral	Muck
Halosulfuron (Sandea)	Tomatoes	Pre-transplant Postemergtence Row middles	0.024 - 0.036	
Remarks: A total of 2 applications of Sandea may be applied as either one pre-transplant soil surface treatment at 0.5-0.75 oz. product; one over-the-top application 14 days after transplanting at 0.5-0.75 oz. product; and/or postemergence applications(s) of up to 1 oz. product (0.047 lb ai) to row middles. A 30-day PHI will be observed. For postemergence and row middle applications, a surfactant should be added to the spray mix.				
Lactofen (Cobra)	Fruiting Vegetables	Row middles	0.25-0.5	---
Remarks. Third Party label for use pre-transplant or post transplant shielded or hooded to row middles. Apply 16 to 32 fluid oz per acre. A minimum of 24 fl oz is required for residual control. Add a COC or non-ionic surfactant for control of emerged weeds. 1 pre and 1 post application may be made per growing season. Cobra contacting green foliage or fruit can cause excessive injury. Drift of Cobra treated soil particles onto plants can cause contact injury. Do not apply within 30 days of harvest. The supplemental label must be in the possession of the user at the time of application.				
S-Metolachlor (Dual Magnum)	Tomatoes	Pretransplant Row middles	1.0 - 1.3	---
Remarks: Apply Dual Magnum preplant non-incorporated to the top of a pressed bed as the last step prior to laying plastic. May also be used to treat row-middles. Label rates are 1.0-1.33 pts/A if organic matter is less than 3%. Research has shown that the 1.33 pt may be too high in some Florida soils except in row middles. Good results have been seen at 0.6 pts to 1.0 pints especially in tank mix situations under mulch. Use on a trial basis.				
Metribuzin (Sencor DF) (Sencor 4)	Tomatoes	Postemergence Posttransplanting after establishment	0.25 - 0.5	---
Remarks: Controls small emerged weeds after transplants are established direct-seeded plants reach 5 to 6 true leaf stage. Apply in single or multiple applications with a minimum of 14 days between treatments and a maximum of 1.0 lb ai/acre within a crop season. Avoid applications for 3 days following cool, wet or cloudy weather to reduce possible crop injury.				
Metribuzin (Sencor DF) (Sencor 4)	Tomatoes	Directed spray in row middles	0.25 - 1.0	---
Remarks: Apply in single or multiple applications with a minimum of 14 days between treatments and maximum of 1.0 lb ai/acre within crop season. Avoid applications for 3 days following cool, wet or cloudy weather to reduce possible crop injury. Label states control of many annual grasses and broadleaf weeds including, lambsquarter, fall panicum, amaranthus sp., Florida pusley, common ragweed, sicklepod, and spotted spurge.				
Napropamid (Devrinol 50DF)	Tomatoes	Preplant incorporated	1.0 - 2.0	---
Remarks: Apply to well worked soil that is dry enough to permit thorough incorporation to a depth of 1 to 2 inches. Incorporate same day as applied. For direct-seeded or transplanted tomatoes.				
Napropamid (Devrinol 50DF)	Tomatoes	Surface treatment	2.0	---
Remarks: Controls germinating annuals. Apply to bed tops after bedding but before plastic application. Rainfall or overhead-irrigate sufficient to wet soil 1 inch in depth should follow treatment within 24 hours. May be applied to row middles between mulched beds. A special Local Needs 24(c) Label for Florida. Label states control of weeds including Texas panicum, pigweed, purslane, Florida pusley, and signalgrass.				
Oxyfluorfen (Goal 2XL) (Goaltender)	Tomatoes	Fallow bed	0.25 - 0.5	
Remarks: Must have a 30 day treatment-planting interval. Apply as a preemergence broadcast or banded treatment at 1-2 pt/A or 1/2 to 1 pt/A to preformed beds. Mulch may be applied any time during the 30-day interval.				
Paraquat (Gramoxone Inteon) (Firestorm)	Tomatoes	Premergence; Pretransplant	0.62 - 0.94	---
Remarks: Controls emerged weeds. Use a non-ionic spreader and thoroughly wet weed foliage.				
Paraquat (Gramoxone Inteon)	Tomatoes	Post directed spray in row middle	0.47	---
Remarks: Controls emerged weeds. Direct spray over emerged weeds 1 to 6 inches tall in row middles between mulched beds. Use a non-ionic spreader. Use low pressure and shields to control drift. Do not apply more than 3 times per season.				

Table 6. Continued.

Herbicide	Labeled crops	Time of application to crop	Rate (lbs. AI./Acre) Mineral	Muck
Paraquat (Gramoxone Inteon)	Tomato	Postharvest dessication	0.62-0.93	0.46-0.62
Remarks: Broadcast spry over the top of plants after last harvest. Use a nonionic surfactant at 1 pt/100 gals to 1 qt/100 gals spray solution. Thorough coverage is required to ensure maximum herbicide burndown. Do not use treated crop for human or animal consumption.				
Pelargonic Acid (Scythe)	Fruiting Vegetable (tomato)	Preplant Preemergence Directed-Shielded	3-10% v/v	---
Remarks: Product is a contact, nonselective, foliar applied herbicide. There is no residual control. May be tank mixed with several soil residual compounds. Consult the label for rates. Has a greenhouse and growth structure label.				
Pendimethalin (Prowl H_20)	Tomatoes	Post-directed Row Middles	0.0475-0.72	---
Remarks: May be applied pre-transplant but not under mulch. May be applied at 1.0 to 1.5pts/A to row middles. Do not apply within 70 days of harvest.				
Rimsulfuron (Matrix)	Tomato	Posttransplant and directed-row middles	0.25 - 0.5 oz.	---
Remarks: Matrix may be applied preemergence (seeded), postemergence, posttransplant and applied directed to row middles. May be applied at 1-2 oz. product (0.25-0.5 oz ai) in single or sequential applications. A maximum of 4 oz. product per acre per year may be applied. For post (weed) applications, use a non-ionic surfactant at a rate of 0.25% v/v. for preemergence (weed) control, Matrix must be activated in the soil with sprinkler irrigation or rainfall. Check crop rotational guidelines on label.				
Sethoxydim (Poast)	Tomatoes	Postemergence	0.188 - 0.28	---
Remarks: Controls actively growing grass weeds. A total of 42 pts. product per acre may be applied in one season. Do not apply within 20 days of harvest. Apply in 5 to 20 gallons of water adding 2 pts. of oil concentrate per acre. Unsatisfactory results may occur if applied to grasses under stress. Use 0.188 lb ai (1 pt.) to seedling grasses and up to 0.28 lb ai (12 pts.) to perennial grasses emerging from rhizomes etc. Consult label for grass species and growth stage for best control.				
Trifloxysulfuron (Envoke)	Tomatoes (transplanted)	Postdirected	0.005-0.01	---
Remarks: Envoke can be applied at 0.1 to 0.2 oz produc/A post-directed to transplanted tomatoes for control of nutsedge, morningglory, pigweeds and other weeds listed on the label. Applications should be made prior to fruit set and at least 45 days prior to harvest. A nonionic surfactant should be added to the spray mix.				
Trifluralin (Treflan HFP) (Treflan TR-10)	Tomatoes (except Dade County)	Pretransplant incorporated	0.5	---
Remarks: Controls germinating annuals. Incorporate 4 inches or less within 8 hours of application. Results in Florida are erratic on soils with low organic matter and clay contents. Note label precautions of planting non-registered crops within 5 months. Do not apply after transplanting.				

Table 7. Disease management for tomato.

Chemical	Fungicide Group[1]	Maximum Rate/Acre/ Application	Season	Min. Days to Harvest	Pertinent Diseases or Pathogens	Remarks[2]
Be sure to read a current product label before applying any chemical.						
Champion WP (copper hydroxide)	M1	4 lbs.		2	Anthracnose Bacterial speck Bacterial Spot Early blight Grey leaf mold Grey leaf spot Late blight Septoria leaf spot	Mancozeb or maneb enhances bactericidal effect of fix copper compounds. See label for details.
Kocide 2000 (copper hydroxide)	M1	3 lbs		1		
Kocide 3000 (copper hydroxide)	M1	1.75lbs.		1		
Champ F2 (copper hydroxide)	M1	2.67 pts		1		
Basicop 53 WP	M1	4 lbs.		1		
Cuprofix Disperss 36.9 DF(copper hydroxide)	M1	6 lbs				
Nu Cop 50WP (copper hydroxide)	M1	4 lb				
Bonide Liquid Copper (copper salts)	M1	6 tsp/ gal		0		
Sulfur (many brands)	M2			1	Powdery mildew	Follow label closely, it may cause phytotoxicity.
Manex 4 F (maneb)	M3	2.4 qts.	16.8 qts.	5	Early blight Late blight Gray leaf spot Bacterial spot[3] Anthracnose Leaf mold Septoria leaf spot	See label for details
Dithane, Manzate or Penncozeb 75 DFs (mancozeb)	M3	3 lbs.	22.4 lbs.	5		
Maneb 80 WP (maneb)	M3	3 lbs	21 lbs.	5		
Dithane F 45 or Manex II 4 FLs (mancozeb)	M3	2.4 pts.	16.8 qts.	5		
Dithane M-45, Penncozeb 80, or Manzate 80 WPs (mancozeb)	M3	3 lbs.	21 lbs.	5		
Maneb 75 DF (maneb)	M3	3 lbs.	22.4 lbs.	5		
Bonide Mancozeb FL (mancozeb)	M3	5 tsp/ gal		5		
Ziram (ziram)	M3	4 lbs	24 lbs	7	Anthracnose Early blight Septoria leaf spot	Do not use on cherry tomatoes. See label for details.
ManKocide 61.1 DF (mancozeb + copper hydroxide)	M3 / M1	5 lbs.	112 lbs.	5	Bacterial spot Bacterial speck Late blight Early blight Gray leaf spot	See label
Bravo Ultrex (chlorothalonil)	M5	2.6 lbs.	18.3 lbs	0	Early blight Late blight Gray leaf spot Target spot Botrytis Rhizoctonia fruit rot Leaf mold	Use higher rates at fruit set and lower rates before fruit set, see label
Bravo Weather Stik (chlorothalonil)	M5	2.75 pts.	20 pts	0		
Equus 720[4], Echo 720, Chloro Gold 720 6 Fls (chlorothalonil)	M5	3 pts. or 2.88 pts.	20.1 pts.	2		
Echo 90 DF or Equus 82.5DF (chlorothalonil)	M5	2.3 lbs.		2		

Table 7. Continued.

Chemical	Fungicide Group[1]	Maximum Rate/Acre/ Application	Season	Min. Days to Harvest	Pertinent Diseases or Pathogens	Remarks[2]
Allpro Exotherm Termil (20 % chlorothalonil)	M5	1 can / 1000 sq. ft.		7	Botrytis Leaf mold Late blight Early blight Gray leaf spot Target spot	Greenhouse use only. Allow can to remain overnight and then ventilate. Do not use when greenhouse temperature is above 75 F. See label for details.
Rally 40WSP, Nova 40 W (myclobutanil)	3	4 oz.	1.25 lbs.	0	Powdery mildew	Note that a 30 day plant back restriction exists, see label
Ridomil Gold EC (mefenoxam)	4	2 pts. / trtd. acre	3 pts / trtd. acre	28	Pythium diseases	See label for details
Ultra Flourish (mefenoxam)	4	2 qts	3 qts		Pythium and Phytophthora rots	See label for details
Ridomil MZ 68 WP (mefenoxam + mancozeb)	4 / M3	2.5 lbs.	7.5 lbs.	5	Late blight	Limit is 3 appl./crop, see label
Ridomil Gold Copper 64.8 W (mefenoxam + copper hydroxide)	4 / M1	2 lbs.		14	Late blight	Limit is 3 appl. /crop. Tank mix with maneb or mancozeb fungicide, see label
Ridomil Gold Bravo 76.4 W (chlorothalonil +mefenoxam)	4 / M5	3 lbs.	12 lbs	14	Early blight Late blight Gray leaf spot Target Spot	Limit is 4 appl./crop, see label
Endura (boscalid)	7	12.5 oz	25	0	Target spot (*Corynespora cassiicola*) Early Blight (*Alternaria solani)*	Alternate with non-FRAC code 7 fungicides, see label
Scala SC (pyrimethanil)	9	7 fl oz	35 fl oz	1	Early blight Botrytis	Use only in a tank mix with another effective fungicide (non FRAC code 9) ; 30 day plant back with off label crops ; see label
Amistar 80 DF (azoxystrobin)	11	2 oz	12 oz	0	Early blight Late blight Sclerotinia Powdery mildew Target spot Buckeye rot	Limit is 6 appl/crop. Must alternate or tank mix with a fungicide from a different FRAC group, see label.
Quadris (azoxystrobin)	11	6.2 fl.oz.	37.2 fl.oz.	0		
Cabrio 2.09 F (pyraclostro-bin)	11	16 fl oz	96 fl oz	0	Early blight Late blight Sclerotinia Powdery mildew Target spot Buckeye rot	Only 2 sequential appl. allowed. Limit is 6 appl/crop. Must alternate or tank mix with a fungicide from a different FRAC group, see label.
Flint (trifloxystro-bin)	11	4 oz	16 oz	3	Early blight Late blight Gray leaf spot	Limit is 5 appl/crop. Must alternate or tank mix with a fungicide from a different FRAC group, see label.
Evito (fluoxastrobin)	11	5.7 fl oz	22.8 fl oz	3	Early blight Late blight Southern blight Target spot	Limit is 4 appl/crop. Must alternate or tank mix with a fungicide from a different FRAC group, see label.
Reason 500SC (fenamidone)	11	8.2 oz	24.6 lb	14	Early blight Late blight Septoria leaf spot	See label for details

Table 7. Continued.

Chemical	Fungicide Group[1]	Maximum Rate/Acre/ Application	Season	Min. Days to Harvest	Pertinent Diseases or Pathogens	Remarks[2]
Tanos (famoxadone + cymoxanil)	11 / 27	8 oz	72 oz	3	Late blight Target spot Bacterial spot (suppression)	Do not alternate or tank mix with other FRAC group 11 fungicides. See label for details
Terramaster 4EC (etridiazole)	14	7 fl oz	27.4 fl oz	3	Pythium and Phytophthora root rots	Greenhouse use only. See label for details
Blocker 4F Terraclor 75 WP (PCNB)	14	See Label	See Label	Soil treatment at planting	Southern blight (*Sclerotium rolfsii*)	See label for application type and restrictions
Botran 75 W (dichloran)	14	1 lb.	4 lbs.	10	Botrytis	Greenhouse use only. Limit is 4 applications. Seedlings or newly set transplants may be injured, see label
Acrobat 50 WP (dimethomorph)	15	6.4 oz	32 oz	4	Late blight	See label for details
Forum (dimethomorph)	15	6 oz	30 oz	4	Late blight	Only 2 sequential appl. See label for details
Ranman (cyazofamid)	21	2.1-2.75 oz	16 oz	0	Late Blight	Limit is 6 appl./crop, see label
Gavel 75DF (zoaximide + mancozeb)	22 / M3	2.0 lbs	16 lbs	5	Buckeye rot Early blight Gray leaf spot Late blight Leaf mold	See label
Curzate 60DF (cymoxanil)	27	5 oz	30 oz per 12 month	3	Late Blight	Do not use alone, see label for details
Previcur Flex (propamocarb hydrochloride)	28	1.5 pints (see Label)	7.5 pints	5	Late blight	Only in a tank mixture with chlorotalonil, maneb or mancozeb, see label
K-phite 7LP Fosphite Fungi-Phite Helena Prophyte Phostrol Topaz (mono-and di-potassium salts of phosphorous acid)	33	See label		0	*Phythophthora* spp. *Pythium* spp. *Fusarium* spp. Rhizoctonia Late Blight Powdery Mildew	Do not apply with copper-based fungicides. See label for restrictions and details
Aliette 80 WDG (fosetyl-al)	33	5 lbs.	20 lbs.	14	Phytophthora root rot	See label for warnings concerning the use of copper compounds.
Revus Top (mandipropamid + difenoconazole)	40/3	7 fl oz	28 fl oz	1	Anthracnose Black mold Early blight Gray leafspot Late blight Leaf mold Powdery mildew Septoria leafspot Target spot	4 apps per season; no more than 2 sequential apps; do not use on varieties with mature fruit less than 2 inches in diameter. Not labeled for transplants. See label
Presidio (Fluopicolide)	43	3-4 fl oz	12 fl oz/ per season	2	Late blight *Phythophthora* spp.	4 apps per season; no more than 2 sequential apps. 10 day spray interval; Tank mix with another labeled fungicide with a different mode of action; 18 month rotation with off label crops

Table 7. Continued.

Chemical	Fungicide Group[1]	Maximum Rate/Acre/ Application	Season	Min. Days to Harvest	Pertinent Diseases or Pathogens	Remarks[2]
Actigard (acibenzolar-S-methyl)	P	0.75 oz	4.75 oz	14	Bacterial spot Bacterial speck Tomato spotted wilt – a viral disease (use in combination of UV-reflective mulch and vector thrips specific insecticides.	Do not use highest labeled rate in early sprays to avoid a delayed onset of harvest. See label for details.
Agri-mycin 17 (streptomycin sulfate)	25	200 ppm			Bacterial spot Bacterial speck	See label for details
Ag Streptomycin (streptomycin sulfate)	25	200 ppm				
Fire Wall (streptomycin sulfate)	25	200 ppm				
AgriPhage (bacteriophage)						
Oxidate (hydrogen peroxide)		1:100 dilution			Anthracnose Bacterial speck Bacterial spot Botrytis Early blight Late blight Powdery mildew Rhizoctonia fruit rot	See label for details
Amicarb 100 Kaligreen Milstop (Potassium bicarbonate)		See label			Powdery mildew	See label for details
JMS Stylet-Oil (paraffinic oil)		3 qts.			Potato Virus Y Tobacco Etch Virus CMV	See label for restrictions and use (e.g. use of 400 psi spray pressure)
Serenade ASO Serenade Max Sonata (*Bacillus* sp.)	Biological material	See label	See label	0	Bacterial spot Early Blight Late Blight Powdery mildew Target spot Botrytis	Mix with copper compounds, see label

[1] FRAC code (fungicide group): Numbers (1-37) and letters (M, U, P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. M = Multi site inhibitors, fungicide resistance risk is low; U = Recent molecules with unknown mode of action; P = host plant defense inducers. Source: http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

[3] Tank mix of mancozeb or maneb enhances bactericidal effect of copper compounds.

Table 8. Selected insecticides approved for use on insects attacking tomatoes.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Acramite-50WS (bifenazate)	0.75-1.0 lb	12	3	twospotted spider mite	un	One application per season.
Actara (thiamethoxam)	2.0-5.5 oz	12	0	aphids, flea beetles, leafhoppers, stinkbugs, whiteflies	4A	Maximum of 11 oz/acres per season. Do not use following a soil application of a Group 4A insecticide.
Admire Pro (imidacloprid)	7-10.5 fl oz	12	21	aphids, Colorado potato beetle, flea beetles, leafhoppers, thrips (foliar feeding thrips only), whiteflies	4A	Most effective if applied to soil at transplanting. Admire Pro limited to 10.5 fl oz/acre.
Admire Pro (imidacloprid)	0.6 fl oz/1000 plants	12	0 (soil)	aphids, whiteflies	4A	Greenhouse Use: 1 application to mature plants, see label for cautions.
Admire Pro (imidacloprid)	0.44 fl oz/10,000 plants	12	21	aphids, whiteflies	4A	Planthouse: 1 application. See label.
Agree WG (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	armyworms, hornworms, loopers, tomato fruitworm	11	Apply when larvae are small for best control. Can be used in greenhouse. OMRI-listed[2].
***Agri-Mek 0.15EC** (abamectin)	8-16 fl oz	12	7	broad mite, Colorado potato beetle, *Liriomyza* leafminers, spider mite, *Thrips palmi*, tomato pinworms, tomato russet mite	6	Do not make more than 2 sequential applications. Do not apply more than 48 fl oz per acre per season.
***Ambush 25W** (permethrin)	3.2-12.8 oz	12	up to day of harvest	beet armyworm, cabbage looper, Colorado potato beetle, granulate cutworms, hornworms, southern armyworm, tomato fruitworm, tomato pinworm, vegetable leafminer	3	**Do not use on cherry tomatoes.** Do not apply more than 1.2 lb ai/acre per season (76.8 oz). Not recommended for control of vegetable leafminer in Florida.
***Asana XL (0.66EC)** (esfenvalerate)	2.9-9.6 fl oz	12	1	beet armyworm (aids in control), cabbage looper, Colorado potato beetle, cutworms, flea beetles, grasshoppers, hornworms, potato aphid, southern armyworm, tomato fruitworm, tomato pinworm, whiteflies, yellowstriped armyworm	3	Not recommended for control of vegetable leafminer in Florida. Do not apply more than 0.5 lb ai per acre per season, or 10 applications at highest rate.
Assail 70WP (acetamiprid)	0.6-1.7 oz	12	7	aphids, Colorado potato beetle, thrips, whiteflies	4A	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. Begin applications for whiteflies when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.
Assail 30 SG	1.5-4.0 oz					

Table 8. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Avaunt (indoxacarb)	2.5-3.5 oz	12	3	beet armyworm, hornworms, loopers, southern armyworm, tomato fruitworm, tomato pinworm, suppression of leafminers	22	Do not apply more than 14 ounces of product per acre per crop. Minimum spray interval is 5 days.
Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, mites, stink bugs, thrips, weevils, whiteflies	un	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
Azatin XL (azadirachtin)	5-21 fl oz	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, weevils, whiteflies	un	Antifeedant, repellant, insect growth regulator.
***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	12	0	beet armyworm(1), cabbage looper, Colorado potato beetle, dipterous leafminers(2), European corn borer, flea beetles, hornworms, potato aphid, southern armyworm(1), stink bugs, tomato fruitworm, tomato pinworm, variegated cutworm , western flower thrips, whitefly adults(2)	3	(1) lst and 2nd instars only (2) Suppression Do not apply more than 0.132 lb ai per acre per season.
Beleaf 50 SG (flonicamid)	2.0-2.8 oz	12	0	aphids, plant bugs	9C	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
Biobit HP (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars (will not control large armyworms)	11	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed[2].
BotaniGard 22 WP, ES (*Beauveria bassiana*)	**WP:** 0.5-2 lb/100 gal **ES:** 0.5-2 qts 100/gal	4	0	aphids, thrips, whiteflies	--	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
***Brigade 2EC** (bifenthrin)	2.1-5.2 fl oz	12	1	aphids, armyworms, corn earworm, cutworms, flea beetles, grasshoppers, mites, stink bug spp., tarnished plant bug, thrips, whiteflies	3	Make no more than 4 applications per season. Do not make applications less than 10 days apart.
CheckMate TPW-F (pheromone)	1.2-6.0 fl oz	0	0	tomato pinworm	--	For mating disruption - See label.
Confirm 2F (tebufenozide)	6-16 fl oz	4	7	armyworms, black cutworm, hornworms, loopers	18	Product is a slow-acting IGR that will not kill larvae immediately. Do not apply more than 1.0 lb ai per acre per season.
Coragen (rynaxypyr)	3.5-7.5 fl oz	4	1	beet armyworm, Colorado potato beetle, fall armyworm, hornworms, leafminer larvae loopers, southern armyworm, tomato fruitworm, tomato pinworm	28	Can be applied by drip chemigation - See label. Do not use more than 15.4 fl oz product/acre per crop.

Table 8. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Courier 40SC (buprofezin)	9-13.6 fl oz	12	1	whitefly nymphs	16	See label for plantback restrictions. Apply when a threshold is reached of 5 nymphs per 10 leaflets from the middle of the plant. Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Allow at least 28 days between applications.
Crymax WDG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	armyworms, loopers, tomato fruitworm, tomato hornworm, tomato pinworm	11	Use high rate for armyworms. Treat when larvae are young.
***Danitol 2.4 EC** (fenpropathrin)	10.67 fl oz	24	3 days, or 7 if mixed with Monitor 4	beet armyworm, cabbage looper, fruitworms, potato aphid, silverleaf whitefly, stink bugs, thrips, tobacco hornworm, tomato pinworm, twospotted spider mites, yellowstriped armyworm	3	Use alone for control of fruitworms, stink bugs, tobacco hornworm, twospotted spider mites, and yellowstriped armyworms. Tank-mix with Monitor 4 for all others, especially whitefly. Do not apply more than 0.8 lb ai per acre per season. Do not tank mix with copper.
Deliver (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb	4	0	armyworms, cutworms, loopers, tomato fruitworm, tomato pinworm	11	Use higher rates for armyworms. OMRI-listed[2].
***Diazinon AG500; 4E; *50 W** (diazinon)	**AG500, 4E:** 1-4 qts **50W:** 2-8 lb	48	preplant	cutworms, mole crickets, wireworms	1B	Incorporate into soil - see label.
Dimethoate 4 EC, 2.67 EC (dimethoate)	**4EC:** 0.5-1.0 pt **2.67:** 0.75-1.5 pt	48	7	aphids, leafhoppers, leafminers	1B	Will not control organophosphate-resistant leafminers.
DiPel DF (*Bacillus thuringiensis* supspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars	11	Treat when larvae are young. Good coverage is essential. OMRI-listed[2].
Durivo (thiamethoxam, chlorantraniliprole)	10-13 fl oz	12	30	aphids, beet armyworm, Colorado potato beetle, fall armyworm, flea beetles, hornworms, leafhoppers, loopers, southern armyworm, thrips, tomato fruitworm, tomato pinworm, whiteflies, yellowstriped armyworm	4A, 28	Apply by drip chemigation only.
Entrust (spinosad)	0.5-2.5 oz	4	1	armyworms, Colorado potato beetle, flower thrips, hornworms, *Liriomyza* leafminers, loopers, other caterpillars, tomato fruitworm, tomato pinworm	5	Do not apply more than 9 oz per acre per crop. OMRI-listed[2].

Table 8. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
Esteem Ant Bait (pyriproxyfen)	1.5-2.0 lb	12	1	red imported fire ant	7C	Apply when ants are actively foraging.
Extinguish ((S)-methoprene)	1.0-1.5 lb	4	0	fire ants	7A	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Fulfill (pymetrozine)	2.75 oz	12	0 - if 2 applications 14 - if 3 or 4 applications	green peach aphid, potato aphid, suppression of whiteflies	9B	Do not make more than four applications. (FL-040006) 24(c) label for growing transplants also (FL-03004).
Intrepid 2F (methoxyfenozide)	4-16 fl oz	4	1	beet armyworm, cabbage looper, fall armyworm, hornworms, southern armyworm, tomato fruitworm, true armyworm, yellowstriped armyworm	18	Do not apply more than 64 fl oz acre per season. Product is a slow-acting IGR that will not kill larvae immediately.
Javelin WG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.5 lb	4	0	most caterpillars, but not *Spodoptera* species (armyworms)	11	Treat when larvae are young. Thorough coverage is essential. OMRI-listed[2].
Knack IGR (pyriproxyfen)	8-10 fl oz	12	14 7 - SLN No FL -200002	immature whiteflies	7C	Apply when a threshold is reached of 5 nymphs per 10 leaflets from the middle of the plant. Product is a slow-acting IGR that will not kill nymphs immediately. Make no more than two applications per season. Treat whole fields.
Kryocide (cryolite)	8-16 lb	12	14	armyworm, blister beetle, cabbage looper, Colorado potato beetle larvae, flea beetles, hornworms, tomato fruitworm, tomato pinworm	un	Minimum of 7 days between applications. Do not apply more than 64 lbs per acre per season.
***Lannate LV, *SP** (methomyl)	**LV:** 1.5-3.0 pt **SP:** 0.5-1.0 lb	48	1	aphids, armyworm, beet armyworm, fall armyworm, hornworms, loopers, southern armyworm, tomato fruitworm, tomato pinworm, variegated cutworm	1A	Do not apply more than 21 pt LV/acre/crop (15 for tomatillos) or 7 lb SP/acre/crop (5 lb for tomatillos).
Lepinox WDG (*Bacillus thuringiensis* subspecies *kurstaki*)	1.0-2.0 lb	12	0	for most caterpillars, including beet armyworm (see label)	11	Treat when larvae are small. Thorough coverage is essential.
Malathion 5 **Malathion 8 F** (malathion)	1.0-2.5 pt 1.5-2 pt	12	1	aphids, *Drosophila*, mites	1B	Can be used in greenhouse (8F).

Table 8. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
***Monitor 4EC** (methamidophos) [24(c) labels] FL-800046 FL-900003	1.5-2 pts	96	7	aphids, fruitworms, leafminers, tomato pinworm(1), whiteflies(2)	1B	(1) Suppression only (2) Use as tank mix with a pyrethroid for whitefly control. Do not apply more than 8 pts per acre per crop season, nor within 7 days of harvest.
Movento (spirotetramat)	4.0-5.0 fl oz	24	1	aphids, psyllids, whiteflies	23	Maximum of 10 fl oz/acre per season.
M-Pede 49% EC (Soap, insecticidal)	1-2% V/V	12	0	aphids, leafhoppers, mites, plant bugs, thrips, whiteflies	--	OMRI-listed[2].
***Mustang Max EW** ***Mustang Max EC** (zeta-cypermethrin)	2.24-4.0 oz	12	1	beet armyworm, cabbage looper, Colorado potato beetle, cutworms, fall armyworm, flea beetles, grasshoppers, green and brown stink bugs, hornworms, leafminers, leafhoppers, *Lygus* bugs, plant bugs, southern armyworm, tobacco budworm, tomato fruitworm, tomato pinworm, true armyworm, yellow-striped armyworm. Aids in control of aphids, thrips and whiteflies.	3	Not recommended for vegetable leafminer in Florida. Do not make applications less than 7 days apart. Do not apply more than 0.15 lb ai per acre per season.
Neemix 4.5 (azadirachtin)	4-16 fl oz	12	0	aphids, armyworms, hornworms, psyllids, Colorado potato beetle, cutworms, leafminers, loopers, tomato fruitworm (corn earworm), tomato pinworm, whiteflies	un	IGR, feeding repellant. OMRI-listed[2].
NoMate MEC TPW (pheromone)		0	0	tomato pinworm	--	For mating disruption - See label.
Oberon 2SC (spiromesifen)	7.0-8.5 fl oz	12	7	broad mite, twospotted spider mite, whiteflies (eggs and nymphs)	23	Maximum amount per crop: 25.5 fl oz/acre. No more than 3 applications.
Platinum **Platnum 75 SG** (thiamethoxam)	5-11 fl oz 1.66-3.67 oz	12	30	aphids, Colorado potato beetles, flea beetles, leafhoppers, thrips, tomato pinworm, whiteflies	4A	Soil application. See label for rotational restrictions. Do not use with other growth insecticidesl
***Pounce 25 W** (permethrin)	3.2-12.8 oz	12	0	beet armyworm, cabbage looper, Colorado potato beetle, dipterous leafminers, granulate cutworm, hornworms, southern armyworm, tomato fruitworm, tomato pinworm	3	Do not apply to cherry or grape tomatoes (fruit less than 1 inch in diameter). Do not apply more than 0.6 lb ai per acre per season.

Table 8. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	24	5	aphids(1), beet armyworm(2), blister beetles, cabbage looper, Colorado potato beetle, cucumber beetles (adults), cutworms, hornworms, fall armyworm(2), flea beetles, grasshoppers, leafhoppers, plant bugs, southern armyworm(2), spider mites(1), stink bugs, thrips(1), tobacco budworm, tomato fruitworm, tomato pinworm, vegetable weevil (adult), whiteflies(1), yellowstriped armyworm(2)	3	(1) Suppression only. (2) First and second instars only. Do not apply more than 2.88 pints per acre per season.
***Proclaim** (emamectin benzoate)	2.4-4.8 oz	12	7	beet armyworm, cabbage looper, fall armyworm, hornworms, southern armyworm, tobacco budworm, tomato fruitworm, tomato pinworm, yellowstriped armyworm	6	No more than 28.8 oz/acre per season.
Provado 1.6F (imidacloprid)	3.8-6.2 fl oz	12	0	aphids, Colorado potato beetle, leafhoppers, whiteflies	4A	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. Maximum per crop per season 19 fl oz per acre.
Pyrellin EC (pyrethrin + rotenone)	1-2 pt	12	12 hours	aphids, Colorado potato beetle, cucumber beetles, flea beetles, flea hoppers, leafhoppers, leafminers, loopers, mites, plant bugs, stink bugs, thrips, vegetable weevil, whiteflies	3, 21	
Radiant SC (spinetoram)	5-10 fl oz.	4	1	armyworms, Colorado potato beetle, flower thrips, hornworms, *Liriomyza* leafminers, loopers, *Thrips palmi*, tomato fruitworm, tomato pinworm	5	Maximum of 34 fl oz per acre per season.
Requiem 25EC (extract of Chenopodium ambrosioides)	2-4 qt	4	0	chili thrips, green peach aphid, *Liriomyza* leafminers, melon, thrips, potato aphid, western flower thrips	un	Begin applications before pests reach damaging levels.
Sevin 80S; XLR; 4F (carbaryl)	**80S:** 0.63-2.5 **XLR; 4F:** 0.5-2.0 A	12	3	Colorado potato beetle, cutworms, fall armyworm, flea beetles, lace bugs, leafhoppers, plant bugs, stink bugs(1), thrips(1), tomato fruitworm, tomato hornworm, tomato pinworm, sowbugs	1A	(1) suppression Do not apply more than seven times. Do not apply a total of more than 10 lb or 8 qt per acre per crop.

Table 8. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
10% Sevin Granules (carbaryl)	20 lb	12	3	ants, centipedes, crickets, cutworms, earwigs, grasshoppers, millipedes, sowbugs, springtails	1A	Maximum of 4 applications, not more often than once every 7 days.
SpinTor 2SC (spinosad)	1.5-8.0 fl oz	4	1	armyworms, Colorado potato beetle, flower thrips, hornworms, *Liriomyza* leafminers, loopers, *Thrips palmi*, tomato fruitworm, tomato pinworm	5	Do not apply to seedlings grown for transplant within a greenhouse or shadehouse. Leafminer and thrips control may be improved by adding an adjuvant. Do not apply more than three times in any 21 day period. Do not apply more than 29 oz per acre per crop.
Sulfur (many brands)	See label	24	see label	tomato russet mite, twospotted spider mite	--	May burn fruit and foliage when temperature is high. Do not apply within 2 weeks of an oil spray or EC formulation.
Synapse WG (flubendiamide)	2-3 oz	12	1	armyworms, hornworms, loopers, tomato fruitworm	28	Do not apply more than 9 oz/acre per season.
***Telone C-35** (dichloropropene + chloropicrin) ***Telone II** (dichloropropene)	See label	5 days (See label)	preplant	garden centipedes (symphylans), wireworms	--	See supplemental label for restrictions in certain Florida counties.
***Thionex EC** ***Thionex 50W** (endosulfan)	0.66-1.33 qt 1.0-2.0 lb	24	2	aphids, blister beetle, cabbage looper, Colorado potato beetle, flea beetles, hornworms, stink bugs, tomato fruitworm, tomato russet mite, whiteflies, yellowstriped armyworm	2	Do not exceed a maximum of 3.0 lb active ingredient per acre per year or apply more than 6 times. Can be used in greenhouse.
Trigard (cyromazine)	2.66 oz	12	0	Colorado potato beetle (suppression of), leafminers	17	No more than 6 applications per crop. Does not control CPB adults. Most effective against 1st & 2nd instar larvae.
Trilogy (extract of neem oil)	0.5-2.0% V/V	4	0	aphids, mites, suppression of thrips and whiteflies	un	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. Do not exceed 2 gal/acre per application. OMRI-listed[2].
Ultra Fine Oil, JMS Stylet-Oil, and others (oil, insecticidal) **Saf-T-Side**	3-6 qts/100 gal water (JMS) 1-2 gal/100 gal	4	0	aphids, beetle larvae, leafhoppers, leafminers, mites, thrips, whiteflies, aphid-transmitted viruses (JMS)	--	Do not exceed four applications per season. Organic Stylet-Oil and Saf-T-Side are OMRI-listed[2].
Venom Insecticide (dinotefuran)	**foliar:** 1-4 oz **soil:** 5-6 oz	12	**foliar:** 1 **soil:** 21	Colorado potato beetle, flea beetles, leafhoppers, leafminers, thrips, whiteflies	4A	Use only one application method (soil or foliar). Limited to three applications per season. **Do not use on grape or cherry tomatoes.** Toxic to honeybees.

Table 8. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code[1]	Notes
***Vydate L** (oxamyl)	**foliar:** 2-4 pt	48	3	aphids, Colorado potato beetle, leafminers (except *Liriomyza trifolii*), whiteflies (suppression only)	1A	Do not apply more than 32 pts per acre per season.
***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	5	aphids(1), beet armyworm(2), cabbage looper, Colorado potato beetle, cutworms, fall armyworm(2), flea beetles, grasshoppers, hornworms, leafhoppers, leafminers(1), plant bugs, southern armyworm(2), stink bugs, thrips(3), tomato fruitworm, tomato pinworm, whiteflies(1), yellowstriped armyworm(2)	3	(1) suppression only (2) for control of 1st and 2nd instars only. Do not apply more than 0.36 lb ai per acre per season. (3)Does not control western flower thrips.
Xentari DF (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2 lb	4	0	caterpillars	11	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production. OMRI-listed[2].

The pesticide information presented in this table was current with federal and state regulations at the time of revision. The user is responsible for determining the intended use is consistent with the label of the product being used. Use pesticides safely. Read and follow label instructions.

[1] Mode of Action codes for vegetable pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 6.1 August 2008.

1A. Acetylcholinesterase inhibitors, Carbamates (nerve action)
1B. Acetylcholinesterase inhibitors, Organophosphates (nerve action)
2A. GABA-gated chloride channel antagonists (nerve action)
3. Sodium channel modulators (nerve action)
4A. Nicotinic acetylcholine receptor agonists (nerve action)
5. Nicotinic acetylcholine receptor allosteric activators (nerve action)
6. Chloride channel activators (nerve and muscle action)
7A. Juvenile hormone mimics (growth regulation)
7C. Juvenile hormone mimics (growth regulation)
9B and 9C. Selective homopteran feeding blockers
10. Mite growth inhibitors (growth regulation)
11. Microbial disruptors of insect midgut membranes
12B. Inhibitors of mitochondrial ATP synthase (energy metabolism)
15. Inhibitors of chitin biosynthesis, type 0, lepidopteran (growth regulation)
16. Inhibitors of chitin biosynthesis, type 1, homopteran (growth regulation)
17. Molting disruptor, dipteran (growth regulation)
18. Ecdysone receptor agonists (growth regulation)
22. Voltage-dependent sodium channel blockers (nerve action)
23. Inhibitors of acetyl Co-A carboxylase (lipid synthesis, growth regulation)
28. Ryanodine receptor modulators (nerve and muscle action)
un. Compounds of unknown or uncertain mode of action

[2] OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted Use Only**

Table 9. Breakeven production costs for tomato at various yield levels in the Miami-Dade County area, 2005-2006.

		Yield (ctn/acre)				
	Cost per acre	**1150**	**1300**	**1450**	**1600**	**1750**
Variable Costs	$5,268.00	$4.58	$4.05	$3.63	$3.29	$3.01
Fixed Costs	$3,056.75	$2.66	$2.35	$2.11	$1.91	$1.75
Harvest Cost/unit		$3.70	$3.70	$3.70	$3.70	$3.70
Total Cost/unit		$10.94	$10.10	$9.44	$8.90	$8.46

Table 10. Breakeven production costs for spring tomatoes at various yield levels in the Manatee/Ruskin area, 2005-2006.

		Yield (ctn/acre)				
	Cost per acre	**1000**	**1200**	**1400**	**1600**	**1800**
Variable Costs	$5,228.42	$5.23	$4.36	$3.73	$3.27	$2.90
Fixed Costs	$2,304.46	$2.30	$1.92	$1.65	$1.44	$1.28
Harvest Cost/unit		$3.64	$3.64	$3.64	$3.64	$3.64
Total Cost/unit		$11.17	$9.92	$9.02	$8.35	$7.82

Table 11. Breakeven production costs for spring tomatoes at various yield levels in the southwest Florida area, 2005-2006.

		Yield (ctn/acre)				
	Cost per acre	**1400**	**1500**	**1600**	**1700**	**1800**
Variable Costs	$5,698.69	$4.07	$3.80	$3.56	$3.35	$3.17
Fixed Costs	$2,693.20	$1.92	$1.80	$1.68	$1.58	$1.50
Harvest Cost/unit		$3.59	$3.59	$3.59	$3.59	$3.59
Total Cost/unit		$9.58	$9.18	$8.83	$8.53	$8.25