

Dr Trevor Atkins, HortPlus Ltd
Email: trevor.atkins@hortplus.com
Web site: www.hortplus.com

Have you ever wondered how a weather station monitors rainfall or leaf wetness? In this month's Weather Sense we "look under the hood" at some of the technology enabling weather stations to accurately sense and measure the environment around them.

When you look at a weather station, you can usually spot the rain gauge easily as it has a funnel at the top (refer back to last month's copy of The Orchardist for a photo of a weather station). The funnel is used to increase the surface area from which rain is collected. In effect, the funnel acts as an amplifier to help with the detection of rain, especially at lower rainfall levels. There are a number of methods available for actually determining rainfall, but the best and now most widely used method to

monitor rainfall is a system called the "tipping bucket". The tipping bucket is quite clever. As rain falls it fills a tiny receptacle (bucket) which when filled becomes over-balanced and tips over. When the bucket tips it triggers a counter which records the fact that the bucket has been filled. A similar bucket on the opposite side of the pivot point then fills until it causes a tipping event, and so on. The buckets are carefully calibrated to hold an exact amount of water before tipping over. The most common volumes correspond to a tip for every 0.1mm or 0.2mm of rain. The higher cost 0.1mm bucket can record rainfall at a resolution of 0.1mm; the generally lower cost 0.2mm tipping bucket rain gauge needs 0.2mm rain before the bucket is filled



sufficiently to tip over. If you want to get good information about rain in light showery conditions a 0.1mm precision rain gauge is required. If cost is a major issue though, the lower cost 0.2mm gauge can save money and is a lot better than no rain information.

The technology available to monitor the environment now goes well beyond just measuring and recording the weather. "Weather stations" can now be outfitted with sensors that enable soil moisture to be monitored for example, or leaf wetness to be estimated. Leaf wetness is of interest to orchardists because of its influence on diseases such as blackspot - the aptly named "wet weather diseases". For many diseases, there is a need for leaves to be wet before infection can occur, and so a number of approaches have been taken over the years to monitor leaf wetness (or surface wetness as it is better known to the technophiles). The most common approach currently in use is a "flat plate". The flat plate is simply a rectangular section of an electrically non-conducting material, onto which is bonded a grid of

gold. As water droplets arrive on the plate during a rain shower, the electrical characteristics of the grid are changed. These changes are used to estimate how wet of how dry the leaves might be. Recently, the cylindrical leaf wetness sensor has been developed in an attempt to better simulate the wetting and drying characteristics of the canopy. The principles remain the same, but rather than the conducting material lying on a plate, it is in a cylinder. The wetting and drying characteristics of these sensors is still the subject of experimental and trial work, the hope is that they will better mimic the wetting and drying characteristics of a canopy in showery weather. Dr Rob Beresford and Warwick Henshall at HortResearch have continuing trials investigating and improving these sensors.



In addition to simply monitoring the environment the high-end weather stations such as those from Campbell Scientific Instruments and the New Zealand made MetTech station (both distributed by Scott Technical Instruments) have sophisticated on-board computers that can perform simple or complex calculations and respond with various actions in an autonomous fashion. Responses can take the form of a number of actions including opening or closing irrigation valves in irrigated blocks, making a telephone call to give a frost alert, or opening or closing vents in glasshouses. These stations are also able to communicate with the outside world, downloading monitoring data to remote computers via telephone and radio link.

As mentioned last month, there are lower cost options for monitoring the environment such as the Tiny Tag range of sensors and loggers (available through Energy Engineering or HortPlus). The Tiny Tag approach is to have one or two sensors connected to a low cost data logger with limited functionality. Communications with the data logger require a direct connection to PC. This is accomplished either by bringing the logger in to the office for downloading or bringing a laptop computer out to the data logger; or by running a cable directly from the data logger into the PC for a permanent connection. (Note that if you are going to run a cable direct to PC, do it through a junction box so the cable can be disconnected between downloading sessions - otherwise you now have a lightning rod permanently attached to your computer!)



This very brief introduction to weather stations and how they monitor the environment is by no means a complete treatise on what is available or what can be done. It was intended really to whet your appetite as to what is possible and to alert you to the fact that there is a very wide range of equipment that is available to you, at a range of costs. An increasing number of growers are no longer satisfied with reading rain gauges on fences and reading the newspaper to get generalised regional weather information. Modern fruit production demands access to good environmental data in an electronic form for input to tools used to assist with decision making. For

these growers, there is now a range of systems available to enable the collection of data about the weather and the wider environment.