

## **Integrated Pest Management Program - IPM Manual for Home & Garden Pests in B.C. - Chapter 13**

### **Integrated Pest Management**

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#### **IPM Manual for Home and Garden Pests in British Columbia**

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#### **Chapter 13: Diseases of Plants**

##### **Learning Objectives**

When you have completed this chapter, you should be able to:

1. List the common diseases of garden plants and describe their general appearance, damage they may cause, and key features of their biology important for their management.
2. List methods to prevent these diseases.
3. List preferred and other control measures for these diseases.

[↑ Top](#)

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### **Introduction**

Many common garden plant diseases are caused by fungi. Diseases discussed in this section are all common foliar diseases except for damping off, which affects seeds, seedlings, and cuttings. Root and stem rots are also a problem but are not covered here because foliar diseases are generally of most concern to home gardeners.

### **Basic Steps to Prevent Disease**

For home gardeners, the most trouble-free approach is to plant disease resistant varieties if these are available. See the tables for rose varieties resistant to certain diseases. For other resistance information, refer to variety descriptions in plant guides and seed catalogues.

General recommendations for control of fungal diseases include:

- Ensure good air circulation around plants by avoiding overcrowding plants and pruning trees and shrubs to leave adequate space around branches.

- Avoid wetting the foliage of susceptible plants for long periods; this allows spores to germinate and infect leaves. Irrigate in the early morning so that plants dry off quickly. Rather than misting, raise humidity by setting pots on trays containing wet sand or gravel, mist the floor of a greenhouse, or install a humidifier.
- Avoid spreading infections on tools or hands, through splashed water.

Preventive steps are important because once diseases are present they are very difficult to control.

**Information in this chapter is intended only as a guide.  
Always apply pesticides according to directions on the label.**

[↑ Top](#)

## Black Spot of Roses

### Description

- Small to large circular black spots with fringed margins found on leaves.



### Damage

- In mild infections, plants are not greatly affected.
- In severe infections, spots become large, irregular blotches, leaves turn yellow and drop, some plants may be defoliated.
- Young leaves (6-14 days old) are most susceptible, especially if they are growing rapidly.
- The disease is most damaging during warm, wet weather.

### Biology

- Overwinter on fallen leaves, in leaf buds and within the canes.
- Germinate and infect leaves when temperatures are warm and moisture is present for at least several hours.
- Symptoms (black spots) are visible 3-10 days after infection.
- Spores are produced throughout growing season, and can cause repeated infections in warm, wet. weather; they spread by air currents, water splashes, insects and on garden tools.

### Prevention

- Plant black spot resistant varieties.

- Choose a planting site in full sun, ensure good air circulation by spacing and pruning, avoid wetting foliage during watering and water early in the day.
- In the fall, prune seriously affected roses to within 10-15 cm of the graft union to remove overwintering spores within cane tissue.
- Remove prunings and leaf debris from around the base of roses and burn or dispose of in garbage (do not compost).
- Mulch roses, in the spring, to prevent overwintering spores on the ground from being splashed onto plants to re-infect.

### **Preferred Controls**

- Spray lime-sulphur before buds break in spring to kill overwintering spores.
- Prune out infected leaves as soon as seen.

### **Other Measures**

- Beginning in the spring, monitor for disease symptoms when temperatures rise above 15°C, especially when weather is humid. If warranted, spray at intervals specified on label to protect young foliage. Use fungicides registered for use on black spot on roses, such as sulphur, copper, and others.

### **Table 4. Rose Varieties Resistant to Certain Diseases**

**ROSE (Rosa spp.)**

	<b>Black Spot</b>	<b>Powdery Mildew</b>	<b>Rust</b>
<b>Hybrid Tea</b>			
Aztec	H.Res.	H.Res.	M.Res.
Bowitched	II.Res.	II.Res.	H.Susc.
Charlotte Armstrong	H.Res.	M.Res.	M.Res.
Chicago Peace	H.Res.	M.Res.	M.Res.
Chrysler Imperial	II.Res.	II.Susc.	H.Susc.
Command Performance	H.Res.	Susc.	H.Res.
Eclipse	—	H.Susc.	II.Res.
Fine Harkness	II.Res.	H.Susc.	H.Susc.
Fragrant Cloud	II.Res.	M.Res.	H.Res.
Garden Party	H.Res.	H.Susc.	II.Res.
Helen Trauoc	H.Res.	M.Res.	M.Res.
Irish Gold	II.Res.	H.Res.	H.Res.
Kordes Perfecta	H.Res.	H.Res.	II.Susc.
Miss All American Beauty	H.Res.	H.Res.	II.Susc.
Mister Lincoln	II.Res.	H.Susc.	H.Susc.
Mojave	M.Res.	M.Res.	M.Res.
Pascali	H.Res.	M.Res.	M.Res.
Peace	H.Res.	M.Res.	II.Susc.
Pink Peace	H.Res.	M.Susc.	H.Susc.
Red Devil	M.Res.	H.Res.	H.Res.
Royal Highness	M.Res.	H.Susc.	II.Susc.
Tiffany	H.Res.	M.Res.	M.Res.
Tropicana	H.Res.	H.Susc.	H.Res.
<b>Grandiflora</b>			
Aquarius	H.Res.	M.Res.	M.Res.
Camelot	H.Res.	M.Res.	II.Susc.
Comanche	H.Res.	M.Res.	H.Susc.
Montezuma	H.Res.	H.Susc.	H.Susc.
Ole	M.Res.	H.Res.	M.Res.
Pink Parfait	M.Res.	M.Res.	M.Res.
Queen Elizabeth	H.Res.	Susc.	M.Res.
Scarlet Knight	M.Res.	M.Res.	M.Res.
<b>Floribunda</b>			
Elizabeth of Glamis	H.Res.	M.Res.	M.Res.
Europeana	H.Res.	H.Res.	H.Res.
Gene Boerner	II.Res.	M.Susc.	H.Res.
Pennocchio	II.Res.	M.Susc.	H.Res.
Redgold	H.Res.	M.Susc.	II.Res.
Roman Holiday	M.Susc.	M.Susc.	II.Res.
Sarabande	II.Res.	H.Res.	H.Res.
Spartan	H.Res.	M.Susc.	H.Res.
<b>Shrub Roses</b>			
Adelaide Houdless	H.Susc.	M.Res.*	M.Res.
Alexander McKenzie	H.Res.	H.Res.	M.Res.
Assiniboine	M.Susc.	SI.Susc.	H.Susc.
Champlain	M.Susc.	H.Susc.*	—

	<b>Black Spot</b>	<b>Powdery Mildew</b>	<b>Rust</b>
<b>Shrub Roses cont'd</b>			
Cuthbert Grant	H.Res.	H.Res.	SI.Susc.
Henry Kelsey	M-H.Res.	H.Res.	H.Res.
John Cabot	SI.Susc.	H.Res.	H.Res.
John Davis	SI.Susc.	H.Res.	II-
M.Res.			
John Franklin	M.Res.	II.Res.	M.Susc.
Morden Blush	M.Res.	H.Res.	H.Res.
Morden Cardinette	M.Susc.	SI.Susc.	H.Res.
Morden Centennial	M.Res.	II.Res.	M.Res.
Morden Fireglow	M.Res.	H.Res.	SI.Susc.
Morden Ruby	M.Res.	H.Res.	H.Res.
Nearbywild	II.Res.	H.Res.	H.Res.
Prairie Joy	II.Res.	II.Res.	H.Res.
Prairie Princess	M.Res.	—	H.Res.
Prairie Youth	M.Susc.	H.Res.	SI.Susc.
William Baffin	II.Res.	II.Res.	H.Res.
Winnipeg Parks	SI.Susc.	SI.Susc.*	—
<i>fortida bicolor</i> 'Persian Yellow'			
	II.Susc.	SI.Susc.	—
<i>rubijolia</i>			
	II-M.Res.	II.Res.	II.Res.
<i>rugosa</i> hybrid 'Blanc double de Coubert'			
	H.Res.	H.Res.	H.Res.
<i>rugosa</i> hybrid 'Charles Albanel'			
	M.Res.	H.Res.	H.Res.
<i>rugosa</i> hybrid 'Harwa'			
	H.Res.	—	—
<i>rugosa</i> hybrid 'Henry Hudson'			
	H.Res.	H.Res.	II.Res.
<i>rugosa</i> hybrid 'Jens Munk'			
	SI.Susc.	II.Res.	H.Res.
<i>rugosa</i> hybrid 'Pink Grootendorst'			
	SI.Susc.	—	—
<i>rugosa</i> hybrid 'Therese Bugnet'			
	SI.Susc.	—	SI.Susc.
	H.Res.	—	—

**Notes:**

- 1) Shrub rose ratings are based on information from the Agriculture and Agri-Food Canada Research Station in Morden, Manitoba. \*Rating based on personal experience of D. Woodsku, BCMAT.
- 2) Two ratings indicate dependence on year. Therefore, a low disease year results in more resistance than in a high disease year.
- 3) The incidence of rust decreases if the stems with the overwintering stage are pruned out and destroyed early in the year.

**Table 5. Rose Disease Ratings**

	Colour	Black Spot	Powdery Mildew	Rust		Colour	Black Spot	Powdery Mildew	Rust
<b>Hybrid Teas</b>					<b>Floribunda cont'd</b>				
Blue Nile	M	M. Res.	M. Res.	Res.	Intrigue	M	M. Res.	M. Res.	Res.
Color Magic	PH	M. Res.	M. Res.	M. Res.	Little Darling	YB	M. Res.	M. Res.	M. Res.
Dainty Bess	LF	M. Res.	M. Res.	M. Res.	Liverpool Echo	OB	Res.	Res.	Res.
Double Delight	RB	M. Res.	M. Res.	M. Res.	Manna	OB	M. Res.	M. Res.	Res.
Electra	OP	Res.	Res.	Res.	Matangi	KB	Res.	Res.	Res.
Folklore	OB	M. Res.	M. Res.	M. Res.	Orangade	OR	Res.	M. Res.	M. Res.
Canada	RB	M. Res.	Susc.	M. Res.	Play Girl	MP	Res.	Res.	Res.
Headliner	FB	M. Res.	Susc.	M. Res.	Play Boy	FB	Res.	Res.	Res.
Thirlburn	M	M. Res.	M. Res.	M. Res.	Regensberg	PB	Res.	Res.	Res.
Hulmut Schmidt	MY	Res.	M. Res.	Res.	Sexy Revy	MP	Res.	Res.	Res.
Honda	W	M. Res.	M. Res.	M. Res.	Shocking Blue	M	M. Res.	M. Res.	M. Res.
Just Joey	OB	Res.	Res.	Res.	Shrubia	MR	Res.	Res.	Res.
Keeper's	FB	Res.	Res.	Res.	Sun Flare	MY	M. Res.	M. Res.	Res.
Las Vegas	OB	Res.	Res.	Res.	Sunspire	OY	M. Res.	M. Res.	M. Res.
Metallic	AB	M. Res.	M. Res.	M. Res.	Trumpeter	OR	Res.	Res.	Res.
New Day	MY	Res.	M. Res.	Res.	Viva	DR	Res.	Res.	Res.
Olympiad	MR	M. Res.	M. Res.	Res.	<b>Climbers</b>				
Paradise	MB	M. Res.	M. Res.	M. Res.	Altissimu	MR	M. Res.	M. Res.	Res.
Peter Frankofeld	DF	Res.	M. Res.	Res.	Durtnunze	MR	Res.	Res.	Res.
Primatum	W	Res.	M. Res.	Res.	Dublin Bay	MR	Res.	Res.	Res.
Princess Platinum	MR	Res.	M. Res.	Res.	Golden Showers	MY	M. Res.	M. Res.	M. Res.
Princess Margaret	MP	M. Res.	M. Res.	Res.	Handel	RB	M. Res.	M. Res.	Res.
Pristine	W	M. Res.	M. Res.	Res.	Joseph's Coat	RB	M. Res.	M. Res.	M. Res.
Silver Jubilee	PB	Res.	Res.	Res.	Royal Sunser	AB	Res.	Res.	Res.
Touch of Class	FB	M. Res.	Susc.	Res.	<b>Colour Classification:</b>				
Woodoo	OB	Res.	Res.	Res.	AB = Apricot Blend	MR = Medium Red			
<b>Grandiflora</b>					CP = Deep Pink	MY = Medium Yellow			
Gold Medal	OY	M. Res.	M. Res.	M. Res.	Dr = Dark Red	OB = Orange Blend			
Love	RB	Res.	Res.	Res.	OY = Deep Yellow	OR = Orange Red			
New Year	OB	Res.	M. Res.	Res.	LP = Light Pink	PB = Pink Blend			
Prominent	OR	M. Res.	M. Res.	Res.	m = Mauve	RB = Red Blend			
Shroveport	OB	M. Res.	M. Res.	M. Res.	MB = Mauve Blend	W = White			
Tournament of Roses	MP	Res.	Res.	Res.	MP = Medium Pink	YD = Yellow Blend			
<b>Floribunda</b>					<b>Note:</b>				
Bonita	MP	Res.	M. Res.	Res.	1) Cultivars in this table were grown and tested at the				
Cherish	MP	M. Res.	M. Res.	Res.	Portland, OR, International Rose Test Garden; many				
Class Act	M	M. Res.	Res.	Res.	also were grown at the Longview, WA Public Library				
Escapade	M	Res.	M. Res.	M. Res.	Rose Garden. Cultivars may react differently in other				
Eye Paint	KB	M. Res.	Res.	Res.	areas of the Pacific Northwest.				
French Lace	W	M. Res.	M. Res.	M. Res.	From the 1997 PNW Plant Disease Control Handbook.				
Iceberg	W	Res.	M. Res.	Res.					
Impatient	OR	Res.	Res.	Res.					

<b>KEY:</b>	HLRes. = Highly Resistant	H.Susc. = Highly Susceptible
	M.Res. = Moderately Resistant	M.Susc. = Moderately Susceptible
	S.Res. = Slightly Resistant	Sl.Susc. = Slightly Susceptible
	Res. = Resistant	Susc. = Susceptible

[↑ Top](#)

## Botrytis (Grey Mold)

### Description

- Water-soaked spots or lesions on leaves, stems and spent blossoms, which soon develop a characteristic soft, fuzzy, greyish mould growth.
- In head lettuce, botrytis begins on leaves in contact with soil and spreads upwards as a slimy rot.

### Damage

- Botrytis enters plants by infecting dying or damaged tissue of many kinds of vegetables and flowers, both in greenhouses and outdoors. It is a common problem in humid conditions with poor air circulation.

## Biology

- Spores overwinter in soil and on plant debris.
- Spores are spread on the wind.
- Spores germinate in high humidity, but disease develops only where damaged tissues or dying blossoms allow the fungus entry.

## Prevention

- Allow surface of soil to dry slightly between waterings.
- Water early in the day so that foliage can dry by nightfall.
- Remove dead or dying plant material (old flowers, fruit, or leaves) promptly.
- Ensure good air circulation around plants.

## Preferred Controls

- Prevention is the most effective approach for this disease.
- In greenhouses, increasing ventilation, promoting air circulation and lowering humidity are effective measures.

## Other Measures

- For serious infections on valuable ornamentals, apply fungicides registered for use on *Botrytis* including benomyl.
- **Note:** At time of printing, no Domestic fungicides products were registered for greenhouse or indoor use.

 [Top](#)

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## Damping Off

### Description

- Seeds fail to germinate (seed rot).
- Seedlings develop water-soaked areas on the stem at the soil line.
- Seedlings in a flat collapse and die over a day or two.

### Damage

- This disease is caused by the spores of several different fungi, which attack seeds, seedlings, and cuttings of many kinds of plants.

- Most infected plants die, or are stunted and weak if they survive.

## Biology

- Spores are always present in the soil.
- Many more spores germinate in cool, wet conditions; damping off is seldom a problem in warm and dry conditions.

## Prevention

- Wait until soil has warmed up before planting susceptible seeds outdoors.
- Use fresh seed and do not presoak seeds.
- Plant seeds at the appropriate depth, in well-drained soil, under warm conditions.
- Cover seedlings with a thin layer of sand, perlite or vermiculite to keep surface dry.
- Do not overwater seed beds and seedlings.
- Maintain good air circulation around seedlings and don't overcrowd seedlings in flats.
- Enrich seedling soil mixes with well-aged compost to inoculate the soil with beneficial fungi that suppress damping-off fungi.

## Preferred Controls

- Prevention is the best control; once infected, most seeds or seedlings die and fungicides will not save infected plants.
- Providing warm, dry conditions immediately may enable some plants in an infected flat to survive; strengthen them by feeding plant with liquid seaweed extract solution.

## Other Measures

If damping off has been a serious problem in the past:

- Use fungicide-treated seeds.
- Apply fungicides containing oxine benzoate.

 [Top](#)

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## Peach Leaf Curl

### Description

- Leaves pucker and curl, developing reddish blisters early in the season. Distorted leaves eventually turn powdery grey and drop.

## Damage

- Peaches and nectarines are affected.
- New growth may be stunted.
- Infected shoots may die back.
- Blossoms and young fruit usually drop early in the season.
- Severe infections can kill trees, however, most trees grow out of the disease later in the season, though crop may be lost.
- Most damaging in coastal BC and worst in years with cool, wet weather in the spring.

## Biology

- Spores overwinter on susceptible trees and on the ground around trees.
- Germinating spores attack young leaves when buds first swell in the early spring. The fungus develops within damaged plant tissues and releases a new generation of spores.
- Young, developing leaves that are exposed to rain or dew will be infected.
- During wet years, the second flush of leaves may be infected.

## Prevention

- Plant resistant cultivars, such as 'Pacific Gold', or 'Renton' peach, and maintain vigorous trees.
- Plant trees against a building where a roof overhang will keep leaves dry.
- For trees that are espaliered on a fence or a wall, build a temporary covering to keep spring rain off of tree while young leaves are most susceptible.
- Rake up and destroy fallen leaves and prune out and destroy dead twigs and branches.

## Preferred Controls

- Apply dormant sprays of lime-sulphur or copper just before bud break to kill overwintering spores in bud scales.
- Apply fixed copper sprays in September, after harvest.
- Pick and destroy all affected leaves as soon as symptoms are visible to prevent the fungus from reproducing.
- Spray liquid seaweed extracts at least once a month during the growing season; these have been shown to reduce damage, possibly by providing micronutrients to trees.

## Other Measures

- Fungicides are no use once the disease becomes evident. No other domestic fungicides are registered for peach leaf curl.

[↑ Top](#)

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## Powdery Mildew

### Description

- Leaves, shoots, fruits, and blossoms are covered by a dusty or powdery white growth.



### Damage

- A wide range of plants are affected, including beans, onions, cucumbers, squash, dephiniums, phlox, roses, zinnias, begonias, fruit trees, grapes, and berries.
- Severe infections slow plant growth, and cause leaves to turn yellow or reddish (especially in strawberries) and die.
- Flowers may die prematurely; fruit, such as apples, may have a russeted appearance; or fruit, such as grapes, may crack and split.

### Biology

- Spores overwinter on and inside older plant tissue, young, vigorous tissue is less susceptible.
- Spores are primarily dispersed by wind.
- Spreads in warm and humid weather because spores do not require a film of water on the leaves to germinate; heavy rains or overhead irrigation reduce infection by washing off spores.
- New spores are produced every four days; powdery growth is visible two days after infection.

### Prevention

- Grow mildew resistant cultivars of cucumbers, squash, roses, apples, and strawberries.
- Prune plants to improve air circulation and remove and destroy infected leaves.
- Clean up all plant debris at season end to remove spore overwintering sites.

### Preferred Controls

- Prune and destroy diseased plant portions to prevent further spread.
- Rinsing leaves thoroughly on both sides with water at 1-2 weeks intervals has been shown to be an effective control (dry rapidly to prevent germination of other fungi).

- Apply lime-sulphur during the dormant season (before buds break in spring) to reduce overwintering spores.
- Apply sulphur dusts or sprays, during the growing season, on plants that can tolerate it (listed on the label).
- Use of anti-transpirants on roses has been shown to also control powdery mildew.

## Other Measures

- Apply fungicides registered for use on powdery mildew, such as sulphur, copper, and others. Check specific formulations for use on ornamentals, food plants, and greenhouse plants. Follow label instructions for timing of applications.

[↑ Top](#)

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## Rust

### Description

- Most infections are a characteristic bright orange, powdery growth.
- Infections begin as rusty orange, yellow or whitish spots on the undersides of leaves, appearing later on upper side of leaf and may involve stems, flowers, and fruit.
- There may be swellings and galls on leaves and stems.



### Damage

- A wide range of plants, including asparagus, bean, blackberry, raspberry, carnation, snapdragon, rose, hollyhock, and pears.
- Rusts weaken plants and reduce yields.
- Severely infected plants drop leaves and may die.
- Most infections remain local on plants and usually do not spread internally, but spores are spread by wind.

### Biology

- Rust diseases are caused by a group of plant parasitic fungi.
- Many rusts are specific to one or two types of plants.
- Spores generally overwinter on fallen leaves and inside plant tissue.
- Spores are spread by wind, rain, insects, animals, and on unsterilized garden tools.
- Rust spreads quickly in warm (18-21°C) conditions when plants are continuously wet for over two hours.
- More spores are produced every 10-14 days in summer.

- New plant tissue is more susceptible than older tissue, therefore check undersides of new foliage in spring and during other periods of growth.

## Prevention

- Grow rust-resistant cultivars.
- Provide good air circulation by proper spacing and pruning.
- Avoid wetting foliage of susceptible plants.
- Use drip irrigation or water plants early in the day to allow them to dry before nightfall.
- Clean up fallen leaves and plant residues at the end of the season to destroy overwintering spores.
- Avoid working among plants while leaves are wet.
- Apply lime-sulphur to deciduous trees and shrubs during dormant season, before buds break in spring, to kill overwintering spores.

## Preferred Controls

- Apply sulphur to susceptible plants when warm temperatures coincide with high moisture levels before plants show damage (sulphur prevents spore germination).
- Pick and destroy infected leaves to slow spread of the disease.
- Remove infected plants and replace with resistant cultivars.

## Other Measures

- Spray or dust susceptible plants at 7-10 day intervals (check label) with sulphur or other fungicides registered for use on rusts.

 [Top](#)

### STUDY QUESTIONS

Answers are provided [here](#).

1. What is the best way to most completely prevent black spot disease on roses?
2. Describe symptoms of peach leaf curl disease.

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