LINCOLN
COLLEGE

GRAPES & WINE

Bulletin 22 A.

Papers in Viticulture

(TAKEN FROM COURSES IN GRAPES AND WINE AT LINCOLN COLLEGE ON NOVEMBER 18th AND NOVEMBER 20 - 22).

LINCOLN COLLEGE

COURSES IN GRAPES AND WINE 1978

The papers in these bulletins (22 A and B) were presented at the two courses in Grapes and Wine held at Lincoln College in November 1978. The programme is given below.

NOTE: Papers in Marketing are not included in Bulletins 22 A or B Papers in fermentation of Wine by Professor Mulcock and Basic Winemaking by Mr Schuster are not printed since this data is adequately covered in Bulletin 18 'Basic Winemaking'. Professor Beaven has condensed his two talks into one paper: "Smelling Good Wine". A report prepared by Mr Steans, and Dr Jackson on the potential of southern areas for viticulture is printed in 22A but was not given at the course.

PROGRAMME

COURSE 1

SATURDAY 18 NOVEMBER

Prospective growers and small-scale wine makers.

8.30 a.m.	Registration desk opens (pre-paid registration only).
9.00	Welcome
9.10	Fermentation of Wine *Professor A.P. Mulcock* How yeasts turn grapes into wine.
9.40	Basic Winemaking *Mr D.F. Schuster* The basic steps required to make wine in cool climates.
10.30	Morning Tea
11.00	Growing Grapes in Canterbury *Dr D.I. Jackson* How to select the best varieties and how to plant and train them.
12.00 noon	The Potential of Marlborough and Nelson *Mr J.E. Marris*
12.45 p.m.	Lunch in the vineyard. Bring your own lunch, tea provided.
2.00	"Shall we have an Appellation Controllee - Marlborough, Nelson, Canterbury or Central Otago". *Mr M.J. Mellon* A review of quality control and creating district identification.
2.45	The Sensory Evaluation of Wine. *Professor D.W. Beaven* How to pick up the taste and smell of wine and how to improve our ability to assess wine.
3.45 p.m.	Wine Characteristics *Mr A.H. Horn and Mr G.F. Steans* Participants will have the opportunity to taste wine in which certain constituents have been emphasised. The ability to assess sugars, acids and tannins varies between individuals. It is useful to know exactly what to look for when assessing these important criteria.
4.45	South Island Wines 1978. A review of what has been achieved and an opportunity to taste some results.
6.00	Closure.

COURSE 2

An advanced course for commercial growers, winemakers, wholesalers and resellers in both the North and the South Island.

MONDAY 20 NOVEMBER

Marketing.

11.30 a.m.	Registration desk opens (pre-paid registrations only)
12.00 noon	Lunch (included in registration fee).
1.00 p.m.	Opening
1.10	New Zealand Wines - Traded or Marketed? *Mr M.J. Mellon* A review of whether wine is just another commodity or a product being marketed to meet consumer needs.
1.40	How the Consumer Spends *Mr R. Brodie* Movements in consumer expenditure patterns need continuous monitoring. Wine will be compared with other beverages and luxury goods and services.
2.20 p.m.	Are New Zealand Wines too Expensive? *Mr D. Lucas* Consideration of production costs, tax and mark-ups.
3.00	Afternoon Tea.
3.30	Rationalisation of Distribution. *Mr N.J. Mackenzie* Pressures on middlemen have increased everywhere, but wholesalers have adapted their activities to still perform an important intermediary role.
4.00	Wine Institute of New Zealand - Three Years Old. A review of its activities; whether it is fulfilling the role of a Producers Association in meeting the "generic" needs of the industry.
5.00	Establishing an EPV for Wine. *Mr M. Dolden* Bowden Communications has developed a procedure for identifying the extra purchase value of products. Wine will be compared with other beverages.
5.30 p.m.	Should N.Z. Wines be Exported? *Mr M.J. Mellon.* Despite Export Year pressures for increased exports the paper will suggest that export activity be delayed until effective control is achieved of nomenclature and quality standards.
6.00	Dinner
7.00	Increasing per capita consumption further. A panel of speakers representing different types of consumers will identify: recent development in consumption patterns, changes in life style, and attitudes to N.Z. wine prices and quality.
8.00	Charting Changes in Public Tastes. *Mr N. Mountier* Paired comparison and rank order testing are used by international consumer industries. Methods for conducting these tests and an introduction to "statistical confidence" will be given. Participants will themselves conduct tests for ranking sugar/acid balances.

TUESDAY 21 NOVEMBER

Viticulture.

8.30 a.m.	Registration desk opens
9.00	Growth and Physiology of the Grapevine. *Dr D.I. Jackson*
9.30	The use of this knowledge for * pruning and training * improving initiation and set * encouraging better ripening *Dr D.I. Jackson*
10.15	Morning Tea.
10.45	New Ideas in Viticulture. Including: pruning, training, harvesting, propagation and spraying. *Mr A.D. Clarke* *Mr R.D. Pollock* Two papers will be presented giving each experts' views on recent developments.
12.10 p.m.	The Peco Mechanical Harvester. *Mr S. Goldsmith* This is the machine about which the Australian grape scientist, Dr P. May, said "the best idea for harvesting grapes I've seen".
12.40	Lunch.
1.40	The Choice of Grape Varieties for New Zealand. *Mr D.F. Schuster*
2.20	The Choice of Soils for Viticulture in New Zealand. *Dr D. Milne*
3.00	Phylloxera Grafting and Rootstocks. *Mr I.A. Gear*
3.40	Afternoon Tea.
4.10	Costs of Vineyard Establishment *Mr M.J. Mellon*
4.40	Problems with 2,4,5 - T, grapes and County Councils. *Mr J.E. Marris.*
5.10	Panel discussion with the day's speakers.
6.00	Dinner.
7.00 p.m.	Films from the French Embassy. "Prestige du Vin de Bordeaux" "Voyage en Champagne". These are excellent films containing a great deal of information on viticulture and oenology.
7.30	Informal tasting of wines.
	CHAIRMAN: Dr H. Connor

WEDNESDAY 22 NOVEMBER

Winemaking and Evaluation.

8.30 a.m.	Registration desk opens.
9.00	Continuous Fermentation - its prospects for the wine industry. *Professor A.P. Mulcock.*
9.45	Microvinification and its uses for testing grape varieties. *Mr K. Cresswell*
10.30	Morning Tea.
11.00	Thermovinification - a comparison with traditional colour - extraction methods. *Dr D. Sheat*
11.45	Problem areas in winemaking. One man's viewpoint. *Mr G. Collard.*
12.30 p.m.	Lunch.
1.30	The wines we should be making in New Zealand. *Mr D.F. Schuster*
2.10	The sensory evaluation of wines by smell. *Professor D.W. Beaven.* The psychophysiology of taste. *Professor R.A.M. Gregson*
3.00	Wine evaluation - a detailed practical session. *Mr A.H. Horn, Mr N.S. Mountier, Mr G.F. Steans.*
5.00	Tasting of Lincoln College Wines.
6.00	Closure.

THE POTENTIAL OF SOUTHERN AREAS FOR WINE-GRAPE PRODUCTION

G.F. STEANS AND D.I. JACKSON,
DEPARTMENT OF HORTICULTURE,
LINCOLN COLLEGE.

Commercial grape production is now well established in Marlborough and, on a smaller scale, in the Nelson Province. Interest is being shown in other southern areas and some small plantings are now being made in the Wairarapa, Canterbury and Central Otago.

Lincoln Trials

Growing of grapes at Lincoln College began in 1973 with a limited planting of a dozen varieties. This collection has now expanded to include 40 wine and 20 table grapes. A pruning and training trial with 14 different systems has also been established and this will yield its first crop next year.

1978 was the first season in which a considerable number of grapes from the variety collection matured and were comparatively assessed for sugar and acid.

The season was a moderately good one. The cold winter followed by a cold and wet early spring resulted in a set which was less than normal. The weather improved in late spring and led into a very warm dry summer. Most varieties matured during the dry warm weather but a wet week in April caused us to pick the later varieties sooner than we would have preferred.

Climatic Needs in Cooler Areas

In cooler districts grapes are best when they ripen to 16-22% sugar with an acid level of 0.6 to 1.0%. Winemakers can still make wine with levels outside this range, but problems are somewhat greater, additives to counter acidity or increase sugar are needed and quality suffers a little, although good wines can still be made. In cool climates we prefer warm dry summers with late autumns and lack of frost in spring and early winter. We know from European experience that a cooler district under these climatic conditions can provide quality which cannot be matched in warmer areas with more reliable climates. These are years of great vintages which are so famous in France and Germany.

The aim of this paper is to examine the climates of southern districts of New Zealand over a number of years, try to predict their potential, and suggest the types of grape which we think are most likely to succeed.

Two Seasons

To put the study in perspective we would like to briefly report on the climate in two seasons at Lincoln and indicate how they have affected the grape and wine quality. The two seasons chosen are 1976 and 1978; the first an unusually cold one and the second a very warm one.

Details are as follows:

1976 1) No spring frosts after bud burst
2) Cold wet summer with only 670°C Days
3) Early autumn frost on 21 April which stopped growth and made it necessary to pick shortly afterwards.

1978 1) No spring frost after bud burst, which was late
2) Hot dry summer of 1200°C Days
3) No autumn frost but heavy rain in mid April caused deterioration of berries and led to early picking of late varieties.

Results for Three Varieties: early, mid season, and late

		Sugar %	Acid %	Picking Date
Gewuerztraminer (Early white grape)	1976	18.4	0.86	7.4.76
	1978	17.8	0.72	5.4.78
Pinot Noir (Mid season, red, Burgundy style)	1976	18.5	1.3	13.4.76
	1978	21.4	0.90	11.4.78
White Riesling (Late white)	1976	16.8	20.0	5.5.76
	1978	19.4	0.83	21.4.78

It can be seen that both seasons were satisfactory for the early Gewuerztraminer. For Pinot Noir 1976 produced a juice in which acid was rather high, nevertheless the quality of the wine was good and a good winemaker could adequately lower it by standard techniques. The late White Riesling (not to be confused with Riesling Sylvaner) was, in 1976, very acid and needed severe treatment to make wine. It would still be suitable for commercial wine but the quality would be below that of earlier-ripening grapes in that year. 1978 was a better season but it was not vintage since this grape needs to hang for as long as possible to create the superb character that distinguishes, say, a Rhine wine in a vintage year.

By comparison of two seasons with 300^{0}C Days either above or below the average we get a good idea of the limits of a climate such as Canterbury. Clearly, early- and mid-season varieties will ripen satisfactorily but later ones will be a little unreliable and might be omitted from standard plantings.

There is one other limit which was not shown in the two years 1976 and 1978. This is spring frost. In 1977 there was a late-spring frost which would have had severe effects in frost-prone sites which had no protection by frost pots or sprinklers.

In this study we examine meteorological data for a series of districts with special emphasis in late spring frosts, degree days, early autumn frost, rainfall and humidity.

Climatic Data for Southern Areas

Meteorological data were obtained for the following stations.

Southern North Island	Masterton
Marlborough	Blenheim
Nelson	Motueka (Riwaka)
	Nelson (Aerodrome)
	Moutere
North Canterbury	Waipara
	Lincoln
	Onawa (Akaroa)
Mid Canterbury	Ashburton
South Canterbury	Waimate
Central Otago	Queenstown
	Alexandra

The following data are presented in Table 1.

Degree Days (October - April)

Calculated as mean temperature (^{0}C) for month minus 10 and multiplied by number of days in month. The degree days for the months of October to April are added together to give the annual total shown in the table.

Most grape-growing areas in the world have heat units above 1000 but the best wines are often produced in areas with slightly above or below this figure. (Geisenheim on the Rhine is 994, Reims (Champagne) is 1011 and Bordeaux is 1328). Too much reliance however has often been put on this figure in New Zealand which has a rather different climatic pattern to Europe and North America where the use of such data originated. For example we have a longer summer but a more variable one. Buds of grapes in the South Island burst in October, in Germany, for example, they burst in the equivalent of November (May). The longer season no doubt compensates for lower average temperatures than continental Europe or America and this is confirmed by our own observation of grape-ripening patterns here at Lincoln in comparison to Europe, and similar observations on other fruit crops. As an example the Granny Smith apple and peaches ripen satisfactorily in Canterbury yet are considered to be too heat demanding for the area of Germany close to where some of the best wines are produced. Such horticultural observations are probably more valuable than meteorological data between countries although measurement of heat by Degree Days does give a useful measure of comparative growing conditions within New Zealand.

From the data in Table 1 Lincoln would be one of the cooller South Island areas yet, as we have already noted, it is quite warm enough to ripen early and mid-season grapes. There is probably no area shown which could not ripen early grapes and we could expect the warmer areas such as Waipara, Akaroa, Blenheim, Nelson and Masterton to be suitable for later-ripening varieties such as Rhine Riesling and perhaps Cabernet Sauvignon.

Frosts

Buds of the grape in the south burst in early to mid October. From that time onwards frosts of 2 or more degrees can damage the shoots and flowers, and ground frosts can harm and even kill freshly-planted vines. A glance at the table shows that frosts can occur in most areas and in fact the local land-form and micro-climate is often a more important factor in selection of an area for grapes.

Sites free of frost from October onwards occur in all districts and are obviously preferred. Otherwise areas subject to late frosts will need some degree of protection if a crop is expected each year. Screen frosts in April can also be a problem in these areas since they will kill leaves and prevent further fruit ripening. Very severe frosts can damage berries at this end of the season.

Rainfall

Grapes, as described elsewhere, are tolerant of dry conditions and when these occur lack of disease can be a positive bonus. The Nelson and Wairarapa (Masterton) areas are the wettest with two to three times the rainfall of the dryer parts of the east coast and Central Otago. The number of days with rain in the growing season (as for example November -December) or in the ripening period (March - April) suggests, however, lesser differences than in total rainfall, and suggests that the wetter parts have no more days with rain than the dryer areas. This might suggest that cultural activities and picking might be no more hindered by rain in these places, except of course that the rain is more likely to be heavy and the ground and berries likely to stay wet rather longer. One worrying aspect of rain is, however, disease. The East Coast and Central Otago tend to have their wet weather coming from the south when temperatures are low. This sort of rain does not greatly encourage disease. As one moves north, more rainfall comes with north and westerly winds creating warmer humid conditions which favour disease. Nelson, Moutere, Motueka would be the worst in this respect with Masterton next and Blenheim experiencing lesser warm rainfall conditions. These districts will have more problems with disease than Canterbury and Central Otago. It will also make these areas slightly less likely to be suitable for producing late-harvest high quality wines.

Micro-climates

All of the above factors can be affected by local conditions as already mentioned. The data for Degree Days for example can be dependent on the position of the meteorological station. These factors are even more modified by local horticultural practices. In Canterbury shelter from the N.E. wind can raise degree days dramatically. (Incidently this is the main reason why Akaroa and Waipara appear so much warmer - they have natural shelter from the north easterlies.) A site with a northern slope can increase heat accumulation as well as reduce frost incidence. The combination of shelter from prevailing cold winds and a site facing the sun can easily add 200 heat units to the basic met-station data.

Clean cultivation of the soil below grapes can also be beneficial in reducing frost damage, reducing humidity after rain and accumulating more heat. Planting systems and training practices can also modify climate but this is a rather more involved issue.

Choice of Varieties

A number of varieties can be tentatively suggested as being appropriate for southern areas. For further details we refer the reader to Bull. 21 'Grape Varieties for New Zealand', Lincoln College.

Early Varieties

Gewuerztraminer
Mueller Thurgau (Riesling Sylvaner)
Pinot Blanc
Chasselas
New German and Austrian introductions?

Early to mid-season

Grey Riesling
Pinot Gris
Sylvaner

Mid-season

Pinot Noir
Gamay Noir (Gamay de Beaujolais)

Late (use only in warmer areas or the best sites)

Rhine Riesling
Petit Syrah (Shiraz, Hermitage)
Cabernet Sauvignon and related cultivars i.e. Merlot, Cabernet Franc

Not recommended due to poor clones at moment

Chardonnay

Still to be assessed but possibly having promise

Semillon
Sauvignon Blanc
Muscats (e.g. Ottonel)
Pinot Meunier

TABLE 1. CLIMATIC DATA FOR SOUTHERN AREAS

Place	Degree Days Oct - Apr	Days of Frost: Ground (G) or Screen (S)														Season (Months above 10°C)	Seasonal Rainfall (mm)	No. of Raindays (with more than 1 mm of rain)	
		October		November		December		January		February		March		April					
		G	S	G	S	G	S	G	S	G	S	G	S	G	S			Nov-Dec	Mar-Apr
Masterton	1003	7.8	2.9	4.2	0.1	1.8	0.0	0.7	0.0	0.5	0.0	2.8	0.1	6.7	0.6	September to May	658	19	17
Motueka	1039	11.2	0.5	0.8	0.0	0.5	0.0	0.0	0.0	0.3	0.2	0.8	0.0	6.8	0.0	October to May	710	20	19
Nelson	1090	4.6	0.6	1.6	0.1	0.7	0.0	0.1	0.0	0.2	0.0	0.9	0.1	5.3	0.4	October to April	543	22	20
Blenheim	1213	2.3	0.6	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	1.4	0.2	September to May	393	19	17
Akaroa	1029	3.0	0.0	0.8	0.0	0.0	0.0	0.8	0.0	0.9	0.0	0.5	0.0	2.4	0.0	September to May	508	24	23
Lincoln	795	5.3	1.0	2.3	0.2	1.0	0.0	0.3	0.0	0.4	0.0	2.1	0.2	5.7	1.0	October to April	363	20	20
Ashburton	923	5.7	1.2	1.4	0.3	0.1	0.0	0.1	0.0	0.0	0.0	0.9	0.0	5.0	1.1	October to April	451	22	20
Waimate	811	5.9	0.3	2.3	0.1	0.4	0.2	0.1	0.0	0.5	0.0	2.2	0.0	6.4	0.2	October to April	414	25	21
Waipara	964	6.2	1.2	2.5	0.7	0.5	0.0	0.0	0.0	0.0	0.0	1.0	0.0	4.0	0.5	October to May	415	19	20
Alexandra	908	12.9	1.9	6.0	0.2	1.3	0.0	1.0	0.0	1.1	0.0	5.1	0,3	11.3	2.9	October to April	243	19	17
Queenstown	684	12.7	0.6	6.1	0.1	2.8	0.0	1.9	0.0	1.8	0.0	4.9	0.0	10.2	0.2	October to April	479	20	18
Moutere	1134	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1	September to May	742	17	14

Data from "Climatographs of New Zealand" - J.C. Gerlach, 1974 (10 years minimum)

POTENTIAL OF NELSON AND MARLBOROUGH AS WINE GRAPE GROWING DISTRICTS

J.E. MARRIS,
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MONTANA PROPERTIES LTD.,
BLENHEIM.

As a brief background, I have been involved with Montana wines Ltd, since it's commencement in Marlborough in 1973. Prior to that I spent 10 years working in the Stock and Station Agency business, also in Marlborough. In the following paper, I would like to point out that I am expressing my personal opinion, based on my own experience as an employee of Montana Wines Ltd., and that naturally the information herein may be challenged.

It is now recognised that the Marlborough region is a proven Wine Grape growing area. The question now to ask is, does it have significant potential. Nelson with a climate of similar nature, should also have a potential, but only time and experience in the region will determine whether this will prove to be significant. We will now evaluate some factors which will influence the potential of these two regions.

The success of Wine Grape growing in any area depends on several factors. These are as follows:-

(a) Climate
(b) Soil Types
(c) Land Availability
(d) Local Government Restrictions
(e) Pest and Disease Potentials
(f) Market Outlets

ACKNOWLEDGEMENTS

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Montana Wines Limited.

Climate

Of the above, a suitable climate is essential, as without this, grape growing for winemaking can be difficult, and in fact totally uneconomic. Various criteria have been laid down for suitability. For example, Professor N.J. Becker from Germany, has mentioned that German growers, looking for land suitable for the growing of Riesling grapes, consider the following climatic factors.

The mean temperature of the warmest month should be greater than 17.5^{o}C.

At least 1250 hours of bright sunshine are required during the growing season.

The average rainfall should be less than 900 mm.

The accumulated growing degree days during the frost free period should lie between 1000^{o}C and 1250^{o}C for Riesling grapes.

It is recognised that climate decides what may be grown in a region, whereas, soils indicate to what extent climatic opportunities can be realised. Climate is of great importance in viticulture, particularly in cool temperate regions, and the "Great Wines" of certain European areas are closely associated with a favourable grouping of the various climatic factors. At present the Viticultural Research Committee of the N.Z. Wine Institute have commenced a climatic analysis of the potential grape growing areas in New Zealand. Some of this data has already been mapped, and was presented by the Meterological Bureau at a recent seminar at Auckland. Unfortunately, much still has to be done in the gathering of this data, as at this stage, only a very broad picture is available. For interest sake, and with permission from the Meterological Department, I have reproduced the maps as presented to the Auckland seminar. (See Appendix).

In dealing with climate, I believe that we in New Zealand will, in time, evolve our own "best areas" climatic recipes. No doubt, it may not be far from Professor Becker's criteria, but there could still be subtle differences. In studying climatic data of the Nelson, Marlborough regions, one could go into much detail. I have endeavoured to pick out factors I consider relevant to wine grape growing, and these are, in order of presentation.

Table 1: Criteria for Selecting Grape Growing Areas

1.	Temperatures (including sunshine hours and heat summation)
2.	Freedom from unseasonable frost
3.	Freedom from hail damage
4.	Wind
5.	Rainfall
6.	Humidity

In dealing with the two provinces, I have selected various weather stations, and will refer to data available from these Stations. There are:

Marlborough

Blenheim Aerodrome	- Located in the middle of the vineyard area 7 km west of Blenheim.
Waihopae Power Station	- 36 km southwest of Blenheim.
Lake Grassmere	- 48 km south by road from Blenheim.

Nelson

Nelson Aerodrome	- 5 km southwest of Nelson City.
Moutere Hills	- 3 km west of Brightwater in the Waimea County.
Appleby	- 16 km west of Nelson City.
Riwaka	- 4 km northwest of Motueka.

Temperature and Heat Summation

In America, after summarising climatological data from the successful winemaking areas, and correlating this with the analytical data and quality scores of the matured wine areas, the only factor of climate that proved to be of predominant importance was temperature. Other factors such as rainfall, fog, humidity and duration of sunshine, may have effects, but these are much more limited than the effect of heat summation. The majority of the diagrams are associated with the growing season of a grape.

Table 2: Mean Temperature for Months of Growing Season

	Blenheim Aerodrome	Waihopai	Lake Grassmere	Nelson Aerodrome	Appleby	Moutere Hills	Riwaka
Oct.	12.1	11.6	12.1	11.5	12.2	12.2	12.1
Nov.	14.4	13.7	14.0	13.8	14.1	14.6	14.2
Dec.	16.5	15.7	15.9	15.5	16.1	16.5	16.1
Jan.	17.8	16.9	17.3	16.7	17.3	17.3	16.7
Feb.	17.8	16.9	17.4	16.7	17.3	17.3	16.7
Mar.	15.8	15.1	15.6	15.3	15.8	16.1	15.6
Apr.	12.9	12.6	13.2	12.3	13.3	13.7	13.0
Average	107.3	102.5	105.5	101.8	106.1	107.7	104.4

In discussing the following data, it must be recognised that the information used is gathered on a broad spectrum, and has not taken into account the many localised areas which, undoubtedly exist with differing climatical effects and micro climates.

In Table 2 you can see that going by Professor Becker's criteria, Blenheim succeeds in reaching over 17.5°C for the hottest month, although Grassmere, Appleby and Moutere Hills are very close.

Table 3:

Sunshine hours Average (35 years)	Blenheim	Nelson
Oct.	226	216
Nov.	239	227
Dec.	245	245
Jan.	262	259
Feb.	225	220
Mar.	215	214
Apr.	189	189
Average Total Growing Season	1601	1570
Total Average for Year (35 years)	2449	2407

Table 3 shows that over a 35 years period there is not a large difference in sunshine hours between Blenheim and Nelson.

Table 4:

Heat Summation for growing Season	Data Period 1947-1976 Blenheim	Data Period 1943-1976 Nelson	Data Period 1966-1975 Appleby
Mean Summation 0°C			
Oct.	94.7	63.8	75.7
Nov.	144.5	114.7	131.6
Dec.	205.2	178.4	198.3
Jan.	239.1	222.3	232.0
Feb.	223.3	203.3	216.0
Mar.	194.3	176.7	204.6
Apr.	104.8	87.4	115.2
Summation Total	1205.9	1046.6	1173.4

In major cool climate viticultural areas it is recognised that degree Brix is more closely correlated with heat summation over 10°C, than with total heat summation or hours of sunshine.

<u>Heat Summation Definition</u>:

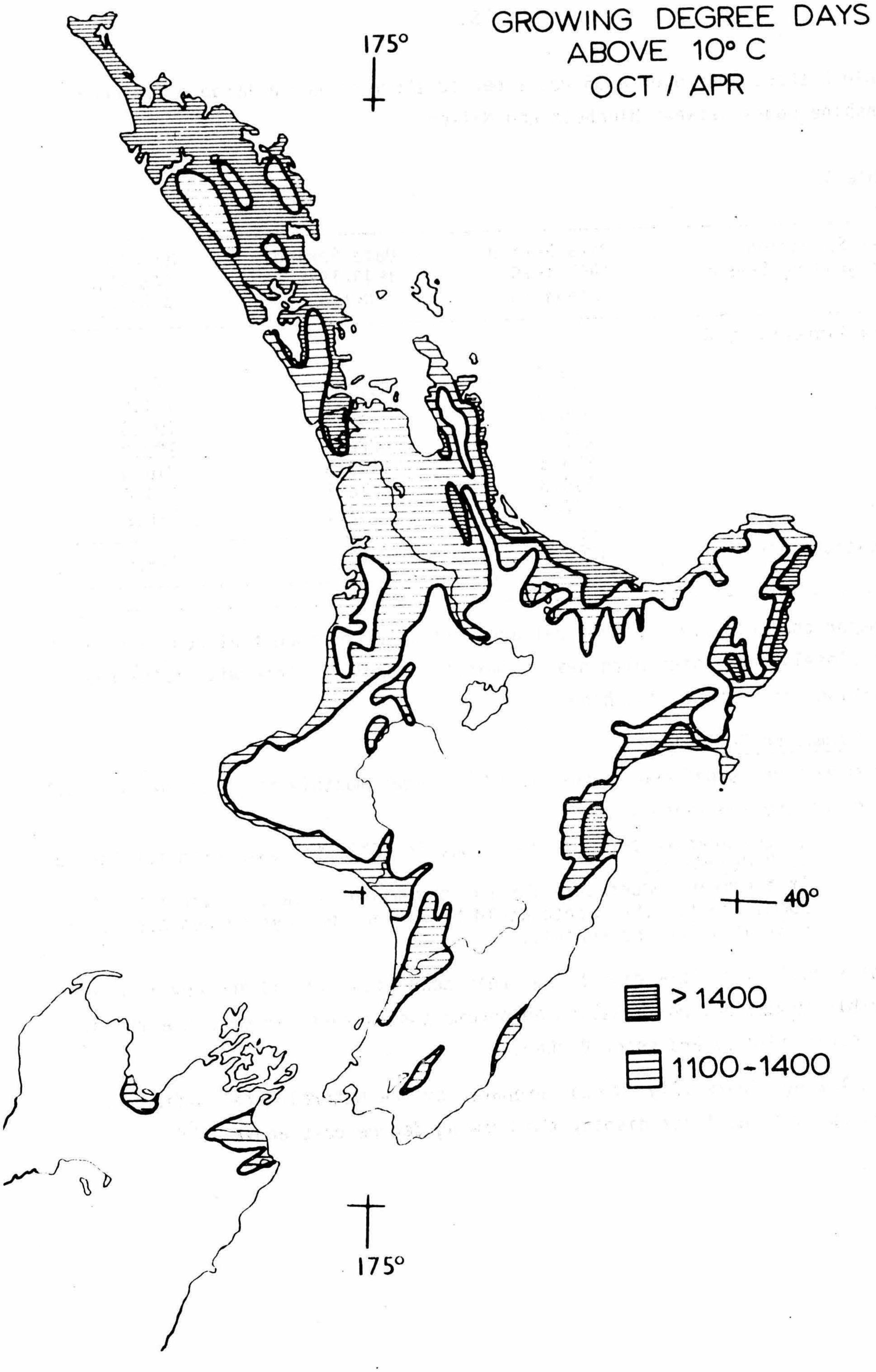
Heat summation is defined as the sum of the mean monthly temperatures over 10°C during the growing season.

e.g. If the mean temperature for a day is 18°C, the summation for that day is 8 degree days.
If the mean temperature for say the month of January was 18°C, the summation for that month would be 248 degree days (8 degrees per day x 31 days for the month)..

A most significant plate displaying areas near Blenheim and Appleby as having desirable summation, while Nelson Aerodrome just scrapes in over the minimum 1000 recommended by Professor Becker.

The following Figure (Fig. 1a) was prepared by the Meterological Office in Wellington and the lines display the growing degree days above 10°C.

Figure 1a


GROWING DEGREE DAYS
ABOVE 10° C
OCT / APR
175°
40°
> 1400
1100-1400
175°

POTENTIAL GRAPE AREAS BASED ON HEAT SUMMATION

Figure 1b

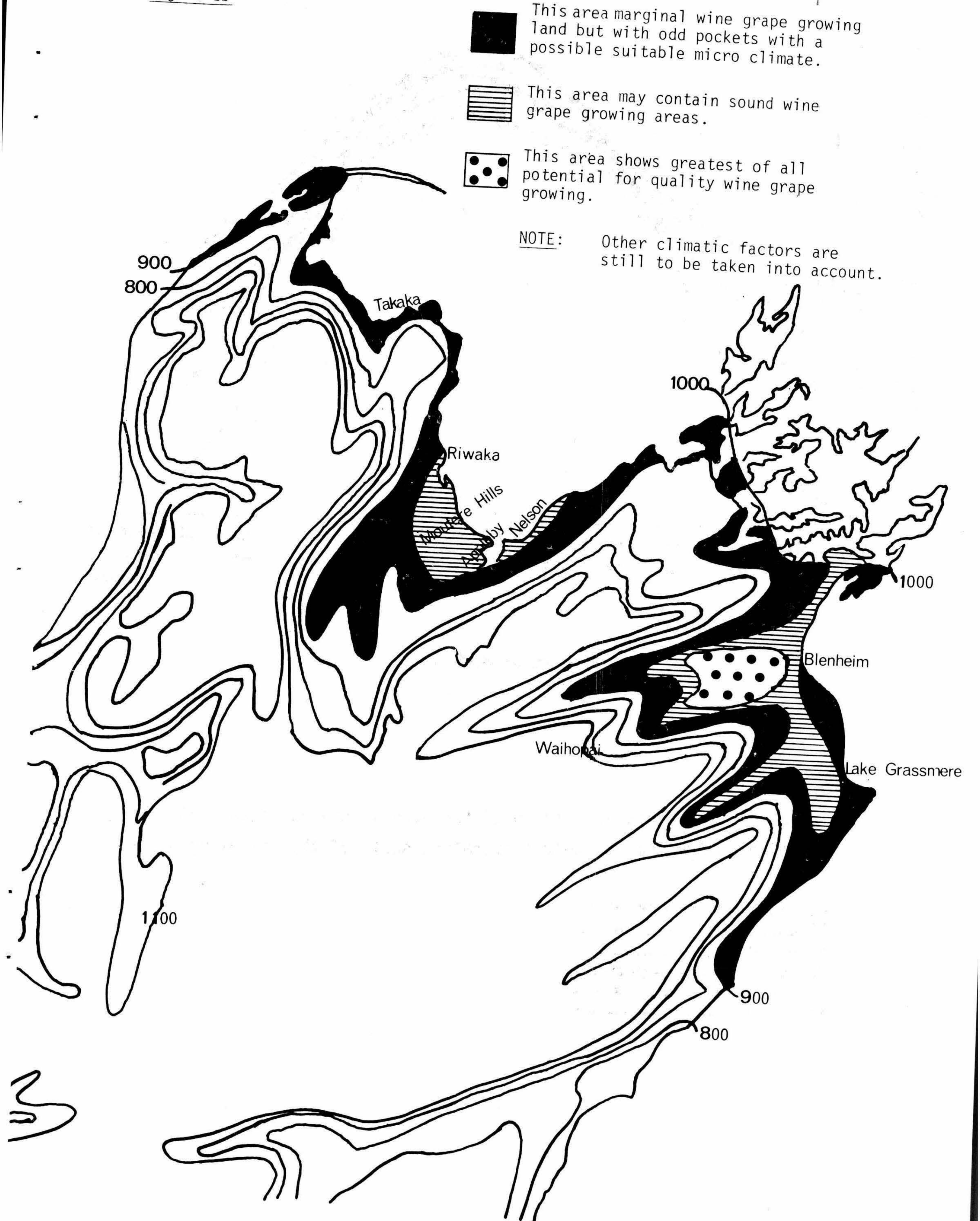
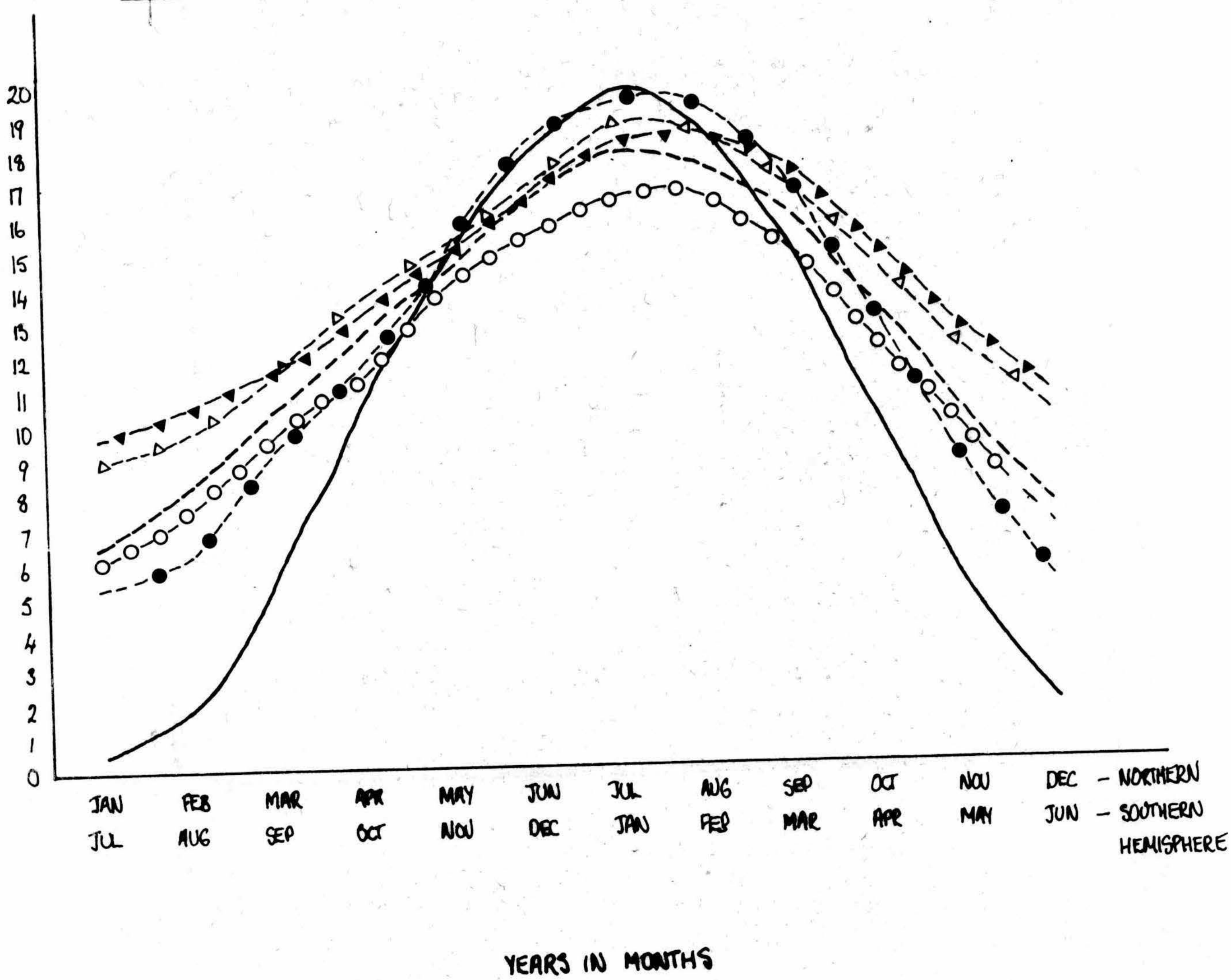


Figure 2



The above figure has been included for purely interest sake, and displays the position on the mean monthly temperature scale of the following areas.

Auckland- ▼–▼–▼–▼–▼–▼
Gisborne- △- - -△- - -△- - -
Blenheim- – – – – – – – –
Nelson -- ○-○-○-○-○-○
Bordeaux -- ●- - -●- - -●- - -
Karlsruhe-- ————

I have adulterated this map by colouring in, according to the heat summation October to April, the areas that, according to heat summation would be suitable for wine grape growing. (Fig. 1b).

NOTE: Be aware that only heat summation has been taken into account in this diagram. Other factors still to be presented will reduce the marked areas.

In summing up the temperature data presented, the final temperature figure tells the story based on the very important heat summation angle.

The area is marginal wine grape growing land, but will have odd pockets of land that could be quite suitable.

The area could have a sound wine grape growing area with good quality potential providing rainfall is not too excessive, say - under 1000 mm.

The area shows the greatest of all potential for quality.

I point out here also, that potential varietal range increases with the higher summation.

e.g. Whereas Cabernet Sauvignon will ripen around Blenheim in the zone, I doubt if this would be so in the zone in either region.

FREEDOM FROM UNSEASONAL FROSTS

This naturally applies to

(a) The early frost which should be of doubtful consequence in Nelson and Marlborough.

(b) The late spring frost, the most dangerous to the viticulturist in cool climates.

Table 5:

Ave. No.days in 10 yrs of likelihood of a screen frost	Blenheim Aerodrome	Waihopai	Lake Grassmere	Nelson Aerodrome	Appleby	Moutere Hills	Riwaka
Oct.	* 9	8	1	4	1	-	3
Nov.	1	**1	-	-	-	-	-
Dec.	-	-	-	-	-	-	-
Feb.	1	-	-	-	-	-	-
Mar.	1	-	-	-	-	-	-
Apr.	2	3	-	2	-	1	1

* This means nearly 1 per year
** This means 1 in 10 years.

This shows the likelihood of a screen frost in the given months. Not necessarily damaging.

Note: The screen frost is measured in a slated box (screen) - 1.3 m above ground.

Figure 3 *FIRST FROST - 50% PROBABILITY*

This means that we can expect a forst on or before these dates in one out of two years.

This plate drawn by the Meterological Office, shows that in the potential wine grape areas of Nelson, Marlborough, an early frost would be well after harvest and therefore, of little consequence as stated above.

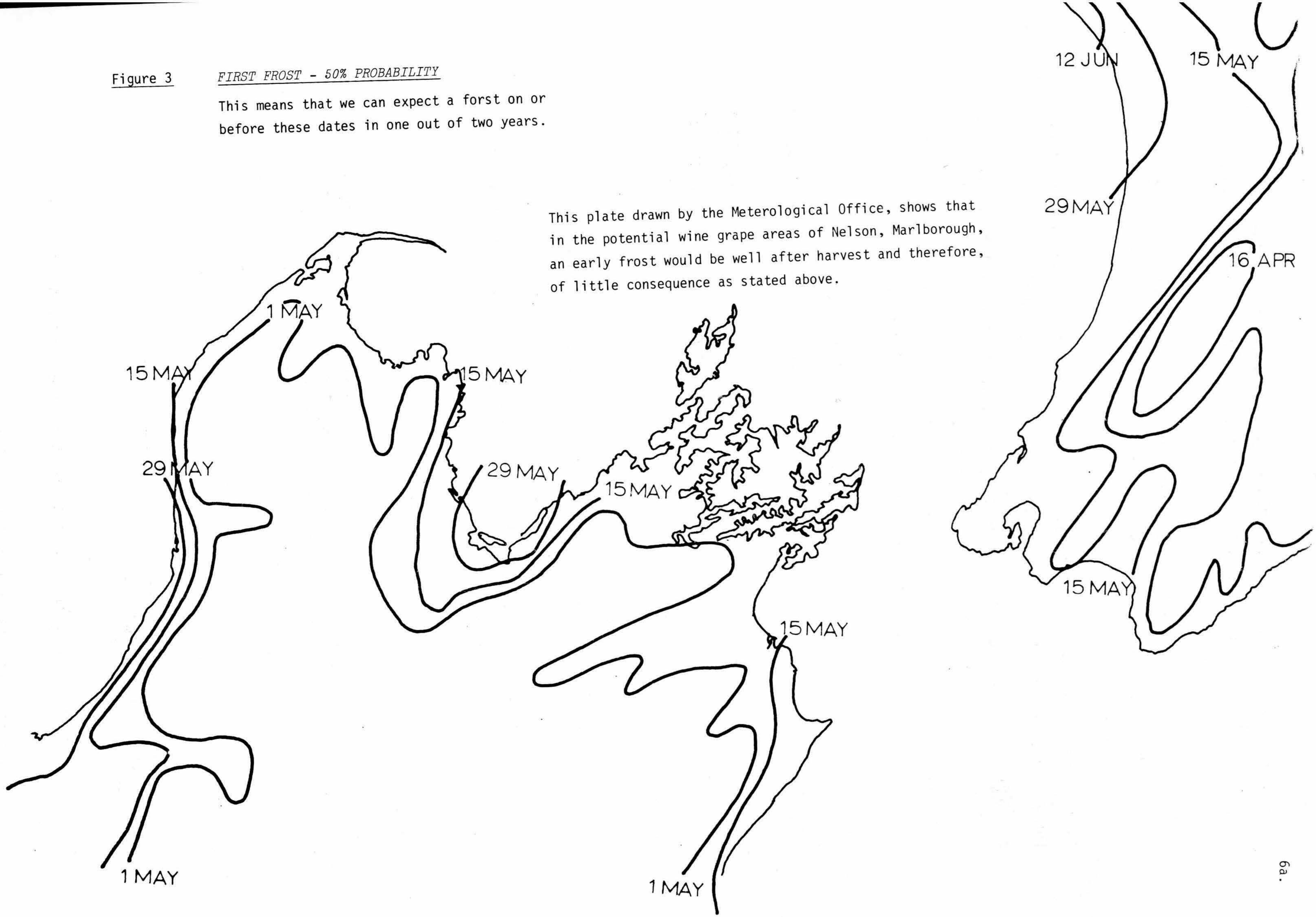


Figure 4 *FIRST FROST - 50% PROBABILITY*

Once again from the Meterological Office. This displays the 50% probability of the shown dates being the last potentially damaging frost. In other words, one can still expect a frost in 1 out of 2 years on or after these dates.

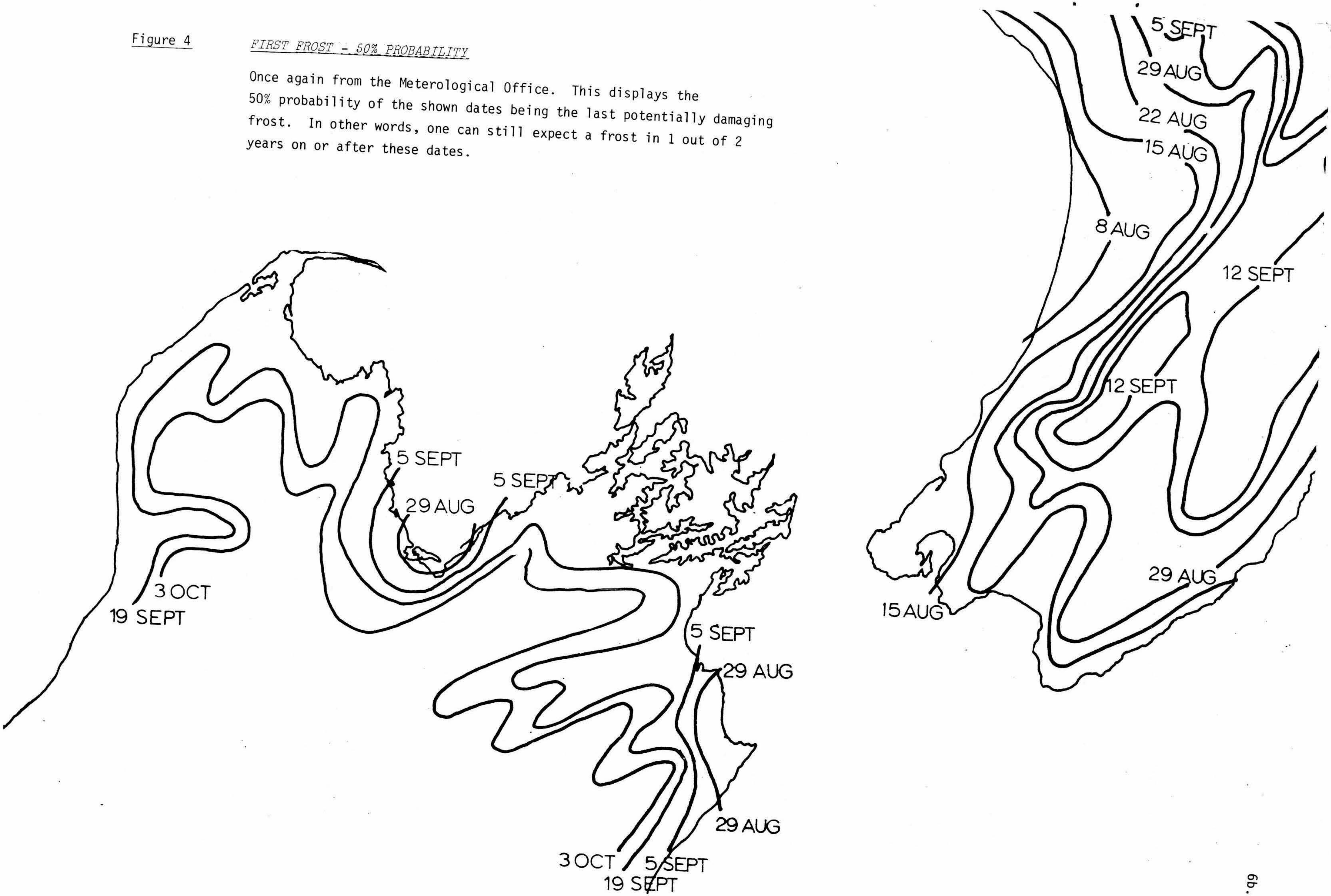


Table 6:

Frost below $-1^{o}C$ in screen - Period 1947-1974

	Blenheim Aerodrome	Nelson Aerodrome	Appleby
Sept.	-2^{o} (2) -1^{o} (18)	-3^{o} (1) -2^{o} (7) -1^{o} (26)	-1^{o} (3)
Oct.	-2^{o} (1) -1^{o} (5)	-1^{o} (3)	
Nov.			
Mar.			
Apr.	-1^{o} (1)	-2^{o} (1) -1^{o} (2)	

( ) Occasions recorded

Table 6 gives a clear indication of the frequency of the frosts actually recorded below $-1^{o}C$ from 1947 to 1974 during the early and late parts of the growing season, and in brackets the number actually recorded.

e.g. At Nelson Aerodrome in September they have recorded only -
once below $-3^{o}C$ Frost
7 times " $-2^{o}C$ "
26 " " $-1^{o}C$ "

The danger month for grape growers is October, where at Blenheim Aerodrome, a $-2^{o}C$ frost has been recorded. In actual fact, this means that further up the adjacent valley, and even nearer Blenheim, frost of over $-2^{o}C$ could have occurred at that time. This is why Montana practise clean cultivation at this time of the year, to eliminate likelihood of frost damage. This can give up to $1^{o}C$ frost protection.

SPRING FROSTS: The succulent shoots and flower clusters of the vine may be killed by temperatures below $-0.6^{o}C$ in spring. If warm weather and rapid growth have immediately preceded a frost, some killing of the most rapidly growing shoots is likely to occur if the temperature falls to $-1.1^{o}C$, but if the temperatures are not lower than $-1.1^{o}C$ and if they are of short duration and occur in periods of cool weather, damage is slight. A temperature of $-3.3^{o}C$ or lower for a few hours will kill all green shoots and flower clusters - even buds that are partly open. Between $-3.3^{o}C$ and $-1.1^{o}C$ the extent of the damage varies directly within the duration of the low temperature period, the daytime temperature preceding the frost, the rate of growth, the variety of grape, and of course, the minimum temperature reached.

It must be clearly understood that the discussion here is on frosts in a screen. Ground frosts are far more intense in strength and frequency, however, providing vines are trellised high enough (3' to 4'), ground frosts are no problem. (Except during the establishment years).

The late frosts as shown for Nelson Aerodrome conflict a little with the Meterological Map, however, these would cause little harm to a mature grape crop.

Table 7:
Lowest Screen Recording:

	Blenheim Aerodrome records 30 yrs	Waihopai records 39 yrs	Lake Grassmere records 18 yrs	Nelson Aerodrome records 50 yrs	Appleby records 38 yrs	Moutere Hills records 8 yrs	Riwaka records 14 yrs
Sept.	-3.4	-6.7	-5.0	-3.7	-2.0	0.7	-2.3
Oct.	-2.7	-2.3	-1.1	-1-7	-0.3	0.0	-1.8
Nov.	-1.2	-1.0	2.8	-1.0	1.4	2.7	1.5
Dec.	1.1	-0.2	1.7	1.2	2.1	3.3	2.5
Mar.	-0.6	0.3	2.2	-0.2	1.0	0.0	1.8
Apr.	-1.4	-2.2	0.4	-2.8	-0.6	2.8	-0.6

Temperatures taken in screen 1.3 m above ground.

Table 7 shows the lowest screen recordings over the stated periods of recordings. Once again Marlborough growers are at more risk than Nelson growers, and will have to farm accordingly to eliminate that risk.

Frost Summary

Screen frosts in the potential areas, as previously shown, should not pose too great a threat to wine grape growers, so long as, in the more marginal areas, particularly around Blenheim, sound frost reducing viticultural practices are carried out.

Even then, it is possible that some isolated area of Marlborough may get an odd nip on infrequent years. This would be, however, at a very early stage of vine growth giving the vine a good chance for strong recovery.

Table 8:

Hail

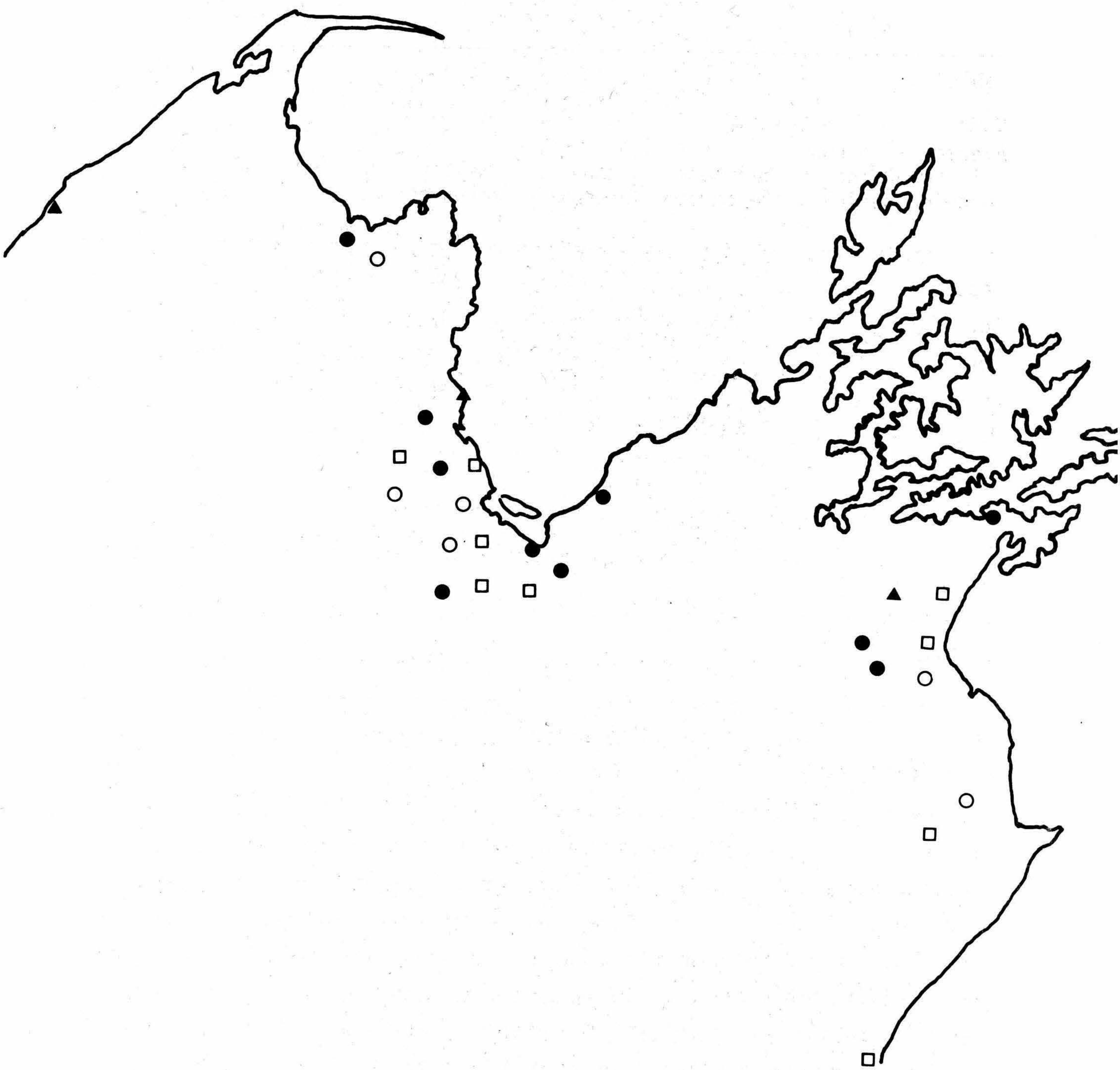
Average No. of likely occurrences in 10 yrs	Blenheim Aerodrome 1941-70	Waihopai 1931-70	Lake Grassmere 1964-70	Nelson Aerodrome 1942-70	Appleby 1932-70	Moutere Hills 1960-70	Riwaka 1956-70
Sept.	1	2	-	1	2	1	1
Oct.	2	2	-	4	3	3	1
Nov.	1	4	-	1	3	3	2
Dec.	1	2	-	2	1	1	2
Jan.	-	1	2	-	2	-	-
Feb.	1	1	1	-	-	1	-
Mar.	1	1	-	-	1	-	-
Apr.	-	1	-	-	-	-	1

Damage depends on the intensity and size of the hail stones.

From historical knowledge, the Nelson Province suffers more from damaging hail storms than the Marlborough Province. It can be seen from Table 8 that Blenheim also suffers from some hail storms, although serious damage is rare. Last year was an exception, when considerable damage occurred in particular, in the Rapaura area. Montana suffered to some extent in that storm. Nelson Province has, however, experienced quite severe damage regularly, in differing areas. Table 8 shows that Appleby and Moutere Hills are more prone than the Waimea Plains area. One could possibly say that, the frequency of hail damage in Nelson could equate with the possibility of frost damage in the Marlborough area. The disadvantage of hail is that there is little that can be done to prevent it, whereas, some methods of frost control are available.

The following figure shows the distribution of severe hailstorms from 1924 to 1973 for the months of October to March inclusive giving the location where the largest hail fell. (Fig. 5).

Figure 5



Scale of hailstone diameters:

□ damage caused (size unknown).

○ 0.5 to 0.9 cm.

● 1.0 to 3.0 cm.

▲ greater than 3.0 cm.

Severe hailstorms 1924-1973 for the months October to March inclusive, giving the location where the largest hail fell. From A.A. Neale (1977). A climatology of severe hail storms in New Zealand. N.Z. Met. Serv. Tech. Note No. 230.

Table 9a

Wind

Average wind run in km during growing period	Blenheim Aerodrome	Lake Grassmere	Nelson Aerodrome	Appleby	Moutere Hills	Riwaka
Sept.	338	502	298	195	325	138
Oct.	356	610	347	217	344	159
Nov.	365	645	374	229	359	180
Dec.	365	573	360	222	344	172
Jan.	320	573	343	217	338	163
Feb.	329	533	316	203	328	151
Mar.	311	525	285	187	323	135
Apr.	303	476	285	150	317	122
Total Wind Run During growing period.	2687	4437	2568	1620	2678	1220

Wind can cause severe economic problems in vineyards. Frequency and strength of wind can dictate the sytle and strength of the vine trellis. It also has bearing on the young vine training practices. Wind can also severely affect flowering and cause young shoot damage before the vine secures itself to the trellis with tendrils. This can vary with the variety naturally. From Tables 9a and 9b we can see that Grassmere area is out as far as growing grapes without tremendous protection. Wind in that region would devastate the vineyard. Recordings in the Moutere Hills is stated as being in an over-exposed position, however, the same could be said for Blenheim and Nelson Aerodrome. These three areas are very similar, and although not as windless as say Riwaka or Appleby, are satisfactory. We are managing alongside Blenheim Aerodrome with one of our vineyards, although some minor shoot damage was experienced towards the end of October and early November until we added an extra wire to catch the growth. Appleby is obviously sheltered and therefore, could possibly get by with a slightly lighter trellis. Wind should not be a problem in the Nelson province at all.

Parts of Marlborough, in particular the Awatere, would experience some wind problems although the main Wairau Plain and adjoining valleys have no problems which cannot be coped with, with a soundly designed trellis. South of the Awatere would be extremely doubtful, unless plantings were in sheltered valleys. Even then significant wind damage could occur without some form of shelter-belt protection.

Table 9b

Average no. days in 10 yr period with gusts 34 knots or over	Blenheim Aerodrome	Lake Grassmere	Nelson Aerodrome	Gisborne
Oct.	42	116	29	54
Nov.	60	130	40	60
Dec.	40	92	40	36
52 knots or over				
Oct.	2	8	-	1
Nov.	?	9	1	1
Dec.	2	7	1	1

Harvest and Rain

Probably the greatest rainfall problems occur in the harvesting month. This is the month when a viticulturist likes to see the least amount of rain. As can be seen on Table 10 Blenheim at 61 mm is good. Last April we experienced 123 mm and I personally, would not like to see much more in order to get in a quality harvest. When one compares the Nelson region this, to my mind, could be one of the disadvantages for quality wine grape production. As can be seen from the highest April rains, these months would be disastrous for producing quality grapes in either region.

Overseas Wine Grape Growing Areas - These we include for comparison.

	Annual Inches	Annual Metric	Average Harvest Month
Rheingau	20.4	510 mm	50 mm
Champagne	25.4	635 mm	52.5 mm
Bordeaux	33.0	825 mm	72.5 mm
Burgundy	28.6	715 mm	55 mm

Rainfall and growth

Coupled with rainfall comes growth. The higher the rainfall the more the vines grow. As Professor Olmo stated recently in Auckland, New Zealand, in particular the major wine producing areas of the North Island, will always be struggling to produce top quality wine, unless they can slow or stop growth prior to harvest. This problem is severe in Gisborne where rainfall is coupled with high fertility. Various practices are now being investigated to try and slow the vines down at, and prior to, this harvest period. This will be a problem in the Nelson region, and cultural practices will need to be investigated to overcome this.

Naturally with the higher rain will come greater tonnages and from a contract growers point of view, this could be an advantage. From the winemakers point of view, however, he will certainly be looking for a drier year for a good vintage in the Nelson region.

In Marlborough we have a different situation where tonnages will be lower, without irrigation, but quality will be higher.

Irrigation

Whether or not supplementary irrigation in either region will be required will depend on the water holding capacities of the soils.

The annual rainfall in Marlborough is rather erratic and has been as low as 571 mm per annum. Although grapes do not require a great rainfall for good production, there is no question that on the lightest gravels in Marlborough, irrigation will be of benefit. This could apply on the lighter stoney areas of the Waimea Plain, but will be doubtful on the Moutere clays. As both areas generally have abundant water supplies, lack of rain is of lesser importance than too much rain.

Table 10:

Rainfall - Annual Rainfall over 30 years.

	Blenheim Aerodrome	Waihopai	Lake Grassmere	Nelson Aerodrome	Appleby	Moutere Hills	Riwaka
May	84	89	69	112	109	122	155
June	61	69	51	79	81	94	119
July	71	79	66	91	91	104	145
Aug.	71	79	53	94	94	104	140
Sept.	64	71	43	76	79	89	117
Oct.	61	76	43	81	79	89	112
Nov.	58	76	46	74	71	84	89
Dec.	53	76	48	74	66	81	91
Jan.	53	69	48	74	64	74	74
Feb.	48	64	38	74	66	76	99
Mar.	53	64	43	81	81	89	104
Apr.	61	76	46	89	86	99	127
Average Total Annual	738	891	594	999	967	1105	1372
Highest Year's Total	1007	1228	881	1543	1427	1632	1880
Lowest Year's Total	571	649	339	708	681	842	919
Dominant Season							
Average Total May to Aug.	287	316	239	376	375	424	559
Growing Season							
Average total Sept. to Apr.	451	575	355	623	592	681	813
Harvest Month							
Average Total Apr.	61	76	46	89	86	99	127
Highest Harvest Month Rainfall	164	173	118	212	271	190	509

If we once again refer back to Professor Becker's criteria which states that rainfall should be less than 900 mm., we see that Marlborough well and truly qualifies, that Nelson and Appleby nearly qualify, Moutere Hills is getting too wet, and Riwaka is out. Rainfall naturally has a large effect on the incidence of most vine diseases (not Powdery Mildew though).

When one considers the annual Auckland rainfall 1268, and the Gisborne rainfall 1034 it is no wonder their spray programmes are so intensive. (30% to 100% greater than Blenheim). These two areas also have higher temperatures added to their problems which compound the situation.

Table 11:

Humidity - Relative Humidity % Average at 9 a.m.

	Blenheim Aerodrome	Waihopai	Auckland	Gisborne Manutuke	Lake Grassmere	Nelson Aerodrome	Appleby	Moutere Hills	Riwaka
Sept.	73	62	77	73	72	78	72	74	76
Oct.	67	59	75	65	65	72	68	72	67
Nov.	62	56	71	65	63	69	65	68	64
Dec.	63	57	71	66	70	68	66	67	65
Jan.	63	56	71	67	69	68	65	69	66
Feb.	65	59	73	70	67	71	67	70	70
Mar.	71	65	75	74	71	75	71	74	77
Apr.	76	68	79	77	70	81	77	75	80
Ave.	67.5	60.25	74	69.62	68.37	72.75	68.87	71.12	70.62

Table 11 shows the humidity taken at 9 a.m. and in my opinion is of little significance other than that Marlborough is a little lower than Nelson. What did surprise me was Table 12 which showed Nelson with a higher relative humidity recording than either Auckland or Gisborne. It appears to me that to cause humidity disease problems, we require higher temperatures, and this is where Nelson and Marlborough have a distinct advantage over most North Island viticultural areas, when the humidity factor is considered.

Table 12:

Mean Humidity Over 24 Hours - Taken from Hygrograph on an hourly basis

	Auckland	Nelson	Gisborne
Sept.	77	80	77
Oct.	76	77	75
Nov.	75	76	70
Dec.	74	77	75
Jan.	74	75	72
Feb.	75	76	74
Mar.	76	78	77
Apr.	77	80	78
Average	604	619	598

CLIMATIC SUMMARY

Temperatures

Slightly in favour of Marlborough with Appleby and Moutere Hills a close second. Could probably be increased to advantage in both regions with shelter belts.

Heat Summation

Higher potential for quality wine grapes in Marlborough with Appleby a close second well ahead of Nelson Plains.

Frosts

In favour of the Nelson region from a possible hazard point of view. Generally speaking frost won't affect the potential of either region.

Hail

An unknown quantity, but a greater problem in the Nelson region than in Marlborough. A minor effect on potential here.

Wind

Favours the Nelson Province, but can be overcome in the worst areas of both regions with shelter. Wind will not affect the potential of either region greatly.

Rainfall

Rainfall will probably have the greatest effect on potential of these regions giving probably higher weighted crops in Nelson than in Marlborough without taking irrigation into account.

Greater wet-weather disease problems (Botrytis and Downy Mildew) in Nelson than in Marlborough, countered by a greater incidence of dry weather diseases (Powdery Mildew) in Marlborough should be evident.

Generally, I predict a lesser likelihood of vintage years in Nelson region, due to higher rainfall in particular near harvest.

Rainfall in Marlborough will favour higher quality crops more consistently.

Humidity

Should not affect the potential of either region.

SOIL TYPES

Grapes are an extremely adaptable plant. Throughout the world they are grown on a wide range of soils ranging from gravelly sands to heavy clays, from shallow to very deep, and from low to high fertility.

As there is a paper to be given specifically dealing with soils at a later session, I will not enter into this area in any depth.

In assessing the soils of the two regions in question, one should avoid heavy clays, very shallow soils and poorly-drained soils. Soils of high salinity must also be avoided.

The largest crops are produced on the higher fertility soils, however, these will not necessarily have the best quality. The better quality grapes have come from soils of lower fertility, or soils limited by a hard pan rocks, or clay substrata. In most cases these soils would not be totally uneconomic for commercial wine grape production.

Drainage

The heavier the rainfall the better must be the drainage. This will obviously be of greater necessity in the Nelson region, in particular as one moves into the Moutere clay area, than in Marlborough.

Deep Ripping

Other than in the sandy gravelly areas, deep ripping will be required as an initial ground preparation, due to the varied state of the flood plains.

I have carried out extensive hole surveys on our own and surrounding properties, using a back hoe. The variability is quite incredible, and almost without exception, the southern side of the Wairau Plain will require deep ripping to some extent. I believe the majority of the soils in both regions will support grapes, and as mentioned earlier, feel that climate is a greater limiting factor.

Water Holding Capacity and Irrigation

One of the factors that will affect production and quality, will be the water holding capacity of the soils. It is all very well getting an adequate rainfall, if the soils do not have the ability to hold this and make it available to the vine in sufficient quantity to sustain a reasonable growth level, then this adequate rainfall becomes inadequate, and some form of supplementary irrigation must take place. This could well take place in Marlborough, in particular on the stoney ridges that extend over much of the Plains.

Likewise, the Waimea Plains Ranzau soils would be another area that may have this problem. In these stoney gravelly areas, irrigation will probably be a necessity for economic crops. With last year's very dry spell it was proven that the extra requirement over and above the existing waterholding capacity for grapes on the majority of our own land was not great. I also understand that those mature vines growing in the Moutere area did not suffer to any great extent. This proves to me, that where there are adequate fines in the soil to provide good water holding capacity, little drought problems will eventuate providing the roots are allowed to penetrate to a plus 3' depth.

LAND AVAILABILITY

When one refers to Fig. 1, it is seen that there is a reasonably large area of land suitable for wine grapegrowing. The limiting factor will be the cost of that land to a potential grower. In the Nelson region, land holdings in the more suitable area tend to be smaller and consequently, dearer. This land is already being used extensively for intensive horticultural production, and therefore, should command a higher price due to this factor alone.

In Marlborough, there is a larger area potential, and this region has the advantage of much larger land holding units. This has, to date, kept the value of the Marlborough land below that of the Nelson area. Higher population demands also have a substantial effect in the Nelson region on land values.

Due to the fairly high establishment costs of grapes, the cost value of the land will have a substantial bearing on where grapes are grown. This may mean, that where growers in Marlborough are still economically able to grow grapes on the flat areas, Nelson growers may be forced into moving up into the more hilly and less valuable terrain, where the economic pressure from other horticultural crops is not so great. This could already be evident by the recent proposed plantings in the Moutere Hills area.

Naturally, the economics of grape growing are tied up with, not only land value, but also crop return. In assessing the land availability, there will have to be a balance between these two factors.

In discussing localities, I have made little mention of the Takaka, Collingwood area. This is mainly due to the fact that I have no available records for climatic study. After holidaying in that area and knowing the fact that they have significantly high sunshine hours, I believe this area could also be considered as having perhaps some potential for grape production, although, high rainfall will limit this.

It is a shame that significant meterological records from this area are not available, so that a more detailed study could be made.

It is understood by the Department of Agriculture, that of the 90,000 to 100,000 ha of land in the Nelson region, 20,000 ha are suitable for special crops, but never more than one third of this area has ever been occupied by horticultural crops. Likewise in Marlborough.

Between these two areas there is obviously significant land availability, but as aforementioned, climate and cost of land will be the limiting factors for economic grape production.

LOCAL GOVERNMENT RESTRICTIONS

I mention this, as Local Government restrictions are becoming more and more stringent as time goes on. I will touch on part of this in another paper at this seminar.

Agricultural Chemical Regulations

Concern at the Agricultural Chemical Spraying Regulations relating to vineyards has meant a total unjustifiable ban in some counties of New Zealand. We have experienced great problems, now being overcome, in Marlborough.

Fortunately in Nelson, this has to date not reared it's ugly head, and I sincerely hope it never will.

Catchment Boards

In Marlborough to date, no problems have been experienced from Catchment Boards other than due to the Agricultural Chemical Regulations.

Nelson has Catchment Board problems, I understand, in the hilly country. This is no doubt associated with rainfall and run off.

This will call for carefull study of cause and effect, and may well place restrictions on the viticultural practices in these areas. Perhaps a better word would be modifications.

Run off is experienced in most hilly viticultural areas in the world, and is being overcome with contouring, cover crop growing and well designed drainage.

PEST AND DISEASE POTENTIAL

I have touched on this to some extent under climate, and will not elaborate much further other than stating that both areas being reasonably new in viticulture, will need a period of experience before they are really aware of the disease problems inherent in the two regions.

I could safely say that the more common problems of the North Island will be evident, but in the case of the wet weather diseases should not be so severe in Nelson and Marlborough. The dry weather problems will no doubt be greater.

Insects, to me, are still an unknown factor, and birds will always be a costly problem in both areas.

MARKET OUTLETS

Providing quality wine is produced, the outlets for wine from these regions should be good.

The areas are uniquely situated on the mainland side of Cook Strait, giving a geographical advantage over other parts of New Zealand for access to the South Island markets, and to some extent possibly the Wellington market.

The tourist market would be another big potential in both areas.

I emphasise that quality will, however, dictate the extent to which the market potential will be realised.

SUMMARY

Marlborough is now a known area where high quality crops of grapes can be grown in large commercial quantities on an economical basis. Its position as a quality area is to my mind, now assured and the potential in the area is significant. For climatic reasons Nelson region is more limited in potential for the production of quality wine grapes, than the Marlborough area.

In the Nelson province, from climatic records, the major things that will limit the localities for the growing of quality wine grapes, are mainly rainfall and temperature.

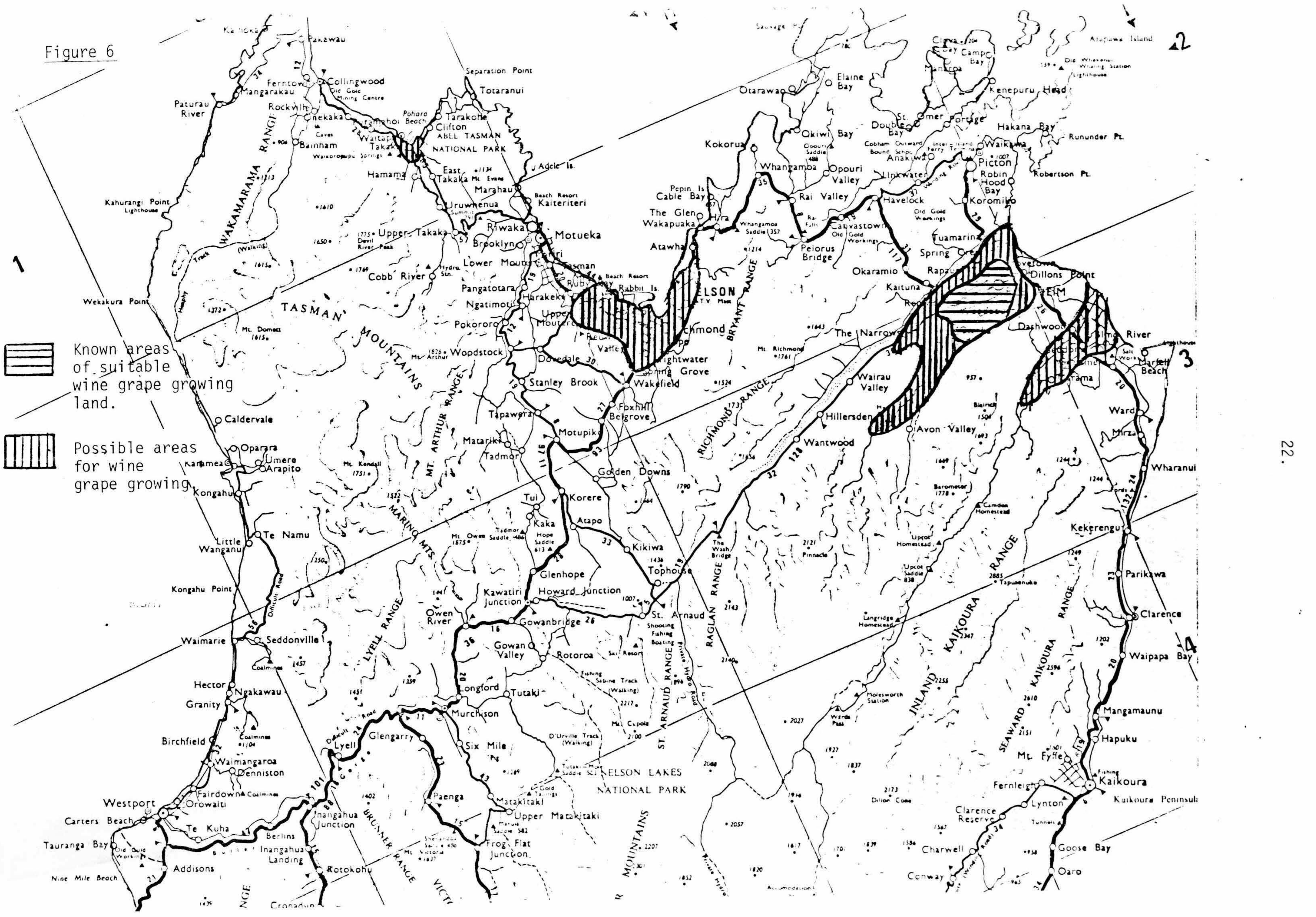
Nelson has produced wines of high quality, but only on a reasonably small individual scale. It's position as a potential quality area for growing of grapes is therefore, still to be clearly understood. With reasonable plantings planned in the near future, the potential of this area should, within the next few years, be realised by the wine drinking public of New Zealand. All other factors point to certain areas within the region being otherwise suited to grape growing.

In the final figure (6), I have drawn in approximate boundaries where, based on the climatic data presented in this paper, I would envisage the most suitable areas for wine grape growing in the Nelson and Marlborough regions.

Other than the high salinity areas in Marlborough, I have not taken soil types into account.

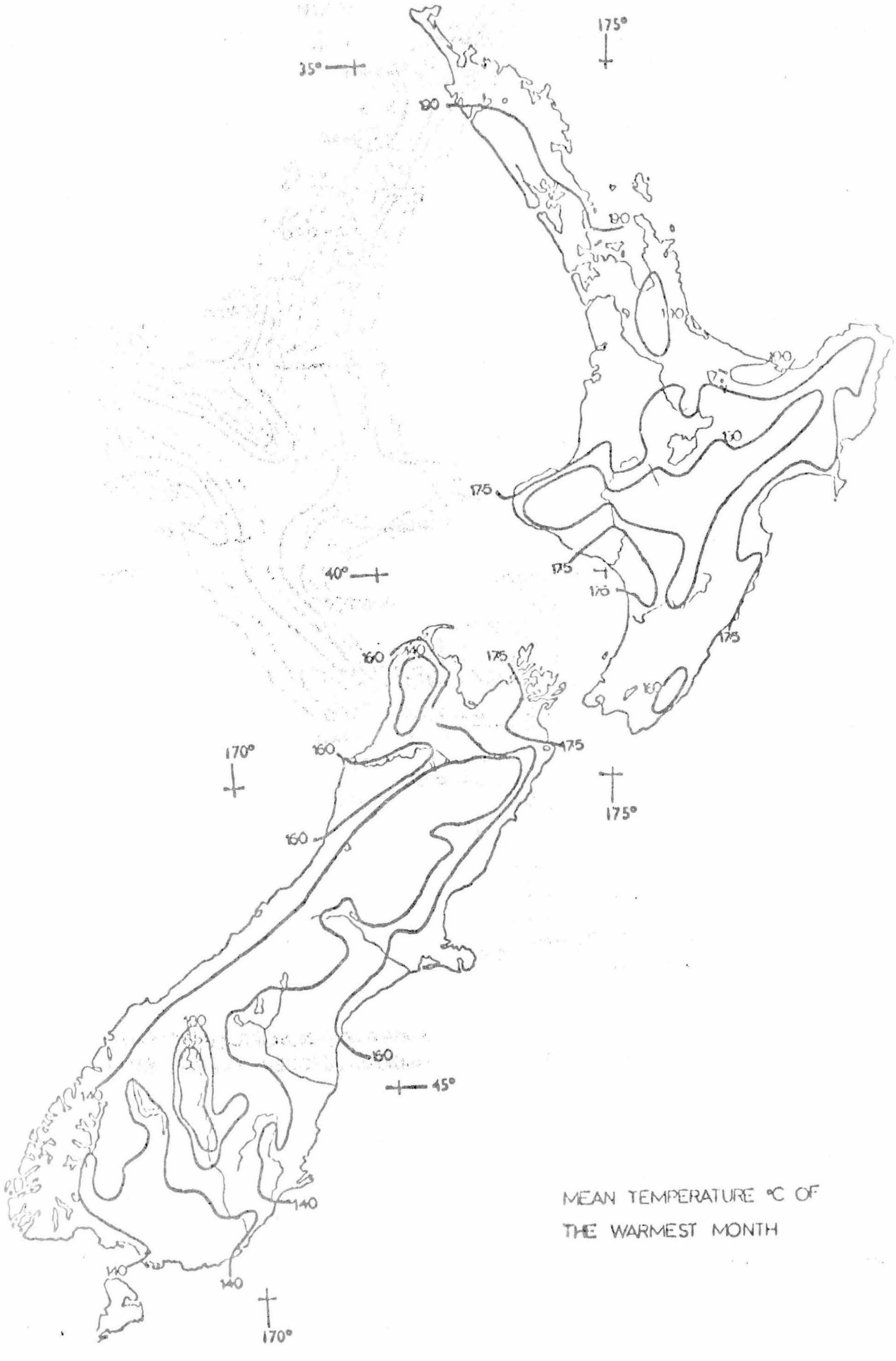
The Takaka area has, unfortunately, available very limited climatic data. It does have good sunshine hours. Based on rainfall it is in a similar climatic situation to Riwaka, and therefore, could be doubtful.

Figure 6



Known areas of suitable wine grape growing land.
Possible areas for wine grape growing
1
2
3
4
Collingwood
Takaka
ABEL TASMAN NATIONAL PARK
Motueka
Kaiteriteri
TASMAN MOUNTAINS
Richmond
Wakefield
Havelock
Picton
Blenheim
Seddon
Ward
Kekerengu
Clarence
Kaikoura
Kaikoura Peninsula
Murchison
Westport
Karamea
NELSON LAKES NATIONAL PARK
RICHMOND RANGE
RAGLAN RANGE
INLAND KAIKOURA RANGE
SEAWARD KAIKOURA RANGE
Wairau Valley
Renwick
Tophouse
St. Arnaud

APPENDIX 1

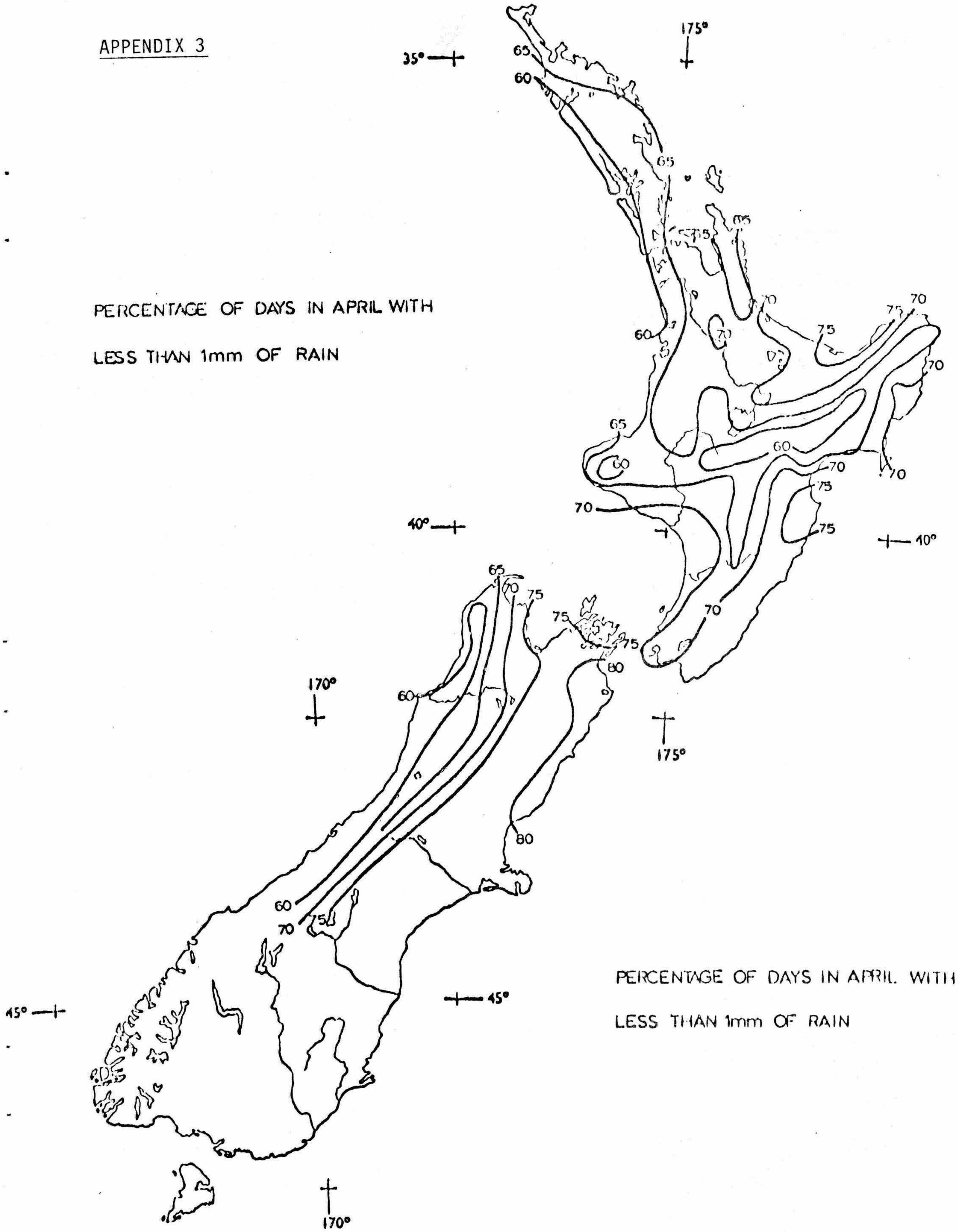


MEAN TEMPERATURE °C OF
THE WARMEST MONTH

APPENDIX 3

PERCENTAGE OF DAYS IN APRIL WITH

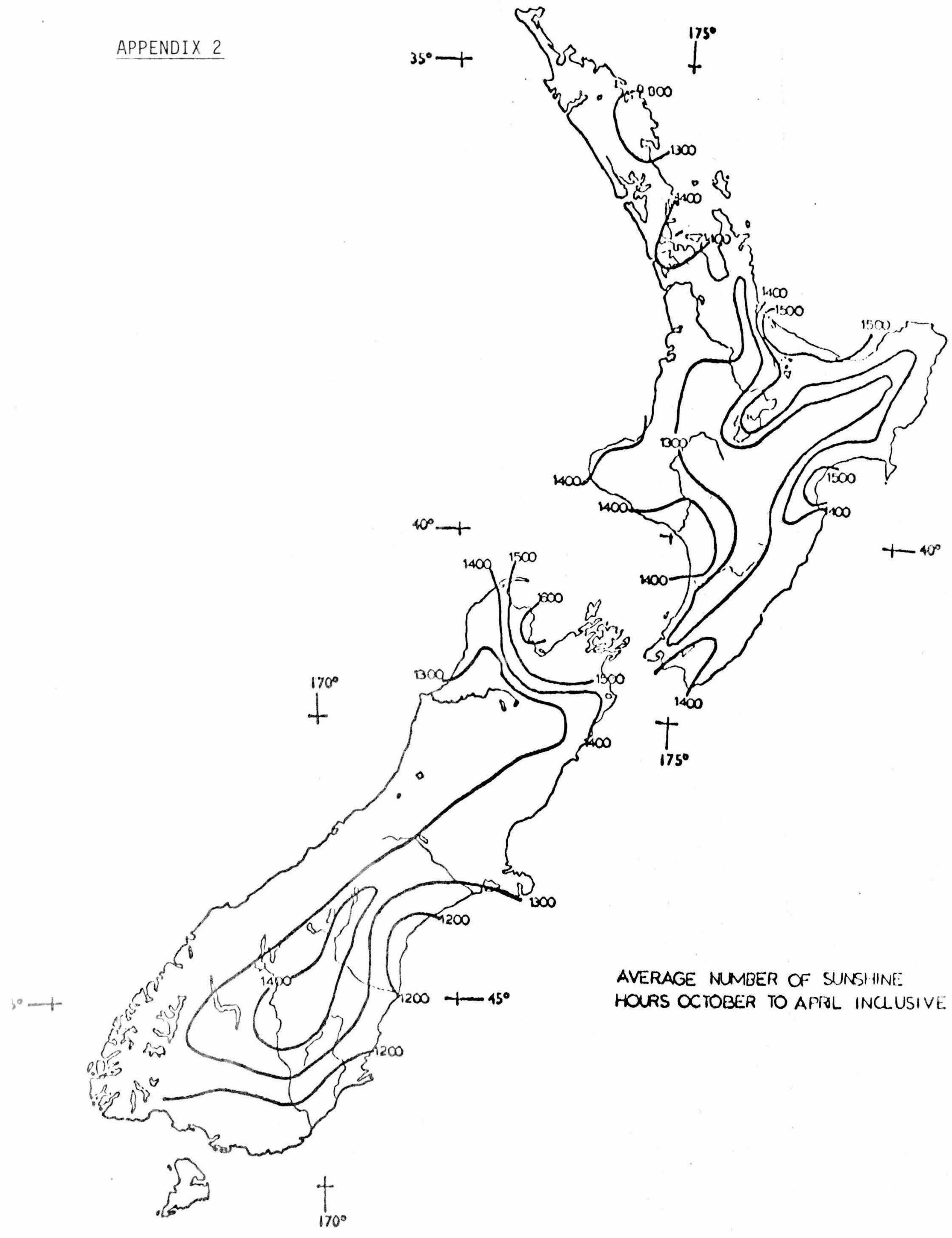
LESS THAN 1mm OF RAIN



PERCENTAGE OF DAYS IN APRIL WITH

LESS THAN 1mm OF RAIN

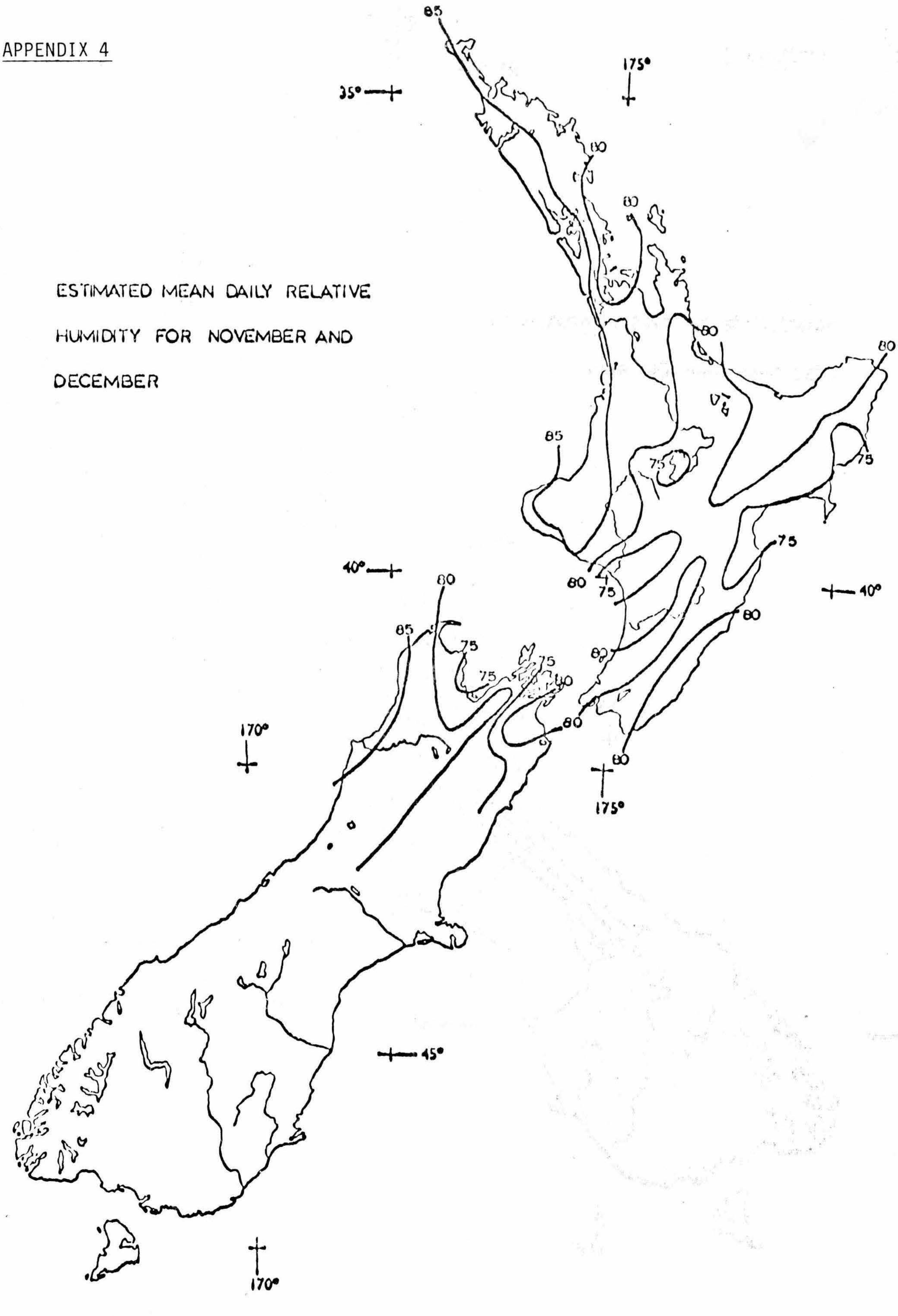
APPENDIX 2



AVERAGE NUMBER OF SUNSHINE HOURS OCTOBER TO APRIL INCLUSIVE

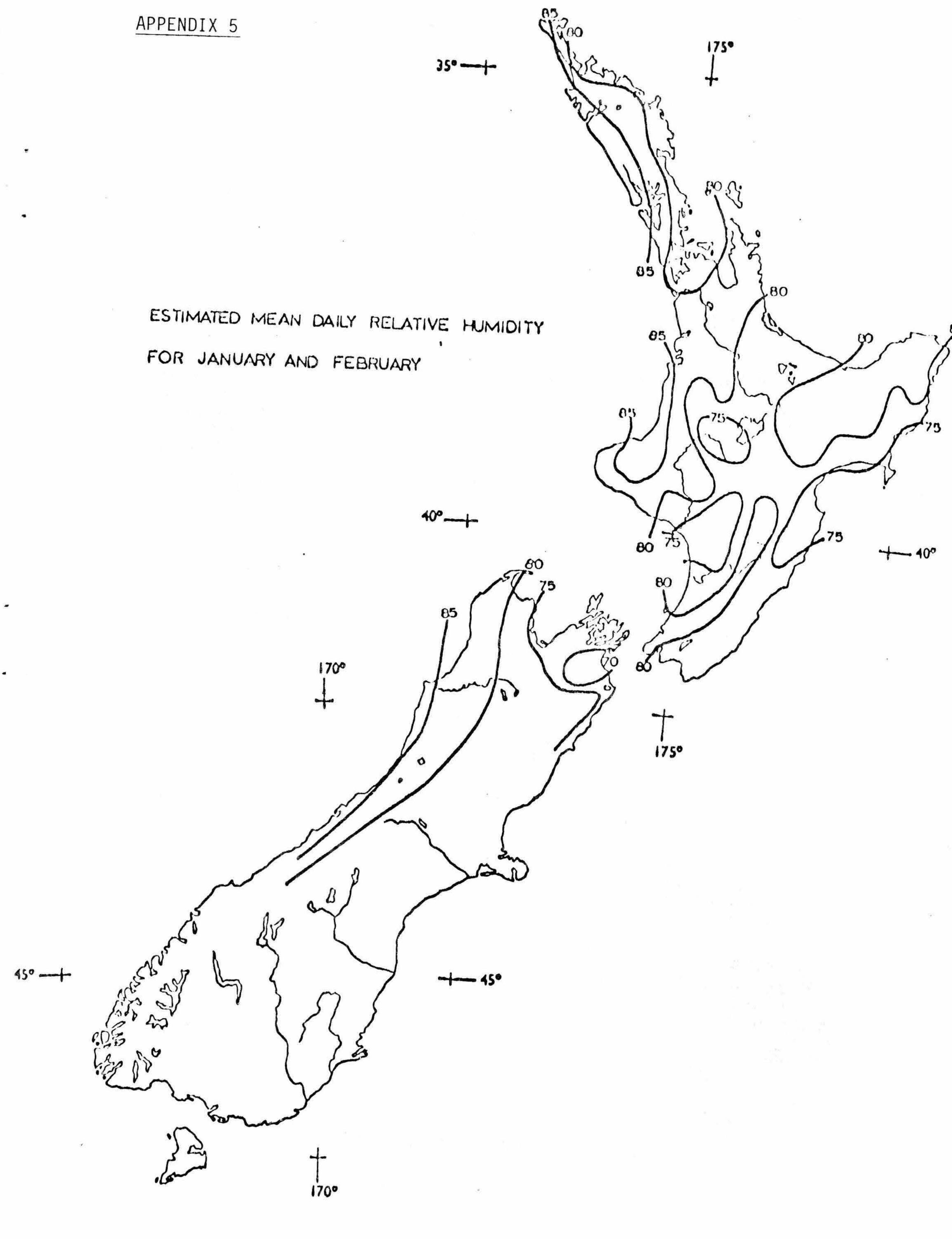
APPENDIX 4

ESTIMATED MEAN DAILY RELATIVE HUMIDITY FOR NOVEMBER AND DECEMBER



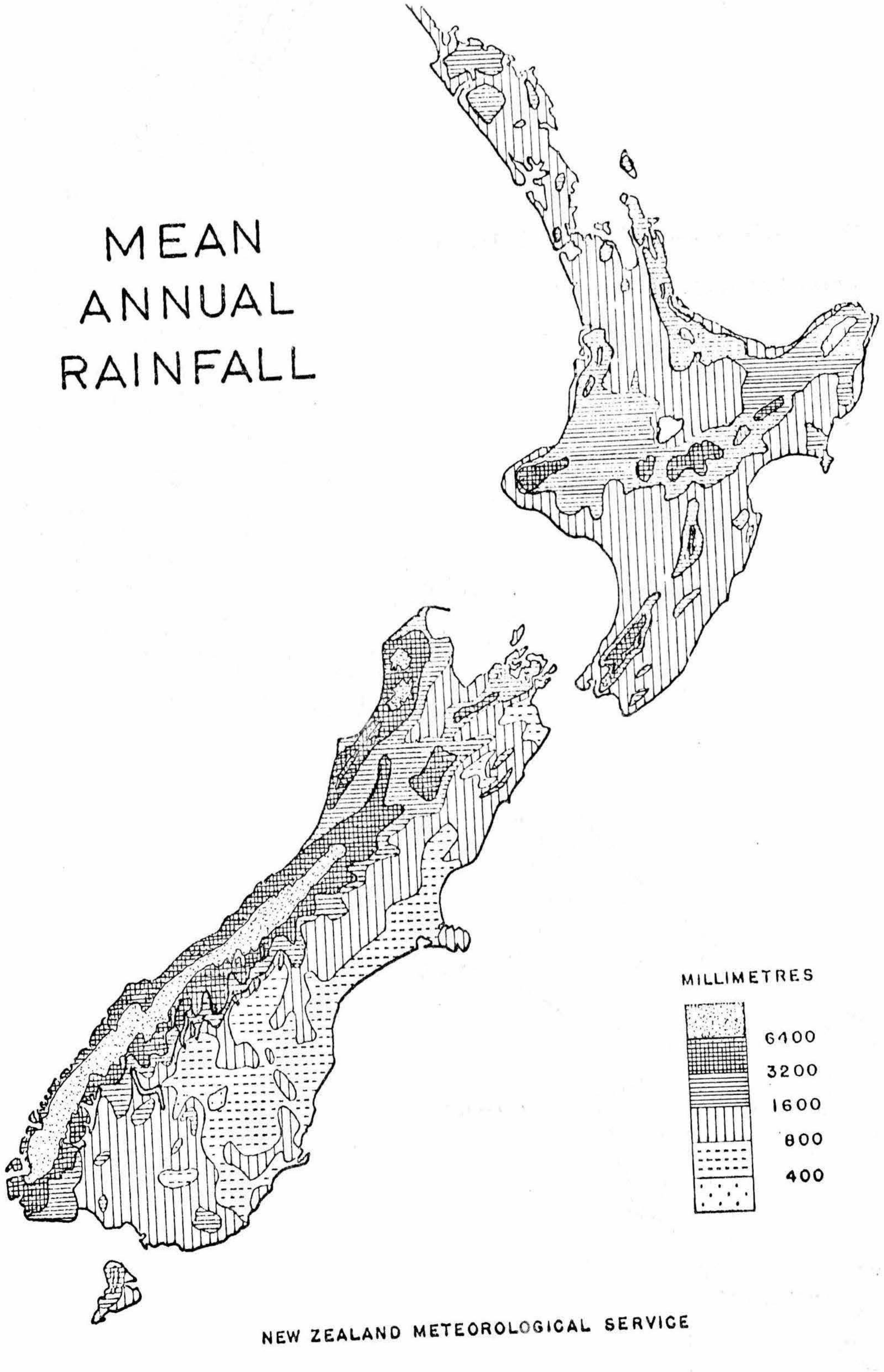
APPENDIX 5

ESTIMATED MEAN DAILY RELATIVE HUMIDITY FOR JANUARY AND FEBRUARY



APPENDIX 6

MEAN ANNUAL RAINFALL

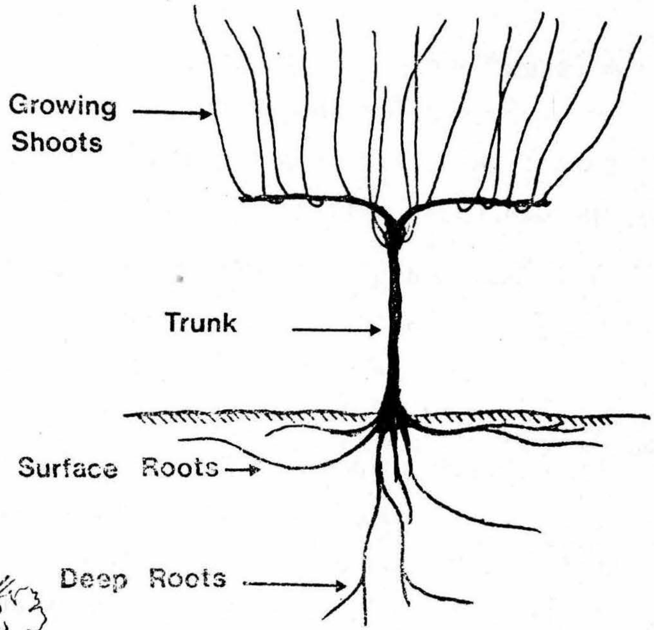


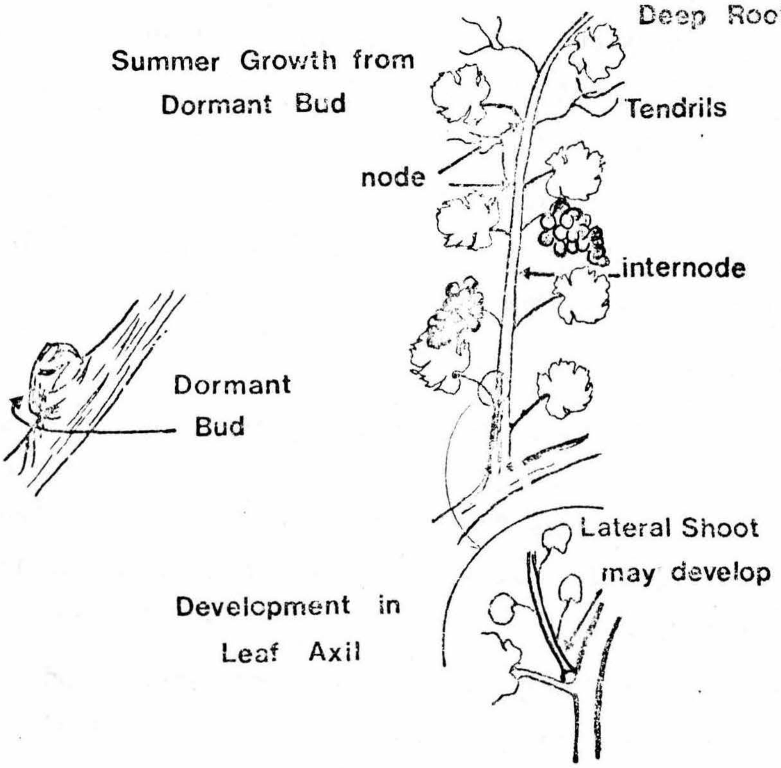
NEW ZEALAND METEOROLOGICAL SERVICE

PHYSIOLOGY OF GRAPE GROWTH

D.I. JACKSON,
DEPARTMENT OF HORTICULTURE,
LINCOLN COLLEGE.

Parts of the Vine





What I intend to do in this lecture is to discuss growth and development of the parts of the vine illustrated above and then subsequently look at some new research that aids our understanding of growth and could have practical application in New Zealand. Unless otherwise stated results quoted in this lecture are obtained from Winkler *et al.* (1974).

Root Growth

The roots of vines have the capacity to penetrate deep into the subsoil and, while the majority may be in the top 1 to 1.5 m, deeper roots may move down 4 m or more. Most nutrients and water will be taken up by roots in the top soil but under conditions of moisture stress the vine will depend more and more upon deeper roots to supply water for growth and development. Vines are renowned for their ability to survive in dry arid areas but if roots cannot penetrate into the lower soil profile, the vines capacity to thrive in such areas will be no better than that of any other plant.

Practical measures to encourage root penetration are, firstly subsoiling or ripping and secondly deep ploughing. Subsoiling is used to break up hard pans which often occur below the topsoil and restrict root growth in the subsoil. It is done either through the whole vineyard or simply along the lines where grapes will be planted. Deep ploughing, which may bury the top soil 60-90 cm, encourages roots to move down to the more fertile top soil and discourages surface rooting. Incidently it moves soil to the surface which is free of weed seeds and weed control for a number of years is simplified. In high-rainfall areas or where irrigation is practiced such measures may not be considered necessary.

Apart from mentioning the belief that excessive fertility in soils reduces grape and wine quality - a belief which later speakers may like to confirm or deny - I do not wish to spend more time on root development.

Shoot Growth

In spring, after dormancy has been broken and temperatures increase, buds swell and shoots emerge. These shoots are soft and tender and susceptible to frost, consequently in southern areas frost protection measures or frost-free sites may need to be considered. It is fortunate that bud burst is late (October) in these areas at a time when most frosts have finished.

Growth of the shoot is dependent not only on suitable temperatures and adequate sunshine, water, and nutrients but also on complex physiological factors with the plant. Very important among these factors are growth regulators or hormones. These, like animal hormones, exist within the tissues at very low concentrations and regulate growth of the plant or animal. Dormancy, for example, probably results from buds and seeds having high levels of inhibitory hormones (inhibitors) which restrict growth even if temperatures are high. This is of advantage to the plant for it prevents buds bursting in the autumn or during warm spells in winter and then being killed by subsequent frosts. As spring approaches inhibitors decline in concentration and promotors increase, thus buds will then grow as the temperature rises.

Growth of shoots continues to be under the control of hormones during the season. Being a vine the rate of growth is faster than most other deciduous plants and continues for a longer period into the season. In apples, for example, shoots make a flush of growth of 30-40 cm in the first six weeks after bud burst and then make little or no further growth until next year. In grapes, shoots, and laterals from those shoots, continue to grow until berries are about 3/4 full size and, in warm and humid climates, even later.

Growth of shoots produces leaves which, by the process of photosynthesis in sunlight, manufacture carbohydrates such as sugar. Carbohydrates are used by developing shoots, leaves, buds, roots and berries. If the use of carbohydrates exceeds production, reserves are used and this is the case in spring before the leaf area has reached a critical size. There are times when it can be advantageous to remove developing shoot tips to allow the metabolites which they consume to be temporarily moved elsewhere. At the time of flowering pinching of the tips or spraying with a growth retardant which reduces vegetative growth can improve set. If vegetative growth is still active at berry ripening, topping may assist the process of maturity.

Formation of Flower Buds

Buds are formed in the axils of leaves as the shoots develop. One bud remains dormant until the next spring while the other develops to a short or long lateral shoot. In the dormant bud leaf and flower initials begin to develop in late November and in 6-8 weeks development is complete. These leaf and flower initials will remain more or less in this form until next spring. It is obvious that if we wish to improve the development of flower initials which will determine next seasons crop we must look at conditions in the previous season.

One factor that has been often noted is that excessive vegetative growth tends to restrict the development of flower initials in the buds. Thus heavy nitrogen fertilisation especially in warm and wet climates can be a factor in producing buds with few flowers. On the other hand too little nitrogen can also restrict flower initiation. We can postulate that one effect of excessive vegetative growth is to starve buds of essential materials.

A critical leaf area is also needed to promote flower initiation and any trimming of shoots that removes large areas of mature leaves could be expected to be deleterious. Flower initiation is also promoted by high light intensity. Again this is restricted by excessive vegetative growth since it is the actual light falling on the buds which is critical. If the foliage is very thick then clearly the light penetration to the leaf axils will be reduced and initiation will suffer.

Temperatures have a marked bearing on floral initiation. Strangely these temperatures have their effect in the first few weeks from the time the node subtending it changes from the shoot apex to ten nodes back on the shoot. This is at a time well before any microscopic evidence of flower initials can be seen. Optimum temperatures shown by Australian work was found to be around 30^{o}C and initiation was low below 20^{o}C. Clearly an open canopy where light can reach the bud position to directly and/or indirectly (by localised temperature increase) stimulate floral initials is good husbandry (Hale and Buttrose, 1974).

The reason why buds at different positions on the cane vary in fruitfulness can now be appreciated. Buds near to the base of the shoot develop in the early part of the season when temperatures are cooler. Perhaps this is the reason for the popularity of cane pruning rather than spur pruning in cooler climates. These buds, too, develop when many of the leaves are young and there is a smaller area of mature leaves producing photosynthates. Buds towards the tips of shoots tend also to be less fruitful. These begin their development late in the season and there may be insufficient time to complete it before winter.

Flower Set

When buds burst in spring, leaves appear before the first flower inflorescences become apparent and flowers do not open until eight weeks after bud burst. Pollination is not dependent on insects such as bees, as it is in many fruit plants, but it does occur more readily in warm and dry weather. Lack of pollination and poor fruit set means that grape berries abscise and drop off, or else develop into small seedless berries with consequent reduction of yield. We have already mentioned how removal of shoot tips or spraying with the inhibitor CCC can assist fruit set.

PLANTING AND TRAINING GRAPE VINES

D.I. JACKSON
LINCOLN COLLEGE

Background

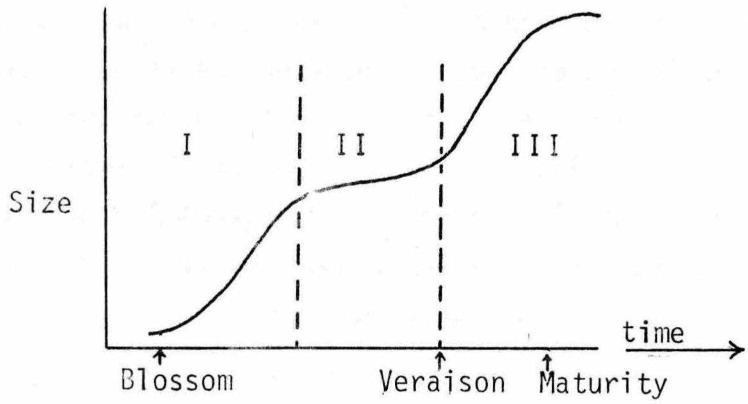
Under natural conditions the grape vine must compete with trees, shrubs and other plants for light, water and nutrients. Since it doesn't have a thick trunk to hold it above the ground it has evolved various other characteristics which enable it to maintain its place in the sun and extract adequate nutrients and water from the soil. These are, firstly, tendrils which clasp neighbouring branches and enable the vine to climb to the top of the canopy of trees and shrubs. The second characteristic is that growth of the vine is very rapid and continues for a long period over spring and summer. Thus, while an apple shoot may grow for only two months and rarely puts on more than 30-40cm a year, a grape may continue growing for 5-6 months and may, if left unchecked, put on several metres of growth. This vigorous growth takes the leaves to the sunlight and ensures they remain there during the growing season. A third feature of grapevines is the vigorous root system which penetrates deep into the soil and enables the vine to extract water or nutrients, even in areas where soils are poor and summers dry.

In the hands of man, these factors have their good and bad points. The lack of a rigid trunk means that some supporting structure, usually a trellis, must be provided. This of course can be costly. When the structures have been built tendrils enable the vine to hold on to these structures, although in fact their construction may be such that tendrils are unnecessary and can even be a hindrance, especially at pruning when they make it difficult to remove canes from the trellis.

Vigorous growth likewise can be a problem. In a vineyard we grow the plant

Growth of Fruit

Growth of fruit after flowering and set occurs in three stages. A period of rapid growth is followed by a slow-growth period and culminates in another rapid growth phase prior to maturity as shown.



A considerable amount of research effort has been made into the understanding of the growth patterns of fruit. Again it is believed that growth regulators or hormones play an important role in development of fruit. During Stage I hormones from the developing seeds are vital to the continued growth and retention of the berry on the bunch. Some varieties can develop without seeds, presumably by some genetic change in developmental physiology, but in New Zealand we do not grow commercially these seedless varieties. In Stage II, berry growth is slow but seeds develop rapidly to their maturity which occurs at the end of this stage. At the end of Stage II also a sudden and dramatic change in the course of development occurs which is called veraison. At this stage growth accelerates again, the berry begins to soften, glucose, and sucrose increase, acidity decreases, chlorophyll is lost and the colour develops in red and black varieties.

At veraison acid levels are high, but after this they are reduced by dilution caused by inflow of water into berries, and by conversion of acids to salts. Tartaric acid drops first and then more or less remains constant. Malic acid drops at a constant rate and may even disappear so that tartaric acid is the only one left. In hot climates malic acid is lost very rapidly whereas in cool climates it remains high longer. Wines of cooler areas are characterised by higher acidity levels, they are more complex and tend to need a longer period of maturation to achieve balance. In cold years excessive acidity can be a problem. In warmer climates loss of acidity and lack of complexity poses different but still serious problems.

At veraison sugar levels begin to increase as acid levels drop. Unlike the reduction of acidity which is dependent on temperature in Stage III, increase in sugars are, strangely, more dependent on the temperatures which were experienced earlier in the season - i.e. in Stages I and II (Hale and Buttrose, 1974). Thus in cooler regions where grapes ripen in the colder temperatures of autumn, the problem is not the build-up of sugars but the retention of high acidity levels. At Lincoln, sugars increase as rapidly as in the North, but acids drop more slowly. Fortunately the dry climate allows us to keep the grapes on the vine in most seasons for sufficient time to achieve a satisfactory sugar/acid balance.

This rather interesting effect of the early temperature regime on sugar development is paralleled by effects on size. The same research showed that the duration of Stage II was increased by low temperatures in Stage I and the rate of size increase in Stage III was promoted by high temperatures in Stages I and II.

Colour changes in Stage III are particularly noticeable in red grapes and again development is temperature-dependent in many varieties. Pigmentation of skins is greater in cooler temperatures, and areas with cool nights tend to produce grapes with better colour than those with warmer nights. At Lincoln Pinot Noir, Gamay, and Hermitage have produced very well-coloured berries. Dry conditions, adequate leaf area and moderate rather than heavy cropping promote development of colour, while excessive nitrogen decreases it. Unlike many other fruits, grapes do not always ripen with better colour in high light intensity. Colour development in many varieties is not affected by light although some, such as Pinot Noir, do gain more colour if intensity is high. For such varieties limited removal of leaves around bunches might be advantageous if colouring is a problem.

Apart from acids, sugars, and colour constituants, there are other compounds which give grapes and wines their characteristic flavour and aroma. These include tannins and the many flavour and aroma constituants that develop, particularly in the final stages of ripening. This is one reason why the final weeks or even days are so significant in the development of wine quality. At Lincoln last season Rhine Riesling berries were quite characterless until about 8-10 days before picking. Rain, disease or frost can lead to premature picking and loss of a potentially outstanding wine.

SOME ADDITIONAL TREATMENTS OF GRAPE VINES

Girdling

Girdling can be done to increase set, increase size of seedless berries and to advance maturity. It consists of removing a narrow strip of bark by using two parallel cuts 4-5 mm apart usually on the canes or the trunk. The belief is that the cuts temporarily check downward flow of nutrients, metabolites and hormones and cause a surplus above the girdle which if timed correctly can have beneficial effects.

Improving set and promoting berry growth by such methods works better on seedless grapes which are not of great significance in New Zealand. Some varieties such as Pinot Chardonnoy which often produce only straggly bunches may yield larger crops if girdled at blossom time. The additional berries are usually seedless. Girdling to advance ripening works on seeded varieties when done shortly after veraison i.e. at the first appearance of colour in red varieties. The few days earlier ripening is not generally considered worth the time involved, but in marginal districts of New Zealand some trials may be worthwhile.

The Use of CCC

We mentioned before that using a growth retardant or topping shoots at or near blossoming can increase set. The chemical used is CCC and gives better results if sprayed from one to three weeks before blossom. (Topping is at blossom time.) Another growth retardant Daminozide (B9, Alar) has had similar effects to CCC especially on *Vitis labrusca* (Funt and Tukey, 1977) but is less effective on *V. vinifera*. CCC at 500 ppm has also been reported to increase the number of flower bunches initiated in the bud (Sigiura, 1976).

Gibberellic Acid

Gibberellic Acid (GA_3) has widespread use for promoting growth of seedless grapes. For seeded grapes its main value may be for berry thinning. A growth promotor, GA_3, tends to stimulate growth of shoots and has opposite effects to CCC or Daminozide. In varieties which have very compact bunches and in areas where fungus is a problem, GA_3 has been used to loosen bunches. If sprayed at about 5 ppm at 2-3 weeks before full bloom beneficial results can be obtained; at high concentrations yield can be seriously reduced and shoot growth and flower initiation will be deleteriously affected.

Ethyphon (Ethrel)

Ethyphon is a chemical which when sprayed onto a plant will release ethylene which is a plant growth regulator. It is generally regarded as a ripening hormone. If sprayed at the end of the first or beginning of the third growth phases it has been reported to advance ripening and increase colouration in red varieties (Weaver, *et al.* 1974; Lavee, *et al.* 1977). Applied shortly after blossoming it will delay maturity.

In addition to promoting the ripening process ethyphon when applied closer to harvest may assist the removal of berries from their bunches. An Australian report (Anon, 1977) suggested that a spray one week before harvest will improve fruit removal by 10% if using a mechanical harvester.

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APPENDIX - Hormone Treatments Worthy of Trial in New Zealand

(after Weaver, R.J. 1976. 'Grape Growing' John Wiley & Sons, New York).

1. *Loosening Bunches of Seeded Varieties*

In warm, wet areas rot of compact bunches of grapes, such as Rhine Riesling, can be a serious problem. The following treatments have been used in the U.S.A.

Material: Gibberellic acid @ 2-10 ppm. Concentration depends on variety and must not be exceeded.

Time of Application: 3 weeks before full-bloom (longer shoots are 15-20 cm and clusters 7-10 cm).

Effect: Some berries don't set and bunch elongates leaving air spaces between berries.

2. *Increasing Berry Size*

A method used for seedless grapes may be useful for varieties like Pinot Chardonnay which often produce a large number of seedless and small berries.

Materials: A) Gibberellic acid @ 2.5-20 ppm.
B) Gibberellic acid @ 20-40 ppm.

Time: Apply A at 30-80% cap-fall and B at fruit set.

Effect: Spray A) reduces set and produces less compact bunches
A and B promote the sizing of remaining berries.

3. *Increasing Set*

Used in U.S.A. more particularly in American varieties.

Materials: Cyclocel (CCC) @ 1000 ppm or SADH (daminozide, B9) @ 2000 ppm.

Time — Two-three weeks before full bloom.

Effect — Increases set but does not necessarily improve yield. The large number of smaller berries may result in improved wine quality due to greater skin to pulp ratio.

4. *Promoting Grape Ripening*

Material — Ethyphon (Ethrel) 100-200 ppm

Time — 5-15% berry colour

Effect — Enhances colour, increases sugar:acid ratio due to its effect in hastening the loss of acids.

PLANTING AND TRAINING GRAPE VINES

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Background

Under natural conditions the grape vine must compete with trees, shrubs and other plants for light, water and nutrients. Since it doesn't have a thick trunk to hold it above the ground it has evolved various other characteristics which enable it to maintain its place in the sun and extract adequate nutrients and water from the soil. These are, firstly, tendrils which clasp neighbouring branches and enable the vine to climb to the top of the canopy of trees and shrubs. The second characteristic is that growth of the vine is very rapid and continues for a long period over spring and summer. Thus, while an apple shoot may grow for only two months and rarely puts on more than 30-40cm a year, a grape may continue growing for 5-6 months and may, if left unchecked, put on several metres of growth. This vigorous growth takes the leaves to the sunlight and ensures they remain there during the growing season. A third feature of grapevines is the vigorous root system which penetrates deep into the soil and enables the vine to extract water or nutrients, even in areas where soils are poor and summers dry.

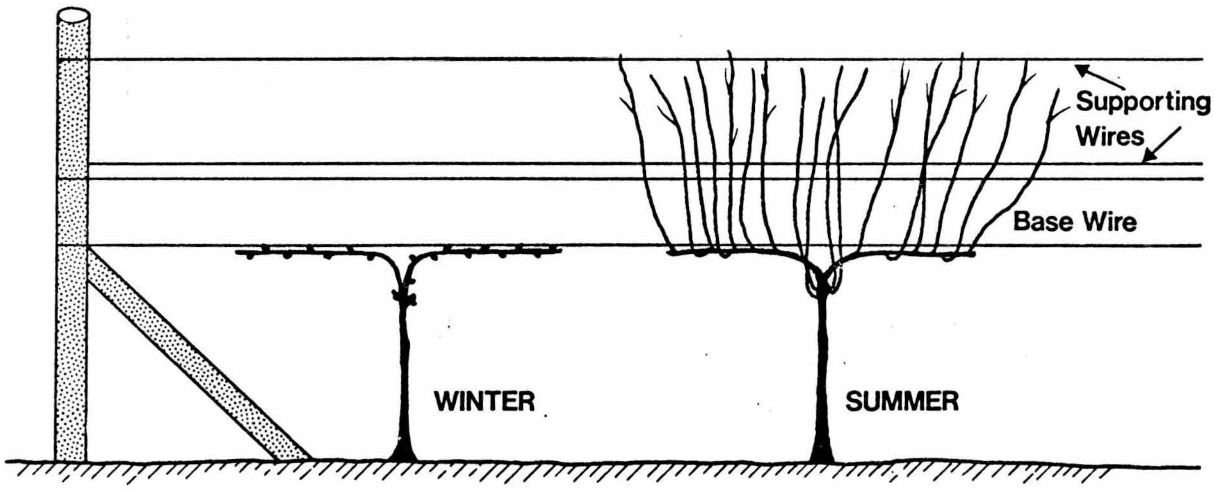
In the hands of man, these factors have their good and bad points. The lack of a rigid trunk means that some supporting structure, usually a trellis, must be provided. This of course can be costly. When the structures have been built tendrils enable the vine to hold on to these structures, although in fact their construction may be such that tendrils are unnecessary and can even be a hindrance, especially at pruning when they make it difficult to remove canes from the trellis.

Vigorous growth likewise can be a problem. In a vineyard we grow the plant in monoculture with no competition except from neighbouring grapes. Under these conditions the excessive growth has little value and in fact every winter we regularly remove 90% of previous-season's canes and also a percentage of summer growth.

The third factor is the root penetration which can be looked upon as a bonus. However many growers, brought up with other horticultural plants which give good responses to fertilisers and water, tend to over-fertilise and over-water grapes. The result can be very excessive vegetative growth, and poor grape and wine quality. To benefit from the root characteristics of grapes, soils should have a free root run and hard and inpenetrable pans should be broken.

Trellising

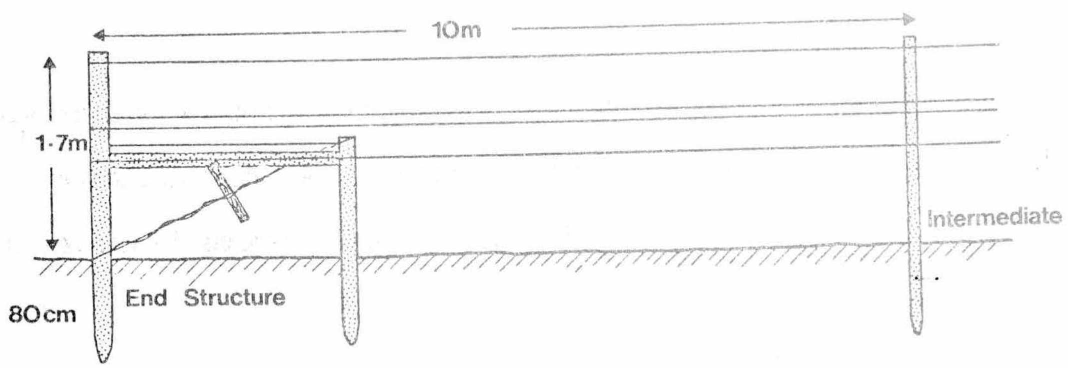
There are numerous trellis structures for supporting grape vines, yet the most common is the simple vertical type shown below.

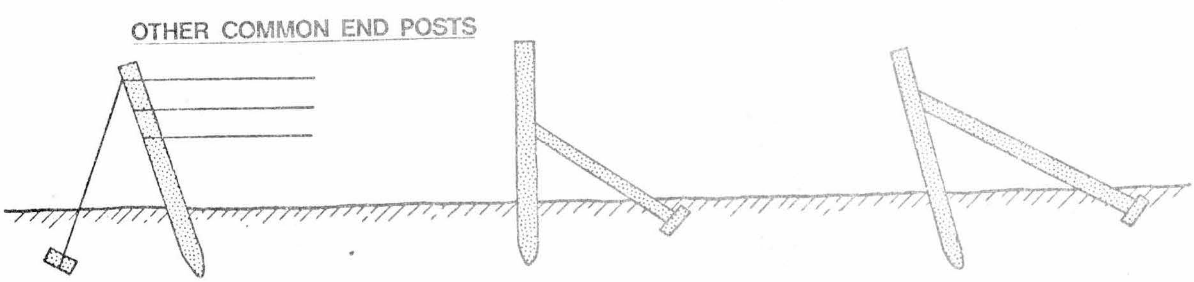


The height is from 1 to 2 metres and the base wire supports the permanent part of the vines. The plant on the left shows the vine in the winter, while on the right, summer shoots are shown growing up or through the three or more wires above the base.

The factor which more than any other can increase yields of a crop is the amount of leaf area exposed to sunlight. For a vertical trellis of the type described, various formulae can be applied to work out the best relationship between height of the trellis and the distance between rows in order to give optimum leaf exposure and crop yield. Interesting though these are, the more realistic way of working out distances and height is in relation to machinery used, cost, and ease of working. With standard tractors, rows will not normally be less than 2.5m apart and a trellis much more than 1.7m will be costly and difficult for the average vineyard worker to prune and train. With such dimensions and with rows going N-S, reasonable exposure of all leaves will be gained and a good compromise between maximum yield and reasonable efficiency will be possible.

Our discussion will be based on a standard trellis of 1.7m high in rows 2.6m apart. Readers may need to vary these in accordance with their own machinery, tractors, harrows, mechanical harvesters and availability and cost of trellising. The following layouts may be adopted for fencing:





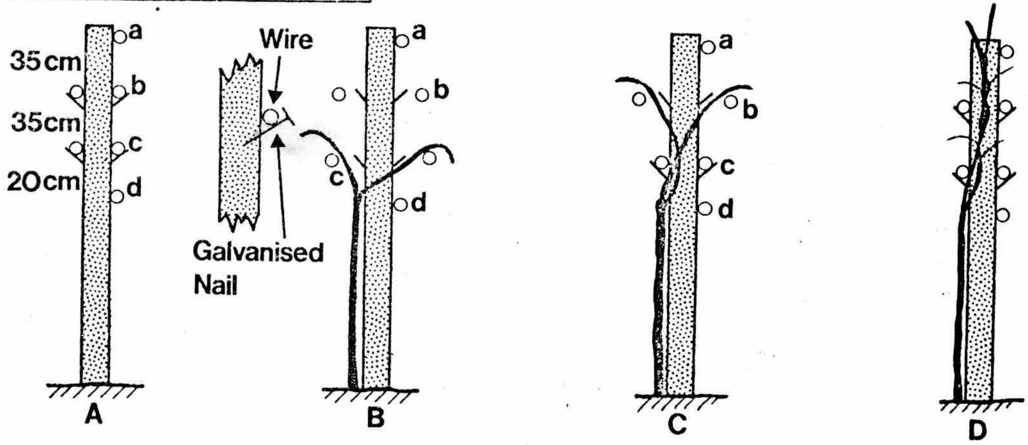
We recommend that the base wire be placed 70-90cm from the ground. This places the fruit sufficiently high above the soil to be free of ground frost, is at a comfortable working distance for pruning and picking, and allows 90cm of trellis on which new canes can grow.

Above the base wire the following wiring systems are suitable:

System A

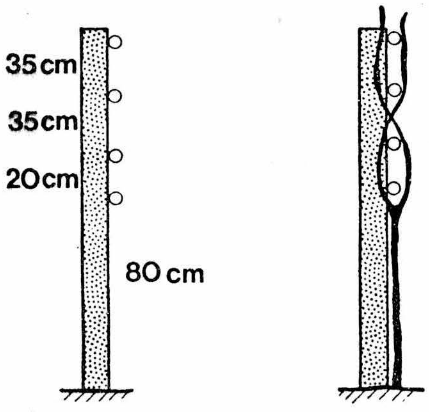
Wires at b and c can be hung below nails prior to growth. As canes grow they fall over the wires b and c which are then lifted over nails as shown in C and D.

END VIEW ALONG TRELLIS



System B

System B perhaps needs a little more labour to train, but it is simple, neat and cheaper due to the use of fewer wires. The canes get more entangled with the wires and are rather difficult to remove in winter pruning.



Canes are tucked between the wires as they grow. Young canes are most likely to get damaged by wind and for this reason it is suggested that the first wire be no more than 20cm above the base one. Thus the young canes quickly become supported at their most vulnerable stage.

Remember: There are many different trellising systems. The above are basically simple, give good yields and are well proven. They should be generally suitable for cool-climate areas. More detailed textbooks will need to be consulted to consider the relative merits of these and other systems and local practice should also be acknowledged.

Pruning

Pruning and trellising systems are intimately connected and there are a great variety of methods which have, and are, being used throughout the world. We can cover only a few.

It was mentioned above that about 90% of the previous-season's growth is removed each winter. It is these one-year-old canes on which the next season's crop will be produced and it could be suggested, therefore, that we are removing 90% of the potential crop. However the trellis and the vine could never support this level and removal of canes is essential. Pruning aims to the following things:

(1) Space the shoots so that each will present its leaves to adequate light.

(2) Space shoots so that air circulation will be encouraged. This will reduce humidity which in turn lowers disease incidence.

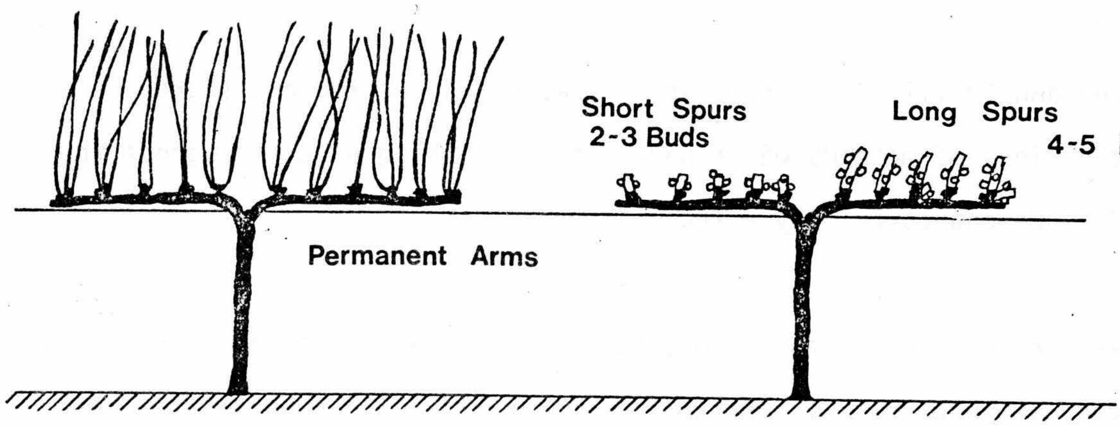
(3) Space shoots to allow adequate penetration of sprays for pest and disease control.

(4) Provide good replacement canes for the next winter's pruning.

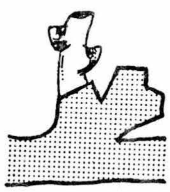
(5) Select the length and position of cane on which the buds have the best potential for fruiting.

To achieve these purposes we normally have a trunk with laterals which are secured to the basal wire. The simplest way is the spur system which in its basic form is shown below.

THE SPUR SYSTEM



In more detail each spur looks like this:

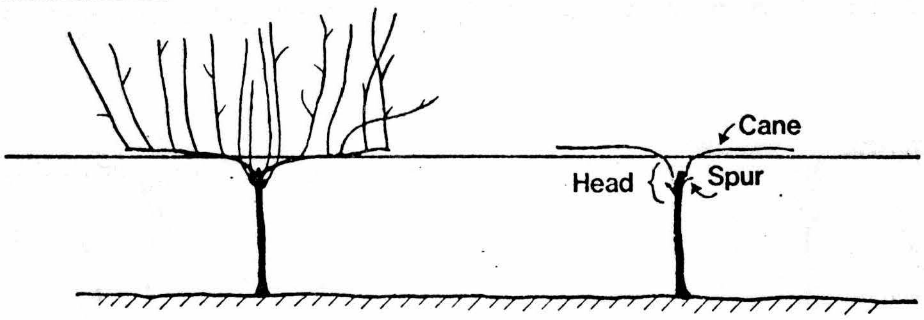


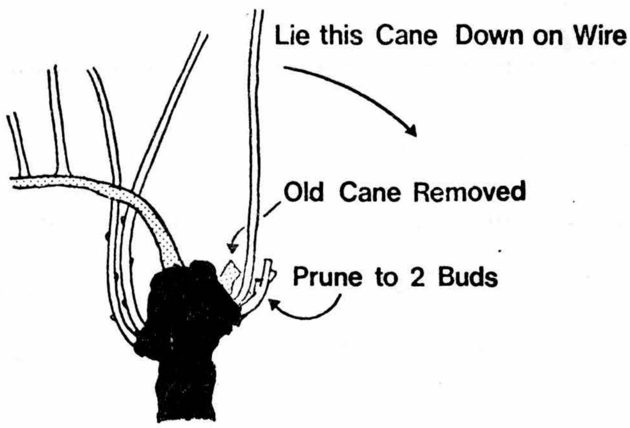
The advantage of the spur system is that it is simple, and easy to teach to inexperienced workers. The disadvantage is that basal buds on certain varieties produce poor bunches of fruit and overall crop can be low. Also, after a number of years, some spurs may die and leave bare areas on the permanent arms which may need to be replaced.

It is the method most commonly used by home gardeners and is ideally adapted to growing on fences, pergolas, sides of houses or in glasshouses (commercial or domestic).

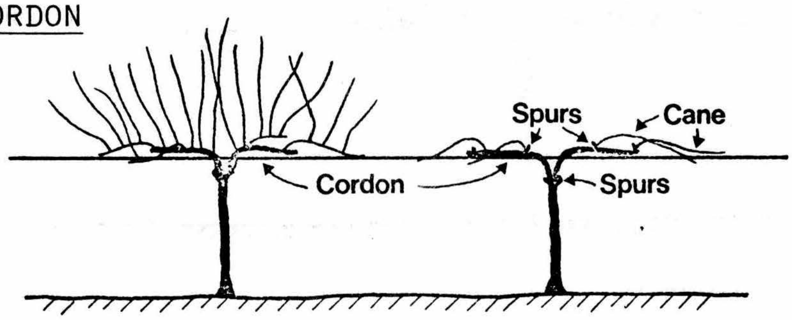
THE CANE SYSTEM

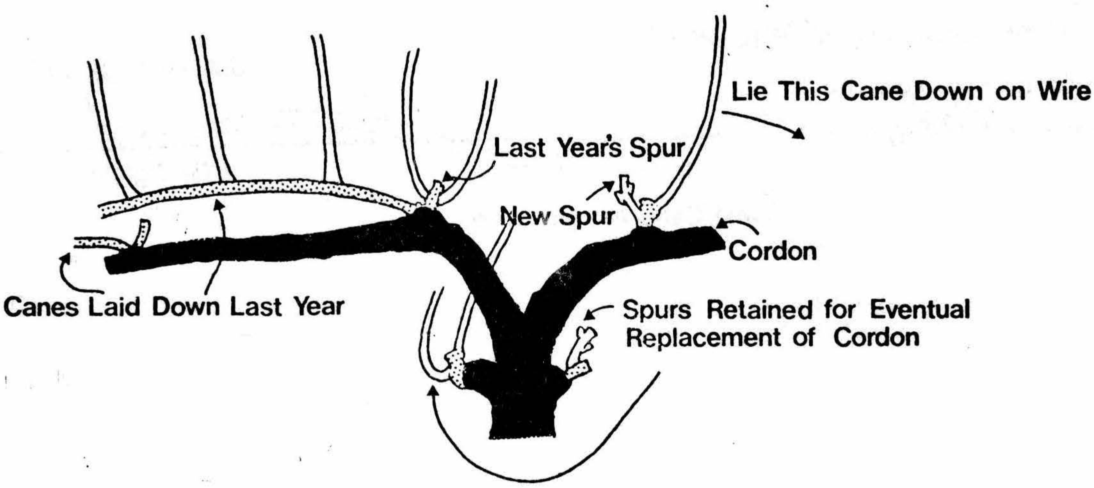
(A) HEAD CANE





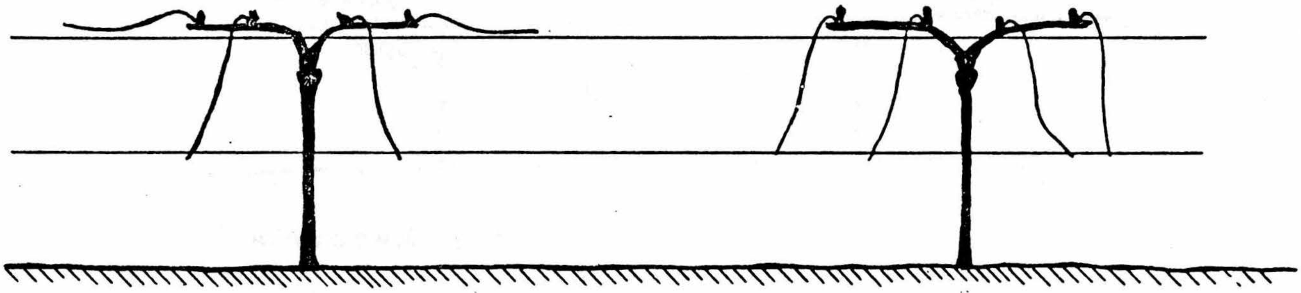
(B) CORDON



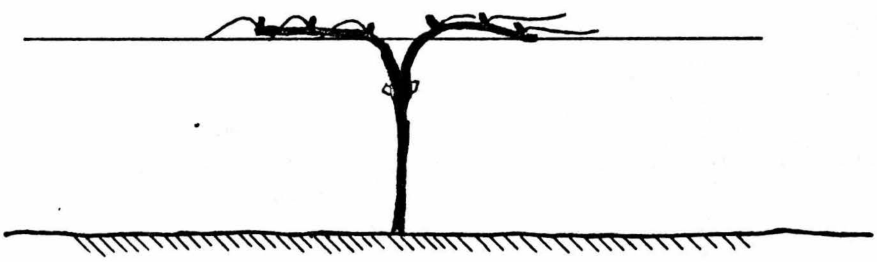


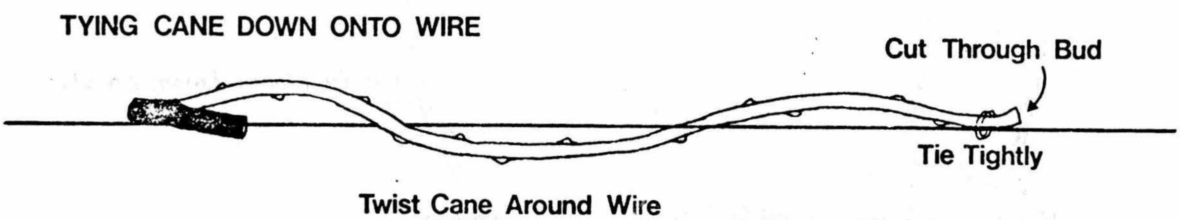
The head cane system is most suitable for weaker varieties where the vine can support a lower number of buds. Where more than one cane is required for stronger varieties the cordon system is more satisfactory.

To use more of the lower part of the trellis and/or reduce vegetative vigour while leaving more buds for fruit these canes are sometimes bent - e.g.



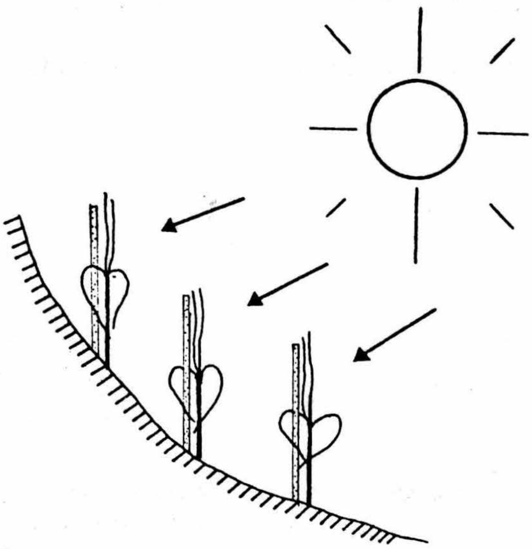
Some varieties have their most fruitful buds in special parts of the cane, for example Cabernet Sauvignon which is a vigorous variety, has the most productive buds at numbers 6-12 from the base. Thus modifications can be made to favour a rather larger number of smaller canes.

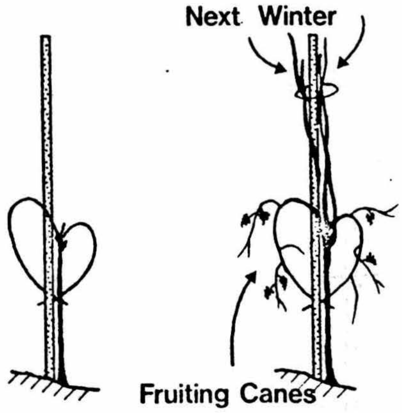




Growing on a pole

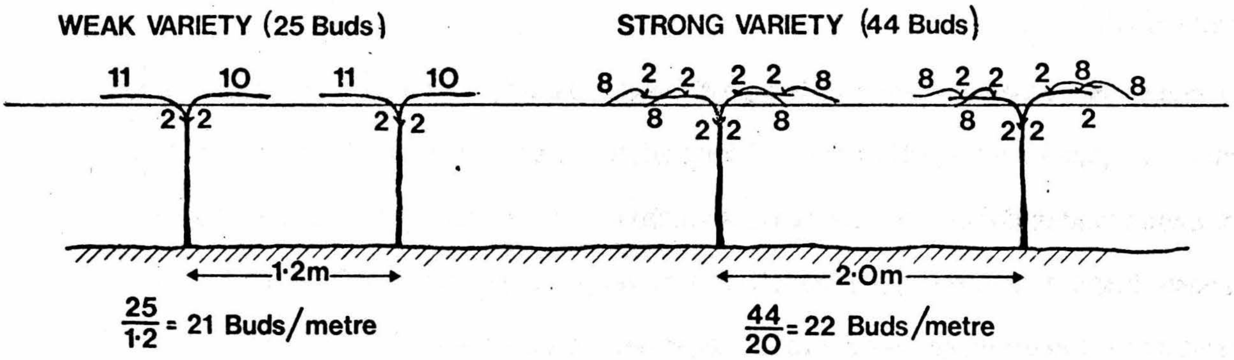
In cool areas where every degree of heat counts, growers will often use steep slopes facing the sun. For such slopes, trellises are difficult to erect and poles can be more suitable. Because hand labour may be needed and tractors are impossible, every square inch of ground is used and poles are often very close together - sometimes little more than one metre apart each way. For plants grown on a pole, a modified head cane is used.





Spacing the Vines in Rows

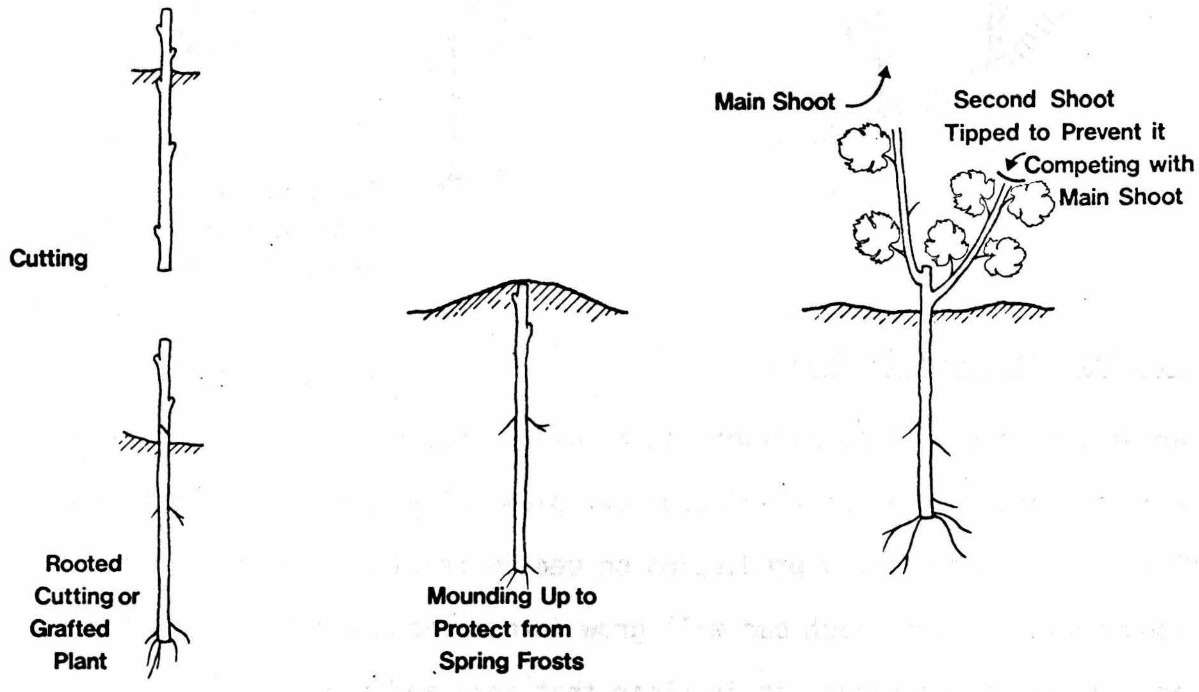
Grape varieties can be categorised as weak or strong. A strong variety will support a total of 40-50 buds per plant after pruning, a weak one 20-30 for optimum berry production on medium fertility soils and normal rootstocks. Since each bud will grow into a shoot which will yield, on an average, two bunches, it is clear that weak and strong varieties planted at the same distance apart will have different yield potentials. Clearly it would be advantageous to plant weaker varieties closer together as we show below.



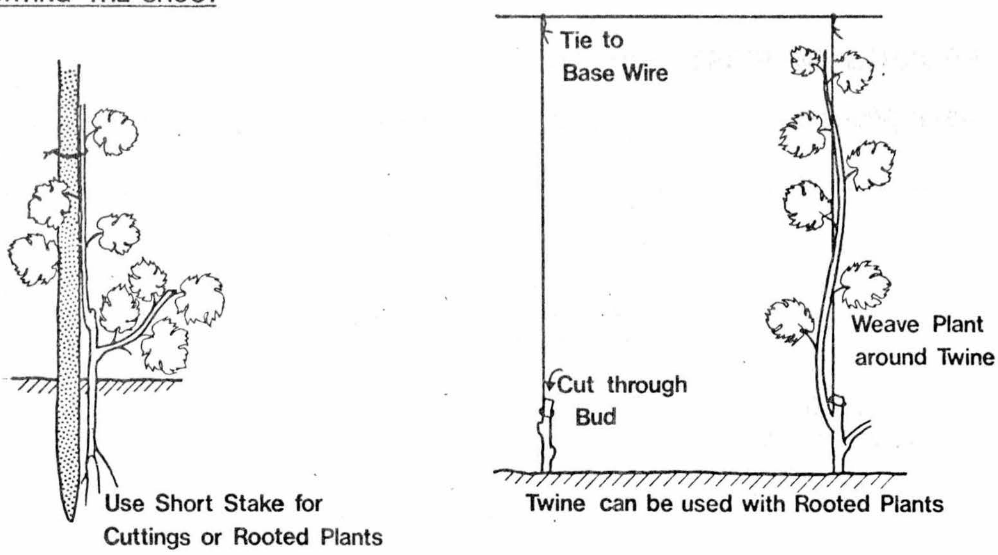
Training the Young Vines

Grapes can be propagated by cuttings or by grafting. In this section we will try to follow the development of a vine from the time it is planted to when it is at the mature stage and will be treated by one of the methods described above.

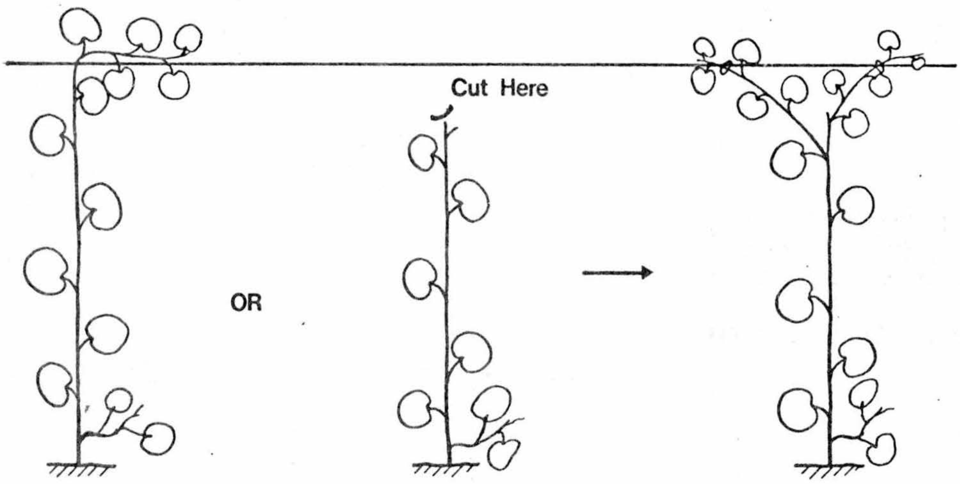
Planting the Vine



SUPPORTING THE SHOOT

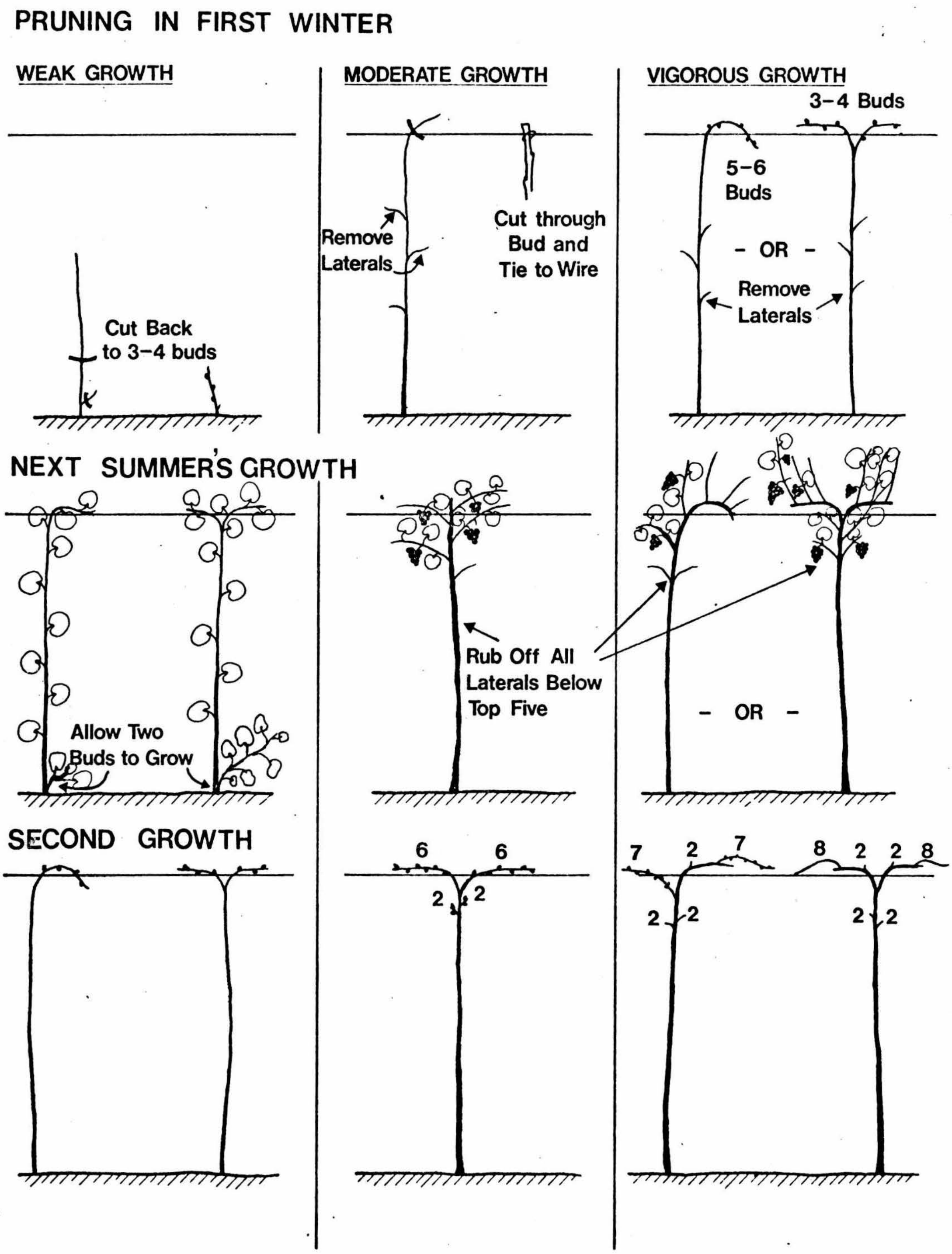


ON REACHING THE WIRE



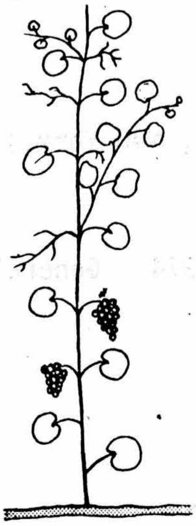
The amount of growth in the first year will depend on the vigour of the plant, water availability, soils and climate. Sometimes the shoot will not reach the wire in which case it is normally pruned back the next winter to two buds.

Pruning in the 1st winter therefore is as follows:

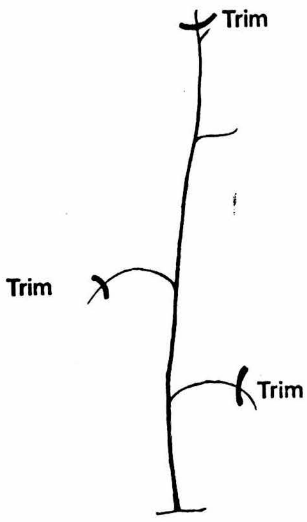


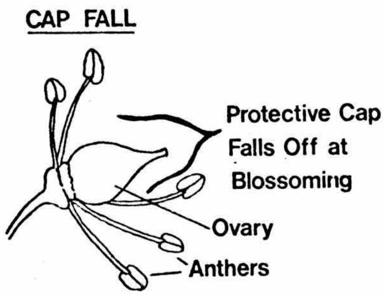
Summer Pruning

Growth of buds from the cane on the base wire proceeds upwards to the top wire. As it grows, some lateral shoots also develop as shown.



Once the shoots reach the top wire they are usually topped and if the lateral becomes too dense, they can also be cut back, often mechanically.





If the tops are trimmed just before flowers are ready to be pollinated (cap fall) fruit set can be improved. Topping and trimming of laterals 2-3 weeks before maturity may assist ripening.

Further Reading

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RECENT DEVELOPMENTS IN VITICULTURE

MR R.P. POLLOCK,
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Introduction

Although grape vines have been cultivated for thousands of years, and wine has been made from grapes for almost as long, recent technology and non-traditional growers have resulted in major changes in grape production methods. Grapes are being grown on rich alluvial flats, irrigated if necessary, regularly sprayed for pests and diseases from the ground and the air, trained on trellises of various designs, have competing vegetation controlled by chemicals (as well as mechanical means), harvested by machine, and even pruned by machine. There are those who still adhere to traditional systems but change is inevitable, and when our present state of knowledge of the vine is considered, desirable.

Recent developments in New Zealand viticulture include:-

(i) Direct planting unrooted cuttings
(ii) Chemical weed control
(iii) Pruning for heavier crops and utilizing the vines vigour
(iv) Cropping young vines as early as possible
(v) Segregating bearing wood from renewal wood
(vi) Machine harvesting
(vii) Machine pruning
(viii) Aerial spraying

Training

Various vineyard operators have used differing training techniques, but most of our older vineyards have bearing arms laid on the bottom one or two wires, while the foliage produced during the growing season is trained above them, often between pairs of wires. It is common to leave one or two spurs beneath these arms to provide the bearing arms for the following season.

The internode length along a cane varies. Normally the first 3 - 4 buds on a cane are closer than those further out. In the first season of cropping bud burst is predictably good. An examination of the positioning of previous season's growth next pruning time, shows that already there is uneven distribution of cane along the wire. The area with most canes is around the head of the vine followed by the ends of the arms, leaving the middle portion of the arm with the weakest growth. The following year the pattern is more clearly defined, dense growth in the head, satisfactory growth at the ends of the arm, and sparse, often weak growth between. The reason for this uneven development is not disease or insects as have been claimed in the past, but physiological.

Dr Murray Hopping conducted some shading experiments at Te Kauwhata in 1975, in which he concluded that the leaf that subtends a bud influences it in three ways: firstly, if it will burst the following spring, secondly, the number of flower clusters the shoot will carry, and thirdly, the size of these flower clusters. The most desirable effect comes from those leaves which function efficiently throughout the season. Some years ago Palomino growers observed that the cane which provided the best bud burst was that which had produced sub-laterals on it during the previous season. We now know that these sub laterals are produced where the lateral has good light exposure.

If light then is so important, why do people train vines in such a way that the renewal arms are taken from the densest part of the vine? Maybe they like long internodes, poor bud burst, uneven crop distribution, more difficult spray penetration, and late change. Centre leader pruning of apple trees developed from a recognition of the principles of fruit production, the same awakening must come to the grape industry.

In the early 1960's, Dr Nelson Shaulis of Cornell University in New York introduced a system of grape vine training called the Geneva Double Curtain. This system makes maximum use of the available light, and in various trial blocks around Gisborne, yields have mostly been 50% or more above conventionally trained vines. It is vital that growth from one side of the curtain is not allowed to interfere with growth on the opposite side, and it is this aspect which most growers have found difficulty with. Some people have advocated the use of wider T's, but if these exceed 1.2m the machine harvester currently used in conventional blocks cannot be used.

A development from this has been the single curtain. Basically there is a single cane at the top of the posts (1.6 - 1.8m high) and growth from this hangs down. Pruning consists of thinning these shoots to a limited extent and reducing the remainder to not more than 5 buds in length. As the base of the shoots receives the maximum amount of light, bud fertility is high. The yields on single curtain compare favourably with the best conventionally pruned vines. Vine training is as follows - a single cane in the second season is taken from ground level to a wire at 90cm to 1 metre, and trained along this in one direction only. This will crop the following season, one of the shoots from directly above the trunk is trained up a string to a second wire at the top of the trellis, and along this wire again in one direction only. The following season cropping is carried out on the wires at both levels. In the third season the lower wire is removed, added to the top wire for additional strength, and the growth from the cane in subsequent seasons can be reduced to 5cm above the wire about 8cm on either side and 30cm below either manually or by machine. With this system retained buds per vine may be as high as 150 compared with standard pruning of 40 - 60. The level of cropping can be varied with the severity of pruning, but crop distribution along the wire is even which allows good spray penetration, and the crop can be left until mature.

Grape maturity is influenced by the season, variety, yield and the company. It appears that some varieties are best picked at the correct acid, while for others higher sugars means higher quality. Grapes carrying a very heavy crop are unlikely to attain the sugar levels of vines of comparable vigour with lighter crops simultaneously.

In the 1974/75 and 1975/76 season we looked at the influence of cropping levels on grape maturity as measured by sugar and acid levels in Riesling Sylvaner own rooted.

Property A:

Full crop	30.6 t/ha	16.7^{0} brix
2/3 flower clusters removed	15.4 t/ha	17.3^{0} brix

Property B:

Full crop	10.0 t/ha	18.3^{o} brix
2/3 flower clusters removed	4.9 t/ha	19.0^{o} brix

1975/76

Property A:

Full crop	19.0 t/ha	19.0^{o} brix
2/3 flower clusters removed	9.2 t/ha	19.96^{o} brix

Property B:

Full crop	19.2 t/ha	18.3^{o} brix	19.1 t/ha	18.8^{o} brix
2/3 flower clusters removed	10.2 t/ha	19.5^{o} brix	10.0 t/ha	19.5^{o} brix

Acidity levels do not appear to be greatly affected by crop yield and from the above data a drastic reduction in yield shows only a moderate increase brix. Of greater significance as far as the accumulation of sugars is concerned, is the time of harvest.

The means brix levels of 6 replicates and three treatments on Property A for 1975/76 season were as follows:-

February 25	March 2	March 9	March 16	March 23
15.59	16.96	18.16	19.14	19.57

Property B: (cultivated)

February 24	March 2	March 9	March 16	March 23
14.75	16.28	17.52	18.33	19.27

Property B: (Grass)

February 24	March 2	March 9	March 16	March 23
14.37	15.53	16.95	17.69	18.80

The effect of a heavier crop on the deep fertile soils in Gisborne seems to be a delay in maturation and the question that remains to be answered is what is a normal crop in our soils? To date the only over cropping I have seen under our conditions is occasional vines in young blocks and vines where the roots have been damaged by fungi or Phylloxera. I do not accept the view held by some in New Zealand that once yields exceed 8 tons/acre quality falls off rapidly. This is an over-simplification and gross generalisation.

Harvesting and Pruning by Machine

Machine harvesting is well accepted. In the Gisborne district, last vintage seven machines were operating. When the first machine was introducted about five years ago there was general concern at the possibility of vine damage, and juice loss. We now know that the machines are capable of harvesting as good or better than hand pickers and at half the cost. The machines do cause some defoliation and the bunch stalks are left behind, so the appearance of the vine after machine harvesting is different to hand harvesting. But the machines are unquestionably here to stay.

The next move is into machine pruning. Like machine harvesting we will have to alter our concept of what a pruned vine will look like. There will be tendrils, dried bunch stalks, and lengths of cut cane, but these need not be a cause of contamination if an adequate spray programme is adopted. Machine pruning is in its infancy. This winter two Gisborne growers pruned their entire vineyard using reciprocating bar hedge trimmers, and at least three other growers did a portion of their vineyard. One of these vineyards is trained on the conventional trellis, the other four have single curtains. Pruning times averaged about 70 hours/ha compared with an average of 270 hours/ha for conventional pruning/range (125 hours to 375 hours). If however, yields decrease by 2 tonnes/hectare, then any savings will be lost.

At the Australian Wine Research Institute Conference last year, R. Hollick stated, "since 1973, when mechanical pruning was started a slight increase in yield has been noticed. The untidieness of the vine is of no commercial consequence, and fruit quality has not been impaired in any way". I am sure that these comments will apply equally well under New Zealand conditions.

The details of machine pruning may vary with variety but I do not believe greatly. In time we will no doubt see pruning equipment fitted to grape harvesters, and pruning times reduced to 3 hours per hectare. The equipment used this seasons consisted of a generator and two hand held hedge trimmers, costing less than $1000 and with the savings in pruning costs, this could be written off with only 4 hectares of grapes!

The next advance will hopefully be in the field of spray application. If this can be satisfactorily done from the air, there is the opportunity for further savings in expenses. In the Coonawarra area of South Australia, Pawnee aircraft fitted with "Micronair" rotary atomisers are used. The payload of 800 l is sufficient for 36 ha, and the cost of application last season was about $5.00 per hectare. Efforts at aerial spraying in New Zealand to date have not met with much success, but hopefully we will not give up.

I am often asked by people without a horticultural background, whether they should work for an established grower for a year or so before going out on their own. My answer is a quite definite, no. Much of the innovation in crop production comes from people new to the game, who do not have the constraints of tradition to contend with. All growers make mistakes, and new growers perhaps more than old, but the former seem more willing to modify their practices in response to the crop.

New ideas in viticulture will continue to emerge. These must not be dismissed out of hand, but evaluated and modified where necessary. Hopefully the end result will be heavier crops of riper grapes. It is then over to the winemaker to use his skills to the satisfaction of the consumer.

NEW IDEAS IN GRAPE PRODUCTION

A.D. CLARK,
HORTICULTURAL ADVISORY OFFICER,
AUCKLAND.

In this paper it is intended to outline some of the current ideas on varieties, rootstocks and propagation and, if time allows, weed control, spray application and harvesting. Most of what I have to say will chiefly be with relevance to the Auckland area.

Pruning and training techniques which have seen some rapid changes in recent years will be covered in the second half of this session by Paul Pollock.

Varieties

The variety situation is slowly changing with lessening emphasis on hybrid varieties. Progress in this field will always be relatively slow as it takes time for both the viticultural and the oenological aspects of a variety to be fully evaluated for commercial expansion - Dr Olmo on his recent visit reckoned on 10 years.

We have also lacked a co-ordinated effort in variety evaluations until recently and I will expand on this soon. It must also be remembered that improvements in wine styles with our presently-grown varieties continue to be made. The improvement in quality of some hybrid wines such as 22A and Siebel 5455 have been significant so that we should not be too hasty in removal of an old variety.

With the increased consumption of white wines at the expense of reds, white varieties are receiving most attention.

Riesling Sylvaner has become the mainstay white but there are other useful early maturing varieties which are being looked at.

The CD Geisenheim selections which have been at Te Kauwhata Research Station for some years may be useful in blends with Riesling Sylvaner. They are being propagated and planted at present to test their worth. Likewise the ZNR Austrian selections introduced recently by Te Kauwhata again may find a place but have not been evaluated.

Sylvaner has been tried in Auckland and shows some promise. Grey Riesling has been cropped in commercial blocks for the last three years with good results - 13 tonne/hectare in sound condition. We are beginning to look at this variety as a possible replacement for Riesling Sylvaner which has cropped poorly in Auckland. It probably will best have a place in carafe style wines.

The Hungarian Furmint and Walsh Riesling (Riesling Italia) are being tried. Initial samples of Furmint are interesting - ripening just after Riesling, weathering well and having a potential to crop heavily. Walsh Riesling will produce its first crop this year - this variety may be a useful bulk white.

Gerwurztraminer has been tried and is being expanded in most districts. Yields are very variable and normally small. We obviously need to understand more about training, pruning and cane selection with this variety to obtain more even cropping. Improved results may also lie in importation of better clones.

Mid-season white varieties of promise include Semillon and Sauvignon Blanc. Small commercial areas of both these have been planted up. Semillon has good weather tolerance, ripens well and with distinctive varietal character. Sauvignon Blanc is similar with even more distinctive character but it may not be as weather tolerant. Chardonnay has been persevered with but lacks good clonal material to improve yields.

Late-maturing varieties such as Rhine Riesling and Chenin Blanc need to be planted with caution - both have a tendency to break down with weather damage.

Red varieties should not be overlooked - trends in wine consumption can change fairly quickly.

Clones of Pinot Noir have seen some of the greatest expansion in new reds with lesser areas of Beaujolais. The virus free Beaujolais we have propagated in recent years is in fact a more upright growing clone of Pinot Noir according to Dr Olmo. The mistake had originally been made in California when clones of both varieties were imported from France.

Merlot has produced poorer yields than Cabernet and appears to lack the weather tolerance of Cabernet.

Petite Syrah has yielded heavily - in fact there is a danger of overcropping in the establishment years. It may lack sufficient weather tolerance but makes an interesting wine.

Hermitage and Malbec have both been disappointing yielders and there is a requirement for better clones.

Virus-free Pinotage and Cabernet Sauvignon have both been improvements on their infected counterparts.

Finally I would like to mention something on clonal selection which has seen some of the biggest advances in improved cropping and ripeness of varieties in other wine producing countries.

Clonal selection entails choosing genetically superior or "stud vines" from within a stand of a variety which will give superior cropping or fruit quality or both. It has been true to say that until recently virus-indexed planting material was promoted in New Zealand as being the best choice but it is premature to believe that all virus-free material will be superior without comparative evaluation. We have already seen instances with early importations of virus-free varieties into New Zealand where the variety has been a poorer cropper than its infected counterpart. Choosing the best performing individual or individuals in the first instance and then rendering them free of known viruses is being more widely adopted today and there is no reason why we could not commence to do clonal selection work in New Zealand in our presently-grown varieties. Some primitive clonal selections done by growers in Riesling and Cabernet already have produced interesting results. However, a scheme such as this relies heavily on co-operation of all facets of the industry. A clonal selection scheme could also incorporate evaluation of new varieties. Outlined to us last year in South Australia was a scheme which could have future application here and briefly entails the formation of regional vine committees in the major grape areas in South Australia. These consist of representatives from the Ministry of Agriculture, growers, nurserymen, winemakers and others who have the job of:-

(a) determining the area of new vines required,

(b) selecting sites for registered source areas of a new variety or clone,

(c) distributing and selling certified cuttings,

(d) promoting use of improved planting material,

(e) assisting in setting up trials to evaluate new clones and varieties,

(f) selecting higher-yielding clones from established vineyards,

(g) developing close liaison with nurserymen and encouraging registration.

Groups of selected growers on these vine committees are trained to pick clones and the candidates chosen are then evaluated at a local research station together with imported clones to find the best. They are then bulked up by the committee in chosen source areas. In the case of new varieties the committee must arrange with a local winery to assess the variety and pass on results. In return the committee establishes five 0.4 hectare source blocks of the variety. The winery signs a contract guaranteeing that it will accept the fruit from these source vines for a period of evaluation. This supplies the winemaker with a reasonable quantity of fruit to do semi-commercial testing and allows the variety to be given a fair testing over five different vineyards. Cutting material remains the property of the Vine Improvement Committee who arrange through certified nurserymen the distribution and price.

A similar system would have merit here and would improve on the present fragmentation that occurs. Much more rapid evaluation of new varieties and selection of the best available planting material could result on an orderly and constructive basis. The results from clonal selection work are not minute -

in South Australia we saw Cabernet clones yielding 16 tonne/hectare, Gerwurztraminer at 9 tonne/hectare and so on. However, as I said previously co-operation is essential and it is hopeful that the steps the Wine Institute are making in this direction may start the ball rolling.

Rootstocks and Propagation

Because of economic damage from Phylloxera Auckland relies on resistant rootstocks, the principal one being Mouvedre x Rupestris 1202, with lesser areas of Rupestris St George, ARG1 and 1613 (Solonis). 1202 has been adopted as most suitable to clay soils and despite criticism that it has insufficient Phylloxera tolerance, Phylloxera has never been seen to debilitate the stock in our district. There is always a wide variation in the response of rootstocks to climate, soil type, scion variety and the presence or absence of soil pests. A single rootstock suited to all purposes does not exist and local field testing is always required to define the potential of rootstocks in a location regardless of the purpose for which they might be intended. This is a principle which some people forget and the direct transfer of rootstock knowledge from one country to another cannot be done. In the first instance a problem must be defined which requires the use of rootstocks and then a series of stocks tested in the district. Current propagation methods in Auckland are based on open ground nurseries striking the stock cuttings the first year and cleft grafting the next. The time taken in producing this type of vine has been reduced recently by one nurseryman who has potted up his rooted stocks after growing them in the nursery then grafting them in the spring of the second year for sale as soon as the scion bud has begun to move. Open ground vine production although slow does produce a strong vine which will grow adequately on our heavy soils. Attempts with mist propagated and bench grafted vines have produced poor products, usually because of dehydration of the union after planting out in the field. A technique seen in Australia last year may increase the success rate of rapid propagation techniques however and is worthy of trial in New Zealand. This technique entails green grafting and is less expensive than benching, has a higher success rate and allows wood of all thicknesses to be used. Growers who had little or no experience with this Chapman Green Grafting technique were attaining good results in Australia.

The technique simply involves taking rootstock cuttings in the normal manner and disbudding as for normal bench or field grafting. The stock cuttings are then rooted in a hotbed beginning in August. The hotbed is placed outside in normal air temperature to maintain dominancy in the top two stock buds whilst forming roots on the bottom. Heating cables are set at 27°C and a rooting media of double washed river sand is used.

A 3.3 m^2 hotbed could hold approximately 4,500 stocks which would form roots in 4-6 weeks. After rooting the stocks are potted up in a suitable free draining potting mix and the potted rootling is transferred to a glasshouse maintaining a temperature of approximately 21°C. The stocks were hand watered as necessary and supplementary feeding given.

The rootlings were ready for grafting when they had produced two shoots of about 40 cm long - about early December. Scion material is also potted up and grown in the glasshouse with the stocks to have green scion material at a similar stage of growth. The leading shoots of the potted scions are kept pinched to encourage side growth and hence maintain a good choice of green scion material.

The green scion material is removed from the "mothers" as required and green grafted with a simple cleft graft into the stock shoot, usually about three or four nodes from the base of the stock shoot. Scion material is kept fresh in water during the operation. The cleft graft is sealed with budding tape and a small polythene bag placed over the scion. The newly grafted vine is then placed in 75% shade in the house. Fourteen days later the plastic bags are removed and the stock disbudded but the stock leaves retained. The graftlings are then transferred to a shade house about a month after grafting. The graftlings are finally deleafed of stock leaves and the grafted vines hardened off into the autumn.

The finished product was not as strong as a field grafted vine but appeared to have more promise than bench grafted products. The amount of gear required for the technique was minimal, the success rate was good and virtually every thickness of stock wood could be used.

Weed Control

Herbicides are being more widely accepted by growers in place of undervine mechanical weeders which, however good the operator is, lead to long term root and trunk damage. Collar rotting on Cabernet Sauvignon and Pinotage has been quite serious where undervine weeders have been regularly used. Current herbicides in use include paraquat, paraquat/diquat mixtures or amitrole to knockdown existing weed growth. One of these materials is normally combined with a residual material such as simazine or diuron. Glyphosate (Roundup) has been the most recent success story in Auckland and has given complete control of paspalum and kikuyu grass not previously controlled by other materials.

Inter-row cultivation is still practiced because grassing down has led to marked drops in production. Overall herbicide application was a new technique seen in South Australia last year. This eliminated any need for cultivation and could be useful on well drained soils to reduce labour costs.

Nursery vines are normally mulched with black polythene film with simazine applied between the rows. Trifluralin has been successful in both nursery and young vineyards, the material worked into the soil prior to planting. Spraying techniques have not changed markedly. Airblast equipment is widely used as well as modified boom sprayers. Aerial spraying with fixed wing aircraft is being widely used in new vineyard districts in South Australia but trials with fixed wing and helicopters in Auckland vineyards provided insufficient coverage for adequate disease control.

Machine harvesting is now widely adopted and new vineyards should be designed for machines. A new self levelling version of the standard slapper harvester has been tried in Auckland and may be able to harvest steeper sloping, low trellised vineyards that cannot be handled at present by standard models.

THE CHOICE OF GRAPE VARIETIES FOR NEW ZEALAND.

D.F. SCHUSTER,
LINCOLN COLLEGE.

Introduction

Between 1960 and 1975 the area planted in grapes in New Zealand increased six-fold (Table 1). New vineyards are still being planted and wine production is likely to increase for some years to come. Along with the increased wine production, other changes have occurred. These have benefited the industry and have enabled the satisfactory absorption of the extra volume of wine.

The most significant has been the change from widespread planting of so-called 'hybrid' grapes (the Franco-American type) from 70% in 1960, to the present situation where the 'vinifera' grapes (European type), constitute over 75% of the total plantings. This alone has improved the quality of the local wines immeasurably, and the better New Zealand wines compare favourably with quality material from overseas.

While acknowledging this quality improvement through the recent 'vinifera' plantings in all grape-growing districts, it should be stressed that much remains to be done if New Zealand wines are to be recognised among the world's best so that, if necessary, local wines can make an impact on overseas markets.

It is the aim of this paper to outline some of the areas in which further improvements are considered necessary, giving attention to the following aspects.

a) Introduction of grape growing into new areas, specifically districts in the South Island.
b) The possible improvement in existing plantings through selection of 'superior plants' in varieties already planted. Clonal selections and introduction of selected material 'free of virus' into the local vineyards.
c) Introduction of new grape varieties into New Zealand.
d) Research into the suitability of varieties for individual districts.

TABLE 1

GRAPE VARIETIES IN NEW ZEALAND. 1960 - 1975 (hectares)

Variety	1960	1965	1970	1975
Albany Surprise	60	60	81	74
Baco 22 A.	45	68	217	208
Baco No. 1.	11	14	17	16
Baco 9/11.	+	+	20	22
Cabernet Sauvignon	+	15	39	179
Chasselas	22	29	129	126
Gaillard-Girerd 157.	+	+	31	25
Gamay Gloriod.	14	12	35	14
Iona	+	11	14	11
Pedro Ximenez.	12	22	19	18
Palomino	21	58	243	338
Chardonnay (Pinot).	+	+	35	52
Pinot Meunier.	22	14	+	+
Pinot Noir.	+	+	21	47
Pinotage	+	+	61	106
Mueller-Thurgau (Riesling x Silvaner).	19	31	194	649
Siebel 5455	29	50	111	129
Siebel 4643	18	+	37	20
Siebel 5437	11	17	66	82
Other varieties.	59	66	163	230
Total planted (ha)	338	507	1.468	2.351
Percentage of vinifera grapes.	30	32	57	72
5-yearly increase		119 ha.	961 ha.	883 ha.

Source of data - 5-yearly survey by Ministry of Agriculture and Fisheries.

\+ = planted on 10 ha. or less.

++ = data not available.

The Introduction of Grape Growing into New areas, specifically districts in the South Island.

It is a recognised fact that the development of grape-growing for production of distinctive wine types overseas has taken considerable time. It would hardly be realistic to expect anything different in New Zealand, given the great variations of climatic and soil conditions found in the local districts. Despite the rapid progress of grape growing in the North Island districts, Gisborne and Hawkes Bay are good examples, it could be said that an introduction of grape growing into the regions of the South Island, gives the New Zealand wine industry yet another dimension. Montana's plantings in Marlborough already produces fine wine from the Mueller-Thurgau (Riesling x Silvaner) grapes, which differs markedly from the wines produced from the same variety under the North Island conditions, say in Gisborne.

It would not only be premature, but also pointless to equal this difference in character to wine quality, as wines of distinction can be made in both Islands. What is far more important to realise, is that due to differences in climatic conditions, mainly the temperature distribution throughout the growing season, the wines of South Island show distinctive regional character. Much of this is due to the difference in flavour and aroma development during the later stages of ripening, when the generally cooler and less-humid climate of the South Island districts allows a slower and considerably longer ripening period. The areas of Marlborough, Nelson and Canterbury show, so far, the best potential for further expansion of grape growing in the South Island.

The Possible Improvements in Existing Vineyards through selection of 'superior plants' of varieties already planted, clonal selections and consequent introduction of selected, 'virus-free' material into New Zealand vineyards.

In the recent past, a number of New Zealand winemakers came to the realisation that well-equipped cellars and sound winemaking alone, cannot produce wine of the quality hoped-for. The grape variety and its performance in both, the yield and ripeness is now recognised as an important quality factor. It is in this area, that the greatest scope for improvements remains.

At first, the reports of 'virus-free', or more accurately, 'free from known virus' plants appeared to present a solution to all problems. While undoubtedly these plants perform better than average under controlled conditions of trials, the long term superiority of such plants in the commercial vineyards can be doubted. In short, the freeing of plants from virus alone, can only be seen as one of the steps in overall improvement of vine performance. The long term answer then appears to be more complex than thought at first.

If it is the long term improvement in performance of the local vineyards that is sought, the ground work must be carried out by the growers themselves. The selection of 'superior plants' in each major variety within already established plantings should, over the next few years, provide sufficient amount of selected material for the more detailed clonal selections needed.

The clonal selections and further testing in each district should then be carried out by the research stations, who should be assisted in this by growers. Some fifteen or more years will be needed to complete this, so that growers can plant their vineyards in vines of improved stock. This may seem rather a lot of work and a long time to wait, but it should be remembered that there is no short-cut alternative. The results of such selections are most desirable, for example the Riesling selections in regions of Germany increased the yield of this variety four-fold in the space of some thirty years, and drop in quality has not been reported.

The Introduction of New Grape Varieties into New Zealand Vineyards.

In recent years a large number of new varieties or their clones have been imported into New Zealand. It would be too optimistic to say that importation of, for example, major 'claret' varieties from Bordeaux, will automatically improve this style in New Zealand. On the other hand, the present varietal assortment in the local vineyards is rather limited, not so much in the number of varieties grown, but rather in their quality. Varieties such as Chardonnay, Pinot Noir, Pinotage and others, could certainly be improved by testing and importing new clones. The responsibility for importation and testing of new varieties should remain with the research institutes rather than with growers. The reason being that both their performance in the trial plots - preferably placed in all major districts - and their wine, through the small scale winemaking, has to be tested. Only the best of the imported varieties can then be recommended to growers for commercial plantings. It should be noted, that work in this aspect has already begun, and number of promising varieties are being tested.

These could include; Merlot, Shiraz, clones of Pinot Noir and Chardonnay, Semillon, Sauvignon Blanc, Pinot Blanc, Pinot Gris, clones of Riesling, Chenin Blanc, Gamay Noir, Grey Riesling, Gewuerztraminer and the better German crossings such as, Ehrenfelser, Rieslaner, Scheurebe, Kerner and others.

It is hoped that some of these varieties will replace the Palomino, Chasselas, Baco and Siebel grapes on the future lists of most planted varieties and if proved suitable in local conditions will assist in further improvements in quality of New Zealand wines.

Research into Suitability of Varieties for individual Districts.

When considering what varieties to plant, the grower has to consider a number of factors:

Climate, with variations in heat consumption, rainfall or frosts and distribution of these factors during the growing season, soil structure and type, and a wide range of economic factors as well. All these aspects are related to time of bud-burst, flowering, ripening, growth vigour, yields, intended trellising and cultivation, so as to achieve a desirable amount of quality grapes, and finally wine of desired type.

There are very few varieties which can adapt well to all districts, as varied as Gisborne, Auckland or Marlborough. The testing of all major varieties in all districts is then desirable to determine which varieties produce the best wines in which district. The varietal composition of each district, will then develop according to local conditions, giving wines of regional character.

The development towards the production of regional wines with strong varietal characteristics should give New Zealand winemakers and grape growers recognition as being among the worlds best, so that local wines can compete on equal quality terms in both the home and overseas markets.

PHYLLOXERA, GRAFTING AND ROOTSTOCKS

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PHYLLOXERA

Phylloxera vitifoliae (Fitch) has been recognised as a pest of vines since the great French outbreaks recorded by Planchon.
Many and varied means of overcoming the ravages of this aphid have been sought. All, bar grafting (on to resistant rootstocks) and to a lesser degree the breeding of resistant cultivars have met with little success. Latterly chemical means of control have been used - however this control is only temporary and needs to be repeated at considerable expense, within two-three years.
Warnings concerning the potential threat of Phylloxera were first issued by the Department of Agriculture in 1885, following reports of the pest infesting vineyards at Mount Eden and Remuera. Further reports were recorded in 1890 in both Auckland and Whangarei. The Department of Agriculture issued warnings to growers stating the potential danger of this pest. In 1900 the parasite was discovered in Hawkes Bay.
Noted phylloxera resistant rootstocks were propagated by the Arataki Horticultural Research Station, Havelock North and made available to growers as early as 1903.
However, despite the good intentions of the Department and the ultimatum, issued in 1920, to remove and burn all phylloxera infested vineyards after July 1922 little was achieved. Due, not only to the total indifference of the growers but also coupled with a complete lack of serious committment by the Government.
Since this time phylloxera has spread and has been reported in Auckland, Te Kauwhata, Napier, Gisborne and as further plantings on their own roots are established in the South Island the pest will progressively follow these plantings.
Quarantine regulations therefore must be considered seriously where the exchange of material from infested or suspect areas takes place. Furthermore, the use of resistant rootstocks must be considered as the only means of insurance against damage in such areas.

Vines being planted in virgin sites, where infection may be delayed by isolation are often planted on their own roots. But the delay is just that, and protection against Phylloxera is only ensured where resistant rootstocks are used.
The choice of rootstocks can influence grafting success, crop, quality and yield, depending on the particular stock/scion combination, while at the same time conferring phylloxera and/or nematode existance.
The performance of rootstock/scion interaction has been reported by Saric et al (1977); Lefort and Legisle (1977).
This paper outlines research being undertaken by the Ministry of Agriculture and Fisheries Viticultural Research team.
Data presented is based on one season's results and serves only to indicate expected trends. Conclusive evidence will require five to ten years results.

PHYLLOXERA RESEARCH

Phylloxera vitifoliae is an aphid pest native to North America. This small yellow/brown aphid, barely visible to the eye has a complex life cycle. (Diagram one) In its natural environment it feeds both on the roots and the leaves of the vine.
However, upon its accidental introduction to Europe the insect when infecting Vitis vinifera vines did not encounter the resistance mechanisms found in the American species.
Rapidly the pest spread through the vineyards of France resulting in the demise of many plantations.
Phylloxera has been recognised as being present in New Zealand since 1885 when the New Zealand Farmer, Bee and Poultry Journal published a set of drawings detailing Phylloxera forms.
Attempts were made to combat the pest by means previously outlined, that effort is now history; the Phylloxera was not eradicated and is still with us today.
The Henderson area is known to be heavily infected. Sunde (1972, 1973) has trapped flying forms during January - March in both 1972 and 1973. Infestations have been reported in Hawkes Bay and Gisborne.

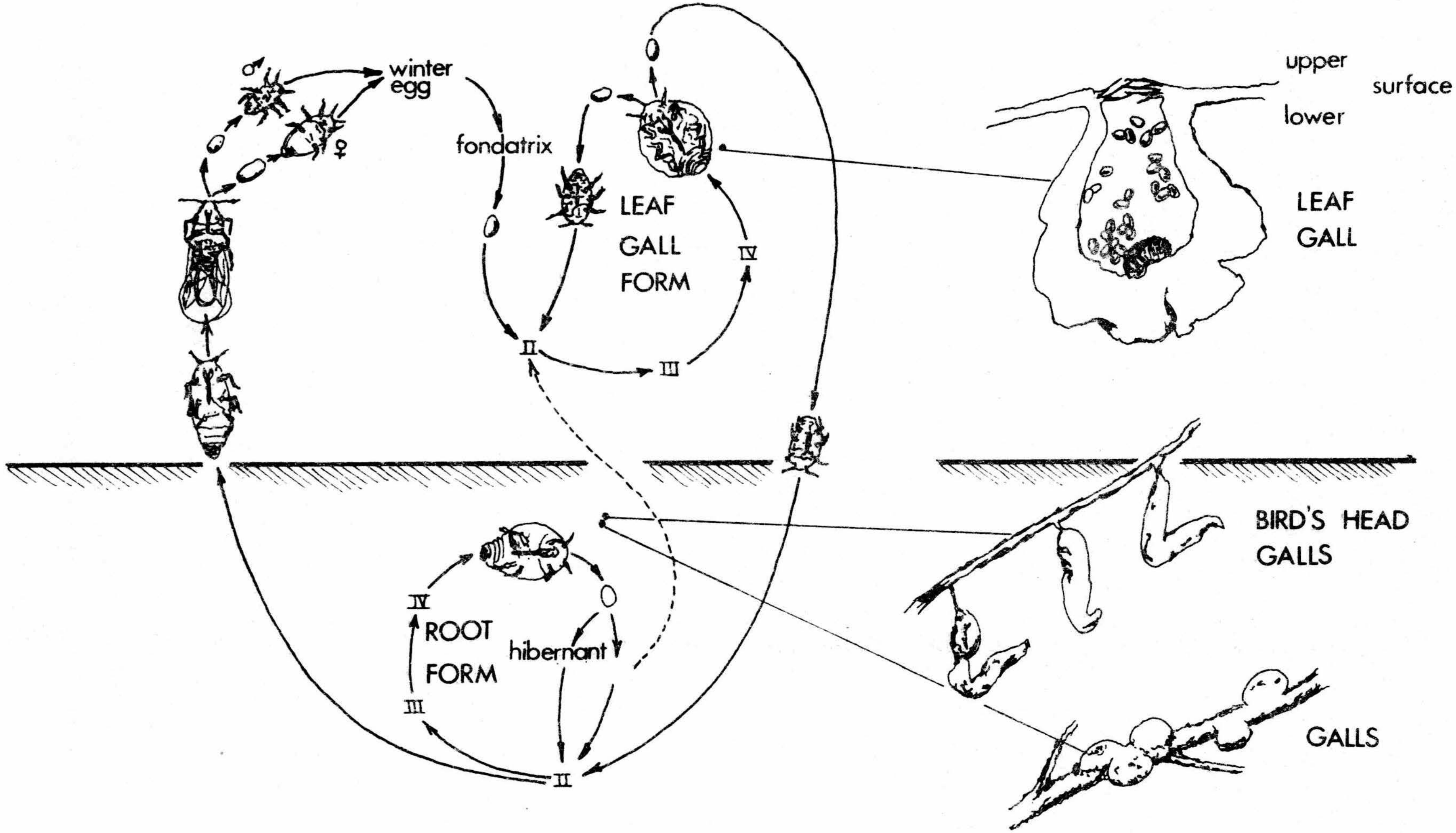

DIAGRAM 1.

PHYLLOXERA vitifoliae (Fitch)

after fallot

Populations are suspected to exist in Nelson and Marlborough although this is as yet unsubstantiated.
At Waimauku, Auckland, the Ministry has an extensive trial (of some 0.6 ha) where rootstocks are being evaluated under Phylloxera infested conditions.
Surveys initiated in May 1978 have confirmed that the occurrence of Phylloxera at Te Kauwhata (refer Table 1).

Table 1

Incidence of observed Phylloxera occurrence on vine roots as percent of total sample at Te Kauwhata Viticultural Research Station May 1978.

	Birds Head Galls	Galls	Tuberous Galls
V. vinifera	71	49	41
Hybrids	99	53	41
Rootstocks	100	41	16

Rootstocks sampled - 1202C, 5BB, 1613C, ARG1

A similar survey conducted at Waimauku found that active feeding sights, indicated by birds head galls were present on all rootstocks. Galls, tuberous galls and root rot were found to a lesser degree.
The trial at Waimauku includes a range of rootstocks (refer Table 2) grafted with the scion cv 'Palomino'. Control plants on their own roots serve as an indicator of the continued presence of Phylloxera.

Table 2

Incidence of observed Phylloxera occurence on vine rootstocks at Penfold's Waimauku vineyard, Ministry of Agriculture's trial block 1978.

Rootstock	Birds Head Galls	Galls	Tuberous Galls
ARG1	x	x	x
420A	x		
41B	x		x
1202C	x	x	x
1613C	x	x	x
R.St. George	x		x
5BB	x		
3306C	x	x	
3309C	x		x
Own Roots	x	x	x

Annual pruning weights and berry yields are recorded in Tables 3 and 4 as an indication of the vigour of the vine and hence Phylloxera infestation. Sustained yields over a period of 10 - 15 years and preferably 15 - 20 years will give an indication of the rootstock's performance.
Initially, a particularly vigorous rootstock may emerge as a high yielding stock. This phase may be transitory, (Table 3) the stock ARG1 in 1978 carried a crop of some 350 kilograms. However, based on European experience this stock will probably result in a decline in yield over time as it has as one parent a Vitis vinifera cultivar "Aramon". Over the next three seasons the ranking within this Table and Table 4 should change as the resistant and more tolerant stocks emerge while others succumb. A correlation should then exist between yield (Table 3) and vine vigour (Table 4).

Table 3

Scion cv 'Palamino' 1978 Yields Recorded As The First Crop Taken From A Rootstock Evaluation Trial Under Phylloxera Infested Conditions At Waimauku, Auckland

Rootstock	Number of Plants	Yield Kilograms
* ARG1	50	350
5BB	46	308
1202C	50	295
3306C	49	267
3309C	49	261
* 420A	50	230
R.St.George	50	225
* 41B	50	224
1613C	50	180
Own Roots	42	51
* Own Roots	37	25

Planted 1973

* Planted 1974

Rootstocks influence vine vigour and vine vigour can affect crop levels (Lefort and Legisle, 1977).
Phylloxera feeding on vine roots will influence vigour and hence cropping levels. Through the duration of this experiment crop quality will be monitored (refer to Table 5) where it should be noted that those stocks and own rooted vines bearing the lighter crops have higher sugar (^{o}Brix) and lower acid content.

Table 4

Scion cv 'Palamino' 1978 Pruning Weight Data Recorded From A Rootstock Evaluation Trial Under Phylloxera Infested Conditions At Waimauku, Auckland

Rootstock	Pruning Weight (kilograms / 50 plants)
1202C	103
3309C	83
5BB	80
3306C	68
R. St.George	66
* ARG1	63
* 41B	63
1613C	56
* 420A	31
Own Roots	15
* Own Roots	7

Planted 1973

* Planted 1974

Table 5

MUST ANALYSES FOR cv PALAMINO 1978 ON ROOTSTOCKS LISTED

PHYLLOXERA TRIAL, WAIMAUKU, AUCKLAND

Rootstock	Sugar °Brix	pH	Total Acid $g.l.^{-1}$
1613C	18.6	3.21	8.1
Own roots	18.6	3.21	6.2
Own roots	18.6	3.28	6.1
5BB	17.4	3.27	6.9
3309C	17.0	3.29	6.9
R.St.George	16.9	3.30	7.0
3306C	16.8	3.20	7.5
41B	16.7	3.22	6.9
ARG1	16.1	3.21	6.3
420A	15.5	3.19	7.4
1202C	14.9	3.23	8.0

THE FUTURE OF PHYLLOXERA RESEARCH

Present Phylloxera research is limited to one extensive rootstock trial at Waimauku. However, with the now widely recognised occurrence of this parasite further work is to be undertaken. This coming summer the biology of Phylloxera vitifoliae (Fitch) will be monitored at Te Kauwhata. In conjunction with the Ruakura Insect Control Group stratified soil and root sampling techniques will be investigated along with trapping methods.

Next winter, 1979, a similar trial to that at Waimauku will be laid down at Te Kauwhata. This trial will include rootstocks such as SO4, Schwarzman, Dog Ridge and Harmony which were not previously available. The cultivar 'Riesling Sylvaner' (Muller Thurgau) will be the scion.

GRAFTING

Extensive bench grafting programmes have been carried out at Te Kauwhata over the last four years. Such programmes are needed tb provide material for the extensive trials and vineyards controlled by the Ministry.
The grafting procedure adopted is based on the well documented practices of Becker (1973,1975) and Fallot (1973).
Material to be grafted is cut into suitable lengths and treated with Chinosol (0.5 - 0.7 %) for 10-15 hours prior to storage at + 1°C in sealed polythene bags. Material used immediately is treated in Chinosol at 0.3 - 0.5% for 10 hours. Prior to grafting stored material is retreated with Chinosol. Fresh material is soaked in clean water to facilitate bud swelling.
Buds are then removed from the rootstock cane by a rotary 'surform'. The stock cuttings are held in fresh water and matched with scion cuttings of the same diameter prior to grafting. Grafted canes are then held in water until dipped in a mixture of Bees and Parafin waxes plus fungicide. Canes are then packed in well wetted peat leaving the union and scion bud exposed.

Boxes are then topped with perlite up to the scion bud, watered and placed either in the growth room or cold storage until such time as they are required.
In the callusing room the temperature is held at 28°C ± 2°C with a relative humidity of 95% and light intensity of 1000 lux until a complete union callus ring is formed (21 - 28 days).
The temperature is then lowered gradually and four days later the canes are potted into 75 mm peat pots (1:1 peat/pumice) and placed on a hot bed at 24°C ± 2°C to force root development.
Shoots and unions are maintained at no more than 15°C in a humid atmosphere until rooting has occured.
Plants are then removed to the shade house and hardened off before being planted out.
Bench grafting has a number of advantages over field grafting, a number of disadvantages are however also recognised.

Advantages

- Many grafts may be produced in a relatively small area.
- Grafted plants may be planted out into the field as soon as danger of frost is past.
- Land is not tied up out of effective production for long periods as in field grafting.
- Large numbers of grafted vines may be processed in a short time.

Disadvantages

- High initial capital investment.
- Losses with some rootstocks tend to higher in bench grafting - however this must be balanced against the potential through put of this process.

While the advantages of bench grafting outweight the disadvantages we are faced with a number of problems that need investigation.
Rootstock/scion incompatibility, which is largely physiological, at grafting is being investigated.
We aim to establish better success rates from our grafting procedures by improved management techniques.

Examples are the choice of base medium used in the callusing room, the material used in the vicinity of the union, and fungicidal treatments both pre and post grafting.
Prior to the commencement of this season's grafting programme additional lighting was installed in the callus room. These additional fluorescent tubes, (double banks of 1200 mm 40 W "Super Grow" tubes positioned 150 mm above the grafting boxes) have provided the minimum threshold light level necessary for healthy callus formation and shoot growth. (Schenk 1971)
The basic method, adapted from Becker (1973,1975) has been followed.
However, a trial concluded recently suggests that in our system, using scion CD 18/92 (Riechensteiner) grafted on to the stock SO4, higher grafting success is achieved where unions are not waxed when embedded in perlite (Table 6).

Table 6

The effect of the media surrounding the scion union and bud on grafting success of waxed and non-waxed unions of CD 18/92 (Riechensteiner) grafted on the stock SO4

Treatment	Successful Union
Perlite/wax	63
Perlite/no wax	95
Polystyrene beads/wax	10
Polystyrene beads/no wax	3
Exposed union/wax	9
Exposed union/no wax	0

Period in callusing room 23 days.
Period acclimatisation prior to potting and grading 4 days.

This trial will be repeated using a number of scions and rootstocks. If the results follow the trends seen this year then the need to wax graft unions may be eliminated. However, the performance of the scion union will have to be monitored, not only after callusing, but also in the glasshouse where root growth is being forced. At that point in the process exposed unions may dessicate resulting in scion death.

ROOTSTOCKS

Rootstocks are recognised as a means of, protecting the plant against Phylloxera; nematodes (Saltcreek, Dogridge); providing the plant with a rooting system tolerant to moist conditions (3306C); Salanity (1613C) and differing soil types (Rupestris St George - poor soils; 1202C - fertile light soils; Dog Ridge - fertile light sandy soils; SO4 - deep clay and clay loams).

Stocks influence scion vigour, cropping ability, quality and mineral uptake Saric et al (1977); Sauer (1968); Winkler (1965); Downtown (1977), Cook and Lider (1964).

ROOTSTOCK RESEARCH

The existing evaluation rootstock phylloxera resistance trial uses one scion.

Rootstocks proven in this screening trial need to be grafted with a range of scions and evaluated.

Two extensive rootstock/scion evaluation trials at Matawhero (Gisborne) and Te Kauwhata are planted with five rootstocks carrying six scions, trained according to three methods. (Table 7).

Table 7

ROOTSTOCK - SCION - TRAINING METHOD TRIAL COMPONENTS

Rootstock	Scion	Training Method
	Pinot Chardonnay	
ARG1/SO4		
	Riesling Sylvaner	
1202C		Guyot
	White Riesling	
Rupestris 'Saint George'		Cordon
	Cabernet Sauvignon	
1613C		'T' Trellis
	Gamay du Beaujolais	
5BB		
	Pinot Noir 'Oberlin'	

NB In the Gisborne Trial SO4 is substituted for ARG1

These trials determine which pruning system is best suited to a particular rootstock/scion combination in a given region. Selected treatments, as determined by must composition, vine and vegetative vigour will later be used to determine the influence on the wine. Must content is influenced by the rootstock. (Table 8)

Table 8

Mean Mineral Composition (ppm in Solution) of cv 'Pinot Noir Oberlin' Musts According To Rootstock.

Rootstock	Mg	Ca	Na	K	Cu	Fe
1202C	72	47	37	1675	0.9	2.7
A.R.G.1	66	43	9	2115	1.1	3.2
1613C	67	44	10	1775	1.1	1.8
5BB	70	53	19	1575	0.7	2.0
R. St. George	83	54	18	1835	0.7	2.0

BERRY COMPOSITION, VINE YIELD AND VIGOUR

Results from the Rootstock/Scion/Training System trials at both Matawhero and Te Kauwhata are present for the cvs 'Riesling Sylvaner' and 'Gamay du Beaujolais'. The data present, from one harvest, 1978, is far from conclusive.

Berry Composition:

Sugar, total acid and pH are monitored during the course of berry development following veraison (colour change). By these analyses the combined effect of rootstock/training system in influencing maturity is followed. When the rootstocks are considered all together, for a particular training system, higher sugar levels (^{o}Brix) cv 'Riesling Sylvaner', Te Kauwhata are recorded from vines trained on Cordon and 'T' Trellis; the reverse is true for Gisborne. (Table 9)

Table 9

BULKED ROOTSTOCK MEAN SUGAR (^{o}BRIX) AND MEAN TOTAL ACID (g.l.$^{-1}$) ACCORDING TO TRAINING SYSTEM FROM TWO SITES WITH cvs 'RIESLING SYLVANER' AND 'GAMAY DU BEAUJOLAIS'.

Training System	Te Kauwhata Sugar (^{o}Brix)	Te Kauwhata Total Acid (g.l.)	Matawhero Sugar (^{o}Brix)	Matawhero Total Acid (g.l.)
cv 'Riesling Sylvaner				
Guyot	16.7	8.3	16.0	7.9
Cordon	17.6	8.3	15.3	7.8
'T' Trellis	17.8	7.5	15.3	7.9
cv 'Gamay du Beaujolais'				
Guyot	22.6	9.7	20.6	8.8
Cordon	22.5	10.2	20.5	9.5
'T' Trellis	21.4	9.2	18.6	8.9

cv 'Riesling Sylvaner' at Te Kauwhata (1978) had better sugar levels, lower acid concentration and higher yields when grown on the 'T' Trellis. The Guyot system gave best results in Gisborne.

At both sites cv 'Gamay du Beaujolais' produced higher sugar when trained on the Guyot system. Low sugar levels, a function of yield, were recorded from the 'T' Trellis (Buttrose 1968). Greatest yields in both cases were produced on the 'T' Trellis.

Yield Data

Yield data indicates the most productive treatment in terms of achieved cropping level. However, such data should be read in conjunction with must analyses.

When considering the yield data of 1978, for cvs 'Gamay du Beaujolais' and 'Riesling Sylvaner' (Table 10) it is apparent that higher yields are achieved in Gisborne.

Table 10

BULKED ROOTSTOCK YIELD DATA (KILOGRAMS) FOR cvs 'RIESLING SYLVANER' AND 'GAMAY DU BEAUJOLAIS' ACCORDING TO TRAINING SYTEM FROM TWO SITES.

Training System	Te Kauwhata (60 vines) Average	Mean	Matawhero (36 vines) Average	Mean
cv 'Riesling Sylvaner'				
Guyot	57.0	57.6	118.2	117.7
Cordon	37.0	28.3	91.4	93.6
'T' Trellis	69.8	71.6	80.7	72.7
cv 'Gamay du Beaujolais'				
Guyot	38.9	37.0	103.3	104.4
Cordon	27.6	22.2	114.1	116.8
'T' Trellis	57.4	54.0	156.8	167.8

Of particular interest are the different effects of training systems on yield according to locality and cultivar. The heaviest crops of cv 'Gamay du Beaujolais' are, in both localities, gained from the 'T' Trellis. cv 'Riesling Sylvaner' at Matawhero is most productive when trained on the Guyot System. The 'T' Trellis proved more productive for this cultivar at Te Kauwhata.

Vine Vigour and Pruning Weights

One aim of these trials is to identify rootstocks that may restrict vine vigour while maintaining production - in effect possible dwarfing characteristics are sought. Rootstock/scion affinity influences vine vigour.
The results obtained are not absolute, as vine trimming (summer pruning) removes considerable quantities of new wood. As winter pruning weights will be greater from Guyot pruned systems (Table 11)

Table 11

BULKED ROOTSTOCK PRUNING WEIGHT (KILOGRAMS) FOR cvs 'RIESLING SYLVANER AND 'GAMAY DU BEAUJOLAIS' DATA ACCORDING TO TRAINING SYSTEM FROM TWO SITES

Training System	Te Kauwhata (60 vines) Average	Mean	Matawhero (36 vines) Average	Mean
cv 'Riesling Sylvaner				
Guyot	18.3	17.9	24.7	25.5
Cordon	17.7	17.0	17.3	18.5
'T' Trellis	16.5	15.8	13.1	11.8
cv 'Gamay du Beaujolais'				
Guyot	27.7	28.7	38.6	42.0
Cordon	20.0	21.1	31.5	26.0
'T' Trellis	20.8	21.2	23.8	26.3

due to the removal of the cane laid down the previous season, along with its attendant new canes, compared with the removal of only new canes from the permanent arms of the Cordon system inter training system comparisons are not reliable. Intra training system comparisons will indicate the less vigorous stocks in that treatment. The magnitude of the losses from summer pruning are so dependant on the training system that inter training system comparisons of wood yields based solely on winter pruning weights must be suspect.

THE FUTURE OF ROOTSTOCK RESEARCH

Present rootstock/scion evaluation trials are limited to two extensive programmes at Te Kauwhata and Gisborne. Future evaluation trials will require the screening of a greater number of cultivars on selected Phylloxera resistant rootstocks.

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LAND FOR VITICULTURE IN THE SOUTH ISLAND

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Introduction

The suitability of land for viticulture is largely determined by two main criteria: (i) climate, and (ii) the physical nature of the land - topography and soils. Climate is the most important criterion, since regardless of the physical nature of the land, grape crops will fail unless temperature and rainfall through the growing season follow fairly restricted patterns. The first element of the physical nature of the land, topography, can cause the climate of a vineyard site to differ appreciably from the regional climate, particularly with respect to frost, sunshine, and wind. It can also strongly influence the drainage of a vineyard site. The second element of the physical nature of land, soil, acts as a storehouse for water and nutrients. It can also influence surface temperatures and humidity patterns at a vineyard site.

This article is a "state of the art" report. Its conclusions and recommendations are based on rather sketchy information drawn together from a number of disparate sources. In the final analysis the surest way to find out whether a site is suitable for viticulture is to plant vines and observe their performance. Because the South Island is a cool climate area viticulturally speaking, the emphasis of this article is on the needs of vines in such areas.

Aspects of Vine Agronomy

Temperature Requirements

Vines require warm sunny conditions for optimum growth, although judged from the limited amount of data in the author's possession[1], cool climate tolerant grape varieties need a surprisingly small amount of heat to produce commercial crops. Very cool climate tolerant grape varieties such as Chasselas and Gewurtztraminer need as little as 750 growing degree days above a base of 10°C to achieve a minimum commercial standard of ripeness - say 16° brix and less than 10 grams per litre acidity. Cool climate tolerant varieties such as Muller Thurgau, Rhine Riesling, Pinot Chardonnay, Pinot Blanc, Pinot Gris, Pinot Noir, and Gamay Noir need at least 800 degree days to achieve a minimum commercial standard of ripeness - 16° brix and less than 15 grams per litre acidity. All the above varieties can reach a good commercial standard of ripeness - 18° or more brix and less than 10 grams per litre acidity - if between 900 and 1000 growing degree days are accumulated. Varieties such as Sauvignon Blanc, Chenin Blanc,Cabernet Sauvignon and Petit Syrah appear to need more than 1000 growing degree days to achieve a commercial standard of ripeness.

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[1] See Appendix 1 for details of data.

For viticulture to be a viable proposition, commercially ripe crops need to be harvested every year. The minimum degree day accumulations outlined above for any particular grape variety should therefore be equalled or exceeded every year in sites where that variety is to be grown. In many areas however, climate records are not sufficiently lengthy or detailed to allow absolute minimum degree day accumulations to be accurately estimated. In such areas, it is suggested that if during four years out of five, 100 or more extra degree days appear likely to accumulate above the minimum needed for a particular variety, then the site is of interest for that variety. For a site to be of interest for Gewurtztraminer or Chasselas, 850 or more growing degree days would therefore need to accumulate during four years out of five.

If a site in Europe is compared with a site in New Zealand that accumulates an identical number of growing degree days, then it will be seen that the New Zealand site has a cooler summer, a rather warmer spring and autumn, and a much warmer winter. In effect the New Zealand site has a longer more temperate growing season than its European counterpart. The milder spring conditions at the New Zealand site would be expected to promote earlier growth than at the European site. In contrast the cooler New Zealand summer will probably result in slower vegetative growth and fuit set, but this delay will be expected to be balanced in part by milder autumn ripening conditions compared with those at the European site.

Since the early and mid-season growth cycle of vines is very dependent on temperature, it is desirable to choose areas which have high summer temperatures as well as having satisfactory degree day accumulations. For New Zealand, it appears that viticulture is most likely to be successful if over the two hottest summer months either: (i) mean daily temperatures average at least 17°C and mean maximum daily temperatures average 23°C or hotter, or (ii) mean daily temperatures average at least 17.5°C.

At the other end of the temperature scale, frosts can damage growing vines. Any screen frost may damage buds and new growth on vines, and screen frosts of -2°C or colder will almost certainly be damaging to new growth. Screen frosts of -2°C or colder may also cause premature leaf drop and fruit damage in autumn. Risk of unseasonal frosts is not of itself sufficient to prevent viticulture in a district. Many of the cooler European vineyard areas can experience severely damaging frosts during early and late parts of the growing season, but frost damage is minimised with the aid of sprinkler irrigation or by hot air generators, whichever is appropriate. Where there is a choice however, the most frost free of the warm sites in an area are obviously the most desirable, and frost hollows should be avoided.

Water Requirements

The water demand of a vine climbs from nothing in early spring to a maximum in early to mid-summer as the vine reaches its peak of vegetative growth. Water demand decreases through late summer and autumn. In regions that accumulate less than 1400 growing degree days, between 400 mm and 500 mm of water in the form of rain, irrigation or ground water, are needed for satisfactory vine growth - half to two-thirds the water needed for optimum pasture growth.

Vines can tolerate high rainfalls and large excesses of soil water while they are dormant, providing that the water excess does not cause prolonged waterlogging of the soil. Vines do not, however, thrive in soils that are prone to waterlogging during the growing season. If supplied with over-abundant water during the two months before vintage, vines will probably continue vigorous vegetative growth, and as a result produce a large but only marginally ripe crop with only modest sugar levels and intensity of flavour.

Vines are susceptible to fungus infections if high rainfalls and high humidities persist during the growing season. Poor pollination and fruit set can result if much rain falls during flowering and pollen is washed off the flowers. Berry splitting and rapid fruit spoilage may occur if a prolonged late summer and early autumn dry spell is followed by heavy rain in the month before vintage.

At the other extreme, vines subjected to continued moisture stress may make inadequate vegetative growth, and as a result produce small crops of grapes with high acid and low sugar contents.

Almost everywhere in Europe and New Zealand, the water requirements of grape vines can be satisfied by rainfall, and long experience in both areas indicates that one of the best guides as to the quality of the vintage from year to year is the pattern of rainfall during the eight weeks or so before the vintage. Excessive rainfall usually is followed by a poor vintage. Accordingly, the table below gives estimates of the amounts of rainfall that can be safely tolerated during the eight weeks before vintage. It is suggested that these rainfalls be exceeded

Growing degree days above 10°C accumulated before vintage	Rainfall from eight to four weeks before vintage (mm)		Rainfall during the last four weeks before vintage (mm)		Total rainfall during the eight weeks before vintage (mm)	
	(a)[1]	(b)[2]	(a)[1]	(b)[2]	(a)[1]	(b)[2]
800-850	70-80	40	40	30	100	60
850-900	70-80	40	40-50	40	120	60
900-950	80-90	50	50-60	50	140	60
950-1000	90-95	60	60-70	50	150	70
1000-1100	95-100	70	70-85	60	160	70
1100-1200	100-105	80	85-95	60	170	80
1200-1400	105	80	95-105	60	180	80

Notes: [1] Maximum safely tolerable rainfall
[2] Maximum rainfall during good vintage year

at most one year out of five in any prospective viticultural area. The table also gives estimates of the maximum amounts of rainfall that accompany good vintage years. It appears that the cooler the growing season, the lower the amounts of rainfall that can be tolerated. It must be stressed that the estimates are those of the author, and they will almost certainly need to be revised in the light of actual viticultural experience over the next few years in New Zealand.

Soil Requirements

Introduction

In many publications concerned with viticulture, statements are made to the effect that vines thrive on a wide range of soil types, and many imply that choice of soil is not important. Such statements convey a quite misleading impression. In fact, soil conditions have a marked effect on the quantity and quality of a grape crop, and in climatically marginal areas the correct choice of soils can mean the difference between success and failure of a vineyard.

Moisture

In the preceding section there was much emphasis on the relationship between rainfall and vintage quality, but in reality vines obtain almost all of their water and nutrients from the soils they are growing in rather than directly from rainfall itself. As a result, vine growth and grape maturation are more influenced by the patterns of soil moisture storage and availability through the growing season than they are by rainfall.

Unless there is a physical soil impediment or drainage problem, vine roots will penetrate to at least 2 metres below the ground level and they have been found as deep as 7.5 m below ground level. In common with many other plants however, vines have a considerable number of shallow roots. It is here postulated that the shallow roots obtain the bulk of the moisture, nitrogen, and phosphorus needed for early season vegetative growth, whereas the deeper roots obtain moisture and possibly most of the potash needed for mid to late season growth and fruit maturation.

Because of their rooting habit, mature vines are thus able to obtain moisture and nutrients from a very large volume of soil, and it is thus most important to be able to estimate what amounts of moisture and nutrients are available from not only the surface soil but also the deep subsoil.

As can be seen from the table below, soils can have widely differing capacities to store moisture, mainly because of differences in texture, that is, differences in proportions of organic matter, clay, sand, silt, and stones and rocks. It should be noted that any soil high in organic matter has a relatively high capacity to store moisture, and in general a soil with a high capacity to store moisture also has a high capacity to store plant nutrients.

Soil texture	Moisture Storage Capacity (Plant available moisture in mm per metre of soil depth)	
	Typical value	Expected range
very fine sandy loam or finer	170	100-250
sandy loam	130	70-200
sand	80	40-100
"dirty" gravels	20	10-50
"clean" gravels	10	1-20

In almost all soils, moisture storage capacities change with depth below ground surface, mainly because soil textures and organic matter levels change with depth. Moisture storage capacities may also be unexpectedly high if there is an abrupt change from fine texture to coarse texture with depth, if the lower horizons lie below the groundwater table, or if the soil is poorly drained for whatever reason.

The actual assessment of the drainage condition and moisture storage capacity of a soil profile can be a complicated business, and it is usually prudent to ask for an opinion from a soil surveyor, or an agronomist with experience of irrigation.

Temperature

In cool climate areas the growth of vines tends to be earlier and faster in warm soils. The soils which absorb heat and warm up most rapidly in spring are stony, well drained, and dark coloured. In contrast, the soils which absorb heat and warm up most slowly in spring are clayey, poorly drained, and light coloured.

Surface temperatures can be greatly improved by a surface layer of stones; evening surface temperatures in particular remain high because the warm stones radiate heat out into the vineyard. In some areas of Germany, basalt and slate are specially quarried and spread over vineyards to help improve surface soil temperatures.

A surface layer of stone may also be beneficial because it helps conserve surface moisture, because it can prevent soil erosion, and because it can inhibit weed growth.

Nutrients

Vines do not require especially nutrient rich soils, and their deep and widespread rooting systems allow them to efficiently scavenge for the nutrients they do need. Vines benefit if small amounts of nitrogen are available during spring and early summer, but because nitrogen encourages vegetative growth vines do not benefit if nitrogen continues to be readily available during late summer and autumn. Vines do need moderate amounts of phosphorus and potassium in order to produce fully ripe and flavorsome grapes.

Nitrogen and potash fertilisers are quite soluble, and following rain the nitrogen and potash will penetrate rapidly and deeply into most soils. In contrast phosphorus fertiliser is not very soluble, and tends to be almost entirely held in the topsoil and thus does not penetrate deeply. Addition of surface fertiliser can thus be expected to fairly readily correct any nitrogen or potassium deficiencies, but in contrast, it cannot be expected to correct phosphorus deficiencies. Vines can suffer from magnesium, zinc, and boron deficiencies, but these deficiencies can be corrected fairly readily should they occur. Many American root stock varieties are not well suited to calcareous soils, and they tend to cause the grafted vines to develop iron deficiency. Along with most other plants, vines are intolerant of concentrations of soluble salts in the rooting zone.

Of the European grape varieties, Pinot Noir and Pinot Chardonnay appear well suited to lime-rich soils. In contrast Cabernet Sauvignon and Gamay Noir appear well suited to rather non-calcareous acid soils.

In Germany, Rhine Riesling and Gewurtztraminer are grown on well drained siltysoils to excessively drained stony soils. In contrast Sylvaner is grown on rather imperfectly drained clayey soils on which neither Rhine Riesling nor Gewurtztraminer would produce grapes of any quality.

Potential Viticultural Areas in the South Island

Introduction

Only a few areas of the South Island appear sufficiently warm to have potential for viticulture and the most extensive areas are in the Marlborough region. Each region is described in the order of climate - temperature, rainfall, frost, and wind - and then soils, and then in some cases recommendations are made as to suitable varieties. The climatic details of the areas are given in Appendix 2. The soils named in the text are described in New Zealand Soil Bureau Bulletin 27, "General Survey of the Soils of South Island, New Zealand", and their broad distribution is shown on the small-scale maps that accompany the bulletin. It should be stressed that the descriptions in Bulletin 27 generally only refer to the upper 50 cm or so of soil, and they do not necessarily give any clue as to the nature of the underlying subsoil materials.

The Nelson Region

The climatic data in Appendix 2 shows the Nelson region to have many lowland areas which accumulate enough heat units in the growing season to ripen cool climate tolerant grapes. All of the areas appear to be too humid however. Only the coastal belt of the Moutere Hills between Motueka and Nelson City and the lowermost part of the Waimea Plain have annual rainfalls of less than 1,000 mm and everywhere the risk of damaging autumn rainfalls is high. Risk of frost and wind damage is however low.

Because of the high rainfall and humidity, it is most important to choose well drained and preferably stony soils with only modest moisture storage capacities. The Ranzau soils (27d)[1] and stony well drained areas within the Waimea soils (98) and Motupiko soils (33g) would appear to be the most suitable for viticulture. There may also be stony well drained areas of soils on the lower hillslopes to the east of Richmond suitable for viticulture. Most of the soils of the coastal Moutere Hills are clayey and poorly drained (32) and are thus not well suited to viticulture.

The most suitable grape varieties would seem to be Gewurtztraminer and Chasselas, which ripen early, or Cabernet Sauvignon, which demands warm conditions and a fairly long growing season, but which is fairly weather resistant.

[1] The numbers refer to soils described in N.Z. Soil Bureau Bulletin 27, and shown on the accompanying maps.

Marlborough Region

As stated in the introduction, the Marlborough region contains by far the largest area in the South Island suitable for commercial viticulture, and must rank with Hawkes Bay as having major potential for commercial viticultural expansion. The potential viticultural area in Marlborough includes many of the fans and terraces in the lower Wairau and Awatere Valleys, and in the tributary valleys draining into the two main valleys from the south. The potential viticultural area also includes sheltered warm sites in the hills to the south of Seddon.

In the Wairau Valley the potential area extends east from Blenheim Township to the western edge of the Waihopai Valley floor. It is bounded to the north by the Wairau River, and to the south by the middle slopes of the Wither Hills. The north, west, and south boundaries broadly coincide with the 800 mm mean annual rainfall isohyet. The eastern boundary has been arbitrarily defined to exclude the windy low-lying area adjoining Cook Strait, but there are some valleys to the south-east of Blenheim which may be sheltered enough to have potential for viticulture.

The largest number of heat units are probably accumulated on the lower slopes of the Wither Hills south of Blenheim Township, and in Blenheim Township itself. It appears that although areas inland from Blenheim accumulate rather fewer heat units, they may experience slightly higher maximum and slightly lower minimum daily temperatures than those experienced in Blenheim itself. All of the above area appears to accumulate enough heat units to allow very cool and cool climate tolerant varieties to ripen. The warmer parts of the area are even warm enough to allow Cabernet Sauvignon grapes to ripen.

As in the Nelson region, rainfall is lowest in summer and highest in winter. However, in contrast to the Nelson region, the risk of damaging autumn rainfall is low providing that the grapes are harvested by mid-April.

Warm dry north-westerly winds can blow fairly vigorously for lengthy periods throughout the Wairau Valley and they can cause dehydration and leaf burn of plants. Cool north-easterly afternoon sea breezes are also a persistent feature of the lower Wairau Valley during settled weather. High ground to the south renders cold southerly winds innocuous.

The worst frosts are likely to occur during clear still nights following southerly storms, but damaging frosts during the growing season appear unlikely to be a serious problem except perhaps in local frost hollows.

There is a wide variety of soils in the lower Wairau Valley and not all of the soils are suitable for viticulture. Recent alluvial soils (89, 90, 92, 95, 95a, 95b, 96a, 96c) are mapped on valley floors. The soils in areas near the coast and in low lying inland areas (89, 90, 92) are not naturally well drained and many in the area mapped as 92 contain harmful concentrations of soluble salts. Even if drained, most of the above soils are probably too nutrient rich and moisture retentive to be useful for more than the production of grapes for medium quality bulk wine production. The deeper of the naturally well drained soils (95, 95b, 96a) are likewise too nutrient rich and moisture retentive to appear to be of great promise for anything but bulk wine production. Most of the areas of the above soils are in any case used for intensive farming or horticulture, and are probably too expensive to purchase for large scale viticulture. The stonier and shallower of the recent alluvial soils (95a, 96c) are however not nearly so valuable for horticulture and intensive farming, but are in general well suited to viticulture.

The lower Awatere Valley has a very similar climate to that of the lower Wairau Valley, except that it is more exposed to the south. Enough heat units to ripen cool climate tolerant grape varieties are accumulated at least as far upstream as The Jordan (305 m above sea level), at which site incidentally the New Zealand record for high temperature was recorded. The driest area receives less than 700 mm annual rainfall. It comprises the Awatere Valley proper from the coast up-valley to some 5 km beyond Seddon Township, together with the coastal hills 10 km south and south-east of Seddon. Up-valley the annual rainfall climbs to 918 mm at Aotea then decreases to 832 mm at Duntroon sited on the south side of the Awatere Valley opposite The Jordan. Risk of damaging autumn rainfall is low in the vicinity of Seddon, slightly higher near the coast and moderate in the relatively high rainfall areas near Aotea and Blairich. Risk at The Jordan appears moderate but at nearby Duntroon it is lower.

Even more so than in the Wairau Valley, the coastal areas of the Awatere Valley are windy, partly because of proximity to Cook Strait, and partly because of the prevalence of sea breezes during settled weather. Up-valley from Seddon, sea breezes are probably of minor significance, judging from the pattern in the Wairau Valley. Up-valley from Seddon also, exposure to the southerly is probably in part compensated by shelter from the northwester offered by the ranges on the north side of the valley. During strong north to north-west winds however, local turbulence and strong wind gusts can be expected in the valley because of the rugged nature of the terrain.

Frost risk at sites in the Awatere Valley would appear to be similar to that at comparable sites in the Wairau Valley.

Recent alluvial soils (95, 95a, and 96c) are mapped on the low terraces within the present gorge. Excluding excessively stony and shallow soils and heavy poorly drained soils, most of the alluvial soils should be suitable for viticulture. Older alluvial soils (14c, 27c) are mapped on most areas of intermediate terraces; their profiles tend to be stony and shallow, and in most places they underlie clean gravels. In the low rainfall areas, most of the soils on the intermediate terraces are probably excessively drained, have inadequate moisture storage capacities, and would benefit from trickle irrigation. In the higher rainfall areas the same soils would still benefit from supplementary irrigation during dry spells, but have the advantage of rapidly conducting potentially damaging excess autumn rain quickly down and away from the rooting zone. Silty soils (11, 15b, 15d, 20c, 25), some from wind-blown dust, are mapped on some fans encroaching onto the intermediate terraces, on the high terraces, and on the rolling hills. Many of the soils have a dense silt "pan" which cannot be easily penetrated by roots, many become rather waterlogged in winter, and some are prone to tunnel gully erosion. In general, such soils are not suitable for viticulture. On the hills within the low rainfall area, a wide variety of soils have been grouped into a single unit (16eH). Well drained stony profiles on sheltered northerly facing slopes within the above area should be suitable for viticulture.

Canterbury Region

In general the Canterbury region appears too cool for commercial viticulture. The areas with the most promise are the Omihi Valley between Omihi and Waipara, and the Waikare Valley between Waikare and Scargill. Climate records during the last five growing seasons indicate that Waipara accumulates about 990 degree days, but it should be noted that in 1976 and 1977 only 770 and 776 degree days were accumulated respectively. On the other hand during the other three years, between 1000 and 1146 degree days were accumulated. It is possible that rather more heat units are accumulated in the lower Waikare and middle Omihi Valleys because both areas are sheltered from prevailing winds by adjoining high ground. Rainfall is low, and risk of crop damage to grape crops from autumn rainfall is low, so that in cool years it is probably an acceptable risk to hold grapes on vines well into late autumn.

Risk of wind damage appears to be low judged by wind run figures for Waipara, but the low wind run probably also means that risk of frost damage is moderate. To ensure that a maximum of heat units is accumulated, and also to minimise frost risk, vineyard sites should be selected on northerly facing lower slopes of the hill slopes and fans.

Although the climate is rather cool, many of the soils of the two valleys have formed from limestone, and potassium-rich sediments. The soils are thus similar to some of the Burgundy, Champagne, Loire and German soils, and grapes grown in such soils can be expected to produce light floral wines. As in other areas it should be confirmed that the soils at interesting sites are freely drained and lack impediments to rooting. Because of the low autumn rainfall, even soils with high moisture storage capacity may have potential for the production of high class light table wines.

As well as Gewurtztraminer and Chasselas, the Waikare and Omihi Valleys probably have potential for cultivation of the premium cool climate varieties Pinot Noir, Chardonnay, and Rhine Riesling.

After the Waipara district, the Banks Peninsula - greater Christchurch district appears to hold the most promise for viticulture in the Canterbury region. Adequate heat units are accumulated at Onawae, Duvauchelle Bay, but as in most of Banks Peninsula the risk of damaging autumn rainfall is high. Warm and dry areas are present between Sumner and the Heathcote Valley, but such areas are unlikely to be of any consequence viticulturally speaking. From the point of view of soils it is a pity that Banks Peninsula does not appear suitable for viticulture, because there are large areas of dark coloured well drained stony soils, and abundant supplies of dark coloured basalt rock suitable for stone mulches.

Lincoln appears too cool and rather too windy to be suited to commercial viticulture, and the rest of the Canterbury Plains appear no more suitable.

Otago Region

As is well known, the inland basins and valleys of Central Otago have the most continental climatic character within New Zealand. Only the hottest basins and valleys accumulate enough heat units and have a long enough growing season to have potential for viticulture however. The areas showing most viticultural promise lie below the 300 m contour within the Cromwell Gorge, the Bannockburn Valley, and the upper Clutha Valley between Cromwell and Luggate. Unlike the other potential viticultural regions, rainfall is probably rather too low for successful viticulture and in many areas some spring and summer irrigation may be needed. Rainfall is highest in summer and decreases through autumn to a winter low, and thus the risk of damage to grape crops from autumn rains is low.

Frost risk throughout much of the area is moderate to high, so great care should be taken to select sites with good cold air drainage, or alternatively to provide adequate frost fighting equipment. The area does not appear to be very windy, but there is some evidence that locally strong gusts can be experienced during storms.

There is a wide variety of soils within the area of viticultural promise, but because of the low rainfall it would appear desirable that soils with good moisture holding capacity be selected for vineyards - fortunately, many Otago soils do have good moisture storage capacities. The best soils would appear to be those on the middle and lower parts of fans, and those formed from wind-blown dust on weathered and fissured schist. In contrast many of the soils on the main terraces of the Clutha River and its major tributaries are formed from clean gravels, and consequently have very low moisture storage capacities. In some areas of the lower Bannockburn Valley the soils have formed from marine sedimentary rocks. Most such soils have dense clayey subsoils and in common with some soils on the toes of fans they may have high concentrations of soluble salts. Such soils are probably quite unsuitable for viticulture.

Although it is drier and slightly cooler, the Central Otago region resembles German and Swiss viticultural regions more closely than any other area in the country. As such it appears that Gewurztraminer, Chasselas, and perhaps premium varieties such as Rhine Riesling and Pinot Noir have commercial potential at least on warm sites.

Summary of South Island Viticultural Potential

The largest and most promising viticultural areas in the South Island are the lower Wairau and Awatere Valleys. Both valleys have potential for the production of grapes for a wide range of light northern European style table wines.

The driest areas in the Nelson region may have some potential for early ripening and rain resistant grape varieties. Small areas in the Waipara-Omihi-Waikare area probably have potential for the limited production of grapes for light Burgundy style and German style wines. Small carefully selected areas in Central Otago may have potential for the production of grapes for German style wines. Banks Peninsula and the Canterbury Plains appear either too cold or too wet to have any potential for commercial viticulture.

Acknowledgments

Thanks are due to Mr S. Hurnard and Drs S. Reid and J. Maunder, N.Z. Meteorological Service for their willing cooperation in supplying climatic information for both New Zealand and overseas areas.

APPENDIX 1

Estimates of heat units needed to ripen grape varieties to given sugar and acid levels are based on data from the following sources:

Zakosek H., et al., 1967: "Die Standortkartierung der hessischen Weinbaugebiete". Abhandlungen des Hessichen Landesamtes für Bodenforschung, Heft 50.

Hallgarten S.F., 1976: "German Wines". Faber and Faber, London.

Jackson D.I., 1967: "South Island will Surprise Us". N.Z. Wine Review.

Jackson D.I., pers comm 1978.

N.Z. Wine Institute Research Committee, pers comm 1978.

Climate data from the New Zealand Meteorological Service.

APPENDIX 2

Climatic Data for Stations within or near Potential Viticultural Areas in the South Island

Notes:

Heat units calculated from N.Z. Met. Service Misc. Pub. 149.

Normal rainfalls obtained from N.Z. Met. Service Misc. Pub. 145.

Rainfall percentiles for February, March, and April obtained from N.Z. Met. Misc. Pub. 141. Estimated rainfall percentile for March-April calculated using formula:

$$\text{8th decile March-April} = \frac{\text{8th decile March} + \text{8th decile April} + \dfrac{(\text{7th decile March} + \text{7th decile April})}{2}}{3}$$

Wind run, wind gusts, and
Screen frosts October-April obtained from N.Z. Met. Service Misc. Pub. 143.

APPENDIX 2

Climate: Temperature and Heat Units

	Average Accumulated Degree Days October-April (^{o}C above a $10^{o}C$ base)							Average daily temp. on the two hottest months (^{o}C)	Average maximum daily temp. on the two hottest months (^{o}C)	Screen frosts during Oct-Apr (Days per year)
	O	N	D	J	F	M	A			
Nelson Region										
Moutere Hills	65	179	362	588	804	993	1095	17.5	21.9	0.1
Appelby	65	188	374	604	814	1002	1099	17.4	22.3	0.1
Nelson	74	203	399	634	850	1048	1159	17.6	22.2	0.6
Marlborough Region										
Wither Hills	71	203	411	653	874	1069	1171	17.8	23.7	0.4
Blenheim	78	213	411	647	862	1048	1141	17.6	23.4	0.9
Blenheim Aero	65	188	377	607	814	991	1078	17.4	23.3	1.4
Waihopai Power Station	50	158	331	552	751	912	978	17.1	23.3	1.2
Lake Grassmere	68	197	380	600	802	975	1071	17.1	21.3	0.1
The Jordan	65	185	368	597	807	984	1065	17.4	24.1	na
Canterbury Region										
Waipara	47	146	332	549	747	909	990	17.3	23.0	na
Onawe Duvauchelle Bay	71	197	371	591	793	963	1053	17.1	22.0	0.1
Lincoln	37	130	282	477	657	793	838	16.3	22.0	2.5
Otago Region										
Otematata	40	136	304	511	696	842	878	16.6	23.1	na
Earnscleugh	31	118	273	468	634	751	751	16.1	23.3	17.6
Alexandra	50	164	347	570	760	903	924	17.0	23.3	4.0
Cromwell	47	161	347	582	784	936	960	17.4	24.0	7.5
Albert Town	25	109	279	506	702	835	844	17.1	24.5	na
Lake Hawea	22	109	276	490	678	814	844	16.8	22.5	1.1

na: Data not available

APPENDIX 2

Climate : Rainfall

	Normal monthly rainfall							Monthly rainfall exceeded 1 year in 5			March-April rainfall exceeded 1 year in 5
	O	N	D	J	F	M	A	F	M	A	
Nelson Region											
Moutere Hills	90	80	80	70	80	90	100	na	na	na	na
Appelby	79	71	66	64	66	81	86	129	132	132	248
Nelson	84	74	74	71	71	84	91	116	105	124	224
Marlborough Region											
Wither Hills	56	51	51	53	46	53	56				
Blenheim	53	48	51	51	43	51	53	76	66	70	131
Blenheim Aero	61	58	53	53	48	53	61	88	72	93	158
Waihopai Power Stn.	76	76	76	69	64	64	76	104	88	112	192
Lake Grassmere	43	46	48	48	38	43	46	70	72	76*	138*
The Jordan	80	80	70	70	50	70	80	na	na	na	na
Duntroon	74	71	66	64	51	58	71	84	80	96	170
Canterbury Region											
Waipara	46	51	66	51	51	51	56	65	61	73	127
Onawae Duvauchelle Bay	58	66	81	64	58	74	102	90	95	147	229
Lincoln	48	53	58	56	56	66	58	69	89	91	157
Otago Region											
Otematata	36	41	48	51	43	41	33	71	71	72*	130*
Earnscleugh	30	33	33	46	38	41	30	na	na	na	na
Alexandra	28	33	30	46	38	38	28	51	54	53	100
Cromwell	33	36	36	43	36	41	33	69	62	58*	115*
Albert Town	58	61	51	58	53	61	51	76	79	88*	157*
Lake Hawea	66	71	58	69	61	71	58	na	na	na	na

* Lake Grassmere data not available, Seddon data quoted

* Otematata data not available, Lake Waitaki data quoted

* Cromwell data not available, Ripponvale data quoted

* Albert Town data not available, Wanaka data quoted

na. Data not available

APPENDIX 2

Climate: Wind runs and wind gusts

	Highest monthly wind run (m/sec)	Days with wind gusts greater than 34 knots
Nelson Region		
Moutere Hills	4.2	na
Appelby	2.7	na
Nelson	2.7	23.2
Marlborough Region		
Wither Hills	na	na
Blenheim	na	na
Blenheim Aero	na	26.9
Waihopai Power Station	na	na
Lake Grassmere	7.5	69.8
The Jordan	na	na
Duntroon	na	na
Canterbury Region		
Waipara	na	na
Onawae Duvauchelle Bay	na	na
Lincoln	3.8	na
Otago Region		
Otematata	na	na
Earnsleugh	na	na
Alexandra	2.5	na
Cromwell	na	na
Albert Town	na	na
Lake Hawea	na	na

na: Data not available

PROBLEMS WITH 2,4,5 -T
GRAPES AND LOCAL AUTHORITIES

J.E. MARRIS,
PROJECT MANAGER,
MONTANA PROPERTIES LTD.,
BLENHEIM.

INTRODUCTION

The Vineyard Regulations Section of the Agricultural Chemicals Regulations 1968, in my opinion, are probably the most widely misinterpreted regulations presently in force on the Agricultural and Horticultural scene.

The wording of the regulations, although supposedly specific, has so far caused great confusion among Local Authorities, Spray Operators, Professional Town-planners, Spray Manufacturers, Farmers and Vineyard Owners alike.

The Vine Regulations must firstly be read in conjunction with the "First Schedule", as listed in the Regulations. In other words, the Regulations only apply to the following chemicals.

		Predominant Purposes of Chemical
1	24D	Weed Spraying in Pasture
2	24DB	Weed Control in New Lucerne
3	Benazolin	Weed Control in Cereals
4	Dicamba	Weed Control in Cereals
5	Dichlorprop (24DP)	Weed Control Pasture
6	245-T (Including isomers of trichlorophenoxyacetic acid)	Gorse and Brush
7	Fenoprop (245TP)	Not now on market
8	MCPA	Weed Control in Cereal & Buttercups
9	MCPB	Weed Control in Peas
10	Mecoprop (MCPP)	Cereals
11	4-CPA	Not Used
12	236-TBA	Not Used
13	Pictoram	Brush
14	Triclophyr	Brush and Scrub weeds

ACKNOWLEDGEMENTS

WINE INSTITUTE OF N.Z.
AGRICULTURAL CHEMICALS BOARD
AERIAL WORK MARLBOROUGH
VARIOUS COUNTIES & INDIVIDUALS
DEPARTMENT OF AGRICULTURE & FISHERIES BLENHEIM

These are basically the hormone type of weedkiller. The Regulations do not apply to any other herbicide.

In dealing with the 3 offending regulations (Nos. 13,14, & 15), I would like to submit a layman's interpretations, based on discussions with personnel from the Agricultural Chemicals Board, over recent months.

Regulation 13 reads:-

"Herbicide dusts - No person shall, at any time during the period commencing with the 1st day of September in any year and ending with the 30th day of April next following, apply or cause to be applied to any land or pasture or to any plant life within 5 miles of any vineyard, any herbicide in the form of a dust, whether or not mixed with agricultural lime, fertiliser, oil, or other substance."

Layman's Interpretation:

Simply as it states:- No person shall apply those chemicals from the first schedule (as previously listed) in dust form from the beginning of September to the end of April, within 5 miles of a vineyard.

This is an extremely hazardous method of applying any form of herbicide, and is now in limited use only. I know of no farmer in our area using or contemplating the use of Herbicidal dust. Permit for use can however, be obtained from the Agricultural Chemicals Board.

Regulation 14 reads:-

"Herbicides in oils - No person shall at any time apply or cause to be applied any herbicide in the form of an oil-soluble ester or in the form of an emulsifiable ester or acid mixed with oil with aromatic content to any land or pasture or plant life -

(a) Within 5 miles of a vineyard, if applied from an aircraft or by an airblast sprayer: or
(b) Within 1 mile of a vineyard, if applied by any other means".

Layman's Interpretation:

You cannot use the chemicals listed in the first schedule at any time within 5 miles of a vineyard if applied by air or airblast sprayer, or within 1 mile if applied by any other means, if they are mixed with an oil, say like diesel.

Regulation 15 reads:-

"Herbicides mixed with water - (1) Except where notice of his intention so to do has been achnowledged by an authorised officer of the Department of Agriculture, no person shall, at any time during the period commencing with the 1st day of September in any year and ending with the 30th day of April next following, apply or cause to be applied, any herbicide in the form of an invert emulsion, a water solution, or an emulsifiable ester or acid mixed with water solution, or an emulsifiable ester or acid mixed with water to any land or pasture or plant life -

(a) Within 5 miles of a vineyard, if applied from an aircraft or by an airblast sprayer; or

(b) Within 1 mile of a vineyard, if applied by any other means.

(2) Any notice under sub clause (1) of this regulation shall expire at the end of 28 days after the date of acknowledgement.

(3) Nothing in subclause (1) of this regulation shall apply to any person who is the holder of chemical rating granted to him pursuant to the Civil Aviation Regulations 1953* *SR 1953/108

This is the critical clause that is most widely misinterpreted.

Layman's Interpretation:

Any person may apply any of the chemicals listed in the first schedule at any time of the year up to the boundary of a vineyard, providing the chemical is mixed with water and providing they notify the Department of Agriculture. The notifications must be renewed at the end of 28 days if the spraying did not take place. In other words, there are no restrictions in the use of hormones mixed in water providing this notification is given to the Department of Agriculture.

Civil Liability:

It is most important to emphasise that notification does not remove or reduce the civil liability of a claim against a spray operator in the event of one person damaging another person's property with any form of chemical spray be it herbicide or otherwise.

Effect of Spray Damage to Vines:

The effect of hormone spray on vines is essentially the acceleration of the metabolism of the vine, activating gross abnormality in growth. The result is that the vine is unlikely to bear fruit. This resultant damage is extremely easy to pick up in a vine, as the leaves display the damage very clearly. I know of one instance of damage that showed up on vines and lead the adjoining neighbour, who owned an apple orchard, to closely inspect his trees, of which he had not been aware of damage. Upon inspection, he discovered that his trees were also affected, but had it not been for the vines indicating damage, he would never have known why those trees did not fruit as well as normal that year.

Historical Problems:

Local Authorities have in the past endeavoured to use land zoning as a way to regulate or circumvent the provisions of the Spraying Regulations.

Matamata County:

Research reveals that this issue was first raised with the review of the Matamata Council District Scheme in about 1974. At that stage the viticultural

Association objected to the proposal that vineyards be considered as a conditional use within the Rural A zone. Evidence was given, and the objection was upheld upon the grounds that Council accepted that:

(i) Vineyards were a legitimate farming activity that ought to be a predominant use in the Rural A zone, and

(ii) That the Agricultural Chemicals Board regulated the competing interests between farmers and those engaged in vineyard activities insofar as the application of chemical sprays was concerned. Council considered that the Board, meeting regularly and having on it representatives from all sectors from rural activities, were in a better position to asses and control the use of chemical sprays than were local authorities. They did consider however that so as to improve the communication between farmers and those engaged in wine making activities, that whenever a vineyard was to be established within the Rural A zone, the person or company responsible should insert two public notices in the local newspaper advising the inhabitants or farmers in the area of their intention to do so. This was to ensure that no accidental damage was occasioned by spraying in the ignorance of a vineyard being established. The prodiminant uses in the rural zone in the Matamata County Council now provide for farming of any kind with the proviso that if any person commences the use of any land as a vineyard he is required to give public notice as defined by Section 2 of the Town Planning Act 1953, (now replaced by the Town and Country Planning Act 1977) of his intention to do so and is required in that notice to include particulars of the area and the legal description of the land so as to enable the same to be reasonably identified.

It is understood that this has proved to be a satisfactory provision in the Matamata County.

Piako County:

The matter was next raised in the review of the Piako County district scheme wherein vineyards were excluded from the Rural zones. One of the farmers in the area took the matter to appeal. The decision upheld the County Council's decision to exclude vineyards, but on the basis that the area within that County is predominantly utilised for pastoral farming purposes and that there is little suitable or available land for horticultural activities such as vineyards.

Rodney County:

In 1976 a farmer at Snells Beach objected to the statement of predominant uses in the Rural A zone within the Rodney County Council. The basis of the Planning Tribunal against this decision stated in their submissions, that grape growing should stand alongside other horticultural crops, and should accordingly have a predominant use, although they felt that if the County wished to segregate vineyards and forestry, the Wairau River would be a good boundary. Unfortunately, for the contract growers and the Company, the appeal has to date, never been heard.

This placed all potential growers, including Montana, in a position of having to apply for a conditional use, which was then of course open to objection. In the case of the growers, in the so-called "Vineyard Areas", there were no objections, as those surrounding farmers realised, that in 5 years the vineyards had not affected their farming practices. Indeed, Montana had proved this conclusively, by growing in and around the vineyards such crops as, peas, barley, wheat, onions, garlic, beans, corn, kale, lucerne, mustard and lupins. In the non Vineyard growing areas, it was a different story. One farmer, 1½ miles from the nearest vineyard, applied for a change of use consent. He had 45 objections from surrounding neighbours. Although various reasons were stated to support their objections, the obvious bogey was their fear of the Agricultural Chemical Regulations. Despite an excellent case put forward by the Solicitor for the vineyard appellant, the County Council, under such pressure from such a large body of objectors, chose to turn down the application.

This, naturally, caused rather an upsurge in publicity, and Montana naturally enough displayed disappointment, as it had taken 3 years to build up stock for the contract growers, and they were now thwarted by this decision, and had to consider whether to hopefully retain the plants in Marlborough, or send them to the Gisborne area, where grapes are grown like any other crop with a predominant use. Many arguments were put forward, both for and against. An "anti-discriminate spraying" group was formed, and held public meeting.

Federated Farmers also held meetings, and I believe, started the tide turning in favour of vineyards, when they announced from their Executives, that they were totally opposed to zoning for horticulture by Councils. I mention the word horticulture as by this time, the realisation was evident, that the real issue was not the zoning of grapes, but, in the final analysis, was the zoning of all forms of permanent horticulture.

2,4,5-T

In the heading of this paper is mention of the chemical 2,4,5,-T. The use the objection was that the zoning permitted vineyards as a predominant use and that this frustrated farmers in the control of noxious weeds. The farmer requested that vineyards be relegated to conditional uses. Following a cross objection by the Wine Institute, the cross objection was upheld and the Rodney District Scheme retained the vineyards as a predominant use in the rural zone.

Hawkes Bay County Council: The Kapiti Borough Council: The Paparua County Council;

At about the same time, the Hawkes Bay County Council, the Kapiti Borough Council, and the Paparua County Council instituted the changes or included in the review of their respective district schemes provisions either excluding completely or restricting vineyards in the rural zones. To date the initial hearings have been heard by all three local authorities on objections lodged by the Wine Institute. The Hawkes Bay County Council have elected to proceed with their change No. 6 excluding vineyards in the whole of the Rural A zone. The decision of the Kapiti Borough Council is not yet known but the most likely outcome is that vineyards rather than being excluded from the zone, will be retained in the rural zones as a conditional use. The Paparua County Council has resolved that vineyards be retained within certain rural zones as conditional uses. The decision of the Hawkes Bay County Council is currently on appeal to the Planning Tribunal and at this stage the matter stands adjourned whilst more technical evidence is obtained as to the necessity for the change.

Marlborough County:

The County and Grape growers in Marlborough have been through the mill on this spraying issue this last season. With the unknown consequences of grape growing in the Marlborough region, the local County Council chose to impose a conditional use of grape-growing in their new county scheme. This, I understand was requested by the Ministry of Works as a precaution. My Company objected to that and that objection was heard by the local authority and disallowed and currently, that is on appeal to the Planning Tribunal although this and a number of other appeals have not yet been determined. It should be noted that the Marlborough County is one of the few local body jurisdictions in the Country without an operative district scheme. Because there is not an operative district scheme this is the reason for applications required of contract growers for consent to a conditional use and/or consent to a change of use.

Naturally, being the only major grower in the area, Montana in appealing to of this chemical mixed in oil by surrounding forestry, also played a large part in the argument.

This chemical is used locally by forestry as a oncer spray, at the initial stage, when spraying takes place prior to a preplant burn-off.

Forestry and the Catchment Boards argued that, they could not afford to change to 2,4,5-T mixed with water, as this would double the cost of this initial spray. Other arguments came forward, that there were indeed sprays as efficient and even less expensive than 2,4,5-T and diesel.

This, of course, all added to the dilemma of our local Council, who, might I add, were completely split on the issue, but at this stage were leaning in the direction of zoning.

TECHNOLOGICAL ADVANCES

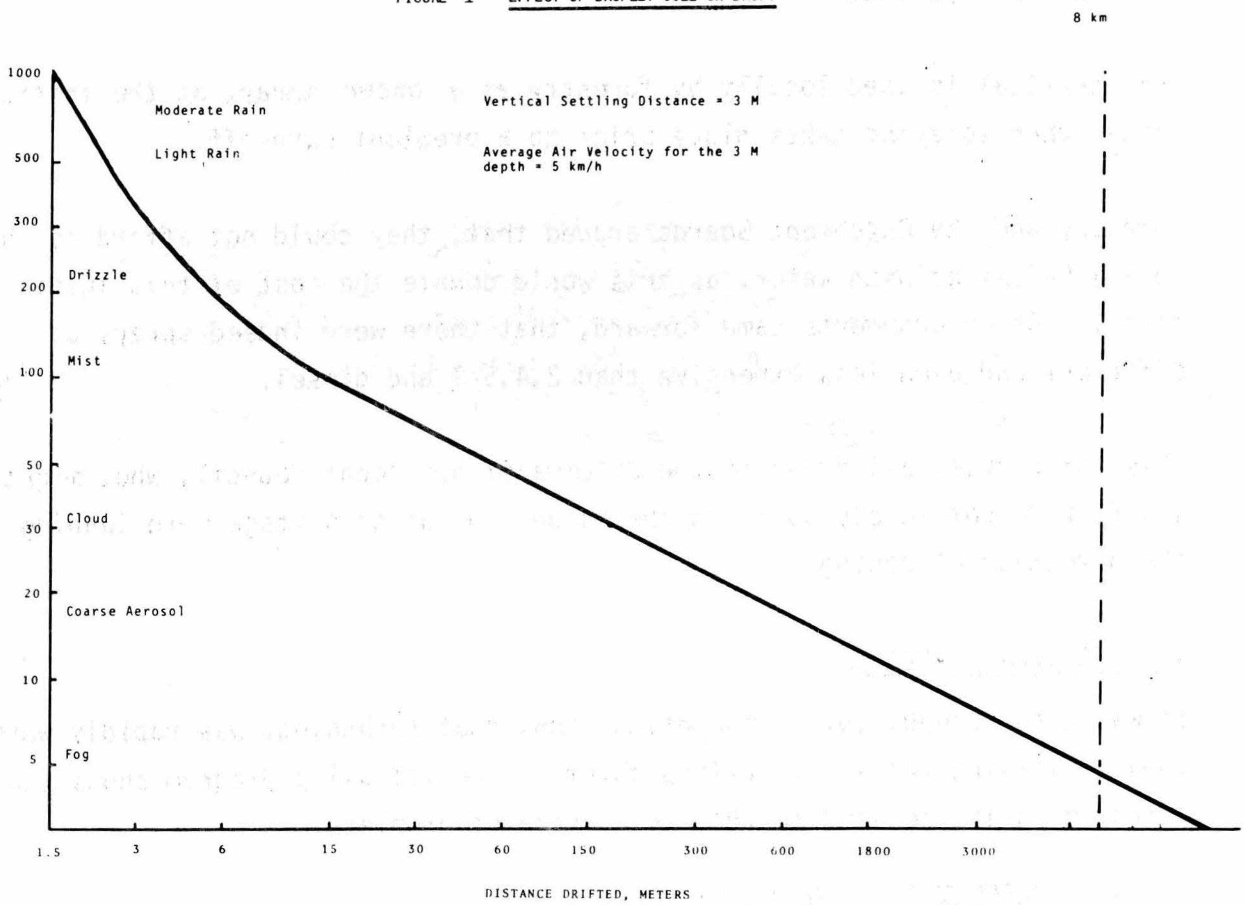
It was also brought out in the discussion, that technology was rapidly working towards solving the spray drift problem. The following diagram shows the effect of drift related to the micron size of droplets.

DROPLET SIZE AND WIND:

Droplet size directly affects coverage, settling velocity, evaporation, movement by air currents and deposition on various targets consequently, the *droplet size spectrum* influences the spray *distribution pattern, efficiencyof pest control* and potential *drift hazards* in a major way.

The relationship of droplet size to drift is shown if Figure 1. and is based on droplets falling 3 metres in a 5 km/h cross wind. For example, a 200 micron droplet in this relatively low cross wind will drift 6 metres when falling 3 metres.

FIGURE 1 EFFECT OF DROPLET SIZE ON DRIFT



Technology is moving towards developing spray nozzles that will effectively contain the droplet size to no smaller than, say, 300 minimum. This in effect would reduce the drift to no more than 18 foot in a 3 mph cross wind.

There are now excellent wetting agents, that, I believe, could replace the need to use diesel in the forestry mix. In addition the use of the Low Drift additives are also having a marked effect on reducing the drift risk factor when applying herbicides.

SOLUTION:

Finally, after much indecision, the Marlborough County, acting in an extremely responsible manner, chose to put aside the growers and farmers alike, and opted to call a meeting of independent people who could assist in clarifying this issue for them.

Subsequently, a meeting was called, attended by the Council, the Department of Agriculture, the State Forestry people, the Wine Institute and most important, the Agricultural Chemicals Board. With rational discussion from all parties, it was resolved that:

(a) The Agricultural Chemicals Regulatons were not designed to restrict any crop growing. They were there as an educational instrument.

(b) Forestry could exist at a much closer range than 5 miles.

(c) It was pointed out that in a situation like this, it was surely the job of the Agricultural Chemicals Board, and not a County Council, to decide on a spraying issue such as this, as they designed the regulation, and should see to it that they were administered correctly. Therefore, it is obvious that Council felt that there was no need to rely on zoning on the plain to enable the continued use on the North side of the Wairau River of 245-T for pre-burn clearance.

This meeting apparently satisfied the Marlborough County Council that the presence of the vineyards as a predominant use on the major part of the plains was desirable, that zoning was most undesirable, and that the regulations under the present situation should be amended. They also felt that consideration should be given to forestry development.

In a decision of the full County in September 1978, they recommended that they would carry out variation procedures on it's proposed district scheme, and that grape growing would be a predominant use South of the Wairau River, and a conditional use North of the River.

This decision was in accord with Montana's own thinking some 18 months previously.

IN SUMMARY:

1. Regulation 14 is restrictive only in so far as it applies to the chemicals, listed in the schedule, when they are mixed in oils such as diesel.

2. Regulation 15 is restrictive only in so far as it requires a farmer within the spraying zone to ring and notify the Department of Agriculture that he intends spraying with those chemicals as listed in the schedule, mixed with water.

3. The regulations do not increase or decrease the liability of a claim for damages if one person damages another person's property. This liability is there regardless of the regulations.

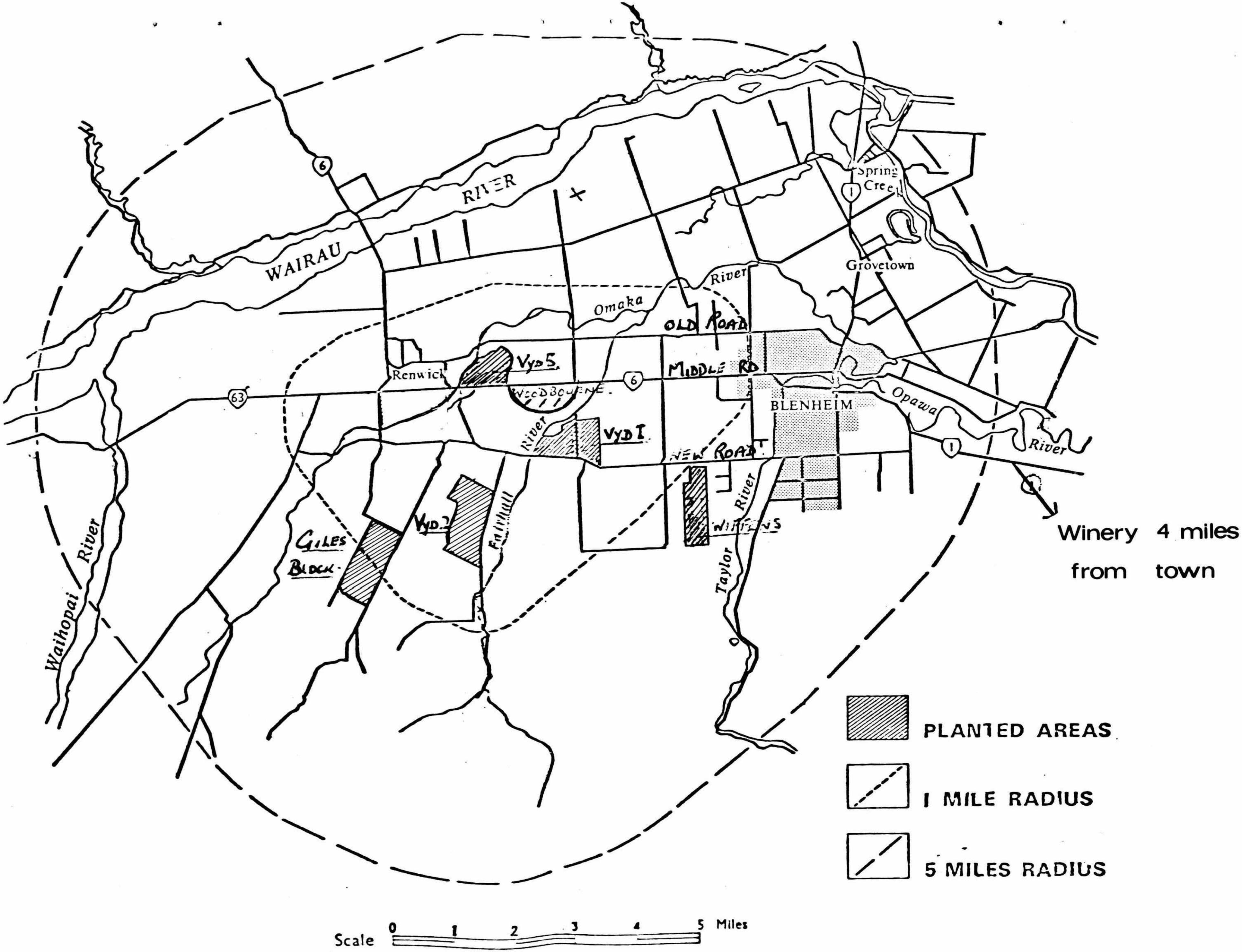
4. It is felt by the writer that, after much indecision, the Marlborough County Council finally found a solution for a difficult situation.

5. It has now clearly been established that endeavouring to control the problem by restrictive land use zoning is inappropriate, as the

regulation of land use in terms of the application of chemical sprays is currently being appropriately administered by the Agricultural Chemicals Board.

6. It is obvious that all Counties placed in a similar situation, should act in a similar manner, and after listening to local opinion, should then resort to obtaining expert independent advice, before making a decision. A decision that can have a far reaching effect on the extention of the horticultural industry within New Zealand.

For interest, I have brought along recent newspaper clippings to give an indication of the problem in Marlborough.


WAIRAU
RIVER
Spring
Creek
Grovetown
Omaka
River
OLD ROAD
MIDDLE RD
Renwick
VYD 5.
WOODBOURNE.
BLENHEIM
Opawa
River
VYD I.
NEW ROAD
Fairhall
Taylor
River
GILES
BLOCK.
Waihopai
River
Winery 4 miles
from town
PLANTED AREAS
I MILE RADIUS
5 MILES RADIUS
Scale
0
1
2
3
4
5
Miles

THE PECO MECHANICAL HARVESTER

S. GOLDSMITH,
PECO LTD,
CHRISTCHURCH.

The mechanical harvesting of grapes is not new. About 1950, self propelled straddle frames were first used and operators within those frames, cut the grapes as the machine traversed the rows. Then automatic cutting was tried, but was not very efficient due to the different levels of fruit.

By the early 1960's, various methods of shaking fruit had been tried and the Cornell harvester came into being. This was a spoked wheel, which engaged with the horizontal wire holding the fruit. By a shaking action from the Cornell wheel, the fruit was removed. That development took place on the East Coast of the U.S.A. About the same time in California, a similar approach developed with a vertical impacter bar, which imposed an intermittent strike from under the wire, giving a jerking action rather than a shaking movement. With this arrangement, the majority of the fruit removed was in clusters, whereas with the Cornell shaker, mostly single berries were removed.

With both these systems, a special trellising was required and moveable wires with a fairly wide gap between them were used.

A third machine developed, which employed long flat bars or round rods that beat the vines from each side and so produced a shaking action. This machine came into favour because it worked quite efficiently on simple vertical trellis systems already in use so there was no extra expense for special trellises.

The development of mechanical harvesting followed rapidly. By 1970 there were some 60 machines in operation in California, harvesting about 100,000 tons of fruit per year which represented about 6½% of the total tonnage. By 1973 the number of machines had trebled and the percentage of the total wine crush by mechanical harvesting was about 16½% and it has steadily increased since then.

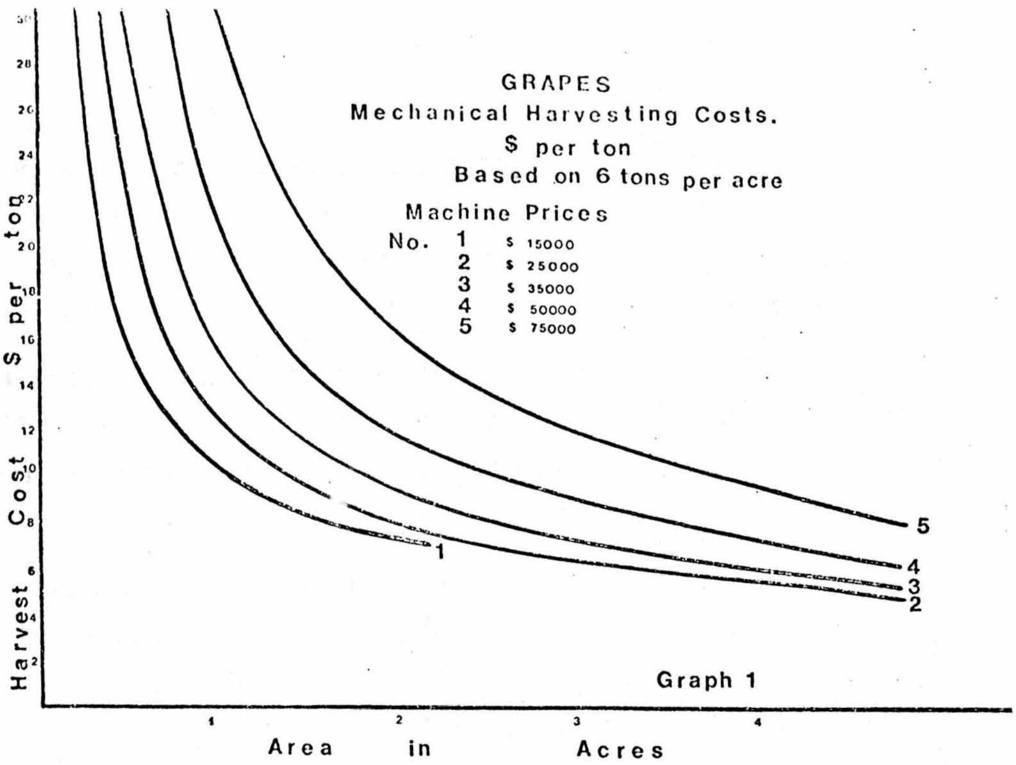
Both the beater and vertical impacter type machines, remove fruit almost as efficiently as hand pickers when operated under optimum conditions. The settings for these machines to suit the particular growing conditions, require a lot of practical skill and all of these machines result in fairly high juice losses.

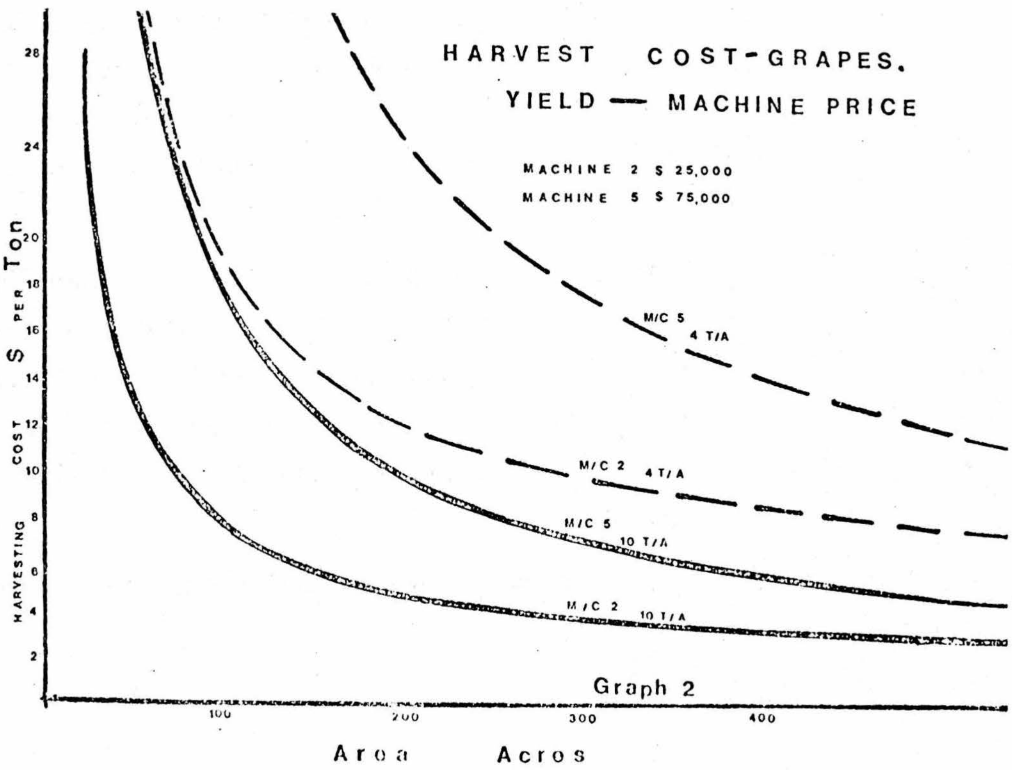
Peco has been looking at adapting their berry harvesters to grapes. We have already produced machines for harvesting blackcurrants, raspberries, boysenberries and blueberries. Initial trials with our new design of shaking system look very promising for the harvesting of both wine grapes and sultanas. It is now a matter of producing a machine at low cost, suitable for harvesting relatively small vineyards, say from ten acres upwards.

Financial success in mechanical harvesting will be a combination of engineering and agricultural technology. With the existing harvesters in the field, harvest losses vary from about seven to twenty-eight percent and cover fruit on the ground, left on the vine and damaged and lost as juice. It should be kept in mind however, that hand harvesting also misses a lot of fruit, perhaps more than 7%.

Attached are two sets of curves. The first of these illustrates the approximate cost per ton for harvesting, using alternative machines. These costs assume loan money for purchase and replacement within ten years life of the machine, and apply exactly the same to each of the five machines. From this you will observe the cost of harvesting with machines of high initial price, is far in excess of hand picking costs when small acreages are considered, but becomes worthwhile when areas under cultivation become considerable, or where experienced hand pickers are not available.

The second set of curves illustrates the variation in owning and operating costs, with varying yields per unit area, and again it shows clearly that with low yields, low cost machines are essential and increasing yields per unit area have far reaching effects on financial returns.





It has been our object in the development of the Grape Harvester, to have reliable machines at low cost that do a minimum of juicing to the harvested fruit.

The shaker system used on the Peco Grape Harvester, uses four shaker heads arranged in two pairs. Each pair of shaker head units is driven from the one power source. They are coupled together in a manner that ensures the finger wheels attached to the output shaft of each shaker head unit are continuously in contact with the vine and follow its contours without damage to the vines as the machine traverses the row.

The number of finger wheels attached to each output shaft is arranged to suit the vine growing conditions. The fingers engage with the vines, imparting a shaking motion to the vine area where the fruit is growing. This in turn causes the fruit to be shaken free with a minimum of juicing, yet the majority of the fruit comes away as separate berries.

Whilst the shaking motion imparted by the shaker head unit is continuous, the vibrating head assembly is arranged in such a manner that the finger wheels free turn, as the machine goes through the bushes at the same speed as the machine traverses.

This minimises the possibility of any damage to the vines, because of imbalance in the shaking system. Both the amplitude and frequency of vibration, imparted by the machine to the vine, are adjustable to suit the particular type of grapes and growing conditions.

With our smaller machines, the fruit is collected on conveyors which run the length of the machine and it is then conveyed over the back into boxes on trailers drawn behind the machine itself. In the larger machines, the fruit is conveyed to the top of the machine and then over the row into bins towed behind a tractor in the adjacent row.

The smallest of the Peco machines can be operated with less than 20hp and weighs less than a tonne, whilst the largest of the machines operate with less than 30hp. The power ratings are much lower than other self propelled straddle type grape harvesters and overall weight of the Peco machines and the overall costs, are much lower than machines using alternative shaker systems.

A Peco Grape Harvester will be in operation in South Australia for the 1979 vintage.

COSTS OF VINEYARD ESTABLISHMENT

M.J. MELLON,
LECTURER IN MARKETING AND
INTERNATIONAL TRADE,
LINCOLN COLLEGE.

1.0 *INTRODUCTION*

1.1 *Purpose of Costing*

Grapes being a capital intensive crop that do not yield a positive cash flow until the fourth year after planting, accurate long term costings are essential before entering development commitments. Such costings will also provide growers with:

(1) Details of the substantial husbandry required.

(2) Maximum capital outlay before returns materialise.

(3) An estimate of a fair value.

Methods to assess the cost of capital with a four tiered interest rate structure, based on differing risk levels within the enterprise, will be introduced.

1.2 *Definition of Establishment*

To minimise ambiguity it will be defined as:
"The period from purchase of bare fenced land in autumn, planting, trellising, training and cultivating up to, but not including, the harvest of year 3."

1.3 *Harvesting Costs Excluded*

It is generally in the third year that the value of the crop will cover harvesting costs. With rooted cuttings small crops have been obtained in year 2, but as mechanical harvesters are unsuitable for such young vines, hand picking costs almost inevitably will exceed the value of the grapes.

With such an establishment "cut-off point" defined, this paper will not concern itself with yields or harvesting costs; it will still be an immense topic to cover in the limited time even with this "cut-off".

1.4 *No Provision for House or Car*

To minimise controversy and to equate better with people in other fields no provision has been made for a house at the vineyard. Similarly no capital provision is made for a car in line with the policy of the New Zealand Meat and Wool Boards Economic Services "Sheep Farm Income Surveys". Commuting from a township to the vineyard will, however, be necessary and a travel charge is included in the summary costings of $4.80 per day worked in the vineyard, based on 30 kilometres at the standard charge of 16c per kilometre for a large car.

2.0 *THE PHYSICAL COSTS*

The key inputs and activities required to establish a vineyard are:

1. Land.
2. Labour.
3. Cultivation and weed control (manual or herbicide).
4. Planting, trellising, training and pruning.
5. Spraying vines (fungicide, insecticide).
6. Machinery.
7. Buildings.

We cost each activity separately in the sequence of operation and total annually.

2.1 *LAND*

2.10 Criteria for Economic Size

The size of the intended vineyard will be the first crucial question and this in turn will be influenced by available capital and location. Caution must be taken over making feasibility studies based on present selling price of grapes as they will tend to indicate a smaller area. Eventually when supply catches up with demand the key criterion for size will revert to labour units.

2.11 *Area Related to Labour Units*

2.111 *Part-Time*

Many people wish to take up grape growing as a sideline in which case 2 hectares (5 acres) would be a minimum to support minimal machinery and 8 hectares (20 acres) about the maximum if one was still to maintain almost another full-time job such as owning a wine shop or a milk round. This limit is derived from a 2,000 hour working year and by estimating the maximum daylight working hours that an owner-manager can inject into the property prior to using outside labour at the peak periods.

Operating Hours	Owner	Outside
Year 1 (establishment year)	571	255
2 (trellising and training)	1,211	472
3	905	822
4 (excluding harvesting)	850	800 (pruning and bird scaring)

2.112 *Influence of Wife*

A number of ventures have the wife also participating which could replace part of the owner's time and almost eliminate outside labour except at pruning and harvesting. Also to be added is owner's management time, say 50 hours per year, but this does not need including as it can be done during evenings. If the involvement of the wife is large, a part-time operator could extend to 12 hectares (30 acres) or alternatively he may wish not to plant and trellis the total area in one year as the above working hours assume.

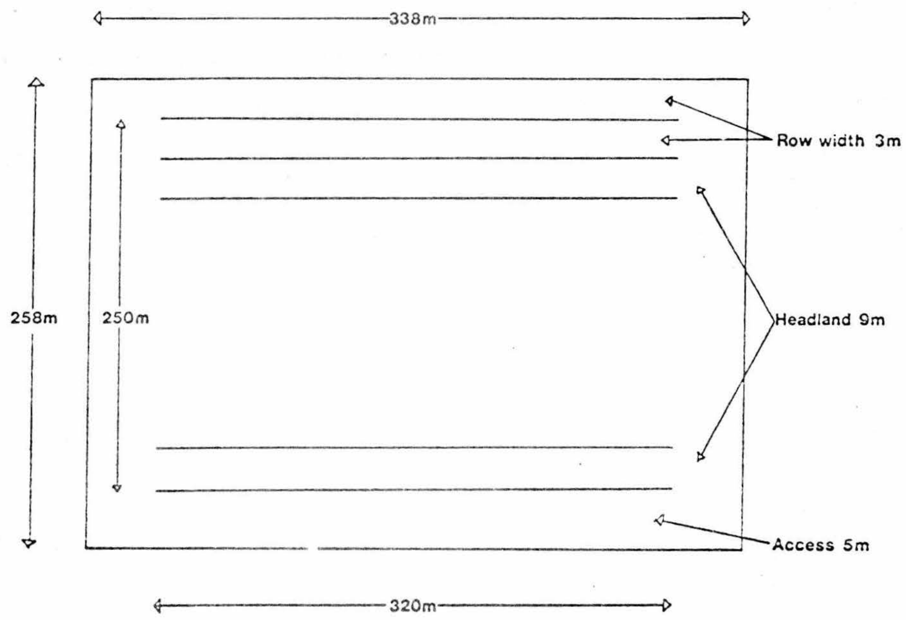
2.113 *Full-Time*

Looking towards the time when supply balances demand a 20 hectares(50 acres) would appear to be the minimum size for a full-time operator in the South Island. Possibly in the heavier cropping areas of the North Island a slightly smaller area may be feasible, particularly in locations close to wineries where transport costs would be lower. If social trends in New Zealand should move towards shorter working weeks and longer holidays so reducing the 2,000 hour working year areas might be reduced, but against this the advent of mechanical pruning must be anticipated.

2.12 *Effective Area*

This is defined as "the area taken up by the trellises". It covers from one end post to the other and from one outside row to its opposite outer row on the other side of the vineyard. Around the effective area needs to be added the headlands (9 metres), the area between the outside row and the fence (3 metres) and on the other side an access way of 5 metres.

Figure 1 - 8 hectares (20 acres) Effective Vineyard



In the above diagram:

Effective planting area is		320 x 250 m.	=	8	ha.
Cultivated area		338 x 258 m.	=	8.72	ha.
Shed and turning area	472 sq.m.			.047	
		Total Area required	=	8.77	

Say 8.8 hectares (approx. 22 acres)

2.13 *Shape and Row Length*

It will not be possible to always purchase blocks of land as symmetrical as the above diagram so that greater allowances will be necessary. Contour will also have some effect, but with growing mechanisation initial expenditure on levelling is recommended. Some sociologists warn against long rows because of manual labour productivity being lowered by psychological discouragement, but with mechanisation of cultivation, spraying, and harvesting longer rows and minimum turning must achieve economies.

2.14 *Cost of Land*

In this paper covering costing principles no attempt will be made to include actual costs of land and materials. Current values rather than historic must be used. Suitable land for grape growing could vary from $500 per hectare in Central Otago to $7,000 per hectare in Gisborne indicating that cost of land is a function of many factors including location to wineries, proximity to consumer markets (large cities), soil type, yield, material costs, availability of labour, machinery, climate, competitive crops, and ultimately risk.

2.2 *LABOUR*

2.21 *Influence of Mechanisation*

The mechanical harvester on contract has created the major revolution in the industry in respect to labour requirements. It has changed the peak useage from the externally high labour demand period of harvesting to winter pruning, a season when adult casual labour is abundant. If mechanical pruning developes there will be no peaks of labour demand remaining except for trellising and training which only occurs during establishment. In 1976 mechanical harvesting contract rates were $17 per tonne as compared to $42 for manual picking teams.

2.22 *Mechanisation not Always the Cheapest*

With the high cost of imported machinery together with high interest charges, calculations should be made to check whether some cultivations such as weeding close to vines can be accomplished more economically manually rather than mechanically. After allowing for careless damage to vines by mechanical operator, hand weeding around vines is still marginally more expensive than mechanical methods, but it only requires a devaluation of the New Zealand dollar to lift fuel and machinery prices to reverse this. New Zealand in 1977 was a relatively low labour cost country and management decisions must take cognizance of this somewhat surprising phenomenon. In 1978 wages have again escalated and the New Zealand dollar has appreciated against the currencies of some of our machinery supplying countries such as U.S.A. and Australia, making machinery imports cheaper from there. At the same time New Zealand has depreciated against the German mark and Japanese yen lifting machinery import costs from these two countries considerably, though at the other end of the scale making our eventual export of wines to those countries more competitive.

2.23 *Employed Labour Charges*

To simplify your estimates I suggest you charge out at two basic rates, namely:

(a)	Skilled worker	$3.20
(b)	Casual worker	$2.40

The official rate of pay under the Agricultural Workers order is $2.33 (November 1978), and in the present economic climate above-award payments are not required in Blenheim, Gisborne, and Nelson. The official wage for a manager is $117.55 per week, but we find in practice above award levels are paid, hence the higher figure of $3.20 per hour.

2.24 *Owners Wages of Labour*

The owner has two functions, one as the skilled worker and sometimes foreman, and the second as the enterprise manager. Whilst performing cultivations on the property the owner should cost out his labour at the same skilled rate as a manager; this is the real cost of the service performed in market terms. This does not attempt to reward the owner for his planning and other entrepreneurial skills, on which it is hard to put a time and a precise value.

2.25 *Owners Wages of Management*

McKenzie in his 1971 Hawkes Bay Apple Orchard costings remunerated management with a fee of $500 per hectare additional to a wage for labour. The Economic Service of the Meat and Wool Board impute reward for the owner operator by supplementing the ruling wage of a married farm worker with a management allowance of 1% on Total Farm Capital, minus homestead and car.

As an example of horticultural crops Moffitt's 74-5 survey of Process Peas and Beans allowed a management charge of 1.5% for Peas and 3% for Beans on Government Capital Valuation adjusted by the length of the growing season occupied by the crop. Net result 1%.

This recognition of management reward being related to Capital involved rather than area covered is in my view the correct approach for grapes. Hence a percentage figure must be derived, but its selection is difficult to make objectively. In 1972 with so much pioneer work, 4% would probably have been appropriate. In 1976 I used 3% and today with the industry and its technology well established I would charge 2% for the North Island. The managers job in Blenheim and Nelson still involves some experimentation and should be reflected by an increase to 2.2%. For Canterbury and Central Otago with varieties and cultivation methods still being tested the fee could be lifted to 2.5%. It must be noted that this fee is a recognition of management technology and not of risk, which will be compensated additionally in part 3.

Assuming that a developed 8 hectare Gisborne vineyard in year 4 has a Total Capital Value of $160,000 ($8,000 per acre) then Owners Wages of Management would be $3,200 on top of his wages of labour.

2.26 *Juvenile Labour*

Whilst equal pay has eliminated cheaper female labour used in the past, good high school labour is readily available in most areas. With 17-18 year olds' wage rates $1.75 at a discount of 25%, savings can be made. We suggest, however, that costings be done at the full casual wage ($2.40) as there are sometimes additional supervisory expenses with juvenile labour that can erode the wage savings.

2.3 *CULTIVATION AND WEED CONTROL*

2.31 *Difficulties in Specifying*

To derive costs, growers are generally asked their experience and their accounts records used. We attempt to specify a cultivation procedure and then put a time to it; the times specified may be questionned and some growers may consider some of the procedures superfluous. Those who perform only limited cultivations will find the speeds allowed inadequate for their infrequent encounters with weeds.

2.32 *Tractor and Machinery Costs*

It is suggested that as labour is costed hourly for the cultivations performed so also should be the tractor. These need to be adjusted for varying power uses and the following table could apply to a 45 HP tractor (MF 135).

Power Utilization	75%	50%	35%	25%
Diesel Fuel (litres/hour)	8.73	6.55	5.36	4.82
Diesel Fuel at 17.2c/litre	1.50	1.13	0.92	0.83
Filters and Oil	0.28	0.17	0.13	0.12
Battery, tyres and repairs	0.20	0.15	0.15	0.14
Total cost per hour	$1.98	$1.45	$1.20	$1.09

The above does not cover depreciation which can be charged separately on an annual basis. Lewis in his detailed work also derives an hourly charge for repairs and maintenance on implements used with the tractor, e.g. Rotary Hoe 27c/hour (1972), Sprayer 18c/hour (1972). Lewis adds a fixed cost including depreciation and an opportunity cost on capital. Whilst endorsing the precision of Lewis's work we have only charged annually depreciation and repairs on implements due to their light use, and the opportunity cost of capital will be handled fully in Section 3.

2.33 *Initial Development*

In some instances drainage and levelling will be required. As these are one time activities investment in the equipment would not be justified and specialist contractors appear to be the solution. Similarly most new properties will require deep ploughing and as the 45 HP tractor, adequate for most vineyard work, cannot cope with deep ploughing, contractors should be used. Such levelling and ploughing may cost about $500.

Because discharrows or grubbers and rotary hoes will be required for routine cultivation the remainder of the initial cultivation can be done by the owner with these implements. This work must be finished by July to permit planting during the First Winter.

2.34 *Cultivations First Summer*

With no trellis or wires installed both between and cross row cultivation will be possible. A total of eight cultivations supplemented by four hand weedings around the young plants will be essential in the North Island and possibly 6 and three times in the South Island. The cultivations can be done by the owner with his own discs and rotary hoe and one assistant will be necessary for the hand weeding.

2.35 *Cultivations Second and Third Summers*

With trellising installed, only between-row cultivation is now possible. Between eight to ten cultivations will be required of which two with the rotary hoe should be adequate bearing in mind its higher cost. The remaining cultivations can either be with the faster discharrows or grubber with harrows.

With the vines longer and the use of herbicides, handweeding around the vines can be reduced. Alternatively Undervine Weeding machine can be used either 3 or 4 times.

2.36 *Chemical Weed Control*

From year two this can be introduced and can be kept to a minimum due to between row cultivation (2.35) leaving only a safety margin of 17.5 cms either side of the vines. Hence a belt of only .35 metres requires spraying, which is less that 1/8 of the vineyard. Hence the amount of herbicide prescribed for one hectare will be sufficient to cover the 8 hectare vineyard. The frequency should be similar to handweeding.

2.37 *Grassing Down*

Despite the cost of these cultivations, grassing down is not recommended for the establishment years. After strong wood has formed on the vines, grassing down can be beneficial both in reducing weed control costs and in providing autumn and winter grazing for sheep.

2.4 *PLANTING, TRELLISING, TRAINING AND PRUNING*

2.41 *Planting*

Accurate layout is crucial, particularly with mechanised harvesting, so that no expense should be spared in careful preparation for layout and marking. It is beyond the scope of an economist to recommend types of cuttings to be used nor specify prices as these range from 2c to 40c. We are using for our costings 10c for virus free plain, and 25c for rooted cuttings. Developers should make allowance for 10% of the unrooted number planted to be held in a nursery so as to cover 8% that do not strike in the first year and a further 2% for second year losses. This will ensure almost similar size vines as replacements where losses have occurred to facilitate mechanical operations generally.

Owners will require additional labour to assist with the marking and planting. Then stakes will also be required for each vine to assist training which together with 10c cuttings will give a planting cost of about $4,500 based on North Island planting rate of 1,690 per hectare. For South Island with distance between plants reduced from 2 m to 1.5 m planting rate will increase to 2,247 per hectare and the cost to about $6,000.

2.42 *Trellising*

To save the interest charges on this heavy investment (approx. $18,000) and at the same time to permit cross row cultivation during the first summer, construction can be delayed until the second winter. The topic is a paper by itself and structure and number of wires will vary according to district's climatic conditions.

Additional labour will be required for 6 weeks and also an outside contractor with a post driver is recommended to save the capital outlay and to keep the property's tractor free for cartage work.

2.43 *Training*

For the first summer there will be tieing up and possibly some very light pruning. In the North Island it will take 3 weeks full-time whereas in the South a full month will be required.

Hence a part-time owner will need assistance to cover the property in reasonable time.

During the second summer further training and tieing occurs as well as disbudding, tucking, tipping of shoots and removal of berries. Again a full-time owner can accomplish this over a two month period, but a weekend only operator will need to employ assistance to ensure these key development tasks are done within reasonable time.

Disbudding and removal of berries will not be necessary in the third summer, but the required tasks of tucking and tieing, together with training replants, will occupy nearly two months full time. Machine trimming will be introduced this year as a crop will be taken.

2.44 *Pruning*

This is done for the first time in the second winter. Outside labour will be required which could be done after trellising or if work fell behind schedule a further outside worker would be required.

In the third winter heavier pruning will be necessary and for it to be accomplished in two months extra labour will be necessary. Assuming mechanical harvesting this is the peak demand period for labour.

2.5 *SPRAYING VINES*

Spraying programmes will varv considerably in different parts of the country with 16 recommended for Gisborne, 9 for Blenheim and only 5 or less in Canterbury.

Being such a frequent operation, tractor speed at 4 km/hour will be important. Based on 84 rows x 332 metres equalling 27.89 kms it will take 7 hours and operating at 65% efficiency to cover tank refilling and transit total tractor and labour time will increase to $10\frac{3}{4}$ hours. Having arrived at an accurate spraying application cost the chemical bill is included in material costs.

As herbicides will be applied with different machinery and the application will relate to grassing down policy,this has been included in 2.36. Only fungicides, insecticides or other viticultural applications with boom or a blast sprayer use the above costs.

2.6 *MACHINERY*

2.61 *Types Required*

Not all machinery need be purchased at once. It is suggested that purchases could be staggered to save capital outlay as follows:

Year 1 : Tractor
Howard Rotary Hoe
Mounted Discs on Tine Grubber
Trailer
Herbicide Spray Unit and Protective Clothing

Year 2 : Fixed Boom or Air Blast Sprayer
Tassone Undervine Weeder (if cheaper than manual)

Year 3 : Sabre Trimmer
Two Bird Scarers
Tools.

2.62 *Costing Method*

A charge is made against each operation per hour of tractor use. It becomes too complicated to also charge for each implement when used so that a single annual Repairs and Maintenance charge of $400 is made. Considering the light use of machinery a tractor should last 20 years so straight line depreciation has been set at 5% of cost. For vulnerable machinery involved with chemicals, depreciation is raised to 10%. Machinery capital cost will additionally be charged at 10% per annum for general purpose agricultural items whereas units with only specialised use suffer the higher risk fee of 12%.

2.63 *Tax Advantage*

The depreciation levels taken above are based on experience. The Inland Revenue Department allow faster rates and in addition to depreciation investment allowances. If the vineyard is your secondary income the taxation benefits are particularly attractive on machinery and other development costs and development losses can be carried forward until profitable years occur.

2.7 *BUILDINGS*

As a Winery is not considered for a 8 hectare property and as personal housing is excluded from the costing, building requirements are minimal. A large shed to accommodate the tractor and implements and a water tank with pipes will be sufficient at an approximate cost of $4,000. Straight line depreciation at 2½% will be taken and capital cost charged at medium risk interest rate of 10%.

3.0 *COST OF CAPITAL*

3.1 *Opportunity Cost Concept*

Many developers just charge a safe basic interest rate to their project, usually the bank overdraft rate. All costing exercises in horticulture have followed this single interest charge until T. Lewis of Gisborne introduced the three tierred risk levels in 1972. I fully endorse Lewis's concept and the key feature of this paper will be a finer disaggregation of capital outlay into more appropriate risk groupings.

Please note that the Opportunity Cost of Capital is the return which could be gained elsewhere by investing the funds in similar risk investment.

3.2 *Influence of Interest Rates*

The frequent changes of general interest rates have a major influence on these considerations as they do on share prices. As interest rates dropped in mid 1978 share prices rose and stock exchange dividend yields declined. Hence the opportunity costs given today should not be taken as inflexible figures because only two months ago with surplus liquidity and cheaper market interest rates I would have suggested lower levels.

3.3 *Establishing Opportunity Cost Rates*

Remember that a "similar risk investment" is the key to setting the rate and that not all vineyard capital expenditure incurs the same risk. Land has a low expected return of about 5% on capital value because it has many uses and potential captial gains and therefore encompasses no downward risk. Assuming that bank overdraft rate is 12% it would be unreasonable to charge interest on land at this rate as it would be to expect this yield on a blue chip equity share to be much above 6%. At the other end of the scale it would be unreasonable to charge the project at bank overdraft rate for such risky components as posts and wire on which the salvage value would be small. People supporting the single rate of interest on capital claim that it averages out, but it is always better to know the real situation before chancing the average.

3.4 *Opportunity Cost of Low Risk Capital*

The activities to be considered in this category would first include land. Even if grapes became a total disaster through either disease or a market collapse, land could readily be used for an alternative enterprise. The salvage value of trellises and wire would cover the cost of clearing the land and returning it to pasture! Only land together with drainage and levelling costs would appear to qualify at this low risk. Special buildings we do not see as having this high security and are not included.

The question then remains as to the appropriate interest charge for these elements. To derive this one must determine your "opportunity cost of capital" invested in activities of similar risk with little or no erosion of real value during inflationary periods (akin to capital gains). Returns on competent farming vary between three and six percent on total capital invested. Blue chip shares yield similarly. As one would naturally expect a new investment to go for the highest yield within a category we have selected 6%. With the current risks of inflation, which produce capital gains that remain tax-free under current legislation, 6% could be considered too high a return, but one must also take into account government policy to deliberately improve returns to capital invested in agriculture, horticulture and export industries. Lewis in 1972 used 10%.

3.5 *Opportunity Cost of Medium Risk Capital*

This is the most difficult set both to define by activities and an appropriate percentage rate. With buildings being excluded from the first low risk land category they will qualify. Buildings and water tanks might have some use if the enterprise was changed from grapes or at least they would be of considerable salvage value.

Machinery such as tractors, discs, rotary hoes and trailers have universal use and so a ready market and selling price can be obtained. With the depreciation already taken in the annual operating expenses and the sound equity of machinery in New Zealand during periods of inflation most risks have been eliminated. Because of this a rate of 10% is suggested generally, being 1.5% above Rural Bank rate and 1.5% below prime bank lending rate. Currently with the generous tax investment allowances of 40% on new plant additional to depreciation, people's opportunity costs for capital expenditure enjoying these incentives will drop. Such an allowance should reduce opportunity cost of money by 2%, but vineyard developers enjoy an excess accumulation of tax credits in the earlier years that the incentive is somewhat reduced. Hence I have valued this at 1%.

Therefore considering these factors we have set the opportunity cost at 10-1 = 9%. If the investment allowances granted under Section 29 of the Land and Income Tax Amendment Act (No. 2) 1976 Part D and Section 117I were cancelled then we believe the interest cost should revert to 10%. Lewis in 1972 used 8%.

3.6 *Influence of Export Suspensory Loans*

As I am confident that export must occur, growers who are also wine makers should consider the enormous benefits of this scheme as wine and grape juice are qualifying products. Loans will be granted by Rural Bank for up to 40% of the capital cost of plant, machinery and certain other developments including planting and trellising. Provided 40% of the annual output is expected within five to eight years, this loan converts into a grant. At the basic rate of interest of 8.5%, this is an attractive source of finance and even if the export target is not achieved nothing is lost. This scheme expires 31 March 1980 and if utilised opportunity costs for medium and high risk capital must be reduced by a further 2%.

3.7 *Opportunity Cost for High Risk Capital (Tax Deferrable)*

Activities to be included in this category are expenditures on machinery which do not have universal demand in New Zealand agriculture such as sprayers and trimmers. Were the industry to collapse they would have only limited salvage value as would posts and wire. However, these items are tangible, unlike development expenses such as cultivation and training, and have the tax advantage of 40% new plant investment allowances and deferrability. This deferrability of development expenses for use at times of high profitability must lower the opportunity cost rate for such capital, but it is hard to quantify. We have set a rate of 12% which we admit is somewhat arbitrary at this stage.

3.8 *Opportunity Cost for High Risk Capital (Intangible)*

This covers cultivation, weed control, training, pruning, planting and other activities that would have no value if the project were to discontinue. Also interest charges for previous years outlay, because they cannot be refinanced at the lower interest rates are interpreted as high risk.

This is a new approach and conflicts with the traditional approach of simply compounding interest expenses at one established rate. Any expense that has gone into thin air such as interest can only be classified as high risk!

To establish an appropriate rate for this high risk is difficult, but now the industry has become stabilised with sound consumer demand the risks are lower. Lewis in 1972 used 14% with which figure we concur for the established North Island areas. The figure relates to 2nd Mortgage interest rates.

With respect to South Island there must still be additional risks, otherwise more companies would have come south. For Blenheim and Nelson we suggest that the High Risk (Intangible) rate be supplemented by 1% to make a 15% opportunity cost charge. For Canterbury the risks must be greater suggesting a 3% supplement or basic giving 17% and for those in Central Otago I would add 6% making 20%.

Risk has been the key feature of this section coupled with suggestions to move awa y from the orthodoxy of charging one interest rate on capital outlay based on bank loan rates. As this four tier rate is so new I am sure that further refinements of my proposals are possible and I welcome suggestions and discussion.