

2015

Louisiana
Plant Disease
Management Guide



2015 Louisiana Plant Disease Management Guide

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Introduction

The LSU AgCenter Plant Disease Management Guide is a resource for crop producers in Louisiana and surrounding states. This guide provides integrated management tactics for the most important or more prevalent diseases that affect agricultural and horticultural crops grown in Louisiana.

Disease management recommendations are based on research results of experiments conducted by the LSU AgCenter, other land-grant universities in the United States and the U.S. Department of Agriculture's Agricultural Research Service. Disease management recommendations found in this guide are updated at least annually and, if necessary, more frequently. The name of the primary contributor for each section and the date the information was last revised are located at the end of each section. Questions pertaining to specific recommendations should be directed to the section contributor(s).

Successful management of plant diseases requires a disease management program that integrates the use of available resistant varieties, good cultural practices, weed and insect control, biocontrol and chemical control. Newly revised chapters include integrated disease management tactics. While many pesticides are labeled for disease management, not all are included in this guide. References to commercial or trade names are made with the understanding that no discrimination is intended and endorsement of a particular product by the LSU AgCenter or LSU is not implied. More information on available pesticides can be obtained at www.cdms.net.

Pesticide Use and Safety

Pesticides are important management tools in an integrated pest management program (IPM). Pesticides should be used in a manner that limits worker, domestic animal and wildlife exposure, as well as runoff, drift and the buildup of pesticide resistant pathogens. Adequate training should be provided to all employees on how to use pesticides safely. For more pesticide safety information or a list of pesticide certifications or recertification conferences for the state go to [http://www.lsuagcenter.com/en/our_offices/departments/W.A. Callegari Environmental Center/pesticide_ed/](http://www.lsuagcenter.com/en/our_offices/departments/W.A._Callegari_Environmental_Center/pesticide_ed/) or contact:

Kim Pope
Pesticide Safety Education Coordinator
kpope@lsuagcenter.lsu.edu
225-578-3018

Before applying a pesticide to a crop:

- Confirm that the problem is due to a pathogen, insect or weed.
- Have the disease identified by an authority on plant pathogens and diseases.
- Select a pesticide that is recommended for the disease.
- Confirm that the pesticide is registered with the Environmental Protection Agency (EPA) and labeled for the crop on which you intend to use it.
- Read the product label in its entirety. Pay particular attention to any application restrictions that may exist for the product.
- Check that your application equipment is functioning properly by testing it using just water. Make all repairs prior to using a pesticide.
- Calibrate application equipment at the beginning of the season and at least twice throughout the season to ensure proper pesticide output.
- Confirm that your respirators fit properly and are clean and functioning.
- Check that gloves and protective clothing fit properly, are clean and free of holes. Always have extra clean clothes available in case of an emergency.

Application of pesticides:

- Always wear protective clothing and a respirator while spraying.
- Spray during calm weather to avoid pesticide drift.

Preparation, storage and disposal of pesticides:

- Always wear protective clothing when handling pesticides.
- Mix pesticides in a well-ventilated area with access to clean water, soap and single-use towels (decontamination supplies).
- Product labels and material safety data sheets, as well as emergency contact information, should be available for quick reference.
- Only compatible pesticides should be tank-mixed. Read labels carefully to confirm pesticide compatibility.
- Do not prepare or store pesticides near food.
- Only prepare the amount of pesticide required to treat the crop.
- Store pesticides in a locked room at the recommended temperature.

Pesticide Use and Safety

- For proper (and legal) disposal of unused pesticides, contact your local solid waste management authority, environmental agency or health department. To identify a local authority, go to: <http://www.epa.gov/wastes/wyl/stateprograms.htm> or call 1-800-CLEANUP. **Do not pour leftover pesticides down the sink, into the toilet or down a sewer or street drain!**

After applying a pesticide to a crop:

- Promptly post signs indicating the crop has been treated with a pesticide.
- Clean and decontaminate equipment according to the product label.
- Document the day, time, crop and type and amount of pesticide applied. **Careful record keeping is extremely important.**

In case of an emergency:

- In the case of direct human exposure that results in personal injury or ingestion of a pesticide, immediately dial 911 and/or contact your local physician.
- In the case of an environmental spill, contact your local environmental protection agency representative.

This section was revised by Dr. M. Lewis Ivey in December 2014.

Fungicide Resistance Management

Fungicides are important tools for managing many diseases in agricultural and horticultural crops. Fungicides are most effective when applied before fungal infections are established. Because protection by fungicides is temporary, they may need to be reapplied to protect new growth.

While many factors can contribute to the failure of a fungicide to protect a crop, the development of resistance by the fungal pathogen is the most difficult to overcome. Resistance is a heritable genetic trait that results in reduced sensitivity to a fungicide by a fungal pathogen. Fungicides that disrupt multiple cellular functions (multisite inhibiting fungicides) in the pathogen are less likely to result in resistant pathogen populations than those that target a single cellular function (single site-specific fungicides). Most new fungicides are single site-specific; however, because they have less of an effect on the environment, including nontarget organisms.

Fungal pathogens that are resistant to one fungicide often are resistant to other fungicides that have a similar or same mode of action. This is called cross-resistance. For this reason, the Fungicide Resistance Action Committee developed fungicide group codes, referred to as FRAC codes, to facilitate resistance management. Fungicides with the same FRAC code have a similar mode of action and could exhibit cross-resistance. There currently are 43 numbered and three lettered FRAC codes. A full list of the codes for all fungicide common names (active ingredients), their modes of action and the risk level (low, medium or high) for fungicide resistance development can be found at <http://www.frac.info/publication/anhang/FRAC%20Code%20List%202013-update%20April-2013.pdf>.

The FRAC codes also are listed on the front of a product label or in the resistance management section.

Fungicide resistance in a pathogen population becomes important when fungicide-resistant isolates outnumber fungicide-sensitive isolates. ***The buildup of resistant isolates is caused by repeated or incorrect use of a fungicide.*** Fungicide resistance within a population occurs at different rates and is affected by the mode of action of the fungicide, the genetics of the pathogen and cropping practices.

Strategies for managing fungicide resistance are aimed at slowing down the development of resistance. Therefore, resistance management plans must be implemented when at-risk fungicides become available for a particular use before resistance becomes a problem. The objective of a resistance management program is to minimize the use of at-risk fungicides without compromising disease control. While specific strategies vary depending on the fungicide FRAC code, the target pathogen and the crop, the general approach is similar. A resistance management program should integrate resistant varieties, good cultural practices and thoughtful and judicious use of fungicides.

Resistant Varieties: Whenever feasible, resistant varieties should be selected. The use of resistant varieties lowers the potential for disease incidence and severity and thereby minimizes the need for fungicides.

Good Cultural Practices: Proper sanitation and crop rotations can lower initial pathogen populations, while proper soil fertility and the use of high quality water can reduce disease incidence. To decrease the potential for fungicide resistance, avoid sites with a history of disease.

Fungicide Resistance Management

Fungicide Use: Fungicides should only be used when alternatives are not available to avoid unnecessary selection of fungicide resistant populations. The following practices should be used when fungicides are necessary:

- Start fungicide applications early in disease development.
- Use low-risk fungicides when possible.
- Use optimal application methods to maximize spray coverage.
- Do not apply fungicides at rates below or above the range specified in the label.
- Do not apply a fungicide more than two times sequentially. Alternate (apply a fungicide at most twice and then switch) fungicides from different FRAC codes.
- Alternatively, tank-mix at-risk fungicides with a protectant fungicide. Refer to product labels to ensure fungicides are compatible or to confirm that the fungicide is not already a pre-mix.
- Refer to product labels for specific resistance management guidelines.
- Do not exceed the number of fungicide applications (or maximum use amount) recommended by the manufacturer.

The fungicide resistance management section was revised December 2014 by Dr. M. Lewis Ivey.

Abbreviations

Throughout this guide, units of measurement and time are abbreviated. The table below lists the units of measure or time and the corresponding abbreviations.

Term	Abbreviation
Day	d
Feet	ft
Fluid ounce	fl oz
Hour	hr
Inch	in
Minutes	min
Ounce	oz
Pint	pt
Pound	lb
Quart	qt
Square feet	ft ²
Year	yr
Other Abbreviations	
Active ingredient	a.i.
Organic Materials Review Institute	OMRI
OMRI Listed	OG

Plant Diagnostic Center

Instructions for Collecting, Packaging and Shipping Plant Samples

Accurate and rapid diagnoses depend on the quality and quantity of the sample submitted.. No one method of preparation for shipping plant materials will guarantee their satisfactory arrival in the laboratory, but following the suggestions given below generally will ensure specimens will be received in good condition.

Specimens completely desiccated or in advanced states of decay, and those that arrive without supporting information and diagnostic fees will have to be discarded. This represents time and labor wasted for the sender and personnel at the LSU AgCenter. **Note:** Findings reported are based on examination of the material submitted. Some diagnoses require intensive studies. Because the time devoted to individual specimens must be limited, reports, while reflecting considered opinion and best judgment, may not always be statements of complete facts.

To get the best possible results, follow these instructions:

General Guidelines for Submitting Plant Samples for Routine Diagnosis:

Please consult the following guidelines before collecting, packing and submitting the samples.

- ✓ Plan to collect and submit samples early in the week.
- ✓ Pack samples properly. (See “Sample Packaging and Mailing” below.)
- ✓ Collect specimens representing a range of symptoms.
- ✓ Collect all parts of the plant that show symptoms.
- ✓ Collect specimens before applying any chemicals.
- ✓ Submit a generous amount of plant material.
- ✓ Samples must be accompanied with a completed “Sample Submission Form.” Samples without this form will not be diagnosed. Place Sample Submission Form in a plastic bag when sample contains roots, soil or perishable tissue.
- ✓ Samples must be accompanied by the diagnostic fee. (Samples without diagnostic fee may not be diagnosed).
- ✓ Write correct mailing address on the package.
- ✓ Specimens from different plant species should be packed separately.
- ✓ Out-of-state samples must be accompanied by the PPQ 526 permit for interstate movement of the plant/plant material. (Contact Dr. Raj Singh at rsingh@agcenter.lsu.edu or 225-578-4562 for the permit.)

For Plant Disease Diagnostics:

Plants showing wilting, yellowing or general decline:

1. Send whole plants including roots, if practical. Be sure to send plants showing early stages of disease.
2. Dig up carefully. (Don't pull up!)
3. Send sample of soil and feeder roots in plastic bag. Seal to avoid loss of moisture. Don't add any excess water to the sample.

Plant Diagnostic Center

Cankers:

1. Select specimens from recent infestations. Send entire cankered portion, if possible, with some of the healthy wood above and below the canker.
2. Branches and twigs that have been dead for several months are useless for identification.

Leaf spots/blights/scorch:

1. Collect several (15-20) leaves showing early and late stages of infestation.
2. For scorch symptoms, send in the affected twig/branch with leaves attached. Cut several foot-long twigs showing leaf scorch symptoms, wrap these in dry paper towel(s) and pack in plastic bag.
3. For spots or blight, wrap leaves in dry paper towel(s) and pack those in plastic bags.
4. It usually is not possible to diagnose marginal burning or other injury symptoms on leaves.

Fleshy organs:

1. Rots of fleshy fruits and vegetables need special attention. Do not send those in advanced stages of decay.
2. Select fresh specimens showing early symptoms.
3. Place specimens in a plastic bag with dry paper towel(s). Do not add extra moisture. Fleshy vegetables and fruit specimens should be wrapped separately. Keep cool until shipped.

Homeowner turfgrass samples:

1. Collect turf samples with early and advanced stages of disease development. Completely dead turfgrass seldom generates an accurate diagnosis.
2. Collect turf sample from transition zone between healthy and diseased turfgrass so it contains both healthy and affected turf.
3. Collect a 6-inch-by-6-inch section of affected turf with soil intact.
4. Wrap the sample in newspaper or aluminum foil.
5. Place sample in a sturdy cardboard box and pack securely.
6. Do not add water to the sample.
7. Place the completed Sample Submission Form and diagnostic fee in a plastic bag and send it with the sample.
8. Ship turf samples to the Plant Diagnostic Center immediately after collection.

For Nematode Diagnosis/Identification:

1. Late summer and fall are the best times to take nematode samples.
2. Nematode samples require at least one pint of soil from approximately 20 random soil probes. Mix soil together and mail in plastic bag.
3. A Nematode Assay Form with required information must accompany samples.
4. Protect sample from heat and light.

Plant Diagnostic Center

For Insect Pests or Mite Diagnosis/Identification:

1. Collect damaged plant parts, such as leaves or twigs, wrap these in dry paper towel(s) and place the wrapped tissue in plastic bags.
2. If root samples are submitted, pack the damaged roots, with soil intact, in plastic bags.
3. Submit insect specimens in glass vials containing ethanol. Label the vials with the collection information, including the site, host, date and collector's name.
4. Complete the Sample Submission Form for each sample/vial submitted for diagnosis.

For Weed Identification:

1. Send the entire plant for identification. Leaves alone may not be sufficient for an accurate identification.
2. Dig up carefully. (Don't pull up!)
3. Wrap roots in plastic bag and rest of the plant in dry paper towel(s) and pack the entire plant in a plastic bag.
4. High-quality images of the plant where it was growing may aid in identification.

Sample Packaging and Mailing:

1. Do not add water to samples.
2. Wrap plant tissue such as leaves or twigs in dry paper towel(s) and place in plastic bags.
3. Pack foliage and roots collected from same plant in separate plastic bags.
4. Wrap fruit samples in dry paper towel(s).
5. Pack samples in a sturdy cardboard box. Wrap package in heavy paper. Attach envelope containing Sample Submission Form to outside of package.
6. Identify package with both outside and inside labels and protect inside label from moisture.
7. Address package to: Plant Diagnostic Center, 302 Life Sciences Building, 110 LSU Union Square, Baton Rouge, LA 70803.
8. Mail packages to arrive on weekdays (Monday through Friday) rather than on the weekend.

Remember, the better the specimen, the more accurate the diagnosis!

Diagnostic Fee Schedule

Diagnostic Service	Diagnostic Fee	
	In-state Samples	Out-of-state Samples
Routine diagnostics	\$20	\$40
Serological and biochemical tests	\$40	\$60
Molecular diagnostics	\$75	\$100
Rapid turfgrass diagnostics	\$75	\$100

Rapid Turfgrass Diagnostics

The rapid turfgrass diagnostics service is intended for commercial golf courses, athletic fields and landscapes. It always is preferred to check with the diagnostician before collecting and submitting turfgrass samples for rapid turfgrass diagnosis.

Plant Diagnostic Center

Turfgrass Sample Collection:

1. Collect turf samples with early and advanced stages of disease development.
2. Collect turf samples from transition zone between healthy and diseased turfgrass so samples contain both healthy and affected turf.
3. Collect two samples from each problem area. Samples can be either “cup cutter” samples or a sample at least 6 inches by 6 inches.
4. Completely dead turfgrass seldom generates an accurate diagnosis.

Turfgrass Sample Packaging:

1. Wrap samples in newspaper or aluminum foil.
2. Place samples in a sturdy cardboard box and pack securely.
3. Do not add water to samples.
4. Ship samples to the Plant Diagnostic Center immediately after collection.
5. Do not forget to include the completed Rapid Turfgrass Sample Submission Form with the samples.
6. Samples without the appropriate Sample Submission Form(s) and diagnostic fee(s) will not be processed.
7. The rapid turfgrass diagnostic service is provided for a charge of \$75 for in-state and \$100 for out-of-state samples.
8. Make check payable to “*LSU AgCenter PDC.*”

Turfgrass Sample Submission:

1. Ship samples to correct mailing address.
2. Ship samples early in the week.
3. Samples should be delivered overnight (preferably via courier services).
4. Samples will not be received on Saturdays, Sundays and other LSU AgCenter holidays.

Sample Submission Address:

Plant Diagnostic Center
302 Life Sciences Building
110 LSU Union Square
Baton Rouge, LA 70803

Contact Information:

Dr. Raghuwinder “Raj” Singh
Email: rsingh@agcenter.lsu.edu
Phone: 225-578-4562
Fax: 225-578-1415
www.lsuagcenter.com/PlantDiagnostics

Commercial Crop Production Field Crops – Corn

Table 1. Symptoms, source of inoculum and management of diseases of corn	
Disease	
Charcoal Rot (<i>Macrophomina phaseolina</i>)	<p>Symptoms: Injury from this disease usually does not become evident until plants approach maturity. Diseased plants exhibit poorly developed ears, premature ripening, lodging and drying of the stalk. Stalks are soft and discolored at the base, and the pith becomes shredded.</p> <p>Source of Inoculum: This fungus survives in old plant debris or in the soil.</p> <p>Management: Rotate crops. Bury stubble. Maintain balanced potassium/nitrogen rates.</p>
Common Rust (<i>Puccinia sorghi</i>)	<p>Symptoms: Common rust can be recognized by small oval to elongated pustules, which are at first cinnamon-brown and then become brownish-black as the corn matures. The pustules may appear on any aboveground part of the plant but are most abundant on the leaves – scattered over both surfaces.</p> <p>Source of Inoculum: Spores usually are windblown from the south. An alternate host is the wood sorrel (<i>Oxalis</i> sp.).</p> <p>Management: Most hybrids are tolerant to this disease. Always use the recommended hybrids for your area.</p>
Fusarium Stalk Rot (<i>Fusarium</i> spp.)	<p>Symptoms: Leaves of infected plants become grayish-green as plants approach maturity. Softening and discoloration of the exterior of lower internodes occur. When stalks are affected with stalk rot, they split and generally will show a reddish discoloration of the diseased area.</p> <p>Source of Inoculum: This fungus lives in old stubble or in the soil.</p> <p>Control: Practice crop rotation. Plow crop residue under. Make sure adequate potassium is applied with high nitrogen rates.</p>
Gray Leaf Spot (<i>Cercospora zae-maydis</i>)	<p>Symptoms: The early lesions produced on the corn leaves by <i>Cercospora zae-maydis</i> are yellow to tan in color and look similar to those produced by other diseases except they have a faint watery halo that can be seen when held up to the light. After about two weeks, the lesions appear tan to brown and rectangular shaped, bordered by the veins of the leaf. When fully expanded, individual lesions may be 3 to 4 inches long and 1/16 to 1/8 inch wide, depending on the distance between veins. If several infections occur near each other on the same leaf, however, a broader lesion will result.</p> <p>Source of Inoculum: The fungus causing gray leaf spot overwinters in and on corn debris left above and on the soil surface.</p> <p>Management: Hybrids are available with moderate resistance. Crop rotation and clean plowing are effective in reducing the level of surviving fungus in fields.</p>
Northern Corn Leaf Blight (<i>Exserohilum tursicum</i>)	<p>Symptoms: Leaves of infected plants have a few to numerous elongated (up to 1 inch by 6 inches) leaf spots that are tan but reveal black spore growth at maturity.</p> <p>Source of Inoculum: Carried on the seed and in old plant refuse, spores also are readily windborne.</p> <p>Management: Disease resistance is available. The hybrids should also be ones recommended for your area.</p>

Commercial Crop Production Field Crops – Corn

Table 1. Symptoms, source of inoculum and management of diseases of corn	
Disease	
Smut (<i>Ustilago maydis</i>)	<p>Symptoms: All aboveground parts of the plant are susceptible, particularly the young, actively growing embryonic corn tissue. Symptoms are easily recognized. Galls are first covered with a glistening greenish-white to silvery-white membrane. Except for galls on leaves, the interiors of the galls soon darken, with the membrane rupturing to expose millions of greasy to powdery, sooty spores known as chlamydospores or teliospores. Galls on leaves seldom develop beyond pea-size, becoming hard and dry without rupturing. Early infection may kill young plants, but not often.</p> <p>Source of Inoculum: The teliospores of this fungus overwinter on the soil surface.</p> <p>Control: Use hybrids recommended for your area. Most have adequate resistance.</p>
Southern Leaf Blight (<i>Bipolaris maydis</i> = <i>Helminthosporium maydis</i>)	<p>Symptoms: Leaves of infected plants have numerous elongated spots between the veins. The spots are buff to reddish-brown.</p> <p>Source of Inoculum: Carried on the seed and in old plant refuse, spores also are readily windborne.</p> <p>Management: Use only seed produced by normal tasseling (N). The hybrids also should be ones recommended for your area.</p>
Southern Rust (<i>Puccinia polysora</i>)	<p>Symptoms: Southern rust is recognized by small circular to oval pustules, which are light cinnamon-brown. The pustules may appear on leaves and sheaths but are most abundant on the leaves.</p> <p>Source of Inoculum: Spores are windblown from the south. No alternate host is known.</p> <p>Management: Use hybrids tolerant to this disease. Fungicides might be necessary if southern rust symptoms are expressed prior to soft dough growth stage.</p>

Management of Corn Diseases Using Fungicides

Based on fungicide experimentation over the past five years, it has been determined that fungicides should only be used if corn foliar diseases are present and threaten the ear leaf with diseased areas covering 5% or more.

The Corn Disease Working Group (CDWG) has developed the following information on fungicide efficacy for control of major corn diseases in the United States. Efficacy ratings for each fungicide listed in the table were determined by field testing the materials over multiple years and locations by the members of the committee. Efficacy ratings are based upon level of disease control achieved by product, and are not necessarily reflective of yield increases obtained from product application. Efficacy depends upon proper application timing, rate, and application method to achieve optimum effectiveness of the fungicide as determined by labeled instructions and overall level of disease in the field at the time of application. Differences in efficacy among fungicide products were determined by direct comparisons among products in field tests and are based on a single application of the labeled rate as listed in Table 2. Available systemic fungicides that have been tested over multiple years and locations are provided in Table 2. The information in Table 2 is not intended to be a list of all labeled products.

Commercial Crop Production Field Crops – Corn

Table 2. Efficacy of systemic fungicides in managing diseases of corn
Efficacy categories are as follows: NR indicates Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent; NL = Not Labeled for use against this disease; -- = Insufficient data to make statement about efficacy of this product for this disease.

Fungicide ¹ Information		Disease						
Class and Mode of Action Group ²	Active Ingredient	Product ³	Rate ⁴ (fl oz)	Common Rust	Gray Leaf Spot	Northern Leaf Blight	Southern Rust	Harvest Restrictions ⁵
QoI Strobilurins Group 11	Azoxystrobin, 22.9%	Quadris 2.08 SC	6-15.5	E	E	G	G	7 days
	Fluoxastrobin, 40.3%	Evito 480 SC	2-5.7	--	--	--	--	R4, dough
	Pyraclostrobin, 23.6%	Headline 2.09 EC/SC	6-12	E	E	VG	E	7 days
	Picoxystrobin	Aproach 2.08 SC	3-12	--	--	--	--	7 days
DMI Triazoles Group 3	Propiconazole, 41.8%	Tilt 3.6 EC, MG7	2-4	VG	G	G	G	30 days
	Prothioconazole, 41.0%	Proline 480 SC	5.7	--	--	VG	G	14 days
	Tebuconazole, 38.7%	Folicur 3.6F, MG7	4-6	--	--	VG	--	36 days
	Tetraconazole, 20.5%	Domark 230 ME	4-6	--	--	--	G	R3, milk

Commercial Crop Production Field Crops – Corn

Table 2. Efficacy of systemic fungicides in managing diseases of corn
Efficacy categories are as follows: NR indicates Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent; NL = Not Labeled for use against this disease; -- = Insufficient data to make statement about efficacy of this product for this disease.

Fungicide ¹ Information			Disease					
Class and Mode of Action Group ²	Active Ingredient	Product ³	Rate ⁴ (fl oz)	Common Rust	Gray Leaf Spot	Northern Leaf Blight	Southern Rust	Harvest Restrictions ⁵
Mixed ⁶	Azoxystrobin, 7.0% Propiconazole, 1.7%	Quilt 200 SC	7-14	VG-E	E	VG	VG	30 days
	Azoxystrobin 13.5% Propiconazole 11.7%	Quilt Xcel 2.2 SE	10.5-14	VG-E	E	VG	VG	30 days
	Pyraclostrobin 13.6% Metconazole 5.1%	Headline AMP 1.68 SC	10-14.4	E	E	VG	VG	20 days
	Pyraclostrobin 8.58% Fluxapyroxad 14.33%	Priaxor 4.17 SC	4-8	--	--	--	G	21 days
	Trifloxystrobin 11.4% Propiconazole 11.4%	Stratego 250 EC	10-12	VG	VG	G	G	14 days

Commercial Crop Production Field Crops – Corn

Table 2. Efficacy of systemic fungicides in managing diseases of corn

Efficacy categories are as follows: NR indicates Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent; NL = Not Labeled for use against this disease; -- = Insufficient data to make statement about efficacy of this product for this disease.

Fungicide ¹ Information			Disease					
Class and Mode of Action Group ²	Active Ingredient	Product ³	Rate ⁴ (fl oz)	Common Rust	Gray Leaf Spot	Northern Leaf Blight	Southern Rust	Harvest Restrictions ⁵
	Trifloxystrobin 32.3% Prothioconazole 10.8%	Stratego YLD 4.18 SC	4-5	E	E	VG	VG	30 days

¹ Additional fungicides are labeled for disease on corn, including contact fungicides such as chlorothalonil. Certain fungicides may be available for diseases not listed in the table, including Gibberella and Fusarium ear rot. Applications of Proline 480 SC for use on ear rots requires a FIFRA Section 2(ee) and is only approved for use in Illinois, Indiana, Iowa, Louisiana, Maryland, Michigan, Mississippi, North Dakota, Ohio, Pennsylvania, and Virginia.

² Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).

³ Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied. Many products have specific use restrictions about the amount of active ingredient that can be applied within a period of time or the amount of sequential applications that can occur. Please read and follow all specific use restrictions prior to fungicide use. This information is provided only as a guide. It is the responsibility of the pesticide applicator by law to read and follow all current label directions. Members or participants in the CDWG assume no liability resulting from the use of these products.

⁴ Rates are the amount of formulation (product) per acre unless otherwise indicated.

⁵ Harvest restrictions are listed for field corn harvested for grain. Restrictions may vary for other types of corn (sweet, seed or popcorn, etc.), and corn for other uses such as forage or fodder.

⁶ Refer to product label for the fungicide class and mode of action group.

⁷ Multiple generic fungicides available.

Commercial Crop Production Field Crops – Corn

Table 3. Recommended fungicides, rates and application timing for corn diseases					
Target	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	Time of Application	PHI ⁴	
Leaf Blights (primarily Helminthosporium and Excerohilum spp.)	AmTide Propiconazole 41.8% EC	3	At first appearance	30	
	Avaris	11	At first appearance	30	
	Bumper	3	At first appearance	30	
	Fitness	3	At first appearance	30	
	Headline AMP	11	Prior to disease development	20	
	Headline SC	11	Prior to disease development	7	
	Manzate Flowable	M	At first appearance	7	
	Orius 3.6F	3	Prior to disease development	36	
	Penncozeb 75DF	M	Onset of disease	40	
	Penncozeb 80WP	7	Onset of disease	40	
	PropiMax	3	At first appearance	30	
	Quadris	11	Prior to disease development	7	
	Quadris S	11	Prior to disease development	7	
	Quilt	11,3	At first appearance	30	
	Quilt Xcel	11,3	At first appearance	30	
	Stratego	11,3	At first appearance	30	
	Stratego YLD	11,3	At first appearance	14	
	Tebuzol 3.6F	3	Prior to disease development	36	
	Tilt	3	At first appearance	30	
	Rust (Common only)	Quadris	11	Prior to disease development	7
Quadris S		11	Prior to disease development	7	
Rusts (Common and southern)	AmTide Propiconazole 41.8% EC	3	At first appearance	30	
	Bumper	3	At first appearance	30	
	Fitness	3	At first appearance	30	
	Headline AMP	11	Prior to disease development	20	
	Headline SC	11	Prior to disease development	7	
	Orius 3.6F	3	Prior to disease development	36	
	PropiMax	3	At first appearance	30	
	Quilt	11,3	At first appearance	30	

Commercial Crop Production Field Crops – Corn

Table 3. Recommended fungicides, rates and application timing for corn diseases				
Target	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	Time of Application	PHI ⁴
	Quilt Xcel	11,3	10.5-14 oz	30
	Stratego	11,3	10-12 oz	30
	Stratego YLD	11,3	4-5 oz	14
	Tebufol 3.6F	3	4-6 fl oz	36
	Tilt	3	At first appearance	30

¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.

²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).

³Rates are the amount of formulation (product) per acre unless otherwise indicated.

⁴Pre-harvest interval (PHI) is the minimum number of days allowed between the last application and harvest.

The corn section was revised December 2014 by Dr. C. Hollier.

Field Crops Cotton

Symptoms, source of inoculum and management of diseases of cotton.	
Disease	
Seedling Diseases (<i>Rhizoctonia</i> spp., <i>Pythium</i> spp., <i>Fusarium</i> spp., and other fungi)	<p>Symptoms: Loss before emergence is characterized by a rot of the seed or seedling. After emergence, affected seedlings have dark lesions on the stem, often girdling the stem and extending downward into the root system. Older plants have reddish-brown, sunken lesions near the soil line.</p> <p>Source of Inoculum: Some of the organisms causing seed rot and seedling diseases may be carried on the seed coat while others persist in the soil.</p> <p>Management: Use only high-quality seed. Plant seed only when soil temperatures at a 4-inch depth reach 68°F for 3 to 4 days. Plant only treated seed to a weed-free seedbed. Plant at proper depth for soil type and weather conditions. Use a recommended soil fungicide or fungicide/nematicide combination. See table on fungicides.</p>
Leaf Spots (<i>Alternaria</i> spp., <i>Cercospora gossypina</i> , <i>Stemphylium</i> spp., and other fungi)	<p>Symptoms: Brown to red to tan circular lesions on leaves that may occur at any stage. Lesions may be up to ¾ inch in size, and margins usually appear reddish to purple. As the diseases progress, centers of lesions may appear sooty due to sporulation of the pathogen and eventually fall away resulting in a “shothole” appearance of foliage. In cases of heavy infestation, lesions may overlap and cause premature defoliation resulting in decreased lint yields.</p> <p>Source of Inoculum: Fungi overwinter in previous crop/weed debris.</p> <p>Management: Plow under infected plant debris. Plant high-quality, acid-delinted, fungicide-treated seed. Avoid nutrient stresses (particularly Potassium), drought stress, and other pest damage. On highly susceptible varieties, foliar fungicides may be beneficial.</p>
Target Spot (<i>Corynespora cassiicola</i>)	<p>Symptoms: Brown to tan circular lesions on leaves usually beginning at bloom or canopy closure. Lesions usually will not have reddish to purple margins when found low in the canopy and will have a “bullseye” appearance. Target spot lesions are usually larger than other leaf spot lesions. The disease progresses from low in the canopy upward, and severe defoliation may occur.</p> <p>Source of Inoculum: The pathogen will overwinter in crop debris. Soybean is an alternative host and may harbor the pathogen.</p> <p>Management: Destroy debris. Some varieties may tolerate target spot better than others. Avoid rank plant growth. Scout closely prior to and after canopy closure. Scout nearby soybeans for target spot. Foliar fungicides may lower disease incidence, and in some cases preserve yield. Fungicide coverage is key, and applications should be made by ground with a minimum total volume of 10 gal/A with high pressure, hollow cone or fine droplet nozzles.</p>
Verticillium Wilt (<i>Verticillium</i> sp.)	<p>Symptoms: Leaf margins and between veins have pale yellow markings. Severely affected plants shed the young bolls. Light brown discoloration occurs in the interior woody tissue of the stem with little to no discoloration just beneath the bark. Occurs in cool weather with or without nematodes.</p> <p>Source of Inoculum: Fungus lives indefinitely in the soil.</p> <p>Control: Rotate with soybeans, sorghum, or small grains.</p>
Fusarium Wilt (<i>Fusarium</i> sp.)	<p>Symptoms: Plants usually are stunted and may fruit early. Leaves may turn yellow, wilt and drop. Brown to dark brown discoloration occurs on woody tissue just beneath the bark. It is more severe on sandy soils, during hot weather and when root-knot or reniform nematodes are present. (See also root-knot nematodes below.)</p> <p>Source of Inoculum: Fungus lives indefinitely in soil. Nematodes, likewise, live from year to year in the soil.</p> <p>Management: Use of tolerant varieties. Most recommended varieties exhibit tolerance to Fusarium wilt. Under more severe conditions, use recommended nematicides. (Refer to table on nematode control in field crops.)</p>

Field Crops Cotton

Symptoms, source of inoculum and management of diseases of cotton.	
Disease	
Root Knot Nematodes (<i>Meloidogyne</i> sp.)	<p>Symptoms: Root systems are knotted or galled. Plants are stunted, slow growing and low yielding. Usually associated with a high incidence of Fusarium wilt. It is most severe on sandy soils. (See Fusarium wilt above.)</p> <p>Source of Inoculum: Root-knot nematodes live from year to year in the soil as eggs or larvae.</p> <p>Management: Use resistant variety. Apply nematicide. Refer to table on nematode control in field crops.</p>
Reniform Nematodes (<i>Rotylenchulus</i> sp.)	<p>Symptoms: These nematodes cause severe stunting, reduced boll set and tight, locked bolls. Root systems are restricted but not knotted. May be found in mixed to heavy soil.</p> <p>Source of Inoculum: Reniform nematodes live from year to year in the soil.</p> <p>Control: Apply nematicides. Refer to table on nematode control in field crops. There are no resistant varieties.</p>
Boll Rots (many fungi and bacteria)	<p>Symptoms: There is a wide range of symptoms since there are many organisms involved and many stages of boll development when damage may occur. Discolored, sunken areas may develop on the boll surface. Seed and fiber may be damaged without surface lesions on the boll. Fiber may be stained.</p> <p>Source of Inoculum: Organisms causing boll rots may be carried over in the soil, on crop debris or on the seed coat.</p> <p>Management: Avoid rank growth and control insects during boll development. Plant growth regulators may be helpful in reducing rank growth and in turn, boll rot incidence.</p>

Table 2. Fungicides for the management of seedling and foliar diseases in cotton.				
Method of Application	Fungicide ¹ and Product Mode of Action Group ²		Rate ³	Target Pathogen(s)
In-furrow spray	Headline 2.08	11	4.3-11.4 fl oz	<i>Rhizoctonia solani</i>
	Quadris 2.08	11	5 fl oz	<i>Rhizoctonia solani</i>
	Reason 500 SC	11	0.45 fl oz/1000 row ft	<i>Pythium</i> spp.
	Ridomil Gold	11	1-2 fl oz	<i>Pythium</i> spp.
	Rovral 4F	4	3.4-6.9 fl oz	<i>Rhizoctonia solani</i>
	Terramaster 4EC	14	4-8 fl oz	<i>Pythium</i> spp.
	Uniform	4+11	4.4-6.5 fl oz	<i>Rhizoctonia solani, Pythium</i> spp.
In-furrow granules	Blocker 10G	14	10-20 lb	<i>Rhizoctonia solani</i>
	Ridomil Gold PC GR	4+14	7-10 lb	<i>Rhizoctonia solani, Pythium</i> spp.
	Ridomil Gold GR	4	1.3-2.5 lb	<i>Pythium</i> spp.
Foliar spray	Headline 2.08	11	6-12 fl oz	<i>Alternaria</i> spp., <i>Cercospora</i> spp.,
	Quadris 2.08	11	6-15.5 fl oz	<i>Stemphylium</i> spp., <i>Ascochyta</i>
	Twinline	3+11	8.5 fl oz	spp., and <i>Corynespora cassicola</i>
<p>¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.</p> <p>²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).</p> <p>³Rates are the amount of formulation (product) per acre unless otherwise indicated. Consult product label for rates specific to row spacing, disease pressure, or additional target pathogens.</p>				

Field Crops Cotton

Table 3. Seed treatment fungicides used to manage cotton seedling diseases.			
Fungicide¹ and Product Mode of Action Group²		Target Pathogen(s)³	
myclobutanil	4	<i>Pythium</i> spp.	
pyraclostrobin	3	<i>Rhizoctonia solani</i>	
metalaxyl	4	<i>Thielaviopsis basicola</i>	
ipconazole	3	<i>Fusarium</i> spp.	
trifloxystrobin	11	<p>A multitude of seed treatment options are available to cotton producers utilizing the fungicides listed in this table and biological compounds. Seed treatment fungicides are currently the preferred method of managing seedling diseases because of convenience and efficacy. Seed treatments with multiple modes of action are recommended to manage a broad spectrum of seedling pathogens.</p>	
iprodione	2		
mancozeb	M3		
azoxystrobin	11		
mefenoxam	4		
triadimenol	3		
difenconazole	2		
fludioxinil	3		
PCNB	4		
thiram	M3		
etridiazole	14		
biologicals	NA		
<p>¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.</p> <p>²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).</p> <p>³Consult product label for proper targeting of pathogens.</p>			

The cotton section was revised December 2014 by Dr. T. Price.

Commercial Crop Production Field Crops - Grain Sorghum

Table 1. Symptoms, source of inoculum and management of grain sorghum	
Disease	
Anthracnose (<i>Colletotrichum graminicola</i>)	<p>Symptoms: Infection first appears on the leaves as small tan to reddish-purple circular spots, which later enlarge and may unite to involve large areas of the leaf. Later, the centers of the leaf spots fade to grayish-tan. Infection on the leaf midrib is strikingly discolored. The leaf anthracnose organism also causes a stalk rot. The stalk rot phase of this disease usually follows the anthracnose stage on the leaves. The fungus enters the stalk directly through the rind or a wound in the rind and spreads to the interior of the plant. The lesions that form on the outside of diseased stalks usually have reddish to purplish margins and whitish centers. When infected stalks are split, the pith is red or purplish-red. Diseased stalks frequently break over at the base or at a point one or more joints above the ground. Poor head and seed development results from severe infections.</p> <p>Management: Plant fungicide-treated seed. Practice at least a three-year rotation with other crops such as wheat, oats, barley, cotton and soybeans. Turn under old crop stubble after harvest. Fungicides are available (see Table 2).</p>
Charcoal Rot (<i>Macrophomina phaseolina</i>)	<p>Symptoms: Injury from this disease usually does not become evident until the plant approaches maturity. Affected plants show poorly developed heads, light kernels, premature ripening, drying of the stalk and lodging. Diseased stalks are soft and discolored at the base, and the pith becomes shredded.</p> <p>Management: Irrigate where possible.</p>
Downy Mildew (<i>Sclerospora</i> sp.)	<p>Symptoms: Systemically diseased seedlings are yellowed, stunted and frequently have a white downy growth on the underside of the yellowed leaves. Later, the plants have green-and-white-striped or mottled leaves. These plants may fail to head, produce sterile heads or form partially affected heads. Diseased plants usually are found in poorly drained areas.</p> <p>Management: Follow cultural practices outlined for anthracnose.</p>
Head Blight (<i>Fusarium moniliforme</i> <i>Curvularia</i> sp. <i>Cladosporium</i> sp.)	<p>Symptoms: Head blight is caused by several fungal organisms that infect plants from flowering to maturity, depending on high moisture conditions. (<i>Fusarium</i> head blight, the most destructive of sorghum head blights, occurs most commonly along the Gulf Coast production areas). The fungus is capable of infecting sorghum heads at and soon after blooming. Panicles and rachis branches are infected first, followed by infection of stalk tissue at and immediately below the head. Weak neck and stalk lodging may follow.</p> <p>Management: While no hybrids are immune, some sustain less damage and less economic loss.</p>
Gray Leaf Spot (<i>Cercospora sorghi</i>)	<p>Symptoms: Small circular to elliptical dark purple or red spots appear on leaf surface. Later, leaf center becomes tan or brown, and spots elongate with gray spore masses covering the spots. Other hosts include corn, Johnson grass and cultivated grasses.</p> <p>Management: Most varieties have adequate tolerance to this disease.</p>
Zonate Leaf Spot (<i>Gloeocercospora sorghi</i>)	<p>Symptoms: On the leaves, circular, reddish-purple bands alternate with tan or straw-colored areas that give a concentric or zonate pattern with irregular borders. Spots may occur along the margins of leaves or on other plant parts.</p> <p>Management: Recommended varieties have some tolerance to the disease. Crop rotation and clean cultivation help.</p>

Commercial Crop Production Field Crops - Grain Sorghum

Table 2. Recommended fungicides, rates and application timing for Anthracnose disease of grain sorghum					
Target	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	Time of Application	PHI ⁴
Anthracnose (<i>Colletotrichum graminicola</i>)	Headline	11	6-12 oz	Apply no later than 25% flowering	-- ⁵
	Headline SC	11	6-12 oz	Apply no later than 25% flowering	-- ⁵
	Quadris Flowable	11	6-15.5 oz	At first appearance	14 days
	Quilt	11,3	14 oz	Prior to disease development	21 days
	Quilt Xcel	11,3	10.5-14 oz	At first appearance of disease	21 days
<p>¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.</p> <p>²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).</p> <p>³Rates are the amount of formulation (product) per acre unless otherwise indicated.</p> <p>⁴Pre-harvest interval (PHI) is the minimum number of days allowed between the last application and harvest.</p> <p>⁵Must be applied prior to 25% flowering.</p>					

The grain sorghum section was revised December 2014 by Dr. C. Hollier.

Commercial Crop Production Field Crops - Oats

Table 1. Symptoms, source of inoculum and management of diseases of oats	
Disease	
<p>Crown Rust (<i>Puccinia coronata</i>)</p>	<p>Symptoms: Small, scattered, oval or oblong, orange-yellow pustules develop principally on the leaves. Similar pustules may occur on the leaf sheaths, stems (culms) and panicles. The pustules soon break open to release a dusty mass of golden spores.</p> <p>Source of Inoculum: The source of spores that cause the primary infection during the fall in Louisiana is not known. Disease spreads by windborne spores.</p> <p>Management: Plant recommended varieties that have resistance to the prevalent races of the rust fungus.</p>
<p>Stem Rust (<i>Puccinia graminis avenae</i>)</p>	<p>Symptoms: Elongated, reddish-brown pustules occur on the stem, leaf sheaths, leaf blades and glumes. Pustules rupture the epidermis to expose a powdery, reddish-brown mass of spores. Fragments of epidermis adhere to sides and ends of pustules to give them a ragged appearance.</p> <p>Source of Inoculum: The source of spores that cause the primary infection is not known. Stem rust has an alternate host, European or common barberry (<i>Berberis vulgaris</i>).</p> <p>Management: Plant recommended varieties that have resistance to the prevalent races of the rust fungus.</p>
<p>Yellow Dwarf (Barley Yellow Dwarf virus)</p>	<p>Symptoms: The most typical symptom is leaf discoloration. Affected oat plants may have leaves that are dull yellow to brilliant red. The red leaf color is not always present, however. Plants infected late in the season may be stunted and have reduced yields.</p> <p>Source of Inoculum: The virus may live in perennial grasses along fence rows and roadways. Aphids spread it.</p> <p>Management: No practical control measure is available.</p>
<p>Leaf Blotch (<i>Drechslera avenacea</i> = <i>Helminthosporium avenaceum</i>)</p>	<p>Symptoms: This fungus can cause seedling disease. On older plants the disease appears as reddish-brown, round to oval spots, primarily on leaves and leaf sheaths but sometimes on stems and floret parts. Spots have irregular margins and frequently have sunken centers. Long linear blotches result from merging of spots. Severely infected leaves turn yellow and die.</p> <p>Source of Inoculum: The fungus can live on seed and plant debris.</p> <p>Management: Rotate oat crops on different fields.</p>

The oats section was revised December 2014 by Dr. C. Hollier.

Commercial Crop Production

Field Crops - Peanuts

Integrated Peanut Disease Management

An effective disease management program incorporates a number of strategies including genetic resistance, seedbed preparation, field drainage, weed/insect management and judicious use of fungicides.

Variety Selection: Successful disease management begins by selecting agronomically acceptable varieties containing effective genetic resistance to plant pathogens. The LSU AgCenter does not have a variety testing program for peanuts, but information on variety performance from the University of Georgia can be found at:

<http://www.caes.uga.edu/commodities/fieldcrops/peanuts/documents/2015peanutupdate.pdf>.

Seedbed Preparation and Planting: Prior to planting, burying plant debris from the previous crop or cover crops can reduce initial inoculum of some soilborne pathogens (*Rhizoctonia solani*, *Pythium* spp., and *Phytophthora* spp.). After seedbed preparation is completed, plant when environmental conditions favor rapid seed germination and seedling establishment. The 4-inch soil temperature should be at least 68°F to 70°F for three consecutive days.

Field Drainage: Avoid planting in poorly drained fields. Waterlogging can result in reduced plant vigor and increased risk to some soilborne pathogens. Ensure fields do not support standing water by strategically cutting water furrows in the field immediately after planting.

Plant Health/Pest Management: After the crop has emerged, maintain plant health to minimize the risk to plant pathogens. This is accomplished in part through effective weed and insect pest management and proper nutrient management.

Commercial Crop Production

Field Crops - Peanuts

Table 1. Recommended pesticides, rates and pesticide use restrictions for peanuts					
Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
Late Leaf Spot (<i>Cercosporidium</i> sp.) Early leaf spot (<i>Cercospora</i> spp.)	Chlorothalonil ⁵				
	Bravo Weather Stik	M5	1-1.5 lb	14	12 pt
	Bravo Ultrex	M5	0.9-1.4	14	10.9 lb
	Chloronil 720	M5	1-1.5 lb	14	12 pt
	Chlorothalonil 720SC	M5	1-1.5 lb	14	12 pt
	Echo 720 (Late leaf spot)	M5	1.5 pt	14	9 lb a.i.
	Echo 720 (Early leaf spot)	M5	1-1.5 pt	14	9 lb a.i.
	Echo 90DF (Late leaf spot)	M5	1.25 lb	14	9 lb a.i.
	Echo 90DF (Early leaf spot)	M5	0.875-1.25 lb	14	9 lb a.i.
	Equus 720 SST	M5	1-1.5 pt	14	12 pt
	Equus DF	M5	0.9-1.4	14	10.9 lb
	Absolute 500SC ⁵	3,11	3.5 fl oz	14	4 app
	Evito T ^{5,6}	3,11	6-9 fl oz	14	44.8 fl oz
	Headline ⁵	11	6-15 fl oz	14	45 fl oz
	Thiophanate methyl				
	T-Methyl 70WSB	1	0.5 lb	14	1.4 lb
	Topsin M 70 WP	1	0.5 lb	14	2 lb
	Topsin M 4.5FL	1	10 fl oz	14	40 fl oz
Stratego	3,11	7 fl oz	14	6 app	
Fontelis	7	16-24 fl oz	14	72 fl oz	
Provost ⁵	3	fl oz	14	fl oz	
Stem Rot (<i>Sclerotium</i> sp.) Limb rot (<i>Rhizoctonia</i> sp.)	Absolute 500SC ⁵	3,11	Refer to label	14	14.0 fl oz
	Tebuconazole ^{5,8}				
	Folicur 3.6F	3	7.2 fl oz	14	28.8 fl oz
	Orius 3.6F	3	7.2 fl oz	14	28.8 fl oz
	Tebustar 3.6F	3	7.2 fl oz	14	28.8 fl oz
	Muscle 3.6F	3	7.2 fl oz	14	28.8 fl oz
	Tebuzol 3.6F	3	7.2 fl oz	14	28.8 fl oz
	Convoy ⁹				
	Stem Rot only	7	20-32 fl oz	40	64 fl oz
	Limb Rot only	7	10-16 fl oz	40	64 fl oz
	Headline ⁵	11	6.1-15.3 fl oz	14	45 fl oz
	Quash ⁵	3	4 oz	14	4 app
	Abound	11	12-24.5 oz	14	49 fl oz
Fontelis	7	16-24 fl oz	14	72 fl oz	
¹ Reference to commercial or trade names is made with the understanding that no discrimination is intended nor is endorsement of a particular product by LSU or the LSU AgCenter implied. ² Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC). ³ Rates are the amount of formulation per acre unless otherwise indicated. Check label for recommended application volume of spray solution per acre.					

Commercial Crop Production

Field Crops - Peanuts

⁴ Post-harvest interval (PHI) is the minimum number of days allowed between the last application and harvest.

⁵ Do not allow livestock to graze treated areas. Do not feed hay or threshings from treated fields to livestock.

⁶ Supplemental label.

⁷ Should be tankmixed with a non-benzimidazole fungicide effective for leafspot management.

⁸ Use a four application spray program (four consecutive applications at 14-day intervals). Consult label for timing of applications.

⁹ Application timings differ for stem rot and limb rot. Consult label for timing of applications.

The peanut section was revised December 2014 by Dr. B. Padgett.

Commercial Crop Production Field Crops - Rice

Table 1. Symptoms, source of inoculum and management of diseases of rice

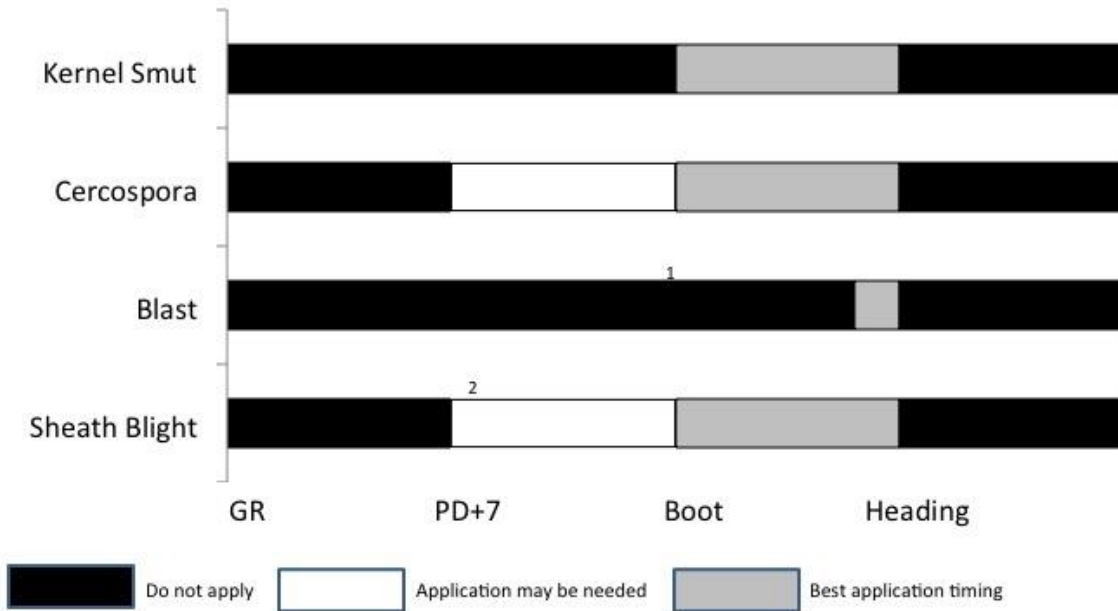
Disease	
<p>Blast (<i>Pyricularia grisea</i>)</p>	<p>Symptoms: Leaf lesions are spindle-shaped and elongated with brown borders and grayish centers. A brownish lesion on the internode at the base of the panicle causes “blasting” of heads followed by breaking over of the head to produce the “rottenneck” symptoms.</p> <p>Source of Inoculum: Fungus may overwinter on diseased straw and stubble, or in some cases it may be carried on infested or infected seed. Source of inoculum for early infection has not been satisfactorily worked out. It spreads in the field by means of airborne spores.</p> <p>Management: For leaf stages of the disease, maintain proper flood level. Infection levels tend to be less severe where floodwater is maintained at adequate but <u>not</u> excessive depths. Plant varieties resistant to prevalent races of the fungus. (See variety list.) Avoid excessive rates of nitrogen (Nitrogen amounts vary with cropping history, soil type, varieties, etc.). The use of fungicides will be helpful in the management of blast. Fungicide timing is critical for effective control.</p>
<p>Sheath Blight (<i>Rhizoctonia solani</i>)</p>	<p>Symptoms: Large spots with cream-colored centers and broad, dark reddish-brown borders appear on sheath, usually beginning near the water line. Alternating wavelike tan and brown bands can extend up the sheath and may include the flag leaf. The wavelike band pattern may extend out on part or the entire leaf surface.</p> <p>Source of Inoculum: Fungus is soilborne and persists as sclerotia or mycelia on straw and stubble of rice and grasses. Weed hosts may serve as sources of inoculum.</p> <p>Management: Thick stands and excessive nitrogen applications tend to favor disease development. Some varieties are less susceptible than others. (See variety list.) Fungicides may be necessary to suppress disease development. Fungicide-resistant populations exist in some fields.</p>
<p>Brown Leaf Spot (<i>Bipolaris oryzae</i>)</p>	<p>Symptoms: Dark reddish-brown spots are somewhat circular or oval to slightly elongated. Mature spots have gray centers. Spots usually associated with low nitrogen or maturity of the plant. Spots also may occur on hulls and kernels with a dark brown fungus sometimes present on kernels.</p> <p>Source of Inoculum: The fungus is seedborne and also may live from one crop to the next on infected rice straw and stubble. It is spread by airborne spores.</p> <p>Management: Maintain good growing conditions through fertilization, land leveling, soil preparation and other cultural practices.</p>

Commercial Crop Production Field Crops - Rice

Table 1. Symptoms, source of inoculum and management of diseases of rice	
Disease	
<p>Narrow Brown Leaf spot (<i>Cercospora janseana</i>)</p>	<p>Symptoms: Leaf spots are light reddish-brown to brown, long and narrow. Reddish-brown discoloration of the sheath may occur when disease pressure is severe. Disease usually occurs after heading.</p> <p>Source of Inoculum: The fungus persists on crop residue and on red rice.</p> <p>Management: Varietal resistance offers the best approach to control. (See variety list.) Fungicides may control narrow brown leaf spot.</p>
<p>Seed and Seedling Diseases Water Molds (<i>Achlya</i> spp., <i>Pythium</i> spp.)</p>	<p>Symptoms: Light to dark brown discoloration on soil surface around seed after water is removed. Usually have fluffy fungal growth around seed before water is removed.</p> <p>Source of Inoculum: These fungi persist in the soil on organic matter.</p> <p>Management: Removing water after seeding will reduce losses. Seeding into clear water reduces the incidence of water mold. Seed treatments may reduce damage.</p>
<p>Seedling Blight (Several fungi)</p>	<p>Symptoms: Young plants have roots and lower stem affected, often resulting in death of the plant. Dark lesion at the junction of seed and root.</p> <p>Source of Inoculum: May be seed-borne or soil-borne.</p>
<p>Stem Rot (<i>Sclerotium oryzae</i>)</p>	<p>Symptoms: Black, discolored areas on leaf sheath near surface of water. Later, small black seedlike sclerotia develop inside leaf sheath and still later inside the stem. Stalks may break over and lodge.</p> <p>Source of Inoculum: Fungus persists in the sclerotial stage in soil and on diseased straw and stubble.</p> <p>Management: Applications of potassium to the soil may reduce the severity of the disease in some instances.</p>
<p>Kernel Smut (<i>Tilletia barclayana</i>)</p>	<p>Symptoms: Black masses of spores replace all or some of the seed endosperm. Often the spores ooze out of the grain, leaving a black mass along the seam of the hulls and on leaves and stem.</p> <p>Source of Inoculum: The fungus overwinters in soil and in seeds.</p> <p>Management: Avoid high nitrogen rates. Application of propiconazole containing fungicides at boot growth stage reduce incidence.</p>
<p>Straighthead (Physiological Disorder)</p>	<p>Symptoms: Rice heads remain upright at maturity because of lack of grain formation. Hulls usually are crescent or “parrot beak” shaped.</p> <p>Source of Inoculum: No organism involved.</p> <p>Management: Drain water from field just prior to jointing stage of growth. Leave water off until cracks form in the mud. Then flood again. Some varieties are moderately resistant to this disorder. (See variety list.)</p>

Commercial Crop Production
Field Crops - Rice

Rice Fungicide Timing



¹A boot application followed by the heading spray may be necessary if diseases pressure is high and the variety is susceptible.

²An early application may be necessary if sheath blight appears early and is severe followed by the boot to heading application.

Commercial Crop Production Field Crops - Rice

Table 2. Rice variety reactions to common diseases in Louisiana

S indicates a susceptible reaction, MS indicates a moderately susceptible reaction, MR indicates a moderately resistant reaction, R indicates a resistant reaction and --- indicates that the reaction is not known. Varieties labeled S or VS for a given disease may be severely damaged under conditions favoring disease development.

Variety	Disease				
	Blast	Sheath Blight	Cercospora	Bacterial Panicle Blight	Straight Head
Antonio	S	MS	MS	MS	---
Caffey	R	MS	R	MS	MS
Catahoula	MR	S	R	MS	S
Cheniere	MS	S	S	MS	MR
CL111	MS	VS	S	VS	S
CL151	VS	S	S	VS	VS
CL152	S	S	MR	MR	MR
CL261	VS	S	MS	VS	S
CL271	MR	S	MR	MS	MR
CLXL729	R	MS	R	R	---
CLXL745	R	MR	R	MR	---
Cocodrie	MS	S	S	VS	S
Colorado	S	MS	MS	MS	---
Cypress	MS	VS	S	S	MR
Della-2	R	S	MS	MS	MR
Jazzman	R	MS	S	S	MS
Jazzman 2	MR	S	S	VS	VS
Jupiter	MS	MS	R	MR	MR
IAkASTE	S	S	MS	S	MS
Mernmentau	S	S	MS	MS	S
Roy J	S	MR	R	MS	S
Tagart	MR	MR	R	MS	MR
XL723	R	MS	R	MR	---
XL753	R	MR	R	MR	---

Commercial Crop Production Field Crops - Rice

Table 3. Efficacy of fungicides in managing diseases of rice
Efficacy categories are as follows: P=Poor; F=Fair; G=Good; VG=Very Good; NL = Not Labeled for use against this disease.

Fungicide Information				Disease			
Class and Mode of Action Group ¹	Active Ingredient	Product(s) ²	Rate ³ (fl oz)	Blast	Sheath Blight	Cercospora	Kernel Smut
QoI Strobilurins Group 11	Azoxystrobin	Quadris 2.08 SC Equation 2.08 SC	9-15.5	G	VG	P	P
	Trifloxystrobin	Gem 500 SC	3.1-4.7	VG	G	P	P
Carboxamides Group 7	Flutolanil	Convoy 3.8 F	16-32	NL	G	NL	NL
	Fluxapyroxad	Sercadis 2.47 SC	4.5-6.8	NL	VG	NL	NL
Demethylation Inhibitors (DMI) Group 3	Propiconazole	Tilt 3.6 EC Bumper PropiMax	6-10 6-10 6-10	NL	F	VG	G
Mixed ⁴	Azoxystrobin, Propiconazole	Quilt 200 SC	14- 34.5	G	VG	VG	G
	Azoxystrobin, Propiconazole	Quilt Xcel 2.2 SE	15.8- 27	G	VG	VG	G
	Trifloxystrobin, Propiconazole	Stratego 250 EC	16-19	VG	G	VG	G

¹Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).

²Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied. Many products have specific use restrictions about the amount of active ingredient that can be applied within a period of time or the amount of sequential applications that can occur. Please read and follow all specific use restrictions prior to fungicide use. This information is provided only as a guide. It is the responsibility of the pesticide applicator by law to read and follow all current label directions. Members or participants in the CDWG assume no liability resulting from the use of these products.

³Rates are the amount of formulation (product) per acre unless otherwise indicated.

⁴Refer to product label for the fungicide class and mode of action group.

The rice section was revised December 2014 by Dr. D.E. Groth.

Commercial Crop Production Field Crops - Soybeans

Table 1. Symptoms, source of inoculum and management of diseases of soybeans	
Disease	
Seedling Disease <i>(Rhizoctonia solani,</i> <i>Phytophthora,</i> <i>Pythium, etc.)</i>	<p>Symptoms: Seed decay and post-emergence “damping off.” Roots and basal portion of stem may deteriorate or be killed.</p> <p>Source of Inoculum: Most of these organisms are soil-borne and persist in crop residue.</p> <p>Management: Seed treatment.</p>
Charcoal Rot <i>(Macrophomina sp.)</i>	<p>Symptoms: Seedling infections result in a discoloration at the soil line. Seedlings may die if hot, dry conditions exist, or they may survive in wet weather with disease symptoms reappearing during hot, dry spells. In older plants, a light brown discoloration of internal tissue occurs. Plants turn yellow and “mature very early.” Below the epidermis, at the soil line, small black bodies appear, giving the tissue a grayish-black “charcoal” appearance.</p> <p>Management: Avoid excessive seeding rates. Rotate with nonhost crops. Maintaining good fertility will reduce the incidence of this disease. Avoid plant stress as much as possible by using good management practices.</p>
Phytophthora Root Rot <i>(Phytophthora sp.)</i>	<p>Symptoms: Destroys roots and tender stems of infected seedlings, resulting in rapid death. Older plants turn yellow and leaves wilt. A brown discoloration develops in the stem.</p> <p>Source of Inoculum: Soil-borne. Damage is most severe on heavy clay soils or on poorly drained soils.</p> <p>Management: Avoid planting susceptible varieties on poorly drained soils. Rotate.</p>
Red Crown Rot (Black root rot) <i>(Calonectria sp.)</i>	<p>Symptoms: First symptoms appear as an interveinal yellowing of the tops of individual plants, generally when plants are in the early pod stage. Later, interveinal tissue of leaves turns brown. That is followed by defoliation. On the stems, reddish-orange fruiting structures appear at the soil surface and up to 3 inches above. Stem tissue appears reddish.</p> <p>Management: Research and field observations indicate there are differences in varieties, but exact ratings are difficult to achieve. Delay planting until later part of recommended planting time.</p>
Southern Blight <i>(Sclerotium sp.)</i>	<p>Symptoms: Scattered plants wilt suddenly and die. White mold appears at the base of the plant and girdles the stem. Tan to brown sclerotia (resting bodies) about the size of mustard seeds appear in the mold.</p> <p>Source of Inoculum: The fungus is soil-borne and occurs widely in many soils. It is capable of persisting on almost any type of organic matter.</p> <p>Management: Losses to this disease usually are minimal and do not warrant control measures.</p>

Commercial Crop Production Field Crops - Soybeans

Table 1. Symptoms, source of inoculum and management of diseases of soybeans	
Disease	
Aerial Blight (<i>Rhizoctonia</i> sp.)	<p>Symptoms: The infected area typically involves the lower third of one or more of the three leaflets. The necrotic areas may vary in shape from circular to irregular with reddish-brown margins. Leaf blight, leaf spots and defoliation are symptoms of the disease. Lesions may vary from reddish-brown to brown or tan. Several leaflets may appear to be “glued together” with a cottony growth (fungus). Petioles, stems and young pods also are attacked.</p> <p>Source of Inoculum: Weed hosts, field trash and soil.</p> <p>Control: Fall cultivation of stubble. Use good seedbed preparation and weed control. Research and field observations indicate there are differences in varieties. Use Quadris fungicide at first appearance of disease and conditions that favor disease development. See manufacturer’s label for suggested rates.</p>
Brown Leaf Spot (<i>Septoria</i> sp.)	<p>Symptoms: Angular brown to reddish-brown spots appear first on lower leaves, causing yellowing and later defoliation. Symptoms usually are seen first on young plants during cool weather. Sizes of spots vary from a pinpoint to ¼ inch diameter.</p> <p>Source of Inoculum: The fungus overwinters in crop residue and on infected seed.</p> <p>Management: Plant disease-free seed. Rotate. Bury crop residue deeply as soon as possible. Development of the disease is limited by warm weather.</p>
Downy Mildew (<i>Peronospora</i> sp.)	<p>Symptoms: Indefinite yellowish-green areas on upper leaf surface. Grayish tufts of mold growth on lower leaf surface beneath chlorotic spots.</p> <p>Source of Inoculum: Overwinters in soil, on seed and in soybean residue.</p> <p>Management: Crop rotation. Use of disease-free seed. Seed treatment reduces seedling infection.</p>
Frogeye Spot (<i>Cercospora</i> sp.)	<p>Symptoms: An eyespot type of lesion with a gray or light tan center and a narrow reddish-brown border forms on the leaves. May cause premature defoliation.</p> <p>Source of Inoculum: Seed and airborne.</p> <p>Management: Use resistant varieties. Apply foliar fungicides (see Table 2).</p>
Purple Seed Stain (<i>Cercospora</i> sp.)	<p>Symptoms: Pink or light purple to dark purple discoloration of seed. Cracks may occur in discolored areas. Reddish-brown angular lesions, approximately 1/16 inch diameter, may occur on leaves, stems or pods late in the growing season.</p> <p>Source of Inoculum: Overwinters in crop residue and on infected seed.</p> <p>Control: Plant disease-free seed. Treat seed with fungicides. Apply foliar fungicides (see Table 2).</p>

Commercial Crop Production Field Crops - Soybeans

Table 1. Symptoms, source of inoculum and management of diseases of soybeans	
Disease	
Anthracnose (<i>Colletotrichum</i> sp.)	<p>Symptoms: Symptoms appear as irregular brown areas most frequently on stems and pods. In advanced stages, affected tissues are covered with black fruiting bodies. The disease may cause serious losses, especially during rainy periods. Seed may fail to form or be wrinkled and moldy.</p> <p>Control: Plant disease-free seed. Some benefit may be derived from seed treatment. Plow under crop residue. Apply foliar fungicides (see Table 2).</p>
Soybean Rust (<i>Phytophthora pachyrhizi</i>)	<p>Symptoms: Rust pustules can be found on the underside of lower leaves when conditions are right for disease development. Pustules are tiny and raised and require at least a 15X hand lens to see the pustules.</p> <p>Management: Fungicides (see Table 2) will control Asian soybean rust, but timing is critical.</p>
Pod and Stem Blight (<i>Diaporthe phaseolorum</i> var. <i>sojae</i> = <i>Phomopsis sojae</i>)	<p>Symptoms: Numerous small black fruiting bodies appear on the pods and stems of mature plants. Blight usually occurs in linear rows on the stem. Under favorable environmental conditions for the disease, it can be observed as a white mycelial growth on seed.</p> <p>Source of Inoculum: Fungus is seed-borne and overwinters on diseased plant tissue in the field.</p> <p>Management: Plant disease-free seed. Some benefit may be derived from the seed treatment. Apply foliar fungicides (see Table 2).</p>
Stem Canker (<i>Diaporthe phaseolorum</i> var. <i>caulivora</i>)	<p>Symptoms: First symptom is the appearance of small reddish-brown lesions on one or both cotyledons. Late in the season, dead plants are seen with dried attached leaves. Interveinal yellowing is evident on leaflets (similar to foliar symptoms of red crown rot). Infection usually starts as a small lesion at the base of a main-stem node. Lesions enlarge rapidly to form a slightly sunken, reddish-brown canker. Plants are brittle and break at the canker.</p> <p>Management: Use resistant varieties. Delay planting until later part of recommended planting time. Avoid stress. Maintain good fertility.</p>
Virus or Virus-like Disease Complex	<p>Symptoms: Infected plants remain green, especially stems, beyond expected harvest date, with welling appearing at the nodes. Few pods are formed, and those that do form contain only one or two beans. A proliferation of buds may appear.</p> <p>Management: Some of the causal agents are carried over in infected seed. Do not save seed from infected fields.</p>

Commercial Crop Production Field Crops - Soybeans

Table 1. Symptoms, source of inoculum and management of diseases of soybeans	
Disease	
Reniform Nematodes <i>(Rotylenchulus reniformis)</i>	<p>Symptoms: Severely infected plants are stunted and may show chlorosis. Severe yield reduction may occur when nematode populations are relatively high.</p> <p>Management: Plant resistant varieties. Rotate with nonhost crops. Under extreme conditions, use nematicides.</p>
Root Knot Nematodes <i>(Meloidogyne incognita group)</i>	<p>Symptoms: Above ground symptoms are poor pod set with wilting and stunting in more-or-less circular patches on lighter soil types. Below ground symptoms are knots or galls on the roots. These swellings are a part of the root and do not “flick off” easily, as bacterial nodules do.</p> <p>Source of Inoculum: The nematode overwinters in the soil as eggs or larvae.</p> <p>Management: See varietal resistance table. Rotate with less susceptible crops. Under extreme conditions, use nematicide.</p>
Soybean Cyst Nematodes <i>(Heterodera glycines)</i>	<p>Symptoms: Stunting and various stages of yellowing occur in roughly circular spots. Symptoms vary, depending on nematode population, soil type and fertility and environmental conditions. Symptoms are most pronounced on sandy soil.</p> <p>Source of Inoculum: Nematodes overwinter in soil, primarily inside resistant cysts. They may be spread to new locations by any means that spread soil.</p> <p>Management: Practice two to four year rotation with cotton, corn or sorghum.</p>
Other Nematodes Spiral, Lance, Ring, Lesion, Stubby-root	<p>Symptoms: Stunting, stand loss and reduced yields are associated with high populations of single or mixed populations of these nematodes. Symptoms will vary depending on nematode type and population levels.</p> <p>Management: Rotate with other crops. If populations are high at planting, a nematicide may be used.</p>

Commercial Crop Production Field Crops - Soybeans

Table 2. Recommended fungicides, rates and application timing for soybean diseases					
<i>Disease are abbreviated as follows: CB=Cercospora blight / purple seed stain, FE=Frogeye, AN=Anthracnose, PS=Pod and stem blight, AB=Aerial blight and SBR=Soybean rust.</i>					
Fungicide	Common Name	Class and Mode of Action Group		Rate	Target Diseases
Alto 100 SL	cyproconazole	Triazole ⁴	3	2.8–5.5 oz (rust only) 4–5.5 oz (others)	SBR, AB, AN, CB, FE, PS
Domark	tetraconazole	Triazole ⁴	3	4-5 oz	CB, FE, AN
Gem RC	trifloxystrobin	Strobilurin ⁵	11	3-3.5 oz	AB, AN, SBR, CB, FE, PS
Headline 2.08EC	pyraclostrobin	Strobilurin ⁵	11	6-12 oz	SBR, CB, FE, AN, PS, AB
Headline SC	pyraclostrobin	Strobilurin ⁵	11	6-12 oz	SBR, CB, FE, AN, PS, AB
Proline 480 SC	prothioconazole	Triazole ⁴	3	2.5-3 fl oz	SBR, FE
Quadris 2.08SC	azoxystrobin	Strobilurin ⁵	11	6-15.5 oz	SBR, CB, FE, AN, PS, AB
Quadris Xtra	azoxystrobin cyproconazole	Strobilurin ⁵ triazole ⁴	11 3	4-6.8 oz	AB, AN, CB, FE, PS, SBR
Quilt	azoxystrobin propiconazole	Strobilurin ⁵ triazole ⁴	11 3	14-20.5 oz	AB, AN, CB, FE, PS, SBR
Quilt Xcel	azoxystrobin propiconazole	Strobilurin ⁵ triazole ⁴	11 3	10.5-21 oz	AB, AN, CB, FE, PS, SBR
Stratego	propiconazole trifloxystrobin	Triazole ⁴ Strobilurin ⁵	3 11	10 oz	AB, AN, CB, FE, PS, SBR
Stratego YLD	trifloxystrobin prothioconazole	Strobilurin ⁵ triazole ⁴	11 3	4-4.7 oz	AB, AN, CB, FE, PS, SBR
Topguard	flutriafol	Triazole ⁴	3	7-14 oz	CB, FE, SBR
Topsin 4.5FL	thiophanate-methyl	Benzimidazole ⁶	1	10-20 fl oz	CB, FE, AN, PS
Tilt Bumper	propiconazole	Triazole ⁴	3	4-6 fl oz	AB, AN, FE, SBR

¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.

²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).

³Rate is per acre unless otherwise noted.

⁴Triazoles have been effective against soybean rust but may not be as effective against other diseases, especially Cercospora blight.

⁵Strobilurins are effective against aerial blight, anthracnose and pod and stem blight but are less effective against soybean rust and Cercospora blight. There is evidence in other states that resistance exists in the Cercospora diseases (frogeye and Cercospora blight) to the strobilurin products.

⁶Benzimidazole fungicides have been inconsistent in their effectiveness against Cercospora blight.

Commercial Crop Production Field Crops - Soybeans

Management of Soybean Diseases Using Fungicides

The North Central Regional Committee on Soybean Diseases and the Regional Committee for Soybean Rust Pathology (NCERA-212 and NCERA-208) have developed the following information on foliar fungicide efficacy for control of major foliar soybean diseases in the United States. Efficacy ratings for each fungicide listed in the table were determined by field-testing the materials over multiple years and locations by the members of the committee. Efficacy ratings are based upon level of disease control achieved by product, and are not necessarily reflective of yield increases obtained from product application. Efficacy depends upon proper application timing, rate, and application method to achieve optimum effectiveness of the fungicide as determined by labeled instructions and overall level of disease in the field at the time of application. Differences in efficacy among fungicide products were determined by direct comparisons among products in field tests and are based on a single application of the labeled rate as listed in the table, unless otherwise noted. Available systemic fungicides that have been tested over multiple years and locations are provided in Table 3. The information in Table 3 is not intended to be a list of all labeled products.

Commercial Crop Production Field Crops - Soybeans

Table 3. Efficacy of systemic fungicides in managing disease of soybean										
<i>Efficacy categories are as follows: NR indicate Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent; NL = Not Labeled for use against this disease; -- = Insufficient data to make statement about efficacy of this product for this disease.</i>										
Fungicide Information					Disease					
<i>Disease are abbreviated as follows: CB=Cercospora blight / purple seed stain, FE=Frogeye, AN=Anthracnose, PS=Pod and stem blight, AB=Aerial blight and SBR=Soybean rust.</i>										
Class and Mode of Action Group¹	Active Ingredient (%)	Product²	Rate³ (fl oz)	AB	AN	CB	FE	PS	SBR	Harvest Restrictions⁴
QoI Strobilurins Group 11	Azoxystrobin 22.9	Quadris 2.08 SC	6-15.5	VG	VG	F	VG	--	G-VG	14 days
	Fluoxastrobin 40.3	Aftershock 480 SC or Evito 480 SC	2-5.7	VG	G	--	VG	--	--	R5, beginning seed, 30 days
	Picoxystrobin	Approach 2.08 SC	6-12	VG	G	--	VG	--	G	14 days
	Pyraclostrobin 23.6	Headline 2.09 EC/SC	6-12	VG	VG	F	VG	--	G-VG	21 days
DMI Triazoles Group 3	Cyproconazole 8.9	Alto 100SL	2.8-5.5	--	--	--	F	--	VG	30 days
	Flutriafol 11.8	Topguard 1.04SC	7-14	--	VG	F	VG	--	E	21 days
	Propiconazole 41.8	Tilt 3.6 EC, MG ⁵	2-4	P	VG	NL	F	NL	VG	R5, beginning seed
	Prothioconazole 41.0	Proline 480 SC ⁶	2.5-4.3	NL	NL	NL	VG	NL	VG	21 days

Commercial Crop Production Field Crops - Soybeans

Table 3. Efficacy of systemic fungicides in managing disease of soybean												
<i>Efficacy categories are as follows: NR indicate Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent; NL = Not Labeled for use against this disease; -- = Insufficient data to make statement about efficacy of this product for this disease.</i>												
Fungicide Information						Disease						
<i>Disease are abbreviated as follows: CB=Cercospora blight / purple seed stain, FE=Frogeye, AN=Anthracnose, PS=Pod and stem blight, AB=Aerial blight and SBR=Soybean rust.</i>												
						NL	VG	F	VG	--	VG-E	R5, beginning seed
MBC Thiophanates Group 1	Tetraconazole 20.5	Domark 230 ME	4-5			NL	--		VG	--	VG-E	R5, beginning seed
	Thiophanate-methy	Topsin-M, MG ⁵	10-20			--	--	F	VG		G	21 days
SDHI Carboximides Group 7	Boscalid 70	Endura 0.7 DF	3.5-11			--	NL	--	P	NL	NL	21 days
Mixed classes	Azoxystrobin 18.2, Dificonazole11.4	Quadris Top 2.72 SC	8- 14			--	--	--	VG	--	VG	14 days
	Azoxystrobin 7.0, Propiconazole 11.7	Avaris 1.66 SC Quilt 1.66 SC HM-0812 1.66 SC	14-20.5			--	--	--	G	--	VG	21 days
	Azoxystrobin 13.5, Propiconazole 11.7	Quilt Xcel 2.2 SE	10.5-21			E	VG	F	VG	--	VG	R6
	Fluoxastrobin 18.0, Tebuconazole 25.0	Evito T 3.99 F	4-6			--	F	--	F	--	--	30 days
	Pyraclostrobin 28.58, Fluxapyroxad 14.33	Priaxor 4.17 SC	4-8			E	VG	F	VG	--	E	21 days

Commercial Crop Production Field Crops - Soybeans

Table 3. Efficacy of systemic fungicides in managing disease of soybean

Efficacy categories are as follows: NR indicate Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent; NL = Not Labeled for use against this disease; -- = Insufficient data to make statement about efficacy of this product for this disease.

Fungicide Information		Disease								
<i>Disease are abbreviated as follows: CB=Cercospora blight / purple seed stain, FE=Frogeye, AN=Anthracnose, PS=Pod and stem blight, AB=Aerial blight and SBR=Soybean rust.</i>										
		Stratego 250 EC	10.0	G-VG	VG	F	VG	--	VG	21 days
Trifloxystrobin 11.4, Propiconazole 11.4		Stratego 250 EC	10.0	VG	VG	F	VG	--	VG	21 days
Trifloxystrobin 32.3, Prothioconazole 10.8		Stratego YLD 4.18 SC9 ⁷	4-4.7	VG	VG	F	VG	--	VG	21 days

¹Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).
²Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied. Many products have specific use restrictions about the amount of active ingredient that can be applied within a period of time or the amount of sequential applications that can occur. Please read and follow all specific use restrictions prior to fungicide use. This information is provided only as a guide. It is the responsibility of the pesticide applicator by law to read and follow all current label directions. Members or participants in the NCERA-212 or NCERA-208 group assume no liability resulting from the use of these products.
³Rates are the amount of formulation (product) per acre unless otherwise indicated.
⁴Harvest restrictions are listed for soybean harvested for grain. Restrictions may vary for other types of soybean (edamame, etc.) and soybean for other uses such as forage or fodder.
⁵Multiple generic fungicides available.
⁶Proline has a supplemental label (2ee) for soybean, only for use on white mold in IL, IN, IA, MI, MN, NE, ND, OH, SD, WI. A separate 2ee for NY exists for white mold.
⁷Stratego YLD has a supplemental label (2ee) for white mold on soybean only in IL, IN, IA, MI, MN, NE, ND, OH, SD, WI.

The soybean section was revised December 2014 by Dr. C. Hollier.

Commercial Crop Production Field Crops - Sugarcane

Integrated disease management of sugarcane

Sugarcane productivity and profitability rely on effective disease management. Most diseases are managed with varietal resistance and a healthy seedcane program. Since sugarcane is vegetatively propagated, regularly obtaining and planting healthy seedcane is essential for the control a group of systemic diseases that include ratoon stunt, leaf scald, smut, mosaic, and yellow leaf. These diseases all can be spread and increased by planting infected stalks. An overview of diseases commonly found in Louisiana and management tactics is provided in Table 1.

Table 1. Symptoms, source of inoculum and management of diseases of sugarcane	
Disease	
<p>Leaf Scald (<i>Xanthomonas albilineans</i>)</p>	<p>Symptoms: Leaves of young plants may show bleaching or yellowing. The characteristic symptom of leaf scald is the presence of one or more narrow, white “pencil lines” running longitudinally along a vein from the leaf margin down the blade into the sheath. Bands of dead tissue then develop along pencil lines starting at the leaf margin and may expand until the entire leaf is dead. Young shoots may be killed. Mature stalks may show leaf symptoms and develop side shoots with symptoms. Under severe disease conditions, entire plants may die. Drought stress can induce severe symptom expression.</p> <p>Source of Inoculum: The bacterium that causes leaf scald lives from year to year in infected plants. It is spread by the harvester and possibly by other cultivation practices that cause plant wounding. The disease can be spread aerially in windblown rain.</p> <p>Management: Varietal resistance is the best means of control. HoCP 96-540, L 01-283, and L 01-299 exhibit field resistance. The other current varieties exhibit varying degrees of susceptibility with L 99-226 and HoCP 00-950 being the most susceptible. Avoid planting seedcane from fields with obvious disease. Regular planting of healthy seedcane produced through tissue culture has kept the incidence of leaf scald low. The heat treatment used to control ratoon stunting disease is not effective against leaf scald.</p>
<p>Mosaic (<i>Sorghum mosaic virus</i> and <i>Sugarcane mosaic virus</i>)</p>	<p>Symptoms: The mosaic pattern of irregular, interspersed, pale green, yellowish, and green areas on leaves varies with cane variety, stage of growth, temperature and the strain of the virus involved. The mosaic symptom is most evident in the youngest emerging leaves.</p> <p>Source of Inoculum: The virus persists from year to year in infected plants. It is spread primarily by migrating aphids and also by planting infected seedcane.</p> <p>Management: Mosaic is controlled primarily with host plant resistance. Historically, mosaic was a major disease adversely affecting sugarcane production in Louisiana. However, basic breeding and development of sources of resistance have greatly reduced the impact of this disease. Currently grown varieties have adequate levels of resistance to mosaic. Planting seedcane produced through tissue culture can help keep disease incidence low in susceptible varieties.</p>

Commercial Crop Production

Field Crops - Sugarcane

Table 1. Symptoms, source of inoculum and management of diseases of sugarcane

Disease	
<p>Ratoon Stunt (<i>Leifsonia xyli</i> subsp. <i>xyli</i>)</p>	<p>Symptoms: Ratoon stunting disease (RSD) has no visible external symptoms. RSD-infected plants may be shorter with little or no decrease in diameter of the stalk. Stunting severity is associated with adverse environmental conditions, particularly drought stress, and it is more severe in ratoon crops. Affected plants, when split, may or may not show a pinkish color in the growing point of young shoots and orange to brownish discoloration of vascular bundles at the nodes in the lower portion of mature stalks.</p> <p>Source of Inoculum: The bacterium lives from year to year in infected stalks. It is spread mechanically by the cane harvester and by planting infected seedcane.</p> <p>Management: A healthy seedcane program is the primary method for RSD control. Seedcane produced from tissue culture free of RSD is commercially available. Heat treatment of seedcane in hot water at 50 degrees Celsius (122 degrees Fahrenheit) for 2 hours can provide control of most RSD bacteria. A regular annual heat treatment program can provide good RSD control. Monitoring of RSD infection levels and the success of a healthy seedcane program can be provided by collecting stalk samples and having them tested at the LSU Ag Center’s Sugarcane Disease Detection Lab. The level of RSD resistance varies among varieties. High levels of resistance are uncommon, so a healthy seedcane program is essential for successful RSD control.</p>
<p>Red Rot (<i>Colletotrichum falcatum</i>)</p>	<p>Symptoms: Red rot adversely affects stand establishment by rotting planted seedcane. Splitting stalks dug up from portions of row without living plants reveals red discoloration of the internode tissue and rotted nodes. Within the red areas, white spots usually elongated at right angles to the long axis of the stalk are diagnostic of red rot infection. Red rot is more severe when planted stalks are exposed to drought stress or waterlogging.</p> <p>Source of Inoculum: The fungal pathogen survives from season to season in infected cane tissues. Fungal inoculum is present on most planted stalks.</p> <p>Management: Plant multiple whole stalks and avoid planting heavily bored or physically damaged seedcane. Provide good drainage for planted seedcane. High levels of varietal resistance are uncommon, so cultural practices that minimize stress on planted seedcane are needed to minimize red rot damage.</p>

Commercial Crop Production Field Crops - Sugarcane

Table 1. Symptoms, source of inoculum and management of diseases of sugarcane

Disease	
<p>Brown Rust (<i>Puccinia melanocephala</i>)</p>	<p>Symptoms: Small chlorotic areas appear on the leaves at first as flecks. Later, the flecks elongate and become reddish-brown. The spots continue to enlarge with a slight yellow halo surrounding the lesion on some varieties. The lesion takes on a pustular appearance on the lower surface of the leaf and pustules erupt, releasing a reddish-brown mass of spores. On susceptible varieties, heavily infected leaves dry out and die prematurely.</p> <p>Source of Inoculum: Rust survives the winter in living green leaf tissue usually in southern areas of the industry. Spores are then produced and aerially dispersed to spread the disease over short and long distances.</p> <p>Management: Host plant resistance is the primary control method. However, the rust pathogen has the capability to adapt and overcome varietal resistance. Once a variety becomes susceptible, rust can be controlled with the application of fungicide. Detailed information on varietal resistance ratings, fungicide labels, and use recommendations can be found through the LSU Ag Center website, lsuagcenter.com, in “Best Management Practices for Minimizing the Impact of Brown Rust in Sugarcane”.</p>
<p>Smut (<i>Sporisorium scitaminea</i>)</p>	<p>Symptoms: Smut is characterized by the production of a black, whip-like structure at the apex of stalks with smaller than normal diameter. The whip often elongates to a length of 2-3 feet and curls downward. The whip is covered by a layer of dark-brown fungal spores. Prior to the emergence of whips, smut-infected plants can have a grassy appearance with many small-diameter shoots.</p> <p>Source of Inoculum: Tremendous numbers of smut spores are released over time from whips and dispersed in air currents to spread the disease over short and long distances.</p> <p>Management: To control smut, grow resistant varieties and plant healthy seedcane. Varieties with a high level of resistance to smut include: HoCP 96-540, HoCP 00-950, L 01-283, L 03-371, HoCP 04-838, and Ho 07-613. Varieties with moderate susceptibility include: L 99-226, L 99-233, and L 01-299. High rates of disease increase do not occur under Louisiana climatic conditions, so it is possible to grow varieties with moderate smut susceptibility, if a rigorous healthy seedcane program is followed. Tissue culture produced seedcane will have little or no smut infection. On-farm roguing of smut-infected plants with glyphosate is only feasible in seedcane sources with low levels of infection. Avoid planting seedcane sources of smut susceptible varieties next to smut infected cane. Do not plant seedcane with more than 2% smut infection.</p>

Commercial Crop Production Field Crops - Sugarcane

Table 1. Symptoms, source of inoculum and management of diseases of sugarcane

Disease	
<p>Yellow Leaf <i>(Sugarcane yellow leaf virus)</i></p>	<p>Symptoms: The underside of the mid-vein on young leaves at the apex of mature plants turns bright yellow in SCYLV-infected plants. The yellowing can spread into the leaf blade, and mid-veins can turn pink in severely infected plants. Due to the short growing season in Louisiana, symptoms are not seen most years because of ripener applications and/or frosts. Despite the lack of visible symptoms, infected plants may exhibit reduced growth and juice quality.</p> <p>Source of inoculum: The sugarcane aphid acquires the virus during feeding on an infected plant. The aphid retains the virus for life and can transmit SCYLV during feeding to healthy plants within the same field or in other fields.</p> <p>Management: Certified seedcane produced through tissue culture is tested for SCYLV. Continuous planting of seedcane with little or no virus infection will keep the incidence of yellow leaf low. Information is lacking on the disease resistance levels of commercial varieties.</p>
<p>Red Stripe and Top Rot <i>(Acidovorax avenae subsp. avenae)</i></p>	<p>Symptoms: Narrow, dark red stripes of variable length run longitudinally along veins. Symptoms are often seen in 4-6 month old cane. The leaf spindle at the shoot apex can become infected in susceptible varieties, particularly under wet conditions. The infection can spread into the shoot apex and cause a top rot. Reddish brown discoloration and cavities may form in stalk internodes. An unpleasant odor is associated with the rotting spindle that may be detected outside the field.</p> <p>Source of inoculum: Bacterial exudates form that are readily spread from plant to plant by wind-blown rain. The bacteria infect through wounds and stomates.</p> <p>Management: Red stripe is usually a minor disease. Most commercial varieties are resistant and never exhibit top rot. HoCP 00-950 is a current variety that may develop top rot during wet growing seasons.</p>
<p>Brown Stripe <i>(Bipolaris stenospila)</i></p>	<p>Symptoms: In leaves, elongate, reddish-brown lesions with an obvious yellow “halo” develop parallel to veins. During severe infection, lesions may coalesce and entire leaves may be killed. Disease is more severe when plants are under nutritional stress or injured by herbicides.</p> <p>Source of inoculum: Spores produced by the fungus are spread by the wind to cause new infections.</p> <p>Management: Brown stripe is usually a minor disease. Obvious disease symptoms have been observed in L 01-299, L 03-371, and HoCP 04-838. Disease development is minimal when conditions are favorable for growth. Symptoms usually diminish after fertilization.</p>

Commercial Crop Production Field Crops - Sugarcane

Table 1. Symptoms, source of inoculum and management of diseases of sugarcane	
Disease	
<p>Pokkah Boeng <i>(Gibberella fujikuroi)</i></p>	<p>Symptoms: Malformed or twisted leaves occur near the shoot apex. Young leaves may exhibit pronounced wrinkling, twisting and shortening. Chlorosis (yellowing) is often evident at the leaf base, and necrosis may develop. Spindle infection can spread into the stalk. In severe cases, dark red streaks, and ladder-like lesions form inside the stalk and the rind. A “knife-cut” lesion may form in the rind.</p> <p>Source of inoculum: Spores of the fungus are spread by wind and rain.</p> <p>Management: Grow resistant varieties. All the current varieties have adequate resistance. Pokkah boeng may become evident during wet periods when rapid plant growth is occurring. However, plants recover, and the effect on yield is minimal.</p>
<p>Orange Rust <i>(Puccinia kuehnii)</i></p>	<p>Symptoms: Leaf lesions very similar to brown rust except that young lesions and the spores produced in pustular lesions on the underside of the leaf are orange. Symptoms will persist into the summer months, whereas few brown rust symptoms are evident in new leaves during summer.</p> <p>Source of inoculum: Same as for brown rust. The fungus overwinters in green leaf tissue, and spores produced during late spring spread the disease over short and long distances.</p> <p>Management: Orange rust was first observed in 2012. Varietal resistance has provided good control.</p>
<p>White Stripe <i>(Physiological disorder)</i></p>	<p>Symptoms: Characterized by variable amounts of longitudinal, white striping on leaves of some plants, usually occurring during spring. The white stripes extend the full length of the leaf. Striping is not considered infectious but rather a growth response to environmental conditions.</p> <p>Management: None. Plants will usually recover after fertilizer uptake in the presence of adequate rainfall.</p>

The sugarcane section was revised December 2014 by Dr. J. Hoy.

Commercial Crop Production Field Crops - Wheat

Table 1. Symptoms, source of inoculum and management of diseases of wheat	
Disease	
Leaf Rust <i>(Puccinia triticina)</i>	<p>Symptoms: Leaf rust is widespread and probably is the most destructive disease on wheat in Louisiana. The leaf rust fungus produces small, yellowish-orange pustules on the leaves. These masses of spores turn dark as wheat matures. Infection usually begins on lower leaves and spreads upward. Infected leaves turn yellow and die.</p> <p>Management: Resistant varieties are the most practical approach, although fungicides may be used (Table 3).</p>
Stem Rust <i>(Puccinia graminis tritici)</i>	<p>Symptoms: Elongated, reddish-brown pustules occur on the stem, leaf sheaths, leaf blades and glumes. Pustules rupture the epidermis to expose a powdery, reddish-brown mass of spores. Fragments of epidermis adhere to sides and ends of pustules to give them a ragged appearance.</p> <p>Source of Inoculum: Has alternate host species of <i>Berberis</i> and <i>Mahonia</i> where new races may occur, but spread in this area primarily is from wheat to wheat.</p> <p>Management: Stem rust is a serious problem in localized regions of Louisiana. Resistant varieties are the most practical approach for control of this disease, although fungicides may be used (Table 3).</p>
Leaf and Glume Blotch <i>(Stagonospora sp.)</i>	<p>Symptoms: The disease appears on the chaff and may be seen as small, irregular, grayish or brownish spots or blotches, which enlarge and become chocolate brown. As the spots age, their centers turn grayish-white and may include tiny, round, raised black spore-bearing bodies. Ordinarily, only a few glumes in a head become infected, but in severe cases the entire head is attacked and turns dark brown. Spots on the sheaths are dark brown and often include most of each sheath. Spots on leaves are light colored and usually surrounded by a brown border.</p> <p>Management: Varieties differ in tolerance to leaf and glume blotch. Consult variety recommendations. For fungicide recommendations, please refer to Table 3.</p>
Powdery Mildew <i>(Erysiphe graminis tritici)</i>	<p>Symptoms: Powdery mildew usually is found on leaves but may attack all aboveground parts of the plant. It first appears as small irregular or circular light gray spots on the upper leaf surface. Later, the plant is covered with a “floury” appearance. Leaves eventually become misshapened and die.</p> <p>Management: The application of fungicide for the control of powdery mildew has rarely been economical.</p>

Commercial Crop Production Field Crops - Wheat

Table 1. Symptoms, source of inoculum and management of diseases of wheat	
Disease	
<p>Bacterial Streak/Black Chaff (<i>Xanthomonas campestris</i> pv. <i>translucens</i>)</p>	<p>Symptoms: Symptoms on leaves begin as dark green, water-soaked spots that eventually become necrotic and develop into streaks. On the heads, black chaff appears as stripes on the glumes, but blackening may be total.</p> <p>Management: Use crop rotation, clean tillage and pathogen-free seed.</p>
<p>Fusarium Head Blight/Scab (<i>Fusarium</i> spp.)</p>	<p>Symptoms: The symptoms after flowering appear as a bleaching of the glumes, spikelets, areas of the head or even the entire head. Salmon-red or pink-red spore masses frequently form on infected heads.</p> <p>Control: Seed treatment fungicides help but do not entirely eliminate the fungus. Well timed, foliar-applied fungicides can reduce incidence.</p>
<p>Stripe Rust (<i>Puccinia striiformis</i>)</p>	<p>Symptoms: The first sign of disease is individual yellow pustules, usually at the top of the leaf. Later, pustules develop in rows, giving the characteristic of striped appearance. Leaves, sheaths, stems and glumes may be attacked.</p> <p>Management: Resistant varieties are the most practical approach for control of this disease, although fungicides may be used (Table 4).</p>
<p>Take-all (<i>Gaeumannomyces graminis</i>)</p>	<p>Symptoms: Affected plants have shortened, bleached heads that stand erect, and the affected plants are distributed irregularly throughout the field. The stem base is blackish-brown, and the roots show dark discoloration and are extensively rotted.</p> <p>Management: Maintain balanced soil fertility and use seed treatment fungicides (Table 2).</p>
<p>Tan Spot (<i>Pyrenophora tritici-repentis</i>)</p>	<p>Symptoms: Tan spot first appears on the lower leaves as small yellowish-brown spots that develop into oval spots. Lesion centers become tan and usually are surrounded by a yellow border or halo. As the leaf declines, the spots expand and merge into irregular tan to brown lesions.</p> <p>Management: Deep plow crop residues. Fungicides may be used (Table 2).</p>
<p>Yellow Dwarf (BYDV)</p>	<p>Symptoms: Leaf discoloration in shades of yellow, red or purple, especially from tip to base and from margin to midrib. Stunting and excessive tillering are noted. White sterile heads may develop.</p> <p>Management: No adequate controls are available at this time.</p>

Commercial Crop Production Field Crops - Wheat

Table 2. Fungicides available to manage seed and seedling diseases in wheat		
Product¹	Rate²	Disease
Apron XL LS	0.3-0.6 fl oz	Pythium damping-off
Dividend XL Dividend XL RTA	1 fl oz 5 fl oz	Loose smut, general seed rots
ManKocide	4 oz per	Bacterial diseases
Manex	2-3.2 oz/bushel	Damping-off Seed rot Seedling blight
Maxim 4FS Maxim XL	0.08-0.16 fl oz 0.167-0.334 fl oz	Damping-off
System 3	2-3 oz/bushel	Damping-off
Vitavax-CT Vitavax M	9-12 oz 9-12 oz	Loose smut
<p>¹ Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.</p> <p>²Rates are the amount of formulation (product) per hundredweight unless otherwise noted.</p>		

Commercial Crop Production Field Crops - Wheat

Table 3. Recommended fungicides, rates and application timing for wheat diseases					
Target	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	Time of Application	PHI ⁴	
Leaf and glume blotch (<i>Phaeosphaeria nodorum</i>⁵)	Bumper 41.8EC	3	4 oz	Protect flag leaf but not past Feeke's GS 10.5	40
	Caramba	3	10-14 fl oz	Protect as flag leaf emerges	30
	Dithane DF Rainshield	M	2 lb	No applications past Feeke's 10.5	26
	Dithane F-45 Rainshield	M	1.6 lb	No applications past Feeke's 10.5	26
	Headline	11	4 oz	No later than the beginning of flowering	14
	Kocide 3000	M	6-9 oz	At first appearance of disease	-
	Manzate Flowable	M	1.6 lb	At first appearance of disease	26
	Manzate Pro-stick	M	2 lb	At first appearance of disease	26
	Penncozeb 4FL	M	0.8-1.6 lb	No applications past Feeke's 10.5	26
	Proline 480 SC	3	4.3-5 fl oz	At first appearance of disease but not past Feeke's 10.5	-
	PropiMax	3	4 oz	At flag leaf emergence	40
	Prosaro 421 SC	3	6.5-8.2 fl oz	At first appearance of disease	30
	Quadris Flowable	11	4-12 oz	Prior to disease up to Feeke's 10.5	45
	Quilt	11,3	10.5-14 oz	No applications past Feeke's 10.5	-
	Quilt Xcel	11,3	10.5-14 oz	No applications past Feeke's 10.5	-
	Stratego YLD	11	4 oz	At first appearance of disease	35
	Tilt	3	4 oz	No applications past Feeke's 10.5	-
Twinline	11,3	7-9 oz	No applications past Feeke's 10.5	-	
Rust	Bumper 41.8EC	3	4 oz	Protect flag leaf but not past Feeke's GS 10.5	40
	Caramba	3	10-14 fl oz	Protect as flag leaf emerges	30
	Dithane DF Rainshield	M	2 lb	No applications past Feeke's 10.5	26
	Dithane F-45 Rainshield	M	1.6 lb	No applications past Feeke's 10.5	26
	Folicur 3.6F	3	4 oz	At first appearance of disease	30
	Headline	11	6-9 oz	No later than the beginning of flowering	14
	Manzate Flowable	M	1.6 lb	At first appearance of disease	26
	Manzate Pro-stick	M	2 lb	At first appearance of disease	26
	Penncozeb 4FL	M	0.8-1.6 lb	No applications past Feeke's 10.5	26
	Proline	3	4.3-5 fl oz	At first appearance of disease but not past Feeke's 10.5	-
	PropiMax	3	4 oz	At flag leaf emergence	40

Commercial Crop Production Field Crops - Wheat

Table 3. Recommended fungicides, rates and application timing for wheat diseases				
Target	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	Time of Application	PHI ⁴
	Prostaro 421 4C	3	Prior to disease up to Feeke's 10.5	30
	Quadris Flowable	11	No applications past Feeke's 10.5	45
	Quilt	11,3	No applications past Feeke's 10.5	-
	Quilt Xcel	11,3	When conditions are favorable for disease development	-
	Stratego YLD	11	No applications past Feeke's 10.5	35
	Tilt	3	No applications past Feeke's 10.5	-
	Twinline	11,3	No applications past Feeke's 10.5	-

¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.

²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).

³Rates are the amount of formulation (product) per acre unless otherwise indicated.

⁴Pre-harvest interval (PHI) is the minimum number of days allowed between the last application and harvest.

⁵Formerly *Stagonospora nodorum* and *Septoria nodorum*

Commercial Crop Production Field Crops - Wheat

Management of wheat and other small grain diseases using fungicides

The North Central Regional Committee on Management of Small Grain Diseases (NCERA-184) has developed the following information on fungicide efficacy for control of certain foliar diseases of wheat for use by the grain production industry in the U.S. Efficacy ratings for each fungicide listed in the table were determined by field testing the materials over multiple years and locations by the members of the committee. Efficacy is based on proper application timing to achieve optimum effectiveness of the fungicide as determined by labeled instructions and overall level of disease in the field at the time of application. Differences in efficacy among fungicide products were determined by direct comparisons among products in field tests and are based on a single application of the labeled rate as listed in the Table 4. Table 4 includes most widely marketed products, and is not intended to be a list of all labeled products.

Commercial Crop Production Field Crops - Wheat

Disease												
Diseases are abbreviated as follows: PM=Powdery Mildew; SLGB=Stagonospora leaf and glume blotch; SLB=Septoria Leaf Blotch; TS=Tan Spot; Stripe=Stripe Rust; LR=Leaf Rust; SR=Stem Rust and; HS=Head Scab												
Fungicide ¹ Information												
Class and Mode of Action Group ²	Active Ingredient	Product ³	Rate ⁴ (fl oz)	PM	SLGB	SLB	TS	Stripe	LR	SR	HS	Harvest Restrictions ⁵
QoI Strobilurins Group 11	Fluoxastrobin 40.3%	Evito 480SC	2-4	G	--	--	--	E	VG	--	--	Feeke's 10.5, 45 days
	Picoxystrobin	Approach SC	6-12	G	--	--	VG	--	VG	--	NL	Feeke's 10.5, 40 days
	Pyraclostrobin 23.6%	Headline SC	6-9	G	VG	VG	E	E ⁶	E	G	NL	Feeke's 10.5
DMI Triazoles Group 3	Metconazole 8.6%	Caramba 0.75 SL	10-17	VG	VG	--	VG	E	E	E	G	30 Days
	Prothioconazole 41.8%	Tilt 3.6 EC4, MG ⁷	4	VG	VG	VG	VG	VG	VG	VG	P	Feeke's 10.5
	Prothioconazole 41%	Proline 480 SC	5-5.7	--	VG	VG	VG	--	VG	VG	G	30 Days
	Tebuconazole 38.7%	Folicur 3.6 F4, MG ⁷	4	G	VG	VG	VG	E	E	E	F	30 Days
	Prothioconazole 19%, Tebuconazole 19%	Prosaro 421 SC	6.5-8.2	G	VG	VG	VG	E	E	E	G	30 Days
Mixed ⁸	Metconazole 7.4% Pyraclostrobin 12%	TwinLine 1.75 EC	7.0-9.0	G	VG	VG	E	E	E	VG	NL	Feeke's 10.5
	Fluxapyroxad 14.3% Pyraclostrobin 28.6%	Priaxor	4.0-8.0	G	VG	VG	E	E	E	VG	NL	Feeke's 10.5
	Propiconazole 11.7% Azoxystrobin 7.0%	Quilt 200 SC4, MG ⁷	10.5-14	VG	VG	VG	VG	E	E	VG	NL	Feeke's 10.5
	Propiconazole 11.7% Azoxystrobin 13.5%	Quilt Xcel 2.2 SE	10.5-14	CG	VG	VG	VG	VG	E	VG	NL	Feeke's 10.5
	Prothioconazole 10.8% Trifloxystrobin 32.3%	Stratego YLD	4.0	G	VG	VG	VG	VG	VG	VG	NL	35 days
	Tebuconazole 22.6% Trifloxystrobin 22.6%	Absolute 500 SC	5.0	G	VG	VG	VG	VG	E	VG	NL	35 days

¹ Additional fungicides are labeled for disease on corn, including contact fungicides such as chlorothalonil. Certain fungicides may be available for diseases not listed in the table, including Gibberella and Fusarium ear rot. Applications of Proline 480 SC for use on ear rots requires a FIFRA Section 2(ee) and is only approved for use in Illinois, Indiana, Iowa, Louisiana, Maryland, Michigan, Mississippi, North Dakota, Ohio, Pennsylvania, and Virginia.

² Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).

³ Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied. Many products have specific use restrictions about the amount of active ingredient that can be applied within a period of time or the amount of sequential applications that can occur. Please read and follow all specific use restrictions prior to fungicide use. This information is provided only as a guide. It is the responsibility of the pesticide applicator by law to read and follow all current label directions. No endorsement is intended for products listed, nor is criticism meant for products not listed. Members or participants in the NCERA-184 committee assume no liability resulting from the use of these products.

⁴ Rates are the amount of formulation (product) per acre unless otherwise indicated.

⁵ Harvest restrictions are listed for field corn harvested for grain. Restrictions may vary for other types of corn (sweet, seed or popcorn, etc.), and corn for other uses such as forage or fodder.

Commercial Crop Production Field Crops - Wheat

⁶Efficacy may be significantly reduced if solo strobilurin products are applied after stripe rust infection has occurred.

⁷Multiple generic fungicides available. Products containing tebuconazole include: Embrace, Monsoon, Muscle 3.6 F, Onset, Orius 3.6 F, Tebucon 3.6 F, Tebustar 3.6 F, Tebuzol 3.6 F, Tegrol, and Toledo. Products containing propiconazole include: Bumper 41.8 EC, Fitness, Propiconazole E-AG, and PropiMax 3.6 EC. Products containing propiconazole + azoxystrobin include: Avaris 200 SC.

⁸Mixed modes of action products generally combine triazole and strobilurin active ingredients. Priaxor is an exception to this general statement and combines carboxamide and strobilurin active ingredients.

The wheat section was revised December 2014 by Dr. C. Hollier.

Commercial Crop Production
Fruit and Nut Crops - Apples

Table 1. Symptoms, source of inoculum and management of diseases of apples	
Disease (Pathogen)	Disease Description
<p>Bitter Rot (<i>Glomerella cingulata</i> = <i>Colletotrichum gloeosporioides</i>)</p>	<p>Symptoms: Although infection can occur at any stage of fruit development, most infection occurs after midseason as the fruit approaches maturity. The disease is characterized by sunken and (more or less) soft and watery, pinkish to brown rotten spots on the fruit. The rotten tissue has a bitter taste.</p> <p>Source of Inoculum: The fungus survives from season to season in mummified fruit and in dead wood and cankers. Fungal spores are dispersed primarily in splashing water, and disease develops best under warm, moist conditions.</p> <p>Management: Remove mummified fruit and dead wood. Follow the apple spray schedule; late cover sprays are important.</p>
<p>Black Rot (<i>Botryosphaeria obtuse</i>)</p>	<p>Symptoms: Sunken cankers with darkened bark that form along the length of the branch. As the canker spreads the leaves on the branch turn bright yellow and fall to the ground. The fungus also causes a leaf spot and fruit rot. Frogeye leaf spots are dark brownish purple with a sharply defined blackened margin. Leaf symptoms occur early in the season when the leaves are unfolding and the weather is cool and wet. Fruit rot occurs at the blossom end as well as the calyx end of the fruit. Rotted areas are round, firm and leathery with concentric rings.</p> <p>Source of Inoculum: The fungus overwinters in cankers, especially in those initiated by fire blight, in dead bark, and in mummified fruit. Spores are released in the spring during rainfall events. Spores are waterborne and continue to be produced during wet periods through the summer.</p> <p>Management: Avoiding stress to the tree allows the tree to better resist initial branch infections. Prune out branches with cankers several inches below the most basal portion of the cankers during the dormant period. Dip pruning tools in 10 percent chlorine bleach solution or another registered disinfectant between cuts. Remove mummified fruit from the orchard. Apply fungicides from silver tip through harvest.</p>
<p>Cedar Apple Rust (<i>Gymnosporangium juniperi-virginianae</i>)</p>	<p>Symptoms: Galls or “cedar apples” are produced on eastern red cedar and yellow-orange spots are produced on the leaves and fruit of apples and crabapples.</p> <p>Source of Inoculum: The cedar apple rust fungus survives from season to season on the familiar “cedar apples” on eastern red cedar. Wind-borne spores are produced during periods of rain in the spring.</p> <p>Management: Rust can be avoided by eradicating cedar trees within 2 miles of apples. Follow a fungicide spray schedule.</p>

Commercial Crop Production
Fruit and Nut Crops - Apples

Table 1. Symptoms, source of inoculum and management of diseases of apples	
Disease (Pathogen)	Disease Description
<p>Fire Blight (<i>Erwinia amylovora</i>)</p>	<p>Symptoms: Affects blossoms, leaves, twigs and young fruit. Infected blossoms wilt suddenly and turn dark brown, followed by blighting of leaves and terminals. Infected twigs and leaves turn dark brown to black, and leaves cling to the stem, often remaining attached most of the season.</p> <p>Source of Inoculum: The bacteria overwinter at the base of blighted twigs or in cankers on larger limbs. Bacteria are spread by bees and splashing rains. Severely infected fruit will ooze bacteria.</p> <p>Management: Prune out and burn infected twigs. Cut 12-15 inches below affected tissue. Dip pruning tools in 10 percent chlorine bleach solution between cuts. Spray during bloom with copper fungicides or streptomycin according to manufacturer's directions.</p>
<p>Flyspeck <i>Schizothyrium pomi</i> (formerly <i>Microthyriella rubi</i>)</p>	<p>Symptoms: Shiny black raised specks arranged in groups on the fruit. These specks are the fruiting structures of the fungus. Spores are produced within the specks during warm and moist weather. Flyspeck and sooty blotch are often observed together on the fruit.</p> <p>Source of Inoculum: The fruiting structures survive between seasons on infected twigs. Spores are dispersed by wind.</p> <p>Management: Well-pruned trees will develop less disease during dry to moderately wet weather. Thin fruit to promote air flow and improve fungicide coverage. Follow an apple spray schedule for summer diseases.</p>
<p>Phytophthora Crown, Collar and Root Rot (<i>Phytophthora</i> spp.)</p>	<p>Symptoms: Foliar symptoms include thinning of the canopy, poor shoot growth and gradual decline. Removal of the outer bark reveals a reddish-brown to brown decay of the phloem and cambium with distinct margins between diseased and healthy tissue.</p> <p>Source of Inoculum: These pathogens are soil-borne organisms.</p> <p>Management: Use a combination of practices, including proper site selection, improving drainage and managing soil water, using resistant rootstocks and preventative applications of selected fungicides.</p>
<p>Powdery Mildew (<i>Podosphaera leucotricha</i>)</p>	<p>Symptoms: Symptoms first appear on the underside of leaves as grayish-white patches. Chlorotic (yellowing) spots appear in the upper surface of the leaves. As the disease progresses grayish-white patches form on the upper leaf surface. Severely infected leaves curl and drop from the tree. Flower buds may also become infected and infected buds open 5-8 days later than non-infected buds. Symptoms also appear on fruit. Diseased fruit are stunted and russeted.</p> <p>Source of Inoculum: The fungus overwinters in dormant terminal buds infected the previous season. As buds break dormancy, the fungus resumes growth and colonizes developing shoots. Spores are released in the air during the day and germinate during dry weather.</p>

Commercial Crop Production
Fruit and Nut Crops - Apples

Table 1. Symptoms, source of inoculum and management of diseases of apples	
Disease (Pathogen)	Disease Description
	<p>Management: Apple varieties vary in their susceptibility to powdery mildew. Avoid varieties such as Cortland, Jonathan, Monroe, and Granny Smith if powdery mildew is a persistent problem in the orchard. Dormant season pruning will reduce the number of potentially infected buds. During the season prune and destroy severely diseased shoots. Fungicides applied at pink bud and during the season will reduce the release of spores and spread within the tree.</p>
<p>Quince Rust (<i>Gymnosporangium clavipes</i>)</p>	<p>Symptoms: Dark green spots form on the calyx end of fruit and extend internally to the core. Fruit are distorted and drop prematurely.</p> <p>Source of Inoculum: Affects fruit of apple, crabapple, pear, hawthorne and quince. This fungus must have eastern red cedar or dwarf or prostrate junipers as alternate hosts to complete its life cycle. Galls are formed on the alternate host in which the fungus survives and infects apples and other host crops.</p> <p>Management: Remove alternate host plants in vicinity of desired trees; or remove all galls from cedar trees during the winter; or follow a regular spray program beginning at blossom and continuing until fruit are formed. A combination of the above measures may be necessary.</p>
<p>Scab (Apple Scab) (<i>Venturia inaequalis</i>)</p>	<p>Symptoms: Spots that are olive green in color with unclear margins appear on the underside of leaves in the spring. Heavily infected leaves become distorted and drop early in the summer. Fruit symptoms are similar to those on leaves but more distinct. Fruit spots darken with age and become scabby. Heavily infected fruit also become deformed and drop prematurely.</p> <p>Source of Inoculum: The fungus overwinters mainly in infected leaves on the ground. In the spring, the fungus produces spores that are released into the air during rainy weather and then carried to and infect young leaves and fruit. These new infections also produce spores that are further dispersed by rain.</p> <p>Management: Select varieties resistant to scab such as Crimson Crisp or Gold, Scarlet, Prima, and Goldrush. Consult your Parish Extension agent for a comprehensive list of resistant varieties. Rake and burn fallen leaves. Begin sprays in April after leaves have unfolded and follow a rigorous spray schedule to control apple scab.</p>
<p>Sooty Blotch (<i>Gloeodes pomigena</i> and other fungi)</p>	<p>Symptoms: Olive green, soot-like smudges on mature fruit. Fungal fruiting bodies are produced in the thallus. Sooty blotch and flyspeck are often observed together on the fruit.</p> <p>Source of Inoculum: The fungus survives between seasons on infected twigs of apple and woody plants common to hedgerows and woodlots.</p>

Commercial Crop Production
Fruit and Nut Crops - Apples

Table 1. Symptoms, source of inoculum and management of diseases of apples

Disease (Pathogen)	Disease Description
	<p>Spores are spread during the spring and early summer by rain. Disease develops through out the entire growing season.</p> <p>Management: Well-pruned trees will develop less disease during dry to moderately wet weather. Thin fruit to promote air flow and improve fungicide coverage. Follow an apple spray schedule for summer diseases.</p>

Commercial Crop Production
Fruit and Nut Crops - Apples

Table 2. Seasonal fungicide spray schedule for apples	
Developmental Stage	Disease(s)
Dormant	No fungicides are applied during dormancy. Cultural practices such as pruning and leaf cleanup and removal are crucial to adequately managing apple scab and fire blight.
Silver tip	Black rot Crown or collar rot Fire blight
Green tip to ½ inch green	Scab
Tight cluster to pink	Black spot Cedar apple rust Frogeye leaf spot Scab Powdery mildew Quince rust
Bloom	Fire blight Cedar apple rust Scab Powdery mildew Quince rust
Petal Fall and first cover	Cedar apple rust Scab Summer diseases* Powdery mildew Quince rust
Second cover spray and later sprays	Alternaria blotch Powdery mildew Summer diseases*
*Summer diseases include white rot, bitter rot, black spot, sooty blotch, and flyspeck.	

Commercial Crop Production
Fruit and Nut Crops - Apples

Table 3. Efficacy of selected fungicides against apple diseases. Table was reproduced from the 2013 Integrated Orchard Management Guide for Commercial Apples in the Southeast (<http://digital.ncdcr.gov/cdm/ref/collection/p249901coll22/id/17399>). Efficacy ratings are as follows: - = ineffective and 1 = slightly effective to 5 = very effective. No data are provided for products that are not labeled for the specific disease or if the efficacy is unknown. These ratings are benchmarks; actual performance will vary.

Chemical name (Fungicide product name)	Summer Diseases							
	Scab	Rusts	Black rot and White rot	Bitter rot	Sooty Blotch and Flyspeck	Alternaria blotch	Powdery mildew	Crown rot
<i>Aluminim tris</i> (Aliette WDG)								4
<i>Myclobutinal</i> (Rally 40WSP)							5	-
<i>Myclobutinal</i> (Rally 40WSP) + Mancozeb (75DF or 80DF) OR Meritran (Polyram 80DF) OR Captan (Captan 50W)	5	5	1-2	1-2	1-3		5	-
<i>Triflumazole</i> (Procure 50WS)							5	
<i>Triflumazole</i> (Procure 50WS) + Mancozeb (75DF or 80DF) OR Meritran (Polyram 80DF) OR Captan (Captan 50W)	5	4-5	1-2	1-2	1-3		4	-
<i>Captan</i> (Captan 50W)	3-4	1	3-4	4	4		-	-
<i>Captan</i> (Captan 50W)+ Prophyt	4	1	4	4	4		-	-
<i>Sulfur</i> (wetable)	1	1	-	-	-		3	-
<i>Mefenoxam</i> (Ridomil Gold EC or WSP)								4
<i>Potassium phosphite</i> (ProPhyt)								4
<i>Ziram</i> (Ziram F4)	3	4	3	4	5		-	-
<i>Kresoxim-methyl</i> (Sovran 50WG)	5	3	4	3	5		3	-
<i>Trifloxystrobin</i> (Flint 50WG)	5	3	4	4	5		3	-
<i>Pyraclostrobin + boscalid</i> (Pristine 38W)	5	3	4	4	5	5	4	-
<i>Thiophanate-methyl</i> (85WDG)	-	-	4	-	5		2	-
<i>Thiophanate-methyl</i> (85WDG) + <i>Captan</i> (Captan 50W)	3-4	1	4-5	3-4	4-5		2	-

Commercial Crop Production
Fruit and Nut Crops - Apples

Table 3. Efficacy of selected fungicides against apple diseases. Table was reproduced from the 2013 Integrated Orchard Management Guide for Commercial Apples in the Southeast (<http://digital.ncdcr.gov/cdm/ref/collection/p249901coll22/id/17399>). Efficacy ratings are as follows: - = ineffective and 1 = slightly effective to 5 = very effective. No data are provided for products that are not labeled for the specific disease or if the efficacy is unknown. These ratings are benchmarks; actual performance will vary.

Chemical name (Fungicide product name)	Summer Diseases							
	Scab	Rusts	Black rot and White rot	Bitter rot	Sooty Blotch and Flyspeck	Alternaria blotch	Powdery mildew	Crown rot
<i>Captan</i> (Captan 50W)+ <i>Ziram</i> (Ziram F4) OR <i>Thiophanate-methyl</i> (85WDG)	3	2	5	4	5		1	-
<i>Difenoconazole</i> + <i>Cyprodinil</i> (Inspire Super)	4	4					3	-
<i>Captan</i> (Captan 50W) + <i>Potassium phosphite</i> (ProPhyt) rotated with <i>Difenoconazole</i> + <i>Cyprodinil</i> (Inspire Super)	5	4	5	5	5		3	-
<i>Fenbuconazole</i> (Indar 75WSP)							4	-
<i>Fenbuconazole</i> (Indar 75WSP) + <i>Mancozeb</i> (75DF or 80DF) OR <i>Metiram</i> (Polyram) OR <i>Captan</i> (Captan 50W)	5	4-5	1-2	1-2	3-4		4	-
<i>Tebuconazole</i> (Tebuzol 45DF)							5	-
<i>Tebuconazole</i> (Tebuzol 45DF) + <i>Mancozeb</i> (75DF or 80DF) OR <i>Meritran</i> (Polyram 80DF) OR <i>Captan</i> (Captan 50W)	4	5	1	2	3		5	-
<i>Flutriafol</i> (Topguard 1.04SC)							5	
<i>Flutriafol</i> (Topguard 1.04SC) + <i>Captan</i> (Captan 50W)	4	5	3	3	3		5	-
<i>Fluxapyroxad</i> + <i>Pyraclostrobin</i> (Merivon 4.18SC)	5	2	3	2	4		5	-
<i>Fluxapyroxad</i> + <i>Pyraclostrobin</i>	5	2	4	4	5		5	-

Commercial Crop Production
Fruit and Nut Crops - Apples

Table 3. Efficacy of selected fungicides against apple diseases. Table was reproduced from the 2013 Integrated Orchard Management Guide for Commercial Apples in the Southeast (<http://digital.ncdcr.gov/cdm/ref/collection/p249901coll22/id/17399>). Efficacy ratings are as follows: - = ineffective and 1 = slightly effective to 5 = very effective. No data are provided for products that are not labeled for the specific disease or if the efficacy is unknown. These ratings are benchmarks; actual performance will vary.

Chemical name (Fungicide product name)	Summer Diseases							
	Scab	Rusts	Black rot and White rot	Bitter rot	Sooty Blotch and Flyspeck	Alternaria blotch	Powdery mildew	Crown rot
(Merivon 4.18SC) + Captan (Captan 50W)								
<i>Fluxapyroxad</i> + <i>Pyraclostrobin</i> (Merivon 4.18SC) + <i>Mancozeb</i> (75DF or 80DF)	5	3	4	4	5		5	-
<i>Penthiopyrad</i> (Fontelis 1.675C)	3	2					3	-
<i>Penthiopyrad</i> (Fontelis 1.675C) + <i>Mancozeb</i> 75DF	5	3					3	
<i>Penthiopyrad</i> (Fontelis 1.675C) + <i>Captan</i> (Captan 50W)	5	2					3	
<i>Mancozeb</i> (75DF or 80DF)	3	4	2	3	3		-	-
<i>Metiram</i> (Polyram 80W)	3	4	2	3	3		-	-
<i>Dodone</i> (<i>Syllit</i> 3.4FL)	4	-	-	-	2		-	-
<i>Cyprodinil</i> (Vangard 75WG)	4	-	-	-	-		-	-
<i>Cyprodinil</i> (Vangard 75WG) + <i>Mancozeb</i> (75DF or 80DF) OR <i>Metiram</i> (Polyram 80DF)	5							
<i>Pyrimethanil</i> (Scala SC)	4	-	-	-	-		-	-
<i>Pyrimethanil</i> (Scala SC)+ <i>Mancozeb</i> (75DF or 80DF) OR <i>Metiram</i> (Polyram 80DF)	5							-

Commercial Crop Production
Fruit and Nut Crops - Apples

Table 4. Recommended pesticides, rates and pesticide use restrictions for apples					
Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Diseases
<i>Boscalid + Pyraclostrobin</i> (7+11)	Pristine	14.5-18.5 oz	74 oz	0	Pear scab Flyspeck Powdery mildew Quince rust (suppression) Sooty blotch
<i>Captan</i>	Captan 50 WP Captan 80 WDG	2.5 lb/100 gal 1.6 lb/100 gal	1 app 1 app	NA NA	Postharvest rots (Captan 50WP can only be used for mechanical fruit dips.)
<i>Copper Hydroxide</i> (M1) ^{6,7}	Badge SC Badge X2 ^{OG} Champ WG Champ Formula2 Kentan DF Kocide 3000 Kocide 2000	0.9 pt 0.5 lb 1 lb 0.66 pt 1 lb 0.5 lb 0.75 lb	56.3 pt 16 lb 32 lb 44 pt 16 lb ai 53.3 lb 45.7 lb	See labels	Apple Scab Fire blight Blossom blast
<i>Copper Hydroxide+ Mancozeb</i> ^{6,7} (M1+M3)	ManKocide	1.5 lb	53.3 lb	See label	Fire blight (Do not apply after bloom.) Blossom blast
<i>Copper Sulfate</i> ^{6,7} (M1)	Cuprofix Ultra 40 Disperss Cuproxat Mastercop Top Cop with Sulfur	0.75 lb 7.5-10 lb (dormant) 15-20 pt (dormant only) 0.5 pt 4.6 pt (dormant) 2 qt/100 gal	40 lb 1 app 1 app 2 pt 1 app	See labels	Fire blight Blossom blast (dormant sprays only)
<i>Copper Sulfate + Copper Oxychloride</i> ^{6,7} (M1)	C-O-C-S WDG	12-15.6 lb (dormant) 0.5-1 lb (bloom)	1 app 31 lb	See labels	Fire blight Blossom blast

Commercial Crop Production
Fruit and Nut Crops - Apples

Table 4. Recommended pesticides, rates and pesticide use restrictions for apples					
Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Diseases
<i>Cyprodinil</i> (9)	Vanguard WG	3-5 oz	30 oz	0	Apple scab
<i>Difenoconazole</i> + <i>Cyprodinil</i> (3+9)	Inspire Super	12 fl oz	60 fl oz	14	Flyspeck Powdery mildew Quince rust Sooty blotch
<i>Fenarimol</i> (3)	Rubigan EC	8-12 fl oz	84 fl oz	30	Apple scab Powdery mildew Rusts
	Vintage SC	4-12 fl oz	48 fl oz	30	Apple scab Powdery mildew
<i>Febuconazole</i> (3)	Indar 2F	4-6 fl oz	32 fl oz	14	Apple scab Flyspeck Powdery mildew Rust Sooty blotch
<i>Fenhexamid</i> (17)	Elevate 50WDG	1-1.5 lb	6 lb	0	Botrytis fruit rot
<i>Fludioxonil</i> (12)	Scholar SC	10-16 fl oz/100 gal	2 app	NA	Postharvest rots (harvested fruit only)
<i>Fluxapyroxad</i> + <i>Pyraclostrobin</i> (7+11)	Merivon	4-5.5 fl oz	22 fl oz	0	Apple Scab Flyspeck Powdery mildew Sooty blotch Quince rust (suppression only)
<i>Fosetyl-Al</i> (33)	Aliette WDG	2.5-5 lb	20 lb	14	Fire blight Phytophthora collar and root rot
<i>Kresoxim- Methyl</i> (11)	Sovran	3.2-6.4 oz	25.6 oz	30	Apple scab Powdery mildew Quince rust (suppression only)

Commercial Crop Production
Fruit and Nut Crops - Apples

Table 4. Recommended pesticides, rates and pesticide use restrictions for apples

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Diseases
<i>Mancozeb</i> ⁷ (M3)	Dithane F45 Rainshield	4.8 qt	19.2 qt	See labels	Apple scab Fire blight (see label for rates) Rusts
	Dithane M45	3-6 lb	21-24 lb		
	Manzate Flowable OR Max	2.4-4.8 qt	16.8-19.2 qt		
	Manzate Pro- stick	3-6 lb	21-24 lb		
	Penncozeb 75DF	3.2-6.4 lb	22.4-25.6 lb		
	Penncozeb 80WP	3-6 lb	21-24 lb		
	Roper Rainshield	3-6 lb	21-24 lb		
<i>Mefenoxam</i> (4)	Ridomil Gold SL Ridomil Gold GR	2 qt see label	2 app see label	NA see label	Phytophthora crown, collar or root rot
<i>Metalaxyl</i> (4)	MetaStar 2E	2 gal	1 app	NA	Phytophthora crown, collar or root rot
<i>Myclobutanil</i> ⁸ (3)	Eagle 20EW	4-6 fl oz	153 fl oz	14	Apple scab Powdery mildew Rust
	Rally 40WSP	5-10 oz	5 lb	14	
<i>Oxytetracycline</i> (41)	Mycoshield	1 lb/100 gal	10 app	60	Fire blight
<i>Propoconazole</i> (3)	Banner Maxx Bumper ES	See label, apply to non-bearing nursery stock only		1 year	Apple scab Powdery mildew Rust
<i>Penthiopyrad</i> (7)	Fontelis	16-20 fl oz	61 fl oz	28	Apple scab Powdery mildew Rusts
<i>Phosphite</i> (phosphorous acid salts) (33)	Alude	1.25-2.5 qt	See labels	See labels	Fire blight Powdery mildew
	Confine Extra	1-3 qt			
	Fosphite	1-3 qt			
	Fungi-phite	1-2 qt			
	Rampart	1-3 qt			

Commercial Crop Production
Fruit and Nut Crops - Apples

Table 4. Recommended pesticides, rates and pesticide use restrictions for apples					
Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Diseases
<i>Pyrimethanil</i>	Scala SC	7-10 fl oz (alone) 5 fl oz (tank mix)	40	72	Apple scab
<i>Streptomycin</i> (25)	Agri-Mycin 17	24-48 oz	See label	30	Fire blight
<i>Sulfur</i> ⁷ (M2)	Liquid Sulfur Six Microfine Sulfur Microthiol Disperss Yellow Jacket Wettable Sulfur	0.75-3.5 pt/100 gal 10-60 lb 10-20 lb 10-60 lb	NA NA NA NA		Apple scab Powdery mildew
<i>Tebuconazole</i> (3)	Tebuzol 45DF	4-8 oz	3 lb	75	Apple scab Powdery mildew
<i>Tebuconazole + Trifloxystrobin</i> (3+11)	Adament 50 WG	4-5 oz	22 oz	75	Apple scab Powdery mildew Flyspeck Sooty blotch
<i>Thiabendazole</i> (1)	Mertect 340F	16 fl oz/100 gal	1 app	NA	Postharvest rots (harvested fruit only)
<i>Thiophanate- Methyl</i> (1)	Cercobin T-Methyl 70WSB Thiophanate methyl 85WDG Topsin M 70WP Topsin M WSB	16.3-21.8 fl oz 1 lb 0.8 lb 1 lb 1 lb	87.2 fl oz 4 lb 3.2 lb 4 lb 4 lb	1 1 1 1 1	Apple scab Black rot Flyspeck Powdery mildew Sooty blotch
<i>Triflumizole</i>	Procure 480SC	8-16 fl oz	64 fl oz	14	Apple scab Powdery mildew
<i>Trifloxystrobin</i> (11)	Flint	2-2.5 oz	11 oz	14	Apple Scab Flyspeck Powdery mildew Sooty blotch
<i>Trifloxystrobin+ Triadimefon</i> (11+3)	Strike Plus 50WDG	3-9 oz/100 gal (garden center and nursery stock only)	207 oz	1 year	Apple Scab Early leaf spots Powdery mildew

Commercial Crop Production
Fruit and Nut Crops - Apples

Table 4. Recommended pesticides, rates and pesticide use restrictions for apples

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Diseases
<i>Ziram</i>	Ziram 76DF	6 lb	42.4 lb	14	Apple Scab Flyspeck Sooty blotch

¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.

²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).

³Rates are the amount of formulation per acre unless otherwise indicated. Usually 100 gallons of water are required to give good coverage with boom sprayers.

⁴Post-harvest interval (PHI) is the minimum number of days allowed between the last application and harvest.

⁵All rates refer to foliar applications unless otherwise noted. Refer to label for other application rates and directions.

⁶See labels for correct application timings and rates to manage Blossom blight.

⁷See labels for variety restrictions and the potential to damage (i.e. russetting) fruit.

⁸ See labels for correct application timings and rates to manage Apple scab. Always tank mix Rally 40WSP with a multi-site (M) product such as Dithane.

Dr. M. Lewis Ivey updated information in this section December 2014.

Commercial Crop Production Fruit and Nut Crops - Citrus

Integrated Citrus Disease Management

Profitable and sustainable citrus production relies on effective management of diseases and insects that transmit diseases. This is particularly important as exotic diseases such as citrus canker and citrus greening threaten the productivity of the citrus industry in Louisiana. In order to manage and prevent the spread of citrus diseases an integrated disease management program that incorporates early and accurate disease identification, cultural practices, fungicides and post-harvest sanitation should be developed. Detailed information on establishing a year round integrated pest management program for citrus can be found at UC-IPM Online (<http://www.ipm.ucdavis.edu/PMG/selectnewpest.citrus.html>). An overview of citrus diseases commonly found on citrus in Louisiana and management tactics is provided in Table 1. A general seasonal fungicide spray schedule (Table 2) and a list of registered fungicides for disease management (Table 3) are also provided in this section.

Citrus Quarantines

Plant quarantines are established to prevent the introduction of economically important plant pathogens or insect pests into a region where it does not occur. The Louisiana Department of Agriculture and Forestry established quarantine effective Nov. 24, 2013. The quarantine restricts movement of ***citrus trees, citrus nursery stock and citrus plant parts, including fruit***, from parishes where plant diseases called citrus greening and citrus canker and the insect called Asian citrus psyllid have been confirmed. Quarantined areas in Louisiana are:

Citrus Greening – Orleans and Washington parishes.

Asian citrus psyllid (transmits citrus greening pathogen) – Entire state of Louisiana for interstate movement of regulated materials, unless properly treated.

Citrus canker – All of Orleans Parish, Jefferson Parish north of the parking entrance to Jean Lafitte Park, all of Belle Chasse and the Naval Air Station in Plaquemines Parish and all of the St. Rose area in St. Charles Parish.

For more information on the diseases, the insect or the restrictions, contact the Louisiana Department of Agriculture and Forestry's Horticulture and Quarantine Programs office at 225-952-8100 or go to www.ldaf.la.gov. More information about citrus canker and citrus greening diseases can be obtained by calling the LSU AgCenter Plant Diagnostic Center at 225-578-4562.

Commercial Crop Production Fruit and Nut Crops - Citrus

Table 1. Symptoms, source of inoculum and management of diseases of citrus	
Disease	
<p>Brown Rot (<i>Phytophthora</i> spp.)</p>	<p>Symptoms: Light brown, leathery-appearing spots develop on the fruit, particularly those low in the canopy or touching the ground. A whitish growth may develop under humid conditions.</p> <p>Source of Inoculum: The pathogen survives in the soil and is splashed onto low-hanging fruit. It can then be spread by rain splash or wind-driven rain.</p> <p>Management: Prune to remove low-hanging branches and fruit. Follow a fungicide spray program to manage <i>Phytophthora</i> root rot (see below).</p>
<p>Citrus Canker (<i>Xanthomonas citri</i> pv. <i>citri</i>)</p>	<p>Symptoms: Leaf lesions are raised on the upper and lower leaf surface. Lesions become corky and crater-like with raised margins, sunken centers, which are surrounded by a yellow halo. Fruit lesions vary in size (2-10 mm). Twigs and stem lesions resemble those on fruit. All citrus cultivars are susceptible to citrus canker.</p> <p>Source of Inoculum: The pathogen reproduces in lesions on leaves, stems, and fruit. Bacteria ooze out of the lesions and are spread by wind-driven rain, overhead irrigation, flooding, and human activities. Human movement of infected plant material is the primary means of spread over long distances.</p> <p>Management: The first line of defense against citrus canker is to prevent the movement of infected tissue from regions with known infections of citrus canker to disease free regions. Good sanitation practices and elimination of inoculum by removal and destruction of infected and exposed trees are recommended. Copper based fungicides can be used to suppress disease.</p>
<p>Citrus Greening or Huanglongbing (<i>Candidatus Liberibacter</i> spp.)</p>	<p>Symptoms: Symptoms differ according to citrus variety. The most common symptom is blotchy mottling (irregular pattern of indistinct light and dark areas) on both sides of the leaf. Fruit are small and lopsided with internal discoloration (orange-brown staining). Overall symptoms in the canopy are unevenly distributed.</p> <p>Source of Inoculum: The pathogen is transmitted by the Asian citrus psyllid. The disease is spread by moving infected plants and plant materials such as bud wood and even leaves.</p> <p>Management: Use clean bud wood, certified healthy trees and only purchase trees from a certified nursery. Use good sanitation practices.</p>

Commercial Crop Production Fruit and Nut Crops - Citrus

Table 1. Symptoms, source of inoculum and management of diseases of citrus	
Disease	
<p>Melanose (<i>Diaporthe citri</i>, <i>anamorph</i> = <i>Phomopsis citri</i>)</p>	<p>Symptoms: Melanose is caused by a fungal pathogen that attacks leaves, shoots and fruit, causing numerous, dark brown dots or spots to develop. These spots are sunken at first but later become raised so area has a rough, sandpaper feel. The spots may be irregularly scattered on the surface of the fruit or they can run in streaks (tear stains). Melanose infections occur only on the young, tender growth, and fruit become resistant as they age. The fungus also infects ripe fruit after harvest causing stem-end rot.</p> <p>Source of Inoculum: The fungus colonizes and survives in dead twigs. Fungal spores are spread primarily by rain splashing and wind-driven rain, although wind-borne spores also may be produced.</p> <p>Management: Prune out and burn dead wood, which eliminates much of the inoculum. Follow a fungicide spray program. Control of melanose will help to reduce fruit loss from stem-end rot.</p>
<p>Citrus Scab (<i>Elsinöe fawcettii</i>, <i>anamorph</i> = <i>Sphaceloma fawcettii</i>)</p>	<p>Symptoms: Citrus scab causes disease on a variety of citrus including grapefruit, lemon, satsuma, and tangerine and on rootstocks of sour and trifoliolate oranges. <i>Sweet orange is not affected</i>. Citrus scab affects the fruit, leaves and young shoots of plants causing irregular, raised, corky, scabby, wart-like outgrowths. Severely scabbed leaves and fruit become misshapen and distorted. The rind of scabbed fruit is thick and puffy.</p> <p>Source of Inoculum: The fungus causing scab survives in old pustules on leaves and fruit. Spores are spread primarily by rain splash.</p> <p>Management: Follow a fungicide spray program.</p>
<p>Greasy Spot (<i>Mycosphaerella citri</i>)</p>	<p>Symptoms: Yellow mottled lesions on upper leaf surface with a matching, slightly raised, pale orange to yellow brown blister on the lower leaf surface. Affected areas later become dark brown to black with a greasy appearance. Black necrotic specks form on fruit.</p> <p>Source of Inoculum: Spores (ascospores) produced in previously infected decomposing fallen leaves during warm, wet periods of late spring and early summer.</p> <p>Management: Good sanitation practices and the use of a fungicide spray program.</p>

Commercial Crop Production

Fruit and Nut Crops - Citrus

Table 1. Symptoms, source of inoculum and management of diseases of citrus	
Disease	
<p>Penicillium Decays (Green, Blue and Whisker molds) (<i>Penicillium</i> spp.)</p>	<p>Symptoms: The pathogen enters the fruit through wounds in the rind. Decay appears as a softened, water-soaked area that is easily punctured by pressure. Later, white mycelium appears on the surface of the fruit, and a mass of powdery olive-green (green mold) or blue spores (blue mold) are produced.</p> <p>Source of Inoculum: These fungi are common saprophytes in citrus groves. They also survive on contaminated packing equipment resulting in post harvest decay.</p> <p>Management: Prevent fruit injury at harvest. Sanitize post harvest equipment and storage areas. Follow a fungicide spray program.</p>
<p>Phytophthora Root Rot, Foot Rot and Gummosis (<i>Phytophthora</i> spp.)</p>	<p>Symptoms: The cortex of infected roots is soft, discolored and sloughs off easily. Growth of and fruit production by infected trees are greatly reduced. Cracked lesions on the bark exude a gummy sap. The spread of lesions around the tree trunk can cause girdling and tree death. Phytophthora root rot symptoms progress more rapidly in the presence of the citrus root weevil.</p> <p>Source of Inoculum: The pathogen survives in the soil and moves in running or splashing water.</p> <p>Management: Use resistant rootstock, improve drainage and manage irrigation. Follow a fungicide spray program.</p>
<p>Post-bloom Fruit Drop (PFD) (<i>Colletotrichum acutatum</i>)</p>	<p>Symptoms: The fungus produces necrotic reddish brown spots on the petals. The entire flower cluster becomes dark brown to orange and the petals dry. Infected young fruits exhibit yellow discoloration and abscise (drop off). The calyx and the floral disc stay intact and are called buttons.</p> <p>Source of Inoculum: The fungus survives on the surface of leaves, twigs, and buttons. Fungal spores are splash-dispersed from infected by rains to healthy flowers by rains.</p> <p>Management: Avoid overhead irrigation during blooming period to reduce leaf wetness period. Follow a fungicide spray program.</p>
<p>Sooty Mold (<i>Capnodium</i> spp.)</p>	<p>Symptoms: The fungi that cause sooty mold are not plant pathogens. They do not penetrate plant tissue and only grow superficially on the honeydew excretions of aphids, mealy bugs, scale insects and white flies. Sooty mold causes an overall decline in plant health because it prevents sunlight from reaching the leaves and hence photosynthesis is reduced. Fruit covered with sooty mold are smaller, do not color well and have an unattractive (dirty) appearance.</p> <p>Management: Control honeydew-producing insects. Wash off with soapy water or loosen and protect using dormant oils.</p>

Commercial Crop Production Fruit and Nut Crops - Citrus

Table 1. Symptoms, source of inoculum and management of diseases of citrus	
Disease	
<p>Sour Rot <i>(Geotrichum candidum)</i></p>	<p>Symptoms: Lesions appear as soft, water-soaked spots on fruit at points where an injury has occurred and may increase to involve the entire fruit. White fungal growth develops on the surface of the infected fruit. A strong sour odor is present.</p> <p>Source of Inoculum: This fungus is a common saprophyte in citrus soils. The pathogen is windborne or splash borne on soil particles and penetrates the fruit through wounds caused by insects or mechanical means. The pathogen can survive on contaminated packing equipment resulting in post harvest decay.</p> <p>Management: Prevent fruit injury during harvesting. Prevent fruit from coming in contact with the soil. Sanitize post harvest equipment daily. Do not reuse packing boxes.</p>
<p>Sweet Orange Scab <i>(Elsinöe australis)</i></p>	<p>Symptoms: Sweet orange scab causes disease on cultivars of sweet orange, satsuma, tangerine, grapefruit, and lemon as well as sour orange and trifoliolate orange rootstocks. Sweet orange scab affects fruit, leaves and young shoots causing irregular, slightly raised, corky, scabby, growths.</p> <p>Source of Inoculum: The fungus causing sweet orange scab survives in old pustules on leaves and fruit. Spores are spread primarily by rain splash.</p> <p>Management: Follow a fungicide spray program.</p>

Commercial Crop Production Fruit and Nut Crops - Citrus

Table 2. Seasonal fungicide spray schedule for citrus		
Season	Fungicide Application Timing	Disease
Pre-bloom	Grapefruit Oranges Satsuma	Citrus scab Sweet orange scab Melanose
Early bloom	Grapefruit Oranges	Post-bloom fruit drop
Late bloom (petal fall)	All Citrus	Citrus scab Melanose Post-bloom fruit drop Sweet orange scab
Post-bloom	All Citrus	Citrus scab Melanose Sweet orange scab
June 15 to July 15	All Citrus	Citrus scab Greasy Spot Melanose Sweet orange scab
October 15 to November 15	All Citrus	Brown rot
Soil treatment	All Citrus	Phytophthora root rot

Commercial Crop Production Fruit and Nut Crops - Citrus

Table 3. Recommended pesticides, rates and pesticide use restrictions for citrus produced in the field¹

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ² and Product Mode of Action Group ³		Rate ⁴	PHI ⁵	Maximum Use
Brown Rot (<i>Phytophthora</i> spp.)	Aliette	33	5 lb	30	20 lb
	Copper hydroxide				
	Champ WG	M	4-6.3 lb	0	25.2 lb
	Kocide 3000	M	1.8-3.5 lb	0	42 lb
	Kocide 2000	M	3-6 lb	0	36 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	3-7 pt	0	44.4 pt
	Badge X2 ^{OG}	M	1.8-3.5 lb	0	12.6 lb Cu
	Copper Sulfate				
	Cuprofix-Ultra Disperss	M	1.8-6 lb	0	31.5 lb
	Cuproxtat	M	5-13 pt	0	62 pt
	Cuprous oxide				
	Nordox	M	4-20 lb		
	Mefenoxam				
	Ridomil Gold SL	4	1-2 qt ⁶		3 app
	Ultra Flourish	4	4-8 pt ⁶		24 pt
	Phosphorous acid				
Helena Prophyt	33	4 pt	0		
Phostrol	33	4.5 pt	0		
Top Cop with Sulfur	M	4 qt/100 gal			
Citrus Canker (<i>Xanthomonas citri</i> pv. <i>citri</i>)	Suppression only				
	Copper hydroxide				
	Champ WG	M	6.3 lb	0	25.2 lb
	Kocide 3000	M	1-2.5 lb	0	42 lb
	Kocide 2000	M	2-4 lb	0	36 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	2-11 pt	0	44.4 pt
	Badge X2 ^{OG}	M	2-5 lb	0	12.6 lb Cu
	Copper sulfate				
	Cuprofix-Ultra Disperss	M	1.3-8 lb	0	31.5 lb
	Cuproxtat	M	3-15.5 pt	0	62.1 pt
Cuprous oxide					
Nordox	M	12 lb	0		
Citrus Scab (<i>Elsinöe fawcettii</i> ,	Abound	11	12-15.5 fl oz	0	92.3 fl oz
	Copper hydroxide				
Champ WG	M	4-6.3 lb	0	25.2 lb	

Commercial Crop Production Fruit and Nut Crops - Citrus

Table 3. Recommended pesticides, rates and pesticide use restrictions for citrus produced in the field¹

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ² and Product Mode of Action Group ³	Rate ⁴	PHI ⁵	Maximum Use	
anamorph = Sphaceloma fawcettii	Kocide 3000	M	1.8-5 lb	0	42 lb
	Kocide 2000	M	3-9 lb	0	36 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	3-11 pt	0	44.4 pt
	Badge X2 ^{OG}	M	1.8-5 lb	0	12.6 lb Cu
	Copper Sulfate				
	Cuprofix-Ultra Disperss	M	1.8-8 lb	0	31.5 lb
	Cuproxat	M	5-15.5 pt	0	62.1 pt
	Enable 2F	3	8 fl oz	0	24 fl oz
	Gem 500SC	11	1.9-3.8 fl oz	0	15.2 fl oz
	Headline and Headline SC	11	12-15 fl oz	0	54 fl oz
	Pristine	7,11	16-18.5 oz	0	74 fl oz
	Quadris Top	11,3	15.4 fl oz	0	61.5 fl oz
Trilogy ^{OG}		1%			
Greasy Spot (Mycosphaerella citri)	Abound	11	12-15.5 fl oz	0	92.3 fl oz
	Actinovate ^{OG}		3-12 oz		
	Copper hydroxide				
	Champ WG	M	4-6.3 lb	0	25.2 lb
	Kocide 3000	M	0.8-2.5 lb	0	42 lb
	Kocide 2000	M	1.5-4.5 lb	0	36 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	1-5 pt	0	44.4 pt
	Badge X2 ^{OG}	M	0.8-2.5 lb	0	12.6 lb Cu
	Copper Sulfate				
	Cuprofix-Ultra Disperss	M	0.8-5 lb	0	31.5 lb
	Cuproxat	M	2-10 pt	0	62.1 pt
	Dormant Oils				
	Dormant Oil 435		5-10 gal		159 lb a.i.
	Suffoil		1-2 gal/100 gal		159 lb a.i.
	Tritek ^{OG}		1-2 gal/100 gal		159 lb a.i.
	Enable 2F	3	8 fl oz	0	24 fl oz
	Gem 500SC	11	1.9-3.8 fl oz	0	15.2 fl oz
	Headline and Headline SC	11	12-15 fl oz	0	54 fl oz
	Pristine	7,11	16-18.5 oz	0	74 fl oz
Propiconazole ⁷					
Amtide Propiconazole 41.8% EC	3	6-8 fl oz	1 yr	24 fl oz	

Commercial Crop Production Fruit and Nut Crops - Citrus

Table 3. Recommended pesticides, rates and pesticide use restrictions for citrus produced in the field¹

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ² and Product Mode of Action Group ³		Rate ⁴	PHI ⁵	Maximum Use
	Banner MAX and MAX II	3	2-4 fl oz/100 gal	1 yr	5.4 gal
	Bumper ES and 41.8 EC	3	6-8 fl oz	1 yr	24 fl oz
	Fitness	3	6-8 fl oz	1 yr	24 fl oz
	Quadris Top	11,3	10-15.4 fl oz	0	61.5 fl oz
	Quilt ⁷	11,3	20.5-27.5	1 yr	83.5 fl oz
	Trilogy ^{OG}		1%		
Melanose (<i>Diaporthe citri</i>, anamorph = <i>Phomopsis citri</i>)	Abound	11	12-15.5 fl oz	0	92.3 fl oz
	Copper hydroxide				
	Champ WG	M	4-6.3 lb	0	25.2 lb
	Kocide 3000	M	1.8-5 lb	0	42 lb
	Kocide 2000	M	3-9 lb	0	36 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	3-11 pt	0	44.4 pt
	Badge X2 ^{OG}	M	1.8-5 lb	0	12.6 lb Cu
	Copper Sulfate				
	Cuprofix-Ultra Disperss	M	1.8-8 lb	0	31.5 lb
	Cuproxtat	M	5-15.5 pt	0	62.1 pt
	Gem 500SC	11	1.9-3.8 fl oz	0	15.2 fl oz
Headline and Headline SC	11	12-15 fl oz	0	54 fl oz	
Pristine	7,11	16-18.5 oz	0	74 fl oz	
Quadris Top	11,3	15.4 fl oz	0	61.5 fl oz	
Penicillium decays (Green, Blue and Whisker molds) (<i>Penicillium</i> spp.)	Abound	11	12-15.5 fl oz	0	92.3 fl oz
	Fungi-Phite	33	2 qt/100 gal		
	Graduate A+	11,12	32-64 fl oz/100 gal ⁸		1 app
	Magnate 500 EC	3	12.5-18.7 fl oz/100 gal ⁸		1 app
Phytophthora root rot, Foot rot and Gummosis (<i>Phytophthora</i> spp.)	Aliette	33	5 lb	30	20 lb
	Copper hydroxide				
	Champ WG	M	1 lb/gal ⁹	0	25.2 lb
	Kocide 3000	M	0.5 lb/qt ⁹	0	42 lb
	Kocide 2000	M	0.8 lb/qt ⁹	0	36 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	1 pt/qt ⁹	0	44.4 pt
	Badge X2 ^{OG}	M	0.5 lb/qt ⁹	0	12.6 lb Cu
	Copper Sulfate				
Cuprofix-Ultra Disperss	M	0.5-1 lb/gal ⁹	0	31.5 lb	

Commercial Crop Production Fruit and Nut Crops - Citrus

Table 3. Recommended pesticides, rates and pesticide use restrictions for citrus produced in the field¹

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ² and Product Mode of Action Group ³	Rate ⁴	PHI ⁵	Maximum Use	
	Cuproxat Mefenoxam Ridomil Gold GR Ridomil Gold SL Ultra Flourish MetaStar 2E Phosphorous acid Helena Prophyt Phostrol Fungi-Phite	M 4 4 4 4 33 33 33	1.2-2 pt/gal ⁹ 40-80 lb ⁶ 1-2 qt ⁶ 4-8 pt ⁶ 1-2 gal ⁶ 4 pt 4.5 pt 2 qt/100 gal	0	62.1 pt 3 app 3 app 24 pt 3 app
Post-bloom Fruit Drop (PFD) (<i>Colletotrichum acutatum</i>)	Abound Gem 500SC Headline and Headline SC Quadris Top Trilogy ^{OG}	11 11 11 11,3	12-15.5 fl oz 1.9-3.8 fl oz 12-15 fl oz 15.4 fl oz 1%	0 0 0 0	92.3 fl oz 15.2 fl oz 54 fl oz 61.5 fl oz
Sour Rot (<i>Geotrichum candidum</i>)	No fungicides are available to manage sour rot decay. Fruit injury prevention and good post-harvest sanitation practices are recommended.				
Sooty Mold (<i>Capnodium</i> spp.)	Dormant Oils Dormant Oil 435 Suffoil Tritek ^{OG} Enable 2F		5-10 gal 1-2 gal/100 gal 1-2 gal/100 gal 8 fl oz	0	159 lb a.i. 159 lb a.i. 159 lb a.i. 24 fl oz
Sweet Orange Scab (<i>Elsinöe australis</i>)	Abound Quadris Top	11 11,3	12-15.5 fl oz 10-15.4 fl oz	0 0	92.3 fl oz 61.5 fl oz

¹Fungicides and application rates apply to open field citrus production unless otherwise noted. Refer to product labels for registered cultivars, rates and restrictions for citrus grown in greenhouses or shadehouses.

²Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.

³Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).

⁴Rates are the amount of formation per acre unless otherwise indicated. Usually 100 gallons of water are required to give good coverage with boom sprayers.

⁵Post-harvest interval (PHI) is the minimum number of days allowed between the last application and harvest.

⁶Apply to soil beneath tree or through irrigation water. Refer to label for other application

Commercial Crop Production Fruit and Nut Crops - Citrus

Table 3. Recommended pesticides, rates and pesticide use restrictions for citrus produced in the field¹

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ² and Product Mode of Action Group ³	Rate ⁴	PHI ⁵	Maximum Use
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methods.

⁷**Do not apply to fruit-bearing trees.** Refer to label for additional restrictions and maximum amount of product allowed per acre per year.

⁸Post-harvest drench. Dip for a minimum of 30 seconds and allow fruit to drain.

⁹Apply by painting the trunk of the tree from the soil surface to the lowest scaffold limbs.

Revised December 2014 by Dr. R. Singh

Commercial Crop Production Fruit and Nut Crops - Figs

Integrated fig disease management

Many homeowners in Louisiana, especially in the southern regions where the threat of freeze damage is minimal, grow fig trees. Figs are well adapted to the climate in Louisiana and produce an abundance of fruit. Several important diseases affect fig production in Louisiana (Tables 1 and 2). These diseases can only be managed using cultural practices and variety selection since no fungicides are currently labeled for use on figs in Louisiana. A list of varieties suitable for production in Louisiana is available in a publication titled "Figs-For Commercial and Home Production in Louisiana" (Publication No. 1529), which can be downloaded at www.lsuagcenter.com using the search word figs.

Table 1. Symptoms, source of inoculum and management of diseases of figs.

MAJOR DISEASES	
Fig Rust (<i>Cerotelium fici</i>)	<p>Symptoms: Small yellowish spots on the leaves that turn reddish brown as the spots enlarge. Spots are relatively smooth on the upper surface of leaves while on the lower surface the spots appear as small blisters. Heavily infected leaves turn yellow or brown and drop prematurely. Fruit are not affected by fig rust.</p> <p>Source of Inoculum: Fungal spores survive on fallen, infected and diseased leaves. Spores are dispersed by wind and splashing rain.</p> <p>Management: Collect and destroy leaf debris. Do not compost diseased leaves. Selective pruning of the trees will increase airflow and decrease leaf moisture. No fungicides are registered for fig rust management in Louisiana.</p>
Leaf Spot (<i>Cercospora fici</i>)	<p>Symptoms: The disease starts as irregular reddish-brown angular spots on the leaves. As the spots enlarge they develop a yellow halo. Severe infection leads to leaf drop. Symptoms also appear on the fruit. Spots on the fruit are brown, slightly sunken with a dark margin.</p> <p>Source of Inoculum: The fungus survives on infested seed and crop debris. Spores are disseminated by wind and splashing rain and irrigation water.</p> <p>Management: Collect and destroy leaf debris. Selective pruning of the trees will increase airflow in the plant canopy and around planting. No fungicides are registered for leaf spot management in Louisiana.</p>
Web Blight (<i>Rhizoctonia solani</i>)	<p>Symptoms: Typical infection starts at the base of the leaves and spreads outward in a fanlike manner. Symptoms appear as yellowish, water-soaked lesions on the leaves that enlarge rapidly and the upper leaf surface looks silvery in appearance. The white to light brown fungal mycelium is readily visible on the underside of the infected leaf, which may shrivel up and die. Some infected leaves shrivel, die and cling to the twig.</p> <p>Source of Inoculum: The pathogen survives as sclerotia on the plant, in plant debris or in the soil.</p> <p>Management: Collect and destroy leaf debris. Selective pruning of the trees will increase airflow in the plant canopy and around planting. Do not wet leaves during irrigation. No fungicides are registered for web blight control in figs in Louisiana.</p>
Root Knot Nematodes (<i>Meloidogyne</i> sp.)	<p>Symptoms: Damage from root knot nematode is progressive and results in poor growth and low vigor of plants, yellowing of foliage, low yield and poor fruit quality. Infected roots are characterized by small galls or swellings on the roots.</p> <p>Source of inoculum: Root knot nematode survives from season to season as eggs in the soil. After the eggs hatch, the second-stage juveniles infest the roots.</p> <p>Management: Nematodes are difficult to control but can be prevented. Choose a planting site where root-knot susceptible plants such as tomatoes,</p>

Commercial Crop Production

Fruit and Nut Crops - Figs

Table 1. Symptoms, source of inoculum and management of diseases of figs.	
MAJOR DISEASES	
	okra, or tobacco have not been recently grown. High organic matter in the soil can reduce root-knot nematodes. Plant only nematode and disease-free plants. Keep the plants in good health with regular fertilizer application and maintain adequate moisture around the plants.
Botrytis Limb Blight or Botrytis Dieback (<i>Botrytis cinerea</i>)	<p>Symptoms: The fungus enters the fruit after frost damage in the early winter and moves to the shoot causing cankers resulting in sudden wilting of new shoots in the spring. In late winter and early spring, buff colored spores develop on infected shoots and fruits. Foliage on infected shoots wilts and turns light green or brown in color. Sclerotia (small black overwintering structures) form on heavily infected limbs.</p> <p>Source of Inoculum: Heavy frosts initiate disease and wet and cool springs favor disease development. Spores are wind dispersed.</p> <p>Management: Remove diseased shoots by pruning below the cankered area. Sanitize pruners with an EPA registered disinfectant between cuts.</p>

Table 2. Symptoms, source of inoculum and management of diseases of figs.	
MINOR DISEASES	
Surface Mold or Alternaria Rot (<i>Alternaria alternata</i>, <i>Cladosporium herbarum</i>)	<p>Symptoms: Occurs on both green and ripe fruit. Lesions first appear as small sunken specks on the fruit. Specks caused by <i>Cladosporium</i> are olive-green to yellow in color. Specks caused by <i>Alternaria</i> are light brown to black in color. Both pathogens can be present at the same time on the fruit although <i>Alternaria</i> is primarily observed on ripe fruit. Lesions are distributed over the entire surface of the fruit.</p> <p>Source of Inoculum: The fungi overwinter on dead dried plant material or on the surface of the soil. Spores are dispersed by wind or on dust particles.</p> <p>Management: Pick fruit before it is overripe. To limit disease spread, reduce dust in the orchard. To prevent disease development during storage, use clean picking boxes and storage containers. No fungicides are registered for surface mold or <i>Alternaria</i> rot management in Louisiana.</p>
Aspergillus Rot (<i>Aspergillus</i> sp.)	<p>Symptoms: The internal tissues of figs turn bright yellow to olive color depending upon the species. Decaying fruit produced masses of powdery spores. Although rare, figs infected by <i>A. flavus</i> or <i>A. parasiticus</i> are contaminated with aflatoxins and should not be consumed or used for animal feed.</p> <p>Source of Inoculum: The fungus overwinters on plant debris and is dispersed by wind or on dust particles.</p> <p>Management: Varieties with small ostioles (eye of the fig) are less susceptible to <i>Aspergillus</i> rot. Avoid water stressing the trees and. reduce dust in the orchards to reduce spore dispersal.</p>

Commercial Crop Production Fruit and Nut Crops - Figs

Table 2. Symptoms, source of inoculum and management of diseases of figs.	
MINOR DISEASES	
<p>Fig Endosepsis (<i>Fusarium</i> sp.)</p>	<p>Symptoms: Initially, a part of the infected fruit shows pink or brown internal discoloration, as well as discolored flowers. As the disease progresses, the pulp becomes soft and purple-brown water soaked areas appear on the skin.</p> <p>Source of Inoculum: The fungus overwinters in the summer caprifig crop or as conidia on mummified fruit of the summer caprifig crop. Spores produced in the spring are carried from flower to flower by the wasp <i>Blastophaga psenes</i> during pollination.</p> <p>Management: Sample fruits when wasps start emerging and discard fruits with any internal discoloration.</p>
<p>Fig Mosaic (Fig Mosaic Virus)</p>	<p>Symptoms: Distinct yellow colored spots on foliage with diffuse margins and these spots blend gradually into the green healthy leaf. The mosaic spots are uniformly distributed across the leaf surface or as irregular patches on the leaf surface. Mature spots develop a rust colored band along the margins. Mosaic spots on fruits are similar to those on leaves. Pre- mature fruit drop may occur.</p> <p>Source of Inoculum: The virus is vectored by fig mites (<i>Aceria fici</i>) or can be transmitted by grafting.</p> <p>Management: Choose disease free trees for propagation material. Examine propagated plants before planting in the field. Controlling fig mites may help to reduce incidence of disease.</p>
<p>Fig Smut (<i>Aspergillus niger</i> and <i>Aspergillus</i> spp.)</p>	<p>Symptoms: Internal tissues of the fruit or the entire fruit discolor and turn into black powdery masses of spores.</p> <p>Source of Inoculum: The fungus is present in the soil and decaying plant material. Nitidulid beetles, vinegar flies, predaceous mites and, thrips, disperse fungal spores. The fungus may directly attack fruit through wounds.</p> <p>Management: Remove all old fruit and debris from the field.</p>
<p>Sour Rot or Souring (various yeasts and bacteria)</p>	<p>Symptoms: Symptoms can be observed when the fruit begin to open. The inner flesh of figs develops a pink color and become water soaked. A pink bubbly syrupy liquid exudes from the figs and the figs give off a fermentation odor. As the disease progresses the pulp disintegrates into a white watery pulp. Figs eventually sag on the twig and dry up. Diseased fruit may remain on the tree or drop to the ground.</p> <p>Source of Inoculum: Nitidulid beetles and vinegar flies feed on the exudates of rotting fruit and can disperse the yeast and bacteria from fruit to fruit or tree to tree.</p> <p>Management: Controlling beetles and flies may to reduce disease incidence. Plants with closed “eyes” (Celeste, Alma, and Texas Everbearing) are resistant to sour rot. Plants with open “eyes” are susceptible to souring.</p>

The fig section was prepared by Drs. J. Sidhu and M. L. Lewis Ivey in December 2014.

Commercial Crop Production Fruit and Nut Crops - Mayhaws

Integrated disease management of mayhaws

The mayhaw tree is the official state fruit tree in Louisiana. The tree is a Hawthorne native to the southeastern United States and is normally found in low and wet areas. Mayhaws flower in February and March and the fruit is commonly used to make jellies. For more information on mayhaw trees visit the Louisiana Mayhaw Association website (<http://www.mayhaw.org>). Mayhaws are susceptible to two diseases in Louisiana: fire blight and cedar-quince rust (or quince rust) (Table 1). These diseases are best managed by using an integrated approach including fire blight resistant varieties, good cultural and sanitation practices, and judicious use of fungicides.

Site selection: Although mayhaws are found in low and wetlands in nature they produce best when planted in well drained upland soils and full sun.

Resistant varieties: Several mayhaw varieties are resistant or tolerant to fire blight. A list of varieties commonly grown in Louisiana and the level of disease resistance to fire blight is provided in Table 2. No varieties have known resistance to cedar-quince rust.

Table 1. Symptoms, source of inoculum and management of diseases of mayhaws
<p>Fire Blight (<i>Erwinia amylovora</i>)</p> <p>Symptoms: Infected blossoms turn black and die. Tender shoots become infected, resulting in a shoot blight that is characterized by dead leaves that remain attached to the shoot, which often develops into a shepherd's crook.</p> <p>Source of Inoculum: The bacterium survives in old cankers and is dispersed by splashing rain, wind-driven rain, bees and other insects.</p> <p>Management: Plant resistant varieties. Prune out diseased branches. Sanitize pruning equipment. Aliette (2.5-5 lb/100 gal) can be applied to non-fruit bearing trees. Fosphite (Aluminum tris, 1-3 qt/100 gal) can be applied to fruit bearing and non-fruit bearing trees.</p>
<p>Cedar-Quince rust (<i>Gymnosporangium clavipes</i>)</p> <p>Symptoms: Infected fruit develop pimply projections and ripen unevenly. Infected twigs become thickened and deformed.</p> <p>Source of Inoculum: The fungus overwinters in cankers on eastern red cedar and some junipers. Spores are wind-dispersed.</p> <p>Management: Inspire Super (12 fl oz/A), Pristine (14.5-18.5 oz/A), Sovran (3.2-6.4 oz/A), and TopGuard (8-12 fl oz/A) can be applied to suppress quince rust.</p>

Commercial Crop Production Fruit and Nut Crops - Mayhaws

Table 2. Mayhaw varieties, variety characteristics and resistance to fire blight. <i>Resistance categories are as follows: = Resistant; T=Tolerant; S=Susceptible and; VS=Very susceptible.</i>		
Variety	Variety Characteristics	Resistance
Big Red	Requires a cross pollinator (i.e. Marlene or Maxine), blooms late, red fruit with pink flesh, yields high on first shaking	R
Cajun	Small to medium sized tree, blooms very late, yields high on first shaking	R
Crimson	Blooms late, mostly red fruit (some pink), moderate to high fruit drop	R
Double G	Well formed tree, blooms early, dark red fruit, yields high on first shaking	S
Elite	Blooms early, deep red fruit, yields high on first shaking	R
Hope 13	Blooms early, large dark red fruit, very low fruit drop, yields high on first shaking	R
Marlene	Blooms very early, medium sized red fruit, high level of fruit drop (use suspended netting to collect dropping fruit)	R
Maxine	Inverted umbrella shaped canopy, large red fruit, blooms late, low fruit drop	R
Red Majesty	Blooms late, red fruit, low level of fruit drop	VS
Red Splendor	Cross between Texas Star and Cajun, blooms early, dark red fruit, holds fruit well, yields high on first shaking	T
Royalty	Blooms early, medium to large sized red fruit, moderate level of fruit drop, does not hold fruit well in high winds	T
Royal Star (G5)	Thorn-less tree, dark red to purple fruit, low fruit drop, yields high on first shaking	S
Spectacular	Requires a cross pollinator (i.e. Texas Star or Royal Star), blooms early, large fruit, yields high on first shaking	R
Super Spur	Bloom early, deep red fruit, resistant to high winds, very high yielding	R
Texas Star	Well formed tree, blooms early, red fruit, yields high on first shaking	S

Revised December 2014 by Dr. M. L. Lewis Ivey.

Commercial Crop Production
Fruit Crops - Pears

Table 1. Symptoms, source of inoculum and management of diseases of pears

Disease (Pathogen)	Disease Description
Black Rot (<i>Botryosphaeria obtuse</i>)	<p>Symptoms: Symptoms are observed on leaves, limbs and fruit. Leaf lesions begin as small purple flecks that enlarge and develop a tan to brown center. Heavily infected leaves become chlorotic (yellow), die and drop off of the tree. Red flecks that develop into purple raised spots are observed on immature fruit. As fruit matures the lesions enlarge with concentric rings and fruit may rot around the core. Slightly sunken red colored cankers can form on the limbs and may cause the limb to crack and die.</p> <p>Source of Inoculum: The fungus survives between seasons on infected wood and fruit. Spores are released from fungal fruiting structures during rain events.</p> <p>Management: Remove and burn infected twigs, limbs and mummified fruit. Dip pruning tools in 10 percent chlorine bleach solution or another registered disinfectant between cuts. Apply fungicides according to the pear spray schedule.</p>
Blossom Blast (<i>Pseudomonas syringae</i>)	<p>Symptoms: Buds are the most sensitive to infection and fail to open when infected. Eventually buds dry out and die. Infections that occur after bloom result in slightly depressed shiny black spots on the fruit and leaves.</p> <p>Source of Inoculum: <i>Pseudomonas</i> is ubiquitous on plants. Cold weather and wet weather favor population and disease development. High populations of pseudomonads induce freeze damage in fruit and foliage tissue at temperatures 3° to 6°F higher than would occur in their absence.</p> <p>Management: Protect trees against frost. Maintain a firm, wet soil surface with a low cover crop to keep orchards warm. Apply copper-based bactericides during dormancy.</p>
Fire Blight (<i>Erwinia amylovora</i>)	<p>Symptoms: Affects blossoms, leaves, twigs and young fruit. Infected blossoms wilt suddenly and turn dark brown, followed by blighting of leaves and terminals. Infected twigs and leaves turn dark brown to black, and leaves cling to the stem, often remaining attached most of the season.</p> <p>Source of Inoculum: The bacteria overwinter at the base of blighted twigs or in cankers on larger limbs. Bacteria are spread by bees and splashing rain.</p> <p>Management: Spray during bloom with copper fungicides or streptomycin according to manufacturer's directions. Prune out and burn infected twigs. Cut 12-15 inches below affected tissue. Dip pruning tools in 10 percent chlorine bleach solution between cuts. Use resistant varieties such as Orient, Moon Glow and Biscamp.</p>

Commercial Crop Production
Fruit Crops - Pears

Table 1. Symptoms, source of inoculum and management of diseases of pears

Disease (Pathogen)	Disease Description
Early Leaf Spot or Fabraea Leaf (<i>Fabraea</i> sp.)	<p>Symptoms: The disease begins on the lower leaves in early spring. Spots on the leaves, mostly circular in outline, are dark brown to nearly black, with purplish margins. Spotted leaves turn yellow and shed.</p> <p>Source of Inoculum: The fungus survives mainly in infected leaves on the ground. May also form minute cankers on the bark of twigs and shoots.</p> <p>Management: Rake and burn fallen leaves. Begin sprays in April after leaves have unfolded. Orient has moderate resistance, and Maxine is very resistant. Follow a pear spray schedule.</p>
Flyspeck (<i>Schizothyrium pomi</i> , formerly <i>Microthyriella rubi</i>)	<p>Symptoms: Shiny black raised specks on the fruit. These specks are the fruiting structures of the fungus. Spores are produced within the specks during warm and moist weather.</p> <p>Source of Inoculum: The fruiting structures survive between seasons on infected twigs. Spores are dispersed by wind.</p> <p>Management: Well-pruned trees will develop less disease during dry to moderately wet weather. Thin fruit to promote air flow and improve fungicide coverage. Follow a pear spray schedule.</p>
Crown Gall (<i>Agrobacterium tumefaciens</i>)	<p>Symptoms: Affects roots and crown of host plant, causing galling of tissue and reduction in the movement of water and nutrients through the plant. Galls may be spongy or hard.</p> <p>Source of Inoculum: This bacterium lives in the soil.</p> <p>Management: Check planting stock for galls or swelling, and rogue infected plants. Avoid planting new plants in the same site for several years. Treat before planting with Galltrol.</p>
Leaf Spots (Various fungi)	<p>Symptoms: Leaf spots vary in size depending on the pathogen. Severely infected leaves turn yellow and drop from the tree.</p> <p>Source of Inoculum: Fungus may overwinter on diseased leaves or twig cankers. Spores are released in the spring and dispersed by rain or irrigation water. Secondary infections can occur during warm and wet periods during the summer.</p> <p>Management: Rake and bury or burn diseased leaves. Dispersion can be reduced by increasing space between trees. Use labeled fungicides.</p>
Powdery Mildew (<i>Podosphaera leucotricha</i>)	<p>Symptoms: Symptoms first appear on the underside of leaves as grayish-white patches. Chlorotic (yellowing) spots appear in the upper surface of the leaves. As the disease progresses grayish-white patches form on the upper leaf surface. Severely infected leaves curl and drop from the tree. Flower buds may also become infected and infected buds open 5-8 days later than non-infected buds. Symptoms also appear on fruit.</p> <p>Source of Inoculum: The fungus overwinters in dormant buds infected the previous</p>

Commercial Crop Production
Fruit Crops - Pears

Table 1. Symptoms, source of inoculum and management of diseases of pears

Disease (Pathogen)	Disease Description
	<p>season. Spores are released in the air during the day and germinate during dry weather.</p> <p>Management: Dormant season pruning will reduce the number of potentially infected buds. During the season prune and destroy severely diseased shoots. Fungicides applied during the season will reduce the release of spores and spread within the tree.</p>
<p>Pear Scab (<i>Venturia pirina</i>)</p>	<p>Symptoms: Dark brown to black spots form on infected fruit, which often are misshapen. Brown lesions form on leaves, but these may appear to be velvety and olive green when the fungus is actively sporulating.</p> <p>Source of Inoculum: The fungus overwinters mainly in infected leaves on the ground but it may also survive in infected twigs.</p> <p>Management: Rake and burn fallen leaves. Begin sprays in April after leaves have unfolded. Follow a pear spray schedule.</p>
<p>Quince Rust (<i>Gymnosporangium clavipes</i>)</p>	<p>Symptoms: Dark green spots form on the calyx end of fruit and extend internally to the core. Fruit are distorted and drop prematurely.</p> <p>Source of Inoculum: Affects fruit of apple, crabapple, pear, hawthorne and quince. This fungus must have eastern red cedar or dwarf or prostrate junipers as alternate hosts to complete its life cycle. Galls are formed on the alternate host in which the fungus survives and infects apples and other host crops.</p> <p>Management: Remove alternate host plants in vicinity of desired trees; or remove all galls from cedar trees during the winter; or follow a regular spray program beginning at blossom and continuing until fruit are formed. A combination of the above measures may be necessary.</p>
<p>Sooty Blotch (<i>Gloeodes pomigena</i> and other fungi)</p>	<p>Symptoms: Olive green, soot-like smudges on mature fruit. Fungal fruiting bodies are produced in the thallus.</p> <p>Source of Inoculum: The fungus survives between seasons on infected twigs of apple and woody plants common to hedgerows and woodlots. Spores are spread during the spring and early summer by rain. Disease develops through out the entire growing season.</p> <p>Management: Well-pruned trees will develop less disease during dry to moderately wet weather. Thin fruit to promote air flow and improve fungicide coverage. Follow a pear spray schedule.</p>

Commercial Crop Production
Fruit Crops - Pears

Table 2. Seasonal fungicide spray schedule for pears	
Developmental Stage	Disease(s)
Dormant	Fire Blight Blossom Blast
Tight (or Green) cluster	Pear Scab Early leaf Spot Powdery Mildew
Pink	Pear Scab Early leaf Spot Powdery Mildew
Bloom	Early leaf Spot Fire Blight Pear Scab Powdery Mildew
Petal Fall	Fire Blight Pear Scab Leaf Spots Powdery Mildew
Cover sprays	Pear Scab Leaf Spots Powdery Mildew Sooty Blotch Fly Speck

Commercial Crop Production
Fruit Crops - Pears

Table 3. Recommended pesticides, rates and pesticide use restrictions for pears					
Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Diseases
<i>Boscalid + Pyraclostrobin</i> (7+11)	Pristine	14.5-18.5 oz	74 oz	0	Pear Scab Flyspeck Powdery Mildew Quince Rust (suppression) Sooty Blotch
<i>Captan</i>	Captan 50 WP Captan 80 WDG	2.5 lb/100 gal 1.6 lb/100 gal	1 app 1 app	NA NA	Postharvest Rots (Captan 50WP can only be used for mechanical fruit dips.)
<i>Copper Hydroxide</i> (M1) ^{6,7}	Badge SC Badge X2 ^{OG} Champ WG Champ Formula2 Kentan DF Kocide 3000 Kocide 2000	0.9 pt 0.5 lb 1 lb 0.66 pt 1 lb 0.5 lb 0.75 lb	56.3 pt 16 lb 32 lb 44 pt 16 lb ai 53.3 lb 45.7 lb	See labels	Fire Blight Blossom Blast
<i>Copper Hydroxide+ Mancozeb</i> ^{6,7} (M1+M3)	ManKocide	1.5 lb	53.3 lb	See label	Fire Blight (Do not apply after bloom.) Blossom Blast
<i>Copper Sulfate</i> ^{6,7} (M1)	Cuprofix Ultra 40 Disperss Cuproxtat Mastercop Top Cop with Sulfur	0.75 lb 7.5-10 lb (dormant) 15-20 pt (dormant only) 0.5 pt 4.6 pt (dormant) 2 qt/100 gal	40 lb 1 app 1 app 2 pt 1 app	See labels	Fire Blight Blossom Blast (dormant sprays only)
<i>Copper Sulfate + Copper Oxychloride</i> ^{6,7} (M1)	C-O-C-S WDG	12-15.6 lb (dormant) 0.5-1 lb (bloom)	1 app 31 lb	See labels	Fire Blight Blossom blast

Commercial Crop Production
Fruit Crops - Pears

Table 3. Recommended pesticides, rates and pesticide use restrictions for pears					
Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Diseases
<i>Difenoconazole+ Cyprodinil</i> (3+9)	Inspire Super	12 fl oz	60 fl oz	14	Flyspeck Powdery Mildew Quince Rust Sooty Blotch
<i>Fenarimol</i> (3)	Rubigan EC	8-12 fl oz	84 fl oz	30	Pear Scab Powdery Mildew Rusts
	Vintage SC	4-12 fl oz	48 fl oz	30	Pear Scab Powdery Mildew
<i>Fenhexamid</i> (17)	Elevate 50WDG	1-1.5 lb	6 lb	0	Botrytis Fruit Rot
<i>Fluxapyroxad + Pyraclostrobin</i> (7+11)	Merivon	4-5.5 fl oz	22 fl oz	0	Flyspeck Pear Scab Powdery Mildew Sooty Blotch Quince Rust (suppression only)
<i>Fosetyl-Al</i> (33)	Aliette WDG	2.5-5 lb/100 gal	20 lb	1 year	Fire Blight
<i>Kresoxim-Methyl</i> (11)	Sovran	3.2-6.4 oz	25.6 oz	30	Pear Scab Powdery Mildew Quince Rust (suppression only)
<i>Mancozeb</i> ⁷ (M3)	Dithane F45	4.8 qt	19.2 qt	See labels	Early Leaf Spot Fire Blight (see label for rates) Pear Scab Rusts
	Rainshield				
	Dithane M45	3-6 lb	21-24 lb		
	Manzate	2.4-4.8 qt	16.8-19.2 qt		
	Flowable OR Max	3-6 lb	21-24 lb		
	Manzate Pro- stick	3.2-6.4 lb	22.4-25.6 lb		
	Penncozeb	3-6 lb	21-24 lb		
75DF	3-6 lb	21-24 lb			
Penncozeb					

Commercial Crop Production
Fruit Crops - Pears

Table 3. Recommended pesticides, rates and pesticide use restrictions for pears					
Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Diseases
	80WP Roper Rainshield				
<i>Oxytetracycline</i> (41)	Mycoshield	1 lb/100 gal	10 app	60	Fire Blight
<i>Penthiopyrad</i> (7)	Fontelis	16-20 fl oz	61 fl oz	28	Pear Scab Powdery Mildew Rusts
<i>Phosphite</i> (phosphorous acid salts) (33)	Alude Confine Extra Fosphite Fungi-phite Rampart	1.25-2.5 qt 1-3 qt 1-3 qt 1-2 qt 1-3 qt	See labels		Fire Blight Powdery Mildew
<i>Pyrimethanil</i>	Scala SC	7-10 fl oz (alone) 5 fl oz (tank mix)	40	72	Pear Scab
<i>Streptomycin</i> (25)	Agri-Mycin 17	24-48 oz	See label	30	Fire Blight
<i>Sulfur</i> ⁷ (M2)	Liquid Sulfur Six Microfine Sulfur Microthiol Disperss Yellow Jacket Wettable Sulfur	0.75-3.5 pt/100 gal 10-60 lb 10-20 lb 10-60 lb	NA NA NA NA		Pear Scab Powdery Mildew
<i>Tebuconazole</i> (3)	Tebuzol 45DF	4-8 oz	3 lb	75	Pear Scab Powdery Mildew
<i>Tebuconazole + Trifloxystrobin</i> (3+11)	Adament 50 WG	4-5 oz	22 oz	75	Pear Scab Powdery Mildew Flyspeck Sooty Blotch
<i>thiabendazole</i> (1)	Mertect 340F	16 fl oz/100 gal	1 app	NA	Postharvest Rots (harvested fruit only)

Commercial Crop Production
Fruit Crops - Pears

Table 3. Recommended pesticides, rates and pesticide use restrictions for pears					
Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Diseases
<i>Thiophanate-Methyl</i> (1)	T-Methyl 70WSB	1 lb	4 lb	1	Pear Scab Flyspeck
	Thiophanate methyl 85WDG	0.8 lb	3.2 lb	1	Leaf Spots Powdery Mildew
	Topsin M 70WP	1 lb	4 lb	1	Sooty Blotch
	Topsin M WSB	1 lb	4 lb	1	
<i>Triflumizole</i>	Procure 480SC	8-16 fl oz	64 fl oz	14	Pear Scab Powdery Mildew
<i>Trifloxystrobin</i> (11)	Flint	2-2.5 oz	11 oz	14	Early Leaf Spot Flyspeck Pear Scab Powdery Mildew Sooty Blotch
<i>Trifloxystrobin+Triadimefon</i> (11+3)	Strike Plus 50WDG	3-9 oz/100 gal (garden center and nursery stock only)	207 oz	1 year	Early Leaf Spots Pear Scab Powdery Mildew
<i>Tiram</i>	Ziram 76DF	6 lb	42.4 lb	14	Early Leaf Spot Flyspeck Pear Scab Sooty Blotch

¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.

²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).

³Rates are the amount of formulation per acre unless otherwise indicated. Usually 100 gallons of water are required to give good coverage with boom sprayers.

⁴Post-harvest interval (PHI) is the minimum number of days allowed between the last application and harvest.

⁵All rates refer to foliar applications unless otherwise noted. Refer to label for other application rates and directions.

⁶See labels for correct application timings and rates to manage Blossom blight.

⁷See labels for variety restrictions and the potential to damage (i.e. russeting) fruit.

Information in the pear section was updated December 2014 by Dr. M. Lewis Ivey.

Commercial Crop Production Fruit and Nut Crops - Pecans

Integrated Pecan Disease Management

Management of diseases and insects is essential for profitable pecan production in Louisiana. Commercial pecan producers must spray at the proper time with recommended fungicides and insecticides. Learning to identify the major insect pests and diseases of pecans is highly desirable and strongly recommended. To obtain adequate disease control and receive maximum benefit from applied fungicides, spray applications must be made on a preventive program. In addition to spraying, cultural practices and sanitation can reduce the severity of certain insects and disease problems. Commercial growers as well as homeowners should follow these practices. More information on pecan IPM can be found on the Pecan IPM-PIPE website (<http://pecan.ipmpipe.org/Index>).

Plant resistant cultivars: Pecan scab is the most widespread and destructive disease of pecans. Selecting cultivars that are resistant or tolerant to pecan scab is recommended (Table 2), especially in southern Louisiana where warm and humid conditions favor disease development. It is important to note that a particular variety may be resistant to scab in one location but susceptible to scab in another location. Contact your Parish agent to identify cultivars suitable for your area. For a full description of pecan cultivars go to <http://cgrou.usda.gov/CARYA/PECANS>.

Use good sanitation practices: Certain leaf diseases, such as scab, and insects, such as the hickory shuckworm, overwinter on shucks and leaves. If these are raked and burned, it will help to reduce the severity of these problems to some extent the following year. Prune dead and broken limbs from trees to remove potential habitats for certain insects and diseases.

Use optimal levels of fertilizer: Proper fertilization will increase production and boost pest control. Well maintained pecan trees are less susceptible to attack by certain diseases and insects. Consult the LSU AgCenter's Louisiana Cooperative Extensive Service for information on leaf and soil sampling techniques, fertilization and cultural practices.

Ensure good spray coverage: Good spray coverage is essential for good disease control and, to a lesser extent, for insect control. A large air blast sprayer (speed sprayer) has proven very satisfactory for treating large acreages of pecan trees for control of insects and diseases.

Use registered chemicals: The potential for developing isolates of pathogens resistant to fungicides is high in pecan production. To slow the development of resistant pathogen populations 1) develop a spray program that uses fungicides with different modes of action; 2) avoid consecutive sprays with fungicides with the same or similar modes of action and 3) only use the labeled rates of recommended fungicides. More information of fungicide resistance management can be found in Section IV.

Commercial Crop Production
Fruit and Nut Crops - Pecans

Table 1. Symptoms, source of inoculum and management of diseases of pecans.	
Disease	
<p>Anthracnose (<i>Colletotrichum</i> spp., <i>Glomerella cingulata</i>)</p>	<p>Symptoms: Brown-black sunken lesions on the leaves and shucks. In the spring and early summer cream to salmon colored spores form on shuck spots.</p> <p>Source of Inoculum: Spores are dispersed in the spring and early summer by rainfall.</p> <p>Management: Plant resistant varieties. Remove and destroy diseased plant material. No fungicides are available for homeowners. Commercial fungicides are listed in Table 4.</p>
<p>Brown Leaf Spot (<i>Cercospora</i> spp.)</p>	<p>Symptoms: Early leaf spots are circular, reddish-brown and often develop grayish concentric zones. Spots become irregular later. Nuts are not susceptible to this fungus. Usually a problem only when trees lack vigor or where rainfall is unusually high. Premature defoliation often occurs when disease is severe.</p> <p>Source of Inoculum: Fungus lives from year to year in infected spots on the old leaves. Spores are windborne.</p> <p>Management: Water and fertilize trees to improve vigor. Fungicides that control scab also control brown leaf spot although not all scab fungicides are labeled for brown leaf spot (see Table 4). Follow Pecan Spray Schedule.</p>
<p>Downy Spot (<i>Mycosphaerella</i> spp.)</p>	<p>Symptom: Appears in late spring or early summer as downy spots on the undersides of the leaflets. Later, greenish-white spots about 1/8 inch in diameter are visible on both sides of the leaves. As the season advances, the color of the spots changes to brown.</p> <p>Source of Inoculum: Fungus lives from year to year in infected leaves.</p> <p>Management: Plant resistant or tolerant varieties (i.e. Schley, Success, Mahan, and Western). Remove and destroy fallen leaves. Follow Pecan Spray Schedule.</p>
<p>Powdery Mildew (<i>Microsphaera alni</i>)</p>	<p>Symptoms: This disease affects both foliage and nuts, forming a white superficial fungal growth early in the growing season. Nuts are affected more adversely than foliage. Nuts infected early in the season may abort or be undersized.</p> <p>Source of Inoculum: Infected leaf and shuck debris.</p> <p>Management: Plant cultivars that are less susceptible to disease. Include sulfur in the June, July and August sprays at the rate of 6 lb per 100 gallons or follow Pecan Spray Schedule. A regular scab spray program will manage powdery mildew.</p>
<p>Scab (<i>Cladosporium carpophilum</i>, <i>C.caryigenum</i>)</p>	<p>Symptoms: Early leaf infections produce pinpoint olive-brown lesions often on veins of undersides of leaves. Spots enlarge and coalesce until large areas of leaves may become almost black. Lesions on nuts are small, black and circular, slightly raised at first but later sunken. The entire surface of nuts of highly susceptible varieties may appear black from extensive infections.</p>

**Commercial Crop Production
Fruit and Nut Crops - Pecans**

Table 1. Symptoms, source of inoculum and management of diseases of pecans.	
Disease	
	<p>Source of Inoculum: Fungus may overwinter in infested shucks, leaf stems or leaves. The fungus is spread by wind-borne spores and is boosted by high humidity.</p> <p>Management: Knock off old shucks and stems before spring. Prune out low limbs to improve air circulation in orchard. Fungicides that control brown leaf spot also control brown leaf spot. Follow Pecan Spray Schedule.</p>
<p>Shuck Dieback and Stem End Blight (<i>Phomopsis</i> spp. and other fungal pathogens)</p>	<p>Symptoms: Disease is more severe in overcrowded orchards or trees that are water or nutrient stressed. The shuck turns black and begins to die near the tip of the nut. The blackened area can spread over the entire shuck, and the shuck may flare open. Stem end blight begins as a brownish black spot on the shuck near the base of the nut. The black area enlarges to cover the entire nut and the nut is easily dislodged from its stem.</p> <p>Source of Inoculum: Fungi overwinter is dislodged nuts.</p> <p>Management: Reduce tree stress by irrigating sufficiently to support the crop load. Thin trees to avoid overcrowding. No fungicides are effective at controlling shuck dieback and stem end blight.</p>
<p>Vein Spot (<i>Gnomonia nerviseda</i>)</p>	<p>Symptoms: Spots (lesions) may originate on vein of leaflets or on leaf stem and are dark brown to black in final stages. On lateral veins, lesions are circular or oval and seldom attain a diameter of more than 1/4 inch. On midribs of leaflets and on leaf stems, spots are long and narrow. When the disease is severe, premature defoliation usually occurs.</p> <p>Source of Inoculum: Fungus lives through the winter on fallen leaves.</p> <p>Management: The pre-pollination spray and first cover sprays are essential for control.</p>
<p>Zonate Leaf Spot (<i>Cristulariella moricola</i>)</p>	<p>Symptoms: Grayish-brown spots on the upper surface of leaves. Leaf spots are light brown with dark margins on the underside of the leaf. Spots have a concentric ring formation that is more distinct on the leaf underside. Severely infected leaves dry and curl and drop from the tree. Severe defoliation of pecan trees occurs during rainy summers.</p> <p>Source of Inoculum: The fungus overwinters in resting bodies, called sclerotia, on plant debris. Leaf wetness in the spring initiates new infections.</p> <p>Management: No known cultivars are resistant to this disease. Remove wild hosts (i.e. hackberry, sassafras, Virginia creeper, and poison oak) of the fungus from around the orchard. Prune lower branches to promote airflow and leaf drying. Follow Pecan Spray Schedule.</p>

**Commercial Crop Production
Fruit and Nut Crops - Pecans**

Table 2. Partial list of varieties of pecans and disease resistance profiles. Descriptions of additional cultivars are available at <http://cgru.usda.gov/CARYA/PECANS/>
Disease resistance categories are as follows: R=resistant, T=tolerant, S=susceptible, VS=very susceptible and -=not known.

Cultivar	Pecan Scab	Other Diseases				
		Downy Spot	Powdery mildew	Shuck dieback	Vein spot	Zonate leaf spot
Caddo	T-S	-	S	-	-	-
Candy	R-T	-	-	-	-	S
Cape Fear	T-S	-	-	-	-	S
Creek	T	-	-	-	-	S
Desirable	S	-	-	-	-	S
Elliott	R	-	-	-	-	S
Excel	R	-	-	-	-	S
Gloria Grande	S	-	-	-	-	S
Jackson	T-S	-	-	-	-	S
Kanza	R	-	-	-	S	-
Kiowa	T-S	-	-	-	-	-
Mahan	VS	R	-	-	-	S
Melrose	T-S	-	-	T	-	-
Moreland	T	-	-	-	-	S
Schley	VS	R	-	S	-	S
Success	VS	R	-	S	-	S
Sumner	R-T	-	-	-	-	S
Western	VS	S	-	S	-	S

**Commercial Crop Production
Fruit and Nut Crops - Pecans**

Table 3. Seasonal fungicide spray schedule for pecans		
Season	Fungicide Application Timing	Disease
First pre-pollination	When leaves are at least 1 inch long	Anthracnose Scab Vein spot Downy spot Zonate leaf spot
Second pre-pollination	When leaves have grown (or 10-14 days after first spray)	Anthracnose Scab Vein spot Downy spot Zonate leaf spot
First cover spray	2-3 weeks after previous spray	Scab Vein spot Downy spot
Second cover spray	2-3 weeks after previous spray	Scab
Third cover spray	2-4 weeks after previous spray	Scab
Fourth cover spray	2-3 weeks after previous spray	Scab
Fifth cover spray ¹	3-4 weeks after previous spray	Scab
Sixth cover spray ²		Scab
¹ Sprays may be omitted during dry weather. ² Do not apply fungicides after shuck split.		

**Commercial Crop Production
Fruit and Nut Crops - Pecans**

Table 4. Recommended pesticides, rates and pesticide use restrictions for pecans					
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.					
Disease (Pathogen)	Product Choices¹ and Product Mode of Action Group²		Rate³	PHI⁴	Maximum Use
Anthracnose (<i>Colletotrichum</i> spp., <i>Glomerella cingulata</i>)	Azoxystrobin				
	Abound	11	12 fl oz	45 ⁶	73.8 fl oz
	Azaka	11	6-12 fl oz	45 ⁶	73.8 fl oz
	Willowood Azoxy 2SC	11	6-18.5 fl oz	14	49 fl oz
	Custodia	3,11	8.6-17.2 fl oz	45 ⁶	69 fl oz
	Merivon ¹⁰				
	Pristine	7,11	5-6.5 fl oz	14	20.4 fl oz
	Quilt	7,11	10.5-14.5 oz	14	58 oz
	Quilt Excel	11,3	14-27.5 fl oz	45	122 fl oz
	Regalia	11,3	14-21 fl oz	45	122 fl oz
	Tebuconazole and trifloxystrobin	P5	0.5-1 qt	0	-
	Absolute 500 SC	3,11	5-7.7 fl oz	30	46 oz
	Adament 50WG	3,11	4-8 oz	60	32 oz
	Topguard	3	7-14 fl oz	14	56 fl oz
Viathon	33,3	2 pt (early season only)	see footnote ⁶	16.5 pt	
	Ziram 76DF	M	6-8 lb	55	48.2 lb
Brown Leaf Spot (<i>Cercospora</i> spp.)	Elast ⁵	M	3 pt	See footnote ⁶	18 pt
	Propiconazole ⁵				
	Banner MAXX	3	12 fl oz	See footnote ⁶	24 fl oz
	Procon-Z	3	12 fl oz	See footnote ⁶	32 fl oz
	Topaz	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Orbit	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Protocol	1,3	1.3-2.5 pt	See footnote ⁶	7.5 pt
	Tebuconazole				
	Folicur 3.6F	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Monsoon	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Onset 3.6L	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Thiophanate-methyl				
	85WDG	1	0.4-0.8 lb	1	2.5 lb
	Topsin M 70WP	1	1 lb	See footnote ⁶	3 lb
	Topsin XTRA	1,3	25 fl oz	See footnote ⁶	See footnote ⁹
	Triphenyltin hydrozide				
	Agri Tin	30	5-7.5 oz	30	45 oz
	Super Tin 80WP	30	5-7.5 oz	30	45 oz
	Viathon	3,33	2-2.5 pt ⁷	See footnote ⁶	16.5 pt

Commercial Crop Production
Fruit and Nut Crops - Pecans

Table 4. Recommended pesticides, rates and pesticide use restrictions for pecans					
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.					
Disease (Pathogen)	Product Choices¹ and Product Mode of Action Group²	Rate³	PHI⁴	Maximum Use	
Downy Spot (<i>Mycosphaerella</i> spp.)	Azoxystrobin and tebuconazole				
	Custodia	3,11	8.6-17.2 fl oz	45	69 fl oz
	Elast ⁵	M	3 pt	See footnote ⁶	18 pt
	Enable 2F	3	8 fl oz	28 ⁶	1.5 qt
	Propiconazole ⁵				
	Procon-Z	3	12 fl oz	See footnote ⁶	32 fl oz
	Topaz	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Orbit	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Protocol	1,3	1.3-2.5 pt	See footnote ⁶	7.5 pt
	Quadris Top	11,3	8-14 fl oz	45	56 fl oz
	Quilt	11,3	14-27.5 fl oz	45 ⁶	122 fl oz
	Quilt Excel	11,3	14-21 fl oz	45 ⁶	122 fl oz
	Tebuconazole				
	Folicur 3.6F	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Monsoon	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Onset 3.6L	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Thiophanate-methyl				
	85WDG	1	0.4-0.8 lb	1	2.5 lb
	Topsin M 70WP	1	1 lb	See footnote ⁶	3 lb
	Topsin XTRA	1,3	25 fl oz	See footnote ⁶	See footnote ⁹
Topguard	3	7-14 fl oz	14	56 fl oz	
Triphenyltin hydrozide					
Agri Tin	30	5-7.5 oz	30	45 oz	
Super Tin 80WP	30	5-7.5 oz	30 See footnote ⁶	45 oz	
Viathon	33,3	2-2.5 pt ⁷	footnote ⁶	16.5 pt	

**Commercial Crop Production
Fruit and Nut Crops - Pecans**

Table 4. Recommended pesticides, rates and pesticide use restrictions for pecans					
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.					
Disease (Pathogen)	Product Choices¹ and Product Mode of Action Group²	Rate³	PHI⁴	Maximum Use	
Powdery Mildew (<i>Microsphaera alni</i>)	Actinovate ^{OG}		3-12 oz		
	Adament 50WG		4-8 oz	60 ⁶	32 oz
	Enable 2F	3	8 fl oz	28 ⁶	1.5 qt
	Potassium phosphite				
	Fosphite	33	1-3 qt		
	K-Phite 7LP AG	33	1-3 qt		
	Rampart	33	1-3 qt		
	Propiconazole ⁵				
	Procon-Z	3	12 fl oz	See footnote ⁶	32 fl oz
	Topaz	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Orbit	3	1.3-2.5 pt	See footnote ⁶	7.5 pt
	Protocol	1,3	4-8 fl oz	See footnote ⁶	32 fl oz
	Quadris Top	11,3	8-14 fl oz	45	56 fl oz
	Quilt	11,3	14-27.5 fl oz	45 ⁶	122 fl oz
	Quilt Excel	11,3	14-21 fl oz	45 ⁶	122 fl oz
	Sulfur				
	Microthiol Disperss	M	5-10 lb		
	Tebuconazole				
	Folicur 3.6F	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Monsoon	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Onset 3.6L	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Thiophanate-methyl				
	85WDG	1	0.4-0.8 lb	1	2.5 lb
Topsin M 70WP	1	1 lb	See footnote ⁶	3 lb	
Topsin XTRA	1,3	25 fl oz	See footnote ⁶	See footnote ⁹	
Trilogy ^{OG}		1%			
Triphenyltin hydrozide					
Agri Tin	30	5-7.5 oz	30	45 oz	
Super Tin 80WP	30	5-7.5 oz	30	45 oz	
Scab (<i>Cladosporium carpophilum</i> , <i>C. caryigenum</i>)	Azoxystrobin				
	Abound	11	6-12 fl oz	45	73.8 fl oz
	Azaka	11	6-12 fl oz	45	73.8 fl oz
	Willowood Azoxy 2SC	11	6-18.5 fl oz	14	49 fl oz
	Custodia	3,11	8.6-17.2 fl oz	45	69 fl oz
	Elast ⁵	M	3 pt	See footnote ⁶	18 pt
	Enable 2F	3	8 fl oz	28 ⁶	1.5 qt
	Helena ProPhyt	33	2-3 pt		
	Pristine	7,11	10.5-14.5 oz	14	58 oz
	Propiconazole ⁵				
	Procon-Z	3	12 fl oz	See footnote ⁶	32 fl oz
	Topaz	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Orbit	3	4-8 fl oz	See footnote ⁶	32 fl oz
Protocol	1,3	1.3-2.5 pt	See footnote ⁶	7.5 pt	

**Commercial Crop Production
Fruit and Nut Crops - Pecans**

Table 4. Recommended pesticides, rates and pesticide use restrictions for pecans					
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.					
Disease (Pathogen)	Product Choices¹ and Product Mode of Action Group²	Rate³	PHI⁴	Maximum Use	
	Quash	3	2.5-3.5 oz	25	14 oz
	Quadris Top	11,3	8-14 fl oz	45	56 fl oz
	Quilt	11,3	14-27.5 fl oz	45 ⁶	122 fl oz
	Quilt Excel	11,3	14-21 fl oz	45 ⁶	122 fl oz
	Regalia	P5	0.5-1 qt	0	-
	Sovran		2.4-4.8 oz ⁸	45	14.4 oz
	Stratego	3,11	10 fl oz	30 ⁶	30 fl oz
	Tebuconazole				
	Folicur 3.6F	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Monsoon	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Onset 3.6L	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Tebuconazole and trifloxystrobin				
	Absolute 500 SC	3,11	5-7.7 fl oz	30	46 oz
	Adament 50WG	3,11	4-8 oz	60	32 oz
	Thiophanate-methyl 85WDG	1	0.4-0.8 lb	1	2.5 lb
	Topsin M 70WP	1	1 lb	See footnote ⁶	3 lb
	Topsin XTRA	1,3	25 fl oz	See footnote ⁶	See footnote ⁹
	Topguard		1%		
	Trilogy ^{OG}	3	7-14 fl oz	14	56 fl oz
	Triphenyltin hydrozide				
	Agri Tin	30	5-7.5 oz	30	45 oz
	Super Tin 80WP	30	5-7.5 oz	30	45 oz
	Viathon	3,33	2-2.5 pt ⁷	See footnote ⁶	16.5 pt
	Ziram 76DF	M	5-6 lb	55	48.2 lb
Vein Spot (Gnomonia nerveda)	Azoxystrobin and tebuconazole				
	Custodia	3,11	8.6-17.2 fl oz	45	69 fl oz
	Enable 2F	3	8 fl oz	28 ⁶	1.5 qt
	Propiconazole ⁵				
	Procon-Z	3	12 fl oz	See footnote ⁶	32 fl oz
	Topaz	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Orbit	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Merivon ¹⁰	7,11	5-6.5 fl oz	14	20.4 fl oz
	Pristine	7,11	10.5-14.5 oz	14	58 oz
	Protocol	1,3	1.3-2.5 pt	See footnote ⁶	7.5 pt
	Quadris Top	11,3	8-14 fl oz	45	56 fl oz
	Quilt	11,3	14-27.5 fl oz	45 ⁶	122 fl oz
	Quilt Xcel	11,3	14-21 fl oz	45 ⁶	122 fl oz
	Tebuconazole				
	Folicur 3.6F	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Monsoon	3	4-8 fl oz	See footnote ⁶	32 fl oz

Commercial Crop Production Fruit and Nut Crops - Pecans

Table 4. Recommended pesticides, rates and pesticide use restrictions for pecans
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Onset 3.6L	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Topsin XTRA	1,3	25 fl oz	See footnote ⁶	See footnote ⁹
	Viathan	3,33	2-2.5 pt ⁷	See footnote ⁶	16.5 pt
Zonate Leaf Spot (<i>Cristulariella moricola</i>)	Copper hydroxide				
	Badge X2 ^{OG}	M	0.75-1.75 lb	See footnote ⁶	1.6 lb
	Champ Formula 2 FL	M	1.33-2.66 pt	See footnote ⁶	23.2 pt
	Kocide 3000	M	0.75-1.75 lb	See footnote ⁶	28 lb
	Copper sulfate				
	Cuprofix Ultra 40	M	1.25-2.5 lb	See footnote ⁶	21 lb
	Custodia	11,3	8.6-17.2 fl oz	45 ⁵	69 fl oz
	Propoconazole				
	Amtide 41.8 EC	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Banner MAXX	3	12 fl oz	See footnote ⁶	24 fl oz
	Bumper 41.8 EC	3	4 fl oz	See footnote ⁶	32 fl oz
	Bumper ES	3	4 fl oz	See footnote ⁶	32 fl oz
	Topaz	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Protocol	3,1	1.3-2.5 pt	See footnote ⁶	7.5 pt
	Quadris Top	11,3	8-14 fl oz	45	56 fl oz
	Quilt XCEL	11,3	14-27.5 fl oz	45 ⁵	122 fl oz
	Quilt	11,3	14-21 fl oz	45 ⁵	122 fl oz
	Tebuconazole				
	Folicur 3.6F	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Monsoon	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Onset 3.6L	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Thiophanate-methyl				
	85WDG	1	0.4-0.8 lb	1	2.5 lb
	Topsin M 70WP	1	1 lb	See footnote ⁶	3 lb
	Topguard	3	7-14 fl oz	14	56 fl oz
	Viathan	3,33	2-2.5 pt ⁷	See footnote ⁶	16.5 pt

¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.

²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).

³Rates are the amount of formation per acre unless otherwise indicated. Usually 100 gallons of water are required to give good coverage with boom sprayers.

⁴Post-harvest interval (PHI) is the minimum number of days allowed between the last application and harvest.

⁵Do not apply to trees that will bear fruit within 12 months.

⁶Do not apply after shuck split.

⁷Use 2 pt per acre early in the season and 2-2.5 pt per acre post pollination.

⁸Use 2.4-3.2 oz per acre pre-pollination and 3.2-4.8 oz post-pollination.

⁹Do not exceed a total application of 2.1 lb a.i. thiophanate-methyl and 0.9 lb a.i. tebuconazole per year.

¹⁰**Supplemental label. Expires on September 30, 2016.**

The pecan section was revised December 2014 by Dr. M. L. Lewis Ivey.

Commercial Crop Production
Fruit and Nut Crops - Stone Fruits

Table 1. Symptoms, source of inoculum and management of diseases of nectarines, peaches, plums, and other stone fruit	
Disease (Pathogen)	Disease Description
Armillaria Root Rot (<i>Armillaria</i> (= <i>Clitocybe</i>) spp.)	<p>Symptoms: Trees appear weak with small yellowish leaves over the entire tree or confined to one or two branches. The entire tree or single branches may die by the end of the summer or the next year. White mycelial growth can be found beneath the bark of roots or base of affected trees at or about the time of death.</p> <p>Source of Inoculum: These fungi live in soil and survive for many years in old, diseased roots.</p> <p>Management: Dig up and burn old roots before planting peach trees. Remove dead trees and as many roots as possible. Fumigate before replanting.</p>
Brown Rot Blossom blight and/or fruit rot (<i>Monilinia</i> spp.)	<p>Symptoms: Occurs on all stone fruits. The brown rot fungus causes blossom and twig blight, fruit rot and canker. Affected blossoms turn gray or light brown and are covered with spores if wet weather prevails. The fungus may invade twigs from infected blossoms, causing twig blight or canker. Fruit infection normally occurs as the fruit near maturity. Small circular light brown spots develop on fruit, often at insect wounds or spots where scab or other diseases occur. These spots enlarge rapidly if the fruit is mature, often rotting the whole fruit. Eventually, the spots become covered with a brownish-gray spore mass.</p> <p>Source of Inoculum: The fungus overwinters in peach “mummies” on the tree or ground and in twig cankers.</p> <p>Management: Remove affected peaches from the orchard at harvest. Remove and bury any peach “mummies” remaining on the trees before spring. Do not just knock fruit to the ground. Destroy wild plum thickets, abandoned stone fruit orchards and fencerow seedlings as far away as possible from producing trees. Follow the stone fruit fungicide spray program.</p>
Bacterial Spot (<i>Xanthomonas arbuticola</i> pv. <i>pruni</i>)	<p>Symptoms: The disease occurs on leaves, twigs and fruit of almost all stone fruits. Leaf spots progress from grayish and water-soaked to deep purple, brown or black and are angular in shape. Spots fall out to give “shot-hole” appearance. Fruit are roughened with cracked, sunken spots. Small, thick-edged depressed spots occur on twigs and larger spots or cankers occur on branches or the trunk.</p> <p>Source of Inoculum: The bacterium survives from one year to the next in twig cankers and is primarily rain-splashed.</p> <p>Management: Obtain healthy, vigorous nursery stock free from bacterial spot cankers. Maintain vigorous growing conditions by proper cultivation and fertilization. <u>Resistant varieties:</u> La. Gold (immune), Bicentennial, La. Premiere (highly resistant), La. Felician, Sure Crop, Majestic, Ruston Red and Ouachita Gold.</p>
Black Knot (<i>Apiosporina=Dibotryon morbosum</i>)	<p>Symptoms: This disease occurs on plum and cherry. Large, rough, coal black, hard swellings or knots occur along the branches, frequently several inches long.</p> <p>Source of Inoculum: The fungus survives in infected tissue of knots or swellings.</p> <p>Management: Prune and burn diseased branches during the fall or winter, making the cut at least 4 inches below the visible infection. Destroy badly infected trees. Remove wild plums in the vicinity of desirable trees.</p>
Crown Gall (<i>Agrobacterium tumefaciens</i>)	<p>Symptoms: Occurs on many fruits including apple, pear, peach and plum. Affects roots and crown of host plant, causing galling of tissue and reduction in the movement of water and nutrients through the plant.</p> <p>Source of Inoculum: This bacterium lives in the soil.</p>

Commercial Crop Production
Fruit and Nut Crops - Stone Fruits

Table 1. Symptoms, source of inoculum and management of diseases of nectarines, peaches, plums, and other stone fruit

Disease (Pathogen)	Disease Description
	<p>Management: Check planting stock for galls or swelling, and rogue infected plants. Treat before planting with Galltrol.</p>
<p>Peach Leaf Curl (<i>Taphrina deformans</i>)</p>	<p>Symptoms: This disease occurs only on peach trees. It has not been a problem in Louisiana, except on first year trees. It apparently does not live over the summer here. In spring, when leaves first appear, they are thickened, and as they develop, the blades becomes puffed and folded with the edges curling inward so that the undersurface of the leaf is a series of concave chambers. Affected leaves become reddish or purplish, later becoming reddish-yellow and shedding.</p> <p>Source of Inoculum: The fungus lives from one year to the next on limbs or on the ground.</p> <p>Management: Monitor trees for symptoms. Apply fungicides if disease is confirmed.</p>
<p>Phony Peach (<i>Xylella fastidiosa</i>)</p>	<p>Symptoms: Trees are dwarfed, foliage is abnormally green and fruit remain small. Phony trees have short terminals and profuse lateral branching. Growth starts in the spring earlier than on normal trees.</p> <p>Source of Inoculum: This bacterium lives in infected trees of many species and is spread by xylem-feeding insects and root grafting.</p> <p>Management: Rogue out and burn all infected trees. Also, destroy wild plum and peach seedlings in the neighborhood of producing trees.</p>
<p>Rhizopus Rot (<i>Rhizopus</i> spp.)</p>	<p>Symptoms: Normally an important post-harvest disease of fruit only. Fruit breaks down quickly into a soft watery rot after harvest and is covered with “whiskers” or raised white fungal growth with little black spores.</p> <p>Source of Inoculum: Spores are present in soil on organic matter and airborne.</p> <p>Management: Avoid wounding the fruit. Practice sanitation within and around the packing shed. Spray with Botran before harvest.</p>
<p>Rust (<i>Tranzschelia discolor</i>)</p>	<p>Symptoms: The disease occurs on leaves, twigs and fruit of almost all stone fruits. Brown pustules occur on the lower leaf surface, marked by a yellowish spot on the upper surface. It may cause leaves to drop prematurely, lowering tree vigor.</p> <p>Source of Inoculum: The fungus overwinters as mycelium in twigs or as spores on twigs or leaves clinging to the tree.</p> <p>Management: Follow the stone fruit fungicide spray program.</p>
<p>Scab (<i>Cladosporium carpophilum</i>)</p>	<p>Symptoms: The disease occurs on leaves, twigs and fruit of almost all stone fruits. Spots on fruit are small, circular, dark olive-greenish, and usually about 1/16 to 1/8 inch in diameter. Spots may be distinctly separate or merge, giving a velvety blotch appearance to half or more of the fruit (usually on the attachment end). Spots are superficial, but cracking or distortion of fruit may follow early or severe infection.</p> <p>Source of Inoculum: The fungus lives from year to year in infected twigs.</p> <p>Management: Prune to allow increased air circulation. Avoid low-lying planting sites. Follow the stone fruit fungicide spray schedule.</p>

Commercial Crop Production
Fruit and Nut Crops - Stone Fruits

Table 2. Seasonal fungicide spray schedule for peach, nectarines, plums, and other stone fruit. Table was developed based on recommendations from the 2014 Southeastern Peach, Nectarine and Plum Pest Management and Culture Guide (<http://www.ent.uga.edu/peach/PeachGuide.pdf>).

Developmental Stage	Pesticide Application Timing ¹	Diseases
Dormant	After leaf fall and before bud swell	Bacterial spot Leaf curl
Delayed dormant	1-5 % bud swell	Bacterial spot Leaf curl
Early bloom	Less than 5% bloom	Bacterial spot Black knot
Bloom	Full bloom	Blossom blight Black knot
Post-bloom	Petal fall to 1% shuck split	Bacterial spot Black knot Scab
	Shuck split to 10% shuck off	Scab Bacterial spot
	7-10 days after shuck split spray	Anthracnose Bacterial spot Scab
Summer cover sprays	7-21 day intervals, usually 14 days	Anthracnose Bacterial spot Scab
Preharvest	21 days before harvest	Brown rot (only if disease pressure is high)
	14 and 7 days (or less) before harvest	Anthracnose Botrytis rot Brown rot Rhizopus rot
Postharvest fruit handling		Botrytis rot Brown rot Gibertella rot Rhizopus rot

Commercial Crop Production
Fruit and Nut Crops - Stone Fruits

Table 3. Efficacy of selected fungicides against peaches, nectarines, and plum diseases. Table was reproduced from the 2014 Southeastern Peach, Nectarine and Plum Pest Management and Culture Guide (<http://www.ent.uga.edu/peach/PeachGuide.pdf>). Efficacy ratings are as follows: - = no benefit, + = suppression, ++ = poor, +++ = fair, ++++ = good activity, +++++ = excellent and, +++++=superior. No data are provided for products that are not labeled for the specific disease or if the efficacy is unknown. These ratings are benchmarks; actual performance will vary.

Chemical name (Fungicide product name)	Leaf curl	Bacterial spot	Blossom blight	Scab	Anthracnose	Red spot	Sooty peach	Brown spot	Rhizopus rot
<i>oxytetracycline</i> (Mycoshield, Fireline)	-	+++ ^R	-	-	-	-	-	-	-
<i>azoxystrobin</i> (Abound)	-	-	-	++++ ^R	++++	-	-	++++ ^R	-
<i>trifloxystrobin</i> (Gem)	-	-	-	++++ ^R	++++	-	-	++++ ^R	-
<i>captan</i> (Captan, Captec, etc.)	-	-	++	++++	+++	-	++	+++	+
<i>chlorothalonil</i>	++++	-	+++	++++	-	-	-	-	-
<i>coppers</i> (various products)	+++	+++ ^R	-	-	-	-	-	-	-
<i>dicloran</i> (Botran)	-	-	+	-	-	-	-	+	++
<i>ferbam</i> (Ferbam)	++++	-	-	-	-	+++	-	-	-
<i>iprodione</i> (Rovral)	-	-	++++	-	-	++	++	-	-
<i>boscalid</i> + <i>pyraclostrobin</i> (Pristine)	-	-	++++	++++	++++	-	-	++++	+++
<i>penthiopyrad</i> (Fontelis)	-	-	++++	++	-	-	-	++++ ^R	+

Commercial Crop Production
Fruit and Nut Crops - Stone Fruits

Table 3. Efficacy of selected fungicides against peaches, nectarines, and plum diseases. Table was reproduced from the 2014 Southeastern Peach, Nectarine and Plum Pest Management and Culture Guide (<http://www.ent.uga.edu/peach/PeachGuide.pdf>). Efficacy ratings are as follows: - = no benefit, + = suppression, ++ = poor, +++ = fair, ++++ = good activity, +++++ = excellent and, +++++=superior. No data are provided for products that are not labeled for the specific disease or if the efficacy is unknown. These ratings are benchmarks; actual performance will vary.

Chemical name (Fungicide product name)	Leaf curl	Bacterial spot	Blossom blight	Scab	Anthraxnose	Red spot	Sooty peach	Brown spot	Rhizopus rot
<i>fluxapyroxad + pyraclostrobin (Merivon)</i>	-	-	+++++	++++	++++	-	-	+++++	+++
<i>cyprodinil + difenoconazole (Inspire Super)</i>	-	-	+++++	+++		-	-	+++++	
<i>cyprodinil + difenoconazole + (Inspire Super + Tilt)</i>	-	-	+++++	+++	++++	-	-	+++++	
<i>tebuconazole + trifloxystrobin (Adament)</i>	-	-	+++	++++	+++	-	-	+++	++
<i>azoxystrobin+ difenoconazole (Quadris Top)</i>	-	-	++++	++++	+++	-	-	++++	++
<i>sulfur (various)</i>	-	-	+	+++	-	-		+	-
<i>tebuconazole (Elite, Orius, Tebuzol)</i>	-	-	+++++	-	-	-	-	++++ ^R	-
<i>Thiram (Thiram)</i>	+++	+	-	+	-	+++	+++	-	-
<i>flutriafol (Topguard)</i>	-	-	++++	-	-	-	-	++++ ^R	-

Commercial Crop Production
Fruit and Nut Crops - Stone Fruits

Table 3. Efficacy of selected fungicides against peaches, nectarines, and plum diseases. Table was reproduced from the 2014 Southeastern Peach, Nectarine and Plum Pest Management and Culture Guide (<http://www.ent.uga.edu/peach/PeachGuide.pdf>). Efficacy ratings are as follows: - = no benefit, + = suppression, ++ = fair, +++ = good activity, ++++ = excellent and, +++++=superior. No data are provided for products that are not labeled for the specific disease or if the efficacy is unknown. These ratings are benchmarks; actual performance will vary.

Chemical name (Fungicide product name)	Leaf curl	Bacterial spot	Blossom blight	Scab	Anthracnose	Red spot	Sooty peach	Brown spot	Rhizopus rot
<i>thiophanate-methyl</i> (Topsin M, Thiophanate-methyl)	-	-	++++ ^R	++++ ^R	-	-	-	++++ ^R	-
<i>pyrimethanil</i> (Vanguard, Scala)	-	-	++++	-	-	-	-	-	-
<i>fludioxonil</i> (Scholar)	-	-	-	-	-	-	-	++++	++++
<i>propiconazole</i> (Orbit, PropiMax, Bumper)	-	-	++++	-	-	-	-	++++ ^R	-
<i>myclobutanil</i> (Rally)	-	-	+++	-	-	-	-	+ ^R	-
<i>Fenbuconazole</i> (Indar)	-	-	++++	++	-	-	-	++++ ^R	-
<i>metconazole</i> (Quash)	-	-	++++	-	-	-	-	++++ ^R	-
<i>ziram</i> (Ziram)	+++	+	-	+	-	+++	+++	-	-

^RResistance (or occasional failure of control) has been observed in some southeastern states, thus, if control failure occurs, it could indicate resistance has developed. The efficacy rating could be impacted by resistance development. If resistance has occurred, use of fungicides in the same class would likewise show resistance, and a substitute fungicide should be considered for pathogen management.

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Table 4. Recommended pesticides, rates and pesticide use restrictions for pears, nectarines, plums, and other stone fruit					
Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Comments
<i>aluminum tris</i> (33)	Aliette	5 lb/100 gal	20 lb	NA	Used to control collar and root rot caused by <i>Phytophthora</i> spp. Apply to trees that will not produce fruit for 12 months only.
<i>azoxystrobin</i> (11)	Abound Willowood Azoxy 2SC	12-15.5 fl oz 12-15.5 fl oz	92.3 fl oz 92.3 fl oz	0 0	See labels for application timings specific to each disease.
<i>azoxystrobin</i> + <i>difenoconazole</i> (11+3)	Quadris Top	12-14 fl oz	56 fl oz	0	See label for application timings specific to each disease.
<i>azoxystrobin</i> + <i>propiconazole</i> (11+3)	Quilt Xcel	14 fl oz	70 fl oz	0	See label for application timings specific to each disease.
<i>boscalid</i> + <i>pyraclostrobin</i> (7+11)	Pristine	10.5-14.5 oz	72.5 oz	0	
<i>captan</i> (M4)	Captan 50WP Captan 80WDG Captec 4L	4-8 lb 2.5-5 lb 0.75-1 qt/100 gal	24-32 lb ai 30-40 lb 24-32 qt	0 0 0	See label for rates specific to each commodity and disease.
<i>chlorothalonil</i> (M5)	Bravo Ultrex ⁵ Chloronil 720 ⁶ Echo 90DF Equus DF	2.8-3.8 lb 3.1-4.1 pt 2.25-3 lb 2.8-3.8	18.8 lb 20.5 pt 15.5 lb ai 16.9 lb	0 0 0	Do not apply Bravo Ultrex or Echo 90DF after shuck split or before harvest.
<i>copper hydroxide</i> (M1)	Badge SC Badge X2 Champ WG Champ Formula 2 Kentan DF Kocide 3000 Kocide 2000	5-14 pt 3.5-7 lb 8-16 lb 5.33-10.66 pt 6-16 lb 3.5-7 lb 6-12 lb	63.4 pt 18 lb 36 lb 49.6 pt 18 lb ai 60 lb 51.4 lb	21 21 21 21 21 6 app 21	See label for application rates specific to each disease.

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Table 4. Recommended pesticides, rates and pesticide use restrictions for pears, nectarines, plums, and other stone fruit

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Comments
<i>copper sulfate</i> (M1)	Cuprofix Ultra 40 Disperss Cuproxtat Top Cop with Sulfur	5-7.5 lb 10-20 pt 0.75-1.26 qt/100 gal	45 lb 88.7 pt	21	Do not apply Cuprofix Ultra 40 Disperss after shuck split.
<i>copper sulfate + copper oocychloride</i> (M1)	C-O-C-S WDG	12-15.6 lb (dormant) 1-2.9 lb (bloom)	35 lb		
<i>cyprodinil</i> (9)	Vanguard WG	5 oz	30 oz	2	No more than 2 applications by air.
<i>difenoconazole+ cyprodinil</i> (3+9)	Inspire Super	16-20 fl oz	80 fl oz	2	No more than 2 applications by air.
<i>dicloran</i> (14)	Botran 75W	2 lb	5.3 lb	10	
<i>fenbuconazole</i> (3)	Indar 2F	6 fl oz	48 fl oz	0	Do not graze livestock in treated areas or feed livestock cover crops grown in treated areas.
<i>fludioxonil</i> (12)	Scholar	8-16 oz/100 gal	1 app	16 oz	Use as a postharvest dip to control brown rot, gray mold, Rhizopus rot and Gilbertella rot. Dip for 30 sec and allow fruit to drain.
<i>fenhexamid</i> (17)	Elevate 50WG	1.5 lb (alone) 1-1.5 lb (tank mix)	6 lb	0	
<i>fuxapyroxad + pyraclostrobin</i> (7+11)	Merivon	4-6.7 fl oz	20.1 fl oz	0	
<i>iprodione</i> (2)	Iprodione 4L AG Meteor Nevado 4F Rovral Flowable	1-2 pt 1-2 pt 1-2 pt 1-2 pt	2 app 2 app 2 app 2 app		Do not apply after petal fall.

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Table 4. Recommended pesticides, rates and pesticide use restrictions for pears, nectarines, plums, and other stone fruit					
Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Comments
<i>mefenoxam</i> (4)	Ridomil Gold SL	2 qt	3 app		Soil application only. Apply to the soil to cover the entire root zone. Do not apply to trees under stress. Do not graze livestock in treated areas or feed livestock cover crops grown in treated areas.
<i>metconazole</i> (3)	Quash	2.5-4 oz	12 oz	14	See label for application rates specific to each disease. Do not make more than two applications AFTER petal fall.
<i>myclobutanil</i> (3)	Eagle 20EW	2-3 fl oz/100 gal	84-100 fl oz	0	See label for maximum application rates specific to each commodity.
	Rally 40WSP	2.5-6 oz	2.75-3.25 lb	0	
<i>oxytetracycline</i> (41)	Mycoshield	12 oz/100 gal	12 lb	21	Bacterial spot management only.
<i>phosphite</i> (phosphorous acid salts) (33)	Confine Extra	1-3 qt (foliar)	NA	0	See label for root dip and trunk injection rates.
	Fosphite	1-3 qt	NA	0	
	Fungi-phite	1-2 qt	NA	0	
	Helena Prophyt	2 pt	4 apps	0	
	Rampart	1-3 qt	NA	0	
<i>propiconazole</i> (3)	Propiconazole	4 fl oz	20 fl oz	0	Do not apply Banner MAXX, Strider, or Procon-Z to trees that will bear harvestable fruit within 12 months.
	Banner MAXX	2-4 fl oz/100 gal	see label		
	Bumper 41.8 EC	4 fl oz	20 fl oz	0	
	Bumper ES	4 fl oz	20 fl oz	0	
	Fitness	4 fl oz	20 fl oz	0	
	Procon-Z	2-4 fl oz/100 gal	see label		
	Strider	2-4 fl oz/100 gal	see label	0	
	Tilt	4 fl oz	20 fl oz	0	
	Topaz	4 fl oz	20 fl oz	0	
Willowood Propicon 3.6EC	4 fl oz	20 fl oz			

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Table 4. Recommended pesticides, rates and pesticide use restrictions for pears, nectarines, plums, and other stone fruit

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Comments
<i>propiconazole + thiophanate-Methyl</i> (3+1)	Protocol	1.3-3.75	6.6 pt	1	See label for application rates specific to each disease.
<i>pyrimethanil</i> (9)	Scala SC	9-18 fl oz	54 fl oz	2	Do not use on cherries.
<i>sulfur</i> (M2)	Liquid Sulfur Six Microfine Sulfur Microthiol Disperss Yellow Jacket Wettable Sulfur	0.66-2.75/100 gal 40-50 lb 10-20 lb 40-50 lb	NA NA NA NA		
<i>tebuconazole</i> (3)	Elite 45-WP Orius 20AQ Tebuzol 45 DF	4-8 oz 8.6-17.2 oz 4-8 oz	3 lb 103 oz 3 lb	0 0 0	The amount of Orius 20AQ depends on tree size and the amount of foliage present.
<i>tebuconazole + trifloxystrobin</i> (3+11)	Adament 50WG	4-8 oz	32 oz	1	
<i>thiophanate-methyl</i> (1)	Cercobin Incognito 4.5F T-Methyl 4.5F T-Methyl 70WSB Thiophanate methyl 85WDG Topsin 4.5FL Topsin M 70WP Topsin M WSB	21.8-32.7 fl oz 20-30 fl oz 20-30 fl oz 1-1.5 lb 0.8-1.2 lb 20-30 fl oz 1-1.5 lb 1-1.5 lb	82.7 fl oz 80 fl oz 80 fl oz 4 lb 3.3 lb 80 fl oz 4 lb 4 lb	1 1 1 1 1 1 1 1	T-methyl 4.5F can only be applied to peaches and cherries during non-bearing years of new plantings and nursery stock.

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Table 4. Recommended pesticides, rates and pesticide use restrictions for pears, nectarines, plums, and other stone fruit

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Comments
<i>trifloxystrobin</i> (11)	Gem	1.9-3.8 fl oz	15.2 fl oz	1	
<i>ziram</i> (M3)	Ziram	3.75-10 lb	40-72 lb	14	See label for rates specific to each commodity and disease.

¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.

²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).

³Rates are the amount of formulation per acre unless otherwise indicated. Usually 100 gallons of water are required to give good coverage with boom sprayers.

⁴Post-harvest interval (PHI) is the minimum number of days allowed between the last application and harvest.

⁵Other generic products include Daconil Ultrex and Ensign 82.5.

⁶Other generic products include Bravo Weather Stik, Chlorothalol 720SC, Docket WS, Echo 720 or Ensign 720 (do not apply after shuck split), Initiate 720, Equus 720 SST, and Daconil Weather Stik.

Information in the stone fruit section was updated December 2014 by Dr. M. Lewis Ivey.

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Abelia	Leaf Spot Powdery Mildew Root Rot	<i>Cercospora</i> <i>Oidium</i> <i>Pythium, Rhizoctonia</i>
African Violet (<i>Saintpaulia</i>)	Gray Mold Leaf Necrosis Leaf Spot Leaf and Stem Rot Necrotic Spot Powdery Mildew Root Rot Root and Crown Rot	<i>Botrytis</i> <i>Alternaria</i> <i>Corynespora</i> <i>Rhizoctonia</i> <i>Impatiens necrotic spot virus</i> <i>Oidium</i> <i>Fusarium, Rhizoctonia</i> <i>Phytophthora, Pythium</i>
Agapanthus	Bacterial Leaf Blight Bulb and Root Rot Gray Mold Leaf Spot Root Rot	<i>Xanthomonas</i> <i>Fusarium, Rhizoctonia</i> <i>Botrytis</i> <i>Colletotrichum, Myrothecium</i> <i>Phytophthora, Pythium</i>
Ageratum	Leaf Spot Powdery Mildew Root Rot Root and Stem Rot Rust Southern Blight	<i>Cercospora</i> <i>Erysiphe</i> <i>Pythium</i> <i>Rhizoctonia</i> <i>Puccinia</i> <i>Sclerotium</i>
Aglaonema	Anthracnose Bacterial Leaf Spot Bacterial Soft Rot Leaf Spot Root Rot Root and Stem Rot Stem Rot Southern Blight	<i>Colletotrichum, Glomerella</i> <i>Pseudomonas, Xanthomonas</i> <i>Erwinia</i> <i>Cercospora, Corynespora, Myrothecium</i> <i>Pythium, Rhizoctonia</i> <i>Cylindrocladiella, Fusarium, Phytophthora</i> <i>Cylindrocladium</i> <i>Sclerotium</i>
Ajuga	Leaf Spot Root Rot Root and Crown Rot Southern Blight	<i>Alternaria, Cercospora, Colletotrichum,</i> <i>Corynespora, Myrothecium, Stemphylium</i> <i>Pythium, Rhizoctonia</i> <i>Fusarium</i> <i>Sclerotium</i>
Almond, flowering (<i>Prunus triloba</i>)	Blossom and Twig Blight Gray Mold Rust	<i>Monilinia</i> <i>Botrytis</i> <i>Tranzschelia</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Alyssum	Basal Stem Rot Damping-off	<i>Pythium</i> <i>Rhizoctonia</i>
American hornbeam (<i>Carpinus</i>)	Leaf Blister Leaf Spot Powdery Mildew	<i>Taphrina</i> <i>Septoria</i> <i>Microsphaera</i> , <i>Phyllactinia</i>
Amaryllis	Red Blotch	<i>Stagnospora</i>
Anemone, Jerusalem	Damping-off	<i>Rhizoctonia</i>
Anthurium	Anthracnose Bacterial Leaf Spot Bacterial Soft Rot Leaf Rot Leaf Spot Root Rot Root and Stem Rot Southern Blight	<i>Gloeosporium</i> <i>Pseudomonas</i> , <i>Xanthomonas</i> <i>Erwinia</i> <i>Botrytis</i> <i>Alternaria</i> , <i>Cercospora</i> , <i>Phomopsis</i> , <i>Phyllosticta</i> , <i>Septoria</i> <i>Fusarium</i> , <i>Pythium</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Rhizoctonia</i> <i>Sclerotium</i>
Aphelandra	Anthracnose Bacterial Leaf Spot Bacterial Soft Rot Leaf Spot Root Rot Root, Crown and Stem Rot Southern Blight	<i>Colletotrichum</i> <i>Pseudomonas</i> , <i>Xanthomonas</i> <i>Erwinia</i> <i>Alternaria</i> , <i>Cercospora</i> , <i>Corynespora</i> , <i>Myrothecium</i> <i>Pythium</i> , <i>Rhizoctonia</i> <i>Phytophthora</i> <i>Sclerotium</i>
Arborvitae (<i>Thuja</i>)	Tip and Twig Blights or Dieback Root Rot Root and Stem Rot	<i>Alternaria</i> , <i>Cercospora</i> , <i>Coryneum</i> , <i>Pestalotiopsis</i> , <i>Phomopsis</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> <i>Rhizoctonia</i>
Aronia	Root Rot	<i>Phytophthora</i>
Ardisia	Leaf Spot Root Rot Stem Rot	<i>Cercospora</i> , <i>Mycosphaerella</i> , <i>Phyllosticta</i> <i>Phytophthora</i> <i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Sclerotinia</i>
Areca palm	Root Rot	<i>Phytophthora</i> , <i>Pythium</i>
Artemisia	Root Rot	<i>Phytophthora</i> , <i>Pythium</i>
Ash	Anthracnose Heart Rot Leaf Spot	<i>Gloeosporium</i> <i>Ganoderma</i> <i>Cercospora</i> , <i>Cercosporidium</i> , <i>Cylindrosporium</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
	Powdery Mildew Rust	<i>Oidium</i> <i>Puccinia</i>
Asian jasmine	Blight Root Rot	<i>Rhizoctonia</i> <i>Fusarium</i>
Asparagus fern	Anthracnose Blight Stem Rot	<i>Colletotrichum</i> <i>Ascochyta</i> , <i>Cercospora</i> <i>Fusarium</i> , <i>Rhizoctonia</i>
Aspidistra (Barroom plant)	Anthracnose Leaf Spot	<i>Colletotrichum</i> <i>Ascochyta</i> , <i>Cercospora</i>
Aster	Powdery Mildew Root Rot Rust Stem Rot	<i>Erysiphe</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i> <i>Puccinia</i> <i>Rhizoctonia</i>
Astilbe	Leaf Spot Powdery Mildew	<i>Cercospora</i> <i>Erysiphe</i>
Aucuba	Anthracnose Leaf Spot Root Rot	<i>Gloeosporium</i> <i>Pestalotia</i> , <i>Phyllosticta</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Azalea	Damping-off Dieback Flower Blight Leaf Gall Leaf Spot Powdery Mildew Root Rot Web Blight	<i>Rhizoctonia</i> <i>Phytophthora</i> <i>Ovulinia</i> <i>Exobasidium</i> <i>Cercospora</i> , <i>Colletotrichum</i> , <i>Pestalotia</i> , <i>Phyllosticta</i> <i>Microsphaera</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Rhizoctonia</i>
Baby's breath (<i>Gypsophila</i>)	Gray Mold Leaf Spot Root Rot Stem Rot	<i>Botrytis</i> <i>Phyllosticta</i> <i>Phytophthora</i> , <i>Pythium</i> <i>Fusarium</i> , <i>Rhizoctonia</i>
Balsam (<i>Impatiens balsamina</i>)	Leaf Spot Root Rot Stem Rot	<i>Cercospora</i> , <i>Septoria</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i> <i>Fusarium</i> , <i>Rhizoctonia</i>
Banana shrub	Algal Leaf Spot Root Rot	<i>Cephaleuros</i> <i>Phytophthora</i> , <i>Rhizoctonia</i>
Barberry	Bacterial Leaf Spot	<i>Pseudomonas</i>

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Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
	Leaf Spot Powdery Mildew Rust	<i>Gloeosporium</i> <i>Erysiphe</i> , <i>Phyllactinia</i> <i>Cumminsiiella</i> , <i>Puccinia</i>
Bay, red	Leaf Spot	<i>Cercospora</i>
Bee balm	Leaf Spot	<i>Cercospora</i>
Beech, American	Leaf Spot Powdery Mildew	<i>Cercospora</i> <i>Phyllactinia</i>
Begonia	Anthracnose Bacterial Leaf Spot Gray Mold Leaf Spot Powdery Mildew Root Rot Stem Rot	<i>Colletotrichum</i> <i>Xanthomonas</i> <i>Botrytis</i> <i>Cercospora</i> , <i>Phyllosticta</i> , <i>Phomopsis</i> <i>Erysiphe</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i> <i>Fusarium</i> , <i>Rhizoctonia</i>
Birch	Anthracnose Leaf Spot Powdery Mildew	<i>Gloeosporium</i> <i>Septoria</i> <i>Phyllactinia</i>
Black cherry	Anthracnose Leaf Blister Leaf Spot Powdery Mildew Rust	<i>Colletotrichum</i> <i>Taphrina</i> <i>Cercospora</i> <i>Podosphaera</i> <i>Tranzschelia</i>
Bleeding heart	Leaf Spot	<i>Cercospora</i> , <i>Colletotrichum</i>
Boston fern	Rust Web Blight	<i>Desmella</i> <i>Rhizoctonia</i>
Bottlebrush	Gall	<i>Nectriella</i>
Bougainvillea	Root Rot	<i>Phytophthora</i> , <i>Pythium</i>
Box elder	Anthracnose Leaf Spot Powdery Mildew	<i>Gloeosporium</i> <i>Ascochyta</i> , <i>Cercospora</i> , <i>Septoria</i> <i>Microsphaera</i> , <i>Uncinula</i>
Boxwood	Canker Leaf Spot Root Rot Stem Blight Stem Dieback	<i>Nectria</i> <i>Macrophoma</i> , <i>Phyllosticta</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Volutella</i> <i>Colletotrichum theobromicola</i>
Browallia	Root Rot	<i>Phytophthora</i> , <i>Pythium</i>
Buckeye	Anthracnose Leaf Blotch	<i>Glomerella</i> <i>Phyllosticta</i>

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Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
	Leaf Spot Powdery Mildew	<i>Cercospora</i> <i>Uncinula</i>
Buckthorn	Leaf Spot Rust	<i>Cercospora</i> , <i>Septoria</i> <i>Puccinia</i>
Buffaloberry	Leaf Spot	<i>Cylindrosporium</i>
Cactus	Leaf Spot Root Rot	<i>Phoma</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Caladium	Root Rot	<i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Calathea	Root Rot	<i>Phytophthora</i> , <i>Pythium</i>
Calceolaria	Root Rot	<i>Pythium</i>
Calendula	Leaf Spot Powdery Mildew Root Rot Rust Stem Rot	<i>Cercospora</i> <i>Erysiphe</i> <i>Phytophthora</i> , <i>Pythium</i> <i>Puccinia</i> <i>Rhizoctonia</i> , <i>Sclerotinia</i>
Camellia	Algal Leaf Spot Flower Blight Leaf Gall Leaf Spot Petal Blight Root Rot	<i>Cephaleuros</i> <i>Ciborinia</i> <i>Exobasidium</i> <i>Guignardia</i> , <i>Pestalotia</i> , <i>Macrophoma</i> <i>Botrytis</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Camphor-tree	Anthracnose Leaf Spot Powdery Mildew	<i>Glomerella</i> <i>Gloeosporium</i> <i>Microsphaera</i>
Candytuft	Gray Mold Stem Rot	<i>Botrytis</i> <i>Fusarium</i> , <i>Rhizoctonia</i>
Canna	Rust	<i>Puccinia</i>
Carissa	Root Rot	<i>Phytophthora</i> , <i>Pythium</i>
Carnation	Anthracnose Branch Rot Damping-Off Leaf Spot Powdery Mildew Root Rot Rust	<i>Colletotrichum</i> <i>Botrytis</i> <i>Pythium</i> <i>Alternaria</i> , <i>Septoria</i> <i>Oidium</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Uromyces</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Catalpa	Anthracnose Leaf Spot Powdery Mildew	<i>Gloeosporium</i> <i>Cercospora</i> , <i>Phyllosticta</i> <i>Microsphaera</i> , <i>Phyllactinia</i>
<i>Cattleya skinneri</i>	Root Rot	<i>Phytophthora</i> , <i>Pythium</i>
Cedar	Leaf Spot Needle Blight Root Rot	<i>Alternaria</i> <i>Cercospora</i> , <i>Phomopsis</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Celosia	Leaf Spot Root Rot	<i>Alternaria</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Ceanothus	Root Rot	<i>Phytophthora</i> , <i>Pythium</i>
Chamaedorea	Root Rot	<i>Phytophthora</i> , <i>Pythium</i>
Cherry-hawthorn	Leaf Spot Rust	<i>Fabraea</i> <i>Gymnosporangium</i>
Cherry-laurel	Leaf Spot Powdery Mildew Root Rot	<i>Cercospora</i> , <i>Septoria</i> <i>Podosphaera</i> <i>Phytophthora</i>
Chestnut	Powdery Mildew	<i>Microsphaera</i> , <i>Phyllactinia</i>
Chinaberry	Leaf Spot Powdery Mildew	<i>Cercospora</i> <i>Phyllactinia</i>
Chinese elm	Anthracnose Leaf Spot Powdery Mildew	<i>Colletotrichum</i> <i>Actinopelte</i> , <i>Phyllosticta</i> <i>Phyllactinia</i>
Chinese evergreen	Powdery Mildew Root Rot	<i>Phyllactinia</i> <i>Phytophthora</i> , <i>Pythium</i>
Chinese forget-me-not	Gray Mold Leaf Spot Stem Rot	<i>Botrytis</i> <i>Cercospora</i> <i>Rhizoctonia</i>
Chinese lantern (<i>Abutilon</i>)	Leaf Spot	<i>Cercospora</i> , <i>Phyllosticta</i>
Chinese parasol tree	Web Blight	<i>Rhizoctonia</i>
Chinese pistachio	Leaf Spot Thread Blight	<i>Septoria</i> <i>Rhizoctonia</i>
Chocolate plant	Leaf Spot	<i>Phyllosticta</i>
Christmas rose	Flower Spot	<i>Botrytis</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Chrysanthemum	Anthracnose Bacterial Blight Damping-Off Gray Mold Leaf Spot Powdery Mildew Ray Blight Root Rot Rust Wilt	<i>Colletotrichum</i> <i>Pectobacterium</i> <i>Pythium</i> <i>Botrytis</i> <i>Septoria</i> <i>Erysiphe</i> <i>Ascochyta, Mycosphaerella</i> <i>Phytophthora, Pythium, Rhizoctonia</i> <i>Puccinia</i> <i>Fusarium</i>
Cineraria	Powdery Mildew Root Rot	<i>Erysiphe</i> <i>Phytophthora, Pythium, Rhizoctonia</i>
Cissus	Leaf Spot Root Rot	<i>Cercospora</i> <i>Phytophthora, Pythium</i>
Clarkia	Gray Mold Root Rot	<i>Botrytis</i> <i>Rhizoctonia</i>
Clematis	Leaf Spot	<i>Ascochyta, Cercospora</i>
Cleyera	Leaf Spot	<i>Cercospora</i>
Cockscomb	Leaf Spot Stem Rot	<i>Cercospora</i> <i>Fusarium, Rhizoctonia</i>
Coleus	Downy Mildew Leaf Blight Root Rot	<i>Peronospora</i> <i>Botrytis</i> <i>Phytophthora, Pythium, Rhizoctonia</i>
Columbine	Leaf Spot Powdery Mildew Root Rot Rust	<i>Ascochyta, Septoria</i> <i>Erysiphe</i> <i>Phytophthora, Pythium, Rhizoctonia</i> <i>Puccinia</i>
Coneflower	Leaf Spot	<i>Cercospora</i>
Confederate jasmine	Anthracnose Leaf Spot Root and Crown Rot Stem Rot	<i>Colletotrichum</i> <i>Cercospora, Corynespora</i> <i>Armillaria</i> <i>Fusarium, Rhizoctonia</i>
Cordylone	Leaf Spot	<i>Cercospora</i>
Coreopsis	Gray Mold Leaf Spot Rust Stem Rot	<i>Botrytis</i> <i>Cercospora, Phyllosticta, Septoria</i> <i>Coleosporium</i> <i>Rhizoctonia</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Cornflower	Leaf Spot Rust Stem Rot	<i>Cercospora</i> , <i>Septoria</i> <i>Puccinia</i> <i>Rhizoctonia</i> , <i>Sclerotinia</i>
Cosmos	Leaf Spot Powdery Mildew Stem Rot	<i>Cercospora</i> <i>Erysiphe</i> <i>Rhizoctonia</i>
Cotoneaster	Leaf Spot Root Rot	<i>Cercospora</i> , <i>Phyllosticta</i> <i>Phytophthora</i> , <i>Pythium</i>
Cottonwood	Leaf Blister Leaf Spot Powdery Mildew Rust	<i>Taphrina</i> <i>Cercospora</i> , <i>Septoria</i> <i>Uncinula</i> <i>Melampsora</i>
Crabapple	Leaf Spot Powdery Mildew Rust Scab	<i>Sphaeropsis</i> <i>Podosphaera</i> <i>Gymnosporangium</i> <i>Venturia</i>
Crape myrtle	Leaf Spot Powdery Mildew Root Rot	<i>Cercospora</i> , <i>Pestalotia</i> , <i>Phyllosticta</i> <i>Erysiphe</i> , <i>Phyllactinia</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Crassula	Leaf Spot Powdery Mildew Root Rot	<i>Cercospora</i> , <i>Phomopsis</i> <i>Spaerotheca</i> <i>Phytophthora</i> , <i>Pythium</i>
Croton	Root Rot	<i>Fusarium</i> , <i>Phytophthora</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Crown vetch	Anthracnose Leaf Spot	<i>Colletotrichum</i> <i>Cercospora</i>
Cycas (Sago palm)	Root Rot	<i>Phytophthora</i>
Cypress	Canker Needle Blight Root and Crown Rot Root Rot Twig Blight	<i>Seiridium</i> <i>Cercospora</i> <i>Armillaria</i> <i>Phytophthora</i> <i>Phomopsis</i>
Daffodil	Bulb Rot Leaf Scorch Root Rot	<i>Fusarium</i> , <i>Penicillium</i> <i>Stagnospora</i> <i>Rhizoctonia</i>
Dahlia	Blight Leaf Spot Powdery Mildew Root Rot	<i>Botrytis</i> <i>Cercospora</i> <i>Erysiphe</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Daisy	Gray Mold Leaf Spot Powdery Mildew Ray Blight Rust Stem Rot	<i>Botrytis</i> <i>Cercospora</i> , <i>Phyllosticta</i> , <i>Septoria</i> <i>Erysiphe</i> <i>Mycosphaerella</i> <i>Puccinia</i> <i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Sclerotinia</i>
Daphne	Leaf Spot Root Rot Stem Rot	<i>Gloeosporium</i> <i>Phytophthora</i> , <i>Pythium</i> <i>Sclerotinia</i>
Daylily	Anthracnose Blight Leaf Spot Root And Stem Rot Rust	<i>Colletotrichum</i> <i>Botrytis</i> <i>Cercospora</i> , <i>Phomopsis</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Rhizoctonia</i> <i>Puccinia</i>
Delphinium	Gray Mold Leaf Spot Powdery Mildew Root Rot Rust Stem Rot	<i>Botrytis</i> <i>Ascochyta</i> , <i>Cercospora</i> , <i>Phyllosticta</i> <i>Erysiphe</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Puccinia</i> <i>Rhizoctonia</i> , <i>Sclerotinia</i>
Deutzia	Leaf Spot Root Rot	<i>Cercospora</i> <i>Rhizoctonia</i>
Dianthus	Root Rot Rust	<i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Uromyces</i>
Dieffenbachia	Bacterial Stem Rot Leaf Spot Root Rot	<i>Erwinia</i> <i>Leptosphaeria</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Dogwood	Blight Leaf Spot Powdery Mildew Root Rot	<i>Cercospora</i> <i>Septoria</i> <i>Microsphaera</i> , <i>Phyllactinia</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Dracaena	Leaf Spot Root Rot	<i>Fusarium</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Duranta skyflower	Leaf Spot	<i>Cercospora</i>
Dusty miller	Root Rot	<i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Dutch iris	Bulb Rot	<i>Sclerotium</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Dwarf bamboo	Leaf Spot Rust	<i>Corynespora</i> <i>Puccinia</i>
Easter lily	Bulb Rot Root Rot	<i>Fusarium</i> , <i>Penicillium</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Echeveria	Root Rot	<i>Phytophthora</i> , <i>Pythium</i>
Elaeagnus	Leaf Spot Root Rot Stem Canker Tip Blight	<i>Cercospora</i> <i>Phytophthora</i> <i>Phytophthora</i> <i>Gloeosporium</i>
Elm	Anthraxnose Bacterial Leaf Scorch Leaf Spot Powdery Mildew	<i>Gloeosporium</i> <i>Xylella fastidiosa</i> <i>Cercospora</i> , <i>Gnomonia</i> <i>Microsphaera</i> , <i>Phyllactinia</i> , <i>Uncinula</i>
Euonymus	Anthraxnose Leaf Spot Powdery Mildew Root Rot	<i>Colletotrichum</i> <i>Cercospora</i> , <i>Phyllosticta</i> , <i>Ramularia</i> , <i>Septoria</i> <i>Microsphaera</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Farkleberry	Leaf Spot	<i>Septoria</i>
Fatsia	Anthraxnose Leaf Spot Root Rot	<i>Colletotrichum</i> <i>Alternaria</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Ferns	Blight Gray Mold Leaf Spot Root Rot	<i>Rhizoctonia</i> <i>Botrytis</i> <i>Cercospora</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Fern (Japanese Holly Fern)	Mosaic	<i>Japanese holly fern mosaic virus</i>
Festuca	Leaf Spot Root Rot Rust	<i>Ascochyta</i> , <i>Septoria</i> <i>Rhizoctonia</i> <i>Puccinia</i>
Ficus	Leaf Spot Root Rot	<i>Cercospora</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Firethorn	Scab	<i>Fusicladium</i>
Fittonia	Root Rot	<i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Forget-me-not	Gray Mold Powdery Mildew Rust	<i>Botrytis</i> <i>Erysiphe</i> <i>Puccinia</i>
Forsythia	Anthracnose Leaf Spot Root Rot	<i>Gloeosporium</i> <i>Alternaria</i> <i>Rhizoctonia</i>
Four o'clock	Leaf Spot Rust Stem Rot	<i>Cercospora</i> <i>Puccinia</i> <i>Rhizoctonia</i>
Foxglove	Leaf Spot Root Rot Stem Rot	<i>Colletotrichum</i> , <i>Phyllosticta</i> <i>Phytophthora</i> , <i>Pythium</i> <i>Rhizoctonia</i>
Fringe-tree	Leaf Spot Powdery Mildew	<i>Cercospora</i> , <i>Septoria</i> <i>Phyllactinia</i>
Fuchsia	Blight Dieback Leaf Spot Rust	<i>Botrytis</i> <i>Phomopsis</i> <i>Septoria</i> <i>Pucciniastrum</i>
Gaillardia	Leaf Spot Powdery Mildew Root Rot	<i>Septoria</i> <i>Erysiphe</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Gardenia	Anthracnose Canker Leaf Spot Petal Blight Powdery Mildew Root Rot	<i>Colletotrichum</i> <i>Phomopsis</i> <i>Cercospora</i> <i>Botrytis</i> <i>Erysiphe</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Geranium	Blight Powdery Mildew Root Rot Rust	<i>Botrytis</i> <i>Erysiphe</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Puccinia</i>
Gerbera	Powdery Mildew Root Rot	<i>Erysiphe</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Ginkgo	Anthracnose	<i>Colletotrichum</i>
Gladiolus	Corm Rot Damping-off Flower Spot Leaf Spot Neck Dry Rot	<i>Fusarium</i> , <i>Penicillium</i> <i>Fusarium</i> , <i>Rhizoctonia</i> <i>Botrytis</i> <i>Curvularia</i> , <i>Stemphylium</i> <i>Sclerotium</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Gloxinia	Root Rot	<i>Phytophthora, Pythium, Rhizoctonia</i>
Golden dewdrop (<i>Duranta erecta</i>)	Leaf Blight	<i>Xanthomonas</i>
Golden rain	Leaf Spot	<i>Cercospora</i>
Grapeleaf ivy	Anthracnose Leaf Spot Powdery Mildew	<i>Colletotrichum</i> <i>Cercospora</i> <i>Oidium</i>
Gynura	Root Rot	<i>Phytophthora, Pythium, Rhizoctonia</i>
Gypsophila	Root Rot	<i>Phytophthora, Pythium</i>
Hackberry	Leaf Spot Powdery Mildew	<i>Phyllosticta</i> <i>Uncinula</i>
Halesia	Leaf Spot	<i>Cercospora</i>
Hawthorne	Fire Blight Leaf Spot Powdery Mildew Root Rot Rust Scab Stem Canker	<i>Erwinia</i> <i>Fabraea</i> <i>Phyllactinia, Podosphaera</i> <i>Rhizoctonia</i> <i>Gymnosporangium</i> <i>Venturia</i> <i>Fusarium</i>
Heather	Root Rot	<i>Phytophthora, Pythium</i>
Hen and chickens	Leaf Spot Root Rot	<i>Cercospora</i> <i>Fusarium, Rhizoctonia</i>
Hibiscus	Anthracnose Gray Mold Leaf Spot Powdery Mildew Root Rot Rust Stem Rot	<i>Colletotrichum</i> <i>Botrytis</i> <i>Cercospora, Phyllosticta</i> <i>Erysiphe, Microsphaera</i> <i>Phytophthora, Pythium</i> <i>Kuehneola</i> <i>Fusarium, Rhizoctonia, Sclerotinia</i>
Hickory	Anthracnose Leaf Spot Powdery Mildew	<i>Gnomonia</i> <i>Cercospora, Septoria</i> <i>Microsphaera</i>
Holly	Leaf Spot Powdery Mildew Purple Spot Root Rot Stem Canker Twig Dieback Web Blight	<i>Gloeosporium, Phyllosticta</i> <i>Microsphaera</i> <i>Cercospora</i> <i>Rhizoctonia</i> <i>Botryodiplodia</i> <i>Phoma</i> <i>Rhizoctonia</i>
Hollyhock	Anthracnose	<i>Colletotrichum</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
	Leaf Spot Petal Blight Powdery Mildew Rust	<i>Asochyta, Cercospora</i> <i>Botrytis</i> <i>Erysiphe</i> <i>Puccinia</i>
Honey locust	Leaf Spot Powdery Mildew	<i>Cercospora</i> <i>Microsphaera</i>
Honeysuckle	Blight Leaf Spot Powdery Mildew Root Rot	<i>Herpobasidium</i> <i>Corynespora, Phyllosticta</i> <i>Microsphaera</i> <i>Phytophthora, Pythium</i>
Hornbeam	Leaf Blister Powdery Mildew	<i>Taphrina</i> <i>Microsphaera, Phyllactinia</i>
Hosta	Crown Rot Leaf Spot Stem Rot	<i>Botrytis</i> <i>Colletotrichum, Phyllosticta</i> <i>Rhizoctonia</i>
Hoya	Root Rot	<i>Phytophthora, Pythium, Rhizoctonia</i>
Huckleberry	Leaf Spot	<i>Phyllosticta</i>
Hyacinth	Black Rot	<i>Sclerotinia</i>
Hydrangea	Blight Leaf Spot Powdery Mildew Root Rot Rust	<i>Botrytis</i> <i>Ascochyta, Cercospora, Colletotrichum,</i> <i>Phyllosticta, Septoria</i> <i>Erysiphe</i> <i>Fusarium, Phytophthora, Pythium,</i> <i>Rhizoctonia, Thielaviopsis</i> <i>Pucciniastrum</i>
Ilex	Root Rot	<i>Fusarium, Phytophthora, Pythium,</i> <i>Rhizoctonia, Thielaviopsis</i>
Impatiens	Downy Mildew Leaf Spot Root Rot	<i>Plasmopara obducens</i> <i>Cercospora, Septoria</i> <i>Fusarium, Phytophthora, Pythium,</i> <i>Rhizoctonia, Thielaviopsis</i>
Iris	Anthracnose Blossom Blight Bulb Rot Crown Rot Leaf Spot Rust	<i>Colletotrichum</i> <i>Botrytis</i> <i>Fusarium, Penicillium</i> <i>Pellicularia</i> <i>Didymellina</i> <i>Puccinia</i>
Iris, African	Root Rot	<i>Phytophthora</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Ivy	Bacterial Leaf Spot Blight Root Rot	<i>Xanthomonas</i> <i>Colletotrichum</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Ivy, Algerian	Root Rot	<i>Phytophthora</i> , <i>Pythium</i>
Ivy, English	Gray Mold Leaf Spot Powdery Mildew Root Rot Stem Rot	<i>Botrytis</i> <i>Cercospora</i> , <i>Colletotrichum</i> <i>Erysiphe</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Fusarium</i> , <i>Rhizoctonia</i>
Japanese plum (<i>Prunus</i> sp.)	Anthraco-nose Leaf Spot Scab	<i>Colletotrichum</i> <i>Septoria</i> <i>Fusicladium</i>
Japanese yew	Leaf Spot Root Rot	<i>Cercospora</i> , <i>Phomopsis</i> <i>Phytophthora</i>
Jasmine	Leaf Spot Root Rot Stem Canker	<i>Colletotrichum</i> <i>Phytophthora</i> <i>Phoma</i>
Java	Leaf Spot	<i>Cercospora</i> , <i>Septoria</i>
Jerusalem cherry	Anthraco-nose Leaf Spot Stem Rot	<i>Colletotrichum</i> <i>Phyllosticta</i> <i>Rhizoctonia</i>
Jerusalem thorn	Dieback Leaf Spot Powdery Mildew	<i>Phomopsis</i> <i>Phyllosticta</i> <i>Erysiphe</i>
Jujube	Leaf Spot Rust	<i>Cercospora</i> <i>Phakopsora</i>
Juniper	Blight Leaf Spot Root Rot Rust	<i>Phomopsis</i> <i>Cercospora</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Gymnosporangium</i>
Justica	Anthraco-nose Leaf Spot	<i>Colletotrichum</i> <i>Cercospora</i> , <i>Corynespora</i>
Kalanchoe	Leaf Spot Powdery Mildew Root Rot	<i>Cercospora</i> <i>Sphaerotheca</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Lantana	Leaf Spot Root Rot Rust	<i>Colletotrichum</i> <i>Rhizoctonia</i> <i>Puccinia</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Larkspur	Root Rot Stem Rot	<i>Phytophthora, Pythium</i> <i>Rhizoctonia</i>
Leatherleaf fern	Blight Leaf Spot	<i>Ascochyta, Rhizoctonia</i> <i>Cercospora, Cylindrocladium</i>
Leopard plant	Root Rot	<i>Rhizoctonia</i>
Leucothoe	Leaf Spot Root Rot	<i>Cercospora</i> <i>Fusarium, Phytophthora, Pythium,</i> <i>Rhizoctonia, Thielaviopsis</i>
Liatis	Leaf Spot Rust	<i>Phyllosticta, Septoria</i> <i>Coleosporium, Puccinia</i>
Ligularia	Root Rot Stem Rot	<i>Rhizoctonia</i> <i>Rhizoctonia</i>
Ligustrum	Leaf Spot Powdery Mildew Root Rot Twig Canker Web Blight	<i>Cercospora</i> <i>Microsphaera</i> <i>Fusarium, Phytophthora, Pythium,</i> <i>Rhizoctonia, Thielaviopsis</i> <i>Botryodiplodia</i> <i>Rhizoctonia</i>
Lily	Blight Gray Mold Root Rot	<i>Phytophthora</i> <i>Botrytis</i> <i>Rhizoctonia</i>
Linden	Anthracnose Leaf Spot	<i>Gloeosporium</i> <i>Cercospora</i>
Liriope	Anthracnose Crown Rot Leaf and Crown Rot Leaf Spot Root Rot	<i>Colletotrichum</i> <i>Fusarium</i> <i>Phytophthora</i> <i>Cercospora</i> <i>Fusarium, Rhizoctonia</i>
Lobelia	Leaf Spot Root Rot	<i>Cercospora, Septoria</i> <i>Fusarium, Phytophthora, Pythium,</i> <i>Rhizoctonia, Thielaviopsis</i>
Locust, black	Anthracnose Leaf Spot Powdery Mildew	<i>Colletotrichum</i> <i>Cercospora</i> <i>Microsphaera</i>
Loquat	Bacterial Leaf Scorch Fire Blight	<i>Xylella fastidiosa</i> <i>Erwinia</i>
Loropetalum	Bacterial Stem Gall Root Rot	<i>Pseudomonas</i> <i>Phytophthora, Pythium, Rhizoctonia</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Lupine	Gray Mold Leaf Spot Powdery Mildew Rust Stem Rot	<i>Botrytis</i> <i>Cercospora</i> , <i>Ramularia</i> <i>Erysiphe</i> <i>Uromyces</i> <i>Fusarium</i> , <i>Rhizoctonia</i>
Magnolia	Algal Leaf Spot Leaf Spot Spot Anthracnose Root Rot Tip Dieback	<i>Cephaleuros</i> <i>Cercospora</i> , <i>Colletotrichum</i> , <i>Gloesporium</i> , <i>Septoria</i> <i>Elsinoe</i> <i>Phytophthora</i> , <i>Pythium</i> <i>Phoma</i>
Mahonia	Leaf Spot	<i>Cercospora</i> , <i>Phyllosticta</i>
Maiden Grass	Sheath Blight	<i>Sclerotinia</i>
Maple	Anthracnose Leaf Spot Powdery Mildew Root Rot	<i>Gloeosporium</i> <i>Alternaria</i> , <i>Phyllosticta</i> <i>Uncinula</i> <i>Phytophthora</i> , <i>Pythium</i>
Maranta	Root Rot	<i>Phytophthora</i> , <i>Pythium</i>
Marigold	Head Blight Leaf Spot Root Rot Rust Stem Rot	<i>Botrytis</i> <i>Ascochyta</i> , <i>Cercospora</i> , <i>Septoria</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Puccinia</i> <i>Fusarium</i> , <i>Rhizoctonia</i>
Mimosa	Leaf Spot	<i>Cercospora</i>
Mock orange	Blight Leaf Spot Powdery Mildew Rust	<i>Botrytis</i> <i>Cercospora</i> <i>Phyllactinia</i> <i>Gymnosporangium</i>
Mondo grass (<i>Ophiopogon</i> sp.)	Anthracnose Crown Rot Root Rot	<i>Colletotrichum</i> <i>Phytophthora</i> <i>Rhizoctonia</i>
Morning glory	Leaf Spot Rust	<i>Cercospora</i> <i>Coleosporium</i> , <i>Puccinia</i>
Mulberry	Bacterial Leaf Scorch Leaf Spot Powdery Mildew Rust	<i>Xylella fastidiosa</i> <i>Cercospora</i> <i>Uncinula</i> <i>Cerotelium</i>
Mulberry, French	Leaf Spot	<i>Cercospora</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Nandina	Anthracnose Bacterial Leaf Scorch Leaf Spot	<i>Glomerella</i> <i>Xylella fastidiosa</i> <i>Cercospora</i>
Narcissus	Blight Root Rot	<i>Botrytis</i> <i>Rhizoctonia</i>
Nasturium	Gray Mold Leaf Spot Root Rot	<i>Botrytis</i> <i>Cercospora</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Natal plum	Anthracnose Blight Leaf Spot Powdery Mildew	<i>Colletotrichum</i> <i>Rhizoctonia</i> <i>Phyllosticta</i> <i>Oidium</i>
Nemesia	Necrotic Spots	<i>Impatiens necrotic spot virus</i>
Nephrolepis	Root Rot	<i>Phytophthora</i> , <i>Pythium</i>
Nephtytis	Leaf Spot Root Rot	<i>Cephalosporium</i> <i>Phytophthora</i> , <i>Pythium</i>
Norfolk island pine	Root Rot	<i>Phytophthora</i> , <i>Pythium</i>
Oak	Anthracnose Bacterial Flux Bacterial Leaf Scorch Heart Rot Leaf Blister Leaf Spot Powdery Mildew Rust	<i>Gloeosporium</i> <i>Bacteria</i> <i>Xylella fastidiosa</i> <i>Ganoderma</i> , <i>Polyporus</i> <i>Taphrina</i> <i>Actinopelte</i> , <i>Cercospora</i> , <i>Septoria</i> <i>Erysiphe</i> , <i>Microsphaera</i> , <i>Phyllactinia</i> , <i>Sphaerotheca</i> <i>Cronartium</i>
Oleander	Anthracnose Bacterial Leaf Scorch Leaf Spot Spot Anthracnose	<i>Gloeosporium</i> <i>Xylella fastidiosa</i> <i>Cercospora</i> , <i>Septoria</i> <i>Sphaceloma</i>
Orchid	Black Rot Blossom Blight Root Rot	<i>Phytophthora</i> <i>Botrytis</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i>
Orchid (<i>Phalaenopsis</i> sp.)	Mosaic	<i>Cymbidium mosaic virus</i>
Oregon grape	Leaf Spot Rust	<i>Cercospora</i> <i>Puccinia</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Osage orange	Gray Mold Leaf Spot Rust	<i>Botrytis</i> <i>Cercospora</i> , <i>Ovularia</i> <i>Cerotelium</i>
Osmanthus	Bacterial Leaf Scorch Leaf Spot	<i>Xylella fastidiosa</i> <i>Phyllosticta</i> , <i>Septoria</i>
Oyster plant	Leaf Spot	<i>Cercospora</i> , <i>Colletotrichum</i> , <i>Curvularia</i>
Oxalis	Rust	<i>Puccinia</i>
Pachysandra	Blight Leaf Spot Stem Rot	<i>Volutella</i> <i>Phyllosticta</i> <i>Rhizoctonia</i>
Palm, Canary Island Date	Rachis Blight Texas Phoenix palm decline Wilt	<i>Botryodiplodia</i> , <i>Serenomyces</i> <i>Candidatus</i> <i>Phytoplasma palmae</i> <i>Fusarium oxysporum</i> f. sp. <i>canariensis</i>
Palm, Date	Heart Rot Texas Phoenix palm decline	<i>Ganoderma</i> <i>Candidatus</i> <i>Phytoplasma palmae</i>
Palm, Parlor	Leaf Spot	<i>Helminthosporium</i>
Palm, Sabal	Leaf Spot Root Rot	<i>Ascochyta</i> , <i>Phyllosticta</i> <i>Rhizoctonia</i>
Palm, Sylvester	Leaf Spot	<i>Graphiola</i>
Palm, Washingtonia	Leaf Spot	<i>Cercospora</i> , <i>Colletotrichum</i>
Palm, Windmill	Bud or Heart Rot	<i>Phytophthora</i>
Pansy	Anthracnose Blight Downy Mildew Leaf Spot Powdery Mildew Root Rot Rust Stem Rot	<i>Colletotrichum</i> <i>Botrytis</i> <i>Peronospora</i> <i>Alternaria</i> , <i>Cercospora</i> , <i>Phyllosticta</i> , <i>Septoria</i> , <i>Sphaerotheca</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i> <i>Puccinia</i> <i>Rhizoctonia</i>
Partridge berry	Stem Rot	<i>Rhizoctonia</i>
Paulownia	Leaf Spot Powdery Mildew	<i>Phyllosticta</i> <i>Phyllactinia</i> , <i>Uncinula</i>
Pawpaw	Leaf Spot	<i>Phyllosticta</i> , <i>Septoria</i>
Pearl bush	Fire Blight	<i>Erwinia</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Pear, flowering	Bacterial Leaf Scorch Fire Blight Powdery Mildew	<i>Xylella fastidiosa</i> <i>Erwinia</i> <i>Podosphaera</i>
Pentas	Leaf Spot Powdery Mildew Stem Rot	<i>Cercospora, Corynespora, Phyllosticta</i> <i>Oidium</i> <i>Fusarium, Rhizoctonia</i>
Peony	Aerial Blight Blight Leaf Spot	<i>Phytophthora</i> <i>Botrytis</i> <i>Alternaria</i>
Peperomia	Leaf Spot Root Rot	<i>Cercospora</i> <i>Phytophthora, Pythium, Rhizoctonia</i>
Periwinkle	Gray Mold Leaf Spot Root Rot Web Blight	<i>Botrytis</i> <i>Colletotrichum, Phyllosticta</i> <i>Phytophthora, Rhizoctonia</i> <i>Rhizoctonia</i>
Persimmon	Anthracnose Powdery Mildew	<i>Gloeosporium</i> <i>Podosphaera</i>
Petunia	Aerial Blight Gray Mold Leaf Spot Powdery Mildew Root Rot	<i>Phytophthora</i> <i>Botrytis</i> <i>Ascochyta, Cercospora</i> <i>Oidium</i> <i>Phytophthora, Pythium, Rhizoctonia</i>
Philodendron	Aerial Blight Bacterial Leaf Spot Leaf Spot Root Rot	<i>Phytophthora</i> <i>Erwinia</i> <i>Dactylaria</i> <i>Phytophthora, Pythium, Rhizoctonia</i>
Phlox	Anthracnose Powdery Mildew Root Rot Rust Southern Blight Stem Rot	<i>Colletotrichum</i> <i>Erysiphe</i> <i>Phytophthora, Pythium</i> <i>Puccinia</i> <i>Sclerotium</i> <i>Rhizoctonia</i>
Phlox, perennial	Gray Mold Leaf Spot Powdery Mildew Rust Stem Rot	<i>Botrytis</i> <i>Cercospora, Septoria</i> <i>Erysiphe</i> <i>Puccinia, Uromyces</i> <i>Rhizoctonia, Sclerotinia</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Photinia	Leaf Spot Powdery Mildew Root Rot Rust Twig Dieback	<i>Cercospora, Entomosporium</i> <i>Oidium</i> <i>Fusarium, Phytophthora, Pythium,</i> <i>Rhizoctonia, Thielaviopsis</i> <i>Gymnosporangium</i> <i>Botryodiplodia</i>
Pieris	Dieback Leaf Spot Root Rot	<i>Phytophthora</i> <i>Phyllosticta</i> <i>Phytophthora, Pythium</i>
Pilea	Root Rot	<i>Phytophthora, Pythium</i>
Pink	Gray Mold Leaf Spot Root Rot Stem Rot	<i>Botrytis</i> <i>Septoria</i> <i>Phytophthora, Pythium</i> <i>Rhizoctonia</i>
Pine	Blight Brown Spot Canker Needle Cast Root Rot Rust Tip Blight	<i>Lophodermella</i> <i>Scirrhia</i> <i>Scleroderris</i> <i>Lophodermium</i> <i>Phytophthora, Pythium, Rhizoctonia</i> <i>Cronartium</i> <i>Sirococcus</i>
Pineapple guava	Leaf Spot	<i>Cercospora</i>
Pittosporum	Leaf Spot Root Rot	<i>Cercospora, Phyllosticta</i> <i>Phytophthora, Pythium, Rhizoctonia</i>
Plane-tree	Powdery Mildew	<i>Microsphaera</i>
Plumbago	Leaf Spot Powdery Mildew	<i>Cercospora</i> <i>Oidium</i>
Podocarpus	Root Rot	<i>Phytophthora, Pythium</i>
Poinsettia	Blight Root Rot Scab	<i>Amphobotrys, Botrytis</i> <i>Phytophthora, Pythium, Rhizoctonia</i> <i>Sphaceloma</i>
Pomegranate	Anthracnose Spot Anthracnose	<i>Colletotrichum</i> <i>Sphaceloma</i>
Poplar	Leaf Spot Powdery Mildew Rust	<i>Marssonina</i> <i>Uncinula</i> <i>Melampsora</i>
Poppy	Gray Mold Leaf Spot Stem Rot	<i>Botrytis</i> <i>Cercospora</i> <i>Rhizoctonia</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Portulaca	Root Rot Stem Rot	<i>Phytophthora, Pythium Rhizoctonia</i>
Potentilla	Rust	<i>Phragmidium</i>
Pothos	Leaf Spot Root Rot	<i>Alternaria, Fusarium, Helminthosporium Phytophthora, Pythium, Rhizoctonia</i>
Prayer plant	Leaf Spot	<i>Helminthosporium</i>
Primrose	Blight Root Rot	<i>Botrytis Phytophthora, Pythium</i>
Privet	Leaf Spot Powdery Mildew	<i>Cercospora Microsphaera</i>
Pyracantha	Fire Blight Leaf Spot Powdery Mildew Scab	<i>Erwinia Fabraea Podosphaera Venturia</i>
Quince	Leaf Spot Rust	<i>Fabraea Gymnosporangium</i>
Redbud	Leaf Spot	<i>Cercospora</i>
Rose	Black Spot Blossom Blight Crown Gall Crown Rot Downy Mildew Leaf Spot Powdery Mildew Root Rot Rust Spot Anthracnose Stem Canker Storage Rot	<i>Diplocarpon Botrytis Agrobacterium tumefaciens Phytophthora Peronospora sparsa Alternaria, Cercospora Sphaerotheca Armillaria, Phytophthora, Pythium, Rhizoctonia Phragmidium Elsinoe Botryodiplodia Botrytis</i>
Rose of Sharon	Leaf Spot	<i>Cercospora, Cristulariella, Phyllosticta</i>
Rudbeckia	Leaf Spot Powdery Mildew Rust	<i>Cercospora, Septoria Erysiphe Uromyces</i>
Russian olive	Leaf Spot Rust	<i>Cercospora Puccinia</i>
Sage, Texas	Powdery Mildew	<i>Oidium</i>
St. John's-wort	Rust	<i>Uromyces</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Salvia	Blight Downy Mildew Leaf Spot Mosaic Root Rot Root and Stem Rot Rust	<i>Botrytis</i> <i>Peronospora</i> <i>Cercospora</i> <i>Clerodendron golden mosaic China virus</i> <i>Phytophthora, Pythium</i> <i>Rhizoctonia</i> <i>Puccinia</i>
Sansevieria	Root Rot	<i>Phytophthora, Pythium</i>
Santolina	Blight	<i>Rhizoctonia</i>
Sassafras	Leaf Spot Laurel Wilt Powdery Mildew	<i>Phyllosticta, Septoria</i> <i>Raffaelea lauricola</i> <i>Phyllactinia</i>
Scabiosa	Leaf Spot Powdery Mildew Rust	<i>Cercospora, Ramularia, Septoria</i> <i>Erysiphe</i> <i>Puccinia</i>
Schefflera	Anthracnose Blight Leaf Spot Root Rot Twig Blight	<i>Colletotrichum</i> <i>Alternaria</i> <i>Cercospora</i> <i>Phytophthora, Pythium, Rhizoctonia</i> <i>Pestalotia, Phomopsis</i>
Sedum	Anthracnose Leaf Spot Powdery Mildew Root Rot Stem Rot	<i>Colletotrichum</i> <i>Cercospora, Corynespora, Phyllosticta, Septoria</i> <i>Erysiphe</i> <i>Phytophthora, Pythium</i> <i>Fusarium, Rhizoctonia</i>
Seedlings (general)	Damping-off	<i>Pythium, Rhizoctonia</i>
Sempervivum	Root Rot	<i>Phytophthora, Pythium</i>
Shasta daisy	Root Rot	<i>Phytophthora, Pythium</i>
Sinningia	Root Rot	<i>Phytophthora, Pythium</i>
Snapdragon	Blight Downy Mildew Leaf Spot Powdery Mildew Root Rot Rust Stem Rot	<i>Botrytis</i> <i>Peronospora</i> <i>Cercospora, Colletotrichum, Phyllosticta</i> <i>Erysiphe</i> <i>Fusarium, Phytophthora, Pythium, Rhizoctonia, Thielaviopsis</i> <i>Puccinia</i> <i>Rhizoctonia</i>
Sourwood	Leaf Spot	<i>Cercospora, Phyllosticta</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Spathiphyllum	Leaf Spot Root Rot Stem Blight	<i>Alternaria, Colletotrichum</i> <i>Phytophthora, Pythium, Rhizoctonia</i> <i>Rhizoctonia</i>
Spider plant	Downy Mildew Leaf Spot	<i>Peronospora</i> <i>Cercospora</i>
Spiraea	Leaf Spot Powdery Mildew	<i>Cercospora</i> <i>Podosphaera</i>
Star magnolia	Leaf Spot	<i>Cercospora, Colletotrichum, Phyllosticta</i>
Statice	Anthracnose Leaf Blight Leaf Spot Root Rot	<i>Colletotrichum</i> <i>Alternaria, Botrytis, Cercospora</i> <i>Alternaria, Botrytis, Fusarium,</i> <i>Helminthosporium</i> <i>Fusarium, Phytophthora, Pythium,</i> <i>Rhizoctonia, Thielaviopsis</i>
Stock	Gray Mold Leaf Spot White Rust	<i>Botrytis</i> <i>Alternaria</i> <i>Albugo</i>
Stokesia	Head Blight Leaf Spot	<i>Botrytis</i> <i>Ascochyta, Cercospora, Phyllosticta</i>
Strawberry geranium	Leaf Spot	<i>Cercospora</i>
Strawflower	Downy Mildew	<i>Bremia</i>
Stromanthe	Root Rot	<i>Phytophthora, Pythium</i>
Sumac	Leaf Blister Leaf Spot Rust	<i>Taphrina</i> <i>Cercospora, Septoria</i> <i>Pileolaria</i>
Sunflower	Downy Mildew Leaf and Stem Blight Leaf Spot Powdery Mildew Rust	<i>Plasmopara</i> <i>Alternariaster helinathi</i> <i>Cercospora, Septoria</i> <i>Erysiphe</i> <i>Puccinia</i>
Swamp red maple	Root Rot	<i>Phytophthora</i>
Sweet gum	Anthracnose Leaf Spot	<i>Gloeosporium</i> <i>Cercospora, Septoria</i>
Sweet olive	Anthracnose Bacterial Leaf Scorch	<i>Colletotrichum</i> <i>Xylella fastidiosa</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Sweet pea	Downy Mildew Gray Mold Leaf Spot Powdery Mildew Rust Stem Rot	<i>Peronospora</i> <i>Botrytis</i> <i>Ascochyta, Colletotrichum, Phyllosticta</i> <i>Erysiphe, Microsphaera</i> <i>Uromyces</i> <i>Rhizoctonia</i>
Sweet william	Leaf Spot	<i>Heterosporium</i>
Sycamore	Anthracnose Leaf Spot	<i>Gloeosporium</i> <i>Cercospora, Septoria, Tubakia</i>
Syngonium	Leaf Spot Root Rot	<i>Cephalosporium</i> <i>Fusarium, Phytophthora, Pythium,</i> <i>Rhizoctonia, Thielaviopsis</i>
Tallow	Leaf Spot	<i>Phomopsis, Phyllosticta</i>
Tecoma	Root Rot	<i>Phytophthora</i>
Titi	Leaf Spot Root Rot	<i>Phyllosticta</i> <i>Phytophthora, Pythium, Rhizoctonia</i>
Tritoma	Anthracnose	<i>Colletotrichum</i>
Tuberous begonia	Leaf Spot Powdery Mildew Rot	<i>Cercospora, Phomopsis, Phyllosticta</i> <i>Erysiphe</i> <i>Pythium, Rhizoctonia</i>
Tulips	Anthracnose Blight Bulb Rot Root Rot	<i>Gloeosporium</i> <i>Botrytis</i> <i>Fusarium, Penicillium</i> <i>Rhizoctonia</i>
Tulip poplar	Anthracnose Leaf Spot Powdery Mildew	<i>Colletotrichum</i> <i>Phyllosticta, Septoria</i> <i>Oidium</i>
Tung oil	Anthracnose Leaf Spot	<i>Glomerella</i> <i>Cercospora, Phyllosticta</i>
Tupelo	Leaf Spot Rust	<i>Cercospora, Phyllosticta</i> <i>Aplopsora</i>
Turkey ivy	Leaf Spot	<i>Ramularia, Septoria</i>
Verbena	Flower Blight Leaf Spot Powdery Mildew Root Rot Rust	<i>Botrytis</i> <i>Cercospora, Septoria</i> <i>Erysiphe</i> <i>Phytophthora, Pythium, Rhizoctonia</i> <i>Puccinia</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Viburnum	Anthracnose Leaf Spot Powdery Mildew Rust Stem Canker	<i>Colletotrichum</i> <i>Cercospora</i> <i>Microsphaera</i> <i>Puccinia</i> <i>Botryosphaeria</i>
Vinca	Flower Blight Root Rot Slime Mold Web Blight	<i>Botrytis</i> <i>Phytophthora, Pythium, Rhizoctonia</i> <i>Stemonitis</i> <i>Rhizoctonia</i>
Violet	Downy Mildew Gray Mold Leaf Spot Powdery Mildew Root Rot Rust Spot Anthracnose Stem Rot	<i>Bremiella</i> <i>Botrytis</i> <i>Cercospora, Colletotrichum, Phyllosticta</i> <i>Sphaerotheca</i> <i>Phytophthora, Pythium, Rhizoctonia</i> <i>Puccinia</i> <i>Sphaceloma</i> <i>Fusarium, Rhizoctonia</i>
Vitex	Leaf Spot	<i>Cercospora</i>
Walnut	Leaf Spot Powdery Mildew	<i>Gnomonia</i> <i>Microsphaera</i>
Wandering yew	Gray Mold Leaf Spot Root Rot	<i>Botrytis</i> <i>Cercospora, Colletotrichum</i> <i>Fusarium, Phytophthora, Rhizoctonia</i>
Wax myrtle	Leaf Spot Rust	<i>Cercospora, Phyllosticta, Septoria</i> <i>Gymnosporangium</i>
Weigela	Leaf Spot	<i>Cercospora</i>
Willow	Powdery Mildew Rust Twig Blight	<i>Uncinula</i> <i>Melampsora</i> <i>Diplodia</i>
Witch hazel	Leaf Spot Powdery Mildew	<i>Phyllosticta</i> <i>Podosphaera</i>
Yarrow	Anthracnose Powdery Mildew Root Rot Rust	<i>Colletotrichum</i> <i>Erysiphe</i> <i>Rhizoctonia</i> <i>Puccinia</i>
Yaupon	Anthracnose Leaf Spot	<i>Colletotrichum</i> <i>Diplodia, Macrophoma, Phyllosticta</i>
Yew	Root Rot Twig Blight	<i>Armillaria, Phytophthora, Pythium</i> <i>Physalospora</i>

Commercial Crop Production Ornamentals

Table 1. Diseases of Ornamental Plants		
Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Zinnia	Bacterial Leaf Spot Blight Leaf Blight Leaf Spot Powdery Mildew Root Rot Stem Rot	<i>Xanthomonas</i> <i>Botrytis</i> <i>Alternaria</i> <i>Cercospora</i> <i>Erysiphe</i> <i>Phytophthora, Pythium, Rhizoctonia</i> <i>Fusarium, Rhizoctonia, Sclerotinia</i>
Zygocactus	Root Rot	<i>Fusarium, Phytophthora, Pythium, Rhizoctonia, Thielaviopsis</i>

Commercial Crop Production Ornamentals

Table 2. Diseases of ornamentals and fungicides and bactericides for disease management	
Disease	Fungicides and Bactericides
Aerial blight (<i>Phytophthora</i>)	aluminum tris azoxystrobin boscalid + pyraclostrobin chlorothalonil copper hydroxide cyazofamid dimethomorph maneb mancozeb phosphite trifloxystrobin
Aerial blight (<i>Rhizoctonia</i>)	chlorothalonil fludioxonil flutolanil iprodione mancozeb myclobutanil propiconazole triflumizole
Algal leaf spot (<i>Cephaleurus</i>)	copper hydroxide copper sulfate
Anthracnose	azoxystrobin boscalid + pyraclostrobin chlorothalonil copper hydroxide copper sulfate kresoxim-methyl mancozeb maneb myclobutanil propiconazole thiophanate-methyl trifloxystrobin
Bacterial blight	aluminum tris (suppression only) copper hydroxide copper sulfate phosphite (suppression only)
Bacterial leaf rot	streptomycin sulfate
Bacterial leaf spot	copper hydroxide copper sulfate
Bacterial stem rot	streptomycin sulfate
Bacterial wilt	streptomycin sulfate
Black root rot	fludioxonil

Commercial Crop Production Ornamentals

Table 2. Diseases of ornamentals and fungicides and bactericides for disease management	
Disease	Fungicides and Bactericides
	thiophanate-methyl trifloxystrobin triflumizole
Black rot <i>(Sclerotinia)</i>	PCNB
Black spot	captan chlorothalonil copper hydroxide kresoxim-methyl mancozeb maneb propiconazole thiophanate-methyl trifloxystrobin
Blossom blight	see Flower blight
Botrytis blight	azoxystrobin boscalid + pyraclostrobin captan chlorothalonil copper hydroxide copper sulfate fenhexamid fludioxonil iprodione mancozeb maneb thiophanate-methyl trifloxystrobin triflumizole
Brown spot	mancozeb propiconazole
Bulb rot	boscalid + pyraclostrobin captan iprodione PCNB thiophanate-methyl
Canker	chlorothalonil mancozeb thiophanate-methyl
Conifer blights	azoxystrobin copper sulfate mancozeb thiophanate-methyl
Corm rot	see Bulb rot

Commercial Crop Production Ornamentals

Table 2. Diseases of ornamentals and fungicides and bactericides for disease management	
Disease	Fungicides and Bactericides
Crown gall	No effective bactericides are available for crown gall management
Crown rot or canker (<i>Cylindrocladium</i> and other fungi)	boscalid + pyraclostrobin fludioxonil mancozeb thiophanate-methyl trifloxystrobin triflumizole
Crown rot (<i>Phytophthora</i>)	aluminum tris boscalid + pyraclostrobin cyazofamid dimethomorph etr Diazole phosphite
Damping-off (<i>Pythium</i>)	boscalid + pyraclostrobin captan cyazofamid etr Diazole mefenoxam propamocarb hydrochloride
Damping-off (<i>Rhizoctonia</i>)	boscalid + pyraclostrobin captan flutolanil PCNB
Dieback	copper hydroxide copper sulfate thiophanate-methyl
Downy mildew	aluminum tris azoxystrobin boscalid + pyraclostrobin copper hydroxide copper sulfate cyazofamid dimethomorph kresoxim-methyl mancozeb phosphite trifloxystrobin
Fire blight	aluminum tris (suppression only) copper hydroxide copper sulfate phosphite (suppression only)

Commercial Crop Production Ornamentals

Table 2. Diseases of ornamentals and fungicides and bactericides for disease management	
Disease	Fungicides and Bactericides
Flower blight	captan chlorothalonil iprodione mancozeb myclobutanil PCNB propiconazole thiophanate-methyl triadimefon
Flower spot	chlorothalonil
Fusarium wilt	triflumizole
Gray mold	see Botrytis blight
Head blight	propiconazole
Leaf blight	chlorothalonil copper hydroxide fludioxonil iprodione mancozeb maneb propiconazole thiophanate-methyl triadimefon
Leaf blister	chlorothalonil copper sulfate mancozeb
Leaf curl	see Leaf blister
Leaf gall	boscalid + pyraclostrobin triadimefon
Leaf spot	azoxystrobin boscalid + pyraclostrobin captan chlorothalonil copper hydroxide copper sulfate fludioxonil iprodione kresoxim-methyl mancozeb maneb myclobutanil propiconazole thiophanate-methyl triadimefon trifloxystrobin

Commercial Crop Production Ornamentals

Table 2. Diseases of ornamentals and fungicides and bactericides for disease management	
Disease	Fungicides and Bactericides
	triflumizole
Needle blight	copper sulfate
Needle cast	copper sulfate mancozeb
Needle rust	azoxystrobin myclobutanil
Petal blight	see Flower blight
Petiole rot (<i>Myrothecium</i>)	fludioxonil trifloxystrobin triflumizole
Powdery mildew	azoxystrobin boscalid + pyraclostrobin calcium polysulfide chlorothalonil copper hydroxide copper oleate copper sulfate fenarimol kresoxim-methyl myclobutanil piperalin propiconazole sulfur thiophanate-methyl triadimefon trifloxystrobin triflumizole triforine
Purple spot	mancozeb
Ray blight (<i>Ascochyta</i> blight)	chlorothalonil iprodione mancozeb maneb myclobutanil propiconazole thiophanate-methyl
Rhizome rot	see Bulb rot
Root rot (<i>Phytophthora, Pythium</i>)	aluminum tris boscalid + pyraclostrobin cyazofamid dimethomorph etr Diazole mefenoxam phosphite

Commercial Crop Production Ornamentals

Table 2. Diseases of ornamentals and fungicides and bactericides for disease management	
Disease	Fungicides and Bactericides
	propamocarb hydrochloride trifloxystrobin
Root rot (<i>Cylindrocladium, Fusarium, Rhizoctonia, Thielaviopsis, etc.</i>)	azoxystrobin fludioxonil flutolanil iprodione PCNB thiophanate-methyl trifloxystrobin triflumizole
Rust	azoxystrobin boscalid + pyraclostrobin calcium polysulfide captan chlorothalonil copper sulfate fenarimol flutolanil kresoxim-methyl mancozeb maneb myclobutanil propiconazole sulfur triadimefon trifloxystrobin triflumizole triforine
Scab	azoxystrobin boscalid + pyraclostrobin chlorothalonil copper hydroxide copper sulfate fenarimol kresoxim-methyl mancozeb myclobutanil propiconazole thiophanate-methyl trifloxystrobin triflumizole
Shoot blight (<i>Phytophthora</i>)	see Aerial blight caused by <i>Phytophthora</i>

Commercial Crop Production Ornamentals

Table 2. Diseases of ornamentals and fungicides and bactericides for disease management	
Disease	Fungicides and Bactericides
Southern blight	azoxystrobin fludioxonil flutolanil
Stem rot (<i>Phytophthora</i>)	aluminum tris dimethomorph etrizazole mefenoxam phosphite
Stem rot (fungal)	fludioxonil iprodione maneb PCNB thiophanate-methyl trifloxystrobin
Storage rot	iprodione
Thread blight	see Aerial blight caused by <i>Rhizoctonia</i>
Tip blight	myclobutanil propiconazole thiophanate-methyl triadimefon
Tuber rot	see Bulb rot
Twig blight	chlorothalonil copper hydroxide copper sulfate myclobutanil thiophanate-methyl
Twig dieback	copper sulfate thiophanate-methyl
Web blight	see Aerial blight caused by <i>Rhizoctonia</i>
White rust	myclobutanil
Wilt (<i>Cylindrocladium</i>)	iprodione triflumizole

Commercial Crop Production Ornamentals

Table 3. Recommended pesticides, rates and pesticide use restrictions for ornamentals.				
Common Name	FRAC Code¹	Trade Name(s)¹	REI (hr)	Comments
aluminum tris (or fosetyl-AI)	33	Aliette WDG Flanker WDG	12	<u>NOT</u> compatible with copper-containing fungicides (do not apply within 7 days of each other)
azoxystrobin	11	Heritage Heritage G Heritage TL	4	Make no more than three sequential applications; no more than eight applications or 10 pounds per crop acre per year
captan	M4	Captan 50 Wettable Powder Captan 80WDG Captec 4L	96	
chlorothalonil	M5	AllPro Exotherm Termil Chlorostar DF Chlorostar VI Chlorothalonil 720 F Countdown LandG Daconil Ultrex Daconil Weather Stik Daconil Zn Echo 720 Turf and Ornamental Echo Ultimate Turf and Ornamental Ensign 720 Ensign 82.5% Turf and Ornamental Initiate 720 Mainsail 6.0 F Mainsail WDG Manicure 6 Flowable Turf and Ornamental Manicure Ultrex Turf and Ornamental Quali-Pro Chlorothalonil 500 ZN Quali-Pro Chlorothalonil DF Quali-Pro Chlorothalonil 700 SFT	12	

Commercial Crop Production Ornamentals

Table 3. Recommended pesticides, rates and pesticide use restrictions for ornamentals.				
Common Name	FRAC Code ¹	Trade Name(s) ¹	REI (hr)	Comments
copper hydroxide	M1	Badge SC Champ DP Kocide 3000	24	Should not be applied in a spray solution with a pH of less than 6.5
cyazofamid	21	Segway	12	For control of <i>Phytophthora</i> , <i>Pythium</i> and downy mildews (see label); no more than two soil applications or four foliar applications per crop cycle
dimethomorph	40	Stature SC	12	For control of downy mildews, aerial <i>Phytophthora</i> and <i>Phytophthora</i> root, crown and stem rots; no more than two sequential applications; no more than eight applications per crop (greenhouse) or 30.6 fluid ounces per acre per year (outdoors); not for landscape use
etr Diazole	14	Terrazole 35% Wettable Powder Terrazole L Truban 25 EC	12	For control of <i>Pythium</i> and <i>Phytophthora</i> only
fenarimol	3	Rubigan A.S.	12	For control of powdery mildew
fenhexamid	17	Decree 50 WDG	12	For <i>Botrytis</i> only; no more than two sequential applications; use no more than 6 pounds per acre per season (outdoors) or 2.2 ounces per crop cycle (greenhouse)
fludioxonil	12	Medallion Mozart TR	12	No more than 80 pounds per year or crop (indoor), 4 pounds per acre per year (outdoor, field-grown) or 8 pounds per acre per year (outdoor, container-grown); Mozart for use in greenhouses only
flutolanil	7	Contrast 70 WSP ProStar 70 WDG ProStar 70 WP	12	For diseases caused by Basidiomycetes; not for use in the landscape; no more than four applications per year
imazalil	3	Fungaflor TR	24	For use in greenhouses only

Commercial Crop Production Ornamentals

Table 3. Recommended pesticides, rates and pesticide use restrictions for ornamentals.				
Common Name	FRAC Code ¹	Trade Name(s) ¹	REI (hr)	Comments
iprodione	2	26GT Chipco 26019 Chipco 26019 Flo Chipco 26019 N/G Iprodione Pro 2SE Iprodione SPC OHP 26 GT-O	12	Not for residential use
kresoxim-methyl	11	Cygnus	12	Not for use in residential landscapes; no more than two sequential applications; no more than six applications per season (outdoors) or eight applications or 25.6 ounces per acre per year (greenhouse)
mancozeb	M3	Dithane 75DF Rainshield Fore 80WP Rainshield Penncozeb (4F, 70DF, 80WP) Protect DF	24	
maneb	M3	Maneb 75DF Maneb 80WP	24	No longer being manufactured, but supplies may be available
mefenoxam	4	Fenox ME Mefenoxam 2 AQ Subdue GR Subdue MAXX Subdue WSP	0	For control of <i>Pythium</i> and <i>Phytophthora</i> by soil application only; not for landscape use
myclobutanil	3	Eagle 20EW Eagle 40WP Eagle WSP Hoist Myclobutanil 20 EW TandO	24	
pentachloronitrobenzene (PCNB)	14	Glacier (10G and 4F) Parflo 4F Turfcide 10% Granular	12	For soil application

Commercial Crop Production Ornamentals

Table 3. Recommended pesticides, rates and pesticide use restrictions for ornamentals.				
Common Name	FRAC Code ¹	Trade Name(s) ¹	REI (hr)	Comments
phosphites, various salts	33	Agri-fos Alude Fosphite Fungi-Phite T and O Primera Magellan Rampart T and O Vital	4	
piperalin	5	Pipron	12	For control of powdery mildew only; for use only in commercial greenhouses or other structures with impermeable roofs
propamocarb hydrochloride	28	Banol Proplant	24	For control of <i>Pythium</i> and <i>Phytophthora</i> ; not for use in landscapes
propiconazole	3	Banner 1.1 EC Banner MAXX Banner Pro Dorado Fathom 14.3 MEC Fitness Honor Guard PPZ ProPensity 1.3ME Propiconazole E-Pro 14.3 MEC Propiconazole G-Pro Propiconazole EC Propiconazole 14.3 Propimax EC Propi-Star EC Savvi Strider	24	Not for use in greenhouses; no more than 5.4 gallons per acre per crop per year (outdoors)
thiophanate-methyl	1	3336 (DG, F, GC and WP) Allban (50 WSB and Flo) Cavalier (50 WSB and F) Fungo (50 WSB and Flo) OHP 6672 (4.5L and 50W) Quali-Pro TM (4.5 and 85 WDG) SysTec 1998 Tee-Off 4.5F T-Methyl E-Pro (4.5F, 50 WSB, GC and Granular) Transom (4.5F and 50	12	

Commercial Crop Production Ornamentals

Table 3. Recommended pesticides, rates and pesticide use restrictions for ornamentals.				
Common Name	FRAC Code¹	Trade Name(s)¹	REI (hr)	Comments
		WSB) T-Storm		
triadimefon	3	Bayleton 50 Turf and Ornamental Fungicide Bayleton Flo Strike 50 WDG	12	
trifloxystrobin	11	Compass Compass O 50WDG	12	No more than two sequential applications (one for powdery mildew); no more than 34.5 ounces per acre per year (outdoors) or 120 ounces per acre per year (indoors)
triflumizole	3	Terraguard SC Terraguard SC/LS	12	SC formulation is for nursery use only. SC/LS formulation is for landscape use only.
ziram	M3	Ziram 76DF	48	
COMBINATION PRODUCTS				
boscalid + pyraclostrobin	7 + 11	Pageant	12	No more than 7.3 pounds per acre per year
chlorothalonil + propiconazole	M5 + 3	Concert	12	
chlorothalonil + thiophanate-methyl	M5 + 1	ConSyst Prominence Spectro 90	12	
copper hydroxide + mancozeb	M1 + M3	Junction	24	
cyprodinil + fludioxonil	9 + 12	Palladium	12	Not for use on residential plantings
etridiazole + thiophanate-methyl	14 + 1	Banrot 8 G Banrot 40 WP	12	
fludioxonil + mefenoxam	12 + 4	Hurricane WDG	48	Not for use in landscapes or field plantings
flutolanil + thiophanate-methyl	7 + 1	SysStar WDG	12	Not for use in landscapes

Commercial Crop Production Ornamentals

Table 3. Recommended pesticides, rates and pesticide use restrictions for ornamentals.				
Common Name	FRAC Code¹	Trade Name(s)¹	REI (hr)	Comments
iprodione + thiophanate-methyl	2 + 1	26/36	12	Not for residential use
mancozeb + myclobutanil	M3 + 3	Clevis	24	
mancozeb + thiophanate-methyl	M3 + 1	Zyban	24	
propamocarb hydrochloride + fluopicolide	28 + 43	Stellar	12	For control of downy mildews, <i>Phytophthora</i> and <i>Pythium</i> .
triadimefon + trifloxystrobin	3 + 11	Armada 50 WDG Armada 50 WP	12	For interior and landscape use only
¹ Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC). ² Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.				

Revised December 2014 by Dr. R. Singh.

Commercial Crop Production
Small Fruits - Brambles

Table 1. Symptoms, source of inoculum and management of diseases of blackberries, raspberries, and other brambles.

Disease (Pathogen)	Disease Description
Anthracnose (<i>Elsinoe veneta</i>)	<p>Symptoms: Symptoms appear on canes and leaves. Both current and second-year canes can be affected. Circular, light gray spots form on canes and as the disease progresses the spots become sunken with a dark purple margin. Leaf spots start off yellow, turn grey with a purple border and eventually dry up and drop out resulting in shot holes. Fruit may ripen abnormally and have an “off” flavor. Anthracnose can cause loss of winter hardiness.</p> <p>Source of Inoculum: The fungus overwinters on bark and cane lesions. In the spring spores are produced, released and spread to new canes by splashing rain and wind.</p> <p>Management: Remove and destroy infected canes. Do not compost canes. Remove and destroy wild brambles. Immediately after harvest remove floricanes to reduce overwintering fungus. Follow a fungicide spray program. Do not use lime sulfur.</p>
Botrytis Fruit Rot and Cane Blight (<i>Botrytis cinerea</i>)	<p>Symptoms: White lesions (bleaching effect) form on new canes and floricanes. Cane blight is more severe on blackberries than raspberries. Botrytis causes flowers to shrivel and turn brown. As the fruit develops and ripens the fruit becomes soft and covered with grey tufts of fungal spores.</p> <p>Source of Inoculum: The fungus survives as sclerotia (overwintering structure) on infected canes and dead leaves and as spores on mummified fruit. During wet and cool conditions sclerotia germinate and the fungus begins to sporulate. Spores are dispersed by wind, rain and overhead irrigation.</p> <p>Management: Promote good air circulation in the planting by pruning and trellising plants. Minimize the use of nitrogen fertilizer. Partial resistance is available for red raspberry varieties. Minimize fruit damage during harvest. Follow a fungicide spray schedule.</p>
Cane Blight (<i>Leptosphaeria coniothyrium</i>)	<p>Symptoms: Dark red to purple lesions form on the canes around wounds. Lesions may be on one side of the cane or may girdle it and kill the shoots.</p> <p>Source of Inoculum: The fungus survives in infected tissues and dead canes. Spores are rain-splashed.</p> <p>Management: Prune out infected canes and remove floricanes immediately after harvest. Avoid wounding the plants.</p>
Cane and Leaf Rust (<i>Kuehneola uredinis</i>)	<p>Symptoms: First seen on floricanes in late spring when large yellow pustules split the bark. Small yellow pustules develop on the lower surface of leaves on the floricanes and may lead to premature defoliation.</p> <p>Source of Inoculum: The fungus overwinters on infected canes. Spores are wind-dispersed.</p> <p>Management: Prune out old diseased canes after harvest. Follow the fungicide spray schedule.</p>
Orange Rust (<i>Gymnoconia nitens</i>)	<p>Symptoms: Disease is evident on new growth in spring as many weak, spindly shoots are formed rather than one strong shoot. Bright orange pustules form on the undersides of infected leaves, and no blooms are produced on the floricanes.</p> <p>Source of Inoculum: The fungus overwinters within systemically infected canes.</p>

Commercial Crop Production
Small Fruits - Brambles

Table 1. Symptoms, source of inoculum and management of diseases of blackberries, raspberries, and other brambles.

Disease (Pathogen)	Disease Description
	<p>Spores are wind-dispersed. Management: Use only disease-free planting materials. Remove infected plants as soon as they are observed. Follow a fungicide spray schedule.</p>
<p>Phytophthora Root Rot (<i>Phytophthora</i> spp.)</p>	<p>Symptoms: Infected primocanes may rapidly wilt and die in the spring or they (and the floricanes) may slowly become chlorotic, wilt and die in the summer. Infected roots exhibit a reddish-brown discoloration of the cortex. Source of Inoculum: The pathogen can be introduced on infected planting material but it also survives in soil. Spreads primarily in water. Management: Use disease-free transplants, improve drainage and avoid low spots. Rogue out infected plants and treat surrounding plants with fungicide.</p>
<p>Powdery Mildew (<i>Podosphaera aphanis</i> (formerly <i>Sphaerotheca macularis</i>))</p>	<p>Symptoms: A whitish gray coat covers both sides of the leaves, flowers, fruit and shoots. Diseased new growth is stunted and distorted. Source of Inoculum: The fungus overwinters as mycelium or chasmothecia in dormant buds of stunted cane tips. Spores are spread by wind. Management: Blackberries are not susceptible to powdery mildew. Plant resistant red raspberry varieties such as Chief, Marcy, and Malling Orion. Follow a fungicide spray schedule.</p>
<p>Rosette (Double Blossom) (<i>Cercospora rubi</i>)</p>	<p>Symptoms: Infected buds give rise to a proliferation of small shoots or witches' broom. Infected flower buds give rise to distorted blossoms from which fruit do not develop. Source of Inoculum: The fungus survives in wild blackberries and dewberries. Spores are wind-dispersed. Management: Eradicate wild blackberries and dewberries in the vicinity. Remove infected blossom clusters before they open. Remove the floricanes immediately after harvest. Follow a fungicide spray schedule.</p>
<p>Septoria Leaf Spot (<i>Septoria rubi</i>)</p>	<p>Symptoms: Frogeye lesions with whitish centers and brown to purple margins are produced on leaves. Similar lesions are found on canes and petioles. Source of Inoculum: The fungus overwinters in dead leaves and stems. Spores are wind-dispersed. Management: Follow a fungicide spray schedule for leaf spots.</p>
<p>Spur Blight (<i>Didymella applanata</i>)</p>	<p>Symptoms: Symptoms appear in primocanes in late spring. Brownish purple lesions appear just below on the lower portion of the stem just below the leaf or bud. In late fall, the bark of infected canes splits longitudinally. Leaflets may have v-shaped brown lesions with chlorosis. Source of Inoculum: The fungus survives the winter in lesions on diseased canes. Spores are carried to new growth in the spring by splashing rain and wind. Management: Promote good air circulation in the planting by pruning and trellising plants. Avoid excessive nitrogen applications, which promotes rapid and excessive growth of new tissue. Remove and destroy wild brambles. Follow a fungicide spray schedule.</p>

Commercial Crop Production
Small Fruits - Brambles

Table 2. Seasonal fungicide spray schedule for blackberry, raspberry, and other bramble diseases	
Developmental Stage	Disease(s)
Delayed Dormant (bud swell to green tip)	Anthracnose Cane blight Spur blight
Shoots 6 inches long until pre-bloom	Anthracnose Cane blight Leaf spots Phytophthora root rot Powdery mildew Spur blight Rusts
Early Bloom (5-10%)	Anthracnose Botrytis gray mold Cane blight Leaf spots Rosette Rusts
Full Bloom (Bramble bloom periods are protracted. Bloom and cover spray stages can be difficult to define clearly. Make sure that the pathogens indicated are addressed with a thorough fungicide program as defined by the variety but do not exceed labeled rates or spray intervals.)	Anthracnose Botrytis gray mold Cane blight Leaf spots Rosette Rusts
Petal Fall	Anthracnose Botrytis gray mold Cane blight Leaf spots Rosette Rusts
Cover Sprays	Anthracnose Botrytis gray mold Cane blight Leaf spots Rosette Rusts
Preharvest (14 days before anticipated harvest date)	Anthracnose Botrytis gray mold Cane blight Leaf spots Rosette Rusts

Commercial Crop Production
Small Fruits - Brambles

Table 2. Seasonal fungicide spray schedule for blackberry, raspberry, and other bramble diseases	
Developmental Stage	Disease(s)
Harvest	Anthracnose Botrytis gray mold Cane blight Leaf spots Rosette Rusts
Postharvest	Cane blight Leaf spots Orange cane blotch Phytophthora root rot Powdery mildew Rusts

Commercial Crop Production
Small Fruits - Brambles

Table 3. Efficacy of selected fungicides against blackberry, raspberry, and other bramble diseases.

Table was reproduced from the 2015 Southeast Regional Caneberries Integrated Management Guide (http://www.smallfruits.org/SmallFruitsRegGuide/Guides/2015/2015BrambleSpray%20Guide12_22_14.pdf).

Efficacy ratings are as follows: - = ineffective and 1 = slightly effective to 5 = very effective. No data are provided for products that are not labeled for the specific disease or if the efficacy is unknown. These ratings are benchmarks; actual performance will vary.

Chemical name (Fungicide product name)	Anthraco	Cane blight	Spur blight	Leaf spots	Botrytis Gray Mold	Rusts	Powdery mildew	Rosette	Phytophthora root rot
azoxystrobin (Abound FL)	5	5	5	5		5	5	5	
azoxystrobin + propiconazole (Quilt Xcel)	5	5	5	5		5	5	5	
Captan (Captan 80WDG, Captec 4L, Captan 50W)	2	2	2	2	2		2		
Copper-based products	1	1	1	1					
myclobutanil (Rally 40WSP)							5		
pyraclostrobin (Cabrio EG)	5	5	5	5		5	5		
pyraclostrobin + boscalid (Pristine WG)	5	5	5	5	5	5		5	
Cyprodinil + fludioxonil (Switch 62.5 WG)					5			5	
Bordeaux mixture 4-4-50								3	
Fenhexamid (Elevate 50WDG)					5				
Iprodione (Rovral 4F, Nevado4F, Iprodione 4L AG)					3				
Mefenoxam (Ridomil Gold SL)									4
Fosetyl-AL (Aliette WDG)									4
Sulfur-based products							3		
Propiconazole (Orbit 3.6EC, Tilt 3.6EC)				4		5			

Commercial Crop Production
Small Fruits - Brambles

Table 4. Recommended pesticides, rates and pesticide use restrictions for blackberry, raspberry, and other bramble diseases					
Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Diseases
Fosetyl-AL (33)	Aliette WDG	5 lb	20 lb	60	Phytophthora root rot
Azoxystrobin (11)	Abound FL	6.0-15.5 fl oz	92.3 fl oz	0	Anthracnose Cane blight Leaf spots Rosette Rusts Spur blight
Azoxystrobin + Propiconazole (11+3)	Quilt Xcel	14-21 fl oz	105 fl oz	30	Anthracnose Cane blight Leaf spots Powdery mildew Rosette Spur blight
Captan (M4)	Captan 50WP Captec 4L	2-4 lb 0.75-1.0 qt/100 gal	10 lb ai 10 lb ai	3 3	Anthracnose Cane blight Leaf spots Spur blight
Copper-based products (M1)	Champ WG Kocide 3000 Kocide 2000 Cuprofix Disperss Cuprofix Ultra 40 Disperss	2-3 lb 0.8-1.3 lb 1.5-2.3 lb 2.5-5 lb 1.25-2.5 lb	See labels	1-2 1-2 1-2 0.5 0.5	Anthracnose Cane blight Leaf spots Orange cane blotch Spur blight
Myclobutanil (3)	Rally 40WSP	1.25-3 oz	10 oz	0	Powdery mildew Rusts
Phosphorous acids (33)	Confine Extra Fosphite Fungi-phite Helena Prophyt Rampart	1-3 qt 1-3 qt 1-2 qt 4 pt 1-3 qt	6 app 4 app	0 0 0 0	Leaf spots Phytophthora root rot
Propiconazole (3)	Bumper 41.8 EC Propi-Star EC Tilt Topaz	6 fl oz 6 fl oz 6 fl oz 6 fl oz	30 fl oz 30 fl oz 30 fl oz 30 fl oz	30 30 30 30	Leaf spots (postharvest only) Powdery mildew Rusts

Commercial Crop Production
Small Fruits - Brambles

Table 4. Recommended pesticides, rates and pesticide use restrictions for blackberry, raspberry, and other bramble diseases					
Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Diseases
Pyraclostrobin (11)	Cabrio EG	14 oz	56 oz	0	Anthracnose Cane blight Leaf spots Powdery mildew Rusts
Pyraclostrobin + Boscalid (11+7)	Pristine WG	18.5-23 oz	92 oz	0.5	Anthracnose Botrytis gray mold Cane blight Leaf spots Powdery mildew Rosette Rusts Spur blight
Cyprodinil + Fludioxonil (9+12)	Switch 62.5 WG	11-14 oz	56 oz	0	Botrytis gray mold
Fenhexamid (17)	Elevate 50WDG	1.5 lb	6 lb	0	Botrytis gray mold (resistance isolates have been detected in other regions of the south)
Iprodione (2)	Iprodione 4L AG Nevado 4F Rovral 4F	1-2 pt 1-2 pt 1-2 pt	4 app 4 app 4 app	0 0 0	Botrytis fruit rot
Mefenoxam (4)	Ridomil Gold SL	0.25 pt/1000 linear feet, 3 ft band	1 app	See label	Phytophthora root rot (raspberries only)
Sulfur (M)	Microfine Sulfur Microthiol Disperss Yellow Jacket Dusting Sulfur	10-30 lb 6-15 lb 3-50 lb	See labels	1 1 1 1	Anthracnose Cane blight Powdery mildew Spur blight

The information in the section was updated by Dr. M. Lewis Ivey December 2014.

Commercial Crop Production

Small Fruits - Blueberries

Integrated Blueberry Disease Management

Successful management of blueberry diseases requires an integrated approach to disease management. Choosing appropriate varieties and a well-suited planting site and good soil preparation before planting are all important for preventing disease problems in blueberries. Well-drained soil is especially important for preventing *Phytophthora* root rot, one of the most significant blueberry diseases. For protection from both frost and disease problems, it also may be beneficial to choose a site from which air can easily drain (e.g., not low sites).

Select varieties appropriate for your region. For variety recommendations as well as information on how to choose a suitable site and prepare soil before planting, see the LSU AgCenter publication “Commercial Blueberry Production” (Pub. 2363) or “Home Blueberry Production in Louisiana” (Pub. 1978), or the Mississippi State University Extension Service publication “Establishment and Maintenance of Blueberries” (Pub. 1758).

Start with clean plants. Use plants that have been propagated from clean (disease-free) planting material, and check plants for disease symptoms before planting.

Use good cultural practices. Pruning is recommended to remove dead, damaged, or diseased limbs so that sunlight and pesticides can penetrate the plant canopy. Pruning recommendations are provided in the LSU AgCenter publication “Commercial Blueberry Production” (Pub. 2363). Apply one inch of mulch under plants each year to minimize the effects of mummy berry disease. Avoid using equipment that has been in orchards infected with mummy berry.

Use crop protectants. Prior to using chemicals, have the disease confirmed by a crop specialist. Once the disease has been confirmed, select a labeled product that has been shown to be effective in reducing disease, and apply the product at the correct stage of plant development (Table 1). Chemicals with proven efficacy against a pathogen will not reduce disease if applied at the wrong time. Always rotate between products with different modes of action (in different FRAC groups; see Table 2) to prevent the development of fungicide resistance in the pathogen (disease-causing agent). If a pathogen becomes resistant to a product, the product will no longer be effective.

Commercial Crop Production Small Fruits - Blueberries

Table 1. Seasonal fungicide spray schedule for blueberries		
Season	Fungicide Application Timing	Disease
Early spring	At planting or, for established plants, while dormant, plus once while conditions favorable (see Table 2)	Phytophthora Root Rot
Pre-bloom	Green tip or when 1-5% of blooms are open (whichever comes first), for mummy berry, followed by a second application 7-14 days later, for both mummy berry and twig blight	Mummy Berry Twig Blight
Bloom	10-20 % bloom, followed by a second application at full bloom	Mummy Berry Twig Blight Botrytis Blight Fruit Rots
Petal fall	Immediately following bloom, followed by applications at 7-14 day intervals	Fruit Rots
Summer	Pre-harvest Post-harvest	Fruit Rots Leaf Spots
Fall	Post-harvest	Leaf Spots

Commercial Crop Production Small Fruits - Blueberries

Table 2. Disease descriptions and recommended pesticides.					
Product Choices ¹ and Product Mode of Action Group ²		Efficacy ³	Rate ⁴	PHI ⁵	Maximum Use ⁶
<p>Phytophthora Root Rot (<i>Phytophthora cinnamomi</i>)</p> <p>Symptoms: Initially, leaves become yellow and plant growth ceases. Rootlets are killed, and infected roots and crowns are discolored. Bushes may defoliate and die.</p> <p>Source of Inoculum: The pathogen survives as chlamydospores in the soil. Disease development is favored by wet soil conditions and temperatures between 68 and 90 °F.</p> <p>Management: Plant disease-free plants in well-drained soil or raised beds. Mefenoxam can be applied to soil while plants are dormant. Aluminum tris or “phosphite” products can be applied to foliage during the entire growing season. If plants are severely infected, chemicals are not likely to result in a return to healthy plant growth.</p>					
Aluminum tris (O-ethyl phosphonate; Aliette WDG)	33	+++	5 lbs	0.5	20 lb
Mefenoxam (Ridomil Gold SL)	4	++++	3.6 pt	0	7.2 pt
(Ultra Flourish)	4	++++	7.2 pt	0	14.4 pt
Phosphites (Fosphite, Rampart)	33	++++	see label	0	
(Fungi-Phite)	33	++++	(rate varies by	0	
(Helena Prophyt)	33	++++	production and	0	
(Phostrol)	33	++++	application method)	0	
<p>Mummy Berry (<i>Monilinia vaccinii-corymbosi</i>)</p> <p>Symptoms: This fungus attacks and kills leaves, twigs, flowers and fruit. Infected fruit turn cream to pink as they begin to mature and then shrivel and harden into “mummies.”</p> <p>Source of Inoculum: The fungus survives in the mummified fruit. Spores are wind-dispersed.</p> <p>Management: Remove or bury mummified fruit. If mummy berry is an ongoing problem then a fungicide spray schedule should be followed. For mummy berry, the first recommended sprays of the season (see Table 1) are very important.</p>					
Azoxystrobin (Abound F)	11	++	6.0-15.5 fl oz	0	46 fl oz
Azoxystrobin and propiconazole (Quilt Xcel)	11,3	+++++	14-21 fl oz	30	82 fl oz
Boscalid and pyraclostrobin (Pristine)	7,11	++++	18.5-23 fl oz	0	92 fl oz
Captan (50 WP)	M	+	5 lb	0	70 lb
(80 WDG)	M	+	3.125 lb	0	43.75 lb
(38.75% FL)	M	+	2.0-2.5 qt	0	35 qt
(Captan 4L)	M	+	2.5 qt	0	35 qt

Commercial Crop Production Small Fruits - Blueberries

Table 2. Disease descriptions and recommended pesticides.					
Product Choices ¹ and Product Mode of Action Group ²		Efficacy ³	Rate ⁴	PHI ⁵	Maximum Use ⁶
Captan and fenhexamid (CaptEstate 68 WDG)	M,17	++	4.7 lb	0	21 lbs
Cyprodinil and fludioxonil (Switch 62.5 WG)	9,12	++	11-14 oz	0	56 oz
Fenbuconazole ⁷ (Indar 2F)	3	+++++	6 fl oz	30	24 fl oz
Metconazole (Quash ⁸)	3	+++++	2.5 oz	7	7.5 oz
Propiconazole (Bumper 41.8 EC, Bumper ES, PropiMax EC, Tilt)	3	+++++	6 fl oz	30	30 fl oz
Ziram (76DF, Granuflo)	M	+	3 lb	-- ⁹	
<p>Stem Cankers and Blights (<i>Phomopsis</i>, <i>Botryosphaeria</i>)</p> <p>Symptoms: <i>Phomopsis</i> twig blight: Flower-bearing year-old stems die. <i>Botryosphaeria</i> canker: Lesions appear on new growth and turn into cankers on susceptible varieties. <i>Botryosphaeria</i> stem blight: Individual branches die.</p> <p>Source of Inoculum: The pathogens survive from year to year in infected stems. Spores are spread by wind or rain. <i>Phomopsis</i> infects stems through flowers.</p> <p>Management: Avoid mechanical injury to stems. Remove canes infected with <i>Botryosphaeria</i>. For <i>Phomopsis</i> twig blight, follow the fungicide spray schedule. Fungicides are not likely to be very effective for management of <i>Botryosphaeria</i>. <i>Fungicide efficacy ratings are for Phomopsis twig blight only.</i></p>					
Aluminum tris (O-ethyl phosphonate; Aliette WDG)	33	+	5 lb	0.5	20 lb
Azoxystrobin (Abound F)	11	++	6.0-15.5 fl oz	0	46 fl oz
Boscalid and pyraclostrobin (Pristine)	7,11	+++	18.5-23 fl oz	0	92 fl oz
Captan (50 WP)	M	++	5 lb	0	70 lb
(80 WDG)	M	++	3.125 lb	0	43.75 lb
(38.75% FL)	M	++	2.0-2.5 qt	0	35 qt
(Captan 4L)	M	++	2.5 qt	0	35 qt
Cyprodinil + fludioxonil (Switch 62.5 WG)	9,12	+++	11-14 oz	0	56 oz
Fenbuconazole ⁷ (Indar 2F)	3	++++	6 fl oz	30	24 fl oz
Metconazole (Quash ⁸)	3	++++	2.5 oz	7	7.5 oz

Commercial Crop Production Small Fruits - Blueberries

Table 2. Disease descriptions and recommended pesticides.					
Product Choices ¹ and Product Mode of Action Group ²		Efficacy ³	Rate ⁴	PHI ⁵	Maximum Use ⁶
Ziram (76DF, Granuflo)	M	+++	3 lb	-- ⁹	
<p>Botrytis Blight (<i>Botrytis cinerea</i>)</p> <p>Symptoms: The fungus attacks tender young twigs, leaves, flowers and fruit, causing them to become brown to black. Infected fruit do not rot until after harvest.</p> <p>Source of Inoculum: The fungus survives as dormant mycelia or sclerotia. Spores are wind dispersed.</p> <p>Management: Follow a fungicide spray schedule.</p>					
Boscalid and pyraclostrobin (Pristine)	7,11	+++++	18.5-23 fl oz	0	92 fl oz
Captan (50 WP)	M	++	5 lb	0	70 lb
(80 WDG)	M	++	3.125 lb	0	43.75 lb
(38.75% FL)	M	++	2.0-2.5 qt	0	35 qt
(Captan 4L)	M	++	2.5 qt	0	35 qt
Captan and fenhexamid (CaptEstate 68 WDG)	M,17	+++++	3.5-4.7 lb	0	21 lb
Cyprodinil and fludioxonil (Switch 62.5 WG)	9,12	+++++	11-14 oz	0	56 oz
Fenhexamid (Elevate 50WDG)	17	+++++	1.5 lb	0	6 lbs
Ziram (76DF, Granuflo)	M	++	3 lb	-- ⁹	
<p>Fruit Rots (<i>Alternaria</i>, <i>Colletotrichum</i>, <i>Phomopsis</i>) (including Anthracnose Fruit Rot or Ripe Rot)</p> <p>Symptoms: A variety of rots develop on the fruit as they mature.</p> <p>Source of Inoculum: The fungi causing fruit rots survive from year to year on or in infected twigs and, for <i>Alternaria</i>, fallen debris.</p> <p>Management: Harvest ripe fruit regularly, and cool it soon after harvest to minimize post-harvest disease development. Follow a fungicide spray schedule. Fungicide efficacy ratings are for <i>Alternaria</i> and <i>Colletotrichum</i> (ripe rot), unless noted.</p>					
Aluminum tris (O-ethyl phosphonate; Aliette WDG)	33	+ (ripe rot only)	5 lb	0.5	20 lb
Azoxystrobin (Abound F)	11	+++++	6.0-15.5 fl oz	0	46 fl oz
Azoxystrobin and propiconazole (Quilt Xcel)	11,3	+++++	14-21 fl oz	30	82 fl oz
Boscalid and pyraclostrobin (Pristine)	7,11	+++++	18.5-23 fl oz	0	92 fl oz
Captan (50 WP)	M	+++	5 lb	0	70 lb
(80 WDG)	M	+++	3.125 lb	0	43.8 lb

Commercial Crop Production Small Fruits - Blueberries

Table 2. Disease descriptions and recommended pesticides.					
Product Choices ¹ and Product Mode of Action Group ²		Efficacy ³	Rate ⁴	PHI ⁵	Maximum Use ⁶
(38.75% FL)	M	+++	2.0-2.5 qt	0	35 qt
(Captec 4L)	M	+++	2.5 qt	0	35 qt
Cyprodinil + fludioxonil (Switch 62.5 WG)	9,12	+++++	11-14 oz	0	56 oz
Fluazinam (Omega 500F)	29	+++	1.25 pt	30	7.5 pt
Metconazole (Quash ⁸)	3	+++++	2.5 oz	7	7.5 oz
Ziram (76DF, Granuflo)	M	++	3 lb	-- ⁹	
<p>Leaf Spots (<i>Septoria</i>, rust) Symptoms: <i>Septoria</i>: Small, circular, light-colored lesions with a purple border are produced on leaves, and sunken lesions may be formed on stems. Rust: Spots develop on upper sides of leaves and change from yellow to red to brown. Orange spores are produced on the undersides of leaves. Source of Inoculum: <i>Septoria</i>: The fungus survives from year to year in infected leaf debris and stems. Spores are windborne. Rust: The fungus is believed to survive on evergreen plants in the blueberry genus (<i>Vaccinium</i>). Management: Follow a fungicide spray schedule. Ratings with (S) next to them indicate they are for <i>Septoria</i> only.</p>					
Aluminum tris (O-ethyl phosphonate; Aliette WDG)	33	++++ (S)	5 lb	0.5	20 lb
Azoxystrobin (Abound F)	11	++++ (S)	6.0-15.5 fl oz	0	46 fl oz
Azoxystrobin and propiconazole (Quilt Xcel)	11,3	+++++ (S)	14-21 fl oz	30	82 fl oz
Boscalid and pyraclostrobin (Pristine)	7,11	+++++	18.5-23 fl oz	0	92 fl oz
Chlorothalonil ¹⁰					
(38.5% F)	M	++++	4.25-5.75 pt	42	17 pt
(54% F)	M	++++	3-4 pt	42	12 pt
(82.5% DF)	M	++++	2.7-3.6 lb	42	10.9 lb
(90% DF)	M	++++	2.5-3.25 lb	42	10.0 lb
Cyprodinil and fludioxonil (Switch 62.5 WG)	9,12	+++ (S)	11-14 oz	0	56 fl oz
Fenbuconazole (Indar 2F)	3	+++++	6 fl oz	30	24 fl oz
Metconazole (Quash ⁸)	3	+++++	2.5 oz	7	7.5 oz

Commercial Crop Production Small Fruits - Blueberries

Table 2. Disease descriptions and recommended pesticides.					
Product Choices ¹ and Product Mode of Action Group ²		Efficacy ³	Rate ⁴	PHI ⁵	Maximum Use ⁶
Phosphites					
(Fosphite, Rampart)	33	++++ (S)	see label	0	
(Fungi-Phite)	33	++++ (S)	(rate varies	0	
(Helena Prophyt)	33	++++ (S)	by product	0	
(Phostrol)	33	++++ (S)	and application method)	0	
Propiconazole (Bumper 41.8 EC, Bumper ES, PropiMax EC, Tilt)	3	+++++	6 fl oz	30	30 fl oz
<p>Bacterial Leaf Scorch (<i>Xylella fastidiosa</i>)</p> <p>Symptoms: In susceptible Southern highbush varieties, the edges of leaves turn brown (marginal necrosis) and eventually drop off the plant, and young twigs and stems may turn yellow. Rabbiteye cultivars may show early fall color, and fruit production may decline over time.</p> <p>Source of Inoculum: Infected plants serve as reservoirs for this bacterium. Bacteria are transmitted through propagation or by sharpshooter insects.</p> <p>Management: No chemicals are available for disease management. Plant disease-free plants, and choose resistant varieties if planting Southern highbush blueberries. See the Southeast Regional Blueberry Integrated Management Guide (http://www.smallfruits.org/SmallFruitsRegGuide/index.htm) for insecticide recommendations for leafhoppers.</p>					
<p>¹Chemical name (trade name). Reference to commercial or trade names is made for the reader's convenience and with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied. In some cases, other brands are available.</p> <p>²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).</p> <p>³Efficacy ratings are on a 1-5 scale where: 5 (+++++) is the most effective and 1 (+) is the least effective. Much of the information in this table, including efficacy ratings, is based on the 2014 Southeast Regional Blueberry Integrated Management Guide of the Southern Region Small Fruit Consortium (http://www.smallfruits.org/SmallFruitsRegGuide/index.htm).</p> <p>⁴Rates are the amount of formulation (product) per acre unless otherwise indicated. Usually 100 gallons of water are required to give good coverage with boom sprayers.</p> <p>⁵Post-harvest interval (PHI) is the minimum number of days allowed between the last application and harvest.</p> <p>⁶Maximum amount per acre per year or growing season. See labels for additional restrictions.</p> <p>⁷If fenbuconazole (Indar 2F) is used during bloom, it should be mixed with captan to prevent a higher incidence of fruit rot.</p> <p>⁸Supplemental label (EPA Reg. No. 59639-147). Label expires Dec. 31, 2016.</p> <p>⁹Do not apply later than three weeks after full bloom.</p> <p>¹⁰Do not apply until after harvest. Many products are available.</p>					

Revised by M.H. Ferguson and Dr. C. Clark in December 2014.

Commercial Crop Production

Small Fruit - Grapes

Table 1. Symptoms, source of inoculum and management of diseases of grapes	
Disease (Pathogen)	Disease Description
Anthracnose <i>(Elsinoe ampelina = Sphaceloma ampelinum)</i>	<p>Symptoms: Fruit infections have light gray centers and reddish-brown borders resembling a bird's eye. Stem lesions are similar in color and sunken, with slightly raised borders. Leaf spots are gray with dark borders; later, the center of the lesion drops out, giving a ragged effect. Badly infected leaves become distorted and curl down.</p> <p>Source of Inoculum: The fungus overwinters in infected fruit on the ground or in infected shoots.</p> <p>Management: Follow the fungicide spray schedule for grapes. Do not apply Pristine to Concord, Worden, Fredonia, Niagara or related grape varieties due to possible injury.</p>
Black Rot <i>(Guignardia bidwellii)</i>	<p>Symptoms: The black rot fungus attacks all parts of the grape plant. Leaf infection appears on the upper surface in early June as tiny reddish-brown spots. The lesions enlarge to 1/4 inch or more in diameter and become brown with black borders. A ring of black fungal bodies develops near the outer edge of the brown area. Lesions on stems and tendrils are longer and darker than those on leaves. Stem lesions are narrow, sunken and often split lengthwise on the vine. Infections begin to appear on the fruit when the berries are about half grown. Initially, a small white spot forms that enlarges rapidly until the entire berry is rotten. Affected berries soon turn black, shrivel and dry up. Minute black fungal fruiting bodies develop on the surface of the dried fruit. On <i>muscadines</i>, lesions on berries are small, black and scabby. The fruit does not rot.</p> <p>Source of Inoculum: The fungus overwinters in mummified fruit on the vine and ground and within lesions on canes.</p> <p>Management: <i>Pruning out mummies, cankers, and dead wood is very important to reduce inoculum load.</i> Follow the fungicide spray schedule for grapes.</p>
Powdery Mildew <i>(Uncinula necator)</i>	<p>Symptoms: Produces a whitish-gray, powdery-appearing growth on affected tissues. All green tissues are susceptible. Infection of young expanding leaves causes them to become distorted. Infection of blossoms results in poor fruit set. Infection of berries results in splitting or a netlike pattern on the surface.</p> <p>Source of Inoculum: The fungus overwinters in dormant buds or on other vine surfaces. Spores are wind-dispersed.</p> <p>Management: Follow the fungicide spray schedule for grapes. Sulfur should be included in a fungicide program.</p>
Botrytis Bunch Rot <i>(Botrytis cinerea)</i>	<p>Symptoms: Infected blooms rot and dry out. Infected berries develop an off-color and either dry out (during dry weather) or burst (during wet weather).</p> <p>Source of Inoculum: The fungus overwinters on canes or in buds. Spores are wind-dispersed.</p> <p>Management: Prune out diseased tissue and destroy. Rake up fallen grapes and destroy. Follow the fungicide spray schedule for grapes.</p>

Commercial Crop Production Small Fruit - Grapes

Table 1. Symptoms, source of inoculum and management of diseases of grapes

Disease (Pathogen)	Disease Description
<p>Downy Mildew (<i>Plasmopara viticola</i>)</p>	<p>Symptoms: This is primarily a disease of bunch grapes; <i>muscadines</i> are relatively resistant. All green parts of the vine are susceptible. Leaf lesions are yellowish- to reddish-brown and may appear angular if they are vein delimited. Infected shoot tips tend to curl. Leaves and shoots become covered with white mycelium. Berries appear grayish and are covered with the downy felt-like growth of the pathogen.</p> <p>Source of Inoculum: The pathogen overwinters in infected leaves. Disease development is boosted by wet weather.</p> <p>Management: Shred and remove or bury by cultivation diseased leaves. Follow the fungicide spray schedule for grapes.</p>
<p>Phomopsis Cane and leaf spot (<i>Phomopsis viticola</i> and <i>Eutypa lata</i>)</p>	<p>Symptoms: Tiny dark spots with yellow margins form on the leaf blades and veins. Heavily infected basal leaves become distorted and may not develop to full size. Infected fruit turn brown, shrivel and drop from the cluster.</p> <p>Source of Inoculum: The fungus overwinters in the bark and leaf petioles. During wet springs fungal spores exude from infected tissues and splash on to new (young) shoot tips. Spores move within the vine causing localized infections in the vineyard. Fruit and cluster stem infections occur from bloom until the fruit are about the size of a pea.</p> <p>Management: At pruning remove dead and diseased wood. Destroy pruned materials and debris by burning, burying, or plowing them into the soil. Sanitize pruners with a registered disinfectant after each cut or between vines. Apply a dormant spray of lime sulfur to reduce overwintering inoculum.</p>
<p>Pierce's Disease (<i>Xylella fastidiosa</i>)</p>	<p>Symptoms: This is a disease of bunch grapes. <i>Muscadines</i> are resistant. Symptoms may vary, but generally are characterized by a scorching of the leaf margins. Grape clusters wilt and dry; bud leaves are slow to develop and show water stress during dry periods.</p> <p>Source of Inoculum: The bacterium survives in infected vines and other hosts. It is transmitted by a number of leafhoppers.</p> <p>Management: Limiting the spread of the insect vector and destruction of wild weed hosts have had limited success. Soil applications of the insecticide Admire Pro or Scorpion 35 SL are recommended. Destroy infected plants.</p>

Commercial Crop Production Small Fruit - Grapes

Table 2. Seasonal fungicide spray schedule for grapes		
Developmental Stage	Pesticide Application Timing¹	Diseases
Dormant	Prior to bud swell (bud is visibly swollen but no green or pink tissue is observed) and break.	Anthracnose Phomopsis Cane and Leaf Spot
Budbreak and new shoot sprays (pre-bloom)	Every 7-10 days from 1-inch shoot growth to pre-bloom.	Black Rot Downy Mildew Phomopsis Cane and Leaf Spot Powdery Mildew
Pre-bloom²	<10% bloom	Anthracnose Black Rot Downy Mildew Phomopsis Cane and Leaf Spot Powdery Mildew
Bloom	10-20% bloom	Black Rot Botrytis Phomopsis Cane and Leaf Spot Powdery Mildew
Post-bloom	First cover spray at 7-10 days after the pre-bloom spray.	Anthracnose Black Rot Downy Mildew Phomopsis Cane and Leaf Spot Powdery Mildew
First and second cover sprays	Every 10-14 days following post-bloom spray.	Anthracnose Black Rot Downy Mildew Phomopsis Cane and Leaf Spot Powdery Mildew
Third and subsequent cover sprays	Matured berries ³ . Every 10-14 days until the preharvest spray.	Anthracnose Black Rot (foliar) Downy Mildew (foliar) Phomopsis Cane and Leaf Spot Powdery Mildew (foliar)
Veraison	Onset of ripening.	Botrytis
Preharvest	10-14 days prior to harvest	Botrytis Downy Mildew Phomopsis Cane and Leaf Spot Powdery Mildew
Postharvest	Every 14-21 days until the first killing frost	Downy Mildew Powdery Mildew
<p>¹For more detailed information, see the 2015 Southeast Regional Bunch Grape Integrated Management Guide of the Southern Region Small Fruit Consortium (http://www.smallfruits.org/SmallFruitsRegGuide/index.htm).</p> <p>²This is one of the most important sprays for downy mildew, powdery mildew, Phomopsis, and black rot as it is the stage when grape berries become susceptible to infection by black rot, downy mildew, and powdery mildew, and all of these pathogens become active due to warmer temperature.</p> <p>³Mature berries are now black rot, downy mildew, and powdery mildew resistant. Sprays are applied to manage foliar infections caused by these diseases.</p>		

Commercial Crop Production Small Fruit - Grapes

Table 3. Efficacy of selected fungicides against grape diseases. Table is reproduced from the 2014 Southern Region Small Fruit Consortium IPM/Production Guide. Efficacy ratings are as follows: - = no significant activity; + = very limited activity, ++ = limited activity, +++ = moderate activity, ++++ = good activity, +++++ = excellent activity. No data are provided for products that are not labeled for the specific disease or if the efficacy is unknown.

Chemical name (Fungicide product name)	Anthraco-nose	Black rot	Botrytis bunch rot	Downy mildew	Phomopsis cane and leaf spot	Powdery mildew
Azoxystrobin (Abound)		+++++	+++ ¹	+++++ ¹	+++	+++++ ¹
Boscalid (Endura)		+++++	+++++ ¹			++++ ²
Boscalid + Pyraclostrobin (Pristine)	++++	+++++	+++++ ¹	+++++ ¹	+++++	+++++
Captan (Captan, Captec, etc.)	+++	+++	++	++++	++++	-
Fixed coppers and Bordeaux mixture (various products)		+++	+++	+++	++	++
Cyflufenamid (Torino)		-	-	-	-	++++
Cyprodinil (Vanguard)		-	+++++ ¹	-	-	++
Cyprodinil + Fludioxonil (Switch)			++++ ¹			
Cyprodinil + Difenconazole (Inspire Super)		++++	++++ ¹			++++
Famoxadone + cymoxanil (Tanos)				+++ ¹		
Fenhexamid (Elevate)		-	+++++ ¹	-	-	-
Ferbam (Ferbam)		++++	-	++	++	-
Fenarimol (Rubigan)		++	-	-	-	+++++ ¹
Fluopicolide (Presidio)	-	-	-	+++++	-	-
Iprodione (Rovral, Meteor)	-	-	+++ ¹	-	-	-
Kresoxim-methyl (Sovran)		+++++	++ ¹	+++ ¹	+++	+++++ ¹
Lime Sulfur (dormant application)	+++		-	-	+++	++
Mancozeb (various: Penncozeb, Dithane, etc)		+++++	-	+++++	+++++	-
Mandipropamid (Revus)	-	-	-	+++++	-	-
Mandipropamid + Difenconazole (Revus Top)		++++	-	+++++	+++ ²	++++
Mefanoxam + Copper (Ridomil Gold Copper)		++	++	+++++	++	++
Mefanoxam + Mancozeb (Ridomil Gold MZ)		+++	-	+++++	+++	-

Commercial Crop Production Small Fruit - Grapes

Table 3. Efficacy of selected fungicides against grape diseases. Table is reproduced from the 2014 Southern Region Small Fruit Consortium IPM/Production Guide. Efficacy ratings are as follows: - = no significant activity; + = very limited activity, ++ = limited activity, +++ = moderate activity, ++++ = good activity, +++++ = excellent activity. No data are provided for products that are not labeled for the specific disease or if the efficacy is unknown.

Chemical name (Fungicide product name)	Anthracnose	Black rot	Botrytis bunch rot	Downy mildew	Phomopsis cane and leaf spot	Powdery mildew
Metrafenone (Vivando)		-	-	-	-	++++
Myclobutanil (Rally)		++++	-	-	-	+++++ ¹
Phosphonate (ProPhyt, Phostrol, etc.)				++++		
Sulfur ³ (various)		-	-	-	++	+++++
Tebuconazole (Elite)			-	-	-	+++++ ¹
Tetraconazole (Mettle)						++++ ¹
Thiophanate-methyl (Topsin M)		++	-	-	+++	+++++ ¹
Trifloxystrobin (Flint)		+++++	++++	+++	++	+++++ ¹
Triflumazole (Procure and Viticure)		+++ ¹	-	-	-	+++++
Ziram (Ziram)		++++	++	++++	+++	-

¹Resistance (or occasional failure of control) has been observed in some southeastern states, thus, if control failure occurs, it could indicate resistance has developed. The efficacy rating could be impacted by resistance development. If resistance has occurred, use of fungicides in the same class would likewise show resistance, and a substitute fungicide should be considered for pathogen management.

²Insufficient data for the pathogen-chemical combination. The rating was given based on the general knowledge on the material.

³Sulfur will cause burn on sensitive varieties, especially on hot days, >85F.

Commercial Crop Production Small Fruit - Grapes

Table 4. Recommended pesticides, rates and pesticide use restrictions for grapes					
Chemical Name (Product Mode of Action Group¹)	Product Name²	Rate^{3,4}	Maximum Use	PHI⁵	Diseases
aluminum tris (33)	Aliette	3-5 lb	7 app	15	Downy mildew
azoxystrobin (11)	Abound 2SC Azoxy 2SC	10.5-15.5 fl oz	92.3 fl oz	14	Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew Botrytis bunch rot (suppression only)
azoxystrobin+ difenoconazole (11+3)	Quadris Top	12-14 fl oz	56 fl oz	14	Anthracnose Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew Botrytis bunch rot (suppression only)
boscalid (7)	Endura 30WG	4.5 or 8 oz	24 oz	14	Botrytis Powdery mildew
boscalid + pyraclostrobin (7+11)	Pristine ⁹	8-12.5 oz	69 oz	14	Anthracnose Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
	Pristine ⁹	18.5-23 oz	69 oz	14	Botrytis
captan (M)	Captan 38.75%	1.5-2 qt	12 qt	0	Black rot (suppression only) Downy mildew Phomopsis cane and leaf spot
	Captec 4L	0.75-1 qt/100 gal	2 qt	0	
copper hydroxide (M)	Champ WG ¹⁰	2-6 lb	40 lb	0	Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
	Champion ¹⁰	0.75-1.75 lb	66.7 lb	0	

Commercial Crop Production Small Fruit - Grapes

Table 4. Recommended pesticides, rates and pesticide use restrictions for grapes					
Chemical Name (Product Mode of Action Group¹)	Product Name²	Rate^{3,4}	Maximum Use	PHI⁵	Diseases
copper hydroxide + mancozeb (M)	ManKocide ¹⁰	2.5 lb	66.7 lb	66	Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
copper sulfate	Cuprofix Ultra 40	1.25-3 lb	50 lb	14	Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
	Disperss ¹⁰ Cuproxtat ¹⁰	2.5-6 pt	98.6 pt	14	
Cyprodinil (9)	Vanguard WG	10 oz (alone) 5-10 oz (tank mixtures)	30 oz	7	Botrytis bunch rot Powdery mildew (suppression)
cyprodinil + difenoconazole (3+9)	Inspire Super ¹¹	16-20 fl oz	80 fl oz	14	Anthrachnose Black rot Botrytis Powdery mildew
cyprodinil + fludioxonil (9+12)	Switch 62.5WG	11-14 oz	56 oz	7	Botrytis
difenoconazole + mandipropamid (3+40)	Revus Top	7 fl oz	28 fl oz	14	Anthrachnose Black rot Phomopsis cane and leaf spot Powdery mildew
famoxodone+ cymoxanil (11+27)	Tanos	8 oz	72 oz	30	Downy mildew
fenarimol (3)	Rubigan EC ¹²	2-6 fl oz ¹³	19 fl oz	21	Powdery mildew
	Vintage SC	3-6 fl oz ¹⁴	21 fl oz	21	
fenhexamid (17)	Elevate 50WDG	1 lb	3 lb	0	Botrytis Powdery mildew (suppression only)
fluopicolide (43)	Presidio	3-4 fl oz	12 fl oz	21	Downy mildew

Commercial Crop Production Small Fruit - Grapes

Table 4. Recommended pesticides, rates and pesticide use restrictions for grapes					
Chemical Name (Product Mode of Action Group¹)	Product Name²	Rate^{3,4}	Maximum Use	PHI⁵	Diseases
iprodione (2)	Iprodione 4L AG	1-2 pt	4 app	7	Botrytis
	Meteor	1-2 pt	4 app	7	
	Nevado 4F	1-2 pt	4 app	7	
	Rovral 4F	1-2 pt	4 app	7	
kresoxim-methyl (11)	Sovran 50WG	3.2-6.4 oz ⁸	25.6 oz	14	Black rot Botrytis bunch rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
mancozeb (M)	Dithane F45	1.2-3.2 qt	19.2 qt	66	Black rot Botrytis bunch rot Downy mildew Phomopsis cane and leaf spot
	Rainshield				
	Dithane M45	1.5-4 lb	24 lb	66	
	Manzate Flowable	1.2-3.2 qt	19.2 qt	66	
	Manzate Max	1.2-3.2 qt	19.2 qt	66	
	Manzate Pro-Stick	1.5-4 lb	7.5 lb	66	
	Penncozeb 75DF	1.5-4 lb	24 lb	66	
	Penncozeb 80WP	1.5-4 lb	24 lb	66	
Roper DF Rainshield	1.5-4 lb	24 lb	66		
mandipropamid (40)	Revus	8 fl oz	32 fl oz	14	Downy mildew
mefenoxam	Ridomil Gold SL	3.6 pt	0.4 lb ai	60	Downy mildew
mefenoxam + copper hydroxide (4+M)	Ridomil Gold/Copper	2 lb	0.4 lb ai	42	Downy mildew
mefenoxam + mancozeb (4+M)	Ridomil Gold MZ WG	2.5 lb	10 lb	66	Downy mildew
myclobutanil (3)	Eagle 20EW	4-6 fl oz/100 gal	153 fl oz	14	Powdery mildew
	Rally 40WSP	3-5 oz	1.5 lb	14	Anthraco- nose Black rot Powdery mildew

Commercial Crop Production Small Fruit - Grapes

Table 4. Recommended pesticides, rates and pesticide use restrictions for grapes					
Chemical Name (Product Mode of Action Group¹)	Product Name²	Rate^{3,4}	Maximum Use	PHI⁵	Diseases
phosphite ¹⁵ (phosphorous acid salts) (33)	K-phite 7LP	1-3 qt	NA	NA	Anthracnose Downy mildew Powdery mildew
	Phostrol	2.5-5 pt	NA	NA	Downy mildew
pyrimethanil (9)	Scala SC	18 fl oz (alone) 9 fl oz (tank mix)	36 fl oz	7	Botrytis
quinoxifen (13)	Quintec	3-6.6 fl oz	33 fl oz	14	Powdery mildew
sulfur (M)	Liquid Sulfur Six	1-2 pt/100 gal	8 pt	NA	Phomopsis cane and leaf spot Powdery mildew
	Microfine Sulfur	3.8-25 lb	NA	NA	
	Microthiol Disperss	3-10 lb	NA	NA	
	Yellow Jacket Dusting	10-20 lb	NA	NA	
	Yellow Jacket Wettable	3.8-25 lb	NA	NA	
tebuconazole (3)	Elite 45DF	4 oz	2 lb	14	Black rot
	Orius 20AQ	8.6 oz	68.8 oz	14	Powdery mildew
	Tebuzol 45DF	4 oz	2 lb	14	
tebuconazole + trifloxystrobin (3+11)	Adament 50 WG ¹⁶	3-6 oz	48 oz	14	Black rot Botrytis bunch rot Downy mildew Phomopsis cane and leaf spot
tetraconazole	Mettle 125 ME	3-5 fl oz	10 fl oz	14	Black rot Powdery mildew
thiophanate-methyl (1)	Thiophanate-methyl 85WDG	0.6-1.2 lb	3.2 lb	14	Black rot Powdery mildew
	T-Methyl 70WSB	.75-1.5 lb	6 lb	7	
	Topsin M 70WP	.75-1.5 lb	6 lb	7	Black rot
	Topsin M WSB	.75-1.5 lb	6 lb	7	Botrytis Powdery mildew

Commercial Crop Production Small Fruit - Grapes

Table 4. Recommended pesticides, rates and pesticide use restrictions for grapes					
Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ^{3,4}	Maximum Use	PHI ⁵	Diseases
triflumizole (3)	Procure 480SC	4-8 oz	32 oz	7	Powdery mildew
trifloxystrobin (11)	Flint 50WG ⁷	1.5-4 oz ⁸	24 oz	14	Black rot Botrytis bunch rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
ziram (M)	Ziram 76DF	3-4 lb	28 lb	21	Black rot Botrytis bunch rot (suppression only) Downy mildew Phomopsis cane and leaf spot

¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.

²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).

³Rates are the amount of formulation per acre of **wine or sherry grapes** unless otherwise indicated. See label for rates and restrictions for table or raisin grapes. Usually 100 gallons of water are required to give good coverage with boom sprayers.

⁴All rates refer to foliar applications unless otherwise noted. Refer to label for other application rates and directions.

⁵Post-harvest interval (PHI) is the minimum number of days allowed between the last application and harvest.

⁶For resistance management purposes only two applications per year is recommended.

⁷Do not use Flint on Concord.

⁸Rates vary depending on disease. Refer to label for rates and timing.

⁹Do not use on Concord or Noiret. Possible foliar injury may also occur on Worden, Fredonia, Niagara, Steuben or Rougeon. See label for additional restrictions.

¹⁰See label for variety restrictions. Add hydrated lime (1-3 lb) per pound of Champ WG to minimize foliar injury.

¹¹Do not use on Concord or Thomcord.

¹²Use a surfactant when Rubigan EC is applied alone.

¹³Prebloom apply 2-4 fl oz/A; Postbloom apply 4-6 fl oz/A and; cover sprays apply 5-6 fl oz/A.

¹⁴Prebloom apply 3-4 fl oz/A; Postbloom apply 5-6 fl oz/A and; cover sprays apply 5-6 fl oz/A.

¹⁵Do not apply when temperatures exceed 90 F, shortly after a rain event, or during color break of the fruit.

¹⁶See label for variety restrictions.

Information in the grape section was updated December 2014 by Dr. M. Lewis Ivey.

Commercial Crop Production Small Fruits – Strawberries

Integrated Strawberry Disease Management

Strawberries are among the most challenging horticultural crops to grow in the South due to high levels of soilborne pathogens. Chemical use, from pre-plant to harvest, is a critical component in maintaining crop yield and producing high-quality fruit. Traditionally, disease management in strawberries has relied on the establishment of a clean crop planted into methyl bromide-fumigated soil. With the phase-out of methyl bromide the use of alternative and more sustainable management strategies are necessary. (For fumigant information see page 4 of the Southeast Regional Strawberry Integrated Management Guide: <http://www.smallfruits.org/SmallFruitsRegGuide/Guides/2015/2015StrawberryIPMGuide.pdf>.)

Rotate your planting site. Rotating where strawberries are planted is an important part of avoiding soilborne disease problems, such as the black root rot complex and nematodes. This is especially important in the absence of fumigation. Try not to plant strawberries in a particular site more than once every three to four years.

Start with clean plants. Purchase plants from a reputable source. Many disease-causing agents can be brought in on plants, and clean plants are especially important for avoiding anthracnose crown rot (caused by *Colletotrichum gloeosporioides*), Phytophthora crown rot, and virus problems.

Use crop protectants. Prior to using chemicals, have the disease confirmed by a crop specialist. Once the disease has been confirmed, select a labeled product that has been shown to be effective in reducing disease, and apply the product at the correct stage of plant development (Table 1). Chemicals with proven efficacy against a pathogen will not reduce disease if applied at the wrong time. Always rotate between products with different modes of action (in different FRAC groups; see Table 2) to prevent the development of fungicide resistance in the pathogen (disease-causing agent). For example, while chemicals in FRAC group 11 are effective against many pathogens, care should be taken to rotate their use with other fungicides effective on the same target pathogen(s) so that the pathogen(s) will not become resistant to fungicides in group 11. If a pathogen becomes resistant to a product, the product will no longer be effective.

Commercial Crop Production Small Fruits – Strawberries

Table 1. Seasonal fungicide spray schedule for strawberries		
Season	Pesticide Application Timing	Diseases
Pre-planting	Pre-planting fungicide dip ¹	Colletotrichum Crown Rot (anthracnose) Phytophthora Crown Rot
Post-planting until pre-bloom	Early post-planting	Colletotrichum Crown Rot (anthracnose) Phytophthora Crown Rot Powdery Mildew
	Warm periods following frost	Botrytis Crown Rot
	New growth	Leaf Spots (bacterial and fungal) Phytophthora Crown Rot Powdery Mildew
Bloom until harvest	Every 7 to 10 days or according to label	Colletotrichum Fruit Rot (anthracnose) Gray Mold Leaf Spots (bacterial and fungal) Phytophthora Crown Rot Powdery Mildew
¹ Bare-root strawberry plants may be dipped in a fungicide suspension prior to planting to provide early season control of root and crown rot diseases. Prior to dipping, the plants should be washed with potable water to remove adhering soil. The entire plant should be treated according to the label. Plants should be planted as soon as possible.		

Commercial Crop Production Small Fruits - Strawberries

Table 2. Disease descriptions and recommended pesticides.

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Product Choices ¹ and Product Mode of Action Group ²		Efficacy ³	Rate ⁴	PHI ⁵	Maximum Use ⁶
Anthracnose Crown Rot (<i>Colletotrichum</i> spp.)					
Symptoms: Plants wilt suddenly and die during warm weather. Crowns have a reddish discoloration extending into the center. Black lesions occur on leaf petioles or runners. Disease development is inhibited by cool weather.					
Source of Inoculum: The fungus survives the winter on infected plant parts or is introduced on infected planting material. Fungal spores are spread primarily by rain splashing and wind-driven rain.					
Management: Use disease-free transplants. Dip plants in a fungicide prior to planting if problems with plant source are identified. Rogue out infected plants and treat surrounding plants with fungicides.					
azoxystrobin (Abound F, Azaka)	11	+++	6.0-15.5 fl oz	0	61.5 fl oz
azoxystrobin and difenoconazole (Quadris Top)	11,3	+++	12-14 fl oz	0	56 fl oz
azoxystrobin + propiconazole (Quilt Xcel)	11,3	+++	14 fl oz	0	56 fl oz
boscalid and pyraclostrobin (Pristine)	7,11	+++	18.5-23 oz	0	115 oz
captan (50 WP)	M	++	3-6 lb	0	48 lb
(80 WDG)	M	++	1.875-3.75 lb	0	30 lb
(38.75% FL, Captec 4L)	M	++	1.5-3.0 qt	0	24 qt
cyprodinil and fludioxonil (Switch 62.5 WG)	9,12	+++	11-14 oz	0	56 oz
fluxapyroxad and pyraclostrobin (Merivon) ⁷	7,11	+++	5.5-8 fl oz	0	33 fl oz
pyraclostrobin (Cabrio EG)	11	+++	12-14 oz	0	70 oz
thiophanate-methyl (Thiophanate Methyl 85 WDG)					
(Topsin M 70WP)	1	++	0.6-0.8 lb	1	3.2 lb
(Topsin 4.5FL)	1	++	0.75-1 lb	1	4 lb
	1	++	15-20 fl oz	1	80 fl oz
thiram (Granuflo 75WDG)	M	+++	4.4 lb	3	22 lb

Commercial Crop Production Small Fruits - Strawberries

Table 2. Disease descriptions and recommended pesticides.

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Product Choices ¹ and Product Mode of Action Group ²	Efficacy ³	Rate ⁴	PHI ⁵	Maximum Use ⁶
Phytophthora Crown Rot (<i>Phytophthora</i> spp.)				
Symptoms: Youngest leaves often wilt first followed by the collapse of the entire plant. Crowns exhibit extensive brown discoloration that extends from the crown downward or from an infected stolon.				
Source of Inoculum: Oospores that survive in the soil or on infected transplants. Spreads primarily in				
Management: Use disease-free transplants, improve drainage and avoid low spots. Dip transplants in suitable fungicide prior to planting. Rogue out infected plants and treat surrounding plants with fungicide.				
aluminum tris (O-ethyl phosphonate; Aliette WDG) ⁸	33	++	2.5-5.0 lb ⁹ (2.5 lb/100 gal for dip)	0.5 30 lb
mefenoxam (Ridomil Gold SL) (Ultra Flourish)	4 4	++++ ++++	1 pt ¹⁰ 2 pt ¹¹	0 0 3 pt 6 pt
phosphites (Fosphite, Rampart) (Fungi-Phite) (Helena Prophyt) (Phostrol)	33 33 33 33	++ ++ ++ ++	see label (rate varies by product and application method)	0 0 0 0 6 apps
Gray Mold and Botrytis Crown Rot (<i>Botrytis cinerea</i>)				
Symptoms: This fungus attacks flowers, flower parts, fruit and leaves. On the fruit, this disease causes a rot that is at first light brown and soft (not “leaky”). As the berry rots, it becomes covered with a grayish, powdery growth, and in the final stages of rot, it becomes tough and firm in texture. Crown rot can be a problem in the winter when early blossoms are killed by frost and a warm period follows.				
Source of Inoculum: The fungus survives in the decaying tissues of strawberries and many other plants. Fungal spores are wind-dispersed.				
Management: Control leaf diseases and remove dead leaves that can furnish a site for the fungus to develop. Harvest fruit frequently, removing infected and other unmarketable fruit from the field. Fungicide resistance in <i>Botrytis cinerea</i> is a major concern. With the exception of fungicides in FRAC group M, resistance to all fungicides listed below, or to a fungicide in the same FRAC group, has been documented in one or more locations. It is very important to rotate fungicides in different FRAC groups. If you suspect that the <i>Botrytis</i> in your field is resistant to a fungicide that you’re using, you can take samples from your plants and send them to be tested, as described here: http://strawberries.ces.ncsu.edu/wp-content/uploads/2014/02/2014-collection-instructions-11.pdf				
For chemical management of crown rot, choose among captan, Switch, and iprodione.				
boscalid and pyraclostrobin (Pristine)	7,11	+++++	18.5-23 fl oz	0 115 fl oz
captan (50 WP) (80 WDG) (38.75% FL, Captec 4L)	M M M	+++ ¹² +++ ¹² +++ ¹²	3-6 lb 1.875-3.75 lb 1.5-3.0 qt	0 0 0 48 lb 30 lb 24 qt

Commercial Crop Production Small Fruits - Strawberries

Table 2. Disease descriptions and recommended pesticides.

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Product Choices ¹ and Product Mode of Action Group ²	Efficacy ³	Rate ⁴	PHI ⁵	Maximum Use ⁶	
captan and fenhexamid (CaptEstate 68 WDG)	M,17	+++++	3.5-5.25 lb ¹³	0	21 lb
cyprodinil and fludioxonil (Switch 62.5 WG)	9,12	+++++ ¹²	11-14 oz	0	56 oz
fenhexamid (Elevate 50WDG)	17	+++++	1.5 lb ¹³	0	6 lbs
Fluxapyroxad and pyraclostrobin (Merivon) ⁷					
iprodione (Rovral 4, Iprodione 4L, Meteor, Nevado 4F)	7,11	+++++	8-11 fl oz	0	33 fl oz
	2	+++++ ¹²	1.5-2 pt	-- ¹⁴	1 app
penthiopyrad (Fontelis) ¹⁵					
pyrimethanil (Scala SC)	7	+++++	16-24 fl oz	0	72 fl oz
thiophanate-methyl (Thiophanate Methyl 85 WDG) (Topsin M 70WP) (Topsin 4.5FL)	9	+++	18 fl oz	1	54 fl oz
	1	++++	0.6-0.8 lb	1	3.2 lb
	1	++++	0.75-1 lb	1	4 lb
Thiram (Granuflo 75WDG)	1	++++	15-20 fl oz	1	80 fl oz
	M	+++	4.4 lb	3	22 lb
Angular (Bacterial) Leaf Spot (<i>Xanthomonas fragariae</i>)					
Symptoms: First visible as tiny, water-soaked spots on the lower leaf surface that enlarge into angular lesions delimited by leaf veins. Lesions appear translucent when held up to the light. Bacterial ooze may be found on lesions on lower leaf surfaces.					
Source of Inoculum: The bacterium survives in infected leaf debris or is introduced on infected planting material. Bacterial cells are spread primarily by rain splashing and wind-driven rain. Disease develops most under cool, wet conditions.					
Management: Use disease-free transplants. Spray with copper fungicides if needed.					
Acibenzolar-S-methyl (Actigard 50WG)	P1	+	0.5-0.75 oz	0	6 oz
Copper-containing products labeled for use on strawberries, including ones with basic copper sulfate, copper hydroxide, copper oxychloride, copper octanoate, copper sulfate pentahydrate, or cuprous oxide - some products OMRI listed ^(OG) ¹⁶	M	+	See label	0	See label

Commercial Crop Production Small Fruits - Strawberries

Table 2. Disease descriptions and recommended pesticides.

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Product Choices ¹ and Product Mode of Action Group ²		Efficacy ³	Rate ⁴	PHI ⁵	Maximum Use ⁶
Powdery Mildew (<i>Sphaerotheca macularis</i> f. sp. <i>fragariae</i>)					
Symptoms: A white powdery growth is present on the undersurface of infected leaves and on fruit. Infected leaves have a tendency to roll up.					
Source of Inoculum: The fungus persists from year to year on infected strawberries and other wild hosts. Usually a problem in the spring and early summer months.					
Management: Many varieties are resistant to this disease. Spray with fungicides if needed.					
azoxystrobin (Abound F, Azaka)	11	++	6.0-15.5 fl oz	0	61.5 fl oz
azoxystrobin and difenoconazole (Quadris Top)	11,3	+++	12-14 fl oz	0	56 fl oz
boscalid and pyraclostrobin (Pristine)	7,11	++	18.5-23 oz	0	115 oz
fluxapyroxad and pyraclostrobin (Merivon) ⁷	7,11	++	4-7 fl oz	0	33 fl oz
myclobutanil (Rally 40WSP)	3	+++++	2.5-5 oz	0	30 oz
propiconazole (Bumper 41.8 EC, Bumper 40.85 ES, Tilt)	3	+++	4 fl oz	0	16 fl oz
pyraclostrobin (Cabrio EG)	11	++	12-14 oz	0	70 oz
quinoxifen (Quintec)	13	+++++	4-6 fl oz	1	24 fl oz
sulfur ¹⁷ (Liquid Sulfur Six)	M	+++	2 pt	0	
(Microfine & Yellow Jacket Wettable II; 90%)	M	+++	3-50 lb	0	
(Microthiol Dispers ^{OG} ; 80%)	M	+++	5-10 lb	0	
triflumizole (Procure 480SC)	3	+++++	4-8 fl oz	1	32 fl oz
Leaf Spot (False Rust, Bird's Eye Spot) (<i>Mycosphaerella fragariae</i>)					
Symptoms: The spots are at first less than 1/8 inch in diameter and purplish-red. Spots enlarge to about 3/16 inch. They have white or gray centers with purplish borders.					
Source of Inoculum: The fungus survives from year to year on infected plant parts.					
Management: Spray with fungicides if needed.					
Azoxystrobin (Abound F, Azaka)	11	+	6.0-15.5 fl oz	0	61.5 fl oz
Azoxystrobin and difenoconazole (Quadris Top)	11,3	+++	12-14 fl oz	0	56 fl oz

Commercial Crop Production Small Fruits - Strawberries

Table 2. Disease descriptions and recommended pesticides.

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Product Choices ¹ and Product Mode of Action Group ²	Efficacy ³	Rate ⁴	PHI ⁵	Maximum Use ⁶	
Boscalid and pyraclostrobin (Pristine)	7,11	+++++	18.5-23 oz	0	115 oz
captan (50 WP)	M	++	3-6 lb	0	48 lb
(80 WDG)	M	++	1.875-3.75 lb	0	30 lb
(38.75% FL, Captec 4L)	M	++	1.5-3.0 qt	0	24 qt
captan + thiophanate-methyl (Captan or Captec product + Topsin M 70WP)	M,1	+++	Use 2/3 of higher rate (above) for captan product + 1 lb Topsin M	1	See above; 4 lb for Topsin M
Copper-containing products labeled for use on strawberries, including ones with basic copper sulfate, copper hydroxide, copper oxychloride, copper octanoate, copper sulfate pentahydrate, or cuprous oxide - some products OMRI listed ^(OG) ¹⁶	M	+	See label	0	See label
fluxapyroxad and pyraclostrobin (Merivon) ⁷	7,11	+++++	4-7 fl oz	0	33 fl oz
myclobutanil (Rally 40WSP)					
pyraclostrobin (Cabrio EG)	3	++++	2.5-5 oz	0	30 oz
thiophanate-methyl (Thiophanate Methyl 85 WDG)	11	+	12-14 oz	0	70 oz
(Topsin M 70WP)					
(Topsin 4.5FL)	1	++	0.6-0.8 lb	1	3.2 lb
	1	++	0.75-1 lb	1	4 lb
Thiram (Granuflo 75WDG)	1	++	15-20 fl oz	1	80 fl oz
	M	++	4.4 lb	3	22 lb
Leaf Blight (<i>Phomopsis obscurans</i>)					
Symptoms: First appears as large, circular, reddish-purple spots that become zonate with age (i.e., they have a dark brown center surrounded by a lighter brown area with a purplish border). Mature spots may be circular, oval or V-shaped.					
Source of Inoculum: The fungus lives from year to year primarily on infected plant tissue.					
Management: Use disease-free transplants. Spray with fungicides if needed.					
boscalid and pyraclostrobin (Pristine)	7,11	+++++	18.5-23 oz	0	115 oz
captan (50 WP)	M	++	3-6 lb	0	48 lb

Commercial Crop Production Small Fruits - Strawberries

Table 2. Disease descriptions and recommended pesticides.

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Product Choices ¹ and Product Mode of Action Group ²	Efficacy ³	Rate ⁴	PHI ⁵	Maximum Use ⁶	
(80 WDG)	M	++	1.875-3.75 lb	0	30 lb
(38.75% FL, Captec 4L)	M	++	1.5-3.0 qt	0	24 qt
captan + thiophanate-methyl (Captan or Captec product + Topsin M 70WP)	M,1	+++	Use 2/3 of higher rate (above) for captan product + 1 lb Topsin M	1	See above; 4 lb for Topsin M
fluxapyroxad and pyraclostrobin (Merivon) ⁷					
myclobutanil (Rally 40WSP)	7,11	+++++	4-7 fl oz	0	33 fl oz
thiophanate-methyl (Thiophanate Methyl 85 WDG) (Topsin M 70WP) (Topsin 4.5FL)	3	++++	2.5-5 oz	0	30 oz
thiram (Granuflo 75WDG)	1	++	0.6-0.8 lb	1	3.2 lb
	1	++	0.75-1 lb	1	4 lb
	1	++	15-20 fl oz	1	80 fl oz
	M	++	4.4 lb	3	22 lb

Leaf Blotch (*Gnomonia* spp.)

Symptoms: First appears as purplish to brownish blotches on young leaves. Later appears as large, light brown spots on older leaves. May affect fruit as well.

Source of Inoculum: The fungus lives from year to year primarily on infected plant tissue.

Management: Spray with fungicides if needed.

captan (50 WP)	M	++	3-6 lb	0	48 lb
(80 WDG)	M	++	1.875-3.75 lb	0	30 lb
(38.75% FL, Captec 4L)	M	++	1.5-3.0 qt	0	24 qt
captan + thiophanate-methyl (Captan or Captec product + Topsin M 70WP)	M,1	+++	Use 2/3 of higher rate (above) for captan product + 1 lb Topsin M	1	See above; 4 lb for Topsin M
myclobutanil (Rally 40WSP)	3	++++	2.5-5 oz	0	30 oz
thiram (Granuflo 75WDG)	M	++	4.4 lb	3	22 lb

Leaf Scorch (*Diplocarpon earlianum*)

Symptoms: The disease first appears on upper leaf surfaces as small purplish spots that enlarge rapidly into irregular purplish blotches from 1/16 inch to 3/16 inch in diameter. The spots may become numerous and coalesce. In severe cases, the edges of the leaflets curl upward and the tissue dies, giving the plant a scorched appearance.

Source of Inoculum: The fungus survives from year to year on infected leaves.

Commercial Crop Production Small Fruits - Strawberries

Table 2. Disease descriptions and recommended pesticides.

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Product Choices ¹ and Product Mode of Action Group ²	Efficacy ³	Rate ⁴	PHI ⁵	Maximum Use ⁶	
Management: Use disease-free transplants. Rotate strawberry fields, if possible. Spray with fungicides if needed.					
captan (50 WP)	M	++	3-6 lb	0	48 lb
(80 WDG)	M	++	1.875-3.75 lb	0	30 lb
(38.75% FL, Captec 4L)	M	++	1.5-3.0 qt	0	24 qt
captan + thiophanate-methyl (Captan or Captec product + Topsin M 70WP)	M,1	+++	Use 2/3 of higher rate (above) for captan product + 1 lb Topsin M	1	See above; 4 lb for Topsin M
myclobutanil (Rally 40WSP)	3	++++	2.5-5 oz	0	30 oz
thiram (Granuflo 75WDG)	M	++	4.4 lb	3	22 lb

Nematode Diseases

Root-knot nematodes (*Meloidogyne* spp.)

Symptoms: Affected plants are stunted, unthrifty, nonproductive and often pale green in color. Galls or knots on the roots are rather small. Numerous secondary roots may develop at the small swellings. Frequently, blackened, rotten roots are associated with root-knot problems.

Source of Inoculum: Root-knot nematodes live from year to year in the soil and on the roots of strawberry plants and many weeds. Root-knot nematodes are more severe in light soil types.

Management: Sample soil for nematodes, and fumigate soil if needed. See recommendations in the Nematode Control section of this guide and on page 4 of the Southeast Regional Regional Strawberry Integrated Management Guide:

<http://www.smallfruits.org/SmallFruitsRegGuide/Guides/2015/2015StrawberryIPMGuide.pdf>.

Summer dwarf or Bud nematodes (*Aphelenchoides besseyi*)

Symptoms: Affected plants are severely stunted during the summer and early fall. Older leaflets usually are darker green with a greasy appearance. Young leaflets are reduced in size, usually crinkled and somewhat elongated, with shorter petioles. Margins of leaflets may curl upward in the young leaflets and downward in the older leaflets.

Source of Inoculum: Bud nematodes live from year to year on infected daughter plants and in the soil.

Management: Fumigate fields where the disease has occurred. Obtain clean plants. There is no satisfactory treatment to eradicate these nematodes from infected plants.

¹Chemical name (trade name). Reference to commercial or trade names is made for the reader's convenience and with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied. In some cases, other brands are available.

²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).

³Efficacy ratings are on a 1-5 scale where: 5 (+++++) is the most effective and 1 (+) is the least effective. Much of the information in this table, including efficacy ratings, is based on the 2014 Southeast Regional Strawberry Integrated Pest Management Guide of the Southern Region Small Fruit

Commercial Crop Production Small Fruits - Strawberries

Consortium (<http://www.smallfruits.org/SmallFruitsRegGuide/index.htm>).

⁴Rates are the amount of formulation (product) per acre unless otherwise indicated. Usually 100 gallons of water are required to give good coverage with boom sprayers.

⁵Post-harvest interval (PHI) is the minimum number of days allowed between the last application and harvest.

⁶Maximum amount per acre per year or growing season. See labels for additional restrictions.

⁷ **Supplemental label (EPA Reg. No. 7969-310). Expires September 2016.**

⁸Make sure to get the Aliette WDG that is labeled for use on strawberries. There is a product of the same name that is not labeled for strawberries.

⁹Do not apply more than 3.75 lbs. product (3 lbs. AI) per acre per application in Livingston or Rapides parishes in order to protect endangered freshwater mollusks and their habitats.

¹⁰ Applications by ground (banded), drip, or overhead chemigation.

¹¹ Apply in banded sprays or drip irrigation.

¹²Rating is for gray mold. For crown rot, ratings are ++ for captan and ++++ for Switch and iprodione.

¹³ "When plastic mulch is used, do not apply within 16 feet...of naturally vegetated or aquatic areas."

¹⁴Do not apply after first fruiting flower.

¹⁵Do not apply to cvs. 'Clancy, 'Jewel', or 'L'Amour'.

¹⁶OMRI-listed copper products include Champ WG (copper hydroxide), Cueva Fungicide Concentrate (copper octanoate), and Badge X2 (copper oxychloride + copper hydroxide).

¹⁷Do not apply when temperatures are expected to exceed 90 °F for three or more days.

Revised by Ms. M.H. Ferguson and Dr. C. Clark in December 2014.

Commercial Crop Production

Sweet Potatoes

Integrated Sweet Potato Disease Management

Successful management of sweet potato diseases requires the same strategies as other vegetables (see Chapter VIII). Using resistant varieties, starting with clean seed stock and good sanitation practices are essential to minimizing diseases of sweet potatoes.

Use disease resistant varieties. Select resistant varieties (Table 1) based on the disease profile for your production region.

Use virus-tested foundation seed. A combination of aphid-transmitted viruses commonly infect sweet potatoes and can significantly reduce yields by up to 25-40 percent even though the symptoms they induce may be very mild. It is not yet possible to totally prevent virus infections in sweet potato, but using virus-tested foundation seed and a good on-farm seed program can minimize their effects on yield. The LSU AgCenter Sweet Potato Research Station provides information on purchasing virus-tested foundation seed:

http://www.lsuagcenter.com/en/our_offices/research_stations/Sweetpotato/Features/misson+and+Foundatio+n+Seed+Programs/index.htm.

Sweet Potato Research Station

LSU AgCenter
130 Sweet Potato Road
Chase, LA 71324
Phone: 318-435-2155
Fax: 318-435-2110

For most growers, it will be necessary to go through a one-year on-farm increase of planting materials from the foundation seed. The foundation seed should be bedded and the seed crops produced should be kept as far away from older virus-infected sweet potato crops as possible to reduce the rate of re-infection with viruses.

Use good sanitation practices. Several bacterial and fungal pathogens that cause sweet potato diseases (bacterial root rot, Fusarium root rot, black rot, foot rot, scurf, as well as root-knot nematode) can be carried in the roots and transmitted onto slips. The use of routine sanitation measures is an essential part of an integrated management program for controlling sweet potato diseases caused by bacteria and fungi. The following sanitation tactics should be used for disease prevention.

1. Select seed free from disease or nematode cracking.
2. Cut transplants at least one inch above the soil rather than pulling slips.
3. Bed in problem-free area and avoid repeated bedding in the same site.
4. Rotate beds and production fields on a regular basis.

Foliar fungicides. Data is lacking to suggest that fungal leaf diseases cause any significant effect on sweet potato yields in the southeastern United States. Thus, while some fungicides (Table 2) may be labeled for controlling these foliar diseases, they have not been evaluated for efficacy or crop tolerance on sweet potatoes. To avoid the buildup of pathogens with fungicide resistance, fungicides should be alternated with fungicides with a different mode of action (see Chapter IV).

Commercial Crop Production Sweet Potatoes

Table 1. Sweet potato variety reactions to common diseases in Louisiana
S indicates a susceptible reaction, R indicates a resistant reaction, I indicates an intermediate reaction and – indicates that the reaction is not known.

Variety	Disease						
	Rhizopus Soft Rot	Root Knot Nematode	Soil Rot	Fusarium Wilt	Sclerotial Blight	Fusarium Root Rot	Bacterial Root Rot
Bayou Belle (L07-146)	R	I-R	I-R	R	-	-	S
Beauregard	R	S	R-I	R	I	R	S
Bonita	S	R	I	I-R	-	S-I	S
Centennial	-	S	S	I-R	I-S	I	R
Covington	I	I-R	I-R	R	-	-	-
Evangeline	R	R	I-R	R	-	R	S
Hernandez	I-S	R-I	R-I	I-R	-	I	R
Jewel	I	R	S	R	I	I	I
Porto Rico (Unit 1)	-	I-S	S	S	S	R-I	R

Commercial Crop Production Sweet Potatoes

Table 2. Recommended pesticides, rates and pesticide use restrictions for sweet potato diseases.					
Disease (Pathogen)	Product Choices¹ and Product Mode of Action Group²	Rate³	PHI⁴	Maximum Use	
Bacterial Root Rot (<i>Erwinia chrysanthemi</i>)	Sodium hypochlorite (chlorine)		100-150 ppm ⁵		1 app
Black Rot (<i>Ceratocystis fimbriata</i>)	Thiabendazole 4L ST (seed root dip only)	1	107 fl oz/100 gal ^{6,11}		1 app
Foot Rot (<i>Plenodomus destruens</i>)	Thiabendazole 4L ST (seed root dip only)	1	107 fl oz/100 gal ^{6,11}		1 app
Fusarium Root Rot (<i>Fusarium spp.</i>)	Proper curing at harvest, good sanitation practices, use of high quality seed roots and prevention of wounding by controlling nematodes and insects are the most effective strategies for reducing Fusarium root rot.				
Rhizopus Soft Rot (<i>Rhizopus spp.</i>)	Dicloran				
	Botran 5F	14	0.6 qt/100 gal		1 app ¹⁰
	Botran 75WP	14	1 lb/100 gal		1 app ¹⁰
	Fludioxonil Scholar SC	12	16-32 fl oz/100 gal		1 app ^{10,11}
Sclerotial Blight (<i>Sclerotium rolfsii</i>)	Dicloran (seed root dip only)				
	Botran 5F	14	0.6 qt/7.5 gal ⁷		1 app
	Botran 75WP	14	1 lb/7.5 gal ⁷		1 app
	Dicloran (spray⁸ application only)				
	Botran 5F	14	5.73 oz/14 gal ⁹		1 app
	Botran 75WP	14	4.8 oz/14 gal ⁹		1 app
	Azoxystrobin				
	Equation	11	0.4-0.8 fl oz ⁹		123 fl oz/A/yr
	Quadris Flowable	11	0.4-0.8 fl oz ⁹		123 fl oz/A/yr
Satori	11	0.4-0.8 fl oz ⁹		123 fl oz/A/yr	
Willowood Azoxy 2SC	11	0.4-0.8 fl oz ⁹		123 fl oz/A/yr	
Scurf (<i>Monilochaetes infuscans</i>)	Dicloran (seed root dip only)				
	Botran 5F	14	0.6 qt/7.5 gal ⁷		1 app
	Botran 75WP	14	1 lb/7.5 gal ⁷		1 app
	Dicloran (spray⁸ application only)				
	Botran 5F	14	5.7 oz/14 gal ⁹		1 app
	Botran 75WP	14	3-3.75 lb/14 gal ⁹		1 app
Thiabendazole 4L ST (seed root dip only)	1	107 fl oz/100 gal ^{6,12}		1 app	

Commercial Crop Production Sweet Potatoes

Table 2. Recommended pesticides, rates and pesticide use restrictions for sweet potato diseases.					
Disease (Pathogen)	Product Choices¹ and Product Mode of Action Group²	Rate³	PHI⁴	Maximum Use	
Soil Rot or Pox (<i>Streptomyces ipomoea</i>)	Resistant varieties (Table 1) should be used. Soil pH should be maintained below 5.2 to minimize disease severity if a susceptible variety is used.				
White Rust (<i>Albugo ipomoeae-panduratae</i>)	Azoxystrobin				
	Quadris Flowable	11	6.0-15.5 fl oz	0	123 fl oz
	Satori	11	6.0-15.5 fl oz	0	123 fl oz
	Willowood Azoxy 2SCReason	11	6.0-15.5 fl oz	0	123 fl oz
	500SC	11	5.5-8.2 fl oz	14	16.4 fl oz
<p>¹ Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.</p> <p>² Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).</p> <p>³ Rates are the amount of formulation (product) per acre unless otherwise indicated. Usually 100 gallons of water are required to give good coverage with boom sprayers.</p> <p>⁴ Pre-harvest interval (PHI) is the minimum number of days allowed between the last application and harvest.</p> <p>⁵ Maintain free chlorine between 100-150 ppm, pH 6.5-7.5. Replace wash water as often as possible or when it becomes obviously dirty.</p> <p>⁶ Replace wash water as often as possible or when it becomes obviously dirty.</p> <p>⁷ Dip seed roots for 10-15 seconds in a well-agitated suspension. Drain and bed immediately. Prepare a fresh suspension daily.</p> <p>⁸ Sprayed onto seed roots and soil after seed roots are laid out in the beds.</p> <p>⁹ All rates are per 1000 linear feet of row on a 42 inch plant bed. Refer to the label for modes of application.</p> <p>¹⁰ For post-harvest disease control. Dip sweet potatoes for 30 seconds in a well-agitated suspension. Do not expose treated roots to direct sunlight.</p> <p>¹¹ To apply as a spray use 16 fl oz/100 ton of sweet potatoes. Refer to label for application directions.</p> <p>¹² Do not use treated roots for food or animal feed.</p>					

The sweet potatoes section was revised December 2014 by Dr. C.A. Clark.

Commercial Crop Production Christmas Trees and Conifers

Integrated Disease Management for Christmas Tree Production

Christmas trees growers face many obstacles to growing healthy trees with the largest challenge being pests. The development of an integrated program for managing diseases as well as insects must begin prior to the establishment of a crop. Successful management of Christmas tree diseases requires proper identification of the tree species as well as the disease, good sanitation practices, fungicide spray applications that target the pathogen's vulnerable life stage, and accurate selection of fungicides. A detailed IPM Guide for Christmas tree production is available from Penn State University and the Pennsylvania Department of Agriculture (<http://pubs.cas.psu.edu/FreePubs/pdfs/agrs117.pdf>).

Most diseases of Christmas trees and conifers are caused by fungi and nematodes (Table 1). Fungal diseases can move rapidly through a plantation as fungal spores are dispersed by wind, rain, animals or, physical activities such as mowing, pruning or harvesting. Fungal diseases are easiest to identify when fruiting bodies (if produced) are present on the needles.

Table 1. Christmas tree and conifer diseases, symptoms and integrated disease management tactics	
Disease	Symptoms and Management
Armillaria Root Rot (<i>Armillaria</i> spp.)	<p>Hosts: Most Christmas tree species</p> <p>Symptoms: Reduced terminal growth. Yellowing and eventual browning of all the needles. A white resin forms at the base of the tree and white fans of fungus form between the bark and wood near the base of the tree. Tan colored mushrooms may form at the base of the tree. Rapid death of young tree groupings may occur.</p> <p>Cultural Management: Remove tree. Dig up stumps, root balls and pruning waste and burn on site. For small trees remove as much soil around the root ball as possible. Do not plant a new tree in the same location.</p> <p>Fungicides: No fungicides are effective at managing Armillaria root rot. Soil fumigants may suppress disease.</p>
Botryosphaeria Canker and Dieback (<i>Botryosphaeria dothidea</i>)	<p>Hosts: All Christmas tree species</p> <p>Symptoms: Disease is more common on environmentally stressed trees. Branch wilting or dieback. Cankers form on twigs and branches. Wood beneath the bark is reddish-brown. Bark may peel from cankered area.</p> <p>Cultural Management: Maintain proper nutrient and water levels so that trees are not stressed. Protect seedlings from freeze injury. Remove and destroy diseased branches.</p> <p>Fungicides: No effective chemicals are available at this time.</p>
Botrytis Blight (<i>Botrytis cinerea</i>)	<p>Hosts: All Christmas tree species</p> <p>Symptoms: Water-soaked spots on needles and shoots that turn brown and girdle the needle or shoot. Blighted new growth (tip dieback) that resembles cold damage. Gray, fuzzy spores are present on diseased needles and shoots.</p> <p>Cultural Management: Space new plantings to promote good air flow and drying. Remove weeds from under and around the trees. Prune out infected tips. Disinfect shears with Clorox bleach (20%) or 70%</p>

**Commercial Crop Production
Christmas Trees and Conifers**

Table 1. Christmas tree and conifer diseases, symptoms and integrated disease management tactics

Disease	Symptoms and Management
	<p>ethanol between cuts. Remove infected seedlings from seedling beds to prevent spore dispersal to healthy seedlings.</p> <p>Fungicides: Fungicides are not effective for established plantings. Apply dicloran (Botran 75W at 2 lb/a) preventatively to nursery, greenhouse, container and bare rootstocks.</p>
<p>Brown Spot Needle Blight (<i>Scirrhia acicula</i>)</p>	<p>Hosts: Pines (especially Scotch).</p> <p>Symptoms: Straw yellow spots form on the needles and later turn to a light brown color with darker margins. Needles begin to die from the tip backward and drop during October and November leaving bare branches.</p> <p>Cultural Management: Do not shear trees in wet weather. Shear disease-free trees first. Cut and remove diseased trees. Avoid leaving live branches on stumps of harvested trees. Plant less susceptible varieties such as long needle varieties (i.e. Austrian Hills or German).</p> <p>Fungicides: Chlorothalonil (i.e. Bravo Ultrex, Daconil Ultrex, Chloronil 720, Initiate 720, Equus 82.5%); mancozeb (i.e. Fore-80WP Rainshield, Manzate max, Penncozeb 75DF); chlorothalonil plus thiophanate methyl (Spectro 90 WDG). Rates vary depending on the product.</p>
<p>Cercospora Needle Blight (<i>Cercosporidium sequoia</i>)</p>	<p>Hosts: Cypress (Arizona, Leyland), juniper, red cedar</p> <p>Symptoms: Disease is more common on environmentally stressed trees or poorly managed trees. Browning of the needles and scales beginning on the inner portions of the lower branches.</p> <p>Cultural Management: Maintain proper nutrient and water levels so that trees are not stressed. Do not let weeds grow up under or between trees.</p> <p>Fungicides: Apply copper in mid- to late spring. Copper sulfate (i.e. Cuprofix-Ultra 40 Disperss, Cuproxat); copper hydroxide (i.e. Kocide 2000 or 3000, Kentan DF, Badge X2, Champ Formula 2 Flowable).</p>
<p>Cyclaneusma Needlecast (<i>Cyclaneusma minor</i>)</p>	<p>Hosts: Pines (especially Scotch).</p> <p>Symptoms: Disease is more common on environmentally stressed trees. Light green spots that become yellow on older needles. This disease is often referred to as the “fall yellower”. Off-white to white fruiting bodies form on yellowed needles.</p> <p>Cultural Management: Maintain proper nutrient and water levels so that trees are not stressed. Do not let weeds grow up under or between trees.</p> <p>Fungicides: Apply fungicides if more than 20% of the trees are diseased. Apply chlorothalonil (i.e. Bravo Ultrex, Daconil Ultrex, Chloronil 720, Initiate 720, Equus 82.5%) prior to budbreak and repeat at 6 to 8 week intervals until late fall. Rates vary depending on the product.</p>

**Commercial Crop Production
Christmas Trees and Conifers**

Table 1. Christmas tree and conifer diseases, symptoms and integrated disease management tactics	
Disease	Symptoms and Management
<p>Diplodia (Sphaeropsis) Tip Blight (<i>Diplodia pinea</i> formerly <i>Sphaeropsis sapinea</i>)</p>	<p>Hosts: Pines (Scotch, red, white and Austrian) and other conifers. Rarely found on Douglas fir or spruce.</p> <p>Symptoms: Discolored needle tips (brown, yellow, gray) on current season's growth. Needles are stunted and shoots may curl. Branch dieback. Small black fruiting bodies form on needles, cones and shoots. Cankers form on stems and branches and ooze resin that drips and adheres to needles. Trees are most susceptible from bud break to needle elongation.</p> <p>Cultural Management: Disease is more common on environmentally stressed trees. Maintain proper nutrient and water levels so that trees are not stressed. Do not let weeds grow up under or between trees. Remove and destroy infected twigs, branches and cones during dry weather.</p> <p>Fungicides: Azoxystrobin (i.e. Equation, Heritage, Satori, Quadris); thiophanate-methyl (i.e. Cercobin, Incognito 4.5F, Topsin 4.5FL). Rates vary depending on the product.</p>
<p>Gall Rusts</p> <p>Pine-oak gall rust (Eastern gall rust) (<i>Cronarium quercuum</i>)</p> <p>Pine-Pine Gall Rust (Western gall rust) (<i>Endocronartium harknessii</i>)</p>	<p>Hosts: Pines (Scotch, red, Virginia, Mugo, Jack, and Austrian). Oaks are an alternate host for Eastern gall rust.</p> <p>Symptoms: Stunting, deformation, and twig and branch dieback. Visible, globe-shaped galls form on the stems or branches. Yellow-orange colored fruiting bodies form on the surface of mature galls in the spring.</p> <p>Cultural Management: Remove seedlings with galls or cut out branches with galls from established trees. Do not remove branches or trees during sporulation. Monitor and manage gall rust in oak trees that are near the plantation.</p> <p>Fungicides: Mancozeb (Dithane 75DF Rainshield and Fore 80W Rainshield). Rates vary depending on the product.</p>
<p>Lophodermium Needlecast (<i>Lophodermium seditiosum</i>, <i>L. pinastri</i>)</p>	<p>Hosts: Pines. Scotch, Austrian, and red pines are the most susceptible.</p> <p>Symptoms: Yellow to reddish-brown spots. Newly infected needles redden by early spring. This disease is often referred to as the "spring reddener". Raised black fruiting bodies form on attached and detached dead needles.</p> <p>Cultural Management: Remove and destroy fallen needles. In the spring remove and destroy severely infected trees.</p> <p>Fungicides: Chlorothalonil (i.e. Bravo Ultrex, Daconil Ultrex, Chloronil 720, Initiate 720, Equus 82.5%); mancozeb (i.e. Fore-80WP Rainshield, Manzate max, Penncozeb 75DF); azoxystrobin (i.e. Heritage, Satori, Quadris). Rates vary depending on the product.</p>
<p>Melampsora Needle Rust (<i>Melampsora occidentalis</i>)</p>	<p>Hosts: Douglas Fir. Black cottonwoods and aspen poplars are alternate hosts.</p> <p>Symptoms: Slightly chlorotic areas on new needles. Needles eventually turn brown, shrivel and drop. Fruiting bodies (cream colored) form on the dead needles. White colored spores are produced from the fruiting</p>

**Commercial Crop Production
Christmas Trees and Conifers**

Table 1. Christmas tree and conifer diseases, symptoms and integrated disease management tactics

Disease	Symptoms and Management
	<p>bodies.</p> <p>Cultural Management: Remove poplars growing near the plantation. Resistant varieties are available.</p> <p>Fungicides: Apply ziram during early stages of shoot development.</p>
<p>Phytophthora Root Rot (<i>Phytophthora</i> spp.)</p>	<p>Hosts: Most Christmas tree species</p> <p>Symptoms: Reduced and stunted growth. Yellowing and eventual browning of all the needles. Bleeding basal cankers and root decay. Rapid tree death.</p> <p>Cultural Management: Do not plant in fields infested with <i>Phytophthora</i>. Plant in well drained fields and avoid standing water in the fields.</p> <p>Fungicides: Fungicides are only effective if used in conjunction with good cultural practices. Fungicides are not effective on trees showing moderate to high levels of disease. Fungicides are most effective when applied to seedlings or at transplant. Dazomat (i.e. BasamidG); metalaxyl (Metastar 2E); mefenoxam (i.e Subdue GR, Subdue Maxx). Rates vary depending on the product.</p>
<p>Phomopsis Blight (<i>Phomopsis juniperovora</i>)</p>	<p>Hosts: Juniper, red cedar, Arizona cypress, arborvitae</p> <p>Symptoms: Shoot tips turn yellow and then brown. Gray cankers on shoots girdle the shoots and cause dieback. Black fruiting bodies can be seen on the canker with a hand lens.</p> <p>Cultural Management: Plant resistant varieties. Prune out diseased shoots when plants are dry. Prune by making a cut 3 inches below the dying shoot. Disinfect shears with Clorox bleach (20%) or 70% ethanol between cuts.</p> <p>Fungicides: Mancozeb (i.e. Fore-80WP Rainshield, Dithane 75DF Rainshield); propiconazole (i.e. Banner Maxx, Bumper ES, Fitness, Procon Z, Protocol); copper hydroxide (i.e. Kocide 2000 or 3000, Champ Formula 2 Flowable); copper sulfate (i.e. Cuprofix Ultra 40 Disperss).</p>
<p>Pine Wilt Disease (nematode) (<i>Bursaphelenchus xylophilus</i>)</p>	<p>Hosts: Pines (especially Scotch)</p> <p>Symptoms: Nematodes are moved from tree to tree by the pine sawyer beetle. Needles turn yellow then reddish-brown and wilt. Needles remain on the tree. The nematodes feed on resin ducts of healthy trees.</p> <p>Cultural Management: Manage beetle infestations. Remove and destroy diseased trees.</p> <p>Chemical control: No chemicals are available at this time.</p>
<p>Ploiderma Needlecast (<i>Ploiderma lethale</i>)</p>	<p>Hosts: Pines (Austrian and red)</p> <p>Symptoms: Reddish-brown spots that girdle the needle and kill the tips. Dead tips may break off leaving a green base attached. Fruiting bodies appear as long black lines on the dead portion of the needle.</p> <p>Cultural Management: Remove and destroy diseased branches or trees.</p> <p>Fungicides: No fungicides are labeled for Ploiderma needlecast</p>

**Commercial Crop Production
Christmas Trees and Conifers**

Table 1. Christmas tree and conifer diseases, symptoms and integrated disease management tactics

Disease	Symptoms and Management
	disease in Louisiana.
Red-band Needle Blight (Dothistroma needle blight) <i>(Mycosphaerella pini)</i>	Hosts: Pines. Austrian, Ponderosa, and Mugo pines are very susceptible. Symptoms: Dark green bands that may contain yellow or tan colored spots. Bands eventually turn brown to reddish-brown. Brown dead needle tips can be observed in late winter. Dark brown fruiting bodies form on dead needles. Cultural Management: Do not shear trees in wet weather. Shear disease-free trees first. Fungicides: No fungicides are labeled for red-band needle blight in Louisiana.
Seiridium Canker or Dieback <i>(Seiridium unicorne)</i>	Hosts: Cypress Symptoms: Water stressed trees are very susceptible to disease. Yellowing and browning of upper lateral shoots. Elongated dark brown or purple cankers are observed on stems, branches and branch axils resulting in dieback. Cankers are sunken with raised margins. Wood beneath the bark oozes resin and is reddish brown in color. Cultural Management: Remove cankered twigs and branches. Prune out infected tips. Disinfect shears with Clorox bleach (20%) or 70% ethanol between cuts. Remove severely diseased trees or trees with cankers on the main trunk. Fungicides: Effective chemical control is not available at this time.
Spruce Needle Rust <i>(Chrysomyxa weirii)</i>	Hosts: Spruce. No alternate host. Symptoms: Pale yellow bands that turn brown and drop after one year. Orange fruiting bodies are present on most new growth. Cultural Management: Cut and remove diseased trees before fruiting bodies mature at bud break. Fungicides: No fungicides are labeled for spruce needle rust in Louisiana.
Uredinopsis Needle Rust <i>(Uredinopsis pteridis)</i>	Hosts: Fir (Grand, White and Shasta). Bracken ferns are an alternate host. Symptoms: Chlorotic areas or blotches on upper surface of the needles. Browning of the needles is not observed. Tube-like fruiting bodies form on the underside of the needles. White colored spores are produced from the fruiting bodies. Cultural Management: Remove and destroy all bracken ferns that are in or near the plantation. Shasta fir is less susceptible than grand or white fir. Fungicides: No fungicides are labeled for spruce needle rust in Louisiana.

The Christmas tree and conifer section was revised December 2014 by Dr. M. L. Lewis Ivey.

Commercial Crop Production Turfgrass

Integrated Turfgrass Disease Management

Effective turfgrass disease management can be achieved by maintaining healthy and vigorously growing grass. Diseases can be avoided by selecting resistant cultivars and turfgrass species that are well adapted to site conditions and the local climate. Establishing a fertility program that promotes turfgrass vigor (Table 1), adopting optimal mowing heights (Table 1) and using good irrigation practices can minimize fungicide use significantly.

Table 1.		
Grass Type	Nitrogen Fertility Timing	Mowing¹
Warm season grasses	Summer (May-August)	1-2 inches
Cool season grasses	Fall	2.5 to 4.0 inches

¹Do not remove more than one-third of the leaf growth during a single mowing. Maintain a sharp blade to minimize mechanical injuries on leaf blades.

Commercial Crop Production Turfgrass

Table 2. Disease identification key for southern turfgrass

Disease identification key was developed by Dr. G. Holcomb, Professor Emeritus

I. Grass affected in distinct patches; yellow to brown in color.

- A. Patches about 3 inches in diameter; leaf lesions present..... **Dollar Spot**
- B. Patches greater than 3 inches in diameter; no leaf lesions present. **Go to 1 or 2.**
- 1. Ring or arc of lush growth or dead grass; mushrooms present or absent..... **Fairy Ring**
- 2. No ring or arc of lush growth present; no mushrooms present.
 - a. Grass often affected in streaks, with leaves matted; primarily on rye grass over seeded on golf courses and Bermuda grass greens..... **Pythium Blight**
 - b. Patches more or less circular, may enlarge to several feet; leaves rotted at the base, can be pulled easily from the leaf sheath..... **Large Patch¹**
 - c. Affected areas irregular in shape, 8-24 inches in diameter (or larger) with a mixture of yellow and dead grass; roots are sparse, short and black; stolons may be rotted..... **Take-all Root Rot²**

II. Grass not affected in patches.

- A. Chlorotic spots and orange powder (spores that can be rubbed off) on leaves..... **Rust**
- B. Leaf spots present, but no orange powder present. **Go to 1, 2, or 3.**
- C. No leaf spots present. **Go to 4 or 5.**
- 1. Leaf spots varying in size; occurring primarily on Bermuda grass and rye grass..... **Melting Out or Leaf Spot**
- 2. Leaf spots oval to irregular in shape with brown borders and tan to gray centers; primarily on St. Augustine grass..... **Gray Leaf Spot**
- 3. Leaf spots reddish brown to brown surrounded by a yellow halo; primarily on centipede grass..... **Anthracnose**
- 4. Grass covered with an easily removed slimy or crusty growth..... **Slime Molds³**
- 5. Mottle, chlorosis or mosaic on leaves; on St. Augustine grass or centipede grass..... **St. Augustine Decline or Centipede Decline⁴**

¹ Formerly known as Brown Patch.

² Take-all Root Rot also resembles chinch bug damage.

³ Non-pathogenic. Not a disease.

⁴ Viral diseases caused by *Panicum mosaic virus*.

Commercial Crop Production Turfgrass

Table 3. Fungicides labeled for use of commercial turfgrasses								
Fungicide ¹	Large Patch	Dollar Spot	Gray Leaf Spot	Leaf Spots & Melting Out	Take-all Root Rot ²	Fairy Ring	Pythium Blight	Algae
azoxystrobin	X		X	X	X	X	X	
boscalid		X						
captan				X				
chlorothalonil		X	X	X				X
cyazofamid							X	
ethazole (etridiazole)							X	
fenarimol		X			X			
fludioxonil			X	X				
fluoxastrobin			X	X	X		X	
flutolanil	X					X		
fosetyl-Al							X	
iprodione	X	X		X				
mancozeb		X	X	X			X	X
mefenoxam							X	
metconazole	X	X				X		
myclobutanil	X	X		X	X			
polyoxin D	X		X	X		X ³		
phosphites (various salts)							X	
propamocarb							X	
propiconazole	X	X	X	X	X			
pyraclostrobin		X ^c	X	X	X	X	X	
quintozene (PCNB)		X		X				
tebuconazole	X	X	X		X			
thiophanate-methyl	X	X	X	X	X			
thiram		X						
triadimefon	X	X	X		X			
trifloxystrobin		X	X	X				

Commercial Crop Production Turfgrass

Table 3. Fungicides labeled for use of commercial turfgrasses								
Fungicide ¹	Large Patch	Dollar Spot	Gray Leaf Spot	Leaf Spots & Melting Out	Take-all Root Rot ²	Fairy Ring	Pythium Blight	Algae
triticonazole	X	X			X			X
vinclozolin		X		X				

¹Active ingredient.
²Also, *Gaeumannomyces graminis* var. *graminis* (Ggg) root decline, Bermuda decline and spring dead spot.
³For disease suppression only.

Table 4. Efficacy ¹ of fungicides in managing turfgrass diseases								
Fungicide ²	Large Patch	Dollar Spot	Gray Leaf Spot	Leaf Spots & Melting Out	Take-all Root Rot ^c	Fairy Ring	Pythium Blight	Algae
azoxystrobin	4		4	3	(3)	3	2	
boscalid		4						
chlorothalonil		3	2	2				3
copper hydroxide + mancozeb								4
cyazofamid							3	
fenarimol		3			(2)			
fludioxonil				3				
fluopicolide + propamocarb							3	
fluoxastrobin							2	
flutolanil	4					3		
fosetyl-al							2	
iprodione	2	3		4				
mancozeb		1	2	3			2	3
mefenoxam							2	
metconazole		4	2			3		
myclobutanil	2+	4		1				
polyoxin D	1		1			2+		

Commercial Crop Production Turfgrass

Table 4. Efficacy ¹ of fungicides in managing turfgrass diseases								
Fungicide ²	Large Patch	Dollar Spot	Gray Leaf Spot	Leaf Spots & Melting Out	Take-all Root Rot ^c	Fairy Ring	Pythium Blight	Algae
Phosphite salts							2	
propamocarb							2	
propiconazole	2	4	2	2	(2)			
pyraclostrobin	3	2+	4	3	(3)	3	2+	
quintozene (PCNB)	4			2				
tebuconazole		4						
thiophanate-methyl		4	4	2				
triadimefon	4	4	2		(2)	3		
trifloxystrobin			3	2				
triticonazole	3	4						2
vinclozolin		4		3.5				

¹Efficacy ratings are on a scale from 1 to 4 where 1=inconsistent but performs well in some instances, and 4=consistently good to excellent results. Efficacy data are based on trials using commercial formulations of the fungicides, not the formulations readily available to homeowners. Ratings were compiled by Drs. Vincelli and Williams at the University of Kentucky (PPA-1 Chemical Control of Turfgrass Diseases 2011; <http://pest.ca.uky.edu/PSEP/Manuals/ppa1.pdf>).

²Active ingredient.

³Also, *Gaeumannomyces graminis* var. *avenae* (Ggg) root decline, Bermuda decline and spring dead spot.

⁴Ratings within parentheses are for take-all patch caused by Ggg.

Commercial Crop Production Turfgrass

Table 5. Fungicides registered for use on commercial turfgrasses only					
Fungicide ¹ and Product Mode of Action Group ²	Trade Name ³	Formulation	Rate ⁴	Maximum Use ⁵	
azoxystrobin	11	Heritage	50% WG	0.2-0.4 oz	3.7 oz
		Heritage G	0.31% G	2-4 lb	37 lb
		Heritage TL	8.8% L	1-2 fl oz	18.5 fl oz
boscalid	7	Emerald ⁶	70% WG	0.13-0.18 oz	1.1 oz
captan	M	Captan	50% WP 80% WDG	0.13-0.2 lb 0.125 lb	
chlorothalonil	M	Chlorostar, Chlorothalonil, Countdown, Daconil, Echo, Ensign, Equus, Initiate, Mainsail, Manicure	38.5% F 54% F 82.5 WDG	1.5-8.3 fl oz 1-5.5 fl oz 1-5 oz	
cyazofamid	21	Segway	34.5% F	0.45-0.9 fl oz	2.7 fl oz
etridiazole (ethazole)	14	Terrazole ⁸	35% WP	2-4 oz	10 oz
fenarimol	3	Rubigan	11.6% L	0.75-8 fl oz	32 fl oz
fludioxonil	12	Medallion	50% WP	0.25-0.5 oz	1.5 oz
fluopicolide	43	Stellar ⁹	5.7 pounds SC	1.2 fl oz	2.4 fl oz
fluoxastrobin	11	Disarm	480 SC 0.25% G	0.09-0.36 fl oz 1.2-4.6 lb	0.4 fl oz
flutolanil	7	Prostar	70% WP	1.5-4.5 oz	4.5 oz
fosetyl-AI	33	Chipco Signature Prodigy Signature	80% WDG 80% WDG	4-8 oz 4-8 oz	
iprodione	2	26GT Chipco 26019 Iprodione Pro	23.3% F 50% WP	3-8 fl oz 1.5-4 oz	35 fl oz 17.6 oz
mancozeb	M	Dithane, Fore, Manzate, Penncozeb, Pentathlon,	37% F 75% DF 80% WP	6.4-12.8 fl oz 4-8 oz 4-8 oz	See label

Commercial Crop Production Turfgrass

Table 5. Fungicides registered for use on commercial turfgrasses only					
Fungicide ¹ and Product Mode of Action Group ²		Trade Name ³	Formulation	Rate ⁴	Maximum Use ⁵
		Protect			
mefenoxam	4	Fenox Mefenoxam Subdue Ultra Flourish	1% G 21.3% L 22.5% F 25.1% 45% WP	12.5-25 oz 0.5-1 fl oz 0.2-1 fl oz 0.5-1 fl oz 0.28-0.56 oz	3 apps/ season
metconazole	3	Tourney	50% WDG	0.18-0.44 oz	4 lb/A
myclobutanil	3	Eagle Hoist	20EW 40% WP	1-2.4 fl oz 0.6-1.2 oz	13.8 fl oz 7.2 oz
phosphite (salts of phosphorous acid)	33	Alude, Exel, Fosphite, Fungi-phite, Helena Prophyt ¹¹ , Primera Magellan, Vital	3.35 ¹² 3.9 4.2 4.32	5-10 fl oz 2-3 fl oz 4-6 fl oz 4.1-8.2 fl oz	
polyoxin D zinc salt	19	Endorse	2.5% WP	Refer to label	
propamocarb hydrochloride	28	Banol	66.5% L	1.3-4 fl oz	12.5 fl oz
propiconazole	3	Banner, Dorado, Fathom, Headway, Honor Guard, Propensity, Propiconazole, Savvi, Spectator	14.3% L 41.8% L	0.5-4 fl oz 0.18-1.44 fl oz	16 fl oz 5.8 fl oz
pyraclostrobin	11	Insignia	20% WG	0.5-0.9 oz	5.5 oz
quintozene (PCNB)	14	Glacier, Parflo, PCNB, Revere, Terraclor, Turficide	10% G 38.3% F 75% WP	5-7.5 lb 11-24 fl oz 7-16 oz	Refer to label
tebuconazole	3	Torque ^{13,6}	38.7% L	0.6 fl oz	3.6 fl oz
thiophanate-methyl	1	3336, Allban, Cavalier, Quali-	2% G 41.25% L 46.2% F	1.5-9 lb 2-6 fl oz	Refer to label

Commercial Crop Production Turfgrass

Table 5. Fungicides registered for use on commercial turfgrasses only					
Fungicide ¹ and Product Mode of Action Group ²	Trade Name ³	Formulation	Rate ⁴	Maximum Use ⁵	
		Pro TM, T-Methyl, Transom, T-Storm	50% WP	1-5 fl oz 2-6 oz	
thiram	M	Defiant, Spotrete, Thiram	42.1% L 75% WDG	3.8-7.5 fl oz 2.5-5 oz	Refer to label
triadimefon	3	Bayleton	50% WP	0.25-2 oz	Refer to label
trifloxystrobin	11	Compass	50% WDG	0.1-0.25 oz	3 apps
triticonazole	3	Trinity, Triton	19.2% L	0.5-2 fl oz	6 fl oz
vinclozolin	2	Curalan Touché	50 EG	1 oz	3 oz
Fungicide Combinations					
azoxystrobin + propiconazole	11,3	Headway Headway G	5.7% + 9.5% L 0.31% + 0.75% G	0.75-3.0 fl oz 2-4 lb	Refer to labels
azoxystrobin + chlorothalonil	11,M	Renown ⁷	3% + 45% L	2.5-4.5 fl oz	
chlorothalonil + propiconazole + fludioxonil	M,3,1 2	Instrata ⁷	29.9% + 4.7% + 1.2% L	2.75-11 fl oz	
chlorothalonil + thiophanate- methyl	M,1	Consyst ⁷ Spectro 90 ⁷ Peregrine ⁷ Quali-Pro TM/C ⁷	50% + 16.7% WDG 72% + 18% WDG	2-5 oz 3-5.8 oz	
fluopicolide + propamocarb hydrochloride	43,28	Stellar ¹⁴	5.54% + 55.4% SC	1.2 fl oz	
fluoxastrobin + chlorothalonil	11,M	Disarm C ⁷	2.44% + 38.4% L	1.5-5.9 fl oz	

Commercial Crop Production Turfgrass

Table 5. Fungicides registered for use on commercial turfgrasses only					
Fungicide ¹ and Product Mode of Action Group ²	Trade Name ³	Formulation	Rate ⁴	Maximum Use ⁵	
fluoxastrobin + myclobutanil	11,3	Disarm M	15.8% + 25.6% L	0.25-1.0 fl oz	Refer to label
iprodione + thiophanate- methyl	2,1	26/36 ¹⁵ TM + IP ¹⁵	19.65% + 19.65% L	1-4 fl oz	14.5 fl oz 6 apps/season
mancozeb + copper hydroxide	M,M	Junction	15% + 46.1% DF	2-4 oz	
propiconazole + chlorothalonil	3,M	Concert ⁷	2.9% + 38.5% L	1.5-8.5 fl oz	
pyraclostrobin + boscalid	11,7	Honor ⁶	16.8% + 11.2% WG	0.55-1.1 oz	
thiophanate- methyl + flutolanil	1,7	SysStar	28.6% + 51.4% WDG	2-3 oz	Refer to label
trifloxystrobin + triadimefon	11,3	Armada Tartan	25% L 50% WP	1-2 fl oz 0.6-1.2 oz	3 apps
triticonazole + chlorothalonil	3,M	Reserve ⁷	5% + 40% L	3.2-5.4 fl oz	

¹Active ingredient
²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).
³Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.
⁴Rates are the amount of formulation (product) per 1,000 square feet unless otherwise indicated.
⁵Maximum use per 1,000 square feet per year unless otherwise noted.
⁶For golf course use only.
⁷Not for use on home lawns or turf associated with apartments, day care centers, playgrounds, or athletic fields next to schools (elementary through high school).
⁸For use on golf course tees and greens only.
⁹Pre-mixed with propamocarb for control of *Pythium*.
¹⁰Do not use on bermuda grass.
¹¹Helena Prophyt for use on sod farms only. Refer to label for modes of application and restrictions.
¹²Formulation based on phosphorous acid equivalent in lb/gal.
¹³Bermuda grass may be sensitive.
¹⁴For use on golf courses and sod farms only.
¹⁵Not for use on commercial sod.

Revised December 2014 by Dr. R. Singh.

Commercial Crop Production

Vegetables

Integrated Vegetable Disease Management

Successful management of vegetable diseases requires a disease management program that integrates the use of resistant varieties, balanced soil fertility, irrigation water management, use of good cultural practices, weed and insect control, biocontrol, and chemical control. Development and implementation of a disease management plan and good record keeping will increase the overall yield and success of the vegetable crop.

Start with clean seed and/or certified disease-free transplants. Many vegetable disease problems originate with the seed or transplants. Seed should be purchased from reputable commercial seed companies and if seed has not been previously treated it should be treated following the seed treatment recommendations provided in Section IV.

Select resistant varieties. The use of resistant varieties is one of the best management strategies in an integrated pest management program as they are inexpensive compared to the cost of fungicides and bactericides and they provide seasonal management. Select resistant varieties based on the disease profile for your production region and soil.

Use good cultural practices. Cultural practices are defined as a broad set of techniques that are used to manipulate the environment to improve crop production. Examples of cultural practices that should be considered in an integrated disease management plan are provided below.

- **Select land suitable for vegetable production.** Start by selecting a site that is well drained, has good air movement, gets at least 6 hours of sunlight each day, and does not have a history of problems with soilborne diseases. Avoid land surrounded by large established trees. Tree roots that extend well beyond the extent of the limbs can exhaust water and nutrient resources that would otherwise be available to the vegetable crop. Some tree roots also produce a toxin (juglone) that causes toxicity in toxin-sensitive vegetables such as tomatoes, peppers, eggplant, potatoes, asparagus, cabbage and broccoli.
- **Have your soil tested.** Many pathogens that cause disease on plants live and survive for long periods of time in the soil. Soil temperature, moisture, pH and fertility all influence a pathogen's ability to survive and colonize plants. Have your soil tested annually to determine the pH, salts, nutrients and organic matter levels, and water holding capacity. For more information on how to sample, test and assess the quality of your soil contact the LSU AgCenter Soil Testing & Plant Analysis Laboratory. Tests are also available that can determine the population levels of some pathogens in the soil. Contact the LSU AgCenter Plant Disease Diagnostic Center for more information on available pathogen tests.

Soil Test and Plant Analysis Lab

LSU/LSU AgCenter
School of Plant, Environmental, and Soil
Sciences
Baton Rouge, Louisiana 70803
Phone: 225-578-1219
Fax: 225-578-1403

Plant Disease Diagnostic Center

LSU/LSU AgCenter
Department of Plant Pathology & Crop
Physiology
Baton Rouge, Louisiana 70803
Phone: 225-578-1219
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Commercial Crop Production Vegetables

- **Use high quality water for irrigation and other agricultural uses.** Untreated surface waters can harbor both plant and human pathogens. If practical, and economical, potable water should be used to irrigate vegetable crops, especially when crops are irrigated using overhead (sprinkler) irrigation systems. Water treatment and filtration practices should be adopted if surface water is the primary source of irrigation water. The timing and frequency of irrigation should also be considered to minimize the risk of disease development. Avoid overwatering and overhead irrigation. Water early in the day so that plants have an adequate amount of time to dry. Consider raised beds to reduce the amount of standing water in the rows.
- **Develop a four-year crop rotation cycle.** Crop rotations are an important component of an IPM program because they interrupt the life cycle of pathogens by placing the pathogens in a non-host environment. Through this interruption the pathogens are unable to accumulate to levels that could cause significant levels of disease and crop losses. Over a four-year period plant plants from a different plant family.
- **Use plastic and organic mulch.** Mulch serves as a barrier between the soil and plant tissue and reduces the amount of pathogen that can be splashed onto leaves, stems and fruit. Light-reflective plastic mulches can deter insects that transmit important viral diseases from landing on plants. Do not reuse plastic mulches. Organic mulches help to retain moisture in the soil and improve soil quality.
- **Use good sanitation practices.** By putting a strong emphasis on sanitation practices disease development can be significantly reduced resulting in less disease and ultimately less chemical usage. A good sanitation practice is any technique that eliminates a desirable place for the pathogen to survive and spread. Removal and destruction of crop debris, weeds and infected plants, and cleaning and disinfection of production tools and equipment are examples of good sanitation practices.

Use registered biorational products. Biorational products (products composed of beneficial microorganisms or their products) are viable alternatives to synthetic chemicals for managing diseases in many vegetable production systems. As with chemical pesticides, biorational products can't be used if they are not registered with the Environmental Protection Agency (EPA). Always read the label and follow all safety precautions provided in the label. Do not use biorationals on a non-labeled crop. A list of biopesticides and fungicide alternatives for vegetables is provided in Table 6.

Use registered chemicals. Fungicides, bactericides, and nematocides are important tools for managing diseases and their efficacy and efficiency can be enhanced when incorporated into an integrated disease management program. Pesticides should be used in a manner that minimizes the risk of a pathogen becoming resistant to a pesticide. Always applying mixtures of pesticides or alternate fungicides that have different modes of action to help reduce pesticide resistance development by the pathogen. More information on pesticide resistance management strategies is provided in Section I-D of this guide. A list of fungicide mode of actions for fungicide resistance management in vegetables is provided in Table 7. Always read the label and follow all safety precautions provided in the label. Do not use pesticides on a nonlabeled crop. A list of selected pesticides with known efficacy to various pathogens that can cause disease on vegetables in Louisiana can be found in Table 1.

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops					
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.					
Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
ASPARAGUS					
Crown and Spear Rot (<i>Phytophthora</i> spp.)	Manzate flowable	M	0.8 qt/100 gal		1 app
	Manzate flowable	M	1.6 qt	180	6.4 qt
	Chlorothalonil 720SC	M	2-4 pt	190	12 pt
	Ridomil Gold SL	4	1 pt	7	4 app
	Phosphorous acid: Fosphite	33	3-4 qt	2	12 fl oz
	Phostrol	33	2.5-5.0 pt	0	7 app
Fusarium Crown and Root Rot (<i>Fusarium oxysporum</i>)	Mancozeb 80WP ⁵	M	1 lb/100 gal		1 app
Purple Spot (<i>Stemphylium</i> spp., <i>Pleospora</i> spp.)	Quadris flowable	11	6.0-15.5 fl oz	100	92 fl oz
	Flint 50WG	11	3-4 oz	180	3 app
	Chlorothalonil 720SC	M	2-4 pt	190	12 pt
Rust (<i>Puccinia</i> spp.)	Rally 40W	3	5 oz	180	6 app
	Mancozeb 80WP	3	2 lb	180	8 lb
	Chlorathalonil 720SC	M	2-4 pt	190	12 pt
	Sulfur ^{OG} 80%	M	20 lb	0	
	90%	M	15 lb	0	
98%	M	45 lb	0		
BASIL					
Downy Mildew (<i>Peronospora belbahrii</i>)	Ranman	21	2.75-3.0 fl oz	0	9 app
	Regalia ^{OG}	P5	0.5-1 qt	0	
	Phosphorous acid Fosphite	33	1-3 qt	0	
	ProPhyt	33	3-4 pt	0	
	Actinovate AG ^{OG}		3-12 oz	0	
BEANS (Snap and Dry)					
Alternaria Leaf and Pod Spot (<i>Alternaria alternata</i>)	Quilt 1.66SC	3,11	14 fl oz	7	3 app
	Priaxor 4.17SC	7,11	4-8 fl oz	7	2 app
	Fontelis 1.67SC	7	14-30 oz	0	72 fl oz
	Quadris Flowable	11	6.2-15.4 fl oz	0	92 fl oz
	Headline 2.09	11	6-9 fl oz	7	2 app
	Actinovate AG ^{OG}		3-12 oz	0	
Anthracnose (<i>Colletotrichum lindemuthianum</i>)	Aproach (dry beans only)	11	6-12 fl oz	7	24 fl oz
	Chlorathalonil (dry beans only)				
	Bravo Ultrex	M	1.25-1.8 lb	7	7.3 lb
	Bravo WeatherStix	M	1.375-2 pt	7	8 pt
	Thiophanate-methyl				
	Topsin M 70WP	1	1.5-2 lb	14	4 lb
	Incognito 4.5F	1	30-40 fl oz	14	80 fl oz
	85 WDG (dry beans)	1	0.8-1.6 lb	28	3.2 lb
	85 WDG (snap beans)	1	0.8-1.6 lb	14	3.2 lb
Quilt 1.66SC	11,3	14 fl. Oz	0	42 fl oz	

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Quilt Xcel	11,3	10.5-14 fl oz	0	42 fl oz
	Priaxor 4.17SC	7,11	4-8 fl oz	7	2 apps
	Fontelis 1.67SC	7	14-30 fl oz	7	72 fl oz
	Quadris Flowable	11	6-15.5 fl oz	0	4 app
	Quadris Opti (dry beans only)	11,M	1.6-2.4 pt	0	4 app
	Headline (dry beans)				
	Headline (snap beans)	11	6-9 fl oz	21	2 app
	Tilt	11	6-9 fl oz	7	2 app
	Copper octanoate	3	4 fl oz	7	12 fl oz
	Cueva ^{OG}	M	0.2-2 gal		
	Cuprous oxide				
	Nordox 75WG ^{OG}	M	0.66-2.5 lb		
Halo and Common Blight (<i>Pseudomonas phaseolicola</i> and <i>Xanthomonas phaseoli</i>)	Copper hydroxide				
	Kocide 3000	M	0.5-1.25 lb	0	15.8 lb
	Kocide 2000	M	0.75-2.25 lb	0	13.5 lb
	Champ WG ^{OG}	M	1.58 lb	7	9.48 lb
	Nu-Cop 50DF	M	1-1.5 lb	7	9 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	1-2 pt	7	16.6 pt
	Badge X2 ^{OG}	M	0.5-1.25 lb	7	2.65 lb
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.75-2 lb		11.19 lb
	Cuproxtat	M	1.5-3.9 pt		23.4 pt
	Copper octanoate				
	Cueva ^{OG}	M	0.5-2 gal/100gal		
	Cuprous oxide				
	Nordox 75WG ^{OG}	M	0.6-2.5 lb		
Botrytis Gray Mold (<i>Botrytis cinerea</i>)	Iprodione				
	Rovral 4 Flowable	2	1.5-2 pt	14	2 app
	Thiophanate-methyl				
	Topsin M 70WP	1	1.5-2 lb	14	4 lb
	Incognito 4.5F	1	30-40 fl oz	14	80 fl oz
	85 WDG (dry beans)	1	0.8-1.6 lb	28	3.2 lb
	85 WDG (snap beans)	1	0.8-1.6 lb	14	3.2 lb
	Fontelis 1.67SC	7	14-30 oz	7	72 fl oz
	Endura	7	8-11 oz	7	2 app
	Cannonball 50WP	12	7 oz	7	28 oz
	Switch 62.5 WG	12,9	11-14 oz	2	56 oz
	Chlorathalonil (snap beans only)				
	Bravo Ultrex	M	2.7 lb	7	10.9 lb
	Bravo WeatherStik	M	3 lb	7	12 pt
	Copper octanoate				
	Cueva ^{OG}	M	0.5-2 gal/100gal		

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops					
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.					
Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
Damping-off (<i>Pythium</i> spp.)	Ridomil Gold PC GR	4,14	0.75 lb ⁶		1 app
	Ridomil Gold SL	4	0.5-1.0 pt ⁸		1 app
	MetaStar 2E	4	2-4 pt ⁸		1 app
	Ultra Flourish	4	1-2 pt ⁸		1 app
	Uniform	4,11	0.34 fl. oz ⁶		1 app
Damping-off (<i>Rhizoctonia solani</i>)	Quadris Flowable	11	0.4-0.8 fl oz ⁶		1 app
	Headline	11	0.1-0.8 fl oz ⁶		1 app
	Blocker 4F	14	2.2-3.3 pt ⁶		1 app
	Uniform	4,14	0.34 fl oz ⁶		1 app
Leaf Spots and Blights (<i>Cercospora</i> spp., <i>Alternaria</i> spp., <i>Ascochyta</i> spp.)	Aproach (dry beans only)	11	6-12 fl oz	7	24 fl oz
	Chlorothalonil (dry beans only)				
	Bravo Ultrex	M	1.25-1.8 lb	7	7.3 lb
	Bravo WeatherStix	M	1.375-2 pt	7	8 pt
	Fontelis 1.67SC	7	14-30 fl oz	0	72 fl oz
	Quadris Flowable	11	6.2-15.4 fl oz	0	4 app
	Quadris Opti (dry beans only)	11,M	1.6-2.4 pt		4 app
	Headline (dry beans)	11	6-9 fl oz	21	2 app
Headline (snap beans)	11	6-9 fl oz	7	2 app	
Rhizocontia Web Blight and Pod Tip Rot (<i>Rhizoctonia solani</i>)	Rally 40WSP (snap beans only, pod tip rot)	3	4-5 oz	0	20 oz
	Tilt	3	4 fl oz	7	12 fl oz
	Quadris Flowable	11	6-15.5 fl oz	0	4 app
	Quadris Opti (dry beans only)	11,M	1.6-2.4 fl oz		4 app
	Quilt	11,3	14 fl oz	7	42 fl oz
	Quilt Xcel	11,3	10.5-14 fl oz	7	42 fl oz
Powdery Mildew (<i>Erysiphe polygoni</i>)	Endura	7	8-11 oz	7	2 app
	Priaxor 4.17SC	7,11	4-8 fl oz	7	2 app
	Fontelis 1.67SC	7	14-30 oz	0	72 fl oz
	Headline (dry beans)	11	6-9 fl oz	21	2 app
	Headline (snap beans)	11	6-9 fl oz	7	2 app
	Phosphorous acid: Fosphite	33	1-3 qt/100 gal	0	
	Sulfur				
	80% ^{OG}	M	20 lb	0	
	90% ^{OG}	M	15 lb	0	
	98% ^{OG}	M	45 lb	0	
Potassium bicarbonate Armcarb 100 ^{OG}		2.5-5 lb	0		
Rust (<i>Uromyces appendiculatis</i> , <i>Phakopsora pachyrhizi</i>)	Aproach (dry beans only)	11	6-12 fl oz	7	24 fl oz
	Proline 480 SC (dry beans only, white mold)	3	5.7 fl oz	7	17 fl oz
	Rally 40WSP	3	4-5 oz	0	20 oz
	Tebuconazole 3.6F				
	Folicur 3.6F (dry)	3	4-6 fl oz	7	12 fl oz
	Folicur 3.6F (snap)	3	4-6 fl oz	7	24 fl oz
	Quilt 1.66SC	3,11	14 fl oz	7	3 app

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Priaxor 4.17SC	7,11	4-8 fl oz	7	2 app
	Fontelis 1.67SC	7	14-30 oz	0	72 fl oz
	Quadris 2.08F	11	6.2-15.4 fl oz	0	4 app
	Quadris Opti (dry beans only)	11,M	1.6-2.4 pt		4 app
	Headline (dry beans)	11	6-9 fl oz	21	2 app
	Headline (snap beans)	11	6-9 fl oz	7	2 app
	Chlorathalonil				
	Dry beans				
	Bravo Ultrex	M	1.25-1.8 lb	7	4 app
	Bravo WeatherStix	M	1.375-2 pt	7	8pt
	Snap beans				
	Bravo Ultrex	M	1.25-2.7 lb	7	10.9 lb
	Bravo WeatherStix	M	1.375-3 pt	7	12 pt
White Mold (<i>Sclerotinia sclerotiorum</i>)	Aproach	11	8-12 fl oz	0	24 fl oz
	Botran 5F (snap beans only)	14	1.3-1.6 qt	2	3.2 qt
	Botran 75W (snap beans only)	14	2.4 lb	2	5.3 lb
	Cannonball	12	7 oz	7	28 oz
	Endura	7	6-9 oz		2 apps
	Fontelis	7	16-30 fl oz	0-14 ¹⁰	72 fl oz
	Iprodione				
	Iprodione 4L AG	2	1.5-2 pt	14	2 app
	Rovral 4 Flowable	2	1.5-2 pt	14	2 app
	Meteor	2	1.5-2 pt	14	2 app
	Nevado 4F	2	1.5-2 pt	14	2 app
	Omega 500SC (succulent)	29	0.5-0.9 pt	14	1.8 pt
	Omega 500SC (dry)	29	0.5-0.9 pt	30	1.8 pt
	Priaxor (dry)	7,11	4-8 fl oz	21	16 fl oz
	Priaxor (succulent)	7,11	4-8 fl oz	7	16 fl oz
	Proline 480SC (dry)	3	5.7 fl oz	7	17.1 fl oz
	Switch 62.5WG	9,12	11-14 oz	7	56 oz
	Thiophanate Methyl				
	85 WDG (succulent)	1	1.2-1.6 lb	14	3.2 lb
	85 WDG (dry)	1	1.2-1.6 lb	28	3.2 lb
	Incognito 4.5F (succulent)	1	30-40 fl oz	14	80 fl oz
	Incognito 4.5F (dry)	1	30-40 fl oz	28	80 fl oz
	Topsin M 70WDG	1	1.5-2 lb	14	4 lb
	(succulent)				
	Topsin M 70WDG (dry)	1	1.5-2 lb	28	4 lb
	Vertisan	7	16-20 fl oz	21	41 fl oz
COLE CROPS (Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Chinese Cabbage, Kohlrabi)					
Alternaria Leaf Spot (<i>Alternaria</i> spp.)	Cabrio	11	12-16 oz	0	64 oz
	Chlorathalonil				
	Bravo Ultrex	M	1.4 lb	7	14.5 lb
	Bravo WeatherStix	M	1.5 pt	7	11.7 lb
	Copper hydroxide				
	Kocide 3000	M	0.5-1.25 lb	0	15.8 lb
	Kocide 2000	M	0.75-2.25 lb	0	13.5 lb

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Champ WG ^{OG}	M	1.58 lb	7	9.48 lb
	Nu-Cop 50DF	M	1 lb	7	5 lb
	Copper hydroxide, Copper oxychloride				
	Badge SC	M	1-2 pt	7	16.6 pt
	Badge X2 ^{OG}	M	0.5-1.25 lb	7	2.65 lb
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.75-2 lb		11.19 lb
	Cuproxtat	M	1.5-3.9 pt		23.4 pt
	Copper octanoate				
	Cueva ^{OG}	M	0.5-2 gal/100gal		
	Cuprous oxide				
	Nordox 75WG ^{OG}	M	0.6-2.5 lb		
	Endura	7	6-9 oz	0-14 ¹⁰	2 app
	Fontelis	7	14-30 fl oz	3	72 fl oz
	Inspire Super	3,9	16-20 fl oz	7	80 fl oz
	Koverall	M	1.6-2.1 lb	7	12.8 lb
	ManKocide	M	1-3 lb	7	8.8 lb
	Manzate Pro-Stik ⁷	M	1.6-2.1 lb	7	12.8 lb
	Milstop ^{OG}		2-5 lb/100 gal		
	Procure 480 SC	3	6-8 fl oz	1	18 fl oz
	Quadris Flowable	11	6-15.5 fl oz	0	3 apps
	Quadris Top	11,3	12-14 fl oz	1	56 fl oz
	Reason 500 SC	11	8.2 fl oz	2	24.6 fl oz
Serenade ASO					
ASO ^{OG}	44	2-6 qt	0		
Max ^{OG}	44	1-3 lb	0		
Switch 62.5 WG	9,12	11-14 oz	7	56 oz	
Basal Stem Rot, Phytophthora root rot (<i>Phytophthora</i> spp.)	Ridomil Gold SL	4	1-2 pt ⁸		1 app
	MetaStar 2E	4	4-8 pt ⁸		1 app
	Ultra Flourish	4	2-4 pt ⁸		1 app
Black Leg (<i>Phoma lingam</i>)	Cabrio	11	12-16 oz	0	64 oz
	Iprodione				
	Rovral 4 Flowable	2	2 pt	0	2 app
	4L AG	2	2 pt	0	2 app
Black Rot (<i>Xanthomonas campestris</i> pv. <i>campestris</i>)	Actigard	P	0.5-1.0 oz	7	4 apps
	Copper hydroxide				
	Kocide 3000	M	0.5-1.25 lb	0	15.8 lb
	Kocide 2000	M	0.75-2.25 lb	0	13.5 lb
	Champ WG ^{OG}	M	1.58 lb	7	9.48 lb
	Nu-Cop 50DF	M	1 lb	7	5 lb
	Copper hydroxide, Copper oxychloride				
	Badge SC	M	1-2 pt	7	16.6 pt
	Badge X2 ^{OG}	M	0.5-1.25 lb	7	2.65 lb
Copper sulfate					

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Cuprofix-Ultra 40 Cuproxtat Copper octanoate Cueva ^{OG} Cuprous oxide Nordox 75WG ^{OG}	M M M M	0.75-1.25 lb 1.5-2.5 pt 0.5-2 gal/100gal 0.6-2.5 lb	6.6 lb 13.1 pt	
Cercospora Leaf Spot (<i>Cercospora brassicola</i>)	Cease Biofungicide ^{OG} Reason 500SC Inspire Super Quadris Top Switch 62.5 WG	44 11 9 11,3 9,12	3-6 qt/100 gal 8.2 fl oz 16-20 fl oz 12-14 fl oz 11-14 oz	0 2 7 1 7	24.6 fl oz 80 fl oz 56 fl oz 56 oz
Clubroot (<i>Plasmodiophora brassicae</i>)	Omega 500F Blocker (Flowable & 4F) Ranman	29 14 21	2.6 pt ⁸ 7.5 gal ⁸ 13-25.8 fl oz ⁸		1 app 1 app 1 app
Damping-off (<i>Pythium spp.</i>)	Ridomil Gold SL MetaStar 2E Ultra Flourish Uniform	4 4 4 4,11	0.25-0.5 pt ⁸ 4-8 pt ⁸ 0.5-1 pt ⁸ 0.34 fl oz ⁶		1 app 1 app 1 app 1 app
Damping-off, Wire Stem (<i>Rhizoctonia solani</i>)	Blocker 4F Uniform Quadris Flowable	14 4,11 11	2.2-3.3 pt 0.34 fl. oz ⁶ 0.4-0.8 fl oz ⁶		1 app 1 app 1 app
Downy Mildew (<i>Peronospora parasitica</i>)	Ultra Flourish Ranman Presidio Quadris Flowable Reason 500SC	4 21 43 11 11	0.25-0.5 pt 2.75 lb 3-4 fl oz 6-15.5 fl oz 5.5-8.2 fl oz	7 0 2 0 2	2 pt 5 app 12 fl oz 92.3 fl oz 24.7 fl oz
Powdery Mildew (<i>Erysiphe polygoni</i> , <i>E. cruciferarum</i>)	Cabrio EG Cease Biofungicide ^{OG} Endura Fontelis Inspire Super Phosphorous acid Confine Extra Fosphite KPhite 7LP-AG Rampart Potassium bicarbonate Armicarb 100 Milstop ^{OG} Kaligreen Fungicide Procure 480SC Quadris Top Serenade ASO ^{OG} Max ^{OG}	11 44 7 7 9 33 33 33 33 3 11,3 44 44	12-16 oz 3-6 qt/100 gal 6-9 oz 14-30 fl oz 16-20 fl oz 1-3 qt 1-3 qt 1-3 qt 1-3 qt 2.5-5 lb/100 gal 2-5 lb/100 gal 2.5-3 lb 6-8 fl oz 12-14 fl oz 2-6 qt 1-3 lb	0-3 ⁹ 0 0-14 ¹⁰ 0 7 0 0 0 0 0 0 1 1 0 0	64 oz 18 oz 72 fl oz 80 fl oz 18 fl oz 56 fl oz

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
	Sonata ^{OG}	44	2-4 qt	0
	Sulfur			
	Microfine Sulfur	M	6-25 lb	
	Microthiol Disperss ^{OG}	M	3-10 lb	
	Yellow Jacket Wettable	M	6-25 lb	
	Switch	9, 12	10-12 oz	7
				56 oz
White Mold <i>(Sclerotinia sclerotiorum)</i>	Endura	7	6-9 oz	0-14 ¹⁰
	Fontelis	7	16-30 fl oz	3
				2 apps
				72 fl oz
White Rust <i>(Albugo candida)</i>	Cabrio EG	11	12-16 oz	0-3 ⁹
	Reason 500SC	11	8.2 fl oz	2
				64 oz
				24.6 fl oz
Cucurbits (Cantaloupe, Cucumbers, Pumpkins, Squash, Watermelons, Zucchini)				
Angular Leaf Spot <i>(Pseudomonas syringae pv. lachrymans)</i>	Actigard	P	0.5-1.0 oz	0
	Copper hydroxide			
	Kocide 3000	M	0.5-1.3 lb	0
	Kocide 2000	M	1-2.3 lb	0
	Champ WG ^{OG}	M	1.5-2 lb	0
	Nu-Cop 50DF ^{OG}	M	1.5-2 lb	0
	Copper hydroxide and copper oxychloride ¹¹			
	Badge SC	M	1-2.5 pt	0
	Badge X2 ^{OG}	M	0.5-1.3 lb	0
	Copper sulfate			
	Cuprofix-Ultra 40	M	1-2 lb	0
	Mastercop	M	0.5-1 pt	0
	Copper octanoate			
	Cueva ^{OG}	M	0.5-2 gal/100gal	0
	Cuprous oxide			
	Nordox 75WG ^{OG}	M	1.5-2 lb	1
	ManKocide	M	2-3 lb	5
				8 app
Anthracnose, Alternaria and Cercospora Leaf Spot <i>(Colletotrichum orbiculare, Alternaria cucumerina, Cercospora)</i>	Actinovate		3-12 oz	0
	Cabrio	11	12-16 oz	0
	Chlorathalonil			
	Bravo Ultrex	M	1.4-2.7 lb	0
	Bravo WeatherStik	M	1.5-3 pt	0
	Bravo Zn	M	2.3-4.3 pt	0
	Chlorathalonil 720 SC	M	1.5-3 pt	0
	Copper hydroxide			
	Kocide 3000	M	0.5-1.3 lb	0
	Kocide 2000	M	1-2.3 lb	0
	Champ WG ^{OG}	M	1.5-2 lb	0
	Nu-Cop 50DF ^{OG}	M	1.5-2 lb	0
	Copper hydroxide and copper oxychloride ¹¹			
	Badge SC	M	1-2.5 pt	0
	Badge X2 ^{OG}	M	0.5-1.3 lb	0
	Copper sulfate			
				18.6 pt
				5.3 lb Cu

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Cuprofix-Ultra 40	M	1-2 lb	0	13 lb
	Mastercop	M	0.5-1 pt	0	6 pt
	Copper octanoate	M	0.5-2 gal/100gal	0	
	Cueva ^{OG}				
	Cuprous oxide	M	1.5-2 lb	1	
	Nordox 75WG ^{OG}				
	Evito 480 SC	11	3-5.7 fl oz	1	22.8 fl oz
	Inspire Super	3,9	16-20 fl oz	7	80 fl oz
	Mancozeb	M	2-3 lb	5	25.6 lb
	Dry formulations				
	Liquid Formulations	M	1.6-2.4 qt	5	19.2 qt
	ManKocide	M	2-3 lb	5	24 lb
	Merivon	7,11	4-5.5 fl oz	0	16.5
	Pristine	7,11	12.5-18.5 oz	0	74 oz
	Quadris	11	11-15.5 fl oz	1	92.3 fl oz
	Quadris Opti	11,M	3.2 pt	1	4 app
	Quadris Top	11,3	12-14 fl oz	1	56 fl oz
	Ridomil Gold Bravo SC	4,M	2.5-3.3 pt	0	4 app
	Satori	11	11-15.5 fl oz	1	92.3 fl oz
	Tanos	11,27	8 oz	3	4 app
	Thiophanate-methyl	1	0.4 lb	1	2.5 lb
	Thiophanate-methyl 85WG				
	Topsin 4.5FL	1	10 fl oz	1	60 fl oz
Topsin M 70WP	1	0.5 lb	1	3 lb	
Topsin M WSB	1	0.5 lb	1	3 lb	
Trilogy ^{OG}		1%	0		
Bacterial Fruit Blotch (<i>Acidovorax avena</i> subsp. <i>citrulli</i>)	Actigard	P	0.5-1.0 oz	0	8 oz
	Copper hydroxide	M	0.5-1.3 lb	0	17.5 lb
	Kocide 3000				
	Kocide 2000	M	1-2.3 lb	0	15 lb
	Champ WG ^{OG}	M	1.5-2 lb	0	10.5 lb
	Nu-Cop 50DF ^{OG}	M	1.5-2 lb	1	10.5 lb
	Copper hydroxide and copper oxychloride ¹¹	M	1-2.5 pt	0	18.6 pt
	Badge SC				
	Badge X2 ^{OG}	M	0.5-1.3 lb	0	5.3 lb Cu
	Copper sulfate	M	1-2 lb	0	13 lb
	Cuprofix-Ultra 40				
	Mastercop	M	0.5-1 pt	0	6 pt
	Copper octanoate	M	0.5-2 gal/100gal	0	
	Cueva ^{OG}				
	Cuprous oxide	M	1.5-2 lb	1	
	Nordox 75WG ^{OG}				
ManKocide	M	2-3 lb	5	8 app	

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops					
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.					
Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
Bacterial Wilt (<i>Erwinia tracheiphilia</i>)	No bactericides available. Control of the cucumber beetle prior to flowering is the only recommended practice.				
Belly Rot (<i>Rhizoctonia solani</i>)	Evito 480 SC	11	3-5.7 fl oz	1	22.8 fl oz
	Evito 480 SC	11	0.2 fl oz ⁶		1 app
	Quadris	11	11-15.5 fl oz	1	92.3 fl oz
	Quadris Opti	11,M	3.2 pt	1	4 app
	Quadris Top	11,3	12-14 fl oz	1	56 fl oz
	Satori	11	0.4-0.8 fl oz ⁶		1 app
	Thiophanate-methyl				
	Thiophanate-methyl 85WG	1	0.4 lb	1	2.5 lb
	Topsin 4.5FL	1	10 fl oz	1	60 fl oz
	Topsin M 70WP	1	0.5 lb	1	3 lb
	Topsin M WSB	1	0.5 lb	1	3 lb
	Uniform	11,4	0.3 fl oz ⁶		1 app
	Downy Mildew (<i>Pseudoperonospora cubensis</i>)	Actigard 50WG	P	0.5-1.0 oz	0
Actinovate AG ^{OG}			3-12 oz	0	
Aliette WDG		33	2-5 lb	0.5	7 app
Alude		33	1.3 qt		6 app
Cabrio		11	8-12 oz	0	64 oz
Chlorathalonil					
Bravo Ultrex		M	1.4-1.8 lb	0	19.1 lb
Bravo WeatherStik		M	1.5-2 pt	0	21 pt
Bravo Zn		M	2.3-2.8 pt	0	30 pt
Chlorathalonil 720 SC		M	1.5-2 pt	0	21 pt
Confine Extra		33	1-3 qt	0	
Copper hydroxide					
Kocide 3000		M	0.5-1.3 lb	0	17.5 lb
Kocide 2000		M	1-2.3 lb	0	15 lb
Champ WG ^{OG}		M	1.5-2 lb	0	10.5 lb
Nu-Cop 50DF ^{OG}		M	1.5-2 lb	1	10.5 lb
Copper hydroxide and copper oxychloride ¹¹					
Badge SC		M	1-2.5 pt	0	18.6 pt
Badge X2 ^{OG}		M	0.5-1.3 lb	0	5.3 lb Cu
Copper sulfate					
Cuprofix-Ultra 40		M	1-2 lb	0	13 lb
Mastercop		M	0.5-1 pt	0	6 pt
Copper octanoate					
Cueva ^{OG}		M	0.5-2 gal/100gal	0	
Cuprous oxide					
Nordox 75WG ^{OG}		M	1.5-2 lb	1	
Evito 480 SC		11	3-5.7 fl oz	1	22.8 fl oz
Flint		11	4 oz	0	16 oz
Forum		40	6 fl oz ¹²	0	30 fl oz
Gavel 75DF					
mancozeb		M	1.5-2 lb	5	8 app

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	zoxamide	22	0.1-0.2 lb	5	8 app
	Mancozeb				
	Dry formulations	M	2-3 lb	5	25.6 lb
	Liquid Formulations	M	1.6-2.4 qt	5	19.2 qt
	ManKocide	M	2-3 lb	5	24 lb
	Milstop ^{OG}		2-5 lb/100 gal		
	Presidio	43	3-4 fl oz ¹²	2	12 fl oz
	Prev-AM		50 fl oz/100gal		
	Previcur Flex	28	1.2 pt	2	6 pt
	Pristine	7,11	12.5-18.5 oz	0	74 oz
	Quadris	11	11-15.5 fl oz	1	92.3 fl oz
	Quadris Opti	11,M	3.2 pt	1	4 app
	Quadris Top	11	12-14 fl oz	1	56 fl oz
	Ranman	21	2.1-2.3 fl oz	0	16.5 fl oz
	Reason 500 SC	11	5.5 fl oz	14	22 fl oz
	Revus	40	8 fl oz ¹²	0	32 fl oz
	Satori	11	11-15.5 fl oz	1	92.3 fl oz
	Tanos	11,27	8 oz	3	4 app
Zampro	40,45	14 fl oz	0	42 fl oz	
Fusarium Wilt (<i>Fusarium oxysporum</i>)	No fungicides available. Soil protectants and resistant varieties are recommended.				
Gummy Stem Blight and Black Rot (<i>Mycosphaerella melonis</i>, <i>Didymella bryoniae</i>)	Alude		1.3 qt		6 app
	Cabrio	11	12-16 oz	0	64 oz
	Chlorathalonil				
	Bravo Ultrex	M	1.4-2.7 lb	0	19.1 lb
	Bravo WeatherStik	M	1.5-3 pt	0	21 pt
	Bravo Zn	M	2.3-4.3 pt	0	30 pt
	Chlorathalonil 720 SC	M	1.5-3 pt	0	21 pt
	Copper hydroxide				
	Kocide 3000	M	0.5-1.3 lb	0	17.5 lb
	Kocide 2000	M	1-2.3 lb	0	15 lb
	Champ WG ^{OG}	M	1.5-2 lb	0	10.5 lb
	Nu-Cop 50DF ^{OG}	M	1.5-2 lb	1	10.5 lb
	Copper hydroxide and copper oxychloride ¹¹				
	Badge SC	M	1-2.5 pt	0	18.6 pt
	Badge X2 ^{OG}	M	0.5-1.3 lb	0	5.3 lb Cu
	Copper sulfate				
	Cuprofix-Ultra 40	M	1-2 lb	0	13 lb
	Mastercop	M	0.5-1 pt	0	6 pt
	Cuprous oxide				
	Nordox 75WG ^{OG}	M	1.5-2 lb	1	
	Evito 480 SC	11	3-5.7 fl oz	1	22.8 fl oz
	Fontelis	7	12-16 fl oz	1	67 fl oz
	Inspire Super	3,9	16-20 fl oz	7	80 fl oz
	Mancozeb				
	Dry formulations	M	2-3 lb	5	25.6 lb

Commercial Crop Production Vegetables

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Liquid Formulations	M	1.6-2.4 qt	5	19.2 qt
	ManKocide	M	2-3 lb	5	24 lb
	Merivon	7,11	5.5 fl oz	0	16.5 fl oz
	Pristine	7,11	12.5-18.5 oz	0	74 oz
	Quadris	11	11-15.5 fl oz	1	92.3 fl oz
	Quadris Opti	11,M	3.2 pt	1	4 app
	Quadris Top	11,3	12-14 fl oz	1	56 fl oz
	Ridomil Gold Bravo SC	4,M	2.5-3.3 pt	0	4 app
	Satori	11	11-15.5 fl oz	1	92.3 fl oz
	Sovran	11	4.8 oz	0	19.2 oz
	Stylet-Oil		3-6 qt/100 gal		
	Switch 62.5WG	9,12	11-14 oz	1	56 oz
	Tebuconazole				
	Monsoon	3	8 fl oz	7	24 fl oz
	Onset 3.6L	3	8 fl oz	7	24 fl oz
	Tebu-Crop 3.6F	3	8 fl oz	7	24 fl oz
	Toledo	3	8 fl oz	7	24 fl oz
	Thiophanate-methyl				
	Thiophanate-methyl 85WG	1	0.4 lb	1	2.5 lb
	Topsin 4.5FL	1	10 fl oz	1	60 fl oz
	Topsin M 70WP	1	0.5 lb	1	3 lb
	Topsin M WSB	1	0.5 lb	1	3 lb
Plectorsporium (Microdochium) Blight (Plectosporium tabacinum)	Cabrio	11	12-16 oz	0	64 fl oz
	Dithane F-45 Rainshield	M	1.6-2.4 qt	5	19.2 qt
	Dithane M-45	M	2-3 lb	5	24 lb
	Evito 480SC	11	3-5.7 fl oz	1	22.8 fl oz
	Merivon	7,11	5.5 fl oz	0	16.5 fl oz
	Roper DF Rainshield	M	2-3 lb	5	25.6 lb
Powdery Mildew (Sphaerotheca fuliginea, Erysiphe cichoracearum)	Actigard 50WG	P	0.5-1.0 oz	0	8 oz
	Actinovate AG ^{OG}		3-12 oz	0	
	Cabrio	11	8-12 oz	0	64 oz
	Chlorathalonil				
	Bravo Ultrex	M	1.4-1.8 lb	0	19.1 lb
	Bravo WeatherStik	M	1.5-2 pt	0	21 pt
	Bravo Zn	M	2.3-2.8 pt	0	30 pt
	Chlorathalonil 720 SC	M	1.5-2 pt	0	21 pt
	Confine Extra	33	1-3 qt	0	
	Copper hydroxide				
	Kocide 3000	M	0.5-1.3 lb	0	17.5 lb
	Kocide 2000	M	1-2.3 lb	0	15 lb
	Champ WG ^{OG}	M	1.5-2 lb	0	10.5 lb
	Copper hydroxide and copper oxychloride ¹¹				
	Badge SC	M	1-2.5 pt	0	18.6 pt
	Badge X2 ^{OG}	M	0.5-1.3 lb	0	5.3 lb Cu
	Copper sulfate				
	Cuprofix-Ultra 40	M	1-2 lb	0	13 lb

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Mastercop	M	0.5-1 pt	0	6 pt
	Cuprous oxide				
	Nordox 75WG ^{OG}	M	1.5-2 lb	1	
	Endura	7	6.5 oz	0	26 oz
	Evito 480 SC	11	3-5.7 fl oz	1	22.8 fl oz
	Flint	11	1.5-2 oz	0	16 oz
	Fontelis	7	12-16 fl oz	1	67 fl oz
	ManKocide	M	2-3 lb	5	24 lb
	Milstop ^{OG}		2-5 lb/100 gal		
	Merivon	7,11	4-5.5 fl oz	0	16.5 fl oz
	Prev-AM	7,11	50 fl oz/100gal		
	Pristine	11	12.5-18.5 oz	0	74 oz
	Quadris	11,M	11-15.5 fl oz	1	92.3 fl oz
	Quadris Opti	11,3	3.2 pt	1	4 app
	Quadris Top	3	12-14 fl oz	1	56 fl oz
	Rally 40WSP	11	2.5-5 oz	0	1.5 lb a.i.
	Satori		11-15.5 fl oz	1	92.3 fl oz
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	Max	44	1-3 lb	0	
	Sonata ^{OG}	44	2-4 qt	0	
	Sovran	11	3.2-4.8 oz	0	19.2 oz
	Sulfur ^{OG}				
	Microthiol Disperss				
	Cucumbers only	M	2-4 lb		
	Melons, Squash, Pumpkins	M	5-10 lb		
	Surround WP ^{OG}		25-50 lb		
	Switch 62.5WG	9,12	11-14 oz	1	56 oz
	Tebuconazole				
	Monsoon	3	4-6 fl oz	7	24 fl oz
	Onset 3.6L	3	4-6 fl oz	7	24 fl oz
	Tebu-Crop 3.6F	3	4-6 fl oz	7	24 fl oz
Toledo	3	4-6 fl oz	7	24 fl oz	
Thiophanate-methyl					
Thiophanate-methyl 85WG	1	0.4 lb	1	2.5 lb	
Topsin 4.5FL	1	10 fl oz	1	60 fl oz	
Topsin M 70WP	1	0.5 lb	1	3 lb	
Topsin M WSB	1	0.5 lb	1	3 lb	
Phytophthora Blight or Crown Rot (<i>Phytophthora capsici</i>)	Forum SC	40	6 fl oz ¹²	0	30 fl oz
	Presidio	43	3-4 fl oz	2	12 fl oz
	Ranman	21	2.8 fl oz	0	16.f fl oz
	Revus	40	8 fl oz	0	32 fl oz
	Tanos	11,27	8-10 fl oz	3	4 app
	Zampro	40,45	14 fl oz	0	42 fl oz
Pythium Bamping-off and Cottony Leak (<i>Pythium</i> spp.)	Actinovate AG ^{OG}		3-12 oz		
	Bio-Tam ^{OG}		1.5-3 oz ⁶		1 app
	Phosphorous acid				

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
	Confine Extra	33	1-4 qt	0
	Rampart	33	1-3 qt/100 gal	0
	Potassium phosphite			
	Fosphite	33	1-3 qt/100 gal	0
	Fungi-phite	33	1-5 qt	0
	Previcur Flex	28	1.2 pt	2
	Ridomil Gold SL	4	1-2 pt ¹³	
	MetaStar 2EC AG	4	4-8 pt ¹³	
	Serenade Soil ^{OG}		2-6 qt ¹³	
	Ultra Flourish	4	2-4 pt ¹³	5
	Uniform	11,4	0.3 fl oz ⁶	
Scab (<i>Cladosporium cucumerinum</i>)	Actigard	P	0.5-1.0 oz	
	Chlorathalonil			
	Bravo Ultrex	M	1.4-1.8 lb	0
	Bravo WeatherStik	M	1.5-2 pt	0
	Bravo Zn	M	2.3-2.8 pt	0
	Chlorathalonil 720 SC	M	1.5-2 pt	0
	Mancozeb			
	Dry formulations	M	2-3 lb	5
	Liquid Formulations	M	1.6-2.4 qt	5
	ManKocide	M	2-3 lb	5
	Ridomil Gold Bravo SC	4,M	2.5-3.3 pt	0
	Trilogy ^{OG}		1%	
Eggplant				
Alternaria Blight and Leaf Spot (<i>Alternaria</i> spp.)	Actinovate AG ^{OG}		3-12 oz	
	Cabrio	11	8-12 oz	0
	Copper hydroxide			
	Kocide 3000	M	0.8-1.5 lb	0
	Kocide 2000	M	1.5 lb	0
	Champ WG ^{OG}	M	1.6 lb	7
	Nu-Cop 50DF ^{OG}	M	1.5 lb	1
	Copper hydroxide and copper oxychloride ¹¹			
	Badge SC	M	1.5 pt	7
	Badge X2 ^{OG}	M	0.8 lb	7
	Copper sulfate			
	Cuprofix-Ultra 40	M	1.3 lb ¹¹	
	Mastercop	M	0.5-1.5 pt	7
	Cuprous oxide			
	Nordox	M	2-4 lb	
	Fluoxastrobin			
	Aftershock	11	2-5.7 fl oz	3
	Evito	11	2-5.7 fl oz	3
	Fontelis	7	16-24 fl oz	0
	Milstop ^{OG}		2-5 lb/100 gal	
	Trilogy ^{OG}		1%	

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Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
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Anthraco (<i>Colletotrichum coccodes</i>)	Actinovate AG ^{OG}		3-12 oz	
	Cabrio	11	8-12 oz	0
	Chlorothalonil			
	Bravo Ultrex	M	1.4 lb	3
	Bravo WeatherStik ¹⁴	M	1.5 pt	3
	Copper hydroxide			
	Kocide 3000	M	0.8-1.5 lb	0
	Kocide 2000	M	1.5 lb	0
	Champ WG ^{OG}	M	1.6 lb	7
	Copper hydroxide and copper oxychloride ¹¹			
	Badge SC	M	1.5 pt	7
	Badge X2 ^{OG}	M	0.8 lb	7
	Nu-Cop 50DF	M	1.5 lb	1
	Copper sulfate			
	Cuprofix-Ultra 40	M	1.3 lb ¹¹	0
	Mastercop	M	0.5-1.5 pt	7
	Cuprous oxide			
	Nordox	M	2-4 lb	
	Flint	11	3-4 oz	3
	Fontelis	7	24 fl oz	0
	Inspire Super	9,3	16-20 fl oz	0
	Priaxor	7,11	4-8 fl oz	0
Quadris	11	6-15.5 fl oz	0	
Quadris Top	11,3	8-14 fl oz	0	
Satori	11	6-15.5 fl oz	0	
Trilogy ^{OG}		1%		
Phomopsis Fruit Rot (<i>Phomopsis vexans</i>)	Copper hydroxide			
	Kocide 3000	M	0.8-1.5 lb	0
	Kocide 2000	M	1.5 lb	0
	Champ WG ^{OG}	M	1.6 lb	7
	Nu-Cop 50DF ^{OG}	M	1.5 lb	1
	Copper hydroxide and copper oxychloride ¹¹			
	Badge SC	M	1.5 pt	7
	Badge X2 ^{OG}	M	0.8 lb	7
	Copper sulfate			
	Cuprofix-Ultra 40	M	1.3 lb ¹¹	0
	Mastercop	M	0.5-1.5 pt	7
	Top Cop with Sulfur	M	2 qt	
Cuprous oxide				
Nordox	M	2-4 lb		
Powdery Mildew (<i>Leveillula taurica</i>)	Cabrio	11	8-16 oz	0
	Chlorothalonil			
	Bravo Ultrex	M	1.4 lb	3
	Bravo WeatherStik ¹⁴	M	1.5 pt	3
	Phosphorous acid			

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Confine Extra	33	1-3 qt	0	
	Rampart	33	1-3 qt/100 gal	0	
	Potassium phosphite				
	Fosphite	33	1-3 qt/100 gal	0	6 app
	Fungi-phite	33	1-5 qt	0	7 app
	Fontelis	7	16-24 fl oz	0	72 fl oz
	Inspire Super	9,3	16-20 fl oz	0	47 fl oz
	Priaxor	7,11	6-8 fl oz	0	24 fl oz
	Quadris	11	6-15.5 fl oz	0	61.5 fl oz
	Quadris Top	11	8-14 fl oz	0	55.3 fl oz
	Satori	11	6-15.5 fl oz	0	61.5 fl oz
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	Max	44	1-3 lb	0	
	Sonata ^{OG}	44	2-4 qt	0	
	Sulfur ^{OG}				
	Microfine Sulfur	M	22-38 lb		
Microthiol Disperss	M	4-6 lb			
Yellow Jacket Wetttable	M	22-38 lb			
Switch 62.5WG	9,12	11-14 oz	0	56 oz	
Trilogy		1%			
Phytophthora Blight or Crown Rot (<i>Phytophthora capsici</i>)	Forum SC	40	6 fl oz ¹²	0	30 fl oz
	Micora	40	8 fl oz ¹²		16 fl oz
	Presidio	43	3-4 fl oz	2	12 fl oz
	Ranman	21	2.8 fl oz	0	16.5 fl oz
	Reason 500 SC	11	8.2 fl oz	14	24.6 fl oz
	Zampro	40,45	14 fl oz	0	42 fl oz
Pythium Damping-off (<i>Pythium</i> spp.)	MetaStar 2EC AG	4	4-8 pt ¹³	7	12 pt
	Ridomil Gold SL	4	1 pt ¹³	7	1.5 lb a.i.
	Ultra Flourish	4	2 pt ¹³	7	6 pt
Southern Blight (<i>Sclerotium rolfsii</i>)	Cabrio	11	12-16 oz	0	96 oz
	Fluoxastrobin				
	Aftershock	11	2-5.7 fl oz	3	22.8 fl oz
	Evito	11	2-5.7 fl oz	3	22.8 fl oz
Priaxor	7,11	4-8 fl oz	0	24 fl oz	
GREENS (Collards, Kale, Mustard, Turnip)					
Alternaria Leaf Spot or Black Leaf Spot (<i>Alternaria brassicae</i>)	Azoxystrobin				
	Quadris	11	6-15.5 fl oz	0	46 fl oz
	Quadris Top	11,3	12-14 fl oz	1	56 fl oz
	Satori	11	12-16 oz	3	64 oz
	Cabrio	11	6-9 oz	14	18 oz
	Endura	7	14-30 fl oz	0	72 fl oz
	Copper hydroxide				
	Kocide 3000	M	0.5-0.8 lb	0	8.8 lb
	Kocide 2000	M	0.8-1.5 lb	0	7.6 lb
	Champ Formula 2 Flowable	M	0.3-0.7 pt	0	7.3 pt
Champ WG ^{OG}	M	1 lb	0	5.3 lb	

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Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
	Copper hydroxide and copper oxychloride ¹¹			
	Badge SC	M	0	18.6 pt
	Badge X2 ^{OG}	M	0	2.7 lb Cu
	Copper sulfate			
	Cuprofix-Ultra 40	M	0	6.6 lb
	Mastercop	M	0	6 pt
	Inspire Super	3,9	7	80 fl oz
	Procure 480 SC	3	1	18 fl oz
	Reason 500 SC	11	2	24.6 fl oz
	Serenade ^{OG}			
	ASO	44		
	Max	44		
	Sonata ^{OG}	44		
	Switch 62.5WG	9,12	7	56 oz
	Tebuconazole			
	Monsoon	3	7	16 fl oz
	Onset 3.6L	3	7	16 fl oz
	Tebu-Crop 3.6F	3	7	16 fl oz
	Toledo	3	7	16 fl oz
Anthracnose (<i>Colletotrichum higginsianum</i>), Cercospora, and Cercospora Leaf Spots	Azoxystrobin			
	Quadris	11	0	46 fl oz
	Quadris Top	11,3	1	56 fl oz
	Satori	11	3	64 oz
	Cabrio	11	14	18 oz
	Endura	7	0	72 fl oz
	Inspire Super	3,9	7	80 fl oz
	Reason 500 SC	11	2	24.6 fl oz
	Switch 62.5WG	9,12	7	56 oz
	Tebuconazole			
	Monsoon	3	7	16 fl oz
	Onset 3.6L	3	7	16 fl oz
	Tebu-Crop 3.6F	3	7	16 fl oz
	Toledo	3	7	16 fl oz
Bacterial Leaf Spot (<i>Xanthomonas campestris</i> pv. <i>armoraciae</i>)	Cease	44	0	
	Serenade ^{OG}			
	ASO	44	0	
	Max	44	0	
	Sonata ^{OG}	44	0	
Black rot (<i>Xanthomonas campestris</i> pv. <i>campestris</i>)	Actigard	21	7	4 apps
	Cease	44	0	
	Copper hydroxide			
	Kocide 3000	M	0	15.8 lb
	Kocide 2000	M	0	8.8 lb
	Champ Formula 2 Flowable	M	0	7.6 lb
	Champ WG ^{OG}	M	0	5.3 lb
	Copper hydroxide, Copper			

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	oxychloride				
	Badge SC	M	1-1.8 pt	0	18.6 pt
	Badge X2 ^{OG}	M	0.5-0.8 lb	0	2.7 lb Cu
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.5-1 pt	0	6 pt
	Mastercop	M	0.5-1 pt	0	6 pt
	Cuprous oxide				
	Nordox	M	1-3 lb		
Downy mildew (<i>Peronospora parasitica</i>)	Actigard 50WG	21	0.8-1 oz	7	4 oz ¹⁷
	Actinovate AG ^{OG}		3-12 oz		
	Aliette WDG	33	2-5 lb	3	7 app
	Alude	33	0.5 gal/40 gal		
	Cabrio	11	12-16 oz	0	64 oz
	Copper hydroxide				
	Kocide 3000	M	0.5-0.8 lb	0	8.8 lb
	Kocide 2000	M	0.8-1.5	0	7.6 lb
	Champ Formula 2 Flowable	M	0.3-0.7 pt	0	7.3 pt
	Champ WG ^{OG}	M	1 lb	0	5.3 lb
	Copper hydroxide and copper oxychloride ¹¹				
	Badge SC	M	1.7 pt	5	28.1 pt
	Badge X2 ^{OG}	M	1.8-3.5 lb	5	8 lb
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.5-1 pt	0	6 pt
	Mastercop	M	0.5-1 pt	0	6 pt
	Cuprous oxide				
	Nordox	M	1-2 lb		
	Forum	40	6 fl oz ¹²	0	18 fl oz
	Micora	40	5.5-8 fl oz ¹²		8 fl oz
	Milstop ^{OG}	40	2-5 lb/100 gal		
	Phosphorous acid				
	Confine Extra		1-3 qt		
	Rampart	33	1-3 qt/100 gal		
	Potassium phosphite	33			
	Fosphite	33	1-3 qt/100 gal		
	Fungi-phite	33	1-5 qt	0	6 app
	Helena ProPhyt	33	2-4 pt	0	7 app
	Ranman	21	2.8 fl oz	0	39.5 fl oz
	Reason 500 SC	11	5.5-8.2 fl oz	2	24.6 fl oz
	Revus	40	8 fl oz	1	32 fl oz
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
Max	44	1-3 lb	0		
Sonata ^{OG}	44	2-4 qt	0		
Zampro	40,45	14 fl oz	0	42 fl oz	

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
Peppery Leaf Spot (<i>Pseudomonas syringae</i> <i>pv. maculicola</i>)	Cease		3-6 qt/100 gal	0
	Serenade ^{OG}			
	ASO	44	2-6 qt	0
	Max	44	1-3 lb	0
	Sonata ^{OG}	44	2-4 qt	0
Powdery Mildew (<i>Erysiphe polygoni</i>)	Actinovate AG ^{OG}		3-12 oz	
	Cabrio	11	12-16 oz	3
	Cease	44	3-6 qt/100 gal	0
	Endura	7	6-9 oz	14
	Fontelis	7	14-30 fl oz	0
	Inspire Super	3,9	16-20 fl oz	7
	MilStop ^{OG}		2-5 lb/100 gal	
	Phosphorous acid			
	Confine Extra	33	1-3 qt	
	Rampart	33	1-3 qt/100 gal	
	Potassium phosphite			
	Fosphite	33	1-3 qt/100 gal	
	Procure 480 SC	3	6-8 fl oz	1
	Quadris Top	11,3	12-14 fl oz	1
	Serenade ^{OG}			
	ASO	44	2-6 qt	
	Max	44	1-3 lb	
	Sonata ^{OG}	44	2-4 qt	
	Sulfur ^{OG}			
	Microfine Sulfur	M	6-25 lb	
	Microthiol Disperss	M	3-10 lb	
	Yellow Jacket Wettable	M	6-25 lb	
	Switch 62.5WG	9,12	10-12 oz	7
Tebuconazole				
Monsoon	3	3-4 fl oz	7	
Onset 3.6L	3	3-4 fl oz	7	
Tebu-Crop 3.6F	3	3-4 fl oz	7	
Toledo	3	3-4 fl oz	7	
Pythium Damping-off (<i>Pythium</i> spp.)	Actinovate AG ^{OG}		3-12 oz	
	Mefenoxam			
	Ridomil Gold SL	4	0.3-0.5 pt ¹³	1 app
	Ultra Flourish	4	0.5-1 pt	4 pt
	Phosphorous acid			
	Confine Extra	33	1-3 qt	
	Rampart	33	1-3 qt/100 gal	
	Potassium phosphite			
	Fosphite	33	1-3 qt/100 gal	
Fungi-phite	33	1-5 qt		
RootShield Granules	44	2.5-6 lb/ ½ acre ¹³	1 app	
Phytophthora Root Rot	Actinovate AG ^{OG}		3-12 oz	
	Mefenoxam			

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	Ultra Flourish	4	0.5-1 pt		4 pt
	Phosphorous acid				
	Confine Extra	33	1-3 qt		
	Rampart	33	1-3 qt/100 gal		
	Potassium phosphite				
	Fosphite	33	1-3 qt/100 gal		
	Fungi-phite	33	1-5 qt		
	RootShield Granules	44	2.5-6 lb/ ½ acre ¹³		1 app
Rhizoctonia Basal Stem and Root Rot, Wire Stem (<i>Rhizoctonia solani</i>)	Azoxystrobin				
	Quadris	11	0.4-0.8 fl oz ⁶		1 app
	Satori	11	0.4-0.8 fl oz ⁶		1 app
	Cabrio	11	12-16 oz	3	64 oz
Sclerotinia Stem Sot (<i>Sclerotinia minor</i>, <i>S. sclerotiorum</i>)	Actinovate AG ^{OG}		3-12 oz		
	Cabrio	11	12-16 oz	3	64 oz
	Endura	7	6-9 oz	14	18 oz
	Fontelis	7	16-30 fl oz	0	72 fl oz
White Rust (<i>Albugo candida</i>)	Azoxystrobin				
	Quadris	11	6-15.5 fl oz	0	46 fl oz
	Satori	11	6-15.5 fl oz	0	46 fl oz
	Cabrio	11	12-16 oz	3	64 oz
	Reason 500 SC	11	8.2 fl oz	2	24.6 fl oz
Herbs (Chervil, Cilantro, Coriander, Endive, Fennel, and Parsley (excluding basil) and Other Leafy Vegetables (excluding lettuces and greens))					
Bacterial Leaf Spot (<i>Pseudomonas syringae</i> pathovars)	No products are currently labeled for bacterial leaf spot of herbs. Hot water treat seed to remove bacteria from the seed surface. See Seed Treatment section of this guide for instructions on how to treat seed.				
Cercospora and Septoria Leaf Blights (<i>Cercospora</i> spp. and <i>Septoria</i> spp.)	Azoxystrobin				
	Quadris	11	6-15.5 fl oz	0	92.3 fl oz
	Quadris Opti	11,M	2.4-3.7 pt	7	footnote ²⁹
	Satori	11	6-15.5 fl oz	0	92.3 fl oz
	Cabrio	11	12-16 oz	0	64 fl oz
	Chlorothalonil				
	Bravo Ultrex	M	1.8-2.7 lb ²⁸	7	21.8 lb
	Chlorothalonil 720 SC	M	2-3 pt ²⁸	7	24 pt
	Fontelis	7	14-24 fl oz	3	72 fl oz
	Propaconazole				
	Bumper 41.8 EC	3	3-4 fl oz ²⁸	14	16 fl oz
	Bumper ES	3	3-4 fl oz ²⁸	14	16 fl oz
	Propi-Star EC	3	3-4 fl oz ²⁸	14	16 fl oz
	Tilt	3	3-4 fl oz ²⁸	14	16 fl oz
	Switch 62.5 WG	9,12	11-14 oz	0	56 oz
Downy Mildew (<i>Peronospora</i> spp.)	Actinovate AG ^{OG}		3-12 oz		
	Aliette	33	2-5 lb	3	7 app
	Azoxystrobin				
	Quadris	11	12-15.5 fl oz		92.3 fl oz
	Satori	11	12-15.5 fl oz ¹⁵		92.3 fl oz

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	Cabrio	11	16 oz	0	64 fl oz
	Micora	40	5.5-8 fl oz ¹²		2 app
	Phosphorous acid				
	Confine Extra	33	1-4 qt		
	Rampart	33	1-3 qt/100 gal		
	Potassium phosphite				
	Fosphite	33	1-3 qt/100 gal		
	Fungi-phite	33	1-2 qt		
	Helena ProPhyt	33	2-4 pt		
	Presidio	43	3-4 fl oz ¹²	2	12 fl oz
	Ranman	21	2.8 fl oz	0	16.5 fl oz
	Reason 500SC	11	5.5-8.2 fl oz	2	24.6 fl oz
	Revus	40	8 fl oz	1	32 fl oz
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	Max	44	1-3 lb	0	
	Sonata ^{OG}	44	2-4 qt	0	
	Tanos	27,11	8-10 oz	1	48 oz
	Zampro	45,40	14 fl oz	0	42 fl oz
Pythium Damping-off (<i>Pythium</i> spp.)	Mefenoxam				
	Ridomil Gold SL	4	1-2 pt ¹³	7	1 lb a.i.
	Ultra Flourish	4	2-4 pt ¹³	7	4 pt
	Phosphorous acid				
	Confine Extra	33	1-4 qt		
	Rampart	33	1-3 qt/100 gal		
	Potassium phosphite				
	Fosphite	33	1-3 qt/100 gal		
	Ranman	21	2.8 fl oz ¹³		16.5 fl oz
	Rootshield Granules	44	2.5-6 lb/ ½ acre ¹³	0	1 app
	Uniform	4,11	0.34 fl oz ⁶		1 app
Rhizoctonia Damping-off (<i>Rhizoctonia solani</i>)	Phosphorous acid				
	Confine Extra	33	1-4 qt		
	Rampart	33	1-3 qt/100 gal		
	Potassium phosphite				
	Fosphite	33	1-3 qt/100 gal		
	Rootshield Granules	44	2.5-6 lb/ ½ acre ¹³	0	1 app
	Serenade Soil	44	2-6 qt ¹³		
White Rust (<i>Albugo occidentalis</i>)	Azoxystrobin				
	Quadris	11	6-15.5 fl oz	0	92.3 fl oz
	Satori	11	6-15.5 fl oz ¹⁵	0	92.3 fl oz
	Cabrio	11	8-12 fl oz	0	64 fl oz
	Presidio	43	3-4 fl oz ¹²	2	12 fl oz
	Ranman	21	2.8 fl oz	0	16.5 fl oz
	Reason 500SC	11	5.5-8.2 fl oz	2	24.6 fl oz
	Serenade ^{OG}				

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops					
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.					
Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	ASO	44	2-6 qt	0	
	Max	44	1-3 lb	0	
	Tanos	27,11	8-10 oz	1	48 oz
Lettuces					
Bacterial Spot (<i>Xanthomonas campestris</i> pv. <i>vitians</i>)	Actinovate AG ^{OG}		3-12 oz		
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	Max	44	1-3 lb	0	
	Sonata ^{OG}	44	2-4 qt	0	
Bottom Rot (<i>Rhizoctonia solani</i>)	Azoxystrobin				
	Quadris	11	0.4-0.8 fl oz ^{6,13}	0	92.3 fl oz
	Satori	11	0.4-0.8 fl oz ^{6,13}	0	92.3 fl oz
	Endura	7	8-11 oz	14	22 oz
	Iprodione				
	Iprodione 4L AG	2	1.5-2 pt	14	3 app
	Meteor	2	1.5-2 pt	14	3 app
	Nevado 4F	2	1.5-2 pt	14	3 app
	Rovral 4F	2	1.5-2 pt	14	3 app
Botrytis Rot (or Gray Mold) (<i>Botrytis cinerea</i>)	Botran 5F				
	At planting	14	0.6 qt	14	3.2 qt ¹⁶
	Pre-thinning	14	0.6-1.8 qt	14	3.2 qt ¹⁶
	Post-thinning	14	1.8-3.2 qt	14	3.2 qt ¹⁶
	Botran 5F				
	At planting	14	1 lb	14	5.3 lb ¹⁶
	Pre-thinning	14	1-3 lb	14	5.3 lb ¹⁶
	Post-thinning	14	3-5.3 lb	14	5.3 lb ¹⁶
	Endura	7	8-11 oz	14	22 oz
	Fontelis	7	16-24 fl oz	3	72 fl oz
	Iprodione				
	Meteor	2	1.5-2 pt	14	3 app
	Nevado 4F	2	1.5-2 pt	14	3 app
	Rovral 4F	2	1.5-2 pt	14	3 app
	Merivon	7,11	8-11 fl oz	1	33 fl oz
	Switch 62.5WG	9,12	11-14 oz	0	56 oz
Downy Mildew (<i>Bremia lactucae</i> , <i>Peronospora</i> spp.)	Azoxystrobin				
	Quadris	11	12-15.5 fl oz	0	92.3 fl oz
	Satori	11	12-15.5 fl oz ¹⁵	0	92.3 fl oz
	Actigard 50WG	21	0.8-1 oz	7	4 oz ¹⁷
	Actinovate AG ^{OG}		3-12 oz		
	Aliette WDG	33	2-5 lb	3	7 app
	Alude	33	0.5 gal/40 gal		
	Cabrio	11	12-16 oz	0	64 oz
	Copper hydroxide				
	Kocide 3000	M	0.8-1.5 lb	0	26.6 lb
	Champ Formula 2 Flowable	M	0.7-1.3 pt	0	22 pt
	Copper hydroxide and copper oxychloride ¹¹				

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Badge SC	M	1.7 pt	5	28.1 pt
	Badge X2 ^{OG}	M	1.8-3.5 lb	5	8 lb
	Cuprous oxide				
	Nordox 75WG ^{OG}	M	1-2 lb		
	Mancozeb				
	Manzate Pro-Stick	M	1.6-2.1 lb	10	12.8 lb
	ManKocide	M	1-2 lb	10	26 lb
	Micora	40	5.5-8 fl oz ¹²		2 app
	Milstop ^{OG}		2-5 lb/100 gal		
	Phosphorous acid				
	Confine Extra	33	1-4 qt		
	Rampart	33	1-3 qt/100 gal		
	Potassium phosphite				
	Fosphite	33	1-3 qt/100 gal		
	Fungi-phite	33	1-2 qt		6 app
	Helena ProPhyt	33	2-4 pt		7 app
	Presidio	43	3-4 fl oz ¹²	2	12 fl oz
	Prev-AM		50 fl oz/100gal		
	Previcur Flex	28	2 pt	2	8 pt
	Ranman	21	2.8 fl oz	0	16.5 fl oz
	Reason 500 SC	11	5.5-8.2 fl oz	2	24.6 fl oz
	Revus	40	8 fl oz	1	32 fl oz
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	Max	44	1-3 lb	0	
	Sonata ^{OG}	44	2-4 qt	0	
	Tanos	27,11	8-10 oz	1	48 oz
Zampro	40,45	14 fl oz	0	42 fl oz	
Lettuce Drop <i>(Sclerotinia minor, S. sclerotiorum)</i>	Botran 5F				
	At planting	14	0.6 qt	14	3.2 qt ¹⁶
	Pre-thinning	14	0.6-1.8 qt	14	3.2 qt ¹⁶
	Post-thinning	14	1.8-3.2 qt	14	3.2 qt ¹⁶
	Botran 5F				
	At planting	14	1 lb	14	5.3 lb ¹⁶
	Pre-thinning	14	1-3 lb	14	5.3 lb ¹⁶
	Post-thinning	14	3-5.3 lb	14	5.3 lb ¹⁶
	Endura	7	8-11 oz	14	22 oz
	Fontelis	7	16-24 fl oz	3	72 fl oz
	Iprodione				
	Iprodione 4L AG	2	1.5-2 pt	14	3 app
	Meteor	2	1.5-2 pt	14	3 app
	Nevado 4F	2	1.5-2 pt	14	3 app
	Rovral 4F	2	1.5-2 pt	14	3 app
Merivon (<i>S. minor</i> only)	7,11	8-11 fl oz	1	33 fl oz	
Switch 62.5WG	9,12	11-14 oz	0	56 oz	
Powdery Mildew <i>(Erysiphe cichoracearum)</i>	Actinovate AG ^{OG}		3-12 oz		
	Azoxystrobin				

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Quadris	11	12-15.5 fl oz	0	92.3 fl oz
	Satori	11	12-15.5 fl oz ¹⁵	0	92.3 fl oz
	Cabrio	11	12-16 oz	0	64 oz
	Endura	7	8-11 oz	14	22 oz
	Fontelis	7	16-24 fl oz	3	72 fl oz
	Milstop ^{OG}		2-5 lb/100 gal		
	Merivon	7,11	4-11 fl oz	1	33 fl oz
	Phosphorous acid				
	Confine Extra	33	1-4 qt		
	Rampart	33	1-3 qt/100 gal		
	Potassium phosphite				
	Fosphite	33	1-3 qt/100 gal		
	Prev-Am		50 fl oz/100 gal		
	Procure 480 SC	3	6-8 fl oz	0	18 fl oz
	Quintec ¹⁸	13	4-6 fl oz	1	24 fl oz
	Rally 40WSP	3	5 oz	3	4 app
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	Max	44	1-3 lb	0	
	Sonata ^{OG}	44	2-4 qt	0	
	Sulfur ^{OG}				
	Microthiol Disperss	M	5-10 lb		
	Switch 62.5WG	9,12	11-14 oz	0	56 oz
	Trilogy ^{OG}		1%		
Pythium Damping-off (<i>Pythium</i> spp.)	Mefenoxam				
	Ridomil Gold SL	4	1-2 pt ¹³	7	1 lb a.i.
	Ultra Flourish	4	2-4 pt ¹³	7	4 pt
	Phosphorous acid				
	Confine Extra		1-4 qt		
	Rampart		1-3 qt/100 gal		
	Potassium phosphite				
	Fosphite		1-3 qt/100 gal		
	Fungi-phite		1-2 qt		6 app
	Previcur Flex	28	2 pt ¹³	2	8 pt
	Ranman	21	2.8 fl oz ¹³	0	16.5 fl oz
	Rootshield Granules	44	2.5-6 lb/ ½ acre ¹³		1 app
	Uniform	4,11	0.34 fl oz ⁶		1 app
Onions (Dry, Green, Shallots, Spanish), Garlic and Leeks					
Bacterial Leaf Blight (<i>Xanthomonas axonopodis</i> pv. <i>allii</i>, <i>Pseudomonas syringae</i> pv. <i>porri</i>)	Actigard 50 WG (dry only)	21	0.75-1 oz	7	4 oz
	Copper hydroxide				
	Kentan DF	M	1.5 lb	0	6 lb
	Kocide 3000	M	0.75-1.5 lb	0	20 lb
	Kocide 2000	M	1.5 lb	0	17.1 lb
	Copper sulfate				
	Mastercop	M	0.5-1.5 pt	7	9 pt

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
Botrytis Leaf Blight, Neck rot, Purple blotch, and Stemphylium blight	Aliette WDG (dry only)	33	2-3 lb	7	7 app
	Cabrio EG	11	8-12 oz	7	72 oz
	Cease Biofungicide ^{OG}	44	3-6 qt/100 gal	0	
	Chlorothalonil				
	Dry and Garlic				
	Bravo Ultrex	M	0.9-2.7 lb	7	18.2 lb
	Bravo	M	1-3 pt	7	20 pt
	Bravo ZN	M	1.5-4.25 pt	7	29 pt
	Chloronil 720	M	1-3 pt	7	20 pt
	Chlorothalonil	M	1-3 pt	7	20 pt
	Echo 720	M	1-2 pt	7	1.5 lb a.i.
	Equus 720SST	M	1-3 pt	7	20 pt
	Equus 500 ZN	M	1.5-4.25 pt	7	29 pt
	Intiate	M	1-3 pt	7	20 pt
	Initiate ZN	M	1.5-4.25 pt	7	29 pt
	Green, leeks, shallots				
	Bravo Ultrex	M	1.47-2.7 lb	14	8.2 lb
	Bravo	M	1.5-3 pt	14	9 pt
	Bravo ZN	M	2.25-4.25 pt	14	17 pt
	Chloronil 720	M	1.5-3 pt	14	9 pt
	Chlorothalonil	M	1.5-3 pt	14	9 pt
	Echo 720	M	1.5-3 pt	14	6.7 lb a.i.
	Equus 720SST	M	1.5-3 pt	14	9 pt
	Equus 500 ZN	M	2.25-4.25 pt	14	13 pt
	Intiate	M	1.5-3 pt	14	3 apps
	Initiate ZN	M	2.25-4.25 pt	14	13 pt
	Copper hydroxide				
	Badge SC	M	1.5 pt		21.1 pt
	Badge X2 ^{OG}	M	0.75 lb		6 lb a.i.
	Champ DP DRY	M	1.33 lb		16 lb
	Champ Formula 2	M	1.33 pt		16.5 pt
	Champ WG ^{OG}	M	2 lb		12 lb
	Kentan DF	M	2 lb		6 lb a.i.
Kocide 3000	M	0.75-1.5 lb		20 lb	
Kocide 2000	M	1.5 lb		17.1 lb	
Cuprous oxide					
Nordox WG ^{OG}	M	1.25-2.5 lb			
Copper sulfate					
Cuprofix Ultra 40 (dry, green, garlic)	M	1.25-2.25 lb		15 lb	
Cuproxat	M	2.5-4.9 pt	7	29.6 pt	
Fontelis					
Helena Prophyt		4 pt	0	7 apps	
Inspire Super (green)	3,9	16-20 fl oz	14	60 fl oz	
Inspire Super (dry)	3,9	16-20 fl oz	7	80 fl oz	
Iprodione (dry onions only)					
Iprodione 4L AG	2	1 pt	7	5 app	
Meteor	2	1 pt	7	10 app	

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Nevado 4F	2	1 pt	7	10 app
	Rovral 4 Flowable	2	1 pt	7	10 app
	Mancozeb				
	Dithane F45 Rainshield	M	2.4 qt	7	24 qt
	Dithane M45	M	3 lb	7	30 lb
	Manzate Flowable (dry, garlic, shallot)	M	2.4 qt	7	24 qt
	Manzate Max (dry, garlic, shallot)	M	1.6-2.4 qt	7	24 qt
	Manzate Pro-Stick (dry, garlic, shallot)	M	3 lb	7	30 lb
	Penncozeb 75DF (dry, garlic, shallot)	M	2-3 lb	7	24 lb
	Penncozeb 80WP (dry, garlic, shallot)	M	2-3 lb	7	24 lb
	ManKocide (dry only)	M	2.5 lb	7	20 lb
	Merivon	7,11	8-11 fl oz	7	33 fl oz
	Omega 500F	29	1 pt	7	6 app
	Pristine	7,11	10.5-18.5 oz	7	111 oz
	Propiconazole				
	Dry, garlic and shallots				
	Amtide	3	2-8 fl oz	14	16 fl oz
	Bumper 41.8 EC	3	2-8 fl oz	14	16 fl oz
	Bumper ES	3	2-8 fl oz	14	16 fl oz
	Fitness	3	2-8 fl oz	14	16 fl oz
	Tilt	3	2-8 fl oz	14	16 fl oz
	Topaz	3	2-8 fl oz	14	16 fl oz
	Green and leeks				
	Amtide	3	2-8 fl oz	0	16 fl oz
	Bumper 41.8 EC	3	2-8 fl oz	0	16 fl oz
	Bumper ES	3	2-8 fl oz	0	16 fl oz
	Fitness	3	2-8 fl oz	0	16 fl oz
	Tilt	3	2-8 fl oz	0	16 fl oz
	Topaz	3	2-8 fl oz	0	16 fl oz
	Quadris	11	9-15.5 fl oz	0	92.3 fl oz
	Quadris Opti (dry, garlic only)	11,M	1.6-3.2 pt	7	3 apps
	Quadris Opti (green, leek, shallots)	11,M	1.6-3.2 pt	14	3 apps
	Quadris Top (dry only)	11,3	12-14 fl oz	7	56 fl oz
	Quadris Top (green only)	11,3	12-14 fl oz	7	42 fl oz
	Quilt (dry only)	11,3	14-27.5 fl oz	14	55.3 fl oz
	Quilt (green only)	11,3	14-27.5 fl oz	0	55.3 fl oz
	Quilt Xcel (dry only)	11,3	14-26 fl oz	14	56 fl oz
	Quilt Xcel (green only)	11,3	14-26 fl oz	0	56 fl oz
	Reason 500 SC	11	5.5 fl oz	7	22 fl oz
	Ridomil Gold Bravo (dry, garlic)	4,M	2.5 pt	7	15 lb a.i.
Ridomil Gold Bravo (green,	4,M	2.5 pt	14	6.75 lb a.i.	

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	leeks, shallots)				
	Satori	11	6-12 fl oz	0	92.3 fl oz
	Scala SC	9	9-18 fl oz	7	54 fl oz
	Serenade				
	ASO ^{OG}	44	2-6 qt		
	MAX ^{OG}	44	1-3 lb		
	Switch 62.5 WG	9,12	11-14 oz	7	56 oz
	Tanos	11,27	8 oz	3	84 oz
	Tebconazole				
	Dry, garlic and shallot				
	Monsoon	3	4-6 fl oz	7	12 fl oz
	Onset 3.6L	3	4-6 fl oz	7	12 fl oz
	Tebustar 3.6L	3	4-6 fl oz	7	12 fl oz
	Toledo 3.6F	3	4-6 fl oz	7	12 fl oz
	Green and leeks				
	Monsoon	3	4-6 fl oz	7	24 fl oz
	Onset 3.6L	3	4-6 fl oz	7	24 fl oz
	Tebustar 3.6L	3	4-6 fl oz	7	24 fl oz
	Toledo 3.6F	3	4-6 fl oz	7	24 fl oz
	Vanguard WG	9	10 oz	7	28 oz
Downy Mildew <i>(Peronospora destructor)</i>	Actigard 50 WG (dry only)	21	0.75-1 oz	7	4 oz
	Actinovate AG	44	3-12 oz	0	
	Aliette WDG (dry only)	33	2-3 lb	7	7 app
	Alude	33	2 qt/100 gal		
	Cabrio EG	11	12 oz	7	72 oz
	Cease Biofungicide ^{OG}	44	3-6 qt/100 gal	0	
	Chlorothalonil				
	Dry and Garlic				
	Bravo Ultrex	M	0.9-2.7 lb	7	18.2 lb
	Bravo	M	1-3 pt	7	20 pt
	Bravo ZN	M	1.5-4.25 pt	7	29 pt
	Chloronil 720	M	1-3 pt	7	20 pt
	Chlorothalonil	M	1-3 pt	7	20 pt
	Echo 720	M	1-2 pt	7	1.5 lb a.i.
	Equus 720SST	M	1-3 pt	7	20 pt
	Equus 500 ZN	M	1.5-4.25 pt	7	29 pt
	Intiate	M	1-3 pt	7	20 pt
	Initiate ZN	M	1.5-4.25 pt	7	29 pt
	Green, leeks, shallots				
	Bravo Ultrex	M	1.47-2.7 lb	14	8.2 lb
	Bravo	M	1.5-3 pt	14	9 pt
	Bravo ZN	M	2.25-4.25 pt	14	17 pt
	Chloronil 720	M	1.5-3 pt	14	9 pt
	Chlorothalonil	M	1.5-3 pt	14	9 pt
	Echo 720	M	1.5-3 pt	14	6.7 lb a.i.
	Equus 720SST	M	1.5-3 pt	14	9 pt
	Equus 500 ZN	M	2.25-4.25 pt	14	13 pt
	Intiate	M	1.5-3 pt	14	3 apps

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Initiate ZN	M	2.25-4.25 pt	14	13 pt
	Copper hydroxide				
	Badge SC	M	1.5 pt		21.1 pt
	Badge X2	M	0.75 lb		6 lb a.i.
	Champ DP Dry	M	1.33 lb		16 lb
	Champ Formula 2	M	1.33 pt		16.5 pt
	Champ WG ^{OG}	M	2 lb		12 lb
	Kentan DF	M	2 lb		6 lb a.i.
	Kocide 3000	M	0.75-1.5 lb		20 lb
	Kocide 2000	M	1.5 lb		17.1 lb
	Copper sulfate				
	Cuprofix Ultra 40 (dry, green, garlic)	M	1.25-2.5 lb		15 lb
	Cuproxtat	M	2.5-4.9 pt	7	29.6 pt
	Cuprous oxide				
	Nordox WG ^{OG}	M	1.25-2.5 lb		
	Forum		6 fl oz	0	30 fl oz
	Mancozeb				
	Dithane F45 Rainshield	M	2.4 qt	7	24 qt
	Dithane M45	M	3 lb	7	30 lb
	Manzate Flowable (dry, garlic, shallot)	M	2.4 qt	7	24 qt
	Manzate Max (dry, garlic, shallot)	M	1.6-2.4 qt	7	24 qt
	Manzate ProStick (dry, garlic, shallot)	M	3 lb	7	30 lb
	Penncozeb 75DF (dry, garlic, shallot)	M	2-3 lb	7	24 lb
	Penncozeb 80WP (dry, garlic, shallot)	M	2-3 lb	7	24 lb
	ManKocide (dry only)	M	2.5 lb	7	20 lb
	Omega 500F	29	1 pt	7	6 app
	Phosphorous acid				
	Confine Extra	33	1-4 qt	0	
	Phostrol (dry only)	33	2.5-3.75 pt	0	7 app
	Rampart	33	1-3 qt/100 gal	0	
	Potassium phosphite				
	Fosphite	33	1-3 qt/100 gal	0	6 app
	Fungi-phite	33	1-5 qt	0	7 app
	Helena ProPhyt	33	4 pt	0	
	Presidio	43	3-4 fl oz	2	12 fl oz
	Pristine	7,11	18.5 oz	7	111 oz
	Quadris	11	9-15.5 fl oz	0	92.3 fl oz
	Quadris Opti (dry, garlic only)	11,M	2.4-3.7 pt	7	3 apps
	Quadris Opti (green, leek, shallots)	11,M	2.4-3.7 pt	14	3 apps
	Quilt Xcel (dry only)	11,3	17.5-26 fl oz	14	56 fl oz
	Quilt Xcel (green only)	11,3	17.5-26 fl oz	0	56 fl oz

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Reason 500SC	11	5.5 fl oz	7	22 fl oz
	Revus	40	8 fl oz	7	32 fl oz
	Ridomil Gold Bravo (dry, garlic)	4,M	2.5 pt	7	15 lb a.i.
	Ridomil Gold Bravo (green, leeks, shallots)	4,M	2.5 pt	14	6.75 lb a.i.
	Ridomil Gold MZ WG	4,M	2.5 lb	7	4 app
	Ridomil Gold Copper	4,M	2 lb	10	0.4 lb a.i.
	Ridomil Gold Copper	4,M	2 lb	7	0.3 lb a.i.
	Satori	11	9-15.5 fl oz	0	92.3 fl oz
	Serenade				
	ASO ^{OG}	44	2-6 qt		
	MAX ^{OG}	44	1-3 lb		
	Trilogy ^{OG}		1%/100 gal		
	Zampro	45,40	14 fl oz	0	42 fl oz
Pythium Damping-off (<i>Pythium</i> spp.)	Mefenoxam				
	Ridomil Gold SL	4	0.5-1 pt ⁸	0	1 lb a.i.
	Ultra Flourish	4	1-2 pt ⁸		4 pt
	Metalaxyl				
	Metastar 2E	4	2-4 pt ⁸		1 app
	Uniform	11,4	0.34 fl oz ⁶		1 app
White Rot (<i>Sclerotinia cepivorum</i>)	Dry, garlic, shallots only				
	Cannonball WP	12	7 oz	7	32 oz
	Dicloran				
	Botran 5F	14	2-3.2 qt		1 app
	Botran 75W	14	3-5.3 lb		1 app
	Fontelis	7	16-24 fl oz	3	72 fl oz
	Tebconazole				
	Monsoon	3	20.5 fl oz		1 app
	Onset 3.6L	3	20.5 fl oz		1 app
	Orious 3.6F	3	20.5 fl oz		1 app
	Tebu-crop 3.6F	3	20.5 fl oz		1 app
	Tebustar 3.6L	3	20.5 fl oz		1 app
	Tebustar 3.6L	3	20.5 fl oz		1 app
	Quadris OPTI	11,M	1.6-3.2 pt	7	3 apps
	Quilt Xcel	3,11	17.5-26 fl oz	14	56 fl oz
	Switch 62.5WG	9,12	7-14 oz		1 app
	Thiophanate Methyl				
	85 WDG	1	0.4-0.6 oz ⁶		1 app
	Incognito 4.5F	1	40 fl oz		1 app
	Topsin 4.5FL	1	40 fl oz		1 app
	Topsin M 70WDG	1	2 lb		1 app
	Topsin M 70WP	1	2 lb		1 app
	Topsin M WSB	1	2 lb		1 app

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
Okra				
Powdery Mildew (<i>Erysiphe cichoracearum</i>) and Cercospora Leaf Spot (<i>Cercospora abelmoschi</i>, <i>C. malayensis</i>)	Chlorothalonil			
	Bravo Ultrex	M	1.4 lb	3
	Bravo WeatherStix	M	1.5 pt	3
	Chloronil	M	1.5 pt	3
	Equus720SST	M	1.5 pt	3
	Copper hydroxide			
	Kentan DF	M	0.5-1.5 lb	
	Kocide 3000	M	0.75-1.5 lb	0
	Kocide 2000	M	1.5-3 lb	0
	Copper sulfate			
	Mastercop	M	0.5-1.5 pt	
	Milstop ^{OG}		2-5 lb/100 gal	0
	Potassium phosphite			
	Confine Extra	33	1-4 qt	0
	Fosphite	33	1-3 qt	0
	KPhite	33	1-4 qt	0
	Rampart	33	1-3 qt/100gal	0
	Inspire Super	3,9	16-20 fl oz	0
	Quadris Flowable	11	6-15.5 fl oz	0
	Quadris Top	11,3	8-14 fl oz	7
	Rally 40 WSP	3	2.5-5 oz	0
	Serenade			
ASO ^{OG}	44	2-6 qt		
MAX ^{OG}	44	1-3 lb		
Sulfur				
Microthiol Dispers ^{OG}	M	3-10 lb		
Switch 62.5 WG	9,12	11-14 oz	0	
Trilogy ^{OG}		0.5-1%/100 gal		
Rhizoctonia Damping-off (<i>Rhizoctonia</i> spp.)	Quadris Flowable	11	0.4-0.8 fl oz ⁵	1 app
Peas (Garden, Green, Sweet)				
Powdery Mildew (<i>Erysiphe pisi</i>)	Actinovate AG ^{OG}		3-12 oz	
	Copper hydroxide			
	Kocide 3000	M	0.5-1.3 lb	0
	Kocide 2000	M	1-2.3 lb	0
	Champ WG ^{OG}	M	1.6 lb	0
	Copper hydroxide and copper oxychloride ¹¹			
	Badge SC	M	1-2.5 pt	0
	Badge X2 ^{OG}	M	0.5-1.3 lb	0
	Copper sulfate			
	Cuprofix Ultra-40	M	1-2 lb	0
	Cuproxat	M	2-3.9 pt	0
	Endura	7	8-11 oz	7
	Fontelis	7	14-30 fl oz	0
	MasterCop	M	0.5-1 pt	

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
	Milstop ^{OG}		2-5 lb/100 gal	0
	Phosphorous acid			
	Confine Extra	33	1-3 qt	
	Rampart	33	1-3 qt/100 gal	
	Potassium phosphite			
	Fosphite	33	1-3 qt/100 gal	
	Fungi-phite	33	1-2 qt	6 app
	Helena ProPhyt	33	2-4 pt	7 app
	Prev-AM		50 fl oz/100 gal	
	Pyraclostrobin			
	Headline or headline SC	11	6-9 fl oz	7
	Priaxor	11,7	4-8 fl oz	7
	Sonata ^{OG}	44	2-4 qt	0
	Sulfur ^{OG}			
	Microfine Sulfur	M	3.8-36 lb	0
	Microthiol Disperss	M	3-10 lb	0
	Yellow Jacket Wettable	M	3.8-36 lb	0
	Top Cop with Sulfur	M	2 qt	0
	Trilogy ^{OG}		1%	
Pythium Damping-off (<i>Pythium</i> spp.)	Actinovate AG ^{OG}		3-12 oz	
	Mefenoxam			
	Ridomil Gold SL	4	0.5-1 pt ⁸	1 app
	Ultra Flourish	4	1-2 pt ⁸	2 pt
	Phosphorous acid			
	Confine Extra	33	1-4 qt	
	Rampart	33	1-3 qt/100 gal	
	Potassium phosphite			
	Fosphite	33	1-3 qt/100 gal	
	Fungi-phite	33	1-2 qt	6 app
	Helena ProPhyt	33	2-4 pt	7 app
Peas (Southern, Dry)				
Alternaria Leaf and Pod Spot (<i>Alternaria alternata</i>)	Quilt 1.66SC	3,11	14 fl oz	7
	Priaxor 4.17SC	7,11	4-8 fl oz	7
	Fontelis 1.67SC	7	14-30 oz	0
	Quadris Flowable	11	6.2-15.4 fl oz	0
	Headline 2.09	11	6-9 fl oz	7
	Actinovate AG ^{OG}		3-12 oz	0
Anthracoze (<i>Colletotrichum lindemuthianum</i>)	Aproach	11	6-12 fl oz	7
	Chlorothalonil			
	Bravo Ultrex	M	1.25-1.8 lb	7
	Bravo WeatherStix	M	1.375-2 pt	7
	Thiophanate-methyl			
	Topsin M 70WP	1	1.5-2 lb	14
	Incognito 4.5F	1	30-40 fl oz	14
	85 WDG	1	0.8-1.6 lb	28
	Quilt 1.66SC	11,3	14 fl oz	0

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops					
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.					
Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Quilt Xcel	11,3	10.5-14 fl oz	0	42 fl oz
	Priaxor 4.17SC	7,11	4-8 fl oz	7	2 apps
	Fontelis 1.67SC	7	14-30 fl oz	7	72 fl oz
	Quadris Flowable	11	6-15.5 fl oz	0	4 app
	Quadris Opti	11,M	1.6-2.4 pt	0	4 app
	Headline	11	6-9 fl oz	21	2 app
	Tilt	3	4 fl oz	7	12 fl oz
	Copper octanoate Cueva ^{OG}	M	0.2-2 gal		
	Cuprous oxide Nordox 75WG ^{OG}	M	0.66-2.5 lb		
Bacterial Blights <i>(Pseudomonas syringae</i> <i>pv. pisi, P.s. pv. syringae)</i>	Copper hydroxide Kocide 3000	M	0.5-1.25 lb	0	15.8 lb
	Kocide 2000	M	0.75-2.25 lb	0	13.5 lb
	Champ WG ^{OG}	M	1.58 lb	7	9.48 lb
	Copper hydroxide, copper oxychloride Badge SC	M	1-2 pt	7	16.6 pt
	Badge X2 ^{OG}	M	0.5-1.25 lb	7	2.65 lb
	Copper sulfate Cuprofix-Ultra 40	M	0.75-2 lb		11.19 lb
	Cuproxtat	M	1.5-3.9 pt		23.4 pt
	Copper octanoate Cueva ^{OG}	M	0.5-2 gal/100gal		
	Cuprous oxide Nordox 75WG ^{OG}	M	0.6-2.5 lb		
	Botrytis Gray Mold <i>(Botrytis cinerea)</i> and White Mold (<i>Sclerotinia</i> <i>sclerotiorum)</i>	Proline 480 SC (white mold)	3	4.3-5.7 fl oz	7
Aproach		11	8-12 fl oz	7	24 fl oz
Iprodione Rovral 4 Flowable		2	1.5-2 pt	14	2 app
Thiophanate-methyl Topsin M 70WP		1	1.5-2 lb	14	4 lb
Incognito 4.5F		1	30-40 fl oz	14	80 fl oz
85 WDG		1	0.8-1.6 lb	28	3.2 lb
Fontelis 1.67SC		7	14-30 oz	7	72 fl oz
Endura		7	8-11 oz	7	2 app
Cannonball 50WP		12	7 oz	7	28 oz
Switch 62.5 WG		12,9	11-14 oz	2	56 oz
Copper octanoate Cueva ^{OG}		M	0.5-2 gal/100gal		
Damping-off <i>(Pythium spp.)</i>		Ridomil Gold PC GR	4,14	0.75 lb ⁶	
	Ridomil Gold SL	4	0.5-1.0 pt ⁸		1 app
	MetaStar 2E	4	2-4 pt ⁸		1 app
	Ultra Flourish	4	1-2 pt ⁸		1 app
	Uniform	4,11	0.34 fl. oz ⁶		1 app

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops					
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.					
Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
Damping-off (<i>Rhizoctonia</i> spp.)	Quadris Flowable	11	0.4-0.8 fl oz ⁶		1 app
	Headline	11	0.1-0.8 fl oz ⁶		1 app
	Blocker 4F	14	2.2-3.3 pt ⁶		1 app
	Uniform	4,14	0.34 fl oz ⁶		1 app
Leaf Spots and Blights (<i>Cercospora</i> spp., <i>Alternaria</i> spp., <i>Ascochyta</i> spp.)	Aproach	11	6-12 fl oz	7	24 fl oz
	Chlorathalonil				
	Bravo Ultrex	M	1.25-1.8 lb	7	7.3 lb
	Bravo WeatherStix	M	1.375-2 pt	7	8 pt
	Fontelis 1.67SC	7	14-30 fl oz	0	72 fl oz
	Quadris Flowable	11	6.2-15.4 fl oz	0	4 app
	Quadris Opti	11,M	1.6-2.4 pt		4 app
Headline	11	6-9 fl oz	21	2 app	
Powdery Mildew (<i>Erysiphe pisi</i>)	Endura	7	8-11 oz	7	2 app
	Priaxor 4.17SC	7,11	4-8 fl oz	7	2 app
	Fontelis 1.67SC	7	14-30 oz	0	72 fl oz
	Headline (dry beans)	11	6-9 fl oz	21	2 app
	Nu-Cop 50DF	M	1.5 lb	1	7.5 lb
	Phosphorous acid: Fosphite	33	1-3 qt/100 gal		
	Sulfur				
	80% ^{OG}	M2	20 lb	0	
	90% ^{OG}	M2	15 lb	0	
	98% ^{OG}	M2	45 lb	0	
Potassium bicarbonate Armicarb 100 ^{OG}		2.5-5 lb	0		
Rhizocontia Web Blight, Pod Tip Rot, (<i>Rhizoctonia</i> spp.)	Tilt	3	4 fl oz	7	12 fl oz
	Quadris Flowable	11	6-15.5 fl oz	0	4 app
	Quadris Opti	11,M	1.6-2.4 fl oz		4 app
	Quilt	11,3	14 fl oz	7	42 fl oz
	Quilt Xcel	11,3	10.5-14 fl oz	7	42 fl oz
Rust (<i>Uromyces</i> spp., <i>Phakopsora pachyrhizi</i>)	Aproach	11	6-12 fl oz	7	24 fl oz
	Proline 480 SC	3	5.7 fl oz	7	17 fl oz
	Rally 40WSP	3	4-5 oz	0	20 oz
	Tebuconazole 3.6F Folicur 3.6F	3	4-6 fl oz	7	12 fl oz
	Quilt 1.66SC	3,11	14 fl oz	7	3 app
	Priaxor 4.17SC	7,11	4-8 fl oz	7	2 app
	Fontelis 1.67SC	7	14-30 oz	0	72 fl oz
	Quadris 2.08F	11	6.2-15.4 fl oz	0	4 app
	Quadris Opti	11,M	1.6-2.4 pt		4 app
	Headline	11	6-9 fl oz	21	2 app
	Chlorathalonil				
	Bravo Ultrex	M	1.25-1.8 lb	7	4 app
	Bravo WeatherStix	M	1.375-2 pt	7	8pt

Commercial Crop Production Vegetables

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
Peppers					
Anthracnose Fruit Rot (<i>Colletotrichum</i> spp.)	Actinovate AG ^{OG}		3-12 oz		
	Azoxystrobin				
	Quadris	11	6-15.5 fl oz	0	61.5 fl oz
	Quadris Top	11,3	8-14 fl oz	0	55.3 fl oz
	Satori	11	6-15.5 fl oz	0	61.5 fl oz
	Cabrio	11	8-12 oz	0	96 fl oz
	Chlorothalonil				
	Bravo Ultrex		1.4 lb	3	10.9 lb
	Chloronil 720	M	1.5 pt	3	12 pt
	Echo 720	M	1.5 pt	3	9 lb a.i.
	Equus 720SST	M	1.5 pt	3	12 pt
	Copper hydroxide				
	Kocide 3000	M	0.8-1.3 lb	0	39.5 lb
	Kocide 2000	M	1.5-2.3 lb	0	33.9 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	1-2.3 pt	3	41.7 pt
	Badge X2 ^{OG}	M	0.8-1.3 lb	3	11.9 lb Cu
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.8-2 lb	3	29.5 lb
	Cuprous oxide				
	Nordox	M	2-4 lb	0	
	Flint	11	3-4 oz	3	16 fl oz
	Fontelis	7	24 fl oz	0	72 fl oz
	Inspire Super	9,3	16-20 fl oz	0	47 fl oz
	ManKocide	M	2-3 lb		39 lb
	MasterCop	M	0.5-3 pt	7	30 pt
	Priaxor	7,11	4-8 fl oz	0	24 fl oz
	Serenade Optimum	44	4-20 oz		
	Tanos	27,11	8-10 oz	3	72 oz
	Top Cop with Sulfur	M	2 qt		
	Trilogy		1%		
Bacterial Soft Rot (<i>Pectobacterium carotovora</i> subsp. <i>carotovora</i>)	Tanos	27,11	8-10 oz	3	72 oz
Bacterial Seedling Blight (<i>Pseudomonas syringae</i> pv. <i>syringae</i>)	Actigard 50WG (Chile only)	21	0.3-0.8 oz	14	6 oz
	Actinovate AG ^{OG}		3-12 oz		
	Agri-Mycin 17 ^{OG,22}		200 ppm		
	Cease		3-6 qt/100 gal		
	Copper hydroxide				
	Kocide 3000	M	0.8-1.3 lb	0	39.5 lb
	Kocide 2000	M	1.5-2.3 lb	0	33.9 lb
Champ WG ^{OG}	M	1.6 lb	0	23.7 lb	
Copper hydroxide, copper oxychloride					

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Badge SC	M	1-2.3 pt	3	41.7 pt
	Badge X2 ^{OG}	M	0.8-1.3 lb	3	11.9 lb Cu
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.8-2 lb	3	29.5 lb
	Cuproxat	M	2.4-3.8 pt	3	58.4 pt
	Cuprous oxide				
	Nordox	M	2-4 lb	0	
	ManKocide	M	2-3 lb	7	39 lb
	MasterCop	M	0.5-3 pt		30 pt
	Serenade ^{OG}				
	ASO	44	2-6 qt		
	Optimum	44	14-20 oz		
	MAX	44	1-3 lb		
	Tanos	27,11	8-10 oz	3	72 oz
	Top Cop with Sulfur	M	2 qt		
Bacterial Spot (<i>Xanthomonas</i> spp.)	Actigard 50WG (Chile only)	21	0.3-0.8 oz	14	6 oz
	Actinovate AG ^{OG}		3-12 oz		
	Agri-Mycin 17 ^{OG,22}		200 ppm		
	Cease		3-6 qt/100 gal		
	Copper hydroxide				
	Kocide 3000	M	0.8-1.3 lb	0	39.5 lb
	Kocide 2000	M	1.5-2.3 lb	0	33.9 lb
	Champ WG ^{OG}	M	1.6 lb	0	23.7 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	1-2.3 pt	3	41.7 pt
	Badge X2 ^{OG}	M	0.8-1.3 lb	3	11.9 lb Cu
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.8-2 lb	3	29.5 lb
	Cuproxat	M	2.4-3.8 pt	3	58.4 pt
	Cuprous oxide				
	Nordox	M	2-4 lb	0	
	ManKocide	M	2-3 lb	7	39 lb
	MasterCop	M	0.5-3 pt		30 pt
	Serenade ^{OG}				
	ASO	44	2-6 qt		
	Optimum	44	14-20 oz		
	MAX	44	1-3 lb		
	Tanos	27,11	8-10 oz	3	72 oz
	Top Cop with Sulfur	M	2 qt		
Blossom End Rot (BER)	Blossom-end rot results from a calcium (Ca) deficiency in young, rapidly expanding pepper fruit tissues. The disorder can be intensified by excess nitrogen. Have soil and water tested for Ca levels prior to planting. Foliar applications of Ca fertilizers are not likely to prevent or reduce BER incidence, as Ca ions are not actively mobilized from the leaf downward to the fruits.				

Commercial Crop Production Vegetables

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
Cercospora Leaf Spot (or Frogeye leaf spot) (<i>Cercospora capsici</i>)	Azoxystrobin Quadris Top	11,3	8-14 fl oz	0	55.3 fl oz
	Chlorothalonil Bravo Ultrex	M	1.4 lb	3	10.9 lb
	Chloronil 720	M	1.5 pt	3	12 pt
	Echo 720	M	1.5 pt	3	9 lb a.i.
	Equus 720SST	M	1.5 pt	3	12 pt
	Copper hydroxide Kocide 3000	M	0.8-1.3 lb	0	39.5 lb
	Kocide 2000	M	1.5-2.3 lb	0	33.9 lb
	Copper hydroxide, copper oxychloride Badge SC	M	1-2.3 pt	3	41.7 pt
	Badge X2 ^{OG}	M	0.8-1.3 lb	3	11.9 lb Cu
	Copper sulfate Cuprofix-Ultra 40	M	0.8-2 lb	3	29.5 lb
	Cuprous oxide Nordox	M	2-4 lb	0	
	Mancozeb Manzate Pro-Stick	M	1.6-3.2 lb	7	12.8-19.2 lb ²⁵
	ManKocide	M	2-3 lb	7	39 lb
	MasterCop	M	0.5-3 pt		30 pt
	Top Cop with Sulfur	M	2 qt		
	Phytophthora Crown and Root Rot (<i>Phytophthora capsici</i>)	Mefenoxam Ridomil Gold SL	4	1 pt ¹³	7
Ultra Flourish		4	2 pt ¹³	7	6 pt
Metalaxyl Metastar 2E		4	4-8 pt ¹³	7	12 pt
Zampro		45,40	14 fl oz	4	42 fl oz
Phytophthora Blight (<i>Phytophthora capsici</i>)		Copper hydroxide, copper oxychloride Badge SC	M	1-2.3 pt	0
	Badge X2 ^{OG}	M	0.8-1.3 lb	0	11.9 lb Cu
	Forum	40	6 fl oz ¹²	0.5	30 fl oz
	Mancozeb Manzate Pro-Stick	M	1.6-3.2 lb	0	12.8-19.2 lb ²⁵
	ManKocide	M	2-3 lb	0	39 lb
	Micora	40	8 fl oz ¹²		2 app
	Presidio	43	3-4 fl oz	2	12 fl oz
	Ranman	21	2.1-2.8 fl oz	0	16.5 fl oz
	Reason 500SC	11	8.2 fl oz	14	24.6 fl oz
	Revus	40	8 fl oz	1	32 fl oz
	Tanos	27,11	8-10 oz	3	72 oz
	Zampro	45,40	14 fl oz	4	42 fl oz

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops					
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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
Pythium Damping-off (<i>Pythium</i> spp.)	Mefenoxam				
	Ridomil Gold SL	4	1 pt ¹³	7	4 app
	Ridomil Gold/Copper	4,M	1 pt ¹³	7	4 app
	Ultra Flourish	4	2 pt ¹³	7	6 pt
	Metalaxyl				
	Metastar 2E	4	4-8 pt ¹³	7	12 pt
	Phosphorous acid				
	Confine Extra	33	1-3 qt		
	Rampart	33	1-3 qt/100 gal		
	Potassium phosphite				
	Fosphite	33	1-3 qt/100 gal		
	Fungi-phite	33	1-2 qt		6 app
	Previcur Flex	28	1.2 pt ⁸	5	6 pt
Rootshield Granules	44	2.5-6 lb/0.5 acre ¹³		1 app	
Serenade Soil	44	2-6 qt ¹³			
Southern Blight (<i>Sclerotium rolfsii</i>)	Blocker 4F (PCNB)	14	4.5-7.5 pt/100gal	0	7.5 lb a.i.
	Fluoxastrobin				
	Aftershock	11	2-5.7 fl oz	0	22.8 fl oz
	Evito 480 SC	11	2-5.7 fl oz	0	22.8 fl oz
	Priaxor	11,7	4-8 fl oz	0	24 fl oz
	Pyraclostrobin				
Cabrio	11	12-16 oz	0	96 fl oz	
Viruses	A list of viruses of pepper can be found in Table 2. Plant resistant varieties. For viruses transmitted by insects, control of the insect vector using insecticides, polyethylene or polyethylene coated mulches, and/or trap crops are recommended. Seed treatments and good sanitation practices are recommended for non-insect transmitted viruses.				
Potatoes (Irish)					
Bacterial Stem Rot (<i>Pectobacterium carotovora</i>)	Tanos	27,11	8 oz	14	6 app
Early Blight (<i>Alternaria solani</i>)	Aftershock	11	2-3.8 fl oz	7	22.8 fl oz
	Azoxystrobin				
	Quadris	11	6-15.5 fl oz	14	123 fl oz
	Quadris Opti	11,M	1.6 pt	14	6 app
	Quadris Top	11,M	8-14 fl oz	14	55.3 fl oz
	Satori	11	6-15.5 fl oz	14	123 fl oz
	Cabrio Plus	11,M	2-2.9 lb	14	17.4 lb
	Chlorathalonil				
	Bravo Ultrex	M	0.7-1.4 lb ²⁶	7	13.6 lb
	Bravo WeatherStik	M	0.8-1.5 pt ²⁶	30	18 pt
	Bravo Zn	M	1.1-2.3 pt ²⁶	7	21.5 pt
	Chlorathalonil 720 SC	M	0.8-1.5 pt ²⁶	7	15 pt
	Copper hydroxide				
Kocide 3000	M	0.5-1.8 lb	0	83.3 lb	

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Kocide 2000	M	0.8-3 lb	0	71.4 lb
	Champ WG ^{OG}	M	1-4 lb	5	50 lb
	Copper hydroxide and copper oxychloride ¹¹				
	Badge SC	M	1-3 pt	5	88.2 pt
	Badge X2 ^{OG}	M	0.5-1.8 lb	5	25 lb Cu
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.8-3 lb	5	62.5 lb
	MasterCop	M	0.5-1.5 pt	5	6 pt
	Endura	7	2.5-4.5 oz	10	20 oz
	Evito 480SC	11	2-3.8 fl oz	7	22.8 fl oz
	Gavel 75DF	M,22	1.5-2 lb	14	12 lb
	Gem 500SC	11	2.9-3.8 fl oz	7	23 fl oz
	Headline and Headline SC	11	6-9 fl oz	3	72 fl oz
	Iprodione				
	Iprodione 4L AG	2	1-2 pt	14	4 app
	Meteor	2	1-2 pt	14	4 app
	Nevado 4F	2	1-2 pt	14	4 app
	Mancozeb				
	Dry formulations	M	0.5-2 lb	14	14-15 lb
	Liquid Formulations	M	0.4-1.6 qt	14	11.2 qt
	ManKocide	M	1.5-5 lb	14	74.7 lb
	Mefenoxam			14	
	Ridomil Gold Bravo SC	4,M	2.5 pt	14	footnote ²⁷
	Ridomil Gold MZ WG	4,M	2.5 lb	14	footnote ²⁷
	Previcur Flex	28	0.7-1.2 pt	7	10 lb
	Priaxor	7,11	4-8 fl oz	14	6 pt
	Reason 500 SC	11	5.5-8.2 fl oz	14	16 fl oz
	Revus Top	3,40	5.5-7.7 fl oz	14	24.6 fl oz
	Rovral 4 Flowable	2	1-2 pt	7	28 fl oz
	Scala SC	9	7 fl oz		4 app
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	MAX	44	1-3 lb	0	
	Sonata ^{OG}	44	2-4 qt	0	
	Tanos	27,11	6 oz	14	6 app
	Top Cop with Sulfur	M	2-3 qt		
	Triphenyltin hydroxide				
	Agri-Tin	30	2.5-3.8 oz	7	11.3 oz
	Super Tin 4L	30	4-6 fl oz	7	18 fl oz
	Super Tin 80WP	30	2.5-5 oz	21	10 oz
Late Blight <i>(Phytophthora infestans)</i>	Aftershock	11	3.8 fl oz	7	22.8 fl oz
	Azoxystrobin				
	Quadris	11	6-15.5 fl oz	14	123 fl oz
	Quadris Opti	11,M	1.6 pt	14	6 app
	Quadris Top	11,3	8-14 fl oz	14	55.3 fl oz
	Satori	11	6-15.5 fl oz	14	123 fl oz
	Cabrio Plus	11,M	2.9 lb	14	17.4 lb

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
	Chlorathalonil			
	Bravo Ultrex	M	0.7-1.4 lb ²⁶	13.6 lb
	Bravo WeatherStik	M	0.8-1.5 pt ²⁶	18 pt
	Bravo Zn	M	1.1-2.3 pt ²⁶	21.5 pt
	Chlorathalonil 720 SC	M	0.8-1.5 pt ²⁶	15 pt
	Copper hydroxide			
	Kocide 3000	M	0.5-1.8 lb	83.3 lb
	Kocide 2000	M	0.8-3 lb	71.4 lb
	Champ WG ^{OG}	M	1-4 lb	50 lb
	Copper hydroxide and copper oxychloride ¹¹			
	Badge SC	M	1-3 pt	88.2 pt
	Badge X2 ^{OG}	M	0.5-1.8 lb	25 lb Cu
	Copper sulfate			
	Cuprofix-Ultra 40	M	0.8-3 lb	62.5 lb
	Mastercop	M	0.5-1.5 pt	6 pt
	Evito 480SC	11	3.8 fl oz	22.8 fl oz
	Gavel 75DF	22,M	1.5-2 lb	12 lb
	Gem 500 SC	11	3.8 fl oz	23 fl oz
	Headline and Headline SC	11	6-12 fl oz	72 fl oz
	Mancozeb			
	Dry formulations	M	0.5-2 lb	14-15 lb
	Liquid Formulations	M	0.4-1.6 qt	11.2 qt
	ManKocide	M	1.5-5 lb	74.7 lb
	Mefenoxam			
	Ridomil Gold Bravo	4,M	2.5 pt	footnote ²⁷
	Ridomil Gold MZ WG	4,M	2.5 lb	10 lb
	Omega 500SC	29	5.5 fl oz	3.5 pt
	Phosphorous acid			
	Confine Extra	33	1-3 qt	
	Rampart	33	1-3 qt/100 gal	
	Potassium phosphite			
	Fosphite	33	1-3 qt/100 gal	
	Fungi-phite	33	1-2 qt	6 app
	Helena Prophyt	33	2-4 pt	7 app
	Previcur Flex	28	0.7-1.2 pt	6 pt
	Priaxor	7,11	4-8 fl oz	24 fl oz
	Ranman	21	1.4-2.8 fl oz	27.5 fl oz
	Reason 500 SC	11	5.5-8.2 fl oz	24.6 fl oz
	Revus Top	3,40	5.5-7.7 fl oz	28 fl oz
	Serenade ^{OG}			
	ASO	44	2-6 qt	
	MAX	44	1-3 lb	
	Sonata ^{OG}	44	2-4 qt	
	Tanos	27,11	6-8 oz	6 app
	Top Cop with Sulfur	M	2-3 qt	
	Triphenyltin hydroxide			
	Agri-Tin	30	2.5-3.8 oz	11.3 oz

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Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops					
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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Super Tin 4L	30	4-6 fl oz	7	18 fl oz
	Super Tin 80WP	30	2.5-5 oz	21	10 oz
	Zampro	45,40	11-14 fl oz	4	42 fl oz
Speckle Leaf Spot (or pepper spotting)	Speckle leaf spot is a result of high ozone levels in the atmosphere and is most likely to occur during the tuber bulking stage. The disorder is intensified by high levels of automobile exhausts, humid with cloudy overcast days, and foggy conditions with heavy dew. 'LaChipper' is insensitive to ozone damage.				
White Mold (<i>Sclerotinia sclerotiorum</i>)	Cabrio Plus	11,M	2.9 lb	14	17.4 lb
	Endura	7	2.5-4.5 oz	10	20 oz
	Headline or Headline SC	11	6-12 fl oz	3	72 fl oz
	Iprodione				
	Iprodione 4L AG	2	2 pt	14	4 app
	Meteor	2	2 pt	14	4 app
	Nevado 4F	2	2 pt	14	4 app
	Omega 500SC	29	5.5-8 fl oz	14	3.5 pt
	Priaxor	7,11	4-8 fl oz	7	24 fl oz
	Rovral 4 Flowable	2	2 pt	14	4 app
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	MAX	44	1-3 lb	0	
	Sonata ^{OG}	44	2-4 qt	0	
	Thiophanate methyl				
	85 WDG	1	0.8-1.2 lb	21	3.2 lb
	Incognito 4.5F	1	20-30 fl oz	21	80 fl oz
	Nufarm T-methyl 70 WSB	1	1-1.5 lb	21	4 lb
	Topsin M 70 WDG	1	1-1.5 lb	21	4 lb
	Vertisan	7	14-24 fl oz	7	72 fl oz
Root Crops (Beet, Carrot, Parsnip, Radish, Turnip)					
Downy Mildew (<i>Peronospora parasitica</i>)	Actinovate AG ^{OG}		3-12 oz		
	Chlorothalonil (parsnip only)				
	Bravo Ultrex	M	1.4-1.8 lb	10	7.3 lb
	Bravo WeatherStik	M	1.5-2 pt	10	8 pt
	Chlorathalonil 720 SC	M	1.5-2 pt	10	8 pt
	Echo 90DF	M	1.4-1.8 lb	10	6 lb
	Phosphorous acid				
	Confine Extra	33	1-3 qt		
	Rampart	33	1-3 qt/100 gal		
	Potassium phosphite				
	Fosphite	33	1-3 qt/100 gal		
	Fungi-phite	33	1-2 qt		6 app
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	MAX	44	1-3 lb	0	
	Sonata ^{OG}	44	2-4 qt	0	
	Top Cop with Sulfur	44	2 qt	0	
	Trilogy		1%		

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Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
Leaf Spots and Blights (<i>Alternaria</i> spp., <i>Cercospora</i> spp.)	Azoxystrobin			
	Quadris	11	9-15.5 fl oz	0
	Satori	11	9-15.5 fl oz	0
	Cabrio	11	8-12 oz	0
	Chlorothalonil			
	Bravo Weather Stik	M	1.5-2 pt	0
	Bravo Zn	M	2.3-2.8 pt	0
	Equus 720SST	M	1.5-2	0
	Copper hydroxide			
	Kocide 3000	M	0.8-1.5 lb	0
	Kocide 2000	M	1.5-2.8 lb	0
	Champ Formula 2	M	1.3 pt	0
	Copper hydroxide, copper oxychloride			
	Badge SC	M	1-1.8 pt	0
	Badge X2 ^{OG}	M	0.8-1.5 lb	0
	Copper sulfate			
	Cuprofix-Ultra 40	M	1.3 lb	0
	Cuproxtat	M	2.5 pt	0
	Endura	7	4.5 oz	0
	Fontelis	7	16-30 fl oz	0
	Gem 500SC	11	1.9-2.9 fl oz	7
	MasterCop		0.5-1.5 pt	
	Merivon	7,11	4-5.5 fl oz	7
	Pristine	7,11	8-10.5 oz	0
	Propiconazole			
	Amtide 41.8%	3	4 fl oz	14
	Bumper 48.1 EC	3	4 fl oz	14
	Tilt	3	4 fl oz	14
	Switch 62.5WG	9,12	11-14 oz	7
	Switch 62.5WG (radish only)	9,12	11-14 oz	7
Top Cop with Sulfur	M	2 qt		
Pythium Damping-off (<i>Pythium</i> spp.)	Mefenoxam			
	Ridomil Gold GR	4	20-40 lb ⁸	
	Metalaxyl			
	Metastar 2E	4	4-8 pt ¹³	
	Phosphorous acid			
	Confine Extra	33	1-3 qt	
	Rampart	33	1-3 qt/100 gal	
	Potassium phosphite			
Fosphite	33	1-3 qt/100 gal		
Fungi-phite	33	1-2 qt		
Serenade Soil	44	2-6 qt ¹³		
Rhizoctonia Damping-off (<i>Rhizoctonia</i> spp.)	Azoxystrobin			
	Quadris	11	0.4-0.8 fl oz ⁶	1 app
	Satori	11	0.4-0.8 fl oz ⁶	1 app

Commercial Crop Production Vegetables

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
SPINACH				
Anthracnose (<i>Colletortichum dematium</i>) and Cercospora Leaf Spots (<i>Cercospora beticola</i>)	Azoxystrobin			
	Quadris	11	6-15.5 fl oz	0
	Satori	11	6-15.5 fl oz	0
	Cabrio	11	12-16 oz	0
	Copper hydroxide			
	Kocide 3000	M	0.8-1.3 lb	0
	Kocide 2000	M	1.5-2.3 lb	0
	Champ Formula 2	M	1.3-2.7 pt	0
	Champ WG ^{OG}	M	1-1.6 lb	0
	Copper hydroxide and copper oxychloride ¹¹			
	Badge SC	M	1-2.3 pt	0
	Badge X2 ^{OG}	M	0.8-1.3 lb	0
	Cuprous oxide			
	Nordox	M	2-3 lb	0
	Copper sulfate			
	Cuprofix Ultra 40	M	1.3-2 lb	0
	Mastercop	M	0.5-1 pt	0
Fontelis	7	14-24 fl oz	3	
Merivon	7,11	4-11 fl oz	1	
Top Cop with Sulfur		2-4 qt	0	
Downy Mildew (<i>Peronospora farinosa</i> f. sp. <i>spinaciae</i>)	Azoxystrobin			
	Quadris	11	12-15.5 fl oz	0
	Satori	11	12-15.5 fl oz	0
	Actigard 50WG	21	0.5-0.8 oz	7
	Actinovate AG ^{OG}	44	3-12 oz	0
	Aliette WDG	33	2-5 lb	3
	Cabrio	11	12-16 oz	0
	Cease	44	3-6 qt/100 gal	
	Copper hydroxide			
	Kocide 3000	M	0.8-1.3 lb	0
	Champ Formula 2	M	1.3-2.7 pt	0
	Champ WG ^{OG}	M	1-1.6 lb	0
	Copper hydroxide and copper oxychloride ¹¹			
	Badge SC	M	1-2.3 pt	0
	Badge X2 ^{OG}	M	0.8-1.3 lb	0
	Cuprous oxide			
	Nordox	M	2-3 lb	
	Mefenoxam			
	Ridomil Gold SL	4	0.3 pt ¹⁹	3-21 ²²
	Ultra Flourish	4	0.5 pt ¹⁹	3-21 ²²
	Ultra Flourish	4	0.3-0.5 pt	3-21 ²²
Micora	40	5.5-8 fl oz ¹²		
MilStop ^{OG}		2-5 lb/100 gal		
Phosphorous acid				

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
	Alude	33	0.5 gal/40 gal	
	Confine Extra	33	1-4 qt	
	Rampart	33	1-3 qt/100 gal	
	Potassium phosphite			
	Fosphite	33	1-3 qt/100 gal	
	Fungi-phite	33	1-2 qt	6 app
	Helena Prophyt	33	2-4 pt	7 app
	Presidio	43	3-4 fl oz	12 fl oz
	Ranman	21	2.8 fl oz	16.5 fl oz
	Reason 500SC	11	5.5-8.2 fl oz	24.6 fl oz
	Revus	40	8 fl oz	32 fl oz
	Serenade ^{OG}			
	ASO	44	2-6 qt	
	MAX	44	1-3 lb	
	Sonata ^{OG}	44	2-4 qt	
	Tanos	11,27	8-10 oz	1
	Top Cop with Sulfur	M	2-4 qt	84 oz
	Trilogy ^{OG}		1%	
	Zampro ²¹	40,45	14 fl oz	0
Pythium Damping-off (<i>Pythium</i> spp.)	Mefenoxam			
	Ridomil Gold SL	4	1-2 pt ¹³	3-21 ²⁰
	Ultra Flourish	4	0.5 pt ¹⁹	3-21 ²⁰
	Phosphorous acid			
	Confine Extra	33	1-4 qt	
	Rampart	33	1-3 qt/100 gal	
	Potassium phosphite			
	Fosphite	33	1-3 qt/100 gal	
	Fungi-phite	33	1-2 qt	6 app
	Ranman	21	2.8 fl oz ¹³	16.5 fl oz
	Rootshield Granules ^{OG}		2.5-6 lb/ ½ acre ¹³	1 app
White Rust (<i>Albugo occidentalis</i>)	Azoxystrobin			
	Quadris	11	6-15.5 fl oz	0
	Satori	11	6-15.5 fl oz	0
	Actigard	21		
	Aliette WDG	33		
	Cabrio	11	8-12 oz	0
	Copper hydroxide			
	Kocide 3000	M	0.8-1.3 lb	0
	Kocide 2000	M	1.5-2.3 lb	0
	Champ Formula 2	M	1.3-2.7 pt	0
	Champ WG ^{OG}	M	1-1.6 lb	0
	Copper hydroxide and copper oxychloride ¹¹			
	Badge SC	M	1-2.3 pt	0
	Badge X2 ^{OG}	M	0.8-1.3 lb	0
	Cuprous oxide			92.3 fl oz

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Nordox	M	2-3 lb		
	Copper sulfate				
	Cuprofix 40 Disperss	M	1.3-2 lb	0	9.9 lb
	Mastercop	M	0.5-1 pt	0	5 pt
	Mefenoxam				
	Ridomil Gold SL	4	0.3 pt ¹⁹	3-21 ²⁰	2 app
	Ultra Flourish	4	0.5 pt ¹⁹	3-21 ²⁰	2 app
	Merivon	7,11	4-11 fl oz	1	33 fl oz
	Presidio	43	3-4 fl oz	2	12 fl oz
	Ranman	21	2.8 fl oz	0	16.5 fl oz
	Reason 500SC	11	5.5-8.2 fl oz	2	24.6 fl oz
	Serenade ^{OG}				
	ASO	44	2-6 qt		
	MAX	44	1-3 lb		
	Tanos	11,27	8-10 oz	1	84 oz
Top Cop with Sulfur	M	2-4 qt			
Tomatoes (Fresh market)					
Anthraco nose Fruit Rot (<i>Colletotrichum</i> spp.)	Actinovate AG ^{OG}		3-12 oz		
	Azoxystrobin				
	Quadris	11	5-6.2 fl oz	0	37 fl oz
	Quadris Opti	11,M	1.6 pt	0	5 app
	Quadris Top	11,3	8 fl oz	0	47 fl oz
	Satori	11	5-6.2 fl oz	0	61.5 fl oz
	Cabrio	11	8-12 oz	0	96 fl oz
	Chlorothalonil				
	Bravo Ultrex	M	1.8-2.6 lb	0	18.3 lb
	Chloronil 720	M	2-2.8 pt	0	20 pt
	Echo 90DF	M	2-3 pt	0	15.1 lb a.i.
	Equus 720SST		2-2.8 pt	0	20 pt
	Copper hydroxide				
	Kocide 3000	M	0.8-1.8 lb	0	26.7 lb
	Kocide 2000	M	1.5-2.3 lb	0	22.8 lb
	Champ WG ^{OG}	M	1.1 lb	3	16 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	1.8 pt	3	28.1 pt
	Badge X2 ^{OG}	M	0.8-1.8 lb	3	8 lb Cu
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.8-3 lb	3	20 lb
	Cuproxtat	M	2.5-5 pt	3	39.4 pt
	Cuprous oxide			0	
	Nordox	M	2-4 lb		
	Flint	11	3-4 oz	3	16 fl oz
	Fontelis	7	24 fl oz	0	72 fl oz
	Inspire Super	9,3	16-20 fl oz	0	47 fl oz
	Mancozeb				
	Dry formulations	M	0.5-3 lb ³⁰	5	21-22.4 lb

Commercial Crop Production Vegetables

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	Liquid Formulations	M	0.6-2.4 qt ³⁰	16.8 qt
	ManKocide	M	1-3 lb	42.7-58 lb ³⁰
	MilStop ^{OG}		2-5 lb/100 gal	
	Priaxor	7,11	4-8 fl oz	24 fl oz
	Revus Top	3,40	5.5-7 fl oz	28 fl oz
	Serenade ^{OG}			
	Optimum	44	4-20 oz	
	Tanos	27,11	8-10 oz	3
	Top Cop with Sulfur	M	2 qt	72 oz
	Trilogy ^{OG}		1%	
Bacterial Spot (<i>Xanthomonas</i> spp.)	Actigard 50WG	21	0.3-0.8 oz	14
	Actinovate AG ^{OG}		3-12 oz	6 oz
	Agri-Mycin 17 ^{OG, 22}		200 ppm	
	Copper hydroxide			
	Kocide 3000	M	0.8-1.8 lb	0
	Kocide 2000	M	1.5-3 lb	0
	Champ WG ^{OG}	M	1.1 lb	0
	Copper hydroxide, copper oxychloride			
	Badge SC	M	1.8 pt	3
	Badge X2 ^{OG}	M	0.8-1.8 lb	3
	Copper sulfate			
	Cuprofix-Ultra 40	M	0.8-3 lb	3
	Cuproxtat	M	2.5-5 pt	3
	Cuprous oxide			
	Nordox	M	2-4 lb	0
	ManKocide	M	1.3 lb	5
	MasterCop	M	0.5-3 pt	
	Serenade ^{OG}			
	ASO	44	2-6 qt	
	Optimum	44	14-20 oz	
	MAX	44	1-3 lb	
	Tanos	27,11	8 oz	3
	Top Cop with Sulfur	M	2-3 qt	72 oz
Bacterial Speck (<i>Pseudomonas syringae</i> pv. <i>syringae</i>)	Agri-Mycin 17 ^{OG, 22}		200 ppm	
	Copper hydroxide			
	Kocide 3000	M	0.8-1.8 lb	0
	Kocide 2000	M	1.5-3 lb	0
	Champ WG ^{OG}	M	2 lb	0
	Copper hydroxide, copper oxychloride			
	Badge SC	M	1.8 pt	3
	Badge X2 ^{OG}	M	0.8-1.8 lb	3
	Copper sulfate			
	Cuprofix-Ultra 40	M	0.8-3 lb	3
	Cuproxtat	M	2.3 pt	3
	Cuprous oxide			

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Nordox	M	2-4 lb	0	
	Mancozeb				
	Dry formulations	M	0.5-3 lb ³⁰	5	21-22.4 lb
	Liquid Formulations	M	0.6-2.4 qt ³⁰	5	16.8 qt
	ManKocide	M	1.3 lb	5	42.7-58 lb ²³
	MasterCop	M	0.5-3 pt		30 pt
	Serenade ^{OG}				
	ASO	44	2-6 qt		
	Optimum	44	14-20 oz		
	MAX	44	1-3 lb		
	Tanos	27,11	8 oz	3	72 oz
	Top Cop with Sulfur	M	2-3 qt		
Bacterial Wilt <i>(Ralstonia solanacearum)</i>	No bactericides available. Plant resistant varieties and crop rotations.				
Blossom End Rot (BER)	Blossom-end rot results from a calcium (Ca) deficiency in young, rapidly expanding tomato fruit tissues. The disorder can be intensified by excess nitrogen. Have soil and water tested for Ca levels prior to planting. Foliar applications of Ca fertilizers are not likely to prevent or reduce BER incidence, as Ca ions are not actively mobilized from the leaf downward to the fruits.				
Buckeye Rot <i>(Phytophthora parasitica)</i>	Azoxystrobin				
	Quadris	11	5-6.2 fl oz	0	37 fl oz
	Quadris Opti	11,M	1.6 pt	0	5 app
	Quadris Top	11,3	8 fl oz	0	47 fl oz
	Satori	11	5-6.2 fl oz	0	61.5 fl oz
	Gavel 75DF	22,M	1.5-2 lb	5	8-16 lb ³⁰
	Serenade ^{OG}				
	Optimum	44	4-20 oz		
	Tanos	27,11	8 oz	3	72 oz
Early Blight <i>(Alternaria solani)</i>	Aftershock	11	2-5.7 fl oz	3	22.8 fl oz
	Azoxystrobin				
	Quadris	11	5-6.2 fl oz	0	37 fl oz
	Quadris Opti	11,M	1.6 pt	0	5 app
	Quadris Top	11,3	8 fl oz	0	47 fl oz
	Satori	11	5-6.2 fl oz	0	61.5 fl oz
	Cabrio	11	8-12 oz	0	96 fl oz
	Chlorothalonil				
	Bravo Ultrex	M	1.3-1.8 lb	0	18.3 lb
	Chloronil 720	M	1.4-2 pt	0	20 pt
	Echo 90DF	M	1.4-2 pt	0	15.1 lb a.i.
	Equus 720SST	M	1.4-2 pt	0	20 pt
	Copper hydroxide				
	Kocide 3000	M	0.8-1.8 lb	0	26.7 lb
	Kocide 2000	M	1.5-2.3 lb	0	22.8 lb
	Champ WG ^{OG}	M	1.1 lb	3	16 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	1.8 pt	3	28.1 pt

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Badge X2 ^{OG}	M	0.8-1.8 lb	3	8 lb Cu
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.8-3 lb	3	20 lb
	Cuproxat	M	2.5-5 pt	3	39.4 pt
	Cuprous oxide			0	
	Nordox	M	2-4 lb		
	Evito 480SC	11	2-5.7 fl oz	3	22.8 fl oz
	Flint	11	2-3 oz	3	16 fl oz
	Fontelis	7	24 fl oz	0	72 fl oz
	Gavel 75DF	22,M	1.5-2 lb	5	8-16 lb ³⁰
	Inspire Super	9,3	16-20 fl oz	0	47 fl oz
	Mancozeb				
	Dry formulations	M	0.5-3 lb ³⁰	5	21-22.4 lb
	Liquid Formulations	M	0.6-2.4 qt ³⁰	5	16.8 qt
	ManKocide	M	1-3 lb	5	42.7-58 lb ³⁰
	MilStop ^{OG}		2-5 lb/100 gal		
	Previcur Flex	28	0.7-1.5 pt	5	7.5 pt
	Priaxor	7,11	4-8 fl oz	0	24 fl oz
	Reason 500SC	11	5.5-8.2 fl oz	14	24.6 fl oz
	Revus Top	3,40	5.5-7 fl oz	1	28 fl oz
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	Optimum	44	4-20 oz	0	
	MAX	44	1-3 lb	0	
	Scala SC	9	7 fl oz	1	35 fl oz
	Switch 62.5WG	9,12	11-14 oz	0	56 oz
	Tanos	27,11	8-10 oz	3	72 oz
	Top Cop with Sulfur	M	2 qt		
	Trilogy ^{OG}		1%		
	Fusarium Wilt (<i>Fusarium oxysporum</i>)	No fungicides available. Soil protectants, resistant varieties and crop rotations are recommended.			
Gray Leaf Spot (<i>Stemphylium</i> spp.)	Chlorothalonil				
	Bravo Ultrex	M	1.8-2.6 lb	0	18.3 lb
	Chloronil 720	M	2-2.8 pt	0	20 pt
	Echo 90DF	M	2-3 pt	0	15.1 lb a.i.
	Equus 720SST	M	2-2.8 pt	0	20 pt
	Flint	11	3-4 oz	3	16 fl oz
	Gavel	22,M	1.5-2 lb	5	8-16 lb ³⁰
	Inspire Super	9,3	16-20 fl oz	0	47 fl oz
	Mancozeb				
	Dry formulations	M	0.5-3 lb ³⁰	5	21-22.4 lb
	Liquid Formulations	M	0.6-2.4 qt ³⁰	5	16.8 qt
	ManKocide	M	1-3 lb	5	42.7-58 lb ³⁰
	Revus Top	3,40	5.5-7 fl oz	1	28 fl oz
	Ridomil Gold Bravo	4,M	2.5 pt	5	see footnote ³¹

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops					
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.					
Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
Gray Mold <i>(Botrytis cinerea)</i>	Actinovate AG ^{OG}		3-12 oz		
	Botran 75-W	14			
	Cabrio	11	12-16 oz	0	96 oz
	Chlorothalonil				
	Bravo Ultrex	M	1.3-1.8 lb	0	18.3 lb
	Chloronil 720	M	1.4-2 pt	0	20 pt
	Echo 90DF	M	1.4-2 pt	0	15.1 lb a.i.
	Equus 720SST	M	1.4-2 pt	0	20 pt
	Endura	7	9-12.5 oz	0	25 oz
	Fontelis	7	24 fl oz	0	72 fl oz
	Priaxor	7,11	4-8 fl oz	0	24 fl oz
Scala SC	9	7 fl oz	1	35 fl oz	
Late Blight <i>(Phytophthora infestans)</i>	Aftershock	11	5.7 fl oz	3	22.8 fl oz
	Azoxystrobin				
	Quadris	11	6.2 fl oz	0	37 fl oz
	Quadris Opti	11,M	1.6 pt	0	5 app
	Quadris Top	11,3	8 fl oz	0	47 fl oz
	Satori	11	5-6.2 fl oz	0	61.5 fl oz
	Cabrio	11	8-16 oz	0	96 fl oz
	Chlorothalonil				
	Bravo Ultrex	M	1.3-1.8 lb	0	18.3 lb
	Chloronil 720	M	1.4-2 pt	0	20 pt
	Echo 90DF	M	1.4-2 pt	0	15.1 lb a.i.
	Equus 720SST	M	1.4-2 pt	0	20 pt
	Copper hydroxide				
	Kocide 3000	M	0.8-1.8 lb	0	26.7 lb
	Kocide 2000	M	1.5-2.3 lb	0	22.8 lb
	Champ WG ^{OG}	M	1.1 lb	3	16 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	1.8 pt	3	28.1 pt
	Badge X2 ^{OG}	M	0.8-1.8 lb	3	8 lb Cu
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.8-3 lb	3	20 lb
	Cuproxtat	M	2.5-6 pt	3	39.4 pt
	Cuprous oxide			0	
	Nordox	M	2-4 lb		
	Evito 480 SC	11	5.7 fl oz	3	22.8 fl oz
	Flint	11	2-3 oz	3	16 fl oz
	Forum	40	6 fl oz	4	30 fl oz
	Gavel 75DF	22,M	1.5-2 lb	5	8-16 lb ³⁰
	Mancozeb				
	Dry formulations	M	0.5-3 lb ³⁰	5	21-22.4 lb
	Liquid Formulations	M	0.6-2.4 qt ³⁰	5	16.8 qt
	ManKocide	M	1-3 lb	5	42.7-58 lb ³⁰
	MilStop ^{OG}		2-5 lb/100 gal		
	Previcur Flex	28	0.7-1.5 pt	5	7.5 pt
	Priaxor	7,11	8 fl oz	0	24 fl oz

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Ranman	21	2.1-2.8 fl oz	0	16.5 fl oz
	Reason 500SC	11	5.5-8.2 fl oz	14	24.6 fl oz
	Ridomil				
	Gold Bravo SC	4,M	2.5 pt	5	see footnote ³¹
	Gold/Copper	4,M	2 lb	14	3 app
	Gold MZ WG	4,M	2.5 lb	5	10 lb
	Revus Top	3,40	5.5-7 fl oz	1	28 fl oz
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	Optimum	44	4-20 oz	0	
	MAX	44	1-3 lb	0	
	Tanos	27,11	8-10 oz	3	72 oz
	Top Cop with Sulfur	M	2 qt		
	Zampro	45,40	14 fl oz	4	42 fl oz
Leaf Mold (<i>Cladosporium fulvum</i>)	Gavel	22,M	1.5-2 lb	5	8-16 lb ³⁰
	Inspire Super	9,3	16-20 fl oz	0	47 fl oz
	Mancozeb				
	Dry formulations	M	0.5-3 lb ³⁰	5	21-22.4 lb
	Liquid Formulations	M	0.6-2.4 qt ³⁰	5	16.8 qt
	ManKocide	M	1-3 lb	5	42.7-58 lb ³⁰
	Quadris Top	11,3	8 fl oz	0	47 fl oz
	Ridomil Gold Bravo	4,M	2.5 pt		see footnote ³¹
	Tanos	27,11	8 oz	3	72 oz
Septoria Leaf Spot (<i>Septoria lycopersici</i>)	Azoxystrobin				
	Quadris	11	5-6.2 fl oz	0	37 fl oz
	Quadris Opti	11,M	1.6 pt	0	5 app
	Quadris Top	11,3	8 fl oz	0	47 fl oz
	Satori	11	5-6.2 fl oz	0	61.5 fl oz
	Cabrio	11	8-12 oz	0	96 fl oz
	Chlorothalonil				
	Bravo Ultrex	M	1.3-1.8 lb	0	18.3 lb
	Chloronil 720	M	1.4-2 pt	0	20 pt
	Echo 90DF	M	1.4-2 pt	0	15.1 lb a.i.
	Equus 720SST	M	1.4-2 pt	0	20 pt
	Copper hydroxide				
	Kocide 3000	M	0.8-1.8 lb	0	26.7 lb
	Kocide 2000	M	1.5-2.3 lb	0	22.8 lb
	Champ WG ^{OG}	M	1.1 lb	3	16 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	1.8 pt	3	28.1 pt
	Badge X2 ^{OG}	M	0.8-1.8 lb	3	8 lb Cu
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.8-3 lb	3	20 lb
	Cuproxtat	M	2.5-5 pt	3	39.4 pt

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
	Cuprous oxide		0	
	Nordox	M	2-4 lb	
	Flint	11	3-4 oz	16 fl oz
	Fontelis	7	16-24 fl oz	72 fl oz
	Gavel 75DF	22,M	1.5-2 lb	8-16 lb ³⁰
	Inspire Super	9,3	16-20 fl oz	47 fl oz
	Mancozeb			
	Dry formulations	M	0.5-3 lb ³⁰	21-22.4 lb
	Liquid Formulations	M	0.6-2.4 qt ³⁰	16.8 qt
	ManKocide	M	1-3 lb	42.7-58 lb ³⁰
	MilStop ^{OG}		2-5 lb/100 gal	
	Previcur Flex	28	0.7-1.5 pt	7.5 pt
	Priaxor	7,11	4-8 fl oz	24 fl oz
	Reason 500SC	11	5.5-8.2 fl oz	24.6 fl oz
	Revus Top	3,40	5.5-7 fl oz	28 fl oz
	Ridomil Gold Bravo SC	4,M	2.5 pt	see footnote ³¹
	Tanos	27,11	8-10 oz	72 oz
Southern Blight (<i>Sclerotium rolfsii</i>)	Aftershock	11	2-5.7 fl oz	22.8 fl oz
	Blocker 4F (PCNB)	14	4.5 to 7.5 pt/100 gal	7.5 lb a.i.
	Cabrio	11	12-16 oz	96 oz
	Evito SC	11	2-5.7 fl oz	22.8 fl oz
	Fontelis	7	1-1.6 fl oz ⁶	24 fl oz
	Priaxor	7,11	4-8 fl oz	24 fl oz
Target Spot (<i>Corynespora cassicola</i>)	Aftershock	11	2-5.7 fl oz	22.8 fl oz
	Azoxystrobin			
	Quadris	11	5-6.2 fl oz	37 fl oz
	Quadris Opti	11,M	1.6 pt	5 app
	Quadris Top	11,3	8 fl oz	47 fl oz
	Satori	11	5-6.2 fl oz	61.5 fl oz
	Cabrio	11	8-12 oz	96 fl oz
	Chlorothalonil			
	Bravo Ultrex	M	1.3-1.8 lb	18.3 lb
	Chloronil 720	M	1.4-2 pt	20 pt
	Echo 90DF	M	1.4-2 pt	15.1 lb a.i.
	Equus 720SST	M	1.4-2 pt	20 pt
	Endura	7	3.5 oz	21 oz
	Evito 480SC	11	2-5.7 fl oz	22.8 fl oz
	Fontelis	7	16-24 fl oz	72 fl oz
	Inspire Super	9,3	16-20 fl oz	47 fl oz
	Priaxor	7,11	4-8 fl oz	24 fl oz
	Revus Top	3,40	5.5-7 fl oz	28 fl oz
	Serenade ^{OG}			
	ASO	44	2-6 qt	
	Optimum	44	4-20 oz	
	MAX	44	1-3 lb	

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops					
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.					
Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Tanos	27,11	8-10 oz	3	72 oz
White Mold (or Timber rot) <i>(Sclerotinia sclerotiorum)</i>	Cabrio	11	12-16 oz	0	96 fl oz
	Priaxor	7,11	4-8 fl oz	0	24 fl oz
Verticillium Wilt <i>(Verticillium dahlia)</i>	Serenade Soil	44	2-6 qt ¹³		
Viruses	A list of viruses of tomato can be found in Table 3. Plant resistant varieties. Table 4 provides a list of varieties with resistance to tomato spotted wilt virus (TSWV). For viruses transmitted by insects, control of the insect vector using insecticides, polyethylene or polyethylene coated mulches, and/or trap crops are recommended. Seed treatments and good sanitation practices are recommended for non-insect transmitted viruses.				
Tomatoes(Greenhouse)					
Bacterial Canker	No bactericides are available. Seed treatments and good sanitation practices are recommended.				
Fusarium Crown and Root Rot <i>(Fusarium oxysporum)</i>	No fungicides available. Resistant varieties, seed treatments and good sanitation practices are recommended.				
Gray Leaf Spot <i>(Stemphylium solani)</i>	Gavel	22,M	1.5-2 lb	5	8-16 lb ³⁰
	Inspire Super	9,3	16-20 fl oz	0	47 fl oz
	Mancozeb				
	Dry formulations	M	0.5-3 lb ³⁰	5	21-22.4 lb
	Liquid Formulations	M	0.6-2.4 qt ³⁰	5	16.8 qt
	ManKocide	M	1-3 lb	5	42.7-58 lb ³⁰
	Tanos	27,11	8 oz	3	72 oz
Gray Mold and Ghost Spot <i>(Botrytis cinerea)</i>	Actinovate AG ^{OG}		3-12 oz		
	Botran 75-W	14	1/100 gal	0	4 app
	Fontelis	7	16-24 fl oz	0	72 fl oz
	Scala SC	9	7 fl oz ³²	1	35 fl oz
	Switch 62.5WG	9,12	11-14 oz ³³	0	56 oz
Leaf Mold <i>(Cladosporium fulvum)</i>	Gavel	22,M	1.5-2 lb	5	8-16 lb ³⁰
	Inspire Super	9,3	16-20 fl oz	0	47 fl oz
	Mancozeb				
	Dry formulations	M	0.5-3 lb ³⁰	5	21-22.4 lb
	Liquid Formulations	M	0.6-2.4 qt ³⁰	5	16.8 qt
	ManKocide	M	1-3 lb	5	42.7-58 lb ³⁰
	Tanos	27,11	8 oz	3	72 oz
Powdery Mildew <i>(Oidium neolycopersici)</i>	Fontelis	7	16-24 fl oz	0	72 fl oz
	Inspire Super	9,3	16-20 fl oz	0	47 fl oz
	Microthiol Dispers ^{OG}	M	5 lb		
	Phosphorous acid				
	Confine Extra	33	1-4 qt		
	Rampart	33	1-3 qt/100 gal		
	Pre-AM		50 fl oz/100 gal		
	Quadris Top	11,3	8 fl oz	0	47 fl oz
	Rally 40WSP	3	2.5-4 fl oz	0	1.3 lb a.i.

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
	Serenade ^{OG}			
	ASO	44	2-6 qt	0
	Optimum	44	4-20 oz	0
	MAX	44	1-3 lb	0
	Switch 62.5 WG	9,12	11-14 oz ³³	0
	Trilogy ^{OG}		1%	56 oz
Pythium Damping-off	Phosphorous acid			
	Confine Extra	33	1-4 qt	
	Rampart	33	1-3 qt/100 gal	
	Previcur Flex	28	12.8 fl oz/100 gal ³⁴	0
Target Spot (<i>Corynespora cassicola</i>)	Fontelis	7	16-24 fl oz	0
	Inspire Super	9,3	16-20 fl oz	0
	Serenade ^{OG}			
	ASO	44		0
	Optimum	44		0
	MAX	44		0
	Tanos	27,11	8 oz	0
				72 fl oz
				47 fl oz
				72 oz
Viruses and Viroids³⁵	A list of viruses and viroids of tomato can be found in Table 3. Plant resistant varieties. For viruses and viroids transmitted by insects, control of the insect vector using insecticides, screens, double entry doors, and/or trap crops are recommended. Seed treatments and good sanitation practices are recommended for non-insect transmitted viruses and viroids.			
Tomatoes (Processing)				
Anthraco nose (<i>Colletotrichum</i> spp.)	Actinovate AG ^{OG}		3-12 oz	
	Azoxystrobin			
	Quadris	11	5-6.2 fl oz	0
	Quadris Opti	11,M	1.6 pt	0
	Quadris Top	11,3	8 fl oz	0
	Satori	11	5-6.2 fl oz	0
	Cabrio	11	8-12 oz	0
	Chlorothalonil			
	Bravo Ultrex	M	1.8-2.6 lb	0
	Chloronil 720	M	2-2.8 pt	0
	Echo 90DF	M	2-3 pt	0
	Equus 720SST	M	2-2.8 pt	0
	Copper hydroxide			
	Kocide 3000	M	0.8-1.8 lb	0
	Kocide 2000	M	1.5 lb	0
	Champ WG ^{OG}	M	1.1 lb	3
	Copper hydroxide, copper oxychloride			
	Badge SC	M	1.8 pt	3
	Badge X2 ^{OG}	M	0.8-1.8 lb	3
	Copper sulfate			
	Cuprofix-Ultra 40	M	0.8-3 lb	3
	Cuproxat	M	2.6 pt	3
				37 fl oz
				5 app
				47 fl oz
				61.5 fl oz
				96 fl oz
				18.3 lb
				20 pt
				15.1 lb a.i.
				20 pt
				58 lb
				49.7 lb
				16 lb
				61.3 pt
				17.4 lb Cu
				20 lb
				39.4 pt

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
	Cuprous oxide Nordox	M	2-4 lb	0
	Flint	11	3-4 oz	3
	Fontelis	7	24 fl oz	0
	Inspire Super	9,3	16-20 fl oz	0
	Mancozeb			
	Dry formulations	M	0.5-3 lb ³⁰	5
	Liquid Formulations	M	0.6-2.4 qt ³⁰	5
	ManKocide	M	1-3 lb	5
	MilStop ^{OG}		2-5 lb/100 gal	
	Priaxor	7,11	4-8 fl oz	0
	Revus Top	3,40	5.5-7 fl oz	1
	Serenade ^{OG}			
	Optimum	44	4-20 oz	
	Tanos	27,11	8-10 oz	3
	Top Cop with Sulfur	M	2 qt	
	Trilogy ^{OG}		1%	72 oz
Bacterial Spot (<i>Xanthomonas</i> spp.)	Actigard 50WG	21	0.3-0.8 oz	14
	Actinovate AG ^{OG}		3-12 oz	
	Agri-Mycin 17 ^{OG, 22}		200 ppm	
	Copper hydroxide			
	Kocide 3000	M	0.8-1.8 lb	0
	Kocide 2000	M	1.5 lb	0
	Champ WG ^{OG}	M	1.1 lb	0
	Copper hydroxide, copper oxychloride			
	Badge SC	M	1.8 pt	0
	Badge X2 ^{OG}	M	0.8-1.8	0
	Copper sulfate			
	Cuprofix-Ultra 40	M	0.8-1.3 lb	0
	Cuproxtat	M	2.6 pt	0
	Cuprous oxide			
	Nordox	M	2-4 lb	0
	ManKocide	M	1.7 lb	5
	MasterCop	M	0.5-3 pt	
	Serenade ^{OG}			
	ASO	44	2-6 qt	
	Optimum	44	14-20 oz	
	MAX	44	1-3 lb	
	Tanos	27,11	8 oz	3
	Top Cop with Sulfur	M	2-3 qt	
				42.7-58 lb ²³
				30 pt
				72 oz
Bacterial Speck (<i>Pseudomonas syringae</i> pv. <i>syringae</i>)	Actigard 50WG	21	0.3-0.8 oz	14
	Agri-Mycin 17 ^{OG, 22}		200 ppm	
	Copper hydroxide			
	Kocide 3000	M	0.8-1.8 lb	0
	Kocide 2000	M	1.5 lb	0
	Champ WG ^{OG}	M	1.1 lb	0
				58 lb
				49.7 lb
				34.8 lb

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Copper hydroxide, copper oxychloride				
	Badge SC	M	1.8 pt	0	61.3 pt
	Badge X2 ^{OG}	M	0.8-1.8	0	17.4 lb Cu
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.8-1.3 lb	0	43.5
	Cuproxtat	M	2.6 pt	0	85.7 pt
	Cuprous oxide				
	Nordox	M	2-4 lb	0	
	ManKocide	M	1.7 lb	5	42.7-58 lb ²³
	MasterCop		0.5-3 pt		30 pt
	Serenade ^{OG}				
	ASO	44	2-6 qt		
	Optimum	44	14-20 oz		
	MAX	44	1-3 lb		
	Tanos	27,11	8 oz	3	72 oz
	Top Cop with Sulfur	M	2-3 qt		
Bacterial Wilt <i>(Ralstonia solanacearum)</i>	No bactericides available. Plant resistant varieties and use crop rotations.				
Blossom End Rot (BER)	Blossom-end rot results from a calcium (Ca) deficiency in young, rapidly expanding tomato fruit tissues. The disorder can be intensified by excess nitrogen. Have soil and water tested for Ca levels prior to planting. Foliar applications of Ca fertilizers are not likely to prevent or reduce BER incidence, as Ca ions are not actively mobilized from the leaf downward to the fruits.				
Buckeye Rot <i>(Phytophthora parasitica)</i>	Azoxystrobin				
	Quadris	11	5-6.2 fl oz	0	37 fl oz
	Quadris Opti	11,M	1.6 pt	0	5 app
	Quadris Top	11,3	8 fl oz	0	47 fl oz
	Satori	11	5-6.2 fl oz	0	61.5 fl oz
	Gavel 75DF	22,M	1.5-2 lb	5	8-16 lb ³⁰
	Serenade ^{OG}				
	Optimum	44	4-20 oz		
	Tanos	27,11	8 oz	3	72 oz
Early Blight <i>(Alternaria solani)</i>	Aftershock	11	2-5.7 fl oz	3	22.8 fl oz
	Azoxystrobin				
	Quadris	11	5-6.2 fl oz	0	37 fl oz
	Quadris Opti	11,M	1.6 pt	0	5 app
	Quadris Top	11,3	8 fl oz	0	47 fl oz
	Satori	11	5-6.2 fl oz	0	61.5 fl oz
	Cabrio	11	8-12 oz	0	96 fl oz
	Chlorothalonil				
	Bravo Ultrex	M	1.3-1.8 lb	0	18.3 lb
	Chloronil 720	M	1.4-2 pt	0	20 pt
	Echo 90DF	M	1.4-2 pt	0	15.1 lb a.i.
	Equus 720SST	M	1.4-2 pt	0	20 pt
	Copper hydroxide				
	Kocide 3000	M	0.8-1.8 lb	0	58 lb

Commercial Crop Production Vegetables

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Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use	
	Kocide 2000	M	1.5 lb	0	49.7 lb
	Champ WG ^{OG}	M	1.1 lb	3	16 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	1.8 pt	3	61.3 pt
	Badge X2 ^{OG}	M	0.8-1.8 lb	3	17.4 lb Cu
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.8-3 lb	3	20 lb
	Cuproxtat	M	2.6 pt	3	39.4 pt
	Cuprous oxide			0	
	Nordox	M	2-4 lb		
	Evito 480SC	11	2-5.7 fl oz	3	22.8 fl oz
	Flint	11	2-3 oz	3	16 fl oz
	Fontelis	7	24 fl oz	0	72 fl oz
	Gavel 75DF	22,M	1.5-2 lb	5	8-16 lb ³⁰
	Inspire Super	9,3	16-20 fl oz	0	47 fl oz
	Mancozeb				
	Dry formulations	M	0.5-3 lb ³⁰	5	21-22.4 lb
	Liquid Formulations	M	0.6-2.4 qt ³⁰	5	16.8 qt
	ManKocide	M	1-3 lb	5	42.7-58 lb ³⁰
	MilStop ^{OG}		2-5 lb/100 gal		
	Previcur Flex	28	0.7-1.5 pt	5	7.5 pt
	Priaxor	7,11	4-8 fl oz	0	24 fl oz
	Reason 500SC	11	5.5-8.2 fl oz	14	24.6 fl oz
	Revus Top	3,40	5.5-7 fl oz	1	28 fl oz
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	Optimum	44	4-20 oz	0	
	MAX	44	1-3 lb	0	
	Scala SC	9	7 fl oz	1	35 fl oz
	Switch 62.5WG	9,12	11-14 oz	0	56 oz
	Tanos	27,11	8-10 oz	3	72 oz
	Top Cop with Sulfur	M	2 qt		
	Trilogy ^{OG}		1%		
Fusarium Wilt (<i>Fusarium oxysporum</i>)	No fungicides available. Soil protectants, resistant varieties and crop rotations are recommended.				
Gray Leaf Spot (<i>Stemphylium solani</i>)	Chlorothalonil		1.8-2.6 lb	0	18.3 lb
	Bravo Ultrex	M	2-2.8 pt	0	20 pt
	Chloronil 720	M	2-3 pt	0	15.1 lb a.i.
	Echo 90DF	M	2-2.8 pt	0	20 pt
	Equus 720SST	M			
	Flint	11	3-4 oz	3	16 fl oz
	Gavel	22,M	1.5-2 lb	5	8-16 lb ³⁰
	Inspire Super	9,3	16-20 fl oz	0	47 fl oz
	Mancozeb				
	Dry formulations	M	0.5-3 lb ³⁰	5	21-22.4 lb
Liquid Formulations	M	0.6-2.4 qt ³⁰	5	16.8 qt	

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	ManKocide	M	1-3 lb	5	42.7-58 lb ³⁰
	Revus Top	3,40	5.5-7 fl oz	1	28 fl oz
	Ridomil Gold Bravo	4,M	2.5 pt	5	see footnote ³¹
Gray Mold (<i>Botrytis cinerea</i>)	Actinovate AG ^{OG}		3-12 oz		
	Botran 75-W	14	1 lb/100 gal water	10	5.3 lb
	Cabrio	11	12-16 oz	0	96 oz
	Chlorothalonil				
	Bravo Ultrex	M	1.3-1.8 lb	0	18.3 lb
	Chloronil 720	M	1.4-2 pt	0	20 pt
	Echo 90DF	M	1.4-2 pt	0	15.1 lb a.i.
	Equus 720SST	M	1.4-2 pt	0	20 pt
	Endura	7	9-12.5 oz	0	25 oz
	Fontelis	7	24 fl oz	0	72 fl oz
	Priaxor	7,11	4-8 fl oz	0	24 fl oz
	Scala SC	9	7 fl oz	1	35 fl oz
Late Blight (<i>Phytophthora infestans</i>)	Aftershock	11	5.7 fl oz	3	22.8 fl oz
	Azoxystrobin				
	Quadris	11	6.2 fl oz	0	37 fl oz
	Quadris Opti	11,M	1.6 pt	0	5 app
	Quadris Top	11,3	8 fl oz	0	47 fl oz
	Satori	11	5-6.2 fl oz	0	61.5 fl oz
	Cabrio	11	8-16 oz	0	96 fl oz
	Chlorothalonil				
	Bravo Ultrex	M	1.3-1.8 lb	0	18.3 lb
	Chloronil 720	M	1.4-2 pt	0	20 pt
	Echo 90DF	M	1.4-2 pt	0	15.1 lb a.i.
	Equus 720SST	M	1.4-2 pt	0	20 pt
	Copper hydroxide				
	Kocide 3000	M	0.8-1.8 lb	0	58 lb
	Kocide 2000	M	1.5 lb	0	49.7 lb
	Champ WG ^{OG}	M	1.1 lb	3	16 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	1.8 pt	3	61.3 pt
	Badge X2 ^{OG}	M	0.8-1.8 lb	3	17.4 lb Cu
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.8-3 lb	3	20 lb
	Cuproxtat	M	2.6 pt	3	39.4 pt
	Cuprous oxide			0	
	Nordox	M	2-4 lb		
	Evito 480 SC	11	5.7 fl oz	3	22.8 fl oz
	Flint	11	2-3 oz	3	16 fl oz
	Forum	40	6 fl oz	4	30 fl oz
	Gavel 75DF	22,M	1.5-2 lb	5	8-16 lb ³⁰
	Mancozeb				

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Dry formulations	M	0.5-3 lb ³⁰	5	21-22.4 lb
	Liquid Formulations	M	0.6-2.4 qt ³⁰	5	16.8 qt
	ManKocide	M	1-3 lb	5	42.7-58 lb ³⁰
	MilStop ^{OG}		2-5 lb/100 gal		
	Previcur Flex	28	0.7-1.5 pt	5	7.5 pt
	Priaxor	7,11	8 fl oz	0	24 fl oz
	Ranman	21	2.1-2.8 fl oz	0	16.5 fl oz
	Reason 500SC	11	5.5-8.2 fl oz	14	24.6 fl oz
	Ridomil				
	Gold Bravo SC	4,M	2.5 pt	5	see footnote ³¹
	Gold/Copper	4,M	2 lb	14	3 app
	Gold MZ WG	4,M	2.5 lb	5	10 lb
	Revus Top	3,40	5.5-7 fl oz	1	28 fl oz
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	Optimum	44	4-20 oz	0	
	MAX	44	1-3 lb	0	
	Tanos	27,11	8-10 oz	3	72 oz
	Top Cop with Sulfur	M	2 qt		
	Zampro	45,40	14 fl oz	4	42 fl oz
Septoria Leaf Spot <i>(Septoria lycopersici)</i>	Azoxystrobin				
	Quadris	11	5-6.2 fl oz	0	37 fl oz
	Quadris Opti	11,M	1.6 pt	0	5 app
	Quadris Top	11,3	8 fl oz	0	47 fl oz
	Satori	11	5-6.2 fl oz	0	61.5 fl oz
	Cabrio	11	8-12 oz	0	96 fl oz
	Chlorothalonil				
	Bravo Ultrex	M	1.3-1.8 lb	0	18.3 lb
	Chloronil 720	M	1.4-2 pt	0	20 pt
	Echo 90DF	M	1.4-2 pt	0	15.1 lb a.i.
	Equus 720SST	M	1.4-2 pt	0	20 pt
	Copper hydroxide				
	Kocide 3000	M	0.8-1.8 lb	0	58 lb
	Kocide 2000	M	1.5 lb	0	49.7 lb
	Champ WG ^{OG}	M	1.1 lb	3	16 lb
	Copper hydroxide, copper oxychloride				
	Badge SC	M	1.8 pt	3	61.3 pt
	Badge X2 ^{OG}	M	0.8-1.8 lb	3	17.4 lb Cu
	Copper sulfate				
	Cuprofix-Ultra 40	M	0.8-3 lb	3	20 lb
	Cuproxtat	M	2.6 pt	3	39.4 pt
	Cuprous oxide			0	
	Nordox	M	2-4 lb		
	Flint	11	3-4 oz	3	16 fl oz
	Fontelis	7	16-24 fl oz	0	72 fl oz
	Gavel 75DF	22,M	1.5-2 lb	5	8-16 lb ³⁰

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops					
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.					
Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Inspire Super	9,3	16-20 fl oz	0	47 fl oz
	Mancozeb				
	Dry formulations	M	0.5-3 lb ³⁰	5	21-22.4 lb
	Liquid Formulations	M	0.6-2.4 qt ³⁰	5	16.8 qt
	ManKocide	M	1-3 lb	5	42.7-58 lb ³⁰
	MilStop ^{OG}		2-5 lb/100 gal		
	Previcur Flex	28	0.7-1.5 pt	5	7.5 pt
	Priaxor	7,11	4-8 fl oz	0	24 fl oz
	Reason 500SC	11	5.5-8.2 fl oz	14	24.6 fl oz
	Revus Top	3,40	5.5-7 fl oz	1	28 fl oz
	Ridomil Gold Bravo SC	4,M	2.5 pt	5	see footnote ³¹
	Tanos	27,11	8-10 oz	3	72 oz
Southern Blight (<i>Sclerotium rolfsii</i>)	Aftershock	11	2-5.7 fl oz	3	22.8 fl oz
	Cabrio	11	12-16 oz	0	96 oz
	Evito SC	11	2-5.7 fl oz	3	22.8 fl oz
	Fontelis	7	1-1.6 fl oz ⁶	0	24 fl oz
	Priaxor	7,11	4-8 fl oz	0	24 fl oz
Target Spot (<i>Corynespora cassicola</i>)	Aftershock	11	2-5.7 fl oz	3	22.8 fl oz
	Azoxystrobin				
	Quadris	11	5-6.2 fl oz	0	37 fl oz
	Quadris Opti	11,M	1.6 pt	0	5 app
	Quadris Top	11,3	8 fl oz	0	47 fl oz
	Satori	11	5-6.2 fl oz	0	61.5 fl oz
	Cabrio	11	8-12 oz	0	96 fl oz
	Chlorothalonil				
	Bravo Ultrex	M	1.3-1.8 lb	0	18.3 lb
	Chloronil 720	M	1.4-2 pt	0	20 pt
	Echo 90DF	M	1.4-2 pt	0	15.1 lb a.i.
	Equus 720SST	M	1.4-2 pt	0	20 pt
	Endura	7	3.5 oz	0	21 oz
	Evito 480SC	11	2-5.7 fl oz	3	22.8 fl oz
	Fontelis	7	16-24 fl oz	0	72 fl oz
	Inspire Super	9,3	16-20 fl oz	0	47 fl oz
	Priaxor	7,11	4-8 fl oz	0	24 fl oz
	Revus Top	3,40	5.5-7 fl oz	1	28 fl oz
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	Optimum	44	4-20 oz	0	
	MAX	44	1-3 lb	0	
	Tanos	27,11	8-10 oz	3	72 oz
Verticillium Wilt (<i>Verticillium dahlia</i>)	Serenade Soil	44	2-6 qt ¹³		
Viruses	A list of viruses of tomato can be found in Table 3. Plant resistant varieties. Table 4 provides a list of varieties with resistance to tomato spotted wilt virus (TSWV). For viruses transmitted by insects, control of the insect vector using insecticides, polyethylene or polyethylene coated mulches, and/or trap crops are				

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops
The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
	recommended. Seed treatments and good sanitation practices are recommended for non-insect transmitted viruses.			
<p>¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.</p> <p>²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).</p> <p>³Rates are the amount of formation per acre unless otherwise indicated. Usually 100 gallons of water are required to give good coverage with boom sprayers.</p> <p>⁴Post-harvest interval (PHI) is the minimum number of days allowed between the last application and harvest.</p> <p>⁵Where mancozeb 80WP is recommended, flowable and dry flowable formulations can be used at the labeled rates.</p> <p>⁶All rates are per 1000 square feet of row. Refer to the label for modes of application.</p> <p>⁷Broccoli and cabbage are covered under a supplemental label (EPA Reg. No. 70506-234).</p> <p>⁸Rates refer to band or broadcast applications. Refer to individual labels for per plant in transplant water rates.</p> <p>⁹For head and stem applications the post harvest interval (PHI) is 0 days. For leafy greens the PHI is 3 days.</p> <p>¹⁰For head and stem applications the post harvest interval (PHI) is 0 days. For leafy greens the PHI is 14 days.</p> <p>¹¹Do not use in a spray solution with a pH less than 6.5.</p> <p>¹²Do not apply alone. Must be applied as a tank mix with another fungicide with a different mode of action.</p> <p>¹³Soil applications. Refer to individual labels for application directions.</p> <p>¹⁴Other product choices that can be applied at the same rate include Echo 720, Equus 720SST, and Chloronil 720.</p> <p>¹⁵Satori must not be tank mixed with another fungicide (i.e. Ambush WP, Pounce WP, Franchise) that may increase the penetration of Satori. Refer to label for addition restrictions.</p> <p>¹⁶Rates are cumulative. Do not apply more than 3.2 qt per acre per year.</p> <p>¹⁷Do not use more than one application of Actigard 50WG on head lettuce intended for bag purposes.</p> <p>¹⁸Supplemental label (EPA Reg. No. 62719-375). Expires March 15, 2015.</p> <p>¹⁹Shank applications only. Apply 21 days after planting or after the first cutting. Refer to label for additional application instructions.</p> <p>²⁰PHI varies depending on the rate and mode of application. Refer to label for specific PHI.</p> <p>²¹Supplemental label (EPA Reg. No. 7969-302). Expires December 31, 2015.</p> <p>²²Transplant production only.</p> <p>²³West of the Mississippi river do not apply more than 42.3 lb per crop per year. East of the Mississippi river do not apply more than 58 lb per crop per year.</p> <p>²⁴West of the Mississippi river do not apply more than 9.6 qt product per acre per year. East of the Mississippi river do not apply more than 14.4 qt product per acre per year.</p> <p>²⁵West of the Mississippi river do not apply more than 12.8 lb product per acre per year. East of the Mississippi river do not apply more than 19.2 lb product per acre per year.</p> <p>²⁶Use a lower rate of chlorothalonil when vines are first exposed and leaf wetness occurs. Increase the rate when vines close between rows or late blight forecasting measures 18 disease severity values or the crop reaches 300 P-days. Refer to labels for detailed application and timing instructions.</p> <p>²⁷Do not exceed 11.3 lb a.i. per acre of chlorothalonil containing products. Do not exceed 0.2 a.i. per season of soil-applied and 0.4 lb a.i. per season of foliar-applied mefenoxam.</p> <p>²⁸Not labeled for all herbs or leafy greens. Rate varies depending on the crop type. Refer to label for labeled crops and specific rates.</p> <p>²⁹Do not exceed 18 lb a.i. per acre of chlorothalonil containing products. Do not exceed 1.5 lb a.i. per acre of azoxystrobin containing products.</p> <p>³⁰Rates vary based on proximity to the Mississippi (west vs. east of the Mississippi river). Refer to labels for exact rates.</p> <p>³¹Do not exceed 15 lb a.i. per acre of chlorothalonil containing products. Do not exceed 0.5 lb a.i. per acre of</p>				

Commercial Crop Production Vegetables

Table 1. Recommended pesticides, rates and pesticide use restrictions for selected vegetable crops

The symbol ^{OG} indicates a pesticide that has been listed by the Organic Materials Review Institute (OMRI) as approved for use in organic production.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
foliar applied azoxystrobin containing products. Refer to label for additional restrictions. ³² Ventilate for at least 3 hours after application. ³³ Do not apply to cherry or grape type tomatoes in the greenhouse. ³⁴ Apply in the evenings through a drip irrigation system. Refer to label for additional application instructions and restrictions. ³⁵ Viroids are the smallest “organisms” known to cause plant diseases. Viroids can also be transmitted by seeds, vegetative propagation, pollen, grafting and insects. Viroids are easily spread by contact with contaminated pruning tools, farm equipment, clothing, crop handling, and contact between neighboring plants.				

Table 2. Pepper virus diseases and modes of transmission

Virus	Transmission
Alfalfa Mosaic Virus (AMV)	Aphids
Cucumber Mosaic Virus ¹ (CMV)	Aphids
Pepper Mild Mottle Virus (PMMoV)	Seed Mechanical
Pepper Mottle Virus (PeMoV)	Aphids
Potato Virus Y (PVY)	Aphids
Tobacco Etch Virus ² (TEV)	Aphids
Tobacco Mosaic Virus (TMV)	Seed Mechanical
Tomato Spotted Wilt Virus (TSWV)	Thrips
¹ CMV is the most important virus disease of peppers worldwide. ² TEV and PVY normally occur together. Planting PVY-resistant varieties often helps control TEV because resistance to both viruses is closely linked.	

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Table 3. Tomato virus diseases and modes of transmission	
Virus	Transmission
Cucumber Mosaic Virus (CMV)	Aphids
Pepino Mosaic Virus ¹ (PeMV)	Mechanical
Potato Leaf Roll Virus (PLRV)	Aphids
Potato Virus Y (PVY)	Aphids
Tobacco Etch Virus (TEV)	Aphids
Tobacco Mosaic Virus (TMV)	Seed Mechanical
Tomato Leaf Curl Virus (TYLCV)	White flies (silver leaf)
Tomato Ring Spot Virus (TRSV)	Dagger nematode Thrips Mites Flea beetles
Tomato Spotted Wilt Virus (TSWV)	Thrips
¹ Reported mostly on tomatoes produced in the greenhouse.	

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Table 4. Tomato varieties with resistance to tomato spotted wilt virus and seed suppliers	
Variety	Source
<i>Fresh Market (indeterminate)</i>	
Amelia	Harris Moran Seed Co.
Bella Rosa	Sakata
BHN 444	BHNSeed
BHN 602	BHNSeed
BHN 640	BHNSeed
Crista	Harris Moran Seed Co.
Finishline	Syngenta
Fletcher	North Carolina State University
Florida 7964	University of Florida
Mountain Glory	NCSU
Nico	Harris Moran Seed Co.
Red Defender	Harris Moran Seed Co.
Redline	Syngenta
Talladega	Syngenta
Top Gun	Twilley Seeds
<i>Roma (Saladette or determinate)</i>	
BHN 685	BHNSeed
Health Kick	Park Seed
Muriel	Sakata
Picus	Seminis

Commercial Crop Production Vegetables

Table 5. Biopesticides and fungicide alternatives for vegetables.

Table reproduced from the 2015 Southeastern US Vegetable Handbook. Table prepared by K. Seebold, Plant Pathologist, University of Kentucky and M. Lewis Ivey, Plant Pathologist, Louisiana State University, LSU AgCenter.

Active Ingredient	Product	Crops	Target Diseases/Pests	Greenhouse Use	OMRI Listed
Acibenzolar-S-methyl	Actigard ¹	chili pepper, cucurbits, lettuce, onion, spinach, tomato	Bacterial blights ⁴ Downy mildew Powdery mildew	No	No
<i>Bacillus amyloliquefaciens</i> D747	DoubleNickel ²	Most vegetables ⁵ , strawberries, citrus, fruit and nuts	Powdery mildew ⁴ Downy mildew Bacterial blights Leaf spots	Yes	Yes
<i>Bacillus pumilus</i> QST2808	Ballad Plus ³ Sonata	Cole crops, cucurbits, legumes, bulb vegetables, root crops, pepper, tomato, sweet corn	Early blight Late blight Downy mildew Powdery mildew Leaf blights Rust	Yes	Yes
<i>Bacillus subtilis</i> MBI 600	Subtilex NG ⁶	cucurbits, eggplant, pepper, tomato	Root diseases Powdery mildew ⁶	Yes	No
<i>Bacillus subtilis</i> QST713	Cease ⁷ Serenade Max ⁷	Cole crops, leafy vegetables, legumes, cucurbits, pepper, tomato	Downy mildew Powdery mildew Leaf blights	Yes	Yes
Bacteriophage (Phage)	Agriphage ⁸	most vegetables ⁵	Bacterial spot Bacterial speck Bacterial canker (foliar only)	Yes	No
<i>Coniothyrium minitans</i>	Contans ⁹	most vegetables ⁵	White mold Timber rot Lettuce drop	Yes	Yes
<i>Gliocladium cantenulatum</i>	PreStop Biofungicide	most vegetables ⁵	Seed rots Root diseases Botrytis stem canker	Yes	No
<i>Gliocladium virens</i> GL-21	SoilGard 12G ¹⁰	most vegetables ⁵	Seed rots Root diseases	Yes	Yes
Hydrogen peroxide	Oxidate Terracide	most vegetables ⁵	Root diseases Leaf blights	Yes	Yes
<i>Myrothecium verrucaria</i>	DiTera DF	Cole crops, cucurbits, eggplant, leafy vegetables, legumes, pepper, root and tuber vegetables, tomato	Nematodes	Yes	Yes
Neem Oil	Trilogy ¹¹	vegetables	Foliar diseases	Yes	Yes
Oils from cottonseed, corn, and garlic	Mildew Cure ¹¹	tomato, cucurbits	Powdery mildew	Yes	No
Oils from clove, rosemary, and	Sporatec ¹²	most vegetables ⁵	Powdery mildew Fungal leaf blights	Yes	Yes

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Table 5. Biopesticides and fungicide alternatives for vegetables.

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Active Ingredient	Product	Crops	Target Diseases/Pests	Greenhouse Use	OMRI Listed
Acibenzolar-S-methyl	Actigard ¹	chili pepper, cucurbits, lettuce, onion, spinach, tomato	Bacterial blights ⁴ Downy mildew Powdery mildew	No	No
thyme					
Oil from soybean	Oleotrol-M ¹³	most vegetables ⁵	Botrytis gray mold Downy mildew Powdery mildew	Yes	Yes
<i>Paecilomyces lilacinus</i>	MeloCon WG	most vegetables ⁵	Nematodes	Yes	Yes
Phosphorous compounds	Alude Fosphite Fungi-Phite Phostrol ProPhyt Rampart	most vegetables ⁵	Downy mildew Powdery mildew Leaf blights	Yes	No
Potassium bicarbonate ¹⁴	Armicarb Kaligreen Milstop	most vegetables ⁵	Powdery mildew Fungal leaf blights	Yes	Yes (except Armicarb)
Potassium salts of fatty acids	M-Pede ¹⁵	most vegetables ⁵	Powdery mildew	Yes	Yes
Potassium silicate	Sil-MATRIX ¹⁶	most vegetables ⁵	Powdery mildew Botrytis gray mold	Yes	Yes
<i>Pseudomonas chloroaphis</i>	Atezec	most vegetables ⁵	Stem and root diseases	Yes (no field use allowed)	No
<i>Reynoutria sachalinensis</i> extract	Regalia ¹⁷	most vegetables ⁵	Powdery mildew Fungal leaf blights	Yes	Yes
<i>Streptomyces griseoviridis</i>	Mycostop ¹⁸	most vegetables ⁵	Seedling, root, and stem rots	Yes	Yes
<i>Streptomyces lydicus</i>	Actinovate AG ⁵	most vegetables ⁵	Seedling, root, and stem rots Foliar blights	Yes	Yes
<i>Streptomyces lydicus</i> + iron, molybdenum, and humic acid	Actino-Iron ⁹	most vegetables ⁵	Seedling, root, and stem rots	Yes	Yes
<i>Trichoderma harzianum</i> ¹⁸	T-22 RootShield PlantShield	Cole crops, eggplant, leafy vegetables, pepper, tomato	Seedling, root, and stem rots	Yes	Yes
<i>Trichoderma viride</i>	Binab	most vegetables ⁵	Seedling, root, and stem rots	Yes	No

Comments:

Commercial Crop Production Vegetables

Table 5. Biopesticides and fungicide alternatives for vegetables.

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Active Ingredient	Product	Crops	Target Diseases/Pests	Greenhouse Use	OMRI Listed
Acibenzolar-S-methyl	Actigard ¹	chili pepper, cucurbits, lettuce, onion, spinach, tomato	Bacterial blights ⁴ Downy mildew Powdery mildew	No	No

¹Do not apply to plants stressed by heat, cold, or moisture extremes.

²pH of spray solution should be between 6.0 and 8.0.

³Labeled for sweet corn only.

⁴Target diseases or pests are crop dependent. Refer to label for specific diseases and crop.

⁵Most vegetables are covered on the label. Refer to the label for specific crops and diseases.

⁶Apply to soil or potting medium; use as a foliar spray for powdery mildew.

⁷Works best when applied prior to disease development and used in an integrated program.

⁸Product is strain specific. Contact your state Vegetable Pathologist Extension Specialist for information on identifying bacterial strains. Apply in the evening or during cloud cover days.

⁹Apply to soil or potting medium.

¹⁰Do not apply in conjunction with chemical fungicides.

¹¹May cause leaf burn; test a small number of plants before spraying entire crop.

¹²Addition of a spray adjuvant (spreader or penetrant) is recommended.

¹³Tank-mix with a spreader-sticker.

¹⁴pH of spray solution should not be below 7.0.

¹⁵To avoid plant injury do not mix with surfactants or apply to stressed plants. Product also has insecticidal properties.

¹⁶Tank-mix with a non-ionic surfactant for best results.

¹⁷First application should be made before symptoms appear.

¹⁸Can be added to potting mix or applied in-furrow to field soil.

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Table 6. Generic fungicides for use on vegetable crops

Table reproduced from the 2015 Southeastern US Vegetable Handbook. Table prepared by K. Seebold, Plant Pathologist, University of Kentucky and M. Lewis Ivey, Plant Pathologist, Louisiana State University, LSU AgCenter.

Common Name	Trade Name(s)
<i>chlorothalonil</i>	Bravo Ultrex (Syngenta)
	Bravo Weather Stik (Syngenta)
	Bravo Zn (Syngenta)
	Chloronil 720 (Syngenta) Chlorothalonil 720 SC (Arysta) Echo 720 (SipcamAdvan) Echo 90DF (SipcamAdvan) Echo Zn (SipcamAdvan) Equus 500 Zn (MANA)
	Equus 720 SST (MANA)
	Equus DF (MANA)
	Initiate 720 (Loveland Products)
	Initiate ZN (Loveland Products)
<i>copper hydroxide</i>	Champ DP Dry Prill (Nufarm)
	Champ Formula 2 Flowable (Nufarm)
	Champ WG (Nufarm)
	Champion Wettable Powder (Nufarm)
	Kentan DF (Isagro USA)
	Kocide 2000 (DuPont)
	Kocide 3000 (DuPont) Nu Cop 3L (Albaugh) Nu Cop 50DF (Albaugh)
	NU Cop 50WP (Albaugh) Nu Cop HB (Albaugh)
<i>copper sulfate (basic)</i>	Basic Copper 53 (Albaugh)
	Copper Z 4/4 (Helena)
	Cuprofix Ultra 40 Disperss (UPI)
	Cuproxat (NuFarm)
<i>osetyl-Al</i>	Aliette WDG Fungicide (Bayer)
	Linebacker WDG (NovaSource)
<i>fludioxonil</i>	Mamim 4FS (Syngenta)
	Spirato 480 FS (Nufarm)
<i>iprodione</i>	Enclosure 4 (Devgen) Iprodione 4L AG (Arysta) Meteor (UPI)
	Nevado 4F (MANA)
	Rovral 4 Flowable Fungicide (Bayer)
	Rovral 4 Flowable-(FMC)
<i>mancozeb</i>	Dithane F-45 Rainshield (Dow) Dithane M-45 (Dow)
	Koverall (Cheminova) Manzate Flowable (UPI) Manzate Max (UPI) Manzate Pro-Stick (UPI) Penncozeb 4FL (UPI) Penncozeb 75DF (UPI) Penncozeb 80WP (UPI)
	Roper DF Rainshield (Loveland Products)

Commercial Crop Production Vegetables

Table 6. Generic fungicides for use on vegetable crops
Table reproduced from the 2015 Southeastern US Vegetable Handbook. Table prepared by K. Seebold, Plant Pathologist, University of Kentucky and M. Lewis Ivey, Plant Pathologist, Louisiana State University, LSU AgCenter.

Common Name	Trade Name(s)
<i>mefenoxam</i>	Ridomil Gold GR (<i>Syngenta</i>) Ridomil Gold SL (<i>Syngenta</i>) Ultra Flourish (<i>Nufarm</i>)
<i>myclobutanil</i>	Rally 40WSP (<i>Dow</i>)
	Sonoma 25EW AG (<i>Albaugh</i>)
	Sonoma 40WSP (<i>Albaugh</i>)
<i>pentachloronitrobenzene</i>	Blocker 4F
<i>phosphite, potassium</i>	Helena Prophyt (<i>Helena</i>)
	Confine Extra (<i>Winfield Solutions</i>)
	Reveille (<i>Helena</i>)
<i>phosphite (mono- and dibasic salts)</i>	Phostrol (<i>Nufarm</i>)
<i>phosphorous acid (mono- and dipotassium salts)</i>	Alude (<i>Cleary</i>)
	Fosphite Fungicide (<i>JK Biotech</i>)
	Fungi-Phite (<i>Plant Protectants</i>)
	K-Phite 7LP AG (<i>Plant Food Systems</i>)
	Rampart (<i>Loveland Products</i>)
<i>propamocarb hydrochloride</i>	Previcur Flex (<i>Bayer</i>)
	Promess (<i>Agriphar</i>)
<i>propiconazole</i>	AmTide Propiconazole 41.8% EC (<i>AmTide</i>)
	Bumper 41.8 EC (<i>MANA</i>)
	Bumper ES (<i>MANA</i>)
	Fitness (<i>Loveland Products</i>)
	Propi-star EC (<i>Albaugh</i>)
	Propicure 3.6F (<i>Direct Ag Source</i>)
	Propimax EC (<i>Dow AgroSciences</i>)
	Shar-Shield PPZ (<i>Sharda USA</i>)
	Tilt (<i>Syngenta</i>)
	Topaz (<i>Winfield Solutions</i>)
Willowood Propicon 3.6EC (<i>Willowood USA</i>)	
<i>sulfur</i>	Cosavet-DF (<i>Sulphur Mills Limited</i>)
	CSC 80% Thiosperse (<i>Martin Resources</i>) CSC Dusting Sulfur (<i>Martin Resources</i>) CSC Thioben 90 (<i>Martin Resources</i>) CSC Wettable Sulfur (<i>Martin Resources</i>)
	Dusting Sulfur (<i>Loveland Products; Wilbur-Ellis</i>) First Choice Dusting Sulfur (<i>Loveland Products</i>) IAP Dusting Sulfur (<i>Independent Agribusiness Professionals</i>)
	InteGro Magic Sulfur Dust (<i>InteGro Inc.</i>)

Commercial Crop Production Vegetables

Table 6. Generic fungicides for use on vegetable crops

Table reproduced from the 2015 Southeastern US Vegetable Handbook. Table prepared by K. Seebold, Plant Pathologist, University of Kentucky and M. Lewis Ivey, Plant Pathologist, Louisiana State University, LSU AgCenter.

Common Name	Trade Name(s)
	Kumulus DF (<i>Arysta</i>) Liquid Sulfur Six (<i>Helena</i>) Micro Sulf (<i>Nufarm</i>)
	Microfine Sulfur (<i>Loveland Products</i>)
	Microthiol Disperss (<i>UPI</i>)
	Special Electric Sulfur (<i>Wilbur-Ellis</i>)
	Spray Sulfur (<i>Wilbur-Ellis</i>)
	Sulfur 6L (<i>Arysta</i>) Sulfur 90W (<i>Drexel</i>) Sulfur DF (<i>Wilbur-Ellis</i>)
	That Flowable Sulfur (<i>Stoller Enterprises</i>)
	Thiolux (<i>Loveland Products</i>)
	Wettable Sulfur (<i>Helena</i>)
	Yellow Jacket Dusting Sulfur (<i>Georgia Gulf Sulfur</i>)
	Yellow Jacket Wettable Sulfur (<i>Georgia Gulf Sulfur</i>)
<i>tebuconazole</i>	AmTide TEBU 3.6F (<i>AmTide</i>)
	Barrier (<i>Real Farm Technologies</i>)
	Folicur (<i>Bayer</i>)
	Monsoon (<i>Loveland Products</i>) Onset 3.6L (<i>Winfield Solutions</i>) Orius 3.6 F (<i>MANA</i>)
	Solera Tebuconazole 3.6F (<i>Solera</i>)
	Tebu-Crop 3.6F (<i>Sharda USA</i>)
	Tebucon 3.6F (<i>Repar Corp.</i>)
	TebuStar 3.6L (<i>Albaugh</i>) Tebuzol 3.6F (<i>UPI</i>) Toledo 3.6F (<i>Rotam</i>)
<i>thiophanate-methyl</i>	Incognito 4.5 F (<i>MANA</i>)
	Incognito 85 WDG (<i>MANA</i>) Thiophanate Methyl 85 WDG (<i>MANA</i>) T-Methyl 4.5F (<i>Nufarm</i>)
	T-Methyl 70W WSB (<i>Nufarm</i>)
	Topsin 4.5FL (<i>UPI</i>)
	Topsin M 70 WDG (<i>UPI</i>)

Commercial Crop Production Vegetables

Table 7. Fungicides mode of actions for fungicide resistance management

Table reproduced from the 2015 Southeastern US Vegetable Handbook. Table prepared by L. M. Quesada-Ocampo, Plant Pathologist, NCSU and M. Lewis Ivey, Plant Pathologist, Louisiana State University, LSU AgCenter.

FRAC Code	Fungicide Resistance Risk	Group Name	Example Active ingredients	Example Products
P1	Unknown	Benzo-thiadiazole (BTH)	Acibenzolar-S-methyl	Actigard
M1	Low	Inorganic copper	Fixed copper	Copper (generic)
M2	Low	Inorganic sulfur	Sulfur	Sulfur (generic)
M3	Low	Dithiocarbamates	Mancozeb	Mancozeb (generic)
M5	Low	Chloronitriles	Chlorothalonil	Chlorothalonil (generic)
1	High	Methyl benzimidazole carbamates (MBC)	Thiophanate-methyl	Topsin M
2	Medium to high	Dicarboximides	Iprodione	Rovral
3	Medium	Demethylation inhibitors (DMI)	Triflumizole Myclobutanil	Procure Rally
4	High	Phenylamide	Mefenoxam	Ridomil Gold
7	Medium to high	Succinate dehydrogenase inhibitors (SDHI)	Boscalid Penthiopyrad	Endura Fontelis
9	Medium	Anilino-pyrimidines (AP)	Pyrimethanil	Scala
11	High	Quinone outside inhibitors (QoI)	Pyraclostrobin Trifloxystrobin Azoxystrobin	Cabrio Flint Quadris
12	Low to medium	Phenylpyrroles (PP)	Fludioxinil	Maxim
13	Medium	Aza-naphthalenes	Quinoxifen	Quintec
14	Low to medium	Aromatic hydrocarbons (AH)	Dichloran	Botran
21	Medium to high	Quinone inside Inhibitors (QiI)	Cyazofamid	Ranman
22	Low to medium	Benzamides (toluamides) Thiazole carboxamide	Zoxamide	Gavel (contains zoxamide and mancozeb)
27	Low to medium	Cyanoacetamide-oximes	Cymoxanil	Curzate
28	Low to medium	Carbamates	Propamocarb	Presidio
29	Unknown	Dinitroanilines	Fluazinam	Omega
33	Low	Phosphonates	Fosetyl A!	Aliette
40	Low to medium	Carboxylic acid amides (CAA)	Dimethomorph Mandipropamid	Forum Revus
43	High	Benzamides	Fluopicolide	Presidio

The vegetable section was revised December 2014 by Dr. Melanie L. Lewis Ivey.

Home Gardens Fruit and Nut Trees

Table 1. Fungicides available for disease management for home fruit and nut production	
Product Name	Comments
CALCIUM POLYSULFIDES Type of fungicide: contact Crops: Most fruits, do not use on apricots Diseases Controlled: Anthracnose, brown rot, leaf curl, leaf spot, mummy berry, powdery mildew, rust, scab and shot hole	
Hi-Yield Improved Lime Sulfur Spray	<ul style="list-style-type: none"> - Highly toxic - Do not apply when temperatures exceed 85°F - Do not apply with oil or near the time of an oil application.
CAPTAN Type of fungicide: contact Crops: Apples, apricots, blueberries, cherries, grapes, nectarines, peaches, plums and strawberries Diseases Controlled: Bitter rot, black rot, Botrytis rot, brown rot, cedar-apple rust, downy mildew, fly-speck, frog-eye, leaf spots, fruit rots and spots, mummy berry, quince rust, scab and sooty blotch	
Bonide Captan 50% WP Hi-Yield Captan 50W Fungicide SA-50 Home and Garden Captan Fungicide	-Bonide Captan 50% WP can be used on Blackberries for anthracnose and Botrytis gray mold.
CAPTAN PLUS INSECTICIDES Type of fungicide: contact Crops: Apples, apricots, cherries, grapes, nectarines, peaches, plums and strawberries Diseases Controlled: Bitter rot, black rot, Botrytis rot, brown rot, cedar-apple rust, downy mildew, fly-speck, frog-eye, leaf spots, fruit rots, fruit spots, quince rust, scab and sooty blotch	
Bonide A Complete Fruit Tree Spray Concentrate Gordon's Liquid Fruit Tree Spray Martin's Rescue One Spray Protection	
CHLOROTHALONIL Type of fungicide: contact Crops: Apricots, blueberries, cherries, nectarines, peaches, plums and prunes Diseases Controlled: Anthracnose, brown rot (blossom and twig blights), cherry leaf spot, leaf curl, mummy berry, scab and shot hole	
Bonide Fung-onil Multi-purpose Fungicide ¹ Ferti-lome Broad Spectrum Landscape and Garden Fungicide ¹ GardenTech Daconil Fungicide ¹ Gordon's Multi-Purpose Fungicide Hi-Yield Vegetable, Flower, Fruit and Ornamental Fungicide Ortho Max Garden Disease Control Concentrate	<ul style="list-style-type: none"> - Do not apply after shuck split or before harvest on stone fruits. - Do not apply after early bloom on blueberries.
COPPER Type of fungicide: contact Crops: Apples, apricots, berries, cherries, citrus, grapes, nectarines, peaches, pears, pecans, plums, prunes, quince and strawberries Diseases Controlled: Angular leaf spot, anthracnose, bacterial canker, bacterial leaf spot, bitter rot, black rot, blotch, brown rot, cane cankers, cedar-apple rust, downy mildew, fire blight, fruit spots, gray mold, leaf blights, leaf curl, leaf scorch, leaf spot, melanose, powdery mildew, quince rust, leaf curl, shot hole and scab	
Bonide Copper Spray or Dust Bonide Liquid Copper Fungicide ¹	- Can be used for organic gardening.

Home Gardens Fruit and Nut Trees

Table 1. Fungicides available for disease management for home fruit and nut production	
Product Name	Comments
Concern Copper Soap Fungicide Gordon's Bordeaux Mixture Hi-Yield Bordeaux Mix Fungicide Hi-Yield Copper Fungicide Lilly Miller Cueva Copper Soap Fungicide Natural Guard Copper Soap Liquid Fungicide ¹ SA-50 Southern Ag Liquid Copper Fungicide	- Do not mix with liquid fertilizers. - Do not use in spray solutions with a pH of less than 6.5. - May cause staining of masonry, concrete, etc.
COPPER PLUS INSECTICIDES	
Type of fungicide: contact	
Crops: Apples, apricots, berries, cherries, citrus, grapes, nectarines, peaches, pears, pecans, plums, prunes, quince and strawberries	
Diseases Controlled: Angular leaf spot, anthracnose, bacterial canker, bacterial leaf spot, bitter rot, black rot, blotch, brown rot, cane cankers, cedar-apple rust, downy mildew, fire blight, fruit spots, gray mold, leaf blights, leaf curl, leaf scorch, leaf spot, melanose, powdery mildew, quince rust, leaf curl, shot hole and scab	
Bonide Garden Dust Bonide Dragoon Dust with Copper	- Can be used for organic gardening. - Do not mix with liquid fertilizers. - Do not use in spray solutions with a pH of less than 6.5. - May cause staining of masonry, concrete, etc.
MANCOZEB	
Type of fungicide: contact	
Crops: Grapes	
Diseases Controlled: Black rot, bunch rot, Eutypa dieback (formerly known as dead arm) and downy mildew	
Bonide Mancozeb Flowable with Zinc Concentrate	- Do not use within 66 days of harvest. - Do not make more than three applications per season.
MYCLOBUTANIL	
Type of fungicide: systemic	
Crops: Apples, apricots, cherries, grapes, nectarines, peaches, plums and prunes	
Diseases Controlled: Anthracnose, black rot, brown rot, powdery mildew, rust, scab and shot hole	
Eagle 20EW Spectracide Immunox Multi-purpose Fungicide Spray Concentrate	-Do not apply Eagle 20EW within 14 days of harvest on apples and grapes.
NEEM OIL	
Type of fungicide: contact	
Crops: All fruits	
Diseases Controlled: Anthracnose, black rot, Botrytis, downy mildew, fungal leaf spots, powdery mildew, rust and scab	
Bonide Rose Rx 3 in 1 ¹ Bonide Tomato and Vegetable 3 in 1 Concern Garden Defense Multi-purpose Spray ¹ Ferti-lome Rose, Flower and Vegetable Spray Gardens Alive! Shield-All II Garden Safe Fungicide 3-in-1 ¹ Green Light Neem Concentrate Green Light Powdery Mildew Killer RTU	- Can be used for organic gardening. - Do not use on sensitive plants (flowers of impatiens, fuchsia and hibiscus and some rose and carnation varieties).

Home Gardens Fruit and Nut Trees

Table 1. Fungicides available for disease management for home fruit and nut production	
Product Name	Comments
Natural Guard Neem Py Southern Ag Triple Action Neem Oil	
NEEM OIL PLUS INSECTICIDES Type of fungicide: contact Crops: All fruits and nuts Diseases Controlled: Anthracnose, Botrytis, downy mildew, fungal leaf spots and blights, powdery mildew, rust and scab	
Ferti-lome Triple Action Plus ¹ Green Light Neem ^{II} Ready-To-Use	- Do not apply to wilted or stressed plants or to newly transplanted material prior to root development.
PHOSPHOROUS ACID Type of fungicide: systemic Crops: Apples, berries, citrus, grapes, loquats, pears, quince, stone fruits and strawberries Diseases Controlled: Root, collar and fruit rots caused by Phytophthora, downy mildew, apple scab and fire blight	
Monterey Agri-Fos Systemic Fungicide	
POTASSIUM CARBONATE Type of fungicide: contact Crops: All fruits Diseases Controlled: Powdery mildew	
Garden-ville Potassium Bicarbonate	
PROPICONAZOLE Type of fungicide: systemic Crops: Apples, cherries, citrus, pecans and walnuts Diseases Controlled: Anthracnose, fungal leaf spots, powdery mildew, rust and scab	
Bonide Infuse Systemic Disease Control Bonide Infuse Systemic Disease Control Lawn and Landscape Ready to Spray Ferti-lome Liquid Systemic Fungicide II Gordon's Systemic Fungicide	- For use on nonbearing (trees that will not produce fruit for at least one year after use of this product) fruit and nut trees.
PROPIOCONAZOLE Type of fungicide: systemic Crops: Apricots, cherries, nectarines, peaches, plums and prunes Diseases Controlled: Brown rot (blossom blight and fruit), cherry leaf spot and powdery mildew	
Bonide Infuse Systemic Disease Control Bonide Infuse Systemic Disease Control Lawn and Landscape Ready to Spray	- For use on bearing fruit trees.
STREPTOMYCIN SULFATE Type of fungicide: contact Crops: Apple and pear Diseases Controlled: Fire blight	
Ferti-lome Fire Blight Spray	-Spray every three to four days during bloom. Do not spray once fruit is visible.

Home Gardens Fruit and Nut Trees

Table 1. Fungicides available for disease management for home fruit and nut production	
Product Name	Comments
SULFUR Type of fungicide: contact Crops: Apples, berries, cherries, citrus, grapes, nectarines, peaches, pears, plums, prunes and strawberries Diseases Controlled: Black rot, brown rot, cedar-apple rust, frog-eye, leaf spot, powdery mildew, quince rust, rust, scab, shot hole and sooty blotch	
Bonide Sulfur Plant Fungicide Ferti-lome Dusting Sulfur Green Light Wettable Dusting Sulfur Hi-Yield Wettable Dusting Sulfur Lilly Miller Sulfur Dust Safer Brand Garden Fungicide II Southern Ag Wettable or Dusting Sulfur (peaches only)	- Do not re-enter treated area for 24 hours after application. - Do not use during periods of high temperatures (85°F or higher) or within two to four weeks of using an oil spray.
SULFUR PLUS POTASSIUM SALTS Type of fungicide: contact Crops: Apples, grapes, pears and strawberries Diseases Controlled: Powdery mildew	
Safer Brand 3-in-1 Garden Spray ¹	- Do not use in full sun, when temperature exceeds 90°F or within four weeks of applying an oil spray.
¹ Available in concentrate and ready to use formulations	

Information in this section was last updated December 2014 by Dr. R. Singh.

Home Gardens Home Landscape

Table 1. Fungicides available for disease management in home landscape	
Product Name	Comments
CALCIUM POLYSULFIDES Type of fungicide: contact Crops: Roses and most landscape trees and shrubs Diseases Controlled: Anthracnose, black spot, powdery mildew and rust	
Hi-Yield Improved Lime Sulfur Spray	- Highly toxic. - Do not apply when temperatures exceed 85°F. - Do not apply with oil or near the time of an oil application.
CAPTAN Type of fungicide: contact Crops: Azalea, camellia, carnation, chrysanthemum, gladiolus, tuberous begonia and rose Diseases Controlled: Black spot, Botrytis flower blight, damping-off, fungal leaf spots, petal blight, rust and tuber rot	
Bonide Captan50% WP Hi-Yield Captan 50W Fungicide SA-50 Home and Garden Captan Fungicide	-Hi-Yield Captan 50W can only be used on azalea, camellia, chrysanthemum and rose.
CAPTAN PLUS INSECTICIDES Type of fungicide: contact Crops: Evergreens, flowers and roses Diseases Controlled: Black spot, flower blight, leaf spots and rust	
Bonide A Complete Fruit Tree Spray Concentrate Gordon's Liquid Fruit Tree Spray Martin's Rescue One Spray Protection	
CHLOROTHALONIL Type of fungicide: contact Crops: Most landscape plants Diseases Controlled: Anthracnose, Botrytis blight, downy mildew, fungal leaf spots and blights, powdery mildew and rust	
Bonide Fung-onil Multi-purpose Fungicide ¹ Ferti-lome Broad Spectrum Landscape and Garden Fungicide ¹ GardenTech Daconil Fungicide ¹ Hi-Yield Vegetable, Flower, Fruit and Ornamental Fungicide Ortho Disease B Gon Garden Fungicide Concentrate Ortho Max Garden Disease Control Concentrate SA-50 Liquid Ornamental and Vegetable Flowable Fungicide	

Home Gardens Home Landscape

Table 1. Fungicides available for disease management in home landscape	
Product Name	Comments
<p>MANCOZEB Type of fungicide: contact Crops: Most landscape plants Diseases Controlled: Anthracnose, downy mildew, fungal leaf spots and blights and rust</p>	
Bonide Mancozeb Flowable with Zinc Concentrate SA-50 Dithane M-45	
<p>MYCLOBUTANIL Type of fungicide: systemic Crops: Most landscape plants Diseases Controlled: Anthracnose, black spot, blossom blight, Cercospora leaf spot, petal blight, powdery mildew, rust and scab</p>	
Spectracide Immunox Multi-purpose Fungicide Spray Concentrate	
<p>MYCLOBUTANIL AND INSECTICIDES AND FERTILIZER Type of fungicide: systemic Crops: A variety of landscape plants Diseases Controlled: Anthracnose, black spot, blossom blight, Cercospora leaf spot, petal blight, powdery mildew, rust and scab</p>	
Spectracide Immunox 3-in-1 Insect and Disease Control Plus Fertilizer Spectracide Immunox Plus Insect and Disease Control Spectracide Immunox Plus Insect and Disease Multi-purpose Concentrate	
<p>NEEM OIL Type of fungicide: contact Crops: Most landscape plants and houseplants Diseases Controlled: Anthracnose, black spot, Botrytis, downy mildew, fungal leaf spots and blights, powdery mildew, rust and scab</p>	
Bonide Rose Rx 3 in 1 ¹ Bonide Tomato and Vegetable 3 in 1 Concern Garden Defense Multi-purpose Spray ¹ Ferti-lome Rose, Flower and Vegetable Spray Gardens Alive! Shield-All II Green Light Neem Concentrate Green Light Powdery Mildew Killer RTU Green Light Rose Defense Green Light Rose Defense Ready-To-Use Garden Safe Fungicide 3-in-1 ¹ Natural Guard Neem Py Southern Ag Triple Action Neem Oil	- Can be used for organic gardening. - Do not use on sensitive plants (flowers of impatiens, fuchsia and hibiscus and some rose and carnation varieties).

Home Gardens Home Landscape

Table 1. Fungicides available for disease management in home landscape	
Product Name	Comments
NEEM OIL PLUS INSECTICIDES Type of fungicide: contact Crops: Most landscape flowers and shrubs and houseplants Diseases Controlled: Anthracnose, Botrytis, downy mildew, fungal leaf spots and blights, powdery mildew, rust and scab	
Ferti-lome Triple Action Plus ¹ Green Light Neem ^{II} Ready-To-Use Green Light Rose Defense II Ready-To-Use	- Do not use on sensitive plants (flowers of impatiens, fuchsia and hibiscus and some rose and carnation varieties).
PHOSPHOROUS ACID Type of fungicide: systemic Crops: Most landscape plants Diseases Controlled: Bacterial blight, downy mildew, Phytophthora and Pythium	
Monterey Agri-Fos Systemic Fungicide	
POTASSIUM CARBONATE Type of fungicide: contact Crops: Most landscape plants Diseases Controlled: Powdery mildew	
Garden-ville Potassium Bicarbonate	
PROPICONAZOLE Type of fungicide: systemic Crops: Most landscape plants Diseases Controlled: Anthracnose, black spot, fungal leaf spots, powdery mildew, rust and scab	
Bonide Infuse Systemic Disease Control Bonide Infuse Systemic Disease Control Lawn and Landscape Ready to Spray Ferti-lome Liquid Systemic Fungicide II Ferti-lome Liquid Systemic Fungicide II Ready to Spray Gordon's Systemic Fungicide	- Do not apply to African violets, begonias, Boston ferns or geraniums
PROPICONAZOLE Type of fungicide: systemic Crops: Most landscape plants Diseases Controlled: Bulb, corm, rhizome, root, crown and stem rots	
Bonide Infuse Systemic Disease Control Bonide Infuse Systemic Disease Control Lawn and Landscape Ready to Spray	- Do not apply to home orchards.
STREPTOMYCIN SULFATE Type of fungicide: contact Crops: Chrysanthemum, dieffenbachia, philodendron, pyracantha and rose Diseases Controlled: Fire blight, Bacterial wilt, Bacterial stem rot, bacterial leaf spot, crown gall	
Ferti-lome Fire Blight Spray	- For crown gall apply as a soil drench.

Home Gardens Home Landscape

Table 1. Fungicides available for disease management in home landscape	
Product Name	Comments
SULFUR Type of fungicide: contact Crops: Most landscape plants Diseases Controlled: Powdery mildew, rust, downy mildew and Botrytis	
Bonide Sulfur Plant Fungicide Ferti-lome Dusting Sulfur Green Light Wettable Dusting Sulfur Hi-Yield Wettable Dusting Sulfur Lilly Miller Sulfur Dust Safer Brand Garden Fungicide II Southern Ag Wettable or Dusting Sulfur	- Do not re-enter treated area for 24 hours after application. - Do not use during periods of high temperatures (85° F or higher) or within two to four weeks of using an oil spray.
SULFUR PLUS INSECTICIDES Type of fungicide: contact Crops: Most landscape plants Diseases Controlled: Black spot, Botrytis blight, downy mildew, leaf spots, powdery mildew, rust and scab	
Bayer Advanced Nataria Insect, Diseases and Mite Control	
SULFUR PLUS POTASSIUM SALTS Type of fungicide: contact Crops: Most landscape plants Diseases Controlled: Black spot, leaf spots, powdery mildew and rust	
Safer Brand 3-in-1 Garden Spray ¹	- Do not use in full sun, when temperature exceeds 90° F or within four weeks of using an oil spray.
TEBUCONAZOLE Type of fungicide: systemic Crops: Most landscape plants and houseplants Diseases Controlled: Black spot, leaf spots, powdery mildew and rust	
Bayer Advanced Disease Control for Roses, Flowers and Shrubs	- Do not apply to plants grown for food.
TEBUCONAZOLE PLUS INSECTICIDES Type of fungicide: systemic Crops: Most landscape plants and houseplants Diseases Controlled: Anthracnose, black spot, leaf spot, petal blight, powdery mildew, rust and scab	
Bayer Advanced 3-in-1 Insect, Disease and Mite Control ¹	- Apply as a foliar spray every 7-14 days as necessary. Do not apply to plants grown for food.
TEBUCONAZOLE PLUS INSECTICIDES Type of fungicide: systemic Crops: Most landscape shrubs and flowers Diseases Controlled: Leaf spots (including black spot), powdery mildew, rust and southern blight	
Bayer Advanced All-in-One Rose and Flower Care Bonide Rose Rx Systemic Drench	- Apply as a drench every six weeks. - Do not apply to plants grown for food.

Home Gardens Home Landscape

Table 1. Fungicides available for disease management in home landscape	
Product Name	Comments
THIOPHANATE-METHYL Type of fungicide: systemic Crops: Most landscape plants Diseases Controlled: Anthracnose, flower blight, fungal bulb/corm/rhizome rots, fungal leaf spots and blights, fungal root/crown/stem rots, petal blight, powdery mildew, scab	
Bonide Infuse Systemic Disease Control Lawn and Landscape Ferti-lome Halt Systemic Rose, Flower, Lawn, Ornamental Fungicide SA-50 ThiomyI Turf and Ornamental Systemic Fungicide	- Apply as a foliar spray, soil drench or bulb soak.
TRIFORINE Type of fungicide: systemic Crops: A variety of landscape plants Diseases Controlled: Azalea petal blight, black spot, Entomosporium leaf spot, powdery mildew and rust	
Ortho RosePride Disease Control Concentrate Ortho RosePride Rose and Shrub Disease Control Concentrate	- Do not use on plants grown for food.
TRIFORINE PLUS INSECTICIDES Type of fungicide: systemic Crops: A variety of landscape plants Diseases Controlled: Azalea petal blight, black spot, Entomosporium leaf spot, powdery mildew and rust	
Ortho Orthenex Insect and Disease Control ¹	- Do not use on plants grown for food.
¹ Available in concentrate and ready to use formulations	

Information in this section was last updated December 2014 by Dr. R. Singh.

Home Gardens Lawns

Table 1. Fungicides available for disease management of home lawns			
Fungicide (type of fungicide)	Products	Diseases Controlled	Comments
AZOXYSTROBIN (systemic)	Maxide Dual Action Disease Killer	Anthracnose, Fairy ring Fusarium patch Gray leaf spot Large patch Leaf spots (melting out) Pythium blight Rust Spring dead spot Take-all patch Zoysia patch	
CAPTAN (contact)	Hi-Yield Captan Fungicide 50% WP Southern Ag Home & Garden Captan Fungicide 50% WP	Damping-off Large patch Leaf spots (melting out) Root rot	
COPPER (contact)	Ferti-lome Blackspot Powdery Mildew Control Hi-Yield Copper Fungicide SA-50 Southern Ag Liquid Copper Fungicide Bonide Liquid Copper Fungicide Natural Guard Copper Soap Liquid Fungicide	Algae Ascochyta leaf blight Dollar spot Rust	Do not mix with liquid fertilizers. Do not use in spray solutions with a pH of less than 6.5. May cause staining of masonry, etc.
MYCLOBUTANIL (systemic)	Ferti-lome F-Stop Green Light Fung-Away Systemic Lawn Fungicide Spectracide Immunox Lawn Disease Control (Concentrate or Granules) Spectracide Immunox Multi-purpose Fungicide Spray Concentrate	Anthracnose, crown rot Dollar spot Fusarium blight Large patch Leaf spots (melting out) Spring dead spot Take-all patch Zoysia patch	

Home Gardens Lawns

Table 1. Fungicides available for disease management of home lawns			
Fungicide (type of fungicide)	Products	Diseases Controlled	Comments
MYCLOBUTANIL PLUS INSECTICIDES PLUS FERTILIZER (systemic)	Spectracide Immunox 3-in-1 Insect & Disease Control Plus Fertilizer Spectracide Immunox Plus Insect & Disease Control Spectracide Immunox Plus Insect & Disease Control Multi-purpose Concentrate	Dollar spot Large patch Leaf spot (melting out) Spring dead spot Summer patch	
PHOSPHOROUS ACID SALTS (systemic)	Monterey Agri-Fos Systemic Fungicide	<i>Pythium</i>	
PROPICONAZOLE (systemic)	Bayer Advanced Fungus Control for Lawns Ready to Spray Bayer Advanced Fungus Control for Lawns Ready to Spread Granules II Bonide Infuse Systemic Disease Control Lawn & Landscape Ready to Spray Ferti-lome Liquid Systemic Fungicide II Gordon's Systemic Fungicide Maxide Dual Action Disease Killer Ready to Spray	Anthracnose Dollar spot Fusarium blight Gray leaf spot Large patch Leaf spot (melting out) Powdery mildew Rust Take-all patch	
THIOPHANATE- METHYL (systemic)	Bonide Infuse Systemic Disease Control Lawn & Landscape Granules Ferti-lome Halt Systemic Rose, Flower, Lawn, Ornamental Fungicide SA-50 Thiomyl Turf and Ornamental Systemic Fungicide	Anthracnose Dollar spot Fusarium blight Large patch Leaf spot (melting out) Summer patch	

Home Gardens Lawns

Table 2. Efficacy of available fungicides for disease management of home lawns							
Fungicide ¹	Diseases						
	Dollar spot	Brown patch	Large patch	Take all root rot, Bermuda decline, Ggg ²	Gray leaf spot	Leaf spots, Melting out	Fairy rings
azoxystrobin		4/3	4	(3)3	4	3	3
myclobutanil	4	2	2			1	
propiconazole	4	3	2	(2)	2	2	
triadimefon	4	2	4	(2)	2		3
thiophanate-methyl	4	2+			4	2	
PCNB		2	4			2	

¹Efficacy ratings are on a scale from 1 to 4 where 1=inconsistent but performs well in some instances, and 4=consistently good to excellent results. Efficacy data are based on trials using commercial formulations of the fungicides, not the formulations readily available to homeowners. Ratings were compiled by Drs. Vincelli and Williams at the University of Kentucky (PPA-1 Chemical Control of Turfgrass Diseases 2011 <http://pest.ca.uky.edu/PSEP/Manuals/ppa1.pdf>).

²*Gaeumannomyces graminis* var. *avenae*

³Ratings within parentheses are for take-all patch caused by *Gaeumannomyces graminis* var. *avenae* (Ggg).

Information in this section was last updated December 2014 by Dr. R. Singh.

Home Gardens Vegetables

Table 1. Fungicides available for disease management in home vegetable gardens	
Product Name	Comments
<p>CHLOROTHALONIL Type of fungicide: contact Crops: Most vegetables Diseases Controlled: Anthracnose, Botrytis, downy mildew, early blight, fruit rots, fungal leaf spots and blights, gummy stem blight, late blight, powdery mildew and rust</p>	
Bonide Fung-onil Multi-purpose Fungicide Ferti-lome Broad Spectrum Landscape and Garden Fungicide ¹ GardenTech Daconil Fungicide ¹ Hi-Yield Vegetable, Flower, Fruit and Ornamental Fungicide Ortho Disease B Gon Garden Fungicide Concentrate Ortho Max Garden Disease Control Concentrate SA-50 Liquid Ornamental and Vegetable Flowable Fungicide	
<p>COPPER Type of fungicide: contact Crops: Most vegetables Diseases Controlled: Anthracnose, bacterial leaf spots and blights, downy mildew, early blight, fungal leaf spots and blights, gummy stem blight, late blight, powdery mildew, scab, white rust and white mold</p>	
Bonide Copper Spray or Dust Bonide Liquid Copper Fungicide ¹ Concern Copper Soap Fungicide Gordon's Bordeaux Mixture Hi-Yield Bordeaux Mix Fungicide Hi-Yield Copper Fungicide Lilly Miller Cueva Copper Soap Fungicide Natural Guard Copper Soap Liquid Fungicide ¹ SA-50 Southern Ag Liquid Copper Fungicide	<ul style="list-style-type: none"> - Can be used for organic gardening. - Do not mix with liquid fertilizers. - Do not use in spray solutions with a pH of less than 6.5. - May cause staining of masonry, concrete, etc.
<p>COPPER PLUS INSECTICIDES Type of fungicide: contact Crops: Most vegetables Diseases Controlled: Anthracnose, bacterial leaf spots and blights, downy mildew, early blight, fungal leaf spots and blights, gummy stem blight, late blight, powdery mildew, scab, white rust and white mold</p>	
Bonide Garden Dust Bonide Dragoon Dust with Copper	<ul style="list-style-type: none"> - Do not mix with liquid fertilizers. - Do not use in spray solutions with a pH of less than 6.5. - May cause staining of masonry, concrete, etc.
<p>MANCOZEB Type of fungicide: contact Crops: Asparagus, corn, cucurbits, onions, potatoes and tomatoes Diseases Controlled: Anthracnose, bacterial leaf spots and blights, downy mildew, early blight, fungal leaf spots and blights, gummy stem blight, late blight, powdery mildew, scab, white rust and white mold</p>	
Bonide Mancozeb Flowable with Zinc SA-50 Dithane M-45	

Home Gardens Vegetables

Table 1. Fungicides available for disease management in home vegetable gardens	
Product Name	Comments
<p>NEEM OIL Type of fungicide: contact Crops: All vegetables, herbs and spices Diseases Controlled: Anthracnose, downy mildew, fungal leaf spots and blights, gray mold, powdery mildew, rust and scab</p>	
Bonide Rose Rx 3 in 1 ¹ Bonide Tomato and Vegetable 3 in 1 Concern Garden Defense Multi purpose Spray ¹ Ferti-lome Rose, Flower and Vegetable Spray Gardens Alive! Shield-All II Garden Safe Fungicide 3-in-1 ¹ Green Light Neem Concentrate Green Light Powdery Mildew Killer RTU Natural Guard Neem Py Southern Ag Triple Action Neem Oil	- Can be used for organic gardening.
<p>NEEM OIL PLUS INSECTICIDES Type of fungicide: contact Crops: All vegetables, herbs and spices Diseases Controlled: Anthracnose, downy mildew, fungal leaf spots and blights, powdery mildew and rust</p>	
Ferti-lome Triple Action Plus ¹ Green Light Neem II Ready-To-Use	
<p>PHOSPHOROUS ACID Type of fungicide: systemic Crops: Most vegetables Diseases Controlled: Root, crown and fruit rots caused by Phytophthora and Pythium, downy mildew, late blight and gummy stem blight</p>	
Monterey Agri-Fos Systemic Fungicide	
<p>POTASSIUM CARBONATE Type of fungicide: contact Crops: Most vegetables Diseases Controlled: Powdery mildew</p>	
Garden-ville Potassium Bicarbonate	
<p>PROPOCONAZOLE Type of fungicide: systemic Crops: Sweet corn Diseases Controlled: Leaf spots and blights and rust</p>	
Bonide Fung-onil Lawn and Garden Disease Control Ready to Spray Bonide Infuse Systemic Disease Control Lawn and Landscape Ready to Spray Ferti-lome Ready to Spray Liquid Systemic Fungicide Maxide Dual Action Disease Killer Ready to Spray	- Do not spray within 14 days of harvest.

Home Gardens Vegetables

Table 1. Fungicides available for disease management in home vegetable gardens	
Product Name	Comments
SULFUR Type of fungicide: contact Crops: Beans (may injure some varieties), cole crops, onions and peas Diseases Controlled: Botrytis, downy mildew, powdery mildew and rust	
Bonide Sulfur Plant Fungicide Ferti-lome Dusting Sulfur Green Light Wettable Dusting Sulfur Hi-Yield Wettable Dusting Sulfur Lilly Miller Sulfur Dust Safer Brand Garden Fungicide II Southern Ag Wettable or Dusting Sulfur	- Do not re-enter treated area for 24 hours after application. - Do not use during periods of high temperatures (85 °F or higher) or within two to four weeks of using an oil spray. - Do not use on cucurbits (cucumbers, squash, melons etc.)
SULFUR PLUS POTASSIUM SALTS Type of fungicide: contact Crops: Beans, cucumbers, peas, potatoes and squash Diseases Controlled: Powdery mildew	
Safer Brand 3-in-1 Garden Spray ¹	- Do not use in full sun, when temperature exceeds 90 °F or within four weeks of an oil spray.
¹ Available in concentrate and ready to use formulations	

Information in this section was last updated December 2012.

Nematode Management Field Crops

Nematode Management in Field Crops

All crops grown in Louisiana are subject to some type of nematode attack. Some nematodes such as root-knot or cyst may be very damaging but others such as stunt or spiral may not. Different crops or even varieties may differ in their response to various nematodes. Chemical control should be used if a nematode population appears to be at damaging levels and is likely to cause significant yield loss.

Table 1. Recommended nematicides, rates and restrictions for managing nematodes in field crops			
Crop	Product Choices¹	Rate²	Comments
Cotton	Telone II	3-6 gal	Apply fumigant 1 week before planting to at least 14 inches beneath the soil surface of the row. Soil should not be excessively wet at the time of application.
	Vydate C-LV (oxamyl)	8.5 - 17 fl oz (first and second applications)	Apply at 2-5 true leaf stage and a second application 7 to 14 days later. Use after initial treatment with a nematicide. For reniform, root-knot, and lance nematodes.
	Vydate L	1-2 pints	
	Avicta Complete Cotton Avicta Duo Cotton	Pre-ordered seed treatment	Use in fields with low-moderate nematode levels only.
	Poncho Votivo	Seed application	For low to moderate nematode levels.
	AERIS Seed Applied System	Pre-ordered seed treatment	For low-moderate nematodes.
Corn	Mocap 15G (ethoprop)	10-13 lb (40" rows)	Apply in a 12-15 inch band at planting. Incorporate into top 2-4 inches of soil.
	Counter 15G Lock 'n Load Counter 15G Smartbox	6-8 oz/1000 ft	Apply in 7-inch band directly behind planter shoe in front of the press wheel. Apply in furrow.
	Counter 20G Lock 'n Load	4.5.6 oz/1000 ft	
	Avicta Complete Corn Avicta Duo	Pre-ordered seed treatment	Use in fields with low-moderate nematode levels only.
	Poncho Votivo	Seed application	
	Telone II	3-6 gal	Apply 1 week pre-plant and 14- inches beneath the row.
Grain Sorghum	Counter 15G Lock 'n Load Counter 15G Smartbox	7 oz/1000 row feet	Apply in a 7-inch band or infurrow.
	Counter 20G	5.2 oz/1000 row feet	
	Poncho Votivo	Seed application	

Nematode Management Field Crops

Table 1. Recommended nematicides, rates and restrictions for managing nematodes in field crops

Crop	Product Choices ¹	Rate ²	Comments
Peanuts	Nemacur 3	2-3.3 qt	Apply in a 12-inch band. Incorporate into the soil.
	Vydate C-LV	34-68 fl oz 17 fl oz (foliar)	Apply in a 7-inch band and incorporate. Apply 28 days after planting and again in 14 days.
Soybean	Poncho Votivo	Seed application	
	Avicta Complete Bean	Seed application	
Sugarcane	Mocap 15G Mocap 15G Lock 'n Load	1.8-3.6 lbs/1000 row	Apply in a 12-15 inch band over seed pieces and cover with soil.
	Mocap 20G Lock 'n Load	1.4-2.8 lbs/1000 row	
Sweetpotato	Mocap 15G Mocap 15G Lock 'n Load	1.6-2.1 lb/1000	Apply in a 12-15 inch band.
	Mocap EC	5.1-6.9 oz/1000 row ft	
	Vydate L	2 gal/20 gal of water (pre-plant) 1-2 gal (in-furrow)	Apply within a week of planting and incorporate 4-6". Apply in at least 200 gal of transplant water during planting of slips (in-furrow).
Tobacco	Nemacur 3	1.3-2 gal	Broadcast and incorporate.
	Mocap 15G Lock 'n Load Mocap 15G	3.2 lb/1000 ft.	Mix with upper 2-4 inches of soil.
	Telone C-17 or C-35	See labels	
	Vydate C-LV	68 fl oz	Apply in an 18-24 foot band.

¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.
²Rates are the amount of formulation (product) per acre unless otherwise indicated.

The nematode sections were revised December 2014 by Dr. C. Overstreet.

Nematode Control Fruit Crops

Table 1. Recommended nematicides, rates and restrictions for managing nematodes in fruit trees and small fruit crops

Crop	Product Choices ¹	Rate ²	Comments
Blackberries, boysenberries, dewberries, raspberries, and strawberries	Telone II	27-35 gal (broadcast)	Apply 14 days prior to planting. <u>Row treatment</u> : Use 2 chisels spaced 12 inches apart per row. Inject chemical to a depth of 10 inches.
	Telone C-17	32.4-42 gal (broadcast)	
	Telone EC	9-24 gal (broadcast)	Apply with drip irrigation equipment. Soil must be moist 9 inches beneath the surface.
	Telone C-35	39-50 gal (broadcast)	
	Ditera DF	5-38 oz/1000 ft ²	Incorporate by mechanical means, irrigation or rainfall.
Strawberries	Telone C-17	32.4-37 gal	Waiting period of 1 week for every 10 gal applied
	Telone C-35	39-45 gal	
	Paladin	35-51.3 gal	There is a 21-42 day waiting period after treatment depending on soil temperature.
Fruit tree sites (pre-plant)	Vapam HL	50-75 gal	Apply by chemigation. Waiting period required.
	K-Pam HL	40-60 gal	
	Telone II Telone C-17 Telone C-35	27-35 gal 32.4-42 gal 39-50 gal	Waiting period of 1 week for every 10 gal applied.
Citrus	Nemacur 3	1.66-2.5 gal	Band and incorporate either mechanically or with irrigation.
	Ditera DF	5-38 oz/1000 row	Pre-plant or post-plant.
Peach Nectarine	Nemacur 3	1.7-2.5 gal (band) 2 qt - 1 gal (low pressure irrigation)	Maximum of 2.5 gals per acre per season.
	Vydate L	2 gal	Apply in 20 gals of water and incorporate 4 to 8 inches. USE ON NON-BEARING TREES ONLY.
	Ditera DF	13-100 lb	Pre- or post-plant.

Nematode Control Fruit Crops

Table 1. Recommended nematicides, rates and restrictions for managing nematodes in fruit trees and small fruit crops

Crop	Product Choices ¹	Rate ²	Comments
Apple	Vydate L	2 gal	Apply in 20 gals of water and incorporate 4 to 8 inches. USE ON NON-BEARING TREES ONLY.
	Ditera DF	5-38 oz/1000 row	Pre- or post-plant.
Grapes	Nemacur 3	1-2 gal (band) 2 qt -1 gal (low pressure irrigation)	Apply in 10 gals of solution and incorporate mechanically or by irrigation. Maximum of 2.5 gals per acre per season.
	Ditera DF	5-38 oz/1000 row	Pre- or post-plant.
¹ Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied. ² Rates are the amount of formulation (product) per acre unless otherwise indicated.			

The nematode sections were revised December 2014 by Dr. C. Overstreet

Nematode Management

Home Gardens

Nematode Management in Home Vegetable Gardens

Root-knot and reniform nematodes cause problems on many vegetables grown in the home garden. Cultural practices and resistant varieties can reduce the amount of damage in the garden.

Cultural Practices

1. Plant early before nematodes become active in soil.
2. Rotate crops in the garden.
3. Rotate the garden site each year.
4. Add organic matter to the soil in the form of green manures or mulches to stimulate natural enemies of nematodes and improve growing conditions within the soil for plants.
5. Use fallow plowing during parts of the summer to reduce nematode levels.
6. Keep the garden clean of weeds and grasses, which serve as natural hosts for nematodes.
7. Keep soil fertility levels high, and have the soil pH in the correct range for your soil type.
8. Provide extra water during prolonged dry spells.
9. Remove crops immediately after they are through producing, especially the roots.
10. Most of the marigolds (except Signet types) are effective trap crops against root-knot nematodes. Plant the marigolds solid for at least 2 to 3 months and then plant vegetables.

Resistant Varieties or Crops

- Root-knot nematode resistant varieties include:
 - **Tomatoes**
 - *Vine types*: Big Beef, Champion, Terrific, Better Boy;
 - *Bush types*: Celebrity, Crista, Fresh Plus; *Others*:, Muriel Roma, Small Fry
 - **Southern Peas**- Mississippi Silver, Mississippi Purple, and Magnolia
- Reniform nematode resistant crops include broccoli, cauliflower, corn, okra, onion, peanut, radish and turnip.

The nematode sections were revised December 2014 by Dr. C. Overstreet

Nematode Management Ornamentals

Table 1. Recommended nematicides, rates and restrictions for managing nematodes in field and commercial ornamentals

Crop	Product Choices ¹	Rate ²	Comments
Field or Commercial	Paladin	35-51.3 gal (broadcast)	Wait 21-42 days after treating before planting depending on soil temperature.
	Telone II	42-55 gal (Pre-plant, 2 weeks, broadcast)	FOLLOW MANUFACTURER'S INSTRUCTIONS.
	Telone C-17	50-66 gal	Wait at least 1 week for every 10 gals applied before planting.
	Telone C-35	60-79 gal	
	Ditera DF	5-38 oz/1000 row	Apply pre-plant, at plant or post plant. Multiple applications may be required.
	Vapam HL K-Pam HL	37-75 gal 30-60 gal	Tarping may be used to prevent fumigant escape.
	Pylon	5.2 – 10 fl oz/100 gal	For foliar nematode. Make first application at first signs of damage and second at 7-14 days.
	Mocap EC	2 qt (broadcast)	Incorporate 2-4 inches. Stock may be transplanted into the treated area after 72 hours. This is for field nursery stock only.

¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.

²Rates are the amount of formulation (product) per acre unless otherwise indicated.

The nematode sections were revised December 2013 by Dr. C. Overstreet.

Nematode Management Turfgrass

Table 1. Recommended nematicides, rates and restrictions for managing nematodes in turfgrasses

Time of Application	Nematicide ¹	Rate ²	Remarks
Pre-plant	Basamid G	11-13 oz/100 sq. feet	Follow label and observe waiting interval before planting.
Post-plant	Multiguard Protect	8 gal (initially) 5-8 gal (for maintenance)	After initial treatment, apply maintenance rates at 14-28 day intervals. Irrigate to a depth of 6 inches. Can be applied up to 6 applications.
	Avid	28.5 59 57 fl oz	Apply as an early curative treatment. Apply when grass is wet from dew or irrigation and water immediately with only 0.1 inch of water. Apply 3 to 4 consecutive applications on a 14-28 day interval.
	Nortica	30-100 lb	Make every 3 months as necessary and irrigate to 4-inch depth.
	Mustgrow Invest	10-20 lbs/1000 ft ²	Apply when grass is dry and water in immediately with 1 inch of water. Repeat every 4-6 weeks.
	Telone II	5-10 gal	Use on established turf for sod farms. Not for golf greens.

¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.

²Rates are the amount of formulation (product) per acre unless otherwise indicated.

The nematode sections were revised December 2014 by Dr. C. Overstreet.

Nematode Management Vegetables

Table 1. Recommended nematicides, rates and restrictions for managing nematodes in vegetable crops.

Crop	Product Choices¹	Rate²	Comments
Beans (Snap, lima)	Mocap 15G Mocap EC Mocap 15G Lock 'n Load	0.9-1.4 lbs/1000 row 2-3.9 oz/1000 row ft 0.9-1.4 lbs/1000 row	Apply in a 12 to 15 inch band.
Cabbage	Ditera DF	10-40 gal (broadcast)	Apply replant and/or in multiple applications.
	Mocap EC	2.4 oz/1000 row ft	Apply in a 15-inch band. Do not use a see furrow treatment or allow granules to contact the seed.
	Mocap 15G Mocap 15G Lock 'n Load	0.9 lb/1000 row ft	Apply in 12- to 15-inch band.
Carrots	Vydate L	1-2 gal (in-furrow)	Use a minimum of 20 gallons of water and incorporate.
Cole crops (broccoli, cabbage, cauliflower)	Ditera DF	5-38.4 oz/1000 ft ²	Apply pre-plant and incorporate.
Cucumbers	Mocap 15G	13 lb	Apply in a 12- to 15-inch band across the row. Mix with the top 2 inches of soil.
Cucurbits (cucumbers, melons, squash, pumpkins, etc.)	Nimitz	3-5 pt (7 days pre-plant)	Apply as broadcast incorporated, banded and incorporated or by drip irrigation. Make no more than one application per crop.
	Vydate L	1-2 gal (broadcast)	Incorporate 2- to 4-inches
	Vydate L	2-4 pt	Foliar spray 2- to 4-weeks after planting and 2- to 3-weeks after first spray.
	Paladin	37-54.2 gal/a broadcast	Apply preplant and observe waiting period of 21-42 days before planting based on temperature.
Eggplant	Nimitz	3-5 pt (7 days pre-plant)	Apply as broadcast incorporated, banded and incorporated or by drip irrigation. Make no more than one application per crop.
	Vydate L	1 gal (in band) 4 pt (foliar)	Apply in a band 2- to 3-weeks after transplanting and again 4-weeks later.
	Nemacur 3	2.66 qt	Apply in a 12-inch band and incorporate.

Nematode Management Vegetables

Table 1. Recommended nematicides, rates and restrictions for managing nematodes in vegetable crops.			
Crop	Product Choices¹	Rate²	Comments
Irish Potatoes	Mocap 15G	1.4 lb/1000 row feet	Apply in a 12-inch band and incorporate. Avoid direct application in the seed furrow.
	Mocap EC	4.4 oz/1000 row ft	Same as above.
	Vydate L Vydate C-LV	1-2 gal 34-68 oz	Apply in-furrow with a minimum of 20 gallons of water
Okra	Nimitz	3-5 pt (7 days pre-plant)	Apply as broadcast incorporated, banded and incorporated or by drip irrigation. Make no more than one application per crop.
Pepper (bell and non-bell)	Nimitz	3-5 pt (7 days pre-plant)	Apply as broadcast incorporated, banded and incorporated or by drip irrigation. Make no more than one application per crop.
	Vydate L	2 pt (transplant water)	Add material to transplant water and use a minimum of 200 gallons of water.
		2-4 pt (foliar treatment)	Supplemental control after a labeled fumigant such as Telone, Vapam, or K-Pam.
	Paladin	35-51.3 gal (broadcast)	Follow label and waiting interval of 21-42 days after treating before planting based on soil temperature.
Sweet Corn	Counter 15G Lock 'n Load Counter 15G Smartbox Counter 20G	6-8 oz/1000 row ft 6-8 oz/1000 row ft 4.5-6.0 lb	Apply in-furrow
	Mocap 15G	12-16 oz/1000 row ft	Apply 12- to 15-inch band. Incorporate to 2 to 4 inches.
Tomatoes	Nimitz	3-5 pt (7 days pre-plant)	Apply as broadcast incorporated, banded and incorporated or by drip irrigation. Make no more than one application per crop.
	Vydate L	2-4 pt	Treat every 1 to 2 weeks throughout the season.
	Paladin	37-54.2 gal/a	Preplant treatment. Observe 21-42 day planting interval after treatment.

Nematode Management Vegetables

Table 1. Recommended nematicides, rates and restrictions for managing nematodes in vegetable crops.

Crop	Product Choices ¹	Rate ²	Comments
Vegetables (general)	Telone II Telone C-17	9-12 gal (broadcast) 10.8-17.1 gal (broadcast)	Apply 2 to 3 weeks prior to planting.
	Telone EC	9-18 gal (broadcast)	Use with drip irrigation and reduce rate to match row width
	Telone C-35	13-20.5 gal (broadcast)	Inject 12-14" beneath the row
	Vapam HL K-Pam HL	37.5- 75 gal 30-60 gal	Inject and tarp. Inject and tarp for best results.

¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.

²Rates are the amount of formulation (product) per acre unless otherwise indicated.

The nematode section for vegetables was revised December 2014 by Drs. C. Overstreet and M. L. Lewis Ivey.

Seed Treatments Field Crops

Seed Treatments for Field Crops

Seed treatments are the cheapest potential way a grower can try to ensure desirable crop stands. Although seed treatment will not make poor seed germinate, when the correct treatment is used on certified seed, it may prevent or reduce seed decay, seedling blights, and other diseases. Seed treatments may act in two ways: 1) They may reduce parasites on the seed, and 2) they may help protect the seed and seedlings from pathogenic organisms in the soil. **Never use treated seed for food, feed, or oil purposes.** The following table lists labeled fungicide seed treatments in most crops grown in Louisiana. Some seed treatments containing insecticides or nematicides may not be listed. Hopper box, chemical box, and in-furrow spray products are not included in this table. **Always refer to product labels for rate and use information.**

Seed Treatments Field Crops

Table 1. Fungicide and biocontrol seed treatments for field crops

BC indicates bicontrol seed treatments

Product Name ¹	Company	Active Ingredient	FRAC Code ²	Crop (Rate fl oz/cwt)	Pathogens/Diseases Targeted
ACCELERON DT-510	Monsanto	myclobutanil	3	Cotton (1.25-4)	<i>Rhizoctonia solani</i> , <i>Thielaviopsis basicola</i> , <i>Pythium</i>
ACCELERON DX-109	Monsanto	pyraclostrobin	11	Cotton (1.5-3) Soybean (0.4-1.5)	<i>Pythium</i> , <i>Fusarium</i> , <i>Phomopsis</i> , <i>Rhizoctonia</i>
ACCELERON DX-309	Monsanto	metalaxyl	4	Cotton, Soybean, Corn (0.75-1.5)	<i>Pythium</i> seed rot, damping-off, <i>Phytophthora</i> (soybean), and systemic downy mildew (corn)
ACCELERON DX-509	Monsanto	ipconazole	3	Cotton (0.085-0.34) Corn (0.085)	<i>Rhizoctonia</i> , <i>Fusarium</i> , <i>Phomopsis</i>
ACCELERON DX-612	Monsanto	fluxapyroxad	7	Cotton (0.47-0.94) Soybean (0.24-0.47)	<i>Rhizoctonia solani</i> and <i>Fusarium</i>
ACCELERON DX-709	Monsanto	trifloxystrobin	11	Cotton, Corn (0.32-0.64)	<i>Alternaria</i> , <i>Aspergillus</i> , <i>Cladosporium</i> , <i>Penicillium</i> , <i>Rhizoctonia solani</i> , and <i>Fusarium</i>
ACQUIRE	BASF	metalaxyl	4	Cotton, Soybean (0.75-1.5), Sorghum (0.375-1.5), Corn (0.75-3.0), Peanut, Wheat (0.10-0.375)	<i>Pythium</i> , <i>Phytophthora</i>
ACTINOVATE AG ^{BC}	Novozymes BioAg	<i>Streptomyces lydicus</i> WYEC 108	n/a	Cotton, Corn, Peanut, Soybean, Sorghum, Wheat (2-6 oz)	<i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Pythium</i> , <i>Phytophthora</i> , <i>Xanthomonas perforans</i> , <i>Verticillium</i> , <i>Botrytis</i> , <i>Sclerotinia</i> , <i>Monilinia</i> , <i>Alternaria</i> , <i>Erwinia</i>
ALLEGIANCE FL	Bayer	metalaxyl	4	Peanut (0.75) Sorghum (0.375-3.0) Wheat, Corn (0.1-0.375) Soybean, Cotton (0.75-1.5)	<i>Pythium</i> seed rot, damping-off, <i>Phytophthora</i> (soybean), and systemic downy mildew (corn, sorghum, wheat)
ALLEGIANCE LS	Bayer	metalaxyl	4	Cotton, Soybean, Peanut (1.2-2.4), Sorghum (0.66-2.4), Wheat, Corn (1.2)	<i>Pythium</i> seed rot, damping-off, <i>Phytophthora</i> (soybean), and systemic downy mildew (corn, sorghum, wheat)

Seed Treatments Field Crops

Table 1. Fungicide and biocontrol seed treatments for field crops

BC indicates biocontrol seed treatments

Product Name ¹	Company	Active Ingredient	FRAC Code ²	Crop (Rate fl oz/cwt)	Pathogens/Diseases Targeted
APRON MAXX RFC	Syngenta	fludioxonil; mefenoxam	12 4	Soybean (1.5)	<i>Pythium</i> , <i>Phytophthora</i> , <i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Phytophthora</i> root rot
APRON MAXX RTA	Syngenta	fludioxonil; mefenoxam	12 4	Soybean (5.0)	<i>Pythium</i> , <i>Phytophthora</i> , <i>Fusarium</i> , <i>Rhizoctonia</i> , (Suppression: <i>Sclerotinia</i> , <i>Phomopsis</i>)
APRON MAXX RTA + MOLY	Syngenta	fludioxonil; mefenoxam	12 4	Soybean (5.0)	<i>Pythium</i> , <i>Phytophthora</i> , <i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Phytophthora</i> root rot, (Suppression: <i>Sclerotinia</i> , <i>Phomopsis</i>)
APRON XL	Syngenta	mefenoxam	4	Wheat, Cotton, Sorghum (0.32- 0.64), Corn (0.32-2.2), Peanut, Soybean (0.16-0.64)	<i>Pythium</i> and <i>Phytophthora</i>
BAYTAN 30 FF	Bayer	triadimenol	3	Wheat (0.75-1.5) Corn (3.0) Cotton (1.0-3.0)	Stinking smut, flag smut, loose smut, glume blotch, foot rot, take-all, head smut, powdery mildew, leaf rust, stripe rust, <i>Rhizoctonia</i> , <i>Thielaviopsis basicola</i>
BEAN GUARD/ALLEGIANCE	Chemtura	captan carboxin metalaxyl	M4 7 4	Soybean (3.33)	<i>Pythium</i> , <i>Rhizoctonia</i> , <i>Fusarium</i> , <i>Helminthosporium</i>
BELMONT 2.7 FS	Chemtura	metalaxyl	4	Cotton, Wheat, Soybean (0.75- 1.5), Corn (0.75-3.0), Peanut (0.75), Sorghum (0.375-3.0)	<i>Pythium</i> and <i>Phytophthora</i> , systemic downy mildew (corn)
CHARTER F2	BASF	metalaxyl triticonazole	4 3	Wheat (5.4)	<i>Tilletia caries</i> , <i>Urocystis agropyri</i> , <i>Fusarium</i> , <i>Ustilago nuda</i> var. <i>tritici</i> (Suppressed: <i>Cochliobolus</i> , <i>Penicillium</i> , <i>Fusarium</i> , <i>Rhizoctonia solani</i>)
CHARTER FUNGICIDE	BASF	triticonazole	3	Wheat (3.1)	<i>Tilletia caries</i> , <i>Urocystis agropyri</i> , <i>Fusarium</i> , <i>Ustilago nuda</i> var. <i>tritici</i> (Suppressed: <i>Cochliobolus</i> , <i>Penicillium</i> , <i>Fusarium</i> , <i>Rhizoctonia solani</i>)
CRUISER VIBRANCE QUATTRO	Syngenta	difenoconazole fludioxonil	3 12	Wheat (5.0)	General seed rots, <i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Pythium</i> , <i>Septoria</i> , <i>Fusarium</i>

Seed Treatments Field Crops

Table 1. Fungicide and biocontrol seed treatments for field crops

BC indicates biocontrol seed treatments

Product Name ¹	Company	Active Ingredient	FRAC		Crop (Rate fl oz/cwt)	Pathogens/Diseases Targeted
			Code ²	Code ²		
		mefenoxam	4			seed scab, common bunt, karnal bunt, loose smut, <i>Pythium</i> damping off, <i>Cochliobolus</i>
		sedaxane	7			
		thiamethoxam	4A			
DITHANE-F45 RAINSIELD	Dow	mancozeb	M3		Corn (4.3-8.6) Cotton (4.8) Peanut (12.8-25.6) Sorghum (4.3-7.2)	Damping-off, seed rots, seed blights, covered kernel smut (sorghum)
DITHANE-M45	Dow	mancozeb	M3		Corn (2.7-5.4) Cotton (3-6) Peanut (8.0-16.0) Sorghum (2.7-4.5) Wheat (2.2-3.3)	Damping-off, seed rots, seed blights, covered kernel smut (sorghum), bunt (wheat)
DIVIDEND EXTREME	Syngenta	difenoconazole	3		Cotton (2.0-5.8)	Cotton: <i>Rhizoctonia</i> , <i>Fusarium</i> , <i>Pythium</i>
		mefenoxam	4		Wheat (1.0-4.0)	Wheat: common bunt, loose smut, dwarf bunt, karnal bunt, flag smut, seed-borne <i>Septoria</i> , general seed rots, <i>Fusarium</i> seed scab, <i>Pythium</i> damping-off.
DIVIDEND XL RTA	Syngenta	difenoconazole	3		Wheat (2.5-10.0)	Common bunt, loose smut, dwarf bunt, flag smut, seed-borne <i>Septoria</i> , general seed rots, <i>Fusarium</i> seed scab, <i>Pythium</i> damping off, powdery mildew, leaf rust, <i>Septoria</i> leaf blotch, <i>Cochliobolus</i> , <i>Fusarium</i> root rot, <i>Fusarium</i> crown rot, take-all, <i>Rhizoctonia</i> root rot,
		mefenoxam	4			
DYNA-SHIELD FLUDIOXONIL	Loveland	fludioxonil	12		Corn, Sorghum, Wheat, Cotton, Soybean, Peanut (0.08-0.16)	Decay, damping-off, and seedling blight
DYNA-SHIELD FOOTHOLD	Loveland	metalaxyl	4		Wheat (5.0-6.5)	Stinking smut, flag smut, loose smut, <i>Septoria</i> disease complex, general seed rots, <i>Pythium</i> , <i>Rhizoctonia</i> , common root rots, <i>Fusarium</i> scab, <i>Fusarium</i> foot
		tebuconazole	3			

Seed Treatments Field Crops

Table 1. Fungicide and biocontrol seed treatments for field crops

BC indicates biocontrol seed treatments

Product Name ¹	Company	Active Ingredient	FRAC		Crop (Rate fl oz/cwt)	Pathogens/Diseases Targeted
			Code ²	Code ²		
DYNA-SHIELD FOOTHOLD EXTRA	Loveland	imidacloprid	4A		Wheat (3.4-5.0)	rot, powdery mildew, rust
		metalaxyl	4			<i>Pythium</i> , stinking smut, loose smut, <i>Septoria</i> , <i>Rhizoctonia</i> root rot, common root rot, <i>Fusarium</i> foot rot, powdery mildew, leaf rust
		tebuconazole	3			
DYNA-SHIELD SMALL GRAINS	Loveland	metalaxyl	4		Wheat (5-6.5)	Stinking smut, flag smut, loose smut, <i>Septoria</i> , general seed rots, <i>Pythium</i> damping-off, <i>Rhizoctonia</i> root rot, common root rot, <i>Fusarium</i> scab, <i>Fusarium</i> foot rot, powdery mildew and rust
		tebuconazole	3			
DYNASTY	Syngenta	azoxystrobin	11		Corn (0.153)	<i>Sphacelotheca reiliana</i> , <i>Rhizoctonia</i> , <i>Penicillium</i> , <i>Pythium</i> ,
					Sorghum (0.308-3.08)	<i>Peronosclerospora sorghi</i> (sorghum),
					Soybean (0.153-0.459)	<i>Sclerotium rolfsii</i> (soybean),
					Wheat (0.153-0.382)	Wheat: common bunt, dwarf bunt
DYNASTY CST	Syngenta	azoxystrobin	11		Cotton (3.1-3.95)	<i>Rhizoctonia solani</i> , <i>Pythium</i> , <i>Fusarium</i>
			12			
ENHANCE	Chemtura	captan carboxin	M4		Soybean (5.0)	<i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Pythium</i> , <i>Tilletia caries</i> , <i>T. foetida</i> , <i>Ustilago nuda</i> , <i>U. kolleri</i> , <i>U. avenae</i> , <i>U. hordei</i>
			7		Wheat (4.0)	
EVERGOL ENERGY	Bayer	metalaxyl penflufen prothioconazole	4		Wheat (1.0)	Common bunt, covered smut, False
			7		Corn (0.5-2.0)	loose smut, flag smut, leaf strip, loose
			3			smut, stinking smut, Stem smut, true loose smut, <i>Rhizoctonia</i> , <i>Fusarium</i> , <i>Cochliobolus</i> , <i>Pythium</i> , <i>Fusarium</i> , common root rot, foot rot, Crown rot, rust, <i>Septoria</i> and powdery mildew
INCENTIVE RTA	Winfield	difenoconazole mefenoxam	3		Wheat (2.5-10.0)	Common bunt, loose smut, dwarf bunt, flag smut, seed-borne <i>Septoria</i> , general
			4			

Seed Treatments Field Crops

Table 1. Fungicide and biocontrol seed treatments for field crops

BC indicates biocontrol seed treatments

Product Name ¹	Company	Active Ingredient	FRAC Code ²	Crop (Rate fl oz/cwt)	Pathogens/Diseases Targeted
INOVATE SEED PROTECTANT	Valent	clothianidin ipconazole metalaxyl	4A 3 4	Soybean (4.74)	seed rots, <i>Fusarium</i> seed scab, <i>Pythium</i> damping-off, <i>Cochliobolus</i> , <i>Rhizoctonia</i> root rot, <i>Fusarium</i> root rot, Take-all, <i>Rhizoctonia</i> root rot
KODIAK HB ^{BC}	Chemtura	<i>Bacillus subtilis</i> strain GBO3	n/a	Cotton, Sorghum, Soybean, Wheat (4.0-8.0), Peanut (2.0-4.0), Corn (4.0)	<i>Phomopsis</i> , <i>Sclerotinia</i> , <i>Fusarium</i> , <i>Penicillium</i> , <i>Aspergillus</i> , <i>Pythium</i> , <i>Rhizoctonia solani</i>
MANKOCIDE	DuPont	copper hydroxide mancozeb	M1 M3	Wheat (4.0)	<i>Pseudomonas syringae</i> , <i>Xanthomonas translucens</i> , <i>Tilletia caries</i>
MANZATE FLOWABLE FUNGICIDE	UPI	mancozeb	M3	Corn (4.3-8.6) Cotton (4.8-5.1) Peanut (12.8-25.6) Sorghum (4.3-7.2) Wheat (3.5-5.2)	Damping-off, seed rot, seedling blights, covered kernel smut, bunt, covered smut
MANZATE MAX	UPI	mancozeb	M3	Corn (4.3-8.6) Cotton (4.8) Peanut (12.8-25.6) Sorghum (4.3-7.2)	Damping-off, seed rots, seedling blight, covered kernel smut (sorghum)
MANZATE PRO-STICK	UPI	mancozeb	M3	Corn (2.7-5.4) Cotton (3.0) Peanut (8.0-16.0) Sorghum (2.7-4.5) Wheat (2.2-3.3)	Damping-off, seed rot, seedling blights, covered kernel smut, bunt, covered smut
MAXIM 4FS	Syngenta	fludioxonil	12	Corn, Sorghum, Wheat, Cotton, Soybean, Peanut (0.08-0.16)	Seed decay, damping-off, seedling blights <i>Sphacelotheca reiliana</i> , <i>Pythium</i>

Seed Treatments Field Crops

Table 1. Fungicide and biocontrol seed treatments for field crops

BC indicates biocontrol seed treatments

Product Name ¹	Company	Active Ingredient	FRAC Code ²	Crop (Rate fl oz/cwt)	Pathogens/Diseases Targeted
MAXIM QUATTRO	Syngenta	azoxystrobin	11	Corn (0.39-0.53 fl oz/80000 kernel)	<i>Sporisorium reilianum</i> , <i>Rhizoctonia</i> , <i>Penicillium</i> , <i>Pythium</i> , <i>Fusarium</i>
		fludioxonil	12		
		mefenoxam	4		
		thiabendazole	1		
MAXIM XL	Syngenta	fludioxonil	12	All Crops (0.167-0.334)	<i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Pythium</i> , <i>Aspergillus</i> , <i>Penicillium</i> , downy mildew
METASTAR 2E	LG Life Sciences	mefenoxam	4		<i>Pythium</i> damping-off, <i>Phytophthora</i>
MERTECT 340-F	Syngenta	thiabendazole	1	Wheat (1.3-2.6)	Common bunt, <i>Fusarium</i> scab, dwarf bunt, <i>Phomopsis</i>
			4	Soybean (0.08-0.16)	
METASTAR ST SEED TREATMENT	LG Life Sciences	metalaxyl	4	Cotton, Soybean, Wheat (0.75 - 15), Peanut (0.75)	<i>Pythium</i> seed rot, damping-off, <i>Phytophthora</i> , systemic downy mildew
			4	Sorghum (0.375-3.0), Corn (0.75-3.0)	
			M3	Corn (2.9-5.8)	
			M3	Cotton (3.2-6.4)	
PENNZOZEB 75DF	UPI	mancozeb	4	Peanut (8.5-17.1)	Damping off, seed rots, seedling blights, covered kernel smut, bunt
			4	Sorghum (2.9-4.8)	
			4	Wheat (2.3-3.5)	
			M3	Corn (2.7-5.4)	
PENNZOZEB 80WP	UPI	mancozeb	M3	Cotton (3.0-6.0)	Damping off, seed rots, seedling blights, covered kernel smut, bunt
			M3	Peanut (8.0-16.0)	
			M3	Sorghum (2.7-4.5)	
			M3	Wheat (2.2-3.3)	
PROCEED CONCENTRATE	Bayer	metalaxyl	4	Wheat (1.0-1.5)	Stinking smut, flag smut, loose smut, covered smut, <i>Septoria</i> disease complex, seed rots, <i>Pythium</i> damping off, <i>Rhizoctonia</i> root rot, <i>Fusarium</i> scab, <i>Fusarium</i> foot rot (Suppression: powdery mildew, rust)
		prothioconazole	3		
		tebuconazole	3		

Seed Treatments Field Crops

Table 1. Fungicide and biocontrol seed treatments for field crops

BC indicates bicontrol seed treatments

Product Name ¹	Company	Active Ingredient	FRAC		Pathogens/Diseases Targeted
			Code ²	Crop (Rate fl oz/cwt)	
PROCEED MD	Bayer	metalaxyl	4	Wheat (5.0-7.5)	Stinking smut, flag smut, loose smut, covered smut, <i>Septoria</i> disease complex, seed rots, <i>Pythium</i> damping off, <i>Rhizoctonia</i> root rot, <i>Fusarium</i> scab, <i>Fusarium</i> foot rot (Suppression: powdery mildew, rust)
		prothioconazole	3		
		tebuconazole	3		
RANCONA 3-8 FS	Chemtura	ipconazole	3	Wheat (0.051-0.085), Soybean (0.085)	<i>Aspergillus</i> , <i>Penicillium</i> , <i>Fusarium</i> , <i>Cochliobolus sativus</i> , <i>Rhizoctonia</i> , <i>Ustilago tritici</i> , <i>Tilletia caries</i> , <i>T. foetida</i> (Suppressed: <i>Cochliobolus sativus</i> , <i>Fusarium</i>) Soybean: <i>Diaporthe (Phomopsis)</i> , <i>Botrytis</i> , <i>Sclerotinia</i>
			4A	Wheat (5.0-8.33)	
RANCONA CREST	Chemtura	imidacloprid	4A	Wheat (5.0-8.33)	<i>Penicillium</i> , <i>Aspergillus</i> , <i>Fusarium</i> , <i>Pythium</i> , <i>Cochliobolus sativus</i> , <i>Ustilago tritici</i> , <i>Tilletia caries</i> , <i>T. foetida</i> , <i>Rhizoctonia</i> , (Suppressed: <i>Cochliobolus sativus</i> , <i>Fusarium</i>)
		ipconazole	3		
		metalaxyl	4		
RANCONA CREST WR	Chemtura	imidacloprid	3	Wheat (5.0-8.33)	<i>Penicillium</i> , <i>Aspergillus</i> , <i>Fusarium</i> , <i>Pythium</i> , <i>Cochliobolus sativus</i> , <i>Ustilago tritici</i> , <i>Tilletia caries</i> , <i>T. foetida</i> , <i>Rhizoctonia</i> , Suppressed: <i>Cochliobolus sativus</i> , <i>Fusarium</i>
		ipconazole	4		
		metalaxyl			
RANCONA CTS	Chemtura	ipconazole	3	Soybean, Sorghum (1.53)	<i>Fusarium</i> , <i>Rhizoctonia solani</i> , <i>Penicillium</i> , <i>Aspergillus</i> , <i>Phomopsis (Diaporthe)</i> , <i>Botrytis</i> , <i>Sclerotinia</i> (Suppressed: <i>Pythium</i> seed rot, damping off, seedling blight), <i>Fusarium</i> , <i>Cochliobolus sativus</i> , <i>Ustilago tritici</i> , <i>Tilletia caries</i> , <i>T. foetida</i> , <i>Rhizoctonia</i>
		metalaxyl	4	Wheat (0.92-1.53)	

Seed Treatments Field Crops

Table 1. Fungicide and biocontrol seed treatments for field crops

BC indicates biocontrol seed treatments

Product Name ¹	Company	Active Ingredient	FRAC		Crop (Rate fl oz/cwt)	Pathogens/Diseases Targeted
			Code ²	Code ²		
RANCONA PINNACLE	Chemtura	ipconazole	3		Wheat (5.0-8.33)	<i>Penicillium</i> , <i>Aspergillus</i> , <i>Fusarium</i> ,
		metalaxyl	4			<i>Pythium</i> , <i>Cochliobolus sativus</i> , <i>Tilletia caries</i> , <i>T. foetida</i> , <i>Rhizoctonia</i>
RANCONA SUMMIT	Chemtura	ipconazole	3		Soybean (4.0)	<i>Fusarium</i> , <i>Sclerotinia</i> , <i>Diaporthe</i>
		metalaxyl	4			(<i>Phomopsis</i>), <i>Rhizoctonia solani</i> , <i>Pythium</i> ,
RANCONA V 100 PRO FS	Chemtura	carboxin	7		Wheat (0.9-1.5)	<i>Aspergillus</i> , <i>Penicillium</i> , <i>Fusarium</i> ,
		ipconazole	3		Corn, Soybean (1.5)	<i>Cochliobolus sativa</i> , <i>Rhizoctonia solani</i> , <i>Ustilago tritici</i> , <i>Tilletia caries</i> , <i>T. foetida</i> , <i>Septoria</i> , <i>Sclerotinia</i>
RANCONA XXTRA	Chemtura	ipconazole	3		Soybean (3.5)	<i>Fusarium</i> , <i>Sclerotinia</i> , <i>Rhizoctonia solani</i> ,
		metalaxyl	4			<i>Pythium</i> , <i>Phomopsis</i> , <i>Penicillium</i> , <i>Aspergillus</i>
RAXIL MID	Bayer	metalaxyl	4		Wheat (5.0-6.5)	Stink smut, flag smut, loose smut,
		tebuconazole	3			<i>Septoria</i> , common rot, <i>Fusarium</i> scab, <i>Fusarium</i> foot rot, powdery mildew, rust
RAXIL MID EXTRA	Bayer	imazalil	3		Wheat (5.0)	Stink smut, flag smut, loose smut,
		metalaxyl	4			<i>Septoria</i> , common rot, <i>Fusarium</i> scab,
		tebuconazole	3			<i>Fusarium</i> foot rot, powdery mildew, rust, <i>Pythium</i> damping off, general seed rot, leaf rust, barley stripe
RAXIL PRO MD	Bayer	metalaxyl	4		Wheat (5.0-7.5)	Stink smut, flag smut, loose smut,
		prothioconazole	3			<i>Septoria</i> , common rot, <i>Fusarium</i> scab,
		tebuconazole	3			<i>Fusarium</i> foot rot, powdery mildew, rust, <i>Pythium</i> damping off, general seed rot, leaf rust, barley stripe
RIZOLEX	Valent	Tolclofos-methyl	14		Soybean, Corn, Sorghum (0.3), Cotton (1.5)	<i>Rhizoctonia solani</i> , <i>Fusarium</i> , other Deuteromycete fungi causing seed decay and seedling blights.
SEBRING 318 FS	Nufarm	metalaxyl	4		Cotton, Soybean (0.75-1.5), Corn, Wheat, Peanut (0.75), Sorghum (0.75-3.0)	<i>Pythium</i> , systemic downy mildew (corn, sorghum, wheat), <i>Phytophthora</i> (soybean)

Seed Treatments Field Crops

Table 1. Fungicide and biocontrol seed treatments for field crops

BC indicates biocontrol seed treatments

Product Name ¹	Company	Active Ingredient	FRAC Code ²	Crop (Rate fl oz/cwt)	Pathogens/Diseases Targeted
SEBRING 480 FS	Nufarm	metalaxyl	4	Cotton, Soybean (0.5-1.0) Peanut, Corn, Wheat (0.5), Sorghum (0.25-2.0)	<i>Pythium</i> , systemic downy mildew, <i>Phytophthora</i> (soybean)
SEED SHIELD	Helena	azoxystrobin	11	Cotton (4.0)	<i>Rhizoctonia solani</i> , <i>Pythium</i> , <i>Fusarium</i>
		difenoconazole	3		
		fludioxonil	12		
		mefenoxam	4		
SEED SHIELD BEANS	Helena	azoxystrobin	11	Soybean (3.0)	<i>Pythium</i> , <i>Phytophthora</i> , <i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Phytophthora</i> root rot, (Suppression: <i>Sclerotinia</i> , <i>Phomopsis</i>)
		fludioxonil	12		
		mefenoxam	4		
		thiamethoxam	4A		
SEED SHIELD SOYBEAN	Helena	azoxystrobin	11	Soybean (3.0)	<i>Pythium</i> , <i>Phytophthora</i> , <i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Phytophthora</i> root rot, (Suppression: <i>Sclerotinia</i> , <i>Phomopsis</i>)
		fludioxonil	12		
		mefenoxam	4		
		thiamethoxam	4A		
SIGNET 480 FS	Nufarm	thiram	M3	Corn (2.67) Cotton (4.5) Peanut (3.0) Soybean (2.0) Wheat (3.3) Sorghum (3.57)	Seed decay, damping-off, and seedling blight, bunt, <i>Claviceps africana</i>
SPERA 240 FS	Nufarm	myclobutanil	3	Cotton (1.25-4.0)	<i>Rhizoctonia solani</i> , <i>Thielaviopsis basicola</i> , <i>Pythium</i>
SPIRATO 480 FS	Nufarm	fludioxonil	12	Corn, Sorghum, Wheat, Cotton, Soybeans, Peanut (0.08-0.16)	Decay, damping off, and seedling blight, <i>Pythium</i>
STAMINA	BASF	pyraclostrobin	11	Corn, Wheat (0.4-0.8) Peanut, Soybean (0.4-1.5) Sorghum (0.8-1.5)	<i>Rhizoctonia solani</i> , <i>Penicillium oxalicum</i> , <i>Penicillium</i> (Suppression: <i>Aspergillus</i> , <i>Fusarium</i> , <i>Pythium</i> , <i>Tilletia caries</i> , <i>Bipolaris sorokiniana</i>)

Seed Treatments Field Crops

Table 1. Fungicide and biocontrol seed treatments for field crops

BC indicates biocontrol seed treatments

Product Name ¹	Company	Active Ingredient	FRAC		Pathogens/Diseases Targeted
			Code ²	Crop (Rate fl oz/cwt)	
STAMINA F3 CEREALS	BASF	metalaxyl	4	Wheat (4.6)	<i>Tilletia caries</i> , <i>Cochliobolus</i> , <i>Penicillium</i> , <i>Urocystis agropyri</i> , <i>Fusarium</i> , <i>Ustilago nuda</i> var. <i>tritici</i> , <i>Pythium</i> , <i>Rhizoctonia solani</i>
		pyraclostrobin	11		
		triticonazole	3		
SYSTIVA XS	BASF	fluxapyroxad	7	Soybean, Wheat (0.24-0.47)	<i>Rhizoctonia solani</i> , <i>Fusarium solani</i> , (Suppression: <i>Blumeria graminis</i> , <i>Puccinia recondita</i> , <i>Septoria tritici</i> , <i>Cephalosporium gramineum</i> , <i>Fusarium</i>)
SYSTEM 3 SEED TREATMENT ^{BC}	Helena	<i>Bacillus subtilis</i> (strain GBO3) metalaxyl PCNB	4	Cotton (2.0)	<i>Pythium</i> , <i>Rhizoctonia</i> , seedling disease complex, common smut or bunt, <i>Pythium</i> , <i>Rhizoctonia</i> , seedling Disease Complex, Early Season <i>Phytophthora</i>
			14	Peanut (4.0-6.0)	
				Corn (3.57-5.36)	
				Soybean, Wheat (3.33-5.0)	
TEBUCON 3.6F	Repar	tebuconazole	3	Corn (0.071-0.54)	<i>Fusarium</i> and <i>Sphacelotheca reiliana</i>
TEBUZOL 3.6F	UPI	tebuconazole	3	Corn (0.071-0.54)	<i>Fusarium</i> , <i>Sphacelotheca reiliana</i>
TOLEDO	Rotam	tebuconazole	3	Corn (0.055-0.54)	<i>Fusarium</i> , <i>Sphacelotheca reiliana</i>
TOP COP WITH SULFUR	Stoller	tribasic copper sulfate sulfur	M1	Cotton, Soybean (8.0-12.0)	Damping-off, seedling diseases
			M2		
TRIO EXTRA	Loveland	azoxystrobin fludioxonil mefenoxam	11	Cotton (3.5)	<i>Rhizoctonia solani</i> , <i>Pythium</i> , <i>Fusarium</i>
			12		
			4		
TRILEX 2000	Bayer	metalaxyl trifloxystrobin	4	Corn (0.5)	<i>Alternaria</i> , <i>Aspergillus</i> , <i>Cladosporium</i> , <i>Penicillium</i> , <i>Rhizoctonia solani</i> , <i>Fusarium</i> , <i>Pythium</i> (Suppression: <i>Phytophthora</i>)
			11	Cotton (2.0) Soybean (1.0)	
TRILEX FLOWABLE	Bayer	trifloxystrobin	11	Cotton, Corn, Sorghum, Peanut, Wheat (0.32-0.64), Soybean (0.32)	<i>Alternaria</i> , <i>Aspergillus</i> , <i>Cladosporium</i> , <i>Penicillium</i> , <i>Rhizoctonia solani</i> , <i>Fusarium</i>

Seed Treatments Field Crops

Table 1. Fungicide and biocontrol seed treatments for field crops

BC indicates biocontrol seed treatments

Product Name ¹	Company	Active Ingredient	FRAC Code ²	Crop (Rate fl oz/cwt)		Pathogens/Diseases Targeted
VIBRANCE	Syngenta	sedaxane	7	Soybean, Wheat (0.08-0.16), Sorghum (0.0008-0.0016 mg ai/seed), Corn (0.0063-0.0125 mg ai/seed)		<i>Rhizoctonia solani</i> , <i>Ustilago tritici</i>
VIBRANCE EXTREME	Syngenta	difenoconazole	3	Wheat (2.8-5.6)		<i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Pythium</i> , Septoria leaf blotch, common bunt, dwarf bunt, karnal bunt, flag smut, <i>Fusarium</i> seed scab, loose smut, <i>Pythium</i> damping off, (Suppressed: <i>Cochliobolus</i> , <i>Fusarium</i> crown and foot or root rot, Take-all
VIBRANCE QUATTRO	Syngenta	difenoconazole fludioxonil mefenoxam sedaxane	3 12 4 7	Wheat (5.0)		<i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Pythium</i> , Septoria leaf blotch, common bunt, dwarf bunt, karnal bunt, flag smut, <i>Fusarium</i> seed scab, loose smut, <i>Pythium</i> damping off, (Suppressed: <i>Cochliobolus</i> , <i>Fusarium</i> crown and foot or root rot, Take-all
VITAFLO-280	Chemtura	carboxin thiram	7 M3	Wheat (3.5-5.0) Soybean (4.0) Corn (4.5-11.0)		<i>Ustilago tritici</i> , <i>Tilletia caries</i> , <i>T. foetida</i> , <i>Fusarium</i> , <i>Cochliobolus sativus</i> , <i>Pythium</i> , <i>Aspergillus</i> , <i>Alternaria</i> , <i>Penicillium</i> , <i>Rhizoctonia</i> , <i>Phomopsis</i> , <i>Penicillium</i> , <i>Sphaelotheca reiliana</i>
WARDEN CEREALS HR	Winfield	imidacloprid ipconazole metalaxyl	4A 3 4	Wheat (5.0-8.33)		<i>Penicillium</i> , <i>Aspergillus</i> , <i>Fusarium</i> , <i>Pythium</i> , <i>Cochliobolus sativus</i> , <i>Ustilago tritici</i> , <i>Tilletia caries</i> , <i>T. foetida</i> , <i>Rhizoctonia</i> , (Suppression: <i>Cochliobolus sativus</i> , <i>Fusarium</i>)

Seed Treatments Field Crops

Table 1. Fungicide and biocontrol seed treatments for field crops

BC indicates bicontrol seed treatments

Product Name ¹	Company	Active Ingredient	FRAC		Crop (Rate fl oz/cwt)	Pathogens/Diseases Targeted
			Code ²			
WARDEN CEREALS WR	Winfield	imidacloprid	4A		Wheat (5.0-8.33)	<i>Penicillium</i> , <i>Aspergillus</i> , <i>Fusarium</i> ,
		ipconazole	3			<i>Pythium</i> , <i>Cochliobolus sativus</i> , <i>Ustilago</i>
		metalaxyl	4			<i>nuda</i> , <i>U. hordei</i> , <i>U. nigra</i> , <i>Rhizoctonia</i> , (Suppression: <i>Cochliobolus sativus</i> , <i>Fusarium</i> , <i>Pyrenophora graminea</i> .)
WARDEN RTA	Winfield	fludioxonil	12		Soybean (5.0)	<i>Pythium</i> , <i>Phytophthora</i> , <i>Fusarium</i> ,
		mefenoxam	4			<i>Rhizoctonia</i> , <i>Phytophthora</i> root rot, Suppression: <i>Sclerotinia</i> , <i>Phomopsis</i>
YIELD SHIELD BIOLOGICAL ^{BC}	Bayer	<i>Bacillus pumilus</i> GB34	n/a		Corn, Cotton, Peanut, Wheat, Soybean (0.1)	<i>Rhizoctonia</i> , <i>Fusarium</i>

¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.

²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).

The seed treatments for field crops section was revised December 2014 by Dr. T. Price, Ms. M. Purvis and Mr. H. Pruitt.

Seed Treatments

Vegetables

Seed Disinfestation and Protection

Bacterial, fungal and viral plant pathogens can be introduced into a crop on or within seeds. Generally, the earlier a pathogen comes into contact with the crop, the greater the potential for a disease problem to develop. Seed treatments are an effective means of preventing seedborne bacterial diseases and damping-off diseases. It is important to note that not all seed sanitizers are approved for organic vegetable production by the Organic Materials Review Institute (www.omri.org; 541-343-7600). Organic producers should verify that a seed treatment is OMRI approved prior to applying a seed treatment.

Seed sanitation to eradicate bacterial or viral plant pathogens – When treating vegetable seeds, it is critical to follow the directions exactly, because germination can be reduced by the treatment and/or the pathogen may not be completely eliminated. The effect of a treatment on germination should be determined on a small lot of seeds prior to treating large amounts of seed. Treatments should not be applied to: 1) pelleted seed, 2) previously treated seed, or 3) old or poor quality seed. A protective fungicide treatment (see below) can be applied to the seed following treatment for bacterial pathogens.

Seed treatments to prevent damping-off diseases – Most commercially available vegetable seeds come treated with at least one fungicide and/or insecticide. Vegetable producers who would like to apply their own seed treatment should purchase nontreated seed. While many fungicides are labeled for use on vegetable seed, most fungicides are restricted to commercial treatment only and should not be applied by producers. Labeled fungicides can be applied to seed following treatment for bacterial pathogens (see above). **Do not use fungicide treated seed for food or feed.**

Seed Disinfectants

Hot Water Treatment

By soaking seed in hot water, seedborne fungi and bacteria can be reduced, if not eradicated, from the seed coat. Hot water soaking will not kill pathogens associated with the embryo nor will it remove seedborne plant viruses from the seed surface.

1. Place seed loosely in a weighted cheesecloth or nylon bag.
2. Warm the seed by soaking it for 10 minutes in 100 degree Fahrenheit (37 Celsius) water.
3. Transfer the warmed seed into a water bath already heated to the temperature recommended for the vegetable seed being treated (Table 1). The seeds should be completely emerged in the water for the recommended amount of time (Table 1). Agitation of the water during the treatment process will help to maintain a uniform temperature in the water bath.
4. Transfer the hot water treated seed into a cold-water bath for five minutes to stop the heating action.
5. Remove seed from the cheesecloth or nylon bag and spread them evenly on clean paper towel or a sanitized drying screen to dry. Do not dry seed in areas where fungicides, pesticides or other chemicals are located.
6. Seed can be treated with a labeled fungicide to protect against damping-off pathogens.

Seed Treatments Vegetables

Table 1. Recommended temperatures and treatment times for hot water disinfestation of selected vegetable seeds.

Vegetable Crop	Water Temperature (°F/°C)	Soaking Time (minutes)
Broccoli	122/50	20-25
Brussels sprout	122/50	25
Cabbage	122/50	25
Carrot	122/50	15-20
Cauliflower	122/50	20
Celery	122/50	25
Chinese cabbage	122/50	20
Collard	122/50	20
Cucumber*	122/50	20
Eggplant	122/50	25
Garlic	120/49	20
Kale, Kohlrabi	122/50	20
Lettuce	118/48	30
Mint	112/44	10
Mustard, cress, radish	122/50	15
Onion	115/46	60
Pepper	125/51	30
Rape, rutabaga	122/50	20
Shallot	115/46	60
Spinach	122/50	25
Tomato	122/50	25
Turnip	122/50	20

*Cucurbits other than cucumbers can be severely damaged by hot water treatment and should be disinfested using chlorine bleach.

Seed Treatments

Vegetables

Chlorine Bleach Treatment

Treating seeds with a solution of chlorine bleach can effectively remove bacterial pathogens and some viruses (i.e. Tobacco Mosaic Virus) that are borne on the surface of seeds.

1. Add 1 quart (946 ml) of Clorox® bleach to 5 quarts (4.7 L) of potable water.
2. Add a drop or two of liquid dish detergent or a commercial surfactant such as Activator 90 or Silwet to the disinfectant solution.
3. Add seed to the disinfectant solution (1 pound of seed per 4 quarts of disinfectant solution) and agitate for 1 minute. Prepare fresh disinfectant solution for each batch of seeds to be treated.
4. Rinse the seed in a coldwater bath for 5 minutes to remove residual disinfectant.
5. Spread seeds evenly on clean papertowel or a sanitized drying screen to dry. Do not dry seed in area where fungicides, pesticides, or other chemicals are located.
6. Seed can be treated with a labeled fungicide to protect against damping-off pathogens.

Hydrochloric Acid Treatment

Tomato seed can be treated with a dilute solution of hydrochloric acid (HCl) solution to eliminate seedborne bacterial pathogens such as *Xanthomonas* spp. (Bacterial leaf spot), *Pseudomonas syringae* pv. *tomato* (Bacterial speck) and *Clavibacter michiganensis* subsp. *michiganensis* (Bacterial canker). Hydrochloric acid can also be used to remove TMV from the surface of tomato seed. **Do not use HCL treated seed for food or animal feed.**

1. Prepare a 5% solution of HCl by adding one part acid to 19 parts potable water. Prepare the acid solution in a well ventilated area and avoid direct skin contact with the acid.
2. Soak seeds for 6 hours with gentle agitation.
3. Carefully drain the acid off of the seed and rinse seed under running potable water for 30 minutes. Alternatively, rinse the seeds 10-12 times with potable water to remove residual acid.
4. Spread seeds evenly on clean papertowel or a sanitized drying screen to dry. Do not dry seed in area where fungicides, pesticides, or other chemicals are located.
5. Seed can be treated with a labeled fungicide to protect against damping-off pathogens.

Trisodium Phosphate Treatment

Tomato seed can be treated with trisodium phosphate (TSP) to eradicate seed-transmitted TMV. **Do not use trisodium phosphate treated seed for food or animal feed.**

1. Prepare a 10% solution of TSP (1 part TSP in 9 parts potable water). Trisodium phosphate is available at most home supply or paint stores. Avoid direct skin contact with the TSP solution.
2. Soak seed for 15 minutes in the disinfectant solution.
3. Rinse the seed in a coldwater bath for 5 minutes to remove residual disinfectant.
4. Spread seeds evenly on clean papertowel or a sanitized drying screen to dry. Do not dry seed in area where fungicides, pesticides, or other chemicals are located.
5. Seed can be treated with a labeled fungicide to protect against damping-off pathogens.

Procedure for Testing Seed Germination After Sanitation with Hot Water, Chlorine Bleach or Hydrochloric Acid

1. Randomly select 100 seeds from each seed lot.
2. Treat 50 seeds using one of the sanitizers described above.

Seed Treatments Vegetables

3. After the treated seed has dried and **before** application of a protectant fungicide, plant the treated and non-treated seed separately in flats containing planting mix according to standard practice. Label each group as treated or non-treated.
4. Allow the seeds to germinate and grow until the first true leaf appears (to allow for differences in germination rates to be observed).
5. Count seedlings in each group separately.
6. Determine the percent germination for each group: $\# \text{ seedlings emerged} \div \# \text{ seeds planted} \times 100$.
7. Compare percent germination between the treated and non-treated groups. Percent germination should be within 5% of each other.

Seed Protectants

Fungicide label registrations are always changing, thus the information provided in this publication may become invalid at anytime. Always read the entire, most recent label carefully and follow all directions and restrictions before using one of the recommended seed protectants.

Thiram and Captan

Thiram is the most commonly used seed-protectant fungicides for vegetable crops however Captan is also labeled as a seed protectant for many vegetables (Table 2). Purchase treated seed, or coat seed by placing seed and fungicide in a closed container and shaking until seed is uniformly coated. **Do not use Thiram or Captan treated seed for food or animal feed.**

Seed Treatments Vegetables

Table 2. Recommended seed treatment dosage rates for selected vegetable seeds.

Vegetable Crop	Thiram ¹ 50WP Ounces (dry wt ³)/100 lb seed	Captan ² Fluid ounces/100 lb seed
Beans (Lima)	3	- ⁴
Beans (Snap)	2	2.5
Broccoli	8	1.5
Brussels sprouts	8	1.5
Cabbage	8	1.5
Cantaloupe	4.5	2.5
Cucumbers	4.5	2.5
Carrots	8	-
Cauliflower	8	1.5
Cowpeas	2	2.5
Endive	8	-
Eggplant	6	-
Kale	8	-
Kohlrabi	8	-
Leafy greens (collards, lettuce, mustard, spinach, Swiss chard, turnip)	8	1.5
Okra	6	-
Peas	3	2.5
Peppers	8	2.5
Pumpkin	4.5	1.5
Radish	8	1.5
Squash	4.5	1.5
Tomato	6	-
Watermelon	4.5	1.5
All other vegetable seed	8	-

¹Thiram belongs to the Fungicide Resistance Action committee (FRAC) group M3.

²Captan belongs to the Fungicide Resistance Action committee (FRAC) group M4.

³See Figure 1 for dry weight conversions.

⁴The dash indicates that the fungicide is not labeled for and/or recommended for the specified vegetable seed.

Seed Treatments Vegetables

Fungicide Seed Protectants for Potatoes

Properly treated seed potatoes can increase stand and improve stand uniformity. Proper application of seed potato protectants is essential as too much chemical can result in phytotoxicity and inadequate coverage can result in poor stand. **Dip treatments are not recommended** as pathogens can easily be spread from treated to non-treated seed using this mode of application. **Do not use treated seed for food or animal feed.**

Table 3. Recommended seed treatment dosage rates and Fungicide Resistance Action Committee (FRAC) group for potatoes				
Vegetable Crop	Fungicide	Rate¹/100 lb	Rate/acre	FRAC² Group
Irish potato	Fludioxonil + mancozeb (Maxim MZ)	0.5 lb	- ³	12, M
	Penflufen + Prothioconazole (Ernesto Silver)	0.37 oz	-	7, 3
	Flutolanil + mancozeb (MonCoat MZ)	0.75 lb	-	7, M
	Flutolanil (Moncut DF)	-	0.71 to 1.1 ⁴	7
Sweetpotato	Dicloran (Botran 75 W)	-	3.0-5.0 lb ^{4,5}	14
¹ Apply as a dust. See Table 4 for dry weight conversions. ² Abbreviation for Fungicide Resistance Action Committee. ³ The dash indicates that the fungicide is not labeled for and/or recommended for the specified application. ⁴ Apply uniformly over and around the seed as an in-furrow spray. Refer to label for detailed application instructions. ⁵ Do not plant tomatoes as a follow-up crop.				

Table 4. Metric conversions for dry weight measures.
1 ounce= 28.4 g
1 gram= 0.035 ounces
1 pound= 454 grams
1 teaspoon= 0.16 ounces

The vegetable seed treatment section was revised December 2014 by Dr. M. L. Lewis Ivey.

Soil Treatments

Management of Nematodes and Soilborne Diseases

There are a number of plant-parasitic nematodes and plant pathogens that inhabit the soil and cause damage to or disease in crops. Soil fumigants (Table 1) can kill parasitic nematodes, soilborne pathogens, insects and weeds in the soil – thereby improving seedling and crop performance. Soil fumigants also kill any beneficial microorganisms in the soil, however, and should be combined with cultural practices that promote good soil health. In addition, many fumigants can be administered only in the presence of a certified applicator. Certified applicators must successfully complete one of the soil fumigant training programs listed on the EPA website (<http://www.epa.gov/fumigantraining>). More information on fumigants registered for nematode management in various crops can be found in the nematode sections of this guide.

Unlike conventional farming systems, organic farming systems cannot rely on soil fumigants for disease management. Soil sterilants (Table 2) and microbial biopesticides (Table 3) are alternatives to fumigants. Soil sterilants are simple, safe and economical and are just as effective as fumigants when used in combination with good cultural practices. Although microbial biopesticides are less toxic than soil fumigants, they have a more limited target range, and the efficacy of microbial biopesticides is more variable than fumigants. Information on cultural practices and resistant varieties available to manage nematodes in home gardens can be found in the Nematode-Home Garden section of this guide.

Table 1. Soil fumigants and rates for control of nematodes, soilborne pathogens and weeds		
Product Choices^{1,2}	Rate³	Pests Controlled
Metam CLR 42% Soil Fumigant	37.5-75 gal	Soilborne fungi ⁴ Nematodes Weeds
Nimitz	3.5-5 pt	Nematodes
Paladin EC	40-51.3 gal	Soilborne fungi ⁵
Telone C-17 Soil Fungicide and Nematicide	10.8-45 gal	Garden centipedes Nematodes Soilborne fungi
Telone C-17 Soil Fungicide and Nematicide	13-45 gal	Garden centipedes Nematodes Soilborne fungi
Vapam HL	37.5-75 gal	Nematodes Soilborne fungi ⁴ Weeds
<p>¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.</p> <p>²Not for use in greenhouses or other enclosed areas.</p> <p>³Rates are the amount of formulation per treated acre for shank applications unless otherwise indicated. Rates vary depending on the crop and soil type. Always refer to the label for correct rates.</p> <p>⁴Includes <i>Rhizoctonia</i>, <i>Pythium</i>, <i>Phytophthora</i>, <i>Verticillium</i>, <i>Sclerotinia</i>, Oak root fungus and Clubroot of crucifers.</p> <p>⁵Includes <i>Rhizoctonia</i>, <i>Pythium</i>, <i>Verticillium</i>, and <i>Sclerotinia</i>.</p>		

Soil Treatments

Sterilant	Method
Dry heat	180 °F, 30 minutes
Steam heat	145-165 °F, 30 minutes
Solarization	99 °F, 2-4 weeks

Product Choices ²	Biocontrol Organism	Target Diseases	Rate ³	Crops
Actinovate AG	<i>Streptomyces lydicus</i>	Damping-off and root rots <i>Pythium</i> spp. <i>Rhizoctonia</i> spp. <i>Phytophthora</i> spp. <i>Fusarium</i> spp. <i>Verticillium</i> spp. Root decay <i>Phymatotrichum omnivorum</i>	3-12 oz ⁴	All food crops grown from seed
Actinovate SP	<i>Streptomyces lydicus</i>	Damping-off and root rots <i>Pythium</i> spp. <i>Rhizoctonia</i> spp. <i>Phytophthora</i> spp. <i>Fusarium</i> spp. <i>Verticillium</i> spp. Root decay <i>Phymatotrichum omnivorum</i>	18-54 oz (turf) 4-6 oz/100 gal (ornamentals)	Turf Ornamentals
Cease	<i>Bacillus subtilis</i>	Sclerotinia diseases <i>S. sclerotiorum</i> <i>S. minor</i>	3-6 qt/100 gal	Leafy vegetables
Contans WG	<i>Coniothyrium minitans</i>	Sclerotinia diseases <i>S. sclerotiorum</i> <i>S. minor</i>	1-4 lb	Most crops
Mycostop		Damping-off and root rots <i>Pythium</i> spp. <i>Fusarium</i> spp. <i>Alternaria</i> spp. <i>Phomopsis</i> spp.	1-2 g/cubic yard	Container ornamentals Vegetable transplants
Plant Shield® HC Biological Foliar and Root	<i>Trichoderma harzianum</i>	Damping-off and root rots <i>Pythium</i> spp. <i>Rhizoctonia</i> spp. <i>Fusarium</i> spp.	4 oz/100 gal ⁴	Container ornamentals Vegetable transplants

Soil Treatments

Table 3. Microbial biopesticides for the management of soilborne pathogens in organic farming¹				
Product Choices²	Biocontrol Organism	Target Diseases	Rate³	Crops
Regalia	Extract of <i>Reynoutria sachalinensis</i>	Damping-off and root rots <i>Pythium</i> spp. <i>Rhizoctonia</i> spp. <i>Phytophthora</i> spp. <i>Fusarium</i> spp. <i>Verticillium</i> spp. Sclerotinia diseases <i>S. sclerotiorum</i> <i>S. minor</i> White Mold <i>Sclerotium rolfsii</i> Clubroot <i>Plasmodiophora brassicae</i> Common scab <i>Streptomyces scabies</i>	1-4 qt	Vegetables Cotton Oil seed crops Peanut Tobacco
Root Shield® Granules	<i>Trichoderma harzianum</i>	Damping-off and root rots <i>Pythium</i> spp. <i>Rhizoctonia</i> spp. Wilts <i>Fusarium</i> spp.	3-12 lb	Ornamentals Flowers Bedding plants Vegetables Herbs Tree nuts Hydroponic crops Pome and stone fruit Oil seed crops
SoilGard12G	<i>Trichoderma virens</i>	Damping-off and root rots <i>Pythium</i> spp. <i>Rhizoctonia</i> spp.	See label ⁵	Ornamentals Bedding plants Vegetables Herbs
T22 HC	<i>Trichoderma harzianum</i>	Damping-off and root rots <i>Pythium</i> spp. <i>Rhizoctonia</i> spp. <i>Fusarium</i> spp.	16-32 oz	Vegetables Herbs

¹For more information on microbial biopesticides for the management of soilborne pathogens in organic farming, refer to the The Ohio State University factsheet HYG-3310-08 (Raudales and McSpadden Gardener, 2008).

²Reference to commercial or trade names is made with the understanding that no discrimination is intended or endorsement of a particular product implied by LSU or the LSU AgCenter.

³Rates are the amount of formulation per acre unless otherwise indicated.

³For agronomic field and row crops, alfalfa hay and forage, small grains and corn apply 1-3 oz/acre.

⁴For use on plants in containers, plug trays or flats.

⁵Rates vary considerably depending on crop and production stage. Refer to labels for specific rates and timing.

The soil treatment section was revised December 2014 by Dr. M. L. Lewis Ivey.



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