

2020

Louisiana Plant Disease *Management Guide*



2020 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 neighboring states. The 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 - Agricultural Research Service. Disease management recommendations within the 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 contributors.

Successful management of plant diseases requires a disease management program that integrates the use of available resistant varieties, good cultural practices, weed and insect management, and biocontrol and chemical management. 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 an important management tool in an integrated pest management program (IPM). Pesticides should be used in a manner that limits worker and domestic animal and wildlife exposure, 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 certification or recertification conferences for the state, go to: [LSU AgCenter Pesticide Safety Education Program \(www.lsuagcenter.com/pesticide\)](http://www.lsuagcenter.com/pesticide) or contact:

Kim Brown
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318-427-2697

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 and labeled in Louisiana 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 only water. Make all repairs prior to using a pesticide.
- Make sure your application equipment is calibrated before applying a pesticide.
- Check that gloves and protective clothing fit properly and are clean and free of holes. Always have extra clean clothes available in case of an emergency.

Application of pesticides:

- Always wear required protective clothing while spraying.
- Spray during weather conditions that mitigate 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 safety data sheets, as well as emergency contact information, should be available for quick reference.
- Only compatible pesticides should be tank-mixed. Read the label carefully to confirm pesticide compatibility. If you are not sure, a jar test is recommended.
- Do not mix or store pesticides near food or feed.
- Only mix the amount of pesticide required to treat the crop.
- Store pesticides in a locked room at the recommended temperature.
- 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 if required by the pesticide label or the Worker Protection Standard requirements for agricultural use products.
- 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.** A complete record-keeping manual can be found on the LSU AgCenter online store.

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. Be sure to have copies of the pesticide label and the safety data sheet for treating medical personnel.

In the case of a pesticide spill, contact the Louisiana Department of Agriculture (LDAF) on the LDAF Emergency Hotline: 855-452-5323.

Pesticide Use and Safety

Worker Protection Standard (WPS)

The Environmental Protection Agency (EPA) Agricultural Worker Protection Standard (WPS) is aimed at reducing the risk of pesticide poisoning and injury among agricultural workers and pesticide handlers. Pesticide applicators must comply with this rule when using agricultural use pesticide products with labels that reference the Worker Protection Standard, 40 CFR 170. In 2015, EPA made major revisions to the Worker Protection Standard (WPS).

The LSU AgCenter has worked to provide an updated WPS Train-the-Trainer program that has been approved by the EPA. In Louisiana those employers that want to train their own workers and handlers must be a certified applicator and go through the new WPS Train-the-Trainer program with the LSU AgCenter. All workers and handlers must now be trained on an annual basis. If you went through a WPS Train-the-Trainer program prior to November 2016, then you will have to attend a new WPS Train-the-Trainer program. Once you have completed that program, WPS Trainer will be added to the back of your pesticide certification card and you will then be able to go to your normal recertification meeting to have that category recertified.

Training dates and locations can be found at [LSU AgCenter Pesticide Safety Education Program at www.lsuagcenter.com/pesticide](http://www.lsuagcenter.com/pesticide).
If you would like to participate in a WPS Train-the-Trainer Program, please email kbrown@agcenter.lsu.edu.

As part of the revised rule, there are a few things that need to be pointed out:

- Workers and handlers must be trained every 12 months.
- WPS Trainers must go through the new EPA-approved Train-the-Trainer Program (See information above).
- Workers and handlers must be trained by using EPA-approved training materials.
- No longer using the card system for records of training. You must maintain the following information:
 - Trained worker's printed name and signature.
 - Date of the training.
 - Information identifying which EPA-approved training materials were used.
 - The trainer's name and qualification to train.
 - The worker or handler employer's name. (The LSU AgCenter has created a form that you are welcome to use. If you would like to download training verification form for WPS.)
- Must retain records of training of workers and handlers for two years.
- Maintain the following information at a Central Location:
 - [New safety poster \(https://npsecstore.com/collections/posters\)](https://npsecstore.com/collections/posters).
 - Application records.
 - Emergency medical contact information.
 - SDS (safety information).
- When using a pesticide that requires a respirator, employers must:
 - Have an employee medically evaluated by a physician or other licensed health care professional.
 - Have employee go through an annual fit test for each type of respirator required by the pesticide product label.
 - Have the employee participate in annual training on how to properly use the respirator(s).
 - Maintain records for two years of the completion of the above requirements.

The How to Comply Manual is a great reference guide and can be ordered at npsecstore.com.

To get more information about the WPS revised rule, you will need to refer to the final rule at [Agricultural Worker Protection Standard \(WPS\)](#).

Where to get updated information:

- [LSU AgCenter Pesticide Safety Education Program \(www.lsuagcenter.com/pesticide\)](http://www.lsuagcenter.com/pesticide).
- [EPA-approved new poster \(https://npsecstore.com/\)](https://npsecstore.com/).
- [EPA-approved training materials \(http://pesticideresources.org/stage/index.html\)](http://pesticideresources.org/stage/index.html).

This section was revised September 2019 by Kim Brown.

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.

Although 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.

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 (FRAC) 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. 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.phi-base.org/images/fracCodeList.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. Although 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 or eliminates 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 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 October 2019 by Boyd Padgett.

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.

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.

Plant Diagnostic Center

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.

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 for In-state samples	Diagnostic Fee for Out-of-state samples
Routine diagnostics	\$20	\$40
Serological and biochemical tests	\$30	\$60
Molecular diagnostics	\$100	\$150
Rapid turfgrass diagnostics	\$75	\$100

Plant Diagnostic Center

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.

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
Baton Rouge, LA 70803**

Contact Information

Dr. 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 corn diseases.

Disease	
Charcoal Rot (<i>Macrophomina phaseolina</i>)	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. Source of Inoculum: This fungus survives in old plant debris or in the soil. Management: Rotate crops. Bury stubble. Maintain balanced potassium/nitrogen rates.
Common Rust (<i>Puccinia sorghi</i>)	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. Source of Inoculum: Spores usually are windblown from the south. An alternate host is the wood sorrel (<i>Oxalis</i> sp.). Management: Most hybrids are tolerant to this disease. Always use the recommended hybrids for your area.
Fusarium Stalk Rot (<i>Fusarium</i> spp.)	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. Source of Inoculum: This fungus lives in old stubble or in the soil. Control: Practice crop rotation. Plow crop residue under. Make sure adequate potassium is applied with high nitrogen rates.
Gray Leaf Spot (<i>Cercospora zeae-maydis</i>)	Symptoms: The early lesions produced on the corn leaves by <i>Cercospora zeae-maydis</i> are yellow to tan 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. Source of Inoculum: The fungus causing gray leaf spot overwinters in and on corn debris left above and on the soil surface. Management: Hybrids are available with moderate resistance. Crop rotation and clean plowing are effective in reducing the level of surviving fungus in fields.
Northern Corn Leaf Blight (<i>Exserohilum tursicum</i>)	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. Source of Inoculum: Carried on the seed and in old plant refuse, spores also are readily windborne. Management: Disease resistance is available. The hybrids should also be ones recommended for your area.
Smut (<i>Ustilago maydis</i>)	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. Source of Inoculum: The teliospores of this fungus overwinter on the soil surface. Control: Use hybrids recommended for your area. Most have adequate resistance.
Southern Leaf Blight (<i>Bipolaris maydis</i> = <i>Helminthosporium maydis</i>)	Symptoms: Leaves of infected plants have numerous elongated spots between the veins. The spots are buff to reddish-brown. Source of Inoculum: Carried on the seed and in old plant refuse, spores also are readily windborne. Management: Use only seed produced by normal tasseling (N). The hybrids also should be ones recommended for your area.
Southern Rust (<i>Puccinia polysora</i>)	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. Source of Inoculum: Spores are windblown from the south. No alternate host is known. Management: Use hybrids tolerant to this disease. Fungicides might be necessary if southern rust symptoms are expressed prior to soft dough growth stage.

Commercial Crop Production

Field Crops – Corn

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.

Fungicide Efficacy for Management of Corn Diseases—January 2018

The Corn Disease Working Group (CDWG), which includes LSU AgCenter pathologists, develops ratings for how well fungicides control major corn diseases in the United States. The ratings are determined by field testing the materials over multiple years and locations. Ratings are based on the product's level of disease control and does not necessarily reflect yield increases obtained from product application. A product's efficacy depends upon proper application timing, rate, and application method as determined by the product label and overall disease level in the field at the time of application. Differences in efficacy among each fungicide product were determined by directly comparing products in field tests using a single application of the labeled rate. The table includes marketed products available that have been tested over multiple years and locations and is not intended to be a list of all labeled products. Efficacy categories: NR=Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent; NL = Not Labeled for use against this disease; U = Unknown efficacy or insufficient data to rank product

Fungicide Class	Active ingredient (%)	Product/trade name	Rate/A (fl oz)	Gray leaf spot	Northern leaf blight	Southern rust	Harvest restriction ¹
QoI Strobilurins Group 11	azoxystrobin 22.9%	Quadris 2.08 SC multiple generics	6.0 - 15.5	E	G	G	7 days
	pyraclostrobin 23.6%	Headline 2.09 EC/SC	6.0 - 12.0	E	VG	VG	7 days
	picoxystrobin 22.5%	Approach 2.08 SC	3.0 - 12.0	F-VG	VG	G	7 days
DMI Triazoles Group 3	propiconazole 41.8%	Tilt 3.6 EC multiple generics	2.0 - 4.0	G	F-G	F-G	30 days
	prothioconazole 41.0%	Proline 480 SC	5.7	U	VG	G	14 days
	tebuconazole 38.7%	Folicur 3.6 F multiple generics	4.0 - 6.0	U	VG	F-G	36 days
	tetraconazole 20.5%	Domark 230 ME	4.0 - 6.0	E	VG	VG	R3 (milk)
Mixed modes of action	azoxystrobin 13.5% propiconazole 11.7%	Quilt Xcel 2.2 SE multiple generics	10.5 - 14.0	E	VG	VG	30 days
	benzovindiflupyr 2.9% azoxystrobin 10.5% propiconazole 11.9%	Trivapro	13.7	E	VG	E	30 days
	cyproconazole 7.17% picoxystrobin 17.94%	Approach Prima 2.34 SC	3.4 - 6.8	E	VG	G-VG	30 days
	flutriafol 19.3% fluoxastrobin 14.84%	Fortix 3.22 SC Preemptor 3.22 SC	4.0 - 6.0	E	VG-E	VG	R4 (dough)
	pyraclostrobin 28.58% fluxapyroxad 14.33%	Priaxor 4.17 SC	4.0 - 8.0	VG	U	G	21 days
	pyraclostrobin 13.6% metconazole 5.1%	Headline AMP 1.68 SC	10.0 - 14.4	E	VG	G-VG	20 days
	trifloxystrobin 32.3% prothioconazole 10.8%	Stratego YLD 4.18 SC	4.0 - 5.0	E	VG	G-VG	14 days
	tetraconazole 7.48% azoxystrobin 9.35%	Affiance 1.5 SC	10.0 - 14.0	U	VG	VG	7 days

¹Harvest 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 – Corn

*This information is provided only as a guide. It is the applicator's legal responsibility to read and follow all current label directions. Reference in this publication to any specific commercial product is for general information only and does not constitute an endorsement or recommendation by the CDWG. Individuals using such products assume responsibility for their use in accordance with current directions of the manufacturer. Members or participants in the CDWG assume no liability resulting from the use of these products.

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	2-4 oz	At first appearance	30
	Avaris	11	7-14 oz	At first appearance	30
	Bumper	3	2-4 fl oz	At first appearance	30
	Delaro	3,11	8-12 fl oz	At first appearance	14
	Fitness	3	2-4 oz	At first appearance	30
	Headline AMP	11	10-14.4 oz	Prior to disease development	20
	Headline SC	11	6-12 oz	Prior to disease development	7
	Lucento	3,7	3-5.5 fl oz	At first appearance	10
	Manzate Flowable	M	1.2 quarts	At first appearance	7
	Orius 3.6F	3	4-6 fl oz	Prior to disease development	36
	Penncozeb 75DF	M	1-1.5 lb	Onset of disease	40
	Penncozeb 80WP	7	1-1.5 lb	Onset of disease	40
	PropiMax	3	2-4 fl oz	At first appearance	30
	Quadris	11	6.2-9 fl oz	Prior to disease development	7
	Quadris S	11	9.2-15.4 fl oz	Prior to disease development	7
	Quilt	11,3	7-14 oz	At first appearance	30
	Quilt Xcel	11,3	7-14 oz	At first appearance	30
	Stratego	11,3	10-12 oz	At first appearance	30
	Stratego YLD	11,3	4-5 oz	At first appearance	14
	Tebuzol 3.6F	3	4-6 fl oz	Prior to disease development	36
	Tilt	3	2-4 oz	At first appearance	30
Rust (Common only)	Quadris	11	6.2-9 fl oz	Prior to disease development	7
	Quadris S	11	6.2-9 fl oz	Prior to disease development	7
Rusts (Common and southern)	AmTide Propiconazole 41.8% EC	3	2-4 oz	At first appearance	30
	Bumper	3	4 fl oz	At first appearance	30
	Delaro	3,11	8-12 fl oz	At first appearance	14
	Fitness	3	4 fl oz	At first appearance	30
	Headline AMP	11	10-14.4 oz	Prior to disease development	20
	Headline SC	11	6-12 oz	Prior to disease development	7
	Lucento	3,7	3-5.5 fl oz	At first appearance	10
	Orius 3.6F	3	4-6 fl oz	Prior to disease development	36
	PropiMax	3	2-4 fl oz	At first appearance	30
	Quilt	11,3	10.5-14 oz	At first appearance	30
	Quilt Xcel	11,3	10.5-14 oz	At first appearance	30
	Stratego	11,3	10-12 oz	At first appearance	30
	Stratego YLD	11,3	4-5 oz	At first appearance	14
	Tebuzol 3.6F	3	4-6 fl oz	Prior to disease development	36
	Tilt	3	4 oz	At first appearance	30
Leaf Blights (primarily Helminthosporium and Excerohilum spp.)	AmTide Propiconazole 41.8% EC	3	2-4 oz	At first appearance	30
	Avaris	11	7-14 oz	At first appearance	30
	Bumper	3	2-4 fl oz	At first appearance	30
	Delaro	3,11	8-12 fl oz	At first appearance	14
	Fitness	3	2-4 oz	At first appearance	30
	Headline AMP	11	10-14.4 oz	Prior to disease development	20
	Headline SC	11	6-12 oz	Prior to disease development	7
	Lucento	3,7	3-5.5 fl oz	At first appearance	10
	Manzate Flowable	M	1.2 quarts	At first appearance	7

Commercial Crop Production

Field Crops – Corn

Target	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	Time of Application	PHI ⁴
	Orius 3.6F	3	4-6 fl oz	Prior to disease development	36
	Penncozeb 75DF	M	1-1.5 lb	Onset of disease	40
	Penncozeb 80WP	7	1-1.5 lb	Onset of disease	40
	PropiMax	3	2-4 fl oz	At first appearance	30
	Quadris	11	6.2-9 fl oz	Prior to disease development	7
	Quadris S	11	9.2-15.4 fl oz	Prior to disease development	7
	Quilt	11,3	7-14 oz	At first appearance	30
	Quilt Xcel	11,3	7-14 oz	At first appearance	30
	Stratego	11,3	10-12 oz	At first appearance	30
	Stratego YLD	11,3	4-5 oz	At first appearance	14
	Tebuzol 3.6F	3	4-6 fl oz	Prior to disease development	36
	Tilt	3	2-4 oz	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.

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

The corn section was revised October 2019 by Boyd Padgett and Dana Landry.

Field Crops

Cotton

Table 1. Symptoms, source of inoculum, and management of selected cotton diseases.

Disease	
Bacterial Blight (<i>Xanthomonas citri</i> pv. <i>malvacearum</i>)	Symptoms: On seedlings lesions appear as small, water-soaked irregular spots eventually turning brown; hypocotyls will appear black with elongated lesions girdling the stem and causing death. Foliar symptoms on older plants consist of angular lesions that initially appear water-soaked and later turn brown to blackish purple, occasionally following main leaf veins and occasionally with yellow halos. Petioles and stems may appear blackened, and significant defoliation may occur. The bacterium may cause boll blight, which begins with round, water-soaked lesions eventually turning brown to black and allowing entry of secondary organisms that cause rot. Source of Inoculum: The primary source of inoculum is seed, and the secondary source is cotton debris. Management: Use acid-delinted seed. Destroy cotton debris, rotate to another crop, and/or use resistant varieties. The pathogen may be moved from field-to-field by equipment or insects. Overhead irrigation or excessive rainfall along with windy conditions may exacerbate disease. Infected bolls will have infected seed, which serves as primary inoculum.
Boll Rots (many fungi and bacteria)	Symptoms: There are 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. Source of Inoculum: Organisms causing boll rots may be carried over in the soil, on crop debris, or on the seed coat. 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.
Fusarium Wilt (<i>Fusarium</i> spp.)	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. Disease is more severe on sandy soils during hot weather when root-knot or reniform nematodes are present. (See root-knot nematode section) Source of Inoculum: The pathogen lives indefinitely in soil along with nematodes. Management: Use tolerant varieties. Most recommended varieties exhibit tolerance to Fusarium wilt. Under more severe conditions, use recommended nematicides.
Leaf Spot Complex (<i>Alternaria</i> spp., <i>Cercospora gossypina</i> , <i>Stemphylium</i> spp., <i>Ascochyta</i> spp., and other fungi)	Symptoms: Brown to red to tan circular lesions on leaves that may occur at any stage. Lesions may be up to ¾ inch, and margins usually appear reddish to purple. As the diseases progress, centers of lesions may appear sooty due to sporulation of the pathogens 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. Source of Inoculum: Fungi overwinter in previous crop/weed debris. Management: Plow under infected plant debris. Plant high-quality, acid-delinted, fungicide-treated seed. Avoid nutrient stresses (particularly Potassium), drought stress, other pest damage, and herbicide injury. Foliar fungicides may reduce incidence and severity, but economic benefit is rare.
Reniform Nematodes (<i>Rotylenchulus reniformis</i>)	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. Source of Inoculum: Reniform nematodes live from year to year in the soil. Control: Apply nematicides. Refer to Nematode Management Field Crops section. There are very few resistant varieties. Rotate to a non-host crop.
Root Knot Nematodes (<i>Meloidogyne</i> spp.)	Symptoms: Root systems are knotted or galled. Plants are stunted, slow growing, and low yielding. Usually associated with a high incidence of Fusarium wilt. Damage from RKN is most severe on sandy soils. (See Fusarium wilt above.) Source of Inoculum: Root-knot nematodes live from year to year in the soil as eggs, juveniles, or adults. Management: Use resistant varieties. Apply nematicides. Refer to table on nematode control in field crops. Rotate to a resistant or non-host crop.
Seedling Diseases (<i>Rhizoctonia</i> spp., <i>Pythium</i> spp., <i>Fusarium</i> spp., and other fungi)	Symptoms: Loss before emergence is characterized by rotting of the seed or seedling. After emergence, affected seedlings have dark lesions on the stem, often girdling and extending downward into the root system. Older plants have reddish-brown, sunken lesions near the soil line. 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. 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 fungicide-treated seed to a weed-free seedbed at proper depth for soil type and weather conditions.
Target Spot (<i>Corynespora cassiicola</i>)	Symptoms: Brown to tan circular lesions on leaves usually beginning low after canopy closure. Lesions usually will not have reddish to purple margins when found low in the canopy and will have a “bullseye”

Field Crops

Cotton

Disease	
	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 in a relatively short period of time, particularly during warm, rainy periods. Source of Inoculum: The pathogen overwinters in crop debris. Management: Destroy debris. Some varieties may tolerate target spot better than others. Avoid excessive nitrogen and rank plant growth (apply PGRs as necessary). Scout closely prior to and after canopy closure. Scout nearby soybeans for target spot. Foliar fungicides may lower disease incidence and in severe 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 using hollow cone or flat fan nozzles. Refer to Table 2.
Verticillium Wilt (<i>Verticillium</i> spp.)	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. Disease occurs in cool weather with or without nematodes. Source of Inoculum: The pathogen lives indefinitely in the soil. Control: Rotate with soybeans, sorghum, or small grains.

Field Crops

Cotton

Table 2. Foliar fungicides labeled for use in cotton.

Fungicide ¹	Mode of Action Group ²	Use Rate (fl oz/A)	Target Disease(s)/Pathogen(s) ³
Amistar Top (Syngenta)	11+3	8-11.6	Alternaria leaf spot (<i>Alternaria</i> spp.), Anthracnose (<i>Glomerella gossypii</i>), Aerolate mildew (<i>Ramularia gossypii</i>), Ascochyta blight (<i>A. gossypii</i>), boll rots (<i>Ascochyta gossypii</i> , <i>Alternaria</i> spp., <i>Diplodia</i> spp., <i>Phoma</i> spp.), cotton rust (<i>Puccinia schedonnardi</i>), Diplodia boll rot (<i>Diplodia</i> spp.), hardlock (<i>Fusarium verticillioides</i>), leafspots and blights (<i>Alternaria</i> spp., <i>Ascochyta gossypii</i> , <i>Cercospora</i> spp., <i>Stemphyllium</i> spp.), Southwestern cotton rust (<i>Puccinia cacabata</i> , <i>Puccinia</i> spp.) Stemphyllium leaf spot (<i>Stemphyllium</i> spp.), target spot (<i>Corynespora cassicola</i>)
Delaro (Bayer)	11+3	8-12	Target spot (<i>Corynespora cassicola</i>), rust (<i>Puccinia</i> spp.)
Elatus (Syngenta)	11+7	5-7.3	Ascochyta blight (<i>A. gossypii</i>), Target spot (<i>Corynespora cassicola</i>)
Headline (BASF)	11	6-12	Alternaria leaf spot, boll rot (<i>Alternaria</i> spp.) Anthracnose, boll rot (<i>Glomerella</i> spp.) Ascochyta blight, boll rot (<i>Ascochyta</i> spp.) Cercospora blight and leaf spot (<i>Cercospora</i> spp.) Diplodia boll rot (<i>Diplodia</i> spp.) Hard lock, boll rot (<i>Fusarium</i> spp.) Phoma blight, boll rot (<i>Phoma</i> spp.) Stemphyllium leaf spot (<i>Stemphyllium</i> spp.)
Priaxor (BASF)	7+11	4-8	Same as above plus: Target spot and Corynespora leaf spot (<i>Corynespora cassicola</i>)
Proline (Bayer)	3	5-5.7	Target spot (<i>Corynespora cassicola</i>)
Quadris (Syngenta)⁴	11	6-9	Same as Amistar Top.
Topguard (FMC)	3	7-14	Alternaria leaf spot, boll Rot (<i>Alternaria</i> spp.) Anthracnose, boll rot (<i>Glomerella</i> spp.) Areolate mildew (<i>Ramularia gossypii</i>) Ascochyta blight, boll rot (<i>Ascochyta gossypii</i>) Cercospora blight and leaf spot (<i>Cercospora</i> spp.) Diplodia boll rot (<i>Diplodia</i> spp.) Fusarium boll rot (<i>Fusarium</i> spp.) hardlock (<i>Fusarium verticillioides</i>) Phoma blight, boll rot (<i>Phoma</i> spp.) Stemphyllium leaf spot (<i>Stemphyllium</i> spp.) target spot (<i>Corynespora cassicola</i>)
Topguard EQ (FMC)	11+3	5-7	Same as Topguard.
Twinline (BASF)	3+11	7-8.5 (10-12 for Target spot)	Same as Priaxor.

¹Reference to commercial or trade names is made with the understanding that no discrimination or endorsement of a particular product is implied by LSU or the LSU AgCenter. Multiple biofungicides, generic tebuconazoles, and other triazoles exist on the market and are not included because these products are not useful in Louisiana cotton.

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

³Consult product label for disease pressure or additional target pathogens.

⁴Multiple generics are available with the same active ingredient.

The cotton section was revised September 2019 by Dr. Trey Price.

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Field Crops - Grain Sorghum

Table 1. Symptoms, source of inoculum and management of grain sorghum.

Disease	
Anthracnose (<i>Colletotrichum graminicola</i>)	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 node low to the ground. Poor head and seed development results from severe infections. 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).
Charcoal Rot (<i>Macrophomina phaseolina</i>)	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. Management: Irrigate where possible.
Downy Mildew (<i>Sclerospora</i> sp.)	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. Management: Follow cultural practices outlined for anthracnose.
Head Blight (<i>Fusarium moniliforme</i> <i>Curvularia</i> sp. <i>Cladosporium</i> sp.)	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. Management: Although no hybrids are immune, some sustain less damage and less economic loss.
Gray Leaf Spot (<i>Cercospora sorghi</i>)	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, johnsongrass and cultivated grasses. Management: Most varieties have adequate tolerance to this disease.
Zonate Leaf Spot (<i>Gloeocercospora sorghi</i>)	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. Management: Recommended varieties have some tolerance to the disease. Crop rotation and clean cultivation help.

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>)	Aframe	11	6-15.5 oz	Prior to disease development	14 days
	Aproach	11	12 oz	Prior to flowering	-- ⁶
	Evito 480 SC	11	2-4 oz	Prior to disease development	21 days
	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
	Nexicor	3,7,11	7-13 oz	Prior to disease development	21 days
	Priaxor	7,11	4-8 oz	Prior to disease development	21 days
	Quadris Flowable	11	6-15.5 oz	Prior to disease development	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
	Topguard	3	7-14 oz	Prior to disease development	7 days
	Topguard EQ	3,11	5-7 oz	Prior to disease development	30 days

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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.

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

⁵Must be applied prior to 25% flowering.

⁶Must be applied prior to flowering.

The grain sorghum section was revised October 2019 by Boyd Padgett and Dana Landry.

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Field Crops - Oats

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

Disease	
Crown Rust <i>(Puccinia coronata)</i>	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. 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. Management: Plant recommended varieties that have resistance to the prevalent races of the rust fungus.
Stem Rust <i>(Puccinia graminis avenae)</i>	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. 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>). Management: Plant recommended varieties that have resistance to the prevalent races of the rust fungus.
Yellow Dwarf <i>(Barley Yellow Dwarf virus)</i>	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. Source of Inoculum: The virus may live in perennial grasses. Aphids spread the virus. Management: No practical control measure is available.
Leaf Blotch <i>(Drechslera avenacea = Helminthosporium avenaceum)</i>	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. Source of Inoculum: The fungus can live on seed and plant debris. Management: Rotate oat crops on different fields.

The oats section was revised October 2019 Boyd Padgett and Dana Landry.

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 and management from the University of Georgia can be found at:

University of Georgia Extension [UGA Peanut Production Quick Reference Guide](http://tiny.cc/UGAPeanutProductionPDF) (<http://tiny.cc/UGAPeanutProductionPDF>).

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	0.9-1.36	14	10.9 lb
	Artisan	3,7	Refer to label	40	84 fl oz
	Absolute 500SC ⁵	3,11	3.5 fl oz	14	4 app
	Elatus	7,11	7.3-9.5 oz	30	21.9 oz
	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
	Lucento ⁵	3,7	3-5.5 fl oz	14	11 fl oz
	Stratego	3,11	7-14 fl oz	14	6 app
	Fontelis	7	16-24 fl oz	14	72 fl oz
	Priaxor ⁵	7,11	4-8 fl oz	14	24 fl oz
	Quash ⁵	3	2.5 oz	14	4 app
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
	Elatus	7,11	7.3-9.5 oz	30	21.9 oz
	Lucento ⁵	3,7	3-5.5 fl oz	14	11 fl oz
	Tebuconazole ^{5, 8}				
	Folicur 3.6F	3	7.2 fl oz	14	28.8 fl oz
	Monsoon	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	7	Refer to label	40	64 fl oz
	Headline ⁵	11	6-15 fl oz	14	45 fl oz
	Quash ⁵	3	2.5 - 4 oz	14	4 app
	Abound	11	12-24.5 oz	14	49 fl oz
	Fontelis	7	13-21 fl oz	14	72 fl oz
	Artisan	3,7	Refer to label	40	84 fl oz
	Priaxor ⁵	7,11	8 fl oz	14	24 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.

⁴ Postharvest 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 tank-mixed 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 October 2019 by Boyd Padgett and Dana Landry.

Commercial Crop Production

Field Crops - Rice

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

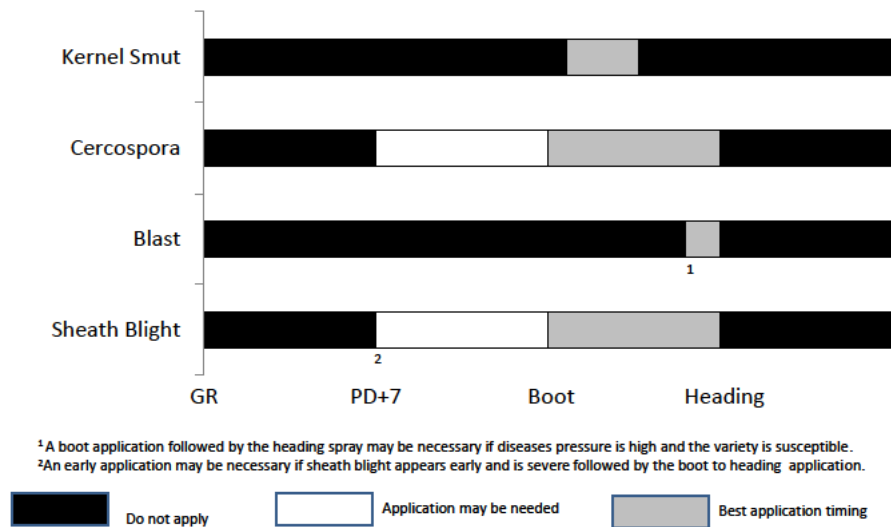
Disease	
Blast <i>(Pyricularia grisea)</i>	Symptoms: Leaf lesions are spindle-shaped and elongated with brown borders and grayish centers. A brownish lesion on the internode at the base of the panicle causes “blasting” of heads followed by breaking over of the head to produce the “rottenneck” symptoms. 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. 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.
Sheath Blight <i>(Rhizoctonia solani)</i>	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. The wavelike band pattern may extend out on part or the entire leaf surface. 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. 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.
Brown Leaf Spot <i>(Bipolaris oryzae)</i>	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. 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. Management: Maintain good growing conditions through fertilization, land leveling, soil preparation and other cultural practices.
Narrow Brown Leaf spot <i>(Cercospora janseana)</i>	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. The disease is usually more severe on the second or ratoon crop. Source of Inoculum: The fungus persists on crop residue. Management: Varietal resistance offers the best approach to control. (See variety list.) Fungicides may control narrow brown leaf spot.
Seed and Seedling Diseases Water Molds <i>(Achlya spp., Pythium spp.)</i>	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. Source of Inoculum: These fungi persist in the soil on organic matter. Management: Removing water after seeding will reduce losses. Seeding into clear water reduces the incidence of water mold. Seed treatments may reduce damage.
Seedling Blight <i>(Several fungi)</i>	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. Source of Inoculum: May be seedborne or soilborne.
Stem Rot <i>(Sclerotium oryzae)</i>	Symptoms: Black angular shaped, 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. Source of Inoculum: Fungus persists in the sclerotial stage in soil and on diseased straw and stubble. Management: Applications of potassium to the soil may reduce the severity of the disease in some instances.
Kernel Smut <i>(Tilletia barclayana)</i>	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. Source of Inoculum: The fungus overwinters in soil and in seeds.

Commercial Crop Production

Field Crops - Rice

Disease	
	Management: Avoid high nitrogen rates. Application of propiconazole containing fungicides at boot growth stage reduce incidence.
Straighthead (Physiological Disorder)	Symptoms: Rice heads remain upright at maturity because of lack of grain formation. Hulls usually are crescent or “parrot beak” shaped. Source of Inoculum: No organism involved. 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.)

Rice Fungicide Timing



Commercial Crop Production

Field Crops - Rice

Table 2. Rice variety reactions to common diseases in Louisiana.

VS = very susceptible reaction, S = susceptible reaction, MS = moderately susceptible reaction, MR = moderately resistant reaction, R = 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
Cheniere	MS	S	S	MS	MR
CLJ01	MR	MS	MR	S	--
CL111	MS	VS	S	VS	S
CL151	VS	S	S	VS	VS
CL153	MS	S	MS	MS	MS
CL163	VS	S	R	MS	MS
CL172	MS	S	S	MS	MS
CL272	MS	S	S	MS	MS
CLXL745	R	MR	R	MR	MR
Della-2	R	S	MS	MS	MR
Diamond	S	S	MR	MS	MS
Gemini 214 CL	R	MR	MR	MR	-
Jazzman	R	MS	S	S	MS
Jazzman 2	MS	S	S	VS	VS
Jupiter	S	MS	R	MR	MR
LaKaste	S	MS	MS	MS	MS
PVL01	VS	S	MR	S	-
PVL02	MS	MS	MS	S	-
RT7301	MR	MS	MR	MR	---
Titan	MS	S	MR	MS	MR
XL753	R	MSLO	R	MR	MR

Commercial Crop Production

Field Crops - Rice

Table 3. Efficacy of fungicides in managing rice diseases.

Efficacy categories: 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	Qol Resistant Sheath Blight	Cercospora	Kernel Smut
QoI Strobilurins Group 11	Azoxystrobin	Quadris 2.08 SC Equation 2.08 SC Others	9-15.5	G	VG	P	P	P
	Trifloxystrobin	Gem 500 SC	3.1-4.7	VG	G	P	P	P
Carboxamides Group 7	Flutolanil	Elegia 3.8 F	16-32	NL	G	G	NL	NL
	Fluxapyroxad	Sercadis 2.47 SC	4.5-6.8	NL	G	G	NL	NL
Demethylation Inhibitors (DMI) Group 3	Propiconazole	Tilt 3.6 EC Bumper PropiMax Others	6-10 6-10 6-10	NL	F	F	G	G
Mixed ⁴	Azoxystrobin, Propiconazole	Quilt 200 SC	14-34.5	G	VG	P	G	G
	Azoxystrobin, Propiconazole	Quilt Xcel 2.2 SE	15.8-27	G	VG	P	G	G
	Trifloxystrobin, Propiconazole	Stratego 250 EC	16-19	VG	G	P	G	G
	Azoxystrobin, Difenoconazole	Amistar Top	10-15	G	VG	G	G	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 October 2019 by Dr. D.E. Groth.

Commercial Crop Production

Field Crops – Soybeans

Table 1. Symptoms, source of inoculum, and management of selected soybean diseases.

Disease	
Aerial Blight (<i>Rhizoctonia solani</i>)	Symptoms: The initial infected area typically involves the lower third of one or more of the three leaflets. 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 (mycelia). Petioles, stems, and young pods also may be infected. Source of Inoculum: Weed hosts, field debris, and soil. Rice serves as an alternative host. Risk of disease is increased in rice/soybean rotations. Control: Fall cultivation of stubble. Use good seedbed preparation and weed control. Research and field observations indicate that some varieties may be tolerant aerial blight. Resistance to strobilurin fungicides has occurred in some areas. SDHI fungicides will be more effective in these areas (Table 2).
Anthrachnose (<i>Colletotrichum</i> spp.)	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. Source of Inoculum: The pathogens are seed- and debris-borne. Control: Plant disease-free seed. Some benefit may be derived from seed treatment. Plow under crop residue. Fungicides may be effective (Table 2).
Brown Spot (<i>Septoria glycines</i>)	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 1/4-inch diameter. Source of Inoculum: The fungus overwinters in crop residue and on infected seed. Management: Plant disease-free seed. Rotate. Bury crop residue if possible. Resistant varieties may be available. Fungicides are effective and may be economically beneficial in severe cases (Table 2).
Cercospora Leaf Blight (<i>Cercospora</i> spp.)	Symptoms: Longitudinal, purplish lesions on petioles appearing at R5 or later. Purpling to bronzing of leaves and/or blighting (brown, necrotic areas on leaflets) beginning in the upper canopy during pod fill. The pathogen may sporulate on leaflets resulting in a grayish hue. Premature defoliation may occur. Source of inoculum: The same fungi cause purple seed stain. Pathogens overwinter in crop debris. Some weeds are alternative hosts. Spores may be airborne. Latent infection occurs with these pathogens; therefore, plants may be infected long before symptoms appear. Management: Use tolerant varieties based on ratings nearest your location. Fungicides may be effective but are notoriously inconsistent (Table 2).
Charcoal Rot (<i>Macrophomina phaseolina</i>)	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. Lower stems may be disintegrated. Management: Avoid excessive seeding rates. Maintaining good fertility will reduce the incidence of this disease. Avoid drought stress as much as possible by using good management practices.
Downy Mildew (<i>Peronospora manshurica</i>)	Symptoms: Indefinite yellowish-green areas on upper leaf surface, later becoming reddish-brown with age. Grayish tufts of mold growth on lower leaf surface beneath chlorotic spots. Source of Inoculum: Overwinters in soil, on seed and in soybean residue. Management: Crop rotation. Use disease-free seed. Seed treatment reduces seedling infection. This disease does not affect yield, and fungicides are ineffective.
Frogeye Leaf Spot (<i>Cercospora sojina</i>)	Symptoms: An eyespot type of lesion with a gray or light tan center and a narrow reddish-brown border forms on the leaves. Usually occurs in the upper half of the canopy. May cause premature defoliation. May occur as purplish lesions on petioles, stems and pods. Source of Inoculum: Seed and airborne. Management: Use resistant varieties. Apply foliar fungicides, if necessary, to susceptible varieties (see Table 2).

Commercial Crop Production

Field Crops – Soybeans

Disease	
Minor Nematodes: Spiral, Lance, Ring, Lesion, Stubby-root	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. Management: Rotate with other crops. If populations are high at planting, a nematicide may be used. Use sanitation with equipment that may spread nematode infested soil.
Phytophthora Root Rot (<i>Phytophthora</i> spp.)	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. Damage is most severe on heavy clay soils or on poorly drained soils. Source of Inoculum: The pathogen is soilborne. Management: Avoid planting susceptible varieties on poorly drained soils. Rotate. Improve drainage.
Pod and Stem Blight (<i>Diaporthe phaseolorum</i> var. <i>sojae</i> = <i>Phomopsis sojae</i>)	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, white mycelial growth may be observed on seed. Source of Inoculum: Fungus is seedborne and overwinters on diseased plant tissue in the field. Management: Plant disease-free seed. Some benefit may be derived from the seed treatment. Foliar fungicides may be effective; however, efficacy data is limited (Table 2).
Purple Seed Stain (<i>Cercospora</i> spp.)	Symptoms: Pink or light purple to dark purple discoloration of seed. Cracks may occur in discolored areas. Source of Inoculum: The same fungi cause Cercospora leaf blight. Pathogens overwinter in crop residue and on infected seed. Some weeds are alternative hosts. Spores may be airborne. Latent infection occurs with these pathogens; therefore, plants may be infected long before symptoms appear. Control: Plant disease-free seed. Fungicide efficacy is unknown. Varieties may vary in susceptibility.
Red Crown Rot (<i>Colletotrichum ilicicola</i>)	Symptoms: First symptoms appear as an interveinal chlorosis in leaves during R5 to R6 followed by browning and defoliation. On the stems, reddish-orange fruiting structures appear at the soil surface and up to 3 inches above. Stem tissue may appear reddish. Source of Inoculum: The pathogen is soilborne. Management: Research and field observations indicate differences in varieties, but ratings are not available. Delayed planting may reduce disease incidence and severity.
Reniform Nematodes (<i>Rotylenchulus reniformis</i>)	Symptoms: Severely infected plants are stunted and may be chlorotic. Severe yield reductions may occur when nematode populations are relatively high. Source of Inoculum: The nematode overwinters in the soil. Management: Planting resistant varieties and rotation with nonhost crops may reduce populations. Nematicides are effective and may be economical if precision application methods are used. Use sanitation with equipment that may spread nematode infested soil.
Root Knot Nematodes (<i>Meloidogyne incognita</i> group)	Symptoms: Aboveground symptoms are poor pod set with wilting and stunting in more-or-less circular patches on lighter soil types. Below ground symptoms appear as knots or galls on the roots. These swellings are a part of the root and are not removeable like bacterial nodules. Source of Inoculum: The nematode overwinters in the soil as eggs or larvae. Management: Resistant varieties may be available, and rotation to less susceptible crops may reduce populations. Precision-applied nematicides may be economically beneficial. Use sanitation with equipment that may spread nematode infested soil.
Seedling Disease (<i>Rhizoctonia solani</i> , <i>Phytophthora</i> spp., <i>Pythium</i> spp., etc.)	Symptoms: Seed decay and postemergence “damping off.” Roots and basal portion of stem may deteriorate or be killed. Source of Inoculum: Most of these organisms are soilborne and persist in crop residue. Management: Fungicide seed treatment or in-furrow spray.
Southern Blight (<i>Sclerotium rolfsii</i>)	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. Southern blight is often seen with southern RKN. Source of Inoculum: The fungus is soilborne and occurs widely in many soils. It is capable of persisting on almost any type of organic matter.

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Field Crops – Soybeans

Disease	
	Management: Losses due to this disease usually are minimal and do not warrant control measures.
Southern Stem Canker (<i>Diaporthe phaseolorum</i> var. <i>meridionalis</i>)	Symptoms: Small reddish-brown lesions may occur on one or both cotyledons. Later in the season, interveinal chlorosis may be evident on leaflets (similar to foliar symptoms of red crown rot) and plants may die leaving dried attached leaves. Infection usually starts as a small lesion at the base of a main-stem node enlarging rapidly to form a slightly sunken, reddish-brown canker. Plants may be brittle and break at the canker. Source of Inoculum: The fungus is seedborne and overwinters on infested soybean debris in the field. There may be alternative hosts. Management: Use resistant varieties. Delayed planting, avoiding stress, and maintaining good fertility may reduce disease incidence and severity.
Soybean Cyst Nematodes (<i>Heterodera glycines</i>)	Symptoms: Stunting and various stages of yellowing occur in roughly circular spots. Symptoms vary depending on nematode population, soil type, fertility, and environmental conditions. Symptoms are most pronounced on sandy soils. May occur in conjunction with sudden death syndrome. Source of Inoculum: Nematodes overwinter in soil, primarily inside resistant cysts. They may be spread to new locations by any means that spread soil. Management: Practice 2- to 4-year rotation with cotton, corn, or sorghum. Use sanitation with equipment that may spread nematode infested soil.
Soybean Rust (<i>Phakopsora pachyrhizi</i>)	Symptoms: Rust pustules can be found on the underside of lower leaves when conditions are right for disease development. Pustules are tiny, raised, and resemble sand grains requiring at least a 15X hand lens. Management: Fungicides are very effective on soybean rust (Table 2).
Sudden Death Syndrome (<i>Fusarium virguliforme</i>)	Symptoms: Interveinal chlorosis and necrosis similar to red crown rot and stem canker. Will cause premature defoliation. Plants are easily pulled from the ground. White/blue spore masses may be found on roots. Vascular discoloration of stems with pith remaining white. May be exacerbated by soybean cyst nematode. Source of Inoculum: The fungus is soilborne; however, the disease is rare in Louisiana. Management: Rotate to a non-host. In-furrow fungicides or seed treatments may be effective. Use sanitation with equipment that may spread infested soil.
Taproot Decline (<i>Xylaria</i> sp.)	Symptoms: Taproot decline may cause plant death at any point during the growing season. On seedlings, cotyledons are characterized by an interveinal mottling. Infection is indicated by a mild interveinal chlorosis on vegetative and early reproductive stage plants. During pod fill, foliar symptoms appear more severe and interveinal necrosis may occur. When affected plants are pulled, they will usually break at the soil line. When excavated, affected tap and lateral roots will have a blackened appearance, and when stems are split at the crown, a white, cottony growth is apparent in the pith. Blackened soybean debris from previous seasons is usually found in close proximity to affected roots. Source of Inoculum: The fungus survives within debris from previous seasons. Management: Rotation to a nonhost and/or tillage may reduce disease incidence and severity. Resistant varieties may be available.

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-137), which also includes members from the Mid-South, have developed the following information on foliar fungicide efficacy for control of major foliar soybean diseases in the United States. Ratings in this table have been modified by LSU AgCenter Pathologists to more accurately reflect observations in Louisiana. 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. The table is not intended to be a list of all labeled products. Efficacy categories: NR=Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent; NL = Not Labeled; U = Unknown efficacy.

Table 2. Efficacy of fungicides used to manage foliar soybean diseases.

AB=Aerial Blight; AN=Anthracnose; BS=Brown spot; CB=Cercospora leaf blight; FE=Frogeye leaf spot; SR=Soybean rust; TS=target spot.

Fungicide Information		Diseases									
Active ingredient	Product/Trade name	Rate/A (fl oz)	AB ¹	AN	BS	CB ²	FE ³	PS	SR	TS	Harvest Restriction
thiophanate-methyl tetraconazole	Acropolis	20.0 - 23.0	NL	U	U	U	VG-E	U	VG-E	U	R5
azoxystrobin tetraconazole	Affiance 1.5 SC	10.0 – 14.0	U	VG	VG	P-G ⁵	VG	U	U	U	R5, 14 days
cyproconazole	Alto 100SL	2.75 – 5.5	U	U	VG	U	F-G	U	VG	U	30 days
picoxystrobin	Approach 2.08 SC	6.0 -12.0	VG	G	G	P	P	U	G	U	14 days
picoxystrobin cyproconazole	Approach Prima 2.34 SC	5.0 – 6.8	U	U	VG	P-G ⁵	G	U	VG	F-G	14 days
prothioconazole trifloxystrobin	Delaro 325 SC	8.0 - 11.0	VG	VG	VG	P	G	U	VG	P	21 days
tetraconazole	Domark 230 ME	4.0 – 5.0	NL	VG	VG	P-G ⁵	VG	U	VG-E	P	R5
fluoxastrobin	Evito 480 SC Aftershock 480 SC	2.0 – 5.7	VG	G	G	P	P	U	U	U	R5, 30 days
boscalid	Endura 0.7 DF	3.5 – 11.0	U	NL	VG	U	P	NL	NL	U	21 days
pyraclostrobin	Headline 2.09 EC/SC	6.0 - 12.0	VG	VG	G	P	P	U	VG	P-F	21 days
flutriafol bixafen	Lucento 4.17SC	3.0-5.5	U	U	VG	P-G ⁵	VG	U	VG-E	U	21 days
pydiflumetofen difenoconazole	Miravis Top 1.67 SC	13.7	U	U	VG	P-G ⁵	VG	G	U	U	14 days
flutriafol fluoxastrobin	Preemptor SC Fortix SC	4.0 - 6.0	U	U	G	P-G ⁵	VG	U	VG	U	R5

Commercial Crop Production

Field Crops – Soybeans

Fungicide Information			Diseases								
Active ingredient	Product/Trade name	Rate/A (fl oz)	AB ¹	AN	BS	CB ²	FE ³	PS	SR	TS	Harvest Restriction
pyraclostrobin fluxapyroxad	Priaxor 4.17 SC	4.0 – 8.0	VG	VG	E	P-G ⁵	F	G	VG	F-G	21 days
prothioconazole	Proline 480 SC	2.5 – 5.0	NL	NL	NL	NL	VG	NL	VG	U	21 days
azoxystrobin	Quadris 2.08SC Multiple Generics ⁴	6.0 - 15.5	VG	VG	G	P	P	U	G-VG	P-F	14 days
azoxystrobin difenconazole	Quadris Top 2.72 SC, Quadris Top SBX	7.0 - 7.5	U	U	G-VG	P-G ⁵	VG	F-G	VG	F-G	14 days
azoxystrobin propiconazole	Quilt 1.66 SC, Multiple Generics ⁴ Quilt Xcel 2.2 SE	14.0 - 20.5 10.5 - 21.0	VG-E	VG	G	P	F	U	VG	P	21 days R6
trifloxystrobin prothioconazole	Stratego YLD 4.18 SC	4.0 – 4.65	VG	VG	VG	P	G	U	VG	P	21 days
propiconazole 41.8%	Tilt 3.6 EC Multiple Generics ⁴	4.0 - 6.0	P	VG	G	P	F	NL	VG	U	R5
flutriafol 11.8%	Topguard 1.04 SC	7.0 – 14.0	U	VG	VG	P-G ⁵	VG	U	VG-E	P	21 days
azoxystrobin, flutriafol	Topguard EQ	5.0 - 7.0	U	U	VG	P-G ⁵	VG	U	VG-E	P	21 days
thiophanate-methyl	Topsin-M Multiple Generics ⁴	10.0 – 20.0	U	U	U	P	VG	U	G	U	21 days
benzovindiflupyr azoxystrobin propiconazole	Trivapro	13.7 - 20.7	E	U	VG	P-G ⁵	F-G	G	VG	U	14 days R6
tetraconazole fluoxastrobin	Zolera FX 3.34 SC	4.4-6.8	U	U	U	U	G-VG	U	U	U	R5 30 days

¹In areas where strobilurin resistance has been found, efficacy of products containing strobilurins may be reduced.

²Fungicides with a solo or mixed Qol or MBC mode of action may not be effective in areas where Qol or MBC resistance exists in the fungal population that causes Cercospora leaf blight.

³Fungicides with a solo or mixed Qol mode of action may not be effective in areas where Qol-resistance exists in the fungal population that causes frogeye leaf spot.

⁴Generics containing the same active ingredient may be available.

⁵Efficacy of this product on CLB has been inconsistent across locations and years.

The soybean section was revised September 2019 by Dr. Trey Price.

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 sugarcane diseases.

Disease	
Leaf Scald (<i>Xanthomonas albilineans</i>)	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. Source of Inoculum: The bacteria that cause leaf scald live 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. Management: Varietal resistance is the best means of control. The current varieties have adequate levels of resistance, particularly when produced with progeny from a tissue-culture based seedcane program. 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.
Mosaic (Sorghum mosaic virus and Sugarcane mosaic virus)	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 and is most easily seen in young plants. 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. 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 with the exception of the two most recently released varieties, HoCP 09-804 and L 11-183. Planting seedcane produced through tissue culture can help keep disease incidence low in susceptible varieties.
Ratoon Stunt (<i>Leifsonia xyli</i> subsp. <i>xyli</i>)	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. Source of Inoculum: The bacteria live from year to year in infected plants. It is spread mechanically by the cane harvester and by planting infected seedcane. 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 C (122 F) 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 (http://www.lsu.edu/agriculture/plant/extension/sugarcane-lab.php). 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.

Commercial Crop Production

Field Crops – Sugarcane

Disease	
Red Rot <i>(Colletotrichum falcatum)</i>	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. Source of Inoculum: The fungal pathogen survives from season to season in infected cane tissues. Fungal inoculum is present on most planted stalks. 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.
Brown Rust <i>(Puccinia melanocephala)</i>	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. The pustules erupt, releasing a reddish-brown mass of spores. On susceptible varieties, heavily infected leaves dry out and die prematurely. 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. 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 in “Best Management Practices for Minimizing the Impact of Brown Rust in Sugarcane” at http://www.lsuagcenter.com/topics/crops/sugarcane/pathology/best-management-practices-for-minimizing-the-impact-of-brown-rust-in-sugarcane.
Smut <i>(Sporisorium scitamineum)</i>	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. 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. Management: To control smut, grow resistant varieties and plant healthy seedcane. Current varieties have adequate resistance to smut with the exception on L 01-299 that is moderately susceptible under field conditions. 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 percent smut infection.
Yellow Leaf (Sugarcane yellow leaf virus)	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. 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. 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

Commercial Crop Production

Field Crops – Sugarcane

Disease	
	yellow leaf low. Information is lacking on the disease resistance levels of commercial varieties.
Red Stripe and Top Rot (<i>Acidovorax avenae</i> subsp. <i>avenae</i>)	Symptoms: Narrow, dark red stripes of variable length run longitudinally along veins. Symptoms are often seen in 4- to 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. 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. 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.
Brown Stripe (<i>Bipolaris stenospila</i>)	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. Brown stripe may be severe in fields cut the previous season for seed cane. Source of inoculum: Spores produced by the fungus are spread by the wind to cause new infections. Management: Brown stripe is usually a minor disease. Obvious disease symptoms have been observed in L 01-299, L 03-371, HoCP 04-838, and HoCP 09-804. Disease development is minimal when conditions are favorable for growth. Symptoms usually diminish after fertilization.
Pokkah Boeng (<i>Gibberella fujikuroi</i>)	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. Source of inoculum: Spores of the fungus are spread by wind and rain. 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.
Orange Rust (<i>Puccinia kuehnii</i>)	Symptoms: Leaf lesions are 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 young leaves during summer. 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. Management: Orange rust was first observed in 2012. Varietal resistance has provided good control. One variety, Ho 05-961, has shown moderate susceptibility to orange rust.
White Stripe (Physiological disorder)	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. Management: None. Plants will usually recover after fertilizer uptake in the presence of adequate rainfall.

The sugarcane section was revised September 2019 by Dr. Jeff Hoy.

Commercial Crop Production

Field Crops - Wheat

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

Disease	
Leaf Rust <i>(Puccinia triticina)</i>	Symptoms: Leaf rust is widespread and probably is a 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. Management: Resistant varieties are the most practical approach. Some seed treatments provide early season suppression, but foliar-applied fungicides are most effective (Tables 2 and 3).
Stem Rust <i>(Puccinia graminis tritici)</i>	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. 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. Management: Stem rust can be a serious problem in some years in localized regions of Louisiana. Resistant varieties are the most practical approach for control of this disease, although fungicides may be used (Table 3).
Stripe Rust <i>(Puccinia striiformis)</i>	Symptoms: The first sign of disease is individual yellow pustules, usually at the tip of the leaf. Later, pustules develop in rows, giving the characteristic of striped appearance. Leaves, sheaths, stems and glumes may be attacked. Management: Resistant varieties are the most practical approach for control of this disease, although fungicides may be used (Table 3).
Powdery Mildew <i>(Erysiphe graminis tritici)</i>	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. Management: The application of fungicide for the control of powdery mildew has rarely been economical.
Bacterial Streak/Black Chaff <i>(Xanthomonas campestris pv. translucens)</i>	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. Management: Use crop rotation, clean tillage and pathogen-free seed.
Fusarium Head Blight/Scab <i>(Fusarium spp.)</i>	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. Control: Well-timed, foliar-applied fungicides only suppress disease incidence (Table 3).
Leaf and Glume Blotch <i>(Stagonospora sp.)</i>	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. Management: Varieties differ in tolerance to leaf and glume blotch. Consult variety recommendations. For fungicide recommendations, please refer to (Table 3).
Take-all <i>(Gaeumannomyces graminis)</i>	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. Management: Maintain balanced soil fertility and some labeled seed treatment fungicides for suppression only.
Tan Spot <i>(Pyrenophora tritici-repentis)</i>	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. Management: Deep plow crop residues. Fungicides may be used.

Commercial Crop Production

Field Crops - Wheat

Disease	
Yellow Dwarf (BYDV)	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. The virus is spread by some species of aphids. Management: No adequate controls are available at this time.

Commercial Crop Production

Field Crops - Wheat

Table 2. Fungicides available to manage seed and seedling diseases in wheat.

Product ¹	Rate ²	Disease
Apron XL LS	0.0425-0.085 fl oz	Pythium damping-off
Charter F2	5.4 fl oz	Common bunt, flag smut, Fusarium seed rot, Fusarium seedling blight, loose smut, Pythium damping-off
Charter	3.1 fl oz	Common bunt, flag smut, Fusarium seed rot, Fusarium seedling blight, loose smut
Dividend XL RTA Dividend Extreme	5-10 fl oz 2-4 fl oz	Common bunt, dwarf bunt, loose smut, flag smut, seed-borne Septoria, general seed rots, Fusarium Seed scab, Pythium damping-off
ManKocide	4 oz	Bacterial diseases, common bunt
Manex	3.5-5.2 fl oz	Damping-off, seed rot, seedling blight
Maxim 4FS Maxim XL	0.08-0.16 fl oz 0.167-0.334 fl oz	Damping-off
Raxil 2.6F	0.1 fl oz	Stinking smut, flag smut, loose smut, early season Septoria disease complex, early season Rhizoctonia root rot, early season common root rot, early season Fusarium foot rot, early season suppression of powdery mildew, early season suppression of wheat leaf rust
Stamina	0.4-0.8 fl oz ³	Dry seed decay, Rhizoctonia seed and seedling disease
Stamina F3	4.6 fl oz	Common bunt, common root rot, dry seed decay, flag smut, Fusarium seed rot, Fusarium seedling blight, loose smut, Pythium damping off, Rhizoctonia root rot
Vibrance Extreme	2.8-5.6 fl oz ³	General seed rots, seedling blight, root rot and damping-off caused by seed- and soilborne Fusarium spp. or Rhizoctonia spp. seedling blight, root rot and damping-off caused by soil-borne Pythium spp. seed-borne Septoria, Septoria leaf blotch common bunt, dwarf bunt, karnal bunt, flag smut, Fusarium seed scab, loose smut, Pythium damping-off

¹Reference to commercial or trade names is made with the understanding that no discrimination or endorsement of a particular product is implied by LSU or the LSU AgCenter. Labels are subject to change and users should always read the label before applying a pesticide.

²Rates are the amount of formulation (product) per-hundredweight unless otherwise noted.

³Consult label for specific rates.

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)	Approach	1,1	6-12 fl oz	Consult label	45
	Approach Prima	3,1,1	3.4-6.8 fl oz	Consult label	45
	Propiconazole Products				
	Bumper 41.8EC	3	4 fl oz	Consult label	-
	PropiMax	3	4 fl oz	Flag leaf emergence	-
	Tilt	3	4 fl oz	No applications past Feeke's 10.54	-
	Caramba	3	10-14 fl oz	Protect as flag leaf emerges	30
	Headline	1,1	6-9 fl oz	No later than Feeke's 10.5	-
	Lucento	3,7	3-5.5 fl oz	Consult label	30
	Miravis Ace	3,7	13.7 fl oz	Do not apply after Feeke's 10.5.4	-
	Priaxor	7,1,1	4-8 fl oz	No later than Feeke's 10.5	30
	Proline 480 SC	3	4.3-5 fl oz	First appearance of disease but not past Feeke's 10.5	30
	Prosaro 421 SC	3	6.5-8.2 fl oz	Consult label	-
	Quilt Xcel	3,1,1	10.5-14 fl oz	No applications past Feeke's 10.5	35
	Stratego YLD	3,1,1	4 fl oz	Consult label	-
	Twinline	3,1,1	7-9 fl oz	No applications past Feeke's 10.5	-
Rust	Approach	1,1	6-12 fl oz	Consult label	45
	Approach Prima	3,1,1	3.4-6.8 fl oz	Consult label	45
	Priaxor	3,7	4-8 fl oz	No later than Feeke's 10.5	-
	Propiconazole Products				
	Bumper 41.8EC	3	4 fl oz	Consult label	-
	PropiMax	3	4 fl oz	Flag leaf emergence	-
	Tilt	3	4 fl oz	No applications past Feeke's 10.54	-
	Caramba	3	10-14 fl oz	Protect as flag leaf emerges	30
	Headline	1,1	6-9 fl oz	No later than Feeke's 10.5	-
	Lucento	3,7	3-5.5 fl oz	Consult label	30
	Proline 480 SC	3	4.3-5 fl oz	First appearance of disease but not past Feeke's 10.5	30
	Prosaro 421 4C	3	6.5 to 8.2 fl oz	Consult label	30
	Quilt Xcel	3, 1, 1	10.5-14 fl oz	No applications past Feeke's 10.5	-
	Stratego YLD	3,1,1	4 fl oz	Consult label	35
	Tebuconazole Products				
	Folicur 3.6F	3	4 fl oz	Consult label	30
	Orius 3.6F	3	4 fl oz	Consult label	30
	Tebustar 3.6F	3	4 fl oz	Consult label	30
	Monsoon	3	4 fl oz	Consult label	30
	Muscle 3.6F	3	4 fl oz	Consult label	30
	Tebuzol 3.6F	3	4 fl oz	Consult label	30
	Twinline	3,1,1	7-9 fl oz	No applications past Feeke's 10.5	-
Scab (suppression only)	Caramba	3	10-14 fl oz	Consult label	30
	Proline 480 SC	3	4.3-5 fl oz	Consult label	30
	Prosaro 421 4C	3	6.5 to 8.2 fl oz	Consult label	30
	Tebuconazole Products				
	Folicur 3.6F	3	4 fl oz	Consult label	30
	Orius 3.6F	3	4 fl oz	Consult label	30
	Tebustar 3.6F	3	4 fl oz	Consult label	30
	Monsoon	3	4 fl oz	Consult label	30
	Muscle 3.6F	3	4 fl oz	Consult label	30
	Tebuzol 3.6F	3	4 fl oz	Consult label	30
	Miravis Ace	3, 1, 1	13.7 fl oz	Do not apply after Feeke's 10.5.4	-

¹Reference to commercial or trade names is made with the understanding that no discrimination or endorsement of a particular product is implied by LSU or the LSU AgCenter. Labels are subject to change and users should always read the label before applying a pesticide. Consult label for restrictions.

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.

⁴Preharvest interval (PHI) is the minimum number of days allowed between the last application and harvest. If not listed consult label.

⁵Formerly *Stagonospora nodorum* and *Septoria nodorum*.

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Fruit and Nut Crops - Apple

Integrated Apple Disease Management

Many diseases commonly occur on apple, which can reduce flowering and the quality of the fruit in Louisiana. Disease management depends largely on the care and attention that trees are given throughout their lifetime. Achieving “store quality” apples in Louisiana is very difficult due to year-round hot and humid conditions, and they usually require an intensive fungicide and insecticide spray program. Planting resistant varieties is one of the best ways to reduce many of these disease problems. For many apple diseases, good sanitation practices are also essential for disease management.

Plant resistant cultivars: Apple scab is the most widespread and destructive disease of apples in North America. Selecting cultivars that are resistant or tolerant to apple scab is recommended, especially in southern Louisiana where warm and humid conditions favor disease development. Fire blight is also a major apple disease, and thus planting varieties with resistance is strongly recommended.

Use good sanitation practices: Certain leaf diseases and fruit rots overwinter on leaves and fruit. Raking and burning leaves will help reduce the severity of apple scab the following year. Prune dead and broken limbs from trees infected with fire blight to prevent the spread of the bacterium in the early spring. Removing dead or rotting fruit from the trees and ground will slow bitter rot development the following season.

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 apple trees.

Use registered chemicals: The potential for developing isolates of pathogens resistant to fungicides is high in apple 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 the front of this guide.

Commercial Crop Production

Fruit and Nut Crops - Apple

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

Disease	
Apple scab <i>(Venturia inaequalis)</i>	Symptoms: Scab may occur on leaves, fruit, leaf and fruit stems and green twigs. Infections of the leaves and fruit are most common and obvious. Leaf spots are diffuse, brown-to-olive green in color and often have a velvety texture. Fruit lesions are dark brown and corky-like. Source of Inoculum: Infected leaves that have fallen to the ground. Spores are wind dispersed. Management: The use of resistant varieties is the most effective means for avoiding apple scab disease. Pruning to establish an open canopy will allow air to move through the tree and dry leaves quickly. Rake and burn fallen leaves. Perfect sanitation can control the disease. Follow the apple spray schedule.
Bitter rot <i>(Glomerella cingulata = Colletotrichum gloeosporioides)</i>	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. 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. Management: Remove mummified fruit and dead wood. Follow the apple spray schedule; late cover sprays are important.
Cedar apple rust <i>(Gymnosporangium juniperi-virginianae)</i>	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. Source of Inoculum: The cedar apple rust fungus survives from season to season on the familiar “cedar apples” on eastern red cedar. Windborne spores are produced during periods of rain in the spring. Management: Rust can be avoided by eradicating cedar trees within two miles of apples. Follow the apple spray schedule.
Fire blight <i>(Erwinia amylovora)</i>	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. 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. 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.
Powdery mildew <i>(Podosphaera leucotricha)</i>	Symptoms: Affects young green tissues and young blossoms. Yellowing of the upper side of young leaves. Infected leaves may crinkle, curl or roll upwards. Premature dropping of severely infected leaves. White fungal growth on leaves, petioles and shoots is a sign of the powdery mildew pathogen. Source of Inoculum: Developing buds become infected and overwinter as fungal strands. Disease is apparent on leaves and flower buds as they emerge in the spring. Management: The use of resistant varieties is the most effective means for avoiding powdery mildew disease. A strict fungicide spray program is required when susceptible varieties are planted.
Phytophthora crown, collar and root rot <i>(Phytophthora spp.)</i>	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. Source of Inoculum: These pathogens are soil-borne organisms. 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.

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Fruit and Nut Crops - Apple

Table 2. List of disease-resistant apple cultivars

Abbreviations for resistant categories: R = resistant; MR = moderately resistant; MS = moderately susceptible; S = susceptible. Additional cultivars are listed at www.extension.purdue.edu/extmedia/BP/BP-132-W.pdf.

Cultivar	Disease			
	Scab	Fire blight	Cedar apple rust	Powdery mildew
Baldwin	S	S	R	S
Cortland	S	S	S	S
Liberty	R	R	R	R
Pixie Crunch	R	MS	S	-
Fuji	S	S	R	R
Gala	S	S	R	MS
Granny Smith	S	S	R	S
Honey Crisp	MR	R	S	S
Crimson Crisp	R	R	S	MR
Freedom	R	MR	R	R
Crimson Topaz	R	MR	-	MR
Florina	R	MR	S	MR
Enterprise	R	R	R	MR
Goldrush	R	MR	S	MR

Table 3. Seasonal fungicide spray schedule for apples

Developmental Stage	Disease(s)
Delayed dormant to 1/2-inch green tip	Scab
Green tip, white bud	Scab
Tight cluster, pre-pink	Scab
Pink bud	Scab, powdery mildew, fire blight and cedar apple rust
Bloom	Fire blight, scab, powdery mildew and cedar apple rust
Petal fall	Fire blight, scab, powdery mildew and cedar apple rust
First cover spray	Scab, powdery mildew, cedar apple rust and fruit rots
Second cover spray	Scab and fruit rots
Third through seventh cover sprays	Scab, fruit rots, sooty blotch and fly speck

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Fruit and Nut Crops - Apple

Table 4. Fungicide efficacy for apple scab and powdery mildew diseases

Symbols for fungicide efficacy categories: ++++ = Excellent and Consistent; +++ = Good and Reliable; ++ = Moderate and Variable; + = Limited and/or Erratic; +/- = Minimal and often ineffective - = Ineffective.

Table was reproduced from 2013 University of California Pest Management Guidelines

(<http://www.ipm.ucdavis.edu/PMG/r4902111.html>).

Fungicide (Product mode of action)	Scab Protectant	Scab Eradicant	Powdery mildew
Inspire Super (3, 9)	++++	++++	++++
Flint (11)	++++	++++	++++
Fontelis (7)	++++	++	+++
Pristine (7, 11)	++++	-	+++
Procure (3)	++++	++++	++++
Scala (9)	+++	+++	+
Sovran (11)	+++	+++	+++
Syllit (M)	+++	+++	-
Tebuzol (3)	+++	+++	+++
Topsin M or T-methyl or Incognito (1)	+++	+++	+++
Vangard (9)	+++	+++	+++
PH-D (19)	+	+	+++
Captan (M)	+++	-	-
Dithane or Manzate or Penncozeb (M)	+++	-	-
Ziram (M)	++	-	-
Copper* (M)	++	-	-
Lime sulfur (M)	-	++++	+++
Sulfur* (M)	++	-	++++

*Copper and sulfur can cause fruit scarring.

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Fruit and Nut Crops - Apple

Table 5. Recommended pesticides, rates and pesticide use restrictions for apple

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 and Product Mode of Action Group		Rate	PHI	Maximum Use
Apple scab (<i>Venturia inaequalis</i>)	Copper hydroxide (various products)	M	See labels	1-2	See labels
	Copper sulfate				
	MasterCop ¹	M	See label	See label	See label
	Double Nickel 55 ^{OG}		0.25-3 lb	0	
	Fontelis	29	16-20 fl oz	28	61 fl oz
	Indar2F	3	6-8 fl oz	14	32 fl oz
	Omega 500F	7	10-13.8 fl oz	28	8.625 pt
	PH-D (suppression only)	19	6.2 oz	0	6 app
	Pristine	7, 11	14.5-18.5 oz	0	74 oz
	Rally 40VSP	3	5-8 oz	14	5 lb
	Rally 40VSP (post-infection)	3	8 oz	14	5 lb
	Scala (applied alone)	9	7-10 fl oz	72	40 fl oz
	Scala (tank mixed)	9	5 fl oz	72	40 fl oz
	Sovran	11	3.2-6.4 oz	30	25.6 oz
	Serenade ^{OG}	44	2-6 qt	0	
	Serenade MAX ^{OG}	44	1-3 lb	0	
	Sulfur (various products)	M	See labels	1	See labels
	Thiophanate-methyl				
	85WDG	1	0.6-0.8 lb	3	3.3 lb
	Topsin 4.5FL	1	15-20 fl oz	1	80 fl oz
	Topsin M WSB	1	0.75-1 lb	1	4 lb
	T-Methyl 4.5F	1	15-20 oz	1	4 lb
	T-Methyl 70WSB	1	1 lb	1	4 lb
	Incognito 4.5F	1	15-20 fl oz	1	80 fl oz
	Cercobin	1	16-21.8 fl oz	1	87.2 fl oz
	Topguard Specialty Crops	3	13 fl oz	14	52 fl oz
	Vacciplant ³		14 fl oz	See label	See label
	Vintage		6-12 fl oz	30	48 fl oz
	Ziram 76DF	M	6-8 lb	14	56 lb
Bitter rot (<i>Glomerella cingulata</i> = <i>Colletotrichum gloeosporioides</i>)	Adament 50WG	3, 11	4-6 oz	75	22 oz
	Captan (various products)	M	See labels	0	See labels
	Copper hydroxide (various products)	M	See labels	1-2	See labels
	Double Nickel 55 ^{OG}		0.25-3 lb	0	
	Flint 50VSP	11	2-2.5 oz	14	11 oz
	Merivon	7, 11	4-5.5 fl oz	0	22 fl oz
	Omega 500F	29	13.8 fl oz	28	8.625 pt
	Pristine	7, 11	14.5-18.5 oz	0	74 oz
	Scholar SC (post harvest drench)	12	10-16 fl oz/100 gal	0	1 app
	Serenade ^{OG}	44	2-6 qt	0	
	Serenade MAX ^{OG}	44	1-3 lb	0	
	Thiophanate-methyl 85WDG	1	0.6-0.8 lb	3	3.3 lb
	Ziram	M	6-8 lb	14	56 lb
Cedar apple rust (<i>Gymnosporangium juniperi-virginianae</i>)	Adament 50WG	3, 11	4-6 oz	75	22 oz
	Double Nickel 55 ^{OG}		0.25-3 lb	0	
	Flint	11	2-2.5 oz	14	11 oz
	Fontelis	7	16-20 fl oz	28	61 fl oz
	Indar 2F	3	6-8 fl oz	14	32 fl oz
	Inspire Super	9, 3	8.5-12 fl oz	14	60 fl oz
	Mancozeb (various products)	M	See labels	See labels	See labels
	Merivon	7, 11	4-5.5 fl oz	0	22 fl oz
	Omega 500F	29	13.8 fl oz	28	8.625 pt
	Pristine	7, 11	14.5-18.5 oz	0	74 oz
	Procure 480SC	3	8-16 fl oz	14	64 fl oz
	Propiconazole				

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Disease (Pathogen)	Product Choices and Product Mode of Action Group		Rate	PHI	Maximum Use
	Inspire Super MP	3	4 fl oz	72	20 fl oz
	Propicon 3.6EC ²	3	4 fl oz	See label	20 fl oz
	Topaz ²	3	4 fl oz	See label	20 fl oz
	Rally 40WSP	3	5-8 oz	14	5 lb
	Serenade ^{OG}	44	2-6 qt	0	
	Serenade MAX ^{OG}	44	1-3 lb	0	
	Sovran	11	3.2-6.4 oz	30	25.6 oz
	Topguard Specialty Crops	3	8-12 fl oz	14	56 fl oz
	Vintage	3	9-12 fl oz	30	48 fl oz
	Ziram	M	6-8 lb	14	56 lb
Fire blight (<i>Erwinia amylovora</i>)	Agri-mycin 17	25	24-48 oz	50	See label
	Aliette WDG	33	2-5 lb	14	20 lb
	Copper hydroxide (various products)	M	See labels	1-2	See labels
	Copper sulfate				
	Copper sulfate crystals	M	5 lb	See label	See label
	Cuprofix Ultra 40	M	5-7.5 lb	See label	40 lb
	MasterCop ¹	M	See label	See label	See label
	Double Nickel 55 ^{OG}		0.25-3 lb	0	
	Mancozeb (various products)	M	See labels	See labels	See labels
	Mankocide	M	8-16 lb	77	See label
	Nordox	M	1-16 lb	1	See label
	Phosphorous acid				
	Alude	33	1-2 qt	0	
	Confine Extra	33	1-3 qt/100 gal		
	K-Phite 7LP	33	2-8 qt/20 gal		
	Phostrol	33	2.5-5 pt		
	Potassium phosphite				
	Fosphite	33	1-3 qt	0	
	Fungi-phite	33	2-4 pt	0	
	Rampart	33	1-3 qt/100 gal		
Phytophthora crown, collar and root rot (<i>Phytophthora</i> spp.)	Serenade ^{OG}	44	2-6 qt	0	
	Serenade MAX ^{OG}	44	2-3 lb	0	
	Vacciplant ³		14 fl oz	See label	See label
	Aliette WDG (root dip)	33	3 lb/100 gal	0	1 app
	Aliette WDG (foliar)	33	2.5-5.0 lb	14	20 lb
	MasterCop ¹	M	1.5 pt	0	1 app
	Mefenoxam				
	Ridomil Gold	4	2 qt		2 app (fall & spring)
	Metalaxyl				
	Metastar 2E	4	2 gal		2 app (fall & spring)
	Metalaxyl 2E AG	4	2 gal		2 app (fall & spring)
	Ultra Flourish	4	8 pt	See label	1 app
	Phosphorous acid				
	Alude	33	0.67 fl oz/gal		
	Confine Extra (root dip)	33	0.67 fl oz/gal		
	K-Phite 7LP (root dip)	33	2.5-5 pt		1 app
	Phostrol				1 app
	Potassium phosphite	33	2 qt/100 gal		
	Rampart (root dip)	33	1-3 qt/100 gal		
	Rampart (foliar)	33			1 app

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Disease (Pathogen)	Product Choices and Product Mode of Action Group		Rate	PHI	Maximum Use
Powdery mildew (<i>Podosphaera leucotricha</i>)	Double Nickel 55 ^{OG}		0.25-3 lb	0	
	Fontelis	7	16-20 fl oz	28	61 fl oz
	Indar 2F	3	6-8 fl oz	14	32 fl oz
	PH-D	19	6.2 oz	0	6 app
	Rally 40WSP	3	5-10 oz	14	5 lb
	Serenade ^{OG}	44	2-6 qt	0	
	Serenade MAX ^{OG}	44	1-3 lb	0	
	Sulfur (various products)	M	See labels	1	See labels
	Thiophanate-methyl 85WDG	1	0.6-0.8 lb	3	3.3 lb
	Topsin 4.5FL	1	15-20 fl oz	1	80 fl oz
	Topsin M WSB	1	0.75-1 lb	1	4 lb
	T-Methyl 4.5Ag	1	15-20 oz	1	4 lb
	T-Methyl 70WSB	1	1 lb	1	4 lb
	Incognito 4.5F	1	15-20 fl oz	1	80 fl oz
	Cercobin	1	16-21.8 fl oz	1	87.2 fl oz
	Topguard Specialty Crops	3	8-12 fl oz	14	56 fl oz
	Propiconazole				
	Inspire Super MP	3	4 fl oz	72	20 fl oz
	Propicon 3.6EC ²	3	4 fl oz	See label	20 fl oz
	Topaz ²	3	4 fl oz	See label	20 fl oz
	Vintage	3	6-9 fl oz	30	48 fl oz

¹Rates vary depending on the time of application (i.e., fall, late dormant, growing season, etc.).

²Registered for nonbearing fruits and nuts only.

³Apply with another registered bactericide or fungicide.

Information in this section was last updated in December 2019 by Dr. R. Singh.

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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. 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 postharvest sanitation should be developed. 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 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 – Jefferson, Orleans, Plaquemine, St. Bernard and Washington parishes.

Asian citrus psyllid (transmits citrus greening pathogen) – Jefferson, Orleans, Lafourche, Plaquemines, St. Bernard, St. Charles, St. James, St. Tammany, Tangipahoa and Terrebonne parishes.

Citrus canker – The current citrus canker quarantined areas include: the entire parishes of Jefferson, Lafourche, Orleans, Plaquemines, St. Bernard, St. Charles, St. James and St. John. Additionally, citrus canker has been detected in East Baton Rouge and Livingston parishes.

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.

For complete information on citrus diseases, consult Louisiana Home Citrus Production Guide, LSU AgCenter Publication 1234 (rev. 5/16).

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Fruit and Nut Crops - Citrus

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

Disease (Pathogen)	
Anthracnose <i>(Colletotrichum spp.)</i>	Symptoms: The disease can cause symptoms on both leaves and fruit. It produces light tan spots with dark purple margins on the leaves. Dry, firm decay of fruits occurs and the entire fruit rots during wet weather. Source of Inoculum: The lesions on the fruit and leaves produce spores that may disperse with water splashed from rain or irrigation. Management: Removal of infected fruits both from the ground and on the tree is crucial to reduce the fungal spores. Follow a fungicide spray program to manage Anthracnose (see below).
Brown rot (<i>Phytophthora</i> spp.)	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. 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. Management: Prune to remove low-hanging branches and fruit. Follow a fungicide spray program to manage <i>Phytophthora</i> root rot (see below).
Citrus canker <i>(Xanthomonas axonopodis pv. citri)</i>	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. 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. 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.
Citrus greening or Huanglongbing <i>(Candidatus Liberibacter asiaticus, C. L. americanus)</i>	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. Leaf veins become raised and corky. Fruit are small and lopsided with internal discoloration (orange-brown staining). The disease causes uneven ripening of fruits and abortion of seeds in the fruit. Overall symptoms in the canopy are unevenly distributed. 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. Management: Use clean bud wood, certified healthy trees, and only purchase trees from a certified nursery. Use good sanitation practices.
Citrus scab <i>(Elsinöe fawcettii)</i>	Symptoms: Citrus scab causes disease on a variety of citrus including grapefruit, lemon, satsuma and tangerine and on rootstocks of sour and trifoliate oranges. Sweet orange is not affected. 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. Source of Inoculum: The fungus causing scab survives in old pustules on leaves and fruit. Spores are spread primarily by rain splash. Management: Follow a fungicide spray program.
Greasy spot (<i>Mycosphaerella citri</i>)	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. Source of Inoculum: Spores produced in previously infected decomposing fallen leaves during warm, wet periods of late spring and early summer. Management: Good sanitation practices and the use of a fungicide spray program.

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Fruit and Nut Crops - Citrus

Disease (Pathogen)	
Melanose <i>(Diaporthe citri)</i>	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. Source of Inoculum: The fungus colonizes and survives in dead twigs. Fungal spores are spread primarily by rain splashing and wind-driven rain, although windborne spores also may be produced. 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.
Penicillium decays (Green, blue and Whisker molds) <i>(Penicillium spp.)</i>	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. Source of Inoculum: These fungi are common saprophytes in citrus groves. They also survive on contaminated packing equipment resulting in postharvest decay. Management: Prevent fruit injury at harvest. Sanitize postharvest equipment and storage areas. Follow a fungicide spray program.
Phytophthora root rot, Foot rot and Gummosis <i>(Phytophthora spp.)</i>	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. <i>Phytophthora</i> root rot symptoms progress more rapidly in the presence of the citrus root weevil. Source of Inoculum: The pathogen survives in the soil and moves in running or splashing water. Management: Use resistant rootstock, improve drainage and manage irrigation. Follow a fungicide spray program.
Postbloom fruit drop (PFD) <i>(Colletotrichum acutatum)</i>	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. 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. Management: Avoid overhead irrigation during blooming period to reduce leaf wetness period. Follow a fungicide spray program.
Sooty mold (<i>Capnodium spp.</i>)	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. Management: Control honeydew-producing insects. Wash off with soapy water or loosen and protect using dormant oils.
Sour rot <i>(Geotrichum candidum)</i>	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. 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 postharvest decay. Management: Prevent fruit injury during harvesting. Prevent fruit from coming in contact with the soil. Sanitize postharvest equipment daily. Do not reuse packing boxes.
Sweet orange scab (<i>Elsinöe australis</i>)	Symptoms: Sweet orange scab causes disease on cultivars of sweet orange, satsuma, tangerine, grapefruit and lemon as well as sour orange and trifoliate orange rootstocks. Sweet orange scab affects fruit, leaves and young shoots causing irregular, slightly raised, corky, scabby growths. Source of Inoculum: The fungus causing sweet orange scab survives in old pustules on leaves and fruit. Spores are spread primarily by rain splash. Management: Follow a fungicide spray program.

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Fruit and Nut Crops - Citrus

Table 2. Seasonal fungicide spray schedule for citrus

Season	Fungicide Application Timing	Disease
Prebloom	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 Postbloom fruit drop Sweet orange scab
Postbloom	All citrus	Anthrachnose Citrus scab Melanose Sweet orange scab
June 15 to July 15	All citrus	Anthrachnose Citrus scab Greasy spot Melanose Sweet orange scab
October 15 to November 15	All citrus	Anthrachnose Brown rot
Soil treatment	All citrus	Phytophthora root rot

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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
Anthraxnose (<i>Colletotrichum</i> spp.)	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 and copper oxychloride	M			
	Badge SC	M	3-7 pt	0	44.4 pt
	Badge X2 ^{OG}		1.8-3.5 lb	0	12.6 lb Cu
	copper Sulfate	M			
	Cuprofix-Ultra Disperss	M	1.8-6 lb	0	31.5 lb
	Cuproxat		5-13 pt	0	62 pt
	cuprous oxide				
Brown rot (<i>Phytophthora</i> spp.)	Nordox	M	4-20 lb		
	Top Cop with Sulfur	M	4 qt/100 gal	0	
	Aliette	33	5 lb	30	20 lb
	copper hydroxide			0	
	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		36 lb
	copper hydroxide and copper oxychloride			0	
	Badge SC	M	3-7 pt	0	44.4 pt
	Badge X2 ^{OG}	M	1.8-3.5 lb		12.6 lb Cu
	copper Sulfate			0	
	Cuprofix-Ultra Disperss	M	1.8-6 lb	0	31.5 lb
	Cuproxat	M	5-13 pt		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			0	
Citrus canker (<i>Xanthomonas axonopodis</i> pv. <i>citri</i>)	Helena Prophyt	33	4 pt	0	
	Phostrol	33	4.5 pt		
	Top Cop with Sulfur	M	4 qt/100 gal		
	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 and copper oxychloride				
	Badge SC	M	2-11 pt	0	44.4 pt
	Badge X2 ^{OG}	M	2-5 lb	0	12.6 lb Cu
Citrus scab (<i>Elsinöe fawcettii</i>)	copper sulfate				
	Cuprofix-Ultra Disperss	M	1.3-8 lb	0	31.5 lb
	Cuproxat	M	3-15.5 pt	0	62.1 pt
	cuprous oxide				
	Nordox	M	12 lb	0	
	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 and copper oxychloride				

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Disease (Pathogen)	Product Choices ² and Product Mode of Action Group ³		Rate ⁴	PHI ⁵	Maximum Use
	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 2 F	3	8 fl oz	0	24 fl oz
	Gem 500 SC	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 (<i>Mycosphaerella citri</i>)	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 and 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 500 SC	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				
	Amide Propiconazole	3	6-8 fl oz	1 yr	24 fl oz
	41.8% EC				
	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%		

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Fruit and Nut Crops - Citrus

Disease (Pathogen)	Product Choices ² and Product Mode of Action Group ³		Rate ⁴	PHI ⁵	Maximum Use
Melanose (<i>Diaporthe citri</i>)	Abound	I I	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 and 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
	Gem 500 SC	I I	1.9-3.8 fl oz	0	15.2 fl oz
	Headline and Headline SC	I I	12-15 fl oz	0	54 fl oz
Penicillium decays (Green, blue and Whisker molds) (<i>Penicillium</i> spp.)	Pristine	7, I I	16-18.5 oz	0	74 fl oz
	Quadris Top	I I, 3	15.4 fl oz	0	61.5 fl oz
	Abound	I I	12-15.5 fl oz	0	92.3 fl oz
	Fungi-Phite	33	2 qt/100 gal		
Phytophthora root rot, Foot rot and Gummosis (<i>Phytophthora</i> spp.)	Graduate A+	I I, 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
	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 and 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
	Cuproxat	M	1.2-2 pt/gal ⁹	0	62.1 pt
	mefenoxam				
	Ridomil Gold GR	4	40-80 lb ⁶		3 app
	Ridomil Gold SL	4	1-2 qt ⁶		3 app
	Ultra Flourish	4	4-8 pt ⁶		24 pt
	MetaStar 2 E	4	1-2 gal ⁶		3 app
	phosphorous acid				
	Helena Prophyt	33	4 pt		
Post-bloom fruit drop (PFD) (<i>Colletotrichum acutatum</i>)	Phostrol	33	4.5 pt		
	Fungi-Phite	33	2 qt/100 gal		
	Abound	I I	12-15.5 fl oz	0	92.3 fl oz
	Gem 500 SC	I I	1.9-3.8 fl oz	0	15.2 fl oz
	Headline and Headline SC	I I	12-15 fl oz	0	54 fl oz
Sour rot (<i>Geotrichum candidum</i>)	Quadris Top	I I, 3	15.4 fl oz	0	61.5 fl oz
	Trilogy ^{OG}		1%		
	No fungicides are available to manage sour rot decay. Fruit injury prevention and good postharvest sanitation practices are recommended.				
Sooty mold (<i>Capnodium</i> spp.)	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. 24 fl oz
Sweet orange scab (<i>Elsinöe australis</i>)	Enable 2 F		8 fl oz	0	
	Abound	I I	12-15.5 fl oz	0	92.3 fl oz
	Quadris Top	I I, 3	10-15.4 fl oz	0	61.5 fl oz

Commercial Crop Production

Fruit and Nut Crops - Citrus

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 shade houses.

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

⁵Postharvest 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 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.

⁸Postharvest 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.

Information in this section was last updated in December 2019 by Dr. R. Singh.

Commercial Crop Production

Fruit and Nut Crops - Fig

Integrated 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 LSU AgCenter publication 1529, "Figs-For Commercial and Home Production in Louisiana."

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

Disease (Pathogen)	
Fig rust (<i>Cerotelium fici</i>)	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. Source of Inoculum: Fungal spores survive on fallen, infected and diseased leaves. Spores are dispersed by wind and splashing rain. 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.
Thread blight (<i>Pellicularia koleroga</i> , formerly <i>Corticium stevensii</i>)	Symptoms: Symptoms appear as semicircular brown spots at the base of the leaf. Most infected leaves shrivel and dry up but do not fall off the tree. Leaves may also be covered with irregular holes. Sometimes white threads or mycelia can be seen on the underside of the leaves. Dead leaves often hang on the tree by threadlike strands similar to spider webs. Figs turn hard and dry if the disease occurs before the fruit ripens. Source of Inoculum: The pathogen survives as sclerotia (overwintering structures) on the plant, in plant debris or in the soil. Management: Collect and destroy leaf debris. Selective pruning will increase airflow in the plant canopy. Pruning should be done in the dormant season to avoid freeze damage. Do not overhead irrigate as leaf wetness promotes infection. No fungicides are registered for control of thread blight in Louisiana.
Leaf spot (<i>Cercospora fici</i>)	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. Source of Inoculum: The fungus survives on infested seed and crop debris. Spores are disseminated by wind and splashing rain and irrigation water. 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.
Web blight (<i>Rhizoctonia solani</i>)	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. Source of Inoculum: The pathogen survives as sclerotia on the plant, in plant debris or in the soil. 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.
Root-knot nematodes (<i>Meloidogyne</i> spp.)	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.

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Fruit and Nut Crops - Fig

Disease (Pathogen)	
	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. Management: Nematodes are difficult to control but can be prevented. Choose a planting site where root knot susceptible plants such as tomatoes, 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>)	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 form on heavily infected limbs. Source of Inoculum: Heavy frosts initiate disease, and wet and cool springs favor disease development. Spores are wind-dispersed. Management: Remove diseased shoots by pruning below the cankered area. Sanitize pruners with an EPA registered disinfectant between cuts.
Surface mold or Alternaria rot (<i>Alternaria alternata</i> , <i>Cladosporium herbarum</i>)	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. Specks caused by <i>Alternaria</i> are light brown to black. 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. 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. 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.
Aspergillus rot (<i>Aspergillus</i> spp.)	Symptoms: The internal tissues of figs turn bright yellow to olive 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. Source of Inoculum: The fungus overwinters on plant debris and is dispersed by wind or on dust particles. 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.
Fig endosepsis (<i>Fusarium</i> spp.)	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. 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. Management: Sample fruits when wasps start emerging and discard fruits with any internal discoloration.
Fig mosaic (<i>Fig mosaic virus</i>)	Symptoms: Distinct yellow spots appear on foliage with diffuse margins. 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. Premature fruit drop may occur.

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Fruit and Nut Crops - Fig

Disease (Pathogen)	
	Source of Inoculum: The virus is vectored by fig mites (<i>Aceria fici</i>) or can be transmitted by grafting. 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.
Fig smut (<i>Aspergillus niger</i> and <i>Aspergillus</i> spp.)	Symptoms: Internal tissues of the fruit or the entire fruit discolor and turn into black powdery masses of spores. 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. Management: Remove all old fruit and debris from the field.
Sour rot or Souring (various yeasts and bacteria)	Symptoms: Symptoms can be observed when the fruit begin to open. The inner flesh of figs becomes pink and water-soaked. A pink bubbly syrupy liquid exudes from the figs, which then 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. 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. 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.

Information in this section was last updated in December 2019 by Dr. R. Singh.

Commercial Crop Production

Fruit and Nut Crops - Mayhaw

Integrated Disease Management

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 lowlands 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 mayhaw diseases

Disease (Pathogen)	
Fire blight (<i>Erwinia amylovora</i>)	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. Source of Inoculum: The bacterium survives in old cankers and is dispersed by splashing rain, wind-driven rain, bees and other insects. Management: Plant-resistant varieties (Table 2). Prune out diseased branches. Sanitize pruning equipment. Aliette (2.5-5 lbs/100 gal) can be applied to nonfruit-bearing trees. Fosphite (Aluminum tris, 1-3 qt/100 gal) can be applied to fruit-bearing and nonfruit-bearing trees. Alude (2.5-5 pt/A) can be applied to manage fire blight.
Cedar-quince rust (<i>Gymnosporangium clavipes</i>)	Symptoms: Infected fruit develop pimply projections and ripen unevenly. Infected twigs become thickened and deformed. Source of Inoculum: The fungus overwinters in cankers on eastern red cedar and some junipers. Spores are wind-dispersed. Management: Adament (4-5 oz/A), 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.

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Fruit and Nut Crops - Mayhaw

Table 2. Mayhaw varieties, variety characteristics and resistance to fire blight

Resistance categories: R = Resistant; T = Tolerant; S = Susceptible; VS = Very susceptible

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-size 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-size 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-size red fruit, moderate level of fruit drop, does not hold fruit well in high winds	T
Royal Star (G5)	Thornless 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

Information in this section was last updated in December 2019 by Dr. R. Singh.

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Fruit Crops - Pear

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

Disease (Pathogen)	
Black rot (<i>Botryosphaeria obtusae</i>)	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. Source of Inoculum: The fungus survives between seasons on infected wood and fruit. Spores are released from fungal fruiting structures during rain events. 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.
Blossom blast (<i>Pseudomonas syringae</i>)	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. 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. 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.
Fire blight (<i>Erwinia amylovora</i>)	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. 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. 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.
Early leaf spot or Fabraea leaf (<i>Fabraea</i> spp.)	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. 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. 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.
Flyspeck (<i>Schizothyrium pomi</i> , formerly <i>Microthyriella rubi</i>)	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. Source of Inoculum: The fruiting structures survive between seasons on infected twigs. Spores are dispersed by wind. 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.
Crown gall (<i>Agrobacterium tumefaciens</i>)	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. Source of Inoculum: This bacterium lives in the soil. 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.
Leaf spots (various fungi)	Symptoms: Leaf spots vary in size depending on the pathogen. Severely infected leaves turn yellow and drop from the tree. 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.

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Fruit Crops - Pear

Disease (Pathogen)	
	Management: Rake and bury or burn diseased leaves. Dispersion can be reduced by increasing space between trees. Use labeled fungicides.
Powdery mildew (<i>Podosphaera leucotricha</i>)	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. Source of Inoculum: The fungus overwinters in dormant buds infected the previous season. Spores are released in the air during the day and germinate during dry weather. 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.
Pear scab (<i>Venturia pirina</i>)	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. Source of Inoculum: The fungus overwinters mainly in infected leaves on the ground but it may also survive in infected twigs. Management: Rake and burn fallen leaves. Begin sprays in April after leaves have unfolded. Follow a pear spray schedule.
Quince rust (<i>Gymnosporangium clavipes</i>)	Symptoms: Dark green spots form on the calyx end of fruit and extend internally to the core. Fruit are distorted and drop prematurely. 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. 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.
Sooty blotch (<i>Gloeodes pomigena</i> and other fungi)	Symptoms: Olive green, soot-like smudges on mature fruit. Fungal fruiting bodies are produced in the thallus. 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 throughout the growing season. 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.

Commercial Crop Production

Fruit Crops - Pear

Table 2. Seasonal fungicide spray schedule for pears

Developmental Stage	Diseases
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

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Fruit Crops - Pear

Table 3. Recommended pesticides, rates and pesticide use restrictions for pears

Chemical Name (Product Mode of Action Group¹)	Product Name²	Rate³	Maximum Use	PHI⁴	Diseases
boscalid + pyraclostrobin (7, 11)	Pristine	14.5-18.5 oz	74 oz	0	Pear scab Flyspeck Powdery mildew Quince rust (suppression) Sooty blotch
captan	Captan 50WP Captan 80WDG	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.)
copper hydroxide (M1) ^{6,7}	Badge SC Badge X20G 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
copper hydroxide+ mancozeb ^{6,7} (M1, M3)	ManKocide	1.5 lb	53.3 lb	See label	Fire blight (Do not apply after bloom.) Blossom blast
copper sulfate ^{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)
copper sulfate + copper oxychloride ^{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
difenoconazole+ cyprodinil (3, 9)	Inspire Super	12 fl oz	60 fl oz	14	Flyspeck Powdery mildew Quince rust Sooty blotch
fenarimol (3)	Rubigan EC Vintage SC	8-12 fl oz 4-12 fl oz	84 fl oz 48 fl oz	30 30	Pear scab Powdery mildew Rusts Pear scab Powdery mildew

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Fruit Crops - Pear

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Diseases
fluxapyroxad + pyraclostrobin (7, 11)	Merivon	4-5.5 fl oz	22 fl oz	0	Flyspeck Pear scab Powdery mildew Sooty blotch Quince rust (suppression only)
fosetyl-al (33)	Aliette WDG	2.5-5 lb/100 gal	20 lb	1 year	Fire blight
kresoxim-methyl (11)	Sovran	3.2-6.4 oz	25.6 oz	30	Pear scab Powdery mildew Quince rust (suppression only)
mancozeb ⁷ (M3)	Dithane F45 Rainshield Dithane M45 Manzate Flowable OR Max Manzate Pro- stick Penncozeb 75DF Penncozeb 80WVP Roper Rainshield	4.8 qt 3-6 lb 2.4-4.8 qt 3-6 lb 3.2-6.4 lb 3-6 lb 3-6 lb	19.2 qt 21-24 lb 16.8-19.2 qt 21-24 lb 22.4-25.6 lb 21-24 lb 21-24 lb	See labels	Early leaf spot Fire blight (see label for rates) Pear scab Rusts
oxytetracycline (41)	Mycoshield	1 lb/100 gal	10 app	60	Fire blight
penthiopyrad (7)	Fontelis	16-20 fl oz	61 fl oz	28	Pear scab Powdery mildew Rusts
phosphite (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
pyrimethanil	Scala SC	7-10 fl oz (alone) 5 fl oz (tank mix)	40	72	Pear scab
streptomycin (25)	Agri-Mycin 17	24-48 oz	See label	30	Fire blight
sulfur 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
tebuconazole (3)	Tebuzol 45DF	4-8 oz	3 lb	75	Pear scab Powdery mildew

Commercial Crop Production

Fruit Crops - Pear

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Diseases
tebuconazole + trifloxystrobin (3, 11)	Adament 50WG	4-5 oz	22 oz	75	Pear scab Powdery mildew Flyspeck Sooty blotch
thiabendazole (1)	Mertect 340F	16 fl oz/100 gal	1 app	NA	Postharvest rots (harvested fruit only)
thiophanate- methyl (1)	T-Methyl 70WSB Thiophanate- methyl 85WDG Topsin M 70WP Topsin M WSB	1 lb 0.8 lb 1 lb 1 lb	4 lb 3.2 lb 4 lb 4 lb	1 1 1 1	Pear scab Flyspeck Leaf spots Powdery mildew Sooty blotch
triflumizole	Procure 480SC	8-16 fl oz	64 fl oz	14	Pear scab Powdery mildew
trifloxystrobin (11)	Flint	2-2.5 oz	11 oz	14	Early leaf spot Flyspeck Pear scab Powdery mildew Sooty blotch
trifloxystrobin+ triadimefon (11, 3)	Strike Plus 50WDG	3-9 oz/100 gal (Non- bearing only, garden center and nursery stock only)	207 oz	1 year	Early leaf spot Pear scab Powdery mildew
ziram	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.

⁴Postharvest 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.

Information in this section was last updated in December 2019 by Dr. R. Singh.

Commercial Crop Production

Fruit and Nut Crops - Pecan

Integrated 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://cgru.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 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 the front of this guide.

Commercial Crop Production

Fruit and Nut Crops - Pecan

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

Disease	
Anthracnose <i>(Colletotrichum spp., Glomerella cingulata)</i>	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. Source of Inoculum: Spores are dispersed in the spring and early summer by rainfall. Management: Plant resistant varieties. Remove and destroy diseased plant material. No fungicides are available for homeowners. Commercial fungicides are listed in Table 4.
Bacterial leaf Scorch <i>(Xylella fastidiosa)</i>	Symptoms: Symptoms of bacterial leaf scorch include chlorotic mottling of the leaves that starts from the tips and margins and progresses toward the midribs. As disease develops, leaf tips and margins become necrotic. Once a tree is infected, there is no cure. Source of Inoculum: The bacterium resides in the xylem vessels (water-conducting channels) of the tree, where it multiplies and blocks these channels and eventually obstructs the flow of water and nutrients within the plant. The bacterium is transmitted and spread by xylem-feeding insects, such as sharp shooters, leaf hoppers or spittle bugs. Management: There are no chemicals available to manage bacterial leaf scorch. Cultural practices that improve plant vigor, such as proper watering and fertilization, may help the infected plants to live longer. Pruning symptomatic branches will not save the plant. Detection and removal of infected plants at early stages may help reduce subsequent spread of the pathogen. Management of insect that transmit bacterial leaf scorch is critical to prevent disease spread.
Brown leaf spot <i>(Cercospora spp.)</i>	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. Source of Inoculum: Fungus lives from year to year in infected spots on the old leaves. Spores are windborne. 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 the pecan spray schedule.
Downy spot <i>(Mycosphaerella spp.)</i>	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. Source of Inoculum: Fungus lives from year to year in infected leaves. Management: Plant-resistant or tolerant varieties (i.e. Schley, Success, Mahan and Western). Remove and destroy fallen leaves. Follow the pecan spray schedule.
Powdery mildew <i>(Microsphaera alni)</i>	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. Source of Inoculum: Infected leaf and shuck debris. 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 the pecan spray schedule. A regular scab spray program will manage powdery mildew.
Scab <i>(Cladosporium carpophilum, C. caryigenum)</i>	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. Source of Inoculum: Fungus may overwinter in infested shucks, leaf stems or leaves. The fungus is spread by windborne spores and is boosted by high humidity. 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 the pecan spray schedule.

Commercial Crop Production

Fruit and Nut Crops - Pecan

Disease	
Shuck dieback and stem end blight <i>(Phomopsis spp. and other fungal pathogens)</i>	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. Source of Inoculum: Fungi overwinter in dislodged nuts. 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.
Vein spot <i>(Gnomonia nerviseda)</i>	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. Source of Inoculum: Fungus lives through the winter on fallen leaves. Management: The pre-pollination spray and first cover sprays are essential for control.
Zonate leaf spot <i>(Cristulariella moricola)</i>	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. Source of Inoculum: The fungus overwinters in resting bodies, called sclerotia, on plant debris. Leaf wetness in the spring initiates new infections. 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.

Commercial Crop Production

Fruit and Nut Crops - Pecan

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: 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 - Pecan

Table 3. Seasonal fungicide spray schedule for pecans.

Season	Fungicide Application Timing	Disease
First pre-pollination	When leaves are at least 1 inch long	Anthrachnose Downy spot Scab Vein spot Zonate leaf spot
Second pre-pollination	When leaves have grown (or 10-14 days after first spray)	Anthrachnose Downy spot Scab Vein spot Zonate leaf spot
First cover spray	2-3 weeks after previous spray	Downy spot Scab Vein 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

¹Sprays may be omitted during dry weather.

²Do not apply fungicides after shuck split.

Commercial Crop Production

Fruit and Nut Crops - Pecan

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
Anthraxnose (<i>Colletotrichum</i> spp., <i>Glomerella cingulata</i>)	azoxystrobin				
	Abound	11	12 fl oz	45	73.8 fl oz
	Aframe	11	12 fl oz	45	73.8 fl oz
	Azaka	11	6-12 fl oz	45 ⁶	73.8 fl oz
	Azoxystar	11	6-12 fl oz	45	73.8 fl oz
	Satori	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 ⁶	69 fl oz
	Orius	3	4-6 fl oz	see footnote ⁶	32 fl oz
	Pristine	7, 11	10.5-14.5 oz	14	32 fl oz
	Quilt	11, 3	14-27.5 fl oz	45	58 oz
	Quilt Excel	11, 3	14-21 fl oz	45	122 fl oz
	Regalia	P5	0.5-1 qt	0	122 fl oz
	Stratego	3, 11	10 fl oz	30 ⁶	-
	tebuconazole + trifloxystrobin				
	Absolute 500SC	3, 11	5-7.7 fl oz	30	30 fl oz
	Adament 50WG	3, 11	4-8 oz	60	46 oz
	Topguard	3, 11	7-14 fl oz	14	32 oz
	Viathon	3, 33	2 pt (early season only)	see footnote ⁶	56 fl oz 16.5 pt
	Willow AzoxyProp	3, 11	14-21 fl oz	45 ⁶	115 fl oz
	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
	Eminent VP	3	6-16 fl oz	30 ⁶	64 fl oz
	propiconazole ⁵				
	Banner MAXX	3	12 fl oz	See footnote ⁶	24 fl oz
	Bumper ES	3	4-8 fl oz	See footnote ⁶	32 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 ¹¹				
	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
	Orius 3.6F	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 2	1, 3	25 fl oz	See footnote ⁶	See footnote ⁹
	triphenyltin hydrozide				
	Agri Tin	30	5-7.5 oz	30	45 fl oz
	Super Tin 80WP	30	5-7.5 oz	30	45 fl oz
	Viathon	3, 33	2-2.5 pt ⁷	See footnote ⁶	16.5 pt

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Fruit and Nut Crops - Pecan

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
Downy spot (<i>Mycosphaerella</i> spp.)	azoxystrobin + 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
	Eminent VP	3	6-16 fl oz	30 ⁶	64 fl oz
	propiconazole ^{5,10}		4-8 fl oz	See footnote ⁶	32 fl oz
	Bumper ES	3	12 fl oz	See footnote ⁶	32 fl oz
	Procon-Z	3	4-8 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	8-14 fl oz	45	56 fl oz
	Quadris Top	11, 3	14-27.5 fl oz	45 ⁶	122 fl oz
	Quilt	11, 3	14-21 fl oz	45 ⁶	122 fl oz
	Quilt Excel	11, 3			
	tebuconazole ¹¹				
	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
	Orius 3.6F	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 2	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	45 oz
	Viathon	33, 3	2-2.5 pt ⁷	See footnote ⁶	16.5 pt
	Willow AzoxyProp	3, 11	14-21 fl oz	30 ⁶	115 fl oz
Powdery mildew (<i>Microsphaera alni</i>)	Actinovate ^{OG}		3-12 oz		
	Adament 50WG	3, 11	4-8 oz	60 ⁶	32 oz
	Enable 2F	3	8 fl oz	28 ⁶	1.5 qt
	Eminent VP	3	6-16 fl oz	28 ⁶	64 fl oz
	potassium phosphite				
	Fosphite	33	1-3 qt		
	K-Phite 7LP AG	33	1-3 qt		
	Rampart	33	1-3 qt		
	propiconazole ^{5,10}				
	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				
	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 2	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

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Fruit and Nut Crops - Pecan

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Super Tin 80WP	30	5-7.5 oz	30	45 oz
	Willow AzoxyProp	3, 11	14-21 fl oz	30 ⁶	115 fl oz
Scab (<i>Cladosporium</i> <i>carpopophilum</i> , <i>C.</i> <i>caryigenum</i>)	azoxystrobin				
	Abound	11	6-12 fl oz	45	73.8 fl oz
	Aframe	11	6-12 fl oz	45	73.8 fl oz
	Azaka	11	6-12 fl oz	45	73.8 fl oz
	Azoxystar	11	6-12 fl oz	45	73.8 fl oz
	Satori	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
	Double Nickel 55 ^{OG}		see label	0	see label
	Elast ⁵	M	3 pt	See footnote ⁶	18 pt
	Eminent VP	3	6-16 fl oz	30 ⁶	64 fl oz
	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 ^{5,10}				
	Bumper ES	3	4-8 fl oz	See footnote ⁶	32 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
	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 ¹¹				
	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
	Orius 3.6F	3	4-8 fl oz	See footnote ⁶	32 fl oz
	tebuconazole + trifloxystrobin				
	Absolute 500SC	3, 11	5-7.7 fl oz	30	46 fl oz
	Adament 50WG	3, 11	4-8 oz	60	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 2	1, 3	25 fl oz	See footnote ⁶	See footnote ⁹
	Topguard				
	Trilogy ^{OG}	3	7-14 fl oz	14	56 fl oz
	triphenyltin hydrozide		1%		
	Agri Tin	30	5-7.5 oz	30	45 fl oz
	Super Tin 80WP	30	5-7.5 oz	30	45 fl oz
	Viathon	3, 33	2-2.5 pt ⁷	See footnote ⁶	16.5 pt
	Willow AzoxyProp	3, 11	14-21 fl oz	30 ⁶	115 fl oz
	Ziram 76DF	M	6-8 lb	55	48.2 lb
Vein spot (<i>Gnomonia nerveda</i>)	azoxystrobin + tebuconazole				
	Custodia	3, 11	8.6-17.2 fl oz	45	69 fl oz
	Eminent VP	3	6-16 fl oz	30 ⁶	64 fl oz
	Enable 2F	3	8 fl oz	28 ⁶	1.5 qt
	propiconazole ^{5,10}				
	Bumper ES	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Procon-Z	3	12 fl oz	See footnote ⁶	32 fl oz

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Fruit and Nut Crops - Pecan

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Topaz	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Orbit	3	4-8 fl oz	See footnote ⁶	32 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 ¹¹				
	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
	Orius 3.6F	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Topsin XTRA 2	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
	Willow Azoxyp	3, 11	14-21 fl oz	30 ⁶	115 fl oz
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 2FL	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 ⁶	69 fl oz
	Eminent VP	3	6-16 fl oz	30 ⁶	64 fl oz
	propiconazole				
	Amtide 41.8EC	3	4-8 fl oz	See footnote ⁶	32 fl oz
	Banner MAXX	3	12 fl oz	See footnote ⁶	24 fl oz
	Bumper 41.8EC	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 ⁶	122 fl oz
	Quilt	11, 3	14-21 fl oz	45 ⁶	122 fl oz
	tebuconazole ¹¹				
	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
	Orius 3.6F	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
	Topsin XTRA 2	1, 3	25 fl oz	See footnote ⁶	See label
	Viathan	3, 33	2-2.5 pt ⁷	See footnote ⁶	16.5 pt
	Willow Azoxyp	3, 11	14-21 fl oz	30 ⁶	115 fl oz

¹Reference to commercial or trade names is made with the understanding that no discrimination or endorsement of a particular product is implied by LSU or the LSU AgCenter.

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.

⁴Postharvest 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.

¹⁰Also registered are: Propensity 1.3ME, Propicure 3.6F, Strider and Willowood Propican 3.6EC.

¹¹Also registered are: Tebu-Crop 3.6F, Tebuzol and Topaz.

Information in this section was last updated in December 2019 by Dr. R. Singh.

Commercial Crop Production

Fruit and Nut Crops - Stone Fruits

Table 1. Symptoms, source of inoculum and management of nectarine, peach, plum and other stone fruit diseases.

Disease (Pathogen)	Disease Description
Armillaria root rot (<i>Armillaria</i> (= <i>Clitocybe</i>) spp.)	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. Source of Inoculum: These fungi live in soil and survive for many years in old, diseased roots. Management: Dig up and burn old roots before planting peach trees. Remove dead trees and as many roots as possible. Fumigate before replanting.
Brown rot blossom blight and/or fruit rot (<i>Monilinia</i> spp.)	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. Source of Inoculum: The fungus overwinters in peach “mummies” on the tree or ground and in twig cankers. 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 fence row seedlings as far away as possible from producing trees. Follow the stone fruit fungicide spray program.
Bacterial spot (<i>Xanthomonas arbuticola</i> pv. <i>pruni</i>)	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. Source of Inoculum: The bacterium survives from one year to the next in twig cankers and is primarily rain-splashed. 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.
Black knot (<i>Apiosporina</i> = <i>Dibotryon morbosum</i>)	Symptoms: This disease occurs on plum and cherry. Large, rough, coal black, hard swellings or knots occur along the branches, frequently several inches long. Source of Inoculum: The fungus survives in infected tissue of knots or swellings. 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.
Crown gall (<i>Agrobacterium tumefaciens</i>)	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. Source of Inoculum: This bacterium lives in the soil. Management: Check planting stock for galls or swelling and rogue-infected plants. Treat before planting with Galltrol.
Peach leaf curl (<i>Taphrina deformans</i>)	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 become 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. Source of Inoculum: The fungus lives from one year to the next on limbs or on the ground. Management: Monitor trees for symptoms. Apply fungicides if disease is confirmed.

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Fruit and Nut Crops - Stone Fruits

Disease (Pathogen)	Disease Description
Phony peach <i>(Xylella fastidiosa)</i>	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. Source of Inoculum: This bacterium lives in infected trees of many species and is spread by xylem-feeding insects and root grafting. Management: Rogue out and burn all infected trees. Also, destroy wild plum and peach seedlings in the neighborhood of producing trees.
Rhizopus rot (<i>Rhizopus</i> spp.)	Symptoms: Normally an important postharvest 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. Source of Inoculum: Spores are present in soil on organic matter and airborne. Management: Avoid wounding the fruit. Practice sanitation within and around the packing shed. Spray with Botran before harvest.
Rust <i>(Tranzschelia discolor)</i>	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. Source of Inoculum: The fungus overwinters as mycelium in twigs or as spores on twigs or leaves clinging to the tree. Management: Follow the stone fruit fungicide spray program.
Scab <i>(Cladosporium carpophilum)</i>	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. Source of Inoculum: The fungus lives from year to year in infected twigs. Management: Prune to allow increased air circulation. Avoid low-lying planting sites. Follow the stone fruit fungicide spray schedule.

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Fruit and Nut Crops - Stone Fruits

Table 2. Seasonal fungicide spray schedule for peach, nectarine, plum 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	Black knot Blossom blight
Postbloom	Petal fall to 1% shuck split	Bacterial spot Black knot Scab
	Shuck split to 10% shuck off	Bacterial spot Scab
	7-10 days after shuck split spray	Bacterial spot Scab
Summer cover sprays	7- to 21-day intervals, usually 14 days	Bacterial spot Scab
Preharvest	21 days before harvest	Brown rot (only if disease pressure is high)
	14 and 7 days (or less) before harvest	Botrytis rot Brown rot Rhizopus rot
Postharvest fruit handling		Botrytis rot Brown rot Gibbertella rot Rhizopus rot

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Fruit and Nut Crops - Stone Fruits

Table 3. Efficacy of selected fungicides against peach, nectarine 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: - = no benefit; + = suppression; ++ = poor; +++ = fair; ++++ = good activity; +++++ = excellent; and ++++++ = superior. No data are provided for products 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
oxytetracycline (Mycoshield, Fireline)	-	++++R	-	-	-	-	-	-	-
azoxystrobin (Abound)	-	-	-	++++ R	++++	-	-	++++ R	-
trifloxystrobin (Gem)	-	-	-	+++++ R	++++	-	-	+++++ R	-
captan (Captan, Captec, etc.)	-	-	++	++++	+++	-	++	+++	+
chlorothalonil	++++	-	+++	++++	-	-	-	-	-
coppers (various products)	+++	++++R	-	-	-	-	-	-	-
(Botran)	-	-	+	-	-	-	-	+	++
(Ferbam)	++++	-	-	-	-	+++	-	-	-
iprodione (Rovral)	-	-	++++	-	-	++	++	-	-
boscalid + pyraclostrobin (Pristine)	-	-	+++++	++++	++++	-	-	+++++	+++
(Fontelis)	-	-	++++	++		-	-	+++++ R	+
(Merivon)	-	-	+++++	++++	++++	-	-	+++++	+++
cyprodinil + difenoconazole (Inspire Super)	-	-	+++++	+++		-	-	+++++	
(Scholar)	-	-	-	-	-	-	-	+++++	++++
tebuconazole + trifloxystrobin (Adament)	-	-	+++	++++	+++	-	-	+++	++
azoxystrobin+	-	-	++++	++++	+++	-	-	++++	++

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Fruit and Nut Crops - Stone Fruits

Chemical name (Fungicide product name)	Leaf curl	Bacterial spot	Blossom blight	Scab	Anthrachnose	Red spot	Sooty peach	Brown spot	Rhizopus rot
difenoconazole (Quadris Top)									
sulfur (various)	-	-	+	+++	-	-		+	-
tebuconazole (Elite, Orius, Tebuzol)	-	-	+++++	-	-	-	-	+++++ R	-
(Thiram)	+++	+	-	+	-	+++	+++	-	-
(Topguard)	-	-	++++	-	-	-	-	++++ R	-
thiophanate-methyl (Topsin M, Thiophanate-methyl)	-	-	++++ R	++++ R	-	-	-	++++ R	-
pyrimethanil (Vanguard, Scala)	-	-	++++	-	-	-	-	-	-
fludioxonil (Scholar)	-	-	-	-	-	-	-	++++	++++
(Orbit, PropiMax, Bumper)	-	-	++++	-	-	-	-	++++ R	-
(Rally)	-	-	+++	-	-	-	-	+ R	-
fenbuconazole (Inder)	-	-	+++++	++	-	-	-	+++++ R	-
metconazole (Quash)	-	-	+++++	-	-	-	-	+++++ R	-
(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 affected 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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Fruit and Nut Crops - Stone Fruits

Table 4. Recommended pesticides, rates and pesticide use restrictions for pear, nectarine, plum and other stone fruit.

Chemical Name (Product Mode of Action Group¹)	Product Name²	Rate³	Maximum Use	PHI⁴	Comments
aluminum tris (33)	Aliette	5 lb/100 gal	20 lb	NA	Controls collar and root rot caused by <i>Phytophthora</i> spp. Apply only to trees that will not produce fruit for 12 months.
azoxystrobin (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.
azoxystrobin + difenoconazole (11, 3)	Quadris Top	12-14 fl oz	56 fl oz	0	See label for application timings specific to each disease.
azoxystrobin + propiconazole (11, 3)	Quilt Xcel	14 fl oz	70 fl oz	0	See label for application timings specific to each disease.
boscalid + pyraclostrobin (7, 11)	Pristine	10.5-14.5 oz	72.5 oz	0	
captan (M4)	Captan 50WP Captan 80WDG Captan 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.
chlorothalonil (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	Do not apply Bravo Ultrex or Echo 90DF after shuck split or before harvest.
copper hydroxide (M1)	Badge SC Badge X2 Champ WG Champ Formula 2 Kantan 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 60 lb 51.4 lb	21 21 21 21 21 6 app 21	See label for application rates specific to each disease.
copper sulfate (M1)	Cuprofix Ultra 40 Disperss Cuproxat 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.
copper sulfate + copper oxychloride	C-O-C-S WDG	12-15.6 lb (dormant) 1-2.9 lb (bloom)	35 lb		

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Fruit and Nut Crops - Stone Fruits

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Comments
(M1)					
cyprodinil (9)	Vangard WG	5 oz	30 oz	2	No more than 2 applications by air.
difenoconazole + cyprodinil (3, 9)	Inspire Super	16-20 fl oz	80 fl oz	2	No more than 2 applications by air.
dicloran (14)	Botran 75W	2 lb	5.3 lb	10	
fenbuconazole (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.
fludioxonil (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.
fenhexamid (17)	Elevate 50WG	1.5 lb (alone) 1-1.5 lb (tank mix)	6 lb	0	
fluxapyroxad + pyraclostrobin (7, 11)	Merivon	4-6.7 fl oz	20.1 fl oz	0	
iprodione (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.
mefenoxam (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.

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Fruit and Nut Crops - Stone Fruits

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Comments
metconazole (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.
myclobutanil (3)	Eagle 20EW Rally 40WSP	2-3 fl oz/100 gal 2.5-6 oz	84-100 fl oz 2.75-3.25 lb	0 0	See label for maximum application rates specific to each commodity.
oxytetracycline (41)	Mycoshield	12 oz/100 gal	12 lb	21	Bacterial spot management only.
phosphite (33)	Confine Extra Fosphite Fungi-phite Helena Prophyt Rampart	1-3 qt (foliar) 1-3 qt 1-2 qt 2 pt 1-3 qt	NA NA NA 4 apps NA	0 0 0 0 0	See label for root dip and trunk injection rates.
propiconazole (3)	Propiconazole Banner MAXX Bumper 41.8EC Bumper ES Fitness Procon-Z Strider Tilt Topaz Willowood Propicon 3.6EC	4 fl oz 2-4 fl oz/100 gal 4 fl oz 4 fl oz 4 fl oz 2-4 fl oz/100 gal 2-4 fl oz/100 gal 4 fl oz 4 fl oz 4 fl oz	20 fl oz see label 20 fl oz 20 fl oz 20 fl oz see label see label 20 fl oz 20 fl oz 20 fl oz	0 0 0 0 0 0 0 0 0 0	Do not apply Banner MAXX, Strider or Procon-Z to trees that will bear harvestable fruit within 12 months.
propiconazole + thiophanate-methyl (3, 1)	Protocol	1.3-3.75	6.6 pt	1	See label for application rates specific to each disease.
pyrimethanil (9)	Scala SC	9-18 fl oz	54 fl oz	2	Do not use on cherries.
sulfur (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		
tebuconazole (3)	Elite 45WP Orius 20AQ Tebuzol 45DF	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.

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Fruit and Nut Crops - Stone Fruits

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Comments
tebuconazole + trifloxystrobin (3, 11)	Adament 50WG	4-8 oz	32 oz	1	
thiophanate-methyl (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 nonbearing years of new plantings and nursery stock.
trifloxystrobin (11)	Gem	1.9-3.8 fl oz	15.2 fl oz	1	
ziram (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 or endorsement of a particular product is implied by LSU or the LSU AgCenter.

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.

⁴Postharvest 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 720SST and Daconil Weather Stik.

Information in the stone fruit section was last updated December 2019 by Dr. R. Singh.

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</i> , <i>Rhizoctonia</i>
African violet (<i>Saintpaulia</i>)	Gray mold 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</i> , <i>Rhizoctonia</i> <i>Phytophthora</i> , <i>Pythium</i>
Agapanthus	Bacterial leaf blight Bulb and root rot Gray mold Leaf spot Root rot	<i>Xanthomonas</i> <i>Fusarium</i> , <i>Rhizoctonia</i> <i>Botrytis</i> <i>Colletotrichum</i> , <i>Myrothecium</i> <i>Phytophthora</i> , <i>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 rolfsii</i>
Aglaonema	Anthraxnose Bacterial leaf spot Bacterial soft rot Leaf spot Root rot Root and stem rot Stem rot Southern blight	<i>Colletotrichum</i> , <i>Glomerella</i> <i>Pseudomonas</i> , <i>Xanthomonas</i> <i>Erwinia</i> <i>Cercospora</i> , <i>Corynespora</i> , <i>Myrothecium</i> <i>Pythium</i> , <i>Rhizoctonia</i> <i>Cylindrocladiella</i> , <i>Fusarium</i> , <i>Phytophthora</i> <i>Cylindrocladium</i> <i>Sclerotium rolfsii</i>
Ajuga	Leaf spot Root rot Root and crown rot Southern blight	<i>Alternaria</i> , <i>Cercospora</i> , <i>Colletotrichum</i> , <i>Corynespora</i> , <i>Myrothecium</i> , <i>Stemphylium</i> <i>Pythium</i> , <i>Rhizoctonia</i> <i>Fusarium</i> <i>Sclerotium rolfsii</i>
Almond, flowering (<i>Prunus triloba</i>)	Blossom and twig blight Gray mold Rust	<i>Monilinia</i> <i>Botrytis</i> <i>Tranzschelia</i>
Adenium (Desert rose)	Leaf spot Root and stem rot	<i>Aristastoma</i> <i>Rosellinia</i>
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>

Commercial Crop Production

Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
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 rolfsii</i>
Aphelandra	Anthracnose Bacterial leaf spot Bacterial soft rRot 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 rolfsii</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 Powdery mildew Rust	<i>Gloeosporium</i> <i>Ganoderma</i> <i>Cercospora</i> , <i>Cercosporidium</i> , <i>Cylindrosporium</i> <i>Oidium</i> <i>Puccinia</i>
Asian jasmine	Blight Root rot	<i>Rhizoctonia</i> <i>Armillaria</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	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>

Commercial Crop Production

Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Azalea	Damping-off Dieback Flower blight Foliage blight Leaf gall Leaf spot Powdery mildew Root rot Web blight	<i>Rhizoctonia</i> <i>Phytophthora</i> <i>Ovulinia</i> <i>Phytophthora</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 Leaf spot Powdery mildew Rust	<i>Pseudomonas</i> <i>Gloeosporium</i> <i>Erysiphe</i> , <i>Phyllactinia</i> <i>Cumminsella</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	Anthrachnose 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	Anthrachnose Leaf spot Powdery mildew	<i>Gloeosporium</i> <i>Septoria</i> <i>Phyllactinia</i>
Black cherry	Anthrachnose 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	Anthrachnose Leaf spot Powdery mildew	<i>Gloeosporium</i> <i>Ascochyta</i> , <i>Cercospora</i> , <i>Septoria</i> <i>Microsphaera</i> , <i>Uncinula</i>

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Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Boxwood	Canker Dieback Leaf spot Root rot Stem blight	<i>Nectria</i> <i>Colletotrichum theobromicola</i> <i>Macrophoma</i> , <i>Phyllosticta</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Volutella</i>
Browallia	Root rot	<i>Phytophthora</i> , <i>Pythium</i>
Buckeye	Anthrachnose Leaf blotch Leaf spot Powdery mildew	<i>Glomerella</i> <i>Phyllosticta</i> <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	Anthrachnose 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	Anthrachnose 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>
Catalpa	Anthrachnose Leaf spot Powdery mildew	<i>Gloeosporium</i> <i>Cercospora</i> , <i>Phyllosticta</i> <i>Microsphaera</i> , <i>Phyllactinia</i>
Cattleya skinneri	Root rot	<i>Phytophthora</i> , <i>Pythium</i>

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Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
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	Anthrachnose Leaf spot Powdery mildew Root rot	<i>Colletotrichum</i> <i>Actinopelte</i> , <i>Phyllosticta</i> <i>Phyllactinia</i> <i>Armillaria</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>
Chrysanthemum	Anthrachnose 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>Alternaria</i> , <i>Septoria</i> <i>Erysiphe</i> <i>Ascochyta</i> , <i>Mycosphaerella</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Puccinia</i> <i>Fusarium</i>
Cineraria	Powdery mildew Root rot	<i>Erysiphe</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Cissus	Leaf spot Root rot	<i>Cercospora</i> <i>Phytophthora</i> , <i>Pythium</i>
Clarkia	Gray mold Root rot	<i>Botrytis</i> <i>Rhizoctonia</i>
Clematis	Leaf spot	<i>Ascochyta</i> , <i>Cercospora</i>

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Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Cleome	White mold	<i>Sclerotinia sclerotiorum</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 Witch's broom	<i>Cercospora</i> <i>Phytoplasma</i>
Confederate jasmine	Anthraxnose Leaf spot Root rot Stem rot	<i>Colletotrichum</i> <i>Cercospora, Corynespora</i> <i>Armillaria</i> <i>Fusarium, Rhizoctonia</i>
Cordyline	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>
Cornflower	Leaf spot Rust Root rot Stem rot White mold	<i>Cercospora, Septoria</i> <i>Puccinia</i> <i>Phytophthora</i> <i>Rhizoctonia</i> <i>Sclerotinia sclerotiorum</i>
Cosmos	Leaf spot Powdery mildew Stem rot	<i>Cercospora</i> <i>Erysiphe</i> <i>Rhizoctonia</i>
Cotoneaster	Leaf spot Root rot	<i>Cercospora, Phyllosticta</i> <i>Phytophthora, Pythium</i>
Cottonwood	Leaf blister Leaf spot Powdery mildew Rust	<i>Taphrina</i> <i>Cercospora, 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	Bacterial leaf spot Leaf spot Powdery mildew Root rot	<i>Xanthomonas</i> <i>Cercospora, Pestalotia, Phyllosticta</i> <i>Erysiphe, Phyllactinia</i> <i>Armillaria, Phytophthora, Pythium, Rhizoctonia</i>
Crassula	Leaf spot Powdery mildew Root rot	<i>Cercospora, Phomopsis</i> <i>Spaerotheca</i> <i>Phytophthora, Pythium</i>
Croton	Root rot	<i>Fusarium, Phytophthora, Rhizoctonia, Thielaviopsis</i>
Crown vetch	Anthraxnose Leaf spot	<i>Colletotrichum</i> <i>Cercospora</i>
Cycas or cycad	Root rot	<i>Phytophthora</i>

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Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
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>Phytophthora</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>
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	Anthraxnose 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>
Dwarf bamboo	Leaf spot Rust	<i>Corynespora</i> <i>Puccinia</i>

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Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
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 Twig dieback Tip blight	<i>Cercospora</i> <i>Phytophthora</i> <i>Phytophthora</i> <i>Fusarium</i> <i>Gloeosporium</i>
Elm	Anthrachnose Bacterial leaf scorch Leaf spot Powdery mildew Root rot	<i>Gloeosporium</i> <i>Xylella fastidiosa</i> <i>Cercospora</i> , <i>Gnomonia</i> <i>Microsphaera</i> , <i>Phyllactinia</i> , <i>Uncinula</i> <i>Armillaria</i> , <i>Phytophthora</i>
Euonymus	Anthrachnose 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	Anthrachnose 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>
Forget-me-not	Gray mold Powdery mildew Rust	<i>Botrytis</i> <i>Erysiphe</i> <i>Puccinia</i>
Forsythia	Anthrachnose 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>

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Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
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	Anthraxnose 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	Anthraxnose	<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>
Gloxinia	Root rot	<i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Golden dewdrop (<i>Duranta erecta</i>)	Leaf blight	<i>Xanthomonas</i>
Golden rain	Leaf spot	<i>Cercospora</i>
Grapeleaf ivy	Anthraxnose Leaf spot Powdery mildew	<i>Colletotrichum</i> <i>Cercospora</i> <i>Oidium</i>
Gynura	Root rot	<i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Gypsophila	Root rot	<i>Phytophthora</i> , <i>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 amylovora</i> <i>Fabraea</i> <i>Phyllactinia</i> , <i>Podosphaera</i> <i>Rhizoctonia</i> <i>Gymnosporangium</i> <i>Venturia</i> <i>Fusarium</i>
Heather	Root rot	<i>Phytophthora</i> , <i>Pythium</i>
Hen and chickens	Leaf spot Root rot	<i>Cercospora</i> <i>Fusarium</i> , <i>Rhizoctonia</i>

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Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Hibiscus	Anthracnose Gray mold Leaf spot Powdery mildew Root rot Rust Stem rot	<i>Colletotrichum</i> <i>Botrytis</i> <i>Cercospora</i> , <i>Phyllosticta</i> <i>Erysiphe</i> , <i>Microsphaera</i> <i>Phytophthora</i> , <i>Pythium</i> <i>Kuehneola</i> <i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Sclerotinia</i>
Hickory	Anthracnose Leaf spot Powdery mildew	<i>Gnomonia</i> <i>Cercospora</i> , <i>Septoria</i> <i>Microsphaera</i>
Holly	Leaf spot Powdery mildew Purple spot Root rot Stem canker Twig dieback Web blight	<i>Gloeosporium</i> , <i>Phyllosticta</i> <i>Microsphaera</i> <i>Cercospora</i> <i>Phytophthora</i> , <i>Rhizoctonia</i> <i>Botryodiplodia</i> <i>Phoma</i> <i>Rhizoctonia</i>
Hollyhock	Anthracnose Leaf spot Petal blight Powdery mildew Rust	<i>Colletotrichum</i> <i>Ascochyta</i> , <i>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</i> , <i>Phyllosticta</i> <i>Microsphaera</i> <i>Phytophthora</i> , <i>Pythium</i>
Hornbeam	Leaf Blister Powdery mildew	<i>Taphrina</i> <i>Microsphaera</i> , <i>Phyllactinia</i>
Hosta	Crown rot Leaf spot Stem rot	<i>Botrytis</i> <i>Colletotrichum</i> , <i>Phyllosticta</i> <i>Rhizoctonia</i>
Hoya	Root rot	<i>Phytophthora</i> , <i>Pythium</i> , <i>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</i> , <i>Cercospora</i> , <i>Colletotrichum</i> , <i>Phyllosticta</i> , <i>Septoria</i> <i>Erysiphe</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i> <i>Pucciniastrum</i>
Ilex	Root rot	<i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Impatiens	Downy mildew Leaf spot Root rot	<i>Plasmopara obducens</i> <i>Cercospora</i> , <i>Septoria</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>

Commercial Crop Production

Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Iris	Anthrachnose Blossom blight Bulb rot Crown rot Leaf spot Root rot Rust	<i>Colletotrichum</i> <i>Botrytis</i> <i>Fusarium</i> , <i>Penicillium</i> <i>Pellicularia</i> <i>Didymellina</i> <i>Rhizoctonia</i> <i>Puccinia</i>
Iris, African	Root rot	<i>Phytophthora</i>
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.)	Anthrachnose Bacterial leaf scorch Leaf spot Scab	<i>Colletotrichum</i> <i>Xylella fastidiosa</i> <i>Septoria</i> <i>Fusicladium</i>
Japanese yew	Leaf spot Root rot	<i>Cercospora</i> , <i>Phomopsis</i> <i>Armillaria</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	Anthrachnose 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	Anthrachnose 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>
Larkspur	Root rot Stem rot	<i>Phytophthora</i> , <i>Pythium</i> <i>Rhizoctonia</i>
Lavender	Root rot	<i>Phytophthora</i>

Commercial Crop Production

Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Leatherleaf fern	Blight Leaf spot	<i>Ascochyta</i> , <i>Rhizoctonia</i> <i>Cercospora</i> , <i>Cylindrocladium</i>
Leopard plant	Root rot	<i>Rhizoctonia</i>
Leucothoe	Leaf spot Root rot	<i>Cercospora</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Liatris	Leaf spot Rust	<i>Phyllosticta</i> , <i>Septoria</i> <i>Coleosporium</i> , <i>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</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i> <i>Botryodiplodia</i> <i>Rhizoctonia</i>
Lily	Blight Gray mold Root rot	<i>Phytophthora</i> <i>Botrytis</i> <i>Rhizoctonia</i>
Linden	Anthraxnose Leaf spot	<i>Gloeosporium</i> <i>Cercospora</i>
Lipstick	Leaf spot	<i>Cercospora</i>
Liriope	Anthraxnose Crown rot Leaf and crown rot Leaf spot Root rot	<i>Colletotrichum</i> <i>Fusarium</i> <i>Phytophthora</i> <i>Cercospora</i> <i>Fusarium</i> , <i>Rhizoctonia</i>
Lobelia	Leaf spot Root rot	<i>Cercospora</i> , <i>Septoria</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Locust, black	Anthraxnose Leaf spot Powdery mildew	<i>Colletotrichum</i> <i>Cercospora</i> <i>Microsphaera</i>
Loquat	Bacterial leaf scorch Fire blight Root rot Twig dieback	<i>Xylella fastidiosa</i> <i>Erwinia amylovora</i> <i>Armillaria</i> <i>Botryodiplodia</i>
Loropetalum	Bacterial stem gall Root rot	<i>Pseudomonas</i> <i>Armillaria</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
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>Gloeosporium</i> , <i>Septoria</i> <i>Elsinoe</i> <i>Armillaria</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>

Commercial Crop Production

Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Maple	Anthrachnose 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.)	Anthrachnose Leaf and 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>
Nandina	Anthrachnose 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	Anthrachnose Blight Leaf spot Powdery mildew	<i>Colletotrichum</i> <i>Rhizoctonia</i> <i>Phyllosticta</i> <i>Oidium</i>
Nematanthus	Root rot	<i>Phytophthora</i>
Nemesia	Necrotic spot	<i>Impatiens necrotic spot virus</i>
Nephrolepis	Root rot	<i>Phytophthora</i> , <i>Pythium</i>
Nephthytis	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	Anthrachnose Bacterial flux Bacterial leaf scorch Heart rot Leaf blister Leaf spot Powdery mildew	<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>

Commercial Crop Production

Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
	Rust	<i>Cronartium</i>
Oleander	Anthrachnose 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>
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 Date palm lethal decline Wilt	<i>Botryodiplodia</i> , <i>Serenomyces</i> <i>Candidatus Phytoplasma palmae</i> <i>Fusarium oxysporum</i> f. sp. <i>canariensis</i>
Palm, Date	Heart rot Date palm lethal decline	<i>Ganoderma</i> <i>Candidatus Phytoplasma palmae</i>
Palm, Fan	Bud rot	<i>Phytophthora</i>
Palm, Parlor	Leaf spot	<i>Helminthosporium</i>
Palm, Sabal	Leaf spot Date palm lethal decline Heart rot Root rot	<i>Ascochyta</i> , <i>Phyllosticta</i> <i>Candidatus Phytoplasma palmae</i> <i>Ganoderma</i> <i>Rhizoctonia</i>
Palm, Sylvester	Leaf spot Lethal yellowing	<i>Graphiola</i> <i>Candidatus Phytoplasma palmae</i>
Palm, Washingtonia	Leaf spot	<i>Cercospora</i> , <i>Colletotrichum</i>
Palm, Windmill	Bud or heart rot	<i>Phytophthora</i>
Palm, Chinese Windmill	Date palm lethal decline Lethal yellowing	<i>Candidatus Phytoplasma palmae</i> <i>Candidatus Phytoplasma palmae</i>
Pansy	Anthrachnose 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>

Commercial Crop Production

Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Pawpaw	Leaf spot	<i>Phyllosticta</i> , <i>Septoria</i>
Pearl bush	Fire blight	<i>Erwinia amylovora</i>
Pear, flowering	Bacterial leaf scorch Fire blight Powdery mildew	<i>Xylella fastidiosa</i> <i>Erwinia amylovora</i> <i>Podosphaera</i>
Pentas	Leaf spot Powdery mildew Stem rot	<i>Cercospora</i> , <i>Corynespora</i> , <i>Phyllosticta</i> <i>Oidium</i> <i>Fusarium</i> , <i>Rhizoctonia</i>
Peony	Aerial blight Blossom blight Leaf spot	<i>Phytophthora</i> <i>Botrytis</i> <i>Alternaria</i>
Peperomia	Leaf spot Root rot	<i>Cercospora</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Periwinkle	Gray mold Leaf spot Root rot Web blight	<i>Botrytis</i> <i>Colletotrichum</i> , <i>Phyllosticta</i> <i>Phytophthora</i> , <i>Rhizoctonia</i> <i>Rhizoctonia</i>
Persimmon	Anthraxnose 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</i> , <i>Cercospora</i> <i>Oidium</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Philodendron	Aerial blight Bacterial Leaf spot Leaf spot Root rot	<i>Phytophthora</i> <i>Erwinia</i> <i>Dactylaria</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Phlox	Anthraxnose Powdery mildew Root rot Rust Southern blight Stem Rot	<i>Colletotrichum</i> <i>Erysiphe</i> <i>Phytophthora</i> , <i>Pythium</i> <i>Puccinia</i> <i>Sclerotium rolfsii</i> <i>Rhizoctonia</i>
Phlox, perennial	Gray mold Leaf spot Powdery mildew Rust Stem rot	<i>Botrytis</i> <i>Cercospora</i> , <i>Septoria</i> <i>Erysiphe</i> <i>Puccinia</i> , <i>Uromyces</i> <i>Rhizoctonia</i> , <i>Sclerotinia</i>
Photinia	Leaf spot Powdery mildew Root rot Rust Twig dieback	<i>Cercospora</i> , <i>Entomosporium</i> <i>Oidium</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i> <i>Gymnosporangium</i> <i>Botryodiplodia</i>
Pieris	Dieback Leaf spot Root rot	<i>Phytophthora</i> <i>Phyllosticta</i> <i>Phytophthora</i> , <i>Pythium</i>
Pilea	Root rot	<i>Phytophthora</i> , <i>Pythium</i>
Pink	Gray mold Leaf spot Root rot Stem rot	<i>Botrytis</i> <i>Septoria</i> <i>Phytophthora</i> , <i>Pythium</i> <i>Rhizoctonia</i>

Commercial Crop Production Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Pine	Blight Brown spot Canker Needle cast Root rot Rust Tip blight Wilt	<i>Lophodermella</i> <i>Scirrhia</i> <i>Scleroderis</i> <i>Lophodermium</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Cronartium</i> <i>Sirococcus</i> <i>Pine wilt nematode</i>
Pineapple guava	Leaf spot	<i>Cercospora</i>
Pittosporum	Leaf spot Root rot	<i>Cercospora</i> , <i>Phyllosticta</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>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</i> , <i>Pythium</i>
Poinsettia	Blight Root rot Scab	<i>Amphobotrys</i> , <i>Botrytis</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Sphaceloma</i>
Pomegranate	Anthraxnose 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>
Portulaca	Root rot Stem rot	<i>Phytophthora</i> , <i>Pythium</i> <i>Rhizoctonia</i>
Potentilla	Rust	<i>Phragmidium</i>
Pothos	Leaf spot Root rot	<i>Alternaria</i> , <i>Fusarium</i> , <i>Helminthosporium</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Prayer plant	Leaf spot	<i>Helminthosporium</i>
Primrose	Blight Root rot	<i>Botrytis</i> <i>Phytophthora</i> , <i>Pythium</i>
Privet	Leaf spot Powdery mildew	<i>Cercospora</i> <i>Microsphaera</i>
Pyracantha	Fire blight Leaf spot Powdery mildew Scab	<i>Erwinia amylovora</i> <i>Fabraea</i> <i>Podosphaera</i> <i>Venturia</i>
Quince	Leaf spot Rust	<i>Fabraea</i> <i>Gymnosporangium</i>
Redbud	Leaf spot	<i>Cercospora</i>
Rose	Black spot Blossom blight Crown gall Crown rot Downy mildew Leaf spot Powdery mildew	<i>Diplocarpon</i> <i>Botrytis</i> <i>Agrobacterium tumefaciens</i> <i>Phytophthora</i> <i>Peronospora sparsa</i> <i>Alternaria</i> , <i>Cercospora</i> <i>Sphaerotheca</i>

Commercial Crop Production

Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
	Root rot Rust Rose rosette disease Spot anthracnose Stem canker Storage rot	<i>Armillaria</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Phragmidium</i> <i>Rose rosette virus</i> <i>Elsinoe</i> <i>Botryodiplodia</i> <i>Botrytis</i>
Rose of Sharon	Leaf spot	<i>Cercospora</i> , <i>Cristulariella</i> , <i>Phyllosticta</i>
Rudbeckia	Leaf spot Powdery mildew Rust	<i>Cercospora</i> , <i>Septoria</i> <i>Erysiphe</i> <i>Uromyces</i>
Russian olive	Leaf spot Rust Stem canker	<i>Cercospora</i> <i>Puccinia</i> <i>Phytophthora</i>
Sage, Texas	Powdery mildew	<i>Oidium</i>
St. John's-wort	Rust	<i>Uromyces</i>
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</i> , <i>Pythium</i> <i>Rhizoctonia</i> <i>Puccinia</i>
Sansevieria	Anthrachnose Root rot	<i>Colletotrichum</i> <i>Phytophthora</i> , <i>Pythium</i>
Santolina	Blight	<i>Rhizoctonia</i>
Sassafras	Leaf spot Laurel wilt Powdery mildew	<i>Phyllosticta</i> , <i>Septoria</i> <i>Raffaelea lauricola</i> <i>Phyllactinia</i>
Scabiosa	Leaf spot Powdery mildew Rust	<i>Cercospora</i> , <i>Ramularia</i> , <i>Septoria</i> <i>Erysiphe</i> <i>Puccinia</i>
Schefflera	Anthrachnose Blight Leaf spot Root rot Twig Blight	<i>Colletotrichum</i> <i>Alternaria</i> <i>Cercospora</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Pestalotia</i> , <i>Phomopsis</i>
Sedum	Anthrachnose Leaf spot Powdery mildew Root rot Stem rot	<i>Colletotrichum</i> <i>Cercospora</i> , <i>Corynespora</i> , <i>Phyllosticta</i> , <i>Septoria</i> <i>Erysiphe</i> <i>Phytophthora</i> , <i>Pythium</i> <i>Fusarium</i> , <i>Rhizoctonia</i>
Seedlings (general)	Damping-off	<i>Pythium</i> , <i>Rhizoctonia</i>
Sempervivum	Root rot	<i>Phytophthora</i> , <i>Pythium</i>
Shasta daisy	Root rot	<i>Phytophthora</i> , <i>Pythium</i>
Sinningia	Root rot	<i>Phytophthora</i> , <i>Pythium</i>

Commercial Crop Production

Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Snapdragon	Blight Downy mildew Leaf spot Powdery mildew Root rot Rust Stem rot White mold	<i>Botrytis</i> <i>Peronospora</i> <i>Cercospora</i> , <i>Colletotrichum</i> , <i>Phyllosticta</i> <i>Erysiphe</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i> <i>Puccinia</i> <i>Rhizoctonia</i> <i>Sclerotinia sclerotiorum</i>
Sourwood	Leaf spot	<i>Cercospora</i> , <i>Phyllosticta</i>
Spathiphyllum	Leaf spot Root rot Stem blight	<i>Alternaria</i> , <i>Colletotrichum</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>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</i> , <i>Colletotrichum</i> , <i>Phyllosticta</i>
Statice	Anthracnose Leaf blight Leaf spot Root rot	<i>Colletotrichum</i> <i>Alternaria</i> , <i>Botrytis</i> , <i>Cercospora</i> <i>Alternaria</i> , <i>Botrytis</i> , <i>Fusarium</i> , <i>Helminthosporium</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>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</i> , <i>Cercospora</i> , <i>Phyllosticta</i>
Strawberry geranium	Leaf spot	<i>Cercospora</i>
Strawflower	Downy mildew	<i>Bremia</i>
Stromanthe	Root rot	<i>Phytophthora</i> , <i>Pythium</i>
Sumac	Leaf blister Leaf spot Rust	<i>Taphrina</i> <i>Cercospora</i> , <i>Septoria</i> <i>Pileolaria</i>
Sunflower	Downy mildew Leaf and stem blight Leaf spot Powdery mildew Rust	<i>Plasmopara</i> <i>Alternariaster helianthi</i> <i>Cercospora</i> , <i>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</i> , <i>Septoria</i>
Sweet olive	Anthracnose Bacterial leaf scorch Root rot	<i>Colletotrichum</i> <i>Xylella fastidiosa</i> <i>Phytophthora</i>
Sweet pea	Downy mildew Gray mold Leaf spot Powdery mildew Rust Stem rot	<i>Peronospora</i> <i>Botrytis</i> <i>Ascochyta</i> , <i>Colletotrichum</i> , <i>Phyllosticta</i> <i>Erysiphe</i> , <i>Microsphaera</i> <i>Uromyces</i> <i>Rhizoctonia</i>

Commercial Crop Production

Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Sweet william	Leaf spot	<i>Heterosporium</i>
Sycamore	Anthraxnose Leaf spot	<i>Gloeosporium</i> <i>Cercospora</i> , <i>Septoria</i> , <i>Tubakia</i>
Syngonium	Leaf spot Root rot	<i>Cephalosporium</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i>
Tallow	Leaf spot	<i>Phomopsis</i> , <i>Phyllosticta</i>
Tecoma	Root rot	<i>Phytophthora</i>
Titi	Leaf spot Root rot	<i>Phyllosticta</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i>
Tritoma	Anthraxnose	<i>Colletotrichum</i>
Tuberous begonia	Leaf spot Powdery mildew Rot	<i>Cercospora</i> , <i>Phomopsis</i> , <i>Phyllosticta</i> <i>Erysiphe</i> <i>Pythium</i> , <i>Rhizoctonia</i>
Tulips	Anthraxnose Blight Bulb rot Root rot	<i>Gloeosporium</i> <i>Botrytis</i> <i>Fusarium</i> , <i>Penicillium</i> <i>Rhizoctonia</i>
Tulip poplar	Anthraxnose Leaf spot Powdery mildew	<i>Colletotrichum</i> <i>Phyllosticta</i> , <i>Septoria</i> <i>Oidium</i>
Tung oil	Anthraxnose Leaf spot	<i>Glomerella</i> <i>Cercospora</i> , <i>Phyllosticta</i>
Tupelo	Leaf spot Rust	<i>Cercospora</i> , <i>Phyllosticta</i> <i>Aplopsora</i>
Turkey ivy	Leaf spot	<i>Ramularia</i> , <i>Septoria</i>
Verbena	Flower blight Leaf spot Powdery mildew Root rot Rust	<i>Botrytis</i> <i>Cercospora</i> , <i>Septoria</i> <i>Erysiphe</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Puccinia</i>
Viburnum	Anthraxnose 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</i> , <i>Pythium</i> , <i>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</i> , <i>Colletotrichum</i> , <i>Phyllosticta</i> <i>Sphaerotheca</i> <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Puccinia</i> <i>Sphaceloma</i> <i>Fusarium</i> , <i>Rhizoctonia</i>
Vitex	Leaf spot	<i>Cercospora</i>
Walnut	Leaf spot Powdery mildew	<i>Gnomonia</i> <i>Microsphaera</i>

Commercial Crop Production

Ornamentals

Ornamental Plant (Latin Name)	Diseases	Pathogen (Genus)
Wandering yew	Gray mold Leaf spot Root rot	<i>Botrytis</i> <i>Cercospora</i> , <i>Colletotrichum</i> <i>Fusarium</i> , <i>Phytophthora</i> , <i>Rhizoctonia</i>
Wax myrtle	Leaf spot Rust	<i>Cercospora</i> , <i>Phyllosticta</i> , <i>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	Anthrachnose Powdery mildew Root rot Rust	<i>Colletotrichum</i> <i>Erysiphe</i> <i>Rhizoctonia</i> <i>Puccinia</i>
Yaupon	Anthrachnose Leaf spot	<i>Colletotrichum</i> <i>Diplodia</i> , <i>Macrophoma</i> , <i>Phyllosticta</i>
Yew	Root rot Twig blight	<i>Armillaria</i> , <i>Phytophthora</i> , <i>Pythium</i> <i>Physalospora</i>
Yucca	Anthrachnose	<i>Colletotrichum</i>
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</i> , <i>Pythium</i> , <i>Rhizoctonia</i> <i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Sclerotinia</i>
Zygocactus	Root rot	<i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>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 mclobutanil propiconazole triflumizole
Algal eaf 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 thiophanate-methyl trifloxystrobin triflumizole
Black rot (<i>Sclerotinia</i>)	PCNB
Black spot	captan chlorothalonil copper hydroxide kresoxim-methyl

Commercial Crop Production Ornamentals

Disease	Fungicides and Bactericides
	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
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 etridiazole phosphite
Damping-off (<i>Pythium</i>)	boscalid + pyraclostrobin captan cyazofamid etridiazole mefenoxam

Commercial Crop Production Ornamentals

Disease	Fungicides and Bactericides
	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)
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

Commercial Crop Production

Ornamentals

Disease	Fungicides and Bactericides
	boscalid + pyraclostrobin captan chlorothalonil copper hydroxide copper sulfate fludioxonil iprodione kresoxim-methyl mancozeb maneb myclobutanil propiconazole thiophanate-methyl triadimefon trifloxystrobin 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	aluminum tris

Commercial Crop Production Ornamentals

Disease	Fungicides and Bactericides
(<i>Phytophthora</i> , <i>Pythium</i>)	boscalid + pyraclostrobin cyazofamid dimethomorph etridiazole mefenoxam phosphite propamocarb hydrochloride trifloxystrobin
Root rot (<i>Cylindrocladium</i> , <i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Thielaviopsis</i> , etc.)	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> spp.

Commercial Crop Production Ornamentals

Disease	Fungicides and Bactericides
Southern blight	azoxystrobin fludioxonil flutolanil
Stem rot (<i>Phytophthora</i>)	aluminum-tris dimethomorph etridiazole 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> spp.
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> spp.
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 Code ¹	Trade Name(s) ¹	REI (hr)	Comments
aluminum tris (or fosetyl-al)	33	Aliette WDG Fosal Select	12	NOT 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 3 sequential applications; no more than 8 applications or 10 pounds per crop acre per year.
captan	M4	Captan 50WP Captan 80WDG Captec 4L	96	
chlorothalonil	M5	AllPro Exotherm Termil Chlorostar DF Chlorostar VI Chlorothalonil 720F 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 6.0F Mainsail WDG Manicure 6 Flowable Turf and Ornamental Manicure Ultrex Turf and Ornamental Quali-Pro Chlorothalonil 500ZN Quali-Pro Chlorothalonil DF Quali-Pro Chlorothalonil 700 SFT	12	
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 2 soil applications or 4 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 2 sequential applications; no more than 8 applications per crop (greenhouse) or 30.6 fluid ounces per acre per year (outdoors); not for landscape use.
etridiazole	14	Terrazole 35WP Terrazole L Truban 25EC	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 50WDG	12	For <i>Botrytis</i> only; no more than 2 sequential applications; use no more than 6 pounds per acre per season (outdoors) or 2.2 ounces per crop

Commercial Crop Production Ornamentals

Common Name	FRAC Code ¹	Trade Name(s) ¹	REI (hr)	Comments
				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 70WSP ProStar 70WDG ProStar 70WP	12	For diseases caused by Basidiomycetes; not for use in the landscape; no more than 4 applications per year.
imazalil	3	Fungaflor TR	24	For use in greenhouses only.
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 2 sequential applications; no more than 6 applications per season (outdoors) or 8 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 2AQ 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 ; Subdue Maxx can be used in commercial and residential landscapes.
myclobutanil	3	Eagle 20EW Eagle 40WP Eagle WSP Hoist Myclobutanil 20EW TandO	24	
pentachloronitrobenzene (PCNB)	14	Glacier (10G and 4F) Parflo 4F Turficide 10% Granular	12	For soil application.
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 1.1EC Banner MAXX Banner Pro	24	NOT for use in greenhouses; no more than 5.4 gallons per acre per crop per year (outdoors).

Commercial Crop Production Ornamentals

Common Name	FRAC Code ¹	Trade Name(s) ¹	REI (hr)	Comments
		Dorado Fathom 14.3MEC 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		
thiophanate-methyl	I	3336 (DG, F, GC and WP) Allban (50WSB and Flo) Cavalier (50WSB and F) Fungo (50WSB and Flo) OHP 6672 (4.5L and 50W) Quali-Pro TM (4.5 and 85WDG) SysTec 1998 Tee-Off 4.5F T-Methyl E-Pro (4.5F, 50 WSB, GC and Granular) Transom (4.5F and 50WSB) T-Storm	12	
triadimefon	3	Bayleton 50 Turf and Ornamental Fungicide Bayleton Flo Strike 50WDG	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, I	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, I	Banrot 8G Banrot 40WP	12	
fludioxonil + mfenoxam	12, 4	Hurricane WDG	48	NOT for use in landscapes or field plantings.
flutolanil + thiophanate-methyl	7, I	SysStar WDG	12	NOT for use in landscapes.

Commercial Crop Production Ornamentals

Common Name	FRAC Code ¹	Trade Name(s) ¹	REI (hr)	Comments
iprodione + thiophanate-methyl	2, I	26/36	12	NOT for residential use.
mancozeb + myclobutanil	M3, 3	Clevis	24	
mancozeb + thiophanate-methyl	M3, I	Zyban	24	
propamocarb hydrochloride + fluopicolide	28, 43	Stellar	12	For control of downy mildews, <i>Phytophthora</i> and <i>Pythium</i> .
triadimefon + trifloxystrobin	3, II	Armada 50WDG Armada 50WP	12	For interior and landscape use only.

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 or endorsement of a particular product is implied by LSU or the LSU AgCenter.

Information in this section was last updated in December 2019 by Dr. R. Singh.

Commercial Crop Production

Small Fruits – Blackberry (Brambles)

Blackberries are the most commonly grown brambles in Louisiana. Blackberries are native to Louisiana and most commercial cultivars are well-adapted to growing conditions in the state. Thorny type varieties such as CVs. Brazos, Brison, Womack are very productive and early bearing in Louisiana but are susceptible to the fungal disease Rosette (Double Blossom). These cultivars require careful attention to disease management tactics such as pruning on time and preventative fungicide spray programs. Alternatives to the thorny varieties are CVs. Navaho and Arapaho, which are thornless types. These two varieties are not as susceptible to double blossom and don't require as high a level of management as the thorny types.

Table 1. Symptoms, source of inoculum and management of blackberry, raspberry and other bramble diseases.

Disease (Pathogen)	
Anthraxnose (<i>Elsinoe veneta</i>)	Symptoms: Symptoms appear on canes and leaves. Both current and second-year canes can be affected. Circular, light gray spots form on canes; 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. 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. 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.
Botrytis fruit rot and cane blight (<i>Botrytis cinerea</i>)	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. 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. 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.
Cane blight (<i>Leptosphaeria coniothyrium</i>)	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. Source of Inoculum: The fungus survives in infected tissues and dead canes. Spores are rain-splashed. Management: Prune out infected canes, and remove floricanes immediately after harvest. Avoid wounding the plants.
Cane and leaf rust (<i>Kuehneola uredinis</i>)	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 floricane and may lead to premature defoliation. Source of Inoculum: The fungus overwinters on infected canes. Spores are wind-dispersed. Management: Prune out old diseased canes after harvest. Follow the fungicide spray schedule.
Orange rust (<i>Gymnoconia nitens</i>)	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. Source of Inoculum: The fungus overwinters within systemically infected canes. 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.
Phytophthora root rot (<i>Phytophthora</i> spp.)	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.

Commercial Crop Production

Small Fruits – Blackberry (Brambles)

Disease (Pathogen)	
Powdery mildew (<i>Podosphaera aphanis</i> (formerly <i>Sphaerotheca macularis</i>))	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.
Rosette (double blossom) (<i>Cercospora rubi</i>)	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.
Septoria leaf spot (<i>Septoria rubi</i>)	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.
Spur blight (<i>Didymella applanata</i>)	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 promote rapid and excessive growth of new tissue. Remove and destroy wild brambles. Follow a fungicide spray schedule.

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Small Fruits – Blackberry (Brambles)

Table 2. List of disease-resistant blackberry cultivars recommended for production in Louisiana. Resistant categories: R = resistant; MR = moderately resistant; MS = moderately susceptible; S = susceptible; – indicates no data for the variety or disease.

Type, cultivars	Disease			
	Anthracnose	Rosette (double blossom)	Orange Rust	Sunburn (abiotic)
Thorny				
Brazos	R	S		
Brisson	-	S	-	-
Cheyenne	-	S	R	-
Womack	-	S	-	-
Apache	-	S	-	-
Rosborough	-	S	-	-
Shawnee	R	S	R	-
Choctaw	-	S	R	-
Kiowa	-	S	R	-
Chickasaw	R	S	R	-
Thornless				
Arapaho	-	R	R	-
Navaho	R	MR	S	-
Apache	R	R	-	S
Ouachita	R	R	R	S
Trailing				
Youngberry	-	S	-	-

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Small Fruits – Blackberry (Brambles)

Table 3. Seasonal fungicide spray schedule for blackberry, raspberry and other bramble diseases

Developmental Stage	Diseases
Delayed dormant (bud swell to green tip)	Anthrachnose Cane blight Spur blight
Shoots 6 inches long until prebloom	Anthrachnose Cane blight Leaf spots Phytophthora root rot Powdery mildew Rusts Spur blight
Early bloom (5-10%)	Anthrachnose 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.)	Anthrachnose Botrytis gray mold Cane blight Leaf spots Rosette Rusts
Petal fall	Anthrachnose Botrytis gray mold Cane blight Leaf spots Rosette Rusts
Cover sprays	Anthrachnose Botrytis gray mold Cane blight Leaf spots Rosette Rusts
Preharvest (14 days before anticipated harvest date)	Anthrachnose Botrytis gray mold Cane blight Leaf spots Rosette Rusts
Harvest	Anthrachnose Botrytis gray mold Cane blight Leaf spots Rosette Rusts
Postharvest	Cane blight Leaf spots Orange cane blotch Phytophthora Root Rot Powdery mildew Rusts

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Small Fruits – Blackberry (Brambles)

Table 4. Efficacy of selected fungicides against blackberry, raspberry and other bramble diseases. Table was reproduced from the 2015 Southeast Regional Caneberries Integrated Management Guide.

Efficacy ratings: - = ineffective; 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, Captac 4L, Captan 50W)	2	2	2	2	2		2		
copper (various 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	
cyprodinil + fludioxonil (Switch 62.5WG)					5			5	
fenhexamid (Elevate 50WDG)					5				
iprodione (Rovral 4F, Nevada 4F, Iprodione 4L AG)					3				
mefenoxam (Ridomil Gold SL)									4
fosetyl-aL (Aliette WDG)									4
sulfur (various products)							3		
propiconazole (Orbit 3.6EC, Tilt 3.6EC)				4		5			

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Small Fruits – Blackberry (Brambles)

Table 5. Recommended pesticides, rates and pesticide use restrictions for blackberry, raspberry and other bramble diseases.

Chemical Name (Product Mode of Action Group¹)	Product Name²	Rate³	Maximum Use	PHI⁴	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 (M1)	ChampWG 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 0	Leaf spots Phytophthora root rot
propiconazole (3)	Bumper 41.8EC 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 (post-harvest only) Powdery mildew Rusts
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 62.5WG	11-14 oz	56 oz	0	Botrytis gray mold

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Small Fruits – Blackberry (Brambles)

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ³	Maximum Use	PHI ⁴	Diseases
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	I I I I	Anthracnose Cane blight Powdery mildew Spur blight

The information in the bramble section was updated December 2019 by Dr. R. Singh.

Commercial Crop Production

Small Fruits - Blueberry

Integrated Blueberry Disease Management

Successful management of blueberry diseases requires an integrated approach. Choosing appropriate varieties, a well-suited planting site and good soil preparation are all important for preventing blueberry disease problems. 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 (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 the soil before planting, see LSU AgCenter publications 2363, “Commercial Blueberry Production” and 1978, “Home Blueberry Production in Louisiana” or the Mississippi State University Extension Service publication 1758, “Establishment and Maintenance of Blueberries.”

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 2363, “Commercial Blueberry Production.” Applying one inch of mulch under plants each year may help 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 2). 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 3) 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. Although some details about chemical application are given in Table 3, always see the label for complete instructions.

Commercial Crop Production

Small Fruits - Blueberry

Table 1. Diseases of blueberry.

Symptoms, Sources of Inoculum, and Management
Bacterial Leaf Scorch (<i>Xylella fastidiosa</i>) 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 before plants die. Rabbiteye cultivars may show early fall color, and fruit production may decline over time. Source of Inoculum: Infected plants serve as reservoirs for this bacterium. Bacteria are transmitted through propagation or by sharpshooter insects. 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 for insecticide recommendations for leafhoppers.
Botrytis Blight (Gray Mold) (<i>Botrytis cinerea</i>) 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. Source of Inoculum: The fungus survives as dormant mycelia or sclerotia. Spores are wind dispersed. Management: Follow a fungicide spray schedule if needed. (See Tables 2 and 3.)
Exobasidium Fruit and Leaf Spot (<i>Exobasidium maculosum</i>) Symptoms: Whitish spots occur on undersides of leaves, with light green spots on the upper sides. Spots turn brown over time. Fruit also has spots, which remain unripe as the rest of the fruit ripens. Source of Inoculum: The life cycle of this pathogen is still being studied, but it is thought that the fungus overwinters on the surface of the plant and/or in bud scales or bark and infects the plant in the spring. Management: Plant in areas with good air movement. Prune appropriately to allow air movement and spray penetration. An application of lime sulfur has been found to be very effective when made at bud swell, before leaves or flowers appear. Other products can be applied from green tip through the cover spray period. (See Tables 2 and 3.)
Fruit Rots (<i>Alternaria</i>, <i>Colletotrichum</i>, <i>Phomopsis</i>) (including Anthracnose Fruit Rot or Ripe Rot) Symptoms: A variety of rots develop on the fruit as they mature. 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. Management: Harvest ripe fruit regularly, and cool it soon after harvest to minimize postharvest disease development. Follow a fungicide spray schedule, at the interval(s) directed on label(s), if needed. (See Tables 2 and 3.)
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: If needed, follow a fungicide spray schedule at the interval(s) directed on label(s). (See Tables 2 and 3.)
Mummy Berry (<i>Monilinia vaccinii-corymbosi</i>) 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." Source of Inoculum: The fungus survives in the mummified fruit. Spores are wind-dispersed. Management: Remove or bury (1 inch depth) mummified fruit. If mummy berry is an ongoing problem then a fungicide spray schedule should be followed. See Tables 2 and 3. For mummy berry, the first recommended sprays of the season are very important.
Phytophthora Root Rot (<i>Phytophthora cinnamomi</i>) Symptoms: Initially, leaves become yellow and plant growth ceases. Rootlets are killed, and infected roots and crowns are discolored. Bushes may defoliate and die. Source of Inoculum: The pathogen survives as chlamydospores in the soil. Disease development is favored by wet soil conditions and temperatures between 68 F and 90 F. 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" (mono- and di-potassium salts of phosphorus acid or potassium phosphite) products can be applied to foliage during the entire growing season. (See Table 3.) If plants are severely infected, chemicals are not likely to result in a return to healthy plant growth.

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Small Fruits - Blueberry

Symptoms, Sources of Inoculum, and Management

Stem Cankers and Blights (*Phomopsis*, *Botryosphaeria*)

Symptoms: *Phomopsis* twig blight: flower-bearing year-old stems die. *Botryosphaeria* canker: lesions appear on new growth and turn into cankers on susceptible varieties. *Botryosphaeria* stem blight: individual branches die.

Source of Inoculum: The pathogens survive from year to year in infected stems. Spores are spread by wind or rain. *Phomopsis* infects stems through flowers.

Management: Avoid mechanical injury to stems. Remove diseased canes/shoots. For *Phomopsis* twig blight, follow the fungicide spray schedule if needed. (See Tables 2 and 3.) Fungicides are not likely to be very effective for management of *Botryosphaeria*.

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Small Fruits - Blueberry

Table 2. Seasonal fungicide spray schedule for blueberry.

Season	Pesticide Application Timing	Disease
Early spring	At planting or, for established plants, while dormant, plus once while conditions favorable (see Table 3)	Phytophthora Root Rot
Early spring	At bud swell	Exobasidium
Prebloom	Green tip or, for mummy berry, when 1%-5% of blooms are open (whichever occurs first); repeat as directed on label	Mummy Berry Twig Blight Exobasidium
Bloom	10%-20% bloom through full bloom (2-3 applications, at interval specified on label)	Mummy Berry Twig Blight Botrytis Blight Fruit Rots Exobasidium
Petal fall and cover sprays	Immediately following bloom, followed by applications at 7- to 14-day intervals or as directed on label	Fruit Rots Exobasidium
Summer	Preharvest and harvest	Fruit Rots
Summer and Fall	Postharvest	Leaf Spots

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Small Fruits - Blueberry

Table 3. Pesticide efficacy¹ and use.

Product Choices ²	Mode of Action Group(s) ³	Botrytis Blight (Gray Mold)	Exobasidium Fruit and Leaf Spot	Alternaria Fruit Rot	Mummy Berry	Phomopsis Twig Blight	Phytophthora Root Rot	Ripe Rot/Anthracnose Fruit Rot (Colletotrichum)	Rust	Septoria Leaf Spot	Rate ⁴	PHI ⁵	Maximum Use ⁶
aluminum tris (O-ethyl phosphonate; Aliette WDG) ⁷	P07	-	-	-	-	P	G	P	-	VG	5 lbs	0.5	4 apps
azoxystrobin (Abound F, others)	I 1	-	-	E	F	F	-	E	G	VG	6.0-15.5 fl oz	0	see label
azoxystrobin and propiconazole (Quilt Xcel)	I 1, 3	-	-	E	E	E	-	E	E	E	14-21 fl oz	30	3 apps
<i>Bacillus subtilis</i> QST 713 strain (Serenade ASO)	44	F	-	F	F	-	-	F	F	F	2-4 qt	0	
<i>Bacillus subtilis</i> QST 713 strain (Serenade MAX)	44	F	-	F	F	-	-	F	F	F	1-3 lb	0	
boscalid and pyraclostrobin (Pristine)	7, I 1	E	F		VG	E		E	F	E	18.5-23 oz	0	4 apps
calcium polysulfide ¹¹ (Lime-Sulfur Solution)	M02	-	E	-	-	-	-	-	-	-	5 - 6 gal	0	30 gal
captan (50 WVP)	M04	F	VG	G	F	F	-	G	-	F	5 lb	0	70 lb
captan (80 WDG)	M04	F	VG	G	F	F	-	G	-	F	3.125 lb	0	43.75 lb
captan (38.75% FL, Captrec 4L, Captan 4L)	M04	F	VG	G	F	F	-	G	-	F	2.0-2.5 qt	0	35 qt

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Small Fruits - Blueberry

captan and fenhexamid (CaptEate 68 WDG)	M04, I7	E	VG	G	-	F	-	G	-	F	-	3.5-4.7 lb (4.7 lb for mummy berry and anthracnose)	0	2 l lb
chlorothalonil ¹¹⁰ (Bravo Weather Stik)	M05	-	-	-	-	-	-	-	-	-	-	3-4 pt	42	12 pt
copper-containing products labeled for use on blueberries, including ones with basic copper sulfate, copper hydroxide, copper oxychloride, copper octanoate, or copper sulfate pentahydrate	M01	-	-	-	-	-	-	-	-	-	-	see label	typically 0 - see label	see label
cypodiniil and fludioxonil (Switch 62.5 WG)	9, I2	E	-	E	-	G	-	E	-	G	-	1 l-14 oz	0	56 oz
fenbuconazole ⁸ (Indar 2F)	3	-	G	-	-	E	-	-	-	G	-	6 fl oz	30	4 apps
fenhexamid (Elevate 50WDG)	I7	E	-	-	-	F	-	-	-	-	-	1.5 lb	0	6 lb
Fish oil (Organic Gem Liquid Fish Fertilizer, Neptune's Harvest Organic Fish Fertilizer)	NC	-	-	-	-	-	-	-	-	-	-	see product instructions		
fluzinam (Omega 500F)	29	F	-	G	-	G	-	G	-	-	-	1.25 pt	30	7.5 pt
mefenoxam (Ridomil Gold SL)	4	-	-	-	-	-	G	-	-	-	-	3.6 pt	0	7.2 pt
mefenoxam (Ultra Flourish)	4	-	-	-	-	-	G	-	-	-	-	7.2 pt	0	14.4 pt
metconazole (Quash)	3	-	-	E	E	E	-	E	-	VG	E	2.5 oz	7	3 apps
mono- and di-potassium salts of phosphorus acid (Agri-Fos, Fosphite, Fungi-Phite, K-Phite 7 LP, Rampart, others)	P07	-	-	-	-	-	VG	-	-	-	-	see label (rate varies by product and application method)	0	see label
potassium phosphite (ProPhyt)	P07	-	-	-	-	-	VG	-	-	-	-	4 pt	0	
propiconazole (Bumper 41.8 EC, Bumper ES, PropiMax EC, Tilt, others)	3	-	-	-	-	E	-	-	-	G	E	6 fl oz	30	30 fl oz
prothioconazole (Proline 480 SC)	3	-	-	-	-	E	-	-	-	E	G	5.7 fl oz	7	2 apps

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Small Fruits - Blueberry

ziram (76DF)	M03	F	-	F	P	G	-	F	-	3 lb	-- ⁹	
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¹Efficacy ratings: E = excellent, VG = very good, G = good, F = fair, P = poor. Actual performance may vary. A "-" indicates that the chemical is not expected to be effective for managing the disease or that data is lacking. Ratings are based on the 2019 [Southeast Regional Blueberry Integrated Management Guide](#) and the 2019 [Southeast Regional Organic Blueberry Pest Management Guide](#) of the Southern Region Small Fruit Consortium.

²Chemical name (trade name). Reference to commercial or trade names is made for the reader's convenience and with the understanding that no discrimination or endorsement of a particular product is intended by LSU or the LSU AgCenter. In some cases, other brands are available.

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

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

⁵Postharvest 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.

⁷Make sure to get the Aliette WDG that is labeled for use on blueberries. There is a product of the same name that is not labeled for blueberries.

⁸If fenbuconazole (Indar 2F) is used during bloom, it should be mixed with captan to prevent a higher incidence of fruit rot.

⁹"Do not apply later than 3 weeks after full bloom."

¹⁰Do not apply before harvest, to avoid fruit injury.

¹¹See labels for restrictions and recommendations regarding use at high temperatures and within given time periods before or after oil applications.

This section was updated by Dr. Mary Helen Ferguson in October 2019.

Commercial Crop Production

Small Fruit - Grape

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

Disease	
Anthracnose (<i>Elsinoe ampelina</i> = <i>Sphaceloma ampelinum</i>)	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. Source of Inoculum: The fungus overwinters in infected fruit on the ground or in infected shoots. Management: Follow the fungicide spray schedule for grapes. Do not apply Pristine to Concord, Worden, Fredonia, Niagara or related grape varieties because of possible injury.
Black rot (<i>Guignardia bidwellii</i>)	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 muscadines, lesions on berries are small, black and scabby. The fruit does not rot. Source of Inoculum: The fungus overwinters in mummified fruit on the vine and ground and within lesions on canes. Management: Pruning out mummies, cankers and dead wood is very important to reduce inoculum load. Follow the fungicide spray schedule for grapes.
Botrytis bunch rot (<i>Botrytis cinerea</i>)	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). Source of Inoculum: The fungus overwinters on canes or in buds. Spores are wind-dispersed. Management: Prune out diseased tissue and destroy. Rake up fallen grapes and destroy. Follow the fungicide spray schedule for grapes.
Downy mildew (<i>Plasmopara viticola</i>)	Symptoms: This is primarily a disease of bunch grapes; muscadines 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. Source of Inoculum: The pathogen overwinters in infected leaves. Disease development is boosted by wet weather. Management: Shred and remove or bury by cultivation diseased leaves. Follow the fungicide spray schedule for grapes.
Phomopsis cane and leaf spot (<i>Phomopsis viticola</i>)	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. 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. 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.
Pierce's disease (<i>Xylella fastidiosa</i>)	Symptoms: This is a disease of bunch grapes. Muscadines 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. Source of Inoculum: The bacterium survives in infected vines and other hosts. It is transmitted by a number of leafhoppers. 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 35SL are recommended. Destroy infected vines.
Powdery mildew (<i>Uncinula necator</i>)	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. Source of Inoculum: The fungus overwinters in dormant buds or on other vine surfaces. Spores are wind-dispersed. Management: Follow the fungicide spray schedule for grapes. Sulfur should be included in a fungicide program.

Commercial Crop Production

Small Fruit - Grape

Table 2. Seasonal fungicide spray schedule for grapes

Developmental Stage	Pesticide Application Timing ¹	Diseases
Dormant	Prior to bud swell (bud is visibly swollen but no green or pink tissue is observed) and break.	Anthrachnose Phomopsis cane and leaf spot
Bud break and new shoot sprays (prebloom)	Every 7-10 days from 1-inch shoot growth to prebloom.	Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
Prebloom²	<10% bloom	Anthrachnose Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
Bloom	10%-20% bloom	Black rot Botrytis bunch rot Phomopsis cane and leaf spot Powdery mildew
Postbloom	First cover spray at 7-10 days after the prebloom spray.	Anthrachnose Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
First and second cover sprays	Every 10-14 days following postbloom spray.	Anthrachnose Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
Berry touch and bunch closure		Botrytis and other fruit rots
Third and subsequent cover sprays	Matured berries ³ . Every 10-14 days until the preharvest spray.	Anthrachnose Black rot (foliar) Downy mildew (foliar) Phomopsis cane and leaf spot Powdery mildew (foliar)
Veraison	Onset of ripening.	Botrytis bunch rot
Preharvest	10-14 days prior to harvest.	Botrytis bunch rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
Postharvest	Every 14-21 days until the first killing frost.	Downy mildew Powdery mildew

¹For more detailed information, see the 2016 Southeast Regional Bunch Grape Integrated Management Guide of the Southern Region Small Fruit Consortium (<http://www.smallfruits.org/SmallFruitsRegGuide/index.htm>).

²This is one of the most important sprays for downy mildew, powdery mildew, Phomopsis and black rot because it is the stage when grape berries become susceptible to infection by black rot, downy mildew and powdery mildew. All of these pathogens become active due to warmer temperatures.

³Mature berries are now resistant to black rot, downy mildew and powdery mildew. Sprays are applied to manage foliar infections caused by these diseases

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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: - = 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)	Ant hrac 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 + difenoconazole (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 + difenoconazole (Revus Top)		++++	-	+++++	+++ ²	++++
mefenoxam + copper (Ridomil Gold Copper)		++	++	+++++	++	++
mefenoxam + mancozeb (Ridomil Gold MZ)		+++	-	+++++	+++	-
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 affected 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, >85°F.

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

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ^{3,4}	Maximum Use	PHI ⁵	Diseases
aluminum tris (33)	Aliette	3-5 lb	7 app	15	Downy mildew
ametoctradin + dimethomorph (45, 40)	Zampro	11-14 fl oz	56 fl oz	14	Downy mildew
azoxystrobin (11)	Abound 2SC Azoxy 2SC AzoxyStar Aframe Satori 2.08 Willowood 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	Anthrachnose 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 bunch rot Powdery mildew
boscalid + pyraclostrobin (7, 11)	Pristine ⁹	8-12.5 oz	69 oz	14	Anthrachnose Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew Botrytis bunch rot
	Pristine ⁹	18.5-23 oz	69 oz	14	
captan (M)	Captan 38.75% Captec 4L (various other formulations are available)	1.5-2 qt 0.75-1 qt/100 gal	12 qt 2 qt	0 0	Black rot (suppression only) Downy mildew Phomopsis cane and leaf spot
copper hydroxide (M)	Champ WG ¹⁰ ChamplON ¹⁰	2-6 lb 0.75-1.75 lb	40 lb 66.7 lb	0 0	Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
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 (M)	Cuprofix Ultra 40 Disperss ¹⁰ Cuproxat ¹⁰ (various other formulations are available)	1.25-3 lb 2.5-6 pt	50 lb 98.6 pt	14 14	Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew

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Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ^{3,4}	Maximum Use	PHI ⁵	Diseases
cyazofamid (21)	Ranman 400SC	2.1-2.75 fl oz	16.5 fl oz	30	Downy mildew
cyflufenamid (U6)	Torino	3.4 oz	6.8 oz	3	Powdery mildew
cyprodinil (9)	Vangard 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 bunch rot Powdery mildew
cyprodinil + fludioxonil (9, 12)	Switch 62.5WG	11-14 oz	56 oz	7	Botrytis bunch rot
difenoconazole + mandipropamid (3, 40)	Revus Top	7 fl oz	28 fl oz	14	Anthrachnose Black rot Phomopsis cane and leaf spot Powdery mildew
dimethomorph (40)	Forum	6 fl oz	24 fl oz	14	Downy mildew
famoxodone+ cymoxanil (11, 27)	Tanos	8 oz	72 oz	30	Downy mildew
fenamidone (11)	Reason 500SC	2.7 fl oz	8.1 fl oz	30	Downy mildew
fenarimol (3)	Rubigan EC ¹² Vintage SC	2-6 fl oz ¹³ 3-6 fl oz ¹⁴	19 fl oz 21 fl oz	21 21	Powdery mildew
fenhexamid (17)	Elevate 50WDG	1 lb	3 lb	0	Botrytis bunch rot Powdery mildew (suppression only)
fluopicolide (43)	Presidio	3-4 fl oz	12 fl oz	21	Downy mildew
iprodione (2)	Iprodione 4L AG Meteor Nevado 4F Rovral 4F	1-2 pt 1-2 pt 1-2 pt 1-2 pt	4 app 4 app 4 app 4 app	7 7 7 7	Botrytis bunch rot
sofetamid (7)	Kenja 400SC	20-22 fl oz	66 fl oz	14	Anthrachnose Botrytis bunch rot Powdery mildew
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 Rainshield Dithane M45 Dithane F45 Manzate Flowable Manzate Max	1.2-3.2 qt 1.5-4 lb 1.2-3.2 qt 1.2-3.2 qt 1.2-3.2 qt	19.2 qt 24 lb 19.2 qt 19.2 qt 19.2 qt	66 66 66 66 66	Black rot Botrytis bunch rot Downy mildew Phomopsis cane and leaf spot

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Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ^{3,4}	Maximum Use	PHI ⁵	Diseases
	Manzate Pro-Stick Penncozeb 75DF Penncozeb 80WP Roper DF Rainshield	1.5-4 lb 1.5-4 lb 1.5-4 lb 1.5-4 lb	7.5 lb 24 lb 24 lb 24 lb	66 66 66 66	
mancozeb + zoxamide (M, 22)	Gavel 75DF	2-2.5 lb	15 lb	66	Botrytis bunch rot Downy mildew Phomopsis cane and leaf spot
mandipropamid (40)	Revus	8 fl oz	32 fl oz	14	Downy mildew
mefenoxam	Ridomil Gold SL, Ultra Flourish	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
metrafenone (U8)	Vivando	10.3-15.4 fl oz	46.2 fl oz	14	Powdery mildew
myclobutanil (3)	Eagle 20EW Eagle 40WP Rally 40WSP Sonoma 20EW AG	4-6 fl oz/100 gal 3-5 oz 3-5 oz 6-10 fl oz	153 fl oz 1.5 lb 1.5 lb 45.6 fl oz	14 14 14 14	Powdery mildew Anthracnose Black rot Powdery mildew
phosphite ¹⁵ (phosphorous acid salts) (33)	K-phite 7LP, Fosphite, Rampart Phostrol, Alude	1-3 qt 2.5-5 pt	NA NA	NA NA	Anthracnose Downy mildew Powdery mildew Downy mildew
polyoxin D zinc salt (19)	OSO 5% Ph-D WDG Ph-D WDG	3.75-13 fl oz 6.2 oz 6.2 oz	6 app 3 app 3 app	0 0 0	Powdery mildew Botrytis bunch rot Anthracnose
pyrimethanil (9)	Scala SC	18 fl oz (alone) 9 fl oz (tank mix)	36 fl oz	7	Botrytis bunch rot
quinoxifen (13)	Quintec	3-6.6 fl oz	33 fl oz	14	Powdery mildew
sulfur (M)	Liquid Sulfur Six Microfine Sulfur Microthiol Disperss Yellow Jacket Dusting Yellow Jacket Wettable	1-2 pt/100 gal 3.8-25 lb 3-10 lb 10-20 lb 3.8-25 lb	8 pt NA NA NA NA	NA NA NA NA NA	Phomopsis cane and leaf spot Powdery mildew

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Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ^{3,4}	Maximum Use	PHI ⁵	Diseases
tebuconazole (3)	Elite 45DF	4 oz	2 lb	14	Black rot Powdery mildew
	Orius 20AQ	8.6 oz	68.8 oz	14	
	Tebuzol 45DF	4 oz	2 lb	14	
	Mettle 125ME	3-5 fl oz	10 fl oz	14	
	Mettle 125ME	3-5 fl oz	10 fl oz	14	Anthrachnose
tebuconazole + trifloxystrobin (3, 11)	Adament 50WG ¹⁶	3-6 oz	48 oz	14	Black rot Botrytis bunch rot Downy mildew Phomopsis cane and leaf spot
tetraconazole	Mettle 125ME	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 Botrytis bunch rot Powdery mildew
	Topsin M WSB	.75-1.5 lb	6 lb	7	
	Incognito 85WDG	0.8-1.2 lb	3.2 lb	14	Bitter rot Black rot Powdery mildew
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.

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

⁶For resistance management purposes, only 2 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; cover sprays apply 5-6 fl oz/A.

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¹⁴Prebloom apply 3-4 fl oz/A; Postbloom apply 5-6 fl oz/A; 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 2019 by Dr. R. Singh.

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Small Fruits - Strawberry

Integrated Strawberry Disease Management

Strawberries are among the most challenging horticultural crops to grow in the South because of high levels of soilborne pathogens. Chemical use, from preplant 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, more sustainable management strategies is necessary. (For fumigant information see the [Southeast Regional Strawberry Integrated Management Guide](#).)

Rotate your planting site. Rotating where strawberries are planted is an important part of avoiding soilborne disease problems. 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.

Minimize plant stress during establishment. Overhead irrigation is recommended during the first one to two weeks after planting bare-root plants. It may also be helpful to provide some overhead water during the first several days after planting plug plants. Drip irrigation can be used after this time.

Correctly diagnose problems. Contact your local extension agent or the LSU AgCenter Plant Diagnostic Center for assistance, if needed. The [Strawberry Diagnostic Key](#) may also be helpful.

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 (see Tables 1 and 3), and apply the product at the correct stage of plant development (Table 2). 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 3) 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. Tests of fungal isolates from Louisiana and other states have shown that the gray mold fruit rot pathogen (*Botrytis cinerea*) is likely to be resistant to common fungicides in several FRAC groups and that the anthracnose fruit rot pathogen (*Colletotrichum* sp.) is likely to be resistant to FRAC 11 fungicides. More information is given in the respective sections. Although some details about chemical application are given in Table 3, always see the label for complete instructions.

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Small Fruits - Strawberry

Table 1. Diseases and nematodes of strawberry.

Symptoms, Sources of Inoculum, and Management
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 bactericide or the plant defense activator Actigard, if needed.
Anthraxnose 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 is often introduced on infected planting material and survives on infected plant parts. Fungal spores are spread by rain splashing and wind-driven rain. Management: Use disease-free transplants. Dip plants in a fungicide prior to planting if problems with the plant source are identified. Remove infected plants and treat surrounding plants with fungicides.
Anthraxnose Fruit Rot (<i>Colletotrichum acutatum</i>) Symptoms: Buds, flowers, sepals and/or flower stems (pedicels and peduncles) often turn brown. Spots on fruit are light brown to black and often begin with a water-soaked appearance and then become firm and sunken. Orange to pink spores can develop when weather is humid. Plant stunting and/or death and petiole lesions may be seen before flower blight or fruit rot occur. Source of Inoculum: The fungus is often introduced on infected planting material and survives on infected plant parts. Fungal spores can be spread by rain splashing, wind-driven rain, workers and equipment. Management: Use disease-free transplants. Do not use an excessive amount of nitrogen fertilizer. If the presence of <i>C. acutatum</i> has been confirmed, begin fungicide applications for fruit rot at bloom. Resistance to the FRAC group 11 fungicides has been found in the pathogen in some instances; three-quarters of 51 samples from Louisiana tested in 2016 were found to be resistant. Captan, thiram, Switch, and propiconazole are still expected to be effective for managing anthracnose fruit rot.
Botrytis Fruit Rot (Gray Mold) and 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: Removing dying and dead leaves shortly before plants flower may be helpful. If applying fungicides, begin while flowers are in bloom; most infections that eventually affect fruit are initiated through flowers. Harvest fruit frequently, removing infected and other unmarketable fruit from the field. Fungicide resistance in <i>Botrytis cinerea</i> is a major concern. Resistance has been documented in one or more locations to many of the fungicides previously effective for managing gray mold. In tests of the fungus from five Louisiana strawberry fields in 2019, all isolates were resistant to thiophanate-methyl and pyraclostrobin, and most were resistant to fenhexamid. Some resistance to penthiopyrad, fluopyram, and boscalid were observed, but resistance to isofetamid was not found, even though it is in the same FRAC group as the former three. Two fields had some level of resistance to at least one of the active ingredients in Switch (cyprodinil and fludioxonil). Captan, thiram, isofetamid (Kenja), polyoxin D salts (Ph-D/OSO 5%SC), and Switch (in most cases) appear to remain effective options for gray mold. Be sure to rotate among modes of action (FRAC groups). For chemical management of crown rot, choose among captan, Switch and iprodione.

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Small Fruits - Strawberry

Symptoms, Sources of Inoculum, and Management
Common 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. While many fungicides are effective on this disease, consider using myclobutanil, a combination of thiophanate-methyl and captan, or captan alone, unless another fungicide is needed for another purpose.
Leaf Blight (<i>Phomopsis obscurans</i> or <i>Dendrophoma 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. While many fungicides are effective on this disease, consider using myclobutanil, a combination of thiophanate-methyl and captan, or captan alone, unless another fungicide is needed for another purpose.
Leaf Blotch (<i>Gnomonia</i> sp. or <i>Zythia</i> sp.) Symptoms: First appears as purplish to brownish blotches on young leaves. Later appears as large, light brown spots on older leaves. Also causes spots on the stem end of fruit. Source of Inoculum: The fungus lives from year to year primarily on infected plant tissue. Management: Spray with fungicides if needed. While many fungicides may be effective on this disease, consider using myclobutanil, a combination of thiophanate-methyl and captan, or captan alone, unless another fungicide is needed for another purpose.
Leaf Scorch (<i>Diplocarpon earlianum</i>) 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. Management: Use disease-free transplants. Rotate strawberry fields, if possible. Spray with fungicides if needed. While many fungicides may be effective on this disease, consider using myclobutanil, a combination of thiophanate-methyl and captan, or captan alone, unless another fungicide is needed for another purpose.
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. It is more likely to be a problem in strawberries grown under cover (e.g., high tunnels). Spray with fungicides if needed.
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 water. Management: Use disease-free transplants, improve drainage and avoid low spots. Dip transplants in suitable fungicide prior to planting if problems with the plant source are identified. Remove infected plants and treat surrounding plants with fungicide. Do not use an excessive amount of nitrogen fertilizer.

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Small Fruits - Strawberry

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 in the [Southeast Regional Strawberry Integrated Management Guide](#).

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.

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Table 2. Seasonal fungicide spray schedule for strawberries.

Season	Pesticide Application Timing	Diseases
Preplanting	Preplanting fungicide dip ¹	Anthrachnose Crown Rot Phytophthora Crown Rot
Postplanting until prebloom	Early postplanting	Anthrachnose Crown Rot Phytophthora Crown Rot Powdery Mildew
Postplanting until prebloom	Warm periods following frost	Botrytis Crown Rot
Postplanting until prebloom	New growth	Leaf Spots (bacterial and fungal) Phytophthora Crown Rot Powdery Mildew
Bloom until harvest	Every 7 to 10 days or according to label	Gray Mold Anthrachnose Fruit Rot Leaf Spots (bacterial and fungal) Phytophthora Crown Rot Powdery Mildew

¹If it is known that plants from a particular source have a problem with one of the root or crown rot diseases, bare-root strawberry plants may be dipped in a fungicide suspension prior to planting to provide early season control. Prior to dipping, the plants should be washed with potable water to remove adhering soil.

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Table 3. Pesticide efficacy¹ and use.

Product Choices ²	Mode of Action Group(s) ³	Angular Leaf Spot	Anthracnose Crown Rot	Anthracnose Fruit Rot	Botrytis Crown Rot	Botrytis Fruit Rot (Gray Mold)	Common Leaf Spot	Leaf Blight	Phytophthora Crown Rot a- Red Stele Root Rot	Powdery Mildew	Rate ⁴	PHI ⁵	Maximum Use ⁶
acibenzolar-S-methyl (Actigard 50WG)	P01	P	-	-	-	-	-	-	-	-	0.5-0.75 oz	0	6 oz
aluminum tris (O-ethyl phosphonate; Aliette WDG) ⁷	P07	-	-	-	-	-	-	-	F	-	2.5-5.0 lb ⁸ (2.5 lb/100 gal for dip)	0.5	30 lb
azoxystrobin (Abound F, others)	I1	-	G ^R	E ^R	-	F ^R	F	-	-	E ^R	6.0-15.5 fl oz (5-8 fl oz/100 gal for dip)	0	61.5 fl oz
azoxystrobin and difenoconazole (Quadris Top)	I1, 3	-	G ^R	E ^R	-	F ^R	G	-	-	E ^R	12-14 fl oz	0	56 fl oz
azoxystrobin and propiconazole (Quilt Xcel)	I1, 3	-	G ^R	E ^R	-	F ^R	-	-	-	E ^R	14 fl oz	0	56 fl oz
boscalid and pyraclostrobin (Pristine)	7, I1	-	G ^R	E ^R	-	G ^R	VG	VG	-	E ^R	18.5-23 oz	0	115 oz
captan (50 WVP)	M04	-	G	G	F	G	F	F	-	-	3-6 lb	0	48 lb
captan (80 WVDG)	M04	-	G	G	F	G	F	F	-	-	1.875-3.75 lb	0	30 lb
captan (38.75% FL, Captec 4L, Captan 4L)	M04	-	G	G	F	G	F	F	-	-	1.5-3.0 qt	0	24 qt
captan and fenhexamid (CaptEvate 68 WDG)	M04, I7	-	F	G	-	E ^R	G	F	-	-	3.5-5.25 lb ⁹	0	21 lb

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Product Choices ²	Mode of Action Group(s) ³	Angular Leaf Spot	Anthracnose Crown Rot	Anthracnose Fruit Rot	Botrytis Crown Rot	Botrytis Fruit Rot (Gray Mold)	Common Leaf Spot	Leaf Blight	Phytophthora Crown Rot a- Red Stele Root Rot	Powdery Mildew	Rate ⁴	PHI ⁵	Maximum Use ⁶
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	M01	P	-	-	-	-	P	-	-	-	see label	typically 0 – see label	see label
cyflufenamid (Torino)	U06	-	-	-	-	-	-	-	-	VG	3.4 oz	0	2 apps
cyprodinil and fludioxonil (Switch 62.5 WG)	9, 12	-	G	G	VG	E	F	F	-	-	11-14 oz (5-8 oz/100 gal for dip)	0	56 oz
fenhexamid (Elevate 50WDG)	17	-	-	-	-	E ^R	-	-	-	-	1.5 lb ⁹	0	6 lb
fluopyram and trifloxystrobin (Luna Sensation)	7, 11	-	G ^R	E ^R	-	E ^R	VG	VG	-	E ^R	4-7.6 fl oz (6-7.6 fl oz for gray mold; 7.6 fl oz for Rhizopus fruit rot and <i>Mycosphaerella</i> leaf spot)	0	27.1 fl oz
flutriafol (Rhyme)	3	-	-	-	-	-	-	-	-	E ^R	5 - 7 fl oz (7 fl oz for charcoal rot)	0	4 apps

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Product Choices ²	Mode of Action Group(s) ³	Angular Leaf Spot	Anthracnose Crown Rot	Anthracnose Fruit Rot	Botrytis Crown Rot	Botrytis Fruit Rot (Gray Mold)	Common Leaf Spot	Leaf Blight	Phytophthora Crown Rot a- Red Stele Root Rot	Powdery Mildew	Rate ⁴	PHI ⁵	Maximum Use ⁶
fluxapyroxad and pyraclostrobin (Merivon)	7, 11	-	GR	ER	-	ER	VG	VG	-	ER	see label (varies by disease)	0	3 apps
iprodione (Rovral 4; Meteor, Nevada 4F)	2	-	-	-	VG	GR	G	-	-	-	1.5-2 pt (2 pt/100 gal for dip)	Do not apply after first fruiting flower.	1 app
isofetamid (Kenja 400SC)	7	-	-	-	-	ER	-	-	-	GR	13.5-15.5 fl oz	0	54 fl oz
mefenoxam (Ridomil Gold SL)	4	-	-	-	-	-	-	-	VG	-	1 pt ¹⁰	0	3 pt
mefenoxam (Ultra Flourish)	4	-	-	-	-	-	-	-	VG	-	2 pt ¹¹	0	6 pt
metalaxyl (MetaStar 2E, Metalaxyl 2E)	4	-	-	-	-	-	-	-	VG	-	2 qt/treated ac	0	6 qt/treated ac
myclobutanil (Rally 40WSP)	3	-	-	-	-	-	VG	VG	-	ER	2.5-5 oz	0	30 oz
mono- and dibasic sodium, potassium, and ammonium phosphites (Phostrol)	P07	-	-	-	-	-	-	-	F	-	see label (varies by product and application method)	0	see label
mono- and di-potassium salts of phosphorus acid (Agri-Fos, Fosphite, Fungi-Phite, K-Phite 7 LP, others)	P07	-	-	-	-	-	-	-	F	-	2.5 – 5.0 pt (2.5 – 5.0 pt/100 gal for dip)	0	

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Product Choices ²	Mode of Action Group(s) ³	Angular Leaf Spot	Anthracnose Crown Rot	Anthracnose Fruit Rot	Botrytis Crown Rot	Botrytis Fruit Rot (Gray Mold)	Common Leaf Spot	Leaf Blight	Phytophthora Crown Rot a- Red	Powdery Mildew	Rate ⁴	PHI ⁵	Maximum Use ⁶
penthiopyrad (Fontelis) ¹²	7	-	F	F	-	ER	-	-	-	GR	16-24 fl oz	0	72 fl oz
polyoxin D zinc salt (Ph-D)	19	-	-	-	-	G	-	-	-	-	6.2 oz	0	6 apps
polyoxin D zinc salt (OSO 5%SC)	19	-	-	-	-	G	-	-	-	-	3.75 – 13.0 fl oz	0	78 fl oz
potassium phosphite (ProPhyt)	P07	-	-	-	-	-	-	-	F	-	2-4 pt (2 pt/100 gal for dip)	0	
propiconazole (Bumper 41.8 EC, Bumper 40.85 ES, Tilt, others)	3	-	F	G	-	-	G	-	-	VGR	4 fl oz	0	4 apps
propiconazole and thiophanate-methyl (Protocol)	3, 1	-	GR	GR	GR	GR	G	G	-	GR	1.33 pt	1	5.3 pt
pyraclostrobin (Cabrio EG)	11	-	GR	ER	-	FR	F	-	-	ER	12-14 oz	0	70 oz
pyrimethanil (Scala SC)	9	-	-	-	-	GR	-	-	-	-	18 fl oz	1	54 fl oz
quinoxifen (Quintec)	13	-	-	-	-	-	-	-	-	E	4-6 fl oz	1	24 fl oz
sulfur ¹³ (Microfine & Yellow Jacket Wettable II; 90%)	M02	-	-	-	-	-	-	-	-	GR	3-50 lb	0	
sulfur ¹³ (Microthiol Disperss; 80%)	M02	-	-	-	-	-	-	-	-	GR	5-10 lb	0	

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Product Choices ²	Mode of Action Group(s) ³	Angular Leaf Spot	Anthracnose Crown Rot	Anthracnose Fruit Rot	Botrytis Crown Rot	Botrytis Fruit Rot (Gray Mold)	Common Leaf Spot	Leaf Blight	Phytophthora Crown Rot a- Red	Powdery Mildew	Rate ⁴	PHI ⁵	Maximum Use ⁶
tetraconazole (Mettile 125 ME)	3	-	-	-	-	-	-	-	-	ER	3-5 fl oz	0	4 apps
triflumizole (Procure 480SC, Trionic 4SC)	3	-	-	-	-	-	-	-	-	ER	4-8 fl oz	I	4 apps
thiophanate-methyl (Incognito 85 WDG)	I	-	GR	-	.R	.R	G	G	-	FR	0.6-0.8 lb	I	3.2 lb
thiophanate-methyl (Topsin M WSB, T-Methyl 70 WSB)	I	-	GR	-	.R	.R	G	G	-	FR	0.75-1 lb	I	4 lb
thiophanate-methyl (Topsin 4.5FL, others)	I	-	GR	-	.R	.R	G	G	-	FR	15-20 fl oz	I	80 fl oz
thiram (SC)	M03	-	F	G	F	G	F	F	-	-	2.6 qt	I	5 or 12 apps ¹⁴

¹Efficacy ratings: E = excellent, VG = very good, G = good, F = fair, P = poor. Actual performance may vary. A superscript "R" indicates that there is a possibility of resistance to the chemical and that the chemical will not be effective, or as effective as noted, if the pathogen is resistant to it. A "-" indicates that the chemical is not expected to be effective for managing the disease or that data is lacking. Ratings are based largely on the 2019 [Southeast Regional Strawberry Integrated Management Guide](#) of the Southern Region Small Fruit Consortium.

²Chemical name (trade name). Reference to commercial or trade names is made for the reader's convenience and with the understanding that no discrimination nor endorsement of a particular product is intended by LSU or the LSU AgCenter. In some cases, other brands are available.

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

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.

⁵Postharvest 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.

⁷Make 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.

⁸Do not apply more than 3.75 lb product per acre per application in Livingston or Rapides parishes.

⁹"When plastic mulch is used, do not apply within 16 feet...of naturally vegetated or aquatic areas."

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

¹¹Apply in banded sprays or drip irrigation.

¹²Do not apply to cvs. 'Clancy', 'Jewel', or 'L'Amour'.

¹³See labels for restrictions and recommendations regarding use at high temperatures and within given time periods before or after oil applications.

¹⁴Five applications per year of Thiram SC are allowed in locations west of the Mississippi River, and 12 applications per year are allowed east of the Mississippi River.

This section was updated by Dr. Mary Helen Ferguson in October 2019.

Commercial Crop Production

Sweet Potato

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 produces virus-tested foundation seed through the [LSU AgCenter Foundation Seed program](#). To learn more, contact:

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 are 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. Fungicide sprays for black rot at transplanting are only recommended if black rot was observed on 'seed' roots or previous year crop. To avoid the buildup of pathogens with fungicide resistance, fungicides should be alternated with fungicides with a different mode of action (see Chapter iv).

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Sweet Potato

Table 1. Sweet potato variety reactions to common diseases in Louisiana

S = susceptible reaction, R = resistant reaction, I = intermediate reaction, – = unknown reaction.

Variety	Disease							
	Rhizopus Soft Rot	Southern Root-knot Nematode	Guava Root-knot Nematode	Soil Rot	Fusarium Wilt	Sclerotial Blight	Fusarium Root Rot	Bacterial Root Rot
Bayou Belle	R	I-R	S	I-R	R	-	-	S
Beauregard	R	S	S	R-I	R	I	R	S
Bellevue	I	HR	S	R	R	-	-	S
Bonita	S	R	S	I	I-R	-	S-I	S
Burgundy	-	R	-	I-R	R	-	-	S
Centennial	-	S	R	S	I-R	I-S	I	R
Covington	I	I-R	S	I-R	R	-	-	-
Evangeline	R	HR	I-S	I-R	R	-	R	S
Hernandez	I-S	R-I	S	R-I	I-R	-	I	R
Jewel	I	I-R	R	S	R	I	I	I
Murasaki	R	HR	R	I-R	R		R	
Orleans	R	S	S	R-I	R	-	R	S
Porto Rico (Unit 1)	-	I-S	-	S	S	S	R-I	R

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Table 2. Recommended pesticides, rates and pesticide use restrictions for sweet potato diseases. Consult the current specimen label for further information on each product.

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
Bacterial Root Rot (<i>Dickeya dadantii</i>)	Sodium hypochlorite (chlorine)		100-150 ppm ⁵		1 app
Black Rot (<i>Ceratocystis fimbriata</i>)	Thiabendazole (seed root dip only) Mertect 340-F	I	107 fl oz/100 gal ^{6,12}		1 app
Foot Rot (<i>Plenodomus destruens</i>)	Thiabendazole (seed root dip only) Mertect 340-F	I	107 fl oz/100 gal ^{6,12}		1 app
Fusarium Root Rot (<i>Fusarium</i> spp.)	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</i> spp.)	Dicloran Botran 5F	14	0.6 qt/100 gal		1 app ¹⁰
	Fludioxonil Scholar SC	12	16-32 fl oz/100 gal		1 app ^{10,11}
	Bio-Save 10 LP	NA	1.1 lb/30 gal		
Sclerotial Blight (<i>Sclerotium rolfsii</i>)	Dicloran (seed root dip only) Botran 5F	14	0.6 qt/7.5 gal ⁷		1 app
	Dicloran (spray⁸ application only) Botran 5F	14	5.73 oz/14 gal ⁹		1 app
	Azoxystrobin Quadris Flowable	11	0.4-0.8 fl oz ⁹	0	123 fl. oz./A/yr
	Satori	11	0.4-0.8 fl oz ⁹	0	123 fl. oz./A/yr
	Willowood Azoxy 2SC	11	0.4-0.8 fl oz ⁹	0	123 fl. oz./A/yr
Scurf (<i>Monilochaetes infusans</i>)	Dicloran (seed root dip only) Botran 5F	14	0.6 qt/7.5 gal ⁷		1 app
	Dicloran (spray⁸ application only) Botran 5F	14	5.73 oz/14 gal ⁹		1 app
	Thiabendazole (seed root dip only) Mertect 340F	I	107 fl oz/100 gal ^{6,12}		1 app
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	6.0-20.0 fl oz	0	123 fl. oz.
	Willowood Azoxy 2SC	11	6.0-15.5 fl oz	0	123 fl. oz.
	Fenamidone Reason 500 SC	11	5.5-8.2 fl oz	14	16.4 fl oz
	Pyraclostrobin Cabrio EG	11	8-16 fl oz ¹³	0	48 fl oz

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

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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.

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

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.

⁶ Replace wash water as often as possible or when it becomes obviously dirty.

⁷ Dip seed roots for 10-15 seconds in a well-agitated suspension. Drain and bed immediately. Prepare a fresh suspension daily.

⁸ Sprayed onto seed roots and soil after seed roots are laid out in the beds.

⁹ Rates are per 1,000 linear feet of row on a 42-inch plant bed. Refer to the label for modes of application.

¹⁰ For postharvest disease control. Dip sweet potatoes for 30 seconds in a well-agitated suspension. Do not expose treated roots to direct sunlight.

¹¹ To apply as a spray use 16 fl oz/200,000 lb of sweet potatoes. Refer to label for application directions.

¹² Do not use treated roots for food or animal feed.

¹³ Do not make more than one (1) application of Cabrio before alternating to a labeled non-Group 11 fungicide with a different mode of action.

¹⁴ Apply over conveyor belt or rollers by drip or spray to sweet potatoes prior to storage. Uniform coverage is required. Apply the entire suspension to 300,000 pounds of stored sweet potatoes

The sweet potatoes section was revised September 2019 by Dr. C. Clark.

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Christmas Trees and Conifers

Integrated Disease Management

Christmas tree 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 establishing a crop. Successful management of Christmas tree and conifers 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

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. Diseases, symptoms and integrated disease management tactics for Christmas trees and conifers

Disease	
Armillaria root rot (<i>Armillaria</i> spp.)	Hosts: Most Christmas tree and conifers 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. 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. Fungicides: No fungicides are effective at managing <i>Armillaria</i> root rot. Soil fumigants may suppress disease.
Botryosphaeria canker and dieback (<i>Botryosphaeria dothidea</i>)	Hosts: All Christmas tree and conifers 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. Cultural Management: Maintain proper nutrient and water levels so that trees are not stressed. Protect seedlings from freeze injury. Remove and destroy diseased branches. Fungicides: No effective chemicals are available at this time.
Botrytis blight (<i>Botrytis cinerea</i>)	Hosts: All Christmas tree and conifers 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. 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% ethanol between cuts. Remove infected seedlings from seedling beds to prevent spore dispersal to healthy seedlings. Fungicides: Fungicides are not effective for established plantings. Apply dicloran (Botran 75W @ 2 lb/a) preventatively to nursery, greenhouse, container and bare rootstocks.
Cercospora needle blight (<i>Cercosporidium sequoia</i>)	Hosts: Cypress (Arizona, Leyland), juniper, red cedar 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. Cultural Management: Maintain proper nutrient and water levels so that trees are not stressed. Do not let weeds grow up under or between trees. 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).
Diplodia (Sphaeropsis) tip blight (<i>Diplodia pinea</i> formerly <i>Sphaeropsis sapinea</i>)	Hosts: Pines (Scotch, red, white, Austrian) and other conifers. Rarely found on Douglas fir or spruce. Symptoms: Discolored needle tips (brown, yellow, gray) on current season's growth. Needles are stunted; shoots may curl. Branch dieback. Small black fruiting bodies form on needles, cones and shoots. Cankers form on stems and branches and

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Christmas Trees and Conifers

	ooze resin that drips and adheres to needles. Trees are most susceptible from bud break to needle elongation. 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. Fungicides: Azoxystrobin (Equation, Heritage, Satori, Quadris); thiophanate-methyl (Cercobin, Incognito 4.5F, Topsin 4.5FL). Rates vary depending on the product.
Pine-oak gall rust (Eastern gall rust) (<i>Cronarium quercuum</i>)	Hosts: Pines (Scotch, red, Virginia, Mugo, Jack and Austrian). Oaks are an alternate host for Eastern gall rust. Symptoms: Stunting, deformation and twig and branch dieback. Visible, globe-shaped galls form on the stems or branches. Yellow-orange fruiting bodies form on the surface of mature galls in the spring. 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. Fungicides: Mancozeb (Dithane 75DF Rainshield and Fore 80W Rainshield). Rates vary depending on the product.
Phytophthora root rot (<i>Phytophthora</i> spp.)	Hosts: All Christmas tree and conifers Symptoms: Reduced and stunted growth. Yellowing and eventual browning of all the needles. Bleeding basal cankers and root decay. Rapid tree death. Cultural Management: Do not plant in fields infested with Phytophthora. Plant in well-drained fields; avoid standing water in the fields. 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 (BasamidG); metalaxyl (Metastar 2E); mefenoxam (Subdue GR, Subdue Maxx). Rates vary depending on the product.
Phomopsis blight (<i>Phomopsis juniperovora</i>)	Hosts: Juniper, red cedar, Arizona cypress, arborvitae Symptoms: Shoot tips turn yellow, 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. 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. Fungicides: Mancozeb (Fore 80WP Rainshield, Dithane 75DF Rainshield); propiconazole (Banner Maxx, Bumper ES, Fitness, Procon Z, Protocol); copper hydroxide (Kocide 2000 or 3000, Champ Formula 2 Flowable); copper sulfate (Cuprofix Ultra 40 Disperss).
Pine wilt disease (nematode) (<i>Bursaphelenchus xylophilus</i>)	Hosts: Pines (especially Scotch) 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. Nematodes feed on resin ducts of healthy trees. Cultural Management: Manage beetle infestations. Remove and destroy diseased trees. Chemical control: No chemicals are available at this time.
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.

The Christmas tree and conifer section was revised December 2019 by Dr. R. Singh.

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. Fertility and mowing practices for turfgrass

Grass Type	Nitrogen Fertility Timing	Mowing ¹
Warm season grasses	Summer (April-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.

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Table 2. Disease identification key for southern turfgrass

Developed by Dr. G. Holcomb, Professor Emeritus

I. Grass affected in distinct patches, yellow to brown.	
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 Bermudagrass 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 Bermudagrass and ryegrass.	Melting out or Leaf spot
2. Leaf spots oval to irregular in shape with brown borders and tan to gray centers; primarily on St. Augustinegrass.	Gray leaf spot
3. Leaf spots reddish brown to brown surrounded by a yellow halo; primarily on centipedegrass.	Anthracnose
4. Grass covered with an easily removed slimy or crusty growth.	Slime molds³
5. Mottle, chlorosis or mosaic on leaves; on St. Augustinegrass or centipedegrass.	St. Augustine decline or Centipede Decline⁴

¹ Formerly known as Brown patch.

² Take-all root rot may also resemble chinch bug damage.

³ Nonpathogenic. Not a disease.

⁴ Viral diseases caused by *Panicum mosaic virus*.

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Table 3. Fungicides labeled for use on 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				
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.

Commercial Crop Production

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Table 4. Efficacy¹ 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 + pfropamocarb							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+		
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

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Turfgrass

readily available to homeowners. Ratings were compiled by Drs. Vincelli and Williams at the University of Kentucky (PPA-I 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.

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Table 5. Fungicides registered for use on commercial turfgrasses only

Fungicide ¹	Product Mode of Action Group ²	Trade Name ³	Formulation	Rate ⁴	Maximum Use ⁵
azoxystrobin	11	Heritage Heritage G Heritage TL	50WG 0.31G 8.8L	0.2-0.4 oz 2-4 lb 1-2 fl oz	3.7 oz 37 lb 18.5 fl oz
boscalid	7	Emerald ⁶	70WG	0.13-0.18 oz	1.1 oz
captan	M	Captan	50WP 80WDG	0.13-0.2 lb 0.125 lb	
chlorothalonil	M	Chlorostar, Chlorothalonil, Countdown, Daconil, Echo, Ensign, Equus, Initiate, Mainsail, Manicure	38.5F 54F 82.5WDG	1.5-8.3 fl oz 1-5.5 fl oz 1-5 oz	
cyazofamid	21	Segway	34.5F	0.45-0.9 fl oz	2.7 fl oz
ethazole (etridiazole)	14	Terrazole ⁸	35WP	2-4 oz	10 oz
fenarimol	3	Rubigan	11.6L	0.75-8 fl oz	32 fl oz
fludioxonil	12	Medallion	50WP	0.25-0.5 oz	1.5 oz
fluopicolide	43	Stellar ⁹	5.7SC	1.2 fl oz	2.4 fl oz
fluoxastrobin	11	Disarm	480SC 0.25G	0.09-0.36 fl oz 1.2-4.6 lb	0.4 fl oz
flutolanil	7	Prostar	70WP	1.5-4.5 oz	4.5 oz
fosetyl-al	33	Chipco Signature Prodigy Signature	80WDG 80WDG	4-8 oz 4-8 oz	
iprodione	2	26GT Chipco 26019 Iprodione Pro	23.3F 50WP	3-8 fl oz 1.5-4 oz	35 fl oz 17.6 oz
mancozeb	M	Dithane, Fore, Manzate, Penncozeb, Pentathlon, Protect	37F 75DF 80WP	6.4-12.8 fl oz 4-8 oz 4-8 oz	See label
mefenoxam	4	Fenox Mefenoxam Subdue Ultra Flourish	1G 21.3L 22.5F 25.1 45WP	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 40WP	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	2.5WP	Refer to label	
propamocarb hydrochloride	28	Banol	66.5L	1.3-4 fl oz	12.5 fl oz
propiconazole	3	Banner, Dorado, Fathom, Headway,	14.3L 41.8L	0.5-4 fl oz 0.18-1.44 fl oz	16 fl oz 5.8 fl oz

Commercial Crop Production Turfgrass

Fungicide ¹	Product Mode of Action Group ²	Trade Name ³	Formulation	Rate ⁴	Maximum Use ⁵
		Honor Guard, Propensity, Propiconazole, Savvi, Spectator			
pyraclostrobin	I I	Insignia	20WG	0.5-0.9 oz	5.5 oz
quintozene (PCNB)	I 4	Glacier, Parflo, PCNB, Revere, Terraclor, Turfcide	10G 38.3F 75WP	5-7.5 lb 11-24 fl oz 7-16 oz	Refer to label
tebuconazole	3	Torque ^{13,6}	38.7L	0.6 fl oz	3.6 fl oz
thiophanate-methyl	I	3336, Allban, Cavalier, Quali-Pro TM, T-Methyl, Transom, T-Storm	2G 41.25L 46.2F 50WP	1.5-9 lb 2-6 fl oz 1-5 fl oz 2-6 oz	Refer to label
thiram	M	Defiant, Spotrete, Thiram	42.1L 75WDG	3.8-7.5 fl oz 2.5-5 oz	Refer to label
triadimefon	3	Bayleton	50WP	0.25-2 oz	Refer to label
trifloxystrobin	I I	Compass	50WDG	0.1-0.25 oz	3 apps
triticonazole	3	Trinity, Triton	19.2L	0.5-2 fl oz	6 fl oz
vinclozolin	2	Curalan Touché	50EG	1 oz	3 oz
Fungicide Combinations					
azoxystrobin + propiconazole	I I, 3	Headway Headway G	5.7 + 9.5L 0.31 + 0.75G	0.75-3.0 fl oz 2-4 lb	Refer to labels
azoxystrobin + chlorothalonil	I I, M	Renown ⁷	3 + 45L	2.5-4.5 fl oz	
chlorothalonil + propiconazole + fludioxonil	M, 3, I 2	Instrata ⁷	29.9 + 4.7 + 1.2L	2.75-11 fl oz	
chlorothalonil + thiophanate-methyl	M, I	Consyst ⁷ Spectro 90 ⁷ Peregrine ⁷ Quali-Pro TM/C ⁷	50 + 16.7WDG 72 + 18WDG	2-5 oz 3-5.8 oz	
fluopicolide + propamocarb hydrochloride	43, 28	Stellar ¹⁴	5.54 + 55.4SC	1.2 fl oz	
fluoxastrobilin + chlorothalonil	I I, M	Disarm C ⁷	2.44 + 38.4L	1.5-5.9 fl oz	
fluoxastrobilin + myclobutanil	I I, 3	Disarm M	15.8 + 25.6L	0.25-1.0 fl oz	Refer to label
iprodione + thiophanate-methyl	2, I	26/36 ¹⁵ TM + IP ¹⁵	19.65 + 19.65L	1-4 fl oz	14.5 fl oz 6 apps/season
mancozeb + copper hydroxide	M, M	Junction	15 + 46.1DF	2-4 oz	
propiconazole +	3, M	Concert ⁷	2.9 + 38.5L	1.5-8.5 fl oz	

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Fungicide ¹	Product Mode of Action Group ²	Trade Name ³	Formulation	Rate ⁴	Maximum Use ⁵
chlorothalonil					
pyraclostrobin + boscalid	I I, 7	Honor ⁶	16.8 + 11.2WG	0.55-1.1 oz	
thiophanate-methyl + flutolanil	I, 7	SysStar	28.6 + 51.4WDG	2-3 oz	Refer to label
trifloxystrobin + triadimefon	I I, 3	Armada Tartan	25L 50WP	1-2 fl oz 0.6-1.2 oz	3 apps
triticonazole + chlorothalonil	3, M	Reserve ⁷	5 + 40L	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.

⁹Premixed with propamocarb for control of *Pythium*.

¹⁰Do not use on bermudagrass.

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.

Information in this section was last updated in December 2019 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 the Vegetable Seed Treatment section of this guide.

Select resistant varieties. The use of resistant varieties is one of the best management strategies in an integrated pest management program because 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 follow:

- **Select land suitable for vegetable production.** Start by selecting a site that is well-drained, has good air movement, gets at least six 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 Diagnostic Center for more information on available pathogen tests.

Plant Diagnostic Center

LSU AgCenter
Department of Plant Pathology & Crop Physiology
Baton Rouge, Louisiana 70803
Phone: 225-578-4562
Fax: 225-578-1415

Soil Test and Plant Analysis Lab

LSU AgCenter
School of Plant, Environmental and Soil Sciences
Baton Rouge, Louisiana 70803
Phone: 225-578-2110
Fax: 225-578-1403

- **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 nonhost 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.

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Vegetables

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 nonlabeled crop. A list of biopesticides and fungicide alternatives for vegetables is provided in Table 6.

Use registered chemicals. Fungicides, bactericides and nematicides 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 IV-ii 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					
Cercospora leaf spot or blight (<i>Cercospora asparagi</i>)	chlorothalonil (various products)	M	2-4 lb	190	12 pt
	mancozeb (various products)	M	See label	See label	See label
	Dexter MAX	M3 + I I	2-2.2 lb	180	See label
Crown and spear rot (<i>Phytophthora</i> spp.)	chlorothalonil (various products)	M	2-4 pt	190	12 pt
	Ridomil Gold SL	4	1 pt	7	4 app
	phosphorous acid	33	3-4 qt	2	12 fl oz
	Fosphite Phostrol	33	2.5-5.0 pt	0	7 app
Purple spot (<i>Stemphylium</i> spp., <i>Pleospora</i> spp.)	azoxystrobin (various products)	I I	6.0-15.5 fl oz	100	92 fl oz
	chlorothalonil (various products)	M	2-4 pt	190	12 pt
	Flint 50WDG	I I	3-4 oz	180	3 app
	Dexter MAX	M3 + I I	2-2.2 lb	180	See label
Rust (<i>Puccinia</i> spp.)	Rally 40W	3	5 oz	180	6 app
	mancozeb (various products)	3	See label	See label	See label
	Chlorothalonil 720SC	M	2-4 pt	90	12 pt
	sulfur ^{OG}			0	
	80%	M	20 lb	0	
	90%	M	15 lb	0	
	98%	M	45 lb		
BASIL					
Downy mildew (<i>Peronospora belbahrii</i>)	Ranman 400SC	2I	2.75-3.0 fl oz	0	27 fl oz
	Regalia ^{OG}	P5	0.5-1 qt	0	
	phosphorous acid				
	Confine Extra	33	1 to 3 qt/20 to	0	
	K-Phite	33	100 gal	0	
	potassium phosphite				
	Fosphite	33	1-3 qt/100 gal	0	
	ProPhyt	33	3-4 pt/100 gal	0	
Leaf spots (<i>Alternaria</i> spp., <i>Botrytis</i> spp., <i>Fusarium</i> spp.)	Presidio	43	4 fl oz	1	12 fl oz
	Revus	40	8 fl oz	1	32 fl oz
	Actinovate AG ^{OG}		3-12 oz	0	
Fusarium wilt and Pythium and Rhizoctonia root rots	phosphorous acid				
	Confine Extra	33	1 to 3 qt/20 to	0	
	K-Phite	33	100 gal	0	
	potassium phosphite				
	Fosphite	33	1-3 qt/100 gal	0	
	ProPhyt	33	3-4 pt/100 gal	0	
BEANS (Snap and Dry)					
Alternaria leaf and pod spot (<i>Alternaria alternata</i>)	Inspire Super (dry beans only)	3, 9	16-20 fl oz	14	80 fl oz
	Quilt I.66SC	3, I I	14 fl oz	7	3 app
	Priaxor Xenium	7, I I	4-8 fl oz	7	2 app
	Fontelis	7	14-30 oz	0	72 fl oz
	Quadris Flowable	I I	6.2-15.4 fl oz	0	92 fl oz

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Headline 2.09 Actinovate AG ^{OG}	I I	6-9 fl oz 3-12 oz	7 0	2 app
Anthracnose (<i>Colletotrichum lindemuthianum</i>)	Inspire Super (dry beans only)	I I	16-20 fl oz	14	80 fl oz
	Aproach (dry beans only) chlorothalonil (dry beans only)	I I	6-12 fl oz	7	24 fl oz
	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	I	1.5-2 lb	14	4 lb
	Incognito 4.5F	I	30-40 fl oz	14	80 fl oz
	85WDG (dry beans)	I	0.8-1.6 lb	28	3.2 lb
	85WDG (snap beans)	I	0.8-1.6 lb	14	3.2 lb
	Quilt 1.66SC	I I, 3	14 fl. Oz	0	42 fl oz
	Quilt Xcel	I I, 3	10.5-14 fl oz	0	42 fl oz
	Priaxor Xenium	7, I I	4-8 fl oz	7	2 apps
	Fontelis	7	14-30 fl oz	7	72 fl oz
	Quadris Flowable	I I	6-15.5 fl oz	0	4 app
	Quadris Opti (dry beans only)	I I, M	1.6-2.4 pt	0	4 app
	Headline 2.09 (dry beans)	I I	6-9 fl oz	21	2 app
	Headline 2.09 (snap beans)	I I	6-9 fl oz	7	2 app
	Tilt	3	4 fl oz	7	12 fl oz
	Cueva ^{OG}	M	0.2-2 gal		
	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 and 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
	Cuproxat	M	1.5-3.9 pt		23.4 pt
	Cueva ^{OG}	M	0.5-2 gal/100 gal		
	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	I	1.5-2 lb	14	4 lb
	Incognito 4.5F	I	30-40 fl oz	14	80 fl oz
	85WDG (dry beans)	I	0.8-1.6 lb	28	3.2 lb
	85WDG (snap beans)	I	0.8-1.6 lb	14	3.2 lb
	Fontelis	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 62.5VG	12, 9	11-14 oz	2	56 oz
	chlorothalonil (snap beans only)				
	Bravo Ultrex	M	2.7 lb	7	10.9 lb
	Bravo WeatherStik	M	3 lb	7	12 pt
	Cueva ^{OG}	M	0.5-2 gal/100 gal		
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, I I	0.34 fl. oz ⁶		1 app
Damping-off	Quadris 2.08F	I I	0.4-0.8 fl oz ⁶		1 app

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
(<i>Rhizoctonia solani</i>)	Headline Blocker 4F Uniform	I I I 4 4, I 4	0.1-0.8 fl oz ⁶ 2.2-3.3 pt ⁶ 0.34 fl oz ⁶		I app I app I app
Leaf spots and blights (<i>Alternaria</i> spp., <i>Ascochyta</i> spp., <i>Cercospora</i> spp.)	Aproach (dry beans only) chlorothalonil (dry beans only) Bravo Ultrex Bravo WeatherStix Fontelis azoxystrobin (various products) Quadris Opti (dry beans only) Headline (dry beans) Headline (snap beans)	I I M M 7 I I I I, M I I I I	6-12 fl oz 1.25-1.8 lb 1.375-2 pt 14-30 fl oz 6.2-15.4 fl oz 1.6-2.4 pt 6-9 fl oz 6-9 fl oz	7 7 7 0 0 7 2I 7	24 fl oz 7.3 lb 8 pt 72 fl oz 4 app 4 app 2 app 2 app
Rhizocontia web blight and Pod tip rot (<i>Rhizoctonia solani</i>)	Rally 40WSP (snap beans only, pod tip rot) Tilt azoxystrobin (various products) Quadris Opti (dry beans only) Quilt Quilt Xcel	3 3 I I I I, M I I, 3 I I, 3	4-5 oz 4 fl oz 6-15.5 fl oz 1.6-2.4 fl oz 14 fl oz 10.5-14 fl oz	0 7 0 7 7 7	20 oz 12 fl oz 4 app 4 app 42 fl oz 42 fl oz
Powdery mildew (<i>Erysiphe polygoni</i>)	Endura Priaxor Xenium Fontelis Headline (dry beans) Headline (snap beans) Fosphite sulfur 80%OG 90%OG 98%OG Armcarb 100OG	7 7, I I 7 I I I I 33 M M M	8-11 oz 4-8 fl oz 14-30 oz 6-9 fl oz 6-9 fl oz 1-3 qt/100 gal 20 lb 15 lb 45 lb 2.5-5 lb	7 7 0 2I 7 0 0 0 0 0	2 app 2 app 72 fl oz 2 app 2 app
Rust (<i>Phakopsora pachyrhizi</i> , <i>Uromyces appendiculatus</i>)	Aproach (dry beans only) Proline 480SC (dry beans only, white mold) Rally 40WSP tebuconazole 3.6F Folicur 3.6F (dry) Folicur 3.6F (snap) Quilt 1.66SC Priaxor Xenium Fontelis azoxystrobin (various products) Quadris Opti (dry beans only) Headline (dry beans) Headline (snap beans) chlorothalonil Dry beans Bravo Ultrex Bravo WeatherStix Snap beans Bravo Ultrex Bravo WeatherStix	I I 3 3 3 3, I I 7, I I 7 I I I I, M I I I I I I M M M M	6-12 fl oz 5.7 fl oz 4-5 oz 4-6 fl oz 4-6 fl oz 14 fl oz 4-8 fl oz 14-30 oz 6.2-15.4 fl oz 1.6-2.4 pt 6-9 fl oz 6-9 fl oz 1.25-1.8 lb 1.375-2 pt 1.25-2.7 lb 1.375-3 pt	7 7 0 7 7 7 7 0 0 7 2I 7 7 7 7 7	24 fl oz 17 fl oz 20 oz 12 fl oz 24 fl oz 3 app 2 app 72 fl oz 4 app 4 app 2 app 2 app 4 app 8pt 10.9 lb 12 pt
White mold (<i>Sclerotinia sclerotiorum</i>)	Botran 75W (snap beans only) Cannonball WG Endura Fontelis iprodione Iprodione 4L AG Rovral 4F	I 4 I 2 7 7 2 2	2.5-4 lb 7 oz 6-9 oz 16-30 fl oz 1.5-2 pt 1.5-2 pt	2 7 0-14 ¹⁰ 14 14	5.3 lb 28 oz 2 apps 72 fl oz 2 app 2 app

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	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 Xenium (dry)	7, 11	4-8 fl oz	21	16 fl oz
	Priaxor Xenium (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				
	85WDG (succulent)	1	1.2-1.6 lb	14	3.2 lb
	85WDG (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 and Kohlrabi)					
Alternaria leaf spot (<i>Alternaria</i> spp.)	Cabrio	11	12-16 oz	0	64 oz
	chlorothalonil				
	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
	Champ WG ^{OG}	M	1.58 lb	7	9.48 lb
	Nu-Cop 50DF	M	1 lb	7	5 lb
	copper hydroxide and 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
	Cueva ^{OG}	M	0.5-2 gal/100 gal		
	Nordox 75WG ^{OG}	M	0.6-2.5 lb		
	Endura	M	6-9 oz		
	Fontelis	7	14-30 fl oz		72 fl oz
	Inspire Super	7	16-20 fl oz	0-14 ¹⁰	2 app
	ManKocide	M	1-3 lb	7	80 fl oz
	Manzate Pro-Stik ⁷	M	1.6-2.1 lb	7	12.8 lb
	Milstop ^{OG}	M	2-5 lb/100 gal	7	8.8 lb
	Procure 480SC	3	6-8 fl oz	14	2 app
	azoxystrobin (various products)				
	Quadris Top	3, 11	12-14 fl oz	1	56 fl oz
	Reason 500SC	11	5.5-8.2 fl oz	2	24.6 fl oz
	Serenade ASO				
	ASO ^{OG}	44	2-4 qt		
	Max ^{OG}	44	1-3 lb		
	Switch 62.5WG	9, 12	11-14 oz	7-10	2 app
Basal stem rot, Phytophthora root rot (<i>Phytophthora</i> spp.) and Damping-off (<i>Pythium</i> spp.)	Ridomil Gold SL	4	1-2 pt ⁸	2	1 app
	Presidio 4F	43	3-4 fl oz		4 app
	MetaStar 2E	4	4-8 pt ⁸		1 app
	Ultra Flourish	4	2-4 pt ⁸		1 app

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
Black leg (<i>Phoma lingam</i>)	Cabrio Rovral 4F Priaxor Xenium	11 2 7, 11	12-16 oz 2 pt 6-8.2 fl oz	0 0 3	64 oz 2 app 24.6 fl oz
Black rot (<i>Xanthomonas campestris</i> pv. <i>campestris</i>)	Actigard 50WG copper hydroxide Kocide 3000 Kocide 2000 Champ WG ^{OG} Nu-Cop 50DF copper hydroxide and copper oxychloride Badge SC Badge X2 ^{OG} copper sulfate Cuprofix-Ultra 40 Cuproxtat Cueva ^{OG} Nordox 75WG ^{OG}	21 M M M M M M M M M M M M	0.5-1.0 oz 0.5-1.25 lb 0.75-2.25 lb 1.58 lb 1 lb 1-2 pt 0.5-1.25 lb 0.75-1.25 lb 1.5-2.5 pt 0.5-2 gal/100 gal 0.6-2.5 lb	7 0 0 7 7 7 7 7 7 7 7 7 7	4 apps 15.8 lb 13.5 lb 9.48 lb 5 lb 16.6 pt 2.65 lb 6.6 lb 13.1 pt
Cercospora leaf spot (<i>Cercospora brassicola</i>)	Cease Biofungicide ^{OG} Inspire Super Quadris Top Switch 62.5WG	44 9 11, 3 9, 12	3-6 qt/100 gal 16-20 fl oz 12-14 fl oz 11-14 oz	0 7 1 7	80 fl oz 56 fl oz 56 oz
Clubroot (<i>Plasmodiophora brassicae</i>)	Omega 500F Blocker 4F Ranman	29 14 21	2.6 pt ⁸ 5.62 gal ⁸ 13-25.8 fl oz ⁸		1 app 22.5 lbs 1 app
Damping-off, Wire stem (<i>Rhizoctonia solani</i>)	Blocker 4F Uniform Quadris Flowable	14 4, 11 11	2.8-3.75 gal ⁸ 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 400SC Presidio 4SC potassium phosphite (various formulations) Quadris 2.08F Revus 2.08SC Zapro	4 21 43 33 11 40 45, 40	0.25-0.5 pt 2.75 fl oz 3-4 fl oz 2-4 pt 6-15.5 fl oz 8 fl oz 14 fl oz	7 0 2 0 0 1 0	2 pt 5 app 12 fl oz 92.3 fl oz 32 fl oz 42 fl oz
Powdery mildew (<i>Erysiphe polygoni</i> , <i>E. cruciferarum</i>)	Cabrio EG Cease Biofungicide ^{OG} Endura 70WP Fontelis Inspire Super phosphorous acid (various formulations) Potassium bicarbonate Armcarb 100 Milstop ^{OG} Kaligreen Fungicide Procure 480SC Quadris Top Serenade ASO ^{OG} Max ^{OG} Sonata ^{OG} sulfur Microfine Sulfur Microthiol Dispers ^{OG} Yellow Jacket Wettable Switch 62.5WG	11 44 7 7 3, 9 33 33 33 33 3 11, 3 44 44 44 M M M 9, 12	12-16 oz 3-6 qt/100 gal 6-9 oz 14-30 fl oz 16-20 fl oz 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 2-4 qt 6-25 lb 3-10 lb 6-25 lb 10-12 oz	0-3 ⁹ 0 0-14 ¹⁰ 0 7 0 0 00 1 1 f0 0 0 0 7	64 oz 18 oz 72 fl oz 80 fl oz 18 fl oz 56 fl oz 56 oz

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
Rhizoctonia bottom rot	Endura 70WP	7	6-9 fl oz	0	2 app
White mold (<i>Sclerotinia sclerotiorum</i>)	Endura 70WP Fontelis	7 7	6-9 oz 16-30 fl oz	0-14 ¹⁰ 3	2 apps 72 fl oz
White rust (<i>Albugo candida</i>)	Cabrio EG Reason 500SC	11 11	12-16 oz 8.2 fl oz	0-3 ⁹ 2	64 oz 24.6 fl oz
Cucurbits (Cantaloupe, Cucumbers, Pumpkins, Squash, Watermelons and Zucchini)					
Angular leaf spot (<i>Pseudomonas syringae</i> pv. <i>lachrymans</i>) and Bacterial leaf spot (<i>Xanthomonas campestris</i> pv. <i>cucurbitae</i>)	Actigard 50 WP	21	0.5-1.0 oz	0	8 oz
	copper hydroxide	M	0.5-1.3 lb	0	17.5 lb
	Kocide 3000	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		
	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
	Cueva ^{OG}	M	0.5-2 gal/100 gal	0	
	Nordox 75WG ^{OG}	M	1.5-2 lb		
	ManKocide	M	2-3 lb	5	8 app
Leaf spots (<i>Alternaria</i> , <i>Cercospora</i>), Anthracnose (<i>Colletotrichum</i>), Gummy stem blight (<i>Didymella</i>), Target spot (<i>Corynespora</i>)	Actinovate	11	3-12 oz	0	
	Cabrio 20WG		12-16 oz	0	64 oz
	chlorothalonil				
	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
	Chlorothalonil 720SC	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		
	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
	Cueva ^{OG}	M	0.5-2 gal/100 gal	0	
	Nordox 75WG ^{OG}	M	1.5-2 lb		
	Evito 480SC	11	3-5.7 fl oz	1	
	Gavel 75DF	M, 22	1.5-2 lb	1	22.8 fl oz
	Inspire Super	3, 9	16-20 fl oz	5	8 app
	mancozeb			7	80 fl oz
	Dry formulations	M	2-3 lb		
	Liquid Formulations	M	1.6-2.4 qt	5	25.6 lb
	ManKocide	M	2-3 lb	5	19.2 qt
	Merivon 500 EC	7, 11	4-5.5 fl oz	5	24 lb
	Monsoon 3.6 F (gummy stem blight only)	3	8 fl oz	7	24 fl oz
	Pristine 38WG	7, 11	12.5-18.5 oz	0	16.5 oz

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Proline 480SC (gummy stem blight only) Quadris 2.08F Quadris Opti Quadris Top 1.67SC Ridomil Gold Bravo SC Satori Tanos 50WP thiophanate-methyl Thiophanate-methyl 85WDG Topsin 4.5FL Topsin M 70WP Topsin M WSB Trilogy ^{OG}	3 11 11, M 11, 3 4, M 11 11, 27 1 1 1 1	5.7 fl oz 11-15.5 fl oz 3.2 pt 12-14 fl oz 2.5-3.3 pt 11-15.5 fl oz 8 oz 0.4 lb 10 fl oz 0.5 lb 0.5 lb 1%	7 0 1 1 1 0 1 3 1 1 1	17.1 fl oz 74 oz 92.3 fl oz 4 app 56 fl oz 4 app 92.3 fl oz 4 app 2.5 lb 60 fl oz 3 lb
Bacterial fruit blotch (<i>Acidovorax avena</i> subsp. <i>citrulli</i>)	Actigard 50WG copper hydroxide Kocide 3000 Kocide 2000 Champ WG ^{OG} Nu-Cop 50DF ^{OG} copper hydroxide and copper oxychloride ¹¹ Badge SC Badge X2 ^{OG} copper sulfate Cuprofix-Ultra 40 Mastercop Cueva ^{OG} Nordox 75WG ^{OG}	21 M M M M M M M M M M	0.5-1.0 oz 0.5-1.3 lb 1-2.3 lb 1.5-2 lb 1.5-2 lb 1-2.5 pt 0.5-1.3 lb 1-2 lb 0.5-1 pt 0.5-2 gal/100 gal 1.5-2 lb	0 0 0 0 1 0 0 0 0 0 1	8 oz 17.5 lb 15 lb 10.5 lb 10.5 lb 18.6 pt 5.3 lb Cu 13 lb 6 pt
Bacterial wilt (<i>Erwinia tracheiphila</i>)	No bactericides available. Control of the cucumber beetle prior to flowering is the only recommended practice. See Louisiana Insect Pest Management Guide.				
Belly (fruit) rot (<i>Rhizoctonia solani</i>)	Aprovia top Evito 480SC Quadris Quadris Opti Quadris Top 1.67SC Satori thiophanate-methyl Thiophanate-methyl 85WG Topsin 4.5FL Topsin M 70WP Topsin M WSB	3, 7 11 11 11, M 11, 3 11 1 1 1 1	10.5-13.5 fl oz 3-5.7 fl oz 11-15.5 fl oz 3.2 pt 12-14 fl oz 0.4-0.8 fl oz ⁶ 0.4 lb 10 fl oz 0.5 lb 0.5 lb	0 1 1 1 1 1 1 1 1 1	53.6 fl oz 22.8 fl oz 92.3 fl oz 4 app 56 fl oz 1 app 2.5 lb 60 fl oz 3 lb 3 lb
Downy mildew (<i>Pseudoperonospora cubensis</i>)	Actigard 50WG Actinovate AG ^{OG} Aliette WDG Alude Cabrio 20WG Catamaran chlorothalonil Bravo Ultrex Bravo WeatherStik Bravo Zn Chlorothalonil 720SC copper hydroxide Kocide 3000	21 33 33 11 M, 33 M M M M M	0.5-1.0 oz 3-12 oz 2-5 lb 1.3 qt 8-12 oz 6 pt 1.4-1.8 lb 1.5-2 pt 2.3-2.8 pt 1.5-2 pt 0.5-1.3 lb	0 0 0.5 0 0 0 0 0 0 0 0	8 oz 7 app 6 app 64 oz 50 pt 19.1 lb 21 pt 30 pt 21 pt 17.5 lb

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	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
	Cueva ^{OG}	M	0.5-2 gal/100 gal	0	
	Nordox 75WG ^{OG}	M	1.5-2 lb	1	
	Curzate 60DF	M	3.2 oz	3	
	Evito 480SC	27	3-5.7 fl oz	1	30 oz
	Flint 50WDG	11	4 oz	0	22.8 fl oz
	Forum	11	6 fl oz ¹²	0	16 oz
	Gavel 75DF	40	1.5-2 lb	5	30 fl oz
	mancozeb				
	Dry formulations	M	1.6-2.4 qt	5	25.6 lb
	Liquid Formulations	M	2-3 lb	5	19.2 qt
	ManKocide	M	2-5 lb/100 gal	5	24 lb
	Milstop ^{OG}		3-4 fl oz ¹²		
	Orondis Ultra (Premix)	40, U15	5.5-8 fl oz	0	32 fl oz
	Presidio 4F	43	50 fl oz/100 gal	2	12 fl oz
	Previcur Flex 6F	28	1.2 pt	2	6 pt
	Pristine 38WG	7, 11	12.5-18.5 oz	0	74 oz
	Quadris 2.08SC	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
	Ranman 400SC	21	2.1-2.3 fl oz	0	16.5 fl oz
	Reason 500SC	11	5.5 fl oz	14	22 fl oz
	Revus 2.08F	40	8 fl oz ¹²	0	32 fl oz
	Satori	11	11-15.5 fl oz	1	92.3 fl oz
	Zampro 4.38SC	40, 45	14 fl oz	0	42 fl oz
	Zing	22, M	36 fl oz	0	8 app
Fusarium wilt (<i>Fusarium oxysporum</i>)	No fungicides labeled				
Plectorsporium blight (<i>Plectosporium tabacinum</i>)	Cabrio 20WG	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
	Flint 50WDG	11	1.5-2 oz	0	16 fl oz
	Merivon 500SC	7, 11	5.5 fl oz	0	16.5 fl oz
	Quadris Top 1.67SC	11, 3	12-14 fl oz	1	56 fl oz
	Roper DF Rainshield	M	2-3 lb	5	25.6 lb
Powdery mildew (<i>Sphaerotheca fuliginea</i> , <i>Erysiphe cichoracearum</i>)	Actigard 50WG	21	0.5-1.0 oz	0	8 oz
	Actinovate AG ^{OG}		3-12 oz	0	
	Cabrio 20WG	11	8-12 oz	0	64 oz
	Catamaran 5.27SC	M, 33	6 pt	0	50 pt
	chlorothalonil				
	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
	Chlorothalonil 720SC	M	1.5-2 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
	copper hydroxide and copper oxychloride ¹¹				
	Badge SC	M	1-2.5 pt	0	18.6 pt

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	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
	Nordox 75WG ^{OG}	M	1.5-2 lb	1	
	Endura	7	6.5 oz	0	26 oz
	Evito 480SC	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 500SC	7, 11	4-5.5 fl oz	0	16.5 fl oz
	Prev-AM	7, 11	50 fl oz/100 gal		
	Pristine	7, 11	12.5-18.5 oz	0	74 oz
	Procure 50WS	3	4-8 oz	0	40 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
	Quintec 2.08SC (not on cucumber or summer squash)	13	4-6 fl oz	3	24 fl oz
	Rally 40WSP	3	2.5-5 oz	0	1.5 lb a.i.
	Satori	11	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	M2	2-4 lb		
	Cucumbers only				
	Melons, squash, or pumpkins				
	Surround WP ^{OG}		25-50 lb		
	Switch 62.5WG	9, 12	11-14 oz	1	56 oz
	Torino 0.85SC	U6	3.4 oz	0	2 app
	tebuconazole (various formulations)	3	4-6 fl oz	7	24 fl oz
	thiophanate-methyl				
	Thiophanate-methyl 85WG	1	0.2-0.4 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>)	Elumin	22	8 fl oz	2	16 fl oz
	Forum 4.17SC	40	6 fl oz ¹²	0	30 fl oz
	Omega 500F	29	1.5 pt	See label	See label
	Orondis Gold 200	U15	4.8-9.6 fl oz	0	19.2 fl oz
	Orondis Ultra (Premix)	40, U15	5.5-8 fl oz	0	32 fl oz
	Presidio 4F	43	3-4 fl oz	2	12 fl oz
	Ranman 400SC	21	2.8 fl oz	0	16.6 fl oz
	Revus 2.08F	40	8 fl oz	0	32 fl oz
	Zapro 4.38SC	40, 45	14 fl oz	0	42 fl oz
Damping-off, Root rot 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				
	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	6 app
	Fungi-phite	33	1-5 qt	0	7 app
	Previcur Flex	28	1.2 pt	2	6 pt

Commercial Crop Production

Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Ridomil Gold SL	4	1-2 pt ¹³		1 app
	MetaStar 2EC AG	4	4-8 pt ¹³		1 app
	Serenade Soil ^{OG}	44	2-6 qt ¹³		
	Ultra Flourish	4	2-4 pt ¹³	5	4 pt
Scab (<i>Cladosporium cucumerinum</i>)	Actigard 50WVP	2l	0.5-1.0 oz		8 oz
	Catamaran 5.27SC	M, 33	6 pt	0	50 pt
	chlorothalonil				
	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
	Chlorothalonil 720SC	M	1.5-2 pt	0	21 pt
	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
	Ridomil Gold Bravo SC	4, M	2.5-3.3 pt	0	15.8 lb a.i.
	Trilogy ^{OG}		1%		
Eggplant					
Leaf blights and spots (<i>Alternaria</i> spp.) Anthraco rot (<i>Colletotrichum coccodes</i>) and Phomopsis fruit rot (<i>Phomopsis vexans</i>)	Actinovate AG ^{OG}		3-12 oz		
	Cabrio 20EG	1 l	8-12 oz	0	96 oz
	copper hydroxide				
	Kocide 3000	M	0.8-1.5 lb	0	26.3 lb
	Kocide 2000	M	1.5 lb	0	22.6 lb
	Champ WG ^{OG}	M	1.6 lb	7	15.8 lb
	Nu-Cop 50DF ^{OG}	M	1.5 lb	1	15 lb
	copper hydroxide and copper oxychloride ¹¹				
	Badge SC	M	1.5 pt	7	27.8 pt
	Badge X2 ^{OG}	M	0.8 lb	7	7.9 lb Cu
	copper sulfate				
	Cuprofix-Ultra 40	M	1.3 lb ¹¹		19.8 lb
	Mastercop	M	0.5-1.5 pt	7	9 pt
	Nordox 75WG ^{OG}	M	2-4 lb		
	Aftershock OR Evito	1 l	2-5.7 fl oz	3	22.8 fl oz
	Fontelis	7	16-24 fl oz	0	72 fl oz
	Milstop ^{OG}		2-5 lb/100 gal		
	Priaxor 500 SC	7, 1 l	4-8 fl oz	0	24 fl oz
	Quadris Top 1.67SC	1 l, 3	8-14 fl oz	0	55.3 fl oz
	Reason 500SC	1 l	5.5-8.2 fl oz	14	24.6 fl oz
	Trilogy ^{OG}		1%		
Powdery mildew (<i>Leveillula taurica</i>)	Ariston	M, 27	2-2.4 pt	3	18.1
	Cabrio 20EG	1 l	8-16 oz	0	96 oz
	chlorothalonil				
	Bravo Ultrex	M	1.4 lb	3	10.9 lb
	Bravo WeatherStik ¹⁴	M	1.5 pt	3	12 pt
	phosphorous acid (various formulations)	33	see labels	0	
	Fontelis	7	16-24 fl oz	0	72 fl oz
	Inspire Super	3, 9	16-20 fl oz	0	47 fl oz
	Priaxor 500SC	7, 1 l	6-8 fl oz	0	24 fl oz
	Quadris 2.08F	1 l	6-15.5 fl oz	0	61.5 fl oz
	Quadris Top	1 l, 3	8-14 fl oz	0	55.3 fl oz
	Satori	1 l	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		

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Yellow Jacket Wettable	M	22-38 lb		
	Switch 62.5WG	9, 12	11-14 oz	0	56 oz
	Trilogy		1%		
	Vivando	U8	15.4 fl oz	0	46.2 fl oz
Phytophthora blight or crown rot (<i>Phytophthora capsici</i>)	Forum SC	40	6 fl oz ¹²	0	30 fl oz
	Micora 2.08F	40	8 fl oz ¹²	1	32 fl oz
	Omega 500F	29	1.5 pt	30	9 pt
	Orondis Gold 200	U15	4.8-9.6 fl oz	0	19.2 fl oz
	Presidio 4SC	43	3-4 fl oz	2	12 fl oz
	Ranman 400SC	21	2.8 fl oz	0	16.5 fl oz
	Reason 500SC	11	8.2 fl oz	14	24.6 fl oz
	Revus 2.08F	40	8 fl oz	1	32 oz
	Ridomil Gold + Copper	4, M	2 lb	7	4 app
	Zapro 525SC	40, 45	14 fl oz	0	42 fl oz
Damping-off (<i>Pythium</i> spp.)	MetaStar 2E	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 20EG fluoxastrobin	11	12-16 oz	0	96 oz
	Aftershock	11	2-5.7 fl oz	3	22.8 fl oz
	Evito 280SC	11	2-5.7 fl oz	3	22.8 fl oz
	OSO 5%	19	6.5-13 fl oz	0	4.2 oz a.i.
	Priaxor 500SC	7, 11	4-8 fl oz	0	24 fl oz
Verticillium wilt (<i>Verticillium</i> sp.)	OSO 5%	19	6.5-13 fl oz	0	4.2 oz a.i.
GREENS (Collards, Kale, Mustard and 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	M	0.3-0.7 pt	0	7.3 pt
	Flowable				
	Champ WG ^{OG}	M	1 lb	0	5.3 lb
	copper hydroxide and copper oxychloride ¹¹				
	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	0.8-1.3 lb	0	6.6 lb
	Mastercop	M	0.5-1 pt	0	6 pt
	Inspire Super	3, 9	16-20 fl oz	7	80 fl oz
	Procure 480 SC	3	6-8 fl oz	1	18 fl oz
	Reason 500 SC	11	8.2 fl oz	2	24.6 fl oz
	Serenade ^{OG}				
	ASO	44	2-6 qt		
	Max	44	1-3 lb		
	Sonata ^{OG}	44	2-4 qt		
	Switch 62.5WG	9, 12	11-14 oz	7	56 oz
	tebuconazole				
	Monsoon	3	3-4 fl oz	7	16 fl oz
	Onset 3.6L	3	3-4 fl oz	7	16 fl oz
	Tebu-Crop 3.6F	3	3-4 fl oz	7	16 fl oz

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Toledo	3	3-4 fl oz	7	16 fl oz
Anthracnose (<i>Colletotrichum higginsianum</i>), Leaf spots (<i>Cercospora</i> spp., <i>Cercospora</i> spp.)	azoxystrobin	11	6-15.5 fl oz	0	46 fl oz
	Quadris	11, 3	12-14 fl oz	1	56 fl oz
	Quadris Top	11	12-16 oz	3	64 oz
	Satori	11	6-9 oz	14	18 oz
	Cabrio 20EG	11	14-30 fl oz	0	72 fl oz
	Endura 70WG	7	14-30 fl oz	0	72 fl oz
	Fontelis 1.67SC	7	16-20 fl oz	7	80 fl oz
	Inspire Super 2.82SC	3, 9	8.2 fl oz	2	24.6 fl oz
	Reason 500SC	11	11-14 oz	7	56 oz
	Switch 62.5WG	9, 12	3-4 fl oz	7	16 fl oz
	tebuconazole	3	3-4 fl oz	7	16 fl oz
	Monsoon	3	3-4 fl oz	7	16 fl oz
	Onset 3.6L	3	3-4 fl oz	7	16 fl oz
	Tebu-Crop 3.6F	3	3-4 fl oz	7	16 fl oz
	Toledo	3	3-4 fl oz	7	16 fl oz
Bacterial leaf spot (<i>Xanthomonas campestris</i> pv. <i>armoraciae</i>)	Cease	44	3-6 qt/100 gal	0	Chemicals are not effective against this disease.
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	Max	44	1-3 lb	0	
Black rot (<i>Xanthomonas campestris</i> pv. <i>campestris</i>)	Sonata ^{OG}	44	2-4 qt	0	4 apps
	Actigard	21	0.5-1.0 oz	7	
	Cease	44	3-6 qt/100 gal	0	
	copper hydroxide				
	Kocide 3000	M	0.5-1.3 lb	0	
	Kocide 2000	M	0.5-0.8 lb	0	
	Champ Formula 2	M	0.8-1.5 lb	0	
	Flowable				
	Champ WG ^{OG}	M	1 lb	0	
	copper hydroxide and copper oxychloride				
	Badge SC	M	1-1.8 pt	0	
	Badge X2 ^{OG}	M	0.5-0.8 lb	0	
	copper sulfate				
	Cuprofix-Ultra 40	M	0.5-1 pt	0	
	Mastercop	M	0.5-1 pt	0	
	Nordox 75WG ^{OG}	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 20EG	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	M	0.3-0.7 pt	0	7.3 pt
	Flowable				
	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
	Nordox 75WG ^{OG}	M	1-2 lb		
	Forum 4.16SC	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				

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	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	0	6 app
	Helena ProPhyt	33	2-4 pt	0	7 app
	Presidio 4SC	43	3-4 fl oz	2	12 fl oz
	Ranman 400SC	21	2.8 fl oz	0	39.5 fl oz
	Reason 500SC	11	5.5-8.2 fl oz	2	24.6 fl oz
	Revus 2.08SC	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	
	Zapro 525SC	40, 45	14 fl oz	0	42 fl oz
Peppery leaf spot (<i>Pseudomonas syringae</i> pv. <i>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		
	Cease		3-6 qt/100 gal	0	
	Cabrio 20EG	11	12-16 oz	3	64 oz
	Endura 70WG	7	6-9 oz	14	18 oz
	Fontelis 1.67SC	7	14-30 fl oz	0	72 fl oz
	Inspire Super	3, 9	16-20 fl oz	7	80 fl oz
	MilStop ^{OG}	40	2-5 lb/100 gal		
	phosphorous acid				
	Confine Extra	33	1-3 qt		
	Rampart	33	1-3 qt/100 gal		
	Fosphite	33	1-3 qt/100 gal		
	Priaxor Xenium	7, 11	6-8.2 fl oz	3	24.6 fl oz
	Procure 480SC	3	6-8 fl oz	1	18 fl oz
	Quadris Top	11, 3	12-14 fl oz	1	56 fl oz
	Quintec	13	4-6 fl oz	1	24 fl oz
	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 62.5VWG	9, 12	10-12 oz	7	56 oz
	tebuconazole				
	Monsoon	3	3-4 fl oz	7	16 fl oz
	Onset 3.6L	3	3-4 fl oz	7	16 fl oz
	Tebu-Crop 3.6F	3	3-4 fl oz	7	16 fl oz
	Toledo	3	3-4 fl oz	7	16 fl oz
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/ 1/2acre ¹³		1 app

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
Phytophthora root rot (<i>Phytophthora</i> spp.)	Actinovate AG ^{OG}	4	3-12 oz		4 pt
	Ultra Flourish phosphorous acid		0.5-1 pt		
	Confine Extra	33	1-3 qt/100 gal		
	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/ ½acre 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 rot (<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 500SC	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., <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 720SC	M	2-3 pt ²⁸	7	24 pt
	Fontelis	7	14-24 fl oz	3	72 fl oz
	propiconazole				
	Bumper 41.8EC	3	3-4 fl oz ²⁸	14	16 fl oz
	Bumper ES	3	3-4 fl oz ²⁸	14	16 fl oz
	Propi-StarEC	3	3-4 fl oz ²⁸	14	16 fl oz
	Tilt	3	3-4 fl oz ²⁸	14	16 fl oz
	Switch 62.5WG	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
	Cabrio	11	16 oz	0	64 fl oz
	Micora	40	5.5-8 fl oz ¹²		2 app

Commercial Crop Production

Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	phosphorous acid	33	1-4 qt		
	Confine Extra	33	1-3 qt/100 gal		
	Rampart				
	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 400SC	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
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		
	Fosphite	33	1-3 qt/100 gal		
	Ranman	21	2.8 fl oz ¹³		16.5 fl oz l
	Rootshield Granules	44	2.5-6 lb/ 1/2acre ¹³	0	app
	Uniform	4, 11	0.34 fl oz ⁶		l app
Damping-off (<i>Rhizoctonia solani</i>)	phosphorous acid				
	Confine Extra	33	1-4 qt		
	Rampart	33	1-3 qt/100 gal		
	Fosphite	33	1-3 qt/100 gal		
	Rootshield Granules	44	2.5-6 lb/ 1/2acre ¹³	0	l 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 400SC	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	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

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
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
	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 2F	M	0.7-1.3 pt	0	22 pt
	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
	Nordox 75WG ^{OG}	M	1-2 lb		
	Manzate Pro-Stick	M	1.6-2.1 lb		
	ManKocide	M	1-2 lb	10	12.8 lb
	Merivon Xenium	7, 11	8-11 fl oz	1	33 fl oz
	Micora	40	5.5-8 fl oz ¹²	10	26 lb
	Milstop ^{OG}		2-5 lb/100 gal		2 app
	Orondis Ultra	40, U15	5.5-8 fl oz	1	32 fl oz
	Orondis Gold 200	U15	4.8-9.6 fl oz	0	19.2 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		
	Fungi-phite	33	1-2 qt		6 app
	Helena ProPhyt	33	2-4 pt	2	7 app
	Presidio	43	3-4 fl oz ¹²		12 fl oz
	Prev-AM		50 fl oz/100 gal	2	
	Previcur Flex	28	2 pt	0	8 pt
	Ranman	21	2.8 fl oz	2	16.5 fl oz
	Reason 500SC	11	5.5-8.2 fl oz	1	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</i> , <i>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
	Endura	7	8-11 oz	14	22 oz
	Fontelis	7	16-24 fl oz	3	72 fl oz
	iprodione				

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	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 Xenium (<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				
	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 Xenium	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		
	Fosphite	33	1-3 qt/100 gal		
	Prev-Am		50 fl oz/100 gal		
	Procure 480SC	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	
	Microthiol Disperss	M	5-10 lb	0	
	Switch 62.5WG	9, 12	11-14 oz		56 oz
	Trilogy ^{OG}		1%		
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		
	Fungi-phite	33	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/ 1/2acre ¹³		1 app
	Uniform	4, 11	0.34 fl oz ⁶		1 app
Okra					
Cercospora leaf spot (<i>Cercospora abelmoschi</i> , <i>C. malayensis</i>)	chlorothalonil				
	Bravo Ultrex	M	1.4 lb	3	10.9 lb
	Bravo WeatherStix	M	1.5 pt	3	12 pt
	Chloronil	M	1.5 pt	3	12 pt
	Equus 720SST	M	1.5 pt	3	12 pt
	tebuconazole				
	(Orius 3.6F, Uppercur, Folicur, Tebustar 3.6L)	3	4-6 fl oz	3	24 fl oz
Downy mildew	Micora	40	5.5-8 fl oz	0	2 app

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Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
Powdery mildew (<i>Erysiphe cichoracearum</i>)	Ariston	27, M	2-4.4 pt	3	17.5 pt
	chlorothalonil				
	Bravo Ultrex	M	1.4 lb	3	10.9 lb
	Bravo WeatherStix	M	1.5 pt	3	12 pt
	Chloronil	M	1.5 pt	3	12 pt
	Equus720SST	M	1.5 pt	3	12 pt
	copper hydroxide				
	Kentan DF	M	0.5-1.5 lb		5.25 lb
	Kocide 3000	M	0.75-1.5 lb	0	17.5 lb
	Kocide 2000	M	1.5-3 lb	0	15 lb
	Mastercop	M	0.5-1.5 pt		9 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/100 gal	0	
	Inspire Super	3, 9	16-20 fl oz	0	47 fl oz
	Quadris Flowable	11	6-15.5 fl oz	0	61.5 fl oz
	Quadris Top	11, 3	8-14 fl oz	7	55.3 fl oz
	Rally 40WSP	3	2.5-5 oz	0	1.25 lb a.i.
	Serenade				
	ASO ^{OG}	44	2-6 qt		
	MAX ^{OG}	44	1-3 lb		
	Microthiol Disperss ^{OG}	M	3-10 lb		
	Switch 62.5WG	9, 12	11-14 oz	0	56 oz
	Trilogy ^{OG}		0.5-1%/100 gal		
	Vivando	U8	15.4 fl oz	0	46.2 fl oz
Damping-off (<i>Rhizoctonia</i> spp.)	Quadris 2.08F	11	0.4-0.8 fl oz ⁶		1 app
Onions (Dry, Green, Shallots and Spanish), Garlic and Leeks					
Bacterial leaf blight (<i>Xanthomonas axonopodis</i> pv. <i>allii</i> , <i>Pseudomonas syringae</i> pv. <i>porri</i>)	Actigard 50WG (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
Botrytis leaf blight, Neck rot, Purple blotch and Stemphylium blight	Mastercop	M	0.5-1.5 pt	7	9 pt
	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 500ZN	M	1.5-4.25 pt	7	29 pt
	Intiate	M	1-3 pt	7	20 pt
	Intiate 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

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Echo 720	M	1.5-3 pt	14	6.7 lb a.i.
	Equus 720SST	M	1.5-3 pt	14	9 pt
	Equus 500ZN	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
	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	7	16-24 fl oz	3	72 fl oz
	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
	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 80WVP (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 41.8EC	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 41.8EC	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

Commercial Crop Production

Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Quadris Opti (dry, garlic only)	1 l, M	1.6-3.2 pt	7	3 apps
	Quadris Opti (green, leek, shallots)	1 l, M	1.6-3.2 pt	14	3 apps
	Quadris Top (dry only)	1 l, 3	12-14 fl oz	7	56 fl oz
	Quadris Top (green only)	1 l, 3	12-14 fl oz	7	42 fl oz
	Quilt (dry only)	1 l, 3	14-27.5 fl oz	14	55.3 fl oz
	Quilt (green only)	1 l, 3	14-27.5 fl oz	0	55.3 fl oz
	Quilt Xcel (dry only)	1 l, 3	14-26 fl oz	14	56 fl oz
	Quilt Xcel (green only)	1 l, 3	14-26 fl oz	0	56 fl oz
	Reason 500SC	1 l	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, leeks, shallots)	4, M	2.5 pt	14	6.75 lb a.i.
	Satori	1 l	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 62.5WG	9, 12	11-14 oz	7	56 oz
	Tanos	1 l, 27	8 oz	3	84 oz
	tebuconazole				
	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 (Peronospora destructor)	Actigard 50WG (dry only)	2 l	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	1 l	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 500ZN	M	1.5-4.25 pt	7	29 pt
	Intiate	M	1-3 pt	7	20 pt
	Intiate 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 500ZN	M	2.25-4.25 pt	14	13 pt
	Intiate	M	1.5-3 pt	14	3 apps

Commercial Crop Production Vegetables

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 WGO ^G	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
	Cuproxat	M	2.5-4.9 pt	7	29.6 pt
	Nordox WGO ^G	M	1.25-2.5 lb		
	Forum	40	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
	Orondis Opti	M5, U15	1.75-2.5 pt	14	10 pt
	Orondis Ultra A	U15	2-4.8 fl oz	0	19.2 fl oz
	Orondis Ultra B	40	8 fl oz	7	24 fl oz
	Orondis Ultra (Premix)	40, U15	5.5-8 fl oz	7	32 fl oz
	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
	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.

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Satori	I I	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		
	Zapro	45, 40	14 fl oz	0	42 fl oz
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
	Metastar 2E	4	2-4 pt ⁸		1 app
	Uniform	1 I, 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
	tebuconazole				
	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	1 I, M	1.6-3.2 pt	7	3 apps
	Quilt Xcel	3, 1 I	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
Peas (Garden, Green and Sweet)					
Gray mold (<i>Botrytis cinerea</i>)	Endura 70WG	7	8-11 oz	7	2 app
	Fontelis 1.67F	7	14-30 fl oz	0	72 fl oz
	Priaxor 500SC	1 I, 7	4-8 fl oz	7	16 fl oz
Powdery mildew (<i>Erysiphe pisi</i>)	Actinovate AG ^{OG}		3-12 oz		
	copper hydroxide				
	Kocide 3000	M	0.5-1.3 lb	0	13.2 lb
	Kocide 2000	M	1-2.3 lb	0	11.3 lb
	Champ WG ^{OG}	M	1.6 lb	0	7.9 lb
	copper hydroxide and copper oxychloride ¹¹				
	Badge SC	M	1-2.5 pt	0	13.9 pt
	Badge X2 ^{OG}	M	0.5-1.3 lb	0	4 lb
	copper sulfate				
	Cuprofix Ultra-40	M	1-2 lb	0	9.9 lb
	Cuproxat	M	2-3.9 pt	0	19.5 pt
	Endura 70WG	7	8-11 oz	7	22 oz
	Fontelis 1.67F	7	14-30 fl oz	0	72 fl oz
	MasterCop	M	0.5-1 pt		7 pt
	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		

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Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Fungi-phite Helena ProPhyt Priaxor 500SC Sonata ^{OG} sulfur ^{OG} Microfine Sulfur Microthiol Disperss Yellow Jacket Wettable Top Cop with Sulfur Trilogy ^{OG}	33 33 11, 7 44 M M M M	1-2 qt 2-4 pt 4-8 fl oz 2-4 qt 3.8-36 lb 3-10 lb 3.8-36 lb 2 qt 1%	 7 0 0 0 0 0	6 app 7 app 16 fl oz
Damping-off (<i>Pythium</i> spp.)	Actinovate AG ^{OG} mefenoxam Ridomil Gold SL Ultra Flourish phosphorous acid Confine Extra Rampart potassium phosphite Fosphite Fungi-phite Helena Prophyt	 4 4 33 33 33 33 33	3-12 oz 0.5-1 pt ⁸ 1-2 pt ⁸ 1-4 qt 1-3 qt/100 gal 1-3 qt/100 gal 1-2 qt 2-4 pt	 0 3 	1 app 2 pt 6 app 7 app
Rust (<i>Uromyces</i> sp.)	Fontelis 1.67F Priaxor 500SC Quadris 2.08F	7 11, 7 11	14-30 fl oz 4-8 fl oz 6.2 fl oz	0 7 0	72 fl oz 16 fl oz 92 fl oz
White mold (<i>Sclerotinia sclerotiorum</i>)	Contans WG ^{OG} Endura 70WG Fontelis Priaxor 500SC	 7 7 11, 7	See label 8-11 oz 14-30 fl oz 4-8 fl oz	0 7 0 7	1 app 2 app 72 fl oz 16 fl oz
Peas (Southern, Dry)					
Alternaria leaf and pod spot (<i>Alternaria alternata</i>)	Quilt 1.66SC Priaxor 4.17SC Fontelis Quadris 2.08F Headline 2.09 Actinovate AG ^{OG}	3, 11 7, 11 7 11 11	14 fl oz 4-8 fl oz 14-30 oz 6.2-15.4 fl oz 6-9 fl oz 3-12 oz	7 7 0 0 7 0	3 app 2 app 72 fl oz 92 fl oz 2 app
Anthrachnose (<i>Colletotrichum lindemuthianum</i>)	chlorothalonil Bravo Ultrex Bravo WeatherStix thiophanate-methyl Topsin M 70WP Incognito 4.5F Thiophanate-methyl 85WDG Quilt 1.66SC Quilt Xcel Priaxor 4.17SC Fontelis Quadris 2.08F Quadris Opti Headline Tilt Cueva ^{OG} Nordox 75WG ^{OG}	M M I I I 11, 3 11, 3 7, 11 7 11 11, M 11 3 M M	1.25-1.8 lb 1.375-2 pt 1.5-2 lb 30-40 fl oz 0.8-1.6 lb 14 fl oz 10.5-14 fl oz 4-8 fl oz 14-30 fl oz 6-15.5 fl oz 1.6-2.4 pt 6-9 fl oz 4 fl oz 0.2-2 gal 0.66-2.5 lb	7 7 14 14 28 0 0 7 7 0 0 21 7	7.3 lb 8 pt 4 lb 80 fl oz 3.2 lb 42 fl oz 42 fl oz 2 apps 72 fl oz 4 app 4 app 2 app 12 fl oz
Bacterial blights (<i>Pseudomonas syringae</i> pv. <i>pisi</i> , <i>P. s. pv. syringae</i>)	copper hydroxide Kocide 3000 Kocide 2000 Champ WG ^{OG} copper hydroxide and copper oxychloride Badge SC	M M M M M	0.5-1.25 lb 0.75-2.25 lb 1.58 lb 1-2 pt	0 0 7	15.8 lb 13.5 lb 9.48 lb 16.6 pt

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	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
	Cuproxat	M	1.5-3.9 pt		23.4 pt
	Cueva ^{OG}	M	0.5-2 gal/100 gal		
	Nordox 75WG ^{OG}	M	0.6-2.5 lb		
Botrytis gray mold (<i>Botrytis cinerea</i>) and White mold (<i>Sclerotinia sclerotiorum</i>)	Proline 480SC (white mold)	3	4.3-5.7 fl oz	7	3 app
	Aproach	11	8-12 fl oz	7	24 fl oz
	Rovral 4F	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	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 62.5WG	12, 9	11-14 oz	2	56 oz
	Cueva ^{OG}	M	0.5-2 gal/100 gal		
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</i> spp.)	Quadris 2.08F	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>Alternaria</i> spp., <i>Ascochyta</i> spp., <i>Cercospora</i> spp.)	Aproach	11	6-12 fl oz	7	24 fl oz
	chlorothalonil				
	Bravo Ultrex	M	1.25-1.8 lb	7	7.3 lb
	Bravo WeatherStix	M	1.375-2 pt	7	8 pt
	Fontelis	7	14-30 fl 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
Powdery mildew (<i>Erysiphe pisi</i>)	Headline	11	6-9 fl oz	21	2 app
	Endura	7	8-11 oz	7	2 app
	Priaxor 4.17SC	7, 11	4-8 fl oz	7	2 app
	Fontelis	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
	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	
	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 2.08F	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>Phakopsora pachyrhizi</i> , <i>Uromyces</i> spp.)	Approach	11	6-12 fl oz	7	24 fl oz
	Proline 480SC	3	5.7 fl oz	7	17 fl oz
	Rally 40WSP	3	4-5 oz	0	20 oz
	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	7	14-30 oz	0	72 fl oz
	Quadris 2.08F	11	6.2-15.4 fl oz	0	4 app

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Quadris Opti	11, M	1.6-2.4 pt	14	4 app
	Headline	11	6-9 fl oz	21	2 app
	chlorothalonil				
	Bravo Ultrex	M	1.25-1.8 lb	7	4 app
	Bravo WeatherStix	M	1.375-2 pt	7	8pt
Peppers					
Anthracnose fruit rot (<i>Colletotrichum</i> spp.)	Actinovate AG ^{OG}		3-12 oz		
	Aprvoia Top	3, 11	10.5-13.5 fl oz	0	53.6 fl oz
	Ariston	27, M	2-2.44 pt	3	18.1 pt
	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 EG	11	8-12 oz	0	96 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 and 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
	Cuprofix-Ultra 40	M	0.8-2 lb	3	29.5 lb
	Nordox 75WG ^{OG}	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
	Reason 500SC	11	5.5-8.2 fl oz	14	24.6 fl oz
	Serenade Optimum	44	4-20 oz		
	Tanos	11, 27	8-10 oz	3	72 oz
	Top Cop with Sulfur	11M	2 qt		
	Trilogy		1%		
Bacterial soft rot (<i>Pectobacterium carotovora</i> subsp. <i>carotovora</i>)	Tanos	11, 27	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 and 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
	Nordox 75WG ^{OG}	M	2-4 lb	0	
	ManKocide	M	2-3 lb	7	39 lb
	MasterCop	M	0.5-3 pt		30 pt

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Serenade ^{OG} ASO Optimum MAX Tanos Top Cop with Sulfur	44 44 44 27, 11 M	2-6 qt 14-20 oz 1-3 lb 8-10 oz 2 qt	3	72 oz
Bacterial spot (<i>Xanthomonas</i> spp.)	Actigard 50WG (Chile only)	2I	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 and 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
	Nordox 75WG ^{OG}	M	2-4 lb	0	
	ManKocide	M	2-3 lb	7	39 lb
	MasterCop	M	0.5-3 pt		30 pt
	Serenade ^{OG} ASO Optimum MAX Tanos Top Cop with Sulfur	44 44 44 27, 11 M	2-6 qt 14-20 oz 1-3 lb 8-10 oz 2 qt	3	72 oz
Blossom-end rot	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 Blossom-end rot incidence, as Ca ions are not actively mobilized from the leaf downward to the fruits.				

Commercial Crop Production Vegetables

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>)	chlorothalonil	M	1.4 lb	3	10.9 lb
	Bravo Ultrex	M	1.5 pt	3	12 pt
	Chloronil 720	M	1.5 pt	3	9 lb a.i.
	Echo 720	M	1.5 pt	3	12 pt
	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 and 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
	Cuprofix-Ultra 40	M	0.8-2 lb	3	29.5 lb
	Nordox 75WG ^{OG}	M	2-4 lb	0	
	Manzate Pro-Stick	M	1.6-3.2 lb	7	12.8-9.2 lb ²⁵
	ManKocide	M	2-3 lb	7	39 lb
	MasterCop	M	0.5-3 pt		30 pt
	Quadris Top 29.6SC	11, 3	8-14 fl oz	0	55.3 fl oz
	Top Cop with Sulfur	M	2 qt		
Phytophthora crown and root rot (<i>Phytophthora capsici</i>)	Elumin	22	8 fl oz	2	16 fl oz
	mefenoxam				
	Ridomil Gold SL	4	1 pt ¹³	7	1.5 lb a.i.
	Ultra Flourish	4	2 pt ¹³	7	6 pt
	Metastar 2EOrondis Gold B	4	4-8 pt ¹³	7	12 pt
	Orondis Gold 200	4	1 pt	7	2 app
	Zampro	U15	4.8-9.6 fl oz	0	19.2 fl oz
		45, 40	14 fl oz	4	42 fl oz
Phytophthora foliar blight and fruit rot (<i>Phytophthora capsici</i>)	copper hydroxide and copper oxychloride				
	Badge SC	M	1-2.3 pt	0	41.7 pt
	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
	Elumin	22	8 fl oz	2	16 fl oz
	Manzate Pro-Stick	M	1.6-3.2 lb	0	12.8-19.2lb 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
	Orondis Gold 200	U15	4.8-9.6 fl oz	0	19.2 fl oz
	Orondis Ultra (Premix)	U15, 40	5.5-8 fl oz	1	32 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
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
	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		
	Orondis Gold B	4	1	7	2 app
	Previcur Flex	28	1.2 pt ⁸	5	6 app
	Rootshield Granules	44	2.5-6 lb/0.5acre ¹³		6 pt
	Serenade Soil	44	2-6 qt ¹³		1 app
Southern blight	Blocker 4F	14	4.5-7.5 pt/100gal	0	7.5 lb a.i.

Commercial Crop Production

Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
(<i>Sclerotium rolfsii</i>)	fluoxastrobin Aftershock Evito 480SC Priaxor Cabrio	11 11 11, 7 11	2-5.7 fl oz 2-5.7 fl oz 4-8 fl oz 12-16 oz	0 0 0 0	22.8 fl oz 22.8 fl oz 24 fl oz 96 fl oz
Target spot (<i>Corynespora cassicola</i>)	Cabrio 20EG Endura fluoxastrobin Aftershock Evito 480SC Inspire Super Priaxor	11 7 11 11 9, 3 7, 11	8-12 oz 3.5 oz 2-5.7 fl oz 2-5.7 fl oz 16-20 fl oz 4-8 fl oz	0 0 3 3 0 0	96 oz 21 oz 22.8 fl oz 22.8 fl oz 47 fl oz 24 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 noninsect transmitted viruses.				
Potato (Irish)					
Bacterial stem rot (<i>Pectobacterium carotovora</i>)	Tanos	27, 11	8 oz	14	6 app
Early blight (<i>Alternaria solani</i>)	Aftershock azoxystrobin Quadris Quadris Opti Quadris Top Satori Cabrio Plus chlorothalonil Bravo Ultrex Bravo WeatherStik Bravo Zn Chlorothalonil 720SC copper hydroxide Kocide 3000 Kocide 2000 Champ WG ^{OG} copper hydroxide and copper oxychloride ¹¹ Badge SC Badge X2 ^{OG} copper sulfate Cuprofix-Ultra 40 MasterCop Endura Evito 480SC Gavel 75DF Gem 500SC Headline and Headline SC iprodione Iprodione 4L AG Meteor Nevado 4F mancozeb	11 11 11, M 11, M 11 11, M M M M M M M M M M M M M M M 7 11 M, 22 11 11 2 2 2	2-3.8 fl oz 6-15.5 fl oz 1.6 pt 8-14 fl oz 6-15.5 fl oz 2-2.9 lb 0.7-1.4 lb ²⁶ 0.8-1.5 pt ²⁶ 1.1-2.3 pt ²⁶ 0.8-1.5 pt ²⁶ 0.5-1.8 lb 0.8-3 lb 1-4 lb 1-3 pt 0.5-1.8 lb 0.8-3 lb 0.5-1.5 pt 2.5-4.5 oz 2-3.8 fl oz 1.5-2 lb 2.9-3.8 fl oz 6-9 fl oz 1-2 pt 1-2 pt 1-2 pt	7 14 14 14 14 14 7 30 7 7 5 5 5 5 5 5 10 7 14 7 3 14 14 14	22.8 fl oz 123 fl oz 6 app 55.3 fl oz 123 fl oz 17.4 lb 13.6 lb 18 pt 21.5 pt 15 pt 83.3 lb 71.4 lb 50 lb 88.2 pt 25 lb Cu 62.5 lb 6 pt 2 app 22.8 fl oz 12 lb 23 fl oz 72 fl oz 4 app 4 app 4 app

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	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
	Quash	3	2.5-4 oz	1	16 oz
	Reason 500SC	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 triphenyltin hydroxide	M	2-3 qt		
	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
	Vertisan	7	10-24 fl oz	7	72 fl oz
Late blight (<i>Phytophthora infestans</i>)	Aftershock	11	3.8 fl oz	7	22.8 fl oz
	Ariston	27, M5	2 pt	14	17.5 pt
	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
	chlorothalonil				
	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
	Chlorothalonil 720SC	M	0.8-1.5 pt ²⁶	7	15 pt
	copper hydroxide				
	Kocide 3000	M	0.5-1.8 lb	0	83.3 lb
	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
	Dexter Max	11, M3	1.6-2.1 lb	14	16 lb
	Evito 480SC	11	3.8 fl oz	7	22.8 fl oz
	Forum	40	6 fl oz	4	30 fl oz
	Gavel 75DF	22, M	1.5-2 lb	14	12 lb
	Gem 500SC	11	3.8 fl oz	7	23 fl oz
	Headline and Headline SC	11	6-12 fl oz	3	72 fl oz
	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				
	Ridomil Gold Bravo	4, M	2.5 pt	14	footnote ²⁷
	Ridomil Gold MZ WG	4, M	2.5 lb	14	10 lb
	Omega 500SC	29	5.5 fl oz	14	3.5 pt

Commercial Crop Production

Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	phosphorous acid	33	1-3 qt		
	Confine Extra	33	1-3 qt/100 gal		
	Rampart				
	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	14	6 pt
	Priaxor	7, 11	4-8 fl oz	7	24 fl oz
	Ranman	21	1.4-2.8 fl oz	7	27.5 fl oz
	Reason 500SC	11	5.5-8.2 fl oz	14	24.6 fl oz
	Revus Top	3, 40	5.5-7.7 fl oz	14	28 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	6-8 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
	Zampro	45, 40	11-14 fl oz	4	42 fl oz
	Zing!	22, M5	24-34 fl oz	7	8 app
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 70WSB	1	1-1.5 lb	21	4 lb
	Topsin M 70WDG	1	1-1.5 lb	21	4 lb
	Vertisan	7	14-24 fl oz	7	72 fl oz
Root crops (Beet, Carrot, Parsnip, Radish and Turnip)					
Downy mildew (<i>Peronospora parisitica</i>)	Actinovate AG ^{OG}		3-12 oz		
	chlorothalonil (parsnip only)				

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Bravo Ultrex	M	1.4-1.8 lb	10	7.3 lb
	Bravo WeatherStik	M	1.5-2 pt	10	8 pt
	Chlorothalonil 720SC	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		6 app
	Fungi-phite	33	1-2 qt		
	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	M	2 qt	0	
	Trilogy ^{OG}		1%		
Leaf spots and blights (<i>Alternaria</i> spp., <i>Cercospora</i> spp.)	azoxystrobin				
	Quadris	I I	9-15.5 fl oz	0	123 fl oz
	Satori	I I	9-15.5 fl oz	0	123 fl oz
	Cabrio	I I	8-12 oz	0	48 oz
	chlorothalonil				
	Bravo Weather Stik	M	1.5-2 pt	0	20 pt
	Bravo Zn	M	2.3-2.8 pt	0	29 pt
	Equus 720SST	M	1.5-2 pt	0	20 pt
	copper hydroxide				
	Kocide 3000	M	0.8-1.5 lb	0	16.7 lb
	Kocide 2000	M	1.5-2.8 lb	0	14.3 lb
	Champ Formula 2	M	1.3 pt	0	13.7 pt
	copper hydroxide and copper oxychloride				
	Badge SC	M	1-1.8 pt	0	17.6 pt
	Badge X2 ^{OG}	M	0.8-1.5 lb	0	5 lb Cu
	copper sulfate				
	Cuprofix-Ultra 40	M	1.3 lb	0	12.5 lb
	Cuproxat	M	2.5 pt	0	24.6 pt
	Endura	7	4.5 oz	0	22.5 oz
	Fontelis	7	16-30 fl oz	0	61 fl oz
	Gem 500SC	I I	1.9-2.9 fl oz	7	11.5 fl oz
	MasterCop		0.5-1.5 pt		6 pt
	Merivon	7, I I	4-5.5 fl oz	7	16.5 fl oz
	Pristine	7, I I	8-10.5 oz	0	63 oz
	propiconazole				
	Amtide 41.8%	3	4 fl oz	14	16 fl oz
	Bumper 48.1EC	3	4 fl oz	14	16 fl oz
	Tilt	3	4 fl oz	14	16 fl oz
	Quardis Opti	I I, M5	2.4 pt	0	6 app
	Quadris Top	I I, 3	12-14 fl oz	7	56 fl oz
	Switch 62.5WG	9, 12	11-14 oz	7	56 oz
	Switch 62.5WG (radish only)	9, 12	11-14 oz	7	28 oz
	Top Cop with Sulfur	M	2 qt		
Damping-off (<i>Pythium</i> spp.)	Ridomil Gold GR	4	20-40 lb ⁸		
	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		

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
Damping-off (<i>Rhizoctonia</i> spp.)	azoxystrobin	I I	0.4-0.8 fl oz ⁶		1 app
	Quadris 2.08F	I I	0.4-0.8 fl oz ⁶		1 app
	Satori	I I	0.4-0.8 fl oz ⁶		1 app
SPINACH					
Anthracnose (<i>Colletortichum dematium</i>) and Leaf spots (<i>Cercospora beticola</i>)	azoxystrobin	I I	6-15.5 fl oz	0	92.3 fl oz
	Quadris	I I	6-15.5 fl oz	0	92.3 fl oz
	Satori	I I	6-15.5 fl oz	0	92.3 fl oz
	Cabrio	I I	12-16 oz	0	64 oz
	copper hydroxide				
	Kocide 3000	M	0.8-1.3 lb	0	13.2 lb
	Kocide 2000	M	1.5-2.3 lb	0	11.3 lb
	Champ Formula 2	M	1.3-2.7 pt	0	10.9 pt
	Champ WG ^{OG}	M	1-1.6 lb	0	7.9 lb
	copper hydroxide and copper oxychloride ¹¹				
	Badge SC	M	1-2.3 pt	0	13.9 pt
	Badge X2 ^{OG}	M	0.8-1.3 lb	0	4 lb Cu
	Nordox 75WG ^{OG}	M	2-3 lb	0	
	copper sulfate				
	Cuprofix Ultra 40	M	1.3-2 lb	0	9.9 lb
	Mastercop	M	0.5-1 pt	0	5 pt
	Fontelis	7	14-24 fl oz	3	72 fl oz
	Merivon	7, I I	4-11 fl oz	1	33 fl oz
	Switch 62.5WG	9, 12	11-14 oz	0	56 oz
	Top Cop with Sulfur	M	2-4 qt	0	
	Topguard	I I, 3	6-8 fl oz	7	4 app
Downy mildew (<i>Peronospora farinosa</i> f. sp. <i>spinaciae</i>)	azoxystrobin	I I	12-15.5 fl oz	0	92.3 fl oz
	Quadris	I I	12-15.5 fl oz	0	92.3 fl oz
	Satori	I I	12-15.5 fl oz	0	92.3 fl oz
	Actigard 50WG	21	0.5-0.8 oz	7	2.3 oz
	Actinovate AG ^{OG}	44	3-12 oz	0	
	Aliette WDG	33	2-5 lb	3	7 app
	Cabrio EG 20%	I I	12-16 oz	0	64 oz
	Cease	44	3-6 qt/100 gal		
	copper hydroxide				
	Kocide 3000	M	0.8-1.3 lb	0	13.2 lb
	Champ Formula 2	M	1.3-2.7 pt	0	10.9 pt
	Champ WG ^{OG}	M	1-1.6 lb	0	7.9 lb
	copper hydroxide and copper oxychloride ¹¹				
	Badge SC	M	1-2.3 pt	0	13.9 pt
	Badge X2 ^{OG}	M	0.8-1.3 lb	0	4 lb Cu
	Nordox 75WG ^{OG}	M	2-3 lb		
	Curzate 60DF	27	5 oz	1	30 oz
	mefenoxam			3-21 ²²	
	Ridomil Gold SL	4	0.3 pt ¹⁹	3-21 ²²	2 app
	Ultra Flourish	4	0.3 pt ¹⁹	3-21 ²²	2 app
	Ultra Flourish	4	0.5 pt ¹⁹	1	1.6 pt
	Merivon 4.18SC	7, I I	4-11 fl oz		33 fl oz
	Micora	40	5.5-8 fl oz ¹²		2 app
	MilStop ^{OG}		2-5 lb/100 gal		
	phosphorous acid				
	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	2	12 fl oz
	Ranman	21	2.8 fl oz	0	16.5 fl oz

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Reason 500SC Revus Serenade ^{OG} ASO MAX Sonata ^{OG} Tanos Top Cop with Sulfur Trilogy ^{OG} Zampro ^{2I}	1 I 40 44 44 44 1 I, 27 M 40, 45	5.5-8.2 fl oz 8 fl oz 2-6 qt 1-3 lb 2-4 qt 8-10 oz 2-4 qt 1% 14 fl oz	2 1 1 0	24.6 fl oz 32 fl oz 84 oz 42 fl oz
Damping-off (<i>Pythium</i> spp.)	mefenoxam Ridomil Gold SL Ultra Flourish phosphorous acid Confine Extra Rampart potassium phosphite Fosphite Fungi-phite Ranman Rootshield Granules ^{OG}	 4 4 33 33 33 33 2 I	 1-2 pt ¹³ 0.5 pt ¹⁹ 1-4 qt 1-3 qt/100 gal 1-3 qt/100 gal 1-2 qt 2.8 fl oz ¹³ 2.5-6 lb/ ½ acre ¹³	 3-21 ²⁰ 3-21 ²⁰ 0	 1 app 1 app 6 app 16.5 fl oz 1 app
White rust (<i>Albugo occidentalis</i>)	azoxystrobin Quadris Satori Actigard Aliette WDG Cabrio copper hydroxide Kocide 3000 Kocide 2000 Champ Formula 2 Champ WG ^{OG} copper hydroxide and copper oxychloride ¹¹ Badge SC Badge X2 ^{OG} Nordox 75WG ^{OG} Copper sulfate Cuprofix 40 Disperss Mastercop mefenoxam Ridomil Gold SL Ultra Flourish Merivon Presidio Ranman Reason 500SC Serenade ^{OG} ASO MAX Tanos Top Cop with Sulfur	 1 I 1 I 2 I 33 1 I M M M M M M M M M 4 4 7, 1 I 43 2 I 1 I 44 44 1 I, 27 M	 6-15.5 fl oz 6-15.5 fl oz 8-12 oz 0.8-1.3 lb 1.5-2.3 lb 1.3-2.7 pt 1-1.6 lb 1-2.3 pt 0.8-1.3 lb 2-3 lb 1.3-2 lb 0.5-1 pt 0.3 pt ¹⁹ 0.5 pt ¹⁹ 4-11 fl oz 3-4 fl oz 2.8 fl oz 5.5-8.2 fl oz 2-6 qt 1-3 lb 8-10 oz 2-4 qt	 0 0 0 0 0 0 0 0 0 0 0 0 3-21 ²⁰ 3-21 ²⁰ 1 2 0 2 1	 92.3 fl oz 92.3 fl oz 64 oz 13.2 lb 11.3 lb 10.9 pt 7.9 lb 13.9 pt 4 lb Cu 9.9 lb 5 pt 2 app 2 app 33 fl oz 12 fl oz 16.5 fl oz 24.6 fl oz 84 oz
Tomato (Fresh market)					
Anthraxnose fruit rot (<i>Colletotrichum</i> spp.)	Actinovate AG ^{OG} Aprovia Top Ariston azoxystrobin Quadris Quadris Opti	 7, 3 M, 27 1 I 1 I, M	 3-12 oz 10.5-13.5 fl oz 2.0-2.44 pt 5-6.2 fl oz 1.6 pt	 0 3 0 0	 4 app 17.5 pt 37 fl oz 5 app

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Quadris Top	I I, 3	8 fl oz	0	47 fl oz
	Satori	I I	5-6.2 fl oz	0	61.5 fl oz
	Cabrio	I I	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	M	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 and 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
	Cuproxat	M	2.5-5 pt	3	39.4 pt
	Dexter Max	I I, M3	0.8-1.1 lb	5	9.14 lb
	Nordox 75WG ^{OG}	M	2-4 lb	0	
	Flint	I I	3-4 oz	3	16 fl oz
	Fontelis 1.67SC	7	24 fl oz	0	72 fl oz
	Inspire Super 2.82SC	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		
	OSO 5%	19	3.75-13 fl oz	0	4.2 oz a.i
	Priaxor	7, I I	4-8 fl oz	0	24 fl oz
	Revus Top	3, 40	5.5-7 fl oz	1	28 fl oz
	Serenade ^{OG} , Optimum	44	4-20 oz	3	72 oz
	Tanos	27, I I	8-10 oz		
	Top Cop with Sulfur	M	2 qt	0	4 app
	Topguard EQ	I I, 3	4-8 fl oz		
	Trilogy ^{OG}		1%		
Bacterial spot (<i>Xanthomonas</i> spp.)	Actigard 50WG	21	0.3-0.8 oz	14	6 oz
	Actinovate AG ^{OG}		3-12 oz		
	Agri-Mycin 17 ^{OG, 22}		200 ppm		
	copper hydroxide				
	Kocide 3000	M	0.8-1.8 lb	0	26.7 lb
	Kocide 2000	M	1.5-3 lb	0	22.8 lb
	Champ WG ^{OG}	M	1.1 lb	0	16 lb
	copper hydroxide and 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
	Cuproxat	M	2.5-5 pt	3	39.4 pt
	Nordox 75WG ^{OG}	M	2-4 lb	0	
	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, I I	8 oz	3	72 oz
	Top Cop with Sulfur	M	2-3 qt		
Bacterial speck	Agri-Mycin 17 ^{OG, 22}		200 ppm		

Commercial Crop Production

Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
(Pseudomonas syringae pv. syringae)	copper hydroxide	M	0.8-1.8 lb	0	26.7 lb
	Kocide 3000	M	1.5-3 lb	0	22.8 lb
	Kocide 2000	M	2 lb	0	16 lb
	Champ WG ^{OG}				
	copper hydroxide and 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
	Cuproxat	M	2.3 pt	3	39.4 pt
	Nordox 75WG ^{OG}	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, I I	8 oz	3	72 oz
	Top Cop with Sulfur	M	2-3 qt		
Bacterial wilt (Ralstonia solanacearum)	No bactericides available. Plant resistant varieties, crop rotations and soil solarization.				
Blossom-end rot	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 blossom-end rot incidence, as Ca ions are not actively mobilized from the leaf downward to the fruits.				
Buckeye rot (Phytophthora parasitica)	azoxystrobin	I I	5-6.2 fl oz	0	37 fl oz
	Quadris	I I, M	1.6 pt	0	5 app
	Quadris Opti	I I, 3	8 fl oz	0	47 fl oz
	Quadris Top	I I	5-6.2 fl oz	0	61.5 fl oz
	Satori	I I, M3	0.8-1.1 lb	5	9.14 lb
	Dexter Max	22, M	1.5-2 lb	5	8-16 lb ³⁰
	Gavel 75DF	U15, M5	1.75-2.5 pt	0	10 pt
	Orondis Opti (Premix)	40, U15	5.5-8 fl oz	1	32 fl oz
	Orondis Ultra (Premix)	4, M1	2 lb	14	6 lb
	Ridomil Gold Copper				
	Serenade ^{OG}	44	4-20 oz		
	Optimum	27, I I	8 oz	3	72 oz
	Tanos				
Early blight (Alternaria solani), Leaf spot (Septoria lycopersici) and Target spot (Corynespora cassicola)	Ariston	M, 27	1.9-3 pt	3	17.5 pt
	azoxystrobin				
	Quadris	I I	5-6.2 fl oz	0	37 fl oz
	Quadris Opti	I I, M	1.6 pt	0	5 app
	Quadris Top	I I, 3	8 fl oz	0	47 fl oz
	Satori	I I	5-6.2 fl oz	0	61.5 fl oz

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Cabrio	I I	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 and copper oxychloride				
	Badge SC				
	Badge X2 ^{OG}	M	1.8 pt	3	28.1 pt
	copper sulfate	M	0.8-1.8 lb	3	8 lb Cu
	Cuprofix-Ultra 40				
	Cuproxat	M	0.8-3 lb	3	20 lb
	Nordox 75WG ^{OG}	M	2.5-5 pt	3	39.4 pt
	Evito 480SC or Aftershock	M	2-4 lb	0	
	Dexter Max	I I, M3	0.8-1.1 lb	5	9.14 lb
	Flint	I I	2-5.7 fl oz	3	22.8 fl oz
	Fontelis	I I	2-3 oz	3	16 fl oz
	Gavel 75DF	7	24 fl oz	0	72 fl oz
	Inspire Super	22, M	1.5-2 lb	5	8-16 lb ³⁰
	mancozeb	9, 3	16-20 fl oz	0	47 fl oz
	Dry formulations				
	Liquid Formulations	M	0.5-3 lb ³⁰	5	21-22.4 lb
	ManKocide	M	0.6-2.4 qt ³⁰	5	16.8 qt
	MilStop ^{OG}	M	1-3 lb	5	42.7-58 lb ³⁰
	Previcur Flex	28	2-5 lb/100 gal		7.5 pt
	Priaxor	7, I I	0.7-1.5 pt	5	24 fl oz
	Reason 500SC	I I	4-8 fl oz	0	24.6 fl oz
	Revus Top 4.16F	3, 40	5.5-8.2 fl oz	14	28 fl oz
	serenade ^{OG}	44	5.5-7 fl oz	1	
	ASO	44	2-6 qt	0	
	Optimum	44	4-20 oz	0	
	MAX	9	1-3 lb	0	
	Scala SC	9, 12	7 fl oz	1	35 fl oz
	Switch 62.5WG	27, I I	11-14 oz	0	56 oz
	Tanos	M	8-10 oz	3	72 oz
	Top Cop with Sulfur		2 qt		
	Trilogy ^{OG}		1%		
Fusarium wilt (<i>Fusarium oxysporum</i>) and Verticillium wilt (<i>Verticillium</i> sp.)	No fungicides available. Soil protectants such as Serenade Soil, resistant varieties and crop rotations are recommended.				
Gray leaf spot (<i>Stemphylium</i> spp.)	Aprovia Top	7, 3	10.5-13.5 fl oz	0	53.6 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	M	2-2.8 pt	0	20 pt
	Dexter Max	I I, M3	0.8-1.1 lb	5	9.14 lb
	Flint 50WDG	I I	3-4 oz	3	16 fl oz
	Gavel 75DF	22, M	1.5-2 lb	5	8-16 lb ³⁰
	Inspire Super 2.82SC	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
	Luna Sensation	7, I I	7.6 fl oz	3	27.1 fl oz

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Quadris Top	11, 3	8 fl oz	0	47 fl oz
	Revus Top	3, 40	5.5-7 fl oz	1	
	Ridomil Gold Bravo	4, M	2.5 pt	5	28 fl oz ³¹
Gray mold (<i>Botrytis cinerea</i>)	Actinovate AG ^{OG}		3-12 oz		
	Ariston	27, M5	1.9-3 pt	3	17.5 pt
	Botran 75W	14			
	Cabrio EG	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 70 WG	7	9-12.5 oz	0	25 oz
	Fontelis 1.67SC	7	24 fl oz	0	72 fl oz
	Inspire Super	3, 9	16-20 fl oz	0	80 fl oz
	Luna Sensation	7, 11	7.6 fl oz	3	27.1 fl oz
	Priaxor	7, 11	4-8 fl oz	0	24 fl oz
	Scala SC	9	7 fl oz	1	35 fl oz
	Switch 62.5WG	9, 12	11-14 oz	0	56 oz
Late blight (<i>Phytophthora infestans</i>)	Aftershock	11	5.7 fl oz	3	22.8 fl oz
	Ariston	27, M5	1.9-3 pt	3	17.5 pt
	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 and 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
	Cuproxat	M	2.5-6 pt	3	39.4 pt
	Nordox 75WG ^{OG}	M	2-4 lb	0	
	Dexter Max	11, M3	0.8-1.1 lb	5	9.14 lb
	Evito 480 SC	11	5.7 fl oz	3	22.8 fl oz
	Flint 50WDG	11	2-3 oz	3	16 fl oz
	Forum 4.18F	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		
	OSO 5%	19	3.75-13 fl oz	0	4.2 oz a.i.
	Orondis Opti (Premix)	M5, U15	1.75-2.5 pt	0	10 pt
	Orondis Ultra (Premix)	40, U15	5.5-8 fl oz	1	32 fl oz
	Previcur Flex	28	0.7-1.5 pt	5	7.5 pt
	Presidio	43	3-4 fl oz	2	12 fl oz
	Priaxor	7, 11	8 fl oz	0	24 fl oz

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
	Ranman 400SC Reason 500SC Ridomil Gold Bravo SC Gold/Copper Gold MZ WG Revus Top Serenade ^{OG} ASO Optimum MAX Tanos Top Cop with Sulfur Topguard EQ Zapro Zing	2 I 1 I 4, M 4, M 4, M 3, 40 44 44 44 27, 1 I M 1 I, 3 45, 40 22, M	2.1-2.8 fl oz 5.5-8.2 fl oz 2.5 pt 2 lb 2.5 lb 5.5-7 fl oz 2-6 qt 4-20 oz 1-3 lb 8-10 oz 2 qt 4-8 fl oz 14 fl oz 36 fl oz	0 14 5 14 5 1 0 0 0 3 0 4 5	16.5 fl oz 24.6 fl oz * footnote ³¹ 3 app 10 lb 28 fl oz 72 oz 4 app 42 fl oz 8 app
Leaf mold (<i>Cladosporium fulvum</i>)	Aprovia Top Gavel 75DF Inspire Super mancozeb Dry formulations Liquid Formulations ManKocide OSO 5% Quadris Top Ridomil Gold Bravo Revus Top Tanos	3, 7 22, M 9,3 M M M 19 1 I, 3 4, M 3, 40 27, 1 I	10.5-13.5 fl oz 1.5-2 lb 16-20 fl oz 0.5-3 lb ³⁰ 0.6-2.4 qt ³⁰ 1-3 lb 3.75-13 fl oz 8 fl oz 2.5 pt 5.5-7 fl oz 8 oz	0 5 0 5 5 5 0 0 1 3	53.6 fl oz 8-16 lb ³⁰ 47 fl oz 21-22.4 lb 16.8 qt 42.7-58 lb ³⁰ 4.2 oz a.i 47 fl oz *footnote ³¹ 28 fl oz 72 oz
Southern blight (<i>Sclerotium rolfsii</i>)	Aftershock Aprovia Top Blocker 4F (PCNB) Cabrio 20EG Evito 480SC Fontelis Priaxor 500SC	1 I 3, 7 14 1 I 1 I 7 7, 1 I	2-5.7 fl oz 10.5-13.5 fl oz 4.5 to 7.5 pt/100 gal 12-16 oz 2-5.7 fl oz 1-1.6 fl oz ⁶ 4-8 fl oz	3 0 0 0 3 0 0	22.8 fl oz 53.6 fl oz 7.5 lb a.i. 96 oz 22.8 fl oz 24 fl oz 24 fl oz
White mold (or Timber rot) (<i>Sclerotinia sclerotiorum</i>)	Cabrio 20EG Priaxor 500SC	1 I 7, 1 I	12-16 oz 4-8 fl oz	0 0	96 fl oz 24 fl oz
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 <i>Tomato spotted wilt virus</i> (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 noninsect transmitted viruses.				
Tomato (Greenhouse)					
Bacterial canker	No bactericides are available. Seed treatments and good sanitation practices are recommended.				

Commercial Crop Production Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²		Rate ³	PHI ⁴	Maximum Use
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 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
Gray mold and Ghost spot (<i>Botrytis cinerea</i>)	ManKocide	M	1-3 lb	5	42.7-58 lb ³⁰
	Tanos	27, 11	8 oz	3	72 oz
	Actinovate AG ^{OG}		3-12 oz		
	Botran 75W	14	1/100 gal	0	4 app
	Fontelis 1.67SC	7	16-24 fl oz	0	72 fl oz
Leaf mold (<i>Cladosporium fulvum</i>)	Scala SC	9	7 fl oz ³²	1	35 fl oz
	Switch 62.5WG	9, 12	11-14 oz ³³	0	56 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				
Powdery mildew (<i>Oidium neolycopersici</i>)	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
	Fontelis	7	16-24 fl oz	0	72 fl oz
Damping-off (<i>Pythium</i> spp.)	Inspire Super	9, 3	16-20 fl oz	0	47 fl oz
	Microthiol Disperss ^{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.
	Serenade ^{OG}				
	ASO	44	2-6 qt	0	
	Optimum	44	4-20 oz	0	
	MAX	44	1-3 lb	0	
	Switch 62.5WG	9, 12	11-14 oz ³³	0	56 oz
	Trilogy ^{OG}		1%		
	Target spot (<i>Corynespora cassicola</i>)	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	4 app
Viruses and Viroids ³⁵	Fontelis	7	16-24 fl oz	0	72 fl oz
	Inspire Super	9, 3	16-20 fl oz	0	47 fl oz
	Serenade ^{OG}				
	ASO	44		0	
	Optimum	44		0	
Viruses and Viroids ³⁵	MAX	44		0	
	Tanos	27, 11	8 oz	0	72 oz
	A list of viruses and viroids of tomato can be found in Table 3. 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				

Commercial Crop Production

Vegetables

Disease (Pathogen)	Product Choices ¹ and Product Mode of Action Group ²	Rate ³	PHI ⁴	Maximum Use
	practices are recommended for noninsect transmitted viruses and viroids. Plant-resistant varieties are listed in Table 4.			

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.

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

⁵Where mancozeb 80WP is recommended, flowable and dry flowable formulations can be used at the labeled rates.

⁶All rates are per 1,000 square feet of row. Refer to the label for modes of application.

⁷Broccoli and cabbage are covered under a supplemental label (EPA Reg. No. 70506-234).

⁸Rates refer to band or broadcast applications. Refer to individual labels for per plant in transplant water rates.

⁹For head and stem applications the postharvest interval (PHI) is 0 days. For leafy greens the PHI is 3 days.

¹⁰For head and stem applications the postharvest interval (PHI) is 0 days. For leafy greens the PHI is 14 days.

¹¹Do not use in a spray solution with a pH less than 6.5.

¹²Do not apply alone. Must be applied as a tank mix with another fungicide with a different mode of action.

¹³Soil applications. Refer to individual labels for application directions.

¹⁴Other product choices that can be applied at the same rate include Echo 720, Equus 720SST and Chloronil 720.

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.

¹⁶Rates are cumulative. Do not apply more than 3.2 qt. per acre per year.

¹⁷Do not use more than one application of Actigard 50WG on head lettuce intended for bag purposes.

¹⁹Shank applications only. Apply 21 days after planting or after the first cutting. Refer to label for additional application instructions.

²⁰PHI varies depending on the rate and mode of application. Refer to label for specific PHI.

²²**Transplant production only.**

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.

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.

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.

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.

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.

²⁸Not labeled for all herbs or leafy greens. Rate varies depending on the crop type. Refer to label for labeled crops and specific rates.

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.

³⁰Rates vary based on proximity to the Mississippi (west vs. east of the Mississippi river). Refer to labels for exact rates.

³¹Do not exceed 15 lb. a.i. per acre of chlorothalonil containing products. Do not exceed 0.5 lb. a.i. per acre of foliar applied azoxystrobin containing products. Refer to label for additional restrictions.

³²Ventilate for at least 3 hours after application.

³³Do not apply to cherry or grape type tomatoes in the greenhouse.

³⁴Apply in the evenings through a drip irrigation system. Refer to label for additional application instructions and restrictions.

³⁵Viroids 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.

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Table 2. Pepper virus diseases and modes of transmission

Virus	Transmission
<i>Alfalfa mosaic virus</i> (AMV)	Aphids
<i>Cucumber mosaic virus</i> ¹ (CMV)	Aphids
<i>Pepper mild mottle virus</i> (PMMoV)	Seed Mechanical
<i>Pepper mottle virus</i> (PeMoV)	Aphids
<i>Potato virus Y</i> (PVY)	Aphids
<i>Tobacco etch virus</i> ² (TEV)	Aphids
<i>Tobacco mosaic virus</i> (TMV)	Seed Mechanical
<i>Tomato spotted wilt virus</i> (TSWV)	Thrips

¹CMV is the most important virus disease of peppers worldwide.

²TEV and PVY normally occur together. Planting PVY-resistant varieties often helps control TEV because resistance to both viruses is closely linked.

Commercial Crop Production Vegetables

Table 3. Tomato virus diseases and modes of transmission

Virus	Transmission
<i>Cucumber mosaic virus</i> (CMV)	Aphids
<i>Pepino mosaic virus</i> ¹ (PeMV)	Mechanical
<i>Potato leaf roll virus</i> (PLRV)	Aphids
<i>Potato virus Y</i> (PVY)	Aphids
<i>Tobacco etch virus</i> (TEV)	Aphids
<i>Tobacco mosaic virus</i> (TMV)	Seed Mechanical
<i>Tomato yellow leaf curl virus</i> (TYLCV)	Whiteflies (silver leaf)
<i>Tomato ringspot virus</i> (TRSV)	Dagger nematode
<i>Tomato spotted wilt virus</i> (TSWV)	Thrips

¹Reported mostly on tomatoes produced in the greenhouse.

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Table 4. Tomato varieties with resistance to *Tomato spotted wilt virus*; 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

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Table 5. Example spray program for foliar disease control in tomato production when early blight is a consistent threat.
Table reproduced from the 2016 Southeastern US Vegetable Handbook. Table prepared by S. Bost, Plant Pathologist, University of Tennessee.

Week	Chemical (Refer to the Label for rates.)	Number of Applications of Chemical Per Season ¹
BEFORE HARVEST (weeks 1 to 10)		
1	Mancozeb + Actigard ²	Mancozeb, 1; Actigard, 1
2	Mancozeb + Copper	Mancozeb, 2; Copper, 1
3	Fontelis ³ + Actigard	Fontelis, 1; Actigard, 2
4	Mancozeb+ Copper	Mancozeb, 3; Copper, 2
5	Inspire Super ³ + Actigard	Inspire Super 1; Actigard, 3
6	Mancozeb + Copper	Mancozeb, 4; Copper, 3
7	Fontelis + Actigard	Fontelis, 2; Actigard, 4
8	Mancozeb + Copper	Mancozeb, 5; Copper, 4
9	Inspire Super + Actigard	Inspire Super, 2; Actigard, 5
10	Chlorothalonil + Copper	Chlorothalonil, 1; Copper, 5
DURING HARVEST (weeks 11 to 15)		
11	Fontelis + Copper	Fontelis, 3; Copper, 6
12	Chlorothalonil + Copper	Chlorothalonil, 2; Copper, 7
13	Inspire Super + Copper	Inspire Super, 3; Copper, 8
14	Chlorothalonil + Copper	Chlorothalonil, 3; Copper, 9
15	Chlorothalonil + Copper	Chlorothalonil, 4; Copper, 10
	Finish season with Chlorothalonil	

¹ For most products, the total number of applications per season is restricted by the label.

² In areas or seasons in which bacterial spot or speck problems are not expected, Actigard and Copper can be omitted.

³ If late blight occurs, appropriate fungicides must be added. Fontelis and Inspire Super do not have any late blight activity.

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Table 6. Biopesticides and fungicide alternatives for vegetables.

Active Ingredient	Product	Crops	Target Diseases/Pests	Greenhouse Use	OMRI Listed
acibenzolar-S-methyl	Actigard ¹	Chili pepper, cucurbits, lettuce, onion, spinach and 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	Bacterial blights Downy mildew Leaf spots Powdery mildew ⁴	Yes	Yes
<i>Bacillus pumilus</i> QST2808	Ballad Plus ³ Sonata	Bulb vegetables, cole crops, cucurbits, legumes, pepper, , root crops, sweet corn and tomato	Early blight Downy mildew Late blight Leaf blights Powdery mildew Rust	Yes	Yes
<i>Bacillus subtilis</i> MBI 600	Subtilex NG ⁶	Cucurbits, eggplant, pepper and tomato	Powdery mildew ⁶ Root diseases	Yes	No
<i>Bacillus subtilis</i> QST713	Cease ⁷ Serenade Max ⁷	Cole crops, cucurbits, leafy vegetables, legumes, pepper and tomato	Downy mildew Leaf blights Powdery mildew	Yes	Yes
Bacteriophage (Phage)	Agriphage ⁸	Most vegetables ⁵	Bacterial canker (foliar only) Bacterial speck Bacterial spot	Yes	No
<i>Coniothyrium minitans</i>	Contans ⁹	Most vegetables ⁵	Lettuce drop Timber rot White mold	Yes	Yes
<i>Gliocladium cantenulatum</i>	PreStop Biofungicide	Most vegetables ⁵	Botrytis stem canker Root diseases Seed rots	Yes	No
<i>Gliocladium virens</i> GL-21	SoilGard 12G ¹⁰	Most vegetables ⁵	Root diseases Seed rots	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 and tomato	Nematodes	Yes	Yes
neem Oil	Trilogy ¹¹	Vegetables	Foliar diseases	Yes	Yes

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Active Ingredient	Product	Crops	Target Diseases/Pests	Greenhouse Use	OMRI Listed
Oils from cottonseed, corn and garlic	Mildew Cure ¹¹	Cucurbits and tomato	Powdery mildew	Yes	No
Oils from clove, rosemary and thyme	Sporatec ¹²	Most vegetables ⁵	Fungal leaf blights Powdery mildew	Yes	Yes
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 Leaf blights Powdery mildew	Yes	No
potassium bicarbonate ¹⁴	Armcarb Kaligreen Milstop	Most vegetables ⁵	Fungal leaf blights Powdery mildew	Yes	Yes (except Armcarb)
Potassium salts of fatty acids	M-Pede ¹⁵	Most vegetables ⁵	Powdery mildew	Yes	Yes
potassium silicate	Sil-MATRIX ¹⁶	Most vegetables ⁵	Botrytis gray mold Powdery mildew	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	Fungal leaf blights Powdery mildew	Yes	Yes
<i>Streptomyces griseoviridis</i>	Mycostop ¹⁸	Most vegetables ⁵	Seedling, root and stem rots	Yes	Yes
<i>Streptomyces lydicus</i>	Actinovate AG ⁶	Most vegetables ⁵	Foliar blights Seedling, root and stem rots	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 and tomato	Seedling, root and stem rots	Yes	Yes
<i>Trichoderma viride</i>	Binab	Most vegetables ⁵	Seedling, root and stem rots	Yes	No

Comments:

¹¹Do not apply to plants stressed by heat, cold or moisture extremes.

¹²pH of spray solution should be between 6.0 and 8.0.

¹³Labeled for sweet corn only.

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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 nonionic 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 7. Various fungicides for use on vegetable crops

Table reproduced from the 2019 Southeastern US Vegetable Handbook. Table prepared by R. Melanson, Plant Pathologist, Mississippi State University and R. Singh, Plant Pathologist, Louisiana State University.

Common Name	Trade Name(s)
azoxystrobin	Aframe (Syngenta)
	Aubrac (AgChem Access)
	Azoxystar (Albaugh)
	Dynasty (Syngenta)
	Equation (Cheminova)
	Equation SC (Cheminova)
	Quadris (Syngenta)
	Satori (Loveland Products)
	Trevo (Innvictis Crop Care)
	Willowood Azoxystrobin 2SC (Willowood USA)
chlorothalonil	Bravo Ultrex (Syngenta)
	Bravo Weather Stik (Syngenta)
	Bravo Zn (Syngenta)
	Chloronil 720 (Syngenta) Chlorothalonil 720SC (Arysta) Echo 720 (SipcamAdvan) Echo 90DF (SipcamAdvan) Echo Zn (SipcamAdvan) Equus 500 Zn (MANA)
	Equus 500ZN (Adama)
	Equus 720SST (Adama)
	Equus DF (Adama)
	Initiate 720 (Loveland Products)
	Initiate ZN (Loveland Products)
copper hydroxide	Champ DP Dry Prill (Nufarm)
	Champ Formula 2 Flowable (Nufarm)
	Champ WG (Nufarm)
	Champion Wettable Powder (Nufarm)
	Kentan DF (Isagro USA)
	Kocide DF (DuPont; Certis USA)
	Kocide 2000 (DuPont; Certis USA)
	Kocide 3000 (DuPont; Certis USA)
	Nu Cop 3L (Albaugh)
	Nu Cop 50WP (Albaugh)
	Nu Cop HB (Albaugh)
copper octanoate	Camelot-O (Sepro)
copper (cuprous) oxide	Nordox (NORDOX Industrier AS)
	Nordox 75WG (NORDOX Industrier AS)
copper sulfate (basic)	Basic Copper 53 (Albaugh)
	Cuprofix Ultra 40 Disperss (UPI)
	Cuproxat (NuFarm)
copper sulfate pentahydrate	Mastercop (Adama)
fosetyl-Al	Aliette WDG Fungicide (Bayer)
	Linebacker WDG (NovaSource)

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Vegetables

Common Name	Trade Name(s)
fludioxonil	Cannonball (Syngenta)
	Dyna-Shield Fludioxonil (Loveland)
	Maxim 4FS (Syngenta)
	Scholar SC (Syngenta)
	Spirato 480FS (Nufarm)
iprodione	Enclosure 4 (Devgen)
	Iprodione 4L AG (Arysta)
	Meteor (UPI)
	Nevado 4F (MANA)
	Rovral 4 Flowable Fungicide (Bayer: FMC)
mancozeb	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 80VWP (UPI)
	Roper DF Rainshield (Loveland Products)
mefenoxam	Ridomil Gold GR (Syngenta)
	Ridomil Gold SL (Syngenta)
	Ultra Flourish (Nufarm)
myclobutanil	Rally 40VSP (Dow)
	Sonoma 25EW AG (Albaugh)
	Sonoma 40VSP (Albaugh)
pentachloronitrobenzene (PCNB)	Blocker 4F
phosphite (potassium)	Helena Prophyt (Helena)
	Confine Extra (Winfield Solutions)
	Reveille (Helena)
phosphite (mono-and-dibasic salts)	Phostrol (Nufarm)
phosphorous acid (mono-and-dipotassium salts)	Alude (Cleary)
	Fosphite Fungicide (JK Biotech)
	Fungi-Phite (Plant Protectants)
	K-Phite 7LP AG (Plant Food Systems)
	Rampart (Loveland Products)
propamocarb hydrochloride	Previcur Flex (Bayer)
	Promess (Agriphar)
propiconazole	AmTide Propiconazole 41.8% EC (AmTide)
	Bumper 41.8EC (Adama)
	Bumper ES (Adama)
	Fitness (Loveland Products)

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Vegetables

Common Name	Trade Name(s)
	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>)
sulfur	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>)
	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>)
tebuconazole	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 3.6F (<i>Adama</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>)
thiophanate-methyl	Cercobin (<i>Cheminova</i>)
	Incognito 4.5F (<i>Adama</i>)
	Incognito 85 WDG (<i>Adama</i>)
	Thiophanate-Methyl 85 WDG (<i>Adama</i>)
	T-Methyl 4.5F (<i>Nufarm</i>)
	T-Methyl 70W WSB (<i>Nufarm</i>)
	Topsin 4.5FL (<i>UPI</i>)
	Topsin M 70WDG (<i>UPI</i>)

Commercial Crop Production Vegetables

Table 8. Fungicides mode of actions for fungicide-resistance management

Table reproduced from the 2016 Southeastern US Vegetable Handbook. Table prepared by L. M. Quesada-Ocampo, Plant Pathologist, NCSU and M. Lewis Ivey, Plant Pathologist, Ohio State University.

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)
I	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 penthioopyrad	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 (Qil)	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-Al	Aliette
40	Low to medium	Carboxylic acid amides (CAA)	dimethomorph mandipropamid	Forum Revus
43	High	Benzamides	fluopicolide	Presidio

Information in this section was last updated in December 2019 by Dr. R. Singh.

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	- 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, fruit rots and spots, leaf spots, mummy berry, quince rust, scab and sooty blotch	
Bonide Captan 50WP Hi-Yield Captan 50W Fungicide SA-50 Home and Garden Captan Fungicide	- Bonide Captan 50WP can be used on Blackberries for anthracnose and Botrytis gray mold.
captan + 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, fruit rots and spots, leaf 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	- 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, scab and shot hole	
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	- 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.

Home Gardens

Fruit and Nut Trees

Product Name	Comments
SA-50 Southern Ag Liquid Copper Fungicide	
copper + 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, scab and shot hole	
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 blight, downy mildew, fungal leaf spots, powdery mildew, rust and scab	
Bonide Rose Rx 3 in 1 ^I Bonide Tomato and Vegetable 3 in 1 Concern Garden Defense Multi-purpose Spray ^I Ferti-lome Rose, Flower and Vegetable Spray Gardens Alive! Shield-All II Garden Safe Fungicide 3-in-1 ^I 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. - Do not use on sensitive plants (flowers of impatiens, fuchsia and hibiscus and some rose and carnation varieties).
neem oil + 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 ^I Green Light Neem ^{II} Ready-To-Use	- Do not apply to wilted or stressed plants or to newly transplanted material prior to root development.
phosphorus acid Type of fungicide: Systemic Crops: Apples, berries, citrus, grapes, loquats, pears, quince, stone fruits and strawberries	

Home Gardens

Fruit and Nut Trees

Product Name	Comments
Diseases controlled: Apple scab, downy mildew, fire blight and root and collar and fruit rots caused by Phytophthora	
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, citrus, pecans and walnuts Diseases controlled: Anthracnose, fungal leaf spots, powdery mildew, rust and scab	
Bonide Infuse Systemic Disease Control Ferti-lome Liquid Systemic Fungicide II Gordon's Systemic Fungicide	- For use on nonbearing fruit and nut trees_(trees that will not produce fruit for at least one year after use of this product).
propiconazole 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. Do not apply to Stanley type plums.
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.
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 + 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.

¹Available in concentrate and ready to use formulations

Information in this section was last updated in December 2019 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 Captan 50WP 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 + 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	
mancozeb Type of fungicide: Contact Crops: Most landscape plants Diseases controlled: Anthracnose, downy mildew, fungal leaf spots and blights and rust	
Bonide Mancozeb Flowable with Zinc Concentrate SA-50 Dithane M-45	
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	
Spectracide Immunox Multi-purpose Fungicide Spray Concentrate	

Home Gardens Home Landscape

Product Name	Comments
myclobutanil + insecticide + 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	
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	
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	
Bonide Rose Rx 3 in 1 ^I Bonide Tomato and Vegetable 3 in 1 Concern Garden Defense Multi-purpose Spray ^I 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 ^I 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).
neem oil + 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 ^I 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).
phosphorus 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	- Do not apply to African violets, begonias, Boston ferns or geraniums.

Home Gardens Home Landscape

Product Name	Comments
Ferti-lome Liquid Systemic Fungicide II Ferti-lome Liquid Systemic Fungicide II Ready to Spray Gordon's Systemic Fungicide	
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 African violets, begonias, Boston ferns or geraniums. - 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 and crown gall	
Ferti-lome Fire Blight Spray	- For crown gall apply as a soil drench.
sulfur Type of fungicide: Contact Crops: Most landscape plants Diseases controlled: Powdery mildew, rust, downy mildew and Botrytis blight	
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 + 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 + 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 house plants 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 + 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	

Home Gardens Home Landscape

Product Name	Comments
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 + 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.
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 and scab	
Bonide Infuse Systemic Disease Control Lawn and Landscape Ferti-lome Halt Systemic Rose, Flower, Lawn, Ornamental Fungicide SA-50 Thiomyl 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 + 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.

¹Available in concentrate and ready to use formulations

Information in this section was last updated in December 2019 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	No longer available
captan (contact)	Hi-Yield Captan Fungicide 50WP Southern Ag Home & Garden Captan Fungicide 50WP	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 Dollar spot Fusarium blight Large patch Leaf spots (melting out) Spring dead spot Take-all patch Zoysia patch	

Home Gardens

Lawns

Fungicide (type of fungicide)	Products	Diseases Controlled	Comments
myclobutanil + insecticides + fertilizer (systemic)	Spectracide Immunox 3-in-1 Insect & Disease Control Plus Fertilizer Spectracide Immunox Plus Insect & Disease Control Spectracide Immunox Plus Insect & Disease Control Multipurpose Concentrate	Dollar spot Large patch Leaf spot (melting out) Spring dead spot Summer patch	
phosphorus acid (systemic)	Monterey Agri-Fos Systemic Fungicide	Pythium blight Pythium root rot	
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	
triadimefon (systemic)	Bonide Fungi-onil Lawn Disease Control Bayer Advanced Fungus Control For Lawns Green Light Fung-Away Systemic Lawn Fungicide Spray High Yield Fungicide Granules	Dollar spot Fairy rings Gray leaf spot Large patch Take-all patch	

Home Gardens Lawns

Table 2. Efficacy of available fungicides for disease management of home lawns

Fungicide ¹	Diseases					
	Dollar spot	Large patch	Take-all patch, Bermuda decline, Ggg ²	Gray leaf spot	Leaf spots, Melting out	Fairy rings
azoxystrobin		4	(3) ³	4	3	3
myclobutanil	4	2			1	
propiconazole	4	2	(2)	2	2	
triadimefon	4	4	(2)	2		3
thiophanate-methyl	4			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-I 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 in December 2019 by Dr. R. Singh.

Home Gardens

Vegetables

The home gardener has several chemical control products to choose from, including fungicides and bactericides. Most of the available products for home gardeners work on contact and must be applied before the disease occurs or as soon as disease symptoms are observed. The most common fungicidal products for home garden use contain chlorothalonil, sulfur or mancozeb. Products containing copper can be used as fungicides or bactericides. Organic gardeners can use sulfur or copper to manage vegetable diseases. A list of available fungicides and bactericides is provided in Table 1. However, many home gardeners prefer to grow their vegetables organically or using products that are more “environmentally or earth friendly” than traditional synthetic chemicals. Biopesticides are derived from natural materials such as plants, animals, minerals and fungi or bacteria, and are most effective when used in conjunction with cultural methods. A list of biopesticides available to home gardeners is provided in Table 2.

Table 1. Fungicides available for disease management in home vegetable gardens

Product Name	Comments
captan Type of fungicide: Contact Crops: Beans, beets, cabbage, corn, melons, peas, spinach, squash and Swiss chard Diseases controlled: Damping-off diseases	
Hi-Yield Captan 50W Fungicide	- Seed treatment only
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	
Bonide Fung-onil Multi-purpose Fungicide Ferti-lome Broad Spectrum Landscape & Garden Fungicide GardenTech Daconil® Fungicide Hi-Yield Vegetable, Flower, Fruit and Ornamental Fungicide Scotts Ortho® MAX® Garden Disease Control	
copper Type of fungicide: Contact Crops: Most vegetables Diseases controlled: Anthracnose, bacterial leaf spots & blights, early blight, fungal leaf spots and blights, gummy stem blight, powdery mildew, scab and white rust	
Bonide Copper Dust Bonide Garden Dust (also contains an insecticide) Bonide Liquid Copper Fungicide Bonide Dagoon Dust with Copper Concern Copper Soap Fungicide Liqui-Cop Copper Fungicide Garden Spray Natural Guard Copper Soap Fungicide SA-50 Southern Ag Liquid Copper Fungicide	- 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: Asparagus, corn, cucurbits, onions, potatoes and tomatoes Diseases controlled: Anthracnose, early blight, fungal leaf spots and blights, gummy stem blight and rust	
Bonide Mancozeb Flowable with Zinc Southern Ag Dithane M-45	
myclobutanil Type of fungicide: Systemic Crops: Asparagus, cucurbits, snap bean and tomatoes Diseases controlled: Pod tip rot, powdery mildew and rust	
Spectracide Multi-purpose Fungicide	- Do not spray within 14 days of harvest.

Home Gardens Vegetables

Product Name	Comments
phosphorus acid Type of fungicide: Systemic Crops: Most vegetables Diseases controlled: Root, crown and fruit rots caused by <i>Phytophthora</i> and <i>Pythium</i> spp., downy mildew and late blight	
Monterey Agri-Fos Systemic Fungicide	
propiconazole Type of fungicide: Systemic Crops: Sweet corn Diseases controlled: Leaf spots and blights and rust	
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.
sulfur Type of fungicide: Contact Crops: Beans (may injure some varieties), cole crops, onions and peas Diseases controlled: Botrytis gray mold, downy mildew, powdery mildew and rust	
Bonide Garden Dust Bonide Sulfur Plant Fungicide Bonide Tomato & Vegetable 3 in 1 Ferti-lome Dusting Sulfur Hi-Yield Dusting Wettable Sulfur 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 + 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.

Home Gardens

Vegetables

Table 2. Biopesticides available for disease management in home vegetable gardens

Product Name	Disease(s) Controlled	Crops	Comments
Bayer Advanced Serenade Garden Disease Control	Alternaria spots and blight Botrytis blight Gummy stem blight Onion purple blotch Powdery mildew	Most vegetables	
GreenCure Foliar Fungicide	Leaf spots and blights Powdery mildew	Most vegetables	
BioSafe Disease Control	Leaf spots and blights Powdery mildew	All vegetables	
Novozyme Actinovate Lawn and Garden	Botrytis gray mold Damping-off diseases Leaf spots and rust	Most vegetables and herbs	
Novozyme Actino-Iron Lawn and Garden	Damping-off diseases Root and crown rots	Most vegetables and herbs	
BioWorks RootShield Home & Garden	Damping-off diseases Root and crown rots	Most vegetables	- Apply to seed, plant roots and soil only
SaferGro Mildew Cure	Powdery mildew	All vegetables	
BioWork MilStop	Powdery mildew	Most vegetables	
Neem Oils (many brands)	Powdery mildew Rusts	Most vegetables	
Dr. Earth Final Stop Disease Control Fungicide	Botrytis gray mold Leaf spots and blights Powdery mildew	Most vegetables	- May cause leaf burn on some plants
Simple Success Companion Biological Fungicide	Damping-off diseases Root and crown rots	Most vegetables and herbs	

Information in this section was last updated in December 2019 by Dr. R. Singh.

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 Choices ¹	Rate ²	Comments
Cotton	Telone II	3-6 gal/A	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.
	AgLogic 15G	3.5-7 lbs/A 5 lbs/A	Apply granules in seed furrow and cover with soil. Side-dress granules in furrow 6-10 inches on side of row. Apply once at 3 weeks through first squaring.
	Vydate C-LV (oxamyl)	17 fl oz (first and second application at 17 fl oz)	Apply at 1-7 true leaf stage and a second application 14 days later. Use after initial treatment with a nematicide. For reniform, root-knot and lance nematodes.
	Acceleron INT-710	Seed application	Use where low-moderate levels of nematodes are present.
	Avicta Duo COT202 Avicta Duo Cotton	Preordered seed treatment	Use in fields with low-moderate nematode levels only.
	Poncho Votivo	Seed application	For low-moderate nematode levels.
	AERIS Seed Applied System	Pre-ordered seed treatment	For low-moderate nematodes.
	Majestene	7.2-19.6 fl oz/1,000 foot row	For low-moderate nematode levels.
	Velum Total	14-18 fl oz/a	In-furrow spray on or below seed.
Corn Grain sorghum	Mocap 15G (ethoprop)	10-13 lb (40-in rows)	Apply in a 12-15 inch band at planting. Incorporate into top 2-4 inches of soil.
	Counter 15G Lock 'n Load Counter 20G Lock 'n Load Counter 20G Smartbox	6-8 oz/1000 ft 4.5-6 oz/1,000 ft	Apply in a 7 inch band. Apply in a 4-5 inch band over open seed furrow in front of press wheel or apply in furrow.
	Avicta Complete Corn 250 Avicta Complete Corn 500 Avicta Duo Corn Avicta Duo 250 Corn	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.
	Counter 15G Lock 'n Load Counter 20G Lock 'n Load Counter 20 Smartbox	7 oz/1,000 row feet 5.2 oz/1,000 row feet	Apply in a 5-7-inch band behind planter shoe in front of press wheel and lightly incorporate with chains or tines.
	Poncho Votivo	Seed application	

Nematode Management Field Crops

Crop	Product Choices ¹	Rate ²	Comments
Peanut	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.
	Velum Total	18 fl oz/a	In-furrow spray on or below seed.
SoybeanSoybean	Poncho Votivo	Seed application	Use for low-moderate populations of nematodes. When high nematode levels are present, use additional management measures.
	ILeVO	Seed application	
	Avicta Complete Beans 500	Seed application	
	Majestene	7.3-19.6 fl. Oz/1000 row feet	Apply at-planting infurrow or in a T-band.
	Telone II	3-6 gal/a	Apply pre-plant under the row. For heavy nematode pressure.
Sugarcane	Mocap 15G	1.8-3.6 lbs/1,000 row 3.5-7 pints/a	Apply in a 12-15-inch band over seed pieces and cover with soil.
	Nimitz		Apply at-planting or at ratoon.
Sweet potato	Mocap 15G	1.6-2.1 lb/1,000	Apply in a 12-15-inch band.
	Mocap EC	5.1-6.9 oz/1,000 row ft	
	Nimitz	3.5-7 pints/A	Application can be made at planting or pre-plant. Apply in a moist, well-prepared seedbed.
	AgLogic 15G	10-20 lbs/A	Apply in a 12 band over open furrow or soil surface and cover immediately during bed forming.
	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 inches. Apply in at least 200 gal of transplant water during planting of slips (in-furrow).
	Dominus	10-40 gal/A	Wait at least 10-14 days after application before planting.
	Movento	4.0-5.0 fl oz/A	Apply in minimum of 10 gal of water and spray when sufficient foliage is present for uptake by the plants. Maximum of 10 fl oz per crop season.
	Velume Prime	6.0-6.84 fl oz/A	Apply using overhead chemigatin equipment. If high levels of root-knot nematode are present, use other suppressive measures as well.
	Telone II	3-6 gals/A	Apply pre-plant beneath the row.
	Majestene	4-8 qts/A	Apply in sufficient water to thoroughly soak root zone or apply prior to, at, or shortly thereafter at transplant.

¹Reference to commercial or trade names is made with the understanding that no discrimination or endorsement of a particular product is implied by LSU or the LSU AgCenter.

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

The nematode sections were revised October 2019 by Dr. C. Overstreet.

Nematode Management 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
Blackberry, boysenberry, dewberry, raspberry, strawberry	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/1,000 ft ²	Incorporate by mechanical means, irrigation or rainfall.
Strawberry	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	Waiting period of 21-42 days after treatment, depending on soil temperature.
	Velum Prime	6.0-6.5 fl oz/A	Apply through low-pressure drip.
Fruit tree sites (pre-plant)	Nimitz	3.5-7 pts/A	Apply 7 days prior to transplanting.
	Vapam HL K-Pam HL	50-75 gal 30-62 gal	Apply by chemigation. Waiting period required.
	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	Velum Prime	6.84 fl oz/A	Apply by chemigation through low-pressure drip.
	Ditera DF	5-38 oz/1,000 row	Pre-plant or post-plant.
	Movento	8.0-10.0 fl oz/A	Do not apply during the bloom phase.
	Vydate L	2 gal	Apply in 20 gal of water and incorporate 4-8 inches. USE ON NONBEARING TREES ONLY.
	Ditera DF	5-38 oz/1,000 ft ²	Pre- or post-plant.
Apple Peach Nectarine	Vydate L	2 gal	Apply in 20 gal of water and incorporate 4-8 inches. USE ON NONBEARING TREES ONLY.
	Ditera DF	5-38 oz/1,000 row	Pre- or post-plant.
Pome fruits (apple, pear, Loquat, crabapple) Stone fruits (peach, apricot, plum, jujube)	Velum Prime	6.5-6.84 fl oz/A	Apply through low-pressure drip.
	Movento	6.0-9.0 fl oz/A	Don't apply during blooming
	Nimitz	3.5-7 pints/a	Apply first application after flower buds start to swell and second application after harvest.
Fruits (general)	Dominus	10-40 gal/a	Apply preplant.

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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 two to three months and then plant vegetables.

Resistant Varieties or Crops

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

The nematode sections were revised October 2019 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.
	Dominus	10-40 gal/a	Has a 10-14-day waiting interval before planting.
	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 gal applied before planting.
	Telone C-35	60-79 gal	
	Ditera DF	5-38 oz/1,000 ft 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.
	Basamid	11-13 oz/100 square feet	Irrigate to activate the chemical after spreading and also to seal the soil.
	Mocap EC	2 qt (broadcast)	Incorporate 2-4 inches. Stock may be transplanted into the treated area after 72 hours. Pertains to field nursery stock only.

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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.
	Dominus	10-40 gal/A	Waiting interval of 10-14 days before planting.
Postplant	Multiguard Protect	8 gal (initially) 5.5-8 gal (for maintenance)	After initial treatment, apply maintenance rates at 14- to 28-day intervals. Irrigate to a depth of 6 inches. Can be applied up to 6 applications.
	Idemnify	0.195-0.39 oz/1,000 sq ft	Apply in 2-5 gallons of water.
	Nortica Nortica 10 WVP	0.7-2.3 lbs/1,000 sq ft 0.8-1.15 lbs/1,000 sq ft	Apply every 3 months as necessary and irrigate to 4-inch depth.
	Telone II	5-10 gal	Use on established turf for sod farms. Not for golf greens.
	Divanem	3.125-6.25 fl oz/A	Apply at this rate on a 14-21-day interval.
		6.25-12.2 fl oz/A	Apply at this rate on a 21-28-day interval.
	Nimitz Pro G	60-120 lb/A	Incorporate by watering with at least 0.5 inch of water.

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The nematode sections were revised October 2019 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	0.9-1.4 lb/1,000 row ft	Apply in a 12- to 15-inch band.
Brassica leafy vegetables	Velum Prime	6.5-6.84 fl oz/a	Apply by chemigation through low-pressure drip.
	Movento	4.0-5.0 fl oz/ a	Apply when sufficient leaf surface is available. Use a spray adjuvant.
	Nimitz	3.5-5 pts/ a	Apply as broadcast incorporated, banded and incorporated or by drip irrigation. Make no more than 1 application per crop.
Cabbage	Ditera DF	5-38 oz/1,000 ft ²	Apply replant and/or in multiple applications.
	Mocap EC	2.4 oz/1,000 row ft	Apply in a 15-inch band. Do not use a see furrow treatment or allow granules to contact the seed.
	Mocap 15G	0.9 lb/1,000 row ft	Apply in 12- to 15-inch band.
Carrot	Vydate L	1 gal (in-furrow)	Use a minimum of 20 gal of water and incorporate.
Cole crops (broccoli, cabbage, cauliflower)	Ditera DF	5-38.4 oz/1,000 ft ²	Apply pre-plant and incorporate.
Cucumber	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	3.5-5 pt (7 days pre-plant)	Apply as broadcast incorporated, banded and incorporated or by drip irrigation. Make no more than 1 application per crop.
	Vydate L	1-2 gal (broadcast)	Incorporate 2- 4 inches.
	Velum Prime	6.5-6.84 fl oz/a	Apply through low-pressure drip.
	Ditera DF	5-38 oz/1000 feet	Apply preplant and incorporate.
	Vydate L	2-4 pt	Foliar spray 2-4 weeks after planting and 2- 3 weeks after first spray.
	Paladin	35-51.3 gal/a broadcast	Apply pre-plant. Observe waiting period of 21-42 days before planting, based on temperature.
Cucurbits	Majestene	4-8 qts/a	Apply by soil drench or chemigation.
Eggplant	Nimitz	3.5-5 pt (7 days pre-plant)	Apply as broadcast incorporated, banded and incorporated or by drip irrigation. Make no more than 1 application per crop.
	Vydate L	1 gal (in band) 4 pt (foliar)	Apply in a band 2-3 weeks after transplanting and again 4 weeks later.

Nematode Management Vegetables

Crop	Product Choices ¹	Rate ²	Comments
Fruiting Vegetables (eggplant, okra, pepper, tomato)	Movento	4.0-5.0 fl oz/a	Apply when sufficient foliage is present to allow absorption by leaves.
	Velum Prime	6.5-6.84 fl oz/ a	Apply using low pressure chemigation.
	Majestene	4-8 qts/ a	Apply in sufficient water to soak root zone. Can be used prior to planting, at planting and after planting.
	Nimitz	3.5-7 pt	Apply 7 days preplant.
Irish Potato	Mocap 15G	1.4 lb/1,000 row ft	Apply in a 12-inch band and incorporate. Avoid direct application in the seed furrow.
	Movento	4.0-5 fl oz/ a	Apply when enough leaves are present.
	Mocap EC	4.4 oz/1,000 row ft	Same as above.
	Velum Prime	6.5-6.84 fl oz/ a	Apply with overhead chemigation.
	Vydate C-LV	34-68 oz	Apply in-furrow with a minimum of 20 gal of water
Leafy Vegetables	Nimitz	3.5-7 pts/a	Apply 7 days pre-plant.
	Velum Prime	6.5-6.84 fl oz/a	Apply through overhead chemigation.
	Movento	4.0-5.0 fl oz/a	Apply when sufficient foliage is available with maximum of 10 fl oz/a during a crop season.
	Ditera DF	5-38.4 oz/1000 sq ft	Apply pre-plant, at plant, or post-plant or through water in drip irrigation system.
Okra	Nimitz	3.5-5 pt (7 days pre-plant)	Apply as broadcast incorporated, banded and incorporated or by drip irrigation. Make no more than 1 application per crop.
Pepper (bell and non-bell)	Nimitz	3.5-5 pt (7 days pre-plant)	Apply as broadcast incorporated, banded and incorporated or by drip irrigation. Make no more than 1 application per crop.
	Vydate L	2 pt (transplant water)	Add material to transplant water. Use a minimum of 200 gal of water.
		2 pt (drip chemigation)	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.
Root vegetables	Nimitz	3.5-7 pts/ a	Apply 7-10 days before seeding.
Sweet Corn	Counter 15G Lock 'n Load	6-8 oz/1,000 row ft	Apply in-furrow
	Counter 15G Smartbox	6-8 oz/1,000 row ft	
	Counter 20G	4.5-6.0 lb	

Nematode Management Vegetables

Crop	Product Choices ¹	Rate ²	Comments
	Mocap 15G	12-16 oz/1,000 row ft	Apply 12- to 15-inch band. Incorporate to 2 to 4 inches.
Tomato	Nimitz	3.5-5 pt (7 days pre-plant)	Apply as broadcast incorporated, banded and incorporated or by drip irrigation. Make no more than 1 application per crop.
	Velum Prime	6.5-6.84 fl oz/a	Apply through low pressure drip.
	Ditera DF	5-38.4 oz/1000 sq ft	Apply pre-plant or in water through irrigation system.
	Vydate L	2-4 pt	Treat every 1-2 weeks throughout the season.
	Paladin	35-51.3 gal/a	Pre-plant treatment. Observe 21- to 42-day planting interval after treatment.
Vegetables (general)	Telone II Telone C-17	9-12 gal (broadcast) 10.8-17.1 gal (broadcast)	Apply 2-3 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 inches beneath the row
	Vapam HL K-Pam HL	37.5- 75 gal 30-60 gal	Inject and tarp. Inject and tarp for best results.
	Dominus	10-40 gal/a	Observe 10-14-day waiting interval before planting.

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The nematode section for vegetables was revised October 2019 by Dr. C. Overstreet.

Seed Treatments, In-Furrow Sprays and Granular Fungicide Options Field Crops

Seed Treatments, In-Furrow Sprays and Granular Fungicide Options 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.** In the past, in-furrow sprays or granules were used; however, because of convenience these options have mostly been replaced with seed treatments. Nevertheless, in-furrow and granular fungicides remain effective for a number of diseases and may be more effective than seed treatments in problem areas.

Corn, Grain Sorghum, and Wheat

Fungicide seed treatments are commonly applied to large and small grain seed. Depending on the package, fungicides from groups 3, 4, 7, 11, and/or 12 are most commonly applied to seed. Data from LSU AgCenter field trials indicate slight increases in stand or emergence; however, seed-applied fungicides very rarely provide economic benefit in these crops. Producers can save input costs by not treating or over-treating these crops. If a field has a history of soilborne seedling disease, fungicide seed treatments may be useful in these situations.

Soybean

Fungicide seed treatments from the same groups listed above are commonly applied to soybean and will provide economic benefit in the event of seedling disease development. Seedling disease issues are more common in soybean than in the crops above. Generally, generic fungicides from groups 3, 4, and 11 are sufficient to protect seed and seedlings from pathogens in soybean.

Cotton

Do not plant cotton without a fungicide seed treatment! Do your homework by figuring out what is already on the seed. If there are a minimum of three different modes-of-action present, over-treating likely is not necessary. If the decision is made to over-treat, use a different mode of action. Significant cost savings can be realized depending on the seed company and seed treatment options.

The following table lists labeled available active ingredients commonly used in field crop production, their mode of action and the targeted organisms listed by companies. This list may not be all-inclusive as new products are developed and multiple online sources were used to compile this information.

Always refer to product labels for rate and use information.

Seed Treatments, In-Furrow Sprays and Granular Fungicide Options Field Crops

Active Ingredients	FRAC Code	Targeted Pathogens
copper hydroxide copper oxychloride	M1	<i>Pseudomonas syringae</i> , <i>Xanthomonas translucens</i> , <i>Tilletia caries</i> ; damping-off/seedling diseases
thiram mancozeb	M3	Seed decay, damping-off, and seedling blights caused by many seedborne and soilborne organisms
thiabendazole	I	Seed decay, damping-off, and seedling blights caused by many seedborne and soilborne organisms
iprodione	2	<i>Rhizoctonia solani</i>
difenoconazole imazalil ipconazole myclobutanil prothioconazole tebuconazole triticonazole	3	<i>Alternaria</i> , <i>Aspergillus</i> , <i>Botrytis</i> , <i>Cochliobolus</i> , <i>Fusarium</i> , <i>Penicillium</i> , <i>Sclerotinia</i> , and <i>Sphacelotheca</i> spp.; <i>Thielaviopsis basicola</i> , <i>Tilletia caries</i> , <i>Tilletia foetida</i> , <i>Urocystis agropyri</i> , <i>Ustilago nuda</i> var. <i>tritici</i> , <i>Rhizoctonia solani</i> , <i>Cochliobolus sativus</i>
mefenoxam metalaxyl	4	<i>Pythium</i> and <i>Phytophthora</i> spp.
boscalid carboxin fluxapyroxad penflufen penthiopyrad sedaxane	7	<i>Cochliobolus</i> , <i>Fusarium</i> , and <i>Pythium</i> spp.; <i>Rhizoctonia solani</i> , <i>Blumeria graminis</i> , <i>Puccinia recondita</i> , <i>Septoria tritici</i> , <i>Cephalosporium gramineum</i> , <i>Ustilago tritici</i> , <i>Sphacelotheca reiliana</i>
azoxystrobin fenamidone fluoxastrobin pyraclostrobin trifloxystrobin	11	<i>Aspergillus</i> , <i>Cladosporium</i> , <i>Colletotrichum</i> , <i>Fusarium</i> , <i>Penicillium</i> , <i>Pythium</i> , and <i>Phomopsis</i> spp.; <i>Rhizoctonia solani</i> , <i>Sclerotinia rolfsii</i> , <i>Sclerotium rolfsii</i> , and <i>Sphacelotheca reiliana</i>
fludioxinil	12	Seedborne and soilborne fungi which cause seed decay, damping-off and seedling blights
etridiazole PCNB tolclofos-methyl	14	<i>Pythium</i> , <i>Fusarium</i> , and other Deuteromycete species causing seed decay and seedling blights; <i>Rhizoctonia solani</i>
ethaboxam	22	Multiple fungal species; <i>Phytophthora</i> spp..

This section was updated/revised September 2019 by Dr. Trey Price.

Seed Treatments, In-Furrow Sprays and Granular Fungicide Options 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 pelleted seed, previously treated seed or 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. Although 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 Disinfestants

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°F (37°C) water.
3. Transfer the warmed seed into a water bath already heated to the temperature recommended for the vegetable seed (Table 1). The seeds should be completely submerged 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, In-Furrow Sprays and Granular Fungicide Options

Vegetables

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

Vegetable Crops	Water Temperature (°F/°C)	Soaking Time (minutes)
Broccoli	122/50	20-25
Brussels sprouts	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 ¹	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 ²	122/50	25
Turnip	122/50	20

¹Cucurbits other than cucumbers can be severely damaged by hot-water treatment and should be disinfested using chlorine bleach.

²Germination may be delayed by 2-3 days depending on the variety

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 one quart (946 ml) of Clorox® bleach to five 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 (one pound of seed per four quarts of disinfectant solution) and agitate for one minute. Prepare fresh disinfectant solution for each batch of seeds to be treated.
4. Rinse the seed in a cold-water bath for five 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.

Seed Treatments, In-Furrow Sprays and Granular Fungicide Options Vegetables

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 *Tobacco mosaic virus* 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 six 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 *Tobacco mosaic virus*. **Do not use TSP treated seed for food or animal feed.**

1. Prepare a 10% solution of TSP (one part TSP in nine 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 five 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 Seed Disinfecting Treatments

1. Randomly select 100 seeds from each seed lot.
2. Treat 50 seeds using one of the sanitizers described above.
3. After the treated seed has dried and **before** application of a protectant fungicide, plant the treated and nontreated seed separately in flats containing planting mix according to standard practice. Label each group as treated or nontreated.
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: number of seedlings emerged ÷ number of seeds planted x 100.
7. Compare percent germination between the treated and nontreated 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, In-Furrow Sprays and Granular Fungicide Options Vegetables

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

Vegetable Crop	Thiram¹ 50WP Ounces (dry wt³)/100 lb seed	Captan² Fluid ounces/100 lb seed
Beans (Lima)	3	- ⁴
Beans (Snap)	2	2.5
Broccoli, Brussels sprouts, Cabbage, Cauliflower	8	1.5
Cantaloupe, Cucumber	4.5	2.5
Carrots	8	-
Cowpeas	2	2.5
Endive	8	-
Eggplant	6	-
Kale, Kohlrabi	8	-
Leafy greens (collard, lettuce, mustard, spinach, Swiss chard, turnip)	8	1.5
Okra	6	-
Pea	3	2.5
Peppers	8	2.5
Pumpkin, Squash, Watermelon	4.5	1.5
Radish	8	1.5
Tomato	6	-
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 table 4 for dry weight conversions.

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

Seed Treatments, In-Furrow Sprays and Granular Fungicide Options 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 nontreated 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	Rate ¹ /100 lb	Rate/acre	FRAC ² 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)	-	0.71-1.1 lb ⁴	7
Sweetpotato	dicloran (Botran 75W)	-	3.0-5.0 lb ^{4, 5}	14

¹Apply as a dust. See table 4 for dry weight conversions.

²Abbreviation for Fungicide Resistance Action Committee.

³The dash indicates that the fungicide is not labeled for and/or recommended for the specified application.

⁴Apply uniformly over and around the seed as an in-furrow spray. Refer to label for detailed application instructions.

⁵Do 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 2019 by Dr. R. Singh.

Soil Treatments

Management of Nematodes and Soilborne Diseases

A number of plant-parasitic nematodes and plant pathogens inhabit the soil and can cause disease in or damage to crops. Soil fumigants (Table 1) can kill plant-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/fumiganttraining>). 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}	Rate ³	Pests Controlled
Metam CLR 42% Soil Fumigant	37.5-75 gal	Soilborne fungi and fungal like organisms ⁴ Nematodes Weeds
Nimitz	3.5-5 pt	Nematodes
Telone C-17 Soil Fungicide and Nematicide	10.8-45 gal	Garden centipedes Nematodes Soilborne fungi and fungal-like organisms ⁴
Vapam HL	37.5-75 gal	Nematodes Soilborne fungi and fungal-like organisms ⁴ Weeds

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.

²Not for use in greenhouses or other enclosed areas.

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.**

⁴Includes Clubroot of crucifers, Oak root fungus, *Phytophthora*, *Pythium*, *Rhizoctonia*, *Sclerotinia* and *Verticillium*.

Table 2. Soil sterilants for control of soilborne plant pathogens, insects, nematodes and weeds

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

Soil Treatments

Table 3. Microbial biopesticides for the management of soilborne plant pathogens in organic farming¹

Product Choices ²	Biocontrol Organism	Target Diseases	Rate ³	Crops
Actinovate AG	<i>Streptomyces lydicus</i>	Damping-off and root rots <i>Fusarium</i> spp. <i>Phytophthora</i> spp. <i>Pythium</i> spp. <i>Rhizoctonia</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>Fusarium</i> spp. <i>Phytophthora</i> spp. <i>Pythium</i> spp. <i>Rhizoctonia</i> spp. <i>Verticillium</i> spp. Root decay <i>Phymatotrichum omnivorum</i>	4-6 oz/100 gal (ornamentals) 18-54 oz/100 gal (turf)	Ornamentals and turfgrasses
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. minor</i> <i>S. sclerotiorum</i>	1-4 lb	Most crops
Mycostop	<i>Streptomyces griseoviridis</i> Strain K61	Damping-off and root rots <i>Alternaria</i> spp. <i>Fusarium</i> spp. <i>Phomopsis</i> spp. <i>Pythium</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>Fusarium</i> spp. <i>Pythium</i> spp. <i>Rhizoctonia</i> spp.	4 oz/100 gal ⁴	Container ornamentals Vegetable transplants
Regalia	Extract of <i>Reynoutria sachalinensis</i>	Damping-off and root rots <i>Fusarium</i> spp. <i>Phytophthora</i> spp. <i>Pythium</i> spp. <i>Rhizoctonia</i> spp. <i>Verticillium</i> spp. Sclerotinia diseases <i>S. minor</i> <i>S. sclerotiorum</i> Southern blight <i>Sclerotium rolfsii</i> Clubroot <i>Plasmodiophora brassicae</i> Common scab <i>Streptomyces scabies</i>	1-4 qt	Cotton Oil seed crops Peanut Tobacco Vegetables
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	Bedding plants Flowers Herbs Hydroponic crops Oil seed crops Ornamentals Pome and stone fruit Tree nuts Vegetables

Soil Treatments

Product Choices ²	Biocontrol Organism	Target Diseases	Rate ³	Crops
SoilGard I2G	<i>Trichoderma virens</i>	Damping-off and root rots <i>Pythium</i> spp. <i>Rhizoctonia</i> spp.	See label ⁵	Bedding plants Herbs Ornamentals Vegetables
T22 HC	<i>Trichoderma harzianum</i>	Damping-off and root rots <i>Fusarium</i> spp. <i>Pythium</i> spp. <i>Rhizoctonia</i> spp.	16-32 oz	Herbs Vegetables

¹For more information on microbial biopesticides for the management of soilborne pathogens in organic farming, refer to 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 2019 by Dr. R. Singh.



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