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Oenological evaluation of experimental wine grape cultivars grown in south-east Queensland

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Abstract

Wine grapes from four experimental vineyards in south-east Queensland were evaluated for oenological suitability by microvinification between 1978 and 1981. Ripening behaviour and grape maturity were variable. Grapes from red cultivars attained more acceptable juice composition at harvest than did white cultivars. Microvinified wines from red grape cultivars Barbera, Cabernet Sauvignon, Merlot, Ruby Cabernet, Shiraz and Jacquez were preferred to Pinot Noir wines by a trained taste panel. Wines from white grape cultivars Muscat Gordo Blanco and Frontignan Blanc were rated highest.

Applethorpe, the coolest vineyard as measured by the viticultural index of mean January temperature, recorded 20.4°C, Warwick had 23.0°C and Inglewood, 25.8°C. Vintage variation had pronouned effects on grape composition and wine quality. Considering the areas investigated, establishment of vineyards is recommended only in the Granite Belt region at either Ballandean or Applethorpe and surrounding districts.

INTRODUCTION

Wine has been made commercially from table grapes for many decades in the Granite Belt region of south-east Queensland. Recently the need to sell wine produced from recognised cultivars has created demands for wine grapes. As generic labelling becomes unpopular in the market place, interest is turning to classic European cultivars and their renowned wine-styles.

The Queensland Department of Primary Industries (QDPI)introduced selections of wine grape cultivars to south-east Queensland in 1969 (Winks and Brienl 1977). Dormant bud-wood of numerous cultivars was received from CSIRO's Division of Horticultural Research at Merbein and the New South Wales Department of Agriculture's Viticultural Research Station at Griffith.

Four experimental vineyards were established. The introduction and cropping programme consequently required single cultivar microvinification and quality assessment by tasting (Becker and Kerridge 1972). From these plantings cultivar performance and wine quality were studied.

The majority of Australian grape growing regions have sunny, warm to hot, dry climates which receive winter rainfall. QDPI vineyards established in south-east Queensland were in cool to hot climates that experienced a summer rainfall. Unlike the majority of Australian wine producing regions which grow grapes at elevations of 550 m or below, one area in Queensland, the Granite Belt, has vineyards planted at elevations from 700m to 900 m.

In this paper, the ripening performance and fruit composition of wine grape cultivars grown in four different vineyards between 1978 and 1981 are reported. The sensory quality of the red and white wines microvinifed from these grapes is also presented. The climatology of the four sites is discussed.

MATERIALS AND METHODS

In 1971, rootlings were planted at the Granite Belt Horticultural Research Station at Applethorpe and graftlings were planted at the Inglewood Field Station at Whetstone. In 1972 rootlings were planted at Sundown Valley Vineyards at Ballandean and a further planting made at Rosenthal near Warwick in 1973.

The Applethorpe and Inglewood crops commenced production in 1975 followed by Ballandean (1976) and Warwick (1977), with microvinification experiments commencing in 1976.

Harvesting

Commencing mid January, grapes from each cultivar at each regional vineyard shown in Table 1 were sampled weekly. The sample, 300 g of berries per cultivar, was taken randomly from three bunch positions (upper, middle and lower) within plots. Each cultivar was harvested when the chemical composition of the juice described by Antcliff and Kerridge (1975) was achieved. Red grapes were to exceed 21° Brix, red wine pH to be less than 3.6 and acidity greater than 6 g/L. White grapes were to exceed 20° Brix, white wine pH to be less than 3.4 and acidity greater than 7 g/L. Crop performance data were recorded by the Applethorpe viticulturist. Grapes, (50 kg) were precooled (1°C) at Applethorpe, transported to Hamilton and stored (1°C) as employed by Becker and Kerridge (1972) prior to processing.

Table 1. Plantings of eight red and twelve white wine grape cultivars at four sites in south-east Queensland 1971–73*

Latitude Longitude	Applethorpe 28° 37′S 151° 57′E	Ballandean 28° 48′S 151° 51′E	Warwick 28° 14′S 152° 2′E	Inglewood 28° 25′S 151° 4–E
Red Grape Cultivars	Shiraz Cabernet Sauvignon Pinot Noir Jacquez	Shiraz Cabernet Sauvignon Pinot Noir Merlot Barbera Ruby Cabernet	Shiraz Cabernet Sauvignon Pinot Noir Merlot Mondeuse	Shiraz Cabernet Sauvignon Pinot Noir Jacquez
White Grape Cultivars	Rhine Riesling† Semillon Sauvignon Blanc‡ Syrian	Rhine Riesling Semillon Frontignan Blanc Chenin Blanc Muscat Gordo Blanco Sauvignon Blanc Gewurztraminer Gros Meslier	Rhine Riesling Semillon Frontignan Blanc Chenin Blanc Muscat Gordo Blanco Sauvignon Blanc Doradillo Palomino Trebbiano	Rhine Riesling Frontignan Blanc Muscat Gordo Blanco Sauvignon Blanc Doradillo Palomino Trebbiano
Harvest years	1977–81	1977–81	1978–79	1977–80

* Cultivars not assessed oenologically due to poor agronomic performance were Mondeuse, Sauvignon blanc, Doradillo, Palomino, Trebbiano and Syrian.

† Later identified as semillon.

‡ Not true sauvignon blanc, nor positively identified.

Microvinification

Red grapes

Grapes, were destemmed crushed (Amos A1 crusher), sulphited (80 mg/kg total SO_2) and placed in open 50 L polythene fermenting bins. The must, equilibrated to 15°C, was inoculated with 5 % v/v aerated log phase *Saccharomyces cerevisiae* 2A-70 yeast (Australian Wine Research Institute Adelaide, $> 2 \times 10^7$ Colony Forming Units (CFU)/mL) and fermented at 20° ± 2°C with the cap plunged twice daily. After the pulp fermentation (4 d) and pressing (Willmes 30 L air-bag press operated at 150 kPa), free run wine was fermented in 20L glass containers to dryness (<0.4 g/L reducing sugar) under fermentation lock. Wines were sulphited (50 mg/L total SO_2), racked after one week settling on gross lees and fined (0.2g/L Volclay sodium bentonite) for clarification. During processing, wines were handled using CO_2 purging of head-space atmospheres in storage and fermentation jars. After stabilisation (3 weeks at 1°C), wines were coarse filtered (Seitz 30 C), sterile-filtered under nitrogen pressure, bottled without oak maturation and cellared at 10°C.

White grapes

Grapes were destemmed, crushed with minimal pomace contact, sulphited (100 mg/kg total SO_2), and were pressed (100 kPa). Juice was collected in 20 L glass containers, pectolytic enzyme added (140 mL/t Pectinol, Rohm GmbH) and the juice cold-settled (1°C), after adjusting free SO_2 to 30 mg/L. The juice was racked from solids after 1 week. Fermentations with yeast (as per red grapes) were undertaken at 15°C until dryness as assessed by reducing sugar analysis. Wines were sulphited (30 mg/L free SO_2), settled for 1 week and bentonited (1.0 g/L) for stabilising. After racking, wines were filtered (coarse and sterile), bottled and cellared.

Chemical analyses

Samples (100 mL) of red juice (after crushing) and white juice (after settling) were analysed for pH, % soluble solids (by refractometer) and titratable acidity (expressed as tartaric acid). Sulphur dioxide was determined by Rankine and Pocock's method (1970) and reducing sugar by test strips (Dextrostix).

Sensory panel

Screening

Twenty-one laboratory staff were screened for ability to discriminate between wines, (red and white) of varying commercial quality. Ten tasting sessions of five wines per session either red or white, were conducted using the Australian show judge scoring system (Rankine 1974). The first session of both red and white wines was omitted from statistical analyses to allow tasters to become familiar with tasting procedures. A randomised block design (9 blocks of 5 treatment wines) was used for presentation of tasting samples and an analysis of variance of tasters' scores undertaken.

Tasters were eliminated from further testing where their total wine scores showed large *F*-values for reproducibility between sessions compared with the majority of tasters and no significant differences between wines. Successful candidates tasted 17 red wines and 16 white wines in two replicates in randomised block design. On the basis of their performances in the screening tests, six panellists were chosen to evaluate the microvinified wines and were subjected to an ongoing wine education programme for the duration of the wine maturation period.

Wine assessment

Each wine was tasted one and four years after bottling. Sessions of four samples were presented to the sensory panel using randomised block assignment of samples, each replicated three times.

Statistical analyses

The trial design was 4 vineyard sites × 5 years with varying numbers of cultivars depending on the site. Taster scores from screening tests, yearly panel assessments, and grape and wine compositional data were analysed using non-orthogonal analysis of variance.

Climatology

Rainfall and temperature data were noted from recording stations adjacent to the vineyards. Heat summation (HDD), the accumulated heat units between April and October above 10°C (Amerine and Winkler 1944), mean January temperature (T_{Jan}), and continentality, (T_{range}), two climatic indices proposed by Dry and Smart (1980), were calculated.

RESULTS AND DISCUSSION

Juice quality

Chemical analyses of red grapes at harvest are given in Table 2 for cultivars, vineyards and years. Cultivars Merlot, Ruby Cabernet, Shiraz and Pinot Noir were harvested prematurely when measured by the sugar accumulation index (>21° Brix). These cultivars required longer ripening times for more acceptable sugar elevation. Grapes grown in the Ballandean and Inglewood vineyards were most affected by early harvesting. The warmest years, 1978 and 1981 particularly, escalated ripening rates and consequently improved sugar levels.

Table 2. Mean juice soluble solids, pH, titratable acidity and harvest time of red cultivars, vineyards and years

	% Soluble solids	pH	% Titratable acidity g/L	Harvest time (d from 1 Jan)
Cultivar				
Barbera	22.8*a**	3.39*a*	8.0*a*	70.8*a*
Cabernet Sauvignon	21.3*ab*	3.60*a*	6.4*a*	75.1*a*
Merlot	18.9*b*	3.60*a*	6.4*a*	57.4*bc*
Ruby Cabernet	20.4*ab*	3.60*a*	5.9*a*	69.0*a*
Shiraz	19.9*b*	3.64*a*	6.8*a*	64.4*b*
Jacquez	21.8*ab*	3.34*a*	8.7*a*	63.9*bc*
Pinot Noir	20.9*ab*	3.40*a*	8.4*a*	50.3*c*
Vineyard				
Applethorpe	21.6*a*	3.42*b*	8.2*a*	77.1*a*
Ballandean	20.7*a*	3.57*ab*	8.0*a*	67.8*b*
Warwick	21.5*a*	3.29*b*	6.6*a*	57.9*c*
Inglewood	19.7*a*	3.76*a*	6.0*a*	55.0*c*
Year				
1977	19.1*b*	3.41*a*	9.3*a*	73.9*a*
1978	22.3*a*	3.37*a*	7.3*b*	49.6*b*
1979	20.7*ab*	3.46*a*	6.6*b*	69.8*a*
1980	20.3*ab*	3.73*a*	7.0*b*	54.1*b*
1981	21.9*a*	3.57*a*	5.9*b*	74.7*a*

*Means within columns followed by a common letter are not significantly different ($P>0.05$) within headings.

Chemical analyses of white grapes at harvest are given in Table 3 for cultivars, vineyards and years. All cultivars save Chenin Blanc and Gewurztraminer failed to accumulate sufficient sugars (>20.0° Brix). Acceptable ripeness was achieved in the Applethorpe vineyard overall, while only grapes grown in one hot year (1980) and one cool year (1977) yielded sufficient sugars.

The accumulation of sugars, the consequent acidity decline and pH rise in ripening grapes is an indicator of berry physiological activity. Winemakers measure the intensification of cultivar flavour by progressive juice tasting after daily or twice weekly field samplings. Premature harvest by grapegrowers and researchers, as experienced in part of this work, results from too much emphasis on fruit appearance and presence of berry breakdown rather than juice flavour. From the sampling and juice tasting assessments undertaken during five vintages, flavour development followed sugar maturity in the grapes grown in these four vineyards. This observation has been confirmed by Jordan and Croser (1984). However, the decision on when to harvest vineyards in summer rainfall climates becomes a compromise involving sugar maturity, flavour accumulation and external berry quality, all of which have important ramifications on subsequent wine quality. Since these cultivars had not been grown previously in south-east Queensland and information on harvesting was lacking, guidance was taken from Antcliff and Kerridge's (1975) chemical indices.

Table 3. Mean juice soluble solids, pH, titratable acidity and harvest time of white cultivars, vineyards and years

	% Soluble solids	pH	% Titratable acidity g/L	Harvest time (d from 1 Jan)
Cultivar				
Muscat Gordo Blanco	17.5*c**	3.40*b*	5.0*b*	55.8*a*
Frontignan Blanc	19.4*b*	3.32*b*	6.2*a*	39.4*b*
Rhine Riesling	19.4*b*	3.38*b*	6.5*a*	51.7*a*
Chenin Blanc	20.1*a*	3.34*b*	7.1*a*	51.5*a*
Gewurztraminer	21.2*a*	3.70*a*	4.5*b*	40.8*b*
Semillon	19.4*b*	3.50*b*	6.2*a*	51.2*a*
Gros Meslier	18.1*bc*	3.28*b*	6.8*a*	56.3*a*
Vineyard				
Applethorpe	20.1*a*	3.31*b*	6.4*ab*	58.7*a*
Ballandean	18.9*a*	3.39*b*	7.0*a*	58.7*a*
Warwick	19.3*a*	3.27*b*	5.5*bc*	43.0*b*
Inglewood	19.0*a*	3.62*a*	5.3*c*	37.6*b*
Year				
1977	20.6*a*	3.38*a*	7.6*a*	61.0*a*
1978	18.7*b*	3.36*a*	7.5*a*	47.5*b*
1979	18.2*b*	3.35*a*	6.3*ab*	57.9*a*
1980	20.2*ab*	3.39*a*	5.0*bc*	44.0*bc*
1981	18.8*ab*	3.51*a*	3.9*c*	37.1*c*

* Means within columns followed by a common letter are notsignificantly different ($P>0.05$) within headings.

Sugar readings at harvest in south-east Queensland appear to need to lie between 20.7 and 24.3° Brix (11.0 – 13.5% v/v potential alcohol), depending on wine-style, to maintain harmony and balance of the wine components. Within these sugar limits, cultivar flavour at harvest is the most important determinant of wine quality. One criteria, harvest sugar for white grapes, warrants raising from the 20° Brix minimum suggested by Antcliff and Kerridge (1975). Higher ripeness and improved flavour has subsequently been achieved in the Applethorpe vineyard (Scudamore-Smith, *et al.* 1987). Harvesting grapes by acidity or pH indices is no longer a relevant consideration where deficiencies in must composition are replaced during the vinification stages.

Seasonal effects on grape composition due to variations in ambient ripening temperatures, rainfall, cloud cover and vineyard management practices are pronounced. Warmer years accelerated the ripening rate and improved sugar accumulation. In cooler years such as 1977, grapes would have needed to remain on the vine longer to achieve equivalent sugars. A consequence of prolonged ripening is the development of more acceptable fruit

flavour intensity. Hence in addition to flavour development and sugar maturity weather conditions also have to be considered when making harvesting decisions. Harvest dates cannot be predetermined in these areas irrespective of vintage.

The depletion of grape acids and consequent high pH measured in juices; for example, from the Inglewood vineyard indicated that grape sugar maturity, flavour presence and acid balance were frequently uncoordinated. Although other workers from the past decade have resisted acid adjustment of musts in their microvinification research (Kerridge 1983), acid adjustment of musts to 8.0 gm/L titratable acidity was commenced in this trial in 1981. This improved overall wine composition, freshened the wines and increased the efficacy of sulphur dioxide. As a result of high must pH, many of the red wines microvinified previously were browning prematurely at the time of assessment, whereas 1981 red wines have maintained red colour during cellar storage.

Wine composition

Red wines made above pH 3.5 to 3.6 are readily susceptible to premature browning (Somers 1975) regarded as a fault in quality wines. Wines from cultivars Barbera and Merlot retained acceptable colours during conservation (Table 4) while browning was a severe problem with cultivars of higher pH. Red grapes grown in all four vineyards, with their differing soils, produced high pH wines. Years had no affect on pH, and in addition 1981 wines were acid-corrected.

Table 4. Mean red wine pH and titratable acidity from cultivars, vineyards and years

	pH	% Titratable acidity g/L
Cultivar		
Barbera	3.57*b**	6.9ab
Cabernet Sauvignon	3.87*a*	5.8*c*
Merlot	3.56*b*	6.1*b*
Ruby Cabernet	3.78*a*	6.1*b*
Shiraz	3.82*a*	6.3*b*
Jacquez	3.82*a*	8.6*a*
Pinot Noir	3.84*a*	6.0*b*
Vineyard		
Applethorpe	3.63*a*	6.6*ab*
Ballandean	3.86*a*	7.3*a*
Warwick	3.69*a*	5.9*b*
Inglewood	3.82*a*	6.4*ab*
Year		
1977	3.87*a*	6.9*a*
1978	3.73*b*	6.3*b*
1979	3.72*b*	6.0*b*
1980	3.88*a*	5.7*b*
1981	3.54*c*	7.7*a*

* Means within columns followed by a common letter are not significantly different ($P>0.05$) within headings.

All white wine cultivar pH were within an acceptable range, <3.4, (Table 5). The Inglewood vineyard overall had excessively high pH levels. The 1977 year was one of high pH wines. Acids were generally deficient (<7 g/L) in Muscat Gordo Blanco, Gewurztraminer and Semillon cultivars, in the Warwick and Inglewood vineyards and particularly in the years 1978, 1979 and 1980.

Table 5. Mean white wine pH and titratable acidity from cultivars, vineyards and years

	pH	% Titratable acidity g/L
Cultivar		
Muscat Gordo Blanco	3.29*a**	5.2*c*
Frontignan Blanc	3.20*a*	7.2*ab*
Rhine Riesling	3.29*a*	7.3*a*
Chenin Blanc	3.25*a*	8.2*a*
Gewurztraminer	3.35*a*	6.5*b*
Semillon	3.21*a*	6.6*b*
Gros Meslier	3.04*a*	7.2*ab*
Vineyard		
Applethorpe	3.16*b*	7.6*a*
Ballandean	3.35*a*	7.3*a*
Warwick	2.99*b*	6.6*ab*
Inglewood	3.44*a*	6.0*b*
Year		
1977	3.43*a*	7.3*a*
1978	3.34*a*	6.8*ab*
1979	3.32*a*	6.3*b*
1980	3.25*a*	6.2*b*
1981	2.82*b*	7.8*a*

*Means within columns followed by a common letter are not significantly different within ($P>0.05$) within headings.

Wine quality

Taste panel scores for red and white wines in descending order of preference are given in Tables 6 and 7. Although the wines were tasted twice no significant differences ($P<0.05$) between wines at either storage period were apparent. Mean scores of both storage periods are reported. Overall, specific cultivar oenological performance was the most important factor influencing wine quality, with direct influence from year only expressed in white wines. The discrepancy between low total white wine score and its good analysis in 1981 was due to a problem with excessive sulphur dioxide. Vineyard sites were not significantly different for white wines ($P<0.05$). The outcome of wine assessments for red wines over the five years in the four vineyards was confounded due to interaction between year and vineyard. As years and vineyards cannot be compared directly, comparisons were drawn between years.

By the microvinification procedures used, wines made from six red cultivars scored equally while Pinot Noir wines were rated unsuitable. The fruity white wines made from Muscat Gordo Blanco and Frontignan Blanc were preferred to wines made from Gewurztraminer, Semillon and Gros Meslier.

The Applethorpe and Ballandean vineyards red wines were equally preferred in the two years of acceptable grape maturity, 1978 and 1981. Inglewood wines that year were scored significantly worse ($P<0.0.5$) than wines from the other three vineyards. From the sensory scores, flavours from fully-ripe grapes in the Applethorpe and Ballandean vineyards were recognised by the taste panel as being transposed into their respective wines. Inglewood wines according to sensory scores were flavour-deficient. This was explained by the short, hot ripening period (55 d) in comparison to longer, cooler ripening conditions at Ballandean (68 d) and Applethorpe (77 d). Wines from the Warwick vineyard were acceptable but more vintages would have been necessary for substantive comparison.

White wines microvinified in 1977, from the first crops at Applethorpe, Ballandean and Inglewood vineyards, scored higher quality ratings than wines microvinified in 1979, 1980 and 1981. The preference for 1977 wines is explained in terms of grape ripeness.

The best overall harvest sugars and hence best flavour accumulations from the longest ripening time, (61 d), were obtained that year.

Table 6. Mean taste panel bouquet, flavour and total scores for red and white wines for cultivars, and for white vintages

Cultivars	Bouquet	Flavour	Total
Red cultivars			
Barbera	4.6*a**	6.2*a*	13.7*a*
Cabernet Sauvignon	4.6*a*	6.1*a*	13.6*a*
Merlot	4.6*a*	6.0*a*	13.5*a*
Ruby Cabernet	4.6*a*	5.9*a*	13.4*a*
Shiraz	4.5*a*	5.7*a*	13.2*a*
Jacquez	4.5*a*	5.7*a*	13.2*a*
Pinot Noir	3.9*b*	4.9*b*	11.3*b*
White cultivars			
Muscat Gordo Blanco	4.8*a*	5.6*a*	13.3*a*
Frontignan Blanc	4.4*ab*	5.5*a*	12.7*a*
Rhine Riesling	4.0*b*	5.3*ab*	12.1*ab*
Chenin Blanc	4.0*b*	5.0*abc*	12.0*ab*
Gewurztraminer	4.1*b*	4.9*bc*	11.8*b*
Semillon	3.8*b*	4.8*bc*	11.5*b*
Gros Meslier	3.8*b*	4.7*c*	11.3*b*
White vintage			
1977	4.7*a*	6.1*a*	13.8*a*
1978	4.6*a*	5.6*ab*	13.0*ab*
1979	3.8*bc*	4.6*c*	11.3*c*
1980	4.3*ab*	5.4*b*	12.5*b*
1981	3.2*c*	3.9*c*	10.0*c*

* Means within columns followed by a common letter are not significantly different ($P>0.05$) within headings.

Table 7. Mean total taste panel scores of red wines from vineyards and vintages

Vineyard	Year				
	1977	1978	1979	1980	1981
Applethorpe	13.1*b*	14.3*a*	13.9*a*	12.8*bc*	13.3*ab*
Ballandean	11.5*c*	13.6*a*	14.3*a*	13.6*a*	13.6*a*
Warwick	n.c.†	14.3*a*	13.1*b*	m.v.‡	m.v.
Inglewood	12.8*bc*	12.3*bc*	12.3*bc*	12.3*bc*	m.v.

* Means followed by a common letter are not significantly different ($P>0.05$).

†n.c. = no crop, first year of production 1978.

‡m.v. = vineyard not productive.

Area suitability

The elements of climatology calculated from data taken at the four vineyards sites are given in Table 8.

Rainfall incidence during the harvest phase exhibited large annual variation, with a wet year in 1977 and a dry year in 1980. Inglewood was the most arid vineyard and Applethorpe the wettest.

The Heat Summation Data (HDD), showed Applethorpe was the coolest vineyard, a climatic feature indicative by its 870 m elevation. The Applethorpe HDD (1692 day °C) has similarity to the Great Western area of Victoria. Warwick (2230 day °C) has similarity

to the Hunter Valley at Cessnock New South Wales and Inglewood (2612 day °C) was hotter than the Swan Valley Western Australia. The HDD at Ballandean, the centre of commercial viticulture, at 724 m elevation would be estimated to be in the vicinity of 1850 day °C; higher than Applethorpe due to the lower altitude. Stanthorpe town has a HDD of 1814 day °C and is situated between the two sites at 792 m.

Table 8. Climatology of four vineyard sites in south-east Queensland for harvests 1977–81

		Applethorpe	Ballandean*	Warwick†	Inglewood‡
Elevation m		870	724	480	265
Annual rainfall		797	801	658	635
Rainfall Feb–Apr mm					
	Long term	197	199	169	161
	1977	317	266	269	258
	1978	151	208	166	141
	1979	186	128	187	88
	1980	80	75	91	23
	1981	228	25	261	135
HDD °C					
	Long term	1692		2230	2612
	1977	1720		2225	2552
	1978	1821		2441	2735
	1979	1615		1866	2540
	1980	1946		2491	2894
	1981	1856		2374	2970
T_{Jan} °C					
	Long term	20.4		23.0	25.8
	1977	20.4		23.0	25.1
	1978	20.9		24.3	26.3
	1979	20.8		23.1	26.5
	1980	22.1		25.0	27.0
	1981	20.8		23.3	27.5
T_{range} °C					
	Long term	13.1		13.7	15.8
	1977	12.8		12.8	15.1
	1978	13.8		14.9	17.1
	1979	13.7		14.0	16.2
	1980	15.1		16.0	17.4
	1981	13.0		13.3	16.2

* Rainfall only recorded.

† Vineyard not productive after 1979.

‡ Vineyard not productive after 1980.

Mean January Temperature T_{Jan} at Applethorpe was 20.4°C, classified as warm by Kirk (1986) for Australian climates. Warwick vineyard's T_{Jan} of 23.0°C classifies the area to be hot, while the Inglewood vineyard relatively was a very hot region.

All vineyard sites were continental, as measured by T_{range} from 13.1 to 15.8°C, indicating large diurnal temperature fluctuation during the ripening of grapes. A maritime climate such as Margaret River WA has a lower T_{range} of 7.7 (Dry and Smart 1984) from less fluctuating daily temperature regimes.

The vineyards at Ballandean and Applethorpe are preferred for wine grape viticulture. In agreement with indications from climatic data,the cooler ripening conditions of these vineyards caused a greater contribution of cultivar fruit characteristics to the flavour of microvinified wines. Grapes ripen from late February to mid March, often avoiding rainfall which is more concentrated in January and February. Ripening the white cultivars to higher sugar content and hence more varietal flavour definition may be required to

differentiate the more preferred vineyards for these wine styles. Warwick vineyard had a maturity span intermediate between Inglewood and the two Granite Belt vineyards. Grapes ripen into late February, producing fruit with excellent external appearance and wines similar to those microvinified from Granite Belt grapes.

The Inglewood vineyard is less suitable for premium wine production with cultivars ripening in the high summer temperatures (T_{Jan} 25.8°C) during January and February. The must pH were excessively high while microvinified red wines were generally least preferred by the taste panel due to pronounced bitterness and hard tannic tastes.

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