

Irrigation Management Series

Irrigation Principles 3

In Irrigation Principles 2 we looked at defining the water contents for Refill or Stress Point. Armed now with the concepts of Field Capacity, Permanent Wilting Point, Plant Available Water and Stress Point we need to delve further into the ways of describing the soil moisture content.

There are two main descriptors of soil water. The first is matric potential and the second the water content. Both descriptors are used to aid irrigation management decisions, but the first has significant limitations in its usefulness.

Any soil volume is made up of three parts: Soil, Air and Water. Water is held in the voids between the soil particles by capillary and absorptive forces. The same forces that will hold water in a drinking straw when it is lifted out of a glass of water. The smaller the void the greater the capillary forces that hold the water and this is the force that the plant must overcome to access water from the soil. Plants are very much like humans and look for the easiest options when it comes to accessing water. This taking water from the largest voids first as it is required to exert less suction to remove the water. So as the soil dries the suction required to remove water will get larger and larger. At a point the suction required to remove water will become so great that the plant can no longer extract the optimum amount of water for growth. This suction represents Stress or Refill Point. The difficulty faced by irrigators is how much water to apply once they reach Stress Point to bring the soil back to Field Capacity. There is a relationship between Matric Potential and Water content. This is called the Soil Moisture Characteristic, but it changes depending on whether the soil is wetting or drying and is very soil dependent. The complicated relationship between matric potential and soil moisture, combined with the fact the sensors such as Gypsum blocks and tensiometers that are used to measure matric potential give variable results and only work reliably over a narrow range of the suctions that are of interest for irrigation management make Matric Potential not ideal for decision making, especially when far more reliable technologies that directly measure water content are freely available.

The key to depth of water you need to apply to refill the soil to field capacity is knowing the Volumetric Water Content. Volumetric Water content is simply the fraction of any volume of soil that is water and is normally represented as a percentage. The key relationship we need is that the percentage converts directly to mm water stored per 100mm depth of soil. For example if our soil had been determined to have a field capacity of 35% we would have 35mm/100mm of water stored in the soil profile when at this water status. For a pasture system we may have determined this Field Capacity in the top 400mm of the profile as this is where the bulk of our root zone is. The total water holding at Field Capacity that we interested in is then $4 \times 35\text{mm} = 140\text{mm}$ as we have the equivalent of 4 100mm thick layers in the root zone all holding on average 35mm of water. Now with an

understanding of the maximum water holding you can maintain, you can measure the current water holding and calculate the deficit so you can apply the correct depth of irrigation. For example you measured your soil moisture and it was 26% in the top 400mm of the soil profile. Using the same calculation as above you would have 104mm of water stored. The deficit is therefore $140-104=36$ mm deficit. Therefore if you should aim to apply in the order of 40mm maximum to avoid significant drainage as the soil will be unable to hold the excess.

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