Pest Management Strategic Plan for Bell and Non-Bell Peppers in Delaware, Eastern Shore Maryland, and New Jersey

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I. Executive Summary

Priorities for Pepper Research, Regulations, and Education

The number in front of the following priorities indicates its rank within that pest category. Needs for each pest category were prioritized separately.

NEEDS FOR WEED CONTROL

Research:

1. Morningglory management.
2. Season-long control of pigweed species (including prostrate) and galinsoga.
3. Nightshade post emergence product that would not hurt peppers.
7. Alternative herbicides with alternate modes of action for ALS resistant weeds.

Regulatory:

4. Use dual twice pretransplant and then one month later especially on bare ground peppers post directed with the second application.
6. Reinstate peppers on dacthal label.
11. Gramoxone labeled for bare ground.

Education:

5. Explain “directed spray” to growers.
8. Resistance management.
9. When to use glyphosate & when not to use glyphosate in peppers (still need the registration)
10. Irrigation/rain will not remove product from plastic.

NEEDS FOR DISEASE CONTROL

Research:

1. Phytophthora-resistant non-bell types, chemical and non chemical controls
2. Pepper fruit disorders: Edema, Silvering, etc.
4. Anthracnose Control on all types
5. Oxidate Efficacy Research

Education:

6. Increase Awareness of Hot Water Seed Treatment

Regulatory:

3. Azoxystrobin at planting through the drip or transplant water for Rhizoctonia control

NEEDS FOR INSECT CONTROL

Research:

1. Research on cyclamen and broad mite, biology and life history
1.* What damage is caused by thrips and plant bugs in flowers?
2. New materials and different modes of action for maggots
3. Stink bug management

5. Management of environment for the promotion of natural enemies of thrips and aphids
6. New materials and different modes of action for worm pests
8. Pepper weevil research - how to sample and time sprays
-Insecticide effectiveness
-Biology and how they spread in the field

Regulatory:

4. Clear new non-pyrethroid chemistry
8. Maintain chemistry for pepper weevil control, just in case
9. inspection of transplants from the south (Delaware)

Education:

6. Non-pyrethroid chemistry information for worms
7. Educate growers on cultural controls, especially ones relating to natural predators

*Needs with the same priority number indicate ties.

II. General Description of Commodity

Production Information

National[1]

The top producing states for bell peppers in the U.S. are California, Florida, Georgia, Michigan, New Jersey, North Carolina, Ohio, and Texas. In 2006, 60,600 acres of bell pepper were harvested in the country for a value of $585,633,000.

The top producers of Chile peppers in the United States are Arizona, California, New Mexico, and Texas. In 2006, 28,400 acres were harvested in the country for a value of $101,788,000.

Delaware[2]

Production information for fresh market sweet pepper and hot pepper is combined with other vegetables (asparagus, beets, lima beans, broccoli, cauliflower, green peas, greens, sweet potatoes, kale, snap beans, squash and turnips) in Delaware to avoid disclosure of individual producers. In 2005, 770 acres of "Other Vegetables" were planted and harvested in the state. The value of production was $1,836,000.

Production information for processing sweet green pepper and hot pepper is combined with other vegetables (carrots, cauliflower, cucumbers, snap beans, spinach, tomatoes and zucchini) in Delaware to avoid disclosure of individual producers. In 2005, 8,410 acres of "Other Vegetables" were planted and 8,390 were harvested. Total production was 24,480 tons and the value of production was $5,812,000.

Maryland[1]

Production information for bell pepper is combined with other vegetables to avoid disclosure of individual producers. In 2006, 12,150 acres of "34 Major Vegetables" were planted and 11,350 were harvested in the state. The value of production was $23,630,000.

New Jersey[1]

In 2006, 3,200 acres of fresh market bell pepper were planted and harvested for a value of $27,848,000.

Production Regions

Most pepper production in Delaware takes place in Sussex County and most is for fresh market[3]. Most production in Maryland is on the Delmarva Penninsula.

Bell peppers are grown in almost all counties in New Jersey. The majority of the wholesale production and acreage is located in southern New Jersey in the counties of Gloucester, Cumberland, Salem, and Atlantic. There are smaller production areas in the remaining counties mainly for the retail trade. Wholesale fresh market peppers are shipped to the eastern United States and Canada depending on the time of year. Processing peppers are generally the number 2 fruit from the wholesale production.[4]

Cultural Practices and Time Lines[5, 6]

Peppers are warm-season vegetables that require a long, frost-free season. There are five types of pepper: Bell, Cherry, Sweet Frying, Hot, and Cheese & Pimento Types. Peppers are transplanted from greenhouse seedlings.

Seed Treatment
To minimize the occurrence of bacterial leaf spot, dip seed in a solution containing 1 quart of Clorox and 4 quarts of water plus ½ teaspoon of surfactant for 1 minute. Provide constant agitation. Use at the rate of 1 gallon of solution per pound of seed. Prepare a fresh solution for each batch of seed. Wash seed in running water for 5 minutes and dry seed thoroughly. Dust or slurry with 1 teaspoon of thiram 75WP per pound of seed. Hot water treatment of seed is also used to control bacterial leaf spot, especially with growers who already use hot water treatment for tomato seeds.

Planting and Spacing
Transplant into the field May 1 to May 30 for summer harvest. In New Jersey, most growers will be setting transplants in the field into July for a late season crop, harvested in September and October. Space rows 4 to 5 feet apart. Set plants 12 to 18 inches apart in the row. Select fields with good drainage and plant

on raised, dome-shaped beds to curb diseases. Peppers planted on raised beds may be planted in single or double rows. To minimize sunscald when growing peppers on sandy soils and on plastic mulch without drip irrigation, plant varieties that have excellent fruit cover.

Drip/Trickle Fertilization

Before mulching, adjust soil pH to around 6.5 and then apply enough farm-grade fertilizer to supply 50 pounds per acre of N, P_2O_5, and K_2O and then thoroughly incorporate into the soil. If the soil tests medium or less in soil potassium, apply a fertilizer with a ratio of 1-1-2 or 1-1-3 carrying 50 pounds of nitrogen per acre.

After mulching and installing the trickle irrigation system, apply completely soluble fertilizers to supply 30 pounds of N, P_2O_5, and K_2O per fertilized-mulched acre during each application. In New Jersey phosphate levels are often excessive and seldom is additional phosphorus needed, especially after the soil has warmed, suitable for planting peppers. On soils testing low and low to medium in boron, also include 0.25 pound of actual boron per fertilized-mulched acre in each soluble fertilizer application.

The first soluble fertilizer application should be applied through the trickle irrigation system within 1 week after field transplanting peppers. The same rate of soluble fertilizer should be applied about every 3 weeks during the growing season for a total of 6 applications through the trickle irrigation system. The soluble fertilizer may be delivered in 12 equally timed applications through the growing season, provided the soluble nutrients are applied at half the above suggested rates per application so that the total seasonal rates of N, P_2O_5, and K_2O and B are the same. The number of fertilizer applications can be reduced for late plantings and in areas where the growing season is short. These rates were developed on sandy loam soils with a cation exchange capacity (CEC) of 3 to 5. If soil has a lower CEC, increase the total seasonal soluble fertilizer nutrient rates by at least one-third. On very coarse, very low CEC soils, it may be profitable to increase the total seasonal soluble fertilizer nutrient rates two-thirds over the first suggestion. On the heavier textured soils with CEC above 3 to 5, decrease the total seasonal soluble fertilizer nutrients by one-half to three-quarters. When farming very heavy soils with high CEC, apply all the total seasonal plant nutrient requirements (according to soil test) preplant before mulching and installing the trickle irrigation system and then just apply water through the trickle irrigation through the growing season.

Mulching

Peppers need to be maintained as weed-free as possible. Hoeing, cultivating, straw mulches, and black plastic mulches can be used. Adequate irrigation will ensure good yields. The use of black plastic mulch with drip irrigation and double rows can greatly increase yields and percentage of No. 1 sized peppers. Use opaque, white plastic when planting in the summer for fall harvest. Plant on raised, dome-shaped beds to aid in disease control. Plant double rows 12 to 15

inches apart with plants staggered 12 to 18 inches apart in each of the double rows. Use 5-foot wide plastic for double rows and 4-foot wide plastic for single row peppers. Do not use plastic mulch without trickle irrigation on sandy soils.

Staking
Staking peppers helps protect fruit from sunburn by holding the plants in an upright position. Use 2- to 2½-foot long by 1¼ x 1½-inch Honduran pine stakes (half length tomato stakes). Drive stakes 6 to 8 inches into the soil every 4 to 5 feet in the plant row. Tie plants with polyethylene string that is used for staked tomatoes. Consider the cost of staking versus reduction in losses and increases in quality and price received when making a decision about staking peppers. The higher price offered for red peppers increases the potential for profit when staking for the red compared to the green market.

Peppers will produce throughout the summer and into fall until frost. It usually takes 75 days from transplanting until the first peppers are picked. They should be picked when they reach 3-1/2 to 4 inches in size and are still firm and green in color.

Worker Activities[3]

Peppers are planted no earlier than May 1. Workers transplant the pepper plants into the field at the start of the growing season. Because most farms rely on herbicides and black plastic for weed control, workers do minimal hand weeding. Workers may tie plants off later in the season to ensure that plants do not lodge. Irrigation is done by trickle irrigation, thus workers are not required to move irrigation equipment. Workers hand pick peppers at harvest. The Delaware Department of Agriculture reports that they are not aware of any problems with workers in pepper fields. Possible pesticide exposure would be to hands and arms during tying-off and hand harvesting.

Critical Pest Information

Weeds
Weeds cause economic loss in peppers in many ways: 1) competition for nutrients, water, and light will reduce yields; 2) weed foliage may intercept the spray of fungicides and insecticides and prevent contact with the pepper foliage and fruit; 3) harvesting crews cannot find the peppers covered by weeds and this slows or prevents harvest; 4) weed leaves or other plant parts that contact pepper fruit usually create an imprint on the fruit and make the pepper unsaleable due to the visual defect.

Many summer and winter annual and perennial weed species are present in pepper fields in the region. Some of the more prevalent weeds include common lambsquarters, pigweed species, common ragweed, morningglory species, yellow nutsedge, and various annual and perennial grasses.

Insects

The primary insect pests attacking peppers include the European corn borer (ECB), pepper maggot, green peach aphid, corn earworm (CEW), fall armyworm (FAW), beet armyworm (BAW), and thrips. The ECB, pepper maggot, CEW, FAW, and BAW all cause direct damage to the fruit. Green peach Aphid is common and destructive. Thrips are important because they vector the tomato spotted wilt virus. Secondary pests are the cutworm, flea beetle, pepper weevil, leafminer, cabbage looper, stink bug, and mite.

Diseases

Diseases of pepper in the region are: Rhizoctonia (damping off or root rot), Pythium (damping off or root rot), Bacterial leaf spot, Anthracnose, Phytophthora Blight, Bacterial soft rot, and various viral diseases such as AMV, TEV, TMV, CMV, PVY, and TSWV. Sclerotinia blight and southern blight are rare diseases in the region. Some diseases can be present during the entire time that peppers are in the field, such as bacterial leaf spot, and some diseases are limited to post harvest (bacterial soft rot). Other diseases are more prevalent during certain months. Nematodes can also be a concern.

Critical Pesticide Information

Herbicides

Herbicides recommended for green pepper in Delaware, Maryland, and New Jersey are s-metolachlor, clomazone, napropamide, halosulfuron, paraquat, clethodim, sethoxydim, and trifluralin. None of these are organophosphates, carbamates, or potential B1/B2 carcinogens.

Insecticides

Insecticides used in the region are bifenzate, thiamethoxam, abamectin, imidacloprid, esfenvalerate, acetamiprid, indoxacarb, cyfluthrin, bifenthrin, tebufenozide, diazinon, dimethoate, spinosad, pymetrozine, methoxyfenozide, dicofol, cryolite, methomyl, oxydementon methyl, zeta-cypermethrin, spiromesifen ,acephate, permethrin, thiamethoxam, gammacyhalothrin, emamectin, carbaryl, spinosad, endosulfan, cyromazine, dinotefuran, oxamyl, and lambda-cyhalothrin. Organophosphate, carbamate, and potential B1/B2 carcinogen categories are provided in the text for each pest insect.

Fungicides

Fungicides used in the region are metam-sodium (potential B1/B2 carcinogen), Clorox seed treatment, streptomycin, fixed coppers, maneb (potential B1/B2

carcinogen), azoxystrobin, pyraclostrobin, trifloxystrobin, famoxodone, cymoxanil, mefenoxam, copper hydroxide, dimethomorph, and PCNB.

III. Pest Management

Weeds and Herbicides[5]

Annual and Perennial Broadleaves and Grasses
Frequency of Occurrence: Annually.
Damage Caused: Reduced yields from weed competition, loss due to hindrance with harvesting equipment, and harboring damaging insects and diseases. Crops can become contaminated with weed plant parts (e.g. nightshade berries, Canada thistle buds or daisy buds) during harvesting which can result in reduced selling price or in severe cases, rejection of the crop.
% Acres Affected: 100%
Pest Life Cycles: A wide range of summer and winter annual and perennial weed species is present in pepper fields in the region. Some of the more common weeds include common lambsquarters, pigweed species, common ragweed, morningglory species, and various annual and perennial grasses.
Timing of Control: Preplant, at planting, and postemergence.
Yield Losses: Can be as high as 100% in severely infested fields
Regional Differences: While weed species spectra can vary regionally, they are a serious pepper pest throughout the region.

Biological Control Practices: None.

Weeds cause economic loss in peppers in many ways. Some of these are 1) competition for nutrients, water and light will reduce yields 2) weed foliage may intercept the spray of fungicides and insecticides and prevent contact with the pepper foliage and fruit 3) harvesting crews cannot find the peppers covered by weeds and this slows or prevents harvest 4) weed leaves or other plant parts that contact pepper fruit and usually create an imprint on the fruit and make the pepper unsaleable due to a visual defect in the fruit.

CULTURAL CONTROL

Cultural Control Practices: Herbicides alone seldom control all weed species. They must be used in conjunction with cultivation to ensure high yields and effective cultural practices in pepper crops.

Fumigation
Fumigants often used for disease control can be effective in killing weed seeds. Methyl bromide was particularly effective for this purpose. Other soil fumigants are not as effective.

Plasticulture
In plasticulture, weeds may be coming from the holes or where soil is covering the plastic, preventing cultivation from controlling these weeds. Peppers grown with plasticulture have the advantage of the black plastic smothering many weeds and preventing these seedlings from becoming established. However, some weeds species (notably nutsedges) can grow through intact plastic and wherever there are holes or rips in the plastic, this is a spot for weeds to become established. Often weeds that become established in the plastic (due to holes or rips) will have a faster growth rate than weeds in bare-ground.

Cultivation
Cultivations are an essential component of pepper production, because herbicides alone seldom control all the weed seeds or all weed species. When weed escapes occur, cultivation is preferable to hoeing or applying post-emergence herbicides. Cultivation is not commonly an option in plasticulture pepper, but is used extensively in bareground pepper production.

Crop Rotations
Since there are a limited number of herbicide options for peppers, it is important to rotate fields used for pepper production with other crops that will allow the opportunity to control (or "clean up") weed species that are not effectively controlled with peppers. For instance, perennial weeds are much more effectively control with other crops than with peppers.

Soil persistence (carryover) from herbicides used on previous crops may cause injury to peppers. Advance planning in herbicide selections is essential to safely rotate peppers after most agronomic crops and some vegetable crops. The herbicides Scepter, Pursuit and Classic have a great potential for crop injury in the next season.

The only safe preemergence herbicides to use on soybeans prior to peppers are linuron (Lorox, Linex), alachlor (MicroTech, Partner) or metolachlor (Dual, Magnum). Also the dinitrioaniline herbicides trifluralin (Treflan, Trilan) and pendimethalin (Prowl) do not carry over to the next year. The postemergence soybean herbicides acifluorfen (Blazer), bentazon (Basagran), lactofen (Cobra), thifensulfuron (Pinnacle) and Roundup would not affect peppers in the next year.

CHEMICAL CONTROL – HERBICIDES
None of the herbicides labeled for peppers are OP, Carbamate, or B1 B2 potential carcinogens.

	Plasticulture		Bare-ground		
Herbicide	Under Plastic	Between rows of plastic	Soil-applied prior to transplanting	Soil-applied direct-seeded	Post-emergence

s-metolachlor (Dual Magnum)	XXX^	XXX^	XXX^		
Clomazone (Command)	XXX^	XXX^	XXX^	XXX^	
napropamide (Devrinol)	XXX^	XXX^	XXX[+]	XXX[+]	
Pendimethalin (Prowl H2O)		XXX^			
halosulfuron (Sandea)		XXX^			
paraquat (Gramoxone)		XXX[a]			
clethodim (Select)		XXX[a]			XXX
sethoxydim (Poast)		XXX[a]			XXX
trifluralin (Treflan)			XXX[#]		

*Labeled for postemergence timing for the crop, but DCPA will not control emerged weeds, so it must be applied before weed emergence or tank-mixed with a herbicide that will control emerged plants.
[#]Pre-plant incorporated only
^Preemergence application only, do not mechanically incorporate.
[+]Can be applied pre-plant incorporated or preemergence.
[a]Postemergence control, does not provide residual control

I. Soil-applied Herbicides

a. Labeled for plasticulture and bare-ground production

- **clomazone (Command 3ME)**

Command 3ME now has a Section 3 label. Command 3ME is for preemergence applications, not preplant incorporated. Command 3ME does not have the volatility concerns that Command 4EC had which would cause severe damage to off-target crops or vegetation from drift during application. Command provides good to excellent control of annual grasses, lambsquarters, purslane and ragweed. Jimsonweed is usually suppressed by Command. Pigweed control is not acceptable with Command alone and combinations with Devrinol and Dual Magnum greatly improve control. Command does not control morningglories.

- **napropamide (Devrinol 50DF)**

Devrional can be applied pre-plant incorporated or preemergence, refer to table above. If Devrinal is used under the plastic, ondensation that forms on the underside of the mulch will activate the herbicide. Annual grasses and certain annual broadleaf weeds will be suppressed or controlled under the mulch and around the plant hole. Use lower rate on coarse-textured or sandy soil. Devrinol

may reduce stand and yield of fall grains. Moldboard plowing will reduce the risk of injury to a small grain follow crop.

- **s-metolachlor (Dual Magnum 7.62E)**

A Special Local-Needs Label 24(c) has been approved for the use of Dual Magnum 7.62E to control weeds in transplanted bell peppers in Delaware, Maryland, New Jersey, Pennsylvania, and Virginia. The use of this product is legal ONLY if a waiver of liability provided by the local growers association has been signed by the grower, all fees have been paid, and a label has been provided by the association. Dual Magnum 7.62E to control annual grasses, yellow nutsedge, galinsoga, and certain other broadleaf weeds. Make only one application during the growing season. DO NOT apply within 65 days of harvest. Other generic versions of metolachlor and s-metolachlor may be available, and may or may not be labeled for use in the crop. Labeled for use in transplanted bell peppers only in DE, NJ, and PA. Labeled for use in bell, chili, Cubanelle, and tabasco peppers in Delaware, Maryland, and New Jersey.

b. Labeled for bare-ground transplant production only

- **trifluralin (Treflan and various other trade names**)

Labeled for transplants in all states and a special Local-Needs Label 24(c) has been approved for the use of Trilin in Maryland with direct-seeded. Apply to trans-planting. Incorporate to a depth of 3 inches. Use the lower rate on coarse-textured soils low in organic matter, and the higher rate on fine-textured soils with high organic matter. Avoid planting during periods of cold, wet weather to reduce the risk of temporary stunting.

II. Soil-applied Herbicides for Between Rows of Plastic

- **halosulfuron (Sandea 75WG)**

Sandea will suppress or control yellow nutsedge and broadleaf weeds including common cocklebur, redroot pigweed, smooth pigweed, ragweed species, and galinsoga. Sandea applied postemergence will not control many common broadleaf weeds including common lambsquarters or eastern black nightshade. As a result, it is best to tankmix Sandea with a non-selective herbicide such as Gramoxone Inteon. Sandea is an ALS inhibiting herbicide (Group 2). Herbicides with this mode of action have a single site of activity in susceptible weeds. The risk of the development of resistant weed populations is high when herbicides with this mode of action are used continuously and exclusively to control a weed species for several years or in consecutive crops in a rotation. Integrate mechanical methods of control and use herbicides with a different mode of action to control the target broadleaf weeds when growing other crops in the rotation.

- **pendimethalin (Prowl H2O 3.8AS)**

Apply Prowl H_2O as a banded directed shielded spray and activate with one-half inch of rainfall or sprinkler irrigation within 48 hours of application to control most

annual grasses and certain broadleaf weeds preemergence. Tank-mix with paraquat to control emerged weeds. Use the lower rate on coarse-textured or sandy soils. Do NOT apply “over the top” of the crop, or severe injury may occur. Labeled for use on bell pepper, chili pepper, cooking pepper, pimento, and sweet pepper.

II. Postemergence Herbicides

- **sethoxydim (Poast 1.5EC)**

With oil concentrate postemergence to control annual grasses and certain perennial grasses. The use of oil concentrate may increase the risk of crop injury when hot or humid conditions prevail. To reduce the risk of crop injury, omit additives or switch to nonionic surfactant when grasses are small and soil moisture is adequate. Control may be reduced if grasses are large or if hot, dry weather or drought conditions occur. For best results, treat annual grasses when they are actively growing and before tillers are present. Poast provides excellent control of fall panicum, goosegrass, lovegrass, and foxtails. Crabgrass smooth and large should be sprayed when relatively small for effective control. Generally Poast is most effective if applied 3 to 5 days prior to cultivation because it will weaken grasses and make them more vulnerable to killing by cultivation. A second application may be made for grasses that are difficult to control or for new flushes of germinating grasses. Poast will control johnsongrass and shattercane and it is also effective for control of volunteer rye and wheat. Repeated applications may be needed to control certain perennial grasses. Yellow nutsedge, wild onion, or broadleaf weeds will not be controlled with Poast. Do not tank-mix Poast with pesticides or apply within 2 to 3 days of any other pesticide unless labeled, because the risk of crop injury may be increased or reduced control of grasses may occur. Observe a minimum preharvest interval of 14 days and apply no more than 3 pints per acre in one season. Use 20 gal/A spray volume or less per acre.

- **clethodim (Select 2EC and SelectMax 0.97EC)**

PHI - 14 days. Postemergence. Select 2EC requires oil concentrate to control many annual and certain perennial grasses, including annual bluegrass. However, it will not consistently control goosegrass. The use of oil concentrate may increase the risk of crop injury when hot or humid conditions prevail. To reduce the risk of crop injury, omit additives or switch to nonionic surfactant -- SelectMax 0.97EC can be applied with nonionic surfactant which reduces the risk of crop injury during “soft” growing conditions -- when grasses are small and soil moisture is adequate. Control may be reduced if grasses are large or if hot, dry weather or drought conditions occur. For best results, treat annual grasses when they are actively growing and before tillers are present. Repeated applications may be needed to control certain perennial grasses.. Yellow nutsedge, wild onion, or broadleaf weeds will not be controlled. Do **NOT** tank-mix with or apply within 2 to 3 days of any other pesticide unless labeled, as the risk of crop injury may be increased, or reduced control of grasses may result. REI - 24 hours.

III. Post-Directed Herbicides

- **carfentrazone (Aim 1.9EW or 2EC)**

Aim as a banded directed shielded spray between the rows of plastic mulch to suppress or control broadleaf weeds including morninglory species, pigweed species, common lambsquarter, and nightshade species when the crop has 2 to 5 true leaves but has not yet begun to bloom. Aim applied postemergence will not control annual or perennial grasses. Add nonionic surfactant to be 0.25 percent of the spray solution (1 quart per 100 gallons of spray solution), or oil concentrate or methylated seed oil to be 1 -2% percent of the spray solution (1-2 gallons per 100 gallons of spray solution). The shielded (hooded) sprayer must be designed to prevent spray or drift from contacting the stems, leaves, flowers or fruit of the crop, or severe injury may occur.

- **paraquat (Gramoxone Inteon 2SC)** –

Use a directed shielded applicator and spray at very low pressure of approximately 20 psi or less. Apply for the control of existing weeds between rows of peppers. Gramoxone provides contact kill of most all broadleaf weeds and small grasses. Grasses may recover from Gramoxone contact injury. Gramoxone will kill most grasses under 2 to 4 inches height, but larger grasses may recover and continue to grow. This application may be made to soil between the rows of peppers on bare ground and on the soil between plastic mulch strips.

IV. Pre-Plant Application

- **glyphosate (numerous formulations**)

for control of annual weeds. Apply 3 days before seeding or transplanting. Used for the control of most annual weeds and cereal cover crops.

Herbicide Pro/Con Table (next page)

	% Crop	Pro	Con

	Treated		
Soil-Applied			
Devrinol	70%	-labeled on multiple crops (Solanaceous), don't view as high risk for resistance	-Sensitive to sunlight - needs irrigation within 48 hours of application
Treflan	15%	-low price	- cannot be used under plastic -must be mechanically incorporated
Dual Magnum	80%	-controls galinsoga	-can cause temporary stunting under plastic - cannot be sprayed over the pepper plant must be sprayed directly at the base of the plant -not a full season treatment option (better in the early season) -post transplant to best control pigweed
Prowl	40-50% DE 60% NJ	- inexpensive -long lasting -consistent -full season control	- cannot be used under plastic - can cause stunting in bare ground peppers - reccomended treatment for between rows
Command	50-60% NJ 70% DE	-very effective on weeds it controls -full season control - backbone of the herbicide program with the exception of fields susceptible to drift injury -more bare ground land in DE MD than in NJ	-high potential for drift injury (roses,cherries, crabapple trees)
Sandea	25%	- best nutsedge herbicide (as post-emergence) - good spectrum of control for broadleaf weeds	-resistance risk (ALS inhibitor) -can only be used inbetween rows of plastic mulch
Post-emergence			
Aim	1% -just labeled	-better than gramoxone on nightshade	- no residual activity - needs to be applied as a directed spray

		-helps when used with gramoxone	
glyphosate products	5-10%		-not for use inbetween rows because of crop death -diffucult to "wash" off plastic
Gramoxone products 1	90% plastic 0% bare ground	-excellent burndown of seasonal annual weeds	-can only be used as direct spray between rows of peppers on plastic -drift will burn/speckle crop, focus on avoiding drift
Poast and Select	10-20%	- excellent control of grassy weeds - good crop safety	-resistance risk, single site of action
Sandea	20% plastic	-best nutsedge product	-resistance risk -controls fewer species of weeds post-emergence than preemergence

V. Postharvest

- **paraquat (Gramoxone Inteon 2SC)**

A Special Local-Needs 24(c) label has been approved for the use of Gramoxone Inteon 2SC as a broadcast spray after the last harvest. Add nonionic surfactant according to the labeled instructions. This application method may be used to prepare plastic mulch for replanting, or to aid in the removal of the mulch.

Herbicide Efficacy Tables

Herbicide	Barnyardgrass	Crabgrass, Large	Fall Panicum	Foxtail sp.	Goosegrass	Johnsongrass (Seedlings)	Yellow Nutsedge	Carpetweed	Cocklebur, Common	Cranesbill	Galinsoga, Hairy
Soil-applied											
Devrinol	G	G	G	G	G	G	N/P	G	N	-	F/P
Treflan	G	G	G	G	G	G	N	G	N	-	N
Dual Magnum	G	G	G	G	G	G	F/G	F	N	-	G
Prowl	G	G	G	G	-	G	N	G	N	-	N
Command	G	G	G	G	G	G	N	N	N/F	-	F
Sandea	N	N	N	N	N	N	F	P	G	-	G
Post-emergence											
Aim	N	N	N	N	N	N	N	G	P	-	-
glyphosate products	G	G	G	G	G	G	F	G	G	G	G
Gramoxone products 1	F/G	F/G	F/G	G	F/G	-	G	G	G	-	G
Poast	G	G	G	G	G	G	N	N	N	N	N
Sandea	N	N	N	N	N	N	G	P	G	-	G
Select	G	G	G	G	P	G	N	N	N	N	N

Herbicide	Jimsonweed	Lambsquarters, Common	Morningglory sp.	Shepherdspurse	Pigweed sp.	Purslane, Common	Ragweed, Common	Smartweed, Pennsylvania	Nightshade, Eastern Black	Velvetleaf
Soil-applied										
Devrinol	N	F/G	N	-	F/G	G	P/F	P	N	N
Treflan	N	F/G	P/F	N	F	G	N	P/F	P	N
Dual Magnum	N	P	N	-	G	F/G	N	P	G	P
Prowl	N	F/G	P	N	F/G	F/G	N	F	P	G
Command	G	G	P	F	N/P	G	F	G	-	G
Sandea	G	F	F	-	G	F	G	F	N	G
Post-emergence										
Aim	P	G	F	-	G	-	F	-	G	G
glyphosate products	G	G	F	G	G	G	F	G	G	G
Gramoxone products 1	G	F/G	F/G	-	G	F/G	G	P	-	-
Poast	N	N	N	N	N	N	N	N	N	N
Sandea	G	N	F	-	G	P	G	F	N	G
Select	N	N	N	N	N	N	N	N	N	N

G = good
F = fair
P = poor
N = no control
- = insufficient data

Pest Insects and Insecticides[5]

The primary insect pests attacking peppers include the European corn borer (ECB), pepper maggot, green peach aphid, corn earworm (CEW), fall armyworm (FAW), beet armyworm (BAW) and thrips. The ECB, pepper maggot, CEW, FAW and BAW all cause direct damage to the fruit. Green peach aphid is common and destructive. Thrips are important because they vector the tomato spotted wilt virus. Secondary pests are: cutworms, flea beetles, pepper weevils, leafminers, cabbage loopers, stink bugs, and mites.

European Corn Borer (ECB)

Biology and Life History: Two to three generations occur each year in the Mid Atlantic region. Corn borers overwinter as fully grown larvae; pupate in late April to early May, emerging as adults in May to early June and again in late July through September. Eggs are laid in masses on the undersides of leaves. Larvae hatch in 4-7 days. The young larvae generally feed on the foliage for a week before boring into stems and developing pepper fruit.

Damage: The European corn borer is the major pest of peppers causing losses from direct damage to fruit and stems as well as contamination problems. Larvae generally bore into the fruit under the cap. If corn is planted late or there is no corn in the area, first generation damage can cause significant plant lodging and stem breakage. Initially, damage is difficult to detect because the only external sign is a pinhole and some sawdust-like excrement near the cap. Once inside the fruit, larvae feed on the seed core and become fully developed inside the fruit. Damaged fruit ripens prematurely. The most significant damage occurs when diseases enter the feeding holes causing the fruit to rot.

Monitoring and Decision Making: Once peppers are infested with ECB, no controls measures can be taken to reduce the problem. Direct sampling for eggs and larvae is impractical due to the low damage tolerance. Therefore, sampling must be done with the use of blacklight or pheromone traps. If using blacklight traps, sprays should be applied within 5-7 days after the first corn borer moth is captured and fruit are at least 1/2 inch in diameter. If a pheromone trap is used, applications should be made within one week after trap catches reach seven per week.

Controls:

Biological: Although there are many general predators that feed on corn borer eggs and small larvae, the low damage tolerance makes it impractical to rely on these predators. Recent research in the Northeast and Mid-Atlantic indicates that the use of *Trichogramma nubilalie* may provide good corn borer control in peppers. Evaluation of the economics and effectiveness in commercial situations is still needed.

Cultural: A number of cultural practices have been used in field corn to reduce corn borer infestations including plowing under corn stalks, keeping fields free of weeds to ensure better spray coverage and keeping a good mineral balance in the soil. However, none of these practices have been evaluated in a pepper system.

Chemical:

(I) Pyrethroids

Asana XL--5.8-9.6 fl oz 0.66EC/A., or
Baythroid XL--1.6-2.8 fl oz /A, or
bifenthrin (Brigade; generics available)--2.1-6.4 fl oz 2E/A, or
lambda-cyhalothrin (Warrior;generics available)--2.56-3.84 fl oz/A
Mustang MAX--2.24-4.0 fl oz/A, or
permethrin (sweet, bell-type only)--8 fl oz 3.2EC/A. , or
Proaxis--2.56-3.84 fl oz/A, or

(II) Organophosphates

Orthene--0.75-1.0 lb 97S/A (Bell Pepper only), or

(III) Carbamates

Lannate--3 pt LV/A or OLF. Treat every 5 to 7 days, or

(IV) Other
Avaunt--3.5 oz 30 WDG/A (Bell Pepper only), or
Confirm--8-16 fl oz 2F/A, or
Entrust--1.0-2.0 oz 80W/A, or
Intrepid--4-8 fl oz 2F/A (early season), 8-16 fl oz/A (late season), or
SpinTor--3-6 fl oz /A, or
Radiant – 5-10 fl oz SC/A (new AI labeled fall 2007 – spinetoram from Dow)

Pepper Maggot

Biology and Life History: This insect overwinters in the soil in the pupal stage. Flies begin to emerge in mid- late June, emerging over a 10-14 day period and surviving less than one month. Female flies insert eggs under the skin and into the flesh of the pepper. The eggs hatch in 8 to 14 days and the maggots mature in 2-3 weeks. There is one generation per year.

Damage: The elliptical egg punctures are the first sign of an infestation. Maggots feed within the core of the fruit but generally emerge and drop to the ground to pupate before peppers are harvested.

As infested peppers enlarge, the egg punctures become shallow depressions in the fruit. If the fruit is green, damage is hard to detect.. Damaged peppers turn red prematurely and rot.

Monitoring and Decision Making: Although pepper maggot flies can be monitored with yellow sticky-traps baited with ammonia, the traps must be suspended at a height of 20 feet within the canopy of a maple tree. This is the only reliable method to detect low population levels. A perimeter of indicator cherry-pepper plants can be used to monitor flies by examining fruit for feeding scars every 3-4 days for a 3 week period. If using traps to monitor populations, two - three sprays will be needed at 5-day intervals as soon as the first fly is caught. If using indicator plants, sprays should be applied as soon as scars are observed on indicator plants.

Controls:

Biological: Although general predators can reduce adult and pupal populations, they will not provide commercial control.

Cultural: The elimination of alternative hosts, like horsenettle, can help reduce populations but will not eliminate the problem. The use of a cherry-pepper trap crop can help with bell peppers only.

Chemical:

(I) Pyrethroids

Mustang MAX--2.24-4.0 fl oz/A, or

(II) Organophosphates

dimethoate--0.5-0.67 pt 4EC/A, or

(III) Other
Thionex--1-2 lb 50WP/A

Green Peach Aphid (GPA)

Biology and Life History: There are a number of aphids that can be found on peppers; however, the green peach aphid is the most common and important one. GPA can attack plants throughout the season; however, the greatest injury occurs late summer through early fall. During most of the season, aphids give birth to live young, usually wingless females. Under warm conditions, the young mature in less than 9 days. Many generations occur in one season.

Damage: Aphids can cause cosmetic problems on peppers as a result of the "honeydew" left on leaves and fruit. At extreme populations, aphids can feed on plant sap resulting in plant chlorosis, curling and distortion which may reduce yields. At low levels, aphids can also transmit viruses

Monitoring and Decision Making: Monitor for aphids by checking the undersides of leaves in late June. Check for aphids on two upper and two lower leaves on 25 plants per field to determine the number of aphids per leaf. A treatment is needed prior to fruit set if you find 5-10 aphids per week for 2 consecutive weeks. After fruit set, a spray should be applied if the population averages 1-2 per leaf and beneficial activity is low. For best green peach aphid control during periods of drought, apply insecticide 2 to 3 days after irrigation. Thorough spray coverage beneath leaves is important when foliar sprays are used.

Controls:

Biological: Naturally occurring predators and parasites usually provide season long suppression. If continuous pyrethroid programs are used, they can kill beneficials as well as repel certain parasites resulting in an aphid explosion.

Cultural: The use of reflective mulches has been shown to delay or reduce aphid colonization of pepper fields but does not eliminate the damage. Other strategies that can lower aphid populations include weed control, removal of perennial hosts and avoiding excessive nitrogen fertilization.

Chemical:

(I) Organophosphate

Metasystox-R--2 pt 2SC/A, or
Orthene--0.5-1.0 lb 97S/A (Bell Peppers); 0.5 lb 97S/A(nonbells), or

(II) Carbamate

Lannate--1.5-3 pt LV/A, or

(III) Other

Actara--2-3 oz 25WDG/A (foliar), or
Admire Pro--7-14 fl oz 4.6F/A (at planting), or
Beleaf – 2.0 -2.8 oz 50SG/A, or
imidacloprid (Admire; generics available)(at planting)--10-24 fl oz 2F/A, or
Assail--2-4 oz 30SG/A (foliar), or
Fulfill--2.75 oz 50WDG/A, (foliar)or
Platinum--5-8 fl oz 2SC/A, or

imidacloprid (foliar-Provado; generics available) (foliar)-3.75 fl oz 1.6F/A, or
Thionex--1-2 lb 50WP/A (foliar), or
Venom--5-6 oz (soil); 1-4 oz (foliar) 70SG/A

Corn Earworm (CEW)

Biology and Life History: This insect overwinters in the region; however, moth activity (overwintering and migratory) is heaviest from mid-August to early October as corn is mature and moths are attracted to peppers. Eggs are laid singly on buds and terminal leaflets close to flowers and small fruit. Eggs hatch in 3-4 days and small larvae move directly to fruit at egg hatch. Individual larvae complete their development inside the fruit before pupating. Complete larval development can take place in 14 days at temperatures of 82 degrees.

Damage: Larvae begin feeding near the stem end of fruit. They feed inside the fruit and create a watery cavity filled with caste skins and excrement. As larvae mature, they often leave the fruit and move into another fruit. Older larvae enter the fruit anywhere, leaving a large hole in the side of the fruit. Damaged fruit becomes infected with diseases and injured fruit often rots before harvest. Contamination is a serious problem for processing peppers because one small hole may be the only evidence of an infestation.

Monitoring and Decision Making: Once small green pepper fruit are present, sampling should begin for corn earworm. Examine the foliage and at least 20 fruit from randomly picked plants in at least 5 locations per field for the presence of small larvae. Although blacklight and pheromone traps are not reliable for timing insecticide applications, moth catches greater than 20 per night indicate the potential for problems. Control CEW beginning in mid-July

Controls:

Biological: Although there are many general predators that feed on corn earworm eggs and small larvae, the low damage tolerance makes it impractical to rely on these predators.

Cultural: None available

Chemical:

(I) Pyrethroids

Asana XL--5.8-9.6 fl oz 0.66EC/A (CEW only), or
Baythroid XL--1.6-2.8 fl oz /A, or
bifenthrin (Brigade; generics available)--2.1-6.4 fl oz 2E/A (CEW only), or
lambda-cyhalothrin (Warrior; generics available)--2.56-3.84 fl oz/A
Mustang MAX--2.24-4.0 fl oz/A, or

Proaxis--2.56-3.84 fl oz/A, or

(II) Carbamates

Sevin--1.5-2.5 lb 80S/A, or

(IV) Other

Entrust--1-2 oz 80W, or
Proclaim--2.4-4.8 oz 5 SG/A, or
Radiant – 5-10 fl oz SC/A
SpinTor--3-6 fl oz 2SC/A, or
Thionex--1.33-2.67 pt 3EC/A (HW only), or

Fall Armyworm (FAW)

Biology and Life History: This insect migrates to the region in late June to early July. Moth activity in peppers is heaviest from late August to early October. Eggs are laid in a mass on the undersides of leaves. Eggs hatch in 2- 10 days and larvae mature in approximately 20-28 days.

Damage: Young larvae enter the fruit under the cap, similar to corn borer; however, the damage is more extensive as larvae mature. Older larvae move from fruit to fruit destroying more than they consume. Injury is easier to detect compared to CEW so contamination is rarely a problem. Damage fruit often drop or rot. Unlike CEW, they also feed extensively on the foliage.

Monitoring and Decision Making: Pheromone traps can be used to monitor moth activity and to determine when moths are actively laying eggs. A green unitrap should be placed within the plant canopy. Field should also be examined for the presence of egg masses. Pheromone trap catches of greater than 10-20 per night in combination with the presence of egg masses indicates the potential for a problem.

Controls:

Biological: None available.

Cultural: None available

Chemical:

(I)Pyrethroids

Mustang MAX--3.2-4.0 fl oz/A, or
lambda-cyhalothrin (Warrior;generics available)--2.56-3.84 fl oz/A

Proaxis--2.56-3.84 fl oz/A

(II) Carbamates

Fall Armyworm
Lannate--1.5-3.0 pt LV/A,

(III) Other

Avaunt--3.5 oz 30WDG/A, or
Confirm--8-16 fl oz 2F/A, or
Entrust--1.25-2.5 oz 80W/A, or
Intrepid--4-8 fl oz 2F/A (early season), 8-16 fl oz/A (late season), or
Proclaim--2.4-4.8 oz 5SG/A, or
Radiant – 5-10 fl oz SC/A
SpinTor--4-8 fl oz 2SC/A,

Beet Armyworm (BAW)

Biology and Life History: This insect migrates to the region in mid-late July. Moth activity in peppers is heaviest from mid-August to early October. Eggs are laid in a mass on the undersides of leaves. Eggs hatch in 3-4 days and larvae mature in approximately 2-3 weeks. One generation can be produced in 3 weeks.

Damage: Small larvae spin webs and feed in groups on the foliage, often skeletonizing the plants. As larvae develop, they encounter fruit and take bites on the surface, bore under the cap or enter the side of the fruit.

Monitoring and Decision Making: Pheromone traps can be used to monitor moth activity and to estimate population levels. A green unitrap should be placed within the plant canopy. Use one trap per field and position lures at the top of the plant canopy. Intensify field scouting when catches reach 20 moths per night. Fields should also be checked twice a week for egg masses and small larvae. Fields should be treated if 5% of the plants are infested with small larvae or you find one egg mass per 100 leaves.

<u>Controls:</u>

Biological: None available.

Cultural: None available

Chemical:

(I) Carbamates

Lannate--1.5 pt LV/A, or

(II) Other

Avaunt--3.5 oz 30WDG/A, or
Confirm--8-16 fl oz 2F/A, or
Entrust--1.25-2.5 oz 80W/A, or
Intrepid--4-8 fl oz 2F/A (early season), 8-16 fl oz/A (late season), or
Proclaim--2.4-4.8 oz 5 SG/A, or
Radiant – 5-10 fl oz SC/A
SpinTor--4-8 fl oz 2SC/A

Thrips

Biology and Life History: This insect overwinters as adults on weed hosts. Adults move to host plants and eggs are produced sexually or asexually. Wingless nymphs can develop into winged adults in 2 weeks. Populations explode under warm, dry weather. In some cases, thrips can be brought north on southern transplants.

Damage: The most significant damage occurs when thrips vector the Tomato Spotted Wilt virus. Transmission can occur in the greenhouse or on transplants outside the greenhouse just before transplanting in the field. Thrips can also directly damage peppers by extracting sap from leaves and fruit. This results in distorted leaves and fruit with silver or brown lesions on the surface. Damage occurs near the cap or where two or more fruit contact each other.

Monitoring and Decision Making: Examine 5 plants in 10 locations for the presence of thrips on leaves and fruit. Although no exact thresholds have been established, a treatment may be needed if 10% of the leaves or fruit are infested with thrips. Plants showing virus symptoms should be rogued out of the field to prevent virus spread.

Controls:

Biological: None available.

Cultural: None available

Chemical:

(I) Pyrethroids

Baythroid XL--2.1-2.8 fl oz /A, or
bifenthrin (Brigade; generics available)--2.1-6.4 fl oz 2E/A, or
lambda-cyhalothrin (Warrior; generics available)--2.56-3.84 fl oz/A, or

Proaxis--2.56-3.84 fl oz/A, or

(II) Carbamate

Vydate--2-4 pt 2L/A, or

(III) Other Chemistry

abamectin (Agri-mek; generics available)--8-16 fl oz 0.15 EC/A,or
Assail--4 oz 30SG/A
Entrust--1.25-2.5 oz 80W/A, or
Radiant 6-10 fl oz SC/A
SpinTor--4-8 fl oz 2SC/A, or
Venom--5-6 oz (soil); 1-4 oz (foliar) 70SG/A,

Spider Mites

Biology and Life History: This arthropod pest overwinters as females on debris and is capable of reproducing sexually or asexually. Eggs are laid on the undersurface of leaves or on protected plant parts. Under hot, dry conditions, eggs hatch in 3 days. Immature mites molt 3 times and can reach adulthood in less than one week

Damage: Nymphs and adults puncture leaf tissue and extract plant juices. Leaf injury first appears as white stippling or small white blotches which fuse together into larger yellow patches. Under heavy infestations, leaves dry out, turn brown and are tied together by webbing. Mites can develop quickly and severely stunt the growth of plants. Mites can also feed on the fruit causing a roughened appearance of the fruit and rendering it unmarketable.

Monitoring and Decision Making: Examine 5 plants in 10 locations for the presence of mites on 2 leaves and 2 fruit per plant. Although no exact thresholds have been established, a treatment may be needed if 10% of the leaves or fruit are infested with mites.

Controls:

Biological: Although natural enemies and fungal pathogens can help to crash populations, they often can not be relied upon to provide economic control.

Cultural: None available

Chemical:

(I) Pyrethroids (excessive use for other insects can cause spider mite outbreaks)

bifenthrin (Brigade; generics available)--5.12-6.4 fl oz 2E/A, or

(II) Other Chemistry

Acramite--0.75-1.0 oz 50 WS/A, or
abamectin (Agri-mek;generics available)--8-16 fl oz 0.15EC/A, or
Kelthane MF--0.75-1.5 pt EC/A, or – some still in pipeline – not sure if should be listed since it is a canceled use by Dow
Oberon--7.0-8.5 fl oz 2SC/A

Pepper Weevil

This insect is an opportunist, being transported in southern transplants destined for this region, or brought in on produce shipments. Though a sporadic pest, it has caused yield losses of 5% to 80% on farms in New Jersey since 2004. The small, 3/8", reddish-brown to black beetle with a curved beak can be transported on plants with well developed flowers and flower buds. Adults lay eggs in flowers and fruit, usually causing them to be aborted by the plants, which is the primary source of loss. Upon hatching the larvae feed internally on the fruit. The larvae are legless, have a brown head and white body in the early stages and then turning white and gray in the last instar before pupating. Pupae reside in circular cells inside the fruit and are white until nearly to the adult stage. The pupae's eyes become pink or reddish as it nears maturity. In the adult stage the weevil exits the fruit by either an existing injured area of the fruit or chewing an exit hole. Pepper weevil can complete its life cycle in 2 ½ to 3 ½ weeks depending upon air temperatures. Damage can be detected by puncture wounds from feeding or egg-laying on the buds and/ or premature dropping of flowers, bud and small pods, however, this is much more difficult to detect once picking has begun.

Pheromone traps are available for use with pepper weevil and can help monitor for the presence of the weevil. The traps should be placed on the field perimeter with the pheromone at approximately the height of the plants. However, the traps do require maintenance and many other species of insects are attracted to the yellow sticky cards used for the trap. Additionally, the currently available pheromones attract several species of weevils and the person inspecting the traps should have a hand lens in order to be able to identify the weevil properly. Pepper weevil is probably the only weevil that we will see on peppers that has a small spur on the underside of the femur near its joint with the tibia. The spur is present on all the weevils' legs.

Best management practice is to avoid southern transplants, especially ones with well developed flowers and buds. If you suspect pepper weevil, look for aborted flowers and fruit and cut these open with a knife looking for the grub. If one pepper weevil is found, insecticide applications should begin immediately. So far, weekly insecticide sprays have only repressed the weevil populations, not eliminated them.

(I) Pyrethroids

bifenthrin (Brigade; generics available)--2.1-6.4 fl oz 2E/A, or
Mustang MAX--2.24-4.0 fl oz/A or
permethrin (sweet bell pepper type only) --4-8 fl oz 3.2EC/A, or
lambda-cyhalothrin (Warrior;generics available)--2.56-3.84 fl oz/A, or
Proaxis--2.56-3.84 fl oz/A

(II) Carbamate

Vydate--2-4 pt 2L/A, or

(III) Other Chemistry

Actara--3-4 oz 25 WDG/A, or
Assail--4 oz 30SG/A, or
Kryocide--10-12 lb 96W/A, or

Table: Insecticide Use Category, REI and PHI

Insecticide	Use Category	REI (hours)	PHI (days)
Acramite	G	12	3
Actara	G	12	0
abamectin (Agri-mek)	R	12	7
Asana XL	R	12	7
Assail	G	12	7
Avaunt	G	12	3
Baythroid XL	R	12	7
Beleaf	G	12	0
bifenthrin (Brigade)	R	12	7
Confirm	G	4	7
diazinon 4EC	R	24	5
Entrust	G	4	1
Fulfill	G	12	0
Guthion	R	5 days	3
Imidacloprid(soil/ foliar)	G	12	21/0

Intrepid	G	4	1
Kelthane MF ?delete	G	12	2
Kryocide	G	12	14
lambda-cyhalothrin	R	24	5
Lannate	R	48	3
Metasystox-R	R	48	3
Mustang MAX	R	12	1
Oberon	G	12	7
Orthene	G	24	7
Platinum	G	12	30
permethrin	R	12	3
Proaxis	R	24	5
Proclaim	R	48	7
Radiant	G	4	1
Sevin/Sevin Bait	G	12	0
SpinTor	G	4	1
Thionex	R	48	4
Trigard	G	12	0
Venom(soil/foliar)	G	12	21/1
Vydate	R	48	7

Insecticide Pro/Con Table on next page

	% of Crop Treated	Pro	Con
bifenzate (Acramite)	1% DE 25-50% NJ	- short harvest interval	-takes longer to work
thiamethoxam (Actara)	30% bare 10% plastic		-expensive and only specific pests on label -poor control of stink bugs, pepper weevil
Abamectin	2%		-expensive -long post harvest interval -slow acting on spider mites
imidacloprid (Admire)	75% transplant treatment		
esfenvalerate (Asana XL)	2%		-repeated use will flare aphids and spider mites
acetamiprid (Assail)	1%		
indoxacarb (Avaunt)	5% early season 70% late season 50% NJ late season	-great beat army worm product	
cyfluthrin (Baythroid XL)	1%		-repeated use will flare aphids and mites
bifenthrin (Brigade)	13%		-repeated use will flare aphids
flonicamid (Beleaf)	<1%	-good selective aphicide	
tebufenozide (Confirm)	2%		

Dimethoate	90%	-can contribute to mite control -most effective and consistent product for pepper maggot control	
spinosad (Entrust)	2%		-expensive but usually used by organic growers
pymetrozine (Fulfill)	2%		- slow acting but works well
methoxyfenozide (Intrepid)	20%	-short days to harvest	
cryolite (Kryocide)	<1%		
methomyl (Lannate)	5%		
oxydementon methyl (Metasystox-R)	<1%		
zeta-cypermethrin (Mustang MAX)	90% DE MD 50% NJ	-1 day to harvest -inexpensive and effective	-repeated use will flare aphids and mites
spiromesifen (Oberon)	2%	-best spider mite product	
acephate (Orthene)	50%		
Permethrin-BP ONLY	2%	-short days to harvest	-repeated use will flare aphids and mites
thiamethoxam (Platinum)	<1%		
gammacyhalothrin (Proaxis)	2%		-repeated use will flare aphids and mites
emamectin (Proclaim)	1%	-good on the army worm complex	-expensive

carbaryl (Sevin)	0%		
spinosad (Spin Tor)	50%	-no flaring -short days to harvest	
endosulfan (Thionex)	5%	-additional stink bug control	
cyromazine (Trigard)	<1%		
dinotefuran (Venom)	<1%	-good stink bug control	
oxamyl (Vydate)	<1%		
lambda-cyhalothrin (Warrior)	30%		-repeated use will flare aphids and mites
spinetoran (Radiant)			

Pro/Con Insect Control – Cultural

	Pro		Con
	% of crop treated		
Plowing under CORN STALKS	50%	-helps with corn borer control	
Keeping fields free of weeds to ensue better spray coverage	70%		
Eliminate alternative hosts, like horsenettle	<1%		
Predators (use and preservation)	75-100%	-aphid, mite, and thrip predators and egg parasites	

Cherry-pepper trap crop	0%		
Reflective mulches	1%	-aphid control	-cost and availability
Remove perennial hosts	1%	-virus management -removal of pokeweed	
Avoid southern transplants	95%	-trying to prevent transport of pepper weevil, leaf miners, thrips	

Efficacy Table: Insects—Chemical Control

	% Crop Treated	Cut-worms	Flea Beetle	Green Peach Aphid	Pepper Maggot	Pepper Weevil	ECB	Leaf miners	CEW	Beet Aryworm	Fall Armyworm	Cabbage Looper	Thrips	Stink Bugs	Mites
bifenzate (Acramite)	**1**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**VG**
Thia-methoxam (Actara)	**5**	**NA**	**G**	**G**	**NA**	**P**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**P**	**NA**
abamectin	**2**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**G**	**NA**	**NA**	**NA**	**NA**	**G**	**NA**	**G**
imidacloprid (Admire)	**1**	**NA**	**G**	**G**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**G**	**NA**	**NA**
esfenvalerate (Asana XL)	**5**	**NA**	**G**	**NA**	**NA**	**P**	**P-F**	**NA**	**G**	**NE**	**NA**	**G**	**NA**	**NA**	**NA**
acetamiprid (Assail)	**1**	**NA**	**NA**	**G**	**NA**	**G**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**G**	**F**	**NA**
indoxacarb (Avaunt)	**10**	**NA**	**NA**	**NA**	**NA**	**NA**	**G-bp**	**NA**	**G**	**G**	**G**	**G**	**NA**	**NA**	**NA**
cyfluthrin (Baythroid XL)	**5**	**G**	**G**	**NA**	**NA**	**P**	**G**	**P**	**G**	**NE**	**NA**	**G**	**F**	**F-G**	**NA**
bifenthrin (Brigade)	**10**	**G**	**G**	**NA**	**NA**	**P**	**G**	**P**	**G**	**NE**	**P**	**G**	**F**	**NA**	**G**
flonicamid	**<1**	**NA**	**NA**	**G**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

(Beleaf)															
tebufenozide (Confirm)	**2**	**NA**	**NA**	**NA**	**NA**	**NA**	**F**	**NA**	**F**	**G**	**G**	**G**	**NA**	**NA**	**NA**
dimethoate	**30**	**NA**	**NA**	**F**	**VG**	**NA**	**NA**	**F**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
spinosad (Entrust)	**2**						**G**		**F**	**G**	**G**	**G**			
pymetrozine (Fulfill)	**2**	**NA**	**NA**	**G**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Methoxy Fenozide (Intrepid)	**10**	**NA**	**NA**	**NA**	**NA**	**NA**	**G**	**NA**	**F**	**G**	**G**	**G**	**NA**	**NA**	**NA**
dicofol (Kelthane)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
cryolite (Kryocide)	**<1**	**NA**	**NA**	**NA**	**NA**	**F**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
methomyl (Lannate)	**5**	**F**	**NA**	**F**	**NA**	**NA**	**F**	**NA**	**NA**	**F**	**G**	**G**	**NA**	**NA**	**NA**
oxydementon methyl (Metasystox -R)	**1**	**NA**	**NA**	**F-G**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
zeta-cypermethrin (Mustang MAX)	**10**	**G**	**G**	**P**	**F**	**?**	**G**	**P**	**G**	**P**	**P**	**G**	**G**	**G**	**NA**
spiromesifen (Oberon)	**2**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**E**
acephate (Orthene)	**50**	**NA**	**NA**	**G**	**NA**	**NA**	**VG-BP**	**NA**	**NA**	**NA**	**NA**	**G**	**NA**	**NA**	**NA**
Permethrin-BP ONLY	**5**	**G**	**G**	**NA**	**NA**	**P**	**G**	**P**	**G**	**NA**	**NA**	**F-G**	**NA**	**NA**	**NA**
thiamethoxam (Platinum)	**0**	**NA**	**G**	**G**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Gamma-cyhalothrin (Proaxis)	**5**	**G**	**G**	**P**	**NA**	**?**	**G**	**P**	**F**	**P**	**F**	**G**	**F**	**F**	**P**
emamectin (Proclaim)	**1**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**P**	**NA**	**G**	**G**	**G**	**NA**	**NA**	**NA**
carbaryl (Sevin)	**0**	**F**	**F**	**NA**	**NA**	**NA**	**P**	**NA**	**P**	**NA**	**P**	**NA**	**P**	**P**	**NA**
spinosad (Spin Tor)	**10**	**NA**	**NA**	**NA**	**NA**	**NA**	**G**	**F**	**G**	**G**	**G**	**G**	**G**	**NA**	**NA**
endosulfan (Thionex)	**2**	**NA**	**F**	**G**	**F-G**	**NA**	**NA**	**NA**	**NA**	**P**	**P**	**NA**	**NA**	**NA**	**NA**
cyromazine (Trigard)	**<1**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**G**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

dinotefuran (Venom)	**?**	**NA**	**G**	**F**	**NA**	**NA**	**NA**	**F**	**NA**	**NA**	**NA**	**NA**	**F**	**G**	**NA**
oxamyl (Vydate)	**?**	**NA**	**NA**	**F**	**NA**	**?**	**NA**	**F**	**NA**	**NA**	**NA**	**NA**	**F**	**NA**	**NA**
lambda-cyhalothrin (Warrior)	**50**	**G**	**G**	**P**	**NA**	**?**	**G**	**P**	**G**	**P**	**F**	**G**	**F-G**	**F-G**	**P**

Efficacy Table: Insects – Cultural Control

	% Crop Treated	**Cut-worms**	**Flea Beetle**	**Green Peach Aphid**	**Pepper Maggot**	**Pepper Weevil**	**ECB**	**Leaf miners**	**CEW**	**Beet Aryworm**	**Fall Armyworm**	**Cabbage Looper**	**Thrips**	**Stink Bugs**	**Mites**
Plowing under corn stalks	**50**	**NA**	**NA**	**NA**	**NA**	**NA**	**G**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Keeping fields free of weeds to insure better spray coverage	**70**	**NA**	**NA**	**G**	**G**	**NA**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**
Eliminate alternative hosts, like horsenettle	**<1**	**NA**	**NA**	**NA**	**G**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Preservation of Predators	**100**	**NA**	**NA**	**G**	**G**	**NA**	**G**	**NA**	**G**	**G**	**G**	**G**	**G**	**G**	**G**
Cherry-pepper trap crop	**0**	**NA**	**NA**	**NA**	**G**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Reflective mulches	**1**	**NA**	**NA**	**G**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Remove perennial hosts	**1**	**NA**	**NA**	**G**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Avoid southern transplants	**95**	**NA**	**NA**	**NA**	**NA**	**G**	**NA**	**G**	**NA**	**NA**	**NA**	**NA**	**G**	**NA**	**NA**

E = excellent
VG = very good
G = good
F = fair
P = poor
? = research needed
NA = not labeled for this pest, not used
NE = although labeled for this pest, product is not effective

Pepper Diseases and Fungicides[5]

Primary diseases of pepper in the region are: Phytophthora Blight (crown and fruit rot), Bacterial leaf spot, Anthracnose fruit rot, Pythium (damping-off or root rot), Rhizoctonia (damping-off or root rot), Bacterial soft rot, Nematode, and virus diseases, such as CMV (Cucumber Mosaic Virus), PVY (Potato Virus Y), and TSWV (Tomato Spotted Wilt Virus).

Damping-Off

Consideration should be given to using soilless mixes containing microorganisms that suppress damping-off fungi. Use of the following will assist in control:

SoilGard 12G--1-1.5 lb/cu yd of soilless mix
SoilGard is a naturally occurring soil fungus that is an antagonist to plant pathogenic fungi. Uniformly add SoilGard 12G when soilless mixes are being blended by mechanical devises. After one day of incubation (keep at room temperature), seed or transplants can be added to the treated mix.

Where planting mix is not used, pre-treat seedbeds with metam-sodium (Vapam HL) at 0.75 quart per 100 square feet.

Do not use recycled soilless media for seeding and transplant production.

Bacterial Leaf Spot

There can be a high risk of developing Bacterial leaf spot when using southern-produced transplants. Use disease-free seed or certified transplants and a 2-year rotation in the seedbed and field.

Plant varieties such as Aladdin X3R, Aristotle, Revolution, Wizard X3R, and Enterprise which have resistance to common races of the pathogen that occur in the region. When producing transplants, Clorox treat seed by adding 1 qt Clorox to 4 qt water for every 1 lb of seed. Submerge seed wrapped in cheesecloth in solution with constant agitation for 1 min. Rinse under continuous tap water for 5 minutes. Place seed on paper towel to dry thoroughly. Treat seed with thiram at 1 teaspoon thiram per lb seed. Always prepare a fresh solution for each batch of seed treated.

During transplant production, apply streptomycin (Agri-Mycin 17, Agri-Strep) sprays (1 pound per 100 gallons, 1¼ teaspoons per gallon) when first true leaves appear and continue every 4 to 5 days until transplanting. Streptomycin cannot be used on transplants after they are field-planted.

Losses from bacterial spot may be reduced by maintaining a high level of fertility. Maintaining high fertility levels will stimulate additional leaf formation to replace those leaves lost from bacterial spot infections. However, sufficient restraint must be used to ensure that plants do not become overly vegetative, or fruit set may be severely reduced. Where disease is present or anticipated, do not work in fields when plant surfaces are wet. Disk field as soon as possible after the growing season. This will hasten breakdown of the crop debris that is harboring the bacteria and minimize overwintering of the bacteria in the field.
Field sprays to reduce spread: Applying fixed coppers (at labeled rate) plus 1.5 lb Maneb 75DF/A, or fixed copper (at labeled rates) or 1.5 lb maneb 75D/A plus 8 to 10 oz Tanos 50WDG/A will help suppress spread of bacterial leaf spot. Begin sprays shortly after transplanting and repeat every 7 to 10 days.

Anthracnose Fruit Rot

Beginning at flowering:
Alternate:
maneb (FRAC code M3) at 1.5-3 lb 75DF/A every 7-10 days
With:
one of the following:
Quadris (azoxystrobin, FRAC code 11) at 6.2–15.4 fl oz 2.08F/A), or
Cabrio (pyraclostrobin, 11) at 8-12 oz 20EG/A, or
Flint (trifloxystrobin, 11) at 3-4 oz 5WDG/A, or
Tanos (famoxadone + cymoxanil, 11 + 27) 8–10 oz 50WDG/A

Bacterial Soft Rot

During periods of humid weather, the stem ends of harvested peppers may develop bacterial soft rot. Pack peppers dry without washing to minimize this disease. If peppers must be washed, then maintain 25 ppm of chlorine (1 tablespoon of Clorox per 8 gallons of water) in the wash water. Avoid washing peppers with water more than 10oF (6oC) cooler than the fruit temperature to prevent movement of bacteria into the stem end of the fruit.

Phytophthora Blight

Phytophthora blight can cause severe losses in all pepper types. Phytophthora blight typically starts in low areas of the field after heavy rains and can spread throughout the entire field during favorable conditions. Planting on a ridge or raised, dome-shaped bed will provide better soil drainage. A 3-year rotation with crops other than peppers, cucurbits, eggplants, or tomatoes is necessary to help reduce the chances for phytophthora blight development. In Phytophthora-infested fields or fields with low-lying areas present, plant Phytophthora-tolerant

varieties, such as Paladin, Aristotle, or Revolution, especially in fields with a history of Phytophthora blight.

For control of the crown rot phase of blight:
Apply 1 pt Ridomil Gold 4E/A or 1 qt Ultra Flourish 2E/A (mefenoxam, 4) broadcast prior to planting or in a 12- to 16-inch band over the row before or after transplanting.

Make two additional post-planting directed applications at 1 pint Ridomil Gold 4E or 1 qt Ultra Flourish 2E per acre to 6 to 10 inches of soil on either side of the plants at 30-day intervals.

When using polyethylene mulch, apply Ridomil Gold 4E at the above rates and timing by injection through the trickle irrigation system. Dilute Ridomil Gold 4E prior to injecting to prevent damage to injector pump.

For suppression of the stem and fruit rot phase of Phytophthora blight:

Apply the following on a 7- to 10-day schedule:
Copper, fixed--at labeled rates, or
Ridomil Gold Copper (mefenoxam + copper, 4 + M1) at 2.5 lb 65WP/A. Make three to four applications at 10- to 14-day intervals. (Only apply Ridomil Gold 4E at planting and 30 days later. The third application of Ridomil Gold 4E cannot be made when Ridomil Gold Copper is applied.)

The following materials are labeled for suppression of the aerial phase of Phytophthora on pepper friut,

For best results tank mix with a copper containing fungicide.
Forum (dimethomorph, 40) at 6.0 oz 4.18SC/A, or
Tanos (famoxadone + cymoxanil, 11 + 27) at 8-10 oz 50WDG/A

Blossom End Rot

This physiological disorder is caused by reduced calcium uptake and reduced calcium movement into the fruit when soil moisture conditions are low. To reduce chances for blossom end rot, maintain proper soil calcium and nutrient balance. The most effective control is to maintain uniform, favorable soil moisture. This is especially important when using raised beds for Phytophthora control, since soil in raised beds dries more quickly than in flat culture. Avoid root pruning and damage which may disrupt the uptake of water into the plant.

Sunscald Injury

To reduce sunscald injury, select varieties with good foliage cover. Maintain vegetative growth by following locally recommended fertility (especially nitrogen)

programs and timely irrigation. To minimize potential losses due to sunscald injury, harvest carefully to avoid damaging stems, branches and foliage which may expose fruit to direct sunlight.

Southern Blight (Sclerotium)

High soil moisture and temperature favor the development of southern blight. Long proper crop rotations with corn and small grains help reduce disease incidence.

Use the following in the transplant water.

Terraclor--3 lb 75WP/100 gal of water and apply 0.5 pint per plant.

Verticillium Wilt

Verticillium is an important soil-borne fungus which can infect a number of different vegetable crops including eggplant, tomato, pepper, potato, and strawberry. Verticillium wilt can survive in the soil for many years, therefore, a long, proper crop rotation is necessary to reduce chances for verticillium development. DO NOT grow tomato, potato, strawberries, or eggplant as an alternate crop. DO NOT plant other solanaceous crops, such as eggplant or tomato between pepper plantings.

Viruses

Aphid-transmitted viruses (PVX, CMV, TEV, PVY, and AMV):

Aphid-transmitted viruses of pepper cannot be adequately controlled with insecticide applications, however, development of symptoms can be delayed through their use. Growers may wish to use yellow trap pans containing water to determine when mass flights of winged aphids occur. Repeated applications of a contact insecticide specific for aphid control at those times are most beneficial.

Thrips-transmitted virus (Tomato Spotted Wilt Virus, TSWV, and Impatiens Necrotic Spot Virus, INSV):

Resistant varieties are available. TSWV can become severe on peppers during greenhouse production of transplants and field production. INSV causes similar symptoms on peppers as TSWV; however, INSV is not as severe and does not limit production to the same extent as TSWV. The virus is spread to peppers by thrips. During transplant production, thrips transmit the virus from infected ornamental plants (flowers). Do not grow any ornamental bedding plants in the same greenhouse as pepper transplants. Monitor greenhouses and scout fields for thrips and begin an insecticide program once observed. Treat with an insecticide to control thrips and rogue out any virus-infected plants.

Tobacco mosaic virus (TMV): TMV is transmitted mechanically. Use resistant varieties to control TMV.

Table - fungicide Use Category, REI and PHI

Fungicide	Use Category	REI (hours)	PHI (days)
Cabrio	G	12	0
copper, fixed	G	24	0
Flint	G	12	3
Forum	G	12	4
maneb	G	24	7
Nova	G	24	0
Quadris	G	4	0
Ridomil Gold	G	12	7
Ridomil Gold Copper	G	48	7
Tanos	G	12	3
Terraclor	G	12	--
Ultra Flourish	G	12	7

Disease Management Pro/Con Table

	% of Crop Treated	Pro	Con
metam-sodium (Vapam HL)	25% NJ 40% DE/MD	-additional nematode suppression, weed suppression	-expensive: special application -timing -non-selective
Clorox seed treatment.	90%	-cost effective -effective	
streptomycin (Agri-Mycin 17, Agri-Strep)	90%	-only product labeled for the greenhouse	-resistance management
fixed coppers	100%	-inexpensive -effective -other targets -short PHI	-resistance management

fixed coppers plus maneb	100%		
maneb plus Tanos	10-15% DE MD 50% NJ		
maneb	<1%		
azoxystrobin (Quadris)	75% NJ 20% DE MD		-resistance management
Oxidate	25% DE MD 75% NJ		
pyraclostrobin (Cabrio)	5%		-resistance management
trifloxystrobin (Flint)	1%		-resistance management
famoxodone + cymoxanil (Tanos)	<1%		
mefenoxam (Ridomil Gold 4E) and Ultra Flourish 2E	50% DE MD 90% NJ		-resistance management
Hot Water Seed Treatment	5%		
mefenoxam + copper hydroxide (Ridomil Gold Copper 65WP)	15%		-resistance management
dimethomorph (Forum 4.18SC)	<1%		-poor performance
PCNB (Terraclor 75WP)	1%	-very effective	-requires special equiptment and application (only the stem and not foliage) -cultivation can nullify the efficacy for bare ground production
Cultural Control:			
disease-free planting mix	100%		

SoilGard	5%		
Resistant varieties	75%		-fruit quality
Rotation	75% NJ 85% DE MD 20% NJ 5% NJ 15% DE MD	*3-year rotation with non-solanaceous crops* *4 year rotation* *5+ year(s) rotation (with corn and small grains)*	
maintain high fertility	100%	-helps the plant grow out of bacterial leaf spot	-elevated level of anthracnose fruit rot
do not work in fields when plant surfaces are wet	50% 90% Mechanical Harvest	- helps reduce spread of leaf spot and anthracnose	-not always efficient: reduces harvest window
Disk field ASAP after growing season	90% bare ground 30% plastic	-helps break down plant material	-dependant on when the plastic mulch is removed
Pack peppers dry	70%		
Avoid washing peppers with water cooler than fruit	40%	-improve fruit quality	-potential increase for soft rot
Plant on ridge or raised, dome-shaped bed	50% DE MD 100% NJ	-improved drainage	
polyethylene mulch	75%	-fruit quality -improved soil moisture -weed control	-disposal

		-water conservation	
maintain proper soil calcium & nutrient balance	100%	-blossom end rot management	
Do not grow any ornamental bedding plants in same greenhouse as pepper transplants	90%		
rogue out infected plant material	5-10%		

Efficacy Table: Fungicides and Cultural Controls

	damping off	**bacterial leaf spot**	**anthracnose fruit rot**	**bacterial soft rot**	**phytophthora blight**	**blossom end rot**	**sunscald**	**southern blight**	**Verticillium Wilt**	**Viruses**
metam-sodium (Vapam HL)	G-VG	NA	NA	NA	P-F	NA	NA	G	G	NA
Clorox seed treatment.	NA	VG-E	VG-E	NA	NA	NA	NA	NA	NA	NA
streptomycin (Agri-Mycin 17, Agri-Strep)	NA	G-VG	NA	NA	NA	NA	NA	NA	NA	NA
fixed coppers	NA	F-G	P	NA	F-P	NA	NA	NA	NA	NA
fixed coppers plus maneb	NA	G	G-VG	NA	P-F	NA	NA	NA	NA	NA
maneb plus	NA	F-P	G	NA	F-P	NA	NA	NA	NA	NA

Tanos										
maneb	NA	NA	G	NA	NA	NA	NA	NA	NA	NA
azoxystrobin (Quadris)	NA	NA	G	NA	NA	NA	NA	NA	NA	NA
pyraclostrobin (Cabrio)	NA	NA	G	NA	NA	NA	NA	NA	NA	NA
trifloxystrobin (Flint)	NA	NA	G	NA	NA	NA	NA	NA	NA	NA
famoxodone + cymoxanil (Tanos)	NA	F-P	G	NA	NA	NA	NA	NA	NA	NA
mefenoxam (Ridomil Gold 4E)	G-VG	NA	NA	NA	P-VG	NA	NA	NA	NA	NA
Ultra Flourish 2E	G-VG	NA	NA	NA	P-VG	NA	NA	NA	NA	NA
mefenoxam + copper hydroxide (Ridomil Gold Copper 65WP)	NA	NA	NA	NA	P-G	NA	NA	NA	NA	NA
dimethomorph (Forum 4.18SC)	NA	NA	NA	NA	P-F	NA	NA	NA	NA	NA
PCNB (Terraclor 75WP)	G	NA	NA	NA	NA	NA	NA	VG	NA	NA
Oxidate	?	?	NA	?	NA	NA	NA	NA	NA	NA
Cultural Control:										
disease-free planting mix	G	NA	NA	NA	VG	NA	NA	VG	VG	NA
SoilGard	?	G	NA	NA	NA	NA	NA	?	NA	NA
Resistant varieties	NA	G	NA	NA	G-VG	NA	NA	NA	NA	VG
maintain high level of fertility	NA	G-VG	P	NA	NA	NA	G	NA	NA	G

do not work in fields when plant surfaces are wet	NA	G-VG	G	NA	NA	NA	NA	NA	NA	NA
Disk field ASAP after growing season	G	G-VG	G	NA	P-G	NA	P-G	P-G	NA	NA
Pack peppers dry	NA	NA	F-G	G-VG	F	NA	NA	NA	NA	NA
Avoid washing peppers with water cooler than fruit	NA	NA	NA	VG	NA	NA	NA	NA	NA	NA
Plant on ridge or raised, dome-shaped bed	F	NA	NA	NA	P-G	NA	NA	NA	NA	NA
3-year rotation with crops other than peppers, cucurbits, eggplants, or tomatoes	NA	G	G	NA	P-G	NA	NA	F-G	F-G	NA
polyethylene mulch	NA	NA	NA	NA	NA	G	NA	NA	NA	NA
maintain proper soil calcium & nutrient balance	NA	NA	NA	NA	NA	G	NA	NA	NA	NA
Long crop rotations with corn and small grains	NA	G-VG	G-VG	G	G	NA	NA	VG	VG	NA
DO NOT grow tomato, potato, strawberries, or eggplant as an alternate	NA	NA	G-VG	G	G-VG	NA	NA	G-VG	VG	NA

crop.										
DO NOT plant other solanaceous crops between pepper plantings.	NA	G-VG	G-VG	G	G	NA	NA	G-VG	VG	NA
Do not grow any ornamental bedding plants in same greenhouse as pepper transplants	G-VG	NA	NA	NA	G-VG	NA	NA	NA	NA	VG
rogue out infected plants	NA	NA	NA	NA	NA	NA	NA	NA	NA	VG

E = excellent
VG = very good
G = good
F = fair
P = poor
? = research needed
NA = not labeled for this pest, not used
NE = although labeled for this pest, product is not effective

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