

Irrigation Management Series

Irrigation Principles 4

Over the last sessions we have looked at ways of characterising the soil in terms of water content and armed with this knowledge we can now look at different soils and how this effects the irrigation requirements of your operation.

We often hear from clients “we have very heavy soils down the bottom and we do not need to irrigate.” This may well be the case, but in many situations the existence of heavier soils on a property may well provide a false sense of security and not actually provide the salvation from the dreaded irrigator that many farmers believe it offers.

Water Holding Capacity

Water holding capacity is controlled by the soil texture and in many New Zealand soils the volume of stones in the soil profile. Soil organic matter levels also control the ability for a soil to hold water. A recent US study found increasing organic matter by 1% in the top 300mm increased water holding by 15 mm, which would be a phenomenal result if it could be achieved in some of New Zealand’s lower water holding capacity soils. While good management of organic matter levels in the soil can assist maintaining or actually improve water holding capacity, the core soil texture is and the volume of stones is where we need to focus to better understand what size the “vault” for lack of a better analogy holds. A vault is probably not that bad an analogy as the more water you can hold, essentially the more money you have left in the bank.

Lighter soils have the coarser textures and as a result a larger proportion of larger pores. Infiltration capacity tends to be higher as water enters the soils more quickly than heavier, finer textured soils, and therefore reduces the chances of surface run off during irrigation which is of benefit, but the larger pores drain easily under gravity and therefore tend to have much lower Field Capacities.

The opposite is true for the heavier soils. Being dominated with more finer clay particles than sands or silts, they pack in tighter producing far less pores that drain easily under the force of gravity and therefore have far higher Field Capacity values. Using published data for some Canterbury soils we can look at a couple of examples. Firstly a Templeton Silt loam with a Field Capacity of 37% or using the calculations from last month $37\% \times 400\text{mm} = 148\text{mm}$ stored in the main root zone of a typical pasture. On the other hand a typical Field Capacity of Temuka Clay loam, which has much higher clay content, could be 45% or 180 mm.

Readily Available Water

While 32 mm additional water stored seems quite a difference, is it really that high? Initially you may be tempted to say at peak of the season an additional 32mm of stored water gives me over 5 days more, at an evapotranspiration rate of 5 mm/day to get back to irrigate this site. But wait, you cannot characterise the soil in terms of its total water holding capacity. The Readily Available water holding is the key to understanding the constraints of your particular soil.

Readily Available Water content is the water the total water held at suctions between Field Capacity and Stress Points.

Taking the above soils again we have for example a Stress Point of 25% or 100 mm for the Templeton, giving $148-100=48$ mm of readily available water. Compare this to the Temuka that may have a stress point at 36% or 144 mm giving a readily available water content of $180-144=36$ mm, the difference between the soils is far less at 12 mm with the Templeton having the greater available Readily Available Water content.

Why?. Because the smaller particle sizes of the clay loam make it more difficult for the plants to extract the water as the resulting pores in the soil are much smaller, so stress is reached at much higher levels. The Temuka Clay loam in this example is over 50% clay compared to the Templeton Silt Loam which is only 21% clay. While the soil may be moist in a heavy soil the water is not always as readily available to the plant.

So heavy soils are not always going to require less irrigation. An understanding of the characteristics of your soil is essential to designing an irrigation system to will work for your property. For example you may have a Readily Available Water Content in a Lismore soil as low as 30 mm. In terms of days from Field Capacity to Refill Point in the middle of the season this may only be 7-8 days. I often visit properties using spray irrigators with return times in the order of 12-14 days on soils similar to this. Long periods of water stress result and in many cases over watering occurs as farmers try and put on the 60-70mm they think they need until they get back next, but most is wasted as it drains from the root zone as the soil will never be able to store this depth of water.

Research clearly shows the effects on production of water stress. For example figures of 1-3% loss in production from arable crops for every 10mm the crop is taken below stress point should focus irrigators on ensuring they understand their soils, design their irrigations systems to match whenever possible and monitor closely soil moisture levels during the season to ensure they maximise their returns.

Measuring the water content is a relatively simple task with a number of user operated systems and pay as you go services available. AQUAFLEX NZ are available to assist you with developing an irrigation management system for your operation, please feel free to contact them on 03 3848900 or visit www.aquaflex.co.nz

	Temuka Clay Loam	Templeton Silt Loam	Lismore Silt Loam
Water Content at Field Capacity (mm)	180	148	124
Readily Available Water (mm)	36	48	35

The above data extracted from published studies show the large difference between water content at Field Capacity and the Readily Available Water Content for three Canterbury Soils. Note the Lismore had little stone in the top 400 mm of the profile.