

Chapter 34.

Pepper Production in Florida

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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. 34-1). 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 8, *Principles and Practices of Irrigation Management for Vegetables*, Table 4 to 6), near 20% of E_{To} (see Chapter 8, *Principles and Practices of Irrigation Management for Vegetables*, Table 3). Water requirements rapidly increase and approach 100% of E_{To} 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 E_{To} 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 specialty pepper varieties for commercial 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	-	-	-
Specialty (Figs. 34-3, 34-4):	Type:			
Ancho Villa (light green)	ancho	-	-	+
Cherry Bomb	cherry	-	-	+
Grande	jalapeno	+	+	-
Hercules	jalapeno	-	-	+
Inferno	Hungarian wax	-	-	-
Large Red Thick	cayenne	-	-	-
Mesilla	cayenne	+	+	+
Mitla	jalapeno	-	-	-
Ventura (dark green)	ancho	-	-	-

¹Tolerant (+), not tolerant (-), Hybrid (H), Green Immature Color(G), Red Mature Color (R), Yellow Mature Color(Y)

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/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	P₂O₅					K₂O				
		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 8 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)	Peppers (bell and non-bell)	Postemergence	0.1-0.125	
Remarks: Use Select for the control of annual and perennial grasses. Use a crop-oil concentrate at 1% v/v in the finished spray volume. Do not apply more than 8 fl. oz. product/A per application. 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.				
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.				
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 directd, 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.				

Table 7. Continued.

Herbicide	Labeled crops	Time of application to crop	Rate (lbs. AI./Acre)	
			Mineral	Muck
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.				
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 management for pepper.

Chemical	Fungicide Group	Maximum Rate/Acre/		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 4 EC (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 20gal water per acre preplant or at planting
Apron XL 3LS (difenconazole + mefenoxam)	3 + 4	0.64 fl oz/100lb seed			Pythium damping-off	Seed treatment only
Cabrio 2.08 F (pyraclostrobin)	11	16 fl oz	96 fl oz	0	Powdery mildew Anthracnose	6 appl. of Cabrio or other group 11 fungicides/season
Forum (dimethomorph)	40	6 oz	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	*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	*Same as Maneb 80 WP
Quadris 2.08 FL (azoxystrobin)	11	15.4 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		
Endura 70 WP (boscalid)	7	3.5 oz	21 oz	0	Botrytis	Limit is 6 appls/crop & alternate chemistries
Manex 4 F (maneb)	M3	2.4 qt	14.4 qt	7	Bacterial spot* Frogeye leaf spot	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	Phytophthora Pythium diseases	Use Ridomil Gold EC on soil at planting & one supplemental appl. at 1 pt./A each before using Ridomil Gold copper
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 Champ, COC, Copper Count-N, Copper Z4/4, Nordox, Nu Cop, Cuprofix Disperss	M1				Bacterial spot Frog eye leaf spot	
Various						
Flint 50 WGD (trifloxystrobin)	11	4 oz	16 oz	3	Powdery mildew	Maximum of 4 appl/season & alternate chemistries
Kaligreen (82% potassium bicarbonate)	33	3 lb		1	Powdery mildew Anthracnose (disease suppression)	

Table 8. Continued.

Chemical	Fungicide Group	Maximum Rate/Acre/		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						
Milstop (85% potassium bicarbonate)	33	5 lb		0	Powdery mildew	Greenhouse only
Previcur Flex (propamocarb) 6 lb/gal	28	1.2 pt	6 pt	5	Phytophthora root rot and seedling disease	Can be applied by directed nozzles to lower part of plants and soil or via drip irrigation
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	Anthrachnose 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 Pythium 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			Phytophthora Pythium	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	25	One application per season.
Actara (thiamethoxam)	2-4 oz	12	0	aphids, flea beetles, pepper weevil, stink bugs, whiteflies	4A	Toxic to bees. Maximum of 8 oz/acre/season.
Admire 2F (imidacloprid)	16-32 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	7-14.0 fl oz					
Admire 2F (imidacloprid)	0.1 fl oz/1000 plants	12	21 (soil)	aphids, whiteflies	4A	Planthouse: 1 application to transplants. See label.
Admire Pro	0.44 fl oz/10,000 plants					
Agree WG (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	0.5-2.0 lb	4	0	lepidopteran larvae (caterpillar pests)	11B1	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, Thrips palmi	6	Do not make more than two sequential applications. Do not apply more than 0.056 lb ai 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, Colorado potato beetle, 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	18B	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	18B	Antifeedant, repellent, insect growth regulator.
*Baythroid 2 (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 Thrips palmi)	3	(1) 1st and 2nd instars only (2) aids in suppression Do not apply more than 0.26 lb ai per acre per season (6 applications) (2) or 0.132 lb ai per acre (XL).
*Baythroid XL (beta-cyfluthrin)						

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)	11B2	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.
*Capture 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	18A	Do not apply more than 1.0 lb ai per acre per season.
Crymax WDG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	4	0	caterpillars	11B2	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	11B2	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.
Dimilan 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	11B2	Treat when larvae are young. Good coverage is essential. OMRI-listed ² .
Endosulfan 3EC (endosulfan)	0.66-1.33 qt	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.
Entrust (spinosad)	0.5-2.5 oz	4	1	armyworms, flower thrips, hornworms, leafminers, loopers, other caterpillars, Thrips palmi, tomato fruitworm, tomato pinworm	5	Do not use more than 9 oz per acre per crop. OMRI-listed ² .

Table 9. 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	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, yellow-striped armyworm	18A	Do not apply more than 64 fl oz per acre per season.
Javelin WG (Bacillus thuringiensis subspecies kurstaki)	0.12-1.50 lb	4	0	most caterpillars, but not Spodoptera species (armyworms)	11B2	Treat when larvae are young. Thorough coverage is essential. OMRI-listed ² .
Kelthane MF 4 (dicofol)	0.75-1.5 pt	12	2	broad mites, twospotted spider mites	20	Do not apply more than 2 applications per season or more than 1.6 pts per year.
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	12	14	armyworm, cabbage looper, hornworms, pepper weevil	9A	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 (Bacillus thuringiensis subspecies kurstaki)	1.0-2.0 lb	12	0	for most caterpillars, including beet armyworm (see label)	11B2	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						
Malathion 8F (malathion)	1.5 pt	12	3	aphids	1B	Can be used in greenhouse.
*MSR Spray Concentrate (oxydemeton-methyl)	2 pt	48	3	aphids	1B	Do not apply more than 2 times 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	18B	OMRI-listed ² .

Table 9. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
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 (thiamethoxam)	5-8 fl oz	12	30	aphids, flea beetles, 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 1.6 lb ai per acre per season.
*Proclaim (emamectin benzoate)	2.4-4.8 oz	48	7	beet armyworm, cabbage looper, fall armyworm, hornworms, southern armyworm, tobacco budworm, tomato fruitworm, tomato pinworm, yellow-striped 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	9A	Do not exceed 24 lb per acre per crop.
Provado 1.6F (imidacloprid)	3.8 oz or 6.2 for pepper weevil only	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	
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, Liriomyza leafminers, loopers, Thrips palmi, 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.
*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)						
Trigard (cyromazine)	2.66 oz	12	0	leafminers	17	No more than 6 applications per crop.

Table 9. Continued.

Trade Name (Common Name)	Rate (product/acre)	REI (hours)	Days to Harvest	Insects	MOA Code ¹	Notes
Trilogy (extract of neem oil)	0.5-2.0% V/V	4	0	aphids, mites, suppression of thrips and whiteflies	18B	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, others (oil, insecticide)	3-6 qt/100 gal (JMS)	4	0	aphids, beetle larvae, leaf- hoppers, leafminers, mites, thrips, whiteflies	--	Stylet Oil helps manage aphid- borne viruses but does not kill aphids. Organic Stylet-Oil is OMRI-listed ² .
Venom Insecticide (dinotefuran)	foliar: 1-4 oz soil: 5-6 oz	12	foliar: 1 soil: 21	flea beetle, leafhoppers, leafminers, thrips, white- flies	4A	Use only one application meth- od (soil or foliar). No more than 3 applications per season. No more than 6 oz (foliar) or 12 oz (soil) per acre per season.
*Vydate L (oxamyl)	foliar: 2-4 pt	48	7	green peach aphid, leafmin- ers, pepper weevil, thrips	1A	Do not apply more than 24 pts per acre per season.
*Warrior (lambda-cyhalothrin)	1.92-3.84 fl oz	24	5	armyworms (1 st & 2 nd instar), cutworms, grasshop- pers, hornworms, leafhop- pers, 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	11B1	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic produc- tion.

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.5.2 September 2006.

- 1A. Acetylcholine esterase inhibitors, Carbamates
- 1B. Acetylcholine esterase inhibitors, Organophosphates
- 2A. GABA-gated chloride channel antagonists
- 3. Sodium channel modulators
- 4A. Nicotinic Acetylcholine receptor agonists/antagonists, Neonicotinoids
- 5. Nicotinic Acetylcholine receptor agonists (not group 4)
- 6. Chloride channel activators
- 7A. Juvenile hormone mimics, Juvenile hormone analogues
- 7C. Juvenile hormone mimics, Pyriproxifen
- 9A. Compounds of unknown or non-selective mode of action (selective feeding blockers), Cryolite
- 9B. Compounds of unknown or non-selective mode of action (selective feeding blockers), Pymetrozine
- 9C. Compounds of unknown or non-selective mode of action (flonicamid)
- 11B1. Microbial disruptors of insect midgut membranes, *B.t.* var *aizawai*
- 11B2. Microbial disruptors of insect midgut membranes, *B.t.* var *kurstaki*
- 12B. Inhibitors of oxidative phosphorylation, disruptors of ATP formation, Organotin miticide
- 15. Inhibitors of chitin biosynthesis, type 0, Lepidopteran
- 16. Inhibitors of chitin biosynthesis, type 1, Homopteran
- 17. Molting disrupter, Dipteran
- 18A. Ecdysone agonist/disruptor (methoxyfenozide, tebufenozide)
- 18B. Ecdysone agonist/disruptor (azadirachtin)
- 20. Site II electron transport inhibitors
- 21. Site I electron transport inhibitors
- 22. Voltage-dependent sodium channel blocker
- 23. Inhibitors of lipid biosynthesis
- 25. Neuronal inhibitors

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