



NITROGEN DEFICIENCIES IN NEW YORK WINE GRAPES

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IN THE FALL OF 1993 we started what is intended to be a multi-year study of nitrogen in New York State grapes and wines and nitrogen's relation to fermentation problems. We hope this study will provide solutions in the form of specific strategies that will allow winemakers to avoid production of reduced-sulfur off-odors and to avoid stuck fermentation. An important part of the project is a survey of New York wine makers to find out what problems are occurring, in which regions, and with which grape cultivars. Our approach was to gather information from the people most directly interested in these problems—the wine makers—by sending them a questionnaire on fermentation and sulfide problems. After this, a number of selected juices from the different wine-growing regions of the state were analyzed to see if there are regional trends regarding the amount of nitrogen compounds required for yeast growth (Figure 1). This compositional analysis, which is summarized here, will be correlated with fermentation performance.

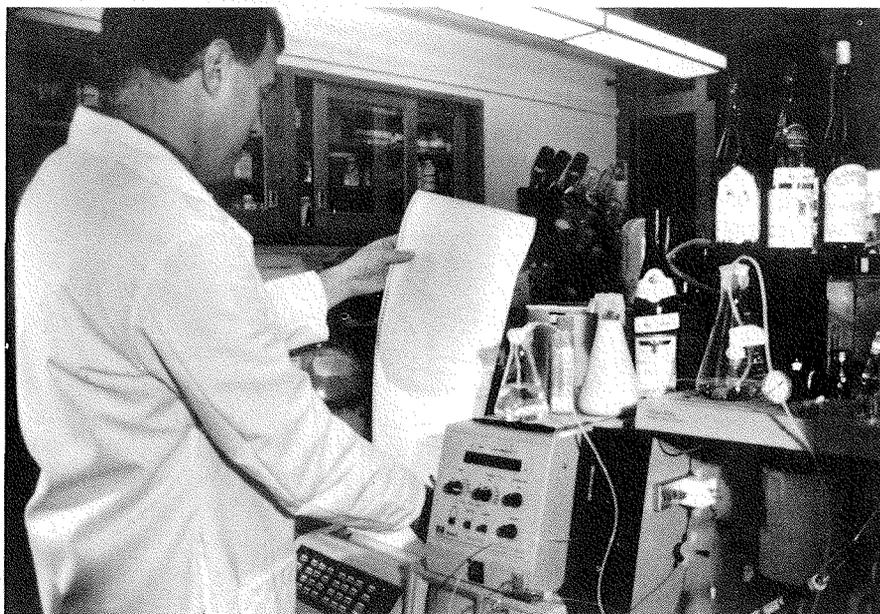


Figure 1. Samples collected for the available nitrogen survey are analyzed for total sugar, acidity, free ammonia and amino nitrogen in the New York Wine Analysis Laboratory, NYSAES, Geneva. Free amino acids are analyzed on contract in another laboratory at Cornell University.

FERMENTATION PROBLEMS

Fermentation problems, such as hydrogen sulfide odors and slow or stuck fermentation, can be caused by a deficiency of nitrogen in the juice. When there is not enough free amino nitrogen available, yeast cells are forced to use alternate nitrogen sources during fermentation, which results in the production of reduced sulfides. In the case of stuck fermentation, yeast cells may be unable to metabolize at all at the end of fermentation (cell growth occurs only during the first half), and thus fail to completely use the sugars present.

Much of the older literature suggests that late sulfur sprays in the vineyard are the main cause of sulfide problems in wine making. Further research in recent years has shown that this is probably not a common cause, and that lack of nitrogen is by far the most likely source of such problems. Ironically, most of the information obtainable on the amount of nitrogen in wine grapes that is available to yeasts indicates that most cultivars have an adequate supply for fermentation. However, studies at Geneva have shown that wine grapes grown in New York generally have significantly less available nitrogen than do the same cultivars grown in California or Germany, for example. In fact, most New York wine grapes are near or below the amount of nitrogen recommended for successful yeast growth (References 1, 2).

The questionnaire sent to wine makers was divided into two sections, the first dealing with sulfur-related problems and the second with general fermentation problems. Below is a summary of the results.

Reduced sulfur odors: While about 40% of respondents reported that they

Table 1. Nitrogen content of 1993 New York State wine grape juices

Cultivar	Region	NH ₃ (mg/L)	Free Amino Acids (mg/L)*	Free Amino Nitrogen (mg/L)**
Cabernet Sauvignon	Finger Lakes	51	619.0	72.8
Cabernet Sauvignon	Lake Erie	46	394.7	74.3
Cayuga	Finger Lakes	68	1482.5	74.3
Chardonnay	Finger Lakes	32	696.0	115.6
Chardonnay	Finger Lakes	32	861.5	155.8
Chardonnay	Finger Lakes	64	653.5	119.5
Chardonnay	Finger Lakes	87	835.8	172.6
Chardonnay	Hudson Valley	29	788.2	119.2
Chardonnay	Lake Erie	49	605.4	136.2
Chardonnay	Long Island	37	1009.2	230.7
Chardonnay	Long Island	36	510.4	156.2
Gewürztraminer	Long Island	67	1264.3	183.6
Merlot	Long Island	33	823.4	159.2
Pinot Noir	Finger Lakes	–	890.7	94.1
Pinot Noir	Finger Lakes	60	824.5	131.5
Pinot Noir	Hudson Valley	49	959.5	107.2
Pinot Noir	Lake Erie	60	968.0	155.0
Pinot Noir	Long Island	38	1203.5	185.4
Riesling	Finger Lakes	49	515.6	62.4
Riesling	Finger Lakes	61	827.8	105.5
Riesling	Hudson Valley	57	541.2	112.5
Riesling	Lake Erie	39	1110	128.2
Seyval	Finger Lakes	42	670.1	63.8
Seyval	Lake Erie	5	817.5	136.0
Seyval	Long Island	9	300.9	46.5
Mean (of 25 samples)		46	806.9	123.9

* Not including proline, which is not used by wine yeasts

**Not including ammonia

had experienced noticeable H₂S production (i.e., "rotten egg" odor), there were no more than one or two instances for each of the nine wineries reporting problems, so this was apparently not a large-scale problem in 1993. When H₂S production occurred, it did so during the second half of fermentation in 70% of the cases. Although yeast foods were often used during fermentation, the amounts of nutrients added varied widely between wineries. Almost all wine makers added yeast nutrients at the beginning of fermentation, which is good, because the yeast cannot take up nutrients at the end of fermentation. Overall, the implications are several: a) there could be problems other than nutrient deficiencies; b) yeast foods were perhaps not used in adequate amounts (since there was a great range of use, perhaps the lower amounts could not prevent problems); c) foods were not added at the right time—yeasts can only assimilate the nutrients during the first half of fermentation (when added later, the nutrients are of no use). It is unlikely that late sulfur sprays in the vineyard were the source of problems.

Another factor is that some yeast strains use much larger amounts of nitrogen compounds than others. With the use of yeast cultures, generally smaller amounts of nitrogen are required for satisfactory fermentation, because less yeast growth is necessary.

At temperatures below 16°C (61°F), the yeasts are stressed and this can be a cause for off-flavor production and also a cause of stuck fermentation, although this usually

results in production of larger amounts of esters.

The cultivars that gave problems were no surprise (Seyval and Chardonnay), although the absence of Riesling was an encouraging exception. Seyval and Chardonnay are well-known for being relatively short on yeast nutrients.

Slow and incomplete (stuck)

fermentation: Of the 364 total fermentations reported, 32 were slow or incomplete. The wine making methods reported were essentially the same as in the sulfur problems, since they were from the same wineries, and, once again, general fermentation problems were most commonly seen with Chardonnay and Seyval.

ANALYSIS OF AVAILABLE NITROGEN IN NEW YORK STATE JUICES AND WINES

Yeast cells contain about 10% nitrogen, so nitrogen is naturally a required nutrient for yeast growth. Most grape musts contain enough nitrogen in the form that yeasts can use (amino nitrogen, but not nitrate nitrogen). However, some cultivars characteristically contain amounts close to the minimum needed; in some cases their musts go below the minimum, causing problematic fermentation and reduced-sulfur odors. Juices should contain total amino acids of about 1 g/L, and this is also the upper limit of DAP (diammonium phosphate) addition allowed by the BATF.

The 1993 survey of grape juices from the four main viticultural regions of New York yielded data which have been summarized in Table 1. These data are from only one vintage, and from a limited number of samples, not enough yet to obtain meaningful statistical information. We hope that after several vintages and a greater accumulation of data we will be able to recognize trends in the differences in cultivar, region, and perhaps individual vintages.

Based on the data that have been gathered and evaluated so far, no one

region seems to stand out as having lower total nitrogen content in its juices than another. However, some cultivars—Chardonnay, Seyval, and Riesling—show a tendency toward low amino nitrogen. Chardonnay and Seyval were the cultivars most often cited in the returned questionnaires as having fermentation problems. Interestingly, Riesling was low in nitrogen in most samples, yet was not named as a trouble-maker. Pinot Noir and Cabernet Sauvignon were also not troublesome, perhaps because of skin fermentation, which might release more nitrogen compounds during the fermentation. More data in future years should resolve the indistinct picture we have now.

Since 1989, results from wines and juices submitted for analysis to the Wine Analytical Lab have been compiled into a database as a source of reference for New York State wines. We now have over 1,600 entries from commercially produced juices and wines representing all the viticultural regions of the state and most of the cultivars. The following cultivars were most often listed in the data base as having sulfur or H₂S-related problems: 37% of the wines were Chardonnay, 19% were Seyval, and 19% were Riesling. Chardonnay and Seyval were also mentioned most often in the nitrogen survey questionnaires. About 90% of the problem wines were still in the tank when the samples were submitted. While this data does not tell us how many problem wines were produced but not submitted to the Wine Analytical Lab, the frequency with which a particular cultivar is mentioned is likely a good indication of its susceptibility to problem fermentation. ■

References:

- 1) Tegmo-Larsson, I.M. and T. Henick-Kling, 1991. The effect of nitrogen composition on the ethyl carbamate formation in New York wine. *Proceedings*, International Symposium on Nitrogen in Grapes and Wine, Seattle, WA, 18-19 June 1991, J. Rantz, Editor, pp. 274-277. Am. Soc. Enol. Vitic., P.O. Box 1855, Davis, CA 95617-1855.
- 2) Edinger, W., & T. Henick-Kling, 1991. Nitrogen deficiency in New York grape musts: survey results and fermentation trials. *Proceedings of the Twenty-third Annual New York Wine Industry Workshop*, NYS Agric. Expt. Sta., Cornell Univ., Geneva, NY 14456-0462.

This project has been supported by a grant from the New York State Wine and Grape Foundation.

ANNOUNCEMENTS



NEW FACES IN CORNELL'S GRAPE BREEDING PROGRAM

Mr. Steve Luce has become the new Research Support Specialist in the grape breeding program of Dr. Bruce Reisch in the Department of Horticultural Sciences at the New York State Agricultural Experiment Station in Geneva. Steve is from Ovid, NY, where he runs a diverse crop farm, including small fruits. He also has a number of years of experience in corn breeding. He graduated with a master's degree from Cornell's

College of Agriculture and Life Sciences in 1978.

Dr. Michael Striem has also joined the grape breeding program as a Postdoctoral Associate in charge of grapevine genetic engineering research. Michael comes from Rehovot, Israel, where he recently completed his Ph.D. degree from the Hebrew University of Jerusalem. In Israel, Michael provided technical support to the wine grape and almond breeding programs. His Ph.D. thesis research goal was to develop a molecular map of
(Continued on page 5)

FROM THE EDITOR



Martin Goffinet

GRAPE HARVEST has now come to a close. It is fitting that we include in this issue of the "News" research information on juice and wine quality. Along these lines, Bill Edinger and Thomas Henick-Kling of the Department of Food Science and Technology, at the New York State Agricultural Experiment Station in Geneva, present some of their research on the analysis of nitrogenous compounds in juice and wine musts. Nitrogen is necessary to proper fermentation of wines and is a necessary nutrient for wine yeasts. Nitrogen deficiencies may lead to a host of fermentation problems, and these are presented in their article.

In agricultural research news these days, there are many articles written concerning "environmentally friendly" approaches to growing crops. Grape research is no exception. You may hear it mentioned as sustainable agriculture, organic grape farming, or some other name. As growers strive to hold down costs, increase quality, and have minimal adverse effects on our environment, is there a place for organic grape growing in the mainstream of New York grape production? Robert Pool summarizes a five-year research effort by many Cornell scientists to understand how sustainable grape growing practices compare to more conventional methods.

This issue of "Grape Research News" is the last for 1994. The next issue should come out in winter 1995. If you have ideas about the types of articles you would like to see published in the "News" next year, please drop me a note on the form printed on the back page. If there is a research effort in the area you mention, there is a good possibility that I can get a grape researcher to submit an article on the subject. ■

POTENTIAL FOR ORGANIC GRAPE PRODUCTION IN NEW YORK STATE

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Figure 1. Research to find methods to reduce weed competition in organically grown grapes includes cultivation, as shown here, but also includes propane weed burning and growing cover crops that will not impact on vine growth while controlling erosion and hindering weed development.

NEW YORK is the third-leading state in grape production, but with funding from Northeast SARE ("Sustainable Agriculture" funding), Cornell University scientists have teamed up with conventional and organic grape growers to explore the potential for New York to become the leading producer of organically grown grapes. The project is conducted at Dresden, New York in vineyards owned by the Taylor (Canandaigua) Wine Co. There are eight Cornell scientists listed as co-principle investigators, but Judy Robinson, who has the task of coordinating the project, receives continuing input from both organic and conventional grape growers. This marks the fifth and last year of the project, which was initiated in response to inquiries from major grape producers about the potential to convert their existing grape production to organic methods.

Because New York's climate favors many fungal and bacterial diseases and because direct and indirect insect damage can be serious, many doubted the approach would be feasible. However, not only have four consecutive organic grape crops been produced (with this fifth year's harvest underway), but, by applying modern integrated pest management techniques — many of which were developed at Cornell — economic analysis has thus far indicated organic production to be profitable. Newer techniques were used in the study, including pheromone mating disruption of grape berry moth and use of bio-control agents to manage fungal disease and leaf hoppers. Such techniques were also combined with more traditional approaches, such as use of manures and legume cover crops to build up soil quality and fertility. Both wine and juice varieties are being grown. To date, taste panels have not been able to distinguish between wines and juices made from organic grapes and those made from conventionally grown grapes.

Finding a method to control weeds without increasing erosion potential has

been the biggest challenge. Yields of organically grown grapes have been somewhat reduced, probably due to increased weed competition. Tillage has been tried for weed removal in the program (Figure 1). Propane weed burning, another non-chemical method of controlling weeds, is being evaluated and offers promise. However, research exploring the application of new cover crop management systems to simultaneously reduce weed competition, erosion hazard and need for persistent herbicides, appears to offer a better long-run solution.

An international, industry-oriented symposium on organic grape production has been scheduled in March of 1995 to present the results of the five-year study to growers and processors. Speakers from Europe and across the United States will help the industry interpret the New York experience. ■

UPCOMING EVENTS



11 January 1995, The Grape Production Research Fund will meet in conjunction with the 1995 Annual Meeting of the New York State Horticultural Society at the Riverside Convention Center in Rochester, NY. Grape researchers will explain their progress and propose 1995 research to the Research Fund board. The Research Fund provides significant research funds that are matched by dollars generated through the New York Wine and Grape Foundation. The Horticultural Society will hold additional presentations on grapes the same day. For further information on the Horticultural Society's full program, contact Rich Erle; phone, 716-326-5179, or Fax 716-326-5494.

21-22 March 1995, Industry Symposium on Organic Grape Growing and Wine Making. Jordan Hall, Cornell University, New York State Agricultural Experiment Station, Geneva, NY 14456. The symposium will be held in conjunction with the 24th Annual New York Wine Industry Workshop (See announcement below).

Under SARE sponsorship, a group of Cornell researchers and organic and conventional grape growers has been studying the feasibility of organic wine and juice grape production in New York (see related article, this issue). Results of this five-year project will be presented at this conference, but other speakers from the organic-producer communities in the Eastern U.S.A., California and France will also share their experiences in organic grape and wine production. The symposium is being conducted under co-sponsorship of the Cornell Alternative Agriculture program, NOFA and the New York State Grape Production Research Fund. The symposium will be immediately followed by the New York State Wine Industry Workshop at the same location (See next announcement). For information, contact Judy Robinson, Department of Horticultural Sciences, NYSAES, Geneva, NY 14456. Phone, 315-787-2238.

22-23 March 1995. The 24th Annual New York Wine Industry Workshop. Jordan Hall, Cornell University, New York State Agricultural Experiment Station, Geneva, NY 14456. This workshop consists of 1.5 days directly following the organic grape growing and wine making symposium of 21-22 March 1995. The focus of the workshop will be on regional differences in climate and soils, differences in viticulture, and regional wine styles in New York. Contact: Thomas Henick-Kling. Phone: 315-787-2274; Fax: 315-787-2397.

17-20 July 1995. The Annual Meeting of the American Society for Enology & Viticulture—Eastern Section. Charlottesville, Virginia. The annual meeting (1.5 days) will be preceded by an International Symposium on Novel Grape Varieties (1.5 days). Contact: ASEV/ES Secretary, Department of Food Science and Technology, New York State Agricultural Experiment Station, Geneva, NY 14456-0462; Fax: 315-787-2397.

(UPCOMING EVENTS, continued on page 6.)

(ANNOUNCEMENTS, continued)

grapevine chromosomes and to locate genes controlling seedlessness in grapes. While at Geneva, Michael will be developing techniques to improve disease resistance of grapevines via genetic engineering techniques.

CORNELL ENOLOGY STUDENT WINS AWARDS

Brigitte Martineau, a Cornell graduate student in the enology program at the New York State Agricultural Experiment Station, Geneva, is the recipient of several awards. She currently holds a Student Award for the 1993–1995 academic years from the American Society for Enology & Viticulture/Eastern Section. This year Brigitte was awarded the American Wine Society Scholarship for 1994–95, and also the American Society for Enology and Viticulture Scholarship for 1994–95. This past July, she was awarded "Best Enology Paper" in the student paper competition at the 19th annual meeting of the ASEV/ES at Cleveland, Ohio. Her winning paper was titled "Synthesis and utilization of diacetyl in wine: kinetics and interaction between yeast and malolactic bacteria." She has submitted the paper for publication in the "American Journal for Enology and Viticulture." Lallemand Inc., Montreal, Canada, sponsored the award. Brigitte is currently working on the energetics of citric acid metabolism of *Leuconostoc oenos* under the tutelage of Dr. Thomas Henick-Kling, Department of Food Science & Technology. During the winter of 1995, Brigitte will spend three months in Dijon, France, working on a collaborative project between her Geneva research group and a French group researching dairy lactic bacteria. She plans to complete her Ph.D. by September 1995, after which she hopes to continue doing wine-related research. ■



(UPCOMING EVENTS, *continued*)

17-21 July 1996 (First Announcement). Fourth International Symposium on Cool-Climate Viticulture & Enology: "APPLYING CURRENT VITICULTURE AND WINE MAKING TECHNOLOGIES TO MAXIMIZE WINE QUALITY." Riverside Convention Center, Rochester, NY, U.S.A. This symposium will be immediately followed by the 21st Annual Meeting of the Eastern Section of the American Society for Enology & Viticulture (See following announcement).

The Cool-Climate Symposium will present the best current technical and scientific data on issues in grape and wine production emphasizing their practical applications. This will provide a varied program of much interest to industry personnel involved in research and production as well as a forum for exchange of current scientific knowledge for generation of new research ideas and collaborations. The program will include keynote speakers, oral and poster presentations, workshops, and a trade exhibition. Hosted by the American Society for Enology & Viticulture—Eastern Section. Sponsored by the International Society for Horticultural Science, and the American Society for Enology and Viticulture.

Program Areas (and Chairmen)::

- VINE STRESS PHYSIOLOGY—Cold Hardiness, Water Stress (Dr. T.K. Wolf)
- ADAPTATION TO REGIONAL ENVIRONMENTS (Dr. C. Edson)
- ECOLOGICALLY SOUND GRAPE AND WINE PRODUCTION METHODS—Integrated Systems, Organic Methods, IPM Systems (Dr. R.M. Pool)
- FLAVOR DEVELOPMENT IN THE VINEYARD—Biochemistry of Fruit Ripening, Flavor Precursors in Grapes • Canopy Management and Flavor Development (Dr. A.G. Reynolds)
- FLAVOR PRODUCTION DURING FERMENTATION—Microbiology of Spontaneous Fermentation, Effect of Yeast Strains, Effect of Malolactic Fermentation, Skin Contact for Aromatic White Varieties, Skin Contact and Fermentation Temperatures for Red Wine Color and Flavor (Dr. T. Henick-Kling);
- WINE SENSORY ATTRIBUTES AND TECHNIQUES OF MEASUREMENT—Practices for Quality Control, Consumer Acceptance, Research Tools (Dr. T.E. Acree)
- UNDERSTANDING THE GENETIC BASIS FOR GRAPE AND WINE PRODUCTION—Genetics of Grape Vines, Disease Resistance, Genetics of Wine Yeast and Bacteria (Dr. J. Gafner, Dr. B.I. Reisch)
- THE WORLD WINE ECONOMY—Marketing Strategies, Trade Regulations (H. Jacobsen, Canandaigua Wine Co.)

Workshops: Winery (Re)Design; Yeast Starter Cultures; Bacterial Starter Cultures; Laboratory Techniques; Sensory Effects of Selected Aroma Compounds; Varietal Focus; Scouting Techniques for IPM Practice

Regional Presentations: Wine Regions of Northeastern U.S.A. and Canada; Geography and History; Wines of New York, Oregon, Washington, Idaho, British Columbia, Ontario, Canada; Specialty Beers of Northeastern U.S.A.; Foods of The Finger Lakes; The Iroquois Indian Federation

Trade Exhibition: One symposium day will be reserved for visits to the trade exhibit

Wine Theme Lunches and Dinners: Featuring regional wines and selected cultivars

Conference Tours: Tours to surrounding grape and wine growing regions will be offered.

Rochester, New York: Rochester is approximately one hour's drive from the scenic Finger Lakes Region which is New York State's largest wine producing area. New

York State has over 100 wineries located in four wine growing regions from Lake Erie in the west to Long Island in the east. At the same time, it is the oldest wine producing state with a long history of wines made from native American grapes and it is a revolutionary new area with premium wines made from vinifera grapes. Rochester is only 1.5 hours from Niagara Falls and Ontario, the largest Canadian wine producing region. Surrounding states—New England, New Jersey, Pennsylvania, Virginia, West Virginia, Ohio, Indiana, Wisconsin, Iowa and Michigan—also have growing wine industries with over 250 wineries.

Transportation: Rochester International Airport has connections through Toronto, New York City airports, and other major U.S. cities. Major car rental companies as well as a shuttle service by the hotels are available.

Official Language at the Symposium: English

For further information:

To receive a Second Announcement, which will list program invited speakers, registration materials, accommodation information, and instructions for contributed papers, please provide the information requested on the form provided on page 7.

July 17–21, 1996. The 21st Annual Meeting of the Eastern Section of the American Society for Enology & Viticulture. Riverside Convention Center, Rochester, NY, U.S.A. This meeting immediately follows the above-announced international symposium on cool-climate viticulture that takes place at the same location. Future issues of "Grape Research News" will give articulars. ■



**Fourth International Symposium on Cool-Climate Viticulture & Enology:
"APPLYING CURRENT VITICULTURE AND WINE MAKING TECHNOLOGIES TO
MAXIMIZE WINE QUALITY."**

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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.

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