

Commercial Greenhouse and Nursery Production

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Disease-resistant Annual and Perennial Production

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Prevention is a cornerstone of disease management, and for many plant diseases, it is the only economically feasible and effective management option available to commercial growers. One of the best ways to prevent serious plant disease outbreaks in the greenhouse, nursery, or landscape is to grow plants with demonstrated disease resistance. Using healthy, disease-resistant plants can help minimize, or even eliminate, the need for pesticides and reduce maintenance.

This publication describes disease resistance in plants, provides management techniques to help avoid disease, and lists species and cultivars of common landscape plants with disease resistance.

Plants can suffer from infections caused by fungi, bacteria, viruses, nematodes, and other pathogens. Disease-resistant plants prevent, or greatly reduce infection by these pathogens. Fungi are the primary source of most plant diseases and cause a variety of leaf spots, blights, gray mold, powdery mildew, and rust. As such, most disease resistance in annuals and perennials is against fungal plant pathogens such as powdery mildew.

Disease Resistance

Disease resistance is a genetic trait (like plant height or flower color) that varies within individual plants, within a species, or among species in a genus. For example, *Monarda fistulosa*, the prairie bee balm with pastel flowers, is more susceptible to powdery mildew than *Monarda didyma*, the bog bee balm with red flowers. By crossing these two different species of bee balm, plant breeders can produce plants that have an array of colors and architecture and many different reactions to powdery mildew — from very susceptible to very resistant, with the majority somewhere in between.

Plant breeders carefully select and combine shapes, colors, and disease resistances, which often leads to a new cultivated plant variety (termed *cultivars* and abbreviated cv.). By using plant species, varieties, or cultivars that are genetically resistant to diseases, growers immediately implement the most effective and sustainable means of plant disease control in greenhouses or nurseries. Ultimately, this reduces the number of fungicide applications needed to manage the disease, which in turn reduces the risk of the pathogens developing fungicide resistance.

Although most plants do not have genetic resistance to many common diseases, incorporating disease-resistant plants into your production cycle whenever possible can minimize the impact of specific disease outbreaks in your facility. Incorporating disease-resistant plants also can reduce pesticide use in the greenhouse, nursery, and ultimately the landscape.

Traditionally, disease resistance in commercially propagated greenhouse and nursery stock is bred into plants with other outstanding horticultural features. Occasionally, observant horticulturists discover disease-resistant plants, as was the case for phlox 'David' (*Phlox paniculata*), a mildew-resistant phlox, and Perennial Plant Association Plant of the Year in 2002.



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Using Disease Resistance

The powdery mildew fungus is ever present in Midwest landscapes. Each summer, the fungus that causes powdery mildew regularly infects zinnia, phlox, and bee balm, so consumers avoid them. Incorporating powdery mildew-resistant plants into the landscape — such as phlox ‘David,’ bee balm ‘Jacob Cline,’ and zinnia ‘State Fair’ —can reduce the amount and severity of powdery mildew. This can improve landscape appearance and reduce the need for fungicides.

It is important to note that disease resistance does not mean a plant is completely immune to disease. Instead, disease resistance refers to a plant’s ability to minimize infection by the pathogen. Unfortunately, no variety is resistant to all diseases. However, careful incorporation of disease-resistant plants in your product selection will provide your customers with options to improve their landscapes and reduce their reliance on pesticides.

It is also important to stress that proper cultural practices are just as important in preventing diseases as disease resistance. Provide your crop with the appropriate growing conditions (for example, reduced growing temperatures can increase disease incidence), and avoid stressful conditions (for example, too much or too little water, excess fertilization, high or low pH). Always use horizontal airflow fans (HAFs) to circulate air evenly (which allows foliage to dry quickly) and provide uniform temperatures throughout the greenhouse. Finally, take care to irrigate plants at the base, not on the foliage or flowers (especially in the late afternoon). This reduces the moisture and humidity fungal spores need to germinate and spread.

Culture-Indexed Stock Plants or Cuttings

In ornamentals, viruses are a significant problem in vegetative propagation. Virus infection symptoms include stunting, deformity, distortion, discoloration, and increased susceptibility to other diseases. Once a plant is infected with a virus, it remains infected, and any cutting taken from that plant will be infected as well. Thus, the best way to manage plant viruses is to purchase only non-rooted cuttings, plugs, or liners from a reputable supplier that certifies their stock plants are virus indexed.



Figure 1. Adequate plant spacing can reduce the risk of foliar diseases by allowing foliage to dry. Overcrowded plants are more prone to foliar diseases, even if they are resistant.



Figure 2. Irrigating plants at the base rather than on the foliage or flowers is important. Although some plants and cultivars are more susceptible to *Pythium* root rot, all of these plants were infected, even if only the plants in the foreground were showing symptoms.

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Figure 3. Culture-indexed plants are virus free, which helps prevent the spread of disease.

Virus-free, culture-indexed plants are produced through a combination of heat and chemical treatments, and must meet program guidelines to be qualified for export throughout the world. Growers who propagate from stock plants can prevent virus spread in greenhouses or nurseries by regularly testing stock plants and replacing them as needed. Growers also need to maintain good insect management to prevent infections by aphids, thrips, whiteflies, and other vectors of viruses. Growing healthy, disease-resistant, virus-free plants in your facility can minimize or even eliminate the need for pesticide use and lead to improved gardens and landscapes for consumers.

The perennials and annuals listed in the tables on pages 4 and 5 were evaluated as resistant to disease. Due to regional variability in weather conditions and pathogen populations, these varieties are only suggested for use, but have been observed to provide excellent results in the Midwest.

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Disease-resistant Perennials

Host (Latin Name)	Disease Resistance	Species and Cultivars with Noted Resistance
aster (<i>Aster</i>)	rust	New England Aster (<i>A. nova-angliae</i>): 'Crimson Beauty,' 'Fanny's,' 'Harrington's Pink,' 'Honeysong Pink,' 'Purple Dome,' 'Wedding Lace.' Wood Aster (<i>A. dumosus</i>): 'Wood's Blue.'
bee balm (<i>Monarda</i> spp. and hybrids)	powdery mildew and rust	'Blaukranz,' 'Colrain Red,' 'Jacob Cline,' 'Marshall's Delight,' 'Petite Delight,' 'Gardenview Scarlett.'
garden mum and Shasta daisy (<i>Chrysanthemum</i> , <i>Dendranthema</i> and <i>Leucanthemum</i> spp. and hybrids)	rust	'Achievement,' 'Copper Bowl,' 'Escapade,' 'Helen Castle,' 'Mandalay,' 'Matador,' 'Miss Atlanta,' 'Orange Bowl,' 'Powder Puff.'
	Fusarium wilt	No species or cultivars have resistance to Fusarium wilt. Avoid susceptible varieties such as 'Bright Golden Ann,' 'Echo,' 'Glowing Mandalay,' 'Mountain Peak,' 'Paragon,' 'Pert,' 'Puritan,' 'Wedgewood.'
	Verticillium wilt	No species or cultivars have resistance to Verticillium wilt. Avoid highly susceptible varieties such as 'Bravo,' 'Illini Trophy,' 'Orange Bowl,' 'Royal Trophy,' 'Yellow Delaware.'
delphinium (<i>Delphinium</i>)	powdery mildew	'Blue Bird,' 'Blue Lace,' 'Cameliard,' 'Galahad,' 'King Arthur,' 'New Zealand series.' Belladonna types (shorter, bushier delphiniums): 'Butterfly Blue,' 'Volkerfrieden.'
geranium (<i>Geranium</i>)	powdery mildew	'Alan Bloom,' 'Buxton's Blue,' 'Biokovo' (<i>G. sanguineum</i> , <i>G. wallichianum</i> , <i>G. x cantabrigiense</i>).
hollyhock and other <i>Malvaceae</i> (<i>Alcea</i> , <i>Sidalcea</i> , <i>Malva</i>)	hollyhock rust	Fig leaf hollyhock (<i>A. ficifolia</i>): 'Happy Lights.' Russian hollyhock (<i>A. rugosa</i>). <i>Sidalcea</i> (all varieties). <i>Malva</i> (all varieties).
peony (<i>Paeonia suffruticosa</i> , <i>P. lactiflora</i>)	botrytis blight	Garden peony (<i>P. lactiflora</i>): 'America,' 'Buckeye Belle,' 'Krinkled White,' 'Old Faithful,' 'Pink Hawaiian Coral,' 'Roselette,' 'Scarlet O'Hara,' 'White Cap.' Tree peony (<i>P. suffruticosa</i>), 'Itoh Hybrids' (<i>P. suffruticosa</i> x <i>P. lactiflora</i>), and other intersectional hybrids are generally more resistant to botrytis blight and peony measles than <i>P. lactiflora</i> (garden peony) cultivars such as 'Bartzella,' 'Gold Crown,' 'Rozella.'
phlox (<i>Phlox paniculata</i> , <i>P. maculata</i>)	powdery mildew	'Alpha,' 'David,' 'Pastel Dream,' 'Frosted Elegance,' 'Laura,' 'Miss Lingard,' 'Norah Leigh,' 'Robert Poore,' 'Shortwood,' 'David's Lavender.'
lungwort (<i>Pulmonaria</i> spp.)	powdery mildew	'Spilled Milk,' 'Benediction,' 'Glaciar,' 'Little Star,' 'Merlin,' 'Excaliber,' 'P. rubra' 'Redstart,' 'David Ward.'
black-eyed Susan (<i>Rudbeckia</i> spp.)	powdery mildew	Annual <i>Rudbeckia</i> , <i>R. hirta</i> Tiger Eye Gold.'
	leaf spot	No species or cultivars have resistance to leaf spot although <i>R. hirta</i> is less prone to the disease. Avoid <i>R.</i> 'Goldsturm' and 'Black Beauty,' both of which appear uniquely susceptible to certain leaf spots.
sage or salvia (<i>Salvia</i> spp.)	powdery mildew	(<i>S. x superba</i>): 'May Night.' (<i>S. x sylvestris</i>): 'East Friesland.' (<i>S. nemerosa</i>): 'Blue Queen,' 'Caradonna,' 'Rose Queen,' 'Blue Hill,' 'Snow Hill.' Silver Sage (<i>S. argentea</i>).
sedum (<i>Sedum</i> spp)	powdery mildew	Most sedum possess good disease resistance. Avoid <i>S.</i> 'Matrona' and 'Autumn Joy.'
speedwell or veronica (<i>Veronica</i> spp.)	powdery mildew	'Icicle,' 'Crater Lake Blue,' 'Sightseeing,' <i>V. schmidtiana</i> .

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Disease-resistant Annuals

Host (Latin Name)	Disease Resistance	Species and Cultivars with Noted Resistance
annual geranium (<i>Pelargonium</i> spp.)	bacterial leaf spot and stem rot	<i>P. domesticum</i> : 'Lady Washington,' 'Martha Washington.' <i>P. x domesticum</i> : 'Madame Loyal,' 'Marie Vogel.' <i>P. tomentosum</i> : 'Torento,' Peppermint. <i>P. scarboroviae</i> : 'Countess of Scarborough.'
begonia (<i>Begonia</i> spp.)	bacterial leaf spot and blight	Rex and tuberous begonias are less severely infected than Rieger begonias. Least susceptible Rex include: 'Duarten,' 'Helen Teupel,' 'Marion Louise,' 'Pauline,' 'Peace,' 'Red Dot,' 'Vesuvius.'
annual vinca or periwinkle (<i>Catharanthus</i> sp.)	Phytophthora aerial blight	'Cora,' 'Little.' 'Nirvana' series: 'Little Bright Eye,' 'Little Linda,' 'Little Pinkie.'
marigold (<i>Tagetes</i> spp.)	Alternaria leaf spot	'Golden Guardian,' 'Doubloon.'
pansy (<i>Viola</i> spp. and hybrids)	Cercospora leaf spot resistance	'Bingo Red,' 'Bingo Yellow,' 'Crown Blue,' 'Crown Golden,' 'Crystal Bowl Supreme Yellow,' 'Crystal Bowl True Blue,' 'Dynamite Red,' 'Dynamite Yellow,' 'Majestic Giants Yellow,' 'Sorbet Blackberry Cream.' The Pansy Patiola series: ('Purple Passion,' 'Pu Yellow,' 'Pu Lemon,' 'Pu Orange') cultivars were less susceptible to leaf spot than pansy 'Colossus' series cultivars.
petunia (<i>Petunia</i> spp.)	botrytis flower blight	'Fantasy Blue,' 'Tidal Wave Hot Pink.'
annual phlox (<i>P. drummondii</i>)	powdery mildew	Most annual phlox are powdery mildew resistant.
snapdragon (<i>Antirrhinum</i> spp. and hybrids)	rust	<i>Few verified reports of rust resistance.</i> 'Wisley Golden Fleece,' 'White Monarch,' and 'Orange Glow' are resistant to most forms of the fungus. Other varieties with reported resistance include the 'Rocket' series and 'Amalia' series.
verbena (<i>Verbena</i> spp. and hybrids)	powdery mildew	Verbena 'Aztec Violet,' 'Laskar,' 'Light Pink,' 'Empress Strawberry,' 'Tukana Deep Red,' 'Burgundy,' 'Dark Blue,' 'Lascar White,' 'Rapunzel Lilac,' 'Aztec Dark Red,' 'Coral,' 'Pink Shades.'
zinnia (<i>Zinnia</i> spp. and hybrids)	powdery mildew	'Oklahoma,' 'Profusion,' 'Crystal White,' 'Ruffles,' 'Panorama Red,' 'State Fair.'

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