



# Organic Fungicides for the Home Garden

WASHINGTON STATE UNIVERSITY EXTENSION FACT SHEET • FS128E

## Introduction

Plant diseases caused by fungal pathogens are very common in home gardens in the Pacific Northwest, particularly west of the Cascade Mountains. Spring rains combine with warm temperatures and tender new plant growth to create ideal conditions for fungi to thrive and spread. Common fungal diseases seen in home gardens include powdery mildew, downy mildews, rusts, and late blight. Some fungal diseases are mild, only affecting the way a plant looks. Others are more serious, impairing tissue growth and plant health, and in severe cases can even cause death of the plant.

Fortunately, there are many products available to home gardeners for managing diseases caused by fungal pathogens on plants. Effective products include those derived from natural substances in addition to the synthetic chemicals commonly used. This fact sheet describes organic fungicides and provides information on:

- which organic fungicides are legal and available to home gardeners,
- how effective these organic fungicides are, and
- whether the products have unintended effects on people or the surrounding environment.

Check the WSU Hortsense Website (<http://pep.wsu.edu/hortsense/>) for a list of fungicides available and labeled for use in Washington.

## What is an organic fungicide?

Materials used in organic gardening must meet a national standard as described in the Organic Food Production Act of 1990. According to the USDA, organic is “a labeling term that indicates that the food or other agricultural product has been produced through approved methods that integrate cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity. Consequently, synthetic fertilizers, sewage sludge, irradiation, and genetic engineering may

not be used.” In contrast, materials promoted as “natural” have no standard and the term “natural” is not regulated. The fungicides reviewed in this fact sheet are labeled as organic and are approved by the Washington State Department of Agriculture for homeowner use to control fungal diseases in the state of Washington.

## How do fungicides work?

Most fungicides act as preventatives (to prevent an infection from taking place) or curatives (to cure an existing fungal infection). The most common organic fungicides are preventative and work by creating a physical or chemical barrier to infection. They must be applied either before or at the very first signs of disease. Some products form a protective coating over the plant tissue, so pathogen spores cannot reach the plant. Others smother any fungal spores already on plant tissues. Finally, some preventative fungicides can change the chemical environment of the plant so disease-causing fungi cannot get established.

Curative fungicides are usually extracts from beneficial bacteria or fungi. When applied, these fungicides change the plant so pathogenic bacteria and fungi are unable to spread from the original infection site. Some of these curative fungicides may also be preventative in that they also give some extended protection to the treated plant.

Some approved organic fungicides are oils identified as surfactants (Table 1). While some surfactant oils do have fungicidal activity on their own, others have no effect. Use of these latter oils on their own is not recommended, even though they are registered as fungicides.

## When should organic fungicides be applied?

Weather is the biggest factor to consider in deciding when to apply a fungicide. Many symptoms of fungal disease first appear in damp weather. To be effective, a preventative fungicide needs to remain on the plant before the disease becomes established. This can be difficult when the plant



*Copper sulfate is one of the active ingredients in organic fungicides registered for home use in Washington. Image courtesy of User: Rai'ke at [http://commons.wikimedia.org/wiki/File:Copper\\_sulfate\\_Chalcanthite.jpg](http://commons.wikimedia.org/wiki/File:Copper_sulfate_Chalcanthite.jpg).*

surface is wet and continued rain or heavy dew may wash off the treatment. If it is not possible to apply a preventative fungicide, choose a curative product instead. Table 1 lists preventative and curative fungicides.

Timing and number of applications are often critical for maximum fungicidal efficacy. Even the most effective organic fungicides will need more applications with less time between treatments than their synthetic counterparts. For these reasons, organic fungicides should be just one part of a good disease management plan.

## What are other strategies for treating fungal infections?

In addition to using chemicals, gardeners can take some preventative actions:

- Purchase proven disease-resistant plant materials at the nursery.
- Plant in locations with the highest light levels that the plant will tolerate. This information will be available on the nursery tag.
- Ensure sufficient air movement around the foliage to allow leaves to dry.
- Maintain good garden hygiene throughout the growing season by locating, removing, and discarding infected plant tissues. Do not leave infected plant tissue that can attack the next year's growth.

**Table 1. Active ingredients in organic fungicides registered for home use in Washington State.**

Active Ingredient	Pest*	Brand Names	Mode of Action	Efficacy and Side Effects**
Ammonium salts of fatty acids	F	Bayer Natria	Unknown	There is no published science on the use of this ingredient as a fungicide.
<i>Bacillus subtilis</i>	B/F	Bayer Natria, Serenade	Curative. Anti-fungal action from bacteria.	Low to moderate efficacy; up to 50% disease reduction. Best results when used to treat powdery mildew and applied at the first signs of disease. Does not persist, so reapplication will be required. May cause slight damage to plant tissues if applied at high levels.
Canola oil	F	Bayer Natria, Earth-Tone, Garden Safe, Worryfree	Surfactant and preventative treatment. Added to formulations to help coat plant surfaces.	Has fungicidal properties with very high (near 100%) efficacy. Best when used before disease symptoms are seen. Acts directly and locally—untreated leaves will show disease symptoms. Too high a concentration may have adverse effects on plant growth.
Cinnamon oil	F	All Natural	Preventative. Prevents germination of spores.	Efficacy may be very high, near 100%, when spores are present at low levels. Effectiveness increases with concentration, but so does the risk of plant tissue damage. Best and safest used before disease symptoms are seen. May help boost numbers of beneficial microbes.
Clove oil	F	All Natural	Preventative. Inhibits the growth of fungal cells.	May have different levels of effectiveness against different pathogens and conditions. May have beneficial effects on plant growth and flowering, as well as beneficial microbes. Documented high efficacy against soilborne fungi, such as wilts and root rots. Efficacy is highest before signs of disease are seen.
Copper octanoate	B/F	Bonide, Concern, L/M Cueva, Earth-Tone, Ortho Elementals, Worryfree	Preventative. Mechanisms not well documented.	Potentially high efficacy, 74% in greenhouse trials against powdery mildew. Material may persist in the soil, but potential effects are not documented.
Copper sulfate	B/F	Bonide	Curative and preventative.	Potentially high efficacy, ranging from 50% up; has been used extensively against many fungi and bacteria, particularly mildews. Does not move freely through soil or plant tissues; is known to persist and accumulate. Dependence upon copper sulfate alone for fungicidal control, over time, may result in stunted plant growth and fruit yield, particularly in acidic soils (below pH 6.5).

Active Ingredient	Pest*	Brand Names	Mode of Action	Efficacy and Side Effects**
Kaolin	F	Surround	Preventative. Adheres to leaf surfaces, preventing spores from infecting tissue.	Low efficacy, around 20%. No known side effects. Reapplication required after rainfall. Efficacy may be much higher on smooth leaf/fruit surfaces than fuzzy or deeply textured ones.
Malic acid	NA	All Natural	Unknown.	There is no published science on the use of this ingredient as a fungicide.
Mineral oil	F	Monterey, Pure Spray, Saf-T-Side	Surfactant only. Added to formulations to help coat plant surfaces.	Used as a surfactant; significantly boosts the antifungal properties of other agents, but does not provide control by itself. May cause some plant tissue damage or cause harm to beneficial insects if misapplied.
Neem oil	B/F	Bayer Natria, Bonide Garden Rite, Concern, Garden Safe, Green Light, Monterey, Safer	Preventative. Smothers fungal spores, preventing germination and growth.	Moderate to high efficacy, from 60–90%. Not long-lasting, so reapplication is necessary. Not known to directly damage plant tissues. A component of neem, azadirachtin, is a well-documented insecticide. Instructions for application must be followed carefully, particularly when bees are present.
Peppermint	B/F	Ecosmart	Preventative. Smothers fungal spores, preventing germination and growth.	Low to moderate efficacy documented. No side effects documented.
Potassium bicarbonate	F	Bi-Carb	Preventative. Mechanisms not well known. May raise the leaf surface pH, making them inhospitable to fungal spores.	Moderate to high efficacy; studies indicate that control may range from 25% disease reduction on rough surfaces to over 90% on smooth surfaces. Acts on contact; does not penetrate plant tissues to provide lasting disease protection. Care should be taken to follow application instructions closely, as too-frequent application may cause some plant tissue damage.
Potassium laurate	F	Safer	Unknown.	There is no published science on the use of this ingredient as a fungicide.
Rosemary oil	B/F	All Natural, Ecosmart, Green Light	Preventative. Smothers fungal spores, preventing germination and growth. May inhibit fungal cell growth.	Low to moderate efficacy. No side effects documented.
Sesame oil	F	All Natural, Organocide	Surfactant only. Added to formulations to help coat plant surfaces.	Used as a surfactant; there is no published science on the use of this ingredient as a stand-alone fungicide.
Sodium lauryl sulfate	B/F	Ecosmart	Surfactant and moderately preventative treatment. Added to formulations to help coat plant tissues.	Older research indicates that sodium lauryl sulfate is toxic to some soilborne fungi. This material is usually used as a surfactant to carry other fungicides within solution.
Sulfur	B/F	Bonide, Defend, Fertlome, Lilly Miller, Safer	Preventative and curative. One of the world's oldest fungicides, sulfur prevents the germination of fungal spores.	Low to moderate, providing some control. Historically used for many diseases, including fruit scabs, mildews, and rots. When applied, most material remains on plant surfaces, but an estimated 1–3% is taken up by the plant as a nutrient, which may help with sustained disease resistance. Generally considered best when used with other agents, as it seems to boost the effectiveness of other antifungal materials as well as impart some degree of resistance to the plant, helping manage ongoing inoculation.
Thyme oil/leaves	B/F	All Natural, Ecosmart	Preventative. Smothers spores and prevents germination, also affects cell growth.	Potentially high, but efficacy varies with different diseases and conditions, from 25% disease reduction for black spot on roses to over 70% disease reduction for powdery mildew. There is documentation that this essential oil may attract beneficial microbes in the soil.

\*B=bacteria; F=fungi; NA=not applicable

\*\*Because there are few scientific studies on some of these products, and because there can be differences between lab studies and field results, product effectiveness can vary. In other words, you may not get satisfactory fungal control with some of these products.

## What precautions should I take when using organic fungicides?

Although organic fungicides are naturally derived, they are still substances that can cause harm if misused or misdirected towards susceptible, non-target organisms. For instance, essential oils used as organic fungicides can also kill beneficial microbes. They can also irritate the skin or eyes. It is important that you read, understand, and follow the directions that appear on the label of any product used to control fungal diseases on plants. Dispose of unused product appropriately, according to your local hazardous waste collections agency. Use the same care when applying organic fungicides as you would use when applying any toxic chemical.

## Additional Readings

The Organic Materials Review Institute provides a free searchable database of approved organic substances. [www.omri.org](http://www.omri.org).

The Washington State Department of Agriculture Organic Food Program provides a free list of approved materials, by brand name. <http://agr.wa.gov/FoodAnimal/Organic/MaterialsLists.aspx>.

The King County Hazardous Waste Program provides a free searchable database of approved homeowner organic

products that are available from Puget Sound retailers. <http://www.growsmartgrowsafe.org/>.

The National Pesticide Information Center (NPIC) provides objective, science-based information about pesticides and pesticide-related topics through a web page, fact sheets, and staffed phone lines. <http://npic.orst.edu/>.

The United States Department of Agriculture National Organic Program (NOP) provides consumer information on organic standards. <http://www.ams.usda.gov/AMSV1.0/nop>.



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