

Proceedings of the UK Controlled Environment Users' Group

**2001 INTERNATIONAL SCIENTIFIC MEETING
with the
NORTH AMERICAN COMMITTEE ON CONTROLLED ENVIRONMENT
TECHNOLOGY AND USE (NCR-101)**

“CONTROLLED ENVIRONMENTS IN THE NEW MILLENNIUM”

Volume 12

Contents

| | |
|--------------|-----|
| 1. Programme | 2-6 |
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**UK CONTROLLED ENVIRONMENT USERS' GROUP
and the
NORTH AMERICAN COMMITTEE ON CONTROLLED ENVIRONMENT
TECHNOLOGY AND USE (NCR-101)**

2001 SCIENTIFIC MEETING

“CONTROLLED ENVIRONMENTS IN THE NEW MILLENNIUM”

The scientific part of the annual meeting consisted of eight sessions each with a number of papers and most sessions were followed by a panel-led discussion. As well there was a poster session of 11 posters. For the record the programme is appended. The programme and the abstracts of papers will be mounted on the NCR-101 web site with a link from the UK CEUG web site. The proceedings will not be printed here this year because of the sheer volume of material. However, the proceedings will be collected and edited and together with the edited transcripts of the panel-led discussion sessions will also be mounted on the NCR-101 web site in .pdf form.

| SUNDAY 9 SEPTEMBER 2001: EVENING | |
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| 17.00-19.30 20.00 | Registration and Buffet Supper at the Sainsbury Centre, University of East Anglia Welcome Reception at the Sainsbury Centre, University of East Anglia |

| MONDAY 10 SEPTEMBER 2001: MORNING | |
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| <u>SESSION 1</u> | <u>GENETICALLY MODIFIED ORGANISMS (GMOs) IN CONTROLLED ENVIRONMENTS</u> |
| Chairman: | P. Mullineaux (Disease and Stress Biology, John Innes Centre, Norwich, UK) |
| 08.45 - 09.15 | D. Adair (Plant Pathology, University of Minnesota, USA) <i>Legislation for GMOs in North America: Design of Containment Facilities</i> |
| 09.15 - 09.45 | P. Logan (Health & Safety Executive, Bootle, UK) <i>Legislation for GMOs in the UK and Europe</i> |
| 09.45 – 10.15 | S. Millam (Scottish Crop Research Institute, Invergowrie, UK) <i>Working within the Legislation</i> |
| 10.15 – 10.45 | Panel-led Discussion Above speakers plus J. Franklin (IACR Rothamsted, Harpenden, UK) and R. Denis (Agritech nove, St Anselme, Canada) |
| 10.45 - 11.15 | Morning Coffee |
| <u>SESSION 2</u> | <u>REPORTING GUIDELINES FOR CONTROLLED ENVIRONMENTS</u> |
| Chairman: | J.C. Sager (Spaceport Engineering & Technology Directorate, Kennedy Space Center, Florida, USA) |
| 11.15 - 11.40 | D.T. Krizek (Sustainable Agricultural Systems Laboratory, USDA, Beltsville, MD, USA) <i>Reporting and Monitoring for Diagnostic Purposes</i> |
| 11.40 – 12.05 | T.W. Tibbitts (Horticulture, University of Wisconsin, Madison, USA) <i>Reporting and Monitoring for User Records</i> |
| 12.05 – 12.30 | L.D. Incoll, D.J. Pilbeam and J. Williams (Biology, University of Leeds, UK) <i>Reporting Guidelines in Practice: A Good Idea, But Does Anyone Take Any Notice?</i> |

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| 12.30 – 12.45 | Panel-led Discussion Above speakers |
| 12.45 - 13.45 | Lunch |

| MONDAY 10 SEPTEMBER 2001: AFTERNOON and EVENING | |
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| 13.45 - 17. 00 | <p><u>Tour of John Innes Centre, Poster Session and Trade Displays</u> Introduction to the John Innes Centre - Talk in the Auditorium by R. Mathias and M. Crawley</p> <p>Tour of the John Innes Centre</p> <ul style="list-style-type: none"> • Small Sanyo Controlled Environment Rooms • Large Sanyo Controlled Environment Rooms • Weiss Technic and In-house Controlled Environment Rooms • South Glasshouses • Containment Glasshouse Complex • Walk-through Major Laboratories • Library - Rare Books Room <p>Trade Displays and Posters</p> |
| 18.30 | <p>Dinner on the Balcony, Lecture Theatre Auditorium, John Innes Centre Revisit Trade Displays and Posters</p> |
| 21.00 | Business Meetings of UK CEUG and NCR-101 and concurrent Bar |

| TUESDAY 11 SEPTEMBER 2001: MORNING | |
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| <u>SESSION 3</u> | <u>ENERGY, CONSERVATION AND RECYCLING: I. TECHNOLOGICAL CHOICES FOR CONTROLLED ENVIRONMENTS IN RELATION TO ENERGY</u> |
| Chairman: | J. Franklin (IACR Rothamsted, Harpenden, UK) |
| 08.45 - 09.15 | S. Pot (Philips Lighting BV, Eindhoven, The Netherlands) <i>Lighting Choices for Plant Growth in Horticulture</i> |
| 09.15 – 09.45 | R. Quiring (Convicon, Winnipeg, Canada) <i>Choices for Temperature and Humidity: Control Systems</i> |
| 09.45 – 10.15 | F. Steimle (Universität Essen, Essen, Germany) <i>Refrigerators and Refrigerants - the Future</i> |
| 10.15 - 10.45 | Morning Coffee |
| 10.45 - 11.15 | Q. Mabbutt and A. Brown (Advantica Technologies Ltd, Loughborough, UK) <i>The Microturbine: Why a Gas Engine May at Last Be of Benefit to the Horticulture Industry</i> |
| <u>SESSION 4</u> | <u>ENERGY, CONSERVATION AND RECYCLING: II. POSITION STATEMENTS AND PANEL-LED DISCUSSION ON ENERGY POLICIES AND PRACTICE IN RELATION TO CONTROLLED ENVIRONMENTS</u> |
| Chairman: | G. Taylor (Sanyo Gallenkamp PLC, Loughborough, UK) |

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| 11.15 - 11.25 | Position Statements on Energy Policy and Practice M.J. Hadlow (IACR Rothamsted, Harpenden, UK) <i>The European Position</i> |
| 11.25 – 11.35 | J.C. Sager (Kennedy Space Center, NASA, Florida, USA) <i>The North American Position</i> |
| 11.35 – 11.45 | L.J. Hoare (South Australian Research & Development Institute, Adelaide, Australia) <i>The Australian Position</i> |
| 11.45 – 11.55 | Y. Kitaya (College of Agriculture, Osaka Prefecture University, Osaka, Japan) <i>The Japanese Position</i> |
| 11.55 – 12.45 | Panel-led Discussion Above eight speakers |
| 12.45 - 13.45 | Lunch |

| TUESDAY 11 SEPTEMBER 2001: AFTERNOON and EVENING | |
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| <u>SESSION 5</u> | <u>CONTROLLED ENVIRONMENTS IN SPACE</u> |
| Chairman: | R. Wheeler (Biological Sciences Branch, Kennedy Space Center, NASA, Florida, USA) |
| 13.45 - 14.10 | W. Zhou (Wisconsin Center for Space Automation & Robotics, University of Wisconsin, Madison, USA) <i>Development of the Commercial Plant Biotechnology Facility for the International Space Station</i> |
| 14.10 – 14.35 | R.E. Fortson (Lockheed Martin Space Operations, Houston, USA) <i>Ground-based Demonstration Chambers In NASA's Advanced Life Support Project</i> |
| 15.00 – 15.30 | Panel-led Discussion Above speakers plus C.A. Mitchell (Horticulture, Purdue University, USA), A. Hoehn (University of Colorado, Boulder, USA) and Y. Kitaya (College of Agriculture, Osaka, Japan) |
| 15.30 - 16.00 | Afternoon Tea |
| <u>SESSION 6</u> | <u>SIMPLE VERSUS COMPLEX CONTROLLED ENVIRONMENTS: A DEBATE</u> |
| Chairman: | L.D. Incoll (Biology, University of Leeds, UK) |
| 16.00 - 16.30 | Proposer – T.A. Mansfield (Biological Sciences, Lancaster University, UK) <i>In Support of Real Environments</i> |
| 16.30 – 17.00 | Proposer – B. Bugbee (Crop Physiology Lab., Utah State University, Logan, USA) <i>In Support of Simple Environments</i> |
| 17.00 – 17.30 | Panel-Led Discussion Above speakers plus P. Austin (Palmerston North Research Centre, New Zealand) and M. Romer (McGill University Phytotron, McGill University, Montreal, Canada) |
| 20.00 | Conference Dinner at the Sainsbury Centre, University of East Anglia |

| WEDNESDAY 12 SEPTEMBER 2001: MORNING | |
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| <u>SESSION 7</u> | <u>SHORT PRESENTATIONS</u> In multiple authored papers the name of the presenting author is underlined |

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| Chairman: | D. Tremmel (National Phytotron, Duke University, Durham, NC, USA) |
| 08.45 – 08.50 | G.D. Goins, G.W. Stutte, R.M. Wheeler and J.C. Sager (Kennedy Space Center, Florida, USA) <i>Light Interception and Canopy Coverage of Lettuce and Radish Grown under Different Wavelengths of Red Light-Emitting Diodes (LEDs)</i> |
| 08.55 – 09.00 | J.M. Frantz*, Changhoo Chun**, R.J. Joly and C.A. Mitchell (Department of Horticulture and Landscape Architecture, Purdue University, West Lafayette, USA, *Dept. of Plants, Soils & Biometeorology, Utah State University, Logan, USA, **Laboratory of Environmental Control Engineering, Chiba University, Chiba, Japan) <i>Intracanopy Lighting as a Sole Source of PAR and PHAR for Planophile Crop Canopies in Controlled Environments</i> |
| 09.05 – 09.10 | J. L. Cuello, Y. Yu, S. Kuwahara, E. Ono, K. Jordan, T. Nakamura* and H. Watanabe** (Department of Agricultural and Biosystems Engineering, The University of Arizona, Tucson, U.S.A, *Physical Science, Inc., San Ramon, U.S.A, **Mitsubishi Chemical Corporation, Yokohama, Japan) <i>Hybrid Solar and Electric Lighting to Alleviate Power Crunch for Bioregenerative Advanced Life Support</i> |
| 09.15 – 09.20 | M. Romer (McGill University Phytotron, McGill University, Montreal, Canada) <i>Carbon Dioxide within Controlled Environments; the Commonly Neglected Variable</i> |
| 09.25 – 09.30 | B. Bugbee (Crop Physiology Laboratory, Utah State University, Logan, USA) <i>Temperature Measurement: a Review of the Advantages and Disadvantages of the 4 Most Common Types of Thermocouple Wire.</i> |
| 09.35 – 09.40 | S. Klassen, T. Tibbitts and B. Bugbee (Crop Physiology Laboratory, Utah State University, Logan, USA) <i>Calibration Standards for Controlled Environments: History and Use of the NCR-101 Instrument Package</i> |
| 09.45 – 09.50 | J.M. Frantz¹, M.W. van Iersel², and B. Bugbee¹ (¹ Crop Physiology Laboratory, Utah State University, Logan, USA, ² Department of Horticulture, The University of Georgia, Griffin, USA. J.M. Frantz as Winner: UK CEUG / NCR-101 Graduate/Postgraduate Travel Award <i>Design and Operation of a Multiple-Chamber Gas-Exchange System for Plant Communities</i> |
| 09.55 – 10.00 | M. Pratt, W. Stoddart and G.C. Whitelam (Biology, University of Leicester, Leicester, UK) <i>Using LEDs to Manipulate Red:Far-Red Ratio and Photomorphogenesis in Controlled Environments</i> |
| SESSION 8 | LARGE SCALE CONTROLLED ENVIRONMENTS |
| Chairman: | J. Lea-Cox (Natural Resource Sciences and Landscape Architecture, University of Maryland, College Park, USA) |
| 10.05-10.30 | W. Bopp (National Botanic Garden of Wales, Llanarthne, South Wales, UK.) <i>Working with Designers on the Great Glasshouse</i> |
| 10.30-11.00 | Morning Coffee |
| 11.00 - 11.25 | P. Thoday (Thoday Associates, Corsham, Wiltshire, UK) <i>The Eden Project, Cornwall - the Humid Tropic and Warm Temperate Biomes</i> |
| 11.25 – 11.50 | A. Wright (Biosphere 2, Columbia University, Oracle, Arizona, USA) <i>Modifications and Upgrades for the Biosphere 2 Laboratory</i> |
| | CONCLUDING ADDRESS |
| 11.50 – 12.30 | D.H. Greer (HortResearch, Palmerston North, New Zealand) |

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| 12.45 - 14.00 | <p><i>Controlled Environments: Past Achievements and Future Directions</i></p> <p>Lunch before departure. Start of Post-Conference Tour</p> |
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| POSTERS | |
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| | Some of these posters, designated * are also being presented as short presentations in Session 7. |
| 1. | T. Agostino (CSIRO Plant Industry, Canberra, Australia) <i>Modernisation of the Canberra Phytotron: Recent Major Modifications Allowing the Facility to Operate as a PC2 (Planthouse) Facility for Work with Transgenic Plants</i> |
| 2. | P.T. Austin, D.H. Greer and H.N. Wiggins (HortResearch, Palmerston North, New Zealand) <i>A Comprehensive Format for Specifying and Reporting Controlled Environment Regimes</i> |
| 3. * | B. Bugbee (Crop Physiology Laboratory, Utah State University, Logan, USA) <i>Temperature Measurement: a Review of the Advantages and Disadvantages of the 4 Most Common Types of Thermocouple Wire</i> |
| 4. * | J. L. Cuello, Y. Yu, S. Kuwahara, E. Ono, K. Jordan, T. Nakamura* and H. Watanabe** (Department of Agricultural and Biosystems Engineering, The University of Arizona, Tucson, U.S.A, *Physical Science, Inc., San Ramon, U.S.A, **Mitsubishi Chemical Corporation, Yokohama, Japan) <i>Hybrid Solar and Electric Lighting to Alleviate Power Crunch for Bioregenerative Advanced Life Support</i> |
| 5. | I.D. Flitcroft, R. Kuchenbuch* and K.T. Ingram (Department of Crop and Soil Sciences, University of Georgia, Griffin, USA.,* Center for Agricultural Landscape and Landuse Research, Institute for Primary Production, Muencheberg, Germany) <i>Nesting Multiple Controlled Environments for Independent Manipulation of Shoot and Root Temperatures</i> |
| 6. | I.D. Flitcroft, K.T. Ingram and G. Hoogenboom* (Department of Crop and Soil Sciences, and *Department of Biological and Agricultural Engineering, University of Georgia, Griffin, USA) <i>The Georgia Envirotron: Multi-Disciplinary Studies of Plant Stresses using Controlled Environment Chambers</i> |
| 7. * | J.M. Frantz¹, M.W. van Iersel², and B. Bugbee¹ (1 Crop Physiology Laboratory, Utah State University, Logan, USA, 2 Department of Horticulture, The University of Georgia, Griffin, USA. J.M. Frantz as Winner: UK CEUG/NCR-101 Graduate/Postgraduate Travel Award <i>Design and Operation of a Multiple-Chamber Gas-Exchange System for Plant Communities</i> |
| 8. | A. Hoehn and J. Clawson (BioServe Space Technologies, University of Colorado, Boulder, , USA) <i>Plants in Space - Transition from Space Shuttle to Space Station and Beyond</i> |
| 9. * | S. Klassen, T. Tibbitts and B. Bugbee (Crop Physiology Laboratory, Utah State University, Logan, USA) <i>Calibration Standards for Controlled Environments: History and Use of the NCR-101 Instrument Package</i> |
| 10. * | M. Pratt, W. Stoddart and G.C. Whitelam (Biology, University of Leicester, Leicester, UK) <i>Using LEDs to Manipulate Red:Far-Red Ratio and Photomorphogenesis in Controlled Environments</i> |