2.3 Surface wetness measurement

Fact sheet objectives

- To describe surface wetness measurement
- To illustrate the use of surface wetness duration in disease models

What affect does crop tissue type have on wetness **incidence and persistence?**

Why measure wetness?

Wet conditions favour the development of many fungal and bacterial diseases that attack plants via leaves and fruit. For growers, a record of leaf wetness is helpful for management of foliar diseases.

Leaf wetness

Leaf wetness can arise from both rain and dew, and to a much lesser extent from guttation, where droplets are exuded onto the surface from within a leaf.

Wetness sensors

The most common form of wetness sensor is an artificial leaf, made up of metal strips on an electrically non-conducting base.

There are two designs, a flat plate and a cylinder.

Wetness sensors may be incorporated into the housing of some commercial weather stations, or they may be stand-alone sensors.

How sensors work

The electrical resistance between the metallic strips changes as moisture settles during rain or dew.

Deployment

Should wetness sensors be set up in a crop canopy?
The sensors will then experience the same environment as the crop, but will also be subject to the day-to-day hazards of orchard management. Build up of spray deposit can degrade sensor performance, and there is always the risk of physical damage during pruning or mowing.

Work at HortResearch and elsewhere indicates within-crop sensor output is variable, depending on the amount of shading. Our experience favours deploying wetness sensors outside the crop, but nearby, out of the way of sprays and tractors. In addition, sensor exposure is more consistent outside the crop.

When wetness sensors are deployed outside the crop, the cylindrical sensor appears to represent crop wetness better than the flat plate.

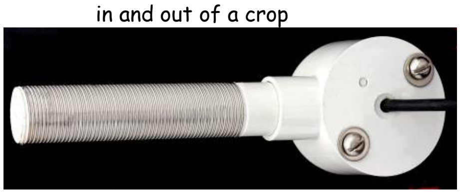
Comparing sensor types and location

In a comparison of flat plate and cylindrical wetness sensors (see Henshall web reference) it was found that these sensors represented leaf canopy leaf wetness reasonably well, although most sensors under most conditions over-predicted canopy wetness. Therefore, the standard mast mounted wetness sensors used on Orchard 2000 weather stations are likely to give a conservative estimate of wetness duration for disease prediction purposes. This conclusion requires further study because it contradicts casual observations from orchardists involved with apple black spot infection period monitoring who have sometimes suggested that apple leaf canopies might stay wet longer than electronic wetness sensors indicate.

There were large differences between top and bottom leaf surfaces in their wetting and drying characteristics. The cylindrical sensors tended to represent both top and bottom surfaces better than did flat plate sensors alone or in shade cloth enclosures. Although the standard flat plate sensor inside a tree canopy was as good as the cylindrical sensor, this deployment option is not considered practical because agrichemical deposits from pesticide spraying alter the performance of sensors and must be avoided.

Greater accuracy of wetness monitoring might be gained by further development of the cylindrical type of sensor. The surface of the cylindrical sensor can exchange radiation with both the sky and the ground, whereas the flat plate sensor radiates to the sky only. Therefore, the wetting and drying characteristics of the cylindrical sensor are probably more similar to a leaf canopy than are those of a flat plate sensor, either within or outside the canopy.

Unpainted flat plate wetness sensors in and out of a crop



Cylindrical wetness sensor

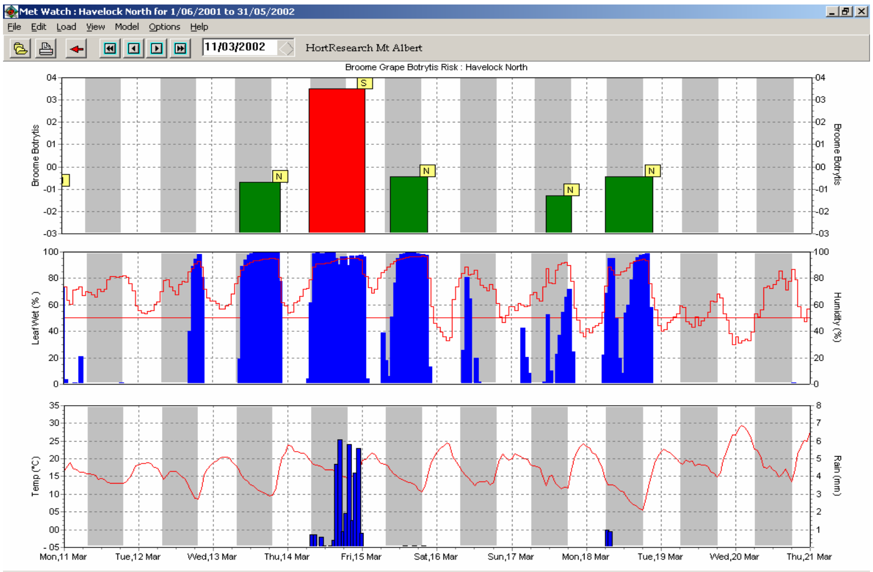
Use in disease models

Wetness sensors are used to define **wetness duration**, the time between wetting up and drying out. Wetness duration helps define an infection period, and combined with temperature and other factors produce an estimate of disease risk.

The figure on the next page shows the output of a disease model for calculating grape botrytis infection periods from weather information, part of the Hortplus™ Metwatch software package. The central blue trace represents wetness sensor output; a value of more than 50% is regarded as wet.

Whenever wetness rises above 50% the computer model starts calculating a risk index. When wetness drops below 50% for more than a few hours the calculation terminates and the risk is displayed in the upper trace (N = nil risk, S=Severe).

Unpainted wetness sensors of the type shown do not respond to humidity. However, it is possible to differentiate dew periods from rainfalls (see wetness record relative to rainfall [blue bars in lower box above] as rainfall gives an abrupt wetness sensor change from dry to wet, while dew periods typically give a gradual rise in wetness readings over 2-4 hours.



Summary Information

- Free moisture on plant surfaces is a key requirement limiting infection by many pathogens
- Surface wetness data can be used in disease predictions
- Wetness sensor type and placement will affect the wetness durations recorded
- Canopy indicate that wetness sensors tend to over estimate canopy wetness periods
- Cylindrical sensors are less affected by wind and other weather conditions than flat plates
- Sensor maintenance and cleanliness is critical to the reliability of wet periods recorded
- Sensor deployment out of the crop canopy is recommended

Further reading and other sources of information

Henshall,W.R. and Beresford, R.M. 1997. Performance of wetness sensors used in plant disease forecasting. Proceedings of the New Zealand Plant Protection Society Conference.

http://www.hortnet.co.nz/publications/nzpps/proceedings/97/97_107.htm

The surface wetness duration homepage (USA)

http://www.nysaes.cornell.edu/pp/faculty/seem/magarey/leafwet/lwtitle2.html

A MAF Sustainable Farming Fund Project:

Sustainable Farming Fund
www.maf.govt.nz/sff

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