

Table 4: Detailed information about the characteristics and use of specific fungicides or bactericides for diseases of woody ornamentals in Massachusetts.

ACTIVE INGREDIENT(S)	DESCRIPTION
Azoxystrobin	Azoxystrobin has the broadest spectrum of any current fungicide. It has both preventative and curative effects with locally systemic properties in the strobilurin class of fungicides. Fungicides with this active ingredient can have utility against several types of cankering and anthracnose fungi. Azoxystrobin is highly phytotoxic on certain apple, crabapple and cherry varieties. Follow label instructions regarding the development of fungicide resistance over time.
Azoxystrobin + Propiconazole	Both chemicals are broad spectrum and have protectant, systemic and curative activity. Because resistance to azoxystrobin by fungal pathogens can develop over time, propiconazole can help to ameliorate this issue through a different mode of action. Mostly used for persistent cankering and anthracnose pathogens.
Boscalid + Pyraclostrobin	Broad spectrum fungicide used mostly for high-value fruit and nut trees. Helps to control powdery mildew, foliar and shoot blight pathogens, including anthracnose. The risk of resistance development is high for both active ingredients.
Calcium Polysulfide (Lime Sulfur)	Inorganic compound used as a fungicide as well as an insecticide (for scales). Often used during the dormant season or just before buds open to reduce over-wintering inoculum. Do not use within 14 days of horticultural oil spray or when temperatures are above 75°F.
Chlorothalonil (R)	A broad-spectrum, protectant fungicide that is effective against numerous anthracnose, needle cast, foliar and shoot blight diseases. Although fungicides with this active ingredient are widely available, chlorothalonil is a restricted use chemical in Massachusetts and should never be used on plants near water sources because of its toxicity to fish and aquatic invertebrates.
Chlorothalonil + Propamocarb Hydrochloride (R)	Broad spectrum contact plus systemic fungicide combination product used to treat both foliar blight and soilborne pathogens. Chlorothalonil is a restricted use chemical in Massachusetts and should never be used on plants near water sources because of its toxicity to fish and aquatic invertebrates.
Chlorothalonil + Propiconazole (R)	Broad spectrum combination product that has utility against a wide array of fungal pathogens, including anthracnose, needlecasts, rusts, foliar blights and stem cankers. Chlorothalonil is a restricted use chemical in Massachusetts and should never be used on plants near water sources because of its toxicity to fish and aquatic invertebrates.
Chlorothalonil + Thiophanate-methyl (R)	Broad spectrum contact plus systemic fungicide combination used to control a broad array of pathogens causing foliar and flower blights, stem cankers, rusts and powdery mildew. Chlorothalonil is a restricted use chemical in Massachusetts and should never be used on plants near water sources because of its toxicity to fish and aquatic invertebrates.
Copper	Copper compounds are toxic to both fungi and bacteria and are used as protectant fungicides and bactericides. Some products are compatible with other fungicides or insecticides and may leave a residue. Copper compounds may injure plants when used at temperatures below 50°F or during periods of high humidity. Phytotoxic when applied in spray solutions having a pH less than 6.5.
Debacarb (+ Imidacloprid)	Broad spectrum fungicide with broad spectrum insecticide applied by microinjection into the vascular system. Used to control a wide array of insect pests and fungal pathogens. Best used on trees that have a complex of chronic insect and disease problems.
Debacarb + Carbendazim	Broad spectrum combination product applied by microinjection into the vascular system. Used to help control vascular wilt diseases (Dutch elm disease and verticillium wilt), stem cankering pathogens, and certain anthracnose diseases. Best used preventatively for wilt diseases, but has therapeutic effects.
Etridiazole	A seed and soil fungicide that is used to control <i>Pythium</i> and <i>Phytophthora</i> . May not be compatible with other pesticides.
Etridiazole + Thiophanate-methyl	Broad spectrum contact plus systemic fungicide used to manage soil-borne diseases. Formulated as a soil drench or side dressing.
Fenarimol	Sterol inhibitor that's a locally systemic foliar fungicide with protective and curative actions. Primarily used to control powdery mildew fungi.
Flutolanil	A systemic fungicide used as a preventative and curative to manage rusts and species of <i>Rhizoctonia</i> . In the benzalide chemical group.
Fosetyl-Aluminum	A narrow-spectrum compound that is used as a fungicide and bactericide. Alternative material for treating <i>Pythium</i> and <i>Phytophthora</i> root rots. Moves both upward and downward in the transpiration stream. May not be compatible with foliar fertilizers or copper-based fungicides. Do not use with spreader-stickers.
Horticultural Oil	Useful for the management of powdery mildews on certain plants. When using horticultural oil, conduct a small-scale test spray on an inconspicuous part of the plant to check for sensitivity to the oil treatment. Greenhouse grown plants tend to be more sensitive to oil treatments. The following environmental conditions increase plant sensitivity to horticultural oil: high humidity, heavy overcast, extended rain, inadequate air movement, intense sun and/or heat build-up that stresses plant, darkness, plants experiencing water shortage, and prior to, during or following unusually cold or freezing temperatures. Check product label for compatibility information regarding the use of oil treatments with other chemicals.
Iprodione	A broad-spectrum foliar fungicide with mostly preventive but some early curative effects. Locally translocated in the plant. Also used as soil drench or dip. Some chance of short term fungicide resistance.

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Iprodione + Thiophanate-methyl	Broad spectrum contact plus systemic fungicide used to control a wide array of foliar blight pathogens.
Kresoxim-methyl (R)	A foliar fungicide for use on ornamentals in nurseries and non-residential landscapes. Provides protective and curative activity against powdery mildew, as well as protective activity against certain leaf spot, rust, anthracnose, and downy mildew diseases. It is most effective when a protective barrier is established and maintained on the plant surface. Kresoxim-methyl is a restricted use chemical in Massachusetts and should never be used near water sources.
Mancozeb	A broad-spectrum contact dithiocarbamate fungicide also used as a soil drench for particular diseases. Surfactants can be used for maximum coverage and retention in wet weather. A coordination product of zinc ion and manganese ethylene bisdithiocarbamate.
Mancozeb + Copper Hydroxide	Broad spectrum, contact fungicide and bactericide product used to control fire blight, anthracnose diseases and needle cast.
Mancozeb + Thiophanate-methyl	Broad spectrum contact plus systemic fungicide.
Mefenoxam	Used for damping off, root and stem rot caused by <i>Pythium</i> and <i>Phytophthora</i> . Apply as a soil drench, soil surface spray, or incorporate into soil mix. May develop resistant strains of the target pathogen. Earlier formulations of Subdue (metalaxyl) are chemically related to mefenoxam.
Myclobutanil	Protectant and curative fungicide for foliar diseases with locally systemic properties. Compatible with most other pesticides and horticultural materials. Spreader-stickers are recommended. Overdosage can result in shortened internodes and excessive foliar greening.
<i>Myrothecium verrucaria</i>	This biological nematicide suppresses a number of parasitic plant nematodes. Incorporate <i>Myrothecium verrucaria</i> into the soil as a dry granule, ground spray, or using approved irrigation systems.
Neem Oil	A fungicide for the prevention of black spot on rose, powdery mildew, Botrytis blight, anthracnose, rust, and scab on a number of plants. Follow label directions to avoid phytotoxicity.
Phosphorous Acid	A systemic fungicide for the prevention of diseases caused by <i>Phytophthora</i> , <i>Pythium</i> and downy mildew on specific labeled host plants. Increasingly being used to treat many other types of diseases. In addition, it suppresses certain bacterial blights on particular labeled hosts.
Potassium Bicarbonate	Broad-spectrum contact fungicide to suppress powdery mildew, Botrytis blight, and some leaf spot diseases.
Propamocarb Hydrochloride	Applied as a soil drench, seed treatment and soil surface spray for prevention of root rot and damping-off by species of <i>Phytophthora</i> and <i>Pythium</i> . Systemic activity is primarily upward in the plant. Compatible with other fungicides. For use on greenhouse crops and field-grown ornamentals.
Propiconazole	Widely used, sterol inhibitor fungicide that has protectant, systemic and curative activity. Mostly used for its long-term protectant and eradicant activity against foliar blights and anthracnose. Formulated as foliar spray or trunk injection.
Streptomycin Sulfate	Antibiotic used as a bactericide. Some practitioners recommend adjuvants that increase the uptake of the Streptomycin sulfate. The extent to which antibiotics should be used for fireblight depends on three things: (1) Susceptibility of the plant: Highly susceptible plants are obviously more at risk. Treating a plant that is not moderately to highly susceptible to fireblight is not recommended. (2) History of fireblight on a site: If there is no history of fireblight, there is little inoculum to cause a problem. This can change quickly if conditions are just right, though. In addition, low levels of fireblight are not very noticeable, so in some cases the disease is present but it is not known. (3) Environmental conditions: Fireblight prediction models track environmental conditions and can indicate when the risk of fireblight infection is high. Contact the UMass Extension Tree Fruit Program at 413-323-4208 during the growing season for ongoing monitoring information, or go online to: extension.umass.edu/fruitadvisor .
Sulfur	Inorganic element or compound used as a foliar fungicide as well as an insecticide. May cause plant injury if used when temperatures are above 75°F. Do not use within two weeks of oil sprays. Primarily used for powdery mildew and foliar diseases of rose.
Tebuconazole + Trifloxystrobin	Limited spectrum contact and systemic combination fungicide with utility against anthracnose, powdery mildew and foliar/ blossom/ fruit blight diseases of fruit trees.
Thiabendazole Hypophosphite	Broad-spectrum systemic fungicide, used preventively as well as therapeutically in the early stages of disease.
Thiophanate-methyl	A broad-spectrum systemic fungicide for foliar applications and soil treatments. Use of spreader-sticker or wetting agent recommended. <i>Do not mix with copper containing materials.</i>
Triadimefon	Sterol inhibitor systemic fungicide with both curative and protective action.
Triadimefon + Trifloxystrobin	Both chemicals are systemic and both curative and protective modes of action. Used to control anthracnose, powdery mildew, rusts and some foliar blight pathogens.

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<i>Trichoderma harzianum</i> var. <i>Rifai</i>	A preventative biological fungicide for management of soilborne root diseases. When applied properly to soil mix or in backfill with transplants the microbe grows into developing plant roots and protects them against root diseases such as <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Fusarium</i> , <i>Cylindrocladium</i> , and <i>Thielaviopsis</i> .
Trifloxystrobin	A strobilurin type fungicide with contact and systemic activity. Follow label instructions for minimizing resistance.
Triflumizole	Protectant fungicide with locally systemic activity. Used as a foliar spray, soil drench or as a soak for propagation. Also used as eradicant.

(R) denotes chemical has restricted use status in Massachusetts.