Frontiers of Plant Science

A REPORT FROM THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

IN THIS ISSUE

Gary Crump

Grapes and Wine in Connecticut
Gary Crump
Owner and Winemaker at Priam Vineyards

Grape Cultivar Selection and Grapevine Canopy Management
William R. Nail, Ph.D.
Department of Forestry and Horticulture
The Connecticut Agricultural Experiment Station

Connecticut grown grapes

personal-sized watermelons

Specialty Fruits Provide New Opportunities for Connecticut Growers
Abigail A. Maynard, Ph.D.
Department of Forestry and Horticulture
The Connecticut Agricultural Experiment Station

Japanese plums

beach plums

Volume 57
Number 1
Fall 2006
ISSN: 0016-2167

GRAPES AND WINE IN CONNECTICUT

Gary Crump
Owner and Winemaker at Priam Vineyards
Connecticut Farm Wine Development Council
Vice President, Connecticut Vineyard and Winery Association

This was the Samuel W. Johnson Memorial Lecture given at Plant Science Day 2006.

Dr. Magnarelli, members of the Board of Control, ladies and gentlemen, thank you for the opportunity to address you on the subject of "Grapes and Wine in Connecticut."

The History

I am honored to deliver this year's Samuel W. Johnson lecture. I started down the road of growing grapes and winemaking by visiting both this station and the facility in Windsor with Dr. Richard Kiyomoto. The first wines I made were with grapes from the experiment station. Dr. Kiyomoto did not realize the impact he was going to have upon me and my wife Gloria with our decision to grow grapes and make wine in Connecticut.

My wife and I would hand crush the fruit that Richard had brought to us then I would ferment it in my garage in West Hartford. That garage was my experimental laboratory where I taught myself how to make wines, using local grapes.

I hope by now most of you have visited the grounds of this beautiful place of inspiration, right in the middle of suburban life, Lockwood Farm. Thanks to all the people that had vision enough to preserve this wonderful farm for a place of research and science. We appreciate the support given to us by everyone here at the Station.

The recent history of making wine in Connecticut is marked by the passing of the Farm Wine Act in 1978. The State passed a law that allowed us to grow grapes and produce wines on our farms, repealing some of the old prohibition provisions (It is amazing how long blue laws hang around). All of the vines across the country were torn out. Very few exceptions existed; Brotherhood and a few others survived prohibition. It set us (as an industry) back decades. We are just now recovering from bad policies.

The Federal Government had passed laws that prohibited the growing or producing of alcohol unless you had a priest on the property making wine for the church. (Amazing you could drink in church, but no where else). Several farms applied for their permits, the ones that survived are as follows: Haight Vineyard, July 1979; Hopkins Vineyard, July 1981; and Di Grazia, 1984.

Farmers had very little factual data to look at when making decisions pertaining to plant selection and their viability. Needless to say, there were many bumps along the road to success. Gerald S. Walton started research here in response to the passage of the Farm Winery Act of 1978.

With the support of The Connecticut Agricultural Experiment Station, Dr. Gerald Walton planted the first vines in 1978 (eight varieties) and added 7 more the following year with research continued by Dr. Richard Kiyomoto in 1990. Today, Dr. William Nail works here at Lockwood Farm and in Windsor to find out what varieties and rootstock combinations of grapes work best in Connecticut. This experiment station has been critical to our survival and success, through the many services offered, plant pathology, entomology, soil analysis, etc... A wealth of knowledge has been garnered in the past 28 years thanks to these efforts and the support of the state legislature.

That was a long time ago, and a lot has changed since then.

Today's Industry and Practices

After the first generation of wineries in the state, the second group had a winery named Chamard in its midst; they did a great job of getting Connecticut wines into local package stores and restaurants. They focused on Burgundy style wines, Chardonnay, Merlot,

Cabernet Sauvignon. By this time, we were starting to understand what really worked in our area. Then, along came Sharpe Hill (the state's largest winery) and made a wine called Ballet of Angels. They now sell around 15,000 cases of just this one wine, nationally. Connecticut now has 21 wineries with 5-10 more in development stages. We have 10-15 small vineyards across the state that grow grapes for some of the local wineries. The success of every winery prior to our entry into the market has helped in our success, and our success helps to foster new vineyards and wineries.

We at Priam Vineyards started as growers of grapes in 1998 and not as a winery. It's amazing how fast things change as you progress down the road in business. We started our winery in 2002 and then opened to the public in 2003. Since then, we have won more than 36 international medals against some of the largest wineries in the world, proving that you can make great wine in Connecticut.

When farmers want to plant grapes today, they only need to make a couple of phone calls and the information is there. We now have books available here at the Station to help you with your decisions. They can call and talk to an expert in the wine industry or visit the Station to look at the vines grown here. Dr. Bill Nail is here to help guide them in their decisions. There are many types of grapes to choose from when starting a vineyard or winery, and I will discuss a couple of them this morning, Vitis Vinifera and French American Hybrids.

Vitis Vinifera contains all of the varieties that we think of as noble grapes such as Merlot, Cabernet, Chardonnay, Riesling and many others.

French American Hybrids were developed to help in areas affected by phylloxera (an insect problem) and cold weather for example. Growers have had some success and some failures with both types of grapes, some of which were economic and not a failure of the plants themselves. Consequently, (businesses closed, there was poor management, etc...) One vineyard and winery in Connecticut, Crosswoods, decided to plant only one type of grape and produce only one wine. They had to close up and are no longer in business. There was not enough demand for a single wine. There are risks in farming, including the grape industry. Spread your risk out with several types of grapes and make wines that your consumers want to buy (not what you like). People say they like dry wines but they tend to buy wine that is a little sweet. White Zinfandel is still a huge segment of the market. That said, I will now talk about some of the success we have achieved as a new industry in Connecticut.

Connecticut Varietals

Cabernet Franc, Chardonnay, and Riesling have proven to be relatively tolerant to our climate. Wineries from across the state have won over 250 medals in international competitions. This level of success is not an accident; it has been a combination of hard work and science. The wineries that have won recent international competitions have focused on quality first and foremost. Quality starts in the vineyards, and then moves into the winery. Vineyard managers and winemakers need to have the same goal, the highest quality grapes possible. This means you may need to have less of a fruit load to insure ripeness at harvest. I feel that 2-3 tons per acre is the maximum for our climate. If one has higher yields of 2-3 tons per acre, it seems to produce off flavors. You need to leave 2-4 canes when cane pruning or 10-15 spurs if spur pruning. Then, later in the season thin out the fruit after fruit set and verasion.

Chardonnay seems to work well in all areas of the state, reasonable yields and high quality. There are some disease problems, such as powdery and downy mildew but overall it's a good grape. This year seems to be a difficult season for Chardonnay with loads of powdery mildew that will not go away. It also allows you the ability to have a couple of wines with only one grape. As a winemaker, you can barrel ferment or ferment in stainless steel tanks, finish it sweet or dry etc...

Riesling is now receiving the attention and praise that it deserves. The grape tolerates cold quite well and makes wonderful wines. It also gives the winemaker a lot of choices: sweet, semi-sweet, dry or a dessert wine all with the same grapes. This grape is one of my favorites. It is not as hard to manage as Chardonnay and is of equal quality or better.

Cabernet Franc is a good choice for a red grape but may not be suited for all areas of the state. You need to get complete ripeness to ensure color and flavor. Then you

can decide if you want to barrel age this wine or not. French American hybrids have at times been well received (during the times of phylloxera) to not being tolerated as vines planted in some countries. (France)

While there are many to choose from, I shall talk about a few of my favorites. Remember, this is subjective to each and every producer. I will mention three white grapes and a couple of reds that have worked well at our vineyard.

Cayuga was developed by Cornell University and it is an all around winner, great yields per acre 4-5 tons and it makes several different styles of wine. Plants are also very disease resistant and cold hardy. If I could plant only one white grape, this would be it.

Traminette is a newcomer to the market with its heritage coming from a German grape called Gewurztraminer. This grape seems to hold a lot of promise when it comes to quality, yields and cold hardiness. It is also very resistant to disease.

Vidal has been around for some time now and makes wonderful wines, of which you can ferment in barrels if you so choose. The yields are good. Plants are very resistant to disease and are cold hardy. However, you need to let this fruit hang a long time (October) to insure ripeness. A site that allows you to be frost free until harvest is desirable.

Now we will talk about a couple of red wine grapes.

St. Croix is grown by several wineries in the state and all seem to have good luck with it. It was developed by E. Swenson in the mid-west and is cold hardy to -20 to -30. Our winters don't seem to bother this grape. Plants have disease resistance, produce great wine with large fruit loads of 4-5 tons per acre, and grapes are ripe in early September. The early ripeness is a huge advantage for the entire state, with no frost danger at harvest. St. Croix is very vigorous and you need to manage the canopy aggressively to control the vegetation. You need to either hedge the vines or let the canes hang from the top wire with the foliage drooping down to the ground. I prefer to hedge and do leaf removal. It's a lot of work but worth it. We set anywhere from 75-100 buds per vine to reduce vigor, but it is still hard to slow this vine down.

Two to three year barrel aging produces an excellent wine, which is comparable to production of a Pinot Noir from the French Burgundy region. We just won a gold international medal and double gold medal with our latest release, making it the best red I have ever produced. St. Croix makes a wonderful burgundy style wine, full of color and fruit.

Chambourcin is another candidate that has a lot of promise. It seems to be cold hardy, resistant to disease, and produces a lot of fruit. The problem seems to be letting it hang on the vine long enough to ripen it, much like Vidal you need a longer frost-free season than some areas of the state offer. I have had a number of very good wines made from this grape, although I do not grow this grape in quantities needed for large-scale wine production. We have a small experimental plot with Chambourcin in it. I make a wine from the grapes in this small block called Westchester Red, which tends to be a little sweet and can be fermented in the barrel. A wonderful wine that sells out as soon as possible.

Temperature Monitoring

We have just started collecting data on Growing Degree Days across the state. There are collection points at 9 wineries, and the information is amazing. Wallingford, Shelton, and Colchester have the warmest sites. Their locations are about the same distance from the Long Island Sound, approximately 15-20 miles. The vineyards in Litchfield County and on the shore line are all in the same ballpark as of 7-28-06 around 1630 degree days, versus 1820 degree days for the first three listed. There is about a 10% difference now and the gap seems to be growing larger. Hopefully, at the end of the season we will have a better picture of seasonal variations in degree days as they relate to general areas of the state.

In closing, we have proven that you can make world-class wines in Connecticut, winning over 250 international medals in the past few years, and we've only just begun. We must continue to focus on quality not quantity. Thanks again to everyone for all of the hard work and research done here at The Connecticut Agricultural Experiment Station.

Thank you.

Gary Crump is partner / winemaker / vineyard manager of Priam Vineyards, in Colchester, CT. He is originally from northern Louisiana, where he got considerable exposure to agriculture on the family farm. He is completely self taught as a winemaker. His background in petroleum engineering and agriculture has given him an understanding of chemistry and science needed to manage winemaking and vineyards.

In 1998, Gary and his wife Gloria founded Priam Vineyards in Colchester, CT., initially to focus on being growers for the CT vineyard industry. In April of 2003, Priam Vineyards opened their winery.

Priam grows classic European varietals: Cabernet Sauvignon, Cabernet Franc, Chardonnay, Gewurztraminer, Riesling, Muscat, and Merlot as well as French American hybrids: Seyval, Cayuga and St. Croix, producing wines in the style of Northern France and Germany. Since opening their winery, Priam has won over 36 international medals in worldwide competition.

Gary has become very involved as a member of The CT Vineyard and Winery Association (CVWA) and has pursued legislation to enhance and further develop the wine industry in CT. He recently participated in writing and passing the new law affecting direct shipping for the State of CT. Since 2001, he has lobbied at the Capitol to establish funding for the CT Grown Program; initiated the concept of and lobbied legislation for a loan program to expand vineyard acreage throughout the state, established a supporting member program for CVWA to both build membership and legislative presence, as well as build funding for the marketing and advertising of CVWA; was instrumental in crafting legislation to increase the deduction of vineyard and winery equipment from $100,000 to $200,000. He is Vice President of The CT Vineyard and Winery Association (CVWA) and Chairman of the CT Farm Wine Development Council. The CT Farm Wine Development Council is a commission that directs policy of the vineyards and wineries of the state and is an appointment by the Governor of CT. He is also a delegate of the New London County Farm Bureau, and is on the Board of Directors of the CT River Coastal Conservation District. He was named CT Wineperson of the Year in 2001 by Amenti delVino.

Priam Vineyards, 11 Shailor Hill Road, Colchester, CT 06415, 860-267-8520, 860-267-8715 FAX, infor@priamvineyards.com, http://www.priamvineyards.com.

SPECIALTY FRUITS PROVIDE NEW OPPORTUNITIES FOR CONNECTICUT GROWERS

Abigail A. Maynard, Ph.D.
Department of Forestry and Horticulture
The Connecticut Agricultural Experiment Station

In recent years, national and world production of fruits and vegetables has grown with the result that increased competition makes wholesale marketing no longer profitable for most Connecticut growers. Thus, the marketing of produce has shifted from wholesale contracts with local supermarkets to direct retail sales. Approximately 560 Connecticut farms now offer a variety of fruit, vegetables, bedding plants, and Christmas trees at roadside stands and sales rooms. In addition, a network of farmers' markets in Connecticut's major urban centers and densely populated suburbs has been developed. In 2005, there were 72 farmers' markets attended by 230 farmers compared to 22 markets in 1986.

Direct retail sales require that the farmer grow diversified high value crops. Thus, many growers are interested in adding specialty crops to their operations. Since 1982, The New Crops Program at the Connecticut Agricultural Experiment Station has investigated the suitability of some 35 specialty vegetable crops for Connecticut's soil and climate. Crops were chosen because they have a high market value and an existing or expanding market that would readily accommodate these commodities. The New Crops Program was expanded to include fruits in 2001. This article reports on trials of Japanese plum, beach plum, and personal-sized watermelon.

Japanese plum. The Japanese plum is native to China, but was domesticated in Japan 400 years ago where it plays an important role in Japanese culture. In spring, it is one of the first blossoming trees and heralds numerous plum festivals throughout the country. It was first brought to California from Japan in 1870. In 1885, Luther Burbank imported 12 seeds from Japan and is credited with the development of many new plum varieties, some of which are still grown. Nearly all current cultivated varieties are derived from those developed by Burbank. Plums are rich in carbohydrates, Vitamins A and C, calcium, potassium, and iron. They also have high fiber contents.

In 2001, in response to grower interest, Japanese plum orchards were established at the Valley Laboratory in Windsor and at Lockwood Farm in Hamden with 12 different cultivar/rootstock combinations. Trees were planted 15 feet apart in rows 20 feet apart.

Japanese plum trees have a rougher bark and more persistent spurs than European plum trees. They are more vigorous, disease resistant, and produce more flowers. They tolerate heat and need only a short period of dormancy. However, early blooms make them susceptible to late spring frosts. Japanese plum has pests and diseases similar to other commercially grown plums, namely, plum curculio, brown rot, and black knot. They can be controlled by season-long applications of insecticides and fungicides on a protective basis or before symptoms occur. Sanitation is very important in the control of black knot and brown rot. All mummified fruit on the ground should be raked and removed to prevent spores from forming on the mummies in the spring. Black knots should be pruned before bud break and cuts made at least 6-8" below any visible swellings or knots.

In general, pruning establishes a framework of branches and fruiting wood and also eliminates dead or diseased wood. Plants should be maintained at a size where picking is practical. Low branches should be removed to keep fruit off the ground. If biennial bearing is a problem, heavy pruning should be done in years when a heavy crop is expected. Trees in our trials were pruned annually to maintain an open canopy, which allows ample light penetration and air circulation. Open-center pruning, commonly done for peach, served as our model.

Nutrients were supplied to the trees by broadcasting fertilizer under the trees each spring. In the planting year, 0.5 pounds of 10-10-10 was applied per plant. In subsequent years, the amount of fertilizer was increased another 0.5 pounds per tree. This will continue up to 5.0 pounds per tree regardless of age.

At Windsor, the trees began bearing fruit in 2004 on a limited basis. In 2005, the greatest average yields were

from Friar (61 lbs/tree) and Shiro (49 lbs/tree), while Obilnaja averaged 32 lbs/tree. In 2006, the greatest average yields were from Shiro (63 lbs/tree), Obilnaja (56 lbs/tree), Methley (32 lbs/tree), and Beauty (31 lbs/tree). Friar, Burbank, and Santa Rosa did not bear in 2006, indicating their biennial nature.

At Hamden, only Friar (44 lbs/tree) and Shiro (25 lbs/tree) produced fruit in 2005. In 2006, Shiro (37 lbs/tree) and Beauty (34 lbs/tree) had the greatest yields. Six cultivars have yet to produce fruit at Hamden. Production has been delayed and reduced at Hamden due to severe deer browse. At Windsor, an 8-foot deer fence surrounded the trees and offered adequate protection. Black rot has been a persistent problem at Hamden due to an abundance of inoculums in the area. Over half of the trees have had black knots pruned out since 2002, and 4 trees have been removed because the base of the tree was affected.

The early data suggest that Shiro is the cultivar of choice as it has produced consistently high annual yields. Friar is also a strong producer, but it appears to be alternate year bearing.

Beach plum. Beach plum (*Prunus maritime* Marsh.) is a fruiting shrub native to Atlantic coastal sand dunes from Maine to Delaware. It is an excellent erosion-control plant that grows well in poor soil. It is also grown as an ornamental shrub. Since colonial times, wild fruit has been collected to make preserves and jelly. Beach plum jam has become a premium product, especially in the Cape Cod region. Currently, the supply of fruit from wild stands does not meet market demand. Wild beach plum picking is a tedious job and attracts few pickers. In addition, native beach plum areas have been encroached by urban development. Because of inadequate supply of beach plums, commercial producers often substitute different varieties of plums in their jams and jellies. In fact, many so-called beach plum jellies and jams contain no beach plums. Commercial production of beach plums would help meet the demand for its fruit and its relatively low growth habit makes it ideal for a pick-your-own operation.

In spring 2003, 210 beach plum seedlings were planted at Lockwood Farm in Hamden and 96 at the Valley Laboratory in Windsor. They were planted 5 feet apart in rows 12 feet apart. These seedlings were raised at Cornell University from seeds collected at 35 sites from Maine to Delaware. The seedlings were mulched with hardwood chips. Weeds that penetrated the mulch were spot treated or removed by hand. In the first year, each seedling was fertilized with 2-oz of 10-10-10 fertilizer. In subsequent years, each seedling received 1-lb of 10-10-10 fertilizer. While beach plum grows naturally under low nutrient conditions, research has shown that fertilizer applied when an orchard is established will promote early growth and earlier fruiting. Fertilization needs vary with soil type and plant size. Shoot growth of 1.5 feet or more during the growing season is desirable.

Beach plums have the same diseases and pests as Japanese plum namely, plum curculio, brown rot, and black knot. They can be controlled by season-long applications of insecticides and fungicides on a protective basis or before symptoms occur. Open center pruning at Windsor has been performed annually. The plants at Lockwood Farm have not been pruned because of severe deer browse.

At Windsor, plants began to bear fruit in 2005, just 2 years after planting. Heavy yielding plants produced as much as 10 lbs/plant in 2005 and as much as 28 lbs/plant in 2006. In 2006, total production from Windsor was estimated to be 1450 pounds from 87 plants. A typical retail price is $6.00/pound. In 2006, the percentage of plants producing fruit increased to 95% compared to 82% in 2005. Only 2% of the crop, thus far, appears to be alternate year bearing.

Plants at Lockwood Farm did not bear fruit in 2005 due to deer browse but started bearing fruit in 2006. The effects of the deer browse were still evident as only 23% plants produced fruit with yields as high as 5 lbs/plant. At Windsor, an 8-foot deer fence protected the plants. Bird predation was not a problem at either site.

In general, beach plums thrive when grown under the same cultural conditions as other plums with full production possible three years after planting. In the early years, protection from deer browse and weed control are very important. Sprays controlled insect pests and diseases and irrigation was not necessary.

Personal-sized watermelon. Four types of watermelons are available in supermarkets. Traditional seeded watermelons have been a major part of the market for many years and weigh 18-35 pounds. Large seedless watermelons have been available since 1988 and usually weigh 15-25 pounds. Icebox-size melons, generally weighing 7-12 pounds, have been

available for about five years. The newest melons on the marketplace are seedless miniature "personal" watermelons, weighing 3-7 pounds each. Personal-sized watermelons first became widely available in markets in 2003. They offer an attractive alternative for small families or for consumers that have limited refrigerator space. In addition to the smaller size, they also have a thinner rind, which reduces waste. Researchers have found that lycopene and beta-carotene contents are abundant in personal-sized watermelons. Lycopene, an antioxidant, has been linked to the possible prevention of cancer and heart disease.

Variety trials of personal-sized watermelons have been conducted in California and in southern states as far north as Virginia. Because of an expanding market and willingness of consumers to pay a premium price ($4.99 per fruit) for these melons, we added personal-sized watermelons to our New Crops program in 2005.

Trials were conducted at the Valley Laboratory, Windsor on a well-drained sandy soil with somewhat limited moisture holding capacity, and at Lockwood Farm, Hamden on a loamy soil with moderate moisture holding capacity. Seeds were sown in April in 3x3x3-inch Jiffy strips, filled with Promix B, and placed in a greenhouse maintained at 75-90F. After germination, plants were thinned to one per pot. Seedlings were moved to a cold frame for hardening before transplanting in the field. Water-soluble 20-20-20 fertilizer (one tbsp/gal) was added to the seedlings before they were transplanted. In mid-June, plants of each cultivar were transplanted 2 feet apart in 50-foot rows. A pollinating cultivar was planted in every third row. Twenty-five feet of each row was mulched with 1.25 mil black plastic (3 ft wide). Row centers were alternatively 5 and 6 feet apart. In 2005, paired rows, 5 feet apart, were covered with Reemay spun-bonded polyester (10.5 ft x 50 ft). The Reemay was pinned to the soil with 6-inch wide staples that penetrated 5 inches into the soil to prevent loosening in high winds. The Reemay was removed in early July to allow bees to pollinate the first female flowers forming along the vines. Reemay was not used in 2006.

The soils were fertilized at a rate of 1000 lb/A 10-10-10 before planting. After the Reemay was removed, the strips between the black plastic were side-dressed with calcium nitrate at a rate of 240 lb/A. Total application of nitrogen for the season was 140 lb/A. Soil pH was about 6.5 at each site so lime was not applied. At Windsor, weeds were controlled by the herbicide Strategy (3 pt/A) that was sprayed in the aisles after planting. At Lockwood Farm, weeds were controlled mechanically by rototilling before vines completely carpeted the aisles. The crops at both sites were irrigated as needed to provide the plants with 1.0 inch of water weekly.

At Windsor, over two years (2005-2006), mulched plots averaged 3.4 melons/plant compared to 2.6 melons/plant from the unmulched plots. At a typical selling price of $4.99/melon, the average gross income is estimated to be $62,000/acre on mulched plots and $47,000/acre on unmulched plots (assume 3630 plants/acre). In 2005, Extazy and Vanessa produced the greatest number/plant (4.6) while, in 2006, Miniput produced the most (3.1 melons/plant).

At Hamden, over two years (2005-2006), mulched plots averaged 2.4 melons/plant compared to 2.2 melons/plant from the unmulched plots. The average gross income is estimated to be $43,000/acre on mulched plots and $40,000/acre on unmulched plots (assume 3630 plants/acre). In 2005, Vanessa produced the greatest number/plant (2.9 melons/plant) while, in 2006, Miniput produced 2.3 melons/plant.

In 2005, of all cultivars evaluated at both sites, Bobbie had the greatest sugar content with an average Brix (total soluble sugars) of 13.0 followed by Extazy (11.5). All other cultivars had Brix readings below 11. In 2006, Petit Treat had the greatest sugar content at both sites with an average Brix of 12.7 followed by Poquito (12.3) and Miniput (12.0). Bobbie and Extazy were not grown in 2006. All other cultivars had Brix readings below 12. Extazy had the highest lycopene content (95-99 ug/g) (as determined by Dr. Penelope Perkins, USDA/ARS, Oklahoma) with the other cultivars averaging 54-85 ug/g.

It appears from these preliminary trials that black plastic mulch increases yields and that Extazy and Miniput are the cultivars of choice. Research will continue with evaluation of additional varieties and various cultural methods to better control optimum size (3-7 lbs).

These studies have shown that Japanese plums, beach plums, and personal-sized watermelons can be grown successfully in Connecticut's soil and climate. Information on varieties and cultural details has been provided to growers to help them diversify their operations. Home gardeners can also use the information if they wish to try something a little new and different.

Dr. Abigail A. Maynard was born in Stamford, Connecticut and attended Wesleyan University and Columbia University, where she received a Bachelor's degree in Biology in 1982. She completed her Masters and Doctoral degrees in Soils in 1989 at Yale University. She joined The Connecticut Agricultural Experiment Station in 1981 as a summer research assistant in the Department of Biochemistry and Genetics and continued in that position for the following seven summers in the Department of Forestry and Horticulture where she assisted in evaluating new crops for Connecticut agriculture. She was appointed assistant soil scientist in the Department of Soil and Water in 1988 to study the utilization of agricultural composts and its effect on vegetable production and nitrate leaching. In the 1990's, she expanded the compost utilization research to include cut flowers and nursery stock as well as vegetables. Currently, she is an Associate Scientist in the Department of Forestry and Horticulture where she directs the New Crops Program, evaluating new specialty crops as well as new cultivars of standard crops for their suitability in Connecticut's climate and soils.

GRAPE CULTIVAR SELECTION AND GRAPEVINE CANOPY MANAGEMENT

William R. Nail, Ph.D.
Department of Forestry and Horticulture
The Connecticut Agricultural Experiment Station

Grapes have been cultivated in Connecticut since at least Colonial times. Significant post-Prohibition commercial winegrape production is a relatively recent phenomenon, beginning with the passage of the Connecticut Winery Act in 1978. There are currently vineyards and wineries in all areas of the state, and the industry is expanding rapidly.

Culture of fine winegrapes in the northeastern United States is a relatively new phenomenon. For many years, it was felt that the climate in most of New England and New York was too cold for fine winegrapes to survive our winters. The first commercial planting of *Vitis vinifera* grapes in the region was not established until the early 1960's in the Finger Lakes region of New York. Since then, plantings of vinifera and hybrid cultivars have greatly expanded throughout the area, and new cultivars are being released from breeding programs. Selections for most new vineyard acreage were originally made by trial and error, succeeded by word of mouth and recommendations from research and extension agencies. Environmental conditions vary greatly among areas of our small state, however, and cultivars appropriate for one site may not be appropriate for another. Also, due largely to the newness and size of the industry, there is no consistent "Connecticut style" that some relatively new regions, like Long Island or the Willamette Valley of Oregon, have established.

While fruit quality is of great importance, horticultural characteristics are frequently the most important elements to consider when choosing cultivars. In Connecticut, these characteristics are primarily the susceptibility to damaging cold temperatures and diseases. Grapevine cultivars vary in their degree of winter hardiness. This is a very important consideration for cultivar selection in Connecticut, as extreme cold events can cause bud injury or death, resulting in crop reduction or loss. In some cases, entire plants may die as a result of extreme cold. Bark splitting as a result of winter injury predisposes trunks to the crown gall disease, caused by the bacterium *Agrobacterium vitis*, which can kill grapevines. Vinifera cultivars are generally the least cold hardy grapevines. These cultivars can be damaged by temperatures below 0°F; severe damage or death is likely at temperatures below -10°F, even if the timing of the cold event is brief. Therefore, these cultivars are likely to sustain cold damage if planted in non-coastal areas of the state. Hybrid cultivars are generally more cold-hardy than vinifera cultivars, and most can tolerate winter conditions in most parts of the state. Some hybrid cultivars developed in the Midwest are extremely cold-hardy and can survive winters in the very coldest areas.

The growing season in Connecticut is warm and humid. This predisposes grapevines to a variety of fungal pathogens that can cause severe diseases of

leaves, stems, and fruit. Vinifera cultivars are native to the arid areas of Asia Minor, and most traditional winegrape growing regions such as France, Italy, and California have warm to hot, arid summers, which do not favor disease development. Most of the important fruit and foliar diseases are native to North America, so vinifera cultivars have very little genetic resistance. Hybrid cultivars vary in their disease resistance, but most are significantly less susceptible than vinifera cultivars. They are also generally considered to be more productive. Many people prefer the flavor of vinifera fruit. This is reflected in higher wholesale prices for vinifera, which are frequently twice that of hybrids.

I am studying the performance of vinifera and hybrid cultivars at four locations in Connecticut. Plantings were established in 1992 at Lockwood Farm in Hamden and in 1995 at the Valley Laboratory in Windsor by former Station Scientist Dr. Richard Kiyomoto. Additional plantings were established at commercial vineyards in Shelton and Colchester in 2000 and 2001. The planting at Lockwood Farm consists of the hybrid cultivars Chambourcin, Seyval Blanc, Villard Blanc, and Villard Noir. The planting in Shelton consists of the vinifera cultivars Cabernet Sauvignon, Merlot, and different clones of Cabernet Franc. The plantings at the Valley Laboratory and Colchester are mixtures of vinifera and hybrid cultivars. Some of the same cultivars are planted at more than one site, so comparisons among sites can be examined.

The necessity of conducting experiments such as these over several years is apparent when looking at the data from 2004-2006. No two Connecticut growing seasons are the same, and this is made apparent by the variations in vine performance among years. Differences in yield among cultivars in the same vineyard have not always shown the same patterns in different years. Some patterns have emerged, although the various sites have demonstrated differing characteristics over this period. In general, white cultivars have consistently had higher yields than red cultivars. Except for the planting at Lockwood Farm, where white cultivars have outyielded red cultivars by almost two to one, the differences have been less than 10%. Hybrid cultivars have usually outyielded vinifera cultivars when grown in the same vineyard. The differences are not as great as we had expected, especially for red grapes, where Cabernet Franc has sometimes slightly outyielded traditional hybrid cultivars. In 2006, hybrid white cultivars only yielded 17% more fruit than vinifera cultivars; for red cultivars, the difference was even less, about 10%.

It should be kept in mind that the vinifera cultivars that have consistently performed well in these trials- Cabernet Franc, Chardonnay, and Merlot- were selected as being likely to do well in our climate. By carefully selecting vinifera cultivars that show promise in an area, the slight decrease in yield may be more than offset by the increased prices that the grapes could be sold for. For wineries, being able to label a wine with an established varietal name like Chardonnay or Merlot can result in higher prices being charged compared to wines made from blends or having relatively unknown varietal names such as Cayuga White or Chambourcin.

Several new cultivars have been released in the last few years, and many others, while not new, are new and untested in Connecticut. New plantings will be made at Lockwood Farm in 2007 and 2008 to evaluate many of these cultivars. These plantings are part of a larger project involving research scientists from 24 states. By coordinating plantings among different regions, a great deal more knowledge of a cultivar's performance will be obtained than one could obtain from independent plantings. Some of these cultivars will be of new, unreleased selections from the Midwest which should be winter-hardy in all areas of the state.

Grapevines vary in their growth habits. Most vinifera cultivars have an upright growth habit, so are typically trained upward. Some hybrids also have an upright growth habit, but the shoots of others tend to grow downward (procumbent) or laterally. These cultivars might benefit from a training system that works with, instead of against, the natural tendency of the vine. Such systems should be less expensive to establish and may require less maintenance during the growing season.

Managing vine vigor in the vineyard is important for maximum production of high quality fruit and streamlining vineyard operations. Many factors influence vine vigor, including cultivar type. Hybrid cultivars are generally more vigorous than vinifera cultivars, although there are substantial variations among hybrids. In a given environment, grapevine vigor is most simply managed by choosing the proper spacing between plants when establishing a vineyard. However, new plantings are usually planted without sufficient knowledge of grapevine performance on the specific site, so plant spacing is based on an educated

guess. Studies comparing different spacings for some of the newer hybrid cultivars have not been done in Connecticut or, in some cases, anywhere. Short of removing alternate plants, which would generally result in plants being too far apart, growers make the best of the spacing they have by other management techniques.

I have overseen the planting in 2005 of an experimental vineyard in Wallingford to address these issues for the three relatively new, but popular, hybrid cultivars: Cayuga White, St. Croix, and Traminette. The vines are planted on both six and eight foot spacings, and four different training systems will be used for each cultivar to determine which combination(s) will be most productive and practical for the grower. Two of the training systems will involve dividing the canopy. Divided canopies can result in greater yield per linear foot of row with little or no loss in fruit quality. They can also be employed to reduce vigor in overly vigorous vines, such as those planted too close together. Divided canopies are rarely employed in Connecticut, but are widely used in many major winegrape growing areas of the world.

As the grape and wine industry in Connecticut continues to grow, new vineyards will be established and older ones renovated. Knowledge of new cultivar performance and management will assist growers in making informed decisions to help ensure a profitable and sustainable enterprise that helps preserve Connecticut farmland.

Dr. William R. Nail was born in Dallas, Texas and graduated from Southern Methodist University in 1979. After extensive restaurant experience, he grew specialty vegetables, mushrooms, and herbs for restaurants in the greater Houston area from 1983-1993. He graduated from Texas A&M University in 1996 with an MS in Horticulture, having served as a teaching assistant in a variety of undergraduate Horticulture courses. He gained extensive experience in viticulture and enology at Michigan State University, where he earned his Ph.D. in Horticulture in 2003, studying both wine and juice grapes. He has been an Assistant Scientist II in the Department of Forestry and Horticulture since 2004, studying best practices viticulture and cultivar evaluation for the rapidly growing Connecticut vineyard and wine industry. Current research projects include the effects of horticultural oil on fruit set, graft union height on winter survival and crown gall, fruit and leaf removal on whole-vine carbon accumulation, and spacing, training, and pruning effects on productivity and fruit quality.

The mission of The Connecticut Agricultural Experiment Station is to develop, advance, and disseminate scientific knowledge, improve agricultural productivity and environmental quality, protect plants, and enhance human health and well-being through research for the benefit of Connecticut residents and the nation. Seeking solutions across a variety of disciplines for the benefit of urban, suburban, and rural communities, Station scientists remain committed to "Putting Science to Work for Society", a motto as relevant today as it was at our founding in 1875

The Connecticut Agricultural
Experiment Station
P.O. Box 1106, New Haven, CT 06504-1106