

# The Low Down on Downy Mildew

With downy mildew season approaching and so much new work being done on this disease, now is a great time for a review.

By A.R. Chase



Downy mildew on rose causes many different symptoms, including leaf spots and stem rot. (All photos courtesy of A.R. Chase)

Get ready for another season of downy mildew. It has been several years since I wrote about downy mildew for *GPN*. With all of the new diseases, chemicals and strategies for downy mildew control, it seemed like a good time to summarize this serious and increasingly common disease.

## WHAT DOES DOWNY MILDEW LOOK LIKE?

Downy mildew looks very different depending on the specific plant, weather, fungicide use and sometimes the species of fungus involved. The most common symptoms are yellow or tan, angular or blotchy spots that appear on the upper leaf surface. Leaf distortion also occurs giving spots a blistered, pale look (common on pansy). On the undersides of the leaves, the white, lavender or purple spores of the pathogen form a “downy” patch between the leaf veins. Occasionally, the spores form all over the leaves. This happens frequently with alyssum, giving plants the appearance of being sprinkled with salt or sugar. In some cases, like with snapdragons, a systemic infection can occur with severe stunting and distortion of the final appearance.

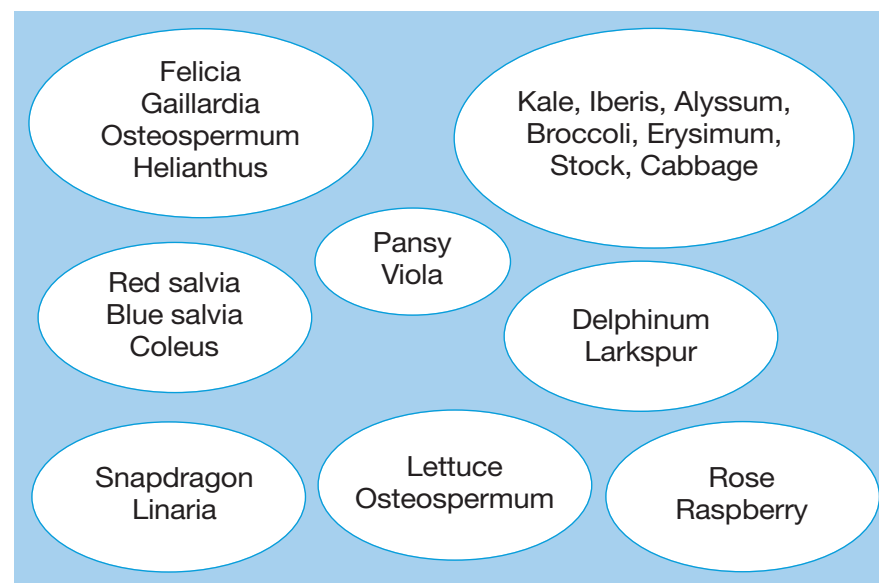
Rose downy mildew is remarkably variable. In the past 10 years the most common symptom has been angular, tan spots with a very small amount of white crystalline sporulation on leaf undersides. The name of the pathogen is *Peronospora sparsa* — a name that reflects the sparse production of white spores of the pathogen. This winter and spring, however, I saw a lot of purple sporulation on leaf undersides and a weird array of other symptoms. We found collapsing buds and cankers on newly emerging rose canes. Finally, we have seen an ever-changing series of leaf spots — from tiny speckles that are tan to spots that are actually pink and may or may not extend through to the underside of the leaf.

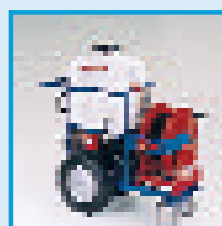
Different species of roses respond differently to downy mildew, making diagnosis very difficult. Leaf drop was also common.

## WHAT PLANTS GET DOWNY MILDEW?

The list of plants that get downy mildew increases almost as fast as the list of ornamentals we grow. You can check our Web site for a partial listing ([www.chaseresearchgardens.com](http://www.chaseresearchgardens.com)). Early in the winter, osteospermum

Figure 1. Some host range groupings for different downy mildew pathogens. Plants in the same circle can be attacked by the same downy mildew fungus.





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Even though fans might move spores, you should use them and venting to reduce humidity and leaf wetness. Try to water early in the day or whenever leaves will dry quickly to ensure dry foliage at night. Check all new plants for symptoms upon receipt. Early detection is the only way to control downy mildew. Scout all plants for symptoms at least once a week and preferably every 2-3 days. Remember that hungry plants are more susceptible to downy mildew. Always maintain a balanced fertility program to protect your crops from this disease. Start early with a rotation of chemical prevention. Weekly spraying to prevent downy mildew on sensitive crops is common. Spraying more than twice a week is counter-productive.

**WHAT FUNGICIDES WORK?**

We try to work on downy mildew at every opportunity. The first trial this season was started on Oct. 11, 2004 with a patented pot rose infected with downy mildew and Botrytis. We applied fungicides twice on a 10-day interval and rated downy mildew and Botrytis severity one week after the second application. The average level of infection when we started the trial was 15-20 percent of plants showing sporulation of *Peronospora sparsa* (the cause of rose downy mildew). We included four strobilurins (Heritage, Syngenta Professional Products, at 1 oz. per 100 gal.; BAS500, BASF, at 2 oz. per 100 gal.; Compass O, OHP, at 1 oz. per 100 gal.; and Cygnus, The Scotts Co., at 3.2 oz. per 100 gal.). The next three treatments were cyazofamid (an experimental compound being developed by ISK BioSciences and FMC) at 2.1, 2.75 and 3.5 oz. per 100 gal. Silwet, Helena Development Lab, was added at 2 oz. per 100 gal. to each cyazofamid treatment. Industry standards were Stature DM, SePRO Corp., (6.4 oz. per 100 gal.) and Aliette, Bayer Environmental Science, (32 oz. per 100 gal.). Results are shown in Figure 2, below. ▶

Figure 2. Eradication of rose downy mildew with strobilurins. Disease was rated as the percentage of leaf area with active downy mildew sporulation.

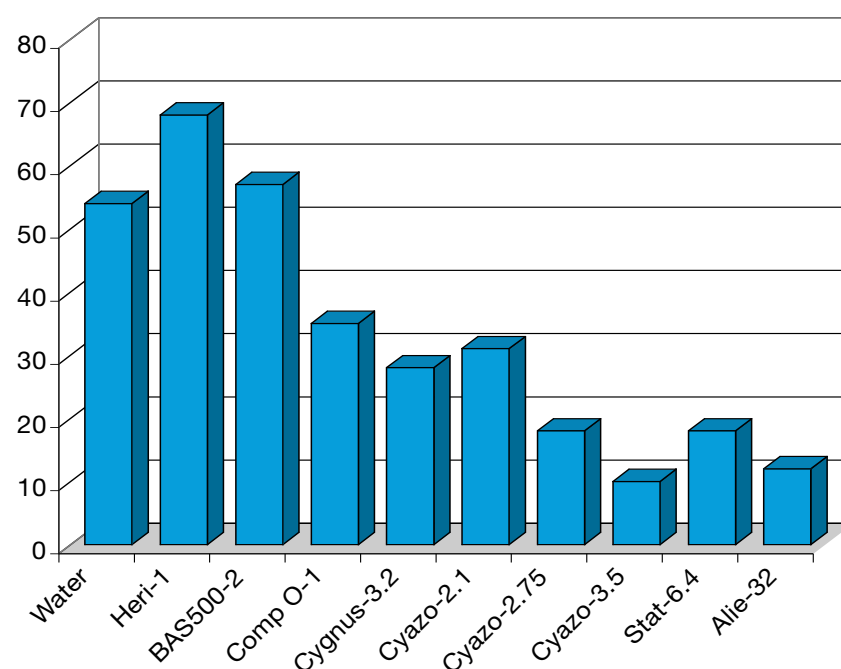


Figure 3. Prevention of downy mildew on stock with Rhapsody and Camelot.

Treatment	Rate per 100 gal.	% DM infection
Water, noninoculated	n/a	42.9
Water, inoculated	n/a	39.2
Rhapsody	128 oz.	35.4
Camelot	16 oz.	7.9
Camelot/Rhapsody	128 oz. and 16 oz.	20.8

were found infected with *Bremia lactucae* (the pathogen causing lettuce downy mildew). For the past few winters, *Plasmopara halstedii* was the pathogen attacking osteospermum but not this year. Statice, foxglove, coreopsis, sunflower, geum, felicia, geranium and scabiosa are a few of the other downy mildew hosts. Finally, this year strawflower (bracteanthemum or helichrysum) was found affected late in the season.

The host range of each downy mildew fungus is limited (see Figure 1, left). Some attack only one or two plants (like *Peronospora violae*), while others (like *Plasmopara halstedii*) attack a wide range of ornamental and other crops. Snapdragons and salvias don't get the same downy mildew. *Salvia farinacea*, *Salvia splendens* and coleus (newly found this past spring in the Northeastern states) are all hosts of *Peronospora lamii* and get downy mildew under "warmer" conditions than snapdragons. Snapdragons are attacked by *Peronospora antirrhini* and can have systemic infections causing stunting and distortion. Be sure to discard any plugs or rooted cuttings with downy mildew symptoms.

**WHAT CONDITIONS PROMOTE DOWNY MILDEW?**

Downy mildew weather is cool to warm and humid to rainy...not hot and dry. Wet leaves and high humidity will trigger sporulation overnight. When the sun comes up, leaves start to dry, and spores are released. Most spores spread by fans or wind and infect new leaves before noon. Six hours of constant leaf wetness is enough for spores of many downy mildew fungi to germinate and infect leaves.



Downy mildew on sunflower (top) and scabiosa (bottom).

## pests & diseases

It was interesting to see that, overall, the strobilurins failed to control this standing infection of downy mildew. This is probably due to the low rates I chose for the trial. Compass O and Cygnus did do bet-

Figure 4. Efficacy of Endorse and Rhapsody in preventing downy mildew on snapdragons. Disease was rated as the percentage of leaf area with active downy mildew sporulation.

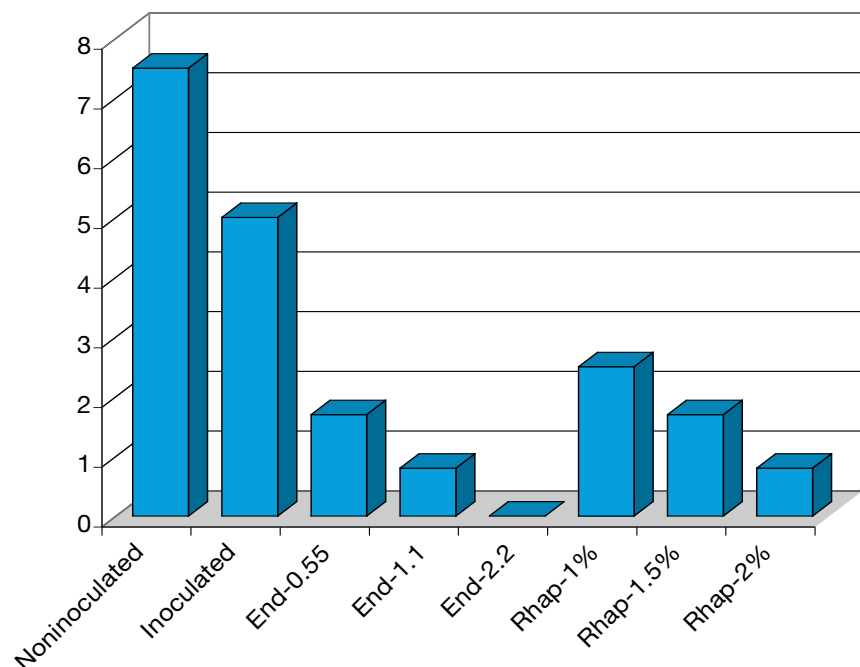


Figure 5. Efficacy of some fungicide drenches in preventing stock downy mildew.

Treatment	Rate per 100 gal.	% DM infection
Water	n/a	70
Fenstar	14 oz.	50
Aliette 80WDG	16 oz.	0
Stature DM	9.6 oz.	0
Heritage 50WDG	2 oz.	58
Subdue MAXX	1 oz.	74

ter than Heritage and BAS500. The experimental product, cyazofamid, did do really well at the highest rate tested. This fungicide is in a chemical class closely related to the strobilurins. Aliette did a very fine job as did Stature DM. This trial shows that eradication of rose downy mildew is very hard, but you can obtain moderate results with the right product at the right rate.

Sometimes you start out looking for one disease and get a different one. Whether by accident or good fortune this happens to us rather frequently. Two years ago Rhapsody (*Bacillus subtilis* by Agraquest) was registered for ornamental use on a variety of diseases, including bacterial diseases. In our early trials, we had evaluated this biological control agent in combination with a copper compound but not in subsequent trials. We started a trial on stock for control of *Xanthomonas* blight but ended up with downy mildew as a bonus. We tested Rhapsody, AgraQuest, and Camelot, Whitmire MicroGen Research Laboratories, both alone and in combination (rates are given in Figure 3, page 21). Rhapsody did not control disease when used alone, while Camelot did a very good job of preventing downy mildew on these stock. The combination was less effective than the Camelot alone, which was really unexpected. Both of these ratings point to the possibility that alternating products is more effective than tank mixing.

We performed another trial last winter with Rhapsody and Endorse (currently registered for turf by Cleary Chemical) for prevention of snapdragon downy mildew. The products were used alone at three rates each. Rhapsody was used at 1, 1.5 and 2 percent, while Endorse was tested at 0.55, 1.1 and 2.2 lbs. per 100 gal. Products were applied weekly for four weeks. Figure 4, left, shows that in each case, increasing the rate resulted in better disease prevention. In fact, the 2.2-lb. rate of Endorse was 100 percent effective in preventing snapdragon downy mildew in this trial. The results with Rhapsody in this trial were much better than those found in the stock trial.

### CAN YOU STOP DOWNY MILDEW WITH A DRENCH?

We performed a trial on pansy downy mildew several years ago with a new fungicide. The most interesting thing about the trial was that we were

## pests & diseases

Figure 6. Summary of downy mildew control trials performed at Chase Research Gardens (1997-2005).

Fungicide	Active ingredient	Control grade
<b>ORGANIC PHOSPHATE</b>		
Aliette 80WDG	Fosetyl aluminum	A
Alude	Phosphorous acid	A
Bio-Phos	"fertilizer"	A
Nutri-Phite PK	"fertilizer"	A-
pHortress	"fertilizer"	A-
<b>CINNAMIC ACID DERIVATIVE</b>		
Stature DM	Dimethomorph	A
<b>STROBILURIN</b>		
Compass O	Trifloxystrobin	B+
Cygnus	Kresoxim methyl	B+
Heritage	Azoxystrobin	A-
<b>AROMATIC — SUBSTITUTED BENZENE</b>		
Daconil Ultrex	Chlorothalonil	D
Spectro	Chlorothalonil and thiophanate methyl	F
<b>BIOLOGICALS</b>		
Actinovate	<i>Streptomyces sp.</i>	C
PlantShield HC	<i>Trichoderma harzianum</i>	C-
Rhapsody	<i>Bacillus subtilis</i>	B
<b>EBDC (CARBAMATE)</b>		
Protect T/O	Mancozeb	B
Dithane Rainshield	Mancozeb	B+
<b>INORGANIC COPPER</b>		
Junction	Mancozeb and cupric hydroxide	C
Camelot	Copper salts of rosin and fatty acids	C
Kocide TNO	Cupric hydroxide	C
Phyton 27	Copper pentahydrate	B
<b>POTASSIUM BICARBONATE</b>		
MilStop	Potassium bicarbonate	B+
<b>STEROL INHIBITOR</b>		
Strike	Triadimefon	C

able to significantly reduce downy mildew severity with a soil drench. The pansy leaves did not have any direct contact with the fungicide.

So we decided to try some of the most effective fungicides for downy mildew in a drench trial. The products were all systemic to some degree. We chose stock (matthiola) in 3½-inch pots that were drenched every 14 days for four applications. The drench rate was equivalent to 1 pint per sq.ft. of surface area. After the third spray we inoculated the plants with a spore suspension of *Peronospora parasitica* (the cause of stock downy mildew).

Plant top grade was not affected by the treatments. However, when we rated downy mildew severity (percent sporulation), it was obvious that some of the fungicides were very effective in preventing downy mildew (see Figure 5, page 22). The best control was achieved with Aliette and Stature DM. Fenstar (under development by Bayer and OHP) gave slight control, but Heritage and Subdue MAXX (Syngenta Professional Products) were the same as using water in this trial. This information is important since it means that 100-percent coverage of the leaves is probably not critical with phosphonates (like Aliette) and Stature DM for control of downy mildew on some crops.

These trials are only a few of those performed over the past eight years. A summary of the results at Chase Research Gardens is presented in Figure 6, left. Be sure to rotate at least two products in different chemical classes. Downy mildew fungi are very adept at becoming resistant to a fungicide when it is used repetitively. It is also important to remember that the only effective rotation program is the one you can implement. If it is too complicated or difficult to deploy then it will not happen. Intending to rotate is not the same as doing it. You might try to start with two products only alternating between them on a 7- to 14-day interval. Be sure to read the product labels — they are still the law. GPN

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