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Alternative Plant Disease Management Practices for the Home Garden

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Introduction

As environmental awareness increases, many home gardeners are interested in growing their gardens with minimal synthetic chemical inputs. Several key components constitute plant disease management by more environmentally sensible means. Managing plant disease organisms without the use of conventional chemical fungicides or bactericides can sometimes be a challenge even to the most avid home gardener. There are several management options the home gardener can practice that have minimal impact on the environment in which we grow and maintain our crops. Extensive research has demonstrated that a vigorous plant is less susceptible to many biotic (infectious) plant diseases. Thus, gardeners should place special emphasis on creating an optimum growing environment in the garden, which in turn minimizes plant stress. Plant stress often leads to many other problems, including infectious diseases which can threaten the aesthetic and economic value of the garden.

Management Tools

There are several "earth friendly" plant disease management methods available to the home gardener. It is important to realize that these tools may not achieve 100% control; thus, gardeners should be willing to tolerate or allow for an acceptable level of disease activity in the garden and still have a productive and pleasing garden.

Utilizing any cultural and chemical management practice requires a good understanding of the life cycle of the infectious disease agent(s) that may have a significant impact on plant health. This understanding is useful for such things as the timing of planting of the garden and application of disease management products such as biopesticides. Biopesticides are those substances that are derived from natural materials such as plants, animals, bacteria and certain minerals. Some select biopesticides consist of a bacterium or fungus as the active ingredient and have been shown to control certain fungal or bacterial plant diseases (**Table 1**). These biopesticides are considered less toxic than many of the "conventional" chemical fungicides or bactericides and generally affect only the target pest or closely related organisms. Examples of other biopesticides include neem and pepper extracts, compost teas, various horticultural or vegetable-based oils and garlic extracts.

Various formulations of elemental copper and sulfur products still continue to be available at many garden centers as a broad spectrum disease control. These products have been certified for organic usage by OMRI (Organic Materials Review Institute) when used according to the product label. For a complete list of these and other related products, gardeners should visit http://omri.org. Household baking soda (sodium bicarbonate) and the related compound potassium bicarbonate are commonly cited for use for certain infectious plant diseases, such as powdery mildew, on some plants. There are currently more biopesticides available to control insects than to control plant disease organisms.

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For maximum efficiency as a plant disease management tool, biopesticides should be used in conjunction with cultural methods which emphasize overall plant vigor and the management of other significant garden pests such as weeds and insects. Such cultural methods include 1) adequate fertility (based on a recent soil test including critical pH) and soil moisture levels for optimum plant growth, 2) selecting hardy, disease-resistant varieties, 3) crop rotation, 4) the addition of soil-building conditioners such as mulches, compost and manures, 5) insect and weed control, 6) prompt removal and destruction of suspected diseased plants (Do not compost these plants!) and 7) being alert to potential diseases. Collectively, we often refer to these practices as integrated pest management (IPM).

Adequate fertility and soil moisture encourage a vigorous plant, which in turn is less likely to become infected. Growing resistant varieties is one of the best and easiest ways to effectively manage many infectious plant diseases. A good example of this is black spot-resistant rose varieties and powdery mildew-resistant varieties of crape myrtle. Breeding and plant selection programs have resulted in the availability of garden vegetable varieties and some ornamental cultivars that exhibit high levels of resistance to certain plant disease organisms.

Crop rotation can be an effective cultural method of disease management for our seasonal vegetables in the home garden. This technique targets those soil-borne plant disease organisms that can survive in the soil for extended periods. The basic goal of this method is to grow a "non host" plant in an area where the plant disease organism is suspected of residing in the soil to reduce the population of the organism, thus lessening the chances of infection. An example of a good rotation scheme to manage many soil-borne organisms might be alternating tomato with corn, beans or lettuce in the same area each year. A poor rotation scheme might be something like tomato, then eggplant, then potato. Since these plants are all related to one another, the organisms which attack one may attack the other, resulting in a buildup of these disease organisms in the soil. This could force the vegetable grower to abandon the garden spot all together.

The addition of compost not only enriches the chemical and physical characteristics of the soil, but it may also provide a generous supply of beneficial microorganisms that enhance plant growth directly and serve as a reservoir for antagonistic organisms against pathogenic organisms in the soil.

Since many of our infectious plant disease agents may be carried or harbored by insects and weeds, growers should not overlook the importance of managing these potential pests within the garden and in adjacent areas as well. Many bacteria and viruses have a weed host and can be carried long distances by insects that feed on our garden plants after acquiring these organisms from an infected plant elsewhere.

Being alert to possible diseases can many times mean the difference between making a crop or not. Each year, the gardener may encounter several plant diseases in the garden, some of which may be significant whereas others may be inconsequential. It is important for the grower to be able to distinguish between the two. In most instances, prevention is much easier and better than trying to cure a disease problem. "Environmental friendly" methods of disease management through the use of biopesticides and good soil stewardship practices are more likely to be successful when problems are detected and identified early in the growing season. Early detection will allow the grower more choices to create an effective pest control program if not for the current year, then for the following season.

Table 1. Microbial Biopesticides for the Control of Plant Pathogens**
(adapted from the Ohio State University ANR HYG-3310-08)

Bactericides				
Biocontrol Organism	**Trade Name**	**Target Disease**	**Crops**	**Efficacy[1,2] (Crop/Disease)**
Bacteriophages of Xanthomonas spp. *and Pseudomonas syringae pv. tomato*	Agriphage™	Bacterial spot in pepper and tomatoes and bacterial speck in tomatoes	Tomatoes and pepper	Bell pepper/bacterial spot: +
Pseudomonas syringae strain ESC 10	Bio-Save® 10LP[3]	Ice-inducing bacteria and biological decay	Apples, pears, lemons, oranges or grapefruit after the fruit is harvested	Sweet potato/Rhizopus soft rot: +
Pantoea agglomerans strain E325	Bloomtime Biological™ 3	Fire blight (*Erwinia amylovora*)	Apples and pears	Apple/fire blight: ±
	Bloomtime Biological™ FD[3]	Fire blight (*Erwinia amylovora*)	Apples and pears	Apple/fire blight: ±

Fungicides				
Organism	**Trade Name**	**Target**	**Crops**	**Efficacy**[1,2]
Streptomyces lydicus WYEC 108	Actinovate® AG	**Soilborne pathogens**: *Pythium* spp.*, Rhizoctonia* spp.*, Phytophthora* spp.*, Fusarium* spp.*, Verticillium* spp.*, Phymatotrichum omnivorum* and other root decay fungi. **Foliar pathogens**: *Podosphaera* spp.*, Botrytis* spp.*, Schlerotinia* spp.*, Monilinia* spp.*, Alternaria* spp.*, Peronospora* spp. and other foliar fungi.	Ornamentals, leafy and fruiting vegetables, fruits, nuts, berries, grapes, cotton and other row crops, citrus, mint, herbs, potatoes and other root crops	*
	Actinovate® SP	**Soilborne pathogens***: Pythium* spp.*, Rhizoctonia* spp.*, Phytophthora* spp.*, Fusarium* spp.*, Verticillium* spp.*, Phymatotrichum omnivorum* and other root decay fungi. **Foliar pathogens***: Podosphaera* spp.*, Botrytis* spp.*, Schlerotinia* spp.*, Monilinia* spp.*, Alternaria* spp.*, Peronospora* spp. and other foliar fungi	Greenhouse, nursery and turf	Pumpkin/powdery mildew: + Pumpkin/Phytophthora leaf blight: o Pepper/Phytophthora foliar blight: +
Bacillus pumilus QST 2808	Ballad® Plus Biofungicide	Rust, powdery mildew, Cercospora and brown spot	Soybeans, cereal crops and potatoes	Soybean/Asian soybean rust: ± Soybean/target spot: ± Snap bean/ashy stem blight: ± Snap bean/rust: +
Coniothyrium minitans strain CON/M/91-08	Contans® WG	*Sclerotinia minor, Sclerotinia sclerotiorum*	Agricultural soils	Snap bean/white mold: ± Snap bean/gray mold: o Lettuce/white mold: ± Lettuce/lettuce drop: +
Bacillus subtilis GB03	Kodiak® Concentrate Biological Fungicide	Rhizoctonia, Fusarium, Alternaria, Aspergillus and others that attack the root systems of plants	Cotton, peanuts, soybeans, wheat, barley, peas and beans	Snap bean/Fusarium root rot: ± Snap bean/Rhizoctonia root rot: o Pea/Fusarium, Phoma, Pythium: ± Wheat/Fusarium crown rot: o Cucumber/damping off: o
Trichoderma harzianum Rifai strain KRL-AG2	Plant Shield® HC Biological Foliar and Root Fungicide	Fusarium, Pythium and Rhizoctonia	Cucurbit vegetables, flowers, bedding plants, ornamentals, fruiting and leafy vegetables, cole crops, hydroponic crops, pome fruits, shade house, outdoor nursery, stone fruit and tree nuts	Dry beans/Fusarium root rot: ± Snap beans/Rhizoctonia root rot: o Tomato/grey mold: o Potato/silver scurf: + Potato/black scurf: o Geranium/black leg disease: o Gladiolus/Fusarium root rot: o African daisy/powdery mildew: ±
	RootShield® Granules	Fusarium, Pythium and Rhizoctonia	Flowers, bedding plants, ornamentals, fruiting vegetables, herbs and spices, hydroponic crops, leafy vegetables, cole crops, pome fruits, stone fruits and tree nuts	Myrtle/leaf milkwort: + Potato/Rhizoctonia canker and black scurf: o Gladiolus/Fusarium corm rot: o Tomato/bacterial speck: ±

Fungicides				
Organism	**Trade Name**	**Target**	**Crops**	**Efficacy**[1,2]
Bacillus subtilis strain QST 713	Serenade® Garden Disease Control Concentrate	Bacterial spot, powdery mildew, rust, gray mold, leaf blight, scab and more	Fruits, vegetables and flowers	*
	Serenade® Garden Disease Control Ready to Use	Bacterial spot, powdery mildew, rust, gray mold, leaf blight, scab and more	Vegetables, fruits, nuts, ornamental plants, annual and perennial flowering plants, tropical foliage, trees and shrubs	*
	Serenade® MAX™	Fire blight, Botrytis, sour rot, rust, Sclerotinia, powdery mildew, bacterial spot and white mold	Vegetables, fruits, nuts and vine crops	Blueberry/anthracnose fruit rot: + Blueberry/mummy berry: ± Cranberry/fruit rot: o Apple/fire blight: o Apple/flyspeck: o Apple/sooty blotch: o Apple/black pox: o Apple/Brooks fruit spot: o
	Serenade® Wettable Powder Biofungicide	Fire blight, Botrytis, sour rot, rust, Sclerotinia, powdery mildew, bacterial spot and white mold	Vegetables, fruits, nuts and vine crops	Apple/fire blight: o Red raspberry/fruit rot: o Grape/bunch rot and powdery mildew: + Turnip greens/bacterial leaf spot: o Hydrangea/powdery mildew: + Pansy/Cercospora leaf spot: + Pumpkin, cantaloupe and honeydew/powdery mildew: + Lettuce/lettuce drop: ± Lettuce/powdery mildew: + Broccoli/downy mildew: +
	Serenade® ASO	Fungi and bacteria that cause scab, powdery mildew, sour rot, downy mildew and early leaf spot, early blight, late blight, bacterial spot and walnut blight diseases	Food crops including cherries, cucurbits, grapes, leafy vegetables, peppers, potatoes, tomatoes and walnuts	Cranberry/cotton ball: ± Spinach/Stemphylium leaf spot: o Snap bean/Rhizoctonia root rot: o Radish/hypocotyl root rot and clubroot: ±
Trichoderma virens (formerly Gliocladium virens)	SoilGard 12G[3]	Pythium, Rhizoctonia and root rots	Ornamental and food crop plants grown in green-houses, nurseries, interiorscapes and outdoors	Geranium/root rot: o Gladiolus/Fusarium corm rot: o Poinsettia/Pythium root rot: + Azalea/Phytophthora root rot: o Potato/black scurf: + Potato/Rhizoctonia and Streptomyces: o Snap beans/gray mold: ± Snap beans/white mold: o Cucumber/damping off: o
Bacillus pumilus QST 2808	Sonata®	Fungal pests such as molds, mildews, blights and rusts	Many food and non-food crops, including trees susceptible to sudden oak death syndrome. For use outdoors, including nurseries, land-scapes and rights-of-way, and for use in greenhouses	Lima beans/white mold: o Lettuce/powdery mildew: + Lettuce/lettuce drop: ± Broccoli/downy mildew: + Pumpkin/powdery mildew: o Radish/downy mildew: + Radish/clubroot and Rhizoctonia hypocotyl root rot: o

Fungicides				
Organism	**Trade Name**	**Target**	**Crops**	**Efficacy**[1,2]
Trichoderma harzianum Rifai strain KRL-AG2	T-22™ HC	Fusarium, Pythium and Rhizoctonia	Agronomic field and row crops, alfalfa, hay and forage crops, bulb crops, cucurbits, fruiting vegetables, herbs, spices, leafy vegetables, cole crops, legumes, root crops, small grains and tuber crops	Soybean/Rhizoctonia solani and drought: o
	T-22™ Planter Box	Fusarium, Pythium and Rhizoctonia	Agronomic field and row crops, alfalfa, hay and forage crops, bulb crops, cucurbits, fruiting vegetables, herbs, spices, leafy vegetables, cole crops, legumes, root crops, small grains and tuber crops	Pea/root rot: ± Bean (baby lima)/root rot: o Pea/root rot: o
Bacillus pumilus GB34	Yield Shield® Concentrate Biological Fungicide	Rhizoctonia and Fusarium	Legumes	Soybean/root rot: o Soybean/Rhizoctonia damping off: o Snap beans/root rot: o
Bacillus subtilis QST 708	Rhapsody®	Fungal and bacterial diseases; brown patch, anthracnose and dollar spot	Turf, ornamentals, trees, shrubs, flowers, bedding plants, tropical plants, seedlings, conifers, fruity and leafy vegetables and bulbs	Creeping bent grass/dollar spot, abiotic stress, brown patch and anthracnose: o Annual bluegrass (60%) and creeping bentgrass (40%)/anthracnose: + Tall fescue/Pythium blight and gray leaf spot: o Geranium/Botrytis blight: + Dogwood/powdery mildew: + Dogwood/Cercospora leaf spot and spot anthracnose: o

[1] The efficacy ratings are based on the results of studies published between 2000 and 2007 in the Plant Disease Management Network reports (http://www.plantmanagementnetwork.org/). These ratings are built on a comparison between untreated controls and the application of each product independently.

[2] + Evidence for disease control and/or yield increase, ± mixed results, o no obvious response to treatment, and * no data available in the selected PDM reports.

[3] **Some products may not be registered in Arkansas.**

** **References to products in this publication are not intended to be an endorsement to the exclusion of others which may be similar. Persons using such products assume responsibility for their use in accordance with current label directions of the manufacturer.**

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