GRAPE RESEARCH NEWS

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Prediction Of Vineyard Site Suitability

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Site Selection

Site selection for vineyard establishment has been known to be important ever since early Roman times and the proverb "*Bacchus amat colles*" (Bacchus loves the hills) was the result of their experience. Maps of vineyard site suitability have been published for many regions, including British Columbia, Ontario, Germany and Oregon. Over the last two years we have been working on a project designed to give the New York grape industry a better picture of vineyard site suitability. The major component of our work has focused on an analysis of site selection for New York State at a 1 km^2 resolution. In New York State the principal site selection factor is for sites that avoid exposure to extreme low temperatures. This is determined by both regional climate and local conditions, including topography, which influences cold air drainage. Other important factors are a site's slope, length of growing season, favorable weather during harvest and soil suitability. In the past, vineyard site selection has relied upon the manual overlay of maps that represented different site suitability attributes. The advent of Geographic Information System (GIS) technology allows the viticulturist the ability to handle site selection factors at a greater resolution and flexibility than ever before. GIS databases are spatial databases that enable the storage and rapid analysis of vast quantities of geographic information.

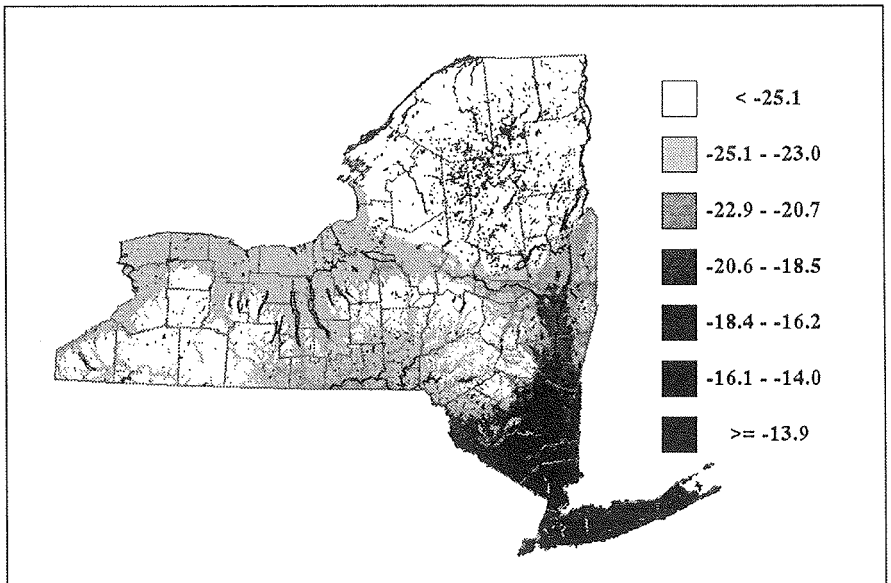


Figure 1. *Lowest winter temperature (°F) likely to occur in New York within a 10-year period. Data presented at a 1 km^2 resolution.*

Maps of New York Site Suitability

We obtained digital maps of climate, soil and land use to do our analysis; in most cases the maps represent information at a 1 km^2 scale. Digital climatic maps of New York State were obtained from ZedX Inc. (a commercial weather information company) and are derived from interpolation of North American weather stations and adjusted for the influence of elevation. The annual mean absolute difference between station values and the ZedX data was 1.0 °F (0.55 °C). The two most important maps were those showing extreme cold temperatures and the length of the frost-free season.

Severe injury to *Vitis vinifera* grapevines are likely to occur any time temperatures are less than -5 to -10 °F. Our climatic maps show almost the entire state experiences temperatures less than these thresholds at least once every ten years (Fig. 1). Grape cultivation also requires at least 160 frost-free days. Our maps show that the length of the growing season is strongly influenced by proximity to water bodies such as the Great Lakes. The most suitable parts of the state climatically were, in order of favorability, Long Island, the Hudson Valley, Niagara and Ontario regions, and parts of the Finger Lakes districts.

Soil suitability is also important. Soils should be deep and well drained (Fig. 2). For *Vitis vinifera*, soils should also have a moderate to high pH. Our soil maps were also based on 1 km^2 information. With these maps we can obtain a general idea of soil suitability. The soil properties themselves are generally governed by the parent material, with the most suitable soils being those derived from limestone bedrocks, which run in a crescent shape across the state.

The climate and soil maps were digitally overlain to show all areas that have both suitable climates and soils. In the final step, the maps are overlain with a land-use map to exclude urban areas and water bodies. The final "suitability maps" correspond well with established grape areas in most cases. The greater favorability of the Hudson Valley compared to other regions has been disputed by several of the reviewers of the project. We are currently investigating other methods of validating these maps.

Local Scale Maps

The limitation with the state scale maps is that they do not capture local scale influences which are extremely important for site selection. We have initiated a site selection study in Seneca County at a 1 hectare (2.2 acre) scale. Our experiences so far have illustrated the difficulties with working at a finer scale. Local scale studies are hampered by the absence of appropriate data and by the increased cost of working at a finer scale. The first problem is especially severe for soil data. In New York State, only 10% of the county soil surveys have been digitized. Climate data is problematic, too. At the local scale, variations such as topography and proximity to smaller water bodies can make the climate extremely variable over even a small distance. Last year we established a temperature survey at a vineyard at Lodi, starting near the lake and finishing 550 feet higher at the hill top. During several nights when the minimum temperature dropped to 15 °F, the top of the hill was 5 °F colder than the bottom. The collaborating grower has observed variation three times as large during extreme events. Colleagues conducting temperature surveys in Ellis Hollow near Ithaca have also observed such large variations within small areas. Currently we have no method of cheaply estimating climate at the local scale. We are collaborating with a team of meteorologists who are investigating whether a local scale atmospheric model could be used to categorize local scale climate. The model would need rigorous testing and then validation by aerial or satellite imagery and field temperature monitoring. Once tested, it could be used at other sites.

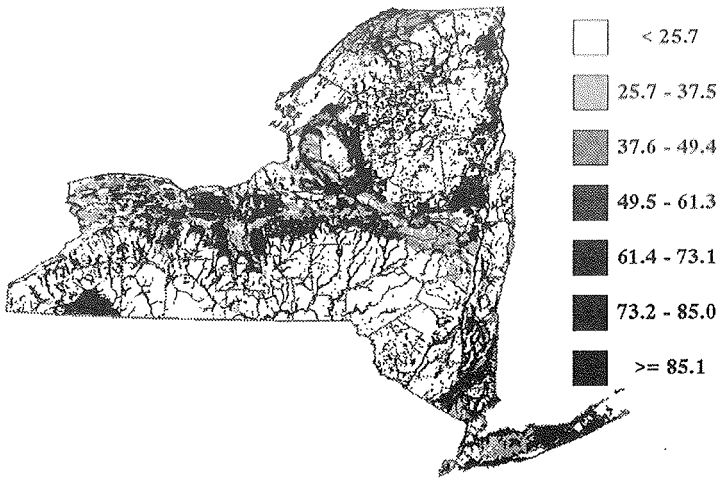
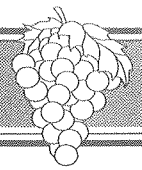


Figure 2.*Percentage of soils with good or excellent drainage. Data presented at a 1 km^2 resolution.*

Site Selection Information On The Web

Our goal is to place the information on the world wide web where it will be available to the industry. A draft of the state study has been finished in web format and is currently under review. The web site is easy to use and allows a user to click on a topic and see maps related to that topic. The web offers incredible potential to disseminate this information. For instance, tools are already available that would allow growers logging on to the web site to construct maps based on their own criteria. Alternatively, points could be selected and then the database could describe all the characteristics of that site. Such capabilities are beyond the scope of the project at present, but are certainly possible in the future.

Acknowledgments: *We thank the Viticulture Consortium for funding. Thanks also to Jim Hazlitt for allowing us to place data loggers at his vineyard site.*



FROM THE EDITOR

Martin Goffinet

Grape research is a data-intense activity. This issue contains two research reports that have been developed via the use of data bases. The first article covers recent efforts by Roger Magarey, Robert Seem and Steven DeGloria to develop a model that could be used to characterize elements for New York vineyard site selection. Vineyard sites often are the main limitation to optimal production of grapes, so precise characterization of a proposed vineyard site's attributes (geology, soil profile, nutrient status, susceptibility to extreme cold or poor air drainage, etc.) would be of great benefit. In the second article, David Gadoury, Robert Seem and Wayne Wilcox explain their ongoing collaborative research into the development of a forecasting model for prediction of grapevine downy mildew infections.

Research on grapevines, grape juice and wines continues on many fronts to help growers and processors produce high-quality, wholesome products at reasonable costs and minimal environmental impact. Each year I give an update of grape-related research projects that are funded by the New York Wine and Grape Foundation through matching money contributed by the grape industry in New York State and, more recently, by the industry in northwest Pennsylvania. Those projects recommended for funding through the Foundation for 1998 are summarized in the table below. In addition, the Wine & Grape Foundation supports the Annual Wine Industry Workshop and provides funding for the production of this publication, "Grape Research News."

Grape-related research projects recommended for funding for 1997–98 by the New York Wine and Grape Foundation via matching money contributed by the New York–Pennsylvania grape industry.

Researcher	Department/Organization	Project
VITICULTURE:		
Terence Bates	Horticultural Sciences, NYSAES, Geneva	Concord roots: growth, biology, and response to environmental soil conditions
Thomas Burr	Plant Pathology, NYSAES, Geneva	Cultural and biological management strategies for crown gall
Ling-Mei Chang	Biology Department, SUNY Geneseo	Genetic engineering of grape for disease resistance
Gregory English-Loeb	Entomology, NYSAES, Geneva	Understanding variation in grape berry moth flight activity and implications for pest management
		With and among vineyard distribution of the banded grape bug and the development of a monitoring program
David Gadoury	Plant Pathology, NYSAES, Geneva	Development of practical models for use in the management of grape powdery mildew
		Forecasts of downy mildew for use in NY and PA grape programs
Dennis Gonsalves	Plant Pathology, NYSAES, Geneva	Restoring the productivity of vineyards infected with tomato ringspot virus
Wolfram Koeller	Plant Pathology, NYSAES, Geneva	Novel opportunities for biological control of grape diseases
Alan Lakso	Horticultural Sciences, NYSAES, Geneva	Atomic isotope signatures as integrators of vine stress and estimators of untypical aging potential in NY wines
		Concord grape rooting responses to wet and dry soils
Wendy McFadden-Smith	University of Guelph, Guelph, Ontario	Reduced pesticide use and improved control of grapevine fungal diseases through trellis design, canopy management and improved spray application efficiency
Robert Pool	Horticultural Sciences, NYSAES, Geneva	Testing varieties, clones, rootstocks and production methods of *Vitis vinifera* in NY
Hugh Price	Horticultural Sciences, NYSAES, Geneva	Enhancing the competitiveness of New York vineyards
Bruce Reisch	Horticultural Sciences, NYSAES, Geneva	Development of embryogenic tissue cultures of Concord suitable for genetic engineering

Researcher	Department/Organization	Project
Bruce Reisch (continued)		Resveratrol content in grapevines: analysis of germplasm used in disease resistance breeding
Michael Saunders	Entomology, Penn State University	Investigating occurrence of races and induction of diapause in the grape berry moth for improved treatment decisions
Warren Stiles	Fruit & Vegetable Science, Cornell, Ithaca	Nutritional factors affecting berry set and yield of grapes
James Travis	Plant Pathology, Penn State University	Inoculum production and infection requirements for black rot cane and shoot infections
Wayne Wilcox	Plant Pathology, NYSAES, Geneva	The biology and epidemiology of cane and fruit infections caused by *Phomopsis viticola*
		Epidemiology and control of black rot
		Sustaining effective and efficient programs for control of grapevine powdery mildew.
		The biology, epidemiology, and control of botrytis bunch rot
PROCESSING/ENOLOGY		
Terry Acree	Food Sci. & Technology, NYSAES, Geneva	Development of a sniff kit for training of wine industry personnel and wine consumers
Thomas Henick-Kling	Food Sci. & Technology, NYSAES, Geneva	Yeasts in New York wines
		Wine analytical laboratory and New York wine data bank
WINE AND HEALTH		
Leroy Creasy	Fruit & Vegetable Science, Cornell, Ithaca	Analysis of NY wines and juice for resveratrol and phenolic antioxidants.
		Control and application of resveratrol in grapes, juice and wine
		Resveratrol lab

MEETINGS & EVENTS

24 June–25 June 1998. American Society for Enology & Viticulture, 49th Annual Meeting. Sacramento Convention Center, Sacramento, CA. For pre-registration and exhibitor information contact the ASEV, P.O. Box 1855, Davis, CA 95617-1855. Phone: 530-753-3142, Fax: 530-753-3318, or E-mail to: asevdavis@aol.com

22–24 July 1998. The 23rd Annual Meeting of the Eastern Section of the American Society for Enology & Viticulture (ASEV/ES), in conjuction with a Sparkling Wine Symposium. The Crowne Plaza Hotel in Grand Rapids, Michigan. On 22 and 23 July, the Sparkling Wine Symposium will detail both viticultural practices and enological methods dealing with sparkling wine production. On 23 and 24 July, the Annual Meeting of the ASEV/ES will serve as the forum for presentation of field and laboratory research topics in viticulture and enology. Also, the program will include a trade show, luncheon matched with sparkling wines, student paper competition, regional wine showcase, and a banquet featuring presentation of society awards. For more information, contact Dr. Ellen Harkness, ASEV/ES Treasurer, Dept. of Food Science, Smith Hall, Purdue University, West Lafayette, IN 47907-1160. Phone: 765-494-6704, Fax: 765-494-7953, email: harkness@foodsci.purdue.edu

Cornell Scientists Win Best Paper Award

Tim Martinson, Richard Dunst, Alan Lakso, and Greg English-Loeb have received the Best Paper of the Year Award in viticulture from the American Society for Enology and Viticulture. The judges found the paper, "Impact of Feeding Injury by Eastern Grape Leafhopper (Homoptera: Cicadellidae) on Yield and Juice Quality of Concord Grapes," to be outstanding in content and declared that it made a substantial contribution to the field of viticulture. The authors, all associated with the Agricultural Experiment Station in Geneva, will receive a $500 award and an engraved plaque .

Research on the Forecasting of Downy Mildew

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New York State Agricultural Experiment Station
Geneva, NY 14456

Introduction. Downy mildew is caused by the fungal pathogen *Plasmopara viticola*. The pathogen overwinters as dormant oospores in fallen infected leaves. In late spring and early summer, the oospores germinate and produce small sacs (sporangia) that contain several smaller infective spores (zoospores) which have the ability to swim in films of water. These zoospores are dispersed by splashing rain to susceptible tissue (leaves, fruit, rachises, tendrils), where they infect and start the new season's disease cycle (primary infections). The typical white, downy growth that develops from infected tissues contains masses of additional sporangia, which can cause an "explosive" spread of the disease through repeated cycles of new infection and spore production every 4 to 5 days under wet conditions. The keys to avoiding severe fruit infection and early defoliation are: (1) prevent the overwintering spores from causing primary infections in the cluster; and (2) suppress the repeating stage of the disease when weather turns favorable for secondary infection cycles.

Why forecast this disease? The relationship between *P. viticola*, environment, and disease development is considerably more complex than for most fungal pathogens. This level of complexity often makes downy mildew seem unpredictable. The disease is certainly sporadic in its occurrence. In New York, downy mildew is not an annual threat in most vineyards. Favorable weather for severe disease across wide regions has occurred only about one year in three since 1985. However, locally favorable conditions happen every year. In other words, everyone is at risk about every third year, but someone is at risk almost every year. This now-you-see-it, now-you-don't pattern makes research on downy mildew a risky business (we don't like to collect a lot of zeros in our research plots). It has also made downy mildew a challenge to control reliably without resorting to "blanket" fungicide programs. Of course, who needs a predictive model if the disease is an ever-present threat? We are not primarily concerned with extreme conditions: these forecasts are "no-brainers." If it rains for three weeks around bloom, the disease will be severe. If it is dry for a month, the disease will be absent. Forecasts of downy mildew are needed for the middle ground: when we're really not sure whether to spray or not. We are working to develop a predictive model precisely because efficient management of this disease requires better information than is now available.

When do the first infections occur? We have been making precise observations of the first occurrence of downy mildew symptoms since 1981. We use the highly-susceptible cultivar Chancellor specifically because its clusters are excellent indicators of the disease: within 5–10 days of infection, they twist into a corkscrew shape that is diagnostic for downy mildew. Beginning 1–2 weeks before bloom each year, we have checked approximately 500 clusters every 3 days to find the first symptoms. We can then work backward through recent weather data to pinpoint the rain event during which the infection probably occurred. After 15 years, we've been able to deduce the following from this collection of circumstantial evidence (Table 1). First, no detectable infections occur before clusters reach Eichorn and Lorenz stage 12 (five to six flat leaves, flower clusters clearly visible and compact). Second, once this growth stage has been reached, primary infection only appears to develop following a rain event of more than 0.10 inches concurrent with temperatures of more than 52°F. Cluster infection in the 'Chancellor' vineyard has always occurred after these two criteria have been satisfied.

How long do fruit remain susceptible? Good question. We don't really know in most cases. There is more diversity in susceptibility to downy mildew among grape species, cultivars, and tissues (leaf, fruit, rachis, shoot) than occurs for most other diseases. For example, foliage of 'Delaware' and 'Aurore' is quite susceptible, but rachises and fruit are apparently immune to infection. 'Chancellor' has a well-deserved reputation for susceptible clusters, but the foliage is remarkably resistant. 'Niagara' and 'Catawba' have susceptible leaves *and* fruit. It's very likely that this variability extends to the duration of fruit susceptibility, but the magnitude of this variation is unknown. What we do know from numerous fungicide timing trials is that the prebloom and postbloom sprays are

critical sprays to control downy mildew on fruit. So, while we don't know exactly when the fruit become immune to infection, we know when cluster infection starts (E&L stage 12), and the duration of maximum risk for fruit (until shortly after fruit set).

Mid-summer heat and downy mildew. Downy mildew epidemics sometimes get off to a good start on foliage, and then fizzle during the month of July. Despite a wealth of susceptible host tissue and occurrence of individual days with weather favorable for infection, the disease simply stops increasing. We believe that this is due to the impact of high daytime temperatures on survival of the sporangia that are responsible for spread of the disease. These are somewhat delicate structures, and are killed after repeated exposures to high temperatures. Without a supply of viable sporangia and the resultant young lesions, production of inoculum spirals downward and the epidemic halts. Of course, if July is predominately cool and wet, this decline does not occur.

It's baaaack. Many of the worst cases of foliar downy mildew occur in commercial vineyards as we return to cooler days and nights with abundant dew formation in August and September. Under favorable weather, the pathogen spreads rapidly in dense canopies that are typical of this time of year. Fungicide programs are generally more relaxed at this time, and the lull in downy mildew's growth during July often fools us into believing that the disease is under control. The later maturing the variety, the greater the potential for loss due to the late-season explosion of downy mildew.

DMCAST. That's the name of the downy mildew forecasting model developed at Geneva. The model was originally designed to run on a personal computer using weather data collected on-site in the grower's vineyard. Our plan is to run the model using the network of stations now deployed throughout the state by the Northeast Weather Association (NEWA), and eventually to use high-resolution weather forecasts to supplement the on-site stations. In DMCAST, the first round of infection (primary infection by oospores) is determined by exceeding the vine development, rainfall, and temperature thresholds mentioned in paragraph 3. Thereafter, DMCAST keeps track of each wave of infection, calculates when it will produce secondary spores, and also calculates how long these spores will survive. Once secondary spores are present (this requires warm, humid nights: the pathogen only sporulates in darkness), DMCAST calculates the wetting and temperature requirements for infection. If viable spores are produced during a rain event, or if some spores remain from a previous event, infection is forecasted based upon meeting the minimum leaf wetness and temperature requirements of DMCAST.

So how does the model work? Quite well. Over a three-year period, disease increased significantly following most infection periods forecasted by DMCAST, and disease never increased significantly unless DMCAST forecasted an infection period. The principal error in the model is that it occasionally forecasts an infection that is not followed by significant disease development. These errors occur primarily during the hottest weather of mid-summer. Some fine-tuning of the spore-survival component of the model is probably needed to cure this. Additionally, the model could be improved by incorporating the development of resistance in fruit of different cultivars as they age. DMCAST is an accurate predictor of primary infection, and an imperfect, but useful predictor of secondary infection periods.

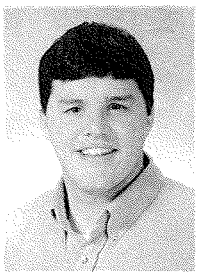
Where does DMCAST fit in a disease management program? Growers must weigh many factors in choosing which material to apply to vines at various times during the year. What is the spectrum of activity required for the disease complex? How does each selection fit in an overall resistance-management program for downy mildew, powdery mildew, and black rot? Is this material the most cost-effective choice? Do I really need to treat for this disease now? Accurate forecasts of downy mildew can allow these decisions to be made with a better knowledge of their ultimate impact on control of the overall disease complex.

Table 1. First occurrence of downy mildew on 'Chancellor' grapevines at Geneva, New York.

	First symptoms:		Infection event preceding symptoms:		
Year	Date	Growth Stage	Date	Rainfall (inches)	Temp. (°F)
1981	17 June	2 days before bloom	11 June	0.10	62
1983	15 June	Bloom	7 June	0.32	54
1985	18 June	Bloom	12 June	1.19	55
1986	6 June	Bloom	1 June	0.15	65
1987	23 June	10 days postbloom	13 June	0.35	68
1988	16 June	1 day before bloom	2 June	0.30	59
1989	14 June	7 days before bloom	6 June	0.17	59
1990	14 June	6 days before bloom	9 June	0.25	64
1991	4 June	3 days before bloom	31 May	0.41	77
1992	14 June	7 days before bloom	8 June	0.14	70
1993	21 June	Bloom	10 June	0.17	72
1994	14 June	3 days before bloom	1 June	1.09	71
1995	13 June	7 days before bloom	3 June	0.53	72
1996	9 June	10 days before bloom	24 May	0.36	60
1997	16 June	12 days before bloom	7 June	0.12	66

PEOPLE IN THE NEWS

New Vineyard Lab Research Associate Appointed at Geneva



Dr. Terence Bates joined Cornell University's Department of Horticultural Sciences at the New York State Agricultural Experiment Station in Geneva, NY, as a research associate. Bates has assumed viticultural duties at the Vineyard Lab in Fredonia, NY. The position will initially be located in Geneva, which allows Bates to facilitate his interactions with others in the grape program, and gives him access to the Geneva Library. The position will eventually move to the Fredonia campus. Terry will work closely with the grape industry in western New York, focusing his research at the Vineyard Lab and with grower-cooperators in the region.

"Terry Bates came on board January 8, 1998, and immediately immersed himself in the task of learning about the New York grape industry," said department Chair, Hugh Price. "He brings an excellent background in plant science and biological research to this position." Price added, "I am encouraging Terry to utilize his knowledge of root development and nutrient uptake to increase our understanding of labrusca grapes. He will be a key member of the Lake Erie Regional Grape Project."

Bate's background is in plant nutrition and root physiology. "There appears to be a general consensus among the researchers and growers that more research needs to be done in these two areas in viticulture," said Bates. "I am sure my background was a major consideration when Cornell decided to hire me for the position. I think that my contribution of research in these two areas is going to complete an existing program in New York viticulture that is already comprehensive in scope."

Bates received his B.S. in Biology from St. John Fisher College in Rochester, NY, in 1992 . He received his M.S. in Horticulture in 1994 and his Ph.D in Plant Physiology in 1997, both from Pennsylvania State University. From 1992 to 1993, Bates was a Technical Assistant at Pennsylvania State University where he determined the efficiency of different bean genotypes under low phosphorus availability. After that, he became a research assistant at Pennsylvania State where he measured the competitive advantage of root hairs at low phosphorus availability. In 1997, he was a National Science Foundation Root Biology Fellow where he developed a technique that used quantitative ratio fluorescence microscopy to measure cytoplasmic pH in growing root hairs.

Bates also has extensive teaching experience. From 1992 to 1997, while at Penn State, he was a teaching assistant in the Plant Nutrition course and the Advanced Plant Nutrition course. He has also been a mentor for both high school and undergraduate students. Bates has authored or co-authored numerous publications. He was awarded the Walter Thomas Memorial Scholarship, and was made a National Science Foundation Root Biology Fellow. He is a member of Sigma Xi, the National Honor Society of Agriculture, and of the American Society of Plant Physiologists.

This summer Bates, with his wife Kelly and son Davis, will be relocating to the Lake Erie grape belt, as he settles into the Viticulture Laboratory in Fredonia, where he already has several research projects underway.

Gadoury Honored with IPM Award

This past January at the Annual Meeting of the New York Horticultural Society in Rochester, David Gadoury, a senior research associate in the Department of Plant Pathology at the NY State Agricultural Experiment Station in Geneva, was presented a State IPM Award. This award was presented by James Tette, Director of Cornell's Integrated Pest Management Program. The purpose of the award is to honor people for developing new IPM methods or for sharing IPM with others. Gadoury works on the biology and ecology of plant pathogens for the better management of diseases. Although he was awarded for his work with both apples and grapes, his current emphasis is on grapevine disease research. Focusing on grapevine powdery mildew, he, together with the late Roger Pearson, determined how the fungus survived winter to cause infection in the spring. They revised the grape disease management program to target the early part of the growing season, when the disease is inconspicuous but easier to control. This new approach reduced the annual number of fungicide applications by as much as 50% in some cases, and simultaneously improved disease control. As a direct result of these changes, New York grape growers save nearly $1 million a year in lower fungicide costs, and produce higher quality fruit. Gadoury's research is expanding our knowledge of how other major grape diseases, such as downy mildew and black rot, develop. New information about diseases developing in sequence as they weaken a plant is helping growers to select fungicides that target each disease at the proper time. Gadoury is also involved in controlling powdery mildew with beneficial mites.

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Application for Grape Grower Membership in the New York Wine & Grape Foundation

Please ***print*** all information legibly.

NAME_____

NAME OF VINEYARD (if applicable)_____

STREET, P.O. OR R.D. ADDRESS_____

COUNTY_____ **CITY (TOWN) & ZIP**_____

TELEPHONE_____ **TOTAL GRAPE ACREAGE (optional)**_____

After completing this form, please send it and a check for the appropriate amount payable to:
New York Wine & Grape Foundation
350 Elm St., Penn Yan, NY 14527
THANK YOU!

1998 Membership Schedule

Dues (circle)	Acres (circle)
$25	0-30
$50	31-60
$100	Over 60

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.; the J.M. Kaplan Vineyard Research Program; and the Lake Erie Regional Grape Program.**