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Testing Varieties and Clones of *Vitis vinifera* for Commercial Production in New York

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This research has the goal of identifying improved germplasm and culture methods that will allow New York grape growers to more reliably grow *Vitis vinifera* grapes and produce superior wines. New York has cold winters, short and cool growing seasons, and summer rainfall. Our climate allows full development of flavor while retaining sufficient acidity for wine freshness and long life, but winter injury or fungal disease can reduce vine life or fruit quality. One solution to these problems is to acquire strains of classic wine varieties developed in regions of the world with climates similar to New York's and to evaluate them for their adaptation to our growing conditions. A second solution is to modify cultural methods so that vines already planted can better endure our climate; a third is to identify rootstocks that are adapted to our special soils, that will control vine vigor, and that ensure attainment of maximum winter cold hardiness.

Rootstocks and cold hardiness

We have produced Chardonnay vines grafted to 22 different rootstocks. Rootstocks have been selected to test the concept that lower-vigor stocks will enhance cold hardiness and make canopy management easier. Stocks which cause scions to terminate shoot growth early in the growing season will reduce canopy crowding, while improving spray penetration and cluster exposure to light. This will reduce fungal disease and increase wine quality. More importantly, such stocks will allow management practices such as summer pruning or vertical training to be used without the danger of inducing re-growth, a problem which has been shown to occur at the expense of fruit development and winter hardiness acquisition.

Earlier research has shown that the rate at which vines acquire hardiness is as important as the ultimate cold hardiness of vines once they have become fully acclimated. Figure 1 shows seasonal changes in cold hardiness of two cultivars. Note that Concord acclimates relatively quickly and consistently, while Cabernet sauvignon is capable of acquiring considerable cold hardiness, but does so more slowly and less consistently. We are attempting to identify ways to enhance the rate at which vines acquire and maintain hardiness. Grafting to well adapted rootstocks is one of these ways.

As part of this study and in cooperation with Mr. Phil Forsline, curator of the National Apple and Grape Germplasm Repository at Geneva, we have been exploring the relationship between geographical origin of potential grape rootstocks and rate of cold hardiness acquisition. To do this we have been measuring the cold hardiness of about 80 grape species and rootstocks during the period Sept. 1, 1992 to Jan. 1, 1993, the time at which full acclimation may be expected. Table 1 reports cold hardiness data for *Vitis riparia*, the native grape with broadest geographic representation in North America and the species for which growth control is most expected. We also report data for other species, such as *V. longii* and *V. aestivalis* which extend the native range of *V. riparia*. The table shows that species from northern areas either begin to acclimate early or show exceptional ability to gain hardiness.

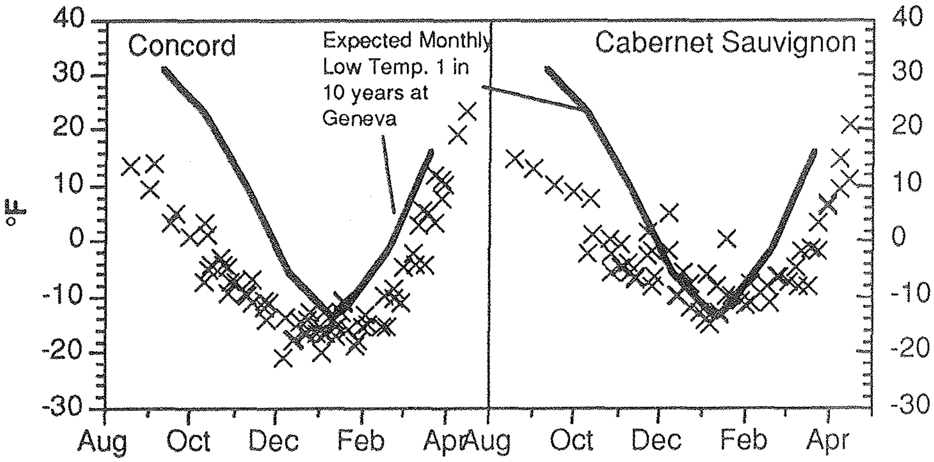

Figure 1. Individual points (x's) show the killing temperature of Concord or Cabernet sauvignon primary buds for the period 1986-90 at Geneva, NY. Solid lines are the expected monthly low temperatures that are experienced about once every 10 years and which reach bud killing temperatures in more cold susceptible vines.

Table 1. Hardiness of *Vitis riparia* clones at Geneva, NY during the fall acclimation period (Sept. 1–Dec. 15, 1992)

Origin of Clone	Killing Temp (°C) Sept 1	Rate of Acclimation (°C/Day)
North East	-7.0	-0.20
North Central	-11.0	-0.18
Central	-8.6	-0.17
Southern	-8.8	-0.19
Related Species	-6.6	-0.11

Table 2. reports data regarding the degree to which these vines underwent leaf senescence, formed shoot periderm or displayed shoot growth during the fall of 1992. Note that selections from the extreme northern part of the range (North Central) which includes states like North Dakota and Montana, or from the North East (Quebec, Maine, New York) reduced terminal shoot growth, began to ripen wood and began leaf senescence earlier than *V. riparia* selections from other parts of the country and also earlier than related species. The data listed as "other" refers to the average for all the rootstocks used in the Chardonnay rootstock experiment. As a group, they do not respond to Geneva's fall weather to the same extent that adapted germplasm does.

Table 2. Rate of leaf senescence, shoot periderm formation and terminal growth of *Vitis riparia* or related species originating in different regions of the U.S.

	Leaf Senescence*				Periderm Development*				Terminal Growth**			
	14-Sep	28-Sep	7-Oct	27-Oct	14-Sep	28-Sep	7-Oct	27-Oct	14-Sep	28-Sep	7-Oct	27-Oct
Northeast	1.1	1.8	2.4	4.6	1.8	2.9	3.6	4.2	2.1	3.2	4.1	4.8
North Central	1.2	2.5	3.2	4.8	2.3	3.0	3.4	4.5	2.1	3.2	3.5	4.5
Central	1.0	1.8	2.2	4.8	1.0	2.0	2.8	4.0	1.7	2.7	3.2	4.8
Southern	1.0	1.3	2.5	3.7	1.3	2.0	2.8	3.3	1.9	2.3	3.0	4.5
Related Species	1.1	1.4	2.0	3.7	1.3	1.9	2.5	3.3	1.5	2.4	2.9	4.2
Other	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0	1.0	1.0	2.0	2.0

* 1 = no senescence or periderm to 5 = complete senescence or periderm
** 1 = rapid terminal shoot growth to 5 = no terminal shoot growth

Table 3 shows that the rootstock which has proven to be generally most adapted to New York, C. 3309 (no.19), attains cold hardiness early in the fall and has good ability to harden further before winter. The data also show that rootstocks such as 5BB (no.3) and Couderc 1202 (no.2) which have generally not been associated with deep winter hardiness have much delayed hardiness acquisition. We are measuring the mid-winter hardiness of Chardonnay grafted to these rootstocks in order to test the hypothesis that rootstock hardiness may influence that of the scion. The data in Tables 1 and 3 were obtained by determining the linear relationship between cold hardiness and time. The value for Sept. 1 was determined by extrapolating back to that date and the rate of acclimation was determined from the slope of the curve. The coefficient of determination for each rootstock in Table 3 indicates that the linear relationship between date and degree of hardiness is generally highly significant, since its largest possible value is 100.

Table 3. Hardiness of rootstocks at Geneva, NY during the fall acclimation period (Sept. 1-Dec. 15)

	Rootstock	Killing Temp (°C) Sept. 1	Rate of Acclimation (°C/Day)	Coefficient of Determination
1	Sonona	-1.0	-0.28	95.4
2	Couderc 1202	-2.5	-0.20	97.0
3	5BB	-3.1	-0.18	93.8
4	MgT 101-14	-3.3	-0.22	98.8
5	Shakoka	-3.7	-0.24	91.1
6	110 R	-4.4	-0.17	91.9
7	Riparia Montreal	-4.9	-0.27	75.9
8	5A	-6.3	-0.12	89.8
9	A X R 1	-6.6	-0.15	87.9
10	C. 1616 E.	-7.6	-1.18	80.2
11	420 A	-8.2	-0.14	56.2
12	SORI	-8.6	-0.20	94.7
13	Harmony	-8.8	-0.09	25.3
14	Concord	-8.8	-0.15	80.6
15	99 R	-9.9	-0.07	97.4
16	MgT 18-815	-10.1	-0.10	80.8
17	41B	-10.2	-0.08	56.1
18	333 EM	-10.4	-0.15	28.9
19	C. 3309	-10.8	-0.16	67.7
20	44-53	-12.4	-0.08	50.0

Training Systems for red and white vinifera

Present rootstock options for New York grape growers result in vigorously growing vines with dense leaf canopies and excessive shoot growth. One solution to growing such big vines is to utilize extensive training systems which spread the canopy over a larger surface area. This allows the excessive shoot growth to be properly displayed, reduces disease and improves the micro-climate so that fruit quality is improved. In 1992, we established experiments which compare training options for three important varieties, Chardonnay, Cabernet sauvignon and Merlot. These plantings are extensive enough to eventually allow production of larger, more representative quantities of wine for proper evaluation. There are also sufficient vines that experiments exploring crop load and fruit quality/leaf area relationships can be done.

Clonal evaluation

Several other studies have been initiated or are now beginning to produce results. An experiment comparing the six available clones of Chardonnay has been planted. The first wines were made from newly available Pinot noir clones from Burgundy. Finally, we made a planting in 1992 that will explore the potential of several vinifera varieties from Europe.

Several funding sources contribute to this research, including US Dept. of Agriculture/ ARS, the New York Wine & Grape Foundation, the N. Y. Grape Production Research Fund and Mr. John Dyson. ■

The 1993 Pest Management Recommendations for Grapes

Mr. Timothy Weigle, Regional Grape IPM Specialist, has edited and collated the recommendations for grape pest management for the coming growing season. All New York and Pennsylvania growers and processors should now be aware that July 1992 marked the beginning of a cooperative effort between Cornell University and Penn State University grape research and extension programs with the formation of the Lake Erie Regional Grape Program. One of the recommendations from the committee in charge of developing this program was that a single set of pest management recommendations for grapes be created for use in both states.

Faculty and staff with grape responsibilities from the universities contributed to make the 1993 New York and Pennsylvania Pest Management Recommendations for Grapes more informative and easier to use than previous editions. While much of the information that growers have found useful in the past has remained virtually unchanged, some sections have been expanded and new sections added, such as detailed descriptions on grape pests and pesticides. The 1993 "Grape Recommends" is expected to become available in mid to late March. Contact your local or regional cooperative extension office for more specifics.

FROM THE EDITOR

Martin Goffinet

This past growing season was a peculiar one in that the lack of sunlight, the rain and the cooler than normal season worked together to impose restrictions on bud development and cold acclimation. At this time of year buds are typically at maximum hardiness before de-acclimation to cold begins in March. This winter season has shown a much broader range in cold hardiness in buds across a range of varieties at the Geneva experiment station and in other areas of the state. It appears that a large proportion of buds sampled in a variety will freeze at warmer temperatures (by several degrees) than the remaining buds. The basal five or six buds on canes appear to be hardier than those farther from the base. Tender varieties such as Cabernet sauvignon and Merlot are especially sensitive to cold this year. This year shows ample reasons for assessing hardiness in the grape breeding and viticulture programs at the New York State Agricultural Experiment Station, Geneva. Variety, origin of the planting stock, the rootstocks used under them, planting site, cultural methods, etc., all impact on our ability to produce grapes in New York State. I have included Dr. Robert Pool's report on funded research on testing varieties and clones of *Vitis vinifera* for commercial production in New York because I think it shows that research into this area is being done and that our industry will ultimately benefit from it.

In addition, I have asked Mr. Joseph Kovach, who coordinates Cornell's integrated pest management program for fruit crops, to explain a method that can be used to assess the overall environmental impact of your insecticide, fungicide, and herbicide spray program. He compares the "environmental impact quotient" for different pesticides and pest management programs and shows how these might affect you and the environment and impact on cost of use. In comparing many of our fruit crops, it appears that grape spray programs fare pretty well.

As a parting note, I remind you that there are many opportunities for you to update your knowledge of grapes and grape growing by attending any of a number of conferences and workshops. By the time you receive this newsletter, the annual Great Lakes Grape Grower Conference will probably have already taken place. But there are many more opportunities for you to meet your fellow growers, industry reps, Cornell grape faculty and extension staff. Several are listed in this newsletter. Please avail yourself of the knowledge generated by a world class grape research and extension effort which is the envy of every grape growing state in this country. ■

ANNOUNCEMENTS UPCOMING EVENTS

The 44th Annual Finger Lakes Grape Growers Convention is scheduled for March 6, 1993, at Keuka College, Keuka Park, New York. Presentations on culture, pest management (recertification credits), marketing; trade show; wine-and-cheese reception. Pre-registration is recommended this year. Contact: David V. Peterson, Finger Lakes Grape Program, 110 Court Street, Penn Yan, NY 14527. Tel: (315)-536-3381 or Fax: (315)-536-5145.

The 1993 Wine Industry Workshop will be a multi-day meeting, held March 30, 31 and April 1, at Jordan Hall, New York State Agricultural Experiment Station, Geneva, NY. The workshop covers enological topics as well as viticultural aspects important to juice and wine quality. For a program and registration form, contact Dr. Thomas Henick-Kling, Department of Food Science & Technology, NYSAES, Geneva, NY 14456. Phone 315-787-2277; Fax 315-787-2397.

American Society for Enology and Viticulture, 43rd Annual Meeting takes place in Sacramento, California on June 23–25, 1993. For information contact the ASEV National Office, (916)-753-3142.

The Second Nelson J. Shaulis Viticulture Symposium: "Pruning Mechanization and Crop Control," will be held on July 13 and 14, 1993, at Fredonia State University, Fredonia, New York. The symposium includes presentations by researchers and growers from Italy, Australia, California, Arkansas and New York. A field tour will be held on July 14. Registration fee is $75, to include a copy of the proceedings. Contact: David V. Peterson, Finger Lakes Grape Program, 110 Court Street, Penn Yan, NY 14527. Tel: (315)-536-3381 or Fax: (315)-536-5145.

The 18th Annual Meeting of the American Society of Enology and Viticulture/ Eastern Section will be held July 15 and 16, 1993, at the Genesee Plaza Holiday Inn, Rochester, New York. The event includes scientific papers and talks on viticultural and enological topics, an industry trade show, wine tastings, and awards banquet. Contact the ASEV/ES secretary: David V. Peterson, Finger Lakes Grape Program, 110 Court Street, Penn Yan, NY 14527. Tel: (315)-536-3381 or Fax: (315)-536-5145. ■

The Environmental Impact Quotient (EIQ): Measuring the Environmental Impact of Pesticides

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Introduction

Pesticides used to control insects, weeds, and diseases are traditionally selected by grape growers primarily by efficacy and/or cost rather than on potential environmental impact. Although some growers and pest management practitioners take into account the effect of the pesticides on the applicator or on beneficial natural enemies such as predatory mites, no formal method has been available to assist them in making environmentally sound pesticide choices. Without an easy method to assess pesticide impacts, each individual had to rely on his own judgment to make these decisions. Some growers — those who are organically approved — felt that only natural pesticides should be used in agricultural production systems because they are naturally occurring and are perceived to be less harmful to the environment. Other growers felt that any pesticide registered by the United States Environmental Protection Agency (EPA) and used according to the label must be environmentally safe.

Because of the EPA pesticide registration process, there is a wealth of toxicological and environmental impact data for most pesticides that are commonly used in agricultural systems. However, these data have not been readily available or organized in a manner that is usable by practitioners of integrated pest management (IPM). In order to assist the IPM practitioner in handling this information, a method called the Environmental Impact Quotient (EIQ) has been devised to calculate the environmental impact of most common fruit and vegetable pesticides (insecticides, fungicides, and herbicides) used in commercial agriculture. The values obtained from these calculations can be used to compare different pesticides and pest management programs to ultimately determine which program or pesticide is likely to have the lowest environmental impact.

EIQ Model

The EIQ is based on data obtained from both printed and electronic information sources. These include EXTOXNET, CHEM-NEWS, SELCTV, the National Pesticide/Soils Database developed by the USDA Agricultural Research Service and Soil Conservation Service, the 1989 New York State Pesticide Recommendations, Material Safety Data Sheets (MSDS), and technical bulletins developed by the agricultural chemical industry. Extracted from these sources are factors describing dermal toxicity, bird toxicity, chronic (long-term health effects) toxicity, bee toxicity, fish toxicity, beneficial arthropod toxicity, plant surface half-life, soil half-life, leaching potential, systemicity, and surface loss potential. These factors have been incorporated into the model to determine effects on the farm worker, consumer, and the ecology. The result of using this model is a single number describing an EIQ value for a particular active ingredient of a pesticide. According to the model, the higher the EIQ value the greater or more toxic the effect on the environment. Over 125 pesticides were evaluated and EIQ values ranged from 12 to 122. Table 1 shows EIQ values for some common grape pesticides.

The New York State Food and Life Sciences Bulletin No. 139, "A Method to Measure the Environmental Impact of Pesticides," describes in detail the derivation of the EIQ. To receive a reprint of this bulletin, $2.00 should be sent to the Bulletin Room, Jordan Hall, NYSAES, Geneva, NY 14456.

Table 1. EIQ values for some common grape pesticides.

Common name	Trade name	EIQ value
Bacillus thuringiensis	Dipel	13.5
diuron	Karmex	20.5
carbaryl	Sevin	22.6
fenarimol	Rubigan	27.3
ferbam	Ferbam	28.8
glyphosate	Roundup	32.4
methyl parathion	Penncap-M	35.2
myclobutanil	Nova	41.2
mancozeb	Manzate	62.3
maneb	Manex	64.1
paraquat	Gramoxone	70.0

EIQ Field Use Rating

Once an EIQ value has been established for the active ingredient of a pesticide, field use calculations can begin. To accurately compare pesticides and pest management strategies, the dose or rate, the formulation or percent active ingredient of the product, and the frequency of application of each pesticide needs to be determined. To account for different formulations of the same active ingredient and different use patterns, a simple equation called the EIQ Field Use Rating was developed. This rating is calculated by multiplying the EIQ value for the specific chemical by the percent active ingredient in the formulation by the rate per acre used (usually in pints or pounds of formulated product) by the number of times applied.

EIQ Field Use Rating = EIQ x % Active Ingredient x Rate x Number of Applications

A lower EIQ Field Use Rating indicates a more environmentally sound pest management strategy. With this method, comparisons of environmental impact between pesticides and different pest management programs can be made. For example, if several pesticides can be used against a particular pest, which pesticide is the least toxic choice? Table 2 compares the environmental impact of one application each of three insecticides: carbaryl (Sevin 50WP), endosulfan (Thiodan 50WP), and azinphos-methyl (Guthion 35WP). Although carbaryl has a lower EIQ than endosulfan or azinphos-methyl, more carbaryl may be needed to provide equivalent control. For example, 6 lbs/acre of Sevin may provide the same level of control of a certain pest as 3 lbs/acre of Thiodan or 2.2 lbs/acre of Guthion. In this situation, Guthion would have the lowest EIQ Field Use Rating (33.2) and would be the least toxic choice. Thiodan (60.8) would be the second choice and Sevin (67.8) would be the last.

Table 2. An example showing the EIQ Field Use Rating of one application of three different insecticides to determine which is the least toxic choice.

Material	EIQ	% Active Ingredient	Rate/Acre	EIQ field use rating
Guthion 35WP (azinphos-methyl)	43.1	0.35	2.2	33.2
Thiodan 50WP (endosulfan)	40.5	0.50	3.0	60.8
Sevin 50WP (carbaryl)	22.6	0.50	6.0	67.8

To compare pest management programs, a grape grower can determine EIQ Field Use Ratings and numbers of applications throughout the season for each pesticide. These values are then summed to determine the total seasonal environmental impact of a particular strategy. Table 3 shows an example of the environmental impact of one Concord grape grower's pest management strategy. Notice that this grower used multiple applications of Manex and Nova but applied a different rate per acre each time. By using the EIQ model, IPM practitioners can rapidly estimate the environmental impact of different pesticides and pest management programs before they are applied, resulting in the implementation of more environmentally sensitive pest management programs.

Comparing grapes with other fruit crops

During the 1991 growing season, the National Agricultural Statistic Service of the USDA conducted pesticide use surveys with growers from the major fruit producing states (excluding California) and published a summary of its findings. Pesticide information for California was not collected because of its mandatory pesticide reporting program and therefore was not reported in the USDA publication. This publication listed the pesticide used, the rate of active ingredient per acre, the percent area treated and the number of applications by state and by crop. By using this information and inserting EIQ values for the appropriate pesticides, an estimate of the environmental impact of growing different crops can be made. Figure 1 summarizes some of these calculations. According to the EIQ model, growing small fruit such as blueberries and grapes on a national basis has much less environmental impact (less than 500 EIQ's per acre) than growing pears or peaches (more than 2,000 EIQ's). This appears to make sense because fewer pests attack blueberries and grapes than attack peaches and therefore fewer chemicals are needed to produce a profitable crop.

Table 3. An example of a typical Concord grape grower spray record and sum of all field use EIQ values.

Common name	Trade name	EIQ	Rate/Acre	% Active Ingredient	No. of applic.	Field Use EIQ
diuron	Karmex	20.5	4.0	0.80	1	65.6
paraquat	Gramoxone	70.0	0.6	0.37	1	16.3
glyphosate	Roundup	32.4	1.0	0.41	1	13.3
maneb	Manex II	64.1	2.4	0.37	1	56.9
maneb	Manex II	64.1	3.2	0.37	1	75.9
myclobutanil	Nova	41.2	0.2	0.40	1	3.1
myclobutanil	Nova	41.2	0.3	0.40	1	4.1
methyl parathion	Penncap-M	35.2	1.0	0.22	1	7.7
myclobutanil	Nova	41.2	0.3	0.40	1	5.1
fenamiphos	Rubigan	27.3	0.4	0.12	1	1.2
carbaryl	Sevin	22.6	2.5	0.80	1	45.2
Total						**294.4**

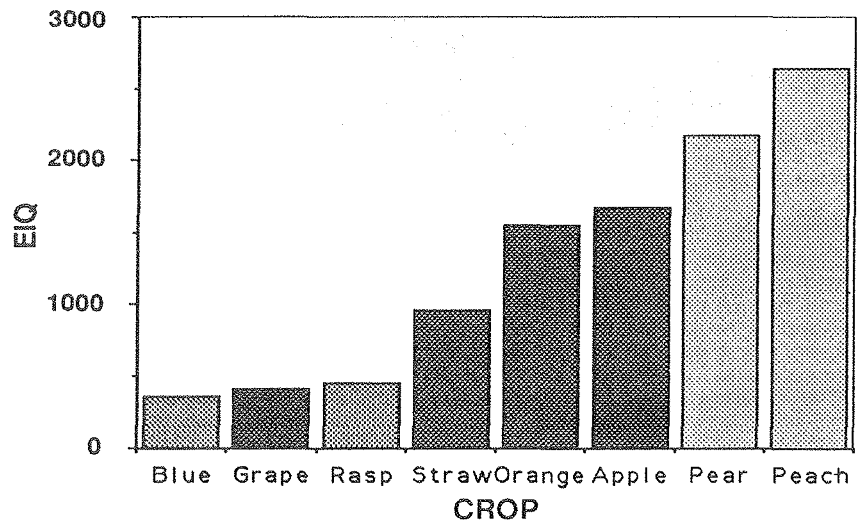

Figure 1. Yearly total EIQ values for some fruit crops grown in major fruit-producing states (excluding California). Calculated from data found in a USDA pesticide survey (1991). Grape values include data from Arizona, Michigan, New York, Oregon, Pennsylvania, Texas, and Washington (total of about 94,000 acres). Lower values indicate less environmental impact.

Summary

The EIQ model has been used to organize the extensive toxicological data available for common fruit and vegetable pesticides. It addresses a majority of the environmental components that are encountered in agricultural systems, including the farm worker, the consumer, and ecological safety. By using the EIQ Field Use Rating, IPM practitioners can incorporate environmental effects along with efficacy and cost into the pesticide decision-making process. As newer biorational pesticides are marketed with lower EIQ values and as more emphasis is placed on biologically based IPM practices (e.g. mating disruption), the EIQ field use ratings should decrease and eventually may approach zero, resulting in environmentally benign agricultural systems. ■

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.

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