Promising New Methods for Controlling Crown Gall in Grapes

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Introduction

Crown gall is a serious disease of grapevines worldwide and causes substantial losses of nursery stock in many other plant species. The most obvious symptom of this disease in grapevines is a fleshy callus-like swelling (a gall) which is most often observed in the crown region of the trunk, just above the soil line (Figure 1).

The pathogens which cause crown gall are in the genus Agrobacterium. More than 200 plant species are reported to be susceptible to crown gall and this disease is economically important in a wide variety of crops. For most crops other than grape, the greatest losses occur in the nursery where plants having gall symptoms must be destroyed. Among the crops most affected by crown gall are grapes, stone fruits, roses, pears, and walnuts.

Figure 1. Crown gall in grapevines is characterized by fleshy callus-like swellings (galls) in the crown region of the trunk, just above the soil line (arrow).

Symptoms of this disease are observed only after the crown gall bacterium inserts some of its own genes (DNA) into the plant cell nucleus. Transfer of bacterial genes is triggered by exposure of the pathogen to wounded plant cells and can only occur if cells are actively dividing. These bacterial genes cause high levels of plant hormones to be produced. High levels of plant hormones affect plant development resulting in the disorganized growths recognized as galls. After bacterial genes are inserted into the plant cell nucleus, they are replicated along with plant genes as cells divide. As a result, gall tissue can continue to grow even if all of the pathogen is killed. The soft gall tissue often desiccates during dry or cold periods and may slough off, but new galls may develop the following year at the same site. A single plant cell transformed by pathogen genes may be enough to produce a crown gall, although in grapes it appears that galls tend to be bigger when more cells receive bacterial genes directly from the pathogen. As an aside, this ability of Agrobacterium to move genes into plant cells is used to “genetically engineer” plants after the disease-causing genes are replaced by genes that may improve plant performance.

Crown Gall in Grape

Crown gall in vineyards is most serious when young plants are affected. The growth of gall tissue can partially girdle young vines and interfere with vine growth. The result is weak plants that are less productive and often less likely to
survive additional stress. Reduction in yield and vine growth is greatest in vines that are more than 50% girdled by crown gall. However, one study, performed in California, found that vines with only a small amount of gall tissue can perform as well as healthy vines. When mature plants develop crown gall, the resulting damage is usually less significant since gall development at this stage will not disrupt the older vascular tissue already present in the plants.

The strains of *Agrobacterium* associated with a great majority of grape crown galls are distinct from pathogens causing crown gall in other crops. There are several reasons why this is important to viticulturists. The strains which cause crown gall in most plant species, other than grapes, are common in soils worldwide. These strains are so widespread that crown gall is thought to develop after soil bacteria are splashed onto plant wounds. In contrast, no detectable levels of the grape crown gall pathogen, designated *Agrobacterium vitis*, have been found on sites where grapes have not been grown. In addition, *Agrobacterium vitis* (or AV) has been shown to exist systemically (throughout plant tissues) within many apparently healthy vines, including some nursery stock, so it is now thought that infected grape nursery stock is the principal source of crown gall inoculum in new vineyards. Pathogenic *Agrobacterium* has been shown to move systemically in a few host species, but this appears to be especially common in grapevines. When crown gall-infected vines are introduced into a vineyard, AV then infests the soil by living in association with roots and sloughed-off gall tissue. These bacteria can survive in the soil for many years, even after living vines are removed. Uninfected susceptible vines can become readily infected by the soil-borne pathogen. Unlike other *Agrobacterium* strains, the grape crown gall pathogen produces lesions on grape roots that may assist entry of the bacterium into the vines.

Our current understanding of crown gall in grapes is that AV is likely to be systemically established in the vine either before the plant leaves the nursery or after exposure to soil-borne AV in a previously infested vineyard. In regions where vines are winter-damaged, wounding from cold injury appears to trigger the transfer of bacterial genes into the plant cells, so that more galls develop in the spring following severe winter temperatures.

A discussion of controlling crown gall in grapes must include two topics: 1) techniques to identify or produce "clean" vines, which may permit avoidance of crown gall in new vineyard sites, and 2) methods for dealing with a vineyard that is already infested with *Agrobacterium vitis*.

**AV-free Vines**

Crown gall may be dramatically reduced in new vineyard sites by simply using AV-free nursery stock, since it appears that significant populations of grape *Agrobacterium* aren’t found in non-vineyard sites. Historically, nursery stock with obvious crown gall has been discarded, but the systemic nature of grape *Agrobacterium* permits infected material to pass visual inspection. Techniques have been developed to screen nursery stock for *Agrobacterium* infection. Typically, water is flushed through shoots and then plated on bacterial culture medium that is selective for AV. Unfortunately, this method is not very sensitive and material must be indexed repeatedly to confidently declare it pathogen-free. We have found that freezing shoots prior to testing greatly enhances the recovery of *Agrobacterium* using this flushing technique. If this procedure simulates events that occur in the vineyard, it is possible that movement of AV from older infected wood into the current season’s growth may be enhanced by exposure to freezing. This suggests that the AV levels in propagation wood may be greatly reduced by collecting canes prior to the onset of freezing temperatures.

Several techniques have been studied for eliminating AV from grapevines. Tom Burr, in the Plant Pathology Department of the Agricultural Experiment Station at Geneva, has shown that shoot-tip culture eliminates this pathogen from grapevines. A few commercial organizations are using this method to produce crown gall-free nursery stock. Chateau Saint Michelle in Washington has been planting AV-free vinifera produced through shoot-tip culture and has greatly reduced the incidence of crown gall on new planting sites.

Another method that may be perfected is the heat treatment of dormant cuttings to eliminate AV. Immersion of cuttings in 50°C (122°F) water for 60 minutes kills more than 95% of the AV present, but so far no reliable procedure has been developed to completely eradicate AV without also killing the cuttings. Pretreatment of dormant canes to increase heat tolerance may resolve this problem.

Use of AV-free material may also reduce the risk of crown gall when vines are replanted into infested sites. However, experiments have shown that susceptible vines exposed to soil AV can become readily infected. What can be done to protect clean vines in a replant situation?

**Controlling Crown Gall with Protective Strains**

One interesting approach is pre-inoculation of plants with non-pathogenic *Agrobacterium* which then will produce antibiotics to prevent growth of other bacteria. This technique has been used for many years for stone fruit nursery stock; however, the protective strain used for stone fruits is not effective against all crown gall pathogens and does not control AV. Strains that prevent AV growth in the laboratory have been identified and several groups are testing these strains. A non-pathogenic AV strain isolated in South Africa, F2/5, has been shown to reduce the growth of most pathogenic AV strains when tested in the laboratory. Greenhouse studies by Tom Burr indicate that treatment with this strain usually reduces crown gall severity when grapevines are inoculated with pathogenic AV.

**Controlling Crown Gall with Resistant Rootstocks**

Grape species vary widely in their susceptibility to crown gall. In our research (Ed Stover, Harry Swartz at the University of Maryland and Tom Burr), we decided to see if potential rootstocks could be identified that would prevent or reduce passage of soil-borne AV into...
Eradication of Existing Galls

Initially, we screened over 50 grape genotypes for susceptibility to crown gall. We found two different resistance groups among the grapevines we tested: 1) the closely related North American species *Vitis riparia* and *V. rupestris*, and 2) some Asian *Vitis* species, most notably *V. amurensis*. These two resistance sources responded differently to the strains of AV that we used, which suggests that they might have different mechanisms of resistance. When we studied steps in the disease process to see where resistance occurs in these genotypes, wounded tissue from crown gall-resistant grapevines was as effective as the crown gall-susceptible in triggering the transfer of bacterial genes. Only rarely were the bacterial genes successfully incorporated into the resistant plant nuclei. Interestingly, the resistant varieties were also much less susceptible to the AV-induced tissue disruption that causes root lesions.

When crown gall-resistant grapevines were inoculated with AV, the pathogen population was suppressed compared to crown gall-susceptible vines. These observations support the idea that use of resistant rootstocks might suppress the development of crown gall when AV-free material is planted on AV-infested sites. One of the pleasant surprises in this work was the discovery that some of the most crown gall-resistant grapevines are rootstock varieties that we are already using (Table 1). Couderc 3309, and *Riparia 'Gloire' were among the most resistant types. A few of the rootstocks that are widely used elsewhere, such as Richter 110 and 420A Mgt, are as susceptible to crown gall as the highly susceptible vinifera cultivar 'Cabernet Sauvignon'. In the spring of 1995, Tom Burr, Bob Pool and I will initiate a field study to test whether crown gall-resistant rootstocks are more effective than crown gall-susceptible rootstocks in protecting susceptible scions when AV-free vines are planted on AV-infested sites. Tom Burr hopes to conduct field tests using an AV suppressive strain of *Agrobacterium* that has been very promising in greenhouse tests.

### Managing an Infected Vineyard

Cultural practices are used by many viticulturists to manage crown gall. Most grapevines in the Northeast are grown with multiple trunks in the hope that crown gall or severe winter-injury will not affect all of the trunks and that reasonable canopy area can be developed from trunks that are undamaged. Hilling of soil over the graft union is sometimes practiced to prevent cold damage and resultant crown gall at the graft union which could prevent establishment of healthy renewal trunks. In areas where cold-injury and associated crown gall are particularly severe, some growers will pull vines down from the trellis and bury them in the fall. These management practices to deal with crown gall in our vineyards are labor intensive and do not eliminate economic damage from this disease. We hope that current research on control of crown gall in grapes will reduce the effort and expense we devote to this disease in our vineyards.

### Table 1. Crown gall formation of *Vitis* genotypes and their hybrids after inoculation with three strains of *Agrobacterium vitis*. Galls were evaluated three months after inoculation and characterized by mean percentage of inoculated sites forming galls, mean size of galls when produced, and largest gall per plant.

<table>
<thead>
<tr>
<th><strong>Vitis Genotype</strong></th>
<th>% with Galls</th>
<th>Gall Size (mm)</th>
<th>Largest Gall (mm)</th>
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<tr>
<td><em>V. riparia</em> X <em>V. rupestris</em> C3309</td>
<td>5.7</td>
<td>a*</td>
<td>ab*</td>
</tr>
<tr>
<td><em>V. riparia</em> 'Gloire'</td>
<td>8.1</td>
<td>a</td>
<td>1.2</td>
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<tr>
<td><em>V. longii</em> X <em>V. riparia</em> C1616</td>
<td>11.8</td>
<td>ab</td>
<td>6.1</td>
</tr>
<tr>
<td><em>V. berlandieri</em> X <em>V. riparia</em> TSC</td>
<td>12.5</td>
<td>abc</td>
<td>3.4</td>
</tr>
<tr>
<td><em>V. rupestris</em> GVIT 279</td>
<td>13.3</td>
<td>abc</td>
<td>2.2</td>
</tr>
<tr>
<td><em>V. rupestris</em> GVIT 277</td>
<td>14.8</td>
<td>abc</td>
<td>1.3</td>
</tr>
<tr>
<td><em>V. riparia</em> Manitoba 37 GVIT 401</td>
<td>21.3</td>
<td>bcd</td>
<td>4.6</td>
</tr>
<tr>
<td><em>V. riparia</em> X <em>V. rupestris</em> 101-14 Mgt</td>
<td>21.4</td>
<td>bcd</td>
<td>3.6</td>
</tr>
<tr>
<td><em>V. rupestris</em> GVIT 202</td>
<td>22.0</td>
<td>bcd</td>
<td>2.7</td>
</tr>
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<td><em>V. rupestris</em> 'St. George'</td>
<td>23.0</td>
<td>bode</td>
<td>2.8</td>
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<tr>
<td><em>V. berlandieri</em> X <em>V. riparia</em> 5BB</td>
<td>23.9</td>
<td>cde</td>
<td>2.5</td>
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<tr>
<td><em>V. amurensis</em> GVIT 1295</td>
<td>25.7</td>
<td>bode</td>
<td>1.2</td>
</tr>
<tr>
<td><em>V. amurensis</em> GVIT 689</td>
<td>28.9</td>
<td>de</td>
<td>3.3</td>
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<tr>
<td><em>V. riparia</em> Geisenheim 1</td>
<td>30.6</td>
<td>de</td>
<td>7.5</td>
</tr>
<tr>
<td><em>V. riparia</em> Quebec GVIT 612</td>
<td>34.4</td>
<td>e</td>
<td>6.1</td>
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<tr>
<td><em>V. berlandieri</em> X <em>V. rupestris</em> 110R</td>
<td>63.1</td>
<td>f</td>
<td>8.2</td>
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<tr>
<td><em>V. champinii</em> 'Dog Ridge'</td>
<td>86.8</td>
<td>f</td>
<td>8.4</td>
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<tr>
<td><em>V. vinifera</em> 'Cabernet Sauvignon'</td>
<td>69.3</td>
<td>f</td>
<td>9.2</td>
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<tr>
<td><em>V. berlandieri</em> X <em>V. riparia</em> 420A</td>
<td>69.5</td>
<td>f</td>
<td>12.0</td>
</tr>
</tbody>
</table>

*Within a column, means followed by the same letter are not significantly different using paired t-tests, probability level 5%.*
Well, here it is the middle of the growing season again. By now most growers know just how much winter injury their vineyards sustained in New York State and what it means to their potential crop this season. One of the many concerns after such a winter is the increased likelihood of crown gall showing up in vineyards this summer. Ed Stover, now at Cornell's Hudson Valley Laboratory, earned his recent Ph.D. while researching grapevine crown gall. I have asked him to submit an article on this bacterial disease, with an emphasis on research perspectives for its control.

Each year I try to give our readers some idea of the types of research done on grapes, wine and juice in New York state. Much of this research relies on grant money administered by the New York Wine and Grape Foundation. The Foundation also matches research dollars generated by others for grapevine research, such as the New York Grape Production Research Fund and Mr. John Dyson. These dollars provide for research in grape breeding, culture, pest and disease control, and juice and wine quality at Cornell University, New York State’s land-grant university. Such funding is critical to the research needed to keep our grape industry competitive. Grape researchers in other states will tell you that New York has the best overall grape research programs in the country. The table below summarizes Cornell's grape research projects supported by matching funds from the New York Wine and Grape Foundation for 1994.

Some last-minute funding to the Foundation from the legislature will allow some additional research this year.

It also bears repeating each year that the Wine Analytical Laboratory, Department of Food Science and Technology, New York State Agricultural Experiment Station, is also subsidized by the Foundation to minimize costs to wineries submitting samples for analysis. The wine lab will taste wine samples and then recommend the next step. Contact Thomas Henick-Kling, Department of Food Science & Technology, for information on wine analysis. Phone: 315-787-2277. Finally, this very newsletter is funded by Foundation dollars so that growers are knowledgeable about recent grape research programs.

### Cornell grape-related research projects funded for 1994 by the New York Wine and Grape Foundation.

<table>
<thead>
<tr>
<th>Researcher</th>
<th>Cornell Department</th>
<th>Projects</th>
</tr>
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<tbody>
<tr>
<td>Christopher Becker and Harvey Hoch</td>
<td>Plant Pathology, Geneva</td>
<td>Epidemiology and control of black rot</td>
</tr>
<tr>
<td>Thomas Burr</td>
<td>Plant Pathology, Geneva</td>
<td>Cultural and biological methods of controlling crown gall</td>
</tr>
<tr>
<td>Lee Creasy</td>
<td>Fruit &amp; Vegetable Sciences, Ithaca</td>
<td>Resveratrol in grapes</td>
</tr>
<tr>
<td>Richard Derksen</td>
<td>Agricultural &amp; Biological Engineering, Ithaca</td>
<td>Vineyard spray application systems</td>
</tr>
<tr>
<td>William Edinger and Thomas Henick-Kling</td>
<td>Food Science &amp; Technology, Geneva</td>
<td>Survey for available nitrogen for yeast growth in NY grape musts</td>
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<tr>
<td>David Gadoury</td>
<td>Plant Pathology, Geneva</td>
<td>Developing a practical model for management of powdery mildew</td>
</tr>
<tr>
<td>Martin Goffinet</td>
<td>Horticultural Sciences, Geneva</td>
<td>Investigations of bud development and crop potential</td>
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<tr>
<td>Dennis Gonsalves</td>
<td>Plant Pathology, Geneva</td>
<td>Eliminating of rupestris stem-pitting virus from vines and diagnosing the virus using nucleic acid probes</td>
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<tr>
<td>Wesley Gunkel</td>
<td>Agricultural &amp; Biological Engineering, Ithaca</td>
<td>Robotic grapevine pruning research</td>
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<tr>
<td>Alan Lakso</td>
<td>Horticultural Sciences, Geneva</td>
<td>Pruning and irrigation interactions on vine performance and vineyard economics</td>
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<tr>
<td>Brigitte Martineau, T. Henick-Kling and Terry Acree</td>
<td>Food Science &amp; Technology, Geneva</td>
<td>Production and metabolism of diacetyl by yeast and malolactic bacteria in NY wines</td>
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<tr>
<td>Timothy Martinson</td>
<td>Entomology, Geneva</td>
<td>Reducing insecticide use for leafhoppers using <em>Anagarus epops</em> as a biological control</td>
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<tr>
<td>Robert Pool</td>
<td>Horticultural Sciences, Geneva</td>
<td>Improving Concord production efficiency via canopy spacing and mechanization</td>
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<tr>
<td>Bruce Reisch</td>
<td>Horticultural Sciences, Geneva</td>
<td>Testing vitis clones and varieties and their suitable rootstocks for New York production</td>
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<tr>
<td>Gilbert Stoewsand</td>
<td>Food Science &amp; Technology, Geneva</td>
<td>Statewide evaluation of new grapevine varieties. Genetic technology to improve vine disease resistance</td>
</tr>
</tbody>
</table>

Wine and health
Grape Extension Publications and Educational Materials

Update of Other States’ Grape Publications

The following listings are in addition to those published in the Summer 1993 issue of “Grape Research News.” The entire listing can be requested from the editor using the “Question” form at the back of this newsletter, or send a note to: Martin Goffinet, Dept. Horticultural Sciences, NY State Agricultural Experiment Station, Geneva, NY 14456.

Arkansas:
Extension Communications, University of Arkansas, Little Rock, AR 72203. Phone: 501-569-2117.
EL246 Spraying grapes
EL648 Plant growth regulators for tree fruits and grapes

California
University of California, Agricultural Sciences Publications, University of California, Berkeley, CA 94720. Phone: 510-642-2431.
No. 4105 Grape pest management

Indiana:
Horticulture Extension Office, 1165 Horticulture, Purdue University, West Lafayette, IN 47907-1165. Phone: 317-494-1349.
No. 10169 Indiana commercial small fruit and grape spray guide
FS1 Home winemaking guide
Other Pubs:
Growing grapes in Indiana (contact: Bruce Bardelon, Dept. of Horticulture, Purdue University, West Lafayette, IN 47907)
Proceedings fruit and berry wine symposium, 1992 (contact: Dr. Richard Vine, Dept. Food Science, 1160 Smith Hall, Purdue University, West Lafayette, IN 47907)

Michigan:
Cooperative Extension Bulletins Center, Michigan State University, East Lansing, MI 48824. Phone: 517-355-0240.
E1899 Grape varieties for Michigan’s vineyards
E1935 Pruning grapevines in Michigan

Mississippi:
MAFES, Dept. of Information Services, Box 5446, Mississippi State University, Mississippi State, MS 39762. Phone: 601-325-2262.
#510 Common insects and diseases of bunch grapes
#1444 Fruit and nut review: bunch grapes and blackberries

Missouri:
#6085 Home fruit production: grape varieties and culture
#5090 Home fruit production: grape pruning systems
#6160 Establishing a vineyard in Missouri
#6161 Pruning and training grapevines
#6162 Training systems for Missouri vineyards
For the following, contact: State Fruit Experiment Station, Rt. 3, Box 63, Mountain Grove, MO 65711. Phone: 417-926-4105.
MS-2 Before establishing a vineyard — plan
MS-7 Management of major grape diseases in Missouri
MS-8 Field evaluation of fungicides for control of grape diseases
MS-10 Initial report on French hybrid wine grape research
MS-11 The grape phylloxera
MS-14 Training and pruning small fruit crops in Missouri
MS-18 Growing fruit for home use
MS-19  Missouri grape pest control guide (current year)
MS-21  Fruit cultivars released by the state fruit experiment station
MS-22  1987 Missouri grape acreage survey
MS-24  Quality evaluation of Missouri wines
MS-26  Laboratory manual for wine and must analysis
MS-27  Laboratory techniques
Bull. #35  Grape growing in Missouri
Bull. #41  Cold hardiness of grapes: a guide for Missouri growers
Unnumbered  Proceedings of the Missouri Small Fruit Conference (1981-93)
Unnumbered  Proceedings of the Midwest Regional Grape And Wine Conference (4th, 5th, 6th)
Newsletter  Vineyard and Vintage View

New Jersey:
Publications Distribution Center, Cook College, Rutgers University, P.O. Box 231, New Brunswick, NJ 08903.
Phone: 908-932-9762.

FS594  Grape Tissue Analysis
Unnumbered  NJ Commercial Vineyard Series I. Site selection
Unnumbered  NJ Commercial Vineyard Series II. Establishing the planting
Unnumbered  NJ Commercial Vineyard Series III. Training and maintenance
Unnumbered  NJ Commercial Vineyard Series IV. Vineyard liming and fertilization
Unnumbered  Proceedings “Grape Expectations – A Viticultural and Enological Symposium” (1999 to present)

North Carolina:
Agricultural Communications, Box 7603, North Carolina State University, Raleigh, NC 27695. Phone: 919-515-2800.

Bull. 470  A guide to the identification and biology of insects feeding on Muscadine and bunch grapes in North Carolina

Ohio:
Extension Publications, Ohio Cooperative Extension Service, The Ohio State University, Columbus, OH 43210.
Phone: 614-292-1607.

OCES Bull. 458  Fertilizing fruit crops
OCES Bull. 506B  Ohio Commercial small fruit spray guide
OCES Bull. 815  Grape production, management and marketing (1991)
Bull. 730  Insect and mite pests of grapes in Ohio. 25 pp.; color plates. (1986)

Virginia:
Virginia Cooperative Extension Division Distribution Center, 112 Landstowne St., Blacksburg, VA 24061. Phone: 703-231-6192.

Pub.423-011  Dormant pruning and training of grapevines in Virginia
Pub.456-017  Pest management guide for horticultural crops
Pub.463-007  Grapevine nutrition
Pub.463-016  Site selection for commercial vineyards
Pub.463-018  A guide to commercial vineyard establishment
Pub.463-019  Commercial grape varieties for Virginia
Pub.463-001  Controlling microbial growth in wine
Pub.463-012  Protein fining agents
Pub.463-013  A review of potassium bitartrate stabilization in wine
Pub.463-014  Bentonite fining of juice and wine
Pub.463-015  Protein stability determination
Pub.463-017  A review of Methode Champenoise production

Other:
“Vineyard and Winery Information” series. For subscription contact: Dr. Tony Wolf, VPI and SU, 2500 Valley Ave., Winchester, VA 22601.
This newsletter and the extensive grape research it is based on are made possible by funding from the New York Wine & Grape Foundation. The Foundation's budget depends totally on private sector contributions which are matched by the State of New York. And now extensive cuts in State funding have made these private sector contributions more vital than ever.

If the Foundation’s research and promotional programs are to continue, we need your support through modest dues—a rate schedule and membership application are below. (Winegrowers and juice manufacturers have already made financial contributions of up to $15,000 each to support the effort.) Please join your neighbors and industry associates in forging a more productive and profitable future. (Join using this form and we’ll send you a “Best of the Bunch!” T-shirt.)

APPLICATION FOR GRAPE GROWER MEMBERSHIP
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) ______ ACRES

ANNUAL DUES (Circle Appropriate Amount)

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<th>Dues</th>
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<td>$25</td>
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<td>$50</td>
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<td>$100</td>
<td>Over 60</td>
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After completing this form, please send it and a check for the appropriate amount payable to the New York Wine & Grape Foundation, 350 Elm St., Penn Yan, NY 14527. THANK YOU!

Question:

________________________________________________________________________

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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.

New York Wine & Grape Foundation
350 Elm Street
Penn Yan, NY 14527

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.

Name: ..........................................................
Address: ................................................................

Mail to:

Martin C. Goffinet
Editor, Grape Research News
Department of Horticultural Sciences
New York State Agricultural Experiment Station
Geneva, NY 14456