DOWNY MILDEW ON ORNAMENTAL CROPS

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Downy mildew has been a serious concern for ornamental growers on the West Coast for many years. Downy mildew fungi attack a wide variety of bedding and cut flower crops and have sometimes been quite a problem on bare-root garden roses. Along the Pacific coast conditions are often cool and wet and humidities are high. In the past couple of years the downy mildew phenomenon has spread throughout the country. I was amazed to find an active serious downy mildew problem in Florida about 18 months ago. The producers in Central Florida were experiencing a severe problem with downy mildew on Salvia despite the fact that they were in the midst of a long-term drought. A few years ago AFE (the American Floral Endowment) funded researchers Dr. Mary Hausbeck (Michigan State) and Margery Daughtrey to work on downy mildew. They have been able to do some excellent work on downy mildew on snapdragons, again in Florida. This fall we have seen downy mildew causing difficulties in pansies across the whole country - even Texas. It seems that our understanding of downy mildew must change. It is time to regroup.

Downy mildew diseases are caused by fungi such as *Peronospora, Bremia, Plasmopara* and *Basidiophora* and appear as white to purplish-gray "down" on leaf undersides when they sporulate. On pansy and snapdragon the color is purple while on alyssum and stock sporulation is white and looks a little like the plants were sprinkled with sugar. The list of plants affected by downy mildew also includes rose, salvia (red and blue), *Buddleia, Geum*, statice (especially 'Misty' cultivars used as cut flowers), *Geranium* spp. (not Florist's geranium), rosemary, and *Scabiosa* (see below).

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The optimal temperature for downy mildew on a many crops is approximately 45-70F. Humidity usually has to reach 85% or higher to favor sporulation and disease development. The infection to sporulation cycle can be as short as 4 days but is usually longer - around 7-10 days.

Control of downy mildew relies heavily on preventative fungicide applications. Weekly applications are usually necessary and some growers report as many as three applications per week. Rotation between chemical classes is critical to prevent development of downy mildew fungi that are resistant to the fungicides. This can also be accomplished through use of tank-mixes. The products that are most effective for downy mildew are listed in the table. Aliette 80WDG, Stature and Heritage 50WDG each provide excellent control when used preventatively.

Table 1. Most effective fungicides for downy milder control.

Fungicide	Class	Efficacy	Crops Tested
Aliette	Phos-Acid	Very good to excellent	Rose, stock
Alude	Phos-Acid	Very good to excellent	Pansy, rose, salvia, snapdragon, stock
BAS500	Strobilurin	None (rose) or very Good to excellent	Pansy, rose
Camelot	Copper	Very good to excellent	Stock
Compass O	Strobilurin	Some to excellent	Rose, pansy
Cygnus	Strobilurin	Good to excellent	Pansy, rose, snapdragon
Fenstar	Related to Strobilurins	Very good	Snapdragon
Heritage	Strobilurin	None (rose) or very good to excellent	Pansy, rose, stock
Milstop	Bicarbonate	Very good to excellent	Stock
Phyton 27	Copper	Very good	Salvia
Phapsody	Biological	None to very good	Snapdragon, stock
Stature DM	Cinnamic acid derivative	Very good to excellent	Pansy, rose, stock
Vital	Phos-Acid	Very good	Snapdragon
Unnamed	Cyazofamid	Very good to excellent	Rose, stock

Compass O, another strobilurin, did not give quite as high a degree of control as Heritage in our tests. This is probably due to the systemic nature of Heritage, which allows penetration of leaf tissue that may be infected. Downy mildew fungi grow inside the leaf and fungicides that are systemic or partially systemic allow better control of this fungus. Aliette is truly systemic moving both upwards and downwards. Heritage is systemic upwards while Compass O is locally systemic (mesostemic).

Fungicides, which have also been moderately effective, are found in the mancozeb chemical class. Tests with both Dithane Rainshield and Protect T/O showed good to very good control in most trials. Of the copper compounds, Phyton 27 provided the most consistent and highest degree of control. Do not use any copper compound on alyssum to avoid phytotoxicity (see photo below). The key to downy mildew control is preventative applications. The time is now. Don't wait until you see the whites of their eyes to fire - it will be too late.

Table 2. Partial listing of downy mildew pathogens on ornamental crops.

Ornamental plant	Downy mildew pathogen
Alyssum (*Lobularia**)	*Peronospora parasitica*
*Alyssum saxatile**	*Peronospora galligena*
Arabis	*Peronospora parasitica*
Anemone	*Plasmopara pygmaea* *Peronospora ficariae*
Argemone (Prickly poppy)	*Peronospora arborescens*
Aster	*Basidiophora entospora*
Broccoli, cauliflower, kale	*Peronospora parasitica*
*Buddleia**	*Peronospora sordida*
Callistephus (China aster)	*Basidophora entospora*

Campanula	*Peronospora corollae*
*Centaurea**	*Bremia lactucae* *Plasmopara halstedii*
Cheiranthus	*Peronospora parasitica*
Chrysanthemum	*Peronospora radii*
Cineraria	*Bremia lactucae* *Peronospora gangliformis* *Plasmopara halstedii*
Clarkia	*Peronospora arthuri*
Coreopsis	*Plasmopara halstedii*
Cynoglossum (hounds'tongue)	*Peronospora cynoglossi*
Delphinium	*Peronospora ficariae*
Dianthus	*Peronospora dianthicola, dianthi*
Dicentra (bleeding heart)	*Peronospora dicentrae*
Digitalis (foxglove)*	*Peronospora grisea*
Dimorphotheca (cape marigold)	*Plasmopara halstedii*
Draba	*Peronospora parasitica*
Eggplant (*Solanum)*	*Peronospora tabacina*
Erigeron (fleabane)	*Plasmopara halstedii* *Basidiophora entospora*
Eustoma grandiflora (lisianthus)	*Peronospora chlorae*
Geranium (not *Pelargonium*)	*Peronospora conglomerata* *Plasmopara geranii*
Gerbera	*Plasmopara sp.*
*Geum**	*Peronospora gei* *Peronospora potentillae*
Godetia	*Peronospora arthuri*
Helianthemum	*Peronospora leptoclada*
Helianthus (sunflower)	*Plasmopara halstedii*
Helichrysum	*Peronospora radii*
Helleborus	*Peronospora pulveracea*
Hesperis (rocket)	*Peronospora parasitica*
*Iberis**	*Peronospora parasitica*
Impatiens (other species than wallerana)	*Plasmopara obducens*
*Kalancoe**	*Peronospora* sp.
Larkspur	*Peronospora ficariae*
Lathyrus (sweet pea)	*Peronospora trifoliorum* *Peronospora viciae*
*Lewisia**	*Peronospora* sp.
Limonium (German statice)*	*Peronospora* sp.
Linaria	*Peronospora linariae*
*Lupinus**	*Peronospora* sp.
Meconopsis	*Peronospora arborescens*
Mesembranthemum	*Peronspora mesembranthemi*
Mimulus (monkey flower)	*Peronospora jacksonii*

Myosotis	*Peronospora myosotidis*
Nicotiana	*Peronospora tabacina*
Oenothera (evening primrose)	*Peronospora arthuri*
Pansy (*Viola x wittrockiana*)	*Bremiella megasperma* *Peronospora violae*
Papaver	*Peronospora arborescens*
Pepper *(Capsicum annuum)*	*Peronospora tabacina*
*Phlox** Wild cultivar	*Peronospora* sp. *P. phlogina*
Potentilla	*Peronospora potentillae*
Primula (primrose)	*Peronospora oerteliana*
Ranunculus	*Peronospora ficariae, hiemalis, pennsylvanica, ranunculi*
*Rosa**	*Peronospora sparsa*
Rudbeckia	*Plasmopara halstedii*
*Salvia**	*Peronospora lamii*
Senecio	*Plasmopara halstedii*
Snapdragon (*Antirrhinum majus*)	*Peronospora antirrhini*
Stock (*Matthiola**)	*Peronospora parasitica*
Strawberry (*Fragariae*)	*Peronospora fragariae*
Verbena	*Plasmopara halstedii*
*Veronica**	*Peronospora grisea*
*Viola odorata** *Viola x wittrockiana* (pansy*/viola)	*Peronospora violae* *Bremiella megasperma*