3. GRAPE PRODUCTION IN AUSTRALIA

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1. INTRODUCTION

The first grapevine planting material arrived in Australia with white settlement in 1788. Today grapes are grown commercially in all States and Territories. Grape growing (wine, raisin, and table) is the largest fruit industry in Australia with production in a wide range of environments from temperate to tropical. Wine grape production and wine making is the largest and most predominant of the three viticulture industries.

There has been considerable change in production in all three industries over the last 4 years, up to 1999. Wine grape production has almost doubled to 1,076,207 tonnes and dried grape production has fallen to 119,438 tonnes, largely in response to export markets plus increasing imports of dried grapes. Table grape production has increased by almost 60 percent to 69,891 tonnes fuelled by industry expansion in sub-tropical regions and increasing exports to Asia. A feature of recent industry expansion has been the increased planting of varieties specific to the end use (wine, dried, table). Nevertheless, the multipurpose varieties such as Sultana, Muscat Gordo Blanco and Waltham Cross continue to account for 40 percent of white grape production in Australia. Grape growers redirect their fruit from drying to processing for wine or production of table grapes as the fortunes of each industry waxes and wanes.

A comparison with other grape producing countries throughout the world shows that Australia was the 14th largest producer of grapes (tonnes) in 1997, when Australia was ranked 9th in the world for volume of wine produced. While 28 percent of production (170.6 ML) was exported, this amounted to only a very small percentage of world wine exports. Australia is a relatively small producer and exporter of table grapes and raisins by world standards.

The viticulture industries in Australia are well developed, innovative and utilize the latest production practices. Australia is ranked among the top 10 countries in terms of average grape yield (t/ha). There is a high degree of mechanization in the vineyard, particularly in the wine grape and raisin industries. A substantial research, development and extension effort continues to generate practices that improve production efficiency and grape quality.

2. CURRENT STATUS OF GRAPE PRODUCTION

Grapes are grown in all States of Australia but most of the production is in the temperate zone. The three largest States by production are South Australia (Riverland), Victoria (Sunraysia) and New South Wales (Riverina) (Table 1). Wine grapes are grown in all States, table grapes in all States except Tasmania and raisins in Victoria, New South Wales, South Australia and Western Australia. Important grape production districts are shown in Figure 1.

Over the last five years wine grape production has almost doubled, raisin production declined slightly and table grape production increased moderately (Table 2). Further substantial increases in wine grape production will occur during the next two to three years as non-bearing vines come into production and reach mature cropping levels. Most of the growth in the table grape industry has occurred in sub-tropical areas across northern Australia. Production volumes will increase over the next two years when these new vineyards come into bearing. New plantings of wine grapes are expected to slow down, while raisin grapes will remain static and table grapes show a slight increase.

Table 1. Production of Wine grapes, Raisins and Table grapes in Australia, 1998-99 (in tonnes).

	Wine making	Drying	Table grape	Total
New South Wales	270,236	19,137	14,128	303,501
Victoria	277,869	96,788	42,391	417,048
Queensland	1,264	-	5,586	6,850
South Australia	491,621	2,764	2,149	496,534
Western Australia	32,067	749	3,531	36,347
Tasmania	3,121	-	-	3,121
Australia	1,076,207	119,438	69,891	1,265,536

Source: Australian Bureau of Statistics, Catalogue No. 1329.0, 1999.

Table 2. Change in Grape Production (in tonnes), 1995 to 1999.

Year	Wine making	Drying	Table grape
1995	577,364	147,006	44,456
1999	1,076,207	119,438	69,891

Source: Australian Bureau of Statistics, Catalogue No. 1329.0, 1999.

A large number of varieties are grown in Australia. The area planted with each variety and tonnage utilized for wine making, drying or as table grapes is shown in Table 3. The major table grape varieties are Thompson Seedless, Red Globe, Flame Seedless and Menindee Seedless. Menindee Seedless is the predominant variety of plantings in northern Australia. Other table grape varieties grown include Cardinal, Emperor, Ribier (Alphonse Lavelle), Marroo Seedless, Calmeria, Ohanez, Purple Cornichon and Waltham Cross.

Table 3. Area under Grape Varieties and Production Extents (1998-99).

Variety	Area of Vines (ha)			Grape Production (tonnes)			
	Bearing	Non-bearing	Total	Wine making	Drying	Table grape	Total
Red Grapes:							
Barbera	111	105	216	669	-	-	669
Cabernet Franc	559	123	687	5 365	-	-	5 365
Cabernet Sauvignon	13 629	7 541	21 169	127 494	-	193	127 687
Currant	889	49	938	5 515	7 189	10	12 714
Grenache	2 025	231	2 255	24 196	53	33	24 281

Malbec	399	49	448	2 857	-	-	2 857
Mataro	683	183	866	9 217	-	69	9 286
Merlot	3 465	292	6 387	31 801	16	246	32 063
Muscat a Petit Grains Rouge/Rose	296	48	345	1 411	46	408	1 865
Petit Verdot	110	261	370	1 045	-	-	1 045
Pinot Noir	2 226	770	2 996	19 668	26	267	19 960
Ruby Cabernet	1 102	876	1 978	18 414	-	49	18 462
Sangiovese	311	129	440	403	-	-	403
Shiraz	16 944	8651	25 596	192 330	36	477	192 843
Tarrango	87	20	107	2 199	-	-	2 199
Other red grapes	2 528	601	3 129	7 228	658	20 179	28 065
Total Red Grapes	45 363	22 563	67 925	449 809	8 025	21 929	479 762
White Grapes*:*							
Chardonnay	15 298	1 558	16 855	210 770	-	299	211 069
Chenin Blanc	884	55	939	16 621	-	-	16 621
Colombard	1 382	266	1 648	34 781	-	-	34 781
Crouchen	83	5	87	1 136	-	-	1 136
Doradillo	306	8	314	6 597	-	1	6 598
Marsanne	137	63	201	1 878	-	-	1 878
Muscadelle	230	17	247	2 106	-	7	2 113
Muscat a Petit Grains Blanc	261	8	269	3 334	5	24	3 363
Muscat Gordo Blanco	2 924	81	3 005	58 017	2 575	112	60 703
Palomino	161	2	163	2 581	-	-	2 581
Pedro Ximenes	146	-	146	1 981	-	-	1 981
Riesling	3 190	157	3 347	30 144	-	-	30 144
Sauvignon Blanc	1 926	487	2 413	22 834	-	100	22 934
Semillon	5 307	737	6 044	80 191	-	-	80 191
Sultana	12 943	696	13 639	117 783	105 982	26 339	250 103
Taminga	44	-	44	862	-	-	862
Traminer	531	7	538	5 357	-	-	5 357
Trebbiano	689	1	690	10 482	-	-	10 482
Verdelho	708	267	975	7 290	-	-	7 290
Viognier	79	51	130	494	-	-	494
Waltham Cross	407	22	429	2 366	2 277	1 200	5 842
Other white grapes	2 303	564	2 867	8 794	575	19 881	29 251
Total White Grapes	49 938	5 052	54	626 398	111	47 962	785

			990		414		774
TOTAL GRAPES	**95 301**	**27 614**	**122 915**	**1 076 207**	**119 438**	**69 891**	**1 265 536**

Source: Australian Bureau of Statistics, Catalogue No. 1329.0, 1999.

3. PRODUCTION OF PLANTING MATERIAL

Production, supply and maintenance of healthy planting material are well organized and wholly undertaken by industry. There are three tiers involved, namely, the national, state and individual nursery operator levels.

The Australian Vine Improvement Association (AVIA) is the national organization responsible for developing standards in vine health maintenance and product quality. Each state has a vine improvement organization (VIO) whose role is to produce healthy cuttings as specified by AVIA, for sale to nurseries. Privately owned nurseries propagate vines for sale to grapegrowers, preferably using cuttings from VIOs but also from commercial vineyards in times of short supply.

In recent years a substantial effort has been made at all levels of the industry to improve the health status of grapevine planting material in Australia. Virus indexing of government germplasm collections using more sensitive techniques is almost complete and indexing of the VIOs source area vineyards, from which cuttings are produced and sold to nurseries, is well advanced. These vines will now be indexed every 2 to 3 years.

AVIA and the state VIOs have jointly developed sanitation protocols for use by nurseries, in particular a hot water treatment (50°C, 30mins) of cuttings for the control of crown gall and phytoplasmas. A quality assurance scheme has been developed by AVIA, which governs the health status and quality of planting material sold by participating nurseries.

The types of planting material available are dormant cuttings, vines on own roots and vines grafted to rootstocks. Most planting material is purchased from nurseries and planted as vines with roots. Some growers continue to plant callused cuttings directly into the vineyard but this practice is dying out. Bench grafting using machines built for the purpose is the most widely used technique by nurseries. A small number of nurseries continue to graft in field nurseries. One specialized nursery has recently started green micro-grafting which enables the production of bench grafted vines all year round.

Throughout the 1990's there was a large increase in the number of vines grafted to rootstocks. More than 20 rootstocks (Table 4) are used in the Australian viticulture industries, primarily for salt tolerance, increased productivity and nematode tolerance. Rapid expansion of the grape industries, mostly wine grape and table grape, has seen large increases in the number of vines produced each year but demand exceeded supply which led to shortages of propagating material. It was estimated that in some years, up to 60 percent of the propagating material used by nurseries came from commercial vineyards and hence had a doubtful health status and quality.

Table 4. Rootstock Cuttings Sold in Australia, 1998.

Variety	Number Cuttings
Ramsey	2,902,841
Schwarzmann	1,863,870

140 Ruggeri	908,332
1103 Paulsen	779,218
K51-40	543,471
99 Richter	536,900
5BB Kober	522,775
101-14	449,059
5BB Kober 5A	429,735
5C Teleki	326,219
SO4	296,466
K51-32	107,855
110 Richter	89,059
Dog Ridge	87,645
Teleki C	36,750
Freedom	29,164
Harmony	22,600
J17-48	18,150
420A	11,210
J17-69	2,200
Rupestris du lot	1,836
34 EM Foex	1,150
Riparia Gloire	400
St George 15-74-2165	215
ARG 1	100
1202 Couderc	100
5A Teleki	20
1616 Couderc	10
Total	**9,967350**

Source: Australian Vine Improvement Association.

4. ESTABLISHING VINEYARDS

Site Assessment

Long-term profitability and ease of management is greatly enhanced by detailed assessment of the proposed vineyard site. Firstly, the optimum district for producing the desired fruit (wine) quality or (table grape) harvest time is determined using long-term weather data. Once a vineyard site is chosen a detailed assessment of water and soil resources is undertaken.

The water survey will include assessment of on-farm water resources, access to off-farm water supplies and quality of the water. A water sample is then collected and analyzed. Grapevines are not highly sensitive to salt but water supplies with a total salinity exceeding 2000 microSiemens per centimetre, sodium content greater than 20 milliequivalents per litre or chloride content greater than 4 meq/L should be avoided. On-farm water resources are surveyed to determine the quantity of water available from dams or underground sources through bores, as well as the catchment area so that recharge rates can be calculated. Much of Australia's viticulture is located in irrigable areas where water supply is reliable and well managed. Many of the new vineyard developments rely upon pumping water from rivers and streams, and this requires a licence issued by a statutory organization.

The quantity and timing of rainfall in relation to the growing season, which varies considerably throughout Australia, is included in the assessment of water resources. The water survey is the major determining factor in the design of the vineyard irrigation systems.

Soil surveys are increasingly used in vineyard planning. They are the major determinant of vineyard layout and indicate what soil ameliorants and physical modifications are required before planting. A simple soil survey involves collecting soil samples for chemical analysis and nematode assay, whilst a detailed survey involves digging soil pits in a 100m grid across the vineyard site. Soil pits are used to determine variability across the site, presence of compaction or impermeable layers, and subsoil chemical status.

Soil Preparation

Soil preparation involves applications of lime or dolomite to adjust pH; superphosphate, as most Australian soils are low in phosphorous; and applications of magnesium, zinc and boron where these nutrients are locally deficient. Ripping along the vine row and sometimes of the entire site is used to break up compaction and impermeable layers and increase soil depth. Where nematodes are present tolerant rootstocks are chosen and ordered from commercial nurseries.

Planting

Immediately prior to planting the soil is cultivated. Planting is commonly carried out in late winter-early spring using dormant vines. Numerous mechanical devices are available to assist with planting of vines. The recent introduction of container grown vines has enabled the planting season to continue through to mid-summer (Dec/Jan), even in sub-tropical areas.

Vine Spacing

Vine spacing varies slightly with grape type (wine, raisin, table), age of vineyard and district. Rows are mostly 3.0-3.6m wide with vines 1.5-2.4m apart. Spacings are commonly at the higher end of the range in more recent vineyards because of larger trellis designs, plus rootstocks and improved management practices contributing to greater vine vigour. A few medium density (2.0m x 1.0-1.5m) wine grape vineyards have been planted but these spacings are not suited to the climate of most grape production districts in Australia.

The use of ‘vine tubes’ to promote faster growth and establishment of young vines has become widespread over the last 5 years. A variety of tubes are available, differing in design, colour, length and material. Vine tubes are rarely used and considered unnecessary in northern Australia, as vines establish quickly and carry their first crop 18 months after planting.

5. VINEYARD MANAGEMENT PRACTICES

The discussion in this section focuses on table grape production in northern Australia (Queensland, Northern Territory, Western Australia). Notable variations in management practices in the wine or raisin grape industries will be highlighted.

Trellis Systems

The most common trellis used for table grapes is a 6 or 8-wire large Y shaped trellis. The 6-wire Sloping T trellis is far less popular. Both trellis designs have two cordon wires and vines are trained to a quadrilateral. Moveable foliage wires are not used nor hand positioning of shoots. Both trellis designs provide good separation of fruit and foliage. The Y trellis is preferred as it provides unobstructed access from

both sides for harvesting and pre-harvest hand manipulation of bunches. The application of plastic vine covers is a little easier with the Sloping T trellis.

Pruning

Most varieties grown are spur pruned even in the tropical areas (Mareeba). Thompson Seedless and Menindee Seedless require cane pruning and there has been a recent shift to cane pruning of Red Globe for greater fruit yield. All pruning of table grapes is done by hand. A large proportion of the wine grape area planted throughout Australia is machine pruned or not pruned at all.

Hydrogen cyanamide (Dormex ®) is applied after pruning to enhance percent bud burst, promote uniform bud burst and advance bud burst time in the early season districts. The interval between application and bud burst increases with latitude from 10 days (Mareeba) to 25 days (St George). Notwithstanding the use of hydrogen cyanamide bud burst is more protracted and the percent bud burst is less than in temperate areas. Our understanding of vine dormancy, interaction with the environment and the manipulation of bud burst needs to be improved if vineyard productivity in sub-tropical areas is to be increased.

Vine Nutrition

Inorganic fertilizers are predominantly used for maintaining vine nutrition. Annual dry matter analysis of petiole samples is commonly used for determining the nutrient requirements of grapevines. Some growers also use soil analyses but generally only every second or third year.

Most grape growers apply inorganic fertilizers through the irrigation system (fertigation) because it is easy, provides a high degree of flexibility and control, minimizes leaching losses in summer rainfall districts and ensures the nutrients are available when required by the plant. Broadcasting of fertilizer for incorporation by rain is uncommon and generally used only for particular fertilizer products.

Annual fertilizer application rates for table grapes in the sub-tropics range from 20 to 40 kg/ha N, 10 to 20 kg/ha P, and 60 to 100 kg/ha K. Dolomite or lime is regularly applied to adjust soil pH. Foliar fertilizers are increasingly being used for the application for micro-nutrients (Zn, B, Mg, Mn).

Only a small number of growers use organic fertilizers but the interest in organic fertilizers is increasing sharply. Organic fertilizers are invariably expensive per kilogram of nutrient, not easily accessible and often in short supply.

Vineyard Floor Management

Standard practice is a weed free strip along the vine row and a permanent plant cover between rows. This minimizes soil erosion and facilitates vehicle access after rain, when the timely application of fungicides for disease control is important. The inter-row plant cover is usually self sown, although in vineyards in temperate southern Australia there is a shift towards the planting of specialist species. The inter-row plant cover is regularly slashed and the under-vine strip maintained weed free with herbicides. Cultivation is generally not practiced.

Irrigation

Irrigation is essential for profitable table grape production. Drip irrigation is the standard technique used. Furrow irrigation or under-vine sprinklers are not used because of limited water supplies and both methods of irrigation are found only in irrigation districts in southern Australia.

Scheduling of irrigation is increasingly used over the traditional practice of regular application of a prescribed amount. Scheduling methods vary from rather inexpensive and simple (crop factors, evaporation and rainfall data, tensiometers, gypsum blocks) to highly technical and more expensive techniques (neutron probes, capacitance probes). Irrigation scheduling provides flexibility of management for growers, leads to efficient use of water, avoids leaching, and maximizes vine performance.

Pest Management

Low chemical input is a characteristic of Australian viticulture and over the last 10 years there has been a shift to greater use of biological control agents. The viticulture industries are moving from routine to strategic spray programmes and this is most advanced in the wine grape industry where higher fruit damage levels are acceptable.

The success of strategic spray programmes is the accurate prediction of pest outbreaks and disease infection periods. This requires monitoring in the vineyard for the presence and development stage of a pest and recording weather data. The 'AusVit' software package analyzes the weather data and vineyard observations to produce recommendations which assists grapegrowers to make spray management decisions.

The list of insects is very similar throughout the grape production regions of Australia. The one notable exception is the occurrence of Queensland Fruit Fly in northern Australia only, which is a major pest of table grapes in this region, and its absence in southern areas. A biological insecticide *Bacillus thuringiensis* is available for control of light brown apple moth (LBAM) and grapevine moth caterpillar. The predatory wasp *Trichogramma* is also effective against LBAM. The pest mites (blister, bunch, rust) are controlled organically by applications of wettable sulphur and several predatory mite species endemic in Australian vineyards. Growers maintain predatory mite populations by the careful selection of safe pesticides. Queensland fruit fly and cadydids (grasshoppers) are the two significant pests of table grapes in northern Australia and require regular control to prevent serious damage.

Diseases are of far greater concern and impact on grape production throughout Australia. Downy mildew (*Plasmopara viticola*), Botrytis (*Botrytis cinerea*) and anthracnose (*Elsinoe ampelina*) are the most damaging diseases of table grapes in northern Australia. Under the high summer rainfall conditions common throughout northern Australia the damage to fruit and foliage can be extensive and severe.

The standard spray programme for table grape production involves regular applications of protectant fungicides with the timing determined by growth stage, weather forecasts and disease incidence the previous season. Copper oxychloride and mancozeb are the major fungicides used for downy mildew control. The eradicant fungicides metalaxyl, phosphorous acid, benalaxyl and oxadixyl are important for the post-infection control of downy mildew, particularly in Queensland where storms and two to three days continuous rainfall are common during the growing season.

The spray programme for Botrytis is very specific and consists of two sprays during flowering, one spray before bunch closure, and one to three sprays during pre-harvest. To avoid resistance developing, particular attention is paid to using a fungicide from a different chemical group at alternate applications. Resistance to benomyl and procymidone exists in some grape districts, particularly Western Australia where resistance is extensive throughout the table grape industry. The biological fungicide *Trichodex* is available but is less effective under high disease

pressures.

Control of anthracnose is possible only with regular applications of the pre-infection dithiocarbomate fungicides or dithianon for woolly bud and whenever new growth is present during wet weather. Once an outbreak of anthracnose has occurred it can take three to five years of good control practices to clean the disease from the vineyard. Fungicides used for anthracnose will also control Phomopsis (*Phomopsis viticola*).

Powdery mildew (*Uncinula necator*) is less important in the wet and humid climate throughout Queensland, but is the major disease of table grapes at Ti Tree (Northern Territory). A programme of three or four sprays at seven to fourteen day intervals from bud burst is very effective in preventing powdery mildew. Wettable sulphur is commonly used early in the season, then as the daytime temperatures exceed 30°C the demethylation inhibitor fungicides are used.

Table Grape Quality

Gibberellic acid is routinely used with Thompson Seedless and Flame Seedless to thin flowers in the inflorescence and increase berry size. Gibberellic acid is not applied to Menindee Seedless because it reduces fruitfulness, or Marroo Seedless because it leads to a large number of green, shot berries in the bunch at harvest.

Plastic rain covers to protect fruit from pre-harvest rain damage are a recent innovation within the table grape industry. The rain covers are spread over the canopy of the vine just after veraison (approximately four to six weeks before harvest). Their use has become widespread in the Sunraysia, is rare in Queensland and is standard practice at Ti Tree with Thompson Seedless.

Trunk or cane girdling is not used in northern Australia because the effectiveness of the technique in sub-tropical environments is not known and growers generally have no experience.

6. HARVESTING AND YIELDS

Table grapes are hand harvested, packed into cardboard cartons, cooled on farm and transported to market in refrigerated trucks. Most growers in northern Australia pack in the vineyard as it is cheaper, the fruit is destined for the domestic market, and is easy to manage as only one line of fruit is being packed. Shed packing is used where there is some damage requiring extra work to clean the fruit, and when the fruit is destined for an export market, multiple lines are packed simultaneously, and for varieties sensitive to handling (e.g. Thompson Seedless).

Polystyrene cartons are rarely used for table grapes since the major retail supermarket chains decided two years ago they would no longer accept produce in polystyrene, because of the waste disposal problems of this bulky material in the cities. This is despite the superior insulation properties and better protection of fruit during transport. Plastic bunch bags were introduced three years ago and their use has increased in response to demand by the retail supermarket chains. Sulphur dioxide pads are not used in northern Australia where fruit is consigned to the domestic market, but are included in cartons of table grapes exported from Sunraysia and Swan Valley.

Northern Australian table grape yields average 7 kg/vine (8.75 t/ha) and only 3 kg/vine (3.75 t/ha) for the major variety Menindee Seedless. In the Sunraysia the average yield is 12 kg/vine (18.5 t/ha) and can exceed 20 kg/vine (31.0 t/ha) for Red Globe.

Low bud fruitfulness due to the growing conditions in the sub-tropics is the major reason for relatively low yields across northern Australia. Low percentage bud burst and hence fewer shoots per vine is a major factor. The short duration of each growth stage (bud burst to harvest) leads to smaller bunches and berry size, which contributes to low yields and impacts on fruit quality.

Average yield of raisin grapes is 25 t/ha (fresh weight) and 6 t/ha of dried grapes to greater than 25 t/ha for wine grapes, largely due to the production system. A sizeable and increasing percentage of the wine grape crop is harvested mechanically. This provides cost savings and is beneficial for maintaining fruit quality. In the modern raisin grape vineyards canes are cut to allow drying of the fruit on the vine and subsequent machine harvesting. Considerable development of mechanical harvesting techniques for wine grapes and raisins has occurred in Australia.

7. MARKETING

Table grapes are sold by two methods in Australia. Firstly, the traditional practice of consigning fruit to a wholesale agent at the central market in each of the capital cities for sale on commission. More recently, an increasing amount of fruit is being sold directly to the retail supermarket chains under contract for an agreed price.

There are no table grape exports from districts across northern Australia as this production is early season and commands a high price on the domestic market. Table grape exports are predominantly from the Sunraysia and Swan Valley. In 1998-99 table grape exports reached a record high of 31,017 tonnes valued at $69.1 million. The major markets were Hong Kong and Singapore accounting for 40 percent and 25 percent, respectively, for a value of $44.3 million. The major varieties exported are Thompson Seedless, Red Globe, Flame Seedless and Menindee Seedless.

Table grape imports have been permitted only from New Zealand and are less than 5 tonnes each year. The Australian Quarantine and Inspection Service announced on 14 January 2000, that table grape imports from California would be permitted. Fruit is expected to arrive from July/August and continue through to December.

Export sales of Australian wine have grown dramatically from 21.3 million liters in 1986-87 to 215.5 million litres in 1998-99. The major markets are Europe, North America and New Zealand. Wine exports to countries throughout Asia have also increased significantly in recent years and this region has become the focus for further export growth.

8. INDUSTRY POTENTIAL

The table grape industry has grown significantly in recent years, mostly in northern Australia and the potential exists for continued expansion in this region. Water and land resources are available and support infrastructure is now well established. The potential exists to greatly increase domestic per capita consumption during the October to December period, which will in turn stimulate industry growth. Several large growers in Queensland have established links with exporters in preparation for export. Continued growth of table grape exports to Asia is likely to lead to industry growth in the Sunraysia and Swan Valley.

Expansion in the wine grape industry will slow but wine exports will continue to grow. Recent expansion of the wine grape industry has been into non-traditional production districts, including more sub-tropical parts of Queensland.

The raisin grape industry is likely to remain static under pressure from imports, loss

of traditional export markets and as grape growers plant wine or table grapes in preference.

The major strengths of the Australian viticulture industries are the extensive research and development efforts and high level of skill amongst grape growers. The research and development effort has led to the current production practices and technologies in Australian viticulture to become some of the most advanced in the world. Grape growers are continually improving their skills and knowledge and adopting the technologies arising from research and development.

The geographic range of grape production districts spreads the risk of crop failure and reduces the likelihood of gaps in supply. The range of climates in which grapes are grown throughout Australia extends the supply time of fresh table grapes and enables a wide variety of wine products to be produced.

There is the potential for further advances in low chemical use production practices and the development of additional biological control methods. Scope exists for greater adoption by grape growers of currently available integrated pest management practices and low chemical input viticulture. Significant improvements in vineyard efficiency and productivity will occur as a result of continued advances in irrigation management, vine improvement and vineyard mechanization.

9. CONTRAINTS ON GRAPE PRODUCTION

Increasing salinity and pressure on water resources in the major grape production districts of southern Australia is a major issue for the future viability and development of all grape industries. There are huge political and environmental implications surrounding both issues. The salinity problem will be expensive and take considerable time to correct and in the meantime could result in some water and land resources becoming unusable.

There are several constraints to development in the table grape industry. Firstly, the lack of new varieties which satisfy domestic and export market preferences and which are suited to local growing conditions, particularly those across northern Australia. Secondly, limited knowledge of vine physiology and performance under sub-tropical conditions is a major limitation to productivity. Specific issues include floral initiation and factors controlling bud fruitfulness, inflorescence and berry growth, vine nutrition, dormancy, the mechanism controlling bud burst, and managing vegetative growth. Major impediments to initiating and developing an export table grape trade from production districts in northern Australia are a lack of market intelligence, poor contacts in Australia and destination markets, and limited export experience amongst grape growers.

Grape growers in Australia are highly skilled, continually updating their viticulture knowledge and have a high propensity to adopting new technologies and practices. There is a comprehensive education programme providing training at all levels. Several universities train viticulturists and oenologists, the extensive network of TAFE colleges across Australia train vineyard workers in the practical skills, Government agriculture agencies provide education and training in new practices and technologies arising from research and development, and numerous secondary schools now teach viticulture. Learning also occurs in the many grape grower discussion groups organized within industry.

10. GOVERNMENT POLICIES AND RESEARCH AND DEVELOPMENT COMMITMENT

The Government is the major funding source for the substantial research effort within Australia on behalf of the viticulture industries. All three grape industries

jointly fund research and development through levies paid by grape growers and processors (wine and raisin). The majority of the viticulture research is on wine grapes. Table grapes receive the least amount of research effort, almost all of which is undertaken in sub-tropical environments by the Queensland Department of Primary Industries, Northern Territory Department of Primary Industries, and Fisheries and Agriculture Western Australia.

Research and development is undertaken by numerous organizations throughout Australia. The major organizations at the national level are the Cooperative Research Centre for Viticulture, Commonwealth Scientific and Industrial Research Organization and Australian Wine Research Institute. The Agriculture Department in each state is another major contributor to viticulture research and development, with the level of commitment varying depending on the size of the grape industries in the state. Several universities across Australia are also involved in grape research. The current research activities of each organization can be found in their annual report or web page.

Each grape industry has a research and development corporation, which formulates research priorities, collects the levy money and then allocates it to research projects. The priorities of the wine grape industry are:

a) Grapevine variety improvement,
b) Management of pests and pathogens,
c) Grape quality,
d) Resource and vineyard management,
e) Economic prediction and assessment,
f) Technology transfer.

Research priorities of the raisin industry are available in the annual report of the Dried Fruit Research and Development Corporation. The table grape industry is not organized at the national level, so priority issues are developed at the state or local level only. The important issues in Queensland are bud fruitfulness, vine nutrition, dormancy and bud burst management, environmentally suited new varieties, quality assurance management, and integrated pest management.

Federal and State governments have policies focusing on expanding exports of food products into Asia. This encompasses wine and table grapes. To achieve this objective, government funds have been committed to strategic projects addressing grape production and farm gate issues. The Federal government also provides funds through several agencies (e.g. Australian Council for International Agricultural Research) for collaborative research and development projects between organizations in Australia and throughout Asia, designed to assist industry development.

11. CONCLUSIONS

The grape industries in Australia are technically advanced with highly skilled operators and an extensive research, development and education programme. Sustained economic viability of the wine grape industry is dependent upon continued growth in wine exports. Asia is an emerging market for Australian vine exports and significant growth in sales in this market is important and will be a focus of export strategies. Enhanced trade links in countries throughout Asia could well benefit Australian wine and table grape exports to the region.

A greatly increased research and development effort in the sub-tropical environments of northern Australia is required, to improve vineyard productivity, achieve competitiveness with Californian imports and hence sustain the expansion of this growing sector of the Australian table grape industry. To enable more

effective management practices to be developed, future research should focus on vine physiology and understanding the interaction between the plant and environment. Opportunities for collaboration in table grape research between Australia and countries in Asia should be explored and mutual benefits identified.

There are opportunities for countries in Asia to utilize the vast array of education programmes in viticulture and oenology, as well as access the extensive information resources available in Australia. Countries throughout Asia could access the technology and skills in wine making in Australia, to assist the development of their emerging wine industries.

Figure 1. Major Grape Growing Districts in Australia.