

Proceedings of the UK Controlled Environment Users' Group

2008 SCIENTIFIC MEETING

“WATER AND ITS MEASUREMENT IN CONTROLLED ENVIRONMENTS”

A WORKSHOP

Volume 19

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UK CONTROLLED ENVIRONMENT USERS' GROUP

2008 WORKSHOP

WATER AND ITS MEASUREMENT IN CONTROLLED ENVIRONMENTS

SYNOPSIS OF PROGRAMME

The three elements of the programme were:

a) A number of **lectures** on water, vapour and liquid (not necessarily one per bullet point) covering:

- Terminology, units and measuring instruments for atmospheric water vapour
- Generating clean and safe water vapour
- Water - calibration of measuring instruments for atmospheric water vapour – local & standards laboratory
- Terminology, units and measuring instruments for liquid water in growth media e.g. soil, compost, agar gel; calibration of measuring instruments for liquid water in soils
- Understanding growth media
- Irrigation in CEs, principles and practice, efficient use of water and water as a sustainable resource - recycling
- The future: New techniques, new instruments, new and better environments and experiments

2. Demonstrations of measuring and calibrating equipment by manufacturers and/or distributors and agents.

3. Hands-on instrument sessions for delegates, in various environments (e.g. CE rooms, cabinets and glasshouses) and in substrates at various water contents (e.g. in soil, compost and tissue culture media):

- Water vapour - capacitance sensors
- Water vapour - dew point sensors
- Soil water content – gravimetric
- Soil water content – capacitance sensors
- Soil water content - tensiometers
- Soil water content - time domain reflectometry (TDR)
- Spatial distribution of water vapour content in CE spaces or canopies
- Spatial distribution of soil water content in soil columns and plant containers
- Calibration of sensors in flowing gas streams and over standard salt solutions

LECTURERS

There were three sessions of lectures. The lecturers were:

- a) Dr C. Atkinson, East Malling Research, East Malling
- b) Dr S. Bell, Thermal Measurement Team, National Physical Laboratory, Teddington)
- c) Prof. G. Campbell, Decagon Devices, Inc., Pullman, USA
- d) Dr P. Hallett, Scottish Crop Research Institute, Invergowrie, Dundee
- e) Prof. H.G. Jones Plant Sciences Division, University of Dundee at SCRI, Invergowrie

- f) Dr J-C. Michel, Institut National d'Horticulture, Angers, France
- g) Mr R. Palamarczuk, Humidification Manager, Walter Meier (Climate UK) Ltd.

PRACTICAL EXERCISES

There were five practical sessions involving manufacturers, lecturers and participants four of which ran concurrently in 2-hour practical sessions with the delegates in each session being divided into 8 groups of 5-7 people.

Themes

1. Measuring and calibrating instruments for atmospheric water vapour

Objectives were

1. To become familiar with a range of sensors calibrated for relative humidity and/or vapour pressure deficit using a range of sensors belonging to the representatives of manufacturers, and to participants.
2. To measure and compare the atmospheric moisture concentration in various controlled environments – cabinets and glasshouses – set to run at various relative humidities..
3. To learn how to calibrate sensors using various calibration instruments belonging to representatives of manufacturers and to participants.
4. To compare different types and makes of sensors measuring the same physical quantity at the same place.

2. Measuring and calibrating instruments for water in growth media

Objectives were:

1. To become familiar with a range of sensors calibrated for soil water content, conductivity and matric potential using a range of sensors, meters and loggers belonging to the representatives of manufacturers and to participants.
2. To measure and compare soil water content and potential in both soil and growth media in various controlled environments with a range of growth media at various water contents and where water content can be altered.
3. To select the best instrument for the task.
4. To learn how to calibrate sensors using various calibration instruments belonging to representatives of manufacturers.
5. To compare different types and makes of sensors measuring the same physical quantity at the same place.

3. Synthesis of results

There was a morning session for analysis and synthesis of results by the eight groups of participants and for reporting to the workshop and discussing the results of the practical sessions and the ideas and theory of the lectures.

MANUFACTURERS' TRADE DISPLAYS AND DEMONSTRATORS IN PRACTICAL SESSIONS

The companies and their representatives demonstrating and instructing are listed below. Their presence on this list does not imply endorsement of their products by the UK CEUG or the University of Dundee or SCRI.

	Company	Products	Field of expertise	Name of representative(s)
1	Decagon	Sensors for growth media water content and water potential	Growth media water	Gaylon Campbell Tim Bonner (Labcell)
2	Delta-T Devices	Sensors: Dielectric moisture content Calibration: Gravimetric	Growth media water	Chris Nicholl Tony Peloe
3	GE Sensing	Sensors and calibrating instruments <ul style="list-style-type: none"> • Condensation hygrometers • Capacitive RH meters • Capacitive dew point meters • Humidity generator/calibrator based on mixed flow principle • Calibration salt solutions • Wireless RH sensors • Handhelds for moisture in air, building materials and soils 	Atmospheric water vapour	Frank Gerritse Neil Holmes Philip Leach
4	LI-COR Biosciences	Sensors: IRGAs Calibration: Dewpoint generator	Atmospheric water vapour	Tanvir Demetriades-Shah
5	Michell Instruments	Sensors and calibrating instruments <ul style="list-style-type: none"> • Two portables using impedance sensor technology. • Two chilled mirror instruments; one fixed for laboratory calibration, one portable. • One humidity generator using a capacitance sensor and a PRT 100 ohm temperature sensor 	Atmospheric water vapour	Martin Wyke David Brunning
6	Skye	Soil water potential sensors (tensiometers)	Growth media water	Belinda Trotter

	Instruments			
7	Rotronic Instruments	Instruments for determining air humidity and temperature; calibration accessories and support laboratory <ul style="list-style-type: none"> • Condensation hygrometers • Capacitive humidity transmitters • Dynamic humidity generator/calibrator • Calibration salt solutions • Humidity data loggers • Hand-held hygrometers • UKAS accredited calibration laboratory 	Atmospheric water vapour	Mike Hibbert Scott Porter
8	Vaisala	Sensors and calibrating instruments <ul style="list-style-type: none"> • Capacitive Relative Humidity Sensors • Capacitive Dewpoint Sensors • Calibration saturated salt solutions 	Atmospheric water vapour	Stephen Danyliw David Cairney (Fluidic)

Note: IRGA = infra red gas analyser

DETAILED TIMETABLE FOR WORKSHOP PROGRAMME

SUNDAY 7 SEPTEMBER 2008: EVENING at WEST PARK	
14:00	Pre-conference visit to jute museum – Verdant Works, Dundee
16:00 – 19:00	Registration in the Burrelton Room at West Park, the University of Dundee
19:00 – 21:00	Buffet Supper in Balbeggie Room
21:00 – 22:00	Pre-conference briefing in Balbeggie Room for participants (30 min) and manufacturer-demonstrators (30 min)
21:00 – 23:00	Bar in Invergowrie Room

MONDAY 8 SEPTEMBER 2008: MORNING at WEST PARK	
07:30 – 08:30	Breakfast in Restaurant
<u>SESSION 1</u>	<u>INTRODUCTION AND ATMOSPHERIC WATER VAPOUR</u> in Sidlaw Conference Centre Chairman: L.D. Incoll
08:45 – 08:55	Introduction to the Workshop
08:55 – 09:40	H.G. Jones (Plant Sciences Division, University of Dundee at SCRI, Invergowrie, Dundee DD2 5DA, UK) <i>Terminology, units and measuring instruments for atmospheric water vapour</i>
09:40 – 10:25	S. Bell (Thermal Measurement Team, National Physical Laboratory, Hampton Road, Teddington TW11 0LW, UK) <i>Calibration of instruments for measuring atmospheric humidity</i>
10:25 – 10:55	Morning Coffee in Sidlaw Conference Centre foyer
10:55 – 11:40	R. Palamarczuk (Walter Meier [Climate UK] Ltd., Highlands Road, Shirley, Solihull, West Midlands, B90 4NL, UK) <i>Generating clean and safe water vapour</i>
11:40 – 12:00	General discussion
12:00 – 13:00	Lunch in Restaurant
13:00 – 13:30	Bus to SCRI, Invergowrie

MONDAY 8 SEPTEMBER 2008: AFTERNOON at SCRI, INVERGOWRIE and EVENING at WEST PARK	
<u>SESSION 2</u>	<p><u>DEMONSTRATIONS AND HANDS-ON PRACTICAL SESSION</u></p> <p>For participants, in various CE cabinets and rooms and in bins of various growth media (e.g. cabinets and glasshouses) using their own instruments and demonstration instruments supplied by manufacturers:</p> <ul style="list-style-type: none"> • Atmospheric water vapour sensors – capacitance, dew point, infra red, psychrometric, mechanical • Precision water vapour generators (flowing gas) • Calibrators – static and dynamic for atmospheric water vapour • Soil moisture sensors – capacitance, tensiometers • Calibration of soil moisture sensors – pressure plate <p>13:45 - 15:15 Demonstrations and Hands-on Practical Session</p> <p>15:15 – 15:45 Afternoon Tea in Canteen</p>
	<p><u>SESSION 3</u></p> <p><u>DEMONSTRATIONS AND HANDS-ON PRACTICAL SESSION</u></p> <p>15:45 – 17:15 Demonstrations and Hands-on Practical Session</p> <p>17:30 – 18:00 Bus to West Park</p> <p>18:30 – 20:00 Dinner in Restaurant</p> <p>20:00 – 23:00 Annual General Meeting of the UK CEUG with open discussion of controlled environment matters in the Balbeggie Room (Bar in Invergowrie Room)</p>

TUESDAY 9 SEPTEMBER 2008: MORNING at WEST PARK	
07:30 – 08:30	Breakfast in Restaurant
<u>SESSION 4</u>	<p><u>LIQUID WATER IN GROWTH MEDIA</u> Chairman: P.J. Gregory</p>
08:45 – 09:30	P. Hallett (Scottish Crop Research Institute, Invergowrie, Dundee DD2 5DA, UK) <i>Liquid water - terminology, units and measuring instruments for liquid water in growth media</i>
09:30 – 10:15	J-C. Michel (Institut National d'Horticulture, 2, Rue Le Nôtre, 49045 Angers, France) <i>Understanding growth media</i>
10:15 – 10:45	Morning Coffee in Sidlaw Conference Centre foyer
10:45 – 11:30	C. Atkinson (East Malling Research, New Road, East Malling ME19 6BJ, UK) <i>Liquid water - irrigation in CEs, principles and practice, efficient use of water" and "Water - as a sustainable resource - recycling</i>
11:30 – 12:00	General discussion
12:00 – 13:00	Lunch in Restaurant
13:00 – 13:30	Bus to SCRI, Invergowrie

TUESDAY 9 SEPTEMBER 2008: AFTERNOON at SCRI, INVERGOWRIE and EVENING at the DISCOVERY QUAY	
<u>SESSION 5</u>	<u>DEMONSTRATIONS AND HANDS-ON PRACTICAL SESSION</u>
13:45 – 15:15	Demonstrations and Hands-on Practical Session
15:15 - 15:45	Afternoon Tea in Canteen
<u>SESSION 6</u>	<u>DEMONSTRATIONS AND HANDS-ON PRACTICAL SESSION</u>
15:45 – 17:15	Demonstrations and Hands-on Practical Session
17:30 – 18:00	Bus to West Park
18:30 – 18:45	Bus to Discovery Point, Dundee.
19:00 – 23:30	Civic Reception, tour of R.R.S. Discovery & conference dinner
23:30 – 23:45	Bus to West Park

WEDNESDAY 10 SEPTEMBER 2008: MORNING at WEST PARK	
7:30 – 8:30	Breakfast in Restaurant
<u>SESSION 7</u>	<u>SYNTHESIS - GROUPS TO REPORT</u>
08:45 – 10:30	Synthesis - Groups to report and open discussion of workshop experiences
10:30 – 11:00	Morning Coffee in Sidlaw Conference Centre foyer
<u>SESSION 8</u>	<u>CONCLUDING ADDRESS: THE FUTURE?</u> Chairman: B. McKenzie
11:00 – 11:45	G. Campbell (Decagon Devices, Inc., 950 NE Nelson Ct., Pullman, WA 99163 USA) <i>The future: new techniques, new instruments, new and better environments and experiments</i>
11:45 – 12:00	Discussion of concluding address
12:00 – 13:00	Finger Buffet in Sidlaw Conference Centre foyer



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