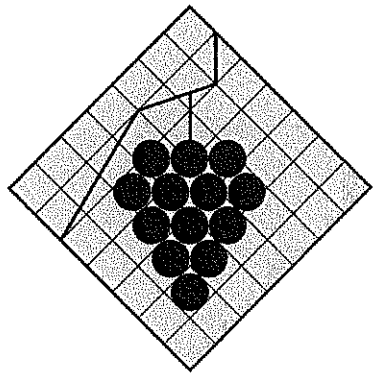


Investigation of clone-site interaction of Pinot Noir in two distinct climatic regions

FINAL REPORT to
GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: **DAS 13 GW**

Principal Investigator: **R Cirami**

Research Organisation: **SARDI**

Date: **December 1993**

GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

FINAL REPORT FOR PROJECT DAS 13 GW

Project Title	Investigation of clone - site interaction of Pinot Noir in two distinct climatic regions.
Organisation	South Australian Research and Development Institute
Location	Nuriootpa Viticultural Centre
Supervisor	Richard Cirami
Principal Researchers	Richard Cirami Andrew Ewart, University of Adelaide
Time Span	1 July 1991 - 30 June 1993
Objectives	To investigate the clone - site interaction of 12 untested clones of Pinot Noir against a reference clone which is widely planted in Australia (D5V12). To compare the performance of these clones in two distinct climatic areas:-Nuriootpa in the floor of the Barossa Valley (warm - 260 m above sea level); Summertown in the Adelaide Hills (cool - 550 m above sea level.

Industry significance:

Pinot Noir is the variety used for the red wines of Burgundy and one of the principal varieties for the white sparkling wines of Champagne. In the cooler areas of Australia the wines can be of excellent quality with a distinctive varietal flavour. There is increasing interest in the variety and the planted area has grown from less than 50 ha in 1974 to over 1,000 ha in 1992.

It is an old and variable variety and some authors claim the existence of over 1000 clones. Amongst the 20 or so clones in Australia there are recognisable differences in growth habit, berry size, bunch compactness and leaf shape.

To date, detailed comparisons on clonal performance have only been done on 9 clones - those clones introduced into Australia in the mid 1960's and early 1970's. An additional 12 clones from France, Germany and Switzerland are now available for detailed comparative testing.

Background

The 12 clones to be tested were introduced into Australia from France, Germany and Switzerland and heat-treated while in quarantine. Subsequent to their release from quarantine in the early 1970's they have never been assessed for performance under Australian growing conditions.

Previous comparisons of other Pinot Noir clones have suggested that some clones are better adapted to particular areas than others. Viticulturists have been able to identify

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recognisable differences in growth habit, berry size, bunch compactness and leaf shape. Other workers have suggested that different clones can contribute to different wine styles, lending a diverse range of flavour options to our winemakers.

The Barossa Valley is a plain, 50 km NE of Adelaide, that runs NE to SW at altitudes between 160 - 290 m. It has moderate rainfall with a marked winter dominance, high summer evaporation and low relative humidity. Vines suffer moisture stress in most parts of the Barossa Valley during most seasons, especially on shallow soils.

The Adelaide Hills surround the eastern urban area of Adelaide and contained few vineyards until the late 1970's when planting began in the Piccadilly-Summertown area. Altitude is 450 - 500 m. Conditions are comparatively more moist and cooler than the Barossa Valley.

The style of wine made from Pinot Noir can vary between regions - for example, the Barossa Valley is noted for the production of dry red wine styles while the Adelaide Hills is noted for the production of sparkling styles.

Methodology

The viticultural performance of twelve clones was compared against a reference clone which is widely planted in Australia (D5V12). The identification and source of the clones compared are shown in Table 1. Clones were arbitrarily numbered from 1 to 13 for identification purposes.

A completely randomised block design with 13 treatments (clones) and ten single vine replicates was planted in 1986 at two sites. One trial was planted in the Barossa Valley on the Nuriootpa Viticultural Centre and the other in a commercial vineyard at Summertown in the Adelaide Hills region of South Australia.

The following data was collected:-

Viticultural measures:- weight of fresh fruit per vine; number of bunches; average bunch weight; average berry weight; number of berries per bunch; pruning weight per vine. Phenological information on time of budburst, flowering, veraison and maturity was also recorded.

Juice composition from a 50 berry sample taken at harvest:- total soluble solids; titratable acidity; Ph.

Must composition from crushed fruit:- total soluble solids; titratable acidity; pH, malate; tartrate; potassium.

Wine and wine colour measurements:- small scale wines were made and anthocyanins and phenolics were analysed by the University of Adelaide Grape and Wine Research Unit at Roseworthy.

Sensory evaluation. Wine was made and evaluated from both the Nuriootpa and Summertown sites for three consecutive vintages up to and including 1993 with the exception of the Summertown site in 1992.

The sensory evaluation program consisted of two levels of wine tasting. Simple difference testing was used to compare each clone with a control or standard clone

(D5V12 in this experiment). The difference testing was employed to determine if overall differences could be detected by a panel of judges. Further testing was carried out using the Australian Wine Show 20-point Score System and expert panels.

Analysis of data:- all data relating to the trials was subjected to analysis of variance.

Virus indexing:- while the 12 nominated clones have all been heat treated, several exhibit marked visual symptoms of virus in the field. All 12 have been grafted to a comprehensive range of indicator plants and have undergo virus indexing.

A major problem was encountered during harvest 1992 when the Summertown site was inadvertently harvested by the property managers and all data was lost.

This project has completed two years of Corporation funding and further involvement has now concluded. The South Australian Vine Improvement Trust Fund financed establishment of the trials and measurement collection in 1991 and will continue to fund the experiments for the 1994 harvest. The 1991 results are included in this report to provide a clearer picture of clonal performance.

Results

Comparisons between clones and sites

Yield. At the Nuriootpa site there were significant clone x year interactions which affected the numerical ranking of some of the clones, as illustrated in Figure 1. The average yield of each clone for 1991-93 is shown in Table 2. Three of the 4 ANTAV clones, the Bourgogne and the Oberlin clones had significantly more yield than the other clones. ANTAV 543 and the industry standard D5V12 had significantly lower yield. At the Summertown site there were also significant clone x year interactions and the average yield for 1991 and 1993 is shown in Table 3. The Bourgogne clones were the highest yielding with Cortaillod 120B being the lowest. Clone D5V12 yielded in the middle of the range at this site. The higher yielding clones had more and heavier bunches which had more berries per bunch. Figure 2 compares the performance of the clones for 1991 and 1993 at both sites and the poorer performance of ANTAV 542 (clone 11) and Cortaillod 120B (clone 5) and the better performance of D5V12 (clone 1) at the Summertown site are obvious. Average yields were considerably higher at the Nuriootpa site.

Pruning Weight. Vines tended to be more vigorous at the cooler Summertown site (Figure 3) with clones Oberlin 120A and 120B, MV6 and D5V12 having heavier prunings per vine and Bourgogne H140A, Geisenheim 20 and ANTAV 542 having lighter prunings. At the Nuriootpa site MV6, ANTAV 151 and 542 and Oberlin 120A and 120B had the heavier prunings with ANTAV 543 and Geisenheim 20 having the lightest.

Composition. Table 4 shows the components of yield and berry composition at the Nuriootpa site for harvest years 1991-93 and Table 5 shows the same for the Summertown site for harvest years 1991 and 1993. Total soluble solids (°Brix) were significantly lower for clones Geisenheim 20, Bourgogne 199A and ANTAV 543 at the Nuriootpa site with MV 6 H170B and Cortaillod H120B having the highest Brix. The 3 Bourgogne clones and Geisenheim 20 had the lowest pH with ANTAV 167 and MV6 having the highest pH and the highest titratable acidity. There were no significant differences in Brix or titratable acidity at the Summertown site and rankings of pH were similar to those at the Nuriootpa site.

Colour Measurements. Table 6 details the average wine colour measurements at Nuriootpa and Summertown for harvest years 1991 and 1993. Wine colour density was adjusted to pH 3.65 and was high at both sites in the Cortaillod and Oberlin 120B clones and low in the 3 Bourgogne clones and the Geisenheim 20. Wine phenolics were high in the Oberlin 120B and ANTAV 151 at Nuriootpa and in the Cortaillod and MV6 at Summertown with the Geisenheim 20 and the 3 Bourgogne clones having low phenolics. Wine anthocyanins were high in the Cortaillod clone and low in the Geisenheim 20 and Bourgogne clones at both sites with D5V12 and MV6 also having high anthocyanin at both sites. Figure 4 illustrates the relative similarity in wine colour measurements at both sites, with the same clone having higher or lower values.

Sensory evaluation 1991. Simple difference testing established highly significant differences (0.10%) between the standard clone D5V12 and all other clones at the Summertown site.

At the Nuriootpa site panellists could not differentiate between D5V12 and the clones Bourgogne H80, Oberlin H120B and MV6. All other clones were found to be significantly different from the D5V12 at the 5% level or higher. The panellists were also asked to give their preferences. No clone was significantly preferred over the industry standard D5V12.

Fifteen judges scored all 13 clones of the Summertown wine on two occasions. On the basis of judge performance statistics five judges were proven reliable and three of these were able to establish significant clonal differences. The top scoring clones (above 15.5) were Oberlin 120A and 120B, Antav 151 and 167 (Figure 5). Wines scoring poorly at this site were D5V12, Bourgogne H199 and H80. The remaining clones scored mid range.

Seven judges scored eight of the Nuriootpa wines on two occasions. Only one judge was able to detect significant treatment differences. The top scoring clones were Cortaillod, Oberlin 120A, Geisenheim 20, Antav 167 and Antav 543 (Figure 6). These were all significantly higher than the industry standard clone D5V12.

Sensory evaluation 1992. Simple difference tests were carried out comparing Bourgogne H199 with 12 other clones. Bourgogne H199 was used for the comparison due to the availability of wine and the fact that in 1991 it was not significantly different from D5V12 at either site. At the Nuriootpa site in 1992 the following clones were identified as being not significantly different from Bourgogne H199:- Bourgogne H80, Oberlin 120A, Geisenheim 20, Antav 167 and Antav 543. Further sensory evaluation will be carried out on the 1992 and 1993 wines.

Virus Indexing. All clones except ANTAV 542 indexed positive for stem pitting. Bourgogne H199A, Geisenheim 20 and ANTAV 543 indexed positive for leafroll virus, but the other 10 clones indexed leafroll free.

Discussion

There were significant differences between clones in virtually all parameters measured with a significant clone x year interaction at both sites. The higher yielding clones tended to have lower Brix and pH, were lower in wine colour measures and were not represented among the higher scoring wines. These clones may be more suitable for sparkling base wine production.

There were also marked clone x site interactions in vine yield and fruit composition with some clones performing quite differently at the 2 locations, as illustrated in Figure 2.

The marked differences in site elevation, microclimate and management no doubt contributed to this interaction. There was, however, considerable uniformity in wine colour measurements between clones and site (Figure 4) and a similar preference for the same wines at each site (e.g. Oberlin 120A and ANTAV 167 wines from both sites were highly scored). This ability of some clones to perform differently in diverse environments was not unexpected, and supports the principle of testing a range of clones at individual properties where cultural management and winemaking practices can be adjusted to suit personal preferences.

Virus and heat treatment effects. The poor yield of ANTAV 543 can be attributed to the virus infection it contains, but neither Bourgogne H199A nor Geisenheim 20 were similarly affected by their virus infection. The heat treatment of the Bourgogne and Oberlin selections did not have any significant influence on their yield performance but differences in wine colour measurements were apparent with, for example, Bourgogne H80A at Nuriootpa being high in colour density while the other Bourgogne clones were lower. The Oberlin 120B was high in phenolics at Nuriootpa with the Oberlin 120A lower.

Furthur work

Phenological, yield and composition data will be collected for the 1994 harvest and will conclude the experiment. The additional data and wine sensory evaluation information from 1992 and 1993 will be used for preparation of a scientific paper on the experiment. The top performing clones will be included in the Vine Improvement Program for ultimate distribution of propagation material to industry.

Acknowledgments

The contributions of David Botting, Tony Davis, Jim Furkaliev, Jeremy Giddings, Richard Hamilton and Patrick Iland are gratefully acknowledged. The financial support of the Grape and Wine Research and Development Corporation and Vine Variety Improvement Trust Fund Advisory Committee are also gratefully acknowledged.

Table 1. Clone identification and source of Pinot Noir selections compared in South Australia.

	Clone Identification and Source	Australian Accession List Number
9	ANTAV 151 H120B High yielding selection in 1966, presumed supplied by Dr. P. Huglin, Station de Recherches Viticoles et Oenologiques, Centre de Recherches Agronomiques, Colmar, France.	I.N.70.0187
10	ANTAV 167 H120B High yielding selection in 1966, presumed supplied by Dr. P. Huglin, Station de Recherches Viticoles et Oenologiques, Centre de Recherches Agronomiques, Colmar, France.	I.N.70.0188
11	ANTAV 542 High yielding selection in 1966, presumed supplied by Dr. P. Huglin, Station de Recherches Viticoles et Oenologiques, Centre de Recherches Agronomiques, Colmar, France.	I.N.70.0185
12	ANTAV 543 High yielding selection in 1966, presumed supplied by Dr. P. Huglin, Station de Recherches Viticoles et Oenologiques, Centre de Recherches Agronomiques, Colmar, France.	I.N.70.0186
2	Bourgogne H80A From Burgundy, but presumed suppled by M. Rochaix, Station d'Essais d'Agriculture, Montagibert, Lausanne, Switzerland.	A.N.71.0331
3	Bourgogne H140A From Burgundy, but presumed suppled by M. Rochaix, Station d'Essais d'Agriculture, Montagibert, Lausanne, Switzerland.	A.N.71.0300
4	Bourgogne H199A From Burgundy, but presumed suppled by M. Rochaix, Station d'Essais d'Agriculture, Montagibert, Lausanne, Switzerland.	
7	Cortaillod H120B A Swiss selection, earlier maturing, presumed supplied by M. Rochaix, Station d'Essais d'Agriculture, Montagibert, Lausanne, Switzerland.	I.N.69.0310

	Clone Identification and Source (con't)	Australian Accession List Number
1	D5V12 An upright growing clone imported from the University of California, Davis as Gamay Beaujolais. This clone is widely planted in Australia and is used here as a reference clone.	I.V.62.2051
8	Geisenheim 20 H120B The most productive clone at Geisenheim in 1966. Presumed supplied by Dr. Hofmann, Hessische Lehr-und Forschunganstalt fur Wein-, Obst-, und Gartenbau, Geisenheim, Germany.	I.N.68.0199
13	MV 6 H170A A selection by G. Gregory from old vines grown at Mt. Pleasant Vineyards in the Hunter Valley. The original vine showed overall good health and apparent freedom from virus.	A.V.71.2340
6	Oberlin H120A From Colmar, but selected by Swiss workers many years ago. Presumed supplied by M. Rochaix, Station d'Essais d'Agriculture, Montagibert, Lausanne, Switzerland.	A.N.72.0301
7	Oberlin H120B From Colmar, but selected by Swiss workers many years ago. Presumed supplied by M. Rochaix, Station d'Essais d'Agriculture, Montagibert, Lausanne, Switzerland.	A.N.72.0302

All of the above clones (except D5V12 and MV 6) were imported into Australia by the N.S.W. Department of Agriculture after an overseas study trip by Graham Gregory in 1966. Most were released from Australian Plant Quarantine from 1969-70, but were then heat treated for extensive periods to attempt to remove virus prior to their limited release. An H followed by a number indicates the number of days of heat treatment received. On any given day more than one shoot tip can be taken for subsequent propagation and this gives rise to the additional letters A, B etc.

Table 2. Average yield of Pinot Noir clones grown at Nuriootpa for harvest years 1991-93.

		Yield (kg/vine)			
	Clone	1991	1992	1993	Average
11	ANTAV 542	4.9	13.4	7.9	8.9
9	ANTAV 151 H120B	5.0	13.3	8.0	8.8
10	ANTAV 167 H120B	4.8	13.8	7.4	8.6
4	Bourgogne H199A	6.6	11.3	7.8	8.6
3	Bourgogne H140A	6.4	11.0	7.6	8.3
6	Oberlin 120A	5.1	12.4	7.5	8.3
7	Oberlin 120B	5.0	12.5	7.4	8.3
2	Bourgogne H80A	5.7	10.2	7.3	7.7
8	Geisenheim 20 H120B	4.8	12.5	7.1	7.2
5	Cortailloid H120B	4.3	11.1	5.7	7.2
13	MV 6 H170B	4.5	10.0	6.3	7.0
1	D5V12	4.0	7.7	5.3	6.5
12	ANTAV 543	2.5	7.7	5.2	5.1
	lsd (P=0.05)	1.8	2.1	1.6	1.4

Table 3. Average yield of Pinot Noir clones grown at Summertown for harvest years 1991 and 1992.

	CLONE	1991 YIELD (kg/vine)	1993 YIELD (kg/vine)	Average YIELD (kg/vine)
4	Bourgogne H199A	4.5	5.6	5.0
3	Bourgogne H140A	4.8	5.1	4.9
2	Bourgogne H80	3.9	4.6	4.2
8	Geisenheim 20 H120B	3.3	4.5	3.9
7	Oberlin H120B	3.9	3.5	3.7
9	151 ANTAV H120B	3.6	3.6	3.6
10	167 ANTAV H120B	3.9	3.1	3.5
1	D5V12	3.5	3.3	3.4
6	Oberlin H120A	3.7	2.7	3.2
11	542 ANTAV	3.2	2.6	2.9
13	MV 6 H170B	3.0	1.9	2.4
12	543 ANTAV	2.4	2.4	2.4
5	Cortaillod H120B	2.0	1.2	1.6
	lsd (P=0.05)	0.9	1.1	0.8

Table 4. Average yield, components of yield and berry composition of Pinot Noir clones grown at Nuriootpa for harvest years 1991-93.

CLONE	YIELD (kg/vine)	BUNCH NUMBER	BUNCH WEIGHT (g)	BERRY WEIGHT (g)	BERRY NUMBER	p H	ACID (g/l)	BRIX
11 ANTAV 542	8.9	93.6	94.1	0.98	102.2	3.45	5.9	24.3
9 ANTAV 151 H120B	8.8	97.4	88.6	0.95	101.6	3.43	6.2	24.2
10 ANTAV 167 H120B	8.6	94.6	89.6	0.96	100.3	3.43	6.3	24.1
4 Bourgogne H199A	8.6	107.2	79.9	0.87	97.3	3.36	6.1	22.5
3 Bourgogne H140A	8.3	97.7	85.6	0.86	105.8	3.36	6.1	23.7
6 Oberlin H120A	8.3	88.4	91.9	0.96	102.0	3.43	6.1	23.8
7 Oberlin H120B	8.3	91.3	88.8	0.94	101.2	3.47	5.8	24.2
2 Bourgogne H80	7.7	97.0	77.9	0.87	95.3	3.38	5.9	23.8
8 Geisenheim 20 H 120B	7.2	85.5	86.1	0.87	103.7	3.38	6.0	22.9
5 Cortaillod H120B	7.2	85.8	82.9	0.90	98.3	3.46	6.1	24.9
13 MV 6 H170B	7.0	92.3	75.2	0.95	84.3	3.41	6.3	24.4
1 D5V12	6.5	79.4	81.4	0.92	93.3	3.45	5.8	23.7
12 ANTAV 543	5.1	77.7	65.7	0.88	79.9	3.48	5.7	23.0
lsd (P=0.05)	1.4	9.8	19.1	0.07	10.4	0.04	0.3	0.5

Table 5. Yield, components of yield and berry composition of Pinot Noir clones grown at Summertown for harvest years 1991 and 1993.

	CLONE	YIELD (kg/vine)	BUNCH NUMBER	BUNCH WEIGHT (g)	BERRY WEIGHT (g)	BERRY NUMBER	p H	ACID (g/l)	BRIX
3	Bourgogne H140A	4.9	65.6	75.2	1.21	63.2	3.27	10.3	22.1
4	Bourgogne H199A	5.0	68.1	74.3	1.21	56.2	3.26	10.4	21.9
7	Oberlin HT120B	3.7	59.4	60.5	1.20	50.6	3.29	10.1	22.5
10	167 ANTAV H120B	3.5	52.2	66.5	1.19	56.1	3.31	10.2	22.7
2	Bourgogne H80A	4.2	55.3	76.3	1.19	64.6	3.26	10.4	22.2
6	Oberlin H120A	3.2	50.9	60.4	1.19	51.5	3.32	10.2	22.6
9	151 ANTAV H120B	3.6	55.7	66.3	1.19	55.8	3.31	10.2	22.6
1	D5V12	3.4	55.3	61.2	1.23	50.0	3.32	9.8	23.0
8	Geisenheim 20 H120B	3.9	51.7	75.9	1.18	64.8	3.30	10.1	22.5
11	542 ANTAV	2.9	43.9	64.8	1.24	52.3	3.31	10.1	23.0
13	MV 6 H170B	2.4	49.4	48.6	1.28	38.3	3.33	10.4	22.2
12	543 ANTAV	2.4	37.3	66.6	1.21	54.9	3.35	10.2	22.5
5	Cortaillod H120B	1.6	40.5	46.8	1.15	40.9	3.33	10.1	23.0
	lsd (P=0.05)	0.8	9.1	9.2	0.06	9.6	0.04	ns	ns

Table 6. Average wine colour measurements of Pinot Noir clones grown at Nuriootpa and Summertown for harvest years 1991 and 1993.

		Nuriootpa			Summertown		
	Clone	Adjusted Density (at pH 3.65)	Total Phenolics (abs. units)	Total Anthocyanins (mg/L)	Adjusted Density (at pH 3.65)	Total Phenolics (abs. units)	Total Anthocyanins (mg/L)
1	D5V12	5.22	27.10	259	3.81	20.76	286
2	Bourgogne H80A	5.38	28.00	255	3.13	19.90	243
3	Bourgogne H140A	4.61	23.00	213	2.96	19.59	232
4	Bourgogne H199A	3.74	23.70	200	2.84	17.98	217
5	Cortailloid H120B	5.48	27.30	229	4.44	22.26	282
6	Oberlin 120A	5.39	24.00	208	3.56	20.10	247
7	Oberlin 120B	5.41	28.30	250	4.05	22.33	275
8	Geisenheim 20 H120B	3.55	22.80	197	3.03	17.71	203
9	ANTAV 151 H120B	5.14	29.40	244	3.79	21.11	249
10	ANTAV 167 H120B	5.00	28.20	233	3.80	21.41	251
11	ANTAV 542	4.69	26.80	219	3.95	21.66	240
12	ANTAV 543	3.83	25.90	205	3.00	22.60	216
13	MV 6 H170B	4.78	27.00	232	4.06	21.05	254

Fifure 1. Average yield of Pinot Noir grown at Nuriootpa illustrating the clone x year interaction for harvest years 1991-93.)

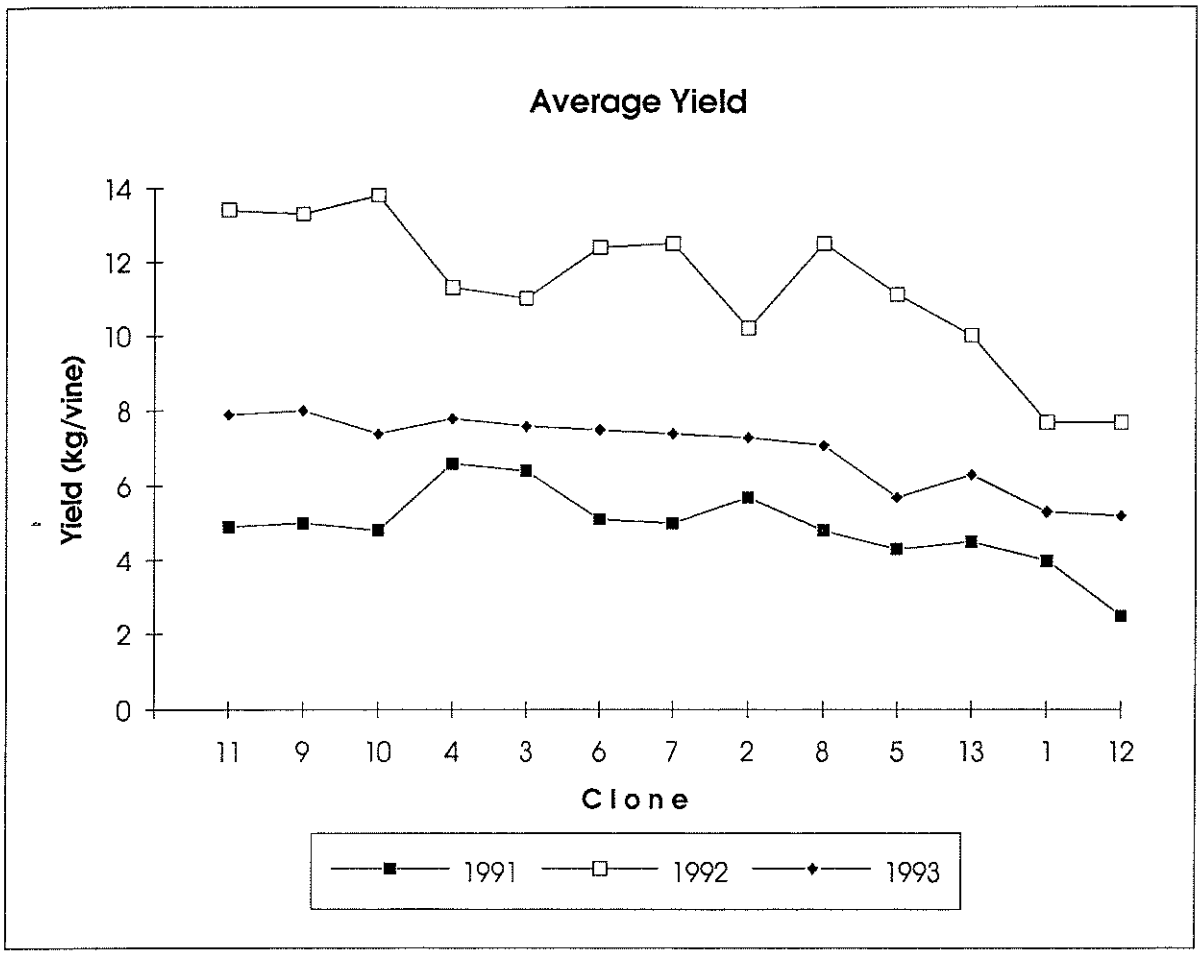


Figure 2. The average yield of Pinot Noir clones grown at Nuriootpa and Summertown for harvest years 1991 and 1993.

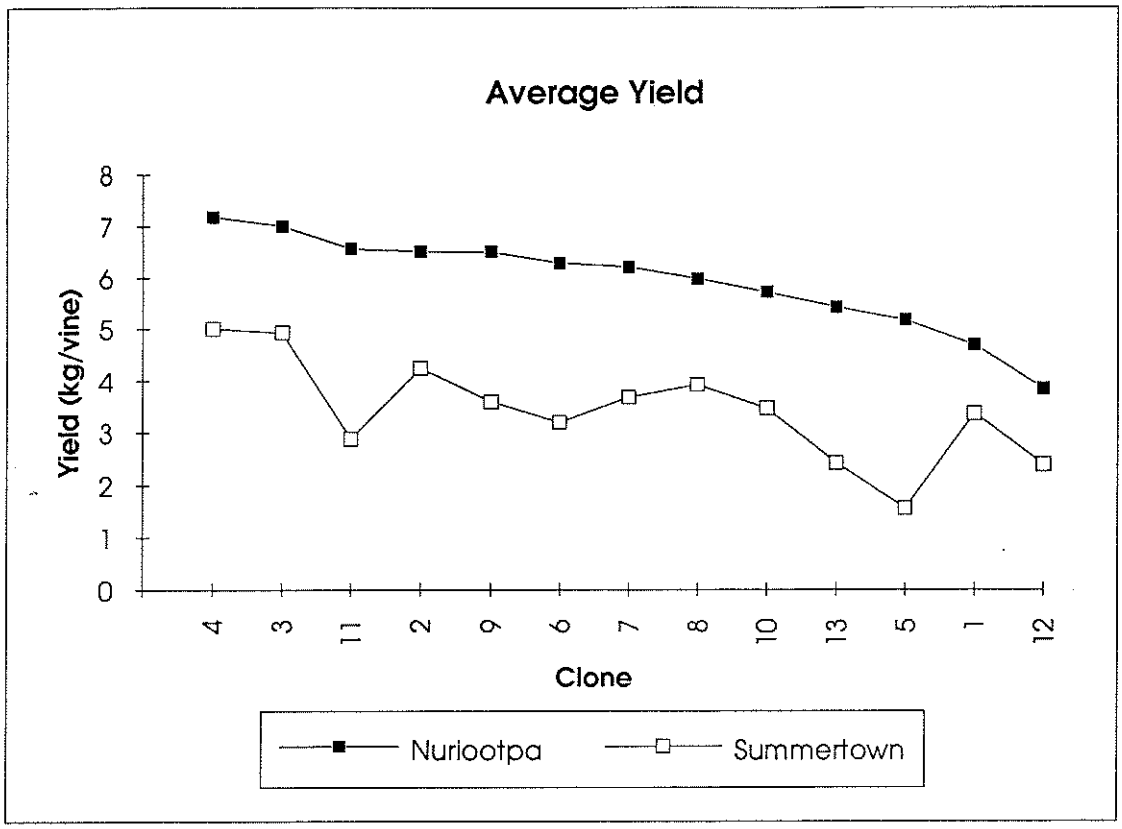


Figure 3. Average pruning weights of Pinot Noir clones grown at Nuriootpa and Summertown for the years 1991-93.

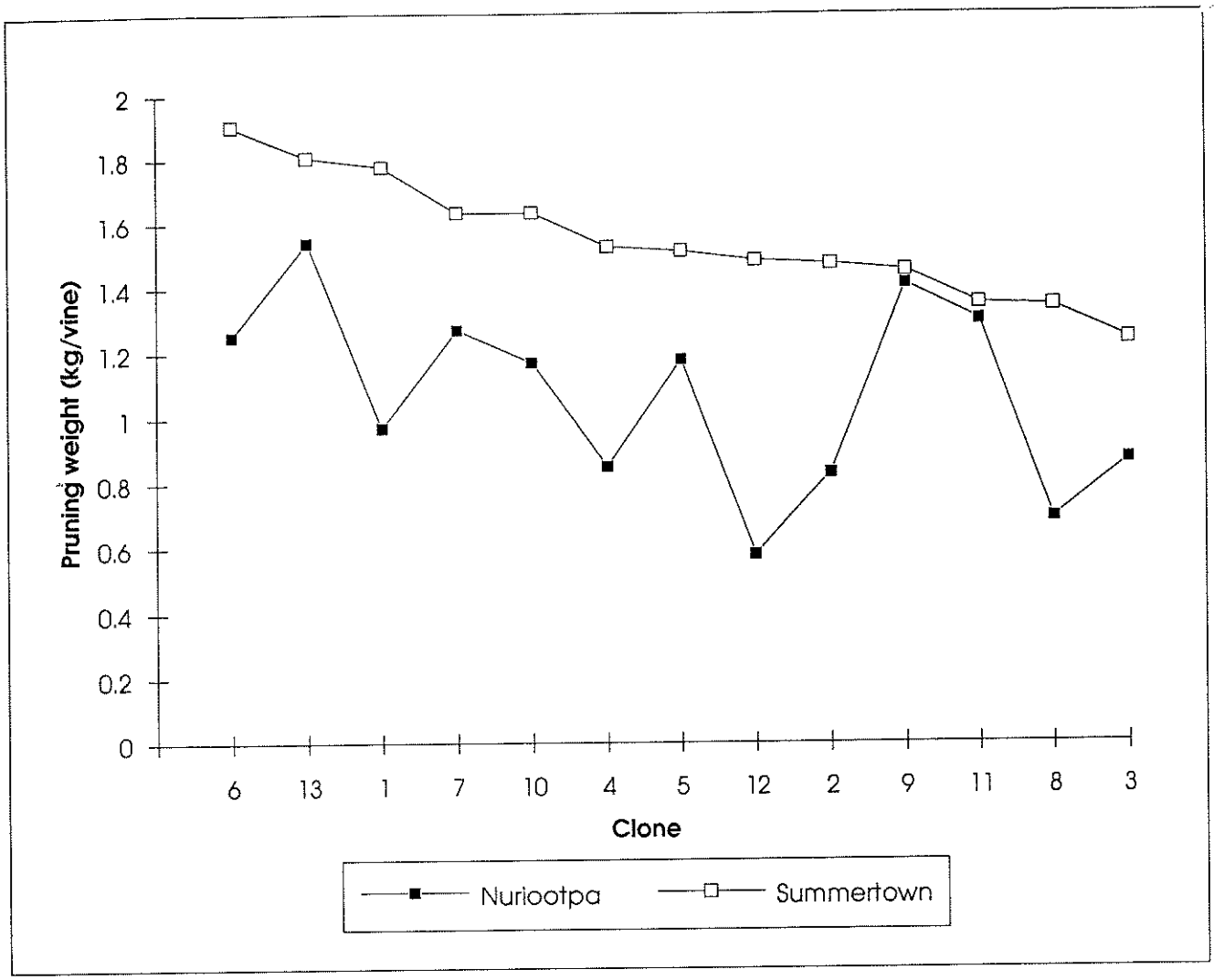
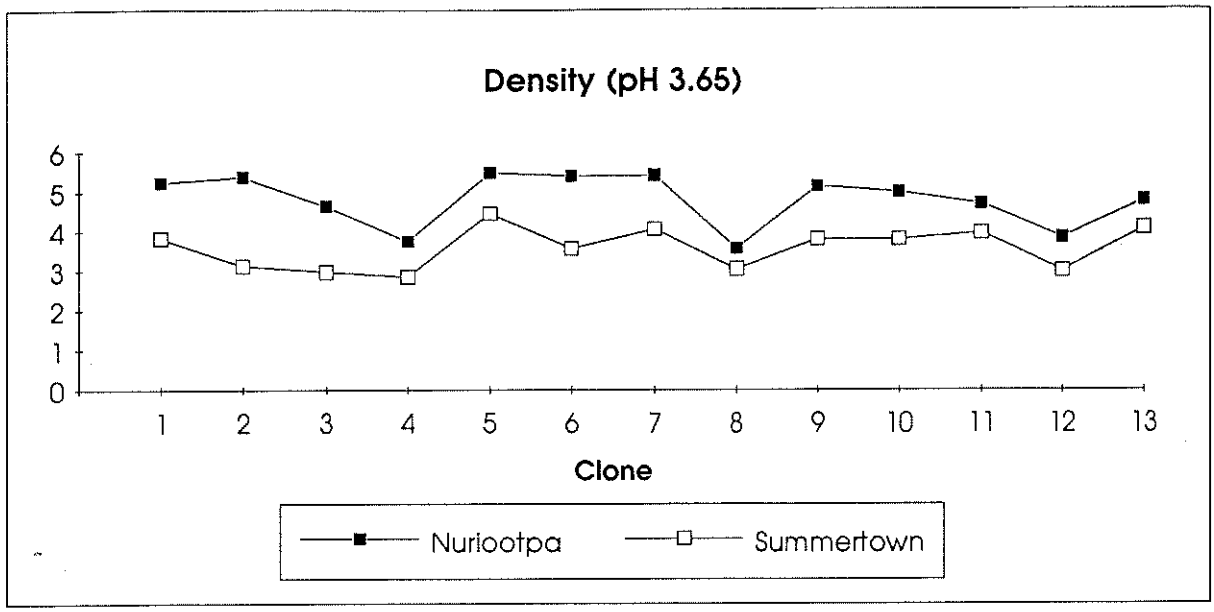
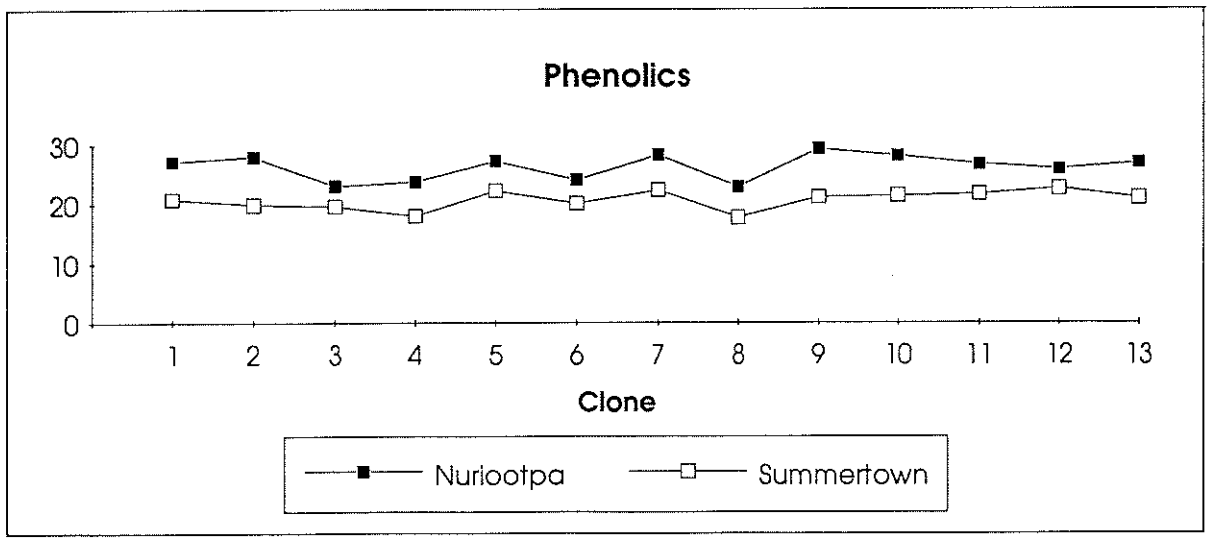


Figure 4. Wine colour measurements of Pinot Noir clones grown at Nuriootpa and Summertown for harvests 1991 and 1993.





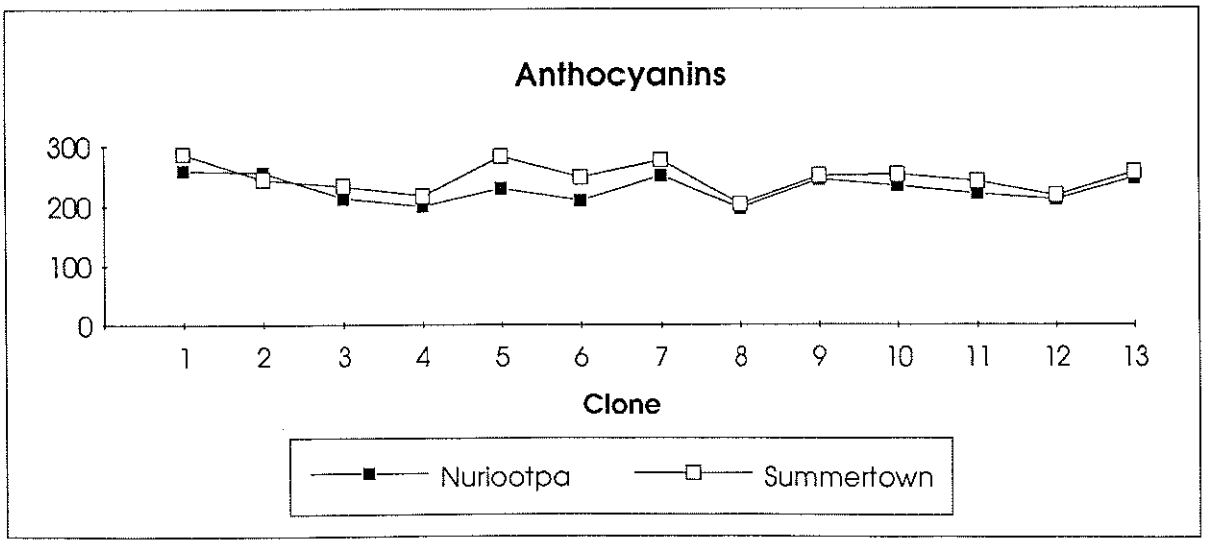


FIGURE 5: Wine Scores of Pinot Noir Clones grown at Summertown for harvest year 1991.

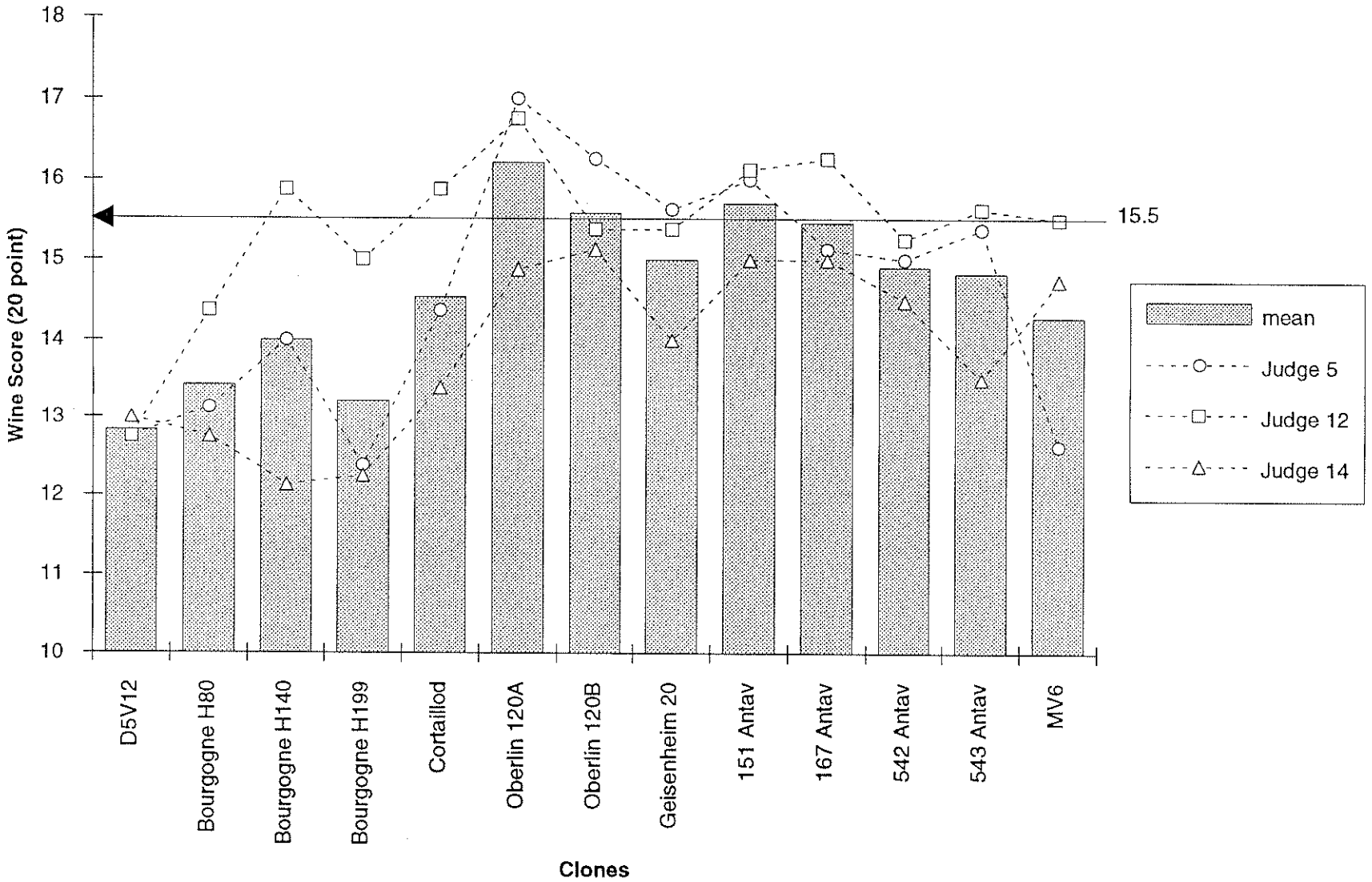


FIGURE 6: Wine Scores (Judge 4) of Pinot Noir Clones grown at Nuriootpa for harvest year 1991.

