



Black Spot of Rose in Hawai'i

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Among the plant diseases affecting roses (*Rosa* sp.) in Hawai'i (Table 1), black spot is the most destructive and widespread. The plant-pathogenic fungus *Diplocarpon rosae* Wolf (*Marssonina rosae*, asexual stage) causes this familiar leaf spot disease throughout the world. These spots cause leaves to die or fall prematurely, progressively weakening the plant and reducing the number of blooms.

Here we describe the pathogen, disease symptoms and epidemiology, and integrated management practices for rose growers and home gardeners.



Severely diseased leaflets die and fall from plants prematurely. Lesions may also appear on petioles and stems.

tissue around the spots turns yellow, and this discoloration may eventually cover the entire leaflet. Lesions enlarge slowly over several weeks, developing tan-colored centers. Close inspection of older lesions reveals tiny black spore-producing structures called acervuli that produce white, slimy masses of spores. Spots may coalesce to form large blighted areas on the leaflets. The pathogen may also infect stipules, pedicels, peduncles, sepals, petals, and fruit. Infected canes have purplish lesions that later become black and blistered. Highly susceptible cultivars may lose most of their leaves.

Pathogen

First reported in Sweden in 1815 and in the United States in 1830, *D. rosae* now occurs in South America, China, Canada, Australia (Mangandi and Peres 2009), and throughout Europe. At least 11 races of the pathogen have been identified, each able to infect a set of rose varieties differentially (Whitaker et al. 2010). This indicates a high level of pathogenic variability among populations of *D. rosae*.

Disease symptoms

Round or irregularly shaped black spots up to 25 mm in diameter and with diffuse, fringed margins appear on the upper surface of rose leaflets of any age. The

Epidemiology

For spore germination and infection to occur, *D. rosae* requires either high relative humidity (95%) or free water on the surface of leaflets for at least seven hours (Watt 2010). Therefore, black spot disease in Hawai'i is more severe in the cooler, wetter regions. Spore-bearing structures form within two weeks after infection and release spores that are mainly dispersed by wind and splashing rain or by irrigation water. Spore germination is most favorable at 18°C (65°F), and symptoms appear within 3 to 16 days of infection (Mangandi and Peres 2009). The disease develops most rapidly, however, at 24°C (75°F), while it is inhibited at 29°C (85°F) (Watt 2010). In temperate climates the fungus overwinters on canes and



Rose leaflets showing typical symptoms for black spot disease. Leaflet tissue that is distal from lesions may turn yellow (right).

- Avoid working with plants when the foliage is wet to reduce the transfer of spores from plant to plant.
- Avoid wetting foliage by sprinkler irrigation, or if this is impossible, irrigate during morning hours so the foliage can dry during the day.
- Destroy wild, abandoned, or unwanted roses that serve as sources of fungal inoculum.
- Control weeds and provide good soil drainage to reduce relative humidity in the plant canopy.
- Periodically apply preventive or curative fungicides to prevent new infections or to arrest symptom development (see section on fungicides).

fallen leaves. In Hawai'i, however, the winters are mild, and low temperatures rarely interrupt the disease cycle.

Disease management

In high-rainfall or humid areas with severe black spot, combine cultural control practices with fungicide sprays to achieve the most effective disease management.

- Plant only top-quality, disease-free plants of resistant varieties (see next section). Use wider plant spacing in areas with high rainfall or high relative humidity. Choose rootstocks and scions well adapted to Hawai'i's conditions.
- Select planting sites in open, sunny locations. This allows air circulation to enhance leaf drying within canopies. Avoid planting near windbreaks.
- Practice strict sanitation: Collect and compost or bury diseased and fallen leaves; remove severely infected leaves from plants.
- Prune canes periodically to improve aeration in the canopy and remove sources of spores.
- Maintain plant vigor. Fertilize according to recommendations.

Disease-resistant roses

Certain species of roses, and cultivars of old garden roses, have more resistance to black spot than some modern cultivars (Mangandi and Peres 2009). Cultivars with thicker or waxier leaf cuticles are more resistant. Resistance to black spot has also been introduced into a number of modern cultivars by crossbreeding with *R. wichuraiana*, *R. multiflora*, *R. cinnamomea*, and *R. pendulina*, which are all highly resistant or immune (Pataky 1987). Other resistant species include *R. arvensis*, *R. canina*, *R. kordesii*, and *R. moshata* (Pataky 1987). The expression of resistance (i.e., how difficult it is for the fungus to penetrate leaf tissues and the time required to complete the disease cycle) may vary regionally due to differences in environment and races of the pathogen. Resistance may be race-specific, meaning that it might be effective only against certain races of *D. rosae*.

Zlesak et al. (2010) recently evaluated more than 70 rose cultivars from different commercial classes for resistance to black spot in Texas. They found nine cultivars resistant to all three North American races of *D. rosae* (races 3, 8, and 9): Brite Eyes™, 'Grouse', Home Run®, Knock Out®, Paprika™, Peachy Cream™, Pink Knock Out®, Rainbow Knock Out®, and Yellow Submarine™. Some other cultivars listed in the article were resistant

to one or two of the races.

Mueller et al. (2008) evaluated 24 Griffin Buck roses for resistance to *D. rosae* in Iowa, finding several cultivars to possess high levels of resistance: 'Care-free Beauty', 'Aunt Honey', 'Honeysweet', 'Earthsong', and 'Pearlie Mae'.

Wallis and Lewandowski (2011) listed the names of a number of varieties with high resistance to black spot. The names in **bold** font below were classified as well suited for cultivation in Hawai'i in the CTAHR publication *Rose growing in Hawaii* (1972). The color of the bloom is in parentheses.

Climbing roses

'Dortmund', 'Dublin Bay', 'Eden', 'John Davis', 'New Dawn', 'Pinkie', 'Prosperity', 'Rambling Red', 'Red Climber', 'Royal Sunset', 'William Baffin'

Floribundas/grandifloras

'Angel Face', 'Betty Prior', 'Carousel', 'Cathedral', 'Europeana', 'Fashion', 'First Edition', '**Gene Boerner**' (pink), 'Goldilocks', 'Impatient', 'Ivory Fashion', 'Love', 'Mirandy', 'Montezuma', 'Pink Parfait', 'Prominent', 'Queen Elizabeth', 'Razzle Dazzle', 'Red Gold', 'Rose Parade', 'Sonia', 'Sunsprite'

Hybrid teas

'Carla', 'Cayenne', 'Charlotte Armstrong', '**Chrysler Imperial**' (red), '**Duet**' (pink), 'Electron', '**First Prize**' (red), 'Forty-Niner', 'Granada', '**Miss All American Beauty**' (pink), '**Mr. Lincoln**' (red), 'Olympiad', 'Pascali', '**Pink Peace**' (pink), 'Portrait', 'Pristine', 'Proud Land', 'Smooth Lady', 'Sutter's Gold', '**Tiffany**' (pink), '**Tropicana**' (orange)

Miniatures

'Always a Lady', 'Angel Darling', 'Anytime', 'Apricot Twist', 'Baby Betsy McCall', 'Beauty Secret', 'Black Jade', 'Centerpiece', '**Cinderella**' (white), 'Cuddles', 'Deep Velvet', 'Green Ice', 'Gourmet Popcorn', 'Jennifer', 'Linville', 'Little Artist', 'Loving Touch', 'Magic Carousel', 'Minnie Pearl', 'Old Glory', 'Pacesetter', 'Queen



The centers of older black spot lesions may turn whitish or tan colored. Adjacent lesions may coalesce to create symptoms of leaf blight and curling.

City', 'Rainbow's End', 'Red Cascade', 'Red Flush', 'Rose Gilardi', 'Simplex', 'Singles Better', 'Sweet Pickens', 'Watercolor', 'Work of Art'

Rugosa hybrids

'Blanc Double de Coubert', 'F.J. Grookendorst', 'Frau Dagmar Hartopp', 'Linda Campbell', 'Polyantha', 'Rugosa Alba', 'Rugosa Magnifica', 'Rugosa Rubra', 'Rose-raie de l'Hay', 'The Fairy', 'Therese Bugnet'

Shrub roses

'Alba Meidiland', 'All That Jazz', 'Baby Love', 'Belinda's Dream', 'Caldwell Pink', 'Carefree Beauty', 'Carefree Delight', 'Carefree Sunshine', 'Carefree Wonder', 'Distant Drums', 'Else Pulsen', 'George Vancouver', 'Harrison's Yellow', 'Katy Road Pink', 'Knock Out', 'Mrs. R.M. Finch', 'Prairie Harvest', 'Prairie Sunshine', 'Robusta', 'Sea Foam', 'Simon Fraser', 'Simplicity', 'Sir Thomas Lipton', 'The Fairy', 'Wanderin' Wind', 'Winter Sunset'

Other black-spot-resistant roses suited for the Midwest US are listed by Beckerman (2007).

Fungicides registered in Hawai'i for black spot

The following products are registered in Hawai'i to control black spot on roses and are used by growers and

other professionals. Other products may be available within each fungicide group. Listing a product in the following section does not constitute an endorsement by the University of Hawai'i at Mānoa, College of Tropical Agriculture and Human Resources.

For the following list of fungicides, the term “Fungicide group” refers to the Fungicide Resistance Action Committee code. The letter (M) and numbers (1-37) distinguish the different fungicide groups based on their modes of action. All fungicides within a given group have either the same active ingredient or a similar mode of action. If a fungus develops resistance to one fungicide in a group, it is usually resistant to all fungicides in the same group. Therefore, the group must be considered when selecting a fungicide in order to get the best disease control and slow the occurrence of fungicide resistance. Rotate among products in the different fungicide groups to avoid the buildup of resistance in the pathogen population. M = multisite inhibitors, for which the probability of developing fungicide resistance is low. Source: <http://www.frac.info/>. Be sure to read and follow the product label before applying a fungicide or any pesticide.

- **Banner Maxx[®]**, active ingredient (a.i.) propiconazole (14.3%). Apply 5–8 fluid oz per 100 gal water. Apply with a registered contact fungicide labeled for black spot as a full-coverage spray to the point of drip. Apply as needed. Fungicide group 3.
- **Captan[®] 50WP**, captan (49%), a microfine wettable powder. Apply 2 lbs per 100 gal water. Repeat at 7- to 14-day intervals or more often during frequent rains or heavy dews. Fungicide group M4.
- **Daconil Zn[®]**, chlorothalonil (38.5%), a flowable fungicide. Apply 1.5 pints (0.75 lb a.i.) per 100 gal water. Fungicide group M5.
- **Dithane[®] 75DF Rainshield**, mancozeb (75%), a dry flowable formulation. Protectant. Limit to 20 applications per year. Apply 1–2 lbs per 100 gal (1.5 lb per acre, outdoor use) at 7- to 10-day intervals. Use a spreader-sticker such as Latron B-1966. Fungicide group M3.
- **Eagle[®] 20EW, Eagle[®] 40WP**, myclobutanil

(19.7%). Systemic, protectant, curative fungicide. Apply on 7- to 10-day schedule. Do not apply more than 20 fluid oz/acre/year. Do not exceed 153 oz/acre/year. Fungicide group 3.

- **Heritage[®]**, azoxystrobin (50%), a broad-spectrum preventative fungicide with systemic and curative properties. It is applied as a foliar spray in alternating spray programs or in tank mixes with other registered crop-protection products. Apply 4–8 oz per 100 gal water every 7–14 days. Do not exceed 24 oz/acre/application. Fungicide group 11.

In addition to the fungicides listed above, other products containing different active ingredients may be labeled for management of black spot in Hawai'i. These products may contain these active ingredients:

- Copper hydroxide (Fungicide group M1)
- Ferbam (Fungicide group M3)
- Petroleum oil
- Paraffinic oil
- Sulfur (Fungicide group M2)
- Thiophanate-methyl (Fungicide group 1)
- Ziram (Fungicide group M3)
- Products having mixtures of any of the aforementioned active ingredients

Fungicides for home gardeners

Fungicides appropriate home gardeners are available in garden stores or other retail outlets. Check with your local garden store for these and other products:

- Chlorothalonil: Ortho[®] Garden Disease Control Concentrate (a.i. 29.6%)
- Copper salts: Bonide[®] Liquid Copper Fungicide Ready To Use (octanoic acid, copper salt 0.08%)
- Mycolbutanil: Spectracide Immunox[®] Multi-Purpose Fungicide Spray Concentrate (a.i. 1.55%)
- Propiconazole: Bonide Fung-onil[®] Lawn and Garden Disease Control Ready to Spray (a.i. 1.55%), Ferti-lome[®] Liquid Systemic Fungicide (a.i. 1.55%)

- Products containing other active ingredients: lime sulfur, neem oil, sulfur, thiophanate-methyl, captan, mancozeb, hydrogen dioxide, triforine, and potassium bicarbonate.

In addition, some biofungicide products are labeled for control of black spot (for example, Cease,TM with 1.34 % QST 713 strain of *Bacillus subtilis*). Such biofungicide products are often attractive to home gardeners who wish to avoid spraying chemical pesticides.

Add household detergent (a teaspoon per gallon of water) or a commercial spreader-sticker to the fungicide spray mix for rose varieties with especially waxy cuticles. This will give better coverage and help the spray stick to the leaf surface.

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Table 1. Some other rose pathogens and the diseases they cause in Hawai'i (1995–2008)¹

Host name	Pathogen name	Disease name
<i>Rosa x hybrida</i> ²	<i>Alternaria</i> sp.	Alternaria leaf spot
	<i>Fusarium</i> sp.	Root rot
	<i>Oidium</i> sp.	Powdery mildew
	<i>Peronospora sparsa</i>	Downy mildew
	<i>Pythium splendens</i> , <i>Pythium</i> sp.	Root rot
<i>Rosa chinensis</i>	<i>Botrytis cinerea</i>	Botrytis blight (bud, twig, and flower; also cane canker)
	<i>Coniothyrium fuckeii</i>	Common stem canker
	<i>Diplocarpon rosae</i> syn. <i>Marssonina rosae</i>	Black spot
	<i>Gloeosporium</i> sp.	Anthrachnose
	<i>Meloidogyne</i> sp.	Root knot
	<i>Pratylenchus</i> sp. (root-lesion nematode)	Root lesions
	<i>Rhizoctonia</i> sp.	Root rot
	<i>Sphaerotheca pannosa</i> var. <i>rosae</i>	Powdery mildew
<i>Rosa multiflora</i>	<i>Phomopsis</i> sp.	Phomopsis stem canker

¹Hawai'i host-pathogen database, www.hawaiiplantdisease.net

²*Rosa x hybrida* is a name for most rose cultivars of the Hybrid tea or Floribunda types. They are derived from complex crosses among a number of species in the genus *Rosa*.

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