Fruits & Nuts

includes :

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Disease and Insect Control in Home Fruit Plantings

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Growing fruit in the home garden can be an interesting, fun and rewarding hobby. Many novices dream of plucking perfect fruit off trees in their yards. This does not happen without a great deal of work. Control of **pests (insects and diseases)** is an integral part of the care necessary to achieve good results.

This publication provides guidelines for spraying home fruit plantings, but good pest control is not possible if spraying is the only action taken. Cultural practices such as pruning, sanitation, variety selection and selecting open, sunny sites for planting are necessary for good pest control. Specific cultural practices for each type of fruit are provided with the spray charts.

How to Use the Spray Schedules

Most **fungicide** (disease control product) and some **insecticide** (insect control product) applications are effective only if applied preventatively, because it is not possible to control the pest satisfactorily after the fact. The timing of these preventive sprays is based on the growth stage of the plant and forms the foundation of the spray charts that follow.

In very rainy seasons, sprays may need to be applied more frequently than the schedule given in the following charts. Wet weather favors development of the disease-causing organisms; thus, more chemical protection is needed. Also, rains can wash off the **pesticides** (fungicides and insecticides). When rain occurs before a spray has dried or if rainfall totals more than 1 inch within 24 hours, the spray should be re-applied. Fungicides provide more benefit when applied before a rain than after, because protection from infection by disease-causing organisms is needed when plant surfaces are wet.

Additional Spray Tips

Thorough coverage of all above-ground plant parts is needed for good pest control. One of the biggest mistakes home fruit growers make is to allow their trees to grow too tall. If trees are maintained at a manageable height, it is easier to spray them properly, as well as to harvest the fruit. Proper pruning practices reduce the amount of spray needed and permit better coverage.

The type of sprayer used depends on the size of the fruit planting. For most plantings of small fruits or for a few small fruit trees, pump-up sprayers are adequate. Trombone-type sprayers are helpful for taller trees. For the increased spray volumes required by larger home orchards, power sprayers are recommended.

Mixing a detergent or commercial spreader-sticker with the spray solution is recommended. This provides better coverage of slick surfaces such as apple fruit or blackberry stems.

Rates of product application are not provided in these charts, because of the diversity of product concentrations offered. **The product labels give the rates; follow them.** The label rates are expressed as amount per gallon of water. The following table can be used to determine the amount of spray mixture needed.

Amount of spray needed for each application

Height in feet	Spread in feet	Gallon per tree per application
5 to 8	3 to 6	½ to 1
8 to 10	4 to 8	1 to 2
10 to 15	8 to 15	3 to 5

Protect Pollinating Insects

Honey bees and other pollinating insects must be protected from insecticides, which will kill them. **Do not spray fruit plants with insecticides while the plants are in bloom.**

Pesticide Safety

Most of the pesticides suggested for use in this publication are low-toxicity materials; however, some precautions are still needed.

- Keep pesticides in the original, labeled container.
- Keep pesticides in a locked storage cabinet, away from children or pets.
- Read the label each time before you use the product.
- Wear rubber gloves, goggles, a long-sleeved shirt, long pants and a hat when mixing and applying pesticides.
- Handle the pesticide carefully when mixing. Avoid breathing dust or vapors. Wash any chemicals off the skin immediately with plenty of water.
- Never apply insecticides or fungicides with a sprayer that has been used for weed killers.
- Do not spray if it is windy.
- Mix only as much as you need. Do not store diluted spray mixtures from one application to the next. They will lose effectiveness and are unsafe.
- Observe the harvest intervals and reentry requirements given in the following table and on the product label.

Multipurpose Fruit Spray

Multipurpose fruit tree spray products are mixtures containing a fungicide (captan) and either one (malathion) or two (malathion and carbaryl) insecticides.

Multipurpose sprays are convenient and are effective against some, but not all, pests. Suggestions for their use are provided in this spray guide. **Mixtures containing carbaryl should not be applied to apple or pear until 21 days after petal fall, as it causes the fruit to drop.**

Harvest Restrictions

The following tables contain the most readily available home fruit pesticides, the crops on which they can be used and the harvest restrictions. If any information in the tables disagrees with the product label, **FOLLOW THE INFORMATION ON THE LABEL.**

Harvest Restrictions for Common Fruit Fungicides

Common Names	Example Brand Names[a]	Waiting period in days between final spray and harvest								
		Apple	Pear	Peach	Cherry	Plum	Blackberry Raspberry	Straw-berry	Grape	Blueberry
captan	Captan	0	nr	0	0	0	nr	0	0	0
chlorothalonil	Daconil, Fung-onil, Garden Disease Control	nr	nr	*	*	*	nr	nr	nr	nr
copper	Bordeaux Mix, Copper Fungicide	0	0	0	0	0	0	0	0	0
lime sulfur	Lime Sulfur	0	0	0	0	0	0	0	0	0
mancozeb	Manzate, Dithane	nr	nr	nr	nr	nr	nr	nr	66	nr
myclobutanil	Immunox[b]	14	nr	0	0	0	0	0	14	nr
propiconazole	Infuse, Liquid Systemic Fungicide	nr	nr	0	0	0	nr	nr	nr	nr
streptomycin	Agri-mycin, Fire Blight Spray	50	30	nr	nr	nr	nr	nr	nr	nr
sulfur	Sulfur	0	0	0	0	0	0	0	0	0
thiophanate-methyl	Thiomyl	1	nr	1	1	1	nr	nr	nr	nr

nr = Not registered for this use.

* Chlorothalonil cannot be applied to peach, plum or cherry between shuck split and harvest.

[a] List of brand names is not complete and does not imply any preference or discrimination to other products of similar, suitable composition.

[b] Immunox is labeled for use on the indicated fruits. Immunox Plus, which contains an insecticide as well as myclobutanil, is labeled only for ornamentals.

Harvest Restrictions for Common Fruit Insecticides/Miticides

Common Names	Example Brand Names[a]	Waiting period in days between final spray and harvest								
		Apple	Pear	Peach	Cherry	Plum	Blackberry Raspberry	Straw-berry	Grape	Blueberry
acetamiprid	Ortho Flower, Fruit, & Vegetable Insect Killer Conc.	7	7	7	7	7	1	1	7	1
carbaryl	Sevin	3	3	3	3	3	7	7	7	7
esfenvalerate	Monterey Bug Buster II	21	28	14	14	14	21	nr	nr	14
gamma-cyhalothrin	Spectracide Triazicide Insect Killer Once & Done Conc.	21	21	14	14	14	nr	nr	nr	nr
insecticidal soap	Insecticidal Soap	0	0	0	0	0	0	0	0	0
malathion	Malathion	3	1	7	3	nr	1	3	3	1
permethrin	Eight, Total Pest Control[c]	*	14	7	nr	nr	14[b]	14[b]	nr	14[b]

Common Names	Example Brand	Waiting period in days between final spray and harvest (continued)								
		Apple	Pear	Peach	Cherry	Plum	Blackberry Raspberry	Straw-berry	Grape	Blueberry
pyrethrins	Monterrey Bug Buster-O[d]	0[e]	0[e]	0[e]	0[e]	0[e]	0[d]	0[e]	0[e]	0[e]
spinosad	Monterey Garden Insect Spray[d]	7	7	1	7	7	1[f]	1[f]	7	3
spinosad	Ferti-lome Borer, Bagworm, Tent Caterpillar & Leaf miner Spray	7	7	14	7	7	3	1[f]	7[f]	3

See label for restrictions on application frequency and number of times each crop can be sprayed each season.
nr = Not registered for this use. * Do not apply after petal fall.

[a] List of brand names is not complete and does not imply any preference or discrimination to other products of similar, suitable composition.
[b] Blackberry not on Total Pest Control or Eight label. Raspberry, strawberry and blueberry not on Total Pest Control label.
[c] See label for restrictions on application frequency for Bonide Eight and Bonide Total Pest Control.
[d] NOP-approved for organic production; also OMRI listed.
[e] Do not harvest until spray dries.
[f] Label does not list fruit fly for these crops.

APPLE AND PEAR

Apple and pear trees are subject to serious damage from pests and, as a result, a preventive spray program is needed. The following practices will improve the effectiveness of the pesticides and may lessen the need for sprays.

Sanitation and Cultural Practices

- Plant disease-resistant varieties. This method of disease control is especially important for fire blight, where chemical control options are limited. Varieties resistant to cedar-apple rust, scab and powdery mildew are also available.
- Rake and destroy leaves in the fall, if apple scab, pear scab or pear leaf spot are problems. The organisms that cause these diseases overwinter in infected leaves.
- For cedar-apple rust control, elimination of the source of spores — cedar trees — is effective but not always possible. Removal of the galls caused by the fungus on cedar trees is helpful.
- Pruning trees according to recommendations improves control of all above-ground diseases. In well-pruned trees, air circulation and sunlight penetration are improved. This helps control diseases by promoting rapid drying after rains and dew, and by aiding penetration of sprays into the canopy.
- Prune out and destroy all dead or diseased shoots and limbs during the dormant season. This helps reduce fire blight, fruit rots and certain leaf spots, as the organisms that cause these diseases overwinter in the wood. Removing mummified (dark, shriveled, dry) fruit helps prevent the overwintering of the fruit rot organisms.
- Thin all tree fruits sot that the mature fruits will not touch each other. This spacing provides better coverage of fruit surfaces by the sprays.
- Pruning out fire blight-affected shoots and blossom clusters during the growing season is warranted if it is done just as symptoms are appearing. Otherwise it is best to let the disease run its course.

APPLE

Time to spray	Material to use*	Remarks
Delayed dormant: When buds swell	Oil emulsion plus copper	Oil for aphids, mites and scales. Use copper if a history of fire blight.
Bud break: From ½ inch long green leaves to tight cluster (when blossom buds are just visible)	Captan	For scab control.
Pink: Just before blooms open	Captan or Immunox plus malathion	If cedar-apple rust has been a problem in past, use Immunox in this and the petal fall and first cover spray. Insecticides for plant bugs, or aphids.
Bloom: Begin at early bloom, repeat at 3- to 5-day intervals	Streptomycin Note: To protect bees, do not apply insecticides during bloom!	Only for fire blight control. USE ONLY IF NECESSARY.
Petal fall: When most of petals have fallen	Captan or Immunox plus malathion	Insecticide for plum curculio, codling moth, plant bugs, aphids, or leafroller.
First cover: 7 to 10 days after petal fall spray	Captan or Immunox plus malathion	Insecticide for plum curculio, codling moth, plant bugs, leafroller, leafhoppers or Oriental fruit moth.
Remaining covers: Apply at 2-week intervals until harvest restriction date	Captan plus malathion	For fruit rots and sooty blotch.

* See pesticide labels for rates. Insecticides listed may not be effective against all insects listed.
ALTERNATIVE PRODUCTS: (1) Multipurpose spray (see discussion) can be substituted for all of the above sprays except the dormant and bloom sprays. Note: Multipurpose sprays will not control cedar-apple rust.
(2) For improved disease control, thiophanate-methyl may be mixed with captan.

PEAR - See page 8

PEACH, PLUM AND CHERRY

Peach, plum, cherry and other stone fruits are commonly affected by serious pest problems and, as a result, a conscientious spray program is needed. The following sanitation and cultural practices will improve the chances of success and may lessen the need for sprays.

Sanitation and Cultural Practices

- Prune trees according to recommendations, to allow better air circulation and sunlight penetration. This helps control diseases by promoting rapid drying after rains and dew. Penetration of sprays into the canopy is also better if the trees are well-pruned.
- Remove the overwintering structure for the brown rot fungus, old mummified fruit left hanging in the tree or on the ground.
- Control of black knot of plum and cherry is dependent on removal of the knots before they begin to produce spores. In late winter, prune out and destroy these rough, black swellings or tumors that develop on limbs and twigs.
- Rake and destroy fallen cherry leaves, the overwintering site of the cherry leaf spot organism.
- Avoid planting peach varieties that are highly susceptible to bacterial leaf spot. Examples are Elberta, Halehaven, Rio-Oso-Gem and Sunhigh. Chemical control of this disease is very limited.
- Cherries will need protection from spotted wing drosophila, if present (see BLUEBERRY).

Time to spray or name of spray	Material to use	Remarks
Delayed dormant: When buds swell	Oil emulsion	For aphids, scales and mites
Bloom	Captan Note: To protect bees, do not apply insecticides during bloom!	Captan not needed on peach at this time if good sanitation is used to control brown rot. Needed on plum and cherry if black knot is a problem, but sanitation is required for good control.
Petal fall: When most of petals have fallen	Captan or sulfur or chlorothalonil plus malathion	Insecticides for control of plum curculio, oriental fruit moth, plant bugs and stink bugs.
Shuck split: When flower shucks begin to split, or 7 days after petal fall	Captan or sulfur or chlorothalonil plus malathion	
Cover sprays: Apply at 10- to 14-day intervals	Captan or sulfur plus malathion	Carbaryl is good for beetle and oriental fruit moth control and can be used beginning at second cover spray. Early cover sprays are key for oriental fruit moth control. Permethrin is very effective, but can cause mite problems.
Trunk and main scaffolds sprays: Direct the spray to the bark on May 31, June 30, July 15 (but not within 14 days of harvest). A final application can be applied after harvest.	esfenvalerate or gamma-cyhalothrin	For control of peachtree borer and lesser peachtree borer
Preharvest sprays: 2-3 weeks before harvest and within 1 week of harvest	Captan plus either thiophanate-methyl, Immunox or propiconazole	CRITICAL SPRAYS FOR BROWN ROT CONTROL.
Early dormant: Late fall, after leaf drop	Copper or chlorothalonil or lime-sulfur	Needed on peach for leaf curl and on plum if plum pockets has been a problem.

Notes: Multipurpose spray (see discussion) can be substituted for all of the above sprays except the dormant, bloom, and preharvest sprays. See pesticide labels for rates. Insecticides listed may not be effective against all

insects listed. Malathion may not be labeled for plum. Substitute gamma cyhalothrin for plum curculio control.

GRAPE

Most home grape plantings will require a preventive schedule of pesticides, since certain pests such as black rot can completely destroy a crop of fruit. However, the following sanitation and cultural practices will reduce the need for pesticides.

Sanitation and Cultural Practices

- Keep vines well-pruned according to recommendations, to prevent overgrowth of vines and dense canopy. Pruning promotes air circulation and sunlight penetration, thus more rapid drying after rains and dew. Penetration of sprays into the foliar canopy is also better if the vines are well-pruned.
- Remove mummified berries (shriveled, dry, raisin-like), as they provide an overwintering site for the fungus that causes black rot. Clusters on the vines as well as those that have fallen to the ground should be removed. Also, destroy infected canes that have been pruned off.
- For control of grape root borer, mounding soil makes it difficult for larvae to reach the roots or adults to emerge. Mound some soil 1 foot high for 1½ feet around each vine between early and mid-June. Remove the mounds around Thanksgiving.

Time to spray	Material to use	Remarks
New shoot sprays: Begin when shoots are 4 to 6 inches long, and repeat 7 to 10 days later	Captan or mancozeb plus malathion	Fungicides for black rot and Phomopsis. If powdery mildew has been a problem, add sulfur. Insecticide for grape berry moth, flea beetle, plant bugs and grape phylloxera.
Pre-bloom: When first blossoms open	Captan or mancozeb or Immunox plus malathion	Most damage from black rot occurs from pre-bloom through 4 weeks after bloom. Mancozeb and Immunox are the most effective.
Post-bloom: When most bloom caps have fallen	Captan or Immunox plus malathion	Fungicides for black rot, downy mildew and powdery mildew. Insecticides for grape berry moth, flea beetle, leafhopper and rose chafer.
Cover sprays: 7 to 10 days later, then at 2-week intervals until harvest restriction date	Captan or Immunox plus malathion or carbaryl	Fungicides for black rot, downy mildew and powdery mildew. Insecticides for leaf hopper, berry moth, Japanese beetle, grape root borer. Carbaryl most effective for Japanese beetle.

Notes:

- Multipurpose spray (see discussion) can be substituted for all of the above sprays .
- Malathion EC may cause injury to Ribier, Italia, Cardinal and Almeria varieties.
- Read the pesticide label for the proper rates of chemical to use. Insecticides listed may not be effective against all insects listed.

PEAR

The only disease-control products labeled for use on home pears are copper, sulfur and streptomycin. Apply a copper product at delayed dormant (for control of fire blight) and at pre-bloom, petal fall and the cover sprays (for control of fungal diseases). Copper applied in early cover sprays may cause fruit russetting. Sulfur may be substituted, but is not as effective against fruit rots. The streptomycin bloom sprays for fire blight control and the insecticide sprays may be applied as indicated in the apple schedule.

STRAWBERRY

An intensive, preventive spray program is generally not needed on strawberry. Treatments can usually be made on an as-needed basis. The following sanitation and cultural practices will reduce the need for pesticides. Note: Day neutral strawberries will need protection from spotted wing drosophila, if present (see BLUEBERRY). For a description of strawberry diseases found in Tennessee, see *Strawberry Diseases in Tennessee*.

Sanitation and Cultural Practices

- Bed renovation immediately after harvest is crucial to managing pest problems. Renovation involves narrowing rows, mowing leaves, removing weeds and fertilization. Rake and destroy cut-off leaves and stems after renovation.
- Maintain narrow rows throughout the growing season (maximum 18 inches wide), to maintain good sunlight and air penetration of the canopy. This provides good berry formation and rapid drying after rains and dew.
- Plant varieties with resistance to red stele and leaf spot. See UT Extension publication W018, *Strawberry Diseases in Tennessee*. Where anthracnose is a problem, consider the resistant varieties Delmarvel, Sweet Charlie and Bish.
- Control weeds throughout the growing season. Weeds increase disease by shading the plants and by interfering with air circulation. Weeds also harbor many insect and mite pests.
- Mulch with straw before berries begin to lie on the ground, to reduce gray mold and leather rot (fruit rots).
- Keep fruit picked to avoid attracting sap beetles.

Time to spray	Material to use	Remarks
Pre-bloom: When blossom buds appear in the spring	Carbaryl or malathion	Use as needed for crown borer, strawberry weevil, strawberry leafroller and catfacing insects
Bloom: At early bloom and again at full bloom	Captan Note: To protect bees, do not apply insecticides during bloom!	Needed for gray mold control if weather is rainy during bloom. For powdery mildew (rare), add Immunox.
Post-bloom to harvest: Every 7 to 10 days as needed. Observe harvest restrictions.	malathion plus captan plus, if needed for spider mites: insecticidal soap plus, if needed for slugs: metaldehyde bait	Insecticides for spittlebugs, aphids, strawberry rootworm, whiteflies, tarnished plant bugs and leafrollers. Captan not needed until berries begin to ripen, and then only if weather is rainy. Miticides should be applied 5 to 7 days apart.
Post-harvest: Every 10 to 14 days as needed.	Malathion or carbaryl plus, if needed for leaf blight or anthracnose: captan	Insecticides for root weevils, leafrollers and rootworm.

Notes:

- Multipurpose spray (see discussion) can be substituted for all of the above sprays except the bloom spray.
- Read the pesticide label for the proper rates of chemical to use. Insecticides listed may not be effective against all insects listed.

BLUEBERRY

If diseases have been a problem in the planting in past years, captan can be used at 7- to 10-day intervals from bud break to harvest. Malathion or carbaryl can be used for occasional insect pests, but should not be used during bloom. Repeated use of carbaryl can lead to mite buildup.

The female spotted wing drosophlia (SWD), a recently introduced species to Tennessee, lays eggs in blueberry fruits with its serrated ovipositor. The fruit is damaged by introduced microorganisms and the developing maggot. Protecting blueberry bushes with insect exclusion netting (1mm mesh) may help reduce the chance of an infestation. Sample SWD traps weekly (https://ag.tennessee.edu/EPP/Fruit%20Pest%20News/Volume%2015,%20No.%201%20May%2014,%202014.pdf). Once a spotted wing drosophila is detected, the crop must be sprayed every 7 days from the time the fruit starts to color until harvest. Control is directed only against adults; at present, no control is available against larvae. Recommendations for control or suppression include rotating the use of pesticides with different modes of action so that resistance does not develop. Pay particular attention to the allowable number of times a product can be used during a season. Organic pesticides may have shorter intervals between applications especially after rain since the residual time is short. Cultural control includes harvesting all ripe fruit to eliminate breeding sites. See http://www.fruit.cornell.edu/spottedwing/pdfs/SWDgarden.pdf and related links for more information.

Sanitation Practices

- If mummy berry disease has been a problem, rake the area beneath and around plants to collect or bury any mummified fruits from the previous year's crop.
- To reduce dieback diseases, prune out and destroy dead twigs and branches

Spray guide for use if spotted wing drosophila is found.

Time to spray	Materials to use in rotation	Remarks
From beginning of berry coloration until harvest	spinosad	Can be applied every 6 days with a limit of 6 times per season.
	acetamiprid	Can be applied every 7 days with a limit of 5 times per season.
	pyrethrins	Can be applied every 3 days or less if pest pressure is great, with unlimited applications during the season.

BLACKBERRY AND RASPBERRY

An intensive, preventive spray program is generally not needed on raspberry or blackberry. Treatments can usually be made on an as-needed basis. The following sanitation and cultural practices will reduce the need for pesticides. Note: Berries will need protection from spotted wing drosophila, if present (see BLUEBERRY).

Sanitation and Cultural Practices

- To reduce a source of pests, remove and destroy nearby wild brambles.
- Remove and destroy fruiting canes immediately after harvest.
- Promote rapid drying conditions and good air circulation in the canopy by controlling weeds, keeping the planting properly thinned and not allowing the row width to exceed 2 feet.
- Pick berries regularly during the harvest period so that overripe fruit do not accumulate. This will reduce problems with fruit rots, sap beetles, wasps and fruit flies.
- Destroy canes of cultivated or wild host plants with gall-like enlargements (red-necked cane borer) or wilting canes (raspberry crown borer) in June-July.
- Prune wilted plants 2 or more inches below where the cane is girdled due to raspberry cane borer.
- To control the spread of orange rust of blackberry and black raspberry, remove and destroy infected canes as soon as symptoms appear in the spring.
- Orange rust is recognized by a thin, willowy growth of new shoots, and the presence of orange spore pustules on the undersides of leaves.
- To control the spread of rosette of blackberry, remove and destroy infected canes before blooms begin to open. Rosette is recognized by the presence of clusters of stems on fruiting canes, producing a bunchy appearance. Sepals are extended and pinkish in color.
- Mow everbearing raspberry varieties after fall harvest to reduce disease carryover. This method produces a single, fall crop the following year.

Time to spray	Material to use	Remarks
Early to mid-bloom	Copper (anthracnose, blackberry rosette, raspberry leafspot) or Immunox (raspberry leafspot, blackberry orange rust, powdery mildew) or sulfur (rusts, powdery mildew) Note: To protect bees, do not apply insecticides during bloom, if possible. Malathion	Apply these materials only if needed, based on occurrence of these pests in prior years or currently observed. Direct insecticide below blooms, if used when blooms are present.
Post-bloom: 3 to 4 additional applications at 2-week intervals. Observe harvest restrictions.	Same as above.	Same as above. Do not make more than 4 applications of Immunox per year. If mite control is needed, apply malathion or insecticidal soap every 5 to 7 days.

IMPORTED FIRE ANT BAITS

There are two approaches to managing fire ants in home fruit plantings. Two insect growth regulator baits, Extinguish Professional Fire Ant Bait and Esteem Ant Bait, are labeled for use within the fruit planting. Esteem is not labeled for caneberries such as blackberry and raspberry. Fertilome Come and Get It Fire Ant Killer (spinosad) lists most crops including, but not limited to, tree nuts, stone fruit, tree fruits, etc. Amdro Pro fire ant bait can be used in grapes and blueberries when applied in bait stations. Other fire ants baits, such as Advion, Amdro, Ascend, Award, Distance, Extinguish Plus and others, can be applied to home lawns adjacent to the planting. Fresh bait should be applied when the ground is dry and rain is not expected, preferably for the next 24 hours. Apply baits when fire ants are actively foraging, preferably when the temperatures are in the 70s and 80s.

See Fire Ants in Tennessee web site, http://fireants.utk.edu or the eXtension web site at http://www.extension.org/fire+ants for more information on fire ant management.

DISEASES OF TREE FRUITS

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Refer to the manufacturer's label and to the spray guides in this publication for information on chemical rates, timing of sprays, resistance management strategies, preharvest intervals, and other restrictions.

Apple Diseases

Disease, Symptoms	Control
Apple Scab Velvety, olive-green leaf spots that later become metallic black and may be puckered; leaves fall from tree. Fruit are scabby, deformed and cracked.	Chemical*: The most effective materials are captan, Flint, Pristine, Indar, Inspire Super, Rally, Procure, Sovran, Fontelis, Merivon, Luna, and Vangard. Early-season sprays are most important. Cultural: Fungus overwinters on fallen leaves and fruit. Rake up and destroy them. Plant scab-immune varieties.
Bitter Rot Small brown spots on the fruit enlarge rapidly becoming sunken and tan to dark brown. Concentric rings of spores are sometimes present. The fruit infection appears "V" shaped in a cross-section cut.	Chemical*: The most effective materials are captan, Inspire Super, Merivon, and Ziram. Summertime sprays are most important. Cultural: Remove mummified fruit, dead wood and fire-blighted twigs. Removal of newly-infected fruit from trees will aid in control.
Black Rot (Frogeye Leaf Spot) Leaf spots are purple with tan centers. The 1/8 inch spots are referred to as frogeye leaf spot. On the fruit, the lesions are dark, often black, firm and not sunken. Infected fruit mummify and often remain attached to the tree.	Chemical*: Captan is the most effective material. Tank-mixing with Topsin M improves effectiveness. Summertime sprays are the most important. Cultural: Remove mummies, dead wood and fire-blighted twigs. Destroy these prunings.
Cedar-Apple Rust Small, yellow spots develop on leaves in spring. These spots gradually enlarge and turn orange. Later, black dots appear in the spots on the upper surface, and tube-like protuberances on the lower surface. Severe infection results in heavy defoliation. Fruit lesions appear near the calyx end and are similar to the leaf lesions.	Chemical*: The most effective materials are Indar, Inspire Super, mancozeb, Rally, Procure, Fontelis, Merivon, Luna, and Ziram. Needed in springtime, between early April and mid-May. Cultural: Overwinters on cedar trees. Removal of nearby cedar trees is helpful, but not always possible. Consider resistant varieties.
Collar Rot Dark coloration of wood at or below the ground line in the root-crown area, sometimes extending up the trunk. Leaves may be small and yellow in summer. Symptoms are same for other root problems, and isolation of fungus often required for positive diagnosis.	Chemical*: Ridomil Gold EC applied to the soil will protect healthy trees and provide some relief to lightly-infected trees. Cultural: Fungus is soil-borne. Select well-drained soil for planting and request rootstocks with resistance if collar rot is anticipated. Avoid MM 106.

Apple Disease, Symptoms	Control
Fire Blight Shoots blight from tip downward; leaves turn brown (apple) or black (pear). Shoot tip bends, resembling shepherd's crook. Blossoms wilt suddenly and turn brown. Limb and trunk blight occur when the infection moves downward from infected shoots or fruit spurs into larger branches on the trunk.	Chemical*: Apply streptomycin sulfate during bloom period only, every 3 to 5 days. Alternate with Kasumin for best results. A late dormant application of a fixed copper spray or Bordeaux mixture is helpful. Streptomycin sprays are not effective after the bloom period. Fixed copper sprays during the growing season are helpful, but are not recommended if fruit are present because of the risk of russet. Cultural: Plant resistant varieties (refer to SP277R, "Fire Blight"). Avoid excessive nitrogen fertilizer applications. Cankers and blighted shoots should be pruned out before the growing season begins. Refer to SP277R for pruning procedures.
Powdery Mildew On leaves, the fungus appears as whitish, felt-like patches that spread and engulf the entire leaf. Infected leaves are narrower than normal, folded and stiff. Infected fruit have a netlike russeting.	Chemical*: The most effective materials are Flint, Indar, Inspire Super, Pristine, Rally, Procure,Merivon, Luna, and Sovran. Topsin M and sulfur are also effective. The most important sprays are the springtime sprays, beginning at tight cluster. Cultural: The fungus overwinters on buds infected the previous summer. Many varieties are resistant.
Sooty Blotch and Fly Speck This condition does not harm the fruit, but is unsightly. Sooty blotch appears as superficial sooty or cloudy blotches on the surface of the fruit. Fly speck appears on fruit as sharply defined, black, shiny dots in groups of a few to 100 or more.	Chemical*: The most effective materials are Flint, Sovran, Pristine, Topsin M, and Ziram. Captan is also effective. Sprays are needed during the summertime. Cultural: These fungi overwinter on twigs of many woody plants. Apple fruit infections are most numerous during the summer. Follow spray schedule and good pruning practices to allow air, sunlight and spray penetration of the canopy.
White Rot (Bot Rot) Fruit rots show up late but develop rapidly, beginning as tan or red spots. In cross section, the rot is cylindrically shaped, extending to the core. The rot may involve the entire fruit and, on green varieties, is tan in color with concentric rings. Branch cankers become tan to orange and papery.	Chemical*: Captan is the most effective material. Tank-mixing with Topsin M improves effectiveness. Summertime sprays are the most important. Cultural: The fungus overwinters in bark and in limb cankers. Fire-blighted branches can be readily colonized by this fungus. Remove and destroy all dead branches and twigs. Practice proper pruning.

Peach and Nectarine Diseases

Disease, Symptoms	Control
Brown Rot, Blossom Blight The most noticeable phase is the fruit rot phase. Small, circular, brown spots enlarge rapidly and become covered with ash-gray tufts or spores. Fruit shrivel and mummify. Shoots can sometimes become infected and die. Infected blossoms wilt and turn brown.	Chemical*: The preharvest and harvest periods are critical. Beginning at two to three weeks prior to harvest, use a sterol inhibitor (Elite, Indar, or Orbit/PropiMax) alternated with a strobilurin (Abound, Flint, or Pristine) or with a Group 7 (Merivon, Fontelis). Captan tank mixes help prevent fungal resistance development. Homeowners can use Immunox plus captan. Cultural: The fungus overwinters in mummified fruit and in cankers. Remove all mummies and blighted twigs from trees after last picking. Follow spray schedule with emphasis on the preharvest period. Control insects that injure the fruit. Keep fruit cool after picking.
Bacterial Spot Leaf spots are small and brown, black or red, more numerous at the leaf tips. The centers of the leaf spots fall out, creating a "shothole" effect. Infected leaves may turn yellow and fall to the ground. Fruit sometimes develop dark pits in the skin.	Chemical*: The most effective materials are fixed coppers and Mycoshield/Flameout/FireLine**.** Chemical control is limited. **The use of coppers after petal fall may cause burn.** Cultural: Use of resistant varieties is the primary method of control, and is highly recommended. Adequate fertility is important in minimizing the effects of this disease.
Peach Leaf Curl Infected leaves are thickened, curled and puckered and often flushed with red or purple. Affected leaves appear in spring and drop from tree.	Chemical*: A single spray, using the correct material, will provide nearly perfect control, if applied before bud swell. After bud swell, the disease cannot be controlled. The most effective materials are chlorothalonil, thiram, and Ziram.
Peach Scab Spots on the fruit are small, dark and circular. These spots usually do not begin to appear until the fruit are well grown, and tend to be concentrated at the stem end. The skin may toughen and crack. Forty to 70 days elapse from the time the spore lands on the fruit until the spots appear.	Chemical*: The most effective materials are Abound, Adament, captan, chlorothalonil, Gem, and Topsin M. Begin sprays at shuck split and repeat every 10 to 14 days until 40 days before harvest. The fungus overwinters in twig lesions. Spores are most abundant two to six weeks after the shuck split stage of development.

Cherry Diseases

Cherry Leaf Spot Small, circular, purple spots on leaves. Only a few lesions per leaf can cause the leaves to turn yellow and fall. The fruit on trees severely defoliated by leaf spot fail to mature properly and are soft and watery.	Chemical*: Apply captan, Gem, Indar, Pristine, Rally, or Adament, beginning at petal fall and repeating at 10-to 14-day intervals until harvest. Rotate classes. Homeowners can use captan or Immunox. Cultural: The fungus overwinters in infected leaves on the ground. Rake and destroy fallen leaves.
Black Knot Elongated swellings or knots on limbs twigs or trunk. The swellings may be less than an inch to over a foot long. Newly formed knots are greenish and soft but become hard and black with age. Affected limbs die.	Chemical*: Apply captan, beginning at pink and repeating at 10- to 14-day intervals until terminal growth stops. Chemical control is only a supplement to the pruning practices below. Cultural: The fungus overwinters in the knots, and spores are discharged from the pink stage of blossom bud growth until terminal growth stops. Prune out knots and destroy. Since the fungus may have extended beyond the swelling, make cuts well below visible infection.
Brown Rot, Blossom Blight See "Peach."	See "Peach."

Pear Diseases

Disease, Symptoms	Control
Fire Blight See “Apple.”	See "Apple." Also see SP277R, and avoid planting highly susceptible varieties.
Pear Scab Caused by a different fungus from apple scab fungus. Symptoms are similar, but twig infections can also occur.	Chemical*: Ferbam, Flint, Sovran, Pristine, Fontelis, Inspire Super, Merivon, Scala, Topsin M, Vangard and Ziram can be used on pear, and a regular spray schedule, as for apple, is needed for control. Mancozeb can also be used, but not within 77 days of harvest. NOTE: Captan is not labeled for use on pears. HOMEOWNERS: Neither mancozeb nor 3336 can be used on residential pear trees. Copper and sulfur products are the only fungicides labeled for use on residential pears. Cultural: Rake and destroy fallen leaves, on which the fungus overwinters.
Fabraea (Entomosporium) Leaf Spot Spots can occur on leaves, shoots and fruit spots are at first purplish-black dots, becoming circular, brown lesions about 1/8 inch in diameter.	Chemical*: The fungus overwinters on twig cankers and on fallen leaves. Mancozeb is the most effective fungicide, but has a 77-day preharvest interval. Ferbam, Flint, Sovran, Pristine, Topsin M, and Ziram are also effective. Cultural: Rake and destroy fallen leaves.

Plum Diseases

Black Knot See "Cherry."	See "Cherry." Avoid planting highly susceptible varieties such as Damson, Stanley, Bluefree and Shropshire.
Brown Rot, Blossom Blight See "Peach."	See "Peach."
Bacterial Spot Can be a severe problem on Japanese plums; American and European plums are less susceptible. See "Peach" for symptoms.	See "Peach." Avoid planting highly susceptible varieties such as AU Frontier, AU Rosa, AU Rubrum, Frontier, Methley and Santa Rosa. Some Japanese plum varieties are resistant.

*Refer to the manufacturer’s label and to the spray guides in this publication for information on chemical rates, timing of sprays, resistance management strategies, preharvest intervals, and other restrictions.

DISEASES OF SMALL FRUITS

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Blackberry Diseases

Disease, Pathogen, Symptoms	Control
Anthracnose *(Elsinoe veneta)* This disease can be severe on thorned blackberries grown in Tennessee. Leaf spots are roughly circular with a light gray center and a reddish-purple margin. On the berry, individual drupelets become purplish brown and sunken after infection. They eventually become dry and scabby. The most damaging phase of anthracnose in Tennessee is the berry phase.	Chemical*: Apply Abound, Cabrio, Pristine, or captan before bloom and repeat at 7- to 14-day intervals through harvest. Make no more than two consecutive applications of Abound, Cabrio, or Pristine before rotating to a non-related fungicide such as captan or copper. Cultural: Destroy nearby wild brambles. Plant in well-drained site and allow good air circulation by spacing plants and controlling weeds. Remove and destroy fruiting canes immediately after harvest.
Cane Blight *(Leptosphaeria coniothyrium)* Cane blight appears only on fruiting canes; infection occurs on primocanes near the end of the growing season. It seems to be most severe when drought stress occurs after widespread infections take place. Cankers form on the cane, often at the nodes, and extend down or encircle it, causing lateral shoots to wilt and die.	Chemical: No fungicides have been identified for this purpose, but late-season applications of basic copper sulfate may be helpful. See label for directions. Cultural: See anthracnose.
Crown Gall *(Agrobacterium tumefaciens)* Wartlike growths (galls) appear on the roots or crowns of infected plants. Gall may range in size from that of a pinhead to several inches in diameter. Plants are weakened and yield dry, poorly developed berries. Galls are caused by bacteria present either in the soil or on planting stock. The bacteria enter the plant only through wounds or growth cracks.	Chemical: None is effective after infection takes place. Cultural: Obtain clean planting stock from a reputable nursery and inspect the roots and crowns for galls. Do not plant in fields with a history of crown gall. Avoid fields previously planted with brambles, grapes, tree fruits or other highly susceptible hosts. The practice of mowing black-berry plants after harvest can cause crown gall problems because of damage to the roots and crowns.
Orange Rust (*Kunkelia nitens*) Orange rust can be a destructive disease trailing blackberries and purple and black raspberries. Most of the erect blackberry varieties grown in Tennessee are resistant. This disease is caused by a fungus that grows systemically through the plant. The new leaves on infected plants are weak, spindly, and yellowish. Later, the undersides of the leaves show visible orange, blisterlike pustles, which release spores. Canes appear to recover in late summer, but are still diseased and will not bear fruit the following year.	Chemical: Apply Abound, Cabrio, Pristine, or Rally beginning in early spring and continue at 10- to 14-day intervals until early summer. Homeowners may use sulfur. These fungicides will not help systemically-infected plants. Cultural: Careful inspection in spring and immediate removal of infected plants is the most important practice for controlling orange rust. Dig up infected plants, roots and all, and burn them. Once the spores are produced, they can cause new infections that may not appear until the following spring. Remove and destroy all nearby wild brambles. Plant resistant varieties.

Rosette *(Cercosporella rubi)* Rosette, or double blossom, can be the most destructive disease of blackberries if allowed to increase after its initial appearance in a planting. "Witches' brooms," broomlike clusters of foliage, arise from buds infected the previous year. Blossoms borne on the bunchy growth fail to bear fruit. Infected blossoms have elongated sepals and wrinkled petals. These blossoms are the sole source of inoculum, which infects new canes. Heavily infected plants are weakened and may die.	Chemical*: Alternate Pristine with Switch every 10 to 14 days from early bloom through harvest. If rosette blooms are still present after harvest, fixed copper or Bordeaux mixture can be used, but can cause plant damage in hot weather. Cultural: Remove rosettes (infected blossom clusters) before they open. Use only roots, not plants for planting stock. Remove and destroy nearby wild brambles. Plant resistant varieties.
Sterility The cause of blackberry sterility is not fully understood, but may be a virus. Affected plants grow vigorously, but they either fail to set fruit or produce few-seeded berries.	Chemical: None. Cultural: Remove and destroy plants that fail to set fruit. Plant only certified, disease-free planting stock. Destroy nearby wild brambles.

Blueberry Diseases

Anthracnose *(Colletotrichum gloeosporiodes)* Also called "ripe rot." Infected berries remain symptomless until maturity, when the infected area becomes slightly sunken. Masses of salmon-colored spores are exuded to the surface.	Chemical: The spray schedule used for mummy berry control will help in controlling anthracnose. Include Abound, Cabrio, Pristine, or Switch where anthracnose problems are expected. Captan can also be used. Cultural: Prune out and destroy blighted twigs, on which the fungus overwinters.
Mummy Berry *(Monilinia vaccinii-corymbosil)* As berries approach maturity, they become light pinkish to cream colored and drop to the ground as mummified fruit. Blighting of leaves, shoots, and flowers can occur. The fungus overwinters on the ground in mummified berries.	Chemical*: Orbit, Tilt, Pristine, and Indar are the most effective materials. Indar should be tank mixed with captan to prevent rots. Make up to four applications, beginning at green tip and repeat at 7- to 10-day intervals through petal fall. Do not apply Pristine more than twice consecutively. Cultural: Where mummy berry is a problem, early spring cultivation will aid in control by covering the overwintered berries.
Stem Blight *(Botryosphaeria dothidea)* One or more branches exhibit yellowed or reddened leaves, followed by death of the branch. Stems show brown discoloration of woody tissue, often only on one side of the stem. Penetration into the plant is primarily through wounds.	Chemical: None. Cultural: Pruning during coldest and driest winter months may reduce infections, since inoculum is at lowest levels during the winter. Avoid nitrogen applications after June, to allow shoots to harden before winter.
Twig Blight *(Phomopsis vaccinii)* Infection occurs in flower buds, and advances down the stem 2 to 6 inches, causing a dieback of the flower bearing stems. The fungus overwinters in twigs infected the previous year.	Chemical: The spray schedule recommended for mummy berry would help in controlling twig blight. Indar (plus captan), Cabrio, Pristine, and ziram are the most effective materials. Cultural: Prune and destroy discolored twigs during dormant pruning and summer.

Grape Diseases

Disease, Pathogen, Symptoms	Control
Anthracnose *(Elsinoe ampelina)* Also known as "bird-eye rot" because of the dark margin around the gray-colored spot on the fruit, this disease is usually confined to certain highly susceptible varieties such as Vidal blanc. Numerous spots may occur on shoots, leaves, tendrils, petioles and fruit stems.	Chemical*: On anthracnose-susceptible varieties, liquid lime-sulfur applied during dormant season is helpful. During growing season, apply Pristine alternated with captan. Other fungicides may be needed for other diseases. Cultural: Destroy pruned canes and clusters during dormancy.
Bitter Rot *(Greeneria uvicola)* Can be severe on certain varieties, such as Catawba. The fungus enters the berry from the stem, and a grayish discoloration of the berry begins on the stem side. The appearance of tiny black fungal fruiting bodies and a shriveling of the berry into a hard, dry mummy can cause this disease to be mistaken for black rot.	Chemical*: Include captan, Abound, Flint, Pristine, or Sovran in late-season sprays. Control is needed in the weeks before harvest, but heed preharvest intervals for the fungicides. Cultural: Destroy prunings and mummified berries.
Black Rot *(Guignardia bidwellii)* Very common and highly destructive. Berry symptoms begin as light brown, circular spots which rapidly discolor the entire berry. The berries shrivel to hard, black wrinkled mummies. Leaf spots are reddish-brown with dark margins. Dark spots form on green stems and tendrils.	Chemical*: The most effective fungicides are Abound, Elite, Flint, ferbam, mancozeb, Rally, Sovran, and Ziram. Captan is also effective. The key spray times are immediately before bloom, at post-bloom, and 10 days later. Sprays prior to or after that period are also helpful. Cultural: Destroy prunings and mummified berries.
Crown Gall *(Agrobacterium vitis)* Knots form on roots, crowns and sometimes, on canes. These galls may grow to several inches in diameter. The amount of damage to the plant varies from none to death of the plant. Winter-injured vines frequently become infected.	Chemical: None. Cultural: Plant winter-hardy varieties, avoid sites with a history of crown gall and avoid injuries to the canes.
Eutypa Dieback (Dead Arm) *(Eutypa lata)* Occurs only in older grapevines because infections develop slowly. Symptoms consist of dying arms and yellowed, cupped leaves on new growth in the spring. Leaves develop small necrotic spots and tattered margins. Infection occurs on trunk and main branches through pruning wounds. Spores are present throughout the year.	Chemical: No registered products protect pruning wounds from infection. Cultural: Avoid pruning during and before wet weather, and make clean, close cuts to encourage callusing. Identify infected plants in spring and remove and burn infected canes when weather is not rainy.
Downy Mildew *(Plasmopara viticola)* Light yellow spots form on upper sides of leaves, and a white, moldy growth is very noticeable on the undersides of the leaves. The affected leaves eventually become dry, brown and crumpled, and fall. Defoliation can be severe on some varieties in wet seasons.	Chemical*: Abound, captan, copper plus lime, Presidio, Pristine, Ranman, Ridomil Gold Copper, Flint, Sovran, Tanos, and Zampro are the effective materials that can be applied in mid- to late-season, when downy mildew is active.

Phomopsis Cane and Leaf Spot (*Phomopsis viticola)* Infected leaves have tiny, dark spots and are often puckered. Stems also show dark lesions. Infected berries form tiny pimple-like structures on the surface. These structures also form on the stems, which often turn light gray to white in winter.	Chemical*: Captan, mancozeb, and Pristine are the most effective materials. Applications should begin shortly after bud break and continue through fruit set. Cultural: Destroy prunings during dormant period.
Powdery Mildew *(Uncinula necator)* This disease usually does not significantly damage the American varieties. However, many of the vinifera varieties show a high degree of susceptibility. It appears as a white powdery growth on the leaves and berry clusters. Severely affected leaves turn brown and fall.	Chemical*: Abound, Elite, Flint, Nova, Pristine, Procure, Rubigan, Sovran, sulfur, and Topsin M are the most effective materials.

Raspberry Diseases

Disease, Pathogen, Symptoms	Control
Crown Gall *(Agrobacterium tumefaciens)* Refer to crown gall of blackberries.	Same as for blackberry.
Gray Mold *(Botrytis cinerea)* In wet seasons, gray mold can cause a significant loss of flowers and fruit. Blossoms may show a blasting that may extend down the pedicel. Infected berries become covered with a gray, dusty fungal growth. Mature berries are more susceptible than young ones. Berries sometimes do not show gray mold until after harvest; they can quickly become a rotted mass in storage.	Chemical*: Apply Elevate, Pristine, Switch, Rovral or Ronilan at early bloom and full to late bloom. Additional applications may be made, as allowed by the label. Cultural: See Septoria leaf spot, below. Also, avoid excessive nitrogen fertilizer applications. Pick fruit frequently and early in the day as soon as plants are dry. Handle berries with care to avoid bruising.
Late Leaf Rust *(Pucciniastrum americanum)* This disease can occasionally be damaging to some varieties of red raspberries, although it occurs late in the season. This rust does not occur on black raspberries or blackberries. Small pustules filled with powdery yellow spores (not waxy like orange rust pustules) form on the underside of leaves. These spore masses can also occur on petioles, canes and berries. Badly infected leaves drop prematurely.	Chemical: Nova, Abound, Pristine, or Cabrio may be helpful. Cultural: The single-crop system of producing everbearing varieties should help control, because this fungus is thought to overwinter on raspberry canes.

Septoria Leaf Spot *(Septoria darrowii)* This is one of the most destructive raspberry diseases in Tennessee. Septoria can cause almost total leaf loss, especially on highly susceptible varieties such as Bababerry. Heritage seems to have some tolerance. Leaf spots have a tan to gray center surrounded by a thin, brown to purple border. The spots are circular and about 1/8 inch in diameter. Leaf spots caused by Septoria are similar to anthracnose leaf spots on raspberry or blackberry. Septoria leaf spots have tiny, black fruiting bodies in the center.	Chemical*: Apply Abound, Cabrio, Pristine, Rally, captan, Tanos, or fixed copper. A 10- to 14-day schedule may be needed throughout the growing season, if weather conditions remain favorable for disease (warm, wet). Cultural: Remove and destroy fruiting canes immediately after harvest. Keep the planting properly thinned and control tall weeds.
Phytophthora Root Rot (*Phytophthora* spp.) This disease is usually associate with heavy soils or portions of the planting that are the slowest to drain. Affected plants may show a general lack of vigor, or they may decline and die. The tissue underneath the epidermis on the main roots and crown is a brick red (later turning brown), rather than a normal white.	Chemical*: Ridomil Gold EC can be applied to the soil in the spring and fall, and Aliette can be applied to the foliage up to 4 times per year. These chemical controls are not very effective if the cultural controls below are not followed. Cultural: Plant only on well-drained sites. Planting on raised beds is helpful, and is important if drainage is occasionally inadequate. Avoid planting highly susceptible varieties.
Viral Diseases (Tomato Ringspot Virus, Mosaic, Leaf Curl) Virus diseases are a major problem in raspberries in the northern United States, but are relatively minor in Tennessee, presumably because of a lack of the proper vectors (carriers). The viruses seen in Tennessee are probably mosaic (a virus complex) and tomato ringspot.	Chemical: None Cultural: Plant only certified, virus-indexed stock. Destroy nearby wild or neglected brambles. Do not plant black or purple raspberries near red raspberries, because reds can tolerate mosaic and act as a reservoir of inoculum which will spread to the black raspberries, if the proper aphid species are present.

Strawberry Diseases

Disease, Pathogen, Symptoms	Control
Anthracnose (*Colletrotrichum acutatum* and others) Fruit lesions are firm, slightly sunken, and may be tan, black, or natural color. Dark, sunken lesions form on all stem structures: stolons, petioles, and pedicels. Crown infections can result in the wilting and death of older plants. Daughter plants often turn dark and die before pegging down.	Chemical*: Follow the gray mold program during bloom, with captan or thiram added to each spray. NOTE: The strobilurins (Abound, Cabrio, Pristine) are limited to 5 applications per crop, either individually or collectively. For this reason, beware of using the strobilurins during bloom, in order tosave the allotment for the critical harvest period. During harvest, apply captan, Switch, Abound, Pristine, or Cabrio frequently, to control the fruit rot phase. Abound, Pristine, and Cabrio must be rotated with non-strobilurin fungicides. Control of the vegetative, (runner) phase in matted-row plantings is difficult. Cultural: Buy plants from anthracnoe-free nurseries. Mulching helps prevent spread. Delmarvel and Sweet Charlie have good resistance.
Gray Mold *(Botrytis cinerea)* A common fruit rot disease that can be very destructive in wet seasons. Gray mold often starts as a blossom blight and continues as a rot of green and ripe fruit. Many fruit infections begin when the fungus enters blossoms and remain latent until fruit begin to mature. In wet weather, diseased plant parts are covered with fuzzy brown to gray masses of fungal spores. Berries become more susceptible as they mature, and gray mold may continue to develop after harvest, becoming a rotted mass.	Chemical*: To avoid resistance problems, choose any 3 of the following 4 fungicides and apply them in any order at weekly intervals during bloom: Elevate, Switch, Scala, or Pristine. Another choice would be captan or thiram (no resistance management needed). Since thiram provides deer and rabbit repellence, it would be preferable over captan where these pests are a problem. Effective control of the berry phase depends on a good spray program during bloom. Cultural: Select a well-drained planting site. Renovate matted-row planting properly to thin plants. Avoid excessive nitrogen fertilizer rates. Mulch to reduce fruit contact with soil. In plasticulture plantings, remove winter-killed leaves before bloom period. Pick berries frequently and refrigerate promptly.
Common Leaf Spot *(Mycosphaerella fragariae)* The most common strawberry leaf disease in Tennessee; leaf spot can be severe on certain varieties. Most varieties show some leaf spot, but no real damage. Lesions are circular, 1/8 to 1/4 inch in diameter, and are purple with a white, gray or tan center. Favored by cool, wet weather.	Chemical*: Apply Topsin M plus captan or thiram on susceptible varieties, beginning in early spring. Repeat at 10- to 14- day intervals until summer. Also needed in fall. Rally is very effective, but is not as broad spectrum. Cultural: Plant resistant varieties. Use certified plants and select a well-drained site. Renovate properly to avoid overly-dense plantings, and do not over-fertilize.
Leaf Scorch *(Diplocarpon earliana)* Round to irregular, purple spots up to 1/4 inch in diameter form on the leaf surface. If the spots become numerous, large areas of the leaf become reddish-purple to brown and the entire leaf may turn brown and die. Not often seen in Tennessee.	Chemical: Same materials as for leaf spot. Control needed during summer. Cultural: Same as for leaf spot.

Disease, Pathogen, Symptoms	Control
Leaf Blight *(Phomopsis obscurans)* Spots are often irregular in shape, brown with a purple border, becoming large, V-shaped areas. Leaf blight is a hot-weather diseasel. Older leaves may become blighted and die in large numbers.	Chemical: Same as for leaf spot. Cultural: Same as for leaf spot.
Leather Rot *(Phytophthora cactorum)* This fruit rot occurs sporadically, but can occasionally cause economic losses. Disease development is very dependent on wet weather. Infected berries are light to dark brown, becoming tough and leathery. In early stages of disease development, infected ripe fruit are softer than healthy ones.	Chemical*: Apply Ridomil Gold EC at fruit set, or Aliette, Cabrio, or Abound at 7-14 day intervals, beginning at bloom. Captan, applied as for gray mold control, is adequate for light cases of leather rot. Cultural: Select a well-drained planting site, and mulch to prevent fruit contact with soil.
Powdery Mildew (*Sphaerotheca macularis*) Particularly severe in greenhouses and in tunnel production. Leaf edges curl upward, with reddish-purplish discoloration. Patches of white, powdery fungus mycelium may appear on leaves. Fruit set may be poor and immature fruit becomes hard and fails to ripen normally.	Chemical*: On susceptible varieties in perennial culture, applications may be needed throughout the growing season, beginning at early bloom. For plasticulture, begin shortly after planting in fall. Rally, Procure, Quintec, or sulfur may be used at 14- to 21-day intervals.
Red Stele *(Phytophthora fragariae)* Red stele is not as common as it once was, because many of today's varieties are resistant to it. It is caused by a soil-borne fungus that is most damaging in heavy, wet-natured soils. Plants first appear stunted and dull in color, then wilt and eventually die. Roots decay and show reddish or brown cores (steles). Roots become devoid of lateral rootlets, giving them a rat-tailed appearance.	Chemical*: Apply Ridomil Gold EC before bloom and again in the fall. Aliette can be applied when growth begins and repeated at 30-60 day intervals. Cultural: Avoid sites having low-lying, clay soils. Plant on raised beds. Purchase certified disease-free plants of resistant varieties. Do not plant in fields with a history of red stele. The causal fungus can remain in the soil up to 13 years.
Verticillium Wilt *(Verticillium albo-atrum)* This disease does not occur frequently on strawberries in Tennessee. Most of the varieties grown are resistant to it. This disease is favored by cool weather. The symptoms are similar to those for red stele, except Verticillium does not cause red discoloration in the roots.	Chemical: Preplant fumigation. Cultural: Adequate control can be obtained without fumigation by planting resistant varieties and avoiding sites planted to susceptible crops such as tomato, potato, eggplant, okra and pepper.

*Refer to the manufacturer's label and to the spray guides in this publication for information on chemical rates, timing of sprays, resistance management strategies, preharvest intervals, and other restrictions.

Commercial Pecan Disease Control Guide

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Time of Application	Disease	Product Choices	Rate/acre	Remarks
First Prepollination When first buds have opened.	Scab, downy spot	Abound 2F or Enable 2F or Headline 2F or propiconazole 3.6F or Quadris Top or Quash 50WG or Quilt 1.66F or Sovran 50WG or Stratego 2F or Super Tin 80WP or tebuconazole 3.6F or Topsin M 70WP	12 fl oz/acre 8 fl oz/acre 6-7 fl oz/acre 4-8 fl oz 10-14 fl oz 2.5-3.5 oz 14-27.5 fl oz 2.4-3.2 oz/acre 10 fl oz/acre 5-7.5 oz/acre 4-8 fl oz/acre 1 lb/acre	Do not make more than 2 consecutive applications of Abound, Headline, Stratego, or Sovran before alternating to a non-strobilurin fungicide. Topsin M should be alternated with other fungicides. Note: No dodine products are currently registered in Tennessee.
Second Prepollination 14 days after First Prepollination spray	Scab, downy spot	Same fungicides as above.		The first two sprays are very important for scab control.
First Cover Spray When young nuts first appear.	Scab, downy spot	Same fungicides as above.		If using Sovran, the rate increases to 3.2-4.8 oz.
Second Cover Spray 2 to 3 weeks after first cover spray.	Scab, leaf blotch, brown leaf spot, powdery mildew	Same fungicides as above.		Sulfur (3 lb per acre) can be added to most fungicides for improved powdery mildew control.
Third Cover Spray 2 to 3 weeks after second cover spray.	Scab, leaf blotch, brown leaf spot, powdery mildew	Same fungicides as above.		Apply cover sprays at 2-week intervals in rainy weather, 3-week intervals if dry conditions exist.
Fourth Cover Spray 2 to 3 weeks after third cover spray.	Same as third cover spray.	Same fungicides as above.		
Fifth Cover Spray 2 to 3 weeks after fourth cover spray.	Same as third cover spray.	Same fungicides as above.		
Sixth Cover Spray 2 to 3 weeks after fifth cover spray.	Same as third cover spray.	Same fungicides as above.		Do not apply fungicides after shucks have started to open.

Homeowner Pecan Spray Guide

Time of Application	Pest Controlled	Pesticide	Remarks
1st Spray - Budbreak	Scab Phylloxera	Thiomyl malathion, Merit 75WP, or Merit 2F	1st Spray is key for Phylloxera control.
2nd Spray - 14 days later	Same as 1st Spray	Same as 1st Spray	Early sprays are key for scab control.
3rd Spray - 3 weeks later	Scab Pecan nut casebearers, aphids and spittlebugs	Same as 1st Spray	Use insecticide only if the stated insects are present. Merit not for pecan nut casebearers.
4th Spray - 3 weeks later	Scab and other leaf & nut diseases Aphids, spittlebugs	Same as 1st Spray	Use insecticide only if the stated insects are present.
5th Spray - 3 weeks later	Scab and other leaf & nut diseases Aphids, spittlebugs	Same as 1st Spray. Omit fungicides if no nuts present.	Use insecticide only if the stated insects are present.
6th Spray - 3 weeks later	Same as for 5th Spray plus fall webworm, shuckworm, & pecan weevil*	Thiomyl if nuts present malathion carbaryl if history of pecan weevil*	Do not apply Thiomyl after shucks have started to open. *For weevil control, make an additional application of carbaryl between the 6th and 7th sprays.
7th Spray - 3 weeks later	Fall webworm, black aphid, and pecan weevil	malathion carbaryl if history of pecan weevil	Merit can be used for black aphid only.