IMPACT OF VINEYARD SOIL MANAGEMENT ON SOIL PHYSICAL PROPERTIES AND VINE RESPONSE

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1 SUMMARY

Due to the rapid expansion of the wine-grape industry in Australia, vineyards have been developed on a wide range of soil types and this has caused performance of vines to be variable. Some soils have natural limitations such as poor aeration and high strength in the grey, gleyed clays, the black cracking clays and the red-brown earths. Other soils have anthropogenic limitations such as degraded soil structure (crusting and hard-setting) and sub-soil compaction. Soil management techniques to counter these natural and man-made limitations have yet to be developed in Australia for the soil types used in wine-grape production.

The majority of research on the effects of management on soil physical fertility and grapevine performance has, until recently, been conducted in South Africa (e.g. van Zyl 1988; Saayman and van Huyssteen 1980, 1983a,b and van Huyssteen and Weber 1980a,b,c). For example, the benefits of deep-ripping and minimal tillage on soil structure, root development and performance of grape vines were demonstrated by van Huyssteen and Weber (1980a,b,c). Myburgh and Moolman (1991), and more recently Eastham et al. (1996), demonstrated the positive impact that mounding the mid-row soil onto the vine row has on soil structure and grapevine performance. However, the potential benefits of combining such mounding treatments with various soil amendments (eg. gypsum and polymers, etc) and surface covers (eg. composts) to improve soil structure and increase water use efficiency in vineyards had not been investigated in Australia. Furthermore, our understanding of potential interactions between soil management and irrigation management was rudimentary, particularly in relation to recent advances in irrigation technology such as partial rootzone drying.

The balance between irrigation management and soil management to maximize available water for certain berry qualities is a site-specific exercise requiring great skill and understanding for different soil types in different viticulture regions. The aims of this thesis were therefore to:

- Evaluate the effects of soil profile management (soil mounding and deep-ripping) and surface-cover management (straw mulch, herbicide, polymer, ryegrass) on soil structure, plant available water and vine performance in some South Australian vineyards on different soils.
- Evaluate the effects of irrigating by Partial Rootzone Drying (PRD) on plant available water and vine performance in combination with various strategies for managing the soil profile and surface covers in some South Australian soils with varying limitations.

The impacts of deep-ripping, mounding, polymers, grape marc, straw mulch, ryegrass, calcium amendments and PRD irrigation on soil structure, grapevine root development, plant available water and grapevine performance were determined in various combinations depending on the limitations at each of three vineyards within South Australia.

The results for the various soil and water management treatments were site-specific and depended on the magnitude of soil limitations present before the treatments were imposed. For example at the Padthaway Plain where the depth of root growth was limited by shallow limestone, mounding increased the amount of available water and increased grape yield. Where soil was relatively deep (eg. Lyndoch), mounding was shown to produce no

benefit. Similarly, deep-ripping greatly reduced soil resistance at the Padthaway Range site and this increased root development, vine performance and yield. The effects, however, lasted for only 2 to 3 years.

Mulches and other soil amendments had varying impacts on soil structure and soil water availability depending on soil texture. For example, mulches had a deleterious effect on soil structure soon after application on the heavier textured soils (Lyndoch and Padthaway Plain) but had a beneficial effect on the soil structure of a sandy soil (Padthaway Range). The impact of mulches on soil salinity was also variable and site specific. At Lyndoch, for example, salinity was reduced under mulch but at both Padthaway sites salinity varied with time and was related to other factors.

As expected yields were greater in those treatments that provided the greatest amount of available water (which across all sites included the mulch treatment). Yields alone, however, did not define total grapevine performance, and the treatments with mulches tended to produce berry juices with reduced colour (quality).

Due to the shallow soil profile the PRD irrigation treatment was difficult to manage so that a water stress was induced. As a result the expected improvement in water use efficiency and the positive impact on root development in the subsoil was not observed.