

Chapter 16.

Pepper Production in Florida

S.M. Olson, E.H. Simonne, W.M. Stall, K.L. Pernezny, S.E. Webb, T.G. Taylor, and S.A. Smith

BOTANY

Nomenclature

Family - Solanaceae

Pepper - *Capsicum annuum*

Origin

Pepper is of New World origin being native to Mexico and Central America.

Related Species

Potato, tomato, and eggplant are other important vegetables included 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

Disease tolerance of some pepper varieties grown in Florida is shown in Table 1.

SEEDING AND PLANTING

Planting dates and seeding information is given in Table 2.

FERTILIZER AND LIME

For unmulched pepper with subsurface or sprinkler irrigation, broadcast all P_2O_5 , micronutrients, and 25 to 50% of N and K_2O in the bed. Use the lower rate of K_2O for subsurface irrigation. Band remaining N and K_2O in two applications during early part of growth cycle. Fruit set may be reduced if too much N is applied early. Leached N and K_2O can be replaced with applications of 30 lb N and 20 lb K_2O/A . (Soil test and fertilizer recommendations for pepper on mineral soils are in Table 3.)

For mulched crops with subsurface irrigation, broadcast all P_2O_5 , micronutrients, and 20 to 25% of N and K_2O in bed (Fig. 16-1). Band remaining N and K_2O in grooves 2 to

3 inches deep in bed surface (single band in bed center or three bands for twin-row pepper).

For drip irrigated crops, apply all P_2O_5 , micronutrients, and up to 20 to 25% of N and K_2O in the bed. Inject remaining N and K_2O through tube using the schedule in Table 4.

PLANT TISSUE ANALYSIS

Plant tissue analysis information for pepper is given in Table 5. The analysis was done during early bloom, 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 adjustment in the fertilization program. Sufficiency ranges for sap testing for pepper are presented in Table 6.

IRRIGATION

Young pepper transplants or seedlings have low water requirements (see Chapter 3, *Principles and Practices of Irrigation Management for Vegetables*, Table 4 to 6), near 20% of ET_o (see Chapter 3, *Principles and Practices of Irrigation Management for Vegetables*, Table 3). Water requirements rapidly increase and approach 100% of ET_o as complete canopy cover and development occur. Fruit production occurs shortly after plants begin the rapid growth and development stage. Thus, proper and timely irrigation is essential to avoid early plant stress and reduced fruit size and quality. Crop water requirements decrease to 85% of ET_o during the final growth stage. However, as long as weather conditions are favorable, plants will continue to set and develop new fruit. Therefore, monitor soil moisture conditions to ensure that adequate, but not excessive moisture conditions exist.

Table 1-A. Disease tolerance of selected bell pepper varieties for commercial production¹.

Variety	Color	Bacterial Spot Race				Potato Virus Y	Tobacco Etch Virus	Cucumber Mosaic Virus	Pepper Mottle Virus	Stip	Tobacco Mosaic Virus	Tobamovirus P ₀
		1	2	3	5							
Aladdin (H)	G:Y	+	+	+	-	+	+	-	-	-	-	+
Aristotle (H)	G:R	+	+	+	-	+	-	-	-	-	-	+
Brigadier (H)	G:R	+	+	+	-	+	-	-	-	-	-	-
Crusader (H)	G:R	+	+	+	-	+	-	-	+	-	+	-
Double-Up (H)	G:R	+	+	+	-	-	-	-	-	-	+	-
Enterprise-X3R(H)	G:R	+	+	+	-	-	-	-	-	-	-	+
Excursion II* (H)	G:R	+	+	+	-	+	-	-	-	-	+	-
Heritage* (H)	G:R	+	+	+	+	-	-	-	-	-	-	-
Lafayette (H)	G:Y	+	+	+	-	+	-	-	+	-	-	-
Legionnaire (H)	G:R	+	+	+	-	-	-	-	-	+	+	-
Olympus (H)	G:R	+	+	+	-	-	-	-	-	-	-	-
Orion (H)	G:R	+	+	+	-	-	-	-	-	-	-	-
Paladin** (H)	G:R	-	-	-	-	-	-	-	-	-	+	-
Patroit (H)	G:R	+	+	+	+	+	-	-	-	-	-	-
Polaris (H)	G:R	+	+	+	-	-	-	-	-	-	-	-
Revolution** (H)	G:R	+	+	+	+	-	-	+	-	-	-	-
Sentry (H)	G:R	+	+	+	-	+	-	-	-	+	-	-
Snapper (H)	G:R	+	+	+	-	-	-	-	-	-	-	+
Telestar (H)	G:R	+	+	+	-	+	-	-	-	-	+	-
Wizard-X3R (H)	G:R	+	+	+	-	0	0	-	-	-	+	-

¹ Tolerant (+), not tolerant (-), unknown (0), Hybrid (H), Green Immature Color (G), Red Mature Color (R), Yellow Mature Color (Y),
* Resistant to Tomato spotted wilt, ** Resistant to Phytophthora

Table 1-B. Disease tolerance of speciality pepper varieties for commercial and local production¹.

Varieties	Color	Potato Virus Y	Tobacco Etch Virus	Common strains of Tobacco Mosaic Virus
Cubanelle				
Aruba	G:R	-	-	-
Biscayne	G:R	-	-	-
Key Largo	G:R	-	-	-
Speciality (Figs. 16-3, 16-4)	Type			
Ancho Villa (light green)	ancho	-	-	+
Don Matais	hot ancho	-	-	-
Ventura (dark green)	ancho	-	-	-
Large Red Thick	cayenne	-	-	-
Mesilla	hot cayenne	+	+	+
Cherry Bomb	cherry	-	-	-
Inferno	Hungarian wax	-	-	-
Delicias	no-heat jalapeno	-	-	-
Conchos	jalapeno	-	-	-
Grande	jalapeno	+	+	+
Hercules	jalapeno	-	-	-
Mitla	jalapeno	-	-	-
Big Chile II	SW chile	?	?	?
Antohi Romanian	sweet frying	-	-	-
Giant Marconi	sweet Italian	-	-	-
Mariachi	hot chile	?	?	?
Serrano del Sol	serrano	?	?	?

¹ Tolerant (+), not tolerant (-), do no know (?), Hybrid (H), Green immature color (G), Red mature color (R)

WEED MANAGEMENT

Herbicides labeled for weed control in peppers are listed in Table 7.

DISEASE MANAGEMENT

Chemicals approved for disease management use on pepper are listed on Table 8.

INSECT MANAGEMENT

Table 9 outlines the insecticides approved for use on insects attacking pepper.

PRODUCTION COSTS

Production costs for pepper in the Palm Beach County area are given in Table 10; for southwest Florida, in Table 11.

Table 2. Seeding and planting information for pepper.

Planting dates	
North Florida	Aug 15 /Feb-Mar
Central Florida	Aug-Sept/Jan-Mar
South Florida	Aug-Feb
Planting information	
Distance between rows (in)	36 - 48
Distance between plants (in)	10 - 24
Seed per acre in transplant (lb)	0.25 - 0.5
Days to maturity from transplant	65 - 75
Plant population ¹ (acre)	17,500

¹ Standard commercial mulched pepper spacing 10-inches in row, 2 rows per bed, 6-ft centers.

Table 3. Soil test and fertilizer recommendations for mineral soils for pepper on 6-foot beds.¹

Target pH	N lb/A	P ₂ O ₅					K ₂ O				
		VL	L	M	H	VH	VL	L	M	H	VH
(lb/A/crop season)											
6.5	200	150	120	100	0	0	200	150	100	0	0

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

Table 4. Fertilization recommendations for pepper grown in Florida on sandy soils testing very low in Mehlich-1 potassium (K₂O)

Production system	Nutrient	Recommended-Base fertilization ^z							Recommended-Supplemental fertilization ^z		
		Total (lbs/A)	Preplant ^y (lbs/A)	Injected ^x (lbs/A/day)					Leaching rain ^{r,s}	Measured "low" plant nutrient content ^{u,s}	Extended harvest season ^{u,s}
				1-2	3-4	5-11	12	13			
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 ₂ O	225	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
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 ₂ O	225	225 ^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 (K₂O) 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 P₂O₅, 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 K₂O are applied preplant. Reduce schedule proportionally to the amount of N and K₂O 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.

^v For standard 13 week-long, transplanted pepper crop.

^v Some of the fertilizer may be applied with a fertilizer wheel though the plastic mulch during the pepper 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 5. Plant tissue analysis at early bloom for pepper. Dry wt. basis.

Status	N	P	K	Ca	Mg	S	Fe	Mn	Zn	B	Cu	Mo
	Percent						Parts per million					
Deficient	<3.0	0.3	2.5	0.6	0.3	0.3	30	30	25	20	5	0.2
Adequate range	3.0 -5.0	0.3 -0.5	2.5 -5.0	0.6 -1.5	0.3 -0.5	0.3 -0.6	30 -150	30 -100	25 -80	20 -50	5 - 10	0.2 -0.8
High	>5.0	0.5	5.0	1.5	0.5	0.6	150	100	80	50	10	0.8
Toxic (>)								1000		350		

Table 6. Sufficiency ranges for petiole sap testing for pepper.

Crop development stage	Fresh petiole sap concentration (ppm)	
	NO ₃ -N	K
First flower buds	1400-1600	3200-3500
First open flowers	1400-1600	3000-3200
Fruits half-grown	1200-1400	3000-3200
First harvest	800-1000	2400-3000
Second harvest	500-800	2000-2400

Table 7. Chemical weed controls: peppers.

Herbicide	Labeled crops	Time of application to crop	Rate (lbs. AI./Acre)	
			Mineral	Muck
Bensulide (Prefar 4E)	Pepper	Preplant incorporated Preemergence	5-6	--
Remarks: Preplant incorporate using power driven cultivations or may be incorporated using irrigation. Controls many grasses. Provides fair to good control of lambsquarters, purslane and amaranths.				
Carfentrazone (Aim)	Pepper	Preplant Directed-hooded Row-middles	0.031	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.				
Clethodim (Select 2 EC) (Arrow) (Select Max)	Peppers (bell and non-bell)	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.				
Clomozone (Command)	Pepper (all except banana)	Preplant incorporated	1.0	---
Remarks: May be utilized as a preemergent soil applied treatment for the control of annual grasses and certain broadleaf weeds, including common ragweed, galinsaga, lambsquarters, prickly sida, purslane, Florida pusley, and others. Make a single application at a rate of 2 pts. (1 lb. ai) per acre prior to seeding or transplanting. Incorporate to a depth of 1 inch or less and place seed or transplant below chemical barrier. May be tank mixed with other herbicides registered for use inpepers. May be applied to all pepper varieties including bell, hot pimento and sweet, except banana.				
DCPA (Dacthal W-75)	Established pepper	Posttransplanting after crop establishment (non mulched) Mulched row middles after crop establishment	6.0-8.0	---
Remarks: Controls germinating annuals. Apply to weed-free soil 4 to 6 weeks after crop is transplanted or seeded crop is 4-6" in height and growing rapidly, or to moist soil in row middles after crop establishment. Note label precautions of replanting non-registered crops within 8 months.				
Flumioxazin (Chateau)	Fruiting Vegetables, Pepper	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.				
Halosulfuron (Sanda)	Pepper	Row middle	0.024-0.048	---
Remarks: Sandea may be applied between rows of direct-seeded or transplanted pepper for the control of nutsedge and other listed broadleaf weeds. Avoid contact of the herbicide with the planted crop. Application to be made at 0.5 to 1 oz. product/A. Do not apply more than 2 oz. per crop cycle. Use a non-ionic surfactant in the spray mix.				
Glyphosate (Roundup, Durango Touchdown, Glyphomax)	Leafy vegetables	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 7. Continued.

Herbicide	Labeled crops	Time of application to crop	Rate (lbs. AI./Acre)	
			Mineral	Muck
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)	Pepper	Pre-transplant Post-transplant (Row middles)	0.64-0.95	---
Remarks: For pre-transplant application, apply as a directed spray to preformed beds. Apply to the soil surface of the bed as the last step immediately prior to the plastic laying operation. Apply at a maximum rate of 0.64-0.95 lbs A.I. (0.67-1 pint) per acre. For post-transplant, apply as a directed, shielded spray to pepper row middles between plastic rows. Spray must Third party registration (TPR, Inc). Use of Dual Magnum on bell pepper row middles without having a signed authorization and waiver and limitation of liability agreement is a misuse of the product.				
Napropamide (Devrinol 50-DF) (Devrinol 2E)	Pepper	Preplant incorporated	1.0 - 2.0	---
Remarks: Apply to well worked soil that is dry enough to permit thorough incorporation to a depth of 1-2 inches. Incorporate same day as applied. For direct seeded or transplanted pepper. Does not control established weeds.				
Napropamide (Devrinol 2E) (Devrinol 50 DF)	Pepper	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.				
Oxyfluorfen (Goal 2XL) (Goaltender)	Pepper	Fallow bed	0.25-0.5	---
Remarks: Must have a 30 day treatment-planting interval. Apply as a preemergent broadcast or banded treatment to preformed beds. Mulch may be applied any time during the 30 day period.				
Paraquat (Gramoxone Inteon) (Firestorm)	Pepper	Preemergence Pretransplant	0.63 - 0.94	---
Remarks: Controls emerged weeds. Use a non-ionic spreader and thoroughly wet weed foliage.				
Paraquat (Gramoxone Inteon)	Pepper	Post directed spray in Pepper	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.				
Pelarganic Acid (Scythe)	Fruiting vegetables (pepper)	Preplant Preemergence Post-Directed	3-10% v/v	---
Remarks: Product is a contact, non-selective, foliar applied herbicide. Provides no residual control. May be tank mixed with soil residual herbicides. Consult label for rates and other information.				

Table 7. Continued.

Herbicide	Labeled crops	Time of application to crop	Rate (lbs. AI./Acre)	
			Mineral	Muck
Pendimethalin (Prowl H ₂ O)	Pepper	Post directed Row Middles	0.0475-.072	---
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.				
Sethoxydim (Poast)	Pepper (all types)	Postemergence	0.188 - 0.28	---
Remarks: Controls actively growing grass weeds. Do not use on grasses under stress or unsatisfactory results may occur. Several applications to a total of 4.5 pts. product per acre may be made per season. Do not apply within 20 days of harvest. Apply in 5 to 20 gals. of water plus 2 pts. of oil concentrate per acre. Use 0.188 lb. ai. (1 pt.) to seedling grasses and up to 0.28 lb. ai. (1.5 pts.) to perennial grasses emerging from rhizomes, etc. Consult label for grass species and growth stage for best control.				
Trifluralin (Treflan TR-10) (Treflan EC) (Treflan MTF)	Pepper	Pretransplant incorporated	0.75 - 1.0 0.5 - 1.0	--- ---
Remarks: Controls germinating annuals. Incorporate 4 inches or less within 8 hours. 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. Label states control of many grasses and broadleaf weeds, including Brachiaria, crabgrass, goosegrass, fall and Texas panicum, Florida pusley, pigweed, purslane and lambsquarter.				

Table 8. Disease control for pepper.

Chemical	Fungicide Group	Maximum Rate Per Acre Per		Min. Days to Harvest	Pertinent Diseases	Remarks
		Application	Season			
* For best possible, available, chemical control of bacterial spot, a copper fungicide should be tank-mixed with a maneb fungicide						
Ridomil Gold 4EC (mefenoxam)	4	1 pt/trtd acre	3 pts/trtd/A		Pythium seedling blights Phytophthora blight	Soil spray broadcast or band. Apply in a minimum of 20 gal water per acre pre-plant or prior to emergence
Apron XL 3LS (difenconazole + mefenoxam)	3 + 4	0.64 fl oz/100lb seed			Pythium damping-off	Seed treatment only
Agrimycin (Streptomycin sulfate and other streptomycin products)	17	200 ppm			Bacterial spot	For use on transplants only. Apply 1 st spray when seedling is in 2-leaf stage. Apply at 4-5 day intervals until transplanting
Cabrio 2.08 F (pyraclostrobin)	11	16 fl oz	96 fl oz	0	Powdery mildew Anthracnose Early blight <i>Botrytis</i> (suppression)	No more than 6 appl. of Cabrio or other group 11 fungicides/season
Forum/Acrobat (dimethomorph)	40	6 oz (Forum) 6.4 oz (Acrobat)	30 oz	0	Phytophthora blight (suppression only)	Apply with another fungicide not in group 40
Maneb 80 WP (maneb)	M3	3 lb	18 lb	7	Bacterial spot* Frogeye leaf spot Anthracnose Phytophthora blight	*Bacterial spot when tank mixed with a copper fungicide. Use of 1 lb Maneb/A per appl. is sufficient.
Maneb 75 DF (maneb)	M3	3 lb	19.2 lb	7	Bacterial spot* Frogeye leaf spot Anthracnose Phytophthora blight	*Same as Maneb 80 WP
Quadris 2.08 FL (azoxystrobin)	11	15.5 fl oz	1.92 qt	0	Powdery mildew Anthracnose	Limit is 4 appl/crop & alternate chemistry
Amistar 80 DF (azoxystrobin)	11	5 oz	1.25 lb	0	Powdery mildew Anthracnose	Limit is 4 appl/crop & alternate chemistry
Manex 4 F (maneb)	M3	2.4 qt	14.4 qt	7	Bacterial spot* Frogeye leaf spot Anthracnose Phytophthora blight	Same for Maneb 80 except adequate rate/A is 0.8 qt
Ridomil Gold Copper 64.8 W (mefenoxam/copper hydroxide)	4 + M1	2.5 lb	10 lb	7	<i>Phytophthora</i> Pythium diseases	Use Ridomil Gold EC on soil preplant or at planting. Make up to 2 additional appl. Use 1 pt/A and apply at a 30 day interval
Presidio (Fluopicolide)	43	4 fl oz		2	Phytophthora blight	A tank mix including a labeled rate of another labeled fungicide with a different mode of action on the target pathogen must be used with Presidio for resistance management. Recommended spray interval 10 days

Table 8. Continued.

Chemical	Fungicide Group	Maximum Rate Per Acre Per		Min. Days to Harvest	Pertinent Diseases	Remarks
		Application	Season			
* For best possible, available, chemical control of bacterial spot, a copper fungicide should be tank-mixed with a maneb fungicide						
Revus 2.08 F (Mandipropamid)	40	8 fl oz (in tank mix with a copper fungicide)	32	1	Phytophthora blight (suppression only)	A non-ionic surfactant, crop oil concentrate or blend is recommended
JMS Stylet Oil		3 qt		NTL	Potato Virus Y Tobacco etch virus Pepper mottle virus	See label for specific app. techniques required (e.g. 400 psi essential)
Various copper compounds (see ind. Labels), including Badge, Champ, COC, Copper Count-N, Copper Z4/4, Kocide, Nordox, Nu Cop, Cuprofix Disperss, etc.	M1	SEE INDIVIDUAL LABELS			Bacterial spot Frogeye leaf spot	
Flint 50 WGD (trifloxystrobin)	11	4 oz	16 oz	3	Powdery mildew Anthracnose (disease suppression)	Maximum of 4 appl/season & alternate chemistries
Kaligreen (82% potassium bicarbonate)	33	3 lb		1	Powdery mildew Anthracnose (disease suppression)	
Milstop (85% potassium bicarbonate)	33	5 lb		0	Powdery mildew <i>Pythium</i>	Greenhouse only
Serenade Max (QST 713 strain of <i>Bacillus subtilis</i>)		3 lb			Bacterial spot Early blight Powdery mildew Gray mold	Use with copper bactericide for bacterial spot control
Sonata (QST 2808 strain of <i>Bacillus pumilus</i>)		4 qt			Bacterial spot Powdery mildew	Tank mix with copper bactericide for bacterial spot control
Tanos (famoxadone/cymoxanil)	11 + 27	10 oz	72 oz	3	Anthracnose Bacterial soft rot (suppression only) Bacterial spot (suppression only) Phytophthora blight (suppression only)	Tank mix with contact fungicides. Do not tank mix or rotate with other group 11 fungicides. Tank mix with copper fungicides for suppression of Phytophthora blight, bacterial spot, and bacterial soft rot
Ultra Flourish (mefenoxam)	4	1 qt/trtd acre	3 qt		Phytophthora blight <i>Pythium</i> diseases	At-planting and directed sprays at crown-see label
Previcur Flex (6 lb a.i./gal) (propamocarb)	28	12.8 oz/100 gal water			<i>Phytophthora</i> <i>Pythium</i>	Greenhouse only

Table 9. Selected insecticides approved for use on insects attacking pepper.

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, pepper weevil, stink bugs, whiteflies	4A	Toxic to bees. Maximum of 11 oz/acre per season.
Admire Pro (imidacloprid)	7-14.0 fl oz	12	21	aphids, Colorado potato beetle, flea beetles, foliar feeding thrips, leafhoppers, whiteflies	4A	Most effective if applied to soil at transplanting.
Admire Pro (imidacloprid)	0.44 fl oz/10,000 plants	12	21 (soil)	aphids, whiteflies	4A	Planthouse: 1 application to transplants. See label.
Agree WG (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	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 0.15 EC (abamectin)	8-16 fl oz	12	7	broad mite, <i>Liriomyza</i> leafminers, spider mites, <i>Thrips palmi</i>	6	Do not make more than two sequential applications. Do not apply more than 48 fl oz per acre per season.
*Ambush 25W (permethrin)	6.4-12.8 oz	12	3	cabbage looper, flea beetles, pepper weevil, vegetable leafminer	3	Do not apply more than 1.6 lb ai/acre per season. Bell peppers only.
*Asana XL (0.66EC) (esfenvalerate)	5.8-9.6 fl oz	12	7	Colorado potato beetle, corn earworm, cucumber beetles (adults), European corn borer, flea beetles, loopers, southern armyworm, aids in control of beet armyworm and pepper weevil	3	Do not apply more than 0.35 lb ai per acre per season, or treat more than 7 times at high rate.
Assail 70WP (acetamiprid)	0.8-1.7 oz	12	7	aphids, pepper weevil, thrips, whiteflies	4A	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 30SG	1.5-4.0 oz					
Avaunt (indoxacarb)	2.5-3.5 oz	12	3	beet armyworm, loopers, southern armyworm, tomato fruitworm	22	Minimum spray interval is 5 days. Do not use more than 14 ounces of product per acre per crop.
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, repellent, 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, repellent, insect growth regulator.
*Baythroid XL (beta-cyfluthrin)	1.6-2.8 fl oz	12	7	beet armyworm (1), cabbage looper, corn earworm, garden webworm, leafhoppers, leafminers (2), pepper weevil (2), stink bugs, thrips (except <i>Thrips palmi</i>)	3	(1) 1st and 2nd instars only (2) aids in suppression Do not apply more than 0.132 lb ai per acre per season.

Table 9. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
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 (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	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 (<i>Beauveria bassiana</i>)	WP: 0.5-2 lb 100/gal ES: 0.5-2 qt 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)	2.1-6.4 fl oz	12	7	armyworms, corn earworm, cucumber beetles, cutworms, leafminers, loopers, mites, pepper weevil, thrips, whiteflies	3	Do not make applications less than 7 days apart. Do not apply more than 0.2 lb active ingredient per acre per season.
Confirm 2F (tebufenozide)	6-16 fl oz	4	7	beet armyworm, black cutworm, cabbage looper, fall armyworm, southern armyworm, tobacco hornworm, tomato hornworm, true armyworm, yellowstriped armyworm	18	Do not apply more than 1.0 lb ai per acre per season.
Coragen (rynaxypyr)	3.5-7.5	4	1	beet armyworm, Colorado potato beetle, fall armyworm, hornworms, leafminer larvae, loopers, southern armyworm, tomato fruitworm, tomatato pinworm	28	Can be applied by drip chemigation. See label.
Crymax WDG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	4	0	caterpillars	11	Use high rate for armyworms. Treat when larvae are young.
Deliver (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-1.25 lb	4	0	caterpillars	11	Use higher rates for armyworms. OMRI-listed ² .
Dibrom 8EC (naled)	1 pt	48	1	aphids, blister beetle, flea beetles, leafminers, mites	1B	Apply no more than 1 pt/acre in Florida. Do not apply when temperatures is over 90°F.
Dimethoate 4EC, 2.67EC (dimethoate)	4EC: 0.5-0.67 pt 2.67: 0.75-1 pt	48	2 - 4EC 0 - 2.67	aphids, leafminers	1B	Highly toxic to bees.
*Dimilin 25 W, 2 L (diflubenzuron)	4-8 oz	12	7	foliage feeding caterpillars, pepper weevil (reduces hatching of eggs produced by adults that have consumed treated foliage)	15	Up to 5 applications per season, but no more than 24 oz per acre per season. IGR - effects not seen for 5-7 days.
DiPel DF (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	4	0	caterpillars	11	Treat when larvae are young. Good coverage is essential. OMRI-listed ² .

Table 9. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
*Durivo (thiamethoxam, chlorantranilprole)	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	5	Apply by drip chemigation only.
Entrust (spinosad)	0.5-2.5 oz	4	1	armyworms, flower thrips, hornworms, leafminers, loopers, other caterpillars, <i>Thrips palmi</i> , tomato fruitworm, tomato pinworm	5	Do not use more than 9 oz per acre per crop. OMRI-listed ² .
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	green peach aphid, potato aphid, suppression of whiteflies	9B	Do not make more than two applications.
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 per acre per season.
Javelin WG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.12-1.50 lb	4	0	most caterpillars, but not <i>Spodoptera</i> species (armyworms)	11	Treat when larvae are young. Thorough coverage is essential. OMRI-listed ² .
Knack IGR (pyriproxyfen)	8-10 fl oz	12	14	whiteflies (immature)	7C	Do not make more than 2 applications per growing season.
Kryocide (cryolite)	8-12 lb	12	14	armyworm, cabbage looper, hornworms, pepper weevil	un	Do not exceed 24 lb/acre per crop.
*Lannate LV, *SP (methomyl)	LV: 0.75-3.0 pt SP: 0.25-1.0 lb	48	3	armyworms, beet armyworm, fall armyworm, green peach aphid, loopers, variegated cutworm	1A	No more than 10 applications per crop or 15 pt LV or 5 lb SP/acre/crop.
Lepinox WDG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	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.
Lorsban 75WG (chlorpyrifos)	1.33 lb	24	7	beet armyworm	1B	Do not apply within 10 days of transplanting or to plants under severe heat or drought stress. Do not make more than 8 applications.
[24(c) label] SLN FL-040005						

Table 9. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
Malathion 8F (malathion)	1.5 pt	12	3	aphids	1B	Can be used in greenhouse.
Movento (spirotetramat)	4.0-5.0 fl oz	24	1	aphids, psyllids, whiteflies	23	Maximum of 10 fl oz per 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 .
Neemix 4.5 (azadirachtin)	4-16 fl oz	12	0	aphids, armyworms, cabbage looper, Colorado potato beetle, corn earworm, cutworms, hornworms, leafminers, thrips, tomato pinworm, tomato fruitworm, weevils, whiteflies	un	OMRI-listed ² .
Oberon 2SC (spiromesifen)	7.0-8.5 fl oz	12	7	broad mite, twospotted spider mite, whiteflies (eggs & nymphs)	23	Maximum amount per crop: 25.5 fl oz/acre. No more than 3 applications.
Orthene 75 S (acephate)	0.33-1.33 lb	24	7	cabbage looper, grasshoppers, green peach aphid, tobacco hornworm	1B	Do not apply more than 2 lb ai per season.
Platinum 75 SG (thiamethoxam)	5-11 fl oz 1.66-3.67	12	30	aphids, flea beetles, leafhoppers, thrips, whiteflies	4A	Soil application. See label for rotational restrictions.
*Pounce 25 W (permethrin)	6.4-12.8 oz	12	3	cabbage looper, corn earworm, cutworms, flea beetles, leafminers, pepper weevil	3	Do not apply more than 0.8 lb ai 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.
Prokil Cryolite 96 (cryolite)	10-12 lb	12	7 (SLN)	armyworms, cabbage looper, flea beetle, hornworms, pepper weevil	un	Do not exceed 24 lb per acre per crop.
Provado 1.6F (imidacloprid)	3.8- 6.2 oz	12	0 foliar	aphids, Colorado potato beetle, leafhoppers, pepper weevil, whiteflies	4A	Do not apply to crop that has been treated with imidacloprid or thiamethoxam. Do not apply more than 19 ozs per acre as foliar spray.
Pyrellin EC (pyrethrin + rotenone)	1-2 pt	12	12 hours	aphids, cabbage looper, Colorado potato beetle, cucumber beetles, flea beetles, leafhoppers, leafminer, loopers, mites, plant bugs, stink bugs, thrips, whiteflies	3, 21	
Radiant (spinetoram)	5-10 fl oz	4	1	armyworms, Colorado potato beetle, flower thrips, hornworms, <i>Liriomyza</i> leafminers, loopers, Thrips palmi, tomato fruitworm, tomato pinworm	5	Maximum of 34 fl oz per acre per season.

Table 9. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
Requiem 25EC (extract of <i>Chenopodium ambrosioides</i>)	2-4 qts	4	0	chili thrips, green peach aphid, leafminers, melon thrips, potato aphid, western flower thrips, whiteflies	un	Begin before pest reach damaging levels.
Sevin 80S; XLR; 4F (carbaryl)	80S: 0.63-2.5 lb XLR; 4F: 0.5-2.0 qt	12	3	Colorado potato beetle, cutworms, fall armyworm, flea beetles, lace bugs, leafhoppers, stink bugs (suppression), tarnished plant bug, thrips (suppression), tomato fruitworm, tomato hornworm, tomato pinworm	1A	Do not apply more than seven times. Do not apply a total or more than 10 lb or 8 qt per acre per crop.
SpinTor 2 SC (spinosad)	1.5-8.0 fl oz	4	1	armyworms, flower thrips, hornworms, <i>Liriomyza</i> leafminers, loopers, <i>Thrips palmi</i> , tomato fruitworm	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.
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)	See label	5 days - See label	preplant	symphylans, wireworms	--	See supplemental label for restrictions in certain Florida counties.
*Telone II (dichloropropene)						
*Thionex 3EC *Thionex 50W (endosulfan)	0.66-1.33 qt 1-26 lb	24	See label 1 or 4, depending on rate used.	armyworms, flea beetles, green peach aphid, hornworms, leafhoppers, pepper maggot, whiteflies	2	Do not apply more than twice a year. Do not exceed 2.0 lb active ingredient per acre per year.
Trigard (cyromazine)	2.66 oz	12	0	leafminers	17	No more than 6 applications per crop.
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. OMRI-listed ² .
Ultra-Fine Oil, JMS Stylet-Oil, Saf-T-Side, others (oil, insecticide)	3-6 qt/100 gal (JMS) 1-2 gal/100 gal	4	0	aphids, beetle larvae, leafhoppers, leafminers, mites, thrips, whiteflies	--	Stylet Oil helps manage aphid-borne viruses but does not kill aphids. 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	flea beetle, leafhoppers, leafminers, thrips, whiteflies	4A	Use only one application method (soil or foliar). No more than 3 applications per season. No more than 6 oz (foliar) or 12 oz (soil) per acre per season.

Table 9. 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	7	green peach aphid, leafminers, pepper weevil, thrips	1A	Do not apply more than 24 pts per acre per season.
*Warrior II (lambda-cyhalothrin)	0.96-1.92 fl oz	24	5	armyworms (1 st & 2 nd instar), cutworms, grasshoppers, hornworms, leafhoppers, loopers, plant bugs, stink bugs, thrips ⁽¹⁾ , tomato fruitworm, vegetable weevil. Suppression of aphids, mites, whiteflies	3	Do not apply more than 0.36 lb ai/acre per season. ⁽¹⁾ Does not control western flower thrips.
Xentari DF (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	0.5-2.0 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.

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 10. Breakeven production costs for pepper at various yield levels in the Palm Beach County area, 2005-2006.

	Cost per acre	Yield (bushels/acre)				
		800	950	1100	1250	1400
Variable Costs	\$4,971.74	\$6.21	\$5.23	\$4.52	\$3.98	\$3.55
Fixed Costs	\$2,919.08	\$3.65	\$3.07	\$2.65	\$2.34	\$2.09
Harvest Cost/unit		\$4.43	\$4.43	\$4.43	\$4.43	\$4.43
Total Cost/unit		\$14.29	\$12.74	\$11.60	\$10.74	\$10.07

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

	Cost per acre	Yield (crates/acre)				
		600	800	1000	1200	1400
Variable Costs	\$5,970.21	\$9.95	\$7.46	\$5.97	\$4.98	\$4.26
Fixed Costs	\$3,632.11	\$6.05	\$4.54	\$3.63	\$3.03	\$2.59
Harvest Cost/unit		\$4.54	\$4.54	\$4.54	\$4.54	\$4.54
Total Cost/unit		\$20.54	\$16.54	\$14.14	\$12.54	\$11.40