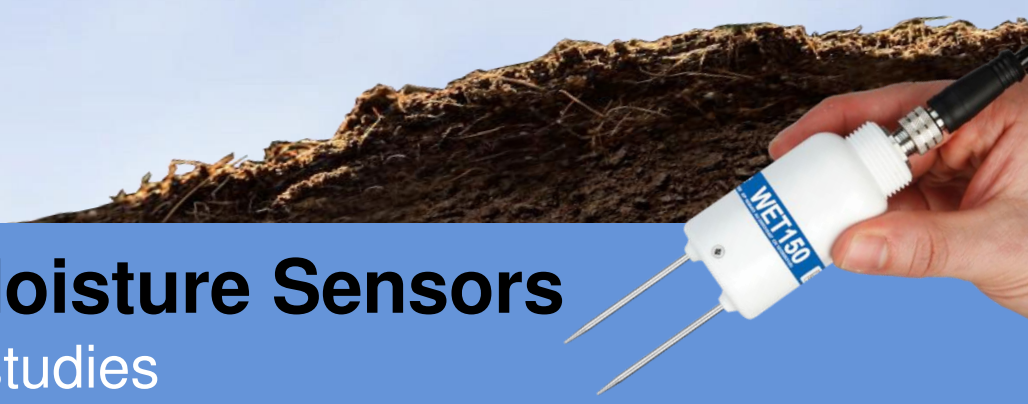
Delta-T Devices

CASE STUDY



Delta-T Soil Moisture Sensors

Seven brief case studies

Rothamsted Research: SM150T Sensor used in major long-term experiment

Rothamsted Research is the longest-running agricultural research institute in the world. Their Park Grass Experiment was established in 1856 - and is still going strong. It studies the effects of different types of mineral fertilizers and organic manures on the yield, botanical composition and quality of a mixed sward cut for hay.

Recently the research team have been keen to characterise the experiment's effects on soil hydrology - by monitoring the soil water content on contrasting plots. To achieve this, they selected a total of 12 treatment plots covering a range of inorganic fertilizer and organic manure inputs – four with liming treatments (to maintain specific soil pH values).

In each of the 12 subplots three Delta-T Devices SM150T Soil Moisture Sensors were installed horizontally at a depth of 20 cm, with the cables relayed back to three GP2 Data Loggers through conduit piping.

The sensor installation was completed in February 2020, and the loggers have since been interrogating the sensors every minute - recording the average, maximum and minimum soil water content every hour, for upload to Delta-T's online data platform: DeltaLINK-Cloud. This approach means that real-time measurements can be viewed by the Rothamsted team remotely on mobile smart devices at any time. This data has shown good agreement between each SM150T sensor within any subplot.

The team has used the data gathered by the Delta-T Devices instruments to explore relationships between the soil water content and soil chemical/microbiological properties.

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The Park Grass Experiment at Rothamsted Research


SM150T Sensor installed at 20cm depth

SBR Agricultural Products, Turkey: Using the WET-2 Multiparameter Sensor to optimise growing conditions, fruit yield, and fruit quality

Major Turkish fruit producer SBR was founded in 1990 and operates in the Mersin Silifke region of Turkey. It specialises in the cultivation berries - using cutting edge techniques. Its growing facilities are substantial - with 400,000 square metres of hydroponic strawberry greenhouses, and separate 50,000 square meter production areas for other berries.

SBR staff have been using the Delta-T Devices WET Sensor (and accompanying handheld readout meter) since 2018 to help manage their hydroponic strawberry production – taking critical measurements of soil moisture and pore EC (Electrical Conductivity) of the water around the plant roots, several times each day.

These measurements are used by SBR's crop managers to fine tune fertigation, in order to maintain optimal water and nutrient levels for each crop.

The overall effect of SBR using the WET Sensor data has been to reduce unnecessary water (pumping) costs, expensive fertiliser use, waste and run-off - whilst increasing crop yield and fruit quality.

SBR's Mehmet Özmen says, "*The portability of the sensor and readout unit, means we can carry it with us when we inspect crops – and the multiple calibrations mean that we can always get a reliable reading, regardless of the growing media. We take multiple readings on a daily basis – and the EC and moisture values the WET-2 Sensor provides enables us to adjust the levels of irrigation and fertigation to achieve ideal soil and substrate conditions*.

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SBR staff member taking portable measurements of substrate moisture. temperature, and EC at their facility in Mersin Silifke.

The Jena Experiment: Use of the PR2 Profile Probe across multiple biodiversity/ecosystem function research experiments

The Jena Experiment is a long-term biodiversity focused research project funded by the German Research Foundation (DFG). The large-scale project has been running since 2002 and involves over 100 scientists. The research is centred around discovering which mechanisms influence ecosystem functions and make them stable.

The experiment takes place on a 10-hectare site in Jena, Germany - which consists of approximately 600 plots of artificially assembled grasslands.

Each plot is different, some are monocultures, others are grassland mixtures with up to 60 different species of grasses, herbs or legumes. Some of the plots are covered with a roof to simulate climatic extremes such as drought.

Research at the Jena Experiment has found that plant productivity increases with increasing plant species richness. That means that meadows that have high diversity produce more biomass.

The PR2 Profile Probe has been an important part of the Jena Experiment's sensor network for nearly the entirety of this long running project.

Dr Anne Ebeling, Scientific Coordinator at the Jena Experiment, explains that,

"Soil moisture is an important parameter for many of the processes studied in our research – especially at depths below the immediate surface soil. For this reason, we have been using the PR2 Profile Probe to measure moisture profiles down to one metre for many years.

The PR2 measures soil moisture at varying depths on a total of 240 experimental plots across the Jena facility. The readings are taken on a weekly basis in the spring and summer, and on a bi-weekly basis in the autumn and winter."

View the full case study here

The expansive research site in Jena, featuring around 600 unique plots of artificially assembled grasslands.

Cranfield University : Using the SM150T to help Improve banana irrigation management and productivity for smallholders in Columbia

As part of an 18-month project funded by Innovate UK, researchers at Cranfield University have been working with UK and Colombian partners to help improve the productivity of banana producers in the Magdalena region.

One of the major project challenges has been gathering locally relevant soils, agroclimate and crop information to support the development of a robust irrigation planning tool - and this is where the involvement of Delta-T Devices has been important.

Professor Jerry Knox of Cranfield University's Cranfield Water Science Institute explains how Delta-T Devices's equipment and technical support plays an important part in the project:

"Working with Delta-T Devices, we installed two arrays of SM150T soil moisture sensors at varying depths - in selected well-managed plantations in the Santa Marta region of Colombia. We also installed a Delta-T WS-GP2 Automatic Weather Station to provide input data to drive our irrigation model - as there is limited agrometeorological recording in the region.

The Delta-T Devices kit has been first class - it has not missed a beat since we installed the equipment. We now plan to leave the SM150T sensors in-situ after the project to continue developing our understanding of the soil-water fluxes under banana crops."

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Professor Jerry Knox works and colleague installing Delta-T sensors and loggers

Clock House Farm, UK : Using the portable WET Kit to help ensure optimum health of large berry crop

Clock House farm nestles in the rolling hills of Kent, a few miles south of Maidstone in the UK. The expansive 250-acre farm grows a variety of fruit, including strawberries, raspberries and blackberries.

Notable innovators in horticulture, Clock House Farm were one of the first commercial growers to adopt table-top production of strawberries (late 1990s).

Since 2008 they have been using Delta-T WET Kits (comprising the WET-2 Sensor & HH2 readout unit) to monitor growing conditions - making thousands of readings a week. Farm Manager Nick Deppe oversees WET Sensor usage across the farm and explains how and why the device is used:

"The WET Sensor measures substrate moisture and EC quickly and easily. These variables are critical for ensuring our fruit are as healthy as possible at all times.

Once a week I meet with an agronomist, and we set 7-day targets for both % moisture levels and EC levels for each fruit substrate. I then produce a sheet on which the current levels can be filled in (on a daily basis) and compared against the agreed target levels.

This approach allows us to continually monitor the moisture and EC situation, hit our targets, and address any shortcomings at very short notice - something that is absolutely critical with fruit such as raspberries, which can deteriorate within a matter of hours under sub-optimum growing conditions."

Nick Deppe explains how his team uses the WET Sensor

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Teesdale Special Flora Research & Conservation Trust : Urgent plant species recovery research using the WET150 Soil Sensor

Upper Teesdale's unique assembly of rare special flora is in crisis. Recent surveys have demonstrated average declines of over 50% since the 1970s - and 28 species are currently threatened with extinction (in part due to an influx of aggressive sedges and rushes).

96-year-old Dr Margaret Bradshaw (MBE) is a nationally renowned botanist, specialising in plant conservation. Her charity, the Teesdale Special Flora Research & Conservation Trust aims to reverse these declines.

Dr David Oatway

Dr David Oatway has recently been contracted by the trust in a bid to better understand the ecological processes at play at this important site of special scientific interest.

One of the most important locations for rare plants in Upper Teesdale is Widdybank Fell. The hydrology at this location is a key factor thought to be underlying a destructive influx of less desirable flora. It is thought that such a situation could have arisen as a result of reduced flow of water through the mire (a consequence of the sward closing up) - resulting in increased acidic surface water that favours the problematic 'influx' plants.

In 2021 a naturally closed historical drain was reopened to increase water flow away from the mire (an unusual and site-specific experimental process). The hand digging of this drain revealed that there is a 10-12cm raw humus layer present over the glacial till, which is also thought to be favouring the acid-loving plants at the expense of the rarer arctic, alpine and montane plants.

Dr Oatway explains further, "*Using the WET150 Sensor I'm examining the differences in the moisture content of the soil surface above and below the newly opened drain, as well as within the calcareous mire more generally, to see if these correlate with any changes in vegetation composition. I'm also looking at pH levels, as it is suspected that water which sits longer on this mire may become more acidic, affecting the growth of certain plants.*"

David's experience of using the WET150 Sensor and kit at Widdybank Fell has been positive. He says, "*It was clear from this project's inception that I needed a soil sensor which was particularly good at differentiating well at high moisture levels. I've now had the opportunity to thoroughly test the WET150 in the field and I'm pleased to say that it appears to have been very effective at recording percentage moisture in a the wet calcareous-fed mire environment. Knowing the topography of the site as I do, I can say that the data visuals we have created using the WET150's output are really exciting.*"

Dr Margaret Bradshaw (MBE)

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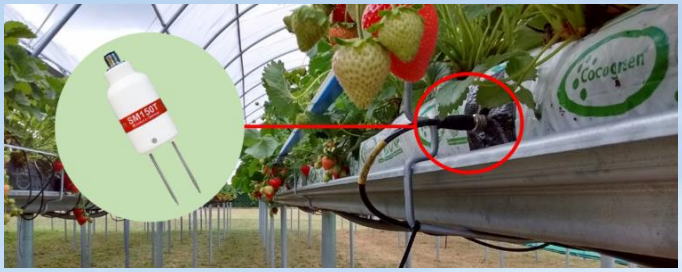
NIAB, East Malling, UK : Use of the SM150T and ML3 ThetaProbe soil sensors to help achieve record yields at NIAB EMR's WET Centre

The WET Centre, based at NIAB EMR in Kent, is an extensive research and demonstration facility that features a portfolio of innovative growing techniques and smart irrigation systems for the soft fruit sector.

Delta-T Devices has been an industry partner of the WET Centre since its inception in 2017, and supplies soil sensors and dataloggers for both its research projects and (commercially available) irrigation systems.

The evolving irrigation technology developed at the WET Centre has shown increasingly impressive results. 2020 saw yield equivalents of up to 72t/ha for class one strawberries (up notably from the previous year). For historical comparison, industry average marketable strawberry yields for the years 2011 – 2013 were 45 t/ha.

The WET Centre's smart irrigation systems also saw large water use efficiency improvements, with the amount of water required to produce a tonne of fruit measured at 37.5 m3 - 44 m3. By comparison, industry average figures from the 2011-2013 period were in the range of 49 m3 - 108 m3 of water. These data clearly show the improvements that advancing technology has brought to these key metrics.



The cutting-edge techniques used to achieve these impressive results revolve around important research by a NIAB EMR team led by Dr Mark Else - using several Delta-T Devices instruments, including the QS5 PAR Quantum Sensor, SM150T and ML3 ThetaProbe soil moisture sensors, GP1 Data Logger, and the GP2 Advanced Data Logger and Controller.

Initial research by the team to manipulate growing environments (for better fruit quality/yields and less water waste) took place in small polytunnels. However, the WET Centre has given the researchers an opportunity to demonstrate that their techniques are just as effective in "real world" environments, i.e. typical large scale commercial farm polytunnel conditions with tabletop configurations.

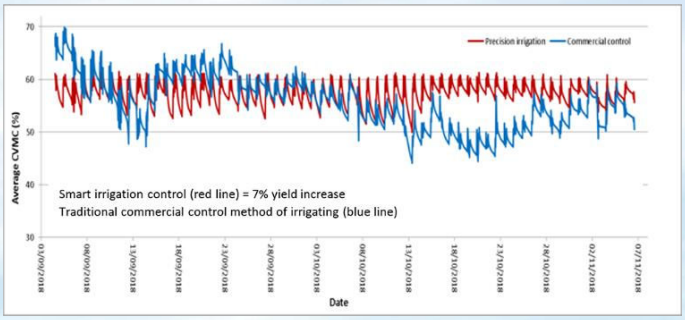
The NIAB EMR team's research focused on the use of automated irrigation control systems, with as little human intervention as possible. The programmable GP2 Datalogger allowed the NIAB EMR team to set different control algorithms for separate experimental irrigation regimes, and then measure and compare the outcome of each approach.

These experiments enabled them to accurately determine key plant stress points and identify optimum moisture content levels in the growing substrate throughout the life cycle of the strawberry plant. The use of smart irrigation technology also allowed the team to ascertain the minimum amounts of water needed to achieve the desired level of strawberry plant quality and yield.

This minimising of wastage is of huge importance given the increasing scarcity of water - and the likelihood that intensive horticultural growing systems will become increasingly based in urban locations, where very strict water waste prevention protocols (and legislation) are likely to be the norm.

The irrigation technology used in the WET Centre is being adopted by an increasing number of large-scale commercial growers. Studies from 2018 at one such UK site clearly showed the benefits of using a precision irrigation package designed by the NIAB EMR research team and based on equipment from Delta-T Devices (SM150T sensors and GP2 Data Logger) and Netafim UK (irrigation system).

Data from this grower (shown below) demonstrates the differences between controlling the levels of substrate moisture with an automated irrigation system (driven by SM150T data) compared to traditional best practice manual methods. The automated system achieved a tightly controlled and highly consistent "saw tooth" pattern (red line) – which resulted in a 7% yield increase relative to the best practice manual control. The manual approach also had notably more episodes of the substrate being too wet or dry (blue line).



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