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NEW YORK WINE & GRAPE FOUNDATION

CONTROLLING MULTIPLE DISEASES OF GRAPEVINE WITH A MINIMUM NUMBER OF FUNGICIDE SPRAYS

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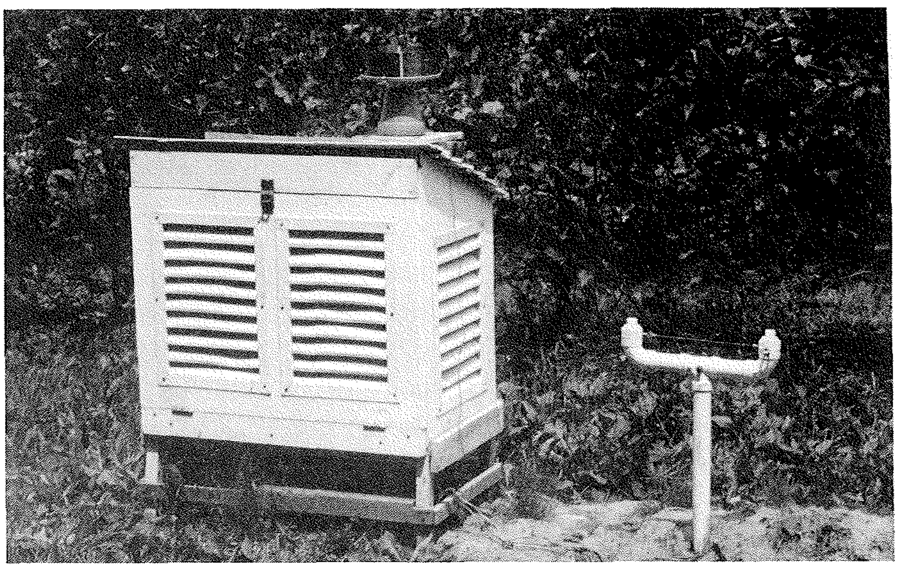

Figure 1.—Weather instrumentation is used to detect infection periods in vineyards. (A) The shelter contains a modified hygrothermograph which provides an hourly record of temperature, humidity, leaf wetness, and rainfall. The T-shaped leaf wetness sensor is in the foreground and a tipping-bucket rain gauge sits atop the shelter. (as discussed on page 3)

Within the confines of a research vineyard, it is a relatively easy task for a scientist to optimize the timing of fungicide sprays to control a single disease, and thus develop a set of rules that can be used to control that disease with a minimum number of fungicide sprays. However, such refinements in control of single pests can be of limited value when pest complexes are present in commercial vineyards. Commercial grape growers in New York face an impressive array of fungal diseases, all of which have the capacity to destroy the crop. In order to control these multiple diseases, we have attempted to deal with all of them simultaneously (as must the grower) rather than as discrete units that can be manipulated without regard to other parts of the complex. Our objective is to develop a system that results in the application of a minimal number of fungicide sprays to efficiently control all of the major fungal diseases of grape in New York. Although the program is not complete, it is currently under evaluation in five commercial vineyards in New York, and we plan to include more vineyards in future years. For the sake of convenience, we will refer to the system as the PI (Post-Infection) program.

(B) A microprocessor-based instrument, which performs all of the functions of the modified hygrothermograph, and which contains programs for several disease forecasting models which use data collected by the instrument. A solar panel with battery back-up provides power for the computer and printer contained within the weatherproof housing.

Before presenting the specific details of the PI Program, we should introduce the major fungal pathogens of grapevines in New York:

Powdery Mildew can affect all green tissues of the vine. Direct loss of yield occurs when the epidermis of berries is infected. The infected epidermis stops growing and the berries then split and rot as the flesh continues to expand. Levels of fruit infection as low as 3 per cent can be detected as off flavors in wine, thus tolerance of the disease is low on high-quality wine grapes. Our wine-grape cultivars are also the most susceptible to this disease. As a result of research conducted in our department over the last eight years, we now know that the pathogen (*Uncinula necator*) overwinters in New York as minute spore-containing structures (cleistothecia) on the bark of the vine. Furthermore, we have shown that the spores are released during a relatively brief period between bud break and bloom of grape (Fig. 2), and then only when rain exceeds 0.10 inches and temperatures are above 40 F. Infection can occur shortly after spore release if temperatures are above 50 F. Secondary inoculum produced from these early-season infections serves to spread and increase the severity of the disease.

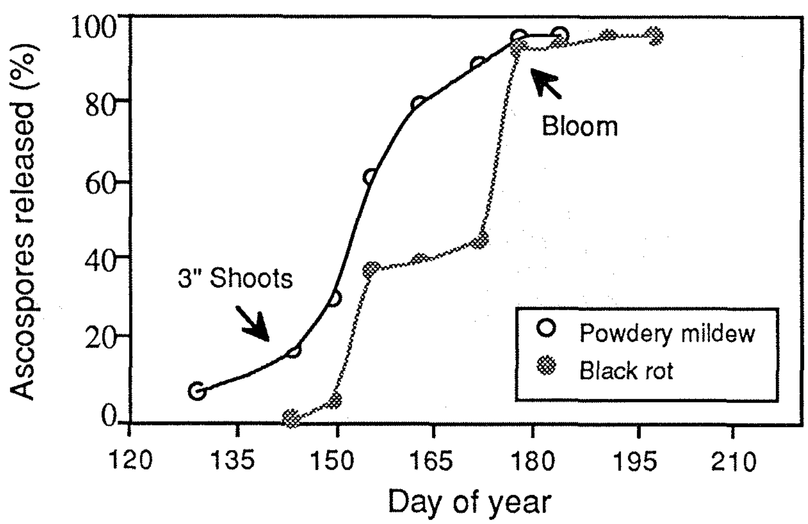

Figure 2.—Release of inoculum by the powdery mildew and black rot fungi in Dresden, New York in 1989. Note that most of the primary spores of both pathogens are released within a four-week period at approximately the same time in spring.

Black Rot, as the name implies, results in dry, blackened, rotted fruit. Once symptoms appear on fruit, no amount of fungicide can halt the progression of the disease, and the berries quickly become mummified. The pathogen (*Guignardia bidwellii*) overwinters in the mummified berries and discharges spores during spring rains. The period of spore release is somewhat longer than that of *U. necator*, but is usually over by fruit set (Fig. 2). Infection requires several hours of wetness on fruit and foliage, and temperatures above 40 F. The exact number of hours of wetness needed is dependent upon temperature, with shorter times being required at higher temperatures. Once established in a vine, *G. bidwellii* can produce secondary inoculum for the remainder of the summer.

Downy Mildew is similar to powdery mildew in appearance, but is caused by a very different pathogen (*Plasmopara viticola*). *P. viticola* can infect both fruit and foliage, and if not controlled can destroy the crop before bloom. Although extremely destructive when severe, downy mildew is the most variable of the three major diseases in its occurrence from year to year. The pathogen overwinters in crop debris on the vineyard floor and, after a period of dormancy, releases spores during wet weather in spring. The effects of weather on downy mildew are complex, but have been simulated in several weather-driven mathematical models that are used to forecast the disease.

The PI Program takes advantage of certain similarities in the biology of the powdery mildew and black rot fungi to time fungicide applications to control both diseases simultaneously. Both fungi release primary inoculum during rain, between bud burst and shortly after bloom, and the minimum temperatures for infection are similar. Also certain fungicides will control either disease up to three days after the onset of infection, and will protect against future infections for up to two weeks after application. We use simple rules to determine when a fungicide should be applied to control black rot *and* powdery mildew: If rain occurs between bud break and bloom and temperature is above 50 F, or if rain occurs and temperature and the duration of leaf wetness are suitable for black rot infection, then a spray is recommended within three days. Thereafter, no sprays are needed for two weeks regardless of how many infection periods occur. Infection periods that occur after the two weeks have elapsed require a second application. In a nutshell, you wait for infection, spray, wait two weeks, and then spray again if there is another infection period.

What about downy mildew? In the PI Program, we use a weather-driven disease forecast model developed in France to predict when downy mildew will occur. The model is called EPI (Etát Potential Infection), and it delivers a forecast based upon the suitability of winter weather for survival and maturation of *P. viticola*. The model also considers the suitability of spring weather for increase of downy mildew. Once a threshold level is reached, fungicides that suppress further development of downy mildew are added to the post-infection sprays for black rot and powdery mildew.

By applying fungicide sprays on an as-needed basis, rather than as preventative measures, we have substantially reduced the number of sprays used to control fungal diseases of grapes. Based on historical weather data, we expect that, in most years, the current PI Program will call for two to four fungicide applications to control the major grape diseases. This can be contrasted with seven or more applications that would be required in a protectant program. On a state-wide basis, each fungicide spray that is eliminated saves hundreds of thousands of dollars in material and application costs. Additional environmental benefits also accrue each year as fungicide use is reduced and selection for fungicide-resistant pathogens is lessened.

To use the PI Program, growers must presently have the capacity to monitor the weather variables used to forecast infection (temperature, rainfall, leaf wetness, and humidity). Instruments that can fill this need on-site range from simple rain gauges and max-min thermometers ($20), to modified hygrothermographs ($2,000), to sophisticated microprocessor-based weather stations ($5,000). Growers choosing the lowest cost instruments must watch the weather closely to record the time that rain begins, and the number of hours of leaf wetness. This isn't always easy when rain begins at night, or if you are away from the farm when the rain occurs. The more expensive units (Fig. 1) require less daily attention, and the microprocessor-based units can perform several functions in addition to running the PI Program (Botrytis forecasting, degree-day accumulation, downloading of environmental and spray data to personal computers, etc.). Choosing the right instrument is often a function of vineyard size, with larger vineyards allowing for more rapid recovery of the cost of instrumentation as sprays are reduced. Conversely, the requirement to apply fungicides within three days of an infection period may place an upper limit on the size of vineyards to be managed under the PI Program. Regional disease forecasts based on high-resolution weather forecasts may someday reduce the need for on-site instrumentation and extend the PI Program to all interested growers.

This research has primarily been supported by the New York Wine and Grape Foundation. Additional support has been received from the Low Input and Sustainable Agriculture Program (LISA) of USDA, the New York State Integrated Pest Management Program, and Neogen Corporation■

FROM THE EDITOR

by Martin Goffinet

In this issue of *Grape Research News*, I have sought out information from researchers that relates to summer efforts in grape growing and to anticipated needs for assessing grape juice and wine quality after harvest. Along this line of thought, three scientists in the Department of Plant Pathology at the agricultural experiment station at Geneva present research-based knowledge on how to control several grape diseases with the fewest possible sprays. Bob Pool, Cornell's viticulture expert, also based at the Station, presents information about the rationale for summer pruning and leaf removal in an overall management program.

The aim of any management program is to produce a high quality crop at season's end. I asked Dr. Thomas Henick-Kling, wine researcher and extension enologist at the Geneva Experiment Station, what is available to New York State juice and wine producers that can be of benefit to the quality control of their products after harvest. The answer, quickly given, was that more of you should be interested in the services of the Wine Analytical Laboratory, which is housed at the station in the Department of Food Science and Technology. This is especially the case if you have a smaller winery, and cannot afford to have complex juice and wine analyses done on the site. The Wine Analytical Laboratory was created specifically to offer New York wineries affordable technical analysis of juice and wine, and to establish a data bank to provide a basis for quality assurance and an information source for grape extension and research staff. The lab is thus closely tied to Thomas' wine research and to his cooperative extension efforts which serve the wine industry.

The Wine Analytical Lab was formally established in 1989 to help New York juice and wine producers understand the characteristics of their products and to help them maintain or enhance wine quality. Henick-Kling used an initial grant from the New York Wine and Grape Foundation to help set up the lab and to subsidize the costs for analysis paid by New York producers. This year the foundation has extended its contribution for all standard analyses done by the lab. This maintains the reasonable cost of analysis for all New York wineries, while providing even more savings to members of the foundation itself. Wineries outside New York State may use the analytical services of the lab, but at full cost. The range of analyses that can be performed by the Wine Analytical Lab are shown in Table 1, with cost paid by members of the Wine and Grape Foundation, by New York producers who are not members, and by those out-of-state.

Table 1. Prices for technical analyses offered by the Wine Analytical Laboratory

Analysis	Member Cost	Non-Member Cost	Out-of-State
pH	No charge	No charge	No charge
Titratable Acidity and pH	$5.00	$7.00	$8.00
Volatile Acidity and pH	8.00	10.00	12.00
Residual Sugar	6.00	8.00	10.00
Alcohol	6.00	8.00	10.00
Fermentable sugars and alcohol	15.00	17.00	20.00
Individual organic acids and alcohol	15.00	17.00	20.00
Sorbate	6.00	8.00	10.00
Citrate	15.00	17.00	20.00
Acetaldehyde	15.00	17.00	20.00
Free & Total SO_2	10.00	12.00	8.00
Ammonia	6.00	8.00	15.00
Total Nitrogen	10.00	12.00	10.00
Potassium	8.00	10.00	10.00
Sodium	8.00	10.00	12.00
Iron	8.00	10.00	12.00
Copper	8.00	10.00	12.00
Heat Stability (protein)	3.00	4.00	5.00
Cold Stability (tartrate)	3.00	4.00	5.00
Sterility Check (yeast & bacteria)	15.00	17.00	25.00
Sterility Check (yeast only)	10.00	12.00	15.00
Sterility Check (bacteria only)	10.00	12.00	15.00
Microscopic Analysis	15.00	17.00	20.00
Sensory Analysis	No charge	No charge	
Group V (12 tests, wine analysis)	25.00	35.00	65.00
Group VI (5 tests, juice analysis)	15.00	20.00	35.00

The charge for each item pays for a technician's salary and materials directly needed for the analysis. The expectation is that the lab will meet its cost of operating by user fees. For $5.00 you can obtain a sample submittal kit for your juice or wine, with instructions for its use, by writing to: The Wine Analytical Laboratory, Department of Food Science and Technology, New York State Agricultural Experiment Station, Geneva, NY 14456-0462. From the day the sample is received, you can expect to have the results in three to five days.

All data from the commercial wines submitted for analysis are recorded and entered into a database (the New York Wine Data Bank) that Thomas has developed as a resource for extension and research support of the New York industry. As such, the information serves as a basis for analysis of winemaking problems encountered in the industry. As it is built up, the data bank will allow indentification of regional, varietal, and yearly fluctuations in the composition and balance of juice and wine, as well as help in identifying wine making problems. Names of submitters of samples to the data base are kept strictly anonymous. The data bank is there to be used, with its information accessible to New York juice and wine producers and to the grape research and extension staff.

The usefulness of the information in the data bank, as in any research-oriented project, relies on as complete a sampling of the population (that's you) as possible. With enough data, questions can be answered concerning any combination of variety, production year, color of wine, chemical composition, etc., by calling up the data out of the database. As Thomas has said in one of his many newsletters, "We expect that with increasing recognition of the value of the analytical services and the wine data bank, the support and the usage of the laboratory will grow."■

SUMMER PRUNING AND LEAF REMOVAL

by Robert M. Pool
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At a time when genetic engineering and molecular biology are in vogue, research exploring the benefits of summer pruning and leaf removal to New York grape growers may seem mundane. However, research done at Fredonia, Geneva, and Long Island has shown that two of the primary objectives of the biotechnologist, reduced use of pesticides and reduced disease, can be accomplished by these two operations. Results from other areas suggest other possible benefit s may be possible, such as a more favorable acid balance or improved fruit flavor. The catch is that the benefits will only be obtained under certain circumstances; summer pruning and leaf removal have the potential to do more harm than good, and they can be quite costly.

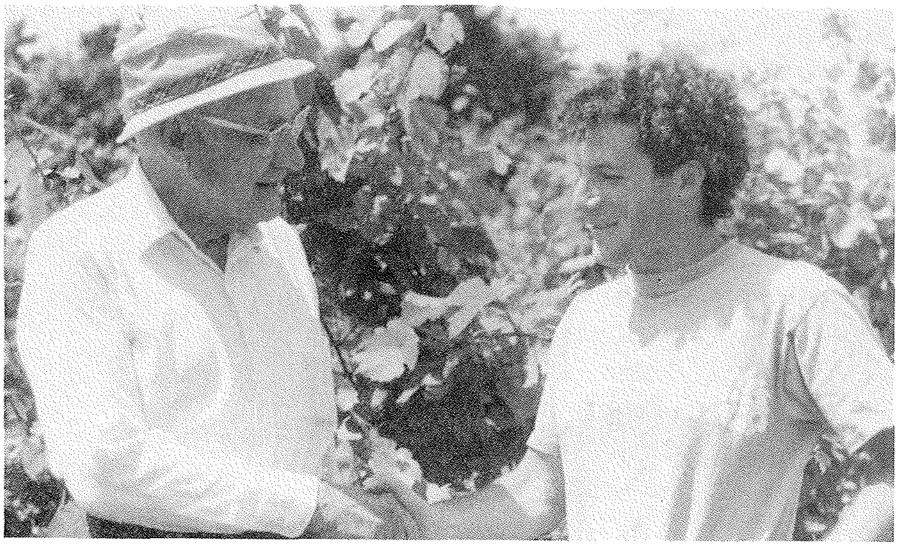
An understanding of how summer pruning and leaf removal accomplish their effects can help you decide about its role in your vineyard. Positive benefits of summer pruning result from an increase in the amount of sun-light which reaches the fruit zone. This is done by removing shoot tips which would produce growth that would shade the cluster region. Leaf removal works by opening up the fruit zone, enhancing spray and light penetration, and increasing ventilation of the region.

These goals tell the grower the circumstances where summer pruning may be beneficial. It is suitable for training systems which have a distinct fruit zone (cordons, flat canes or umbrella type training) and where excessive shoot growth shades fruit (low heads). Because the primary benefit is reduced bunch rot, most dramatic effects will be obtained with varieties sensitive to bunch rot, such as Chardonnay or White Riesling. Similarly, leaf removal will only be effective when the fruit region is crowded and when removing leaves will relieve that congestion.

There are two potential negative effects. In other regions shoots may be growing vigorously at the time of summer pruning, and prolific re-growth may result. The growth spurt may divert photosynthates from developing fruit, delaying fruit maturity. This has not been a problem in New York, possibly because we use relatively low vigor rootstocks or because we summer prune when the days are beginning to shorten and shoot growth rate is slowing. The second potential problem is excessive leaf removal which may reduce the size of the light intercepting leaf canopy to the extent that photosynthesis becomes limiting. That is most likely when leaf removal is done shortly after bloom, a time when the canopy is still small.

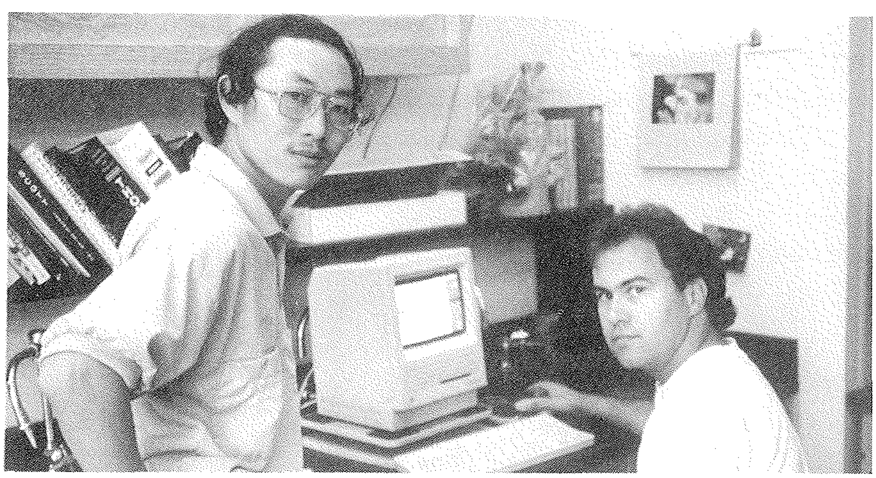
To avoid sunburning the fruit, leaf removal should be done either just after bloom, or delayed until veraison when the fruit begins to sugar up. Summer pruning should be done when further shoot growth will shade the lower canopy. In New York, that is usually about the last week in July or the first week in August. Machines have been developed to do both of these operations, but mechanical leaf removal should be done just before veraison. At that time it is possible to minimize the danger of inadequate leaf surface, fruit sunburning, and the danger of inducing bunch rot when fruit is damaged by the leaf remover. Our studies have shown that, following physical damage, pre-veraison fruit will generally heal over, while post-veraison damaged fruit usually decays. ■

Nelson J. Shaulis Advancement of Viticulture Award



Eric J. Sussman is the 1990 winner of the Nelson J. Shaulis Advancement of Viticulture Award, which is administered by the New York State Grape Production Research Fund, Inc., a non-profit organization funding grape research. Sussman, a senior in Cornell's College of Agriculture and Life Sciences, is using the $1,900 scholarship to work this summer in the viticulture program of Professor Robert Pool, at the New York State Agricultural Experiment Station, Geneva. He is interested in wine grape growing and in low input sustainable agriculture. The Shaulis Award honors Nelson J. Shaulis, Professor Emeritus at the Geneva Station, for his many contributions to viticulture.

Cornell Graduate Students Win Society Awards



Zongming Cheng and Donald Cox (missing from picture, Erik Olsen)

Three Cornell graduate students doing research at the New York State Agricultural Experiment Staion at Geneva recently won student awards at the annual meeting of the Eastern Section of the American Society for Enology and Viticulture, at Rochester, NY, July 11–13.

Zongming Cheng a student of Bruce Reisch in the grape breeding program, won a $500 award for best paper in a viticultural topic, "Biological Control of Biovar 3 Strains of *Agrobacterium tumefaciens* by Agrosin-producing Strain HLB (*A. radiobacter*)." Cheng's research efforts emphasize genetic engineering of grapevines for crown gall resistance.

Donald Cox, an enology student of Thomas Henick-Kling in the Department of Food Science and Technology, won $500 for best paper in the enology area for his presentation, "The Physiology of the Malolactic Conversion and its Role in Winemaking." Co-authors of Cox's paper were Sybille Krieger (visiting scientist) and Henick-Kling.

Erik Olsen, another of Henick-Kling's students, and **Donald Cox** each won a $1000 scholarship for best student of enology and viticulture. The scholarship is based on past performance, published papers, scholastic standing, research planning and future direction. Olsen's research objective is to understand how malate is transported in bacteria important to malolactic fermentation during wine making. Cox is working on the bioenergetics of malolactic fermentation.

The New York Red Wine Symposium

takes place August 9–10 at the Culinary Institute of America, Hyde Park, NY. Contact Dr. Thomas Henick-Kling, Department of Food Science and Technology, New York State Agricultural Experiment Station, Geneva, NY 14456. Phone: 315-787-2277.

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Question:

Gratitude is expressed to those organizations whose support makes possible ongoing and valuable research activities for the benefit of the State's grape industry. Major funding is provided by the **New York State Wine & Grape Foundation; the Grape Production Research Fund, Inc.; and, the J.M. Kaplan Vineyard Research Program.**

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Got A Question? We are trying to address the many questions from grape growers and processors that come to Cornell's grape research community. We invite you to write to us at *Grape Research News* to bring to our attention any questions you have about grapes. We will see to it that those questions are answered by someone knowledgeable in the area of your concern.
Save yourself a long distance phone call. Put it in writing on the back of form below, cut it out, and send it to us.

— CUT HERE —

Name ______________________________
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Mail to:

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