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Using Organic Fungicides

Janna Beckerman
Department of Botany and Plant Pathology, Purdue University

When confronted with a disease, many homeowners and landscape professionals say they prefer to use organic products because they are more environmentally friendly. Others say they just want to use a product that works, regardless of the ecological impact. Many organic fungicide products can satisfy the needs of both groups in one container, providing effective control with minimal ecological impact. However, improperly using any chemical (organic or otherwise) will result in poor control and may harm non-target organisms.

This publication offers strategies for properly using organic fungicides and describes various kinds of these products.

Plant Health Management

Effectively using organic fungicides (or any fungicide for that matter) requires a solid plant health management strategy. A traditional integrated pest management (IPM) program focuses solely on the pest or pathogen. However, good plant health management focuses more on the actual plant, including:

- Identifying the right plant for the site.
- Using resistant varieties (when available).
- Practicing strategies that help keep that plant healthy and avoid insect and disease problems in the first place.

The key to effective plant health management is prevention. This includes doing your homework before planting by carefully matching plants that are appropriate to the type of soil, sunlight levels, and watering conditions of the site. Once the plants are in the ground, successful plant health management relies on proper sanitation, appropriate fertilization, and necessary pruning practices.

Using pesticides may be one part of a plant health program, but it is never the sole strategy for plant health management.

Photo by Dan Egel

Figure 1. *Some plants can be "allergic" to a given chemical — this is called phytotoxicity. Always check product labels to reduce the chance of unintentionally injuring plants.*

Be Certain Before You Spray

Before applying any pesticide, good plant health management requires that the problem be properly diagnosed before any management program is implemented. Purdue Extension publications provide descriptions of some landscape plant disease problems (www.extension.purdue.edu/extmedia/botany.htm#3) and some fruit disease problems (www.extension.purdue.edu/extmedia/botany.htm#2). The most accurate diagnosis, however, will come from a certified testing lab, like the Purdue Plant

& Pest Diagnostic Laboratory (for sampling and submission guidelines, visit www.ppdl.purdue.edu). After accurately diagnosing the problem, the next step is to identify which pesticide is best for the problem you wish to manage.

Remember to always check the product label to be sure the plant you wish to treat is labeled and that no contraindications exist. The label is not only the law (which means you must follow the recommended doses and rates) it also provides important warnings to help protect your plants and your health. Sometimes, a plant is "allergic" to a given chemical (termed *phytotoxicity*). In such cases, the "allergic" plant is listed as a contraindicated plant on the product label (Figure 1). Pesticide labels also provide temperature and weather limitations, and requirements for protective measures you should take before application.

Carefully follow the labeled rates for any pesticide. Too often, users apply pesticides at higher rates than specified on the label, hoping for better control or a more lasting effect. But over applying a pesticide like this is dangerous for the plant, the applicator, and the environment. The application rates on a pesticide label are based on the amounts needed for control. If these rates don't achieve reasonable control, it is often the result of choosing the wrong pesticide for the problem, making an incorrect diagnosis, or applying the chemical at the improper time — not applying an inadequate amount.

However, it is frequently necessary to repeat applications at intervals of 7, 10, or 14 days over the growing season to protect the new growth that has developed since the last spray, or to replace spray residues that are no longer effective because of weathering and chemical breakdown. Due to their nature, organic pesticides often require more frequent applications than their synthetic counterparts.

Ultimately, following practices that prevent diseases is essential to successful organic gardening (or any type of plant health management) because established populations of plant pathogens don't respond well to any chemical — organic or synthetic.

There are a number of organic fungicides growers can use to prevent plant diseases:

- Sulfur
- Copper
- Oils
- Bicarbonates

Each of these products and their uses are described in more detail below.

Sulfur

Sulfur is the oldest recorded fungicide and has been used for more than 2,000 years. Early in agricultural history, the Greeks recognized its efficacy against rust diseases on wheat.

Table 1. Natural Fungicides Available

This is a partial list of organic fungicides available for home or professional use. Note: not all natural fungicides are considered organic, or bear Organic Materials Review Institute (OMRI) labels.

Active Ingredient	Chemicals for Homeowners	Chemicals for Professionals
sulfur	Bonide Liquid Sulfur® Bonide Sulfur Plant Fungicide® micronized sulfur	Microthiol Disperss®, micronized sulfur Sulfur 6L® Sulfur 90W®
lime-sulfur	Polysul® Lime Sulfur Spray®	lime-sulfur lime sulfur solution lime sulfur six
copper	Liqui-Cop® Concern Copper Soap® Liquid Copper 4E® Copper Dust®	Kocide 3000® Cuprofix Ultra 40 Disperss®COCS copper
horticultural oil	Green Light Horticultural Oil® All Seasons Horticultural Oil® Summit Year Round Horticultural Oil®	Dormant Oil 435® Forest Crop Oil® JMS Stylet-Oil® Organic JMS Stylet-Oil® ProNatural Dormant Oil®
neem oil	70% neem oil	Triact-70®
bicarbonates	GreenCure® Kaligreen® Bi-Carb® Remedy®	Armicarb 100® Remedy®

Although few homeowners grow their own wheat, sulfur can be a preventive fungicide against powdery mildew, rose black spot, rusts, and other diseases. Sulfur prevents fungal spores from germinating, so it must be applied before the disease develops for effective results. Sulfur can be purchased as a dust, wettable powder, or liquid.

Do not use sulfur if you have applied an oil spray within the last month — the combination is phytotoxic (plant-killing). Likewise, do not use sulfur when temperatures are expected to exceed 80°F to reduce the risk of plant damage. Finally, there are certain "sulfur-shy" plants (including varieties of gooseberries, currants, apricots, raspberries, and cucurbits) that should never be treated with sulfur.

Lime-sulfur is a form of sulfur mixed with lime (calcium hydroxide), and is mostly used as a dormant spray, meaning it should not be applied to plant foliage. Lime-sulfur is more effective than elemental sulfur at lower concentrations; however, its strong, rotten-egg odor usually discourages its use over extensive plantings.

Copper

Several copper fungicide formulations are available to organic growers. Regardless of the formulation, copper fungicides effectively kill fungi and bacteria. Unfortunately, care must be taken to prevent copper from damaging the host plant.

Copper sulfate (also called bluestone) was one of the original forms of copper used as a fungicide.

Bordeaux mixture combines copper sulfate with lime (calcium hydroxide), which acts as a "safener" to neutralize the acidic copper sulfate — this reduces plant damage.

Although not the oldest fungicide, Bordeaux mixture has been used successfully for more than 150 years on fruits, vegetables, and ornamentals. Sulfur is only fungicidal, but Bordeaux mixture also is bactericidal, which means that it can be effective against disease caused both by fungi (such as powdery mildew, downy mildew, and various anthracnose pathogens) and by bacteria (such as bacterial leaf spots and fire blight).

Bordeaux mixture owes part of its success to its ability to persist through spring rains and adhere to plants. Bordeaux mixture comes in several formulations. One of the most popular, effective, and least phytotoxic formulations for general home garden and orchard use is the 4-4-50 formulation. The numbers translate into the number of pounds of copper sulfate (4) and pounds of lime (4) that should be in 50 gallons of water. This formulation was developed because copper, like sulfur, can be phytotoxic.

Young foliage is especially sensitive to copper, so if you apply Bordeaux mixture in the spring after the plant breaks dormancy (for example, to prevent infection by the fire blight bacterium, *Erwinia amylovera*), use a weaker, more dilute formulation to reduce the risk of plant injury. Take care when applying this fungicide to the young, tender leaves of apple (*Malus* spp.), pear (*Pyrus* spp.), plum (*Prunus* spp.), or rose (*Rosa* spp., but especially *R. rugosa* spp. and hybrids). Sensitive plants include geranium (*Pelargonium sp.*), ivy (*Hedera sp.*), pansy (*Viola x wittrockiana*), celery (*Apium graveolens*), strawberry (*Fragaria* sp.), azalea and rhododendron (*Rhododendron* spp.), dogwood (*Cornus* sp.), juniper (*Juniperus* sp.), and alyssum (*Alyssum* spp.).

For some diseases or late-season applications, some Bordeaux mixture labels recommend twice as much fungicide, which translates into an 8-8-50 formulation. As always, refer to the label for recommended rates.

Applying Bordeaux mixture when it's hot (above 85°F) may cause leaves to turn yellow and drop. Additionally, leaves can be burned if it rains soon after a Bordeaux application. The burn risk can be reduced by adding a spray oil (see below).

Bordeaux mixture can be applied as a dust or liquid formulation. Some sensitive plants require diluting the product to half strength, so again, always read the product label.

Oils

Oils are most frequently used to manage insects. However, certain oils (horticultural oils and neem oil) can minimize the spread of viruses by controlling the insects that transmit them, namely aphids, whiteflies, and mites. Aphids transmit the viruses that cause many common landscape and garden diseases, including Cucumber mosaic virus, Potato virus Y (potyvirus), and Watermelon mosaic virus. Also, oils have also been found to control thrips — an important vector of Impatiens necrotic spot virus (INSV) — and to reduce the spread of Tobacco mosaic virus by human and tool contact. Oils effectively manage powdery mildew on many plants, but are significantly less effective against other leaf spot diseases.

Several plant species are sensitive to oils, particularly black walnut (*Juglans nigra*), maples (especially Japanese (*Acer palmatum*) and red maple (*A. rubrum*)), hickories (*Carya* spp.), redbud (*Cercis* spp.), and smoke tree (*Cotinus coggygria*). Other trees susceptible to damage from oils include the following conifers: junipers (*Juniperus spp.*), cedars (*Thuja* sp. and *Cedrus* spp.), spruce (*Picea* spp.), and Douglas-fir (*Pseudotsuga menziesii*).

In conifers, damage ranges from needles being stripped of their bluish color to turning completely brown. In broadleaf plants, oil damage causes a light yellowing that later develops into water-soaked lesions that darken and eventually die.

Horticultural Oils

Mineral oils are a type of refined petroleum product, and horticultural oils (Sunspray®, Scalecide®, Volck®) are mineral oils that have been distilled to remove impurities that can damage plants. The final formulations of these oils are combined with an emulsifying agent that allows the oil to mix with water.

Several different types of horticultural oil may be used in the landscape or garden. In the past, this led to a great deal of confusion. Historically, "summer" and "dormant" described different oils and their uses. Summer oil (a lighter oil) was used on green tissue during the growing season, while dormant oil was used on woody plants (especially fruit trees) when they were dormant. Today, dormant oil refers to the application timing, not to any specific type of oil. Most oils currently available are the "superior" type, which means they are more highly refined and can be used over a range of conditions without phytotoxicity (assuming users follow the labels).

Do not apply horticultural oil when the temperature exceeds 90°F or falls below 40°F. In the Midwest, high humidity can prevent rapid oil evaporation, which can contribute to plant phytotoxicity. Ideally, apply horticultural oil when the relative humidity is less than 65 percent so the oil can evaporate quickly.

Neem Oil

Neem oil is pressed from the fruit and seeds of the neem tree (*Azadirachta indica*). At a 70 percent concentration, neem oil kills powdery mildew spores, virus vectors (such as aphids and white fly), and the eggs of numerous insect pests. It is less effective against rose black spot (caused by *Diplocarpon roseae*) and other fungal diseases.

Bicarbonates

Baking soda (sodium bicarbonate) has been used as a fungicide since 1933. Recent research has demonstrated that although baking soda can be effective against plant diseases when used with oil, its sodium component can build up and become toxic to plants.

Better control, and plant health, was obtained with potassium bicarbonate and ammonium bicarbonate, although different bicarbonate salts have produced different results in different plants, which make specific recommendations difficult. Furthermore, baking soda without oil is ineffective against most diseases. For this reason, using ammonium bicarbonate or potassium bicarbonate is recommended. These bicarbonates have the added advantage in that they provide nitrogen and potassium (nutrients plants need), unlike baking soda, which leaves behind toxic sodium.

Conclusion

Managing plant disease problems in the Midwest is a challenge. Successfully managing your plant health problems organically requires carefully choosing the right plants, properly planting and maintaining them, and quickly diagnosing any problems correctly before you apply any chemical.

Reference

Ellis, Barbara W. and Fern Marshall Bradley. 1992. *The Organic Gardener's Handbook of Natural Insect and Disease Control.* Rodale Press. Emmaus, PA. 534 pp.

Reference to products in this publication is not intended to be an endorsement to the exclusion of others that may be similar. Persons using such products assume responsibility for their use in accordance with current directions of the manufacturer.

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