



**McCrometer CONNECT Weather Stations Help
UC Davis Researchers Control Grape Powdery Mildew**

White Paper

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Grape Powdery Mildew

One of the most serious and persistent diseases that plagues grape growers on the West Coast is Grapevine powdery mildew (*Erysiphe necator*). It is a fungal disease that effects wine grape, table grape, and raisin vineyards. This disease has a very swift onset and if not controlled immediately can have devastating consequences to a vineyard in terms of severely reducing yields or requiring the use of very expensive fungicide controls and washes. Despite a significant number of dollars spent on powdery mildew control, crop losses attributed to the disease remain extremely high. Powdery mildew persists in each California commercial grape production area. (See Fig 1.)



Figure 1: Grapevine Powdery Mildew
(*Erysiphe necator*)

Powdery mildew develops in two stages. It survives the winter as dormant mycelium under infected buds or as dormant cleistothecia, which are washed off leaves and shoots onto the bark of upper trunks and cordons during fall rains. In the primary infection stage, a combination of warm, wet conditions cause the cleistothecia to release ascospores. If these ascospores land on green tissue such as leaves and

buds then they initiate the primary infection phase and fungal colonies can develop in a little as 6 to 7 days.

With the correct temperature conditions (canopy temperatures between 67° and 86°F, the optimum being 77°F) the fungal colonies can move into a secondary infection stage. This stage is sometimes referred to as the epidemic stage as the fungus reproduces asexually at an extremely fast rate. At optimum temperatures, the generation time between spore germination and production of spores by the new colony is only 5 days. Vineyard managers and growers strive to avoid reaching this stage because the efforts to recover control of the disease at this stage can be extremely expensive.

Not only can recovering control be expensive, but the effect on crop quality can be significant:

- Infection can shorten storage life of table grapes
- Wine quality can be affected by as few as 3% of diseased berries
- Severe mildew may cause berries to crack, allowing rot organisms to enter
- Early fruit infections cause stunted berries, scarring, and off-flavors
- Severe infection may affect the rate of photosynthesis by the leaves
- Severe infection of the vines may impair their ability to produce adequate amounts of sugar

Gubler-Thomas Grape Powdery Mildew Model

Early powdery mildew control strategies focused on a fixed or “calendar” treatment schedule. With this strategy treatments are applied at a regular schedule. The schedule may vary depending upon how long a particular material/application can protect the crop, but in general there is no period where the vine/crop is left unprotected. Under this calendar method,

a vineyard being treated with a chemical/material that lasts one week is faced with applying 20-28 treatments each season, depending upon when bud break starts and the length of the season.

Although this type of calendar treatment strategy can be effective in the short term, it has a number of drawbacks. These include a tendency to over-apply fungicides and chemicals, as well as contributing toward the disease's resistance to a particular treatment. This can be a significant issue as the development process for acquiring new fungicides/chemical treatments can be lengthy and extremely expensive.

Many fungicides, chemicals and cultivation practices have been developed to help combat grape powdery mildew. One of the most effective tools developed to date is the UC Davis Gubler-Thomas Grape Powdery Mildew (GPM) model. Dr. Doug Gubler is an Extension Plant Pathologist and lead author/developer of the Gubler-Thomas Grape Powdery Mildew Model. He has been working for more than 29 years helping grape growers combat grape powdery mildew.

Dr. Gubler's GPM model helps growers predict the onset of disease and sporulation by the pathogen so that growers can proactively treat for the disease without wasting resources. The model uses weather conditions to track the primary infection and lets growers know when to start treatment in the beginning of the season. In particular for tracking the secondary infection cycle, the model includes a powdery mildew index (PMI) that is an indicator of the growth conditions for the fungus. The PMI ranges from 0-100 and helps growers estimate the timing for their next fungicide application. (See Fig 2.)

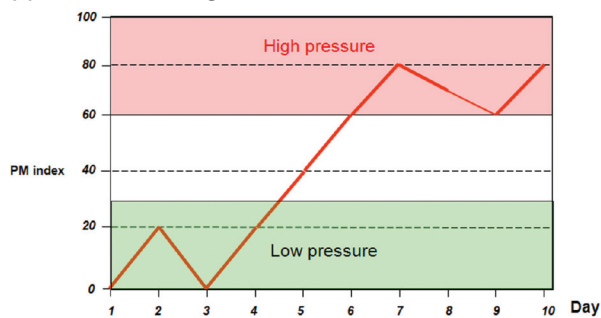


Figure 2: Powdery Mildew Index

Research has shown that growers using the Grape Powdery Mildew Model save an average of three fungicide applications per year. It is estimated the model is used on over 250,000 acres in California

alone. Considering the average sulfur application is approximately 10 pounds per acre, the model is therefore helping avert the unneeded application of more than 7.5 million pounds of sulfur each year – a significant savings in terms of both labor and material.

Facts about the Gubler-Thomas Powdery Mildew Model include:

- The majority of PMI users report an increase in confidence using the model from the initial use to 2012
- The percentage of grape growers who report regularly using the Gubler-Thomas PMI has increased from about 50% in 2007 to about 75% in 2012
- Approximately 50% of raisin growers regularly use the model
- About 50% of wine grape growers use on-site weather stations to run their PMI
- The PMI can be easily used without a computer
- A single weather station can support multiple blocks and varieties of grapes in a similar climate
- If a grower must use a calendar based schedule then the PMI can effectively determine WHEN to start and which product to use

UCD Continues Partnership in Data Collection with McCrometer CONNECT

Accurate weather data is critical for developing the model for grape powdery mildew. Dr. Gubler and his Team have been using McCrometer CONNECT wireless field stations and sensors since 1995. These durable UHF radio systems have been used with the PMI model since it was introduced 18 years ago with automated weather networks established in Napa, Sonoma, and Kern counties. Dr. Gubler has continued his partnership with McCrometer by expanding with 18 additional weather stations. The choice to continue with the McCrometer CONNECT turn-key product line was based on "quality, ease of use and proven reliability" as cited by Dr. Gubler.

The new weather stations are the latest generation wireless data loggers using upgraded sensors and GPRS (cellular) communication. The GPRS (cellular) based technology of these field stations allows the research team greater flexibility for deployment nearly anywhere in California (or the USA). For further ease of use, data hosting and technical support are provided by McCrometer CONNECT. The data is

automatically delivered via a web based platform where the research team can use trending tools, modify and run variations of the PMI model, run statistics or export the data as needed for continued improvement of the model.

Site Specific Powdery Mildew Disease Risk Assessment for Growers

The most accurate way to calculate a Powdery Mildew Index for a vineyard is to deploy a site specific weather station. The temperature, relative humidity and leaf wetness sensors are set within the grape canopy to record the exact conditions the vine/fruit are experiencing. This data is automatically fed into the model, serving to help growers reliably achieve:

- Better disease control
- Reduced chemical costs
- Reduced labor costs
- Increased and reliable yields

The same McCrometer CONNECT weather stations being used by Dr. Gubler and UC Davis are available for growers as well. The field stations are wireless and designed to run on small solar panels and rechargeable battery packs. Wireless options include satellite, GPRS (cellular), and radio to flexibly cover the needs in any vineyard. The data is recorded and automatically delivered to a web based platform and available via PC, smart phone, or tablet. (See Fig 3.)

Growers can use the Powdery Mildew model in a number of ways. The PMI index can be used as a general guideline or the grower can enter each treatment into the system's web based software and track the detailed treatment recommendations provided by the model. This detailed use of the model allows the grower to integrate the exact control duration, wash off limits (if the treatment was counteracted by being washed off) and an integrated spray stretching algorithm that allows growers to stretch the interval between treatments when weather conditions are not conducive for disease growth.



Figure 3: McCrometer CONNECT Weather Station