How much water do I need?

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As mentioned last month, the plan is to grow the horticultural sector to $10 billion by 2020. Last month we focused on site selection but this month we will focus on water. Water is critical for crops. Not only to grow, but, also to protect from frosts. Increasingly we will see water becoming a big issue. Already in Canterbury it is a huge issue and there is some talk about installing water meters in the Hawke's Bay. In some areas of the Bay of Plenty water meters are already installed. They can add quite a cost burden for growers. Given that we may soon need to pay for water we need to make the best use of it.

The traditional way of optimising water use is with a water budget using ET data. ET stands for Evapotranspiration and describes the process by which plants and soil loose and use water. Evaporation is the loss of water from the soil while transpiration describes how plants use water. How it all works is shown in figure 1.The mechanics of calculating ET are difficult and involve the interaction between sunshine, temperature, wind and humidity. Fortunately, the calculation can be done for you by either HortPlus or NIWA. Both of these organizations use the modified Penman equation to estimate ET and you should be able to get these from either MetWatch Online or the NIWA database.

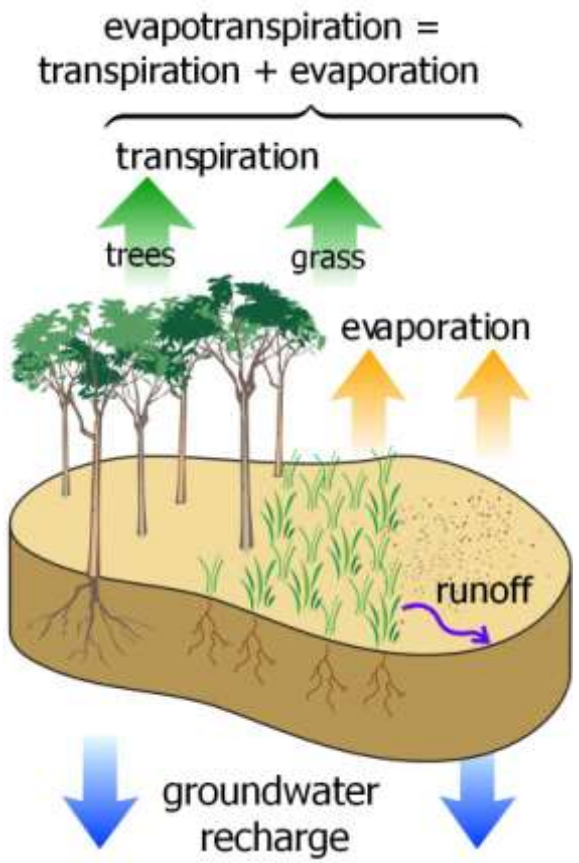

Figure 1

An example water budget is shown in figure 2. This example shows inputs from rain and irrigation and outputs from ET. Imagine your plants and soils are like a bucket. Water enters the bucket by either rainfall or irrigation. It will leave the bucket by drainage, evaporation or transpiration. So all you will need to keep a track of is your rainfall, irrigation applied and the ET values for your area. You can get another look at this process by looking at the UN irrigation brochure listed here: http://www.fao.org/docrep/X0490E/x0490e00.htm This is an excellent document to read and identifies

irrigation management practices that should optimise yield. It is interesting to note that the UN sees the need for targeted irrigation.

Block	Home
Field capacity	33%
Stress point	20%
Available water	13%

Date	Max temp	Min temp	Average tamp	ET	Crop Factor*	Rainfall	Irrigation	Soil deficit
1/09/2007	20.4	7.0	13.7	4.1	0.95	0.0	0	-3.9
2/09/2007	20.0	-0.3	9.9	3.8	0.95	0.0	0	-7.5
3/09/2007	22.1	2.3	12.2	3.9	0.95	0.0	8	-3.2
4/09/2007	21.3	7.4	14.4	3.0	0.95	10.5	0	4.4
5/09/2007	12.1	3.5	7.8	4.0	0.95	5.3	0	5.9
6/09/2007	12.5	-1.9	5.3	4.2	0.95	0.4	0	2.4
7/09/2007	13.0	-2.6	5.2	4.1	0.95	0.0	0	-1.5
8/09/2007	18.6	3.0	10.8	5.0	0.95	0.0	5	-1.3

* = Based on FAO guidelines for mid-season apples

Figure 2 : Example water budget

Figure 2 demonstrates some important features of soil water management even though it is based on example data. The first thing is the Field capacity of your site. This is the amount of water your soil can hold before drainage occurs. In this example it is set to 33%, that is for each meter of soil there will be 33% of water or 33% of 1000 mm which equals or 330mm of water. The other point to note is the stress point. This is the point below which there will be no growth and the plant will die. That means the total amount of available water will be 330mm - 200mm = 130mm. Typically a grower will suffer economic loss above the stress point. Apples for example start to loose fruit size at about 22% in the Hawkes's Bay but stonefruit will suffer at 25%. These figures should give you an idea of how much water is available and needs to be replaced by either rainfall or irrigation.

Figure 2 shows how a typical water budget would operate. Each day the ET is subtracted from the soil deficit and rainfall and irrigation are added. In the example shown we have 8mm of irrigation on the 03/09/2007. This will compensate for the deficit of -7.9mm. This shows another important example of why a water budget will be useful. As well as telling you when to apply irrigation, it tells you how much to apply. For this to work properly you will need to know the output of your irrigation system. This can be easily measured by putting a bucket underneath a sample of sprinklers and timing their output. Once you know the area covered you should be able to estimate the amount per hour in mm. Preventing irrigation amounts above the field capacity value will minimise leaching, an important factor to consider if you live close to a large body of water. Please note that the raw ET value, based on a grass cover, and needs to be adjusted to suit a crop and groundcover type. This is called the crop factor and makes an allowance for the type of crop being grown. The value chosen is from the FAO guidelines mentioned earlier.

This all demonstrates an important point. You will need some knowledge of your site. Each site is quite different. For example, the light volcanic soils in the Bay of Plenty have a low field capacity value but the plants will root deeply. I was lucky enough to witness Dr Garth Smith excavate a kiwifruit vine on Bill Baldwins property on No. 3 Road in Te Puke. The taproot went a long way down and even in a severe drought they were able to extract enough water. Contrast that with the Whakatu area of Hawkes Bay. The alluvial soils have a relatively high field capacity but the rooting depth is much lower because of the high water table. The high water table tends to prevent root penetration because of the low oxygen content. So each grower will need an in depth knowledge of their site to effectively manage soil moisture levels. The Gimlett Gravels of Hawkes Bay is an interesting area. It has an extremely low field capacity value. Coupled with high wind levels, irrigation should be required every day during summer. An ideal opportunity to positively influence grape quality and hence wine quality. Some of the soils in Central Hawkes Bay are also like this.

To compliment a water budget, a grower may need a direct measurement of available soil water. This can be done with either a tensiometer or one of the high tech gadgets available, which includes a time domain reflectometer (TDR) or a neutron probe. When used in conjunction with a water budget it will provide a valuable tool for managing soil moisture. By the way, HortPlus is involved in a major project to make a water budgeting tool available to growers so watch this space.