Soil And Water Management in a Kiwifruit Orchard

Through regular soil water monitoring of orchard crops using the neutron probe, farmers and consultants have gained valuable insights into the problems associated with frequent wheel tractor activity on orchard soils under frequent sprinkler irrigation. In a wide range of crops such as kiwifruit at Shepparton, grapes at Pokolbin and macadamias at Bundaberg, neutron probe data has shown that dry subsoils, a result of poor infiltration of irrigation water into the root zone, and a small effective root volume caused by mechanical compaction of the inter-row subsoil are major factors determining yield and quality of orchard crops.

Two important questions are often asked by orchardists in relation to soil water management. They are, firstly, what is the effective root volume of my tree or vine and what has been the long term effect of inter row cultural practices on soil structure and plant water use.

The answers to these questions are being provided by neutron probe soil water data collected in the course of regular soil water monitoring. The data is being used increasingly by orchardists to make sound agronomic decisions as to the need for fundamental changes to be made in their orchard management programs. The two major considerations are the need for deep ripping between tree rows to break up hard pans and the effectiveness of the existing sprinkler or drip irrigation system on variable soil types.

In order to determine the effective root volume of a kiwifruit vine in sand soil, five aluminium tubes were inserted along the row at 30 cm intervals from the base of the kiwifruit vine, tube 1 being the closest at 30 cm from the vine and tube 5 the furthest at 150 cm from the vine (Figure 1). The sprinklers were removed from the surrounding area and the soil water content measured as the soil dried out. The soil water content was measured daily at depths of 20, 30, 40, 50, 60, 80, 100 and 120 cm using the neutron probe.

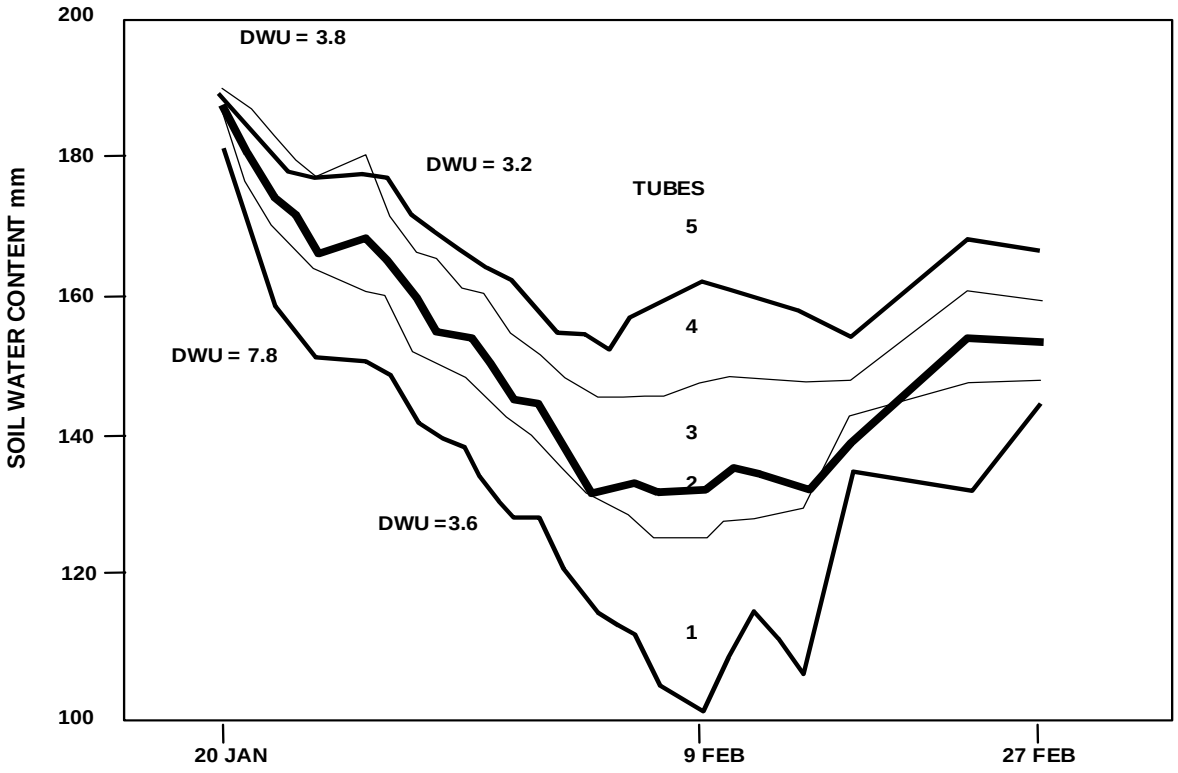

Figure 1: Soil water content in the surface 0-70 cm at 30 cm intervals along a Kiwifruit vine row.

The neutron probe readings taken on 20 January showed the soil water content for Sl five tubes to be essentially the same with only 9 mm difference in soil water content between tube 1, the wettest, and tube 5, the driest at 18 mm below the previously measured full point of 200 mm in the top 0-70 cm which is the main root zone.

The refill point was reached on 24 January as determined by a decrease in daily water use at all tubes. The average daily water use between 20 January and 24 January decreased with distance away from the vine and decreased after 24 January from 7.8 to 3.6 mm/day for tube 1 and from 3.8 mm/day to 3.2 mm/day for tube 5. The refill point occurred at increasing soil water content with distance away from the vine. The depth of soil water extraction decreased from 80 cm at tube 1 to 40 cm at tube 5 at the refill point on 24 January.

Additional data for tubes placed at 30 cm intervals perpendicular to the kiwifruit vine row would provide a three dimensional picture of soil water extraction and hence effective root volume for the kiwifruit vine. The effect of sprinkler pattern and inter row compaction on root distribution may be readily determined from the data.

In the course or regular soil water monitoring, twice weekly measurements of soil water content in kiwifruit on sand soil were made over two summer growing seasons from December 1986 to February 1988 (Figure 2). The first neutron probe reading taken on 16 December showed the profile to be at the full point (180 mm, 0-70 cm). However despite frequent irrigation the soil water content declined rapidly to the refill point.

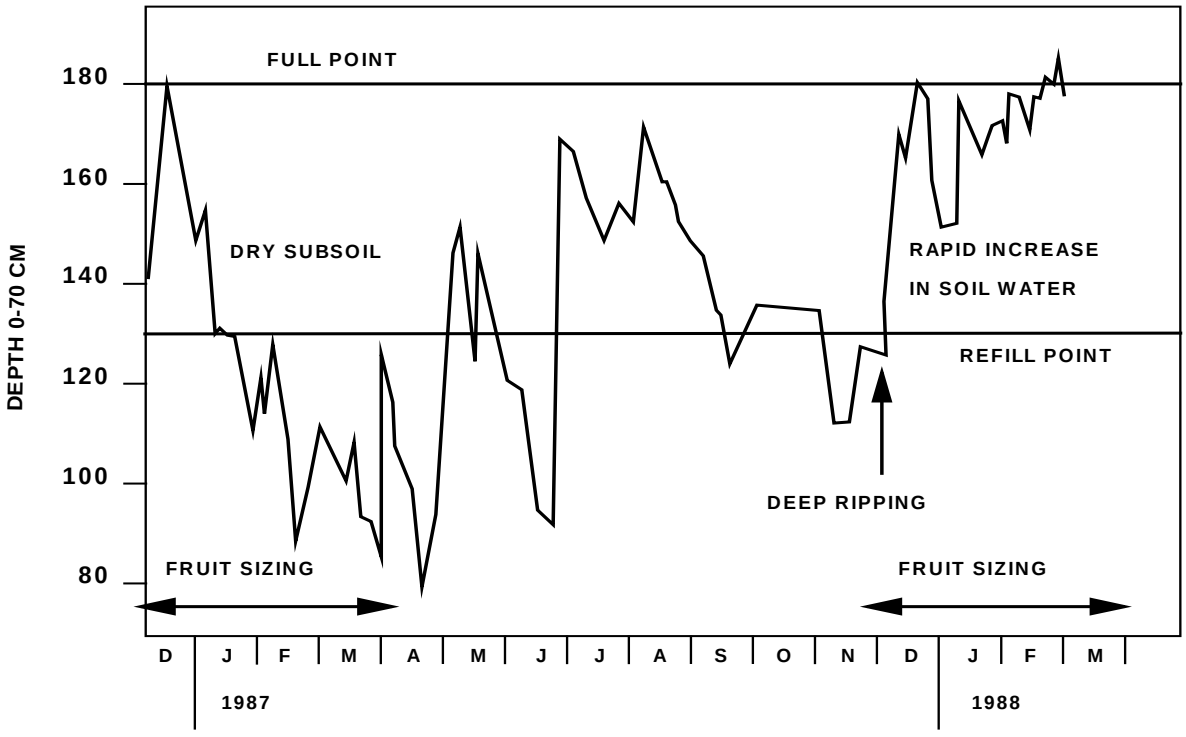

Figure 2: Soil water content in the surface 0-70 cm during the 1986/87

and the 1987/88 Kiwifruit growing seasons.

The soil water extraction pattern during the critical fruit sizing period from December 1986 to April 1987 (Figure 3) shows water use at 80 cm only at the refill point (130 mm on 7 January). By 15

April, however the soil water content was severely depleted at depths greatly exceeding 120 cm. Kiwifruit size during this time was substantially reduced as a result of plant water stress.

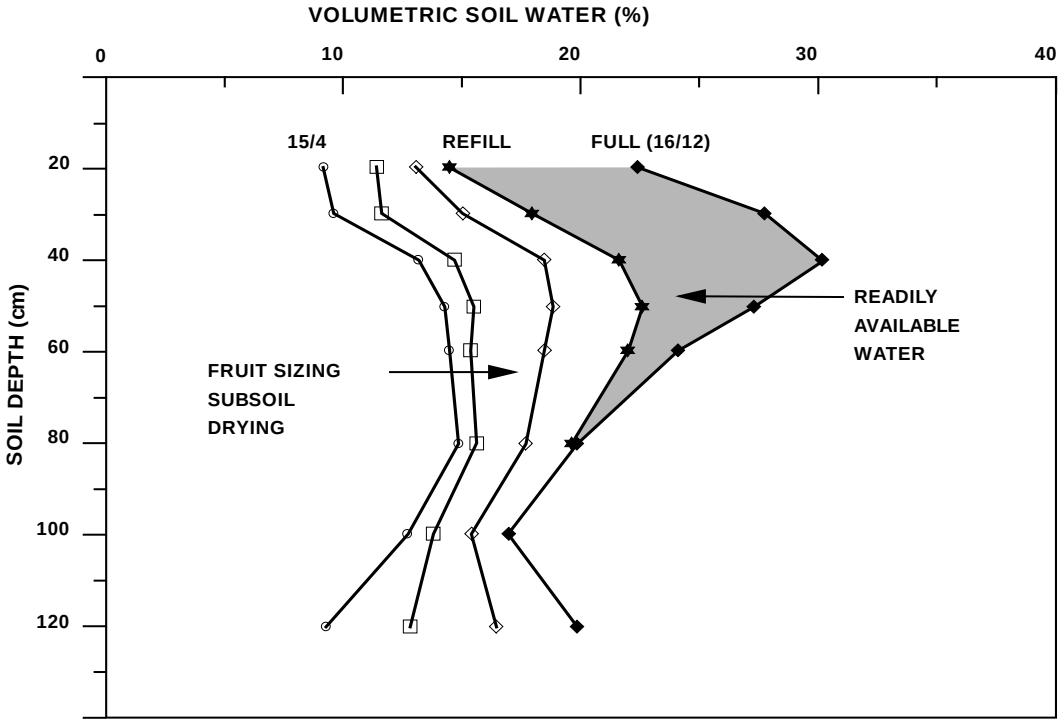

Figure 3: Subsoil water extraction during the 1986/87 Kiwifruit growing season.

The period from 15 April to 15 May was characterised by frequent rainfall supplemented by irrigation which allowed good infiltration of water into the 070 cm layer of the profile as shown by an increase in soil water content from 80 to 150 mm (0-70 cm). The existence of a compaction layer in this very sandy soil is evident from an infiltration “bottle-neck" at 6080 cm (Figure 4). On 15 May no water infiltrated below 80 cm despite quite high soil water content in the 0-70 cm soil layers.

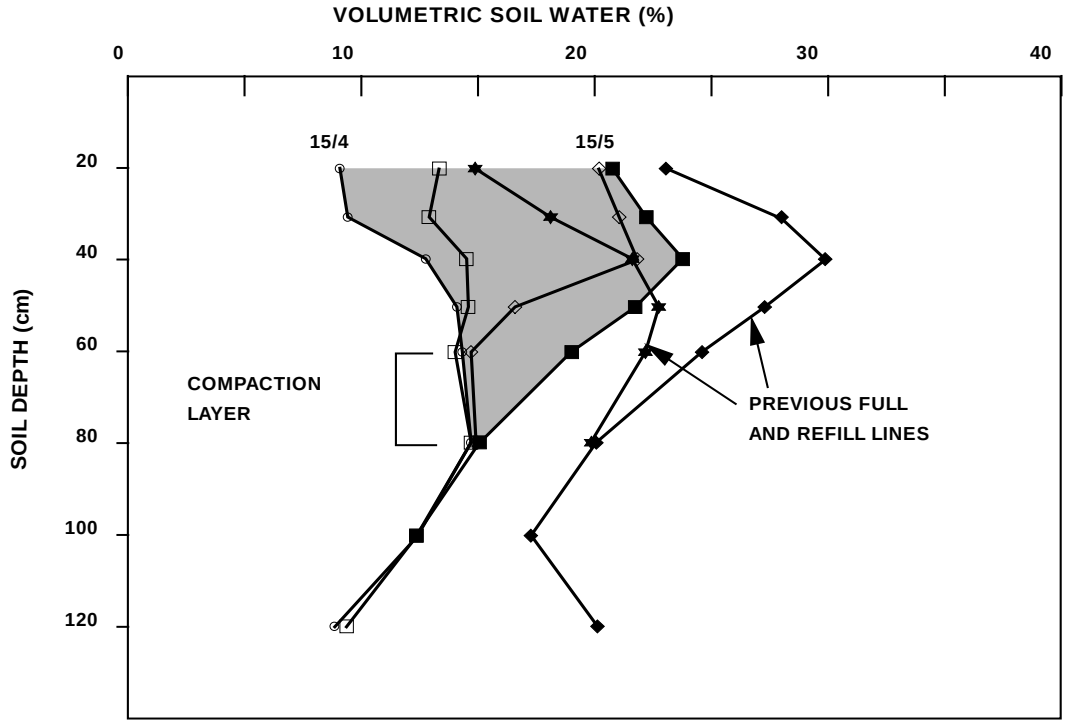

Figure 4: Soil water infiltration due to rainfall and irrigation between 15/4 and 15/5/87

Generally adequate levels of 0-70 cm soil water content were maintained from May to October 1987 as a result of winter rainfall and reduced plant water requirements, despite the dry subsoil which existed, but by November the soil water content was again approaching critically low levels.

The soil was deep ripped to a depth of 60 cm on 30 November resulting in a rapid and substantial increase in subsoil water levels (Figure 5). The soil water content during this second season was maintained at optimum levels during the critical fruit sizing period resulting in much higher yield and quality of kiwifruit.

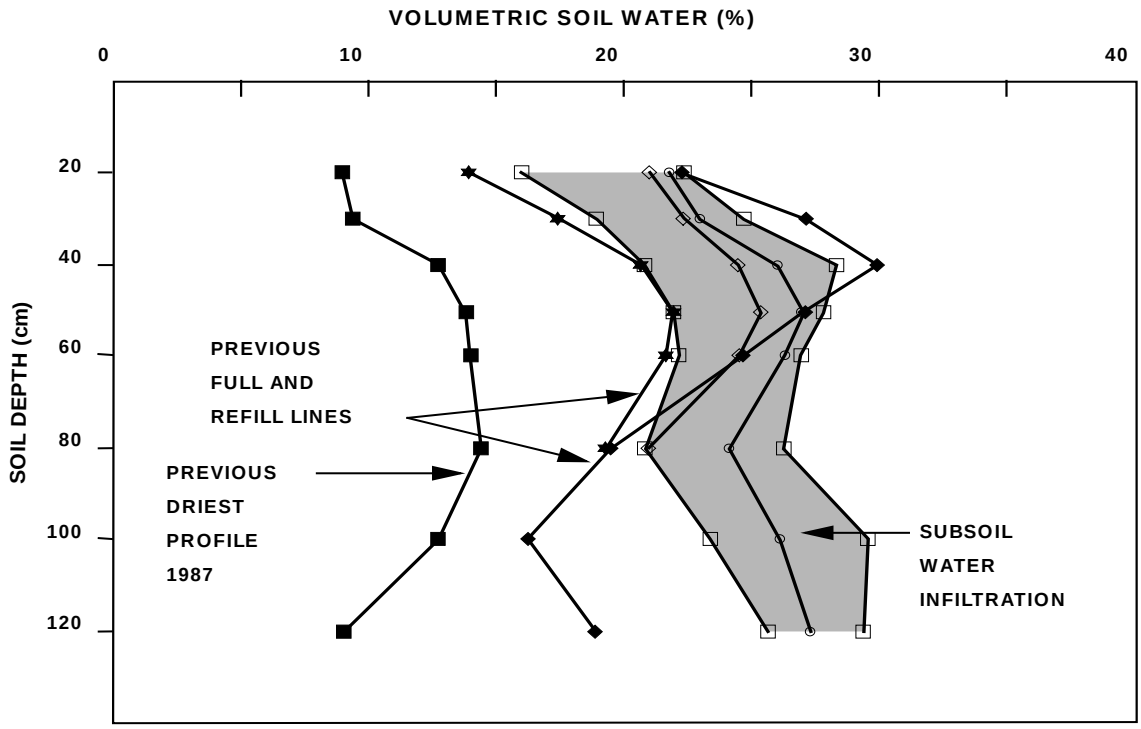

Figure 5: Subsoil water infiltration during the 1987/88 Kiwifruit growing season as a results of deep ripping on 30/11/87

Conclusion

Neutron probe readings in other orchard situations have revealed similar soil structural problems such as compaction and poor infiltration of water into the subsoil. By monitoring soil water with the neutron probe these conditions may be quantified so that appropriate changes can be made and their consequent effect on soil water recorded. The neutron probe is an effective tool for establishing critical soil water levels which must be attained by bud-burst and maintained through to fruit maturation if high yields of export quality kiwifruit are to be achieved

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