

ROSES: DISEASES AND ABIOTIC DISORDERS

Integrated Pest Management for Home Gardeners and Landscape Professionals

A variety of plant pathogens can attack roses. The most common problem in California is powdery mildew, but a number of other diseases including rust, black spot, botrytis, downy mildew, and anthracnose may cause problems where moist conditions prevail.

To limit problems, choose varieties and irrigation practices carefully, promote air circulation by following appropriate pruning techniques and providing sufficient space between plants, and remove severely infested material promptly. Although some rose enthusiasts consider regular application of fungicides a necessary component of rose culture, many gardeners are able to sustain plants with little to no use of fungicides, especially in California's dry interior valleys.

In addition to diseases that bacterial, fungal, and viral pathogens cause, roses may display similar damage symptoms resulting from chemical toxicities, mineral deficiencies, or environmental problems. Such problems are termed abiotic disorders, and changing environmental conditions often can correct these symptoms.

LEAF AND SHOOT DISEASES AND DISORDERS

Powdery mildew, caused by the fungus *Podosphaera* (previously *Sphaerotheca*) *pannosa* var. *rosae*, produces white to gray powdery growth on leaves, shoots, sepals, buds, and occasionally on petals (Fig. 1). Leaves may distort and drop.

Powdery mildew doesn't require free water on plant surfaces in order to develop and is active during California's warm, dry summers. Overhead sprinkling, such as irrigation or washing, during midday may limit the disease by disrupting the daily spore-release

cycle yet allows time for foliage to dry before evening.

The pathogen requires living tissue in order to survive, so pruning, collecting, and disposing of leaves during the dormant season can limit infestations although it may not entirely eradicate them, since airborne spores from other locations can provide fresh inoculation.

Rose varieties vary greatly in resistance, with landscape (shrub) varieties among the most resistant. Glossy-foliaged varieties of hybrid teas and grandifloras often have good resistance to powdery mildew as well. Plants grown in sunny locations with good air circulation are less likely to have serious problems.

Fungicides such as triforine (Ortho Rosepride) are available, but generally you must apply them to prevent rather than eradicate infections, so timing is critical and repeat applications may be necessary. In addition to synthetic fungicides, least-toxic fungicides are available, including horticultural oils, neem oil, jojoba oil, sulfur, potassium bicarbonate, and the biological fungicide Serenade. With the exception of the oils, these materials are primarily preventive, although potassium bicarbonate has some eradicant activity. Oils work best as eradicants but also have some protectant activity. Do not apply oils to water-stressed plants or within two weeks of a sulfur spray.

See the Pest Note: *Powdery Mildew on Ornamentals* for more details on management.

Downy mildew, caused by the fungus *Peronospora sparsa*, requires a narrow range of temperature and humidity to thrive. Interveinal, angular purple, red, or brown spots appear on leaves, which then become yellow and drop (Fig. 2).



Figure 1. Powdery mildew on a rose.



Figure 2. Downy mildew on a rose leaf.

You occasionally may observe fruiting bodies of the fungus on the undersides of leaves.

To reduce downy mildew, increase air circulation through pruning and avoid frequent overhead irrigation that results in foliage that stays wet. Control with fungicides is very difficult; environmental management is much more

likely to be effective. Because downy mildew requires moist, humid conditions, it is most likely to cause problems in coastal areas of California and, during a narrow period of time in spring and fall, in the Central Valley.

Rust, caused by the fungus *Phragmidium mucronatum* (formerly *P. disciflorum*), prefers cool, moist weather such as that found in coastal areas of California but also may be a problem inland during wet years. Infected plants have small, orange pustules on the undersides of leaves while the upper sides of leaves may discolor and drop (Fig. 3).

Avoid overhead watering and prune back severely affected canes. During the winter collect and dispose of any leaves remaining on the plants and those that have fallen off. Plants can tolerate low levels of damage without significant losses. You can use preventive applications of fungicides, but it may require frequent applications to keep plants rust free, which may not be justifiable in garden or landscape situations.

Black spot, caused by the fungus *Diplocarpon rosae*, produces black spots with feathery or fibrous margins on the upper surfaces of leaves and stems (Fig. 4). Small, black fruiting bodies often are present in spots on the upper sides of leaves. No fungal growth occurs on the undersides.

This fungus requires free water to reproduce and grow, so don't allow leaves to remain wet for more than 7 hours. When hosing off aphids, do it in the morning or midday, so leaves have a chance to dry before evening. Provide good air circulation around plants. Remove fallen leaves and other infested material, and prune out infected stems during the dormant season.

Black spot usually is not a problem in most of California. Miniature roses are more susceptible than other types, although a few varieties are reliably resistant to all strains of black spot. Apply fungicides such as chlorothalonil or triforine as preventatives. Oils, includ-

ing neem oil, potassium bicarbonate, and sulfur, as discussed above under "Powdery mildew," or neem oil also has been shown to be effective in reducing black spot.

Anthracnose, caused by the fungus *Sphaceloma rosarum*, results in leaf spots. When first formed, spots are red or sometimes brown to purple. Later the centers turn gray or white and have a dark red margin. Fruiting bodies may appear in the middle of the spot, and the lesion may fall out creating a shot-hole symptom.

No information on management is available. Hybrid teas and old-fashioned climbing and rambler roses are the most affected.

Viruses and virus-like diseases occur wherever roses grow, although damage may be mostly cosmetic with little reduction in plant vigor.

Rose mosaic disease (RMD) is named after the leaf symptoms infected roses display. Ringspots, line patterns, mosaics, and distortion or puckering are typical (Fig. 5). Leaf symptoms will vary depending on which virus or viruses are present, the rose cultivar, the time of year, and growing conditions. Color break on flowers also can be symptomatic of rose mosaic disease.

Visual symptoms also can be transient; for example, hot, bright days can cause the symptoms to appear milder or disappear. The virus remains, and the plant becomes a symptomless carrier.

RMD is the result of an infection with a number of different viruses, the most common being *Prunus necrotic ringspot virus* and *Apple mosaic virus*. *Arabidopsis mosaic virus* also can cause RMD. These viruses may be present alone or in various combinations, accounting in part for the array of symptoms observed on infected plants. An accurate diagnosis may require laboratory tests and biological indexing.

A group of diseases of unknown causes that mimic some of the symptoms of



Figure 3. Rose rust appears as reddish brown spots on the lower leaf surface (left and bottom) and as yellow patches on the upper leaf surface (right).



Figure 4. Black spot causes dark blotches and yellowing.



Figure 5. Rose mosaic disease has damaged this foliage.

mosaic were discovered in California and other parts of the United States. These diseases include rose ring pattern, rose spring dwarf (RSD), and rose leaf curl. RSD causes rosetting or a balled appearance in the new growth following bud break. The leaves first emerging in the spring are recurved or very short and show conspicuous vein clearing or a netted appearance. These symptoms become less apparent as

shoots eventually elongate. Canes may develop a zigzag pattern of growth as the season progresses. Recent studies have associated a new virus with this condition; see the publication by N. Salem listed in References.

Viruses present many problems to commercial rose growers. Rose gardeners, retailers and regulatory officials don't like the look of the symptoms. Cut flower producers may see a significant decrease in production and/or bloom quality, depending on the variety of rose and type of virus. Nursery plant producers may face rejection of interstate shipments; destruction may become severe enough that large numbers of plants become unsalable.

For homeowners, the problem largely is unsightly foliage, with possible decreased plant vigor and smaller and/or fewer flowers.

The most common causes for the spread of these viruses are propagation procedures such as budding an infected scion onto a healthy understock or a healthy scion to an infected understock. Disease symptoms aren't always obvious, which is why the use of virus-tested planting stock is advantageous. Some evidence indicates rose mosaic spreads in commercial rose plantings via root grafts.

Many rose catalogs and books refer to "virus-free" roses. The science of plant virology has shown in recent years that most horticultural plants have cryptic viruses in them, the function and importance of which aren't known. As more sophisticated virus-testing techniques have been developed, many "virus-free" programs discovered their stock was not as free of virus as thought.

Foundation Plant Services (FPS) at UC Davis uses the term "virus tested" or "specific virus tested," meaning tested for the specific viruses known to cause rose mosaic disease. FPS currently employs two virus-elimination techniques, heat therapy and meristem tissue culture, to re-establish a rose

cultivar without the virus pathogens. Both are slow, time-consuming processes. Worldwide, plant material that has been tested for and found free of viruses known to cause disease symptoms is referred to as "clean stock."

For the home rose grower, no effective method exists for eliminating the viruses that cause rose mosaic disease. Use of virus-indexed stock—plants that have tested negative for these viruses by laboratory and field methods—for field propagation is the recommended preventative practice.

Nutrient deficiencies cause specific symptoms such as leaves that yellow and older leaves that drop (Fig. 6). Because many California soils have low percentages of organic matter, the nitrogen reserve typically is low, so you should add this nutrient as inorganic fertilizer or from organic sources.

Micronutrient deficiencies, especially iron and zinc, appear as interveinal chlorosis of new leaves. These elements may be deficient, because soils are too wet or too alkaline or because the soil type, such as sandy loam, is low in micronutrient content. Because inorganic forms of iron and zinc form insoluble precipitates in alkaline soils, you can apply iron and zinc directly to foliage. You can apply iron and zinc in a chelated form to either soil or foliage.

Nutrient excesses may limit rose growth if the total salt level becomes too high; a value of less than or equal to 2 dS/m (decisiemens per meter) is recommended. Plants may show a lack of vigor and short shoots, although no definitive leaf symptoms may occur. However, if salt concentrations are found to be very high (greater than 4 dS/m), you also may see browning of the leaves.

A few nutrients cause specific toxicities. Boron, which can reach high levels in some California soils, will cause stunting of plants, chlorosis, and marginal browning of the newest leaves. A soil concentration of less than or equal to 1 part per million is recommended.



Figure 6. Nitrogen deficiency has caused these lower rose leaves to develop interveinal chlorosis, a yellowing effect that occurs between the veins while the veins themselves remain green. The virus-infested upper leaves exhibit a condition known as pale vein clearing.



Figure 7. Injury from a glyphosate (e.g., Roundup) herbicide has caused the rose on the left to develop a pale, underdeveloped blossom and pucker-like shoots.

Herbicide damage may manifest itself in a variety of symptoms, which include cupped, curled, or yellowed leaves, small leaves, or death of the entire plant. The herbicide class and dosage to the plant determine which symptoms appear and their severity. Injury from glyphosate (e.g., Roundup) is relatively common.

Damage symptoms may not appear during the application season, especially if the application occurred in autumn, but may appear the following spring as a proliferation of small shoots and leaves from buds (Fig. 7). The plant will outgrow the injury if the dosage was not too high.

SYMPTOMS ON FLOWER PETALS AND BUDS

Botrytis blight, caused by the fungus *Botrytis cinerea*, thrives in high humidity (Fig. 8). Affected plants have spotted flower petals and buds that fail to open, often with woolly, gray fungal spores on decaying tissue. Twigs die back, and large, diffuse, target-like splotches form on canes.

Lessen humidity around plants by modifying irrigation and pruning techniques and reducing ground cover. Remove and dispose of fallen leaves and petals and prune out infested canes, buds, and flowers. Botrytis blight is a problem usually only during spring and fall in most of California and during summer along coastal areas when the climate is cool and foggy.

Rose phyllody is a flower abnormality recognized for more than 200 years in which leaf-like structures replace flower organs (Fig. 9). The fundamental cause seems to be changes in plant hormone balance, brought about by abiotic conditions such as environmental stress or living infectious agents. Some rose varieties such as floribundas are more likely to exhibit phyllody symptoms, probably due to genetic susceptibility. In fact, one floribunda ancestor is *Rosa chinensis*, from which came the "Green Rose," a curious variety that has a stable mutation causing phyllody in all its flowers.

Phytoplasmas and viruses can disrupt normal hormone production, inducing phyllody in many plant species, but play less important roles in rose phyllody. Although a few reports exist of rose phyllody caused by phytoplasmas, the association is poorly documented. Rose rosette disease, believed to be caused by a virus vectored by the eriophyid mite *Phyllocoptes fructiplilus*, also is reported to cause phyllody of rose blossoms. Insects—most often leafhoppers—can spread these diseases, so the appearance of phyllody often raises concerns about possible disease spread through the garden.

However, in roses the most common cause of phyllody is environmental stress, such as hot weather when flower buds are forming, or water stress. If environmental factors are the cause, affected plants usually have normal and abnormal flowers simultaneously but otherwise look healthy. When the weather cools, the bush resumes producing normal flowers.

Rose growers familiar with the characteristics of individual varieties can assess if phyllody is caused by disease or environmental stress by carefully examining plants. A lack of stunting or yellowing and good overall growth indicate a virus or phytoplasma likely isn't the cause but instead an individual flower probably is responding to specific environmental conditionals.

No management practices are suggested other than pruning out individual blooms.

CANKERS OR GROWTHS ON CANES

Botrytis blight, as described above, can cause twig dieback and blotches on canes. A number of different fungi can cause stem cankers and dieback. Cankers are brown, often with gray centers or small, black, spore-producing structures on dead tissue.

It is important to provide proper care to keep plants vigorous to prevent problems. Prune out diseased or dead tissue, making cuts at an angle in healthy tissue just above a node, and avoid wounding canes. Cankers often develop after cold temperature injury, so early spring pruning may not effectively eliminate them if late frosts occur; additional late spring pruning may be necessary.

Winter injury from cold temperatures results in dead or dying flowers, twigs, and stems. A thick layer of leaf mulch may protect roses during the winter in cold mountain areas. Stem canker diseases caused by pathogens that move into injured tissue may follow winter injury.



Figure 8. Botrytis blight has infected these rose petals.



Figure 9. This rose exhibits symptoms of phyllody in the center of its flower.

Sunburn appears as blackened areas, especially on the south and west sides of canes. Excessive temperatures on rose canes cause sunburn, usually as an indirect result of drought stress or spider mite pressure, which caused defoliation. Reflected heat from masonry, vinyl siding, or rock mulch also can cause canes to sunburn.

Crown gall, caused by the bacterium *Agrobacterium tumefaciens*, affects many woody plants including fruit trees, ornamentals, and roses as well as some herbaceous plants including chrysanthemums and daisies. Crown gall bacteria invade tissue after wounding. Galls, in the form of large, distorted tissue growth, form at the base of the cane or sometimes on roots or farther up on stems. Infected canes can be stunted and discolored. Do not plant susceptible plants in infested soil or near infected plants. Purchase and plant only high quality stock.

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AUTHORS: J. F. Karlik, UC Cooperative Extension, Kern Co.; and D. A. Golino, Foundation Plant Services, UC Davis.

TECHNICAL EDITOR: M. L. Flint

COORDINATION AND PRODUCTION: M. L. Fayard

PHOTOGRAPHS: **Figs. 1 and 3-8.** J. K. Clark; **Fig. 2.** J. F. Karlik; **Fig. 9.** B. S. Ferguson.

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