



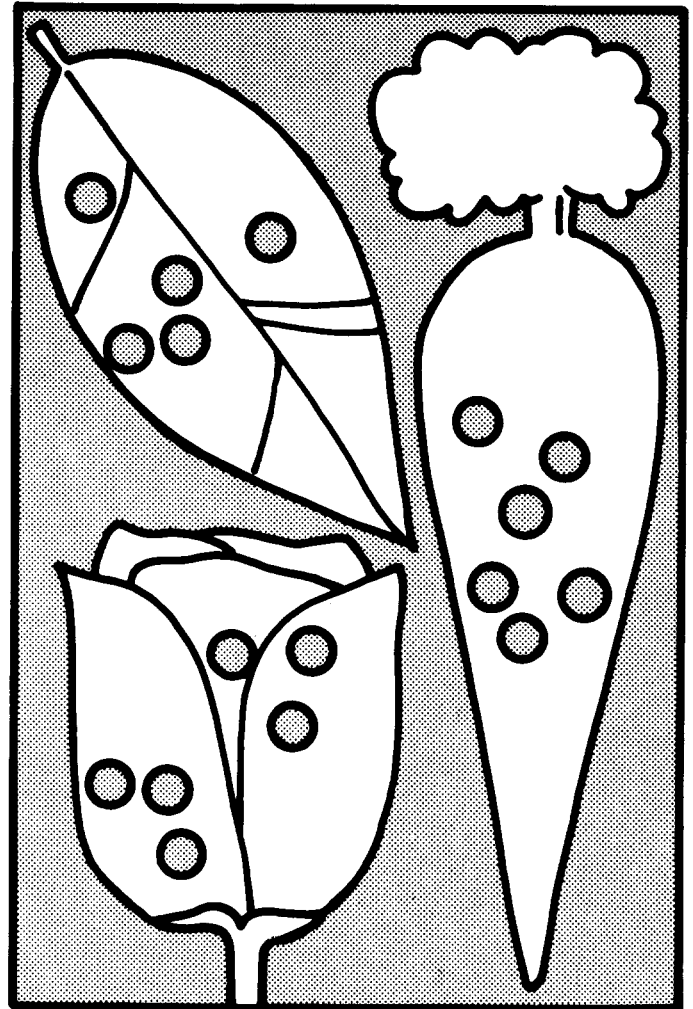
# Plant Disease Management in the Home Garden

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Diseases kill or defoliate home garden vegetable, fruit, and ornamental plants every year. Disease losses can be reduced by following some proven disease management practices: (1) select disease resistant varieties adapted to your area, (2) use transplants that are free from disease, (3) rotate garden areas so the same or closely related vegetables are not grown in the same area each year, (4) control weeds, (5) control insects that may carry disease, (6) remove and destroy diseased plants and plant parts, (7) clean up or destroy plant refuse right after harvest, (8) plant companion crops (two unrelated crops planted together), (9) disinfect garden tools and shears, (10) treat seed with a fungicide, and (11) recognize the onset of leaf diseases and apply fungicidal sprays or dusts at that time for optimum control.

The most effective disease control uses a combination of these methods. This is called integrated pest management (IPM). This concept is discussed later under "Disease Management."



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## Resistant Varieties

Many varieties of vegetable and ornamental plants are resistant, but not immune, to certain diseases. If a disease is known to occur in your area, use a resistant variety, if available.

Vascular wilt diseases cannot be controlled by protectant fungicides. Since the pathogens that cause wilts survive many years in the soil, varietal resistance provides the best means of disease management. This includes the management of tomato wilts — look for tomato seed sources marked VF, which means Verticillium-Fusarium resistant. Other tomato varieties are marked VFN, which means Verticillium-Fusarium-Nematode resistant. However, nematodes are not known to be a problem in North Dakota home gardens.

Other diseases best managed by resistant varieties include cabbage yellows, potato scab, strawberry red stele, cucumber mosaic and fireblight of apple and crabapple. Information on disease resistance is available from various sources. Seed and nursery catalogs and several Extension circulars discuss current variety choices that may be resistant to important diseases.

## Disease Free Seed and Transplants

Since many disease-causing organisms survive in the seed, do not save seed from the garden. Old seed may also have reduced germination and vigor. Purchase good quality seed and transplants. Purchase seed packaged for the current year — a date should be printed on the packet. Inspect plants before purchase and reject any with curled leaves, aphids or spider mites (look for aphids and spider mites on the lower leaf surface). Reject any moldy bulbs, sets or other propagative material. Reject six-packs of transplants in which several plants are missing and have presumably died.

If transplants are started from seed, purchase high quality seed. Sow and transplant into pasteurized potting medium. Pasteurization is described in Circular PP-744, "House Plants — Proper Care and Problem Solving."

## Crop Rotation

Change the location of various crops in the garden, each year if space permits. Many disease-causing organisms do not survive long in the soil if a different crop is planted. Some exceptions are the tomato wilts, asparagus root rot and cabbage yellows. Once the soil is infested with the organisms that cause these diseases, it remains infested for a long time; the only way to manage these sites is to use resistant varieties.

When rotating crops in the garden, rotate between different families of vegetables, as members of the same family may be susceptible to many of the same diseases. For example, tomatoes, potatoes, eggplant, and peppers are all members of the potato family and have many of the same diseases. Cucumbers, melons, and squash are all members of the cucurbit family. Cole crops or crucifers include cabbage, broccoli, brussels sprouts, cauliflower, kohlrabi, turnip, radish, and mustard.

## Control Weeds

Many weeds harbor disease organisms that can spread to nearby gardens. Most of these disease organisms are insect-transmitted viruses and mycoplasmas. Destroy weeds in and around the garden and along fences to destroy the source of these disease-causing organisms. For example, dandelions harbor the aster yellows mycoplasma; dandelion control can reduce the amount of aster yellows spread by the aster leafhopper to nearby susceptible hosts such as marigold or carrots.

## Control Insects

Some insects transmit disease organisms. Aphids, for example, transmit several viruses, including cucumber mosaic virus. The aster leafhopper transmits the aster yellows mycoplasma to many flowers and certain vegetables (e.g., carrots). The cucumber beetle transmits the bacterial wilt organism and squash mosaic virus. Control of these and certain other insects is essential to disease management.

Some insects may cause direct plant damage that can be confused with plant disease. The tarnished plant bug may inject its saliva into plants and cause a toxic reaction such as bud death of china aster, dahlia, gladiolus, balsam, salvia, straw flowers and zinnias — this toxic reaction is not technically a plant disease, but resembles one. The saliva of the potato leafhopper can cause hopper burn on various garden plants, such as garden beans; this toxic reaction shows as leaf curling and chlorosis (yellowing), stunted growth, and reduced yield. Hopper burn is more severe in hot, dry weather.

## Destroy Diseased Plant Parts

Many diseases can build up and spread rapidly through the production of millions of fungus spores. Promptly remove diseased plant parts to retard the spread of disease. Examples where removal is effective, especially if used in combination with fungicides, include: Botrytis blight (gray mold) of begonia, geranium, peony, tulip, and strawberry; geranium rust; rust and powdery mildew of rose; black knot, plum pockets, and brown rot of plum and cherry; tomato leaf spots and fruit rots; cucurbit fruit rots; and powdery mildew of various ornamentals.

## Dispose of Plant Refuse

Disease-causing organisms may survive the winter on diseased plant refuse. Infected refuse gives diseases an early start. Remove and destroy plant refuse in the fall. Spade or rototill the remaining refuse into the soil — this destroys most disease organisms.

Remove and destroy all tomato and potato vines, cucumber and melon vines, rose leaves, raspberry and strawberry leaves, and peony and hollyhock tops. Remove and destroy all diseased canes from rose and raspberry bushes. Rake up and destroy all diseased apple leaves.

Composting crop refuse may destroy disease organisms if the **compost heats properly and is turned frequently**. To kill pathogens in the compost pile, the compost must have a **minimum** volume of one cubic yard. Turn the pile every two to three days to provide aeration and mixing. Add sawdust, leaves, etc., to help provide a mixture more likely to heat properly. Maintain the pile at 65-75 percent moisture (fairly moist, but not wet). Add water if

necessary to maintain the moisture level. These procedures help maintain high temperatures. Pathogens are killed if the temperature in the pile is 120-160°F for two to three weeks. Check pile temperatures with a candy or meat thermometer. If the temperature is too low or if turning is not frequent enough, some pathogens will survive, particularly those near the edges of the pile. See Circular H-885, "Composting Practices," for further information.

## Plant Companion Crops

Two unrelated crops planted in the same area are called companion crops. NDSU has experimented with various companion crops for several years. The following combinations have been successful for at least one season at the Carrington Research and Extension Center. These combinations can greatly reduce the numbers of destructive insects as well as help reduce disease and more efficiently use soil nutrients. Potatoes have been successfully planted with beans, corn, and marigolds. Squash has been successfully planted with nasturtium, corn and borage. Tomato has been successfully planted with chives, onion, parsley, marigolds, and nasturtiums. Peas are a good companion crop for almost any vegetable because of their nitrogen fixing ability. Leeks, carrots, onions, and celery can be interplanted with mutual benefit.

## Disinfect Garden Tools and Shears

Garden tools can be sanitized of viruses by washing them with detergent (not soap). The detergent not only physically removes the virus from the tools but inactivates any remaining virus. Tools used to prune apple and crabapple trees can be sanitized of any fireblight bacteria by dipping in household bleach diluted to 20 percent (3 cups to 1 gal. water) or old fashioned liquid Lysol (use only the Regular Lysol in the red box or with the red label, containing o-phenyl-phenol and o-benzyl-p-chlorophenol — this should smell like creosote) diluted to 20 percent. Denatured alcohol (available as shellac thinner) and Pine Sol (19.9 percent pine oil) are nearly as effective when used full strength. Bleach and Pine Sol are very corrosive to tools, so be sure to rinse and oil the tools after use to prevent rusting.

## Seed Treatment

Seed treatment is most effective when used with crop rotation. Use fungicide-treated seed to help ensure good stands and avoid replanting costs. The objectives of seed treatment are:(1) to kill disease-causing organisms on the seed surface and (2) to protect the seed and young seedlings from disease-causing organisms in the soil. This helps promote quick emergence.

Some seed, especially sweet corn, is sold already treated and the packet is marked "treated."

Treated seed is usually colored red or some other easily identifiable color. If untreated seed is purchased, the gardener may treat it using recommended chemicals such as thiram or captan according to the manufacturer's directions.

To treat small paper packets of seed, tear off one corner of the packet. Put about twice as much chemical in the packet as can be picked up on the first half inch of the flat end of a toothpick. Shake the packet until the seed is evenly coated with the chemical.

Purchase seed of cabbage or related plants that is of high quality. For small plantings it may be best to buy plants started by commercial growers.

Many annual flowers have extremely small seed which should be seeded in flats or seedbeds containing pasteurized potting mix before planting in the garden. Treat the seed with captan or thiram or mix captan or thiram with the top 2 1/2 to 3 inches of potting mix in the seedbed to help obtain a better stand.

Plant only disease-free corms (gladioli), bulbs (tulips), tubers (potatoes — be sure to use certified seed potatoes), rhizomes (iris), tuberous roots (tuberous begonia) and roots (asparagus and rhubarb). Dust with captan or thiram before planting to retard certain soil-borne diseases. Follow label directions.

When harvesting corms, bulbs and tuberous roots, be sure to remove any discolored ones. Cure them for several days at 60-70°F in a dry, well-ventilated area. Before storing, dust them with thiram or captan fungicide to retard storage rot.

## Spraying and Dusting Fungicides

### General Information

Many leaf (foliar) diseases can be managed by spraying or dusting plants with an effective fungicide. A few fungicides may be classed as organic; these are discussed below. Fungicide treatments should be applied at seven to 10-day intervals during humid weather to protect young growing shoots and replace fungicide washed off by rain or watering. Plants and fruits must be completely covered with spray or dust for good disease control.

Most fungicides are protectants. They work on the plant surface and protect against infection; they do not "cure" infections already established. If considerable disease is already present, it is too late to use protectant fungicides except to protect new leaves as they emerge. If disease is not detected early, establish effective control on new leaves by removing older diseased leaves and providing regular application of a fungicide.

A few fungicides on the market today are systemic; they move into the plant tissues and up the plant in the sapstream. Currently, benomyl (several labels), triforine (Funginex), triadimefon (several labels), and thiophanate-methyl (Green Light Systemic Fungicide). Triforine, triadimefon, and thiophanate-methyl have some curative properties on established infections, although they will not make spots disappear. Benomyl will not provide curative action.

### Organic Fungicides

Bordeaux mixture, some other copper fungicides, and lime sulfur are generally considered as organic by many organizations that certify organically produced crops. Sulfur, if it comes from a mined source, also may be considered organic by many certifying organizations. Home gardeners who wish to use only organic products may find these products helpful in their disease management programs. Compounds that may qualify as organic are listed in bold type in the fungicide recommendation tables at the end of this publication.

### Fungicide Use Tables

Fungicides for managing home garden vegetable diseases are listed in Table 1. Those for managing home garden fruit diseases are listed in Table 2. Fungicides for managing ornamental diseases are listed in Table 3. If a range of doses is given in the tables (eg. 1-1½ tablespoons), use the lower rate for disease prevention or when only a little disease is present; use the higher rate when there is a lot of disease present. There are 3 level teaspoons in a level tablespoon, so a dose of 2/3 tablespoon equals 2 teaspoons.

## Sulfur

Sulfur can be used for managing powdery mildew on various plants in the home garden. These are listed in the tables. Do not apply sulfur when temperatures are above 90°F or are expected to exceed 90°F during the day as injury may occur.

## Combination Products

The home gardener can also purchase general purpose combination dusts or sprays to control a wide variety of diseases and insects. Although these combinations suppress many common disease and insect problems, they do not suppress all the diseases or insects which may attack a plant.

## Disease Management

The most effective home garden disease control program uses a combination of practices to avoid disease damage. These are use of resistant varieties, planting disease-free plants, rotating garden areas, weed control, insect control, destroying diseased plants or plant parts, proper fall cleanup and use of fungicides as needed. Such practices may result in diseases remaining at non-destructive levels. Other practices that help avoid disease damage include proper watering, using wider row spacing, alternating varieties from year to year, and interplanting (e.g. planting pole beans with corn) or growing companion crops.

If gardens are watered after plants are established, apply 1-2 inches of water slowly enough for it to soak in, then allow the soil surface to dry before another application. Avoid frequent light waterings and early morning or late evening overhead irrigation. These practices result in prolonged leaf wetness, which favor disease. To minimize disease, overhead irrigation should be done in late morning or early afternoon when the leaves will dry rapidly. However, overhead irrigation at this time of day is very inefficient, and on hot windy days 33-40 percent of the water may evaporate before it reaches the ground. Watering with soaker hoses, in-ground furrows, or drip applicators is better than using sprinklers because the leaves remain dry and water is used efficiently.

Wide row spacing helps reduce disease development by promoting rapid leaf drying; it also separates plants and reduces the chances of disease spread. Alternating plant varieties or species also reduces the chances of disease spread from plant to plant.

Fungicides are not always needed if other disease management practices are observed. However, if disease was severe in recent years or the weather is humid, fungicides may be essential for reducing disease losses.

Many plants have waxy leaves that are not easily wetted by a spray. Common examples include cabbage, onion, and iris. Spray tends to form large droplets similar to those that form on the hood of a freshly waxed car, then the droplets roll off. A spreader-sticker should be used to help wet waxy foliage and also to retard wash-off of the fungicide in subsequent rains. Spreader-stickers are available at larger garden care centers. As a substitute for a spreader-sticker, home gardeners may use 1/4 teaspoon of a mild liquid detergent per gallon of water. This will help wet the leaf, but will not retard wash-off in subsequent rains, so is not as effective as a spreader-sticker.

## IMPORTANT

All fungicides except sulfur are poisonous and should be handled with care. Sulfur and many other fungicides are eye and skin irritants. Do not get sulfur or other fungicides in eyes or on skin. Wash hands after using chemicals. Store chemicals in the original container in a locked area away from children and pets. Do not transfer chemicals from the original container to a make-shift container.

Rinse and air dry sprayer after each use. Empty duster at the end of the season; apply oil or graphite to the leather plunger.

## R<sub>x</sub> for Control

Read and follow label directions — this is your prescription for control. The label lists the ingredients — it will give the chemical name (a very long name) and the common name (for example, captan). The label states the percent active ingredients. Some home garden preparations contain both fungicide and insecticide for both disease and insect control. Be sure to read the label to determine if the product contains the ingredients you need to control a specific problem.

Read the label statement entitled "Caution" or "Warning". This contains important safety information on handling the fungicide. Also read the statements on environmental hazards, directions for use, storage and container disposal. Read the section of the label that pertains to the crop being treated and check the harvest limitations (see below).

Some fungicides have harvest restrictions on food crops — for example, Ortho Multi-Purpose Fungicide Daconil 2787 should not be applied to sweet corn within 14 days of harvest or to green beans within seven days of harvest. These limitations are given in Tables 1 and 2 and are stated on the labels.

Some products are marketed under a brand name — for example, Ortho brand captan is marketed under the name Orthocide; mancozeb is marketed as Dithane M-45, Manzate 200, or Penncozeb; copper fungicides are marketed as Bordeaux Mixture, Tri Basic Bordeaux, and under other names; and chlorothalonil is marketed as Ortho Multi-Purpose Fungicide Daconil 2787 (for home gardens), Daconil 2787 (for ornamentals) and Bravo 720 (for farm crops). The percentage of active ingredients may vary from brand to brand.

## Disease Diagnosis

Proper identification of a disease is essential for an accurate prescription for control. Several types of diseases are easily recognized.

The **rusts** produce pustules that break through the surface of the leaf and produce masses of orange to orange-brown powder, which are the spores of the rust fungus.

**Powdery mildews** produce a cobwebby white growth on the leaf surface, then develop a white powder, which is a mass of the powdery mildew spores.

Many of the leafspots are described in circulars that discuss diseases of specific groups of plants, such as apples, stone fruits, cucurbits (cucumber, melon, squash), tomatoes, potatoes, deciduous trees and evergreen trees.

If an entire plant **wilts**, the problem may be a root rot, a canker (disease) on the main stem, or a wilt disease that attacks the vascular (water conducting) system.

**Viruses** may produce leaves that are mottled green and yellow. **Mycoplasmas**, such as aster yellows, may produce plants that are yellow and have a bushy appearance due to excessive branching.

Fungicides are not effective against vascular wilts, viruses or mycoplasmas.

The information given herein is supplied with the understanding that no discrimination is intended and no endorsement by the North Dakota State University Extension Service is implied.

An effort has been made in this publication to represent all products known to be available across the state.

**Products listed in BOLD print in the following tables may be considered "organic" pest control compounds.**

**Table 1. Fungicides for disease management in vegetables**

Crop	Disease	Fungicide	Harvest Limitation*	Tablespoons/ gal. of water
Asparagus	Rust	mancozeb	Apply these products only after harvest	
		Green Light Broad Spectrum Mancozeb Fungicide		2
		Bonide Mancozeb Flowable with Zinc		1-1/3
		Bonide Mancozeb Plant Fungicide		2
Bean	Bacterial blights	<b>Bonide Liquid Copper Fungicide</b>	None	1 1/3
	Rust	chlorothalonil	7 days	3-2/3
		Bonide Liquid Fungicide		
		Ortho Multi Purpose Fungicide	1	
		copper + sulfur	None	See label
	<b>Bonide Garden Dust<sup>b</sup></b>			
	sulfur			
		<b>Green Light<sup>b</sup></b>		
	White mold	benomyl	14 days	1½ - 2 tsp.
		Bonide Benomyl 50% WP		
Carrot	Leaf blight	Bordeaux mixture	None	4½ - 9½ + 2/3 hydrated lime
		<b>Bonide Copper (Bordeaux) Spray or Dust</b>		
		chlorothalonil	None	6 - 7
		Bonide Liquid Fungicide	None	1
		Ortho Multi Purpose Fungicide		
	copper	None	See label	
	<b>Bonide Rotenone-Copper Dust</b>			
Corn	Rust	Ortho Multi Purpose Fungicide	14 days	1
	Rust, leaf spot	mancozeb	7 days	2
		Green Light Broad Spectrum Mancozeb Fungicide		
		Bonide Mancozeb Flowable with Zinc		
	Bonide Mancozeb Plant Fungicide	7 days	1½	
Crucifers ( <i>Broccoli, Brussels sprouts, cabbage, cauliflower</i> )	Downy mildew and leaf spot	Bordeaux mixture	None	4½ - 6½
		<b>Bonide Copper (Bordeaux) Spray or Dust</b>		
		chlorothalonil	None	1
	Ortho Multi Purpose Fungicide			
		copper	None	See label
		<b>Bonide Rotenone-Copper Dust</b>		
	Downy mildew	copper	None	1-1/3 - 2
		<b>Bonide Liquid Copper Fungicide</b>	None	See label
		<b>Bonide Rotenone-Copper Dust</b>		
		chlorothalonil	None	2
		Bonide Liquid Fungicide	None	1
Cucurbits ( <i>Cucumber, melon, squash, pumpkin</i> )	Angular leaf spot	Bordeaux mixture	None	4½ - 11½
		<b>Bonide Copper (Bordeaux) Spray or Dust</b>		
		copper	None	1 - 1/3
		<b>Bonide Liquid Copper Fungicide</b>	None	See label
		<b>Bonide Rotenone-Copper Dust</b>		

Crop	Disease	Fungicide	Harvest Limitation*	Tablespoons/ gallon of water	
Cucurbits - <i>con't.</i>	Anthracnose	benomyl, 50%	None	½	
		Bordeaux mixture			
		<b>Bonide Copper (Bordeaux) Spray or Dust</b>	None	4½ - 11½	
		chlorothalonil			
		Ortho Multi Purpose Fungicide	None	2/3	
		copper			
	Downy mildew	Downy mildew	<b>Bonide Rotenone-Copper Dust</b>	None	See label
			mancozeb		
			Bonide Mancozeb Flowable with Zinc	7 days	4 - 5 tsp.
			Bonide Mancozeb Plant Fungicide <sup>c</sup>	5 days	2 - 3 Tbsp.
			Bordeaux mixture		
			<b>Bonide Copper (Bordeaux) Spray or Dust</b>	None	4½ - 11½
	Powdery mildew	Powdery mildew	copper		
			<b>Bonide Rotenone-Copper Dust</b>	None	See label
			mancozeb		
Bonide Mancozeb Flowable with Zinc			None	4 - 5 tsp.	
Bonide Mancozeb Plant Fungicide			5 days	2 - 3 Tbsp.	
chlorothalonil					
Onion	Downy mildew, leaf blight, purple blotch	Bonide Liquid Fungicide	None	6 7 tsp.	
		Ortho Multi Purpose Fungicide	7 days	2/3	
		benomyl			
		Bonide Benomyl 50% WP	None	¼ - ½ tsp.	
		Bordeaux mixture			
	Downy mildew	Downy mildew	<b>Bonide Copper (Bordeaux) Spray or Dust</b>	None	4½ - 11½
			chlorothalonil		
			Ortho Multi Purpose Fungicide	None	1
			copper		
			<b>Bonide Rotenone-Copper Dust</b>	None	See label
Pea	Powdery mildew	copper + sulfur			
		<b>Bonide Garden Dust<sup>b</sup></b>	None	See label	
		sulfur			
		<b>Bonide<sup>b</sup></b>	24 hours	1½ - 3 Tbsp.	
		<b>Green Light<sup>b</sup></b>	24 hours	2 Tbsp.	
		<b>Ortho Flotox<sup>b</sup></b>	None	2½ Tbsp.	
Potato	Leaf blights	<b>Bonide Liquid Copper Fungicide</b>	None	4 tsp.	
		Bordeaux mixture			
		<b>Bonide Copper (Bordeaux) Spray or Dust</b>	None	4½ - 12	
		chlorothalonil			
		Bonide Liquid Fungicide	None	1¼ - 1-4/5	
		Ortho Multi Purpose Fungicide	None	½	
		copper			
		<b>Bonide Liquid Copper Fungicide</b>	None	Early blight 4 - 6 tsp. Late blight 7 tsp.	
		<b>Bonide Rotenone-Copper Dust</b>	None	See label	
		copper + sulfur			
		<b>Bonide Garden Dust<sup>b</sup></b>	None	See label	
		mancozeb			
Green Light Broad Spectrum Mancozeb Fungicide	None	½ - 1			
Bonide Mancozeb Flowable with Zinc	14 days	2 - 4 tsp.			
Bonide Mancozeb Plant Fungicide	14 days	1 - 2 Tbsp.			

Crop	Disease	Fungicide	Harvest Limitation <sup>a</sup>	Tablespoons/ gallon of water		
Tomato	Leaf spots, leaf blights	Bordeaux mixture	None	4½ - 12		
		<b>Bonide Copper (Bordeaux) Spray or Dust</b>				
		chlorothalonil				
		Bonide Liquid Fungicide				
		Ortho Multi Purpose Fungicide				
		copper (not recommended for late blight management)				
		<b>Bonide Liquid Copper Fungicide</b>			None	2 - 2-1/3
		<b>Bonide Rotenone-Copper Dust</b>			None	1
		copper + sulfur			None	4 - 6 tsp.
		<b>Bonide Garden Dust<sup>b</sup></b>			None	See label
Bacterial spot, bacterial speck		mancozeb	None	See label		
		Green Light Broad Spectrum Mancozeb Fungicide				
		Bonide Mancozeb Flowable with Zinc				
		Bonide Mancozeb Plant Fungicide				
		5 days			½ - 1	
		5 days			3 - 5 tsp.	
		5 days			1½ - 2 Tbsp.	
		copper			None	See label
		<b>Bonide Rotenone-Copper Dust</b>				

<sup>a</sup> Harvest limitations indicate the minimum amount number of days before harvest that the last application can be made. None indicates that application can be made up to harvest.

<sup>b</sup> Do not apply sulfur when temperatures are greater than 90F. Under those conditions, plant injury may occur.

<sup>c</sup> Apply only to melons. Cucumbers are not listed on the label.

**Table 2. Fungicides for disease management in fruits**

Crop	Disease	Fungicide	Harvest Limitations <sup>a</sup>	Tablespoons/ gal. of water	
Apple	Fireblight	Bordeaux mixture	None	See label <sup>b</sup>	
		<b>Dexol Bordeaux</b>			
		streptomycin, 21%			
			Agri-Strep	50 days	1 tsp. <sup>c</sup>
			Bonide Fire Blight Spray	None stated	2/5 <sup>c</sup>
			Black rot & Frogeye leaf spot	Bordeaux mixture	None
	<b>Bonide Copper (Bordeaux) Spray or Dust</b>				
	captan				
			Ortho Home Orchard Spray	None	5
			Bonide Captan 50% WP	None	2
			Powdery mildew	benomyl + captan	None
	Bordeaux mixture				
	<b>Bonide Copper (Bordeaux) Spray or Dust</b>				
	copper				
	<b>Bonide Rotenone-Copper Dust</b>				
sulfur					
		<b>Bonide<sup>1</sup></b>	None	1 - 2½ t	
		<b>Bonide Liquid Sulfur<sup>1</sup></b>	None	2 - 2½ t	
		Apple scab	benomyl + captan	None	¼ + 2
captan					
Ortho Home Orchard Spray					
Bonide Captan 50% WP					
sulfur					
<b>Green Light<sup>1</sup></b>	None		See label		
<b>Bonide Liquid Sulfur<sup>1</sup></b>	None	2½ tsp.			
Sooty blotch & Fly speck		captan	None	5	
		Ortho Home Orchard Spray			
		Bonide Captan 50% WP			None

Crop	Disease	Fungicide	Harvest Limitations*	Tablespoons/ gal. of water
Stone fruits (Cherry, plum)	Black knot	lime sulfur (dormant spray)	None None	10 <sup>d</sup> 22½ <sup>d</sup>
		<b>Orthorix</b> <b>Bonide Oil &amp; Lime Sulfur Spray</b>		
	Brown rot	benomyl	None	1
		Bonide Benomyl 50% WP	None	9 - 12
		Bordeaux mixture <b>Bonide Copper (Bordeaux) Spray or Dust</b>		
		captan, 14.7%	None	5
		Ortho Home Orchard Spray	None	See label
		copper <b>Bonide Rotenone-Copper Dust</b>		
		sulfur <b>Bonide</b> <sup>f</sup>		
	<b>Bonide Liquid Sulfur</b> <sup>f</sup>	None	1 - 3 t	
	<b>Flotox</b> <sup>f</sup>	None	1 - 2½ t	
	<b>Green Light</b> <sup>f</sup>	None	2½	
	Leaf spot	benomyl	None	1
		Bonide Benomyl 50% WP	None	¼ - 2
		benomyl + captan captan, 50%	None	5
Plum pockets	lime sulfur (dormant spray)	None	10	
	<b>Orthorix</b> <b>Bonide Oil &amp; Lime Sulfur Spray</b>	None	22½ T	
Powdery mildew	benomyl + captan	None	¾ + 1½	
	sulfur <b>Bonide</b> <sup>f</sup>	None	1 - 3	
Grape	Powdery mildew, dead arm, downy mildew	copper	None	4 - 6 tsp.
		Bonide Liquid Copper Fungicide (for mildews)		
		sulfur	None	2½
		<b>Flotox</b> <sup>f</sup>	66 days	2 - 4 tsp.
		mancozeb		
		Green Light Broad Spectrum Mancozeb Fungicide	66 days	3 - 4 tsp.
		Bonide Mancozeb Flowable w/ Zinc	None	5
		captan		
Ortho Home Orchard Spray				
Bonide Captan 50% WP	None	2		
Brambles (Raspberry, blackberry)	Anthracnose	copper	None	4 - 6 tsp.
	<b>Bonide Liquid Copper Fungicide</b>			
	Anthracnose and spur blight	lime sulfur (dormant spray)	None	10 <sup>g</sup>
		<b>Orthorix</b> <b>Bonide Oil &amp; Lime Sulfur Spray</b>	None	22 ½ <sup>g</sup>
	Powdery mildew	benomyl, 50%	3 days	¾
		sulfur <b>Bonide</b> <sup>f</sup>	24 hours	2 - 2½
Fruit rot	Green Light Broad Spectrum Mancozeb Fungicide	30 days	1 - 2	
Yellow rust	<b>Bonide Liquid Copper Fungicide</b>	None	4 - 6 tsp.	
Strawberry	Gray mold (Botrytis)	benomyl	None	½ - 1 tsp. <sup>b</sup>
		Bonide Benomyl 50% WP		
		captan	None	5
		Ortho Home Orchard Spray	None*	2
	Bonide Captan 50% WP	None	½ - 1 tsp. <sup>h</sup>	
benomyl				
Leaf spot and leaf scorch	Bonide Benomyl 50% WP	None	1 - 1-1/3	
	copper	None	See label	
	<b>Bonide Liquid Copper Fungicide</b> <b>Bonide Rotenone-Copper Dust</b>			



Crop	Disease	Fungicide	Harvest Limitations <sup>a</sup>	Tablespoons/ gal. of water
Strawberry - con't.	Powdery mildew	benomyl Bonide Benomyl 50% WP	None	½ - 1 tsp. <sup>h</sup>
		sulfur <b>Bonide Sulfur<sup>i</sup></b>	None	1 - 2
		<b>Bonide Liquid Sulfur</b>	None	1/3

<sup>a</sup> Harvest limitations indicate the minimum amount number of days before harvest that the last application can be made. None indicates that application can be made up to harvest.

<sup>b</sup> See label; apply as a dormant or delayed dormant spray. Do not apply after fruits have formed as russetting may occur.

<sup>c</sup> Spray every 5 days during bloom and after hail.

<sup>d</sup> Dormant spray. On plum and cherry, all black knot cankers should be pruned out before spraying with lime-sulfur.

<sup>e</sup> This treatment is less effective than others listed.

<sup>f</sup> Do not apply when temperatures exceed 90F, as injury may occur.

<sup>g</sup> Apply in early spring when leaf buds are just showing green (green tip stage).

<sup>h</sup> Apply at 10% bloom and at full bloom; use ½ tablespoon/gal. Every 10-14 days thereafter.

<sup>i</sup> Apply throughout season, from first growth and every 7 days, thereafter; when plants are bearing and disease is severe, treat after each picking.

**Table 3. Fungicides for disease management in ornamentals**

Plant species	Disease	Fungicide	Rate/gal. of water
Ash, green	Anthracnose	Bordeaux mixture	See label
		<b>Acme Bordeaux Mixture</b>	
		lime sulfur (dormant spray)	1½ cups <sup>a</sup> See label <sup>a</sup>
		<b>Orthorix</b>	
		<b>Acme Lime Sulfur Spray</b>	
chlorothalonil	2/3		
Daconil 2787 Flowable, 40.4%			
thiophanate-methyl	2½ tsp.		
Green Light Systemic Fungicide			
Aster	Rust	triforine	1
		Funginex, 6.5%	
		triadimefon	2 - 4
		Bonide Bayleton Systemic Fungicide	
thiophanate-methyl	1 - 2		
Green Light Systemic Fungicide			
Begonia	Gray mold blight (Botrytis)	mancozeb Bonide Mancozeb Flowable with Zinc	1
	Powdery mildew	triforine Funginex, 6.5%	1
Begonia, tuberous	Rot of tuberous root	captan	See label for rates of each of these products
		thiram	
		<i>(Many broad spectrum blends of products contain one of these fungicides)</i>	
Chrysanthemum	Powdery mildew	sulfur	2½ 2
		Flotox Green Light	
Crabapple, ornamental	Frogeye leaf spot	chlorothalonil	See label
		Dexol Fungicide containing Daconil 2787 (12.5%)	
		Daconil 2787 WDG	
		Daconil 2787 Flowable, 40.4%	
	Ortho Multi Purpose Fungicide	3/4	
	Powdery mildew	triadimefon	1 - 2 2 - 4
Green Light Fung-Away Bonide Bayleton Systemic Fungicide			

Plant species	Disease	Fungicide	Rate/gal. of water
Crabapple ornamental - <i>con't.</i>	Rust	chlorothalonil	
		Dexol Fungicide containing Daconil 2787 (12.5%)	See label
		Daconil 2787 WDG	2/3
		Daconil 2787 Flowable, 40.4%	2/3
		Ortho Multi Purpose Fungicide	3/4
		thiophanate-methyl	
		Green Light Systemic Fungicide	1
		triadimefon	
		Bonide Bayleton Systemic Fungicide	1
		Green Light Fung-Away	1 - 2
	Apple scab	chlorothalonil	
		Dexol Fungicide containing Daconil 2787 (12.5%)	See label
		Daconil 2787 WDG	2/3
		Ortho Multi Purpose Fungicide	3/4
Dahlia	Powdery mildew	triadimefon	
		Bonide Bayleton Systemic Fungicide	2 - 4
		Green Light Fung-Away	1 - 2
		triforine	
		Funginex, 6.5 %	1
		sulfur	
<b>Ortho Flotox</b>	2½		
Delphinium	Powdery mildew	triadimefon	
		Bonide Bayleton Systemic Fungicide	2 - 4
		Green Light Fung-Away	1 - 2
		triforine	
Funginex, 6.5 %	1		
Geranium	Gray mold blight (Botrytis)	chlorothalonil	
		Dexol Fungicide containing Daconil 2787 (12.5%)	See label
		Daconil 2787 WDG	2/3
		Daconil 2787 Flowable, 40.4%	2/3
		Ortho Multi Purpose Fungicide	3/4
	triadimefon		
	Bonide Bayleton Systemic Fungicide	2 - 4	
	Rust	chlorothalonil	
		Dexol Fungicide containing Daconil 2787 (12.5%)	See label
		Daconil 2787 WDG	2/3
Daconil 2787 Flowable, 40.4%		2/3	
Ortho Multi Purpose Fungicide		3/4	
triadimefon			
Green Light Fung-Away	1/3 - 2/3		
Gladiolus	Leaf and flower spot (Botrytis)	chlorothalonil	
		Dexol Fungicide containing Daconil 2787 (12.5%)	See label
		Daconil 2787 WDG	2/3
		Daconil 2787 Flowable, 40.4%	2/3
		Ortho Multi Purpose Fungicide	3/4
	mancozeb		
	Green Light Broad Spectrum Mancozeb Fungicide	1/3	
	Corm rot	captan	See label for rates of each of these products
		thiram	
		<i>(Many broad spectrum blends of products contain one of these fungicides)</i>	
Hawthorn	Rust	chlorothalonil	
		Dexol Fungicide containing Daconil 2787 (12.5%)	See label
		Daconil 2787 WDG	2/3
		Daconil 2787 Flowable, 40.4%	2/3
		Ortho Multi Purpose Fungicide	3/4
		triadimefon	
Bonide Bayleton Systemic Fungicide	2 - 4		
Green Light Fung-Away	1/3 - 2/3		

Plant species	Disease	Fungicide	Rate/gal. of water
Hollyhock	Rust	chlorothalonil	
		Dexol Fungicide containing Daconil 2787 (12.5%)	See label
		Daconil 2787 WDG	2/3
		Daconil 2787 Flowable, 40.4%	2/3
		Ortho Multi Purpose Fungicide	3/4
		triadimefon	
Bonide Bayleton Systemic Fungicide	2 - 4		
Green Light Fung-Away	1/3 - 2/3		
Horse Chestnut, Buckeye	Leaf blight, leaf blotch	chlorothalonil	
		Dexol Fungicide containing Daconil 2787 (12.5%)	See label
		Daconil 2787 WDG	2/3
		Daconil 2787 Flowable, 40.4%	2/3
		Ortho Multi Purpose Fungicide	3/4
Iris	Leaf spot	chlorothalonil	
		Dexol Fungicide containing Daconil 2787 (12.5%)	See label for rates
		Daconil 2787 WDG	1/2
		Daconil 2787 Flowable, 40.4%	1/2
		Ortho Multi Purpose Fungicide	2/3
		thiophanate-methyl	
		Green Light Sytemic Fungicide	2 1/2 tsp. (Use a spreader-sticker)
		triadimefon	
		Bonide Bayleton Systemic Fungicide	2 - 4
		Green Light Fung-Away	1 - 2
Lilac	Powdery mildew	triforine	
		Funginex, 6.5%	1/3
		triadimefon	
Green Light Fung-Away	1 - 2		
Lily	Gray mold blight (Botrytis)	chlorothalonil	
		Dexol Fungicide containing Daconil 2787 (12.5%)	See label
		Daconil 2787 WDG	1/2
		Daconil 2787 Flowable, 40.4%	1/2
Ortho Multi Purpose Fungicide	2/3		
Oak	Anthracnose	Bordeaux mixture	
		<b>Dexol Bordeaux</b>	See label
		<b>Acme Bordeaux</b>	See label
		lime sulfur	
		<b>Ortho Dormant Season Control</b> <b>Bonide Oil &amp; Lime Sulfur Spray</b> <b>Acme Lime Sulfur Spray</b>	1 1/2 cups <sup>a</sup> 22 1/2 <sup>a</sup> See label <sup>a</sup>
Petunia	Gray mold (Botrytis) and Phytophthora blight	chlorothalonil	
		Dexol Fungicide containing Daconil 2787 (12.5%)	See label
		Daconil 2787 WDG	1/2
		Daconil 2787 Flowable, 40.4%	1/2
Ortho Multi Purpose Fungicide	2/3 <sup>c</sup>		
Phlox	Powdery mildew	triforine	
Funginex, 6.5%	1		
Poplar	Marssonina leaf spot	chlorothalonil	
		Dexol Fungicide containing Daconil 2787 (12.5%)	See label
		Daconil 2787 WDG	1/2
		Daconil 2787 Flowable, 40.4%	1/2
	Ortho Multi Purpose Fungicide	2/3	
	Rust	triforine	
Funginex, 6.5%	1		
Rose	Blackspot	Bordeaux mixture	
		<b>Bonide Copper (Bordeaux) Spray or Dust</b>	
		captan	
Bonide Captan 50% WP	1-2/3		

Plant species	Disease	Fungicide	Rate/gal. of water
Rose - <i>con't.</i>	Blackspot	chlorothalonil	
		Dexol Fungicide containing Daconil 2787 (12.5%)	See label
		Daconil 2787 WDG	1/2
		Daconil 2787 Flowable, 40.4%	1/2
		Ortho Multi Purpose Fungicide	2/3
	Brown canker	mancozeb	
		Green Light Broad Spectrum Mancozeb Fungicide	1
		thiophanate-methyl	
		Green Light Systemic Fungicide	2½ tsp.
		triforine	
Powdery mildew	Funginex, 6.5%	1	
	lime sulfur		
	<b>Orthorix</b>	1½ cups <sup>a</sup>	
	<b>Bonide Oil &amp; Lime Sulfur Spray</b>	22½ T <sup>a</sup>	
	<b>Acme Lime Sulfur Spray</b>	See label <sup>a</sup>	
Rust	chlorothalonil		
	Dexol Fungicide containing Daconil 2787 (12.5%)	See label	
	triforine		
	Funginex, 6.5%	1	
	<b>Ortho Flotox</b>	2½	
Snapdragon	Powdery mildew	triforine	
		Funginex, 6.5%	1
		triadimefon	
Spruce	Rhizosphaera needlecast	Green Light Fung-Away	1 - 2
		Bordeaux mixture	
		<b>Dexol Bordeaux</b>	See label <sup>d</sup>
		<b>Acme Bordeaux Mixture</b>	See label <sup>d</sup>
		chlorothalonil	
Tulip	Fire (Botrytis)	Daconil 2787 WDG	2¼ <sup>d</sup>
		Daconil 2787 Flowable 40.4%	2½ <sup>d</sup>
		Ortho Multi Purpose Fungicide	3 <sup>d</sup>
Zinnia	Powdery mildew	chlorothalonil	
		Daconil 2787 WDG	2/3
		Daconil 2787 Flowable, 40.4%	2/3
		Ortho Multi Purpose Fungicide	3/4
		triforine	
		Funginex, 6.5%	1
Zinnia	Powdery mildew	triadimefon	
		Green Light Fung-Away	1 - 2

<sup>a</sup> Dormant spray. Apply before budbreak.

<sup>b</sup> Do not apply sulfur during periods of high temperatures (above 90 F) as plant injury may occur.

<sup>c</sup> May cause discoloration of blooms in some varieties.

<sup>d</sup> Apply when shoots are ½ - 2 inches long; make a second application in three to four weeks.

#### ATTENTION COMMERCIAL APPLICATORS

If a homeowner formulation of a fungicide is listed in this publication, check labels for commercial formulations of the same active ingredient.



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