Project Title: Soil moisture status of high density vineyards

Project Number: DAS 2GW

Organisation: South Australian Department of Agriculture

Location: Nuriootpa

Supervisor: M G McCarthy

Time Span: 1987 – 1990

EXECUTIVE SUMMARY

Background:
As the availability of suitable viticultural land diminishes as a result of cost, planning controls, urban expansion etc., there will be a need to optimise the quantity and quality of winegrapes. High density vineyards have the possibility of achieving these objectives of high quality and yield and hence the economic viability of Australian grapegrowers. The concept of high density plantings is a totally new concept to Australia and little is understood about the performance of such vineyards. To ascertain the effects of high vine density on wine quality a 2 ha Shiraz vineyard planted at 8888 vines per ha (1.5 m rows with vines 0.75 m apart) was established in Coonawarra in 1985 with funding from the Rural Credits Development Fund. A 2 ha vineyard planted at traditional spacing (1600 vines per ha) was established adjacent to the high density planting. A replicated planting density experiment was also established on the Barossa Viticultural Centre. This experiment comprised five replicates of three planting densities with Shiraz scions grafted to either a low, medium or high vigour rootstock. The experimental planting was irrigated with an under-vine micro-jet irrigation system. An extensive grid of neutron probe tubes was installed in each spacing x rootstock configuration in the Barossa experiment and a set of tubes were installed in the experimental plots used for the Flavour Indices for Winegrapes project (GWRC project UA-2V). In total 48 neutron probe access tubes were installed in Coonawarra. Probes were read weekly by Penfold's Wines during the 1989/90 season. Vine performance and soil water data was collected over several consecutive seasons.

Compared to the standard planting distance used in the Coonawarra planting the high density planting averaged 4.5 t/ha more fruit and in 1992 yielded approximately 20 t/ha compared with 14.9 t/ha from the standard planting distance. Vines at both planting densities have received the same quantity of irrigation, as overhead irrigation, each year, although the amount has varied between years, depending on seasonal conditions. In the Barossa experiment widely spaced vines yielded more fruit per vine than closely planted vines in each of the four years harvested, and in 1992 yielded more than three times more fruit per vine. Yield per vine was significantly higher at all planting densities in 1992 compared with that of the previous three years. Except for the 1992 harvest, closely spaced vines yielded about 2 kg per vine which was the initial goal. In comparison, vines at intermediate density yielded on average 3.7 kg per vine and widely spaced vines approximately 6.3 kg per vine. However, expressed as a derived yield per hectare, closely planted vines yielded between 1.7 and 2.2 times more fruit than widely spaced vines or approximately 10 T/ha more fruit. Vines planted at the intermediate distance of 2.5 m by 1.25 m have yielded more fruit per hectare than widely spaced vines, but less than closely spaced vines. There was no effect of vine density on berry weight in each year, although there were differences between years. Berries were always less than 1 g fresh weight at harvest.

Planting density did not affect the ^{o}Brix of fruit at harvest in 1989 and 1992. In the other two seasons, fruit from closely planted vines was riper than fruit from widely spaced vines. Fruit from vines planted at the intermediate density were of similar maturity to that from widely spaced vines in one of these two years and of similar ^{o}Brix in the other.

Soil water content was measured with a neutron probe on 13 separate occasions during the 1989/90 season, on 18 occasions during the 1990/91 season and on seven occasions during 1991/92. There was little difference in the overall pattern of soil water extraction between widely or closely spaced vines. Examination of soil water data from the three tubes at different distances from the vine trunk in closely spaced vines suggested no water depletion across the inter–row space and this was is in contrast to continued soil water depletion across the inter-row area in widely spaced vines. There

was little difference in the rate of soil water depletion at each depth measured mid–row for either of the planting densities with the whole profile drying at a similar rate.

It was apparent by the 1991/92 growing season that there was a significant difference in the hours of sunlight penetrating to the vineyard floor within the different planting densities. It was hypothesised that sunlight, through an effect on soil temperature, may be influencing the rate of soil water loss mid–row. For a period of about four weeks from mid–January to mid–February, a series of thermistors was placed on the soil surface at a range of distances from the vine trunk in each planting density. The 11 sensors were programmed to record every 30 min. Sensors were not covered, they were responsive to direct sunlight. By mid–morning, sensors placed mid–row in 3.5 m wide rows were in full sunlight. Sensors mid–row in 2.5 m wide rows were not in full sun until about 2 pm (4 h later), and mid–row sensors received either no direct sunlight or a period of direct sunlight of less than one hour. By sunset all sensors recorded a similar temperature.

Although only two years of soil moisture data were collected the results are cause for much speculation over the future design of Australian vineyards. In both years narrow rows have produced significantly more fruit than the traditional widely spaced rows and vines. High vine density has not reduced vine vigour although this may change when the vines mature as pruning weights of widely spaced vines are low in comparison to other Shiraz vines on the Research Centre. Although there do not appear to be any significant differences in maturity between the three spacings fruit from narrow rows had smaller berries and bunches; both are claimed to be important for producing high quality wines. Crop water use data are the first to be derived for the Barossa Valley and again demonstrate the high crop water use efficiency of grapevines. The almost halving of the amount of water used per tonne of fruit produced or total vegetative growth per hectare demonstrated the high crop water use efficiency of high density plantings. This needs further investigation to examine the importance of other factors such as shading of the ground, air movement, humidity etc. through high density vine canopies. Crop water use data from the Barossa experiment needs collaborating with results from the larger Coonawarra experiment once field calibrations are completed as the results presented here may be biased by the small plot size. If higher crop water use efficiency can be maintained these results will have important and long-term effects for all the rain-fed grapegrowing districts in Australia. In South Australia all rain-fed grapegrowing areas (Coonawarra, Padthaway, Southern Vales, Barossa and Clare) already have close controls on the use of underground water and these are likely to become stricter. If a significant improvement in crop water efficiency can be achieved through the use of higher plant densities the long-term viability of these areas is assured.

The apparently high level of soil water evaporation from the mid–row area of widely spaced vines offers an explanation for the significant increase in vegetative growth that is often reported when the inter-row area is mulched. Mulch significantly reduces soil evaporation (McCarthy - unpub.) and if vine roots are present in the mid-row area vegetative growth increases. The interaction of planting row width and mulch may warrant investigation as mulching wide rows may give a similar improvement in water use efficiency.

This project has created a pleasing level of interest. Nearly all the Barossa Valley Agricultural Bureaux groups (about 200 growers) have been shown the planting density experiment on the research centre and grapegrowers supplying grapes to several wineries have inspected the planting as part of their annual `grower days' over the last twelve months. Several articles have been written in the popular farming press. There would be few proprietary vineyard managers in South Australia who have not inspected the commercial high density planting in Coonawarra and several organised inspections by both local and interstate grower groups have been arranged. Preliminary yield results from the commercial experiment in Coonawarra were presented by M. McCarthy at the 1989 Wine Industry Technical Conference in Adelaide. This presentation created much interest as it stimulated thought on the relative merits of high density vineyards and widely spaced vineyards with elaborate trellising systems.