MARCH 1995 NUMBER 69

SPECIAL REPORT

New York State Agricultural Experiment Station, Geneva, A Division of the College of Agriculture and Life Sciences
Cornell University, Ithaca

Organic Grape and Wine Production Symposium

21-22 MARCH 1995

New York State Agricultural Experiment Station • Geneva, NY • Jordan Hall

SPONSORS

New York Grape Production Research Fund, Inc.
Northeast Organic Farming Association (NOFA)
Cornell Alternative Agriculture Program
Sustainable Agriculture Research and Education Program (SARE)
New York State Agricultural Experiment Station

Organic Grape and Wine Production Symposium

Cornell University, Department of Horticultural Science
New York State Agricultural Experiment Station
Geneva, New York 14456-0462 USA

Telephone: (315) 787-2238 • FAX: (315) 787 2216

SPONSORED BY:

New York Grape Production Research Fund, Inc.
Northeast Organic Farming Association (NOFA)
Cornell Farming Alternatives Program
Sustainable Agriculture Research and Education Program (SARE)
New York State Agricultural Experiment Station

EDITOR - ROBERT M. POOL

ORGANIZING COMMITTEE:

Robert M. Pool, Chair
Richard Figiel
Thomas Henick-Kling
David V. Peterson
Judy Robinson

COVER DESIGN BY

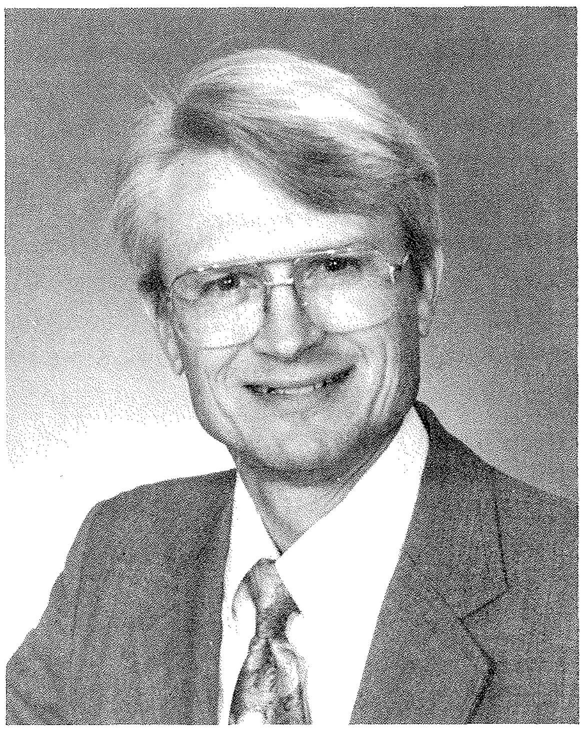
Elaine L. Gotham, Communications Services

PUBLISHED BY

Communications Services
New York State Agricultural Experiment Station
Cornell University — Geneva

TABLE OF CONTENTS

DEDICATION



ROGER C. PEARSON
PROFESSOR OF PLANT PATHOLOGY

The New York grape producers showed the respect they had for Dr. Pearson when they asked him to help explore options for organic grape culture in New York. Faculty across several disciplines also showed their faith and respect by responding to his request that they participate in this study.

New York and the world lost a valuable and productive scientist, and we faculty at Cornell lost a very close friend when Roger died. We respectfully dedicate this volume to the memory of Roger C. Pearson

THE NORTHEAST ORGANIC FARMING ASSOCIATION
NOFA - NY

The Northeast Organic Farming Association of New York, Inc., (NOFA - NY) is a not-for-profit educational association incorporated in 1983. We are a membership organization of consumers, gardeners and farmers creating a sustainable regional food system which is ecologically sound and economically viable. Through demonstration and education, we promote land stewardship, organic food production, and local marketing which brings consumers and farmer closer together to make a high quality food available to all people.

NOFA - NY publishes a bi-monthly newsletter (NOFA - NY NEWS), holds a two day Annual Educational Conference in March and a one day Outreach Conference in the fall and hosts workshops and on-farm tours and demonstrations throughout the year. We bring our educational message to the public at the New York State Fair, the New York Farm Show, and other agricultural and environment fairs and festivals across the state.

NOFA - NY's Organic Farm Certification Program has been the primary organic certification program in New York State since 1984. The program publishes annual production standards for crops, livestock, and some processed commodities. Participants provide documentation of their production practices which are verified by field representatives of the program. In 1994, NOFA - NY certified 108 farms in New York and Pennsylvania representing over 6,000 acres.

NOFA - NY is one of seven independent NOFA organizations in the northeastern states. We work together through an interstate council to publish the quarterly *The Natural Farmer* and host an annual summer conference.

For membership information, contact Ammie Chickering, NOFA - NY, P.O. Box 21, South Butler, NY 13154 (315) 365-2299. For information on organic certification, contact Patricia Kane, NOFA - NY Organic Farm Certification Program, 472 Monkey Run Road, Port Crane, NY 13833 (607) 648-5557.

NEW YORK STATE GRAPE PRODUCTION RESEARCH FUND, INC.

The New York State Grape Production Research Fund, Inc. (Fund) was organized in 1954 by members of the Chautaqua Country Extension Fruit Commodity Committee. It was later expanded to include the major grape producing areas of New York state. Its membership includes most of the New York state processors and wineries, and grower representatives from the major grape producing counties of the state. The Fund is a non profit corporation financed by the voluntary contributions of its members.

Since 1962, the main objectives of the Fund have been to support research aimed at solving current viticultural problems and to dispense information gained from such research to processors and growers.

The Fund assists, or may completely fund, research projects aimed at improving the quantity and/or quality of grape production in New York state. The director and staff members of the New York State Agricultural Experiment Station supervise these projects. Each winter Fund members meet with the research staff to discuss previous year's results of supported projects and to accept proposals for the current year. At a later meeting, members evaluate and prioritize proposals. Since 1955, the Fund has contributed over $1,000,000 to viticultural research.

Several notable breakthroughs in viticulture have come about as a result of Fund sponsored research. One of these was a major research project that lead to the development of the commercial grape harvester.

Current research, supported by the Fund and directed toward the development of mechanical pruning and shoot positioning equipment, has the potential to effect substantial reductions in grower labor costs. Other research supported by the Fund is aimed at solving serious industry disease and insect problems. In addition, ongoing research is directed toward improving varietal selection and productivity.

The Fund serves not only to promote research on viticultural problems, but also has demonstrated the close cooperation between growers, processor and government that has been most effective in solving problems that beset this important segment of our agricultural industry.

Thomas G. Davenport
National Grape Cooperative

CORNELL FARMING ALTERNATIVES PROGRAM

Stimulating Rural Economics Development. The Farming Alternatives Program helps farmers and communities to discover - and act on- new opportunities for agriculture-based economic development. We provide research and education on agricultural diversification, entrepreneurship and market development opportunities to farmers, agricultural educators, planners ad community leaders throughout New York.

Promoting Self-Help Solutions For Farm Families. We help farmers develop the entrepreneurial skills and the knowledge they need to improve profitability and environmental impacts. The Annual Transitions Conference, Farming For the Future and other educational programs bring together farmers and agricultural professionals to learn about new enterprise opportunities, technologies and management strategies. Research on production and marketing innovations helps NY farmers to stay in business and to meet environmental goals.

Helping Communities Find Local Solutions. We believe the future of farming will depend on the creativity and commitment of local farmers and their communities, working together to meet the challenges and opportunities facing agriculture today. Over forty community agriculture development groups in New York now rely on the Farming Alternatives Program for information and networking, and this number is steadily growing. Our newsletter, educational programs and research help them identify agriculture development strategies, share information and learn from each others' successes and failures.

Educating the Educators. As part of the Cornell Cooperative Extension System, we work closely with Extension agents, Cornell faculty, staff and students, providing information, training, research and publications on sustainable agriculture and community agriculture development. We provide in-service programs for agricultural educators, on-campus seminar series, and make presentations at local workshops and conferences.

Planning For Tomorrow's Agriculture. The Farming Alternatives Program plays a key role, around the state and within the Cornell community, in raising critical questions and stimulating dialogue about the future of NYS agriculture.

To subscribe to the Farming Alternatives newsletter and find out more about or program and publications, write:

Farming Alternatives Program
Department of Rural Sociology Cornell University
Ithaca, NY 14853

WHY GROW ORGANICALLY?

Elizabeth Henderson
Organic Grower, Rose Valley Farm, Rose, New York
NOFA Representative

In my work on transitions, I have asked this question of a lot of farmers - why farm organically? Farmers, of course, give various answers. Some make the choice to cut out synthetic materials because of illness in the family or out of a desire to make the farm a safer place for their children. For other farmers, the primary motivation is economic: the premium prices paid for some organic products or the greater independence that comes with reducing expensive off-farm inputs. A few farmers attribute their decision to make changes to a spiritual awakening to their role as steward of God's creation. But the most frequent reason for eliminating toxic chemicals given by farmers I have interviewed is that they noticed that, compared with childhood memories, wildlife had diminished on the farm and earthworms had become so scarce that the soil seemed dead. Organic methods offered a way to bring life back to the farm.

Making the decision to change is the hardest part. Once made, you discover that you are entering a community of farmers who are seeking greater environmental, economic and social sustainability. There is a sense of excitement because there is no set orthodoxy. The solutions for each farm are unique, every season brings new discoveries and further changes. Organic standards are amended every year as we learn more and additional discoveries are made, particularly in the area of biological controls. There is also a sense of nervousness about making these changes because there are no guarantees and not a lot of help from the usual sources, although recently there has been steady improvement in the availability of the information we need. With few exceptions, farmers who have begun to make changes themselves are generous about sharing what they have learned with other farmers.

In the marketplace, "organic" is presented with a stress on the negatives - no synthetic pesticides, herbicides, or fertilizers, along with the irritatingly misleading label "no spray." Those of us who are farming organically prefer to stress the positive side of our work. We have three interlocking goals: 1) To conserve and build healthy soils; 2) to create and maintain diversity; and 3) to cycle and "recycle" nutrients through the farm system, reducing dependence on non-renewable inputs. If there is an organic orthodoxy, it consists of the simple belief that healthy soils produce healthy plants and that people and animals that eat those plants will tend to be healthier.

As scientists begin to study mature organic systems more carefully, they are making some suprising observations. Tissue tests of organic crops show a higher level of mineral content, especially potassium and phosphorous, than additions of soil amendments can explain. The mechanisms by which biologically active soils and plants interact are poorly understood. In practice, however, many farmers are using organic methods successfully. This is documented in the book The Real Dirt: Farmers Tell About Organic and Low-Input Practices in the Northeast, which is based on interviews with farmers running sixty farms in nine northeast states.

As the researchers in the SARE Organic Grape Project have learned, converting to organic management is not just a matter of substituting organic materials for conventional ones. Substitution is only the first step. For a crop to do well using organic materials, begin by thinking of the field, and then think of the farm as part of an integrated natural system in which all parts are interrelated. One must go beyond substitution to redesign; changing varieties, soil treatment, pest management, rotations, cover crops and ground covers, and often modifying equipment and marketing as well. A farmer can approach this as a big headache, or as an exciting opportunity to develop a comprehensive approach to planning for the entire farm.

Personally, I find the challenge of working with natural systems very satisfying. At a time when so many farms are going out of business, it is a source of hopefulness to be part of a growing group of farmers and consumers who care deeply about the stewardship of the earth and who see our work as the creation of a regional, sustainable food system. When the organic certification program representatives of the northeast got together to begin a transition to regional standards, we wrote a preamble which sets forth the philosophical framework for organic agriculture in the region.

It reads:

* To replenish and maintain long-term fertility by providing optimal conditions for soil biological activity.

* To produce viable quantities of high-quality, nutritious food and feed.

* To work with natural systems rather than seeking to dominate them.

* To reduce pollution that may result from farming.

* To work as much as possible within a closed system with regard to organic matter and recycled nutrients.

* To encourage the use of renewable resources in regionally organized agriculture systems.

* To create conditions for farm livestock that ensure them a life free of undue stress, pain, or suffering, and to provide for their sustenance in a way that is respectful of the carrying capacity of the land.

* To ensure decent and non-exploitive treatment of farm workers.

* To allow agricultural producers an adequate return and satisfaction from their work, including a safe working environment.

* To maintain the genetic diversity of the agricultural system and its surroundings, including the protection of plant and wildlife habitats.

* To consider the wider social and ecological impact of the farming systems.

* To educate farmers and the public about organic methods.

* To encourage new organic farms and the conversion of existing conventional farms to organic methods.

* To sustain the land in healthy condition for future generations.

THE SARE - CORNELL ORGANIC GRAPE PROJECT

Dr. R. M. Pool, Professor of Viticulture
and J. A. Robinson, Project Coordinator
Department of Horticultural Science
Cornell University
New York State Agricultural Experiment Station
Geneva, New York

BACKGROUND

In 1989, Dr. Roger Pearson of Cornell's Department of Plant Pathology, was asked to advise the Taylor Wine Company of New York on the feasibility of growing organic grapes in New York state. At that time, there was already considerable experience with commercial organic grape and wine production in California and in Europe, but there was much less experience in the eastern U.S.

In many ways eastern grape production is unique. Grapes are the number one fruit crop in the world, but most grapes are grown in areas with Mediterranean climates, which are characterized by near rainless summers and moderate winter temperatures. New York has summer rains and high humidity during the growing season which greatly increase disease and insect pressure. Our grapevines are also exposed to very low winter temperatures which can injure vines. Because of this, most New York production is based upon different grape varieties than commonly grown elsewhere. Elsewhere, varieties of *Vitis vinifera*, the European grape, are grown. They have little resistance to fungal diseases like powdery mildew, downy mildew and black rot which originated in the eastern U.S. and which thrive in our humid climate.

In New York, resistant native American varieties developed from wild *Vitis labrusca* and interspecific hybrids produced by crossing American native grape species with the European grapes are most common.

These varieties differ from the common *V. vinifera* varieties in soil and cultural requirements and in sensitivity to fungicides. To some extent, New York grapes also differ in composition and are used to produce unique wines and juices. Thus, the experience gained by organic grape producers elsewhere was not directly transferable to New York.

Fortunately, the grape research program at Geneva had many strong research programs in viticulture, plant pathology and entomology directed toward developing improved grape culture methods, and the experiment station was home to Cornell's Integrated Pest Management program which strives to develop and disseminate information on improved, low impact production methods. As a result of the inquiry, Dr. Pearson organized an advisory team of Cornell researchers and organic as well as conventional grape growers to define the problems and devise approaches.

This group then applied for and received funding from the northeastern regional federal research program called LISA (Low-Input Sustainable Agriculture) to explore the feasibility of organic grape production. This group and its successor (SARE, Sustainable Agriculture Research and Education) has supported a five year project to evaluate conversion from conventional to organic grape production. During this period, Cornell faculty have been advised by a committee made up of commercial growers, faculty, Cornell IPM and Cornell Cooperative Extension staff.

These advisors include:

Dr. Roger Pearson , Department of Plant Pathology, New York State Agricultural Experiment Station, Geneva, NY, Cornell University

Dr. Chris Becker, formerly Department of Plant Pathology, New York State Agricultural Experiment Station, Geneva, NY, Cornell University

Dr. Timothy Dennehy, formerly Department of Entomology, New York State Agricultural Experiment Station, Geneva, NY, Cornell University

Dr. Stuart Falk, formerly Department of Plant Pathology, New York State Agricultural Experiment Station, Geneva, NY, Cornell University

Ken Farnan, Buzzard Crest Vineyard, Penn Yan, N.Y.

Richard Figiel, Silver Thread Vineyard, Trumansburg, N.Y.

Jay Freer, interim LISA project coordinator, 1992, formerly Department of Plant Pathology, New York State Agricultural Experiment Station, Cornell University

Dr. David Gadoury, Department of Plant Pathology, New York State Agricultural Experiment Station, Geneva, NY, Cornell University

Dr. Thomas Henick-Kling, Department of Food Science and Technology, New York State Agricultural Experiment Station, Geneva, NY, Cornell University

Timothy Johnson, LISA project coordinator 1992 formerly Department of Plant Pathology, New York State Agricultural Experiment Station, Cornell University, currently Department of Horticultural Sciences, New York State Agricultural Experiment Station, Geneva, NY, Cornell University

Heather Jones, LISA project coordinator 1990-1992, formerly Department of Plant Pathology, New York State Agricultural Experiment Station, Geneva, NY, Cornell University

Dr. Joseph Kovach, Integrated Pest Management, New York State Agricultural Experiment Station, Geneva, NY, Cornell University

Dr. Alan Lakso, Department of Horticultural Sciences, New York State Agricultural Experiment Station, Geneva, NY, Cornell University

Dr. Timothy Martinson, Department of Entomology, New York State Agricultural Experiment Station, Geneva, NY, Cornell University

George McDonald, Department of Horticultural Sciences, New York State Agricultural Experiment Station, Geneva, NY, Cornell University

Tom Mitchell, formerly of the Taylor Wine Company.

Walter Pedersen, Four Chimneys Vineyard, Himrod, N.Y.

Dr. David Peterson, Cornell Cooperative Extension, Finger Lakes Region

Duane Riegel, Department of Plant Pathology, New York State Agricultural Experiment Station, Geneva, NY, Cornell University

Judy Robinson, LISA project coordinator 1993-1994, Department of Horticultural Sciences, New York State Agricultural Experiment Station, Geneva, NY, Cornell University

Dr. Robert Pool, Department of Horticultural Sciences, New York State Agricultural Experiment Station, Geneva, NY, Cornell University

Scott Smith, Four Chimneys Vineyard, Himrod, N.Y.

Tim Weigle, Integrated Pest Management, Vineyard Research Laboratory, Fredonia, NY, Cornell University

Dr. Gerald White, Department of Agricultural, Resource, and Managerial Economics, Cornell University, Ithaca, NY

A major element of the success of this project has been the enthusiastic cooperation of the Taylor Wine Company and the current managers of the property, The Canandaigua Wine Company. Four men in particular should be recognized. Mr. Bill Dunn has been responsible for day to day operations during the five year period. He has never failed to cheerfully and skillfully manage the large research plots. Mr. Tom Mitchell was very instrumental in initiating and encouraging this project, and James Finkle and Richard Riesenberger patiently cooperated following the acquisition of the Taylor Wine Co. by Canandaigua Wines.

METHODS

The primary aim of this project was to explore the feasibility of commercial organic grape culture. Three cultivars were evaluated: Concord, Elvira and Seyval. Concord is the leading grape variety in New York state. In this experiment it was evaluated for juice production. Elvira is the native American wine cultivar with the least stringent cultural requirements; it has broad disease and cold resistance and is harvested at a low sugar concentration to make relatively neutral flavored table and dessert wines. Seyval is a complex interspecific hybrid variety (French Hybrid) which is used for table wine production. Relative to the other varieties, it requires more intense management to avoid excessively large crops which reduce wine quality. The target maturity levels are high (18-21% soluble solids) relative to the other two varieties.

CULTURE

About 10 acre production blocks of each variety were divided; one half was used for organic culture and the other treated with conventional management. In general, the management of these blocks is highly mechanized and reflects the current state of the art technology of New York wine grape production. Vines were trained to high cordons and were pruned using machine hedgers, except existing hand pruned sub-plots were separately evaluated. Crop of Seyval was further controlled by machine thinning after berry fruit-set in July (or August). Extensive soil and petiole testing has been used in these vineyards to monitor nutritional status. Fruit was machine harvested. Our overall goal was to alter the conventional production as little as possible while maintaining and meeting organic culture production standards as defined by the Northeastern Organic Farming Association (NOFA) which certifies New York state organic producers.

Aspects of the project were lead by separate Cornell faculty as follows:

Overall Vine Growth and yield (Dr. Robert Pool, viticulturist from Geneva)

Crop records of each row were obtained by measuring bin depth during mechanical fruit harvest. Detailed sub-blocks were established throughout each major grape block. Detailed follow-up pruning to remove dead and diseased wood was done to half the machine pruned vines in the sub-plots to evaluate its impact on disease development. Node, shoot, and cluster counts were made for each vine. Each vine was separately hand harvested; fruit was weighed and sub-samples taken for juice analysis. The hand harvested fruit was transported to Geneva for processing into wine or juice.

Nutrition/Soils (Dr. David Peterson, Cornell Cooperative Extension Grape Specialist for the Finger Lakes area)

Conventional nutrition involved annual applications of ammonium nitrate, and periodic applications of potassium based upon petiole analysis. Organic plots received annual applications of manure. Legume (clover) sub-plots were established to evaluate the role and impact of legumes on vine growth and nutrition. Details on nutrition and soil analysis will be given in a separate paper.

Disease (Drs. Roger Pearson, David Gadoury, Chris Becker, and Stuart Falk, plant pathologists, from Geneva)

Environmental data was monitored by a field computer acquisition system, and models used to predict black rot infection. Other environmentally driven disease models were used as decision tools for fungicide application. A combination of preventative and post infection applications were made. In some years dormant season fungal eradicants were evaluated. Sulfur and fixed copper were used to control disease in the organic blocks. Vines were frequently monitored for disease development. Details on methods and results are given in a separate paper.

Insects (Drs. Timothy Dennehy and Timothy Martinson, entomologists from Geneva)

The primary insect of concern was grape berry moth. Decision to treat conventional blocks was based upon insect trap counts and a risk assessment model. Primary control for organic blocks was by pheromone disruption, but *Bacillus thurengiensis* (BT) was applied to one block in one year. Grape leaf hopper populations were primarily controlled by encouraging *Anagrus* wasp egg parasites. Grape leaf hopper populations were monitored using sticky traps and assessing injury. When required, insecticidal soap treatments were made to organic blocks to suppress leaf hoppers. Details and results are presented in a separate paper.

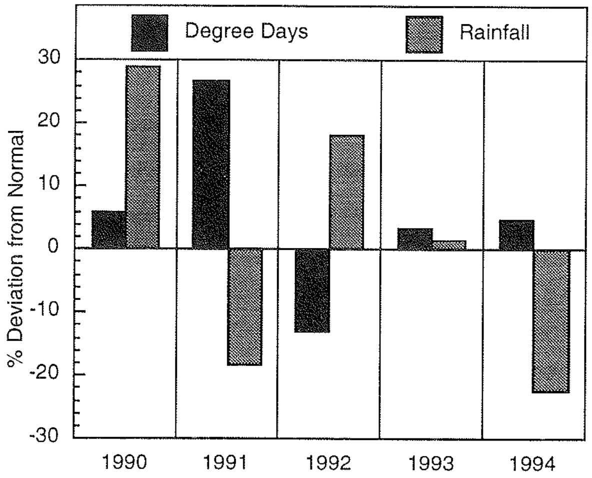


Figure 1. Deviation in seasonal degree day and rainfall accumulation during the years 1990-94.

Weed and Vineyard Floor Management (Dr. Robert Pool, viticulturist from Geneva)

Conventional in-row weeds were controlled by pre-emergence herbicides and spot treatment with post-emergence herbicides where required. In-row weed management in the organic blocks was by cultivation (grape hoeing) combined with propane weed burning. Conventional between-the-row floor management used a single near grape bloom application of glyphosate (round-up) to kill established weeds and ensure low weed competition for the month following bloom. Organic blocks had sod row middles which were cultivated during periods of maximum drought stress. Separate cover crop trials were established to evaluate 10 different cover crop systems. Details will be given in a separate paper.

Enology and Juice Processing (Dr. Thomas Henick-Kling, enologist from Geneva)

Fruit from the hand harvested plots was processed into separate lots of hot pressed grape juice (Concord) or must (Elvira and Seyval). Musts were fermented, clarified and evaluated using trained panels. Juice and wine chemical analyses were performed. Results will be summarized in a separate paper.

Table 1. Effect of cultural method on average yield per acre of machine harvested blocks for the period 1990-1994

	Method	Tons/ Acre	Significance
Concord	Conventional	6.1	0.0001
	Organic	4.9	
Elvira	Conventional	7.8	0.1511
	Organic	7.5	
Seyval	Conventional	7.5	0.0001
	Organic	5.2	

Economics (Dr. Gerry White, agricultural economist from Ithaca)

Taylor Wine Company maintains detailed records of labor, machine and material inputs for each block. These data were used for a complete economic analysis of the two different culture methods for each variety. Details are given in a separate paper.

Table 2. Effect of culture method on 1990-1994 yield components of hand harvested sub-plots of three grape varieties growing at Dresden, New York.

Date	Variety	Method	Clusts/ Vine		Cluster Wt. (g)		Berries/ Clust.		Berry Wt. (g)		Tons/ Acre		Soluble Solids (%)	
1990	Concord	Conv.	169.4	***	65.7	ns	19.9	ns	3.35	ns	7.2	**	14.0	**
		Org.	136.9		70.4		21.9		3.22		6.0		15.2	
	Elvira	Conv.	191.5	***	55.0	*	29.5	**	1.95	**	6.7	**	13.0	ns
		Org.	248.2		48.9		22.9		2.19		8.0		13.3	
	Seyval	Conv.	203.0	***	103.4	***	61.9	***	1.69	ns	13.4	***	14.7	***
		Org.	112.6		132.4		75.4		1.79		8.9		16.0	
		Variety	**0.0001**		**0.0001**		**0.0001**		**0.0001**		**0.0001**		**0.0001**	
		Method	**0.0118**		**0.0005**		**0.0327**		0.1039		**0.0001**		**0.0001**	
		VxM	**0.0001**		**0.0001**		**0.0001**		**0.0030**		**0.0001**		0.1229	
		Follow	0.4689		0.9075		0.9243		0.9604		0.3358		0.3296	
		Vx F	0.2514		0.5156		0.9311		0.4417		0.3148		0.2201	
		Mx F	0.6888		0.7360		0.2451		0.1925		0.6533		0.2969	
		VxMxF	0.2766		0.7276		0.5808		0.6264		0.2029		0.7476	
1991	Concord	Conv.	259.4	ns	61.7	ns	26.3	ns	2.34	ns	10.1	***	14.0	***
		Org.	185.5		58.3		25.0		2.33		7.0		15.6	
	Elvira	Conv.	325.9	***	43.5	ns	25.3	ns	1.71	***	9.2	***	15.7	ns
		Org.	222.1		46.0		24.4		1.89		6.5		15.4	
	Seyval	Conv.	103.2	ns	120.9	***	76.5	**	1.59	**	8.2	***	21.3	***
		Org.	83.4		94.9		66.2		1.43		5.0		22.5	
		Variety	**0.0001**		**0.0001**		**0.0001**		**0.0001**		**0.0003**		**0.0001**	
		Method	**0.0001**		**0.0001**		**0.0010**		0.9555		**0.0001**		**0.0001**	
		VxM	**0.0108**		**0.0001**		**0.0042**		**0.0001**		0.8707		**0.0001**	
		Follow	0.8327		0.0731		0.5719		**0.0283**		0.6735		0.9337	
		Vx F	0.6454		0.3089		0.9555		0.1683		0.8482		0.8635	
		Mx F	0.8871		0.9900		0.5403		0.2306		0.6282		0.8569	
		VxMxF	0.8297		0.9295		0.9386		0.8165		0.9492		0.6603	
1992	Concord	Conv.	134.3	ns	63.0	*	19.4	ns	3.26	***	5.5	ns	13.7	ns
		Org.	143.5		57.6		19.3		2.98		5.3		13.6	
	Elvira	Conv.	192.5	ns	64.9	***	31.3	***	2.07	ns	8.0	ns	11.7	**
		Org.	207.1		52.2		24.7		2.13		7.0		10.7	
	Seyval	Conv.	122.9	ns	100.7	*	62.7	ns	1.62	ns	8.1	ns	15.1	*
		Org.	104.3		114.2		67.5		1.70		7.5		14.4	
		Variety	**0.0001**		**0.0001**		**0.0001**		**0.0001**		**0.0001**		**0.0001**	
		Method	0.8060		0.4701		0.5569		0.1575		0.0989		**0.0137**	
		VxM	0.2079		**0.0001**		**0.0034**		**0.0001**		0.6483		0.4079	
		Follow	**0.0001**		**0.0155**		0.7896		**0.0001**		**0.0001**		0.1096	
		Vx F	0.3285		0.4021		0.9743		0.7977		0.9265		0.1597	
		MxF	0.8146		0.8587		0.9947		0.5305		0.9851		0.4699	
		VxMxF	0.8867		0.3932		0.9454		**0.0281**		0.9556		0.6628	

Date	Variety	Method	Clusts/ Vine		Clust Wt. (g)		Berries/ Clust.		Berry Wt. (g)		Tons/ Acre		Soluble Solids (%)	
1993	Concord	Conv.	307.9	***	38.8	ns	20.9	ns	1.85	ns	7.7	***	13.7	*
		Org.	193.8		41.4		22.1		1.85		4.8		12.5	
	Elvira	Conv	322.2	ns	26.6	ns	22.4	ns	1.19		5.5	ns	12.3	ns
		Org.	319.6		28.8		20.8		1.38	**	5.7		12.0	
	Seyval	Conv	82.1	**	75.5	ns	46.0		1.64	***	3.7	**	18.5	***
		Org.	56.5		69.1		56.0	*	1.25		2.5		14.4	
		Variety	**0.0001**		**0.0001**		**0.0001**		**0.0001**		**0.0001**		**0.0001**	
		Method	**0.0001**		0.7821		**0.0354**		**0.0282**		**0.0001**		**0.0001**	
		VxM	**0.0001**		0.2488		**0.0050**		**0.0001**		**0.0001**		**0.0001**	
		Follow	0.4349		0.6718		0.9057		0.4444		0.4576		0.9461	
		Vx F	0.3116		0.9090		0.9998		0.6951		0.2554		0.3747	
		MxF	0.9094		0.5984		0.6170		0.7868		0.5934		0.1139	
		VxMxF	0.8811		0.9071		0.9606		0.3315		0.9598		0.1197	

Date	Variety	Method	Clusts/ Vine		Clust Wt. (g)		Berries/ Clust.		Berry Wt. (g)		Tons/ Acre		Soluble Solids (%)	
1994	Concord	Conv.	58.5	ns	60.6	ns	22.0	ns	3.0	ns	2.1	ns	17.6	ns
		Org.	57.7		60.3		20.9		2.9		2.4		18.3	
	Elvira	Conv	133.4	ns	48.3	ns	29.6	ns	1.6	*	4.4	ns	10.5	ns
		Org.	134.3		78.7		44.7		1.7		5.2		10.1	
	Seyval	Conv	105.8	***	151.8	ns	88.8	ns	1.8	ns	10.4	***	15.3	***
		Org.	52.3		138.6		80.6		1.7		4.6		16.9	
		Variety	**0.0001**		**0.0001**		**0.0001**		**0.0001**		**0.0001**		**0.0001**	
		Method	**0.0273**		0.4761		0.6848		0.9541		**0.0010**		**0.0429**	
		VxM	**0.0125**		0.0802		0.1511		0.2282		**0.0001**		0.0897	
		Follow	**0.0158**		0.2567		0.8028		0.4484		0.3042		0.6092	
		Vx F	0.1492		0.5376		0.2015		**0.0035**		0.6742		0.1814	
		MxF	0.5975		0.5127		0.4978		0.1308		0.4004		0.3533	
		VxMxF	0.8039		0.2015		0.4381		0.6331		0.2928		0.2561	

ns=no significant difference, * p=0.05, ** p=0.01, *** p=0.001

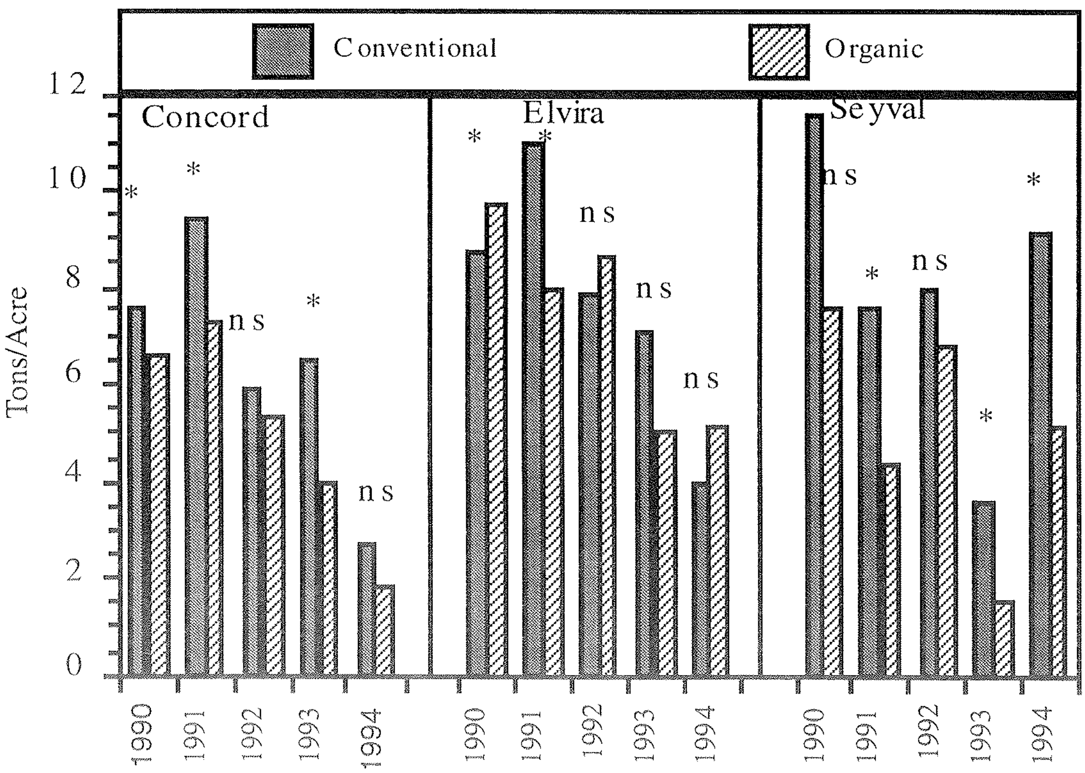


Figure 2. Annual yield of hand harvested plots in the organic viticulture project for the years 1990-94.
* = significant difference between organic and conventional yield for that variety and year;
ns = no significant difference

RESULTS

Details about different aspects of the project will be given in separate papers in this proceedings; this section will primarily concern vine yield and growing conditions.

Weather: Figure 1 summarizes growing season weather during the five year period of the project. Although New York is noted for variable weather, variation in growing conditions during the five year period was unusually large. Seasonal summations can only convey a certain amount of information and should be interpreted with caution. Two of the 5 years had above average total rainfall, but only 1990 could be considered really high in rainfall, and it was only during that year that fungal disease pressure was above average.

Although the figure makes it look as if 1991 was a year of water deficits, in general rains were well distributed and vine growth and function was excellent because of the very warm and sunny weather. The excellent growing conditions during 1991 caused the buds that developed for the 1992 growing season to be much more fruitful than normal. This large crop potential was coupled with a very cool and wet 1992 growing season. The result was not only increased disease pressure, but low sunlight which made it difficult to achieve fruit maturity and reduced the fruitfulness of the canes and buds which bore the 1993 crop.

The 1993 growing season illustrates why simple seasonal totals can be so misleading. Although total rainfall was average, the summer was divided into an early season where rainfall was much above average and a late season drought. The result was considerable early season disease pressure and severe water stress during the fruit maturation period. Many leaves had ceased to function by harvest, and the crop ripened at the expense of vine reserves. As a result there was an inadequate number of buds to produce a normal crop in 1994. Any conditions which increased water stress in 1993 further impacted 1994 cropping. The winter of 1993/94 was probably the coldest in more than 50 years, but there was no evidence of winter cold injury to buds or trunks. Again, the data would lead one to think that water stress was a great problem in 1994, but well timed rains meant that stress symptoms did not develop until very late in the growing season. Because the leaf canopy was reduced in size as a result of the 1993 growing conditions, the vines did not require as much late season water as they normally would.

To sum up the weather, there were two wet years and three dry ones. Disease pressure was only really above average during the 1992 growing season, but accumulated effects of water stress resulted in yearly reductions in the vine's ability to produce large crops (Figure 2, Table 1). Any factors which increased water stress resulted in further reductions in yield especially during the last two years of the experiment.

Yields and quality : Because row by row yield records had been recorded in 1989, we were able to show that there had been no significant yield differences between the experimental areas in the year previous to the initiation of the project for any of the three cultivars. Figure 2 and Tables 1 and 2 show that the yields were not always affected by culture method during each year, but that in general, yields of organic grapes were lower than yields of conventional grapes in years following a period of drought stress. An exception was Elvira. For Elvira overall yield did not differ significantly between the two systems (Table 2), and in the two years when yield did differ, organic vine yield was higher than conventional yield in one year and lower in the other (Figure 2). Overall yields of organically grown Concords was about 20% lower than conventionally grown Concord and organic Seyval yield was reduced by about 30%.

There are two primary reasons for the difference among varieties. Even though we attempted to match blocks, it was apparent that the soil of the organically grown Seyval was inferior to the conventional soil. The primary difference was the extent of erosion in the organic section which meant that some areas had shallow soils with less water holding capacity and a greater requirement for potassium addition. We saw no similar difference in the Concord soils, but in general soil in the Concord blocks had higher pH.

Because nutritional management is more complicated for Concord grapevines growing in a higher pH soil, and because organic management tended to increase soil pH and magnesium content, the organic vines may have suffered in the short range. It would be very interesting to observe these vineyards during the next five year period when the benefits of five years of soil building by the organic management would be expected to increase the yield. A similar pattern of five years inferior yield followed by 5 to 10 years of equal or better yield of organically managed soils has been observed with annual crops.

The primary reason for the reduced yield of organic grapes was increased competition from weeds and cover crops. Until less competitive organically acceptable weed control measures are identified, growers must expect lower yield potential from organically managed vineyards.

Effect of management on fruit quality will be covered in more detail in a later paper, but in brief, there were differences in fruit composition and product quality, but they primarily reflected crop load rather than culture method differences. There was some concern about increased levels of copper in products produced from organically grown grapes.

CONCLUSIONS

Disease and insect management during the five year period was adequate under both culture systems. There is some concern about long term build-up of disease when there are no really effective organically acceptable fungicides available. These include black rot and phomopsis cane and leaf spot.

Although arthropods did not become problematic, there is concern that as growers discontinue use of broad spectrum insecticides, formerly minor pests may tend to become more serious. An example is grape root worm which was formerly controlled by treatments targeted at grape berry moth, and may become more serious in the future. This is not a problem solely for organic grape growers, as conventional practice is to discontinue prophylactic treatment with broad spectrum insecticides.

As has been observed with other crops, yields have tended to be lower in the organic blocks, but only when vines have suffered drought stress. This primarily reflects the effect of less precise weed management. We are investigating alternate cover crop systems to reduce vine competition from weeds. Growers who have irrigation available should be less vulnerable to the increased competition from weeds.

REFERENCES

Pool, R.M., C.M. Becker, S.P. Falk, D.M. Gadoury, D.G. Riegel, A.N. Lakso, J.A. Robinson, T. Henick-Kling, T.E. Martinson, G.B. White, F. DesJardins, and D.V. Peterson. 1993. Whole farm impact of converting conventionally managed eastern vineyards to organic management practices. Annual report of 1993 (Subcontract No. 90-10-01).

Weigle, T.H. and A.J. Muza. 1993. New York and Pennsylvania pest management recommendations for grapes. Cornell Cooperative Extension, Cornell University, Ithaca, N.Y.

MANAGING SOIL FERTILITY WITH ORGANIC AMENDMENTS

L.E. Drinkwater
Rodale Institute Research Center
Kutztown, Pennsylvania 19530

Abstract

Amendments and fertilizers are materials added to the soil to enhance soil quality and promote plant growth. Organic soil amendments and fertilizers are used for these same purposes, and are materials specifically derived from living organisms such as animal manures, composts, food processing wastes, and green manures. There are both advantages and drawbacks to consider in choosing which organic materials to use in a particular production system. The nutrients in organic amendments are generally less concentrated than in synthetic fertilizers and must be mineralized by the decomposers before they can be taken up by plants. Consequently, it is often difficult to predict how much of a given material is needed to supply the crop with adequate nutrients. On the other hand, additions of organic residues can improve soil tilth and fertility by increasing soil organic matter levels and biological activity. Furthermore, use of organic amendments can reduce nitrogen losses due to leaching. In order to make the best use of organic amendments in managing soil fertility, it is necessary to understand the process of decomposition. The booklet, *Organic Soil Amendments and Fertilizers* by D.E. Chaney, L.E. Drinkwater, and G.S. Pettygrove, explains the basics of soil organic matter dynamics, offers general guidelines for evaluating organic amendments and deciding which to use, and includes details on various organic materials currently available.

MANAGING ANIMAL MANURES

Dr. Stuart Klausner
Senior Extension Associate
Department of Soil, Crop and Atmospheric Science
Cornell University, Ithaca, N.Y.

For centuries farmers have spread animal manures on the land as a way to increase soil productivity. Once applied to the soil, manure is decomposed by microorganisms, forming humus and releasing essential elements for plant growth. The economic value of manure is related to its fertilizer replacement value, its organic matter content, and probably some unknown factors that enhance crop production.

Management is the key to efficient use of nutrients by a crop. Proper management will increase economic crop returns and reduce the potential for polluting surface and ground waters. This chapter discusses the basic principles regarding the use of manure in a soil fertility program and presents general guidelines for managing manure for optimum crop production.

Nutrient Content

Depending on the species, approximately 70-80% of the nitrogen, 60-85% of the phosphorus, and 80-90% of the potassium fed to animals are excreted in the manure. The high nutrient return in manure permits a recycling of plant nutrients from crop to animal and back to the crop again.

The amount of nutrients contained in manure and their eventual uptake by plants will vary considerably from farm to farm. The major factors determining nutrient content and availability are (I) composition of the feed ration, (2) amount of bedding and water added or lost, (3) method of manure collection and storage, (4) method and timing of land application, (5) characteristics of the soil and the crop to which manure is applied, and (6) the climate.

Table 8 shows the wide range in nutrient composition of manures sampled from numerous farms. Because of the large amount of variation, it is not advisable to use the average nutrient contents often seen in publications. Average values are very misleading. The best way to determine the nutrient content of manure is by laboratory analysis. The minimum analysis should include the percentage of dry matter,

Table 8. Range in nutrient analysis of manure for various handling systems

	Nonliquid systems			Liquid systems		
Type	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	lb/ton			lb/1000 gal		
Dairy	5-16	2-16	2-31	3-51	2-21	2-58
Beef	4-20	1-13	3-29	6-37	1-29	5-30
Swine	3-27	1-62	2-18	1-65	1-63	1-49
Poultry	4-111	1-96	2-55	35-75	13-91	13-39

Source: Adapted from T. Bates and E. Gagnon, 1981, Nutrient content of manure, University of Guelph, Guelph, Ontario, Canada.

ammonium nitrogen (NH_4), total nitrogen (ammonium N + organic N), phosphorus (P or P_2O_5), and potassium (K or K_2O).

The key to an accurate manure analysis is proper sampling. Samples should be taken just before spreading to account for losses during handling. Storages should be sampled each time they are emptied, and daily spread operations should be sampled several times throughout the year to obtain a good average nutrient value. When the results become reasonably consistent, sampling can be done less frequently. Samples should be taken from representative loads to give the nutrient content at the time of application. Be sure liquid storages are agitated thoroughly before unloading. Place a composite sample in a plastic bottle, seal tightly, and freeze immediately Freezing is to preserve the sample, because a considerable amount of nitrogen can be lost by improper handling.

Nutrient Availability

The nutrients in manure cannot be substituted for the nutrients in commercial fertilizer on a pound-for pound basis. A portion of the nutrients are not as readily available, nor can they be as accurately applied as those in fertilizer. How efficiently they are used by a crop depends on management of the land application program, as well as the rate of biological breakdown of the organic material and release of plant-available nutrients. The following sections describe how nutrient availability can be estimated.

NITROGEN

There is no quick soil test procedure to determine the N supply from organic matter. Therefore, the N supply from manure in the soil must be estimated from research studies and applied to individual farm conditions.

Because of its chemical nature, manure N is more difficult to manage than other nutrients. There are two forms of N in manure, namely the unstable and stable organic N (Fig. A). In either form, the organic N must be decomposed by microorganisms to an inorganic N form before it can be used by plants. The resulting inorganic N is available for crop growth as nitrate (NO_3) and ammonium (NH_4).

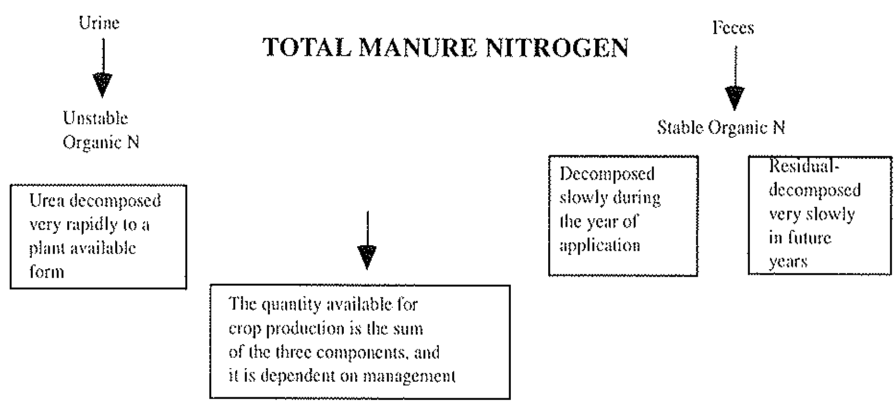


Figure A. Form and degree of nitrogen availability in manure.

The unstable organic N is present in urine as urea or uric acid and may account for more than 50% of the total N. Urea in manure is no different from urea in commercial fertilizer. It decomposes very rapidly to ammonium (NH_4) and, in turn, converts very quickly to ammonia (NH_3) as the pH increases and the manure begins to dry.

All the ammonium in manure is immediately available for plant growth. Ammonia is extremely volatile, however, so exposure of manure on the barn floor, in the feedlot, in storage, or after spreading increases the N loss. At every step between production and its use by the crop, ammonia is the most valuable and most easily lost component. It is also the most variable component between management systems, and therefore, an analysis of the manure is useful to determine how much ammonia has been conserved before spreading.

Table 9 shows a typical field loss of ammonia after spreading. The more stable organic N is present in the feces and is a more slowly released form of organic N than urea. The decomposition of stable organic N to a plant-available form occurs at two rates. The less-resistant organic N decomposes during the year of application, whereas the more-resistant organic N decomposes very slowly in future years. Repeated application to the same field results in an accumulation of a slow-release manure N source.

Table 9. Loss of ammonia by volatization after a surface application of dairy manure.

Days after application	Ammonia N loss, %
1	20
2	40
3	50
4	60
10	75
15	90

A decay, or decomposition, series is commonly used to estimate the rate of N availability from stable organic N. A decay series of .35-.12-.05-.02 is used to estimate the rate of decomposition of organic N in fresh manure in New York. The sequence of numbers means that 35% of the organic N is decomposed during the year applied, 12% of the initial organic N application is decomposed during the second year, 5% is decomposed the third year, and 2% the fourth year. The last three numbers in the decay series are the annual rates of decomposition of the residual organic N from past applications.

There is some evidence that manure containing large amounts of bedding may decompose at a slower rate than fresh manure. Therefore, the estimated availability of N during the year applied is reduced from 35 to 25% when the dry matter content exceeds 18%.

The amount of N available during the growing season is equal to the ammonium N + decomposed organic N from the present application + decomposed organic N from past applications. An estimate of N availability in New York is shown in Figure B. The quantity that is available can vary from year to year and from farm to farm because the rate of microbiological breakdown depends upon soil characteristics and climatic conditions. Other factors affecting availability are animal species, moisture content, bedding, and method of manure storage. However, the guidelines in Figure B are reasonable estimates.

At the present time, there is not enough research data to determine N availability from manure when left on the surface throughout the growing season. The value of N in manure spread for no-till crops or for top-dressings on hayfields or pastures will have to be based on your past experiences.

A work sheet is provided to make it easier for you to estimate N availability from present and past applications. Transfer the values in Figure B to work sheet 1 to determine availability based on your management practice. The example in work sheet 1 shows that the amount of available N will be low when manure is spread during the fall of the year. The nitrogen value increases

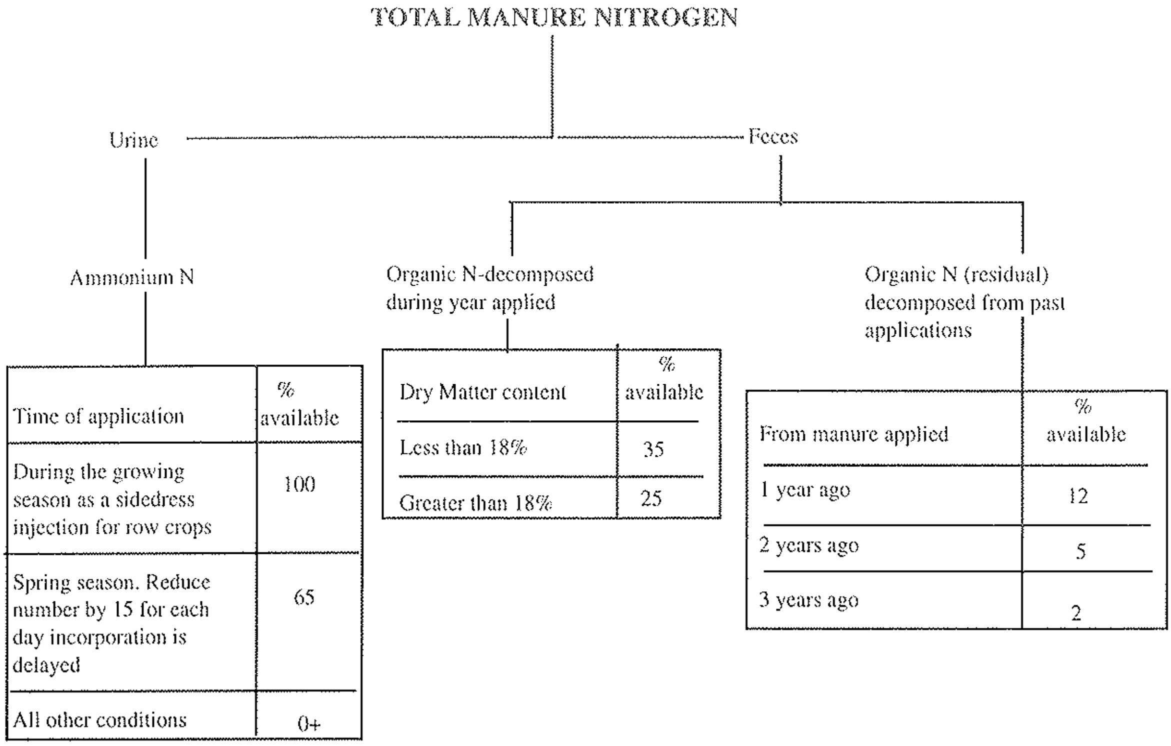


Figure B. Estimated availability of the different forms of nitrogen in manure.

considerably by applying and immediately incorporating manure in the spring.

Work sheet 1 is also available in computer program form at your Cooperative Extension office. If you do not have a manure analysis, the work sheet or computer program will not be very helpful.

PHOSPHORUS AND POTASSIUM

Manure is an excellent source of P and K. When manure is applied at a rate to supply the N needed, P and K will most likely be applied in excess of crop needs.

Not all the P in manure is immediately available for plant use. Some of the P is in an organic form that has to decompose before it is available. P is not very mobile in the soil. Therefore, broadcasted manure is not an efficient method of applying P when establishing a crop. Some P will be recommended in a band-placed starter fertilizer except when the soil test level is extremely high. For top-dressing hayfields, the P in broadcasted manure is probably as efficiently used as P in broadcasted fertilizer.

Essentially all the K in manure is available for plant growth during the year applied. K can be used efficiently by a crop as either a band or broadcast application.

The fertilizer requirements for P and K on manured fields can be determined by soil testing. The soil test levels are a reflection of how much P and K have been applied from past manuring; and these values should be used to determine the amount of fertilizer needed.

If manure was applied before the soil test was taken, follow Cornell's P_2O_5 and K_2O fertilizer recommendations. The P and K applied will be reflected in the soil test values. If manure will be applied after the soil test is taken, the following guidelines are offered.

Table 10. Corn yields on a manured field with various rates of fertilizer

Manure Input, lb/A			Cornell Soil Test	
N = 149	P2O5 = 59		pH = 6.4	K = 375 (H)
K20 = 149			P = 16 (H)	Mg = 320 (H)
Fertilizer applied			**Corn silage, T/A**	
N	P2O5	K2O, lb/A		
0	0	0	19.3	
20	40	20	19.0	
40	40	20	20.7	
80	40	20	19.3	
120	40	20	19.3	
120	40	80	20.1	

NOTE: Manure was spring applied at 4500 gal/A and plowed down within 8 hr.

Phosphorus *For crop establishment or top-dressing:*

a. If the fertilizer recommendation is less than 40 lb/acre, apply the entire amount as fertilizer.

b. If the fertilizer recommendation exceeds 40 lb/acre, apply 40 lb and use the P in manure to supply the rest.

Potassium *For crop establishment:*

a. If the fertilizer recommendation is less than 20 lb/acre, apply the entire amount as fertilizer.

b. If the fertilizer recommendation exceeds 20 lb/acre, apply 20 lb and use the potassium in manure to supply the rest.

For top-dressing:
The potassium in manure can be used to supply the entire amount.

MICRONUTRIENTS

Manure contains small quantities of micronutrients; hence, micronutrient deficiencies on manured fields are not very common. Because of the slow availability of micronutrients in manure, a micronutrient deficiency should be corrected with a commercial fertilizer source.

Economics

The effectiveness of manure as a fertilizer is based on the nutrients it contains that are not supplied in adequate amounts by the soil. Thus, the fertilizer dollar value of manure is equal to the cost of the fertilizer that has to be purchased if manure is not applied. In fields where the soil test levels for P and K indicate these nutrients are in adequate supply, only the fertilizer nitrogen value of the manure should be considered.

When contemplating capital investments for manure handling, make a careful economic analysis of the change in your management. For instance, an expenditure that produces nutrient surpluses is not economical unless the surplus can be sold; on the other hand, an expenditure that markedly improves nutrient recycling, environmental quality, or your management ability is a good investment.

The results of several field trials (Tables 10 and 11) illustrate the effectiveness of manure as a

Work Sheet 1. Estimating the amount of nitrogen available for crop production

Example: A dairy manure sample was taken from a nonliquid storage facility and analyzed. The following calculations show how to estimate the amount of nitrogen that will be available during the growing season from the current manure application and from previous applications. Assume that 25 tons/acre, having an organic N content of 6 lblton, were applied in each of the past 3 years.

Calculations

A. Insert the percentage of dry matter and the nitrogen value of the manure from the analysis in lb per ton for a nonliquid system or lb per 1000 gal for a liquid system. Organic N = Total N - Ammonium N.

	Example	Your Farm
Dry Matter	15%	____________
Total N*	10 lb/ton	____________
Ammonium N	4 lb/ton	____________
Organic N*	6 lb/ton	____________

B. Determine the availability of nitrogen during the first year. Available N = lb of ammonium N or organic N in item A x the percentage of availability from Figure B.

	Time of Application	Quantity Available From: Ammonium N (lb x %)		Organic N (lb x %)		Available N
Examples:	Fall	4 X 0	+	6 X .35	=	2.1 lb/ton
	Spring Incorp. delayed 2 days	4 X .35	+	6 X .35	=	3.5 lb/ton
	Spring immed. incorp.	4 X .65	+	6 X .35	=	4.7 lb/ton
Your Farm:	____________	________		________		________

C. Determine the availability of nitrogen from previous applications. Omit those years when manure was not applied. Available N per acre = application rate from previous records in tons or 1000s of gal x lb of organic N per ton or per 1000 gal x percentage of availability from Figure B.

Quantity available from residual organic N from:

	1 year ago (rate x N x %)		2 years ago (rate x N x %)		3 year s ago (rate x N x %)		Residual N Availability
Example:	25x6x.12	+	25x6x.05	+	25x6xl02	=	28.5 lb/A
Your Farm:	______	+	______	+	______	=	______

*Some laboratories may report their nitrogen results under the heading "nitrogen" and "ammonium or ammonia N." The larger of the two numbers is total N. Many laboratories do not report organic N simply because it is the difference between total N and ammonium N.

Table 11. Corn yields on a manured field with various rates of fertilizer

Manure Input, lb/A		Cornell Soil Test	
N = 342 K20 = 294	P2O5 = 56	pH = 6.3 P = 11 (H)	K = 320 (H) Mg = 360 (H)

Fertilizer applied N	P2O5	K2O, lb/A	Corn silage, T/A
0	0	0	20.8
20	40	40	22.5
40	40	40	23.4
80	40	40	23.0
120	40	40	23.3
120	80	80	23.7

NOTE: Manure was spring applied at 30 T/A and plowed down within 6 hr.

fertilizer. The corn yields shown in Table 10 are typical of those found on farms where manure has been applied uniformly at a high rate for many years. Under these conditions, nutrients accumulate in the soil, the soil test levels increase, and the need for commercial fertilizer decreases. When corn is in rotation with hay, some additional N will be supplied by the previous sod crop. On this farm there was no economic advantage to applying fertilizer.

The yields shown in Table 11 were on a field in continuous corn that did not receive much manure in the past; therefore, N availability may be low because of little or no supply from previous application. Although this year's manure application supplied plenty of P and K, it was economical to add a starter fertilizer containing up to 40 pounds of N. Even at high rates of manure there is an advantage to using a band-placed starter fertilizer with the planter, especially with the cold, wet springs experienced in New York.

Land Application

The goal of a well-managed land application program is to develop a soil fertility program that uses manure to supply as much of the needed plant nutrients as possible, with commercial fertilizer providing only what is additionally needed.

A particular kind of manure-handling system does not, in itself, increase or decrease nutrient use by a crop; management does!

Table 12. A nutrient balance on a typical dairy farm in New York

Nutrients produced in manure	Nutrient requirements from soil testing
75 cows + 53 heifers Manure, T = 1,830 Analysis, lb/T = 10-5-9	Soil = silt loam, 228 A Soil test = medium Rotation = 4 yr. corn 4 yr. alfalfa
N = 18,300 lb P_2O_5 = 9,100 lb K_2O = 16,400 lb	N = 11,800 lb P_2O_5 = 7,300 lb K_2O = 11,100 lb

The first step in developing a land application program is to determine the amount of nutrients collected in manure; the second is to soil test to determine of nutrient requirements of the crop rotation; the third is to estimate nutrient availability in manure; and the fourth is to calculate a compatible rate of application.

The quantity of nutrients produced should be compared with the total nutrient requirement of your crop rotation. Table 12 shows a typical nutrient balance for a 75-cow dairy in New York. With similar information for your farm, a management program can be developed to ensure that manure will supply a major portion of the nutrient requirement.

If your crops require more nutrients than are available in manure, you should consider changing your management practices to conserve more. On the other hand, if the availability of nutrients in manure exceeds crop requirements, there is no advantage in changing management to conserve more unless (a) you can sell the excess, (b) the convenience or environmental concerns outweigh the economic returns, and (c) the change enables you to manage other areas more effectively.

The example in work sheet 2 showed that a 120-pound-per-acre N requirement for corn could be met by a combination of residual N from past applications, applying 30 tons of manure, and adding 30 pounds of N in the starter fertilizer at planting. Thirty tons per acre will also contain 150 pounds of P_2O_5 and 270 pounds of K_2O. For the spreader being used, it took 44 loads to apply 30 tons per acre to a 15-acre field.

The amount of liquid manure applied by irrigation can be measured by placing cans in the field to record the depth of water applied. There are 27,150 gallons in 1 acre-inch.

To save a lot of tedious calculations, contact your extension office. It has a computer program that will calculate annual manure production on your farm, the amount of nutrients (from a manure analysis) collected, the nutrient requirements of your crop rotation, and estimates N availability for various management practices. From the computer printout a compatible rate of application can be determined.

After determining the rate for each field, add the total amount of manure needed and compare this to the amount collected. If there is an excess, divide it among those fields having the highest nutrient demand.

Excessive rates of manure will oversupply nutrients that may affect plant growth and animal nutrition. Excessive rates of application as well as accumulations of manure around barn lots will eventually cause water pollution. Examples include aquatic growth in lakes and high nitrate levels in groundwater. Preventing such problems calls for a combination of appropriate soil and water conservation practices and proper management of the rate, timing, and method of manure application. In extreme cases additional land must be used to lower the application rate.

MAXIMIZING THE VALUE OF MANURE

The timing and method of manure application determine the efficiency of nutrient recycling. Some important points follow:

- Incorporating manure immediately minimizes odors and ammonia loss. If manure supplies more N than is needed, some ammonia loss is unimportant as far as the crop is concerned. Ideally, ammonia should be conserved so that N can be applied to a larger number of acres. Incorporation of manure too far in advance of crop needs will result in N losses. Spring or early summer incorporations are best.

Table 13. Approximate manure spreader capacities

Nonliquid system

Spreader volume (Measure all dimensions in feet and tenths of feet.)

Box spreader: cubic feet = length x width x average depth.

Barrel spreader: cubic feet = 0.393 x d^2 (diameter squared) x length.

Irregular shapes: Use manufacturer's rated capacity. Estimate the percentage of a full load.

Spreader capacity

Tons per load = cubic feet x 62 Ib per ft^3 (Use 55 Ib per ft^3 2000 lb per ton for extremely dry manure.)

Liquid system

Tank spreader: Use manufacturer's data to determine gallon capacity. Estimate the percentage of a full load. There are approximately 8,300 lb in 1,000 gal.

- Surface runoff and erosion must be controlled. Using tillage to incorporate manure on erosive soils in the fall may result in unacceptable soil losses. Applying manure as close to planting as feasible reduces the potential for nutrient loss.
- As is the case with commercial fertilizer, manure must be spread uniformly to get consistent results.
- Amounts of commercial fertilizer should be reduced according to the nutrient value of the manure and the accumulation of nutrients in the soil from past manuring. Avoid over-applications.

The recommendations from Cooperative Extension should be followed to ensure a proper balance of plant nutrients. Keep a record of nutrient levels in fields and use this information as the basis for adjusting your manure management and soil fertility program.

Work Sheet 2. Estimating a Rate of Application

Example: A dairy operator will apply manure to a 15-acre cornfield in the early spring and incorporation will be delayed for 1 week. From the manure analysis and available N calculations in work sheet 1, determine the rate of application to meet the N requirement, the amount of P_2O_5 and K_2O added, the amount of commercial fertilizer needed, and the number of spreader loads needed to apply the desired application rate.

Calculations	Example	Your Farm
A. Determine the nutrient needs of the crop.		
1. Crop to be grown	Corn	______
2. Nutrient requirements from the Cornell soil test	N = 120 lb/A	______
	P_2O_5 = 30 lb/A	______
Soil Test P = <u>8 (med)</u>, K = <u>150 (high)</u>	K_2O = 20 lb/A	______
B. Determine the nutrient value of manure. Express as pounds per ton for a nonliquid system or pounds per 1000 gallons for a liquid system		
1. Available N from item B in work sheet 1	N = 2.1 lb/A	______
2. P_2O_5 from recent analysis	P_2O_5 = 5 lb/A	______
3. K_2O from recent analysis	K_2O = 9 lb/A	______
C. Determine the rate of application.		
1. Nutrient having the highest priority	= N	______
a. Amount to be supplied by manure. Express as pounds needed in item A.2 minus amount of fertilizer applied. 120 lb - 30 lb at planting	= 90 lb/A	______
b. If nitrogen, subtract residual N availability from item C in work sheet 1. 90 lb - 28 lb/A residual	= 62 lb/A	______
2. Rate of manure needed to supply highest priority nutrient (item C. 1 . item B). Express in tons per acre for a nonliquid system or as 1000s of gallons per acre for a liquid system. 62 lb/A / 2.1 lb/ton.	= 30 ton/A	______
3. Pounds of N, P_2O_5, and K_2O applied per acre with manure.		
a. N value from item B. 1 times manure rate from item C.2 plus residual N availability from item C in work sheet 1. (2.1 lb/ton x 30 tons) + 28 lb.	N = 90 lb/A	______
b. P_2O_5 value from item B.2 times manure rate from item C.2. (5 x 30)	P_2O_5 = 150 lb/A	______
c. K_2O value from item B.3 times manure rate from item C.2. (9 x 30)	K_2O = 270 lb/A	______

Work sheet 2 (continued)

D. Determine the amount of commercial fertilizer needed
-- 30 lb N based on 90 lb from manure.
-- P_2O_5 and K_2O based on soil test recommendation

N = 30 lb/A ______

P_2O_5 = 30 lb/A ______

K_20 = 20 lb/A ______

E. Determine the number of manure spreader loads required to apply the application rate in C.2.

1. Spreader capacity (use equations from Table 13).

a. Liquid System:
(Express in units of 1000s of gal. per load) = ______ ______

b. Nonliquid system

cu ft of spreader = 16.9" x 6.3" x 3.2' = 340 ft^3 ______

tons per load = 340 ft^3 x 62 lb/ft^3 / 2000 = 10.5 tons/load ______

2. Number of loads needed.

a. Loads per acre = manure rate in C.2 / spreader capacity from E.1 (30 / 10.5) = 2.9 loads/acre ______

b. Loads per field = loads per acre x acres. (2.9 x 15) = 44 loads ______

LEGUMES AND OUR LIMITED EXPERIENCE IN EASTERN VITICULTURE

James Kamas[1], Dr. Robert Pool[2], Dr. Alan Lakso[2], Richard Dunst[1] and Andrew Fendinger[1]

[1]Vineyard Research Laboratory, Cornell University, Fredonia, NY; [2]New York State Agricultural Experiment Station, Cornell University, Geneva, NY

INTRODUCTION

The use of cover crops in vineyard row centers has several advantages over cultivation including erosion control, increased equipment mobility and preservation of vineyard soil structure. Although vineyard cover crops have been used for many years, there has been little work done on the potential benefits of leguminous species as covers under eastern viticultural conditions. Indigenous plant covers often contain species which serve as alternate hosts for virus diseases of grapevines. Legumes are generally less laterally aggressive than grass crops and offer the potential benefit of fixing atmospheric nitrogen. The release and availability of additional nitrogen late in the growing season is theoretically beneficial in its ability to facilitate fruit and cane maturation, however, conventional wisdom dictates that available nitrogen late in the growing season may decrease grapevine winter hardiness. In unirrigated vineyards, the main disadvantage of any green cover during the growing season is competition for water during critical growth periods which may influence crop size and canopy function.

Two legumes, Crown vetch (*Coronilla varia L.*) and clover (*Trifolium spp.*) were included in a floor management experiment established in a mature 'Concord' vineyard at the Vineyard Laboratory in Fredonia, New York. Alsike clover (*Trifolium hybridum L.*), originally planted in clover plots succumbed to rust disease in the summer of 1993, but plots were immediately replanted to rust resistant white or ladino clover (*Trifolium repens L.*). White clover plots were fully established early in the 1994 growing season. Plots were approximately 18 ft. wide and 72 ft. long, with each treatment replicated in four blocks. Standards for comparison include mulch (5 tons of oat straw per acre per year), 1.5 qt. glyphosate (Roundup®) application at bloom and 4-5 shallow cultivations from bud break through early August. Covers were initially established in 1991, but because of drought conditions, several treatments were not well established until 1992.

Table I. Annual Pruning Weights (lbs.) of 'Concord' Grapevines Under Five Row Center Management Systems

Treatment	1992	1993	1994
Mulch	3.4 a	3.2 abc	3.9 a
Roundup®	3.4 a	2.5 bc	3.1 abc
Clover	3.1 ab	1.9 cd	3.1 abcd
Vetch	3.4 a	1.9 cd	3.0 bcd
Cultivation	3.4 a	2.8 abc	3.6 abc

Vines were balance pruned (20+20) and response was monitored through measurements of growth, yield and fruit quality. All vines received fifty pounds of actual nitrogen broadcast before budbreak and an additional thirty pounds broadcast after bloom.

VINE GROWTH

Initial pruning weights were taken after the 1992 growing season and while growth rates varied under different row center management strategies, there were no significant differences in the 1993 growing season. In 1994, however, vines grown in mulch plots had significantly higher pruning weight than did those in vetch plots.

YIELD AND FRUIT QUALITY

In 1993, yields ranged between 5.6 tons per acre in the cultivated plots and 6.5 tons per acre in the mulch plots, but there were no significant differences between treatments. There were, however, significant differences in fruit quality among treatments. In 1993, fruit soluble solids in the mulch plots averaged 15.1° Brix and were significantly lower than the clover and vetch plots which were measured at 16.0° and 15.8° Brix respectively. This difference in fruit quality can at least partially be explained by treatment cropping level differences. Fruit quality from the Roundup® and cultivated plots were not significantly different than either of the other three treatments in 1993 (Figure 1).

There were significant differences in the 1994 yields among treatments. Mulch plots had significantly higher yields than either leguminous cover crop treatment. Roundup® and cultivated plots were not different than other row center management systems. Because retained node number after dormant pruning was dependent upon pruning weight, yield difference in 1994 are in part the result of mean 1993 pruning weight differences between treatments (Figure 1).

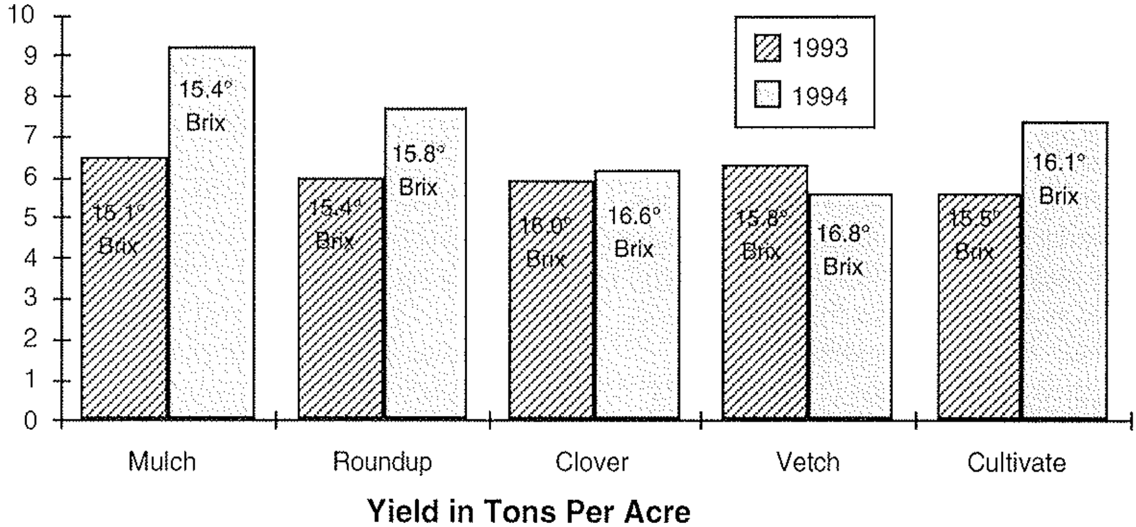


Figure 1. Results of yields in tons per acre and percent soluble solids for different cover management systems in Concord grapes in 1993 and 1994 at the Vineyard Research Laboratory in Fredonia, New York.

WATER USE

Polyethylene pots, buried to ground level and filled with soil from the plot profiles were located in field plots and contained the same representative plant cover as did the plots. Pots were weighed throughout the season to measure water loss under each treatment regime. The

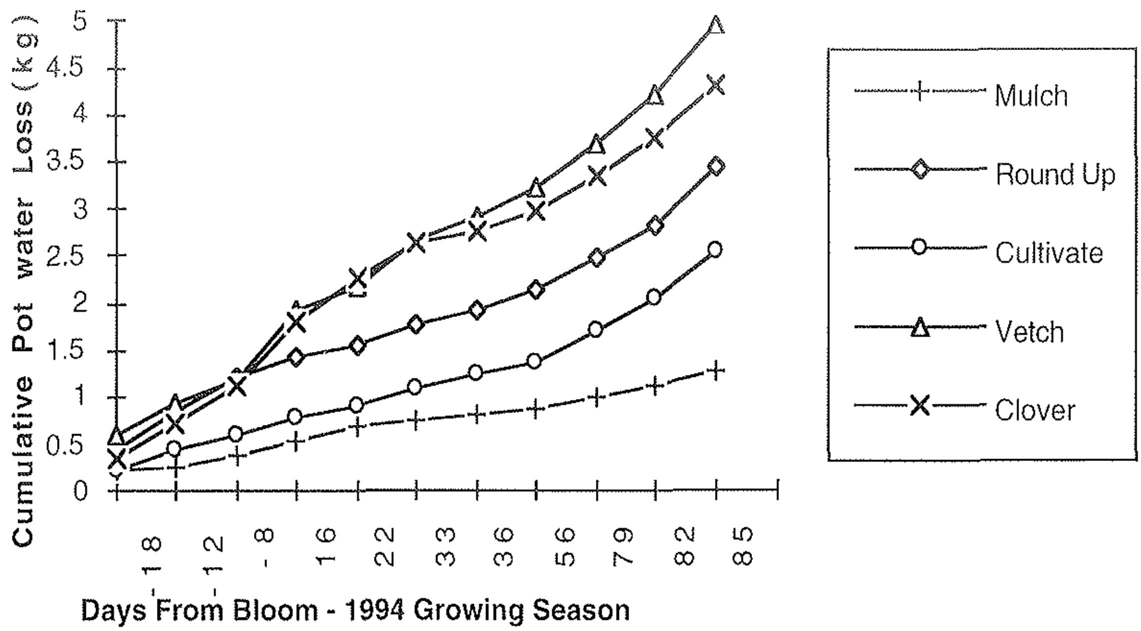


Figure 2. Difference in water use among cover management systems as measured throughout the 1994 growing season for Concord grapes at the Vineyard Research Laboratory in Fredonia, New York.

Figure 2 shows the difference in water use among cover management systems as measured throughout the 1994 growing season. As expected, mulch plots appear to be the most efficient in conserving soil moisture followed by cultivation and Roundup ® treatments. The water use from clover and vetch plots diverged from the other treatments shortly after bloom and became most evident as the season progressed into the dry 1994 harvest period. Our limited experience with other cover crop systems suggests that if any green cover is present during the growing season, water deficit will occur and vines will pay a price in vigor and ultimately, in yield over time. Vetch and clover plots lost three times as much water over the course of the season as did mulch plots.

NUTRIENT LEVELS

Petioles were collected from plots in the fall of 1992, bloom and fall of 1993 and during bloom of 1994. Fall 1992 petiole analysis shows significantly higher potassium values in Roundup® and crown vetch plots than those from clover or cultivated plots. No other significant differences were found at this sampling time (Figure 3). By bloom of 1993, the release of potassium in mulch plots resulted in higher petiole potassium status than those in Roundup® plots (Figure 4). All other treatments were intermediate in potassium level. Mulch plots had higher nitrogen status than those from clover or vetch plots but were not significantly different than vines in cultivated or Roundup® plots. The difference in nitrogen status continued in a similar trend through the fall. Vetch and clover plots had significantly lower nitrogen levels than mulch plots, but again cultivated and Roundup® plots were intermediate (Figure 5). There were no meaningful differences in nutrient levels in bloom 1994 petiole sampling (Figure 6).

CONCLUSIONS

Results from this experiment indicate that the competition for water from green covers during the summer months resulted in lower yield than those where existing vegetation was managed through physical or chemical means. Other row center experiments have shown that in wet

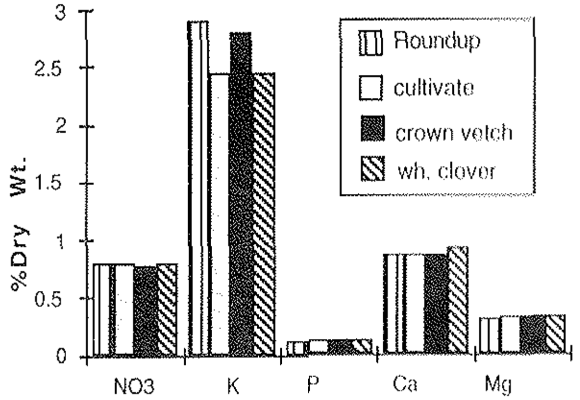


Figure 3. 1992 Fall Petiole Values for Concord Grapes under different management treatments at the Vineyard Research Laboratory in Fredonia, New York

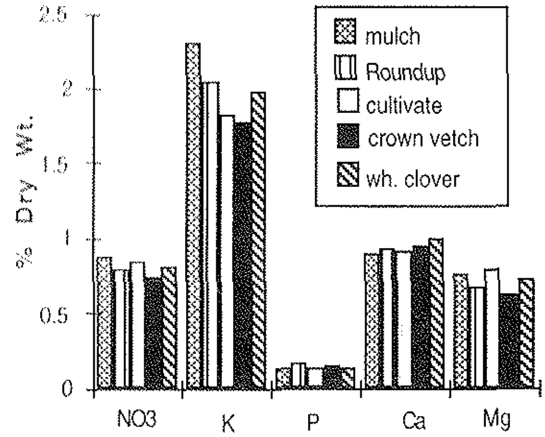


Figure 4. 1993 Bloom Petiole Values for Concord Grapes under different management treatments at the Vineyard Research Laboratory in Fredonia, New York

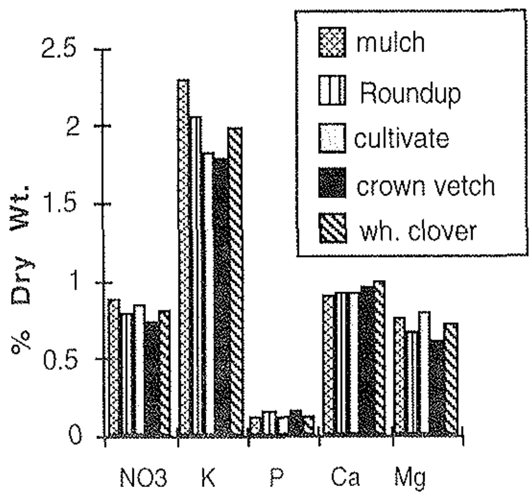


Figure 5. 1993 Fall Petiole Values for Concord Grapes under different management treatments at the Vineyard Research Laboratory in Fredonia, New York

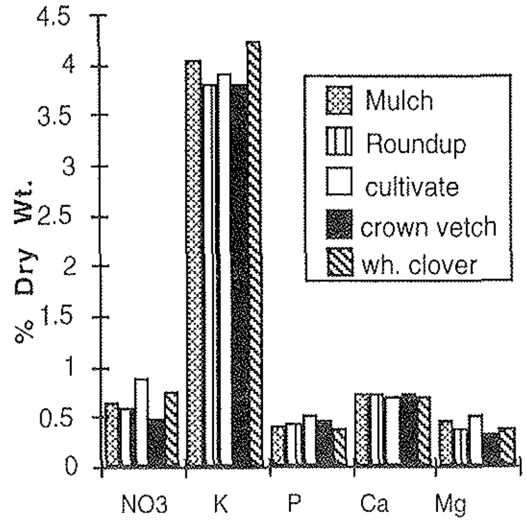


Figure 6. 1994 Bloom Petiole Values for Concord Grapes under different management treatments at the Vineyard Research Laboratory in Fredonia, New York

years, green row center covers had little effect on growth, yield or quality, but in dry years, there was a reduction in at least one of these parameters. In cultivars or locations where excessive vine vigor is a problem, or if supplemental water is added during critical growth periods, the use of these cover crops may result in an efficient management of row center vegetation.

Vines grown with leguminous row center covers did not have significantly higher nitrogen levels at any sampling date in the experiment. In other studies, legumes fixed higher levels of atmospheric nitrogen when soil nitrogen levels were low. Under conditions where there are restrictions on a grower's ability or inclination to apply nitrogenous fertilizers, the use of legumes may provide beneficials of available nitrogen.

VINE NUTRITION: SARE PROJECT RESULTS

David V. Peterson
Area Extension Specialist
Finger Lakes Grape Program
Penn Yan, NY 14527-1130

INTRODUCTION

Nitrogen (N) is the most commonly applied nutrient in New York vineyards. Application rates typically vary from 50-100 pounds actual N per acre, depending primarily on the previous season's growth, trellis fill, and expected crop load. Needs for other nutrient elements are determined primarily by petiole analysis, although soil analysis is often used to help determine the rate of application, if an adjustment is determined necessary. Potassium (K) is the most commonly applied nutrient after nitrogen.

The most commonly available sources of N for organic growers are various forms of manure. Composition varies by source, and they also contain varying quantities of other nutrients. Legumes grown as row middle cover crops are another potential means of supplying vines with N. The major concerns with using manure and legume cover crops are control of composition, rate and timing of each of the nutrient elements, particularly N. Mined potassium sulfate is available as an organic source of potash, and is an excellent source for both conventional and organic growers. Some manure sources also contain a significant amount of K.

SARE PROJECT

Ammonium nitrate was used as the primary source of N fertilizer in conventionally managed blocks, although ammonium sulfate was occasionally used on higher pH blocks. A local source of cow manure was used in the organic blocks in 1990, but difficulties in obtaining this manure led to a late application and poor uptake. In 1991, we switched to chicken manure pellets, which allowed for more control of timing and rate. The chicken manure pellets (1994 analysis - 3.62% N, 3.73% P_2O_5, 3.85% K_2O, 2.32% Ca, and 0.62% Mg) were lower in N in 1994 than in the previous years, with the 1991-93 N levels being approximately 5-6%. Other nutrients in the manure varied less than N from year to year. Nitrogen was used as the driving factor in determining rate of chicken manure pellets applied. Regardless of source, both conventionally and organically managed blocks received approximately 100 pounds actual N per acre in most years. White clover as a row middle cover crop was established in subplots within the organically managed blocks.

Table 1. Bloom and Fall (post-veraison) petiole nitrogen levels (%) for conventionally and organically managed blocks, 1990-1992.

		1990		1991		1992	
Cultivar	Method	Bloom	Fall	Bloom	Fall	Bloom	Fall
Concord	Conventional	1.19 a	0.81 a	2.28 a	0.84 a	1.31 a	0.66 b
	Organic	0.92 b	0.77 a	1.88 b	0.80 a	1.30 a	0.74 a
Elvira	Conventional	1.25 a	0.77 a	1.83 a	0.82 a	1.74 a	0.62 a
	Organic	0.86 b	0.75 a	1.33 b	0.68 b	1.22 b	0.62 a
Seyval	Conventional	1.32 a	1.04 a	2.14 a	0.87 a	1.66 a	0.86 a
	Organic	1.03 b	0.87 b	1.76 b	0.80 a	1.62 a	0.91 a

Table 2. Bloom and Fall (post-veraison) petiole nitrogen levels (%) for conventionally and organically managed blocks (including clover sub-plots), 1993 and 1994.

Cultivar	Method	1993 Bloom	Fall	1994 Bloom	Fall
Concord	Conventional	1.28 a	0.77 c	1.27 a	0.73 b
	Organic	1.14 b	0.87 b	1.00 b	0.79 a
	Clover	1.32 a	0.95 a	1.20 a	0.81 a
Elvira	Conventional	1.53 a	0.88 a	1.05 b	1.07 a
	Organic	1.17 b	0.73 b	0.90 c	0.82 b
	Clover	1.02 c	0.83 ab	1.19 a	1.03 a
Seyval	Conventional	1.41 a	0.84 a	1.66 a	1.27 a
	Organic	1.06 c	0.84 a	1.26 b	0.94 b
	Clover	1.20 b	0.82 a	1.33 b	0.98 b

Corrective K additions were based primarily on petiole analyses, although crop load and soil levels were also considered. Muriate of potash was used in conventionally managed blocks and sulfate of potash was used in organically managed blocks. The chicken manure used in the organically managed blocks also contributed some K.

Since stored N is the major N source utilized during the first few weeks after bud break, N deficiency that was observed in organic blocks in 1990 and resulted in low early season N in 1991 (Table 1). By veraison in 1991, however, N levels in organically managed blocks were generally comparable to conventionally managed blocks. Although chicken manure pellets were applied in late April-early May in 1991-94, bloom petiole N levels were generally lower in organically managed blocks than in conventionally managed blocks (Tables 1 and 2), indicating that the manure N source was not available as quickly as the synthetic source (ammonium nitrate). The white clover cover crop, once established, resulted in increased petiole N as compared to the rest of the organic blocks in both the Concord and Elvira, but not in the Seyval (Table 2). The lack of response in the Seyval is presumably due to the comparatively poorer stand of clover in the Seyval, as compared to the subplots in the other varieties. Bloom petiole N in the Concord and Elvira clover subplots generally was comparable to the petiole N in the conventionally managed blocks, even though the organically managed blocks had received only half of their N (50 pounds N/acre) prior to bloom (1994 data). Other studies indicate that clover cover crops supply approximately 30-60 pounds of N per acre, which apparently helped elevate petiole N levels in the clover subplots.

Potassium deficiencies occurred in several years in both conventionally and organically managed blocks (Table 3). Deficiencies were generally most severe in the driest years, 1991 and 1993, although deficiencies also occurred in 1990. Large crop loads exacerbated the deficiencies in some cases, and severe water stress due to weed competition (especially in the organic blocks)

Table 3. Fall (post-veraison) petiole K levels for conventionally and organically managed blocks, 1990-1994.

Cultivar	Method	1990	1991	1992	1993	1994
Concord	Conventional	0.57 b	0.53 b	1.28 a	0.32 a	1.21 a
	Organic	0.79 a	0.99 a	1.49 a	0.48 a	1.08 a
Elvira	Conventional	1.25 a	0.70 b	2.02 a	1.31 a	2.87 a
	Organic	0.88 b	1.38 a	2.19 a	1.44 a	1.77 b
Seyval	Conventional	1.01 a	1.38 a	1.85 a	1.66 a	1.99 a
	Organic	0.80 a	1.35 a	1.65 a	1.29 a	1.50 b

Table 4. Fall (post-veraison) petiole levels for conventionally and organically managed blocks, 1994.

		%				ppm		
Cultivar	Method	P	K	Mg	Ca	B	Mn	Cu
Concord	Conventional	.14 b	1.21 a	.38 b	1.16 b	36 a	106 a	7 b
	Organic	.20 a	1.08 a	.61 a	1.45 a	35 a	69 a	53 a
Elvira	Conventional	.22 b	2.87 a	.17 b	1.19 b	27 b	573 a	15 b
	Organic	.38 a	1.77 b	.27 a	1.65 a	32 a	187 b	34 a
Seyval	Conventional	.26 a	1.99 a	.70 a	2.32 a	24 b	153 a	10 b
	Organic	.13 a	1.50 b	.63 a	1.97 a	26 a	169 a	30 a

contributed to the problems. Concord blocks required the heaviest potassium applications, with both conventionally and organically managed blocks receiving over 1700 pounds K_2O over the 5 years. Rates were substantially lower in most other blocks, although the organically managed Seyval required approximately 1500 pounds K_2O over the course of the study. The extreme potassium deficiency that occurred in both the conventionally and organically managed Concord blocks was alleviated by heavy K applications, although the lighter crop loads that generally occurred the following year also created less stress. Organic Concord blocks were still slightly deficient in 1994, however, and this was likely exacerbated by the excessive magnesium (Mg) level (Table 4) as well as the greater apparent moisture stress. It should be noted, however, that the soils in the Concord blocks were initially much higher in pH, Mg and Ca than the other blocks. Conversely, excessive petiole K in the conventionally managed Elvira block contributed to a Mg deficiency in additions of small amounts of Ca and Mg in the chicken manure pellets. There appeared to be no meaningful trends in differences in soil organic matter, and any statistical differences were inconsistent with respect to treatments, and were, therefore, likely due more to sampling variation than any real differences.

Fungicide applications affected petiole copper (Cu) levels in the organic blocks and petiole manganese (Mn) levels in the conventionally managed blocks. Petiole Cu levels were higher in organic blocks of all varieties (Table 4) and there was also a trend toward higher soil Cu levels in organically managed blocks as well. All soil Cu levels were below 0.5 ppm, however, and the levels were so low that statistical differences were unlikely to be meaningful. Elevated soil Cu levels may be a concern where Cu fungicides are used over decades, but over the course of this study, there appeared to be no significant buildup. Copper residues on the fruit were of more immediate concern than soil levels. The use of mancozeb fungicide in the conventionally managed blocks resulted in significantly higher petiole Mn levels (Table 4), although they were still in a desirable range and there was no apparent soil buildup.

DISCUSSION

Nutrition of organically managed grapevines need not be a factor that limits production. Although nitrogen deficiency was evident in the

Table 5. Surface soil data for conventionally and organically managed blocks, 1994.

Cultivar	Method	pH	% OM	lb P/A	lb K/A	lb Ca/A	lb Mg/A
Concord	Conventional	6.07 b	5.4 a	6.4 b	190 b	1927 a	189 a
	Organic	6.79 a	5.2 a	21.7 a	247 a	2623 a	225 a
Elvira	Conventional	4.79 b	3.4 a	3.0 b	140 a	642 b	61 b
	Organic	5.63 a	3.7 a	8.8 a	144 a	993 a	104 a
Seyval	Conventional	4.42 b	3.3 b	9.9 b	77 b	410 b	38 b
	Organic	5.08 a	4.4 a	12.7 b	158 a	935 a	89 a

first year of the study due to problems with the initial source, this was largely overcome by the end of the second season by switching to the chicken manure pellets. Supplying adequate N is generally the greatest challenge for all grape growers, both conventional and organic. The major concerns with organic sources are identifying the composition, having N available at times that are efficient for uptake, and avoiding excessive uptake at critical times (i.e. bloom, fall). The lower bloom petiole N levels in organically managed blocks indicates that getting adequate early season N may be more difficult, or at least may require changes in timing or combining of strategies. Getting into the vineyard to make an application earlier in April is often difficult due to field conditions, while applications made in the winter could result in runoff and leaching problems. Due to the slower release nature of most organic materials, excessive uptake at the wrong time should not be a major problem, provided that rates are not excessive and application timing is reasonable. Many conventionally managed vineyards show low N symptoms late in the season, which potentially may be overcome by using organic sources. Splitting applications of the conventional N source into two different timings may also be helpful, but summer rainfall is frequently sporadic and may or may not result in good uptake at the targeted times. Legume cover crops appear to offer good potential to enhance nitrogen uptake, and based on our data may be useful in insuring adequate bloom N as well as an adequate late season supply. If N demands are high (>40-50 pounds N/acre), however, white clover would be unlikely to supply the vine's entire needs without some additions of manure or another N source. Other legumes (i.e. hairy vetch) could supply significantly more N than white clover, but these sources may also be more competitive for water than white clover. Potassium deficiency is potentially problematic for both conventional and organic growers. Mined potassium sulfate (sulfate of potash) is an excellent source of K that is organically acceptable, and has been used by conventional growers as well. Potassium uptake is lower under dry conditions, and may be more problematic in some organically managed vineyards due to increased weed competition. Potassium nutrition should be carefully monitored for this reason, among others. Mechanical cultivation, such as with a grape hoe, can reduce weed competition, but root damage also results. Although this may be preferential to just allowing weeds to grow, cutting roots also limits the vine's ability to obtain water. Amendments, such as hay or straw mulch, are likely to be helpful in reducing moisture stress and, therefore, should result in improved K uptake and likely will provide direct nutrient benefits as well.

The use of copper fungicide over many decades in some European vineyards has resulted in undesirably high soil Cu levels. No significant buildup occurred over the five years of our study, however. Copper fungicides are used by both conventional and organic growers in New York, and are likely to be critical to the success of most varieties that are organically grown under our conditions. Where they are used over the course of several decades, soil levels should be monitored for buildup. Copper is tied up with high organic matter and near-neutral soil pH, so plant uptake and leaching should be minimal as long as these conditions are maintained.

All good vine nutrition programs should include routine monitoring by soil and petiole analysis. Balancing K levels with Mg and Ca levels is important for all growers, organic or conventional. In our study, the organic chicken manure source contained Mg and Ca, and Mg became excessively high in the Concord block (which was initially a higher lime soil). While adding Mg and Ca was probably advantageous in the Elvira and Seyval blocks, it exacerbated the potassium deficiency in the Concord. The composition of both synthetic and organic fertilizer sources should be carefully considered. Regardless of whether or not a fertilizer is synthetic or organic, need, rate and timing must all be considered to insure good vine growth and long term productivity.

CONTROLLING FUNGAL DISEASES OF GRAPEVINE UNDER ORGANIC MANAGEMENT PRACTICES

David M. Gadoury
Department of Plant Pathology, Cornell University
New York State Agricultural Experiment Station
Geneva 14456

INTRODUCTION

The purpose of this review is to aid those growers who have chosen to grow grapes organically in the control of the major fungal diseases. As a source for standards of acceptable organic practices, I have tried to adhere to the guidelines of the Northeast Organic Farming Association of New York (NOFA-NY).

There are five major fungal diseases of grapevines in New York: powdery mildew, downy mildew, black rot, phomopsis fruit rot, and botrytis bunch rot. The ranking of these in economic importance varies with cultivar susceptibility and weather. For example, botrytis fruit rot is rarely seen on the cultivar Concord, but is common on Aurore. Both powdery mildew and downy mildew will race to destroy Chardonnay; the winner will be the one favored by the peculiar weather of a certain year. Any discussion of organic disease control will therefore require a prior discussion of the biology of each of these pathogens, and exactly what factors favor development of disease.

POWDERY MILDEW

Grape powdery mildew is caused by *Uncinula necator*. The pathogen is native to North America, where it coevolved with wild ancestors of *Vitis labrusca* grape cultivars. The disease was of minor importance in viticulture until its introduction to Europe in 1848. It rapidly spread throughout the continent, and nearly destroyed the European industry before it was controlled by the use of sulfur in the 1850s. It is now distributed worldwide. Powdery mildew became more destructive in New York viticulture with the planting of more susceptible *Vitis* interspecific hybrid cultivars in the latter half of this century. The most recent introduction and widespread planting of cultivars of the European wine grape (*Vitis vinifera*) has further increased the acreage planted to mildew-susceptible cultivars.

The pathogen overwinters as small (100 µm), spherical fruiting structures called cleistothecia. The pathogen population is composed of two mating types (i.e., male and female strains) Cleistothecia form when mildew colonies of opposite mating types grow together on the same leaf. Because the pathogen population is split into two mating types, disease must increase to a level where pairing becomes probable before cleistothecia form. This usually occurs in late summer or early fall. Once formed, cleistothecia are washed by rain to the bark of the vine, where they overwinter. In spring, beginning shortly after bud break of grapevines, spores within the cleistothecia are discharged during rain. Significant discharge and infection of emerging tissues can occur whenever rain exceeds 0.10 inches (2.5 mm) and temperatures are above 50 F (10 C).

Initial infections occur on the undersides of the first-formed leaves of shoots growing close to the bark of the vine. Within 5-10 days, a colony approximately 1/2 inch will be visible. The metallic sheen of the colony is due to the formation of thousands of small stalks bearing chains of minute glass-like spores. Spores break off the chains and are wind-dispersed to other tissues to spread the disease. Unlike the spores of the overwintering stage, these secondary spores are produced every day, disperse every day, and infect every day, for so long as temperatures remain above 50 F. This omnipresent secondary cycle is one reason why this disease can seem to develop so rapidly.

All green tissues of the vine may be infected. The pathogen is nearly wholly external, and grows on the surface of infected tissue, except for small absorptive structures that penetrate the epidermal cells. Both leaves and fruit become more resistant to infection as they age (ontogenic resistance). In leaves, ontogenic resistance is of academic more than practical interest, since the leaves decline in susceptibility, but are never immune. However, in fruit ontogenic resistance is significant. The berries of certain cultivars, notably Concord, become nearly immune to infection within 2-3 weeks after fruit set. Fruit of Chardonnay and Riesling remain susceptible for up to 8 weeks longer, or until fruit sugar levels reach approximately 8%.

Powdery mildew symptoms are similar on all parts of the vine. The pathogen grows on the epidermis, producing small colonies that may later merge to give entire leaves a whitened appearance. The skins of severely infected fruit stop growing, and the berries split and rot. Rachises remain susceptible after fruit have become resistant, and may be nearly white with powdery mildew by harvest on some cultivars. Colonies on shoots die when periderm begins to form, leaving a diffuse, blackened or reddish blotch on the cane. Leaf infection reduces photosynthesis when severe, and leads to early defoliation. Direct fruit damage reduces yield and quality. More than 3% berry infection can be detected as an off-flavor in wine.

Variation in resistance to powdery mildew among grape species and cultivars is considerable, and should be the first criterion considered in developing an organic disease control program. In general, cultivars of native North American *Vitis labrusca*, and hybrids with substantial *V. labrusca* parentage and phenotype are most resistant. There are some minor differences in susceptibility to powdery mildew among cultivars of *V. vinifera*, but none approach the substantial resistance of the most resistant labrusca or hybrid cultivars (Table 1).

DOWNY MILDEW

The fungus *Plasmopara viticola* causes downy mildew. It is another native North American pathogen. It was also exported to Europe; later in the 19th century than was powdery mildew, but with similar consequences. *Vitis vinifera* had not coevolved with the pathogen, had little resistance to infection, and was severely damaged before the disease was controlled by the widespread use of copper fungicides in the late 1880s.

The pathogen overwinters as thick-walled spores (called oospores) in fallen infected leaves and in soil. These spores mature when grape shoots have 4-5 flat leaves (Eichorn and Lorenz stage 12) and send out a short stalk. At the tip of this stalk is borne a swelling containing 1-10 individuals of a second spore type. This second spore type can swim in water films, and is called a zoospore. These are the spores which actually infect the vine. Zoospores are splashed by rain to leaves, young shoots, or clusters. They then swim to the stomata, and enter the plant through these natural openings.

Rain is important in downy mildew epidemiology. Rain splashes the zoospores from the ground to the vine, maintains a water film for the zoospores to swim to the stomata, and provides wetness required for infection. The first wave of infection requires temperatures above 50 F, 2-6 hours of leaf wetness, and sufficient rain (perhaps 0.10-0.40 inches) to saturate soils or cause pooling of water.

Within a week after tissues are infected, the pathogen is capable of producing a second crop of spores on the infected tissue. Whether it does so is dependent on the environment. The pathogen not only infects through stomata, it also emerges from the stomata to produce new spores. Since stomata are located on the lower surface of grape leaves, downy mildew sporulation occurs there. This is one way to distinguish powdery mildew from downy mildew. Powdery mildew can be found both leaf surfaces. Powdery mildew colonies also have a translucent velvet-like appearance. Downy mildew is milky-white, somewhat fluffy in appearance, and is only found on the lower leaf surface. The leaf tissue beneath a young powdery mildew colony will appear healthy. The tissue of the upper surface of a leaf newly infected with downy mildew will bear a yellow-green blotch in exactly the same shape and location as the downy mildew colony on the underside of the leaf. The yellowed tissue may later die, but may still be surrounded by a ring of white sporulation on the lower leaf surface.

Downy mildew varies greatly in severity from year to year. The relationship of weather to cycles of secondary infection is complex. High humidity (>93%), darkness, and temperatures above 55 F are required for emergence of the pathogen through stomata, and production of the zoospore-containing vesicles. Thereafter, leaves or fruit must remain wet for a sufficient time for the vesicles to be blown to new tissues, release the zoospores, which must then swim to stomata and infect. The duration of leaf wetness required to complete these steps is temperature dependent. Forecasting occurrence of downy mildew requires some sophisticated and expensive equipment. A useful rule of thumb to remember is that warm, wet nights spread disease.

Leaves remain susceptible to downy mildew throughout the growing season. However, fruit become resistant to infection as they approach veraison. As in the case of powdery mildew, none of the cultivars of *V. vinifera* can be considered resistant to downy mildew. Many interspecific hybrids are also extremely susceptible, as are a few cultivars of native American species. In discussing susceptibility of cultivars, the tissue infected must be considered. For example, the hybrid cultivar Chancellor has extremely susceptible fruit, but moderately resistant leaves. The hybrid cultivar Aurore has highly susceptible leaves, but fruit infection is rare. Both leaves and fruit of the *V. labrusca* cultivar Catawba are susceptible.

BLACK ROT

The causal agent of black rot is another native north American fungus: *Guignardia bidwellii.* The pathogen overwinters primarily in mummified infected berries on the vineyard floor. Flask-shaped fruiting bodies form in the berries during winter. Each fruiting body contains dozens of small sacks, each of which contain 8 spores. These spores mature when grape shoots are about 6 inches long, and are released during rain. Major spore releases require 0.10 inches of rain or more. Infection requires the presence of free water on tissue. The duration of wetness required is dependent on temperature (Table 2). Because of the dependence on the quality and frequency of warm, heavy rains; this disease can vary greatly in its severity from year to year.

Once the overwintering spores have infected emergent leaves, they form a circular, brown lesion approximately 1/8 - 1/4 inch in diameter after about 12 days. A dark brown border may surround the lesion. Similar lesions may be seen on shoots and leaf petioles. Fruiting bodies form in the center of the lesion and release spores to spread the disease in subsequent rains. On young fruit, symptoms appear as small cream-colored spots on the berry. Infected berries shrivel and become hard blue-black mummies within a few days after these spots appear. Under favorable conditions for disease, entire clusters may be destroyed.

There are other potential sources of overwintering inoculum in addition to the mummified berries on the vineyard floor, but these are exceptional. For example, severe outbreaks of black rot in early spring can result in infection of the basal internodes of shoots. Infection of internodes produced in mid-season occurs also, but if these are removed in pruning they are relatively unimportant. Lesions on basal internodes retained after pruning can overwinter and release infectious spores during spring rains. Crop loss due to black rot in the previous year may also result in large numbers of mummified berries being retained in the trellis, especially if vines are hedge-pruned. The spores within these mummies mature later in the summer, long after the supply from the ground-borne mummies is exhausted. It should be noted that these are additional sources of inoculum that occur sporadically following failed disease control programs, and that they will probably be accompanied by large numbers of mummified berries on the vineyard floor. Disease control programs targeting the mummified berries on the vineyard floor have provided good control in the presence of these additional sources of inoculum.

The seasonal development of the spores released from mummies on the vineyard floor has an important impact on disease severity. Spore release begins about two weeks after bud break, and continues until shortly after bloom, when the supply is exhausted. Application of conventional fungicides during this period of ascospore release provides season-long suppression of black rot, even when fungicide use is stopped after fruit set. However, neither copper nor sulfur based fungicides provide appreciable control of this disease. Under organic management practices, black rot must be controlled through cultural practices, and proper site and cultivar selection. The most critical time for control is from 6 inches of shoot growth until berries are pea-sized. If fruit are disease free during this time, the natural acquisition of ontogenic resistance will greatly reduce or prevent any late-season development of black rot.

PHOMOPSIS FRUIT ROT

This disease is sporadic in its occurrence, but can cause extensive crop loss. Severe epidemics occurred in New York in 1986 and 1994. The disease remained at low levels in most vineyards from 1987-1993, even in many vineyards not treated with fungicides. Phomopsis fruit rot is caused by the fungus *Phomopsis viticola*. The pathogen overwinters in lesions of the basal internodes of infected canes. Fruiting bodies within these lesions mature coincident with shoot emergence of grapevine, and release a gelatinous ribbon of spores during rain. The millions of spores within these ribbons are splash dispersed throughout the trellis. Infection requires only a brief wetting period following spore dispersal (Table 2).

Although fruit rot does not occur every year, spores released in early spring also infect leaves, shoots, and rachises. On infected leaves, a small (1/16 inch) circular yellow-green spot forms. Within 7 days, these spots turn coal-black. On shoots and rachises, the lesions are also black, but due to growth of these tissues, the lesions may be more elliptic in shape than circular.

There are two principle reasons for the sporadic occurrence of the fruit rot phase. First, the host is only briefly susceptible; and second, severe fruit infection requires more than the minimum wetting periods shown in Table 2. In both 1986 and 1994, severe fruit rot occurred when 3-6 inches of rain fell on several days between the bloom and fruit set stages. Although copper-based fungicides may provide some slight reduction of leaf infection, none have significant activity against the fruit rot phase.

Because the primary inoculum for this disease comes from lesions on infected canes, Phomopsis fruit rot is affected greatly by pruning. Mechanically hedged vines harbor more inoculum and are at great risk for complete crop loss when heavy rains occur during the most susceptible stage of growth. In previous research, only low levels of fruit rot developed on hand-pruned, Umbrella-Kniffen trained vines under heavy disease pressure. In fact, disease levels on the above vines were equal to those observed on hedge-pruned top-wire-cordon trained vines that received several conventional fungicide sprays. In other words, the benefit of hand pruning and Umbrella-Kniffen training was equal to that provided by a full season spray program on top wire cordon trained, hedge-pruned vines.

The reported resistance of cultivars to this disease varies. However, due to the impact of pruning and training on disease severity, the sporadic occurrence of severe fruit rot (twice in the last 10 years), and given the relatively short time that certain hybrids and *V. vinifera* cultivars have been grown in New York, the reported resistance of any cultivar should be interpreted cautiously. The absence of disease on certain cultivars thought to be resistant may reflect the typical pruning and training systems employed, and the short history of their culture in New York more than resistance to fruit rot.

BOTRYTIS BUNCH ROT

Botrytis bunch rot is caused by the fungus *Botrytis cinerea.* The pathogen has a very broad host range, and can also subsist on decaying vegetation. Thus, there are several possible sources of overwintering inoculum. Under unfavorable conditions, the pathogen forms a resting stage called a sclerotium. Sclerotia can germinate to produce two types of airborne spores in spring, both of which can infect grapevines. The quantity of inoculum in vineyard air increases throughout spring and summer. Germination of these spores and infection of grapevine probably requires free water, but is also associated with relative humidity >90%. It is likely that condensation occurs on some leaves and fruit when relative humidity exceeds this level, although surface wetness may not be observed. Because inoculum is ubiquitous, epidemics are generally limited more by unfavorable weather and cultivar resistance.

Severity of botrytis bunch rot is increased by extended rainy periods during bloom, and cool, wet, weather during ripening in late summer. Unlike most of the other fungal pathogens, spores of *Botrytis cinerea* can germinate and infect at 34 F, thus low temperature is usually not a limiting factor. Within the optimal temperature range for this disease (60-70 F) infection can occur after 15 hours of wetness.

Susceptibility to botrytis bunch rot is partially determined by cluster architecture. Cultivars such as Chardonnay with closed, compact clusters retain post-bloom debris within the cluster. The debris may harbor and serve as a food base for *Botrytis cinerea.* The compact cluster also dries more slowly, resulting in a more favorable microclimate for disease within the cluster. Infections may occur at bloom, during early fruit formation, or as fruit ripen. Early infections may lie dormant until sugar accumulation begins in late summer. The rot then progresses rapidly. Grayish sporulation of the pathogen can be observed on infected clusters in the later stages of the disease. The berries eventually shrivel to form hard, blue-black mummies similar in appearance to black rot mummies.

Neither sulfur nor copper fungicides are effective against this disease. However, adequate control can generally be obtained on loose-clustered cultivars (such as Concord) by avoiding poor air circulation within the grapevine canopy, both through proper canopy management, and through proper site selection for the vineyard. Site selection is also important with respect to proximity to woodland edges, which may place the vineyard at risk for damage from berry moth. Fruit damaged by berry moth are eventually colonized by *Botrytis cinerea*, which may then spread to the rest of the cluster. In addition to the foregoing, more intensive management is required for consistent control on cultivars with compact clusters, such as Riesling and Delaware. Hand removal of leaves surrounding the cluster has been demonstrated to effectively reduce losses due to bunch rot. Nitrogen fertilization, especially with manures, must be performed in such a way as to avoid lush canopy growth. Many of the above cultural practices will also reduce losses due to black rot and downy mildew.

ELEMENTS OF AN EFFECTIVE DISEASE CONTROL PROGRAM

Cultivar selection. This is an important factor in determining the risk of disease in a vineyard. Certain cultivars are relatively trouble-free *in most years* with respect to the major fungal diseases. However, it is important to recognize that in some years, significant losses due to one disease or another can potentially occur on any cultivar grown under organic management practices. Copper and sulfur fungicides simply will not control black rot, botrytis bunch rot, or phomopsis fruit rot under the most severe conditions; and no cultivar is immune to all of the major diseases. Market forces will largely dictate which cultivars can be grown profitably. Nonetheless, a grower can minimize losses by selecting cultivars with some measure of resistance to the major diseases. In general, all cultivars of *Vitis vinifera* are highly susceptible to powdery mildew, downy mildew, and black rot. Most cultivars of *Vitis labrusca* are less susceptible to powdery mildew, but susceptibility to downy mildew and black rot varies within the species. The greatest variation in resistance occurs within the interspecific hybrid cultivars. In general, those hybrid cultivars that most resemble *Vitis vinifera* are more susceptible to the major diseases, while those that resemble *Vitis labrusca* are less susceptible. As previously mentioned, cultivars with compact, closed clusters are most susceptible to bunch rots.

Cultivars also differ in their sensitivity to copper and sulfur fungicides. Certain cultivars are severely injured by either copper, sulfur or both. This, coupled with high susceptibility to major fungal diseases can make some cultivars poor choices for organic growers. For example, Rougeon is highly susceptible to powdery and downy mildew, and is injured by the only two fungicides available to organic growers (Table 1). The susceptibility of major grape cultivars to the five major fungal diseases, along with their sensitivity to copper and sulfur fungicides, is summarized in Table 1.

Site selection. Gently sloping land with a southeast or southwest exposure, absence of woodland borders and wild or abandoned vineyards, and excellent air-drainage will all lessen the severity of most fungal diseases, both directly and indirectly. Rapid drying of vines after rain or dew is a major factor affecting growth of the black rot and downy mildew pathogens, both of which requires free water for infection. Woodland borders shade nearby rows, restrict air drainage, and increase the time that foliage remains wet. Wild or escaped cultivated grapes inhabiting woodland edges, and abandoned vineyards serve as reservoirs of inoculum for the major diseases. Abandoned vineyards can produce dense clouds of powdery mildew spores by mid-summer, and may overwhelm the disease control program in adjacent plantings. Gradients of powdery mildew resulting from the influx of spores from abandoned vineyards may be clearly visible up to 300 ft from the source, so removal or avoidance of these vines can contribute to disease control. As mentioned above, the risk of berry moth infestations and secondary development of botrytis bunch rot is also most severe near woodland edges.

Cultural practices. As previously mentioned, pruning and training practices have both direct and indirect effects of disease development. Open, well aerated canopies are less conducive to development of downy mildew, black rot, botrytis bunch rot, and phomopsis fruit rot. Similarly, weed and ground cover management, both under the trellis and within the alley will effect the environment for disease. Although the greatest reductions of phomopsis fruit rot occur when vines are Umbrella-Kniffen trained and hand-pruned, even hedge-pruned vines will benefit from hand follow-up pruning to remove excess dead wood from the trellis. Black rot mummies should not be left exposed in the vineyard, either in the trellis or on the ground. The mummies can be buried during cultivation, if necessary.

Some common practices can lead to problems with one or more of the major diseases. For example, the practice of dumping pomice within vineyard rows can create an ideal environment for an epidemic of downy mildew. Seeds from cold-pressed grapes can produce a dense carpet of highly susceptible seedlings on the vineyard floor. Establishment of downy mildew on these seedlings often leads to later severe infection of the vines.

Fungicides. The original copper fungicide was copper sulfate mixed with lime (Bordeaux mixture), and this is still used today, although other formulations are available and are easier to use. The effective component of this mixture is the copper ion in copper sulfate. This is also what injures copper-sensitive vines. Lime was added to reduce the solubility of copper, and thereby reduce the concentration of copper ion in solution. This had the effect of making the mixture less toxic to vines, without greatly reducing efficacy against fungi. The same effect is achieved in other copper fungicides (often called "fixed coppers") by using less soluble forms of copper (copper hydroxide or copper oxychloride sulfate). Lime may also be added to fixed coppers to further reduce the risk of injury, but this may also reduce efficacy. Injury due to copper application varies among cultivars, but is also dependent on environment. Even less-sensitive cultivars may be injured when cool, wet conditions persist after application, resulting in a high concentration of copper ion for long periods on plant tissue. Copper fungicides are very effective against downy mildew when used properly. They must be used as protectants, and have little or no curative activity. When applied according to label directions, they provide 10-14 days of protection. They are somewhat resistant to wash-off by rain, if the applied material dries before rain begins. They also have some activity against powdery mildew, and when used at 14 day intervals may control powdery mildew on moderately resistant cultivars such as Concord. They will not control powdery mildew on *Vitis vinifera* cultivars or on highly susceptible hybrid cultivars, nor do they have any significant activity against black rot, phomopsis fruit rot, or botrytis bunch rot.

Sulfur provides control of powdery mildew, but has no significant activity against other diseases. Its efficacy declines rapidly below 65 F, and mediocre control may be obtained on mildew-susceptible cultivars if disease is severe from May to mid-June. Sulfur is also easily washed from foliage by rain, even when applications dry before rain begins. Flowable sulfur formulations are more tenacious and effective that most wettable powdery formulations. Sulfur provides from 7-14 days of protection from powdery mildew, with the shorter interval applying to highly susceptible cultivars and less tenacious formulations of sulfur. Like copper fungicides, sulfur is injurious to some cultivars, notably Concord (Table 1).

Organic growers have no fungicide options for control of black rot, botrytis bunch rot, and phomopsis fruit rot, and should weigh the risks involved in selecting certain cultivars, sites, and cultural practices accordingly. Fungicides are therefore timed for optimal control of powdery mildew and downy mildew. Powdery mildew infection can occur as soon as shoots are 1 inch long. Initial downy mildew infection does not occur until 2 weeks before bloom (Eichorn and Lorenz stage 12). If both copper and sulfur may be used, use sulfur alone in applications until downy mildew is expected. Depending upon the cultivar sensitivity to powdery and downy mildew, a combination of both materials could be used (best for cultivars highly susceptible to powdery and downy mildews), or copper could be used alone (powdery mildew resistant cultivars only). The interval between applications can vary between 7-14 days. No applications should be needed after veraison. Of all sprays applied, those used between prebloom and fruit set contribute the most to control of fruit infection. Even in minimal-spray programs, these applications should not be neglected.

GROWING GRAPES WITHOUT FUNGICIDES IN NEW YORK

It is entirely possible to grow grapes in New York without any fungicides. However, very few cultivars are suited to this approach, and the risk of substantial crop loss in some years is a near certainty. Powdery mildew resistance is required, since this disease is destructive nearly every year on unsprayed vines of susceptible cultivars. Downy mildew resistance would also be required, because serious fruit losses can occur 1 year in 3, and late-season defoliation nearly every other year. Less emphasis can be placed on a high level of resistance to black rot, but highly susceptible cultivars should be avoided. It may take more than 5 years before black rot builds to significant levels in new plantings. Careful attention to sanitation may delay its introduction for many more years. Both botrytis and phomopsis can be addressed in most years through a combination of canopy and ground cover management, and proper site selection. Botrytis losses in particular can be reduced by early harvest of some cultivars.

H = High M = Moderate L = Low

Table 1. Susceptibility of grapevines to the major fungal diseases in New York.

	Relative susceptibility						
Cultivar	Powdery mildew	Downy mildew	Black rot	Phomopsis fruit rot	Botrytis bunch rot	Copper sensitivity	Sulfur sensitivity
Aurore	H	M[1]	H	M	H	M	L
Baco Noir	M	L	H	L	M	?	L
Cabernet Franc	H	H	H	?	L	L	L
Cabernet Sauvignon	H	H	H	H	L	L	L
Canadice	L	M	H	?	M	?	L
Cascade	M	L	L	M	L	?	L
Catawba	M	H	H	H	L	M	L
Cayuga White	L	M	L	L	L	L	L
Chancellor	H	H[2]	L	H	L	H	H
Chardonel	M	M	?	?	M	?	L
Chardonnay	H	H	H	H	H	L	L
Chelois	H	L	L	H	H	L	L
Concord	M	L	H	H	L	L	H
DeChaunac	M	M	L	H	L	L	H
Delaware	M	H[1]	M	H	L	L	L
Dutchess	M	M	H	M	L	?	L
Elvira	M	M	L	L	H	M	L
Einset Seedless	M	H	H	?	L	?	?
Foch	M	L	M	?	L	?	H
Fredonia	M	H	M	M	L	?	L
Gewürztraminer	H	H	H	?	H	L	L
Himrod	M	L	M	?	L	?	L
Ives	L	H	L	?	L	?	H
Melody	L	M	H	?	L	?	L
Merlot	H	H	M	L	M	M	L
Moore's Diamond	H	L	H	?	L	?	L
Niagara	M	H	H	H	L	L	L
Pinot blanc	H	H	H	?	M	L	L
Pinot noir	H	H	H	?	H	L	L
Riesling	H	H	H	M	H	L	L
Rosette	H	M	M	M	L	H	L
Rougeon	H	H	M	H	M	H	H
Sauvignon blanc	H	H	H	?	H	L	L
Seyval	H	M	M	M	H	L	L
Steuben	L	L	M	?	L	?	L
Vanessa	M	M	H	L	L	?	?
Ventura	M	M	M	L	L	?	L
Vidal 256	H	M	L	L	L	L	L
Vignoles	H	M	L	M	H	?	L

1 Berries are not susceptible.
2 Leaves are not susceptible.

Table 2. Duration of leaf wetness required for infection of grapevine by the Black Rot and Phomopsis fruit rot pathogens.

Temperature	Minimum number of hours of leaf wetness required for infection	
	Black Rot	Phomopsis fruit rot
50	24	12
55	12	10
60	9	8
65	8	7
70	7	6
75	7	5
80	6	6
85	9	8

MANAGEMENT OF INSECT PESTS IN ORGANIC VINEYARDS

Tim Martinson
Department of Entomology
NYS Agricultural Experiment Station, Geneva, N.Y.
Cornell University

Organic grape growers are faced with the same complex of insect pests as are conventional grape growers. Growers of both organic and conventional grapes will likely be faced with the need to manage grape berry moth and grape leafhopper, the two major pests that are widely distributed and common throughout grape growing areas in the Northeast. In addition to these two key pests, growers in specific areas may face other common pests such as cane borers (common in vineyards surrounding Keuka lake), Japanese beetles (somewhat common in the Lake Erie region), European red mite (Long Island) or rose chafer (vineyards with sandy soils). Other pests, such as flea beetles, cutworms, tumid gall makers, and grape rootworm, may only appear sporadically. The difference in conventional and organic management methods for insect pests largely rests on what actions a grower is willing to take (or materials he is willing to apply) when confronted with an economically-important pest problem. Ten to 15 years ago, the gap between 'conventional' practices and 'organic' practices was enormous. Pest management recommendations at that time called for 3 applications of insecticides to all vineyard blocks on a preventative basis - a "one size fits all" recommendation. More recently, however, this 'preventative' approach has been supplanted by the Integrated Pest Management (IPM) approach. IPM practices -including Risk Assessment, vineyard sampling for pests, and economic injury levels - have been developed and adopted by many grape growers. The average number of insecticide applications made in New York vineyards has been reduced from three down to one per vineyard through the use of these practices. As a result, the gap between 'conventional' and 'organic' management has narrowed.

Successful management of many grape pests is possible using organic control methods, such as those approved by NOFA- NY or other certification organizations. In this talk I will first describe the key components common to successful IPM programs- whether conventional or organic. I will then explain what types of spray materials are available to organic growers. Finally, I will outline organic management options available for the two major grape pests- Grape berry moth and Eastern grape leafhopper, and briefly touch on how other pest populations may be affected by current organic practices.

Components of IPM. Organic and IPM approaches to pest management are approaches that rely on knowledge and informed decision making. The key components of the IPM approach are:

1. Pest Identification. Proper identification of insect pests and an understanding of their biology is essential for successful management. Many insects feed in vineyards, but only a few cause economic damage. Some cause very conspicuous feeding injury but have no effect on vine productivity. Grape Plume Moth larvae, for example, emerge early in the spring and web together leaves. The result- although conspicuous- has no economic effect, because this pest completes its development and disappears by mid-June. Yet, many growers mistakenly apply treatment, most often after the larvae have completed their development. Other less conspicuous pests, like grape rootworm, may cause more serious injury. Proper identification of the pest is an essential first step to appropriate management.

2. *Monitoring Pest Populations.* Economic effects of insect infestations depend on population levels of pests. Especially in vineyards, pest populations vary greatly from year to year and vineyard to vineyard. Monitoring vineyards to determine population levels is the key to avoiding unnecessary spray applications - and for timely application of spray materials when necessary to prevent economic damage.

3. *Economic Thresholds.* The economic threshold is defined as the population or injury level (determined by monitoring) at which a treatment should be applied to prevent economic losses due to the pest. Our research program has developed economic thresholds for grape berry moth and grape leafhopper that provide guidance for making treatment decisions.

4. *Risk Assessment.* Risk assessment means using information about the vineyard site, weather conditions, and crop condition (such as cropping level and vigor) to forecast or predict the likelihood that pest populations will cause economic injury. Through research, we have developed risk assessment criteria for grape berry moth and leafhoppers that are useful guides to management, as I will mention later in this presentation.

These four elements are common to both conventional IPM and organic management programs. Using them is the key to taking full advantage of the natural factors (biological and non-biological) that often keep insect populations well below the economic threshold.

Organic Spray Materials. Where organic and conventional IPM programs differ is in the types of spray materials that can be used. Organic growers use only non-synthetic, naturally derived materials. These materials, by their nature, are less toxic, more selective, and less persistent than conventional pesticides. They are often more costly to apply. Using these control methods requires more careful attention to results, and sometimes more applications to achieve the desired results.

Organic materials fall into many different categories. Some of the major ones are:

1. *Botanicals* are insecticides extracted or derived from plants. Many are very toxic to insects. These include rotenone, pyrethrum, ryania, sabadilla, and neem. Note that some plant-derived materials (such as nicotine) are not considered acceptable under organic certification standards.

2. *Oils and Soaps.* These materials control insects through physical effects on respiration, feeding, or by disrupting the insect cuticle. Included in this category are mineral oils, vegetable oils, dormant oils, and insecticidal soap.

3. *Biologicals.* Materials derived from pathogenic organisms, such as nematodes, bacteria (*Bacillus thurengiensis),* fungal and viral pathogens are in this class.

4. *Behavioral Control Agents* Materials that protect crops by modifying insect behavior -such as repellents, antifeedants, attractants or sex pheromones used in mating disruption - but do not kill insects are in this category.

Growers that wish to be certified by an organic certification organization such as NOFA-NY need to carefully study guidelines to determine what specific materials are allowed. Some botanical insecticides, for example, contain ingredients such as petroleum distillates, spray adjuvants, or synergists (such as piperonyl butoxide, commonly used with pyrethrum), that are prohibited. Many surfactants, spreader-stickers, and other spray adjuvants are also prohibited.

Organic Management for Grapes. Over the past several years, we have extensively monitored insect pests in vineyards that have received no insecticide treatments. Our studies have consistently shown that economically significant pest infestations failed to develop in well over 50% of vineyards surveyed. Moreover, high insect populations tend to occur at the same small proportion of vineyard sites year after year. What this means is that insect pressure is not a major impediment to organic production for many growers. Organic alternatives are available for the two major pests of grapes- grape berry moth and eastern grape leafhopper.

Grape Berry Moth. Research has shown that grape berry moth infestations tend to recur in the same sites year after year. By following guidelines in the publication *Risk Assessment for Grape Berry Moth and Guidelines for Management of Eastern Grape Leafhopper,* growers can classify each vineyard block as 'high-risk' or 'low-risk'. Many 'low-risk' areas will not develop economic infestations of berry moth in most years. For high-risk areas, two alternatives are available. *Pheromone mating disruption* using ISOMATE-GBM® is a control method that is non-toxic and highly specific to grape berry moth. Pheromone dispensers are placed on the top wire of the vineyard in early May. The pheromones then diffuse out of the dispensers over a period of 10- 14 weeks, disrupting the chemical signals used by male moths to locate and mate with females. This prevents oviposition and subsequent larval damage. Use of this material is described fully in the bulletin *Pheromonal control of the grape berry moth: an effective alternative to conventional insecticides. Bacillus thurengiensis* is a biological insecticide that is effective in controlling larval berry moth. Applications of this material require careful timing, because larvae need to ingest it before burrowing into the grape cluster and feeding internally. Two applications during the extended egg-laying period of each generation are required, because this material persists for < 3 days in the field.

Grape Leafhopper. Grape leafhopper is a pest that can affect vineyard productivity, but that often fails to develop high populations. Our studies have shown that vines can tolerate moderate populations of leafhoppers, without affecting productivity. In addition, high leafhopper populations tend to occur in a small proportion of vineyards. This is because optimal weather conditions for population growth occur only in warmer than average years, and an egg parasite, *Anagrus epos*, is often effective in preventing population growth. However, we have noted that in some organically-managed vineyards, high populations of leafhoppers can develop over a period of a few years, and may require treatment. Organic vineyards with recurring problems may require a different approach than conventional vineyards. In organic vineyards, application of organic materials around bloom may be necessary to reduce populations and allow biological control by *Anagrus epos* to prevent population growth later in the season. In trials, insecticidal soap has sometimes been effective in reducing leafhopper populations. However, this material, to be effective, must be applied with adequate coverage (high water volume), and only remains active until it dries. Thus it is most effective when applied around dawn or dusk. Repeat applications are probably necessary. Some botanicals, such as rotenone, and pyrethrum/rotenone mixtures have also been effective in insecticide trials.

Other Insect Pests. Many other insect pests appear sporadically in vineyards, or occur at a small proportion of vineyard sites. Specific information about these pests can be found in a series of fact sheets available through Cornell Cooperative Extension. Efficacy of organically acceptable materials for controlling these pests is unknown, and organic growers may have to devise, through trial and error, their own methods for dealing with these pests.

In closing, I want to briefly mention results from our ongoing SARE project that terminated in

1994. Over five years, and in three different varieties, Concord, Elvira, and Seyval, we had economically-important infestations of grape leafhopper only in one year of the project, and failed to have economic infestations of grape berry moth, in part through the use of mating disruption. A longer-term problem, however, began to emerge. Starting in the fourth year of the project, significant infestations of grape rootworm began to appear in the Concord block. While adults of this root-feeding species are easily controlled with conventional insecticides, no organic methods are available. In future years, as growers adopt both conventional and organic IPM tactics, this pest may again emerge as a major concern for grape growers. Further studies are needed to assess alternate control methods for this pest.

References

Dennehy, T.J., L.G. Clark, and J.S. Kamas. 1991. Pheromonal control of the grape berry moth: an effective alternative to conventional insecticides. New York's Food and Life Sciences Bull #135.

Martinson, T.E., C.J. Hoffman, T.J. Dennehy, J.S. Kamas, and T. Weigle. 1991. Risk assessment of grape berry moth and guidelines for management of the eastern grape leafhopper. New York's Food and Life Sci. Bull. #138. 10 pp.

Grape IPM Fact Sheets. (Series of six, available through Cornell Cooperative Extension).

WEED MANAGEMENT

R. M. Pool[1], A. N. Lakso,[1] R. M. Dunst[2], J. A. Robinson[1],
A. G. Fendinger[2] and T. J. Johnson[1]
[1]Department of Horticultural Sciences, Cornell University,
N.Y. State Agricultural Experiment Station, Geneva, N.Y.
[2]Vineyard Research Laboratory, Cornell University, Fredonia, N.Y.

GENERAL GOALS OF WEED MANAGEMENT

If asked what we do, most of us would answer - grow grapes. It is easy to forget that, in terms of biological complexity, our vineyards are no less complex than any "natural" ecosystem. In addition to grapevines, growers manage (or are being managed by) populations of fungi, insects, nematodes, bacteria, mammals and, not least of all, other plants than grapevines, some of which are weeds. Weeds, by the usual horticultural definition, are plants growing where they are not wanted. In our vineyards even grapevines can be weeds (if they are the wrong variety or feral). However, some plants other than grapevines, especially cover crops, are tolerated or even encouraged.

To attempt to manage rationally we need to understand the management goals, and to realize that we will never be able to exert absolute control over weeds any more than we can ultimately control the rest of the vineyard ecosystem. Instead we should attempt to use techniques which encourage a beneficial, rather than a detrimental, mix of plant growth in the vineyard.

Plants growing in the vineyard do many things. They compete with grapevines for water, nutrients and sunlight. They can directly add nutrients (legumes) or, by adding organic matter, they can indirectly supply nutrients. They can harbor pests or diseases or they can sustain predators of the same pests and diseases. They can harm workers (I'm very sensitive to poison ivy, and view it as some people do snakes or spiders - the only good poison ivy is dead poison ivy), or they can feed workers (I also like a spring burdock feed). Most importantly, they maintain soil quality by preventing erosion, by providing support to heavy equipment moving through the vineyard and by adding organic matter. Although changing markets often are cited as the reason for reduced acreage in the Finger Lakes, 100 years of deep and continuous cultivation produced so much erosion that many formerly profitable vineyard soils are no longer able to sustain competitive production.

What are the goals? The first goal should be, but not always is, sustainability. Erosion needs to be prevented. Soil organic matter should be maintained or enhanced. Support for equipment should be provided so that timely sprays and

Table 1. Comparison of Conventional and Organic Weed Control In-The-Row Post Harvest Weed Assessment October 20, 1993

Variety	Method	Percent Ground Cover Average	Standard Error
Concord	Organic	56.2	3.50
	Conventional	5.6	1.37
Elvira	Organic	47.5	4.14
	Conventional	0.3	0.30
Seyval	Organic	55.5	6.02
	Conventional	0.3	0.26

harvest can be made without causing rutting and soil compaction. The best way to accomplish these tasks is to have live or dead plants established in the vineyard. Mulches can be useful, but they are expensive, and often restrict rather than enable equipment access to vineyards.

Secondly, plants should not excessively compete with the vines for water, nutrients or sunlight. This is accomplished by managing where, when and what kind of other plants grow in the vineyard.

Thirdly, vineyard floor management should reduce the environmental impact of grape growing. This is accomplished by preventing erosion (a major source of phosphorus build-up in water supplies) by serving as a reservoir for nutrients during periods when grapes are not taking them up; and by avoiding export of herbicides or other chemicals outside the vineyard. Non-grape plants should harbor predators, not pests, and they should not become contaminates of the grapes delivered to processors.

Because grapevines are planted in rows, their roots and leaf canopies are not distributed uniformly in the vineyard. Thus we recognize two different management zones, the in-row zone under the leaf canopy and the between-the-row zone between the canopies. The management needs and options of these two areas differ, so they will be discussed separately.

In-the-row weed management is more difficult. This is the area of maximum grapevine root function, so it is the area where vines least tolerate competition for water or nutrients. Plants which can grow in this shaded part of the vineyard tend to be very vigorous and competitive. Tall weeds will compete for light, reduce spray coverage, increase humidity and drying time and can directly contaminate machine harvested grape loads. Management options are also reduced in this area. Herbicide labels often do not permit contact with grape foliage, and impact of cultivation on grape roots is greatest where grape root density is greatest. The primary goal then is to prevent any non-grapevine plants from growing in this area. A problem with this approach is the high erosion potential. A way to reduce erosion hazard, especially in winter and spring, without increasing grapevine competition is needed.

Between-the-rows weed management is much different. In this region there is a different balance between negative aspects of non-grape plant growth (competition) and their positive impacts (erosion control, soil quality enhancement, pest management and equipment floatation). The historic practice of deep cultivation is thankfully just that, historic. Present standard commercial practice in New York uses a no-till approach where glyphosate (round-up) replaces cultivation to suppress weed growth during periods when the grapevine is most sensitive to competition from other plants. We also have considerable research and commercial experience with continuous "natural" sods (primarily covers of mixed orchardgrass and broad leaf weeds such as dandelion and plantains). In the typical New York vineyard situation these provide excessive competition, but where soils are very deep and vine vigor much above average, sods offer many advantages and few problems (primarily harboring cut worms and plants which serve as reservoirs of the soil nematode transmitted ringspot virus disease complex).

PRESENT ORGANIC WEED MANAGEMENT OPTIONS

In-the-row organic weed management options are limited and include cultivation, the use of a "natural" contact herbicide - sharpshooter, and the propane weed burner. Other options such as mulches or less competitive cover crops might be feasible, but their utility has not been proven. For this project we primarily relied upon mechanical cultivation (grape hoe) or a combination of mechanical cultivation and propane weed burning to manage in-the-row weeds. None of these proved to be wholly satisfactory.

Table 2. Effectiveness of propane weed control and paraquat treatment in controlling different weed species.

Weed Common Name	Genus species	Plant Height (cm)	% Mortality 8 days after treatment: Propane Weed Control	Paraquat
Quackgrass	*Agropyron repens*	10	0	99
Plantain Buckhorn	*Plantago lanceolata*	5	80	99
Leafy Spurge	*Euphorbia esula*	25	100	99
Horsetail	*Equisetum arvense*	7.5	>10	25
Lambsquarter	*Chenopodium album*	10	99	99
Grape Seedlings	*Vitis sp.*	6.3	100	99
Velvetleaf	*Abutilon theophrasti*	7.5	100	99
Virginia Creeper	*Quinquifolia parthenocissus*	5	80	99
Morning-glory Bigroot	*Ipomoea pandura*	7.5	90	90

Cultivation was effective in removing weed competition (Figure 1, Table 1), but it is a very expensive operation which must be done several times per season, and it has the detrimental effects of causing root pruning and encouraging erosion. We are experimenting with the use of special plants and mulches for in-row weed management, but to date no satisfactory organic alternative has been identified.

Sharpshooter appears to be as effective as paraquat in controlling emerged weeds. However, in spite of being a "natural" herbicide, its use does not really fit in with the spirit of organic weed management and eradication. Its cost is also prohibitive.

The propane weed burner produced mixed success. We spent much time trying to apply this technique to the vineyard situation as a non-chemical method of weed control. First results were partially satisfactory, but the equipment was inadequate. Later with improved equipment we were able to achieve sufficient

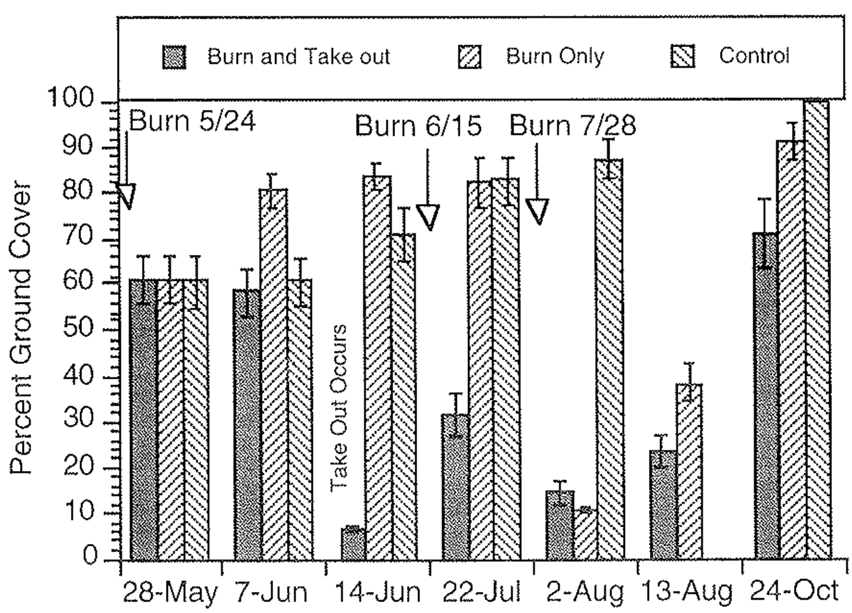


Figure 1 In the row percent weed cover response to liquid propane weedburner applications at various times during the 1993 growing season in the Concord organic block at Taylor Wines, Dresden, N.Y.

weed control relative to paraquat (Table 2), but there were still problems which are illustrated in Figure 1. Our basic strategy was to use the weed burner in combination with cultivation. We were concerned that weed burning alone would lead to a build-up of perennial and biennial weeds, so we planned on at least one take-out and hill-up each season.

In Figure 1 three treatments are shown. A control treatment with no weed control, a weed burning only treatment and a cultivation (take-out) treatment combined with weed burning. The first weed burn in 1993 was on May 24. The day was foggy, and unknown to us, a film of water on the plants prevented the attainment of lethal temperatures. The first take out was on June 14, and weeds were re-burned on June 15. Again, thermal weed control was inadequate. After much work, we found that the propane nozzles were not delivering sufficient pressure. The burning of July 28 was more successful, and produced results comparable to cultivation. However, at that time we found that, although foliage damage had not been a problem previously, treatment at a time when the vines were under water stress and the leaves were not transpiring freely, resulted in some grape foliage injury. Our later experience working with large Concord vines with closed canopies also resulted in excessive grape foliage injury.

In summary, the weed burner offers some prospects to supplement mechanical or chemical means of weed control. However, only when the vines are not under water stress and have relatively open canopies. Propane weed burning did an excellent job of sucker control relative to paraquat. At optimum operation and when substantial quantities of propane were purchased, the cost of propane treatment was not greater than treatment with paraquat

Between-the-row weed management was no-till round-up for conventional management and continuous sod for the organic blocks. Sub-plots were established in the organic blocks comparing clover and natural sod covers. All of these options are desirable in terms of sustainability, but the permanent covers were more competitive than the conventional not-till approach. The excessive competition was the primary reason that yields in the organic treatments were lower than conventional vine yields, especially following years of inadequate rainfall (see table 4).

Because cultivation is very undesirable, we were not able to identify practices which were both sustainable and acceptable for organic grape growers. As a result, we initiated work with alternative systems. We have made good progress with these approaches and will present data below. Future application of these techniques will depend upon future funding to pursue the research.

Ten systems are being evaluated in the research block. The treatments are listed in Table 3. This

Table 3. Floor management treatments being evaluated at the Vineyard Laboratory, Fredonia, New York.

1. Mulch. with oat straw at ~5 tons/acre
2. Herbicide. Glyphosate applied at grape bloom with 1.5 qt. Roundup.
3. Cultivate. Goal is to eliminate competing weed growth from bud break (~May 1) till early August with 4-5 cultivations.
4. Orchardgrass, *Dactylis glomerata* L. (unmowed permanent sod).
5. Orchardgrass. Mowed 5-6 times per year when grass reaches height of 12-15".
6. Kentucky bluegrass, *Poa pratensis* L. (permanent cover).
7. Crown vetch, *Coronilla varia* L. (permanent cover).
8. White (alsike) clover, *Trifolium hybridum* L. (permanent cover).
9. Annual rye grass, *Lolium multiflorum* Lam. Annual seeding in early August.
10. Killed annual rye. Annual seeding in August, killed with glyphosate at about grape bloom.

Table 4. Effects of between-the-row floor management on 1993 vegetative growth (cane pruning weight) and 1994 yield and quality of balance pruned Concord grapevines growing at Fredonia, NY.

Floor cover	Cane Pruning Wt. (lb)		Clusters/ Vine		Tons/ Acre		Juice Soluble Solids (%)	
Mulch	3.2	abc	150.4	abc	9.2	ab	15.4	de
Round-up	2.5	bc	121.0	bcd	7.7	bc	15.8	cd
Cultivate	2.8	abc	137.5	abc	7.4	bcd	16.1	bcd
Orchard Grass	1.4	d	68.8	d	4.7	e	16.7	ab
Mowed Orchgrass	1.5	d	68.8	d	4.5	e	16.8	ab
Blue Grass	1.9	cd	84.3	d	5.1	e	17.0	a
Annual Rye	2.4	bc	129.5	abc	8.0	abc	15.6	de
Killed Rye	3.3	a	166.1	a	9.8	a	14.9	e
Crown Vetch	1.9	cd	88.8	cd	5.6	de	16.8	ab
Red Clover	1.9	cd	92.5	cd	6.2	cde	16.6	abc

research is being conducted on mature, balance pruned (20 nodes/ lb of prunings) Concord grapevines growing at the Vineyard Laboratory in Fredonia, New York. Several aspects of floor cover management are being considered.

Mulching insures minimum cover competition and is included as a reference. Similarly, treatments 2 and 3 represent the best current commercially recommended herbicide and cultivation treatments respectively. Effect of mowing standard orchardgrass and replacing it with supposedly more drought intolerant blue grass is also being evaluated. The contribution and competitiveness of two legumes, clover and crown vetch, are evaluated because of their potential to enhance the nitrogen status of the

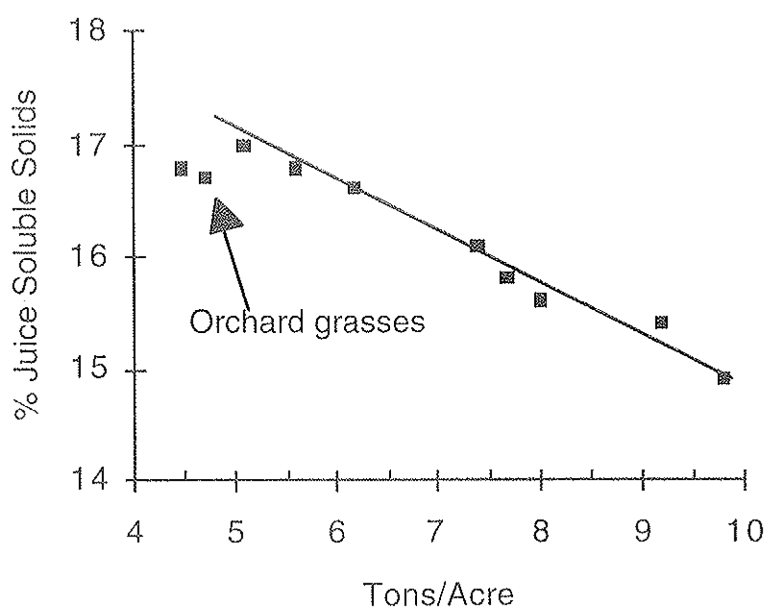


Figure 4. Concord fruit maturity in 1994 as related to 1994 vine yield for the 10 cover crop management systems at Fredonia. Note that orchard grass and mowed orchard grass covers had low maturity relative to other treatments indicating increased stress.

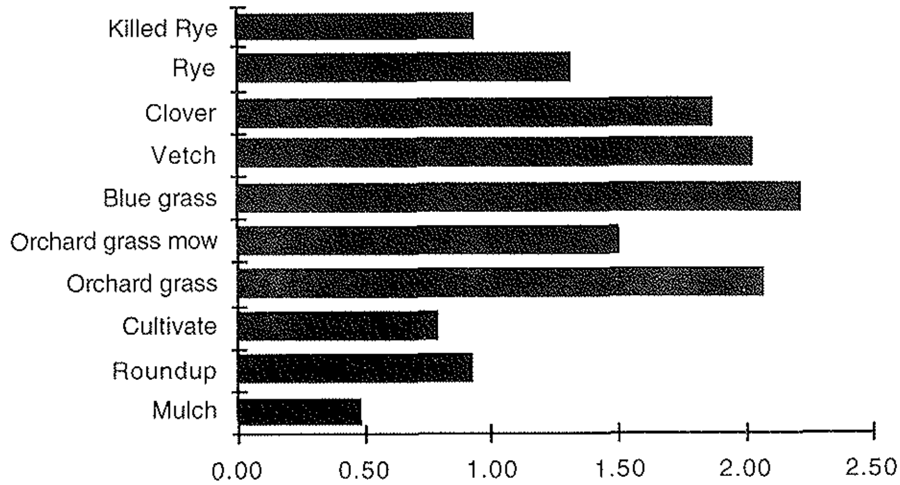


Figure 5. Relative water use by different cover crops during the period bloom to veraison.

soil. Finally, an allelopathic grass, rye, which potentially may replace herbicides in suppressing weed germination and growth is being tested.

Covers were planted in 1991 but did not become fully established until 1992. Data for 1994 thus reflect effect of covers on 1993 and 1994 growth. Because of a very dry late summer in both years, mulch treatments have the highest combination of vine size and yield (Table 4). Cultivated and no-till plots maintained good vine size and yield. The effect of competitive covers is seen with the grasses and legumes which reduced vine size and yield. Mowing orchardgrass did not substantially reduce its competitiveness. The rye covers did not induce maximum vine size, but were associated with high yields (Table 4), reduced competition (Figure 3), and reduced water consumption by the cover crop itself (Figure 5). In addition to evaluating the time when cover crop plants are active (Figure 4), water consumption of covers was monitored by placing double pots planted to the different cover crop systems in row middles and following water consumption gravimetrically (Figure 5). Figures 4 and 5 show the importance of water competition. Generally, covers which used less water resulted in higher yields and satisfactory fruit maturity. However, Figure 4 shows that competition affects more than just vine vigor. The high water consuming orchardgrass plots not only had small yields, but because late season water stress reduced grapevine photosynthesis, they also produced fruit of lower quality relative to the yield.

SUMMARY

Present floor management options open to organic grape growers are cultivation or a continuous cover. Experience has shown that, in dry years, organically managed vines suffer increased drought stress when the "natural" cover (mixed orchard grass and broad leaf weeds) which develops when Finger Lakes row middles are only mown, are used instead of the conventional glyphosate no-till approach. Legume covers appear to be at least as competitive as the natural covers. Tests with alternate cover crops have generally not verified reported benefits from reportedly low competition covers such as bluegrass, but inclusion of rye grass appears to offer real benefit. Decaying rye grass debris inhibits weed seed germination and reduces vine competition during critical periods. The result has been enhanced vine growth, yield and quality. These approaches need to be more broadly applied; the potential for allelotrophic suppression of in-the-row weeds should be evaluated.

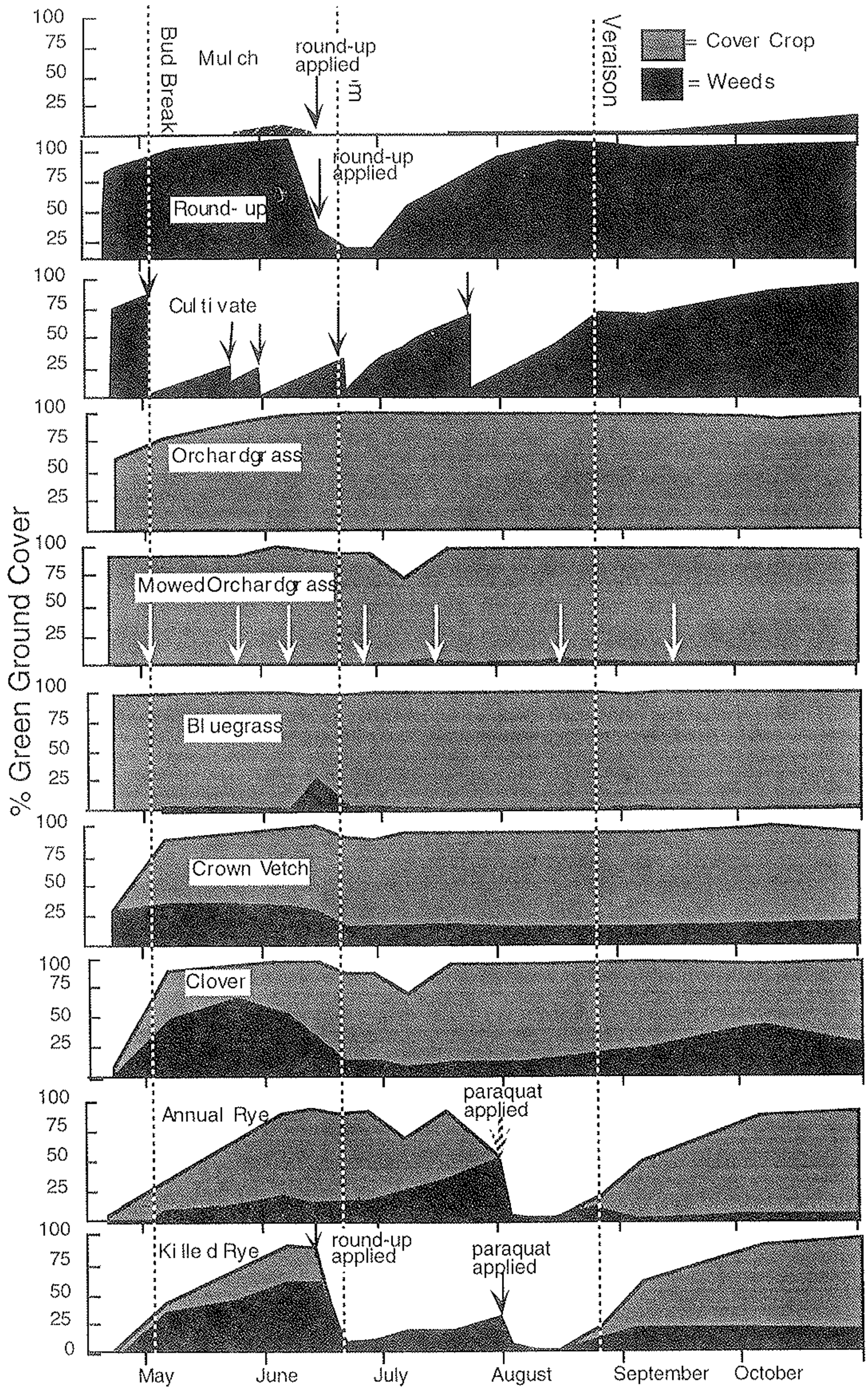


Figure 3. Season percentage cover for different floor management strategies during 1994 at the Fredonia Vineyard Laboratory cover crop experiment.

REFERENCES

Dunst, R., R.M. Pool and J. Kamas. 1994. Postemergence weed control - development of a complete postemergence strategy. Proc. 2nd Ann. Lake Erie Regional Grape Program. 2;10-13.

Dunst, R.M., R.M. Pool, J.S. Kamas, and A.G. Fendinger. 1995. Development of a postemergence vineyard weed management program. Proc. N.E. Weed Sci. Soc. 49:in press.

Dunst, Richard M., Andrew F. Senesac, and Robert M. Pool. 1990. Managing weeds in New York vineyards. IV. Post-emergence herbicides. Cornell Grape Facts I-4.

Pool, R.M. and A.N. Lakso. 1994. Cover crop management for vineyards. N.Y. State I.P.M. Report. p 14-18.

Pool, Robert M., Richard M. Dunst and Andrew F. Senesac. 1990. Managing weeds in New York vineyards. I. Choosing a weed management program. Cornell Grape Facts I-1.

Pool, Robert M., Richard M. Dunst and James S. Kamas. 1990. Managing weeds in New York vineyards. V. Managing vineyard floors using no-tillage. Cornell Grape Facts I-5.

Shaulis, N. J. and R. G. D. Steele. 1969. The interaction of resistant rootstock to the nitrogen, weed control, pruning and thinning effects on the productivity of Concord grapevines. J. Amer. Soc. Hort. Sci. 94:422-429.

Stobie, W.B., P. Lombard, and S. Price, Irrigation and perennial cover crop trial progress report. Annu. Rep. Oreg. Hortic. Soc, Portland: The Society, 19; 77.

Temple, S.R, O.A. Somasco, M. Kirk and D. Friedman. 1994. Conventional, low-input and organic farming systems compared. Calif. Agric. 48; 14-19.

ORGANIC GRAPE GROWING IN JAPAN: GROWING TOP QUALITY TABLE GRAPES WITHOUT ANY CHEMICALS

Dr. Sawanobori
Organic Fruit Grower, Makioka, Yamanashi, Japan

Japan has very wet climate conditions during the growing season. Most people believe that it is not possible to grow top quality table grapes organically in Japan. We have been growing table grapes organically since early in 1970 without the use of any chemical sprays. Kaoru Sawanobori established a type of greenhouse structure built to avert rain water and to reduce humidity to aid in the control of disease problems. We have finally realized success in growing Black Olympia, Olympia, and other cultivars completely organically. The structure is called the K.S. Type Sideless House and was patented in 1982 in Japan.

Wine grapes are also grown under the structure. The grapes are sent to a contracted winery for processing into organic grape juice and wine. We are very proud that we are the only Japanese grape grower producing top quality table grapes without using any chemical sprays. There are a few other organic growers in Japan, however, who use organic compounds such as sulfur in their management plans.

ONE GROWER'S EXPERIENCE WITH ORGANIC VITICULTURE IN THE FINGER LAKES

Richard Figiel
Silver Thread Vineyard
Trumansburg, New York

A. Background

1. Location: East side of Seneca Lake
2. Five Acres, not all producing - Riesling, Chardonnay, Pinot Noir
3. Planted in 1982 - 1984; never insecticides or chemical fertilizer
4. Organic (NOFA) regimen since 1989; winery in 1991

B. First Priority: A strong link between vine and healthy soil

1. Consider the use of conventional chemical fertilizers

    a. We put down water soluble nitrate, muriate of potash, etc.

    b. Vine roots suck up some; the rest drops to water table, runoff; creeks and lakes fill with algae, fish decline

    c. The vine has a chemical diet of mainly N, P and K

    d. Root systems stay near surface where food comes, not encouraged to probe and explore full spectrum of minerals and foods in a complex soil environment

2. Herbicides compound the situation

    a. Killing soil biology, microorganisms critical to the food chain

    b. No coincidence that herbicides and chemical fertilizers developed simultaneously: one requires the other

3. Results

    a. Undernourished, less healthy, more disease prone vines -
    — But they are "green and lush" much like people walking out of McDonalds's - fat and malnourished

    b. Less interesting wine

    — If the vine is disconnected from its soil and site, how can the wine show terrior?

    — Wine writers complain about the "sameness" of wines from around the world; loss of regional identity. Usually blamed on varieties and French oak, but what about the same chemical diet for vineyards worldwide?

C. **I try to let the soil play its natural role as the vineyard's stomach**

1. Alternate row middles: New Zealand (low, slow-grow cover)
   a. Research shows mowing adds as much N as disking
   b. Fescues compete less for water but more for N
2. Alternate row middles: Hay / straw mulch in round bales
   a. Excellent studies by James Beattie in Ohio in 1940's and 1950's
   b. Leave it on surface to break down gradually
   c. Adds organic matter, N and K, improves structure plus water conservation (reduces runoff by 90% / erosion), yields up.
3. Manure supplements: sheep for K (tailor to your soil needs)
4. Mineral supplements: rock dusts - sulfate of potash, sul-po-mag, greensand, pulverized glacial gravel (remineralization)
5. Seaweed / kelp - K plus micronutrients
6. Biodynamic treatments

D. **Weed Control**

1. Under-Trellis
   a. Mechanical and Hand Hoe

      — Take-out before bud break (covers disease inoculum under vines followed by hand-hoeing around trunks (easy if done immediately after)

      — One pass with grape hoe mid-summer to cover new weeds

      — Hill up in November

      — With careful timing, weeds have become easier to manage
2. Between rows: clover and mulch; disk in May, then mow

E. **Sprays**

1. Sulfur
   a. 3-12# / Acre

      — 10-12# has worked well against powdery mildew outbreaks if caught early
   b. Hot days have not caused phytotoxicity problems
2. Bordeaux Mix for rots, downy mildew
   a. Certification standards require mixing it yourself
   b. 1.5-2.5# / Acre + twice lime

c. I spray in may (with vinifera) but not when wet: moisture is the critical factor (dew) not cool temperature

d. Some effectiveness against Botrytis

e. I try to minimize use

3. Horsetail (equisetum) helps against Botrytis

— Pick before midsummer, dry in shade, boil 20 min. in water to cover, leave 1 day to cool and strain, dilute 10 to 1 and spray.

4. Will try AQ10: new in 1995, a biological control for powdery mildew

5. Frequency of sprays at Silver Thread Vineyard

— 1990: 12 X
— 1991: 10 X
— 1992: 14 X
— 1993: 10 X
— 1994: 8 X (5/24 - 8/10, including 4X with BM)

G. Training System

1. Modified Pendelbogen (rather than cordon) to spread out fruit zone or aeration

2. High trellis to keep air space open between vine and ground / weeds

3. Vertical training: single catch wires with double hangers to move up as shoots grow

H. Insects

1. Leafhoppers have been the biggest problem

a. Roses and blackberries along headlands to encourage *Anagris* predator

b. Will try safer soap with natural oil, carefully timed, to deal with severe pressure

2. Grape Berry Moth - pheromone ties

3. Aphids - ladybugs; weeds provide alternate hosts

I. Overall Results

1. Disease control comparable to or better than neighbors

2. Yields range from 1 (1993 Riesling, PN) to 4.5 (1992 Riesling) tons per Acre

USE OF TERM "ORGANIC" ON WINE LABELS

Richard M. Gahagan, Wine Technical Advisor
Bureau of Alcohol, Tobacco and Firearms
5200 N. Palm Ave., Suite 204 Fresno, CA 93727

BACKGROUND

In 1990 Congress passed the Organic Food Act. The United States Department of Agriculture (USDA) was charged with drafting the implementing regulations. USDA established an advisory board, the National Organic Standards Board (NOSB), to consider issues, collect data, conduct research and ultimately develop regulatory requirements. Although final regulations were mandated by October 1993, to date only one notice of proposed rule-making has been published. That notice related only to livestock.

The Organic Food Act includes fermented beverages. ATF, therefore initiated and has maintained contact with USDA. ATF has attended several USDA/NOSB meetings and has provided input on the production of beverage alcohol products, particularly wine.

CURRENT STATUS

Section 105(e) of the Federal Alcohol Administration Act (FAA Act), authorizes ATF to issue regulations intended to prevent deception of the consumer, and to provide the consumer with adequate information as to the identity of beverage alcohol, including wine. There are currently no regulations specifically authorizing the use of the phrase "organic" on wine labels. Furthermore, there is no "organic wine" designation currently defined in the regulations which provide standards of identity for wine. However, regulations provide that wine labels may contain information other than the mandatory information as long as the additional information is truthful, accurate and specific, and which is neither disparaging of a competitor's products nor misleading.

Despite the absence of specific regulations, ATF does not prohibit organic claims on beverage alcohol labels. These claims are considered additional truthful information, providing the claims are documented. Acceptable documentation for organic claims is certification by an accredited or recognized certifying agency of State or foreign government. When seeking ATF label approval, a copy of the "organic" certificate should be submitted to ATF's Product Compliance Branch along with ATF Form 5100.31, Application for and Certificate of Label Approval.

For New York wines, a certificate issued by the Northeast Organic Farming Association (NOFA) is acceptable to ATF for the purposes of organic labeling claims. The Washington State Department of Agriculture issues "Organic Food Producers' Certificates" in that State. In California, ATF has received and accepted certifications from county agricultural commissioners, California State Department of health Services, California Department of Food and Agriculture and the California Certified Organic Farmers (CCOF), a private certifying agency.

Most organic claims relate to the commodity from which the beverage is made, e.g., "organically grown grapes." ATF does not, however, allow designation of the finished products as organic, for example, "organic red wine" or "organic Seyval blanc."

In rare instances, ATF has permitted the description of wine as "organically produced" and beer as "organically brewed." There has been only one winery, Hallcrest Vineyards, dba The Organic Wine Works, of Felton, California, which has been certified to make this claim. This approval was based on documentation that the California Department of Health Services, Food and Drug Branch, made a thorough inspection of the winery's raw materials, production methods, and records and determined that Hallcrest Vineyards, dba The Organic Wine Works, purchased organically grown grapes and processed them into wine in compliance with the California Organic Food Act of 1990.

As necessary, ATF verifies the acceptability of the certifying body with USDA. USDA maintains a list of recognized U.S. and international certifying authorities.

WHAT DO WE MEAN BY ORGANIC WINE?

John Schumacher
President and Winemaker
Hallcrest Vineyards: The Organic Wine Works
Felton, Santa Cruz County, California

Americans have become increasingly sophisticated and discriminating about how they live, eat and play within an ever changing world. One of the most pressing concerns regarding our health and environment is the use of chemicals and pesticides in the food we eat and drink. Wine is, of course, an agricultural product in which the use of chemicals, pesticides and added preservatives have increasingly become an issue to the consumer.

Over the years, many wines have been released claiming that they are "Organic" but confusion still exists about just what constitutes an organic wine. While some organic wines are produced from grapes that are organically grown, most still have added sulfites or preservatives that may cause allergic reactions or other health problems for sensitive people. The Organic Wine Works wines are not only produced from organically grown grapes, but are organically processed as well. We are one of two vintners that produce an organic, unsulfited wine that is nationally distributed. And the first winery to release 100% Certified Organic wines in the country.

We at Hallcrest saw a need for untreated wines and established the Organic Wine Works label, so our customers would not be confused from our wines that are organically grown but traditionally processed. The Organic Wine Works has taken on a challenge that the rest of the wine industry has virtually ignored: producing quality wines that can be enjoyed by wine lovers who are sensitive to sulfites.

Growing grapes without the use of chemicals is an environmentally conscious step. We feel that it is just as important for the winemaker to make the same efforts to maintain the integrity of the Organic concept.

There are now eight varietals of the Organic Wine Works wines; three white and five red. All have been grown and processed in accordance with the California Organic Foods Act of 1990. Now, four of these wines are 100% certified by the California Certified Organic Farmers (CCOF). Our eight releases are currently among a select few non-sulfited wines available in the United States.

THE MOST COMMON QUESTIONS ASKED ABOUT OUR WINES

How long is the shelf life?

Our white wines show very well within a year and a half. Most white wines are consumed within a week after purchase. Our reds should age like other red wines; we've tasted many unsulfited reds that have aged for six to eight years and they have held together beautifully. We do recommend, as with any fine wine, to ship and store your wines at less than 60 degrees and keep out of sunlight.

Aren't sulfites a natural by-product of fermentation?

Yes and No. Our research has shown that most of our wines have little or no sulfites. Although some wines do produce over 10 parts per million, this is very uncommon. Most wines do not produce sulfites as a by-product.

Is the sulfite issue with consumers just hype?

We don't think so. Food allergies are very complex, therefore, a customer's concern cannot be taken for granted. If they are having problems with other wines, suggest they try a bottle of The Organic Wine Works wine. If they do not have the same reaction, then their concerns about sulfites may be legitimate. If they do have a similar reaction as with other wines, then there might be a common component in wine for which they have an adverse reaction.

THE ORGANIC WINE WORKS

The Organic Wine Works has just become the first 100% Certified Organic Wine to be grown and processed and available in the United States. The California Certified Organic Farmers (CCOF) have certified Hallcrest Vineyards, Inc., the producers of The Organic Wine Works, as an organic wine processor. The release of the 1992 vintage marks the first time that a wine can display the CCOF seal certifying that the wine has been "Organically grown and processed in accordance with the California Organic Foods Act of 1990." (This means wine with no added sulfites), and is the first wine approved by the Federal Bureau of Alcohol, Tobacco and Firearms (BATF) as organically grown and processed.

Consumers can purchase the wine with confidence that the grapes are grown without any pesticides or synthetic chemical additives and that the wine is produced without any chemical additives, including no added sulfites. The California law states that a product labeled as "organic" must contain 100% organic ingredients. The requirements of the California law provide a great deal of protection for consumers buying produce and processed foods labeled as "organic." The CCOF is funded through membership fees, not tax dollars, so the costs of certification are shared by the producers and consumers of organic products.

Many wineries, like Hallcrest Vineyards, are currently using organically grown grapes in their wines and are actively converting their vineyards and growers to organic farming but they are not organically processing their wines, hence these wines are produced from organically grown grapes, but are not organic wines.

The Organic Wine Works is releasing six wines certified as organically grown and processed in accordance with the California Organic Foods Act of 1990. The include three white wines; Chardonnay, Fume Blanc, and Semillon, and three reds; Pinot Noir, Cabernet Sauvignon and Merlot.

SULFITE PRODUCTION IN WINE FERMENTATIONS: HOW MUCH SULFITE IS PRODUCED BY YEASTS IN GRAPE MUST WITH NO ADDED SULFITES?

Lyle C. Abrahamson
Enologist
Hallcrest Vineyards: The Organic Wine Works
Felton, Santa Cruz County, California

In order to answer this question a research project was undertaken during the 1991 harvest. There are many claims for natural sulfite production in wine fermentations but a scarcity of research results in this area. The research of Rankine and Pocock (1969) on sulfur dioxide formation during fermentation is the most pertinent. However, all of the results were based on three liter volumes of grape juice with sulfur dioxide added before fermentation or in defined growth media with added sulfur sources. Their results are very interesting, but the well documented variability of small scale fermentations is troubling and the effects of adding sulfur dioxide before fermentation to the subsequent sulfur dioxide formation is not mentioned. In light of the various claims based on few results it was necessary to conduct this independent research to measure sulfite production in full scale commercial wine fermentations.

A total of fifteen wines from both conventionally and organically grown grapes were tested for total sulfur dioxide during and after fermentation. The total sulfur dioxide was determined using the aeration-oxidation method. These are all commercial fermentations ranging from 132 gallon barrel fermentations to 3500 gallon temperature controlled fermentations in stainless steel tanks. The chosen method of vinification eliminates sulfur dioxide additions in any of the grape musts before or during fermentation. This choice has certain stylistic results in the finished wines and also simplifies the interpretation of the data. Any sulfur dioxide detected originates with yeast activity during the fermentation.

The range of sulfite production is 0-41 ppm. Yeast strain appears to be a significant factor which is not a new result. The white wine fermentations produced sulfites more often and at higher levels than the red wine fermentations. It is not clear whether this is related to the nutrient level in the juice, the higher temperature of fermentation, or other factors. The only red fermentation that produced any significant level of sulfites was the Barbera. This may be due to the very low pH or other factors. No free sulfur dioxide was detected in any fermentation, all is in the bound form, which agrees with the findings of Rankine and Pocock (1969). The peak levels of sulfite formation generally occurred during the most rapid period of fermentation, although not in all cases. After the peak level of sulfites were reached they slowly deceased over time with the aging of the wines and various processing steps such as racking, filtration and bottling. The result is that there ends up being little or no detectable total sulfur dioxide in the bottled wines.

In conclusion, blanket statements such as "all fermentations produce 10 to 100 parts per million of sulfur dioxide appear to be contrary to the facts determined in this research. The level of sulfite production may indeed range up to 100 ppm in some fermentations, but this would seem to be an exception rather than the usual case. The production of sulfite is influenced by many factors including yeast strain, nutrient profile, fermentation temperature, inoculation level, pH, oxidation - reduction potential, fermentor shape and size, and processing methods. The nutrient profile of grapes varies according to vintage and varietal rendering to a prior prediction of sulfite levels as well as hydrogen sulfide formation difficult if not impossible. Recent research indicates the levels of sulfites and hydrogen sulfide production depends on the interaction between yeast strain and juice. The production of wines without added sulfites presents many additional challenges in addition to those already facing the winemaker interested in producing high quality wines. In short, the winemaker can only rely on technology, innovation, experience, skill, and intuition to produce wines of distinction with or without added sulfites.

ORGANIC GRAPE AND WINE PRODUCTION: GROWER EXPERIENCES IN GERMANY

Günter Schruft
State Viticulture and Wine Research Institute
Merzhauserstr. 119 D-79100 Freiburg, Germany

1. INTRODUCTION

First, I would like to show you the basis of the wine production in the European Union (EU) and Switzerland in comparison to the U.S.A. (Table 1).

In the European Union (EU) organic grape and wine production is governed by EU order number 2092/91 of June 24, 1991 which regulates organic agriculture. It details acceptable methods for the production and labeling for products of ecological organic agriculture. They apply to all member countries of the European Union. On the basis of these directions, special federations or unions for organic viticulture have made guiding rules for their practical application.

Wines produced under these EU directions must be named with the following terms:

English .... Organic
French .... Biologique
German .... Ökologisch
Greek .... βιολογικσ
Italian .... Biologico
Spanish............... Ecologico

2. ORGANIC VITICULTURAL AREAS

The size of organic viticulture operations differ greatly among the EU member countries which cultivate grapevines.

In Italy, the number of organic growers is not known.

Table 1. Grape Production in the European Union (EU) and Switzerland in comparison to the USA

Country	Acres (1000's)	Wine Production 100's hectoliters	Wine Consumption gallons/person
Austria	139.2	2588	8.5
Belgium	–	2	5.4
France	2263.2	65,401	16.6
Germany	256.8	13,400	5.9
Great Britain	2.4	26	3.2
Greece	331.2	4,050	8.1
Italy	2419.2	68,686	15.6
Luxembourg	2.4	272	15.4
Netherlands	–	–	4.3
Portugal	888.0	7,555	14.2
Spain	3264.0	37,036	10.1

In France, 2,938 ha (0.3% of the total 943,000 ha of vineyards) are grown organically.

In Germany, about 330 enterprises cultivate an area of about 1,316 ha in organic production. This corresponds to 1.2% of the total vineyard area of Germany. The most progress in organic viticulture has been achieved in Baden, the region which neighbors Switzerland to the southeast and Alsace to the west. In Baden 105 farms and cooperatives produce organic wines on 350 ha, (2.2% of the 16,000 total ha cultivated in Baden).

In comparison with the organic viticulture in Germany, the integrated production has progressed to a more ecological form of viticulture, the so-called "controlled environmentally protecting viticulture." With exception of the permitted use of organic fungicides, for the most part this type of grape production is similar to organic viticulture. Organic production is based on a mental attitude to a holistic world.

3. BASIC RULES OF ORGANIC VITICULTURE

In Germany, five organic producing unions exist. Of these, the Bundesverband Okologischer Weinbau - Federal Association of Organic Viticulture (BOW) is the largest and unique in that only grape-wine producers can be members. In Figure 1 you will find the names, year of the foundation, trade name and trademark, along with the number of enterprises and size of the viticultural area of the German organic associations.

The BOW was founded in 1985 with the goal to represent and to lobby all organic grape growers in Germany. BOW also organizes events such as shows and specific fairs for presentation and sale of organically produced wines.

In 1985 the first national rules for organic grape production were proposed by the BOW, amended in 1989 and 1992. The rules give

Figure 1 **Der ökologische Weinbau in der Bundersrepublik Deutschland (Stand: 01.01.1994)**

	biol. - dynamitsch	organ. biologisch	Naturland	BOW	Gäa
Gründungsiahr	1924	1971	1982	1985	1989
Warrenname und Schutzzeichen	"Wein aus demeter Trauben"	BIOLAND	NATURLAND	ECOVIN	GÄA OKOLOGISCHER LANDBAU
Anbauflache (ha)	31.73	182	109	ca. 990	3.5
Zahl der Betriebe	25	53	17	ca. 234	1
Adresse der Anbauberater	Forschungsring für Biol. - Dyn. Wirtschaftsweise c. V., Demeter-Bund Baumschulenweg 11 D-64295 Darmstadt Tel. 06155-2674 Fax 06155-5774	Bioland - Verband für organisch-biologischen Landbau e. V., Nördliche Ringstr. 91 D-73033 Göppingen Tel. (07161) 910120 Fax (07161) 910127	Naturland Verband für naturgemäben Landbau e. V. Kleinhademer Weg 1 D-82166 Gräfelfing Tel. 089-8545071 Fax 089-855974	Bundesverband Okologischer Weinbau e. V. (BOW) Zuckerberg 19 D-55276 Oppenheim Tel. 06133-1640 Fax 06133-1609	Gäa c. V. Vereinigung Okologischer Landbau Plauenscher Ring 40 D-01187 Dresden Tel.0351-4012389 Fax.0351-4012389

general and specific directions in the field of cultivation techniques, soil treatment, plant protection and vinification.

The objectives of organic grapevine cultivation are:

1. Conservation and raising the natural soil fertility by suitable cultivation procedures, but also omitting all measures which are contradictory, such as the use of synthetic fertilizers;

2. Cultivation of healthy resistant plants without any application of herbicides, insecticides and organic fungicides to avoid the dangerous counter-regulations from the ecosystem;

3. Use of raw materials and waste products which do not contain pollutants and extensive use of a product recycling;

4. Reduction of stress and contamination for water and soil, e.g. by nitrate, phosphate and pesticides;

5. Advancement and increase of species diversity of plants and fauna in the vineyard ecosystem;

6. Rejection of gene-manipulated plants, e.g. grapevines or green plants;

7. Organization of a reliable livelihood on the basis of satisfactory living conditions.

4. PHASE OF CONVERSION

The conversion of a vineyard from traditional to organic production needs an approved schedule of three years at most, during which time, the whole enterprise must be converted. In the meantime, marketing is possible, but only with the reference "in conversion." Three years after the conversion, the enterprise obtains a contract of admission with a registration number, under which the wine can be marked with the trade mark label ECOVIN.

5. CULTIVATION DIRECTIONS

Following directions for organic grapevine cultivation is obligatory for BOW members:

Soil Management

1. Fundamental green cover for all vineyards is necessary for soil maintenance, soil loosening, resowing. During dryness in summer and in young vineyards after planting, the green cover can be unbroken for a maximum of three months. Green cover may consist of natural flora or be a specially sown green cover variety mixture.

2. The application of herbicides is forbidden. Management of the green cover mulch is especially important during dry periods.

3. The use of synthetic nitrogen and soluble phosphate are forbidden. The recommended organic manures and composts as well as the mineral additives are listed in Table 2.

4. The natural structure and fertility of the soil has to be considered with all soil cultivation methods. All must be done carefully and at the right time. Avoid soil-turning.

Pest and Disease Management

The application of chemical - synthetic insecticides, miticides and organic fungicides is forbidden. The permitted products for plant care and protection are listed in Table 3.

In Baden we use the following guidelines to regulate and control the most important grapevine pests and diseases:

Inorganic copper (copperoxichloride) and sulfur are used against downy and powdery mildew. The amount of copper is limited to 3 kg active

Table 2. Soil improving compounds and manures permitted for organic viticulture.

Organic Manures and Composts

- animal manure (composted in stacks or bigger areas)
- chicken manure
- abatoir affal (horn, blood, bone meal, feathers, bristles)[1]
- seaweed flours and extracts
- composts from biological scraps (home and greenery scraps)[2]
- harvest residues and waste from wine making
- plant manure
- straw
- bark compost (mulch cover)[2]
- organic manures[1]
- bio-dynamic compost and spray preparations

Mineral Manures (addatives)

- rock, clay material
- lime, seaweed lime
- rock/phosphate, basic slag[1]
- potassium, potassium sulphate[1]

[1] possible only after soil analysis

[2] heavy metal and pesticide residue analysis is required

---

copper ingredient by hectare and year. To support these products, plant preparations and/or mineral products can be added. Excoriose (*Phomopsis viticola*) and rotbrenner (*Pseudopeziza tracheiphila*) (similar to angular leaf scortch) are also treated with these products. To prevent and reduce grey mold, which is not as frequent nor dangerous due to the renunciation of synthetic nitrogen fertilizers, the cultivation practice of leaf removal in the grape zone for better drying is practiced.

The most important grape pests are the grape berry and vine moths (*Eupoecilia ambiguella* and *Lobesia botrana*) , which produce two generations per year. The first generation attacks the inflorescence and blossoms; the second attack the young berries. Because the application of synthetic insecticides is forbidden in organic viticulture, two alternative procedures are in practice in Germany. The first is mating disruption by use of pheromones. Within the vineyard, 500 pheromone dispensers per hectare are attached to the vines causing a pheromone cloud to arise. Male and female moths are unable to find each other and do not mate. The female lays infertile eggs from which no larval instars hatch. This method was first registered for viticulture in Germany in 1986. Since then, about 13,000 ha (approximately 50%) of vineyards have been treated with this method, especially in our area. Unfortunately, the mating disruption method is very expensive, e.g. DM 450 - against both grapevine tortricids per ha, less DM 150 - from the government for the control measures, which are necessary for the supervision of the vineyards.

Where the mating disruption method can not be used, a *Bacillus thuringiensis* (BT) product is applied. Presently, seven products with *Bacillus thuringiensis* are registered for use in German viticulture.

Spider mites were another group of harmful pests in German vineyards for a long time. However, protection of the predator mite (*Typhlodromus pyri*) have effectively controlled spider mite populations and they are no longer considered an important pest.

In the past few years weather conditions were favorable for the increased populations of the leaf curl rust mite (*Calepitrimerus vitis*) and warranted control measures. The application of sulfur early in spring immediately after budbreak with weekly repetitions was successful. In summer, the predator mite (*Typhlodromus pyri*) helps to control this pest, too.

In vineyards where no synthetic insecticides are used, many minor insect and mite pests occur; rarely causing an outbreak over the economic threshold.

The number of treatments against the main diseases in organic vineyards (as in traditional vineyards) depends upon weather conditions. The meteorological data were collected by suitable apparatus that gives temperature (min-max), humidity, precipitation and leaf wetness. With these parameters the necessity and timing of fungicide applications can be determined very well so that we are able to limit the sprays to 8-10 per season.

6. ECONOMIC STATEMENT

An economic statement for organic viticulture is just as difficult as for traditional management because it depends on technical equipment and personnel, the number and size of the lots, and so on. A specific study by Kauer (1994) compared the costs of machines and the need of man-hour per hectare (Table 4) for different procedures in the vineyard. In a comparison to traditional viticulture organic culture has 61% higher machine costs. Concerning the man hours per hectare, a reduction of 4% occurred. Usually, there is a higher machine requirement for organic viticulture, with a greater money input required. At the beginning of the conversion phase, the costs for machines and man hours per hectare are about 20 - 25% more than for conventional production.

One of the most important questions concerning profitability of organic viticulture is yield. Generally, there is a yield reduction of 20 to 25% and most growers experience such a decrease immediately after conversion to organic management. After some years, however, yield returns to previous numbers with a slight decrease of 2 - 5%.

Usually prices for organically produced wines are 10 - 20% higher compared to the prices for integrated or traditionally produced wines.

Table 3. Plant protection products and procedures permitted for organic viticulture on biological, biotechnical, vegetable, mineral and inorganic base.

- release and protection of auxiliaries (e.g. predator mites)
- use of auxiliaries (e.g. parasitic wasps)
- bird protection
- glued traps
- pheromones
- *Bacillus thuringiensis*
- plant preparations (liquid manures, teas, extracts)
- quassia wood tea
- seaweed flours and extracts
- propolis
- milk and whey products
- homeopathic preparations
- biologic-dynamic preparations
- water glass
- rock and clay minerals
- wettable sulfur
- inorganic copper preparations (max. 3 kg Cu/ha and year)
- plant oil (rape seed oil)
- paraffin oil (free of insecticides)
- paraffin waxes (free of insecticides)
- soft soaps
- alcohol

Table 4. Machine costs (DM/ha) and man-hours per ha.

	Traditional	Integrated	Organic
Machines and Materials DM (ha)			
Machines	2,384 (100)	3,115 (131)	3,389 (161)
Pesticides	641 (100)	530 (83)	821 (128)
(Insecticides)	2%	41%	27%
Manure	191 (100)	273 (143)	413 (216)
Total DM/ha	**3,216 (100)**	**3,918 (122)**	**5,073 (158)**
Man Hours Per ha			
Grapevine Treatment	200 (100)	186 (93)	179 (90)
Soil Management	21 (100)	41 (195)	37 (176)
Manure	3 (100)	7 (233)	9 (300)
Plant Protection	18 (100)	19 (105)	32 (178)
Harvest	250 (100)	250 (100)	215 (86)
Other Work	40	40	40
Total	**532 (100)**	**543 (102)**	**512 (96)**

On the other hand, some subsidies and furtherances for organic production exist. The EU order number 2078/92 from June 30, 1992 makes a maximum subsidy of 700 ECU/ha (about DM 1,000 = $878 US) available for the conversion from traditional to organic production under the condition that a considerable reduction of fertilizer and pesticides is given. In the German states with appreciable viticulture, different subsidies are available. In Baden, the Market Discharge and Cultural Landscape Compensation Program (MEKA) gives points for specific ecological procedures, such as green cover, renunciation of herbicides, synthetic pesticides and fertilizer, as well as for organic and integrated production. Presently, one point is equal to DM 20 ($13.50 US). A maximum number of 20 points per hectare or DM 400 can be earned.

7. CONTROL PROCEDURES

The EU order number 2092/91 prescribes a control procedure for organic production. The control refers to the vineyards during the season regarding green covers and the states of insect pests and diseases. Periodic, chemical analyses of leaves, berries and/or soil samples are performed to guarantee organic production. Enterprises with wine production are controlled during wine processing. On farms, accuracy of required bookkeeping and the nature of plant protection products are also controlled. Fees for a control procedure depends on the size of the vineyard and ranges from DM 150 for 0.5 ha to DM 900 for over 30 ha. This is in addition to a basic rate of DM 100 of which the government pays an amount to promote organic production. A certificate is issued after inspection.

8. WINE PROCESSING

Only grapes processed from organic vineyards can be used for wine making. The first goal must be for a product with high sensory quality, pleasant taste and digestibility.

All processing treatments of grapes, juice, and still or sparkling wines have to follow these regulations:

- Sulfur dioxide should be used only sparingly.
- Methods using base products and energy are to be avoided.
- All treatment compounds doubtful in their origins, application or recycling for the environment and health are to be avoided.
- Physical methods are preferred to chemical because of waste avoidance.
- All residues and waste water from processing have to be treated in such a way that they do not burden the environment. Wineries and cooperatives have to prove adequate treatment.
- Only recyclable bottles can be used. Exemptions are granted only if bottles are taken back and used again.
- To avoid waste, the use of caps is not recommended. Caps with lead and tin are not permitted.

The processing and treatment methods permitted for organic wine production is listed in Table 5.

9. PROSPECTS

Organic viticulture is not a complete system, but a movement. Problems are evident in the field of plant protection and soil cultivation.

The use of copper is one critical point, because copper accumulation in the soil is an increasing problem. So, a very intensive search for copper substitutes is one of the most important research fields of responsible institutions. Many products of different origins have been tested in the past, for example rock minerals rich in silicate, water glass, differently activated.

On the other hand, an excellent solution to this problem would be to develop mildew resistant grapevine cultivars. We have 3 to 5 mildew resistant cultivars at our Institute. They have a high resistance to mildews under different location conditions and a good wine quality (the complex origin of the cultivars FR 993-60 and FR 250-75 from 1928 to 1975 is shown in Figure 2).

Within the EU, cultivation of such interspecific cultivars is forbidden, so they can be planted only in small numbers under the inspection of the breeder. Interest of organic growers in such resistant cultivars is not very high. A well known representative of organic viticulture and wine making is reported to have said that, "the breeding of interspecific crossings to create fungus resistant vines, similar to gene technology, is an intrigue and must be rejected as being an artificial product; such plants do not fit into the context of ecological viticulture." The acceptance of these wines with a name unknown to the customer is not very popular.

Table 5. Prohibited processing and treatment methods and materials for organic wine making and marketing

- use of microorganisms genetically changed
- high sulfur addition to sweet reserves
- chaptalisation of sweet reserve
- hot bottling of wine
- blue fining
- copper sulphate
- sorbic acid, ascorbic acid
- PVPP
- caps containing lead or tin
- chlorinated natural cork
- styropor boxes
- adhesive tapes

Table 6. Fungicides and insecticides registered and permitted for traditional, integrated, and organic viticulture in Germany.

Registered	Integrated	Organic
Fungicides		
Carbendazim	—	—
Copper	Copper	Copper
Cymoxanil	Cymoxanil	—
Dichlofluanid	Dichlofluanid	—
Diethofencarb	—	—
Dinocap	—	—
Dithianon	Dithianon	—
Fenarimol	Fenarimol	—
Iprodion	—	—
Mancozeb	(Mancozeb)	—
Metiram	(Metiram)	—
Penconazol	Penconazol	—
Procymidon	—	—
Propineb	(Propineb)	—
Sulphur	Sulphur	Sulphur
Tebuconazol	Tebuconazol	—
Triadimenol	Triadimenol	—
Vinclozolin	—	—
Insecticides / Miticides		
Bacillus thuringiensis	*Bacillus thuringiensis*	*Bacillus thuringiensis*
Clofentezin	—	—
Deltamethrin	—	—
Fenbutatinoxyd	—	—
Hexythiazox	—	—
Insegar	—	—
Methidathion	—	—
Oxydemeton-methyl	—	—
Paraffin oil	Paraffin oil	Paraffin oil
Parathion-methyl	—	—
Pheromone	Pheromone	Pheromone
Rape-seed oil	Rape seed oil	Rape-seed oil

In the past years, another problem was discussed by many wine makers and grape growers who cultivate the vineyards under total green cover. It seems that the wines grown under such conditions have an inferior quality. At present, many studies are undertaken to investigate this effect and the exact interdependencies.

We assume that a considerable increase of organic viticulture is not to be expected in the future. Instead, integrated viticulture is increasing because it is easier to realize and because of the minor risk of a quantitative and qualitative yield reduction by critical attack of pests and diseases or by other factors. With regard to the environment, integrated viticulture is progressing by avoiding synthetic insecticides and herbicides without any risk (Table 6).

Organic viticulture requires a holistic philosophy, which will be limited to a select number of persons. The clientele for wines from organic production is limited, too. Most of the people don't accept an ideology, nor do they want to pay more for a wine produced for a healthy environment.

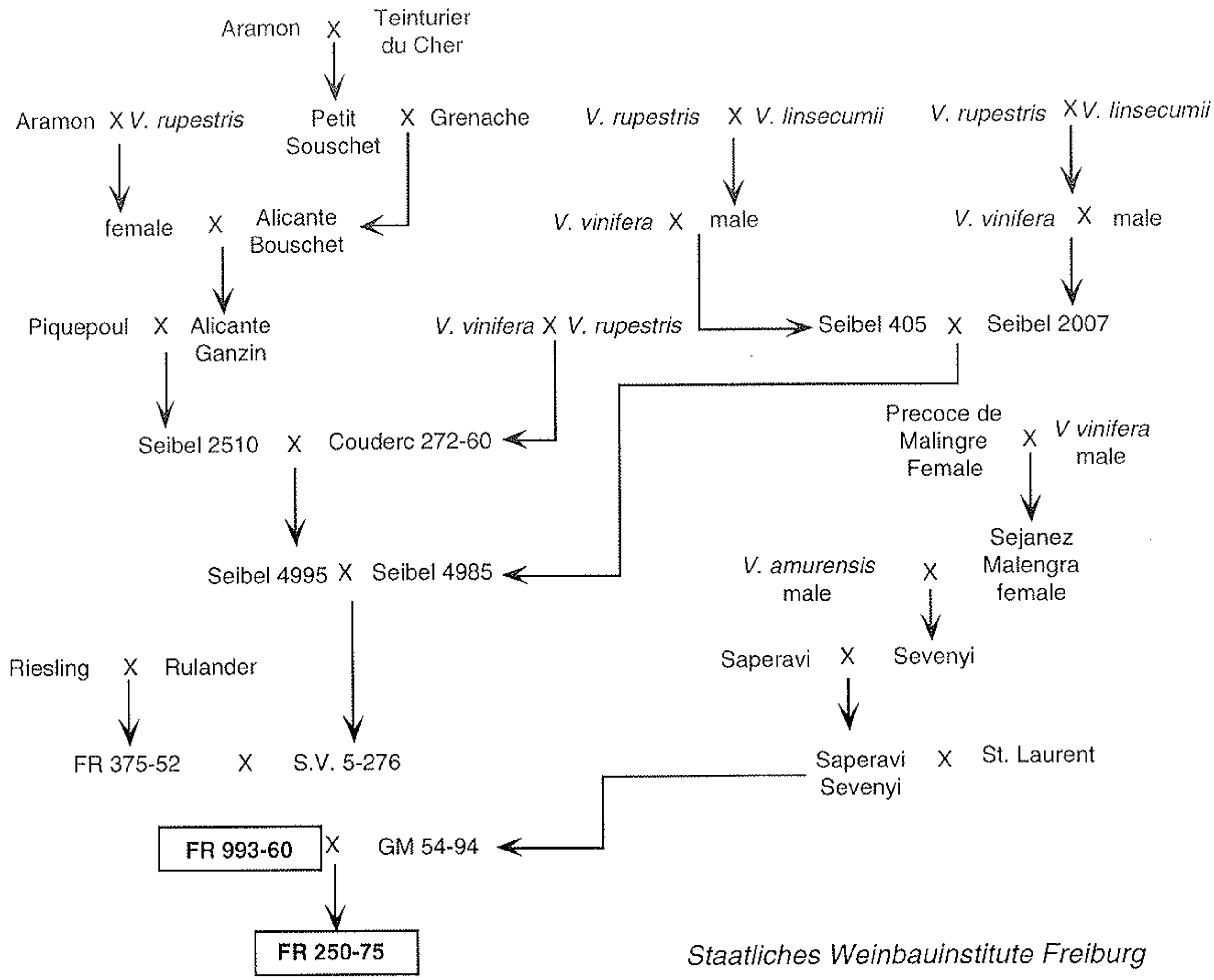


Figure 2. Geneology of the mildew resistant cultivars, FR 993-60 and FR 250-75

THE ECONOMICS OF GROWING GRAPES ORGANICALLY

Gerald B. White
..Department of Agricultural, Resource, and Managerial Economics,
Cornell University, Ithaca, N.Y.

INTRODUCTION

For the past five growing seasons (1990 - 1994), we have tracked the economic results of three grape varieties (Concord, Elvira, and Seyval Blanc) grown under two different management regimes (conventional and organic) at Taylor Wine Company's Dresden, New York vineyards. The purpose of this paper is to give growers and other interested industry personnel a guide to determine the economic impacts of growing grapes organically compared to a conventional management system. Growing costs, yields, and prices of grapes and inputs were recorded carefully over the life of the project, in cooperation with researchers from the Geneva Experiment Station and the management of Taylor Vineyards.

This paper has two objectives:

(1) To summarize and compare the five year costs and other economic results of growing grapes using conventional management practices compared with organic management practices; and

(2) To suggest the operations, inputs, and resulting costs and returns for growing Concord, Elvira and Seyval grapes using organic management practices in a typical season.

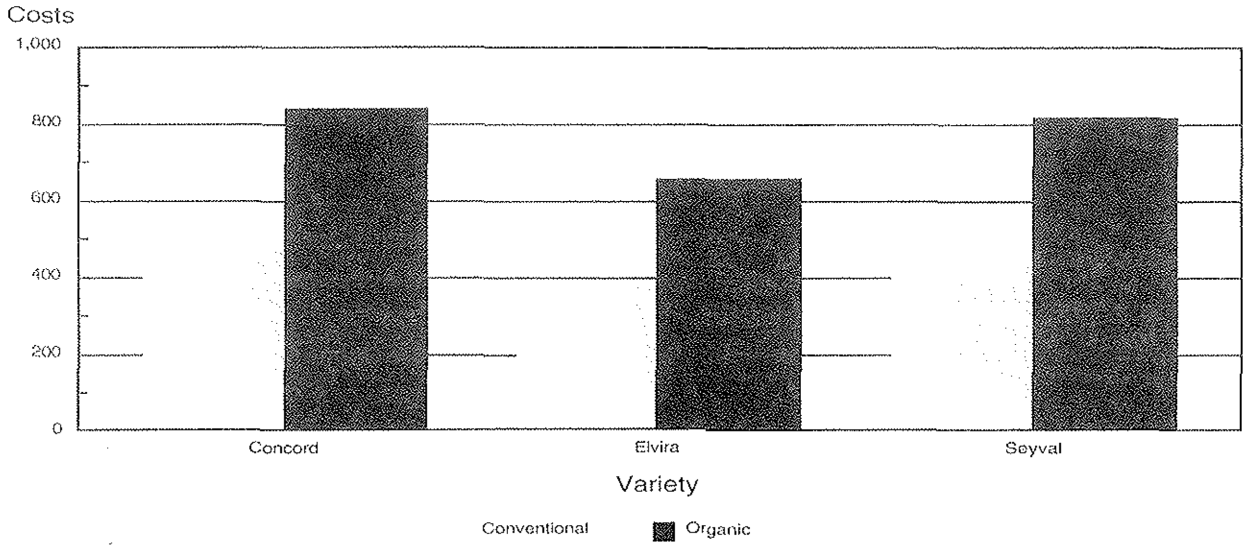
METHODS

The impact of converting vineyards to organic management practices was assessed for each variety by comparing vineyard block revenues and costs for both organic and conventional management practices. In cooperation with management at Canandaigua Wine Company, Inc., procedures were established at the beginning of the project to collect data on labor time and cost, equipment time and cost, and materials cost for each of the six vineyard blocks. Throughout the season, the numbers of sprays were recorded for each block by the research team at the Geneva Experiment Station. Vintner's International, Inc. (now part of Canandaigua Wine Company) management team recorded all other data regarding growing and harvesting costs. In order to generalize the analysis, and to avoid disclosure of proprietary data, wage rates typical for the Finger Lakes Region were used to compute labor costs. Wage rates used in the analysis were \$8.64 for skilled labor and \$5.40 for unskilled and hand labor. Wage rates were unchanged from 1993 based on wage rate data from New York Agricultural Statistics, 1993-1994. Harvesting and hauling costs of \$50 per ton (typical for custom rates in the Finger Lakes Region) were charged.

Commercial (machine harvest) yields as measured by the research team at the Geneva Experiment Station were utilized. Prices by variety as reported by the New York Agricultural Statistics Service were used to estimate receipts.

Interest on operating capital was charged based on the local Production Credit Association's (PCA's) rate for medium-sized commercial farms in 1994, or 9.25 percent annually. It was assumed that operating capital was borrowed for six months.

Figure 1. Annual Average Growing Costs Per Acre
Conventional and Organic Management Practices,
Three Varieties, 1990 - 1994



Fixed costs generally do not change between varieties and management systems; however, returns to management were computed to present a view of overall profitability. According to management, most equipment was more than 20 years old; therefore, depreciation was not included as a cost. Machinery repairs were relatively high, offsetting to a certain degree the exclusion of depreciation as a cost. Using similar logic, vineyard depreciation was not included in costs. These capital assets were assessed an opportunity cost of 9.0 percent, the PCA local association's rate for longer-term capital for medium-sized commercial loans in 1994. Interest charges were computed on the market value of all assets. Procedures were followed in estimating returns to management by the use of spreadsheet templates developed in White and Kamas.

Certain overhead items, such as property taxes, insurance, and utilities were assessed based on the most recent Grape Farm Business Summaries (Putnam, White, and Himelrick; Whitaker, White, and Zabadal). The costs from 1993 were updated by the index of prices paid by farmers (Agricultural Prices).

In order to provide information which will be useful to growers in assessing the feasibility of growing grapes organically, we developed growing costs and expected receipts and expenses for a typical growing season. For reasons to be explained later in the paper, we chose 1991 as a typical growing season.

For this section of the analysis, yields were specified at the average of the five seasons. Grape prices were also averaged by variety for the five years using data from the New York Agricultural Statistics Service. No difference in price was assumed for conventionally grown grapes compared to organically grown grapes. Prices of inputs, services, and fixed costs were taken from the final results of the most recent season, 1994.

SUMMARY AND COMPARISON OF RESULTS, 1990-1994

Growing costs were averaged for the five seasons. Results in terms of growing costs per acre are shown in Figure 1. Figure 1 shows clearly that the growing costs were higher for the organic management system. In fact, this was true for all varieties in all seasons, i. e. for 15 comparisons. On average, the growing costs for the organic system were 79 per cent higher for the Concord variety, 69 per cent higher for the Elvira variety and 91 per cent higher for the Seyval variety.

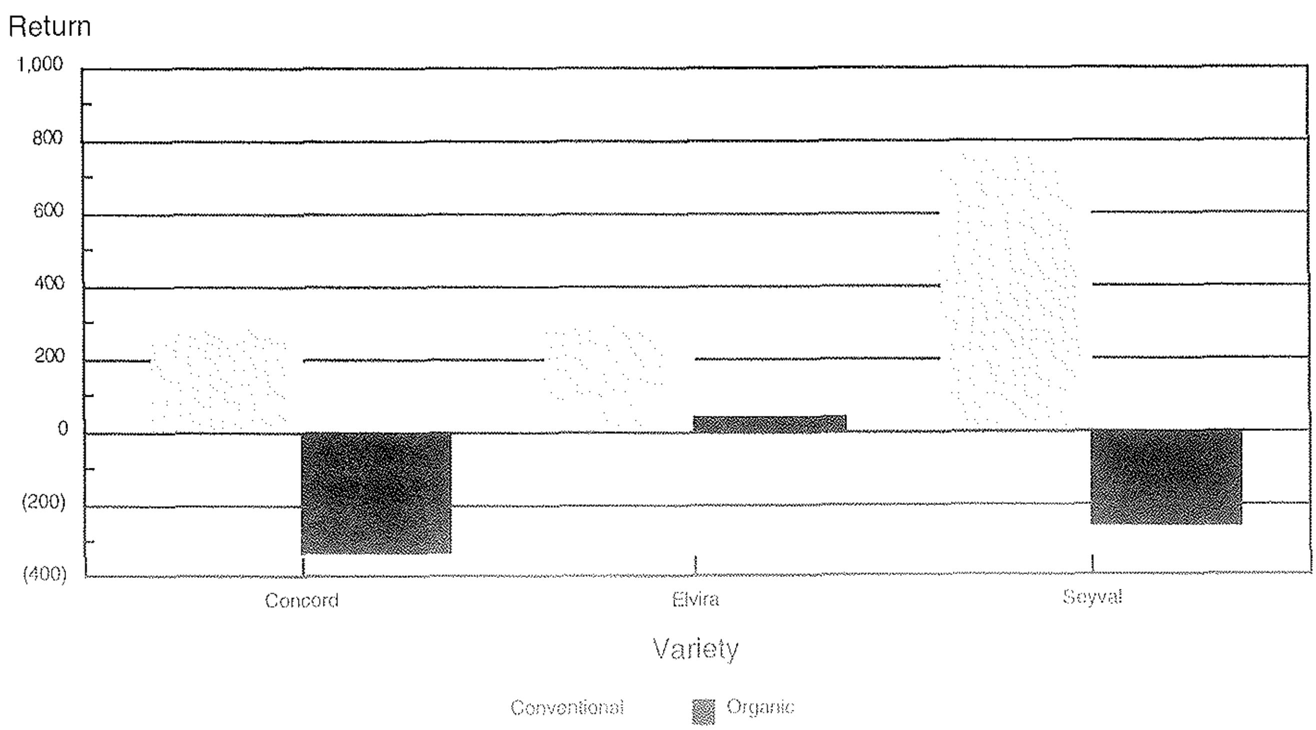
Operations which were expensive in the organic system included fertilization, to include the expensive chicken manure at $228 per ton, but also the extra cost for labor and machinery for handling the bulky material; tillage operations which replaced herbicides in the conventional system; and hand hoeing which was occasionally necessary to supplement weed control in the organic system.

The organic system had a clear advantage in the cost of the spraying operations. In a wet season (1992), however, when disease pressure was exceptionally high and the organic Seyval block required 17 spray applications, the cost of spraying was higher for the organic management system for the Seyval variety because of higher labor and machinery costs for the additional spray applications required.

Average annual returns to management was the measure of profitability employed in this study to summarize five-year results. Figure 2 indicates that the conventional management system was more profitable than the organic system for all varieties. The difference was greater than the difference in growing costs alone because average yield for the five-year period was greater for the conventional management system for all three varieties. Average yields for the conventional system were 28 percent higher for the Concord variety, five percent higher for Elvira, and 55 percent higher for Seyval compared to the organic management system.

In the short to intermediate term, growers can operate as long as cash costs are covered by cash operating receipts. The organic management system met this criterion for all three varieties on average. For the Elvira variety, fixed as well as variable costs were covered by average cash receipts, giving a positive return to management of $35 per acre for organic management practices. This indicates long-run profitability,

Figure 2. Average Annual Returns to Management Per Acre, Conventional & Organic Management Practices, Three Varieties 1990 - 1994



implying that with the Elvira variety, long term survival is feasible using organic management practices given the yields, costs, and prices realized at Taylor's Dresden vineyard.

It should be realized that all labor, including that of the owner, was charged as a cash cost; therefore owners who furnish all or a part of the labor for their grape enterprises would receive a return for their own labor that is used in the enterprise when receipts exceed other variable cash costs.

ECONOMIC RESULTS FOR A TYPICAL ORGANIC MANAGEMENT PROGRAM

Those growers who are growing, or are contemplating growing grapes organically, will need economic information for planning purposes. The intent of this section of the paper is to suggest the inputs, and operations necessary for organic production in a typical growing season. In some respects, there was not a "typical" season in the five-year period for the organic management system. In 1990, the vineyards were converted to organic management practices, and thus results were not representative of long run results. In addition, we had a problem getting an adequate amount of nutrients on the organic blocks because of difficulties in handling dairy farm manure. The 1991 season was extraordinarily favorable for grape yields and quality. The 1992 growing season was unusually wet, with abnormally high disease pressure. The 1993 season marked the lowest grape yields in the Finger Lakes Region and in the State of New York since 1977. The Concord blocks demonstrated abnormally low yield in 1994 for yet to be determined reasons.

In consultation with Vineyard manager, Bill Dunn, 1991 was chosen as the most typical season in terms of operations to be included in the planning budget. In some instances, practices and operations were modified from the 1991 season where "better" practices have been established as a result of research in subsequent season. For example, the typical organic budget includes a pass with the weed burner for sucker control, which was actually accomplished in 1991 by a hand operation.

Growing costs for a typical season are shown in Table 1 (for the Concord and Elvira varieties) and Table 2 (for the Seyval Blanc variety). Although growing costs have consistently been lower for Elvira (five -year average costs of $658 per acre compared with $839 per acre for Concord), when viewed on an operation by operation basis, no differences could be speci-

Table 1.
Growing Cost Per Acre, Concord and Elvira Grapes, Organic Practices. (CONGCFIN)

Operation	Labor Hours	Equip. Hours	Labor Cost	Equip. Cost	Materials Cost	Total Cost/Acre
Pruning	14.50	1.70	125.28	20.45	0.00	145.73
Brush removal	1.00	0.25	8.64	2.09	0.00	10.73
Chicken manure (1X)	3.00	1.50	25.92	15.00	184.00	224.92
Fertilizer (potash)	1.25	1.25	10.80	10.04	115.20	136.04
Plow (2X)	2.50	2.00	21.60	16.00	0.00	37.60
Takeout (2X)	4.50	2.50	38.88	34.78	0.00	73.66
Hand hoe	13.00	0.00	70.20	0.00	0.00	70.20
Mowing (3X)	1.50	1.50	12.96	16.95	0.00	29.91
Diggers (3X)	2.50	2.50	21.60	26.78	0.00	48.38
Disc (1X)	1.25	1.25	10.80	10.00	0.00	20.80
Suckering (propane)	0.70	0.70	6.05	9.88	13.87	29.79
Vine spray (5X)	2.50	2.50	21.60	23.20	12.87	57.67
Trellis repair (1)	0.60	0.70	5.18	2.59	4.32	12.09
TOTALS	48.80	18.35	379.51	187.75	330.26	897.52

(1) Maintenance performed every fifth year. One fifth of cost is included in annual budget.

Table 2.

Growing Cost Per Acre, Seyval Grapes, Organic Practices. (SEYGCFIN)

Operation	Labor Hours	Equip. Hours	Labor Cost	Equip. Cost	Materials Cost	Total Cost/Acre
Pruning	18.50	1.70	159.84	20.45	0.00	180.29
Brush removal	1.00	0.25	8.64	2.09	0.00	10.73
Chicken manure (1)	3.00	1.50	25.92	15.00	184.00	224.92
Fertilizer (potash) (1X)	0.40	0.40	3.46	3.21	38.40	45.07
Plow (2X)	2.50	2.00	21.60	16.00	0.00	37.60
Takeout (2X)	4.50	2.50	38.88	34.78	0.00	73.66
Hand hoe	13.00	0.00	70.20	0.00	0.00	70.20
Mowing (3X)	1.50	1.50	12.96	16.95	0.00	29.91
Diggers (3X)	2.50	2.50	21.60	26.78	0.00	48.38
Disc (1X)	1.25	1.25	10.80	10.00	0.00	20.80
Suckering (propane)	0.70	0.70	6.05	9.88	13.87	29.79
Vine spray (11X)	5.50	5.50	47.52	51.04	10.25	108.81
Trellis repair (2)	0.60	0.70	5.18	2.59	4.32	12.09
TOTALS	54.95	20.50	432.65	208.76	250.84	892.25

(1) Applied every third year. One-third of cost is included in annual budget.

(2) Maintenance is performed every fifth year. One-fifth of cost is included in annual budget.

fied. Therefore, it was decided to use the same set of practices for both varieties. For the Seyval block, more pruning is expected in a typical year than for the Concord and Elvira varieties. Potash fertilizer would be required for Seyval only once every third year, compared to every year for the Concord and Elvira varieties. Seyval grapes would require more spray applications—an estimated 11 applications per year compared with 5 applications in a typical season for Concord and Elvira. As noted in the tables for growing costs, eight different cultivation operations are required for weed control; operations identified as plowing (2 times), takeout (2 times), diggers (3 times), and disc (1 time). The estimated typical growing costs would be $892 per acre for Seyval and $898 per acre for Concord and Elvira. It should be noted that we believed it was necessary to include a hand hoeing operation which cost $70 per acre to maintain acceptable weed control, even though hand hoeing was seldom done on the organic blocks because the Taylor operation did not have the necessary manpower to accomplish this task whenever it might have seemed beneficial. That this cost was seldom incurred should be kept in mind when interpreting the data on growing costs of the five year experience (e. g. Figure 1). Perhaps hand hoeing would result in a slightly higher yield, but we have no basis for estimation of the incremental yield increase.

Tables 3, 4, and 5 show the complete accounting for projected expenses and receipts for Concord, Elvira, and Seyval, respectively. To compute receipts, five year average yields and prices were used. Projected total variable costs are greater than total receipts for the Concord variety, indicating that a grower would not choose to farm that variety organically even in the short run unless he or she could obtain some combination of higher yields, higher prices, or lower costs. The other two varieties have positive returns over variable costs, but negative returns to management in the amounts of ($238) for Elvira and ($359) for Seyval.

MARKETING AND PRICES

Since it costs more to grow grapes organically, and since not having used inorganic pesticide could be looked upon as a favorable attribute by some consumers, should not the price for organic grapes be higher than for grapes grown conventionally? In 1990 and 1991 we investigated this issue with a survey of organic growers. Through the sources available at that time, we identified 40 organic vineyards and/or wineries, of which 34 were located in California and four were located in the Finger Lakes region of New York. By initial response and telephone follow-up, 23 usable surveys were obtained. These vineyards had acreages of grapes farmed organically which ranged from one acre to 250 acres.

In order to charge a higher price for organically grown grapes, the wine must be designated as produced with organically grown grapes. Only 11 of the 21 producers who marketed wine indicated that they used an organic label. It was interesting to note that the two largest organic producers (250 and 240 acres, both in California) did not distinguish that the grapes were grown organically. One winery was not yet willing to be bound to organic guidelines, even though they were following them on a large portion of their acreage. The other was concerned that selling both organic and conventionally labeled bottles of the same variety would be potentially confusing to their customers and could hurt sales. Larger wineries may also fear that if organic wines are promoted, consumers will wonder what is "wrong" with their non-organic wines (New York Times).

Fewer wineries responded to the second half of the survey, which asked for the amount of price premium for organic wine. The few vintners who responded indicated that there was no difference in the bottle price of organic wine compared to conventional wine. This may be due to the complexity of the wine market and also because consumers are more concerned with sulfite content than whether or not the wine is organic.

These results suggested that it is unlikely that organic wines bring a price premium. It is possible that consumers' attitudes have changed since this survey was done in 1990. If there were a price premium for wine, then organically grown grapes could be expected to command a higher price. The breakeven price in Tables 3, 4, and 5 were as follows: Concord, $319 per ton breakeven compared to five-year average price of $230 per ton; Elvira, $235 breakeven price compared to $202 for the five year average; and Seyval, $339 per ton breakeven compared to $269. These breakeven prices suggest the price premium that would be necessary to induce growers to produce organically grown grapes.

SUMMARY AND CONCLUSIONS

Our five years of experience suggest that grapes can be successfully grown using organic management practices, although at a higher cost than is necessary for conventional management systems. Growing costs were from 69 to 91 percent higher, depending upon variety. Yield per acre for the organic system over the five years was 22 percent lower for the Concord variety, five percent lower for the Elvira variety, and 35 percent lower for the Seyval Blanc variety. The incidence of higher costs and lower returns meant that returns to management (a measure of profitability) were significantly lower for the organic management practices for all three varieties. The most favorable economic results were obtained for the organic management practices employed with the Elvira vineyard.

The results point out the importance of herbicides in growing grapes using conventional management practices. Conversely, the results indicate the difficulty of viticulture without herbicides, resulting in a high cost of labor and machinery for the eight machine operations and the hand hoeing that is necessary for weed control in organic grape productions. Negative results are exacerbated by the lower yields obtained from the additional competition from weeds.

Growers who are considering growing grapes organically should carefully consider the potential costs and returns. Receipts and expenses for

Table 3.
Receipts and Expenses, Concord Vineyard, Organic Practices. (CONORGF)

Item	Per Acre
Receipts:	
Yield, tons per acre	5.0
Price, $ per ton	230
Total receipts	$1,150
Costs:	
Variable	
Growing	898
Interest on operating capital (9.25 % for 6 months)	42
Harvesting & hauling (@ $50 per ton)	250
Total variable costs	$1,190
Fixed	
Interest on machinery & equipment (9.0 % X market value (1)	45
Interest on buildings (9.0 % X market value) (1)	10
Interest on vineyard ($2500 X 9.0 %)	225
Property taxes (2)	70
Insurance (1), (3)	35
Utilities (3)	22
Total fixed costs	$408
Total costs	$1,597
Returns to management	($447)
Breakeven price	$319
Breakeven yield (tons/acre)	7.5

(1) White and Kamas. Value of buildings and equipment assessed at 50 percent of new cost per acre of vineyard.

(2) Value from 1993 adjusted by 5 % according to index of prices paid for taxes, AGRICULTURAL PRICES, NASS, USDA, July 29, 1994.

(3) Value from 1993 adjusted by 0.0 % according to index of prices paid for farm services and rent, AGRICULTURAL PRICES, NASS, USDA, July 29, 1994.

Table 4.

Receipts and Expenses, Elvira Vineyard, Organic Practices. (ELVORGF)

Item	Per Acre
Receipts:	
Yield, tons per acre	7.3
Price, $ per ton	202
Total receipts	$1,475
Costs:	
Variable	
Growing	898
Interest on operating capital (9.25 % for 6 months)	42
Harvesting & hauling (@ $50 per ton)	365
Total variable costs	$1,305
Fixed	
Interest on machinery & equipment (9.0 % X market value) (1)	45
Interest on buildings (9.0 X market value) (1)	10
Interest on vineyard ($2500 X 9.0 %)	225
Property taxes (2)	70
Insurance (1), (3)	35
Utilities (3)	22
Total fixed costs	$408
Total costs	$1,712
Returns to management	($238)
Breakeven price	$235
Breakeven yield (tons/acre)	8.9

(1) White and Kamas. Value of buildings and equipment assessed at 50 percent of new cost per acre of vineyard.

(2) Value from 1993 adjusted by 5.0 % according to index of prices paid for taxes, AGRICULTURAL PRICES, NASS, USDA, July 29, 1994.

(3) Value from 1993 adjusted by 0.0 % according to index of prices paid for farm services and rent, AGRICULTURAL PRICES, NASS, USDA, July 29, 1994.

Table 5.
Receipts and Expenses, Seyval Blanc Vineyard, Organic Practices. (SEYORGF)

Item	Per Acre
Receipts:	
Yield, tons per acre	5.1
Price, $ per ton	269
Total receipts	$1,372
Costs:	
Variable	
Growing	892
Interest on operating capital (9.25 % for 6 months)	41
Harvesting & hauling (@ $50 per ton)	255
Total variable costs	$1,188
Fixed	
Interest on machinery & equipment (9.0 % X market value) (1)	45
Interest on buildings (9.0 X market value) (1)	10
Interest on vineyard ($4000 X 9.0 %)	360
Property taxes (2)	70
Insurance (1), (3)	35
Utilities (3)	22
Total fixed costs	$543
Total costs	$1,731
Returns to management	($359)
Breakeven price	$339
Breakeven yield (tons/acre)	6.7

(1) White and Kamas. Value of buildings and equipment assessed at 50 percent of new cost per acre of vineyard.

(2) Value from 1993 adjusted by 5.0 % according to index of prices paid for taxes, AGRICULTURAL PRICES, NASS, USDA, July 29, 1994.

(3) Value from 1993 adjusted by 0.0 according to the index of prices paid for farm services and rent, AGRICULTURAL PRICES, NASS, USDA, July 29, 1994.

a typical growing season were presented to aid interested growers in planning organic production.

A key to economic success with organic production will be whether or not a premium can be realized for organic wine. Our survey of five years ago suggested that a price premium was not being realized at that time. However, some vintners in selected markets may be able to sell for a premium over conventional wine. Vintners who are selling wine direct to consumers where the market area is characterized by a relatively high proportion of higher educated and higher income consumers would have the best opportunity to realize a price premium for organic wine.

REFERENCES

Agricultural Prices, 1994. National Agricultural Statistics Service, USDA, July 29.

New York Times, Organic Wines Enter the Mainstream, November 19, 1991, p. D6.

New York Agricultural Statistics, 1993-1994, New York Agricultural Statistics Service, New York State Department of Agriculture and Markets, Albany, NY. July 1994.

Putnam, L.D., G.B. White, and D.G. Himelrick, 1985. Great Lakes Region Grape Farm Business Summary, 1983, A.E. Ext. 85-4, Department of Agricultural Economics, Cornell University, Ithaca, NY. 18 pp.

Whitaker, D.B., G.B. White, and T.J. Zabadal, 1984. Finger Lakes Region Grape Farm Business Summary, 1982, A.E. Ext. 84-9, Department of Agricultural Economics, Cornell University, Ithaca, NY. 15 pp.

White, G.B. and J.S. Kamas, 1990. The Economics of Concord and Niagara Grape Production in the Great Lakes Region of New York, 1989, A.E. Ext. 90-3, Department of Agricultural Economics, Cornell University, Ithaca, NY. 15 pp.

MARKETING ORGANIC WINES IN NEW YORK

Walter Pedersen
Owner and Founder
Four Chimneys Winery and Vineyard
Himrod, New York

We at Four Chimneys have been asked to comment on marketing organic wines in New York. As North America's first winery producing and selling wines from certified organically grown grapes, now in our fifteenth anniversary year, we probably know more about the subject than anyone, only because for most of those years we were the only vineyard on the East Coast to produce and market organic wines. We have recently been joined by our friend, Richard Figiel, at Silver Thread Vineyard.

When we first approached wine stores and restaurants in the early 1980's we were most commonly met by a puzzled look on the faces of proprietors and wine buyers. Customers, too, were rather befuddled. Many, maybe the majority, had never heard the term "organic" in an agricultural sense and certainly never applied to wine. Many of the comments regarding organic chemistry were apparently not just poor attempts at humor, but a sincere desire to comprehend something new.

In the history of organic wine marketing in New York, I recognize four phases. In phase one, Four Chimneys was it. There was no other. No one had heard of the hundreds of organic growers pre-existing in Europe. Wine buyers, proprietors, and consumers were very doubtful when informed of our organic European counterparts. In addition, at that time there was a vehemently anti-New York sentiment regarding New York wines in general. This attitude is evaporating before our very eyes in the 1990's. I remember bringing our 1980 Cabernet Sauvignon that had received a silver medal in a prestigious wine competition to Soho Wines and Spirits in Manhattan. The wine buyer at the time wondered out loud whether it was the soil in New York that made this Cabernet taste like Concord. (Honestly, we didn't blend any "natives" in to add character!) It was during this phase we began fantasizing: can you imagine if we imported organic wines from some of our French and Italian colleagues, it would be like shooting ducks in a pond with these "European" New Yorkers!!

Phase two was later in the decade when a number of small California producers brought their wines into New York. Many of these had wine disease problems or were oxidized (maybe they couldn't sell them in California?), mostly because the winemakers were new and hadn't worked the kinks out of winemaking. By this time, the image of "hippie" had caught on for organic wines: stinky, countercultural, and unkempt.

Phase three was when we finally got our act together and imported our first container of wines from six of our friends in France - all excellent wines, certified organic, and of varying prices. Although we didn't see the writing on the wall before we ordered, in hindsight what happened is not all that surprising. What sold out like hot cakes was the cheapest of the Côtes du Rhône. Wine snobs were not interested - they were still in phases one and two (see above).

Phase four is the present era; represented by at least two events. The first is the present symposium. The second (preceding the first in time, and, quite possibly, in importance) is the launching of Fetzer's new Bonterra line of wines from certified organically grown grapes. We have become acquainted with the Fetzer family who began the Fetzer wine production. They are a very large family (somewhat like us in our beginnings, but with a *lot* of money) with all but one of ten siblings involved in the operation. They, however, recently sold the winery, maintaining only the organic grape production. The new owner is responsible for the daring move of adding an organic line to their already existing non-organic production - something others in California have resisted fearing the boomerang effect it might have on the image of existing non-organic products.

Where things are headed in phase four is anybody's guess. However, with good wines coming from organic growers on the West Coast - a Garden of Eden for organic viticulture, compared to cold and damp New York - we should be seeing a change in the perception of our product. It is very rare for anyone in the trade to ask "what's organic?" these days. Consumers are, for the most part, still somewhat unaware, although this is very much a function of where the consumer lives. It appears that organic consciousness is in reverse proportion to the distance from agricultural production areas. New York City, especially Manhattan, and Long Island consumers appear to be the most educated. The inhabitants of the larger communities in our region - Syracuse, Rochester, and Ithaca - have some level of organic awareness. The rest of the state is less so.

With regard to our own marketing, the major outlet is from our estate. *National Geographic* awarded us the monicker of "most picturesque winery in the Finger Lakes." Our Victorian house and barns, our chamber music series (which just ended its tenth year), and our setting on the lake are selling points - as is our large selection of wine styles, including some "foxy" items. I am sure that many more than half our customers are not buying the wines because of their organic quality, though there is no way of really ascertaining that.

We also sell to over 200 liquor stores and restaurants in New York State. Our UPS deliveries, very profitable in comparison to sales to wholesalers, has dropped off precipitously over the past few years. Two reasons explain this phenomenon. First, no carrier is willing to ship wine over state lines from the Finger Lakes (although they freely do it for the wine industry in other regions of the country) and this has created a tremendous loss of sales for Four Chimneys as well as other wineries in the region. Second, as our sales to retail stores have been increasing over the years, many former UPS customers are buying the wines at those outlets.

When it became legal to sell wine at not-for-profit farmers' markets in New York State, we were the first winery to sell in the New York City Greenmarket system in 1984. Of all the marketing we do, this is the least profitable and bears with it the most liabilities. With two vans stolen, a number of van break-ins, two major thefts of a week's take, and one armed robbery, not to speak of hundreds of tussles with criminals, the mentally deranged, the homeless, and the banana republic politics of the Big Apple, it certainly is the most problematic of all our sales venues. Most of the many wineries that attempted selling at the Greenmarket have pulled out. We are presently looking into export as being a simpler alternative.

In addition to the problems of UPS out-of-state shipments and the Greenmarket nightmare (which would be common problems to all wineries in the region), there are at least three more problems that relate more specifically to the marketing of organic wine. First is the price factor. In order to pay for the greater labor needs and other higher costs both in grape growing and winemaking, organic products must move at higher prices. There is often much resistance by middlemen who do not appreciate the organic difference.

Second, health food restaurants, which should be the best customers of an organic winery, often would rather not serve organic wine if their menu is not organic, not wanting to draw attention to that. This is slowly changing as the popularity and demand for organic wines increases.

Third is the problem with organic legislation. Wines grown organically cannot be labeled as such unless they are certified. Certification agencies unanimously require three years of organic practices - which for perennial crops can mean in essence up to four years - before a product can acquire an organic label. It is precisely during this start-up period of time that the grower needs whatever extra price increment the market can offer to offset the economic stresses of the transition to organic. The organic movement is well aware of this problem, and in some quarters this is regarded as an apt way of keeping the market small. In Europe there is a transitional designation that is understood by consumers, thus offering at least economic aid from the marketplace to growers who are undergoing what most likely will be the riskiest part of their organic history. What the solution will be for the U.S., or whether there will be one, is still up in the air.

As for the future and phase five, I really do not know. Interest in organic is definitely on the rise, as evidenced by this symposium. Perhaps one day conventional growing will become so ecological that organic will simply merge with it, and the organic movement's role as a cry in the wilderness will vanish as the essence of its message will have been heard and received. I hope so. At that point the "history of organic marketing" will be over.

SUMMARY OF EFFECTS OF ORGANIC AND CONVENTIONAL GRAPE PRODUCTION PRACTICES ON JUICE AND WINE COMPOSITION

Dr. Thomas Henick-Kling
Associate Professor of Enology
Department of Food Science
New York State Agricultural Experiment Station
Cornell University
Geneva, New York, 14456

The overall objective of this study was to determine the impact of vineyard conversion to organic farming practices on juice and wine quality.

METHODS

Samples of fruit from organically and conventionally managed vineyards were tested for differences in composition. Juices and wines were analyzed for differences in color, pH, titratable acidity, sugar (soluble solids °Brix), individual organic acids, and potassium. Additionally, wines were analyzed for residual sugar content (glucose and fructose) and ethanol. Concord was hot-pressed as is common practice (hot-pressed at 65°C, 10 minutes). Since in Concord and Elvira sensory differences other than color and acidity are not considered important in current industry practice, the wines from these cultivars were not analyzed for further taste and aroma differences. Seyval Blanc is a major wine grape variety in North Eastern USA producing a wide range of wines with different qualities. Because of this Seyval Blanc wines were analyzed by taste panels for changes in aroma, taste and texture.

What follows are summaries of juice and wine analyses for the years 1990 to 1994.

1990 RESULTS OF JUICE ANALYSES

CONCORD

Juice and wine from the Concord grapes showed some significant differences in their composi-

Juice analysis, Concord (averages of four replicates)

Treatment	pH	TA g/L	Brix*	tartrate g/L	malate g/L	acetate g/L	K^+ mg/L
Conventional	3.24	8.5	13.8	3.96	3.01	<0.1	709
Organic	3.23	9.9	15.3	4.07	2.84	<0.1	783
Significance	none	0.07	**0.02**	none	none	none	none

Treatment	browning 420 nm	red 520 nm	hue 420/520 nm	brightness 420+520 nm
Conventional	0.093	0.188	0.498	0.281
Organic	0.148	0.280	0.547	0.428
Significance	0.000	**0.020**	none	**0.002**

* Brix: total soluble solids (sugars) by refractometer (g/100 mL)

tion as a result of the two different farming systems. The juice from the organically grown grapes was of better quality (higher maturity) than that from the conventionally grown grapes. It contained more sugar (Brix) and more color, it also had a higher acid content. The wine from the organically grown grapes still had a deeper color (conventional av. 0.408, organic av. 0.536, s 0.057) and a higher tartaric acid content (4.408 vs 4.048, s 0.064).

The higher maturity in the organically grown fruit is likely due to the lower cropping on these vines.

ELVIRA

The juice analysis of the organically and the conventionally farmed grapes showed no consistent difference. Although the pH was lower and the higher content of tartaric acid in the organically farmed fruit might indicate a lower maturity, this is contradicted by the lower malic acid content and the trend to lower TA which both indicate higher maturity. There was no significant difference in the juice color although the juice and wine from the organically farmed grapes tended to be lighter in color. The pH of the wines was significantly lower for the organically grown grapes.

Juice analysis, Elvira (averages of three replicates)

Treatment	pH	TA g/L	Brix*	tartrate g/L	malate g/L	acetate g/L	K^+ mg/L	color 420nm
Conventional	3.36	9.6	14.4	3.75	4.45	<0.1	1079	0.174
Organic	3.15	8.5	13.2	4.22	3.03	<0.1	799	0.133
Significance	**0.006**	0.072	0.060	**0.048**	**0.009**	none	**0.002**	0.147

Wine analysis, Elvira (averages of three replicates)

	pH	TA	alc.	tartrate	malate	acetate	K^+	color
Treatment		g/L	vol.%	g/L	g/L	g/L	mg/L	420 nm
Conventional	3.23	8.89	10.8	1.79	3.88	0.33	555	0.121
Organic	3.01	8.35	11.4	2.42	3.41	0.25	374	0.087
Significance	**0.005**	none	none	0.209	none	none	0.004	0.155

SEYVAL

The chemical composition of juice and wine showed no major differences between the two treatments. There was a trend towards lower pH, higher TA and malate and tartrate in the organically grown fruit, indicating a somewhat lower maturity. Fruit from both growing systems had high acetate content indicating significant bunch rot in both systems.

Wine sensory analysis

The sensory analysis of the wines produced from the conventionally and the organically grown grapes showed only a small difference in the wine quality. Comparing all the attributes which were rated by the tasters, the wine from the organically grown grapes was rated slightly better than that from the conventionally grown grapes (p=0.06, multivariate analysis of variance, Wilk's Lambda), fruitiness was rated higher in the conventional wine (p=0.002). There was no difference in the overall quality as perceived by the tasters, nor in the wines' floral, spicy, sweetness, acidity, earthy, and vegetative characteristics, nor in body and length of finish.

Juice analysis, Seyval (averages of three replicates)

Treatment	pH	TA g/L	Brix*	tartrate g/L	malate g/L	acetate g/L	K^+ mg/L
Conventional	3.04	9.54	11.3	3.12	2.95	0.44	678
Organic	2.94	10.1	14.0	4.40	3.22	0.43	746
Significance	**0.021**	none	none	none	none	none	none

Wine analysis, Seyval (averages of three replicates)

Treatment	pH	TA g/L	alc. vol.%	tartrate g/L	malate g/L	acetate g/L	K^+ mg/L
Conventional	3.00	9.63	10.2	3.10	3.75	0.33	652
Organic	2.92	9.36	11.3	3.18	3.02	0.33	434
Significance	none	none	none	none	0.074	none	0.087

1991 RESULTS OF JUICE ANALYSES

CONCORD

There were no significant differences between the juices from the conventionally and the organically grown Concord grapes. The differences indicated by the average values for each treatment were not significant due to a somewhat large variation between replicate samples. Still, these differences indicate only a small difference in the juice quality, the juice from the organically grown grapes had a higher sugar content but also a higher acetate content which indicates a higher percentage of rotten fruit in these grapes. This concentration of acetic acid is close to the taste threshold (0.4 g/L) which some individual samples exceeded. Importantly, there was no difference in the color quality of the grapes.

Juice analysis, Concord (averages of three replicates)

Treatment	pH	TA g/L	Brix*	tartrate g/L	malate g/L	acetate g/L	K+ mg/L	color 420 nm	520nm
Conventional	3.22	6.83	13.3	4.46	1.44	0.04	999	0.109	0.108
Organic	3.30	6.72	14.6	4.01	1.02	0.28	1100	0.087	0.101
Significance	none	none	none	none	none	none	none	none	none

ELVIRA

The organically grown Elvira grapes were of better quality, their sugar content was slightly higher, titratable acidity was higher and pH was lower, tartrate and malate content were higher. The acetic acid content in the conventionally grown grapes indicates more bunch rot in these grapes. The juice from the organically grown grapes was more brown (s=0.01).

Juice analysis, Elvira (averages of three replicates)

Treatment	pH	TA g/L	Brix*	tartrate g/L	malate g/L	acetate g/L	K+ mg/L	color 420 nm
Conventional	3.53	5.76	15.8	2.9	1.08	0.77	853	0.143
Organic	3.17	6.98	16.3	3.26	1.82	0	945	0.277
Significance	**0.013**	0.084	**0.033**	**0.029**	**0.031**	**0.025**	**0.018**	**0.01**

SEYVAL BLANC

The organically grown Seyval Blanc grapes were more mature than the conventionally grown grapes, sugar content was higher and acid content lower. The juice from the organic grapes as in the Elvira tended to be browner.

Juice analysis, Seyval (averages of three replicates)

Treatment	pH	TA g/L	Brix*	tartrate g/L	malate g/L	acetate g/L	K+ mg/L	color 420 nm
Conventional	3.03	11.43	19.9	3.68	2.93	0	1062	0.065
Organic	3.03	9.95	21.8	4.04	2.25	0	878	0.219
Significance	none	**0.007**	**0.049**	none	0.068	0	0.269	0.09

Wine sensory analysis

1991 SEYVAL Wines

The statistical analysis of the sensory quality of the Seyval wines from the 1991 vintage shows only a very small difference between organically and conventionally managed grapes. The wines were rated by a taste panel for the following qualities: *fruity, spicy, earthy, vegetative,* body + mouthfeel, finish, sweetness, acidity, and overall quality. The wines differed in perceived earthy and spicy characters, not in overall quality.

The overall small difference between the wine from conventionally and organically managed vineyards is likely due to the very favorable growing conditions in 1991. Vines under both cultivation systems were able to mature a crop of good maturity that was essentially rot free.

Summary 1990 and 1991

Juice from Concord vines under organic management and conventional management showed no difference. Juice from Elvira vines under conventional management was of better quality than that from organically managed vines in 1990, whereas the opposite was true in 1991. There was no difference in juice or wine quality from Seyval vines on either management system in 1990. However, in 1991 Seyval juice from the organically managed vines was of higher quality than that from the conventionally managed vines. In general, better quality juice is associated with more mature crops which in turn are dependent on crop size and canopy size and function. Presently, there are no obvious trends favoring one management system over the other.

1992 RESULTS OF JUICE ANALYSES

CONCORD

The results of the juice analyses indicate that conventionally grown Concord grapes were slightly riper than the organically grown grapes. In the conventionally grown grapes, the pH was significantly higher. In addition, although not significantly, the sugar content tended to be higher and acidity tended to be lower (TA and tartaric and malic acid content). There was no significant difference in juice color.

Juice analysis, Concord (averages of three replicates)

Treatment	pH	TA g/L	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K+ mg/L	color 420 nm	520nm
Conventional	3.21	11.9	13.1	3.13	3.35	0	340	0.062	0.234
Organic	3.17	13.1	12.4	3.60	3.66	0	392	0.088	0.276
Significance*	**0.008**	0.175	0.416	0.184	**0.069**	0	0.264	0.550	0.722

*T-test (n=3)
°Brix: measured by refractometer in g/100mL
TA: titratable acidity, expressed as tartaric acid

ELVIRA

There were no significant differences in the juice quality between conventionally and organically grown grapes.

Juice analysis, Elvira (averages of three replicates)

Treatment	pH g/L	TA	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K^+ mg/L	color 420 nm
Conventional	2.91	17.8	11.8	4.55	6.79	0	746	0.101
Organic	2.83	19.3	11.3	5.01	7.06	0	737	0.87
Significance*	0.193	0.525	0.140	0.184	0.726		0.819	0.763

*T-test (n=3)
°Brix: measured by refractometer in g/100mL
TA: titratable acidity, expressed as tartaric acid

SEYVAL

Because of the high incidence and severity of bunch rot in 1992, grapes were separated into "clean" and "field run". For the "clean" fraction the grapes were harvested from the replicate blocks and the bunch rot infected grapes were sorted out of each of the replicates. The clean sorted replicates were then processed and evaluated separately. For the "field run" samples, no selection of clean and infected fruit was made. These samples represent the grape quality as expected from mechanical harvest or hand harvest without selecting before processing. In situations with severe bunch rot , a processor may have to use additional labor to preselect the fruit in order to maintain good quality in juice and wine.

The juice from the non-selected, "field run" shows several differences in the quality of the conventionally and the organically grown fruit. The conventionally grown fruit was riper which is shown in a higher sugar content, higher pH, and lower acidity. There was no significant difference in the color of the juice. The fruit from both cultivation methods suffered from mold infections. The much stronger browning of the juices from the field run samples (mean 0.181 absorbance units at 420 nm) compared to that of the selected clean fruit (mean 0.038 abs. units) shows that this selection of clean fruit significantly (s=0.013, n=6) improved the quality of the juice from both cultivation practices. The clean sorted fruit from both treatments also had a significantly higher potassium content (s=0.048, n=6) and higher pH (s=0.039, n=6).

The chemical analyses of the juices from the clean fruit showed no difference based on the farming practices.

Further differences between the organically and the traditionally grown fruit and the selected and non-selected fruit can be expected in the sensory quality of the wines.

Juice analysis, Seyval, field run, non-selected fruit with bunch rot infection (averages of three replicates)

Treatment	pH	TA g/L	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K+ mg/L	color 420 nm
Conventional	2.92	11.4	15.5	4.01	3.73	0	773	0.131
Organic	2.84	12.9	13.3	4.18	3.89	0	677	0.23
Significance*	**0.033**	0.103	**0.007**	0.096	0.687	0	0.079	0.270

*T-test (n=3);
°Brix: measured by refractometer in g/100ml;
TA: titratable acidity, expressed as tartaric acid

Juice analysis, Seyval, selected clean fruit (averages of three replicates)

Treatment	pH g/L	TA °Brix	sugar g/L	tartrate g/L	malate g/L	acetate mg/L	K+ 420 nm	color
Conventional	2.82	13.2	14.7	3.82	3.67	0	557	0.020
Organic	2.86	12.4	13.9	4.29	3.86	0	636	0.054
Significance*	0.926	0.233	0.173	0.177	0.388	0	0.481	0.164

*T-test (n=3)
°Brix: measured by refractometer in g/100mL
TA: titratable acidity, expressed as tartaric acid

Summary 1992

This year, as opposed to last year, the Concord grapes grown under conventional management were slightly riper in sugar and acid content than those farmed organically, yet there was no difference in juice color. There was no significant difference in the juice quality of the Elvira grapes from the organically and the conventionally farmed vineyard blocks. Because of the high incidence and severity of bunch rot (mainly powdery mildew, downy mildew, and black rot) it was decided to separate the fruit from both treatments 'clean' and 'field run' samples. For the 'clean' samples grape bunches free of mold infection were selected from each replicate. For the 'field run' samples no selection was made. These samples were intended to represent machine harvested fruit. The hand selection of fruit before processing might be chosen by a winery in order to work with high quality grapes. This practice of course adds significantly to the cost of the grapes. Analysis of the juice from the non-selected grapes showed that the grapes from the conventionally farmed vines were more mature with higher higher pH and higher sugar content. There was no significant difference in the amount of acetic acid, indicating that no secondary infection of the fruit by acetic acid producing bacteria and yeast occurred. The juice from the selected clean fruit showed no significant differences in quality from the two growing systems. The sensory analysis of the wines will tell whether there was a difference in the maturity of the fruit aromas. In the 1991 Seyval wines there were only two small differences in the sensory quality. The wines differed slightly in perceived spicy and earthy characters but not in overall quality. Overall, in the 1992 season, the fruit from the conventionally farmed vineyard was somewhat more mature.

1993 RESULTS OF JUICE ANALYSES

CONCORD

The most important difference between the juices from the two treatments is the much increased content of copper in the juice from the organically farmed grapes. These higher amounts of residue likely are a direct result of the increased use of copper under organic farming practice to control fungal infections. The organic blocks received four sprays with a total of 8 lbs/acre COCS 50WP, the conventionally farmed blocks received no copper sprays. Residual copper on the grape berry does enter the juice during the pressing of the grapes. The residual amount of copper in the organic juice is above the limit for copper in wine (0.4 mg/L) but there is no federal standard for copper concentration of grape juice. If this juice was fermented, the copper concentration would be reduced as up to 90% of the copper can be removed by adsorption to yeast.

Yield in the conventionally farmed blocks was much higher than in the organic, but it did not result in an apparent difference in fruit maturity. There was no difference in color, titratable acidity was lower in the organic fruit, yet sugar content, pH, and individual organic acids showed no change. Apparently, the conventionally farmed vines were able to ripen this higher crop load. The small difference in the potassium (K^+) content can, with our current knowledge, not be related to the different farming practices. According to the petiole analysis, vines in both treatments were deficient in potassium.

Juice analysis, Concord (averages of three replicates).

Treatment	pH	TA g/L	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K^+ mg/L	Cu mg/L	color 420 nm	520nm
Conventional	2.84	10.8	13.5	2.51	0.98	<0.1	789	0.15	0.295	0.301
Organic	2.83	11.5	13.8	2.45	1.18	<0.1	863	0.55	0.281	0.300
Significance*	0.14	**0.04**	0.29	0.40	0.24		**0.04**	**0.002**	0.16	0.3

*T-test (n=3)
°Brix: measured by refractometer in g/100mL
TA: titratable acidity, expressed as tartaric acid

ELVIRA

As with the Concord juice, the most important difference is the different residual amounts of copper. The juice from the organically farmed grapes contained approximately twice as much copper than that from the conventionally farmed grapes. This difference can not be explained by different spray applications - there was no copper applied to the organic nor the conventionally farmed vines this season. Overall, there was no important difference in the fruit maturity. Small, statistically significant, differences in the juice quality show a trend that the organically grown fruit is riper than that from the conventional farming practice. The difference in the color indicates that the juice from the conventionally farmed grapes browned more easily. This difference might not be apparent in the wine since most of the easily oxidizable phenols precipitate during fermentation and clarification. These small differences in the juice quality are likely not important in the wine quality. There was no difference in the yield from the two farming practices.

Juice analysis, Elvira (averages of three replicates).

Treatment	pH	TA g/L	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K+ mg/L	Cu mg/L	color 420 nm
Conventional	2.97	10.2	13.9	1.73	1.86	<0.1	845	0.20	0.147
Organic	2.81	9.6	14.5	1.88	1.50	<0.1	905	0.41	0.126
Significance	**0.1**	0.18	**0.07**	0.36	0.11		0.37	**0.05****	**0.10**

*T-test (n=3) **T-test (n=2)

°Brix: measured by refractometer in g/100mL

TA: titratable acidity, expressed as tartaric acid

SEYVAL

Fruit from both farming practices had the same degree of fungal infection (approx. 10%) therefore, no fruit was selected out before processing. The chemical analyses of the juices indicates that the fruit from the organically managed vines was riper. The titratable acidity and malic acid content were lower, tartaric acid content was higher. There was a significant difference in yield from the two farming practices. The higher yield in the conventionally farmed vines might be responsible for the apparent lower maturity. Sensory analysis of the wines must confirm whether there is a difference in wine quality. The difference in the copper residue also indicates that higher residues are likely due to the organic practice. Copper was applied to the organically farmed blocks in mid-July (2 lbs/acre of COCS). The residue in the juice from the conventionally farmed grapes is surprisingly high considering that no copper spray was used in this block in 1993.

Juice analysis, Seyval, (averages of three replicates).

Treatment	pH	TA g/L	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K+ mg/L	Cu mg/L	color 420 nm
Conventional	2.82	10.3	19.5	1.86	1.46	<0.1	934	0.46	0.138
Organic	2.82	8.97	19.7	2.26	1.05	<0.1	839	0.61	0.137
Significance	0.5	**0.06**	0.36	**0.04**	**0.03**		**0.11**	**0.03**	0.43

*T-test (n=3)

°Brix: measured by refractometer in g/100mL

TA: titratable acidity, expressed as tartaric acid

Results of Wine Analyses For 1993

CONCORD

As anticipated, the small differences in juice composition which were apparent before fermentation were no longer apparent after fermentation and stabilization (and clarification) of the wines. Potassium content remains the only significant difference.

Wine analysis, Concord (averages of three replicates)

Treatment	pH	TA g/L	tartrate g/L	malate g/L	lactate g/L	acetate g/L	K+ mg/L	Cu mg/L	color 420 nm	520nm
Conventional	3.16	0.99	1.84	0.71	0.23	0.24	421	0.30	0.25	0.49
Organic	3.16	1.04	2.05	0.82	0.25	0.23	789	0.33	0.33	0.62
Significance*	no	no	no	no	no	no	**yes**	no	no	no

*t-test; alpha = 0.05 (n=3)
Analysis done by t-test using Data Desk statistical analysis program
TA: titratable acidity, expressed as tartaric acid

ELVIRA

As in the Concord sample, the small differences apparent in the juices were no longer present in the wine. The lactic acid content in the wines from the two treatments is different. This is not due to an effect of the grape growing conditions but rather due to winemaking differences. Samples from the conventionally farmed grapes apparently underwent spontaneous malolactic fermentation (bacterial conversion of malic to lactic acid). Overall, the wines showed no difference due to the different farming practices.

Wine analysis, Elvira (means of three replicates)

Treatment	pH	TA g/L	tartrate g/L	malate g/L	lactate g/L	acetate g/L	K+ mg/L	Cu mg/L	color 420 nm
Conventional	3.56	1.03	1.01	1.44	1.08	0.44	516	<0.2	0.24
Organic	3.25	0.97	0.81	1.12	0.08	0.33	421	<0.2	0.57
Significance	no	no	no	no	yes	no	no	no	no

Analysis done by t-test using Data Desk statistical analysis program
*t-test; alpha= 0.05 (n=3)
TA: titratable acidity, expressed as tartaric acid

SEYVAL

The tartaric acid content remains the only difference in the wines. All others differences noted in the juices from the two farming practices did disappear with vinification. The wines were tasted by a "free choice profiling" method. The panel consisted of eight experienced wine tasters. All samples were done in duplicate, and presented in a randomized order. The numerical values were based on a line scale with values ranging from a minimum of zero and a maximum of eight. In the sensory analysis, the wines were found to differ in spicy, skunky characteristics, the wine from the organically farmed grapes were judged in their overall quality slightly higher than that from the conventionally farmed grapes. This very small difference overall between the wines is certainly due to the very favorable growing conditions in this year. Vines under both cultivation systems were able to mature a good crop with low incidence of bunch rot.

Wine analysis, Seyval Blanc, (averages of three replicates)

Treatment	pH	TA g/L	tartrate g/L	malate g/L	lactate g/L	acetate g/L	K^+ mg/L	Cu mg/L	color 420 nm
Conventional	2.98	0.95	0.49	1.17	0.08	0.4	430	<0.2	0.12
Organic	2.92	0.87	1.09	0.94	0.07	0.25	406	<0.2	0.13
Significance	no	no	**yes**	no	no	no	no	no	no

*t-test; alpha=0.05 (n=3)
Analysis done by t-test using Data Desk statistical analysis program
TA: titratable acidity, expressed as tartaric acid

SENSORY TEST

SEYVAL BLANC

Treatment	Fruity	floral	spicy	earthy	vege-tative	Body/ mouthfeel	finish	flinty	skunky	overall
Conventional	3.8	2.5	3.1	2.3	2.1	3.9	4.1	3.0	4.7	3.5
Organic	4.2	2.7	3.2	1.7	1.8	3.9	4.1	3.2	2.5	4.7
Diff. @ 95%	no	no	**yes**	no	no	no	no	no	**yes**	**yes**

Summary 1993

Due to the very favorable growing conditions during this season, there was very little disease pressure and fruit from both farming practices was able to mature well without significant bunch rot. The most important difference is the clearly increased copper residue in the juice from the organically farmed grapes. With the necessity to rely solely on copper and sulfur sprays under organic farming practices to control fungal diseases we have to accept higher residual amounts of these substances in the juice and the wine. Higher residual amounts of sulfur can have an organoleptic impact (formation of H_2S during fermentation), the copper residues found in grape juice and wine can reach the legal limit in wine and cause haze formation. US Federal drinking water standard (1992) sets a tolerance of 1 mg/L for copper. There is no health concern from the copper residue found in the juices. (Note: In the juice analysis the sugar content was found to be significantly higher than sugar levels reported in Table 1.10 in the 'Yield' component of this report. We attribute this difference to be the difference in the sample size for each evaluation. In the 'Yield' component, 100 berries were taken from clusters from each hand harvested vine. In contrast, sugar levels obtained from the juice analysis component were a mixture of clusters taken from hand harvested vines throughout the sample plots.

1994 RESULTS OF JUICE ANALYSES

CONCORD

The most important difference between the juices from the two treatments is the much increased content of copper in the juice from the organically farmed grapes. These higher amounts of residue likely are a direct result of the increased use of copper under organic farming practice to control fungal infections. The organic blocks received four sprays with a total of 8 lbs/acre COCS 50WP, the conventionally farmed blocks received no copper sprays (last application was on 7/26/94; harvest was on October 3). Residual copper on the grape berry does enter the juice during the pressing of the grapes, especially with hot pressing. This amount of copper in the juices is below the legal maximum (0.4 mg/L in wine). It can be expected that this amount of copper is lowered during fermentation as up to 90% of the copper can be removed by adsorption to the yeast.

The organically grown Concord has higher acidity. This can indicate delayed ripening of these grapes.

Juice analysis, Concord (averages of three replicates)

Treatment	pH	TA g/L	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K^+ mg/L	Cu mg/L	color 420 nm 520nm
Conventional	3.52	0.49	16.8	1.32	0.61	<0.1	745	0.16	sampling error
Organic	3.34	0.84	17.2	1.80	1.27	<0.1	848	0.33	sampling error
Significance*	no**	no**	no	no**	**Yes****	no	no	YES	

*t-test; alpha = 0.05 (n=3)
**t-test;alpha = 0.2 (n=3)
Analysis done by t-test using Data Desk statistical analysis program
TA: titratable acidity, expressed as tartaric acid

ELVIRA

Again, as in the Concord juices, the most important difference is the different residual amounts of copper. The juice from the organically farmed gapes contained approximately four times as much copper than that from the conventionally farmed grapes. The organic blocks received three sprays with a total of 9 lbs/acre copper sulfate ($CuSO_4$), (last application was on 7/27/94; harvest was on August 30). The juice from the conventionally farmed grapes also showed a relatively high copper content although these grapes had received no copper sprays. Overall there was no important difference in the fruit maturity evident in these analyses, sugar and malic acid content were similar in both treatments, yet the higher titratable acidity and tartaric acid content indicate a delay in ripening in the organically farmed grapes.

Juice analysis, Elvira (means of three replicates)

Treatment	pH	TA g/L	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K^+ mg/L	Cu mg/L	color 420 nm
Conventional	2.79	1.89	9.7	2.39	6.48	0.05	642	0.43	0.25
Organic	2.62	2.50	9.4	2.67	6.55	0.05	540	1.63	0.19
Significance*	no	**Yes**	no	no	no	no	no	**Yes**	no

*t-test; alpha = 0.05 (n=3)
Analysis done by t-test using Data Desk statistical analysis program
TA: titratable acidity, expressed as tartaric acid

SEYVAL

As with the other varieties, the copper residue is higher in the juice from the organically farmed grapes. This difference indicates that the increased use of copper sprays to control fungal disease on the grape vines does lead to higher residues in the juice. The organic blocks received three sprays with a total of 9 lbs/acre copper sulfate ($CuSO_4$), (last application was on 7/26/94; harvest was on September 9) and the conventionally farmed blocks received no copper sprays. There are no other significant differences apparent in these analyses.

Juice analysis, Seyval,(averages of three replicates)

Treatment	pH	TA g/L	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K^+ mg/L	Cu mg/L	color 420 nm
Conventional	2.93	1.16	14.9	2.11	3.17	0.05	555	0.5	0.15
Organic	2.87	1.27	15.3	2.13	2.81	0.06	642	1.23	0.15
Significance*	no	no	no	no	no	no	no	**Yes**	no

*t-test; alpha = 0.05 (n=3)
Analysis done by t-test using Data Desk statistical analysis program
TA: titratable acidity, expressed as tartaric acid

Wine Analysis 1994

Throughout the five years it has been practice for a panel to sample the wines six or more months after bottling. The 1994 wines, therefore, will not be sampled until a later date.

Summary 1994

Due to the growing conditions during this season, there was very little disease pressure and fruit from both farming practices was able to mature well without significant bunch rot. The most important difference is the clearly increased copper residue in the juice from the organically farmed grapes. With the necessity to rely solely on copper and sulfur sprays under organic farming practices to control fungal diseases we have to accept higher residual amounts of these substances in the juice and the wine. In organically produced Elvira and Seyval juice the copper residue was above the limit set by processors. For good manufacturing practice, large juice processors have set a maximum of 0.47 mg/L copper in single strength juice. Higher residual amounts of sulfur can have an organoleptic impact (formation of H_2S), the copper residues found in grape juice and wine can reach the legal limit in wine and cause haze formation. Fruit maturity was delayed in the organically farmed Concord and Elvira grapes.