

Commercial Vegetable Disease Control Guide – 2009



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2009

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Cover Photos:

Upper left: Tomato spotted wilt virus on tomato fruit
Lower left: Southern blight on tomato stem

Upper right: Downy mildew on pumpkin leaf
Lower right: *Phytophthora capsici* on watermelon fruit

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Pesticide Safety

- Follow the directions, and heed all precautions on the labels.
- Know any hazards that the pesticide might present – to you or anyone else.
- Avoid prolonged inhalation of pesticide sprays or dusts; wear personal protective equipment and clothing if specified on the container.
- If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first-aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on the skin or clothing, remove the clothing immediately and wash skin thoroughly.
- Comply with the Worker Protection Standard (WPS). The WPS requires the agricultural employer to be responsible for reducing the pesticide exposure of employees. The WPS mandates pesticide safety education, specific restricted entry intervals (REI's), personal protective equipment and worker access to information. A product's WPS specific requirements are found in the Agricultural Use section of the label. All require employers to notify workers of a pesticide application with a display at a central location.

- Comply with the Right-To-Know law. Have the product labels readily available for workers to see. Have the Material Safety Data Sheet (MSDS) for each product available for workers to see and for rescue or fire personnel to use in case of emergency.
- Store pesticides in original containers under lock and key – out of the reach of children and animals – and away from food and feed.
- Apply pesticides so they do not endanger humans, livestock, crops, beneficial insects, fish and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants or in ways that may contaminate water or leave illegal residues.
- Do not clean spray equipment or dump excess spray material near ponds, streams or wells. Do not use the same equipment for insecticides or fungicides that you use for herbicides.
- Restricted-use products may only be purchased and applied by certified applicators or persons under their direct supervision. There are categories of applicators, and a test must be passed to become a certified applicator in the appropriate category. Once the test is passed, the applicator must be recertified periodically through continuing education.
- The USDA requires that records are kept for the use of all restricted-use products. Forms are available at your county Extension office. Record keeping is advisable for non-restricted pesticides as well.
- Dispose of empty pesticide containers promptly and according to the law.



Precautionary Statement

To protect people and the environment, pesticides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store or dispose of a pesticide. According to laws regulating pesticides, they must be used only as directed by the label.

Disclaimer Statement

PESTICIDES RECOMMENDED IN THIS PUBLICATION WERE REGISTERED FOR THE PRESCRIBED USES INSOFAR AS WE WERE ABLE TO ASCERTAIN WHEN PRINTED. PESTICIDE REGISTRATIONS ARE CONTINUOUSLY BEING REVIEWED, AND OFTEN CHANGE. IF ANY INFORMATION IN THESE RECOMMENDATIONS DISAGREES WITH THE LABEL, THE INFORMATION MUST BE DISREGARDED. ANY PERSON USING PRODUCTS LISTED IN THIS PUBLICATION ASSUMES FULL RESPONSIBILITY FOR THEIR USE IN ACCORDANCE WITH CURRENT LABEL DIRECTIONS OF THE MANUFACTURER.

Use of trade or brand names in this publication is for clarity and information; it does not imply approval of the product to the exclusion of others that may be of similar, suitable composition, nor does it guarantee or warrant the standard of the product.

Foreword: What Is a Plant Disease?

The term **plant disease**, as used in this publication, refers to a plant problem caused by a pathogen, such as a fungus, bacterium, virus or nematode. Other types of plant problems include **disorders**, caused by cultural or environmental factors, and **pest damage**, caused by insects or other animals that feed on or otherwise damage plants. This publication only deals with pathogen control and does not address disorders and pest damage.

I. Cultural Practices for Disease Control

Chemical control practices comprise a large part of this publication, because they change so frequently, but make up only a small part of the overall disease control program. Cultural practices are the backbone of disease control.

Crop Rotation

Rotating fields to unrelated crops each year will decrease the populations of many types of disease-causing organisms in the soil. Because pathogens tend to attack several members of one plant family but not another, crop rotations should involve different families. Grass crops or corn almost always make a good rotation crop. At least two years should be allowed between plantings of the same family, but the longer the rotation, the less likely that an early-season outbreak of a disease will occur. The vast majority of plant diseases are lessened even by one year out of a crop.

Crop rotation is effective in reducing pathogens that spend at least part of their life cycle in the soil, which applies to most of them. Examples of pathogens that do not survive in the soil and, thus, are not controlled by crop rotation, include the rusts, the downy mildews, the powdery mildews and viruses other than tobacco mosaic. Crop rotation is very effective against pathogens that survive short periods in the soil on plant debris, such as those that cause foliar and fruit diseases. Crop rotation will reduce, but not eliminate, soil inhabitants that are long-lived, such as *Phytophthora* and *Fusarium*.

Proper environment

Provide the crop with favorable drying conditions and soil drainage so that the plants are not exposed to prolonged wet conditions, which favor both root and foliar diseases. Select sites that are not lined by trees and have good internal soil drainage. Using raised beds, reducing plant densities and foregoing sprinkler irrigation are considerations for minimizing diseases. Weeds can increase diseases by interfering with drying conditions and by providing an alternate host for certain pathogens.

Resistant Varieties

The use of resistant varieties is one of the most economical ways of controlling vegetable diseases. Resistance to a disease should be employed if a farm or the vicinity has a history of the disease. Especially when used in combination with crop rotation, varieties with resistance to soilborne diseases will result in the long-term decline of the pathogen population. The use of resistance to foliar disease will decrease the reliance on chemical control. Resistant varieties are not available to all diseases or may only be effective against certain strains. Resistant varieties may become ineffective as pathogens develop the ability to overcome the resistance.

Good Crop Husbandry

Plants that have good, but not excessive, vigor are the most resistant to disease. Plants weakened by improper soil pH, inadequate fertilization, crowding, weed competition or planting when the soil is too cool are more subject to pathogen invasion and disease development. Lush growth caused by excessive fertilization can decrease drying conditions. Follow closely all production recommendations for each crop.

Prevent Disease Introduction

Often the most effective and successful control of a disease is to prevent it from occurring in the first place. Many diseases are difficult to deal with after they appear, as they lack adequate controls.

Disease-free seed and transplants are a must. Do not save seed or use locally grown transplants, as they have a greater risk of harboring pathogens. External appearance of seed or transplants cannot be relied upon as an indicator of the presence of the pathogen, as there are usually no symptoms. Buy certified transplants, understanding that certification is no guarantee of freedom from disease. Buy seed that is certified and, if possible, has been tested for bacterial pathogens. Hot water and chlorine bleach treatments of seed decrease the chance of

pathogen infestation, but do not substitute for the certification process. The western U.S. is a preferred source of seed because the arid climate decreases the chance of disease transmission. However, western-grown seed is not always available.

Some disease-causing organisms can be introduced to a field on contaminated equipment or containers. Cultivate non-infested vegetable fields before moving to fields infested with particularly troublesome pathogens. Equipment or containers that have been used in infested fields should be washed with a strong stream of water and disinfested with a bleach solution before being used in other fields.

Avoid using tobacco while working in tobacco mosaic-susceptible crops, such as tomato and pepper. Tobacco mosaic virus is carried in tobacco products and is easily transmitted on workers' hands. Workers should wash their hands thoroughly in soap and water after handling tobacco and before they work with tobacco mosaic-susceptible plants.

Remove the Pathogen

Destroy the overwintering habitat of the pathogen, such as crop debris left in the field. The most practical way to do this is to disk it into the soil. Most pathogens are unable to survive once the crop residue decomposes, and disking it in enhances the decomposition process. Eliminate cull piles by burying before the next crop is planted.

Removing diseased plant parts from the field is not a common practice in vegetable production but may have a role in certain systems, such as asparagus production. As a perennial crop, disking crop debris at the end of the growing season is not an option. However, removing the debris and burning it reduces overwintering inoculum of foliar diseases.

Roguing, or removing entire plants from the field, may be used in certain situations for reducing inoculum. It generally is only effective when done immediately upon the first detection of a disease, with the goal of arresting an epidemic in its initial stage. Furthermore, roguing can actually result in increased disease by scattering the pathogen during the removal process (e.g., southern blight) or by causing insect vectors to scatter (e.g., tomato spotted wilt virus).

II. Chemical and Biological Control

Biological and chemical controls are available for management of diseases caused by fungi, bacteria and nematodes. Although there are no viricides, virus diseases that are vectored by insects may be managed with certain insecticides.

Plant diseases cannot be controlled satisfactorily just by spraying. Disease control should be approached as a program that integrates all of the cultural practices mentioned above. Applications of sprays, dusts, fumigants, etc. for plant disease control should only be considered supplements to the cultural practices.

The use of certain strains of bacteria and fungi to control plant pathogens is called **biological control** or **biocontrol**. Some of these organisms are commercially available and can be quite effective in certain situations. Biocontrols offer the advantage of lessened environmental impact and increased worker safety. Often, biocontrols work more slowly and tend not to be as effective as synthetics when disease pressure is high. Certain biocontrol products are listed in the recommendations if adequate research has been conducted to elucidate their role.

Chemical control of plant diseases includes synthetic and naturally occurring compounds. Most chemicals affect the pathogen directly while some, such as Actigard, induce plant resistance to certain pathogens.

Disease-control products include seed treatments, soil sprays, soil fumigation, nematicides, foliar sprays and post-harvest treatments. Products available for use are addressed in the sections that follow. Only brief instructions for use are provided; **always refer to the label for full instructions, restrictions and other information.**

A. Seed Treatment

Seed treatment accomplishes plant disease control by reducing seedling disease as well as mature-plant diseases caused by seed-borne pathogens. Most seedling diseases are caused by pathogens found in the soil, whereas those pathogens found on or in the seeds tend to cause mature-plant diseases. Seed disinfestation and seed protection are types of seed treatments used to reduce diseases.

1. Seed Disinfestation

Seeds can be disinfested, i.e., cleaned of most pathogens carried on the seeds, by treatment with hot water, chlorine bleach or trisodium phosphate. Hot water also kills some of the bacteria carried inside the seed. None of these treatments provides residual protection against organisms encountered in the soil after planting. Treatment of seeds with fungicides is required for such protection.

Most seed companies offer seed treatment options, and it is recommended that you utilize such services, rather than attempt to treat the seeds yourself. Unless the procedures are adhered to closely, much damage can be done during the seed treatment process. For example, an entire lot of seeds can be contaminated with bacterial pathogens that spread in water that is not hot enough; seed germination can be reduced by water that is just slightly too hot. Furthermore, many fungicide seed treatments can only be applied by a commercial seed treater and are not available for purchase by the grower. Pelletized seed must be treated prior to the coating process.

Hot water treatment: Pre-warm seed in a cheesecloth bag for 10 minutes in 100 degree F water. Place pre-warmed seed in a water bath that will constantly hold the water at the recommended temperature (see Table 1). Length of treatment and temperature of water must be exact. Agitation of the water during the treatment cycle will help maintain a uniform temperature in the water bath. After treatment, dip the bag in cool water to stop the heating action. Spread seed out on paper towel to dry. A seed treatment fungicide can then be applied to protect against pathogens in the soil.

Caution: Hot water treatment can reduce germination to some degree. The viability of older seed (more than 1 year old) may be drastically reduced. A small sample of seed should be treated and tested for germination before the entire lot is treated. Vegetable seeds other than those listed in Table 1 should **not** be hot-water treated. These seeds may be severely harmed by hot water treatment and other methods should be used. Included are beans, sweet corn, onions and, especially, cucurbits other than cucumber.

Table 1. Water bath temperatures and soaking times for selected vegetable seeds.

Crop	Temp. (°F)	Minutes
Brussels sprouts, cabbage, eggplant, spinach and tomato	122	25
Broccoli, cauliflower, cucumber, carrot, collard, kale, kohlrabi, rutabaga and turnip	122	20
Mustard, cress and radish	122	15
Pepper	125	30
Lettuce and celery	118	30

Bleach treatment: Pathogens can be removed from the surface of seeds with bleach treatments. This method is particularly useful for control of bacterial diseases such as bacterial spot of tomato or pepper. Mix 1 quart of bleach (sodium hypochlorite) with 4 quarts of water and a few drops of dish detergent to decrease surface tension. Soak seed for 1 minute, remove and rinse seed thoroughly in running tap water for 5 minutes; spread seeds on paper towels to dry. North Carolina State University reports that tomato seeds can be soaked in this bleach solution for 40 minutes without serious harm to the seeds. Treat a small sample size and test for seed germination before the entire lot is treated. After drying, a seed treatment fungicide may be applied.

Tobacco mosaic virus on pepper and tomato seeds can be reduced with a **trisodium phosphate treatment**. Soak seeds for 15 minutes in a 10 percent solution, rinse and dry before treating with household bleach.

2. Seed Protection

The purpose of seed protection is to reduce the plant stand loss effect of seed rots and damping-off, caused by soil-borne fungi. Most vegetable seed is pretreated by the seed company, using treatments aimed at the common fungi. Captan and thiram are the most common treatments used. If you have unusual seedling disease problems, refer to Table 2 for appropriate treatments and request them when you place your seed order with the company. Certain products can be applied on the farm; follow label directions in treating your own seeds.

Table 2. Common seed treatments for disease control.

Product	Active Ingredient	Pathogen Controlled	Crop
Allegiance-FL Allegiance Dry	metalaxyl	Pythium, suppression of Phytophthora	Most vegetables
Apron Maxx	mefenoxam and fludioxonil	Pythium, Rhizoctonia, Fusarium, suppression of Phytophthora	Legume vegetables
Apron XL LS	mefenoxam	Pythium, suppression of Phytophthora	Most vegetables
Captan 400-C, others	captan	Rhizoctonia, suppression of Pythium, Fusarium and miscellaneous other fungi	Most vegetables
Catapult XL	chloroneb and mefenoxam	Rhizoctonia, Pythium	Legume vegetables
Coronet	pyraclostrobin, boscalid	Rhizoctonia, Penicillium, Fusarium	Brassica, bulb, cucurbit and legume vegetables
Dividend Extreme	difenaconazole, mefenoxam	Rhizoctonia, Fusarium, Pythium	Sweet corn
Dynasty	azoxystrobin	Rhizoctonia, suppression of Pythium, Fusarium and miscellaneous fungi	Legume vegetables
FarMore D300	azoxystrobin, mefenoxam, and fludioxonil	Rhizoctonia, Pythium, and Fusarium, suppression of Phytophthora	Tomatoes, peppers, lettuce, spinach, carrots, onions, cucumbers, melons, squash, watermelon, broccoli, cabbage and cauliflower
Kodiak	Bacillus subtilis strain GB03	Rhizoctonia, Fusarium, Alternaria, Aspergillus	Legume vegetables
Maxim 4FS	fludioxonil	Fusarium, Rhizoctonia, Helminthosporium, Aspergillus, Penicillium	Most vegetables and herbs
Prevail	carboxin	Rhizoctonia	Beans
Protector-D	thiram	Rhizoctonia, suppression of Pythium, Fusarium and miscellaneous other fungi	Beans
Thiram 50WP 42-S Thiram	thiram	Rhizoctonia, suppression of Pythium, Fusarium and miscellaneous other fungi	All vegetables
Vitavax-34	carboxin	Rhizoctonia	Beans
Vitaflo-280	carboxin, thiram	Rhizoctonia, suppression of Pythium, Fusarium and miscellaneous other fungi	Beans, sweet corn

B. Soil Fumigation

This method will reduce, but not eliminate, fungal, bacterial and nematode pathogens in the soil prior to planting. Some fumigants also provide weed and soilborne insect control. Table 3 contains a brief description of application methods for labeled fumigants. Refer to the label for complete instructions and restrictions. Soil should be warm, well-worked and free from undecomposed plant debris and have adequate moisture for seed germination.

Table 3. Soil fumigants for vegetable crops.

Vegetable Crop	Product	Broadcast Rate/Acre*	Remarks
Most Vegetables	Telone II (for nematodes only)	9 - 12 gal	Chisels should be inserted 12 inches deep and spaced 12 inches apart for broadcast applications. Wait 2-3 weeks before planting; longer if soil is cold or wet.
	Chloropicrin SMDC (Metam CLR, Vapam, or Sectagon 42) K-Pam HL Telone C-17 Telone C-35	150 - 500 lb (1 gal=13.85 lb) 40 - 100 gal 30 - 60 gal 10 - 17 gal 13 - 20.5 gal	Multipurpose fumigants. See label for chisel depth and spacing and plant-back restrictions. Wait 2-3 weeks before planting, or longer in cold, wet soil, or if odor persists.
Asparagus, broccoli, cauliflower, eggplant, lettuce, muskmelon, dry onion, pepper, tomato	Terr-O-Gas 50 Terr-O-Gas 67	360 - 480 lb 270 - 355 lb	Multipurpose fumigants. Chisels spaced 12 inches apart, 6-8 inches deep. Cover with plastic film. Refer to label for plant-back intervals and risk-mitigation requirements (buffer zones, personal protective equipment, worker notification, etc.).
Pepper, tomato	Midas 50:50	200 - 350 lb (standard film) 150 - 200 lb (highly retentive film)	Injected. See Terr-O-Gas remarks.
	Midas EC Bronze	200 - 350 lb (standard film) 150 - 200 lb (highly retentive film)	For application only through drip irrigation on raised beds. Drip tape must be buried 2-4 inches deep.

* In-row applications reduce the per-acre rates proportionately to row spacing and row width.

C. Nematicide Applications

Nematode control is needed in fields in which root galling has been found in the past. At the end of each growing season, plants should be dug up in several locations in each field and examined for evidence of root galling. This direct method of detection of the root-knot nematode is the most accurate. If desired, soil samples can be submitted to a laboratory for analysis. This method can detect all types of nematodes, but root inspection will detect root-knot, which is the most important nematode in vegetable production in Tennessee.

Successful nematode control depends on cultural practices. Refer to SP 291-I, "Managing Nematodes in Commercial Vegetables," for information on these practices as they apply to nematodes.

Products for controlling nematodes, called nematicides, serve as supplements to cultural practices, not as substitutes. Nematicides are of two types: fumigants and non-fumigants. For fumigant products, see "Soil Fumigants," above. Non-fumigant products are provided in Table 4.

Table 4. Non-fumigant nematicides for vegetable crops.

Product Choices	Application Method	Formulated Rate		Schedule and Remarks
		Per Acre	Per 100 sq ft or 100 ft row	
Bean, snap and lima				
Mocap - various formulations	Broadcast or banded	See label	See label	Incorporate 2 to 4 in. deep. See label.
Cabbage				
Mocap - various formulations	Broadcast or banded	See label	See label	Incorporate 3 in. deep. See label.
Carrot				
Vydate L	Preplant broad cast	2 gal	--	Apply within 1 week before planting, incorporate into soil 4 to 6 in. deep.
	In seed furrow	1 - 2 gal	--	
Cucumber				
Mocap - various formulations	Banded only	See label	See label	Incorporate 2 to 4 in. deep. See label.
Cucurbits (cucumber, squash, cantaloupe, watermelon, honeydew, pumpkin)				
Vydate L	Preplant broadcast	1 - 2 gal	--	Incorporate 2 to 4 in. deep. 1 st application 2 to 4 weeks after planting; repeat 2 to 3 weeks later. Do not treat within 1 day of harvest.
	Foliar spray	2 - 4 pt	--	
Eggplant				
Vydate L	Postplant band	1 gal	--	Apply 2 to 3 weeks after transplanting; repeat 4 weeks later. Incorporate by water or mechanically. Apply 2 to 4 weeks after the 2 nd soil treatment.
	Foliar	4 pt	--	
Pepper, bell				
Vydate L	Transplant water	2 pt in 200 gal water	--	Use as a supplement to transplant treatment 14 days after transplanting. Repeat at 1- to 2-wk intervals.
	Drip irrigation	2 - 4 pt in 40 - 200 gal water	--	
Potato				
Mocap - various formulations	Broadcast or banded	See label	See label	Incorporate 2 to 4 in. deep. See label.
Vydate L	At planting in-furrow	1 - 2 gal in 20 gal water		Begin when early season control has diminished.
	Foliar	2 - 4 pt		
Sweetpotato				
Mocap - various formulations	Broadcast or banded	See label	See label	Incorporate 2 to 4 in. deep. See label.
Vydate L	Preplant broadcast	2 gal in 20 gal water	--	Thoroughly incorporate into soil 4 to 6 in. deep within 1 week of planting.
	Transplant water	1 - 2 gal in 200 gal water	--	

Table 4. Non-fumigant nematicides for vegetable crops, continued.

Product Choices	Application Method	Formulated Rate		Schedule and Remarks
		Per Acre	Per 100 sq ft or 100 ft row	
Sweet corn				
Mocap - various formulations	Banded only	See label	See label	Incorporate 2 to 4 in. deep. See label.
Counter 15G	Row, 30-in. minimum	Maximum of 8.7 lb	0.8 oz	Place granules directly in the seed furrow behind planter shoe.
Tomato				
Vydate L	Foliar	2 - 4 pt	--	Spray when plants are established. Repeat at 1- to 2-week intervals.
	Drip irrigation	2 - 8 pt	--	Apply at 1 st irrigation; repeat every 1 to 2 weeks. Use 2 to 4 pt while plants are small, increasing gradually to 8 pt.

D. Fungicide and Bactericide Sprays

1. The Purpose of Table 5

In Table 5, chemical and biological control product choices are provided for the major diseases on the major crops in Tennessee. This table is not a spray schedule; it provides product choices for a number of diseases for each crop. It is intended as a reference, so that the grower can develop a spray program suitable for his/her farm situation. Diseases that are important to you may not be a factor elsewhere, and vice versa.

2. Designing a Spray Program

In general, incorporate the chosen products into a spray program that features disease prevention while minimizing the number of applications and abides by product label restrictions. Excessive use of chemicals is expensive and increases the chances of resistance development in the pathogen populations.

- Disease control must be approached preventively, for the most part. Plan your program by selecting broad-spectrum, protectant fungicides such as mancozeb, maneb or chlorothalonil that are labeled for the crop.
- Use Table 5 to determine which products are labeled for use and are effective against the diseases that are important on your farm. Use efficacy tables, if available, to compare the fungicides for effectiveness on those diseases. Two such tables can be found in Appendices 3 and 4. Price should also be a consideration in product selection.
- When to begin spraying depends on the crop, the weather, the disease history in the field and when the crop was planted. On crops that are highly subject to foliar diseases, such as tomatoes, the spray program should begin as soon as the first week after planting, especially on late plantings.
- How often to spray depends on the weather, but usually is in the 7- to 14-day range. Five-day intervals, if allowed by the label, may be necessary if certain difficult-to-control diseases are present and rainy weather occurs. Rainy weather favors most diseases, and more frequent sprays are needed under such conditions.
- Scout the crop regularly and add specialized fungicides to the program as appropriate for diseases such as late blight of tomato, downy mildew of cucurbits, powdery mildew of cucurbits and *Phytophthora capsici* blight of several crops.
- Engage in resistance management for those fungicides that are at risk for losing effectiveness (Appendix 2). The at-risk group includes the strobilurins, which are commonly used in vegetable production. Most at-risk fungicides must be alternated with non-related fungicides, although some can be applied two consecutive times before rotating to a non-related fungicide.
- Most products have a labeled limit on the number of times or the amount applied to a crop. Abide by these limits in designing your program. They are found on the label and in Table 5.
- Heed the pre-harvest interval (PHI). It may be necessary to make an alternate choice of fungicides during the harvest period. For example, the 5-day PHI of mancozeb on tomato interferes with the harvest schedule.

Table 5. Foliar, soil and post-harvest applications of disease-control products.

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
ALL VEGETABLES					
Post-harvest rots	sodium hypochlorite (various brands)	See label			Submerge 2 min., rinse. Change solution when visibly dirty. Never permit chlorine solution to fall below 25 ppm.
	hydrogen dioxide	See label			See label
	peroxyacetic acid + hydrogen peroxide (various brands)	See label			See label
ASPARAGUS					
Rust Brick-red pustules on ferns.	chlorothalonil 6L ³	2 - 4 pt	190	12 pt	Apply only to ferns after harvest. Begin at first appearance of disease. Nova and Folicur are in Group 3 and should be alternated with non-Group 3 fungicides. Jersey male hybrids are resistant to rust.
	Folicur 3.6F	4 - 6 fl oz	180	3 app	
	mancozeb 80WP ³	2 lb	180	8 lb	
	Nova 40W	5 oz	180	6 app	
	sulfur	See label	0	NL	
Cercospora leaf spot (bight) Tan spots with purple margins.	chlorothalonil 6L ³	2 - 4 pt	190	12 pt	Apply only to ferns after harvest. Apply mancozeb at 10-day intervals, beginning at first appearance of disease. The minimum re-treatment interval for chlorothalonil is 14 days.
	mancozeb 80WP ³	2 lb	180	8 lb	
Fusarium crown and root rot Deterioration of root system and poor growth of plants.	mancozeb 80WP ³	1 lb/100 gal Preplant root dip.			See label. Chemical control is limited. Avoid acidic and poorly drained soils. Avoid excessive cutting. Jersey male hybrids tolerant.
Stemphyllium purple spot Purple lesions with brown centers on spears and ferns.	Quadris 2.08F ³	6.2 - 15.4 fl oz	100	4 app	Do not make more than 1 application of Quadris before alternating with a fungicide with a different mode of action. Remove and destroy fern debris in fall.
	chlorothalonil 6L ³	2 - 4 pt	180	12 pt	
BEAN, SNAP					
Alternarial leaf and pod spot Dark flecks on pods and leaves, and large brown leaf spots.	Headline 2.09F	6 - 9 fl oz	7	2 app	Do not make more than 1 application of Headline or Quadris before alternating with a fungicide with a different mode of action. *Apply no later than peak bloom.
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	
	Rovral 4F	1.5 - 2 pt	*	2 app	
Anthracnose Dark, sunken spots on pods and stems with pinkish ooze.	chlorothalonil 6L ³	1,375 - 3 pt	7	12 pt	Use Western-grown seed. If plants become infected, do not work in fields while plants are wet. Spray at 7- to 10-day intervals. Do not make more than 1 application of Headline or Quadris before alternating with a fungicide with a different mode of action.
	Headline 2.09F	6 - 9 fl oz	7	2 app	
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	
	Topsin M 70WP	1.5 - 2 lb	14	4 lb	
Bacterial blights Water-soaked spots on leaves and pods. Red margin and sometimes a yellow halo around spot.	fixed copper	See label	0	NL	Use Western-grown seed. If plants become infected, do not work in fields while plants are wet.
Gray mold (Botrytis) Gray moldy growth on pods and stems.	Endura 70WG	8 - 11 oz	7	2 app	Begin at 10 to 25% bloom. Repeat at peak bloom. *Apply no later than peak bloom.
	Rovral 4F or Iprodione 4F	1.5 - 2 pt	*	2 app	
	Topsin M 70WP	1.5 - 2 lb	14	4 lb	
	chlorothalonil 6L ³	3 pt	7	12 pt	
Mosaic viruses Yellowed leaves, with or without crinkling or speckling. Leaves cupped, runners killed.					Use resistant varieties. Half runners are most susceptible, particularly "Pink." Make successive plantings, as mosaic is more severe at certain times of the year.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
BEAN, SNAP (CONT'D)					
Powdery mildew White, powdery mold on surface of leaves.	sulfur	See label	0	NL	Use resistant varieties.
	Endura 70WG	8 - 11 oz	7	2 app	
	Headline 2.09F	6 - 9 fl oz	7	2 app	
Rusts Reddish-bronze pustules on leaves, stems and pods.	Nova 40W	4 - 5 oz	0	20 oz	Spray plants when rust first appears and repeat at 7- to 10-day intervals. Nova may be used at lower than labeled rates for rust control under EPA FIFRA Section 2(ee). Research has shown that 2.5 - 3 oz/A can provide good rust control. Under conditions of high disease pressure, 4 - 5 oz/A may be needed. Do not make more than 1 app. of Headline or Quadris before alternating with a fungicide with a different mode of action.
	chlorothalonil 6L ³	3 pt	7	12 pt	
	Endura 70WG	8 - 11 oz	7	2 app	
	Folicur 3.6F	4 - 6 fl oz	7	24 fl oz	
	Headline 2.09F	6 - 9 fl oz	7	2 app	
	Quadris 2.08F ³	6.2 fl oz	0	4 app	
Seedling disease Rots of seeds and death of seedlings (damping off) and root rots.	For Rhizoctonia and Pythium: Ridomil Gold PC 11G	0.75 lb/1000 row ft			Ridomil Gold PC and Terraclor are in-furrow applications. Quadris can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Rotate fields, avoid double-cropping beans and turn under plant debris well in advance of planting. See SP277-O.
	For Rhizoctonia only: Quadris 2.08F ³	0.4 - 0.8 fl oz/1000 row ft			
	Terraclor 10G	15 - 20 lb			
	Terraclor 75WP	2 lb in 10 gal water			
White mold (Sclerotinia) White moldy growth on pods and stems.	Endura 70WG	8 - 11 oz	7	2 app	Spray at 10 - 25% bloom; repeat at full bloom. Botran may be applied at 7-day intervals; use low rate for bush varieties, high rate for pole. *Apply no later than peak bloom.
	Rovral 4F or Iprodione 4F	1.5 - 2 pt	*	2 app	
	Topsin M 70WP	1 - 1.5 lb	14	4 lb	
	Botran 75WP	2.25 - 4 lb	2		
BEAN, DRY (Navy, Pinto, Kidney, Lima, Southern pea, etc.)					
Anthracnose Dark brown to brick-red spots on stems and pods.	chlorothalonil 6L ³	1.375 - 2 pt	14	8 pt	Begin applications during early bloom stage and repeat at 7- to 10-day intervals. Refer to Quadris, Quadris Opti and Headline labels for resistance management guidelines.
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	
	Quadris Opti 5.5SC	1.6 - 2.4 pt	14	4 app	
	Headline 2.09F	6 - 9 fl oz	21	2 app	
	Topsin M 70WP	1 - 2 lb	28	4 lb	
Gray mold (Botrytis) Gray, moldy growth on pods and stems.	Endura 70WG	8 - 11 oz	21	2 app	Begin applications during early bloom stage and repeat at 7- to 10-day intervals. *Apply no later than peak bloom.
	Rovral 4F or Iprodione 4F	1.5 - 2 pt	*	2 app	
	Topsin M 70WP	1 - 2 lb	28	4 lb	
Rust, bean Reddish-bronze pustules.	chlorothalonil 6L ³	1.375 - 2 pt	14	8 pt	Begin applications during early bloom stage and repeat at 7- to 10-day intervals. Refer to Quadris, Quadris Opti and Headline labels for resistance management guidelines.
	Endura 70WG	8 - 11 oz	21	2 app	
	Quadris 2.08F ³	6.2 - 15.2 fl oz	0	4 app	
	Quadris Opti 5.5SC	1.6 - 2.4 pt	14	4 app	
	Folicur 3.6F	4 - 6 fl oz	14	12 fl oz	
	Headline 2.09F	6 - 9 fl oz	21	2 app	
Rust, soybean Small, tan spots on leaves.	Nova 40W	4 - 5 oz	28	2 app	Section 18 quarantine exemption. Use only if soybean rust present in U.S. Expires June 30, 2009.
BEAN, LIMA					
Gray mold (Botrytis) Gray, moldy growth on pods and stems.	Endura 70WG	8 - 11 oz	7	2 app	Begin applications at early bloom stage. * Apply no later than peak bloom.
	Rovral 4F or Iprodione 4F	1.5 - 2 pt	*	2 app	
	Topsin M 70WG	1 - 2 lb	14	4 lb	

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
BEAN, LIMA (CONT'D)					
Stem anthracnose Reddish-brown spots on leaves, pods and stems.	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	Plant disease-free seed and rotate lima beans with other crops. Start applications of fungicide at first bloom and continue at 7- to 10- day intervals. Do not make more than 1 application of Quadris before alternating with a fungicide with a different mode of action.
	Topsin M 70WP	1 - 2 lb	14	4 lb	
Rust, soybean Small, tan spots on leaves.	Nova 40W	4 - 5 oz	28	2 app	Section 18 quarantine exemption. Use only if soybean rust present in U.S. Expires June 30, 2009.
Seedling disease Pythium	Ridomil Gold SL	0.5 - 1 pt/treated A	NA	1 app	Preplant incorporated. See label for band rates.
	MetaStar 2E AG	2 - 4 pt/treated acre	NA	1 app	
Seedling disease Rhizoctonia	Quadris 2.08F ³	0.4 - 0.8 fl oz/1000 row ft			Quadris can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Terraclor is an in-furrow application.
	Terraclor 75WP	2 lb in 10 gal water			
White mold (Sclerotinia) White moldy growth on pods and stems.	Endura 70WG	8 - 11 oz	7	2 app	Spray at 10 - 25% bloom; repeat at full bloom. * Apply no later than peak bloom.
	Rovral 4F or Iprodione 4F	1.5 - 2 pt	*	2 app	
	Topsin M 70WP	1 - 2 lb	14	4 lb	
BEET					
Rust Bronze pustules.	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	Spray at first appearance and repeat at 7- to 10-day intervals. See Quadris and Cabrio labels for resistance management guidelines. Folicur for Cercospora only. Use 14-day intervals for Folicur.
	sulfur	See label	0	NL	
Downy mildew, Leaf spots Various leaf spots.	fixed copper	See label	0	NL	Spray at first appearance and repeat at 7- to 10-day intervals. See Quadris and Cabrio labels for resistance management guidelines. Folicur for Cercospora only. Use 14-day intervals for Folicur.
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	
	Cabrio 20EG	8 - 12 oz	0	3 app	
Pythium and Phytophthora Damping off and root rot.	Folicur 3.6F	3 - 7.2 fl oz	7	28 fl oz	Apply only before planting (incorporated into top 2 inches of soil) or at planting on surface. May be broadcast or banded.
	Ridomil Gold SL	1 - 2 pt/treated acre	NA	1 app	
	MetaStar 2E AG	4 - 8 pt/treated acre	NA	1 app	
	Ultra Flourish	2 - 4 pt/treated acre	NA	1 app	
BROCCOLI, BRUSSELS SPROUTS, CABBAGE, CAULIFLOWER					
Alternarial leaf spot Target spots on older leaves. Small, black spots may also occur.	Endura 70WG	6 - 9 oz	0	2 app	Apply on 7- to 14-day intervals until disease is under control. Refer to product labels for resistance management guidelines for Endura, Cabrio, Quadris and Switch.
	maneb 80WP ³	1.5 - 2 lb	7	12 lb	
	Ridomil Gold Bravo SC	1.5 pt	7	4 app	
	Cabrio 20EG	12 - 16 oz	0	4 app	
	chlorothalonil 6L ³	1.5 pt	0	16 pt	
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	
Downy mildew Yellow leaf spots with gray flecks.	Switch 62.5EG	11 - 14 oz	7	56 oz	Actigard must be used preventively and repeated at 7-day intervals. Other materials: 7- to 10-day intervals until disease is under control. Do not make more than 1 application of Quadris or Reason or 2 consecutive apps. of Cabrio, Presidio or Revus before alternating with a fungicide with a different mode of action. Use adjuvant with Revus.
	Ridomil Gold Bravo SC	1.5 pt	7	4 app	
	Cabrio 20EG	12 - 16 oz	0	4 app	
	chlorothalonil 6L ³	1.5 pt	0	16 pt	
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	
	Actigard 50WG	1 oz	7	4 oz	
	Aliette 80WG	2 - 5 lb	3	7 app	
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	Reason 4.13 SC	5.5 - 8.2 fl oz	2	24.6 fl oz	
	Revus 2.08SC	8 fl oz	1	4 app	
Black leg Lower stem turns brown and rots causing a canker.	Rovral 4F or Iprodione 4F (Broccoli only)	2 pt	0	2 app	Use certified disease-free seeds or transplants. Direct spray to base of plant and adjacent soil surface.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
BROCCOLI, BRUSSELS SPROUTS, CABBAGE, CAULIFLOWER (CONT'D)					
Black rot Yellow to brown, V-shaped spots on edge of leaves.	Actigard 50WG	1 oz	7	4 oz	Suppression only. Apply at 7-day intervals, beginning 7-10 days after thinning or transplanting. Use certified disease-free seeds or transplants. Use tolerant varieties of cabbage. Avoid infested fields. See Extension publication SP277-P.
Bacterial soft rot Dark, soft rot. Favored by hot, wet conditions. Begins in center of broccoli head.					Control of black rot will also help control bacterial soft rot. Avoid damage to the crop, which will provide infection sites for soft rot bacteria.
Rhizoctonia damping off and wire stem Seedlings die; young plants stunted; stem hard and constricted.	<u>transplant seedbed</u> Terraclor 75WP	1 level TBSP/gal water/50 sq ft			Sterilize seedbed soil. Apply Terraclor drench after seeding.
	<u>field</u> Quadris 2.08F ³	0.4 - 0.8 fl oz/1000 row ft			Quadris can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence.
	Terraclor 75WP	10 - 15 lb/10,900 row ft			Terraclor sprayed as 8-inch band over the row.
Pythium damping off Dark rot of roots and stem	Ridomil Gold SL	0.25 - 0.5 pt	NA	1 app	Apply only before planting, incorporated into top 2 inches of soil. May be broadcast or banded.
	MetaStar 2E AG	1 - 2 pt	NA	1 app	
	Ultra Flourish	0.5 - 1 pt	NA	1 app	
Club root Galls or clubs on roots. Plants are pale and stunted.	Hydrated lime	1500 lb			Broadcast and work lime into soil by disking within 3 days before planting. Then apply 1/2 pint of Terraclor solution per plant as transplant solution.
	Terraclor 75WP	2 lb/100 gal (transplant solution)			
Powdery mildew White, powdery growth on leaves.	Endura 70WG	6 - 9 oz	0	2 app	Apply when disease first appears; continue at 7- to 14-day intervals. See product labels for resistance management guidelines.
	Switch 62.5WG	11 - 14 oz	7	56 oz	
	Cabrio 20EG	12 - 16 oz	0	4 app	
Rhizoctonia bottom rot Rot begins at lower part of head.	Endura 70WG	6 - 9 oz	0	2 app	Begin applications prior to disease development. Repeat 7 - 14 days later.
White mold (Sclerotinia) Soft, wet rot and white fungal growth on head.					
CANTALOUPE (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)					
Bacterial wilt Individual runners suddenly wilt and die.					Apply insecticide to control cucumber beetles, which spread the bacterium. See SP277-C and insect control section of this publication.
Alternaria leaf spot Tan target spots on leaves, followed by blighting.	Cabrio 20EG	12 - 16 oz	0	4 app	Begin applications prior to disease onset. Repeat every 7 - 10 days. Do not make consecutive applications of Cabrio, Pristine, Quadris or Quadris Opti; these products should be alternated with non-Group 11 fungicides. See Cabrio, Quadris and Quadris Opti labels for restrictions on tank mix partners. Sovran not for alternaria, anthracnose or downy mildew.
	chlorothalonil 6L ³	1.5 - 3 pt	0	21 pt	
	mancozeb 80WP ³	2 - 3 lb	5	25.6 lb	
maneb 80WP ³	1.5 - 2 lb	5	16 lb		
Anthracnose Sunken spots on fruit and tan leaf spots.	Pristine 38WG	12.5 - 18.5 oz	0	4 app	
	Quadris 2.08F ³	11 - 15.4 fl oz	1	4 app	
Downy mildew Large, yellow spots that turn necrotic.	Quadris Opti 5.5SC	3.2 pt	1	4 app	
	Ridomil Gold Bravo SC	2.5 - 3.25 pt	0	4 app	
	Ridomil Gold MZ	2.5 lb	5	4 app	
	Sovran 50WG	4.8 oz	0	4 app	
Gummy stem blight Brown, round leaf spots. Cracks on stems with gummy ooze.					

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
CANTALOUPE (CONT'D) (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)					
Downy mildew Large, yellow spots that turn necrotic.	above products, or dimethomorph:				Begin applications prior to infection, 7- to 10-day spray schedule. Most of these products require alternation with downy mildew fungicides with a different mode of action or tank mix with a protectant fungicide such as chlorothalonil, mancozeb or maneb. See label. Some varieties are sensitive to Gavel; see label.
	Acrobat 50WP	6.4 oz	0	5 app	
	Forum 4.18F	6 fl oz	0	5 app	
	Curzate 60DF	3.2 - 5 oz	3	30 oz	
	Gavel 75DF	1.5 - 2 lb	5	8 app	
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	Previcur Flex 6F	1.2 pt	2	6 pt	
	Reason 4.13F	5.5 fl oz	14	4 app	
	Ranman 3.33SC	2.1 - 2.75 fl oz	0	6 app	
	Revus 2.08SC	8 fl oz	0	4 app	
Tanos 50WG	8 oz	3	4 app		
Phytophthora blight Rot of fruit covered with thin, white mold.	dimethomorph:				Dimethomorph, Presidio, Ranman and Revus must be tank mixed with and alternated with non-related fungicides (Appendix 1). Phosphorus acid products: Apply preventively on 7- to 14-day schedule, beginning after plants become established. See product labels. Exception for Fosphite: Apply at 2 - 4 week intervals (see label). Although not labeled for Phytophthora blight, copper fungicides have been shown to be helpful in suppressing this disease.
	Acrobat 50WP	6.4 oz	0	5 app	
	Forum 4.18F	6 fl oz	0	5 app	
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	Ranman 3.33SC	2.1 - 2.75 fl oz	0	6 app	
	Revus 2.08SC	8 fl oz	0	4 app	
	phosphorous acid:				
	Agri-Fos	1.25 qt/A	0	6 app	
	Fosphite	1 - 3 qt	0	NL	
	ProPhyt	1 - 3 qt	0	NL	
Phostrol	2.5 - 5 pt	0	7 app		
Powdery mildew White, powdery mold on surface of leaves.	chlorothalonil 6L ³	2 - 3 pt	0	21 pt	For varieties susceptible to powdery mildew: Apply chlorothalonil on a preventive, 7- to 10-day schedule. Add one of the other listed products if needed for extra powdery mildew control. Do not apply sulfur if temperatures exceed 90 F. Thorough coverage is critical for chlorothalonil and sulfur. Pristine and Quintec must be rotated with fungicides with different modes of action. See Procure label for plantback restrictions. Resistance to the strobilurins (Cabrio, Quadris, Sovran and Flint) is widespread in cucurbit powdery mildew in Tennessee.
	sulfur	See label	0	NL	
	Folicur 3.6F	4 - 6 fl oz	7	24 fl oz	
	Nova 40W	2.5 - 5 oz	0	24 oz	
	Procure 50WP	4 - 8 oz	0	40 oz	
	Pristine 38WG	12.5 - 18.5 oz	0	4 app	
	Quadris Opti 5.5SC	3.2 pt	1	4 app	
	Quintec 2.08F	4 - 6 fl oz	3	4 app	
Seedling disease Failure of seedlings to emerge or death after emergence.	Quadris 2.08F ³	0.4 - 0.8 fl oz/1000 row ft			Can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Use the higher rates where disease pressure is high.
	CARROT				
Alternaria blight Numerous dark brown spots which may coalesce.	Cabrio 20EG	8 - 12 oz	0	3 app	Spray at first appearance and repeat at 7 - 10 day intervals. Alternaria blight can spread rapidly. Refer to Quadris, Quadris Opti, Cabrio, Endura, Pristine and Switch labels for resistance management guidelines.
	chlorothalonil 6L ³	1.5 - 2 pt	0	20 pt	
	Endura 70WG	8 - 11 oz	0	5 app	
	Pristine 38WG	8 - 10.5 oz	0	6 app	
	Rovral 4F or Iprodione 4F	1 - 2 pt	0	4 app	
	Quadris 2.08F ³	9.2 - 15.4 fl oz	0	4 app	
	Quadris Opti 5.5SC	2.4 pt	0	6 app	
	Switch 62.5WG	11 - 14 oz	7	56 oz	
Cercospora leaf spot Small, dark brown to black spots on leaves.	Cabrio 20EG	8 - 12 oz	0	3 app	Spray at first appearance and repeat at 7 - 10 day intervals. Alternaria blight can spread rapidly. Refer to Quadris, Quadris Opti, Cabrio, Endura, Pristine and Switch labels for resistance management guidelines.
	chlorothalonil 6L ³	1.5 - 2 pt	0	20 pt	
	Pristine 38WG	8 - 10.5 oz	0	6 app	
	Quadris 2.08F ³	9.2 - 15.4 fl oz	0	4 app	
	Quadris Opti 5.5SC	2.4 pt	0	6 app	

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
CARROT (CONT'D)					
Southern blight White fungal growth on lower stem.	SMDC Telone C17 Telone C35	See Table 3			
CAULIFLOWER (SEE BROCCOLI)					
COLLARD, MUSTARD					
Alternaria leaf spot Dark brown leaf spots.	Endura 70WG Switch 62.5WG fixed copper Folicur 3.6F maneb 80WP ³	6 - 9 oz 11 - 14 oz See label 3 - 4 fl oz 1.5 lb	14 7 0 7 14	2 app 56 oz NL 16 fl oz 4.5 lb/3 lb	Begin applications prior to disease onset and follow 7- to 10-day schedule during rainy weather. Maintain thin plant stand and avoid low-lying or poorly drained soils. Maneb: Apply on 14-day intervals; no more than 4.5 lb per cutting on collard, 3 lb per cutting on mustard. See Quadris, Endura and Switch labels for resistance mgmnt. guidelines. Endura and Switch not for Cercospora.
Cercospora leaf spot Tan leaf spots with yellow haloes.	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	3 app	
Downy mildew Yellow leaf spots with white to gray mold on underside.	Aliette 80WDG Actigard 50WG dimethomorph: Acrobat 50W Forum 4.18F Reason 4.13 SC Ridomil Gold SL fixed copper maneb 80WP ³ Quadris 2.08F ³ Revus 2.08SC	3 - 5 lb 1 oz 6.4 oz 6 fl oz 5.5 - 8.2 fl oz 0.125 - 0.25 pt See label 1.5 lb 6.2 - 15.4 fl oz 8 fl oz	3 7 0 0 2 7 0 14 0 1	7 app 4 oz 5 app 5 app 24.6 fl oz 4 app NL 4.5 lb/3 lb 3 app 4 app	Actigard must be used preventively and repeated at 7-day intervals. Other materials: 7- to 10-day (14, for Ridomil) intervals until disease is under control. Do not make more than 1 app. of Quadris or Reason or 2 apps. of dimethomorph before alternating with a fungicide with a different mode of action. Dimethomorph and Ridomil must be tank mixed with a fungicide with a different mode of action. Use adjuvant with Revus. Do not tank mix Aliette with copper fungicides.
Powdery mildew White, powdery growth on leaves.	Endura 70WG Switch 62.5WG Folicur 3.6F sulfur	6 - 9 oz 11 - 14 oz 3 - 4 fl oz See label	0 7 7 0	2 app 56 oz 16 fl oz NL	Apply when disease first appears; continue at 7- to 14-day intervals if needed. See Endura and Switch labels for resistance management guidelines.
Rhizoctonia bottom rot Firm rot of stem.	Endura 70WG	6 - 9 oz	0	2 app	Begin applications prior to disease development and repeat 7 to 14 days later.
Sclerotinia stem rot Soft rot of stem with white mold.					
CORN, SWEET					
Blights Spots on leaves and drying or blighting of leaves.	chlorothalonil 6L ^{3*} maneb 80WP ³ mancozeb 80WP ³ propiconazole 3.6EC	0.75 - 2 pt 1.5 lb 1.5 lb	14 7 7	12 pt 22.5 lb 22.5 lb	Begin applications when conditions favor disease development and repeat at 7- to 10-day intervals. Quilt, Tilt and Propimax applied on 7- to 14-day schedule. Do not feed forage to livestock within 14 days of application of Tilt, Propimax or Stratego. Sweet corn treated with other listed products cannot be used as livestock forage. See Quilt, Quadris, Stratego or Headline label for resistance management guidelines. *Chlorothalonil for fresh market only.
Rusts Bronze, elongate spots.	Tilt Propimax Bumper Headline 2.09F Quadris 2.08F ³ Quilt 1.66SC Stratego 2.08SC	2 - 4 fl oz 2 - 4 fl oz 2 - 4 fl oz 6 - 12 fl oz 6.2 - 9.2 fl oz (rust), 9.2 - 15.4 fl oz (blights) 10.5 - 14 fl oz 10 fl oz	14 14 14 7 7 7 14 14	16 fl oz 16 fl oz 16 fl oz 6 app 6 app 56 fl oz 30 fl oz	
Maize dwarf mosaic Plants stunted, leaves reddened or yellowed.					Plant early and avoid fields heavily infested with johnsongrass. Plant tolerant varieties if johnsongrass is present.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)		
CORN, SWEET (CONT'D)							
Stewart's wilt Brown streaks in leaves parallel to veins.					Control corn flea beetle. See insect control section of this publication.		
CUCUMBER, FIELD (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)							
Angular leaf spot Brown, angular spots that usually fall out.	fixed copper	See label	0	NL	Spray at first appearance and repeat at 7 - 14 day intervals. Copper can injure young plants. Plant resistant varieties.		
Bacterial wilt Individual runners wilt; later, entire plant wilts and dies.					Apply insecticide to control cucumber beetles, which spread the disease. See insect control section of this publication.		
Belly rot Soft, sunken rot on side of fruit in contact with soil.	chlorothalonil 6L ³	2 pt	0	21 pt	Applied to foliage every 7 to 10 days, beginning at vine tip-over.		
	plus Topsin M 70WP	0.5 lb	0				
	Quadris 2.08F ³	11 - 15.4 fl oz	1	4 app			
Alternaria leaf spot Tan target spots on leaves, followed by blighting.	Cabrio 20EG	12 - 16 oz	0	4 app	Begin applications prior to disease onset. Repeat every 7 - 10 days. Do not make consecutive applications of Cabrio, Pristine, Quadris or Quadris Opti; these products should be alternated with non-Group 11 fungicides. See Cabrio, Quadris and Quadris Opti labels for restrictions on tank mix partners. Sovran not for alternaria, anthracnose or downy mildew.		
	chlorothalonil 6L ³	1.5 - 3 pt	0	21 pt			
	mancozeb 80WP ³	2 - 3 lb	5	25.6 lb			
	maneb 80WP ³	1.5 - 2 lb	5	16 lb			
Anthracnose Sunken spots on fruit and tan leaf spots.	Pristine 38WG	12.5 - 18.5 oz	0	4 app			
	Quadris 2.08F ³	11 - 15.4 fl oz	1	4 app			
	Quadris Opti 5.5SC	3.2 pt	1	4 app			
Downy mildew Large, yellow spots that turn necrotic.	Ridomil Gold Bravo SC	2.25 - 3.5 pt	0	4 app			
	Ridomil Gold MZ	2.5 lb	5	4 app			
	Sovran 50WG	4.8 oz	0	4 app			
Gummy stem blight Brown, round leaf spots. Cracks on stems with gummy ooze.							
Downy mildew Large, yellow spots that turn necrotic.	above products, or dimethomorph:				Begin applications prior to infection, 7- to 10-day spray schedule. Most of these products require alternation with downy mildew fungicides with a different mode of action or tank mix with a protectant fungicide such as chlorothalonil, mancozeb or maneb. See label.		
	Acrobat 50WP	6.4 oz	0	5 app			
	Forum 4.18F	6 fl oz	0	5 app			
	Curzate 60DF	3.2 - 5 oz	3	30 oz			
	Gavel 75DF	1.5 - 2 lb	5	8 app			
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz			
	Previcur Flex 6F	1.2 pt	2	6 pt			
	Reason 4.13F	5.5 fl oz	14	4 app			
	Ranman 3.33SC	2.1 - 2.75 fl oz	0	6 app			
	Revus 2.08SC	8 fl oz	0	4 app			
	Tanos 50WG	8 oz	3	4 app			
	Phytophthora blight Rot of fruit covered with thin, white mold.	dimethomorph:					Dimethomorph, Presidio, Ranman and Revus must be tank mixed with and alternated with non-related fungicides (Appendix 1). Phosphorus acid products: Apply preventively on 7- to 14-day schedule, beginning after plants become established. See product labels. Exception for Fosphite: Apply at 2 - 4 week intervals (see label). Although not labeled for Phytophthora blight, copper fungicides have been shown to be helpful in suppressing this disease.
		Acrobat 50WP	6.4 oz	0		5 app	
Forum 4.18F		6 fl oz	0	5 app			
Presidio 4SC		3 - 4 fl oz	2	12 fl oz			
Ranman 3.33SC		2.1 - 2.75 fl oz	0	6 app			
Revus 2.08SC		8 fl oz	0	4 app			
phosphorous acid:							
Agri-Fos		1.25 qt/A	0	6 app			
Fosphite		1 - 3 qt	0	NL			
ProPhyt		1 - 3 qt	0	NL			
Phostrol	2.5 - 5 pt	0	7 app				

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
CUCUMBER, FIELD (CONT'D) (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)					
Powdery mildew White, powdery mold on surface of leaves.	chlorothalonil 6L ³	2 - 3 pt	0	21 pt	For varieties susceptible to powdery mildew: Apply chlorothalonil on a preventive, 7- to 10-day schedule. Add sulfur, Nova, Procure or Pristine if needed for extra powdery mildew control. Do not apply sulfur if temperatures exceed 90 F. Thorough coverage is critical for chlorothalonil and sulfur. Pristine must be rotated with fungicides with different modes of action. See Procure label for plantback restrictions. Resistance to the strobilurins (Cabrio, Quadris, Sovran and Flint) is widespread in cucurbit powdery mildew in Tennessee.
	sulfur	See label	0	NL	
	Folicur 3.6F	4 - 6 fl oz	7	24 fl oz	
	Nova 40W	2.5 - 5 oz	0	24 oz	
	Procure 50WP	4 - 8 oz	0	40 oz	
	Pristine 38WG	12.5 - 18.5 oz	0	4 app	
Quadris Opti 5.5SC	3.2 pt	1	4 app		
Scab Sunken spots on fruit.	chlorothalonil 6L ³	2 - 3 pt	0	21 pt	Resistant varieties widely available.
	Ridomil Gold/Bravo	2 - 3 lb	0	4 app	
Seedling disease Failure of seedlings to emerge or death after emergence.	Quadris 2.08F ³	0.4 - 0.8 fl oz/1000 row ft			Can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Use the higher rates where disease pressure is high.
CUCUMBER, GREENHOUSE					
Angular leaf spot, downy mildew, powdery mildew	Kocide DF	1.5 - 2 Tbsp/1000 sq ft	0	NL	Apply weekly, beginning when plants begin to vine.
	Kocide 2000	1.25 - 1.5 Tbsp/1000 sq ft	0	NL	
Anthraxnose, Cercospora leaf spot, downy mildew, gummy stem blight, scab	mancozeb 80WP ³	1.5 - 2 lb/100 gal	5	25.6 lb	Spray at first appearance of disease, repeat at weekly intervals.
Powdery mildew	Armcarb 85WP	2.5 - 5 lb/100 gal	0	NL	Spray at 1 st sign of mildew and repeat at 5-14 day intervals. NOTE: Although other diseases are on the label, Armcarb has not been shown to control them satisfactorily.
	Microthiol Disperss	2 lb/43,560 sq ft	0	NL	Spray at 1 st sign of disease and repeat as needed. Do not apply if temps will exceed 90F within the 3 days following spraying.
Pythium root rot	Previcur Flex	see label		6 app	Applied as a root drench. See label for use directions.
Sclerotinia white mold	Botran 75WP	1.33 lb/100 gal	1	NL	May be applied every 14 days.
	Contans WG	0.75 - 1.5 oz/1000 sq ft	NA	NL	Biological. Apply to soil about 3 months prior to planting. Till 2 - 8 inches deep.
EGGPLANT					
Leaf blights, fruit rots Various spots on leaves and fruits.	Cabrio 20EG	8 - 12 oz	0	6 app	Begin spraying at first fruit cluster and repeat at 7-10 day intervals. See Quadris and Cabrio labels for resistance management guidelines.
	fixed copper	See label	0	NL	
	maneb 80WP ³	1.5 - 2 lb	5	14 lb	
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)	
EGGPLANT (CONT'D)						
Phytophthora blight - crown and root phase Rapid wilt and death of plants in wet areas of field.	Ridomil Gold EC	1 pt/treated acre	7	3 app	Plant on raised beds, improve field drainage, and do not plant wet areas. Crown and root phase is caused by root infections. Fruit phase is caused by air-borne spores. Ridomil Gold and Ultra Flourish are soil-applied at planting and up to 2 supplemental applications at 30-day intervals.	
	Ultra Flourish	2 pt/treated acre	7	3 app		
	phosphorous acid: Fosphite	Pre-plant root dip: 2 qt/100 gal Drip irrig.: 2-3 qt in at least 100 gal	0	NL		
Phytophthora blight - fruit phase Liver-colored rot of fruit.	dimethomorph: Acrobat 50WP	6.4 oz	0	5 app		Dimethomorph and Presidio are foliar-applied every 7-10 days as a tank mix with and alternated with other effective products. Agri-Fos is foliar-applied every 21 days; Fosphite, every 2 - 4 weeks (see label). Although not labeled for Phytophthora blight, copper sprays have been shown to be helpful in suppressing this disease.
	Forum 4.18F	6 fl oz	0	5 app		
	maneb 80WP ³	2 - 3 lb	7	18 lb		
	phosphorous acid: Agri-Fos	1.25 qt	0	6 app		
	Fosphite	1-3 qt	0	NL		
Presidio 4SC	3 - 4 fl oz	2	12 fl oz			
GINSENG						
Phytophthora root rot and leaf blight Wilt, soft rot of root, wet blight of leaves.	Aliette 80WDG	5 lb	31	9 app	Begin Aliette in spring, continue at 7-day intervals. Mix in at least 100 gal water/A. Apply Ridomil Gold EC or MetaStar in 100-400 gal water to soil surface in spring before plants begin growing.	
	Ridomil Gold EC	0.75 pt	NA	1 app		
	Ridomil Gold GR	15 lb	9	60 lb		
	MetaStar 2E AG	1.5 qt	NA	1 app		
Alternaria leaf spot Tan leaf spots.	Rovral 4F	2 pt/100 gal	36	5 app	Spray first appearance; alternate Rovral with Quadris or Cabrio. See Quadris and Cabrio labels for resistance management guidelines.	
	Quadris 2.08F ³	6.2 - 1.3 fl oz	0	4 app		
	Cabrio 20EG	8 - 12 oz	0	3 app		
Seedling disease Failure of seedlings to emerge or death after emergence.	Quadris 2.08F ³	0.4 - 0.8 fl oz/1000 row ft			Can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Use the higher rates where disease pressure is high.	
KALE						
Alternaria leaf spot Dark brown leaf spots.	Endura 70WG	6 - 9 oz	0	2 app	Begin applications prior to disease onset and follow 7- to 10-day schedule during rainy weather. Maintain thin plant stand and avoid low-lying or poorly drained soils. Maneb: Apply on 14-day intervals; no more than 4 per cutting. See Quadris, Endura and Switch labels for resistance management guidelines. Endura and Switch not for Cercospora.	
	fixed copper	See label	0	NL		
	Folicur 3.6F	3 - 4 fl oz	7	16 fl oz		
	Switch 62.5WG	11 - 14 oz	7	56 oz		
	maneb 80WP ³	1.5 - 2 lb	10	4 lb		
Cercospora leaf spot Tan leaf spots with yellow haloes.	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	3 app		
Downy mildew Yellow leaf spots with white to gray mold on underside.	Aliette 80WDG	3 - 5 lb	3	7 app	Actigard must be used preventively and repeated at 7-day intervals. Other materials: 7- to 10-day (14, for Ridomil) intervals until disease is under control. Do not make more than 1 app. of Quadris or Reason or 2 apps. of dimethomorph before alternating with a fungicide with a different mode of action. Dimethomorph and Ridomil must be tank mixed with a fungicide with a different mode of action. Do not tank mix Aliette with copper fungicides. Use adjuvant with Revus.	
	Actigard 50WG	1 oz	7	4 oz		
	dimethomorph: Acrobat 50W	6.4 oz	0	5 app		
	Forum 4.18F	6 fl oz	0	5 app		
	fixed copper	See label	0	NL		
	Reason 4.13 SC	5.5 - 8.2 fl oz	2	24.6 fl oz		
	maneb 80WP ³	1.5 lb	14	4.5 lb/3 lb		
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	3 app		
	Revus 2.08SC	8 fl oz	1	4 app		
	Ridomil Gold SL	0.125 - 0.25 pt	7	4 app		
Powdery mildew White, powdery growth on leaves.	Endura 70WG	6 - 9 oz	0	2 app	Apply when disease first appears; continue at 7- to 14-day intervals. See Endura and Switch labels for resistance management guidelines.	
	Folicur 3.6F	3 - 4 fl oz	7	16 fl oz		
	Switch 62.5WG	11 - 14 oz	7	56 oz		
	sulfur	See label	0	NL		

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
LETTUCE, FIELD					
Bottom rot (Rhizoctonia) Wet, brown rot begins on lower leaves and progresses into head.	Quadris 2.08F ³	6.2 - 15.4 fl oz	7	4 app	Do not disturb soil after spraying. Direct nozzles to cover lower part of plants and surrounding soil surface. Do not make more than 1 application of Quadris before alternating with a fungicide with a different mode of action.
	Rovral 4F or Iprodione 4F	1.5 - 2 pt	14	3 app	
Botrytis rot Gray, fuzzy mold.	Use above products or				Make up to 2 applications – 1 immediately after emergence or transplanting. Make a second if conditions continue to favor disease or if soil surface is disturbed by cultivation. Botran rate depends on timing.
	Botran 75WP	2 - 5.3 lb	14	5.3 lb	
	Endura 70WG	8 - 11 oz	14	2 app	
Drop (Sclerotinia) Wet rot of head with white, cottony mold.					
Downy mildew Yellow spots, turning necrotic.	dimethomorph:				Tank mix and alternate with fungicide from a different resistance management group. Max. of 2 consecutive applications.
	Acrobat 50W	6.4 oz	0	5 app	
	Forum 4.18F	6 fl oz	0	5 app	
	Curzate 60DF	3.2 - 5 oz	3	30 oz	Must tank mix with a protectant fungicide such as maneb.
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	Tank mix and alternate with fungicide from a different resistance management group.
	Previcur Flex 6F	2 pt	2	8 pt	Tank mix and alternate with fungicide from a different resistance management group.
	Reason 4.13 F	5.5 - 8.2 fl oz	2	4 app	Alternate with fungicide from a different resistance management group.
	maneb 80WP	1.5 - 2 lb	10	12 lb	Spray on 7- to 10-day intervals. Remove residues from head lettuce by trimming.
	Quadris 2.08F	15.4 fl oz	7	4 app	Max. of 2 consecutive applications before rotating to a fungicide with a different mode of action.
	Revus 2.08SC	8 fl oz	1	4 app	Max. of 2 consecutive applications before rotating to a fungicide with a different mode of action. Use with an adjuvant.
Pythium root rot	Ridomil Gold 4EC	1 - 2 pt/treated acre	NA	1 app	Apply preplant incorporated or surface application at planting.
	Ultra Flourish 2EC	2 - 4 pt/treated acre	NA	1 app	
	MetaStar 2E AG	4 - 8 pt/treated acre	NA	1 app	
LETTUCE, GREENHOUSE					
Leaf spots, downy mildew	maneb 80WP ³	1.5 - 2 lb/100 gal	10	6 app	Spray on 7- to 10-day intervals. Remove residues from head lettuce by trimming.
Botrytis	Botran 75WP (leaf lettuce only)	2.6 lb/43,560 sq ft	14	2 app	Spray 7 days after transplanting and when half mature. Do not make more than 2 consecutive applications of Decree.
	Decree 50WDG	1.5 lb/43,560 sq ft	3	3 lb	
Sclerotinia drop	Contans WG	0.75 - 1.5 oz/1000 sq ft	NA	NL	Biological. Apply to soil about 3 months prior to planting. Till 2 - 8 inches deep. Botran as used for control of Botrytis should provide some control of Sclerotinia.
Pythium root rot	Previcur Flex 6F (leaf lettuce only)	see label	2	6 app	See label for information on timing of applications.
MUSTARD (SEE COLLARD)					

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
OKRA					
Pod blight Young pods fail to develop and deteriorate.					Often associated with poor pollination, but the fungus <i>Choanephora</i> also attacks the flowers & young pods. Remove several upper leaves to improve sunlight penetration and air circulation.
Powdery mildew, leaf spots	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	Not often a problem. See label for resistance management guidelines.
	Folicur 3.6F	4 - 6 fl oz	3	24 fl oz	
Seedling disease Poor stand.	Apron XL LS (seed treatment)	0.32 - 0.64 fl oz/cwt			Use thiram-treated seed. Plant in warm soil. Quadris can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence.
	Quadris 2.08F ³	0.4 - 0.8 fl oz/1000 row ft			
Verticillium wilt Yellowing of leaves. Brown discoloration inside stem.	SMDC	See nematode section			Rotate with non-solanaceous crops.
ONION, GREEN					
Downy mildew Pale green, oval, sunken spots on leaves. Purplish mold in spots.	Cabrio 20EG	12 oz	7	6 app	Apply when conditions become favorable for disease and repeat at 7- to 10-day intervals; Pristine: 14-day intervals. Quadris, Quadris Opti, Cabrio, and Pristine, and Reason should be rotated with non-Group 11 fungicides after each application. Dimethomorph, Switch, Presidio, Revus and Scala should be rotated with fungicides from a different resistance management group after the 2 nd consecutive application. See resistance management sections of labels. Dimethomorph and Presidio must be tank mixed with non-related fungicides. See labels for plantback restrictions. Use silicone surfactant with Revus. Presidio not for purple blotch. * The 9 fl oz rate is for tank mixes; use the 18 fl oz rate when not mixed with another fungicide.
	chlorothalonil 6L ³	1.5 - 3 pt	14	3 app	
	Acrobat 50WP	6.4 oz	0	5 app	
	Forum 4.18F	6 fl oz	0	5 app	
	maneb 80WP ³	2 - 3 lb	7	13.5 lb	
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	Ridomil Gold Bravo SC	2.5 pt	14	2 app	
	Quadris 2.08F ³	9.2 - 15.4 fl oz	0	3 app	
	Quadris Opti 5.5SC	2.4 - 3.7 pt	14	3 app	
	Reason 4.13F	5.5 fl oz	7	4 app	
Revus 2.08SC	8 fl oz	7	3 app		
Leaf blight (Botrytis) White spots on leaves followed by dieback.	chlorothalonil 6L ³	1.5 - 3 pt	14	3 app	
	Endura 70WG	6.8 oz	7	6 app	
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	Pristine 38WG	14.5 - 18.5 oz	7	6 app	
	Ridomil Gold Bravo SC	2.5 pt	14	2 app	
	Scala 5SC	9 - 18 fl oz*	7	54 fl oz	
Purple blotch (Alternaria) Purple target spots on leaves.	Same as for Botrytis, or	Same as for Botrytis			
	Cabrio 20EG	12 oz	7	6 app	
	Folicur 3.6F	4 - 6 fl oz	7	12 fl oz	
	maneb 80WP ³	2 - 3 lb	7	13.5 lb	
	Quadris 2.08F ³	6.2 - 12.3 fl oz	0	3 app	
	Quadris Opti 5.5SC	1.6 - 3.2 pt	14	3 app	
	Reason 4.13F	5.5 fl oz	7	4 app	

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
ONION, DRY					
Downy mildew Pale green, oval, sunken spots on leaves. Purplish mold in spots.	Aliette 80WDG	2 - 3 lb	7	7 app	Apply when conditions become favorable for disease and repeat at 7- to 10-day intervals. Rovral applied at 14-day intervals. Do not apply maneb or mancozeb to exposed bulbs. Do not tank mix Aliette with copper materials. See labels for plantback restrictions. See resistance management sections of labels. Dimethomorph and Presidio must be tank-mixed with non-related fungicides. Use silicone surfactant with Revus. Scala: 9 fl oz rate for tank mixes; 18 fl oz rate when used alone.
	Cabrio 20EG	12 oz	7	6 app	
	chlorothalonil 6L ³	1.5 - 3 pt	14	3 app	
	dimethomorph:				
	Acrobat 50WP	6.4 oz	0	5 app	
	Forum 4.18F	6 fl oz	0	5 app	
	maneb 80WP ³	2 - 3 lb	7	13.5 lb	
	mancozeb 80WP ³	3 lb	7	32 lb	
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	Ridomil Gold Bravo SC	2.5 pt	7	4 app	
	Quadris 2.08F ³	9.2 - 15.4 fl oz	0	3 app	
	Quadris Opti 5.5SC	2.4 - 3.7 pt	14	3 app	
Reason 4.13F	5.5 fl oz	7	4 app		
Revus 2.08SC	8 fl oz	7	4 app		
Leaf blight (Botrytis) White spots on leaves followed by dieback.	chlorothalonil 6L ³	1.5 - 3 pt	7	20 pt	Apply when conditions become favorable for disease and repeat at 7- to 10-day intervals. Rovral applied at 14-day intervals. Do not apply maneb or mancozeb to exposed bulbs. Do not tank mix Aliette with copper materials. See labels for plantback restrictions. See resistance management sections of labels. Dimethomorph and Presidio must be tank-mixed with non-related fungicides. Scala: 9 fl oz rate for tank mixes; 18 fl oz rate when used alone.
	Endura 70WG	6.8 oz	7	6 app	
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	Pristine 38WG	14.5 - 18.5 oz	7	6 app	
	Ridomil Gold Bravo SC	2.5 pt	7	4 app	
	Quadris Opti 5.5SC	1.6 - 3.2 pt	7	3 app	
	Scala 5SC	9 - 18 fl oz	7	54 fl oz	
	Switch 62.5WG	11 - 14 oz	7	56 oz	
Purple blotch (Alternaria) Purple target spots on leaves.	Same as for Botrytis, or	Same as for Botrytis			
	Cabrio 20EG	12 oz	7	6 app	
	Folicur 3.6F	4 - 6 fl oz	7	12 fl oz	
	maneb 80WP ³	2 - 3 lb	7	30 lb	
	mancozeb 80WP ³	3 lb	7	32 lb	
	Quadris 2.08F ³	6 - 12 fl oz	0	3 app	
	Reason 4.13F	5.5 fl oz	7	4 app	
	Rovral 4F or Iprodione 4F	1.5 pt	7	5 app	
PEA, ENGLISH					
Ascochyta blight Lesions on stems, pods, and leaves.	Headline 2.09F	6 - 9 fl oz	7	2 app	Do not make more than 1 application before rotating to a non-Group 11 fungicide.
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	
Powdery mildew White, powdery mold on surface of leaves.	Headline 2.09F	6 - 9 fl oz	7	2 app	Spray at first appearance and repeat every 7 to 10 days if needed. Do not spray sulfur on hot days or when plants are wet. Headline must be rotated.
	sulfur	See label	0		
Seedling disease Pythium	Ridomil Gold SL	0.5 - 1 pt/treated A	NA	1 app	Preplant incorporated. See label for band rates.
	MetaStar 2E AG	2 - 4 pt/treated acre	NA	1 app	
Seedling disease Rhizoctonia	Quadris 2.08F ³	0.4 - 0.8 fl oz/1000 row ft			Quadris can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Terraclor is an in-furrow application.
	Terraclor 75WP	2 lb in 10 gal water			
PEA, SOUTHERN (Succulent only -- For dried pea culture, see "Bean, Dry.")					
Rusts Bronze pustules.	Endura 70WG	8 - 11 oz	7	2 app	Spray at early bloom and repeat at 7- to 14-day intervals. Do not make more than 1 application of Quadris or Headline before alternating with a fungicide with a different mode of action.
	Headline 2.09F	6 - 9 fl oz	7	2 app	
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	
Rust, soybean Small, tan spots on leaves.	Nova 40W	4 - 5 oz	28	2 app	Not a major problem on pea. Section 18 quarantine exemption. Use only if soybean rust present in U.S.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
PEA, SOUTHERN (CONT'D)					
Powdery mildew Dull white, felt-like growth on leaves.	Endura 70WG	8 - 11 oz	7	2 app	Begin applications at first appearance of mildew and repeat at 7- to 14-day intervals. Headline must be rotated.
	Headline 2.09F sulfur	6 - 9 fl oz See label	7 0	2 app NL	
Mosaic viruses Distortion of leaves and pods. Pale lines in leaves.					Use virus-free seed. Plant resistant varieties.
Seedling disease Pythium	Ridomil Gold SL	0.5 - 1 pt/treated A	NA	1 app	Preplant incorporated. See label for band rates.
	MetaStar 2E AG	2 - 4 pt/treated acre	NA	1 app	
Seedling disease Rhizoctonia	Quadris 2.08F ³	0.4 - 0.8 fl oz/1000 row ft			Quadris can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence.
White mold (Sclerotinia) White mold growth on pods and stems.	Endura 70WG	8 - 11 oz	7	2 app	Apply at first appearance and 7 - 10 days later, if needed.
PEPPER					
Bacterial spot Black to tan angular spots on leaves. Dark, raised spots on fruits. Plants shed infected leaves.	fixed copper	See label	0	NL	Use disease-free seed or buy disease-free transplants. For best results, apply before disease appears. Repeat at 7-10 day intervals. May be useful where copper-resistant bacterial strains are present. Cannot be tank-mixed with copper. Use as part of cooperative program with Omni-Lytics, (866-285-2644), which formulates the bacteriophage to match your bacterial strains. Re-sample frequently, to accommodate strain shifts.
	+ maneb 80WP ³	1.5 - 3 lb	7	18 lb	
	AgriPhage	1 pt	0	NL	
Blossom-end rot Tan sunken areas on blossom end and side of fruit.					Lime soil to provide adequate calcium. Avoid planting on droughty soils. Do not use excessive nitrate fertilizer. Irrigate and provide uniform soil moisture.
Cercospora leaf spot Circular spots with gray centers develop on leaves.	Cabrio 20EG	8 - 12 oz	0	6 app	Apply as soon as disease appears and continue as needed on a 7- to 10-day schedule. See Quadris and Cabrio labels for resistance management guidelines.
	maneb 80WP ³	1.5 - 3 lb	7	18 lb	
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	
Anthracnose Sunken spots on ripening fruit.					
Phytophthora blight - crown and root phase Rapid wilt and death of plants in wet areas of field.	MetaStar 2E AG	4 - 8 pt/treated acre	7	12 pt	Plant on raised beds, improve field drainage and do not plant wet areas. Crown and root phase is caused by root infections. Foliar and fruit phase is caused by air-borne spores. MetaStar, Ridomil Gold and Ultra Flourish are soil-applied at planting and up to 2 supplemental applications at 30-day intervals. Tanos, Presidio, Reason, Revus and dimethomorph must be tank mixed with and alternated with a fungicide with a different mode of action. Spray intervals for phosphorous acid products: Agri-Fos: 1 - 2 wks; Fosphite: 2 - 4 weeks (see label). Phostrol: 2 - 3 weeks; ProPhyt: weekly. Although not labeled for Phytophthora blight, copper sprays have been shown to be helpful in suppressing this disease.
	Ridomil Gold EC	1 pt/treated acre	7	3 app	
	Ultra Flourish	2 pt/treated acre	7	3 app	
	phosphorous acid: Fosphite	Pre-plant root dip: 2 qt/100 gal Drip irrig.: 2-3 qt in at least 100 gal	0	NL	
	ProPhyt	Drench to transplants: 4 pt/100 gal In-furrow drench: 5 fl oz/1,000 ft row	0	NL	

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
PEPPER (CONT'D)					
Phytophthora blight - foliar and fruit phase Blighting of some shoots and fruit; plant usually remains alive.	dimethomorph:				
	Acrobat 50WP	6.4 oz	0	5 app	
	Forum 4.18F	6 fl oz	0	5 app	
	Ridomil Gold Copper	2.5 lb	7	4 app	
	maneb 80WP ³	2 - 3 lb	7	18 lb	
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	Reason 4.13 SC	8.2 fl oz	14	24.6 fl oz	
	Revus 2.08SC	8 fl oz	1	4 app	
	Tanos 50WG	8 - 10 oz	3	72 oz	
	phosphorous acid:				
	Agri-Fos	1.25 - 2 qt	0	6 app	
Fosphite	1 - 3 qt	0	NL		
Phostrol	1 - 2 qt	0	NL		
ProPhyt	3 qt	0	NL		
Southern blight Plants wilt and die. White mold can often be seen on base of stem.	Terraclor 75WP (soil treatment)	See label			Turn soil deep to bury plant debris that might harbor disease organism. Use Terraclor in setting water. Rotate with sod crops.
POTATO					
Black leg Stem turns black. Plant wilts and dies.	streptomycin sulfate 21.2WP	0.5 lb/100 gal			Soak cut seed pieces for 30 min. and plant.
Seed piece decay	Maneb 4F mancozeb 80WP ³ Maxim 0.5 D Maxim 4FS Maxim MZ Moncoat MZ 7.5 D	0.8 qt/10 gal 1.25 lb/50 gal 0.5 lb/100 lb seed 0.08 - 0.16 fl oz/100 lb seed 0.5 lb/100 lb seed 1 lb/100 lb seed			If possible, cut seed pieces, wound-heal for 2 to 3 days at 55 to 65 F and high relative humidity, then treat (dust or dip) with fungicide prior to planting. If cut seed pieces are not wound-healed, dust or dip with fungicides and allow to dry in a cool place before planting. Do not use treated seed pieces for feed or food.
Early blight Brown target spots followed by blighting of foliage.	chlorothalonil 6L ³ Endura 70WG Evito 480SC Headline 2L Quadris 2.08F ³ Quadris Opti 5.5SC Ridomil Gold Bravo SC Ridomil Gold MZ Rovral 4F or Iprodione 4F maneb 80WP ³ mancozeb 80WP ³ Reason 4.13F Scala 5SC Tanos 50WG	1 - 1.5 pt 2.5 - 4.5 oz 3.5 fl oz 6 - 9 fl oz 6.2 - 12.4 fl oz 1.6 pt 2.5 pt 2.5 lb 1 - 2 pt 2 lb 2 lb 5.5 - 8.2 fl oz 7 fl oz 6 - 8 oz	7 30 7 3 14 14 14 14 14 14 14 14 7 14	15 pt 2 app 6 app 2 app 6 app 6 app 3 app 3 app 4 app 14 lb 15 lb 24.6 fl oz 35 fl oz 6 app	Start applications when plants are 4 - 6 inches high and continue at 7- to 10-day intervals. Alternate Ridomil products with protectant fungicide on 7-day schedule. See labels for other restrictions. See Endura, Evito, Headline, Quadris, Quadris Opti, Reason, Scala and Tanos labels for resistance management guidelines. Scala and Tanos must be tank mixed with another early-blight fungicide.
Late blight Irregular dead areas on leaves. Plants appear scalded.	dimethomorph: Acrobat 50WP Forum 4.18F Curzate 60DF Gavel 75DF Omega 500F 4.2L Previcur Flex 6F Ranman 3.33SC Reason 4.13F Tanos 50WG	4 - 6.4 oz 4 - 6 fl oz 3.33 oz 1.5 - 2 lb 5.5 fl oz 0.7 - 1.2 pt 1.4 - 2.75 fl oz 5.5 - 8.2 fl oz 8 oz	4 4 14 14 14 14 7 14 14	5 app 5 app 7 app 6 app 3.5 pt 6 pt 10 app 24.6 fl oz 6 app	Late-blight fungicides should be tank-mixed with or alternated with a broad-spectrum protectant fungicide such as chlorothalonil, mancozeb or maneb. The purpose is to discourage resistance and to provide control of early blight. Begin applications when late blight is imminent, repeat at 5- to 7-day intervals. See product labels for resistance management guidelines.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
POTATO (CONT'D)					
Fusarium tuber rot Dry, brown rot of stored tubers.	Mertect 340-F	0.42 fl oz/ton of tubers			Mist unwashed tubers on a conveyor line entering storage with enough of the solution to provide complete coverage. Tubers may be treated again before shipment if necessary.
Rhizoctonia stem canker (black scurf) Dark stem rot, poor growth.	Seed-piece treatment: Maxim 0.5 D Moncoat MZ 7.5 D	0.5 lb/100 lb seed 1 lb/100 lb seed			See Maxim and Moncoat MZ label for plantback and other restrictions. Quadris can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Use the higher rates where disease pressure is high. *Terraclor not for silver scurf. Apply Terraclor in 8½-inch band in furrow over the seed and cover with soil during planting operation.
	Soil treatment: Quadris 2.08F ³	0.4 - 0.8 fl oz/1000 row ft			
Silver scurf Light areas with silvery sheen on surface of tuber.	Terraclor 4F*	5.2 - 10.4 fl oz/1000 row ft			
Scab Rough, scabby spots on tubers.					Use disease-free seed. Where soil is infested with scab organism, use resistant variety and rotate crops. See SP277-G.
White mold (Sclerotinia) Dying stems with black, pea-like structures inside.	Endura 70WG Omega 500F 4.2L Rovral 4F or Iprodione 4F	5.5 - 10 oz 5.5 - 8 fl oz 2 pt	30 14 14	2 app 3.5 pt 4 app	Begin when plants are 6 to 8 inches tall or when conditions favor disease development. Omega can be repeat at 7- to 10-day intervals. Apply Endura 2 times at 14-day intervals.
PUMPKIN (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)					
Angular leaf spot Brown, angular-shaped spots.	fixed copper	See label	0	NL	Spray at first appearance and repeat on 7- to 10-day schedule. Discontinue in dry weather. Fruit most susceptible when small and expanding rapidly.
Bacterial spot (Xanthomonas) Small, tan fruit spot with dark halo.					
Anthracnose Black, circular spots on fruit.	Cabrio 20EG chlorothalonil 6L ³	12 - 16 oz 1.5 - 3 pt	0 0	4 app 21 pt	Begin applications prior to disease onset. Repeat every 7 - 10 days. Do not make consecutive applications of Cabrio, Flint, Sovran, Pristine, Quadris or Quadris Opti; these products should be alternated with non-Group 11 fungicides. See Cabrio, Quadris, Quadris Opti labels for restrictions on tank mix partners. Sovran not for anthracnose, downy mildew, or plectosporium blight.
Downy mildew Tiny yellow spots on leaves.	Flint 50WG maneb 80WP ³ Pristine 38WG	1.5 - 2 oz 1.5 - 2 lb 12.5 - 18.5 oz	0 5 0	4 app 16 lb 4 app	
Gummy stem blight (black rot) Black, circular spots on fruit.	Quadris 2.08F ³ Quadris Opti 5,5SC Ridomil Gold Bravo SC	11 - 15.4 fl oz 3.2 pt 2.5 - 3.25 pt	1 1 0	4 app 4 app 4 app	
Plectosporium (Microdochium) blight White dashes on stem and fruit surface.	Sovran 50WG	4.8 oz	0	4 app	
Downy mildew Large, yellow spots that turn necrotic.	above products, or dimethomorph: Acrobat 50WP Forum 4.18F Curzate 60DF Gavel 75DF Presidio 4SC Previcur Flex 6F Reason 4.13F Ranman 3.33SC Revus 2.08SC Tanos 50WG	6.4 oz 6 fl oz 3.2 - 5 oz 1.5 - 2 lb 3 - 4 fl oz 1.2 pt 5.5 fl oz 2.1 - 2.75 fl oz 8 fl oz 8 oz	0 0 3 5 2 2 14 0 0 3	5 app 5 app 30 oz 8 app 12 fl oz 6 pt 4 app 6 app 4 app 4 app	

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
PUMPKIN (CONT'D) (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)					
Phytophthora blight Rot of fruit covered with thin, white mold.	dimethomorph:				Dimethomorph, Presidio, Ranman and Revus must be tank mixed with and alternated with non-related fungicides (Appendix 1). Phosphorus acid products: Apply preventively on 7- to 14-day schedule, beginning after plants become established. See product labels. Exception for Fosphite: Apply at 2 - 4 week intervals (see label). Although not labeled for Phytophthora blight, copper fungicides have been shown to be helpful in suppressing this disease.
	Acrobat 50WP	6.4 oz	0	5 app	
	Forum 4.18F	6 fl oz	0	5 app	
	phosphorous acid:				
	Agri-Fos	1.25 qt/A	0	6 app	
	Fosphite	1 - 3 qt	0	NL	
	ProPhyt	1 - 3 qt	0	NL	
	Phostrol	2.5 - 5 pt	0	7 app	
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
Ranman 3.33SC	2.1 - 2.75 fl oz	0	6 app		
Revus 2.08SC	8 fl oz	0	4 app		
Mosaic viruses Green patterns on fruit.					Reflective mulches, aphid control and weed control may be of some value.
Powdery mildew White, powdery mold on surface of leaves.	chlorothalonil 6L ³	2 - 3 pt	0	21 pt	For varieties susceptible to powdery mildew: Apply chlorothalonil on a preventive, 7- to 10-day schedule. Add one of the other listed products if needed for extra powdery mildew control. Do not apply sulfur if temperatures exceed 90 F. Thorough coverage is critical for chlorothalonil and sulfur. Pristine must be rotated with fungicides with different modes of action. See Procure label for plantback restrictions. Resistance to the strobilurins (Cabrio, Quadris, Sovran and Flint) is widespread in cucurbit powdery mildew in Tennessee.
	wettable sulfur	See label	0	NL	
	Folicur 3.6F	4 - 6 fl oz	7	24 fl oz	
	Nova 40W	2.5 - 5 oz	0	24 oz	
	Procure 50WP	4 - 8 oz	0	40 oz	
	Pristine 38WG	12.5 - 18.5 oz	0	4 app	
	Quadris Opti 5.5SC	3.2 pt	1	4 app	
SPINACH					
Downy mildew (blue mold) Yellow spots on upper leaf surface. Gray downy fungus on underside of leaf.	Actigard 50WG	0.75 oz	7	3 app	Start fungicide applications at first sign of disease and continue at 7- to 10-day intervals as necessary. Where white rust has been a problem in the past, spraying should start when the first true leaves develop. Begin Actigard applications at 1 st or 2 nd true leaf; do not use if plants are under stress. Ridomil Gold Copper must be used with preplant Ridomil Gold EC soil application. (See below.) Aliette can cause speckling if leaves remain wet for long periods. Adjust spray pH to 6.0 or above. Quadris can contribute to phytotoxicity under certain circumstances. Proceed with caution with regard to tank mixes and adjuvants when treating spinach with Quadris. See Quadris, Presidio, Reason, Cabrio and Revus labels for resistance management guidelines.
	Aliette 80WP	3 - 5 lb	3	7 app	
	Cabrio 20EG	12 - 16 oz	0	4 app	
	fixed copper	See label	0	NL	
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	Reason 4.13SC	5.5 - 8.2 fl oz	2	24.6 fl oz	
	Revus 2.08SC	8 fl oz	1	4 app	
	Ridomil Gold Copper	2.5 lb	21	2 app	
White rust Yellow spots on upper leaf surface. White powdery mass on underside of leaf.	Actigard 50WG	0.75 oz	7	3 app	
	Cabrio 20EG	8 - 12 oz	0	4 app	
	fixed copper	See label	0	NL	
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	
	Reason 4.13SC	5.5 - 8.2 fl oz	2	24.6 fl oz	
Anthracnose Water-soaked dark gray spots.	fixed copper	See label	0	NL	
	Cabrio 20EG	12 - 16 oz	0	4 app	
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	
Cercospora leafspot Small, tan spots.					
Rhizoctonia seedling disease Failure of seedlings to emerge or death after emergence.	Quadris 2.08F ³	0.4 - 0.8 fl oz/1000 row ft			Can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Use the higher rates where disease pressure is high.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
SPINACH (CONT'D)					
Pythium seedling disease Dark rot of roots and stem.	MetaStar 2E AG	4 - 8 pt/treated acre	21	11 pt	Ridomil and Ultra Flourish are applied preplant incorporated or surface band at planting. For downy mildew and white rust control, shank in 0.25 pt/A Ridomil, 1 pt MetaStar or 0.5 pt/A Ultra Flourish after 1 st and 2 nd cuttings.
	Ridomil Gold EC	1 - 2 pt/treated acre	21	2.75 pt	
Downy mildew (See above)	Ultra Flourish	2 - 4 pt/treated acre	21	5.5 pt	
White rust (See above)					
SQUASH (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)					
Blossom blight (wet rot) Blossoms and fruits rot; whisker-like fungal growth.					Select sites and plant spacings that provide good air circulation for rapid drying.
Downy mildew Tiny, yellow spots on leaves followed by blighting.	Cabrio 20EG	12 - 16 oz	0	4 app	Begin applications prior to disease onset. Repeat every 7 - 10 days. Do not make consecutive applications of Cabrio, Flint, Pristine, Quadris or Quadris Opti; these products should be alternated with non-Group 11 fungicides. See Cabrio, Quadris and Quadris Opti labels for restrictions on tank mix partners. See Flint label for downy mildew control.
	chlorothalonil 6L ³	1.5 - 3 pt	0	21 pt	
	mancozeb 80WP ³	2 - 3 lb	5	25.6 lb	
	maneb 80WP ³	1.5 - 2 lb	5	16 lb	
	Flint 50WG	1.5 - 2 oz	0	4 app	
Plectosporium (Microdochium) blight White dashes on stem surface.	Gavel 75DF	1.5 - 2 lb	5	8 app	
	Pristine 38WG	12.5 - 18.5 oz	0	4 app	
	Quadris 2.08F ³	11 - 15.4 fl oz	1	4 app	
	Quadris Opti 5.5SC	3.2 pt	1	4 app	
	Ridomil Gold Bravo SC	2.5 - 3.25 pt	0	4 app	
	Ridomil Gold MZ	2.5 lb	5	4 app	
Downy mildew Large, yellow spots that turn necrotic.	above products, or dimethomorph:				Begin applications prior to infection, 7- to 10-day spray schedule. Most of these products require alternation with downy mildew fungicides with a different mode of action or tank mix with a protectant fungicide such as chlorothalonil, mancozeb or maneb.
	Acrobat 50WP	6.4 oz	0	5 app	
	Forum 4.18F	6 fl oz	0	5 app	
	Curzate 60DF	3.2 - 5 oz	3	30 oz	
	Gavel 75DF	1.5 - 2 lb	5	8 app	
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	Previcur Flex 6F	1.2 pt	2	6 pt	
	Reason 4.13F	5.5 fl oz	14	4 app	
	Ranman 3.33SC	2.1 - 2.75 fl oz	0	6 app	
	Revus 2.08SC	8 fl oz	0	4 app	
	Tanos 50WG	8 oz	3	4 app	
	Phytophthora blight Rot of fruit covered with thin, white mold.	dimethomorph:			
Acrobat 50WP		6.4 oz	0	5 app	
Forum 4.18F		6 fl oz	0	5 app	
phosphorous acid:					
Agri-Fos		1.25 qt/A	0	6 app	
Fosphite		1 - 3 qt	0	NL	
ProPhyt		1 - 3 qt	0	NL	
Phostrol		2.5 - 5 pt	0	7 app	
Presidio 4SC		3 - 4 fl oz	2	12 fl oz	
Ranman 3.33SC		2.1 - 2.75 fl oz	0	6 app	
Revus 2.08SC	8 fl oz	0	4 app		
Mosaic viruses Greening of fruit. Leaves mottled, vines stunted.					The precocious yellow-stemmed varieties mask the fruit-greening effects. Some resistant varieties for certain viruses.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
SQUASH (CONT'D) (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)					
Powdery mildew White, powdery mold on surface of leaves.	chlorothalonil 6L ³	2 - 3 pt	0	21 pt	For varieties susceptible to powdery mildew: Apply chlorothalonil on a preventive, 7- to 10-day schedule. Add one of the other listed products if needed for extra powdery mildew control. Do not apply sulfur if temperatures exceed 90 F. Thorough coverage is critical for chlorothalonil and sulfur. Pristine must be rotated with fungicides with different modes of action. See Procure label for plantback restrictions. Resistance to the strobilurins (Cabrio, Quadris, Sovran and Flint) is widespread in cucurbit powdery mildew in Tennessee.
	wettable sulfur	See label	0	NL	
	Folicur 3.6F	4 - 6 fl oz	7	24 fl oz	
	Nova 40W	2.5 - 5 oz	0	24 oz	
	Procure 50WP	4 - 8 oz	0	40 oz	
	Pristine 38WG	12.5 - 18.5 oz	0	4 app	
Quadris Opti 5.5SC	3.2 pt	1	4 app		
Scab Sunken or raised spots on fruit.	chlorothalonil 6L ³	2 - 3 pt	0	21 pt	Begin applications prior to disease onset. Repeat every 7 - 10 days. Ridomil Gold Bravo limited to 4 applications per crop. See label for other restrictions.
	Ridomil Gold Bravo	2 - 3 lb	0	4 app	
SWEETPOTATO					
Plant Bed					
Black rot Black spot on roots. Dry, black decay extends in flesh of root.	Mertect 340F	8 fl oz/7.5 gal water			Dip seed roots for 1 - 2 minutes and plant immediately. Do not use treated roots for food or feed. Four-year crop rotation.
	Botran 75WP	1 lb/7.5 gal (dip) or 3 - 3.75 lb/14 gal for 1000 sq ft (spray)			
Scurf Brownish-black "stain" on surface of potato.	Mertect 340F	8 fl oz/7.5 gal water			Dip seed roots for 1 - 2 minutes and plant immediately. Do not use treated roots for food or feed.
	Botran 75WP	1 lb/7.5 gal (seed dip) or 3 - 3.75 lb/14 gal for 1000 sq ft (bed spray)			
Southern blight (Sclerotial blight) Plants die, white growth on lower stem.	Botran 75WP	1 lb/7.5 gal (seed dip) or 3 - 3.75 lb/14 gal for 1000 sq ft (bed spray)			Dip seed potatoes 10 - 15 seconds, drain and bed promptly; or spray over bedded potatoes before covering with soil.
Field					
Southern blight (Sclerotial blight), Rhizoctonia stem canker, Pythium root rot	Quadris 2.08F	0.4 - 0.8 fl oz/1000 row ft			Apply in-furrow at planting or banded shortly after planting.
Foliar diseases Leaf spots, powdery mildew, rust	Headline 2.09F	6 - 12 fl oz	3	2 app	See product labels for resistance management guidelines.
	Quadris 2.08F	9.2 - 15.4 fl oz	0	4 app	
Soil rot (pox) Circular sunken areas on fleshy roots; feeder roots blackened.					Low pH reduces soil rot, but control should be centered around crop rotation and the use of resistant varieties.
Stem rot (Fusarium wilt) Plants yellow and stunted.					Use certified seed potatoes of a resistant variety.
Post-Harvest					
Sanitation Various rots.	Calcium hypochlorite 65%	10 oz/100 gal			Spray or dip 2 to 5 minutes. Proper curing is best control. See PB1054.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
SWEETPOTATO (POST-HARVEST CONT'D)					
Rhizopus rot Gray, fuzzy mold.	Botran 75WP	1 lb/100 gal			Spray method: Spray immediately after washing. Do not rinse after treatment. Dip method: Dip roots for 5 to 10 seconds in well agitated suspension. Do not rinse after treatment.
TOMATO, PLANT BED, OUTDOOR (For transplant production in greenhouses, see "Tomato, greenhouse")					
Damping off Lower stem shrivels and seedling collapses.	<i>Rhizoctonia, Fusarium</i>	Fungicide-treated seed. See "Seed Treatment"			Prevention only; no effective treatments after seeding.
	<i>Pythium, Phytophthora</i>	Previcur Flex	32 fl oz/1000 sq ft at seeding 16 fl oz/1000 sq ft after emergence	NA	2 app
Botrytis (gray mold) Gray, fuzzy growth.	chlorothalonil 6L ³	1.38 - 2 pt/43,560 sq ft	NA	20 pt	Spray first true leaves, repeat at weekly intervals. For outdoor beds only.
Early blight Brown spots on leaves or stem.					
Bacterial canker, spot, speck Tiny, dark brown to black spots on leaves.	sodium hypochlorite (Clorox)	1 qt in 4 qt water	NA	NL	Wash seed for 40 min in solution with continuous agitation; air dry promptly. Use 1 gal solution per 1 lb seed.
	streptomycin sulfate	1 lb/100 gal	NA	NL	For transplant production only. Apply if symptoms appear and repeat at 4-5 day intervals until transplanting.
	AgriPhage	3 - 8 fl oz/9600 sq ft	NA	NL	Apply every day if symptoms present. Do not mix with copper products.
TOMATO, FIELD (For assistance with fungicide selection, see Appendix 4 for a suggested spray program and relative effectiveness of fungicides)					
Bacterial spot and speck Small, dark spots on foliage and fruit.	Actigard 50WG	0.33 - 0.75 oz	14	6 app	Actigard is a plant resistance activator. Under certain conditions, this product may lead to reductions in yield. Refer to label for disclaimer. Begin applications within 1 week of transplanting. Make up to 6 applications, at weekly intervals. After the sixth application, switch to copper sprays if bacterial diseases are present. Begin Actigard applications at 0.33 oz/A, increasing to 0.75 oz/A as plants grow.
Bacterial spot, speck, and canker Small, dark spots on foliage and fruit.	fixed copper +	See label	0	NL	Ridomi/Copper can be used, but see label for limitations on use of Ridomil. Adding Tanos to copper and mancozeb/maneb may slightly enhance efficacy.
	mancozeb 80WP ³	1.5 lb	5	22.4 lb	
	or + maneb 80WP ³	1.5 lb	5	21 lb	
	AgriPhage	1 pt	0	NL	
Blossom-end rot Firm, sunken area on blossom end of fruit.	calcium chloride	4 lb/100 gal	0	4 app	Apply as soon as problem is detected or earlier. Maintain adequate calcium level in soil and uniform soil moisture. Avoid excessive irrigation when plants are small.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)	
TOMATO, FIELD (CONT'D) (For assistance with fungicide selection, see Appendix 4 for a suggested spray program and relative effectiveness of fungicides)						
Early blight Brown target spots followed by blighting of foliage.	Prior to Fruit Set Cabrio 20EG chlorothalonil 6L ³ mancozeb 80WP ³ maneb 80WP ³	8 - 16 oz 1.38 - 2 pt 1.5 - 3 lb 1.5 - 3 lb		6 app 20 pt 22.4 lb 21 lb	Start spraying soon after plants are set and repeat at 7- to 10-day intervals. Notes for Quadris: Do not apply until 21 days after transplanting. Alternate with a non-related fungicide. Do not mix with an adjuvant. Use higher rate when late blight is present. Notes for Cabrio: See label for precautions on tank mixes. Use higher rate only when late blight is a threat, and alternate with a non-strobilurin fungicide. Notes for late blight: Most strains are resistant to Ridomil. Control of late blight by chlorothalonil, mancozeb or maneb can be improved by using high-pressure sprays and by adding fixed copper. The late blight fungus can overwinter in potato tubers and in greenhouse tomato plants. Tanos must be tank mixed with and alternated with a non-Group 11 fungicide such as chlorothalonil, mancozeb or copper.	
Late blight (also see late blight, below) Dark, irregular spots, often worse on younger leaves. Favored by mild, wet weather.	Quadris 2.08F ³ Quadris Opti 5.5SC Tanos 50WG	5 - 6.2 fl oz 1.6 pt 6 - 8 oz		5 app 5 app 72 oz		
Anthracnose Circular, sunken spots on ripe fruit.	After Fruit Set Cabrio 20EG chlorothalonil 6L ³ mancozeb 80WP ³ maneb 80WP ³	8 - 16 oz 2 - 2.75 pt 3 lb 3 lb	0 0 5 5	6 app 20 pt 22.4 lb 21 lb		
Septoria leaf spot Small, gray circular leaf spots with dark borders.	Quadris 2.08F ³ Quadris Opti 5.5SC Tanos 50WG	5 - 6.2 fl oz 1.6 pt 8 oz	0 0 3	5 app 5 app 72 oz		
Fusarium wilt Bright yellowing of foliage. Brown color inside stem.						Crop rotation, fumigation and resistant varieties are treatments. Maintain soil pH between 6.5 and 7.0.
Buckeye fruit rot Circular, zonate bands within large spot on fruit, worse on lower clusters.	Gavel 75DF Quadris 2.08F ³ Quadris Opti 5.5SC Presidio 4SC Ridomil Gold Bravo SC Ridomil Gold Copper	1.5 - 2 lb 5 - 6.2 fl oz 1.6 pt 3 - 4 fl oz 2.5 pt 2 lb	5 0 0 2 14 14	8 app 5 app 5 app 12 fl oz 3 app 3 app		All are foliarly applied. Certain mefenoxam and metalaxyl products can be applied in drip irrigation, but have 28-day PHI's.
Gray mold (Botrytis) Gray, fuzzy mold on blighted foliage and fruits.	chlorothalonil 6L ³ Endura 70WG Scala 5SC	2.75 pt 9 - 12.5 oz 7 fl oz	0 0 1	20 pt 25 oz 35 oz		Endura may only be applied 2 times per season when applied at the gray mold rate. It is labeled for early blight control at 2.5 - 3.5 oz/A. Scala must be tank mixed with Endura or chlorothalonil.
Early blight (See above)						
Leaf mold Yellow spots on upper surface of leaf, olive to gray mold on underside.	chlorothalonil 6L ³ mancozeb 80WP ³ maneb 80WP ³ Tanos 50WG	2.75 pt 1.5 - 3 lb 1.5 - 3 lb 8 oz	0 5 5 3	20 pt 22.4 lb 21 lb 72 oz		Tanos must be tank mixed with and alternated with a non-strobilurin fungicide such as chlorothalonil, mancozeb or maneb. The PHI of the tank mix is determined by the tank mix partner.
Late blight Large, irregular spots on leaves; firm rot of fruit.	dimethomorph: Acrobat 50WP Forum 4.18F Curzate 60DF Gavel 75DF Presidio 4SC Previcur Flex 6F Ranman 3.33SC Reason 4.13F (Also see "late blight" above.)	6.4 oz 6 fl oz 6 fl oz 3.2 - 5 oz 1.5 - 2 lb 3 - 4 fl oz 0.7 - 1.5 pt 2.1 - 2.75 fl oz 5.5 - 8.2 fl oz	4 4 4 3 5 2 5 0 14	5 app 5 app 5 app 30 oz 8 app 12 fl oz 7.5 pt 6 app 24.6 fl oz		Begin applications before onset of disease and repeat on a 5- to 10-day schedule. Use 5-7 day intervals during mild, wet weather or if late blight is present. Most of these products require alternation with late blight fungicides with a different mode of action (see Appendix 1). Tank mix with a protectant fungicide such as chlorothalonil, mancozeb or maneb.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
TOMATO, FIELD (CONT'D) (For assistance with fungicide selection, see Appendix 4 for a suggested spray program and relative effectiveness of fungicides)					
Phytophthora blight (<i>P. capsici</i>) Rot of roots and crown.	MetaStar 2E AG	2 - 4 qt	28	6 qt	Plant on raised beds, improve field drainage and do not plant wet areas. Apply MetaStar, Ridomil or Ultra Flourish preplant incorporated or see label for other methods. Apply Fosphite at 2 - 4 week intervals (see label).
	Ridomil Gold SL	1 - 2 pt/treated acre	28	3 pt	
	Ultra Flourish	2 - 4 pt/treated acre	28	6 pt	
	phosphorous acid: Fosphite	Pre-plant root dip: 2 qt/100 gal Drip irrig.: 2 - 3 qt in at least 100 gal	0	NL	
Pythium root and stem rot Dark, watery rot of lower stem of young plants.	MetaStar 2E AG	2 - 4 qt	28	6 qt	Apply MetaStar, Ridomil or Ultra Flourish preplant incorporated or see label for other methods. Aliette is a foliar spray.
	Ridomil Gold SL	1 - 2 pt/treated acre	28	3 pt	
	Ultra Flourish	2 - 4 pt/treated acre	28	6 pt	
	Aliette 80WDG	2.5 - 5 lb	14	20 lb	
Sclerotinia stem rot (timber rot) Dry, brown rot on stem. Hard, black pea-like structures form inside stem.	See remarks.				The Endura tomato label does not include this disease; however, applied as for early blight control, Endura should provide suppression of Sclerotinia.
Southern blight Plants wilt and die. White mold can often be seen on base of stem.	Terraclor 75WP (soil treatment)				Turn soil deep to bury plant debris which might harbor disease organisms. Use Terraclor in setting water. Rotate with sod crops.
Verticillium wilt Subtle wilting and yellowing.					Crop rotation, fumigation and resistant varieties are treatments.
TOMATO, GREENHOUSE					
Begin spray program when conditions are favorable for disease or as soon as disease appears. Repeat at weekly intervals. Ventilate houses well, provide continuous air circulation and maintain relative humidity below 90%. Use leaf mold-resistant varieties. Protect bumblebee hives when applying these products.					
TRANSPLANT PRODUCTION - Do not use any of these products on young plants unless experience has indicated that such use is safe.					
Early blight, gray leaf spot, late blight, leaf mold	mancozeb 80WP ³	1.5 - 2 lb/43,560 sq ft	NA	22.4 lb	Apply in 100 gal of water.
Botrytis - general	Decree 50WDG	1.5 lb/43,560 sq ft	NA	6 lb	Do not make more than 2 consecutive applications of Decree before rotating with another effective product.
	Serenade	2 - 6 qt/43,560 sq ft	NA	NL	
Bacterial spot and speck	streptomycin sulfate 17WP	1 lb/100 gal	NA	NL	For transplant production only. Apply if symptoms appear and repeat at 4-5 day intervals until transplanting.
	AgriPhage	3 - 8 fl oz/ 9600 sq ft	NA	NL	Apply every day if symptoms present. Do not mix with copper products.
Pythium root rot	Previcur Flex	Stock solution: 12.8 fl oz/100 gal	NA	2 app	Before transplanting: Apply stock solution to pre-wet cubes at 3.4 - 6.8 fl oz per cube. Refer to label for application to soil or soilless seed beds.
AFTER TRANSPLANTING IN GREENHOUSE					
Early blight, gray leaf spot, late blight, leaf mold	maneb 80WP ³	1.5 - 2 lb/100 gal	5	21 lb	Tanos must be tank mixed with and alternated with a non-strobilurin fungicide such as mancozeb or maneb.
	mancozeb 80WP ³	1.5 - 2 lb/100 gal	5	22.4 lb	
	Tanos 50WG	6 - 8 oz/43,560 sq ft	3	72 oz	
Botrytis - stem canker	Botran 75WP	1 lb/100 gal	10	4 app	Botran is sprayed to stem of plant from ground level up to height of 18-24 inches.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
TOMATO, GREENHOUSE (CONT'D)					
Botrytis - general	Decree 50WDG	1.5 lb/43,560 sq ft	0	6 lb	Foliar sprays. Do not make more than 2 consecutive applications of Decree before rotating. Scala must be tank-mixed with another effective fungicide. Ventilate for at least 2 hours after Scala application to avoid plant damage from the vapors.
	Scala 5SC	7 fl oz/100 gal	1	35 fl oz	
	Serenade	2 - 6 qt/43,560 sq ft	0	NL	
Bacterial speck, bacterial spot, early blight, late blight, Septoria leaf spot	Kocide DF	2 - 4 Tbsp/1000 sq ft	0	NL	Foliar sprays.
	Kocide 2000	1.5 - 2.25 Tbsp/1000 sq ft	0	NL	
Pythium root rot	Previcur Flex	Stock solution: 12.8 fl oz/100 gal	5	4 app	After transplanting: Apply stock solution through drip system at 3.4 - 6.8 fl oz per cube. Limit to 3.4 fl oz during first 2 weeks after transplanting.
	Terramaster 4EC	0.01% solution, e.g., 6.5 fl oz/500 gal	3	4 app	Apply through drip system, no sooner than 3 weeks after transplanting, in volume of 6 - 8 fl oz per plant. Re-apply as needed, but no sooner than 3 weeks after a previous application.
Sclerotinia stem rot (timber rot)	Contans WG	0.75 - 1.5 oz/1000 sq ft	NA	NL	Biological. Apply to soil about 3 months prior to planting. Till 2 - 8 inches deep. Botran as used for control of Botrytis should provide some control of timber rot.
Powdery mildew	Armicarb 85WP	2.5 - 5 lb/100 gal	0	NL	Spray Armicarb at 1 st sign of mildew and repeat at 5- to 14-day intervals. Due to sulfur's high effectiveness, extended spray intervals may be possible. Re-apply only if mildew resumes activity. Do not apply if temps will exceed 90F for 3 days.
	sulfur 90WP	5 lb/43,560 sq ft	0	NL	
TURNIP GREENS					
Alternaria leaf spot Dark brown leaf spots.	fixed copper	See label	0	NL	Begin prior to disease onset and follow 7- to 10-day schedule during rainy weather. Maintain thin plant stand and avoid low-lying or poorly drained soils. Copper can burn leaves in hot weather. Maneb: one application per cutting. Alternate Quadris with a non-related fungicide.
	Folicur 3.6F	3 - 4 fl oz	7	16 fl oz	
Anthracnose Small, tan leaf spots with brown margins.	maneb 80WP ³	1.5 lb	14	1.5 lb	
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	
Cercospora leaf spot Tan spots, yellow haloes.					
Downy mildew Yellow leaf spots with white mold on underside.	Actigard 50WG	1 oz	7	4 app	Apply Actigard at 7-day intervals, beginning 7-10 days after thinning. Dimethomorph and Ridomil must be tank mixed with a downy mildew fungicide from a different resistance management group.
	dimethomorph:				
	Acrobat 50WP	6.4 oz	0	5 app	
	Forum 4.18F	6 fl oz	0	5 app	
	fixed copper	See label	0	NL	
	maneb 80WP ³	1.5 lb	14	1.5 lb	
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	
Ridomil Gold SL	0.125 - 0.25 pt	7	4 app		
Powdery mildew White, powdery growth on leaves.	Quadris 2.08F ³	9.2 - 15.4 fl oz	0	4 app	Apply when disease first appears; continue at 7- to 14-day intervals. See product label for resistance management guidelines. Sulfur not for Alternaria.
	Switch 62.5WG	11 - 14 oz	7	56 oz	
	sulfur	See label	0	NL	
Alternaria leaf spot Dark brown leaf spot.					

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
TURNIP GREENS (CONT'D)					
Pythium and Phytophthora Damping off and root rot.	Ridomil Gold SL	1 - 2 pt/treated acre	NA	1 app	Apply only before planting (incorporated into top 2 inches of soil) or at planting on surface. May be broadcast or banded.
	MetaStar 2E AG	4 - 8 pt/treated acre	NA	1 app	
	Ultra Flourish	2 - 4 pt/treated acre	NA	1 app	
TURNIP, RUTABAGA (Harvested for roots only)					
Alternaria leaf spot Dark brown leaf spots.	Cabrio 20EG	8 - 12 oz	0	3 app	The Cabrio and Quadris labels require alternation with a non-Group 11 fungicide. Since no other fungicide labeled for rutabaga is known to be effective against the target diseases, only 1 application of 1 product is allowed. Cultural practices are important: Maintain thin plant stand and avoid poorly drained soils. Planting in rows provides better drying conditions than broadcasting.
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	
	Folicur 3.6F (turnip only)	4 - 7.2 fl oz	7	28 fl oz	
Anthracnose Small, tan leaf spots with brown margins.					
Cercospora leaf spot Tan spots, yellow haloes.					
Downy mildew Yellow leaf spots with white mold on underside.	Actigard 50WG	1 oz	7	4 app	
	Cabrio 20EG	8 - 12 oz	0	3 app	
	Quadris 2.08F ³	6.2 - 15.4 fl oz	0	4 app	
	Presidio 4SC	3 - 4 fl oz	7	12 fl oz	
Powdery mildew White, powdery growth on leaves.	sulfur	See label	0	NL	Apply at early leaf stage and repeat every 10 - 14 days, if necessary.
Pythium and Phytophthora Damping off and root rot.	Ridomil Gold SL	1 - 2 pt/treated acre	NA	1 app	Apply only before planting (incorporated into top 2 inches of soil) or at planting on surface. May be broadcast or banded.
	MetaStar 2E AG	4 - 8 pt/treated acre	NA	1 app	
	Ultra Flourish	2 - 4 pt/treated acre	NA	1 app	
WATERMELON (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)					
Alternaria leaf spot Brown, target spots on leaves.	Cabrio 20EG	12 - 16 oz	0	4 app	Begin applications prior to disease onset. Repeat every 7 - 10 days. Do not make consecutive applications of Cabrio, Pristine or Quadris; these products should be alternated with non-Group 11 fungicides. See Cabrio and Quadris labels for restrictions on tank mix partners. Note: Spraying mature watermelons with chlorothalonil products, including Quadris Opti, may result in sunburn of the upper surface of the fruit. See label for restrictions on the use of the product.
	chlorothalonil 6L ³	1.5 - 3 pt	0	21 pt	
	mancozeb 80WP ³	2 - 3 lb	5	25.6 lb	
maneb 80WP ³	1.5 - 2 lb	5	16 lb		
Anthracnose Brown leaf spots and sunken spots on fruit.	Pristine 38WG	12.5 - 18.5 oz	0	4 app	
	Quadris 2.08F ³	11 - 15.4 fl oz	1	4 app	
	Quadris Opti 5.5SC	3.2 pt	1	4 app	
Downy mildew Large yellow spots.	Ridomil Gold Bravo SC	2.5 - 3.25 pt	0	4 app	
	Ridomil Gold MZ	2.5 lb	5	4 app	
	Sovran 50WG	4.8 oz	0	4 app	
Gummy stem blight Large brown leaf spots. Gum may ooze from stem cankers.					
Cercospora leaf spot Tiny, dark brown spots.					

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices	Rate ¹	PHI ²	Maximum Use/Acre/Season	Remarks (Resistance management groups are provided in Appendix 1)
WATERMELON (CONT'D) (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)					
Downy mildew Large, yellow spots that turn necrotic.	above products, or dimethomorph:				Begin applications prior to infection, 7- to 10-day spray schedule. Most of these products require alternation with downy mildew fungicides with a different mode of action or tank mix with a protectant fungicide such as chlorothalonil, mancozeb or maneb.
	Acrobat 50WP	6.4 oz	0	5 app	
	Forum 4.18F	6 fl oz	0	5 app	
	Curzate 60DF	3.2 - 5 oz	3	30 oz	
	Gavel 75DF	1.5 - 2 lb	5	8 app	
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	Previcur Flex 6F	1.2 pt	2	6 pt	
	Reason 4.13F	5.5 fl oz	14	4 app	
	Ranman 3.33SC	2.1 - 2.75 fl oz	0	6 app	
	Revus 2.08SC	8 fl oz	0	4 app	
Tanos 50WG	8 oz	3	4 app		
Phytophthora blight Rot of fruit covered with thin, white mold.	dimethomorph:				Dimethomorph, Presidio, Ranman and Revus must be tank mixed with and alternated with non-related fungicides (Appendix 1). Phosphorus acid products: Apply preventively on 7- to 14-day schedule, beginning after plants become established. See product labels. Exception for Fosphite: Apply at 2 - 4 week intervals (see label). Although not labeled for Phytophthora blight, copper fungicides have been shown to be helpful in suppressing this disease.
	Acrobat 50WP	6.4 oz	0	5 app	
	Forum 4.18F	6 fl oz	0	5 app	
	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	Ranman 3.33SC	2.1 - 2.75 fl oz	0	6 app	
	Revus 2.08SC	8 fl oz	0	4 app	
	phosphorous acid:				
	Agri-Fos	1.25 qt/A	0	6 app	
	Fosphite	1 - 3 qt	0	NL	
	ProPhyt	1 - 3 qt	0	NL	
Phostrol	2.5 - 5 pt	0	7 app		
Seedling disease Failure of seedlings to emerge or death after emergence.	Quadris 2.08F ³	0.4 - 0.8 fl oz/1000 row ft			Can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Use the higher rates where disease pressure is high.
Powdery mildew White, powdery mold on surface of leaves.	chlorothalonil 6L ³	2 - 3 pt	0	21 pt	For varieties susceptible to powdery mildew: Apply chlorothalonil on a preventive, 7- to 10-day schedule. Add one of the other listed products if needed for extra powdery mildew control. Do not apply sulfur if temperatures exceed 90 F. Thorough coverage is critical for chlorothalonil and sulfur. Pristine and Quintec must be rotated with fungicides with different modes of action. See Procure label for plantback restrictions. Resistance to the strobilurins (Cabrio, Quadris, Sovran and Flint) is widespread in cucurbit powdery mildew in Tennessee.
	wettable sulfur	See label	0	NL	
	Folicur 3.6F	4 - 6 fl oz	7	24 fl oz	
	Nova 40W	2.5 - 5 oz	0	24 oz	
	Procure 50WP	4 - 8 oz	0	40 oz	
	Pristine 38WG	12.5 - 18.5 oz	0	4 app	
	Quadris Opti 5.5SC	3.2 pt	1	4 app	
	Quintec 2.08F	4 - 6 fl oz	3	4 app	

FOOTNOTES USED IN TABLE 5:

- ¹ Rates are amount of formulation per acre unless otherwise stated. Usually 100 gallons of water are required to give adequate coverage with boom sprayers. Less water is required with air blast or mist blower-type sprayers.
- ² PHI (pre-harvest interval) is the minimum number of days between last application and harvest.
- ³ Where maneb 80WP is recommended, dry flowable or flowable formulations of maneb or maneb plus zinc can also be used. Where mancozeb 80WP is recommended, flowable formulations (e.g., Dithane F-45) and dry flowable formulations (e.g., Manzate 200DF) of mancozeb can be used at the labeled rate. Where chlorothalonil 6L is recommended, other formulations can also be used. Where Quadris 2.08F is recommended, Amistar 80WG can also be used. Refer to product labels for rates.

Appendix 1

Chemical Control Products for Diseases of Vegetables

This listing does not imply any recommendations, but is provided solely as a reference. List of trade names is not complete.

Common Name	Trade Names	Type	Resistance Management Group	REI* (hours)	Formulations
acibenzolar-S-methyl	Actigard	PA	21	12	50% WDG
azoxystrobin	Quadris Amistar	F	11	4	2.08 L 80%WDG
azoxystrobin + chlorothalonil	Quadris Opti	F	11 + M	12	0.5 L + 5 L
azoxystrobin + propiconazole	Quilt	F	11 + 3	24	0.62L + 1.04L
boscalid	Endura	F	7	12	70%WDG
chloropicrin	(R)Chlor-o-pic	Fum		72	96.5% L
chlorothalonil	Bravo Echo Equus	F	M	48	4.2 L, 6 L, 82.5% WDG 4.2 L 6 L, 82.5% WDG
coppers, fixed	Basicop Champ Cuprofix Disperss Kocide Copper Count N Tenn-Cop 5E	B,F	M	24-48	Various
copper-sulfur	Top Cop with Sulfur	F	M	24	1 + 6.25 L
cyazofamid	Ranman	F	21	12	3.33 L
cymoxanil	Curzate	F	27	12	60% DF
cyprodinil + fludioxonil	Switch	F	9 + 12	12	37.5% + 25% WDG
dicloran	Botran Chlortran	F	14	12	75% WP
1,3-dichloropropene	(R)Telone II	Fum		120	94% L
1,3-dichloropropene + chloropicrin	(R)Telone C-17 (R)Telone C-35	Fum Fum		120 120	78.3% + 16.5% L 63.1% + 34.7% L
dimethomorph	Acrobat Forum	F	40	24	50% WP 4.18 L
famoxadone + cymoxanil	Tanos	F	11	12	50%WG
fenamidone	Reason	F	11	12	4.13 L
fenhexamid	Decree	F	17	12	50%WDG
fluazinam	Omega	F	29	48	4.2L
fludioxonil	Maxim	F	12	12	0.5% D, 4 L
fluopicolide	Presidio	F	43	12	4L
fluoxastrobin	Evito 480SC	F	11	12	4 L
flutolanil + mancozeb	Moncoat MZ	F	7 + M	24	1.5% + 6% D
fosetyl-Al	Aliette	F	33	12	80% WDG
iprodione	Rovral Iprodione	F	2	12	4 L 4 L
iodomethane + chloropicrin	(R)Midas	Fum		120	various

Chemical Control Products for Diseases, *Continued*

Common Name	Trade Names	Type	Resistance Management Group	REI* (hours)	Formulations
kresoxim-methyl	Sovran	F	11	12	50 WG
maneb	Maneb 80 Maneb Plus Zinc F4 Manex	F	M	24	80% WP 4 L 4 L
mancozeb	Dithane DF Rainshield Dithane F45 Dithane M-45 Manex II Manzate 200 Penncozeb Penncozeb DF	F	M	24	75% DF 4 L 80% WP 4 L 75% DF 80% WP 75% DF
mandipropamid	Revus	F	40	12	2.08 L
mefenoxam	Ridomil Gold SL Ultra Flourish	F	4	48	4 L 2 L
mefenoxam + chlorothalonil	Flouronil Ridomil Gold Bravo	F	4 + M	48	4.5% + 72% WP 3.3% + 33.1% L
mefenoxam + copper	Ridomil Gold Copper	F	4 + M	48	5% + 60% WP
mefenoxam + mancozeb	Ridomil Gold MZ	F	4 + M	48	4% + 64% WP
mefenoxam + PCNB	Ridomil Gold PC	F	4 + 14	48	0.5% + 10% G
methyl bromide + chloropicrin	(R)Terr-O-Gas 50 (R)Terr-O-Gas 67	Fum		72	50% + 50% L 67% + 33% L
metiram	Polyram	F	M	24	80% DF
metalaxyl	MetaStar	F	4	48	2 L
myclobutanil	Nova	F	3	24	40% WP
PCNB	Terraclor	F	14	12	2 L, 4 L, 75% WP, 10% G
potassium bicarbonate	Armcarb 100	F		4	85% WP
potassium methyl dithiocarbamate	K-Pam HL	Fum		48	54% L
phosphorous acid	Agri-Fos Fosphite ProPhyt Phostrol	F	33	4	3.35 L 3.90 L 4.2 L 4.32 L
propamocarb	Previcur Flex	F	U	12	6 L
propiconazole	Bumper Tilt PropiMax	F	3	24	3.6 L
propiconazole + trifloxystrobin	Stratego	F	3 + 11		2.08 L
pyraclostrobin	Cabrio Headline	F	11	12	20% WDG 2.09 L
pyraclostrobin + boscalid	Pristine	F	7 + 11	24	38%WG
pyrimethanil	Scala	F	9	12	5 L
quinoxifen	Quintec	F	13	12	2.08 L
sodium methyl dithiocarbamate (metam sodium)	Metam CLR Sectagon 42 Vapam	Fum		72	33% L

Chemical Control Products for Diseases, *Continued*

Common Name	Trade Names	Type	Resistance Management Group	REI* (hours)	Formulations
streptomycin sulfate	Ag Streptomycin Agri-mycin 17 Firewall	B	18	4	21% WP
sulfur	Liquid Sulfur Six Microthiol Disperss Wettable Sulfur Thiolux Jet	F	M	24	6 L 80% DF 92% WP 80% DF
thiabendazole	Mertect 340-F	F	1	12	3.8 L
thiophanate-methyl	Topsin-M Thiophanate Methyl	F	1	12	70% WP 85%WDG
trifloxystrobin	Flint	F	11	12	50% WDG
triflumizole	Procure	F	3	12	50% WP
triphenyltin hydroxide	Super Tin	F	30	48	80% WP
ziram	Ziram 76	F	M	48	76% DF
zoxium + mancozeb	Gavel	F	22 + M	48	8.3% + 66.7% DF

* REI (restricted entry interval) is the time immediately after a pesticide application when entry into the treated area is limited. Refer to the product label for early-entry requirements.

Guide to abbreviations used: (R) = restricted-use pesticide; B = bactericide; F = fungicide; Fum = fumigant; PA = plant activator; G = granules; DF = dry flowable; D = dust; WDG = water dispersible granules; WP = wettable powder; L = liquid. Liquid formulations are expressed as pounds of active ingredient per gallon unless percent is specified.

Appendix 2

Resistance Management

Most modern fungicides and bactericides are subject to losing effectiveness due to resistance development and must be involved in a resistance management program. The essence of such programs is to minimize the use of the product, which includes rotating it with non-related products that are effective against the target disease. A “non-related” product is one that belongs to a different resistance management group. These groups are defined and separated by their mode of action, i.e., how they attack the fungus. The Fungicide Resistance Action Committee (FRAC) has established the following table to classify disease-control products. Groups that are at medium to high risk of resistance development must be alternated or tank-mixed with members of other groups.

Table 1. Resistance management groups for disease control products for vegetables.

Group Number	Group Name and Examples
Medium- to High-Risk Groups (resistance management needed)	
1	benzimidazoles (ex. Mertect, Topsin M)
2	dicarboximides (ex. Iprodione, Rovral)
3	demethylation inhibitors (DMI's), includes the <i>imidazoles</i> (ex. Procure) and the <i>triazoles</i> (ex. Nova, Tilt)
4	phenylamides (ex. Ridomil Gold, Ultra Flourish)
5	carboxamides (ex. Vitavax, Moncoat, Endura)
6	anilinopyrimidines (ex. Vanguard, Scala)
11	quinone outside inhibitors (Qoi's) (ex. Quadris, Headline, Cabrio, Flint)
12	phenylpyrroles (ex. Maxim)
13	quinolines, (ex. Quintec)
14	aromatic hydrocarbons (ex. Botran; Terraclor)
17	hydroxyanilids (ex. Decree)
21	quinone inside Inhibitors (Qii's) (ex. Ranman)
22	benzamides (ex. Gavel)
25	glucopyranosyl antibiotic (ex. Agri-mycin 17, Ag Streptomycin, Firewall)
27	cyanoacetamideoximes (ex. Curzate)
28	carbamates (ex. Previcur Flex).
40	carboxylic acid amides (ex. Acrobat, Forum, Revus)
43	acylpicolides (ex. Presidio)
Low-Risk Groups (resistance management not needed)	
29	2,6-dinitroanilines (ex. Omega)
30	organo-tin compounds (ex. Super Tin)
33	ethyl phosphonates (ex. Aliette), and phosphorous acid (ex. ProPhyt, Phostrol, AgriFos)
M1	inorganics - copper - Resistance management recommended for bacterial diseases (medium risk)
M2	inorganics - sulfur
M3	dithiocarbamates (ex. mancozeb, maneb, metiram, thiram, ziram)
M4	phthalimides (ex. captan)
M5	chloronitriles (ex. chlorothalonil)
P1	benzo-thiadiazole (ex. Actigard)
P2	harpin protein (ex. Messenger)
NC	oils, bicarbonates, biologicals (ex. neem oil, Armicarb, Contans, Serenade, AgriPhage)

M = multi-site activity, P = plant defense induction, NC = not classified

Appendix 3

Cucurbit Spray Program

Table 1. Suggested spray program for disease control in cucurbit crops.

Early season:

Use a primary fungicide (chlorothalonil, mancozeb or maneb) every 7 to 14 days (more frequently in wet weather, less frequently in dry weather). Begin the program at vine tip-over to early bloom (3 to 4 weeks after seeding). Inspect the field for disease symptoms beginning at seedling emergence so that the spray program can be started sooner than planned, if needed. If plectosporium blight appears in pumpkin or squash, Flint or Cabrio should be alternated with the primary fungicide. Otherwise, there is little need to rotate the primary fungicides with other fungicides in the early season. (Chlorothalonil, mancozeb and maneb are not subject to the development of resistance, so continued use is not a problem).

Mid-Late Season:

Scout for powdery mildew when this disease becomes a threat, around mid-summer. When the first powdery mildew colonies (circular, white patches) are seen, add sulfur, Nova or Procure to the tank with the primary fungicide (preferably chlorothalonil, when powdery mildew is present). This tank mix can be alternated with Pristine, if desired. Do not depend on Flint, Cabrio or Quadris for powdery mildew control, since this fungus has begun developing resistance to the strobilurins. Various diseases can occur in mid-late season, and the choice of fungicides should be determined by which diseases appear in the current year, or have occurred in the field in previous years. Air blast sprayers are needed when canopies become thick. Apply sprays every 7 to 14 days, depending on rainfall. Add copper to the tank mix if angular leaf spot or bacterial leaf spot appear.

Table 2, on the following page, provides efficacy ratings for disease-control products labeled for cucurbit crops. It will assist in selecting the most appropriate fungicide for the diseases encountered in a field.

Table 2. Relative effectiveness of disease-control products in cucurbit crops (0 to 5 scale).

Product ^a	Alternaria Leaf Spot	Anthracnose	Downy Mildew	Gummy Stem Blight	Phytophthora Blight	Plectosporium (Microdochium) Blight	Powdery Mildew
Acrobat	0	0	1	0	1	0	0
Aliette	0	0	1	0	0	0	0
Cabrio	4	4	3	4	1	4	0 - 4 ^b
chlorothalonil	3	4	3	4	0	3	3
copper, fixed	0	1	3	1	1	2	2
Curzate	0	0	3	0	2	0	0
Flint	4	4	1	4	0	4	0 - 4 ^b
Gavel	3	2	4	2	1	2	1
maneb, mancozeb	3	3	3	3	1	3	1
mefenoxam	0	0	0 - 3 ^b	0	0 - 3 ^b	0	0
Nova	0	0	0	0	0	0	5
phosphorous acid	0	0	2	0	1	0	0
Previcur Flex	0	0	3	0	1	0	0
Presidio	0	0	4	0	2	0	0
Pristine	4	4	3	5	1	3	3
Procure	0	0	0	0	0	0	5
Quadris, Amistar	4	4	3	4	0	2	0 - 4 ^b
Quintec	0	0	0	0	0	0	5
Ranman	0	0	4	0	2	0	0
Reason	2	0	4	0	--	0	0
Revus	0	0	2	0	3	0	0
sulfur	0	0	0	0	0	0	4
Tanos	–	–	4	0	–	0	0
Topsin-M	0	2	0	2	0	2	0 - 4 ^b

0= not effective, 1= slight control, 2= fair control (adequate only when conditions are unfavorable for the disease), 3= moderate control (adequate in most seasons), 4= very good control, 5= excellent control. All of these ratings apply to the use of these materials on a regular, preventive schedule begun before the onset of disease.

^a Please refer to Table 7 for trade names.

^b The occurrence of resistance in pathogen populations results in unpredictable control by these materials.

Appendix 4

Tomato Spray Program

A tomato spray program should focus on materials that protect against early blight while also providing some protection against other diseases. A broad-spectrum material should be included each application and add specialized products, listed in this publication, as needed for other unexpected diseases that may occur, such as late blight, gray mold or Sclerotinia.

If problems with bacterial spot or speck are expected, apply mancozeb+Actigard the first week after transplanting. Use mancozeb+copper the following spray and alternate that with a strobilurin (Cabrio or Quadris)+Actigard until the allowed number of applications has been reached (6 for strobilurins, 6 for Actigard). If bacterial disease control is still needed at that time, use copper in each application. The 5-day PHI for mancozeb may not be compatible with a harvest schedule. If so, substitute chlorothalonil for mancozeb during harvest. Likewise, Actigard should be discontinued during harvest because of its 14-day PHI.

Table 1. Suggested spray program for disease control in tomato crops.

Week	Products
1	man. + Act.
2	man. + cop./phage
3	strob. + Act.
4	man. + cop./phage
5	strob. + Act.
6	man. + cop./phage
7	strob. + Act.
8	man. + cop./phage
9	strob. + Act.
10	man. + cop./phage

Week	Products
11 - begin harvest	strob. + cop./phage
12	chlor. + cop./phage
13	strob. + cop./phage
14	chlor. + cop./phage
15	chlor. + cop./phage

man. = maneb or mancozeb

Act. = Actigard

cop./phage = choice of copper or Agri-Phage

strob. = Quadris or Cabrio (strobilurins)

chlor. = chlorothalonil

In areas in which bacterial spot or speck problems are not expected, omit Actigard, copper and Agri-Phage. Copper and Agri-Phage can be added if bacterial diseases appear.

Table 2, on the following page, provides efficacy ratings for disease-control products labeled for tomato. It will assist in selecting the most appropriate fungicide for the diseases encountered in a field.

Table 2. Relative effectiveness of disease-control products in tomato (0 to 5 scale).

Product ^a	Early Blight	Late Blight	Septoria Leafspot	Gray Mold	Bacterial Spot, Speck
Actigard	0	0	0	0	3
AgriPhage	0	0	0	0	2
Acrobat	0	4	0	0	0
Cabrio	5	4	4	0	0
chlorothalonil	3	4	4	2	0
copper, fixed	2	2	2	0	3
Curzate	0	4	0	0	0
Endura	4	0	--	3	0
Flint	3	2	--	0	0
Gavel	3	4	3	0	0
maneb, mancozeb	3	2	4	0	0
mefenoxam	0	– ^b	0	0	0
Previcur Flex	0	3	0	0	0
Quadris, Amistar	5	3	4	0	0
Ranman	2	3	0	0	0
Reason	3	3	1	0	0
Scala	2	0	0	3	0
Tanos	3	4	3	0	1

0= not effective, 1= slight control, 2= fair control (adequate only when conditions are unfavorable for the disease), 3= moderate control (adequate in most seasons), 4= very good control, 5= excellent control. All of these ratings apply to the use of these materials on a regular, preventive schedule begun before the onset of disease. These ratings apply to commonly used rates of the products, applied so that the plants are adequately covered.

^a Please refer to Table 7 for trade names.

^b Not recommended for late blight control because of the prevalence of resistant strains.