Cornell University
College of Agriculture and Life Sciences

Pinot Noir Clonal Research in New York

Introduction

There are thousands of wine grape varieties available to grape growers; however, out of all these thousands only a few are widely planted. Jancis Robinson, in her book "Vines Grapes and Wines" lists only four "classic" red wine varieties and ten "major'" ones (Table 1.) The select few share the traits of general adaptation to the local climate and soils and superior red wine quality.

Table 1. Most important quality red wine grape varieties grown in the world*

Classic Varieties	Major Varieties
Cabernet Sauvignon Pinot Noir Syrah Merlot	Cabernet Franc Gamay Grenache Cinsaut Carginan Barbera Nebbiolo Sangiovese Tempranillo Zinfandel
*Source: *Robinson, Jancis. Vines, Grapes and Wines. Alfred A. Knopf, NY 1986*	

One might well ask, even though we have reduced the choice from thousands to only 15, why do we spend so much time attempting to grow Pinot Noir? This is especially puzzling when, to again quote Robinson:

> "… Pinot Noir is a minx of a vine. … an exasperating variety for growers, winemakers and winedrinkers alike. It leads us a terrible dance, tantalizing with an occasional glimpse of the riches in store for those who persevere, yet obstinately refusing to be tamed."

In spite of its capricious reputation, Pinot Noir is the "logical" classic wine grape to consider for northern viticultural production regions; the reader should be cautioned, however, that part of the allure of the variety is the challenge it poses. For New York grape growers, that challenge is balanced by potential rewards in terms of the personal satisfaction and in the affirmation that New York is among those few places in the world where superior wines are produced.

It is also reassuring to know that compared to the other "classic" varieties, Pinot Noir is adaptable. The great, long-lived red wines from Burgundy whose value justify low yields, expensive winemaking, and long storage receive most of the attention, but Pinot Noir is also widely grown to make wines which meet the expectations of those who are looking for a superior, but not budget destroying, wine experience.

Pinot Noir and its Wines

We associate Pinot Noir with a single region, Burgundy, but in fact it is grown extensively in many places in the world, and it is made into wines with styles ranging from classic, generous Grand Cru Burgundies through much lighter regional Burgundy wines to the fruity red wines of Switzerland, Alsace, Germany and Italy. Insufficient color is often a problem with Pinot Noir, but even where color is lacking it is valued for the production of white sparkling wines as in Champagne. The fact that Pinot Noir wines can be produced with a range of styles offers reassurance to those who are experimenting with the variety. Regardless of where it is grown, only a small fraction of Pinot Noir wines achieve the ultimate in color, intensity of flavor and body which characterize the grand crus, but everywhere that sound grapes can be grown, Pinot Noir produces wines which are regional favorites.

Table 2. Seasonal degree day accumulation and average low temperature of the coldest month for world grape production areas.

Location	Latitude	Seasonal Degree Day Accumulation (50°F base)	Mean Min Temperature of Coldest Month (°F)
Reims, France (Champagne)	49° 20′	1756	30
Zurich, Switzerland	47° 23′	1874	26
Würzburg, Germany	49° 48′	1908	26
Dijon, France (Burgundy)	47° 15′	2084	29

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Table 2. Seasonal degree day accumulation and average low temperature of the coldest month for world grape production areas (Cont.)

Location	Latitude	Seasonal Degree Day Accumulation (50°F base)	Mean Min Temperature of Coldest Month (°F)
Genève, Switzerland	46° 12′	2090	29
Roseburg, OR	43° 20′	2115	36
Penn Yan, NY	42° 30′	2390	15
Bordeaux, France	44° 50′	2464	35
Geneva, NY	43°	2519	17
Fredonia, NY	42° 30′	2531	18
Keckskemét, Hungary	46° 54′	2588	23
Cutchogue, NY	41°	2676	22
Canberra, Australia	36°	2714	33
Bolzano, Italy	46° 30	2985	24
Glenham, NY	42°	2992	17
Udine, Italy	46° 04	3168	31
St. Helena, CA	38° 30	3302	36
Fresno, CA	36° 40	4684	38

Where is Pinot Noir Grown?

Pinot Noir is an early ripening grape. Where there is too much heat, the sun burns the fruit badly, acid concentration becomes insufficient, pH is too high and fruity aromas are lost. Pinot Noir is a variety for cool growing areas. The French emphasize that in comparison with the other “classic” varieties, Pinot Noir is adapted to cool, continental climates. The Bordeaux reds were selected for cooler maritime climates and other “classic” reds listed in Table 1, require much more seasonal heat accumulation than does Pinot Noir.

Table 2 lists data about regions where Pinot Noir is important. North American locations tend to be much more southerly than European ones and their continentality is indicated by the relative low expected winter temperatures. The data also show that, relative to Burgundy, New York locations have somewhat greater seasonal accumulation of heat and experience more winter cold.

Climates of Burgundy and New York (Finger Lakes)

Growing season data from a Finger Lakes (New York) site are compared to those of Burgundy (Dijon) in Figure 1. In France Burgundy is considered to have a continental climate. Continental climates have little water moderation. There tends to be greater differences among the seasons (hotter summers and cooler winters). The summer temperatures especially are important. Daytime maxima are higher and nighttime minima are lower for continental than for maritime climates.

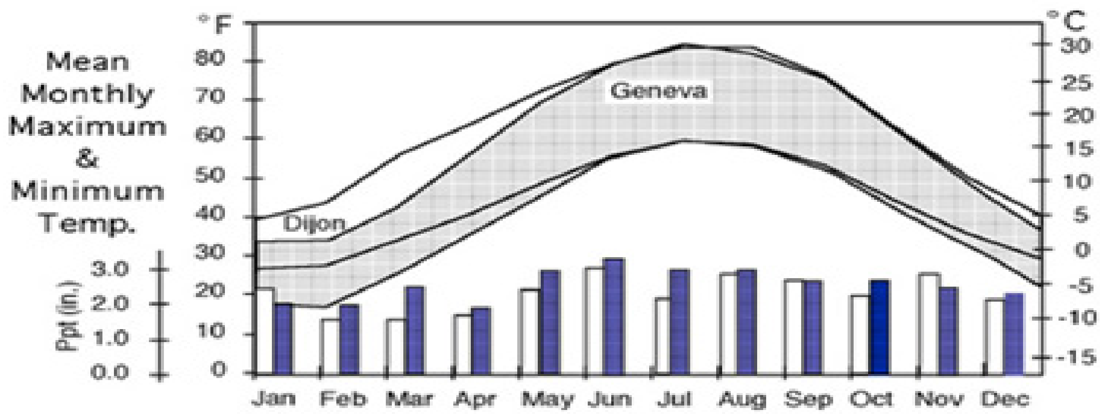

Figure 1. Mean monthly maximum and minimum temperatures for Geneva, NY and Dijon, France.

Figure 1 shows that the Finger Lakes have a more continental climate than Burgundy does. Several factors are important. In both places Pinot noir matures in very early October. At that time day time temperatures are high enough to ripen the fruit, but not so high that the fruit becomes baked (insufficient acidity and loss of aromas). The night temperatures are also favorably low. Low night temperatures favor the retention of acids and color. That is the good part, but note how quickly temperatures drop in the fall in New York relative to Burgundy. This means that there is less margin for error in New York; a cold fall will likely mean insufficient ripeness.

If the falls cool more quickly, the springs also warm more quickly. In both locations there is little danger of below freezing temperatures at time of bud break, and the temperatures in June are favorable and encourage a reliable fruit-set. Winter temperatures are another story. The data show that our winter cold hazard is much greater than that of Burgundy.

The precipitation data indicate rainfall should provide ample water in normal years at Geneva. Geneva tends to have slightly more rainfall than Burgundy during the early season and during the critical final ripening period in October. This indicates that we have to be even more concerned with preventing rain induced bunch rot than are the Burgundians.

Soils

Pinot Noir succeeds in many soil types. As with all grapes, optimal wine quality has been obtained when vines are grown on well drained soils. Burgundy Pinot Noir soils are variable in lime content. Soils in most of the better appellations are limestone derived, but others in the Burgundy appellation are depleted of lime in the surface levels. Relative to the Bordeaux varieties, which appear to be best adapted to deep gravels and sands, Pinot Noir does well in heavier, clay-loams and silty-clay-loam soils. Typical Grand Cru soils in Burgundy have 30-40% clay particles. What seems to primarily distinguish soils of the better vineyards is: moderate depth (and water holding capacity), excellent internal drainage and good external drainage. Shallow soils do not retain sufficient water to carry the vines over rainless periods and deep soils provide water so abundantly that excessive vegetative growth competes with fruit development, wood maturity and results in shaded canopies which encourage bunch rot. Figure 2 shows a profile of the Côte de Beaune and indicates that upper, shallow soils and lower, deeper soils produce wines which receive lesser appellations than wines from mid-slopes where the combination of moderate depth, internal and external drainage is optimal.

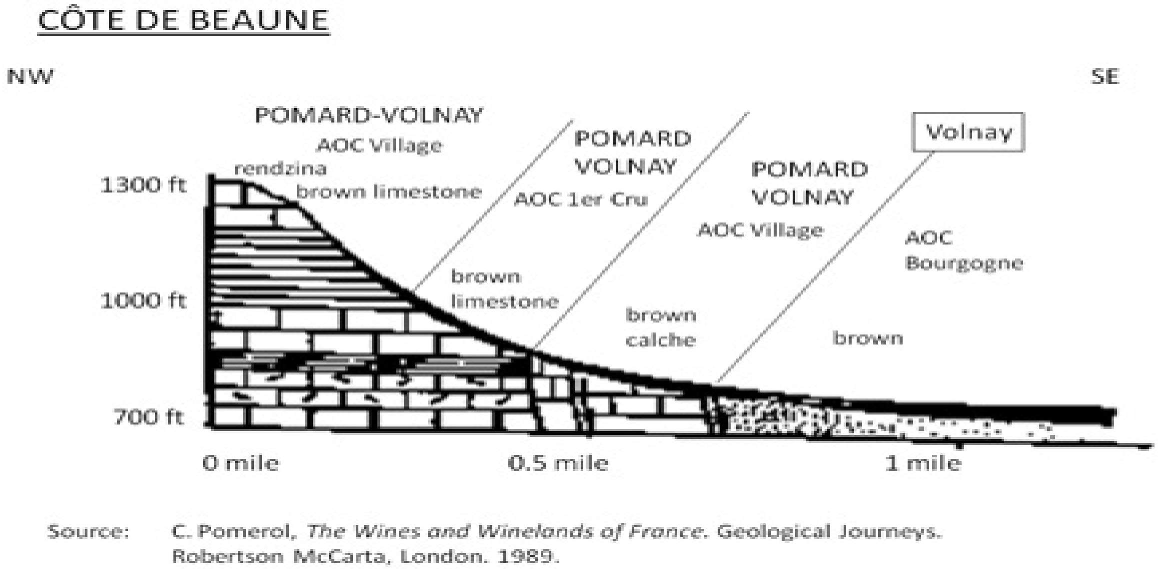

Figure 2. Profile of the Côte de Baune showing that mid-slope vineyards receive the highest appellation. This is because the combination of internal and external drainage and depth of soil are optimal to ensure an adequate but not excessive supply of water.

Summary

The similarities in climate and soil between the wine growing areas of New York and Burgundy support the idea that red Pinot Noir wines of quality can be expected in New York, especially in the Finger Lakes and the Hudson Valley which have less water moderation and silty-clay-loam soils. The greatest hazards are winter injury and bunch rot. This suggests that cultural practices which minimize these hazards should be utilized for Pinot Noir. Suggestions include: selection of less vigorous rootstock, vertical training, summer pruning, leaf removal, botryticide application, double pruning and multiple trunks to allow compensation for winter injury.

These data also have helped to guide our research on growing Pinot Noir in New York. We have emphasized clonal testing to select cultivars which have superior winter cold hardiness, which resist bunch rot and which produce wines with sufficient color and flavors characteristic of mature fruit, even in cooler growing seasons.

Important Considerations for New York Pinot Noir

The previous section compared New York's climates with those of major Pinot Noir producing areas in the world with an emphasis on Burgundy, the home of the variety. That data highlighted several important limitations regarding the variety and its potential adaptation to New York's varied climates.

Winter Cold Hardiness:

The most important feature distinguishing New York is winter cold. In all New York winegrowing districts winter temperatures are much lower than are those in even the coldest European Pinot Noir producing district. Hence, winter survival and direct measurements of cold hardiness are critical to an understanding of the relative adaptation of a particular clone to New York.

Bunch Rot:

A second fact is that Pinot Noir does not resist infection by Botrytis cinerea, the gray mold fungus. Botryis infection greatly reduces varietal wine character and adds special aromas of its own which are not appreciated in Pinot Noir wines. It also produces the enzyme, lactase, which destroys anthocyanin coloring pigments. Unless affected musts are heated to destroy the enzyme, the result is wines with little color and flavor. More importantly, Botrytis infection causes grape skins to break down leaving the fruit subject to a whole host of secondary spoilage bacteria, yeast, and other fungi which result in pre-harvest fermentation and acetic acid spoilage. This whole microbial complex is termed bunch rot.

A combination of methods are used to combat bunch rot, including selecting cultural techniques which increase cluster exposure to light and result in low leaf density. These include low head, vertical training and summer pruning to eliminate vegetative growth which would otherwise shade the fruit zone; use of less vigorous rootstocks; leaf removal to ensure cluster exposure, and use of botryticides. Another important consideration is clone. There are important differences in rot resistance among clones; however, none are sufficiently bunch rot resistant to allow ignoring of the important cultural practices which combat bunch rot.

Yield

Depending upon the use and the market, high Pinot Noir yield may or may not be desirable. Although there is never a strict relationship between yield and quality over the whole range of potential vine yield, most people feel that color and extract of Pinot Noir wines are negatively impacted by high yield. On the other hand when yield is too low, vines become excessively vegetative, fruiting zones become shaded and fruit quality suffers. When used for sparkling wine production, fruit is generally harvested at a lower soluble solids (sugar) concentration. This means that high yield is consistent with high quality sparkling base wine production. Because Botrytis susceptibility becomes more serious only during the final phases of fruit maturation, bunch rot resistance is of less importance when Pinot Noir is grown for sparkling wine.

Fruit and Wine Quality

Pinot Noir is inherently difficult and expensive to grow in New York as it is in the rest of the world. The only justification for expending the time, money and effort involved in its culture is to produce products which command superior prices. This means that quality is the most important factor we consider when we evaluate clones or cultural methods.

Clones Evaluated

Our work on clonal evaluation is a continuous process. As additional clones become available we add them to our tests. This makes complete comparisons among clones somewhat difficult, because vines are at different ages when tested. It also means the degree of confidence we apply in our assessments of the various clones varies depending upon how much experience we have with the various clones.

For this discussion we will consider three different levels of confidence. Two clones of Pinot Noir, the ones we call “Geneva” and Gamay Beaujolais (Table 3) have been cultivated for many years at Geneva, their acquisition pre-dates any of the authors’ tenure at Geneva.

We are continuously attempting to import additional clones. The primary source of additional clones was the Foundation Plant Materials Service which is associated with the University of California at Davis. A few clones came to us from the import program of Oregon State University. Unfortunately, that program has been disbanded and the grape virology position was terminated upon the retirement of the former occupant. A third, very important continuing source of clones is the Agriculture Canada quarantine station located in Saanichton, British Columbia. In the past Agriculture Canada was very careful to ensure that Canadian quarantine requirements were congruent with those of the USA. They have been very generous in sharing their tested plant material with USA researchers. Because most of the world does not recognize the virus disease, rupestris stem pitting, as a quarantinable disease, Agriculture Canada made the decision that it would no longer deny their grape growers access to clones based upon presence of a positive rupestris stem pitting test. This means that this important route of entry may no longer be available. (Note added in 1998 – the Ag. Canada quarantine station no longer functions – its collection of vines has been turned over to commercial nurseries.)

With the cooperation of the New York State Department of Agriculture and Markets and Cornell University plant pathologists, we have been able to import some grape clones directly from European programs into Geneva. However, possibly due to budget cut-backs by the state, the NY Agriculture and Markets virus index vineyards have not been evaluated for several years, stranding material in a quarantine limbo. The final source of clones we evaluate is private growers. Over the years clones with reputed European origin have come into private hands. Some of these clones are being evaluated. Table 3 lists clones which are reported herein and their source.

Table 3. Pinot Noir clones being evaluated at Geneva, NY. Year is year that formal evaluations began. Source indicates our source, not original. In many cases original source is obscure or in doubt.

Pinot Noir Clone	Year Evaluation Started	Source
Geneva	1985	unknown
Gamay Beaujolais	1985	FPMS
Blauer Spätburgunder	1985	Germany via Ag. Canada
Clevener Mariafeld	1985	Switzerland via FPMS
Pinot Meunier	1985	Dr. A. Goheen, Univ. Calif., Davis
FPMS 29 (Jackson)	1985	FPMS
Espinette	1985	Saanichton, BC
Pernand	1985	FPMS
Pomard	1989	FPMS
2A	1989	Sitzerland via FPMS
FPMS 13 (Martin)	1989	FPMS
Clone V	1989	Burgundy?
Clone7	1989	K. Frank, Hammondsport, NY
Espiquette 236	1989	France
PN Oregon (Ponzi)	1989	Pozi vineyards, OR
PN Canada	1989	Burgundy?
Clone 113	1991	Burgundy via Oregon State Univ.
Clone 115	1991	Burgundy via Oregon State Univ.
Clone 10/18	1991	Burgundy via Oregon State Univ.
Calera	1992	Calera region, California

Culture

Vines are grafted to Couderc 3309 rootstock and planted at 9 feet x 6 feet (row by vine spacing), in the vineyards of the New York State Agricultural Experiment Station at Geneva, NY. Post length (24 foot) plots of 4 vines are replicated at least 3 times. Vines are head pruned and cane pruned. They are trained to a vertical trellis using low arched canes and moveable catch wires (Figure 3). Several methods are used to minimize the impact of winter cold injury on performance. These include multiple trunks and double pruning wherein extra canes are retained during dormant pruning and those not required for fruiting are removed following bud break. The goal is for each vine to have 27 shoots per vine. This is equivalent to 4.5 shoots/foot of canopy.

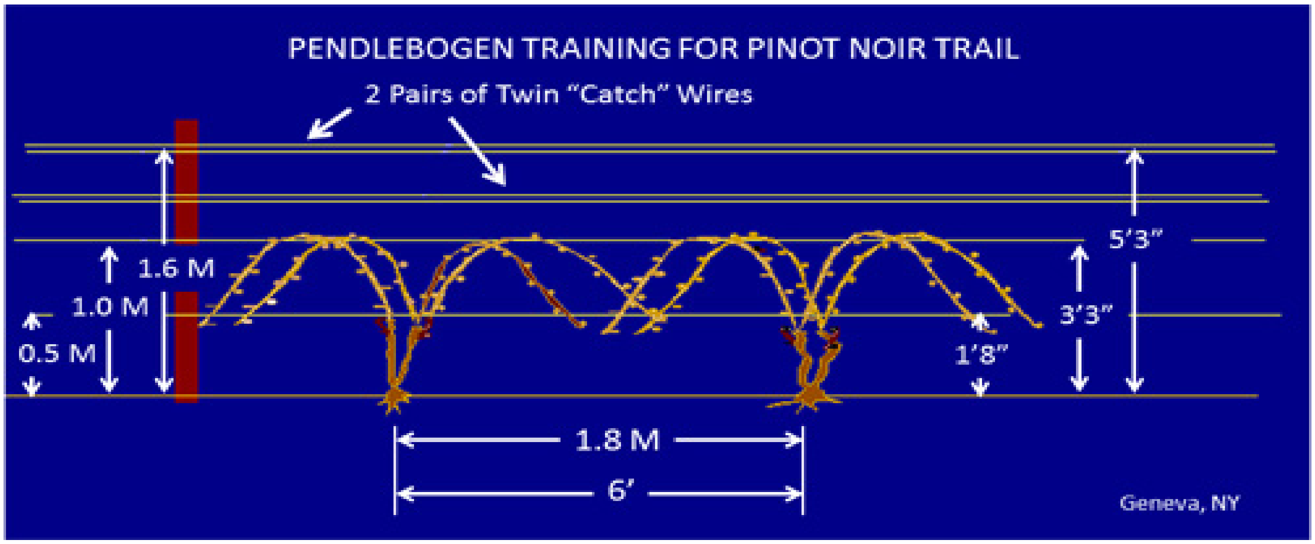

Figure 3. Pendelbogen (head trained, cane pruned, multiple trunk, vertically positioned) training as used in Pinot Noir clonal evaluations at Geneva.

Vertical canopies are ensured by the use of moveable catch wires. Vines are topped when shoot growth threatens to droop and shade the lower canopy. This is usually done only once during the last week of July or the first week of August. Summer pruning of the sides is rarely required. Some leaf removal is done just before veraison in the fruiting region, but only enough to ensure cluster exposure. The following data is recorded for each vine: cane pruning weight, node number retained, number of shootless nodes, number of base shoots, number of nodes with double shoots, and number of shoots retained. At harvest number and weight of sound and bunch rot affected clusters are recorded separately for each vine. Berry samples are taken and used to determine berry weight and juice soluble solids. Remaining fruit is vinified at the Department of Food Science & Technology in Geneva.

Wine Evaluation

Vinification

Fruit is hand harvested into 30 lbs plastic crates and stored 12 to 24 hours at 10° C before processing. Visible bunch rot is selected out in the field and at the stemmer. Grapes are destemmed without crushing. The majority of the berries are broken during destemming. Musts are weighed and sugar concentration determined by refractometer. Based on experiments with chapatlization of Pinot Noir must to various sugar concentration (19° to 24° Brix) we determined that a final alcohol concentration of 12 to 13% (w/v) most complements the fruit, acid, and tannin balance of our Pinot Noir wines. Therefore, when sugar concentration of the must is below 22° Brix, cane sugar is added to increase it to a minimum of 22° Brix. Acid adjustments in the must are usually not necessary since pH and titratable acidity (TA) are generally acceptable. Sulfur dioxide is added after destemming to the must at 50 mg/L.

Fermentations are carried out in 120 liter stainless steel, upright drums. Initial wine evaluations for clones in the 3rd to 5th growing season are sometimes done in 10 gallon stainless steel drums. Musts are skin fermented unless special qualities are tested such as suitability of the clone for production of sparkling wine (pressed before fermentation) or to test effects of must pasteurization of bunch rot affected grapes on wine quality. Musts are inoculated with pure culture yeast (Lalvin strain EC1118, Lallemand, Inc.) after rehydration to manufacturer's instructions. Fermentations are at ambient temperatures (18°-25°C). Must temperature typically reached 30°-35°C in the cap during day 2-4 of fermentation. Total length of fermentation was typically six days. Drums were loosely capped. The cap of skins was punched down one to two times daily until the sugar concentration reached <1% residual sugar when the wine was pressed and filled into 20 liter glass carboys, fitted with fermentation locks. Carboys were transferred to a 16°C fermentation room and left to complete alcoholic fermentation. After completion of alcoholic fermentation, the wines were racked and transferred to a 20°C fermentation room. They are then inoculated with a bacterial starter culture to induce malolactic fermentation (MLF), and topped up. Different malolactic starter cultures were used in different years (vino, Condimenta; MCW and X-3, Lallemand, Inc.) but in each year the same strain was used for all lots of the Pinot Noir clonal study. After completion of MLF (residual malic acid less than 0.1 g/L, checked by enzymatic or HPLC analysis), the wines are racked and sulfated (30 mg/L free SO2), and pH and TA are adjusted when necessary. In most years pH of the Pinot Noir wines after MLF increases to as high as 3.8-4. In those cases wines are adjusted with tartaric acid to a pH of approximately 3.5 and TA was adjusted to a minimum of 6 g/L. For tartrate stabilization, the wines are transferred into a cold room (-2°C) for 2-3 months. After cold stabilization the wines are again tested for pH, TA, and free/total SO2. If the wines have not clarified by this time, they are returned to the cold room. Clear wines are bottled (750 ml, natural corks) without filtration using a nitrogen pressure system. Free SO2 before bottling is adjusted to 30-40 mg/L.

Tasting

The bottled wines are stored at 14°C for at least 4 months before tasting. Typically the wines are tasted 14 months after harvest, in some cases they are tasted again two to three years after harvest. The wines are evaluated by an expert panel of four to eight tasters. Wines are presented blind, rated for overall quality on a 10 point scale, and much attention is given to describing the characteristics of fruit aromas, structure and overall balance.

Cold Hardiness

In addition to recording winter survival, bud cold hardiness has been directly measured several times using differential thermal analysis. The most complete assessments were in mid-winter of 1987/88 and in early winter of 1992/93. Because the 1992 growing season weather was very poor (cold and rainy), the 1992/93 data reflect the extent to which bud hardiness was attained in a poor growing season.

Hardiness can be assessed in several different ways. In late January 1988 and again in early January 1993, critical freezing temperature of primary buds was measured using differential thermal analysis (DTA). Bud freezing temperature is indicated by the median temperature of the low temperature exotherm (LTE). These data are indicated in Tables 4 and 5. On December 12, 1988, the low temperature in these vineyards was -12°F. This cold event happened before most vines had achieved maximum bud hardiness. At that time DTA of buds of varieties which rapidly attain winter cold hardiness such as Concord and White Riesling indicated critical freezing temperatures below -13°F. They suffered very little injury. DTA of later hardening varieties like Cabernet Sauvignon showed critical values higher than -10°F. Such varieties suffered almost 100% bud injury. Thus bud survival following the 1988/89 winter was very meaningful. There was little bud injury to any potentially cold hardy variety in Geneva in the years of 1991 and 1992. The incidence of bud kill was very low, but ranking was similar to that obtained in years with more important injury. These data are reportent because they give preliminary estimates of cold hardiness of some of the clones with which we have less experience.

In Table 4 below Clones 29, Pernand and Meunier exhibited consistently a high degree of cold hardiness. Gamay Beaujolais and Geneva also have above average hardiness. Mariafeld and Spätburgunder have suffered above average winter kill. Ratings for other clones must be considered preliminary.

Table 4. Summary of cold hardiness data for Pinot Noir clones being evaluated at Geneva, NY.

Pinot Noir Clone	LTE Jan. 1988 (°F)	Node Survival 1988/89	LTE Jan. 1993 (°F)	Mean Node Survival 1991-92	% Node Survival 1994		Tons /Acre 1994	Tonnes /ha	
Espinette	-7.2	less hardy	-8.6	moderate	68.2	f	1.7	3.7	abc
Geneva	-9.8	hardy	-7.6	hardy	67.3	ef	1.7	3.7	abc
Meunier	-8.5	very hardy		hardy	66.8	ef	1.7	3.7	abc
Cl. 29	-10.3	very hardy	-10	hardy	62.9	ef	1.8	3.9	ab
Gamay B.	-7.1	hardy	-8.9	hardy	61	ef	1.9	4.1	ab
Pernand	-10.5	hardy		hardy	60.1	ef	1.9	4.1	ab
Cl. 7				hardy	57.8	def	1.6	3.5	abc
Pomard			-6.7	moderate	47.6	bcd	1.8	3.9	ab
Mariafeld	-7.6	tender	-6.9	moderate	46.8	bcd	1	2.2	bc
Spätburgunder	-7.6	less hardy		moderate	46.3	bcd	2	4.4	a
Canada			-8.6	moderate	44.1	bc	1.4	3.1	abc
Cl. 13			-6.3	tender	41.8	b	2.1	4.6	a
Cl. 2A			-5.9	tender	29.7	a	0.8	1.7	c
Cl. 236			-7.8	tender	25.9	a	1.1	2.4	abc

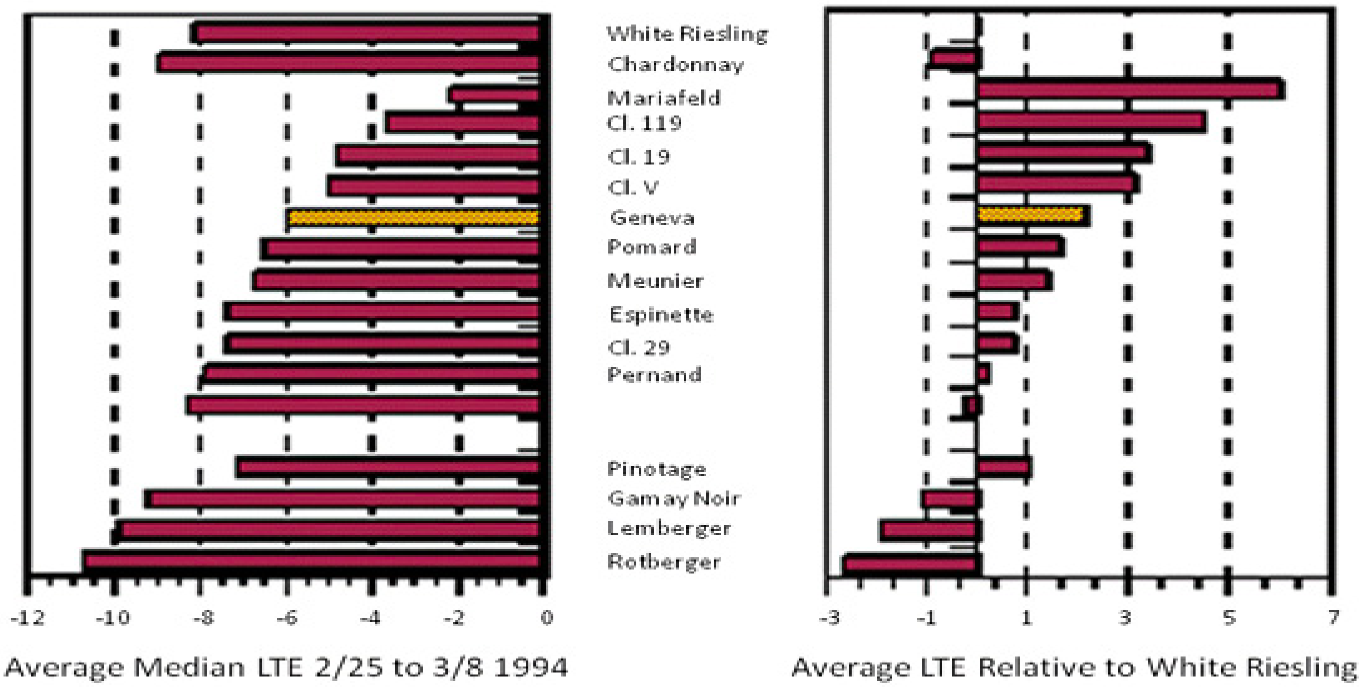

Figure 4. Median Low Temperature Exotherm in late winter, 1998. Left is values for individual clones and right is difference from the freezing temperature of White Riesling primary buds.

Table 5. Percent node survival in different years.

Clone	**1994**		**1996**	**1997**	
Meunier	67	ab	86	93	a
Espinette	68	a	80	91	a
Gamay	61	ab	85	91	a
Cl. 29	63	ab	82	91	a
Pernand	60	ab	85	87	ab
Canada	44	de	84	86	bc
Cl. 7	58	abc	81	86	bc
Blauer Spate	46	cde	74	85	bc
Mariafeld	55	bcd	73	85	bc
Cl. 115				84	cd
Cl. 64				81	de
Cl. 13	42	e	74	81	de
Pomard	48	cde	73	79	de
Cl. 236	26	f		77	de

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Table 5. Percent node survival in different years (Cont.)

Clone	1994		1996	1997	
Cl. 2A	30			76	de
Calera				73	ef
Cl. 113				72	ef
Geneva	67	ab	86	69	ef
Cl. 10/18				68	ef

Bunch Rot Resistance

Bunch rot data is summarized in the Table 6. In 1987 bunch rot was so severe that essentially only Clevener Mariafeld could be harvested. In 1989 bunch rot was quite severe; on average, there was little bunch rot in 1990, 1991 and 1992. In general, the relative ranking is similar among the columns. This gives us more confidence in the observations made on clones which were not fruiting in 1988 (indicated by question marks in overall rating). Clevener Mariafeld is noted for bunch rot resistance in European tests, and it had lowest bunch rot in our experiments. Gamay Beaujolais also has lower than average incidence of bunch rot. In the past we have recommended that clone because its bunch rot resistance allows harvest to be delayed until full maturity. This means that its wines will sometimes be superior to clones which actually have higher quality potential, but which have to be harvested early to avoid bunch rot. Pinot Meunier is rated as susceptible even though it did not have high amount of bunch rot in 1988. That was because it was harvested early that year as is appropriate for a Champagne variety. Most of the better quality clones are bunch rot susceptible. This reinforces the idea that, if quality red wine is the goal, then cultural practices which reduce bunch rot must be used so that fruit may be retained on the vine long enough to attain full maturity. The Mariafeld clone has superior bunch rot resistance, and makes wines which have many desirable attributes. Mariafeld is a good selection to grow in combination with other high quality red wine clones.

Table 6. Percent bunch rot by weight for different clones for 1988 and 1991-92.

PN Clone	Bunch Rot 1988 (% by wt.)	Mean Bunch Rot 1991-92 (% by wt.)	Overall Rating
Mariafeld	1.9 c	0 c	Very Resistant
Gamay B.	9.3 c	0 c	Resistant
Cl. 7		0 c	Resistant?
Cl. 2A		0.2 c	Resistant?
Cl. 236		0.3 c	Resistant?
Cl. 13		0.6 abc	Moderate
Espinette	5.4 c	0.8 abc	Moderate
Pomard		0.7 abc	Moderate?
Meunier	13.6 bc	0.7 abc	Susceptible
Pernand	26.4 a	0.7 abc	Susceptible
Canada		1.6 abc	Susceptible?

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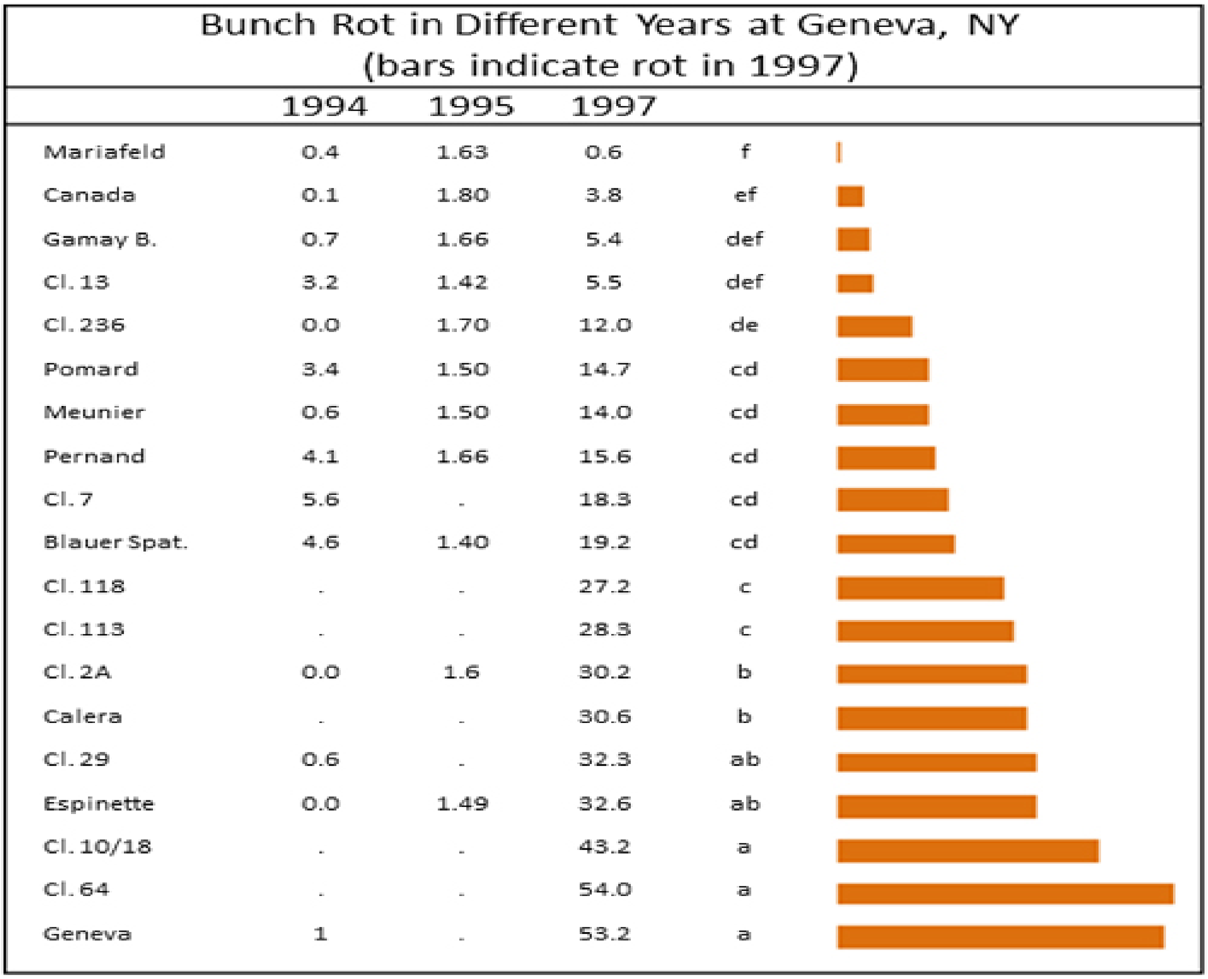
Table 6. Percent bunch rot by weight for different clones for 1988 and 1991-92 (Cont.)

PN Clone	Bunch Rot 1988 (% by wt.)	Mean Bunch Rot 1991-92 (% by wt.)	Overall Rating
Cl. 29	32.2 a	2.2 abc	Susceptible
Geneva	33.4 a	2.8 ab	Susceptible



Bunch Rot in Different Years at Geneva, NY (bars indicate rot in 1997)

	1994	1995	1997	
Mariafeld	0.4	1.63	0.6	f
Canada	0.1	1.80	3.8	ef
Gamay B.	0.7	1.66	5.4	def
Cl. 13	3.2	1.42	5.5	def
Cl. 236	0.0	1.70	12.0	de
Pomard	3.4	1.50	14.7	cd
Meunier	0.6	1.50	14.0	cd
Pernand	4.1	1.66	15.6	cd
Cl. 7	5.6	.	18.3	cd
Blauer Spat.	4.6	1.40	19.2	cd
Cl. 118	.	.	27.2	c
Cl. 113	.	.	28.3	c
Cl. 2A	0.0	1.6	30.2	b
Calera	.	.	30.6	b
Cl. 29	0.6	.	32.3	ab
Espinette	0.0	1.49	32.6	ab
Cl. 10/18	.	.	43.2	a
Cl. 64	.	.	54.0	a
Geneva	1	.	53.2	a

Figure 5. Percent bunch rot by weight for different clones for 1994, 1995 and 1997.

Yield and Maturity

Yields are shown in Table 7. Tasting notes are presented in Table 8. As noted above, maximum yield is not necessarily an appropriate goal for Pinot Noir destined for red wine production. All of the clones listed in Table 7 produced satisfactory yields with the possible exception of Clone 236. We have only limited experience with that clone and it may just be a slow starter. Spätburgunder is not listed because yields and survival have been so low with that clone that we have not always bothered to collect data on it. We do not recommend Spätburgunder.

Table 7. Yield data, wine score, quality and general comments for 10 clones.

PN Clone	**Relatice Yield**	**Typical tons/acre**	**Typical %SS at harvest**	**Typical Wine Score***	**General Red Wine Quality**	**Typical Comments**
Cl. 29	Moderate	4.5	22	6.5-7	Good	Good color and body, strong berry aromas
Mariafeld	Moderate	4.5	22	7.3	Good	Good color and tannin, strawberry and berry aromas
Pernand	Moderate	4.5	22	7	Good	Mod./Good color, very good tannins, rich fruit aromas
Meunier	Moderate	4.5	19	5 (7)	Moderate/Good	In normal years low color and spoilage, in dry years, good color, rich taste and spicy aromas
Espinette	Moderate	4	21	5	Moderate	Moderate color, cherry fruit, often spoiled by bunch rot
Cl. 236	Low?	3	18	5,8	?	Moderate color, cherry and woody aromas, soft tannins
Cl. 13	Moderate	4	19	5	?	Moderate color, good tannins, cooked fruit aromas
Gamay B.	High	5	20	4.5	Low	Light colr, thin, berry and cherry aromas
Geneva	High	5	22	4.5	Low	Moderate to low color, moderate berry fruit aromas, low tannins
Pomard	High?	5	19	5	?	Moderate to low, thin, stewed fruit aromas

Table 8. Tasting notes from wines made in 1996 and evaluated by a large panel of New York winemakers.

PN Clone	% Tasters Noting Fermentation Defect	% Tasters Suggesting Further Testing	Avg. Score (20 pts.)	Comments
Cl. 113	15.8	88.9	15	Citrus, cherries, good body, color OK
Cl. 7	15	87.5	15	More complex nose, fair body
Geneva	14.3	87.5	14	Good nose, color but thin
Calera	10.5	80	14	Spicy, red fruits, good body, best color
Cl. V	72.2	47.1	14	Violets, but distinctly reduced
Cl. 115	95.2	53.3	14	Mercaptans
Mariafeld	10.5	70.6	13	Berries with fair body but light color
Cl. 29	19	58.8	13	Berry aromas but thin

Summary Recommendations

Overall recommendations for clones with which we have had sufficient experience are summarized in Table 9 which lists the primary attributes of the clone.

Table 9. Strong and weak points for each clone for which we have enough experience to make recommendations on.

Clone	Strong Points	Weak Points
Recommended Clones:		
FPMS 29 (Jackson)	Most cold hardy Quality wine	Bunch rot susceptible
Mariafeld	Bunch rot resistance Pleasant fruity aromas & good balance	Cold hardiness Medium color
Pernand	Cold hardiness Quality wine	Availabilty Only slight bunch rot resistance
Clones with limited recommendation for red wine production:		
Meunier	Cold hardiness Yile Good quality when ripe (primary use for sparkling wine)	Ripeness attained only in certain years
Gamay Beaujolais	Cold hardiness Bunch rot resistance	Mediocre quality

Continue on next page

Table 9. Strong and weak points for each clone for which we have enough experience to make recommendations on (Cont.)

Clone	Strong Points	Weak Points
Geneva	Cold hardiness Experience	Bunch rot susceptible Mediocre quality
Espinette	This is a compromise clone – No extreme strengths or weaknesses	
Not recommended:		
Spätburgunder		Low color hardiness Bunch rot susceptible Poor quality Low yield

Testing has not been sufficiently long to make unqualified recommendations for the following clones, but our observations are summarized.

Pomard: Appears to be cold tender, some bunch rot resistance, first wines were disappointing.

Cl. 2A – First indications are not very cold hardy, reputation is for quantity not quality

Cl. 7 – First tests indicates some cold hardiness

Cl. 236 – Mixed results in regards cold hardiness, not extreme bunch rot susceptibility, wines have been low color, but have nice mouth feel. Reputed to be a Champagne clone

Cl. V – First wine quality results are very encouraging. Under our conditions this selection can give well structured, tannic wines with floral and wet earth aromas. We consider this clone worth further trials and it might make a valuable addition to the flavor profile and structure of our Pinot Noirs. Viticulture considerations?

Cl. 115 – First wine quality results are encouraging. Wine has good color, characteristic ripe fruit, plums aromas and medium structure.

Cl. 13 – Pleasant characteristic fruit flavors, good tannins structure.

As outlined in the introduction to this summary of our evaluation of Pinot Noir clones for New York State, the cold winters and the high pressure for bunch rot are the main determinants for the selection of cultivars. For the production of sparkling wines, the clones Mariafeld, Pinot Meunier, and Gamay Beaujolais provide good to outstanding base wines.

Currently our evaluation program focuses on the selection of clones with highly desirable attributes for production of premium red wines. Until we find the perfect clone which is (1) winter hardy, (2) bunch rot resistant, and (3) displays all the desirable flavor characteristics of very fine Pinot Noir our selection strategy is two-pronged: first, to identify clones which are highly tolerant to our very restrictive climatic conditions and have acceptable flavor qualities and, second, to identify clones which add strongly desirable flavor characteristics to our wines with an acceptable higher risk of winter injury and bunch rot infection. We are optimistic that some the clones which we have started to test only recently provide a stronger tannin structure, more varied berry and plum fruit aromas, and floral and wet earth aromas that allow our winemakers to blend more complex and more diverse styles of Pinot Noir.