The Return of Downy Mildew

By Bob Martin

I was first introduced to severe downy mildew in my rose garden in 1991. It is not a coincidence that a Type 1 El Niño occurred in 1991-1992. During those years downy mildew was widely reported in the rose literature and much written about it, including my own article on the subject which appeared in the October, 1993 issue of *The Pasadena Rose*. Although eliciting a lot of excitement and even dread at the time, the subsequent years of relatively dryer weather has reduced discussion of downy mildew to a relative whisper.

Well my friends - Its baaack! I have seen some in my garden and have received reports from rosarians throughout California of major outbreaks. The reason, of course, is the current El Niño. And so, at the request of our Editor, I have dusted off my research on the subject, updated it as appropriate, and here set forth much more than you will probably ever care to know about downy mildew. But before you go on, let me set your minds at ease. Downy mildew is just another fungus among us. With knowledge and the proper approach a reasonable level of control can be obtained. And even without a control, your roses will in all likelihood survive until the heat of summer bails us all out.

So, that said, here are the facts:

The symptoms of downy mildew are easily confused with the symptoms of other rose problems.

The principle symptoms of downy mildew are irregular purplish blotches on leaves. This blotching generally occurs between the leaf veins and follows their pattern, seldom actually crossing the veins. Later the leaves turn yellow and defoliation occurs, sometimes in spectacular fashion. In severe cases purplish, black areas also appear on the stems and peduncles.

In all cases the infection is accompanied by loss of plant vigor; in severe cases the loss of vigor is remarkable. Young or weak plants can actually die although this is less common.

The symptoms of downy mildew are often confused with other water borne fungus diseases such as black spot and other leaf spot diseases such as anthracnose, alternaria or cercospora. Black spot is manifested by circular black spots with a feathery edge; the center can be whitish or black or even purplish as the fruiting bodies of the fungus are found there. To my eye black spot looks as if someone has been extinguishing cigarettes on the leaves.

More commonly, downy mildew is confused with fungal leaf spot diseases such as anthracnose (Sphaceloma rosarum), alternaria and cercospora. These appear generally as small irregular black, purple or reddish brown spots. Leaf spots do not have the feathery edge of black spot and the center may be white to grey or even black and depending on the fungus and the time of the year, the center may even fall out giving a shot hole appearance. Leaf spots can appear anywhere on the leaf surface depending on the weather conditions of the area; it is my experience that they most commonly occur on the edges of the leaves.

The symptoms of downy mildew are also confused with pesticide toxicity. Pesticide toxicity is typically manifested by brown spots or markings and wrinkling or deformation of the leaf surface. This can occur anywhere on the surface of the leaves but seem more common at the edges.

In evaluating anecdotal and experimental methods for the treatment of downy mildew, it is important to bear in mind this ease of confusion since the reported results may actually reflect the treatment of some other problem.

Unlike powdery mildew the downy mildew fungus itself is rarely observed.

A typical fungus consists of a mass of branched tubular filaments that bear spores by which they reproduce. These filaments are collectively known as the mycelia. The mycelia may be external or internal to the host plant.

In the case of the familiar powdery mildew the mycelia of the fungus is largely external and the powdery white growth which is easily observed is the mycelia of the fungus itself. In the case of downy mildew, however, the mycelia is largely internal and is rarely observed itself. This explains the puzzlement of those looking for a growth that appears to be downy. It also explains why it is sometimes called "false mildew".

The symptoms of downy mildew are therefore the effects of the fungus and not the fungus itself.

Downy mildew is spread by spores which typically enter the plant from the lower leaf surfaces.

As with all fungus the mycelium of downy mildew grows and at a state of maturity form spores that detach and start new organisms. Infection of the rose typically takes place when the spores of the downy mildew fungus encounter the surface of the leaves.

Here again downy mildew differs from powdery mildew in that the spores of the powdery mildew fungus typically enter the rose through the upper leaf surfaces. The spores of downy mildew, however, typically attach to the lower surface of the leaf where it remains wet longer.

The spread of downy mildew spores requires an ideal combination of moisture and temperatures.

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Downy mildew spores travel in moisture by means of flagella (small tails). As a consequence roses are unaffected by downy mildew when humidity is less than 85%. The optimal temperature for the development of downy mildew spores is 64 degrees. Spores do not germinate at 41 degrees and are killed by exposure to temperatures in excess of 81 degrees for 24 hours.

The importance of moisture and temperature to the development of downy mildew spores explains the appearance of downy mildew in California gardens during El Niño years. The heavy warm rains of El Niño provide ideal conditions for downy mildew.

It should also be noted that high soil moisture levels favor development of downy mildew both because of the moisture and because of the decreased oxygen levels in such soil. This underscores the importance of good drainage and explains why areas with high clay content in their soils, such as California and Texas, experience higher levels of the disease.

Downy mildew spores are either killed or become dormant in warm dry weather.

Downy mildew spores are killed by exposure to temperatures over 81 degrees for 24 hours; they also will not spread during times of the year when the daytime temperatures are at least 80 degrees and the nightime temperatures exceed 60 degrees. In Southern California this generally includes the entire summer and part of the fall.

This explains the common greenhouse practice of turning up the temperature to control outbreaks of downy mildew. It also explains many of the reports of seemingly miraculous cures effected on downy mildew. You could spray your roses with your grandmother's perfume just before the weather turns hot and attribute the rose's recovery to the spraying when, in reality, it is the heat that did the job. It also gives reason for optimism in the control of downy mildew in Southern California, as nature will do the job itself for much of the growing season.

Downy mildew infections are facilitated by mechanical damage and poor horticultural practice.

The spores of downy mildew germinate to form a germ tube which grows on the lower surface of the leaf until it finds an opening such as an air pore (stomate) in a leaf or a wound. Wounds can be caused by wind damage which explains why outbreaks of downy mildew follow strong rain storms. Prompt removal of damaged leaves under such conditions is therefore important.

Staking of roses to prevent canes from whipping in the winds and pruning to avoid excessive cane contact with adjacent leaves are also useful practices. Other preventative practices should focus on avoiding to the extent practicable the exposure of roses to prolonged periods of moisture when the weather is cool. For example watering at night or overhead watering during cool periods should be avoided; instead during cool weather roses should be watered at times and in a manner that will permit the foliage to remain or become dry as soon as possible. Pruning to open up the bush in order to provide good drying air circulation is helpful in reducing moisture. Also spore production can be reduced by the removal of severely infected leaves and stems.

Downy mildew spores and mycelia can remain dormant and a threat to the bush for a very long time.

Downy mildew spores can survive in a dormant state on and in living or dead plant matter and in soil. For example, research has shown that spores can remain viable on dried fallen leaves for over a month. It is therefore important that the rosarian remove fallen leaves regularly and maintain good sanitation in the garden.

There is some evidence that a copper based dormant spray is helpful in killing dormant spores in the soil. This practice is usually recommended during the dormancy of the rose as copper solutions can damage a growing plant; in Southern California, however, roses rarely enter true dormancy so this practice must be approached with caution. One application of a copper based fungicide principally around the ground area of the rose during the coldest part of January may provide some help.

Downy mildew spores are sparse and easily killed before they cause damage, however complete control is not possible when conditions are optimum.

The causal organism of downy mildew is known as *Peronospora sparsa*. The word *"sparsa"* reflects the fact that there are not usually a lot of them. However it only takes a few to do a great deal of damage. This is the "good news-bad news" story of downy mildew. The good news is that there are very few spores to kill - the bad news is that if only a few get through there will be a lot of damage. And the real bad news is that if a lot get through, there will be spectacular damage, a condition that my friend Dr. Justin Ekuan describes as the epidemic stage.

The implications of this observation are worth considering carefully. It is very unlikely that even a diligent rosarian will be able to get enough coverage to provide complete control of downy mildew spore formation if the conditions for their formation are otherwise right. This means that under those conditions, there will be downy mildew in your garden. On the other hand, failure to undertake control measures when conditions are optimal can result in spectacular defoliation and damage to your roses. Then again if you do nothing, there will always be summer to bail you out. The roses will be weaker but nearly all will survive and still be very beautiful and this may be enough for most rose growers.

Reasonable control of downy mildew spore production can be obtained with available fungicides

If it is not good enough for you to wait until nature takes its course, the reasonable prevention of downy mildew spore production may be obtained through the application of a fungicide containing zinc, manganese

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or a weak solution of copper. This is not new knowledge. Dr. Cynthia Westcott in her 1952 work "Anyone Can Grow Roses" recommends weak copper or zineb, a zinc based compound. In fact products such as zineb, maneb (a manganese based compound), mancozeb (a combination compound of manganese and zinc) and copper compounds were for years mainstay fungicides in the rose garden. Their use has waned in recent years as more specific fungicides have come on the market. They have also become much more difficult to find because of increased pesticide regulation.

An effective product for use against downy mildew spores continues to be mancozeb, which is sold under various names. It should be applied at the recommended rate on the label which is typically one Tablespoon per gallon. And it is important to spray it on the underside of the leaves where the fungus enters.

A related product, formerly known as manzate, is sold as Pentathlon DF. There are also a number of new fungicides labeled for use on downy mildew, including Heritage and Stature. The main drawback to such products is cost because they are typically only available in quantities that provide a lifetime supply for a home gardener.

"Organic" solutions to downy mildew are more problematic. There are indications that oil based products such as Rose Defense containing neem oil, may have effect on downy mildew spores. The action appears to be that the oil displaces the water in which the spores would otherwise travel. Also the oil may coat the stomata to discourage penetration of the leaf by the germ tube.

The damage caused by downy mildew is internal to the bush and spreads down to its roots.; future damage can be prevented

Fungi such as downy mildew secure food through the action of enzymes where they are growing. These enzymes digest the food which is absorbed by the fungi. In the case of downy mildew, the internally growing mycelium also produces haustoria, which are absorbing structures that branch off and enter the cells of the plant. This entire organism also secretes a particularly damaging enzyme which can penetrate down into the

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roots of the rose itself. I first learned of this effect when a commercial grower showed me some miniature roses which had been badly infected. Pulling the plant from the pot, he showed me the roots which had turned black.

The damage caused by this internal invasion of the rose cannot be reversed; instead only future damage can be prevented. This observation explains why some rosarians have come to think that no fungicide, including mancozeb, is effective against downy mildew. Mancozeb kills spores, but once the mycelium and haustoria have become established, the damage caused continues. It may also explain the variance in reports on the efficacy of oil based "organic" products since, again, the oil may discourage the action of the spores, but can do nothing against the internal effects of the fungus.

To counter the effect of the enzyme, the rose's system can be purged with a systemic fungicide. A good product for this purpose is Alliette, an aluminum-based fungicide. Alliette is highly acidic and should not be used with a spreader-sticker or combined with any other chemical. Another treatment that has shown effectiveness is a soil drench with the fungicide metalaxyl, a widely used agricultural fungicide. However, it is very difficult to find a product with metalaxyl registered for garden use or directly for roses. Some products with metalaxyl are labeled for use on outdoor roses to control root rot diseases caused by *Phytopthera,* a genus of fungus diseases that includes the family *Peronosporacae,* one of the members of which is downy mildew of roses. In such a case, as long as the dosage is not increased beyond that recommended. it is legal to use it.

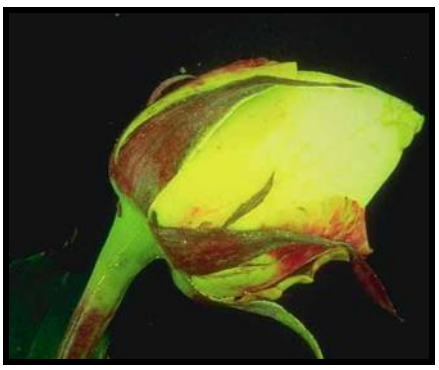
Downy mildew affects all roses; there are no resistant cultivars with the possible exception of some species roses

Complete control of downy mildew is not possible and a reasonable level of control requires preventative measures and a lot of work. Faced with this problem some rosarians, including Dr. Ekuan and Phil Ash, have attempted to identify rose varieties that are resistant to downy mildew. Baldo Villegas also suspects that there are various levels of resistance in roses.

I, for one, am not encouraged by this approach. I have grown over 1000 different varieties of roses in my garden during the downy mildew years and only one comes to mind, *rosa laevigata* (The 'Cherokee Rose') has not had downy mildew. It is true that some get it faster than others. *Honor* and the miniature *Captivation* are the first to get it. They are also the first to recover which explains why they do much better in the fall than the spring. Roses with leathery or rough foliage such as *Peace, Playboy* and the rugosas, get it last. This is good if the heat of summer comes fast, as they may not get it at all.

In conclusion, it should be noted that downy mildew is not a new disease of roses, having been reported in England as early as 1862. However, prior to 1984 many plant pathologists in California thought that it was a disease of greenhouse roses only. It was the through the persistence of Baldo Villegas that many plant pathologists came to recognize it as a problem in field grown roses in California. Its prevalence varies from year to year with the weather patterns, horticultural practice and available fungicides. And, no matter how bad a year it is, we can always count on a warm summer to provide control even if we do nothing else. But armed with a knowledge of its workings, we can do much more and the roses will, as always, reward us handsomely for our efforts.

* The author extends appreciation to Baldo Villegas, Orangeville, CA for his many helpful comments on this article.



Notice the purplish irregular blotches as well as the necrotic areas sometimes attributed to pesticide burn.

Side view of an infected leaf. Notice the fine whitish mycelia near the midrib of the leaf. This is the location directly under one of the purple blotches.

Photos above courtesy of Baldo Villegas
http://www.sactorose.org/ipm/83downymildew.htm

Left, reddish blotches can also appear on bloom, sepals and stem.