

GLASSHOUSE CROPS RESEARCH INSTITUTE

Director : Dr. D. Rudd-Jones, CBE

AFRC CE USERS GROUP MEETING

Thursday, 4th October 1984

PROGRAMME

10.00 - 10.30 am Coffee
10.15 am Welcome by the Director
followed by Discussion: Chairman : Dr. K.E. Cockshull

AGENDA

10.00 Coffee
10.30 Welcome by the Director, GCRI
1. Approval of minutes of 1983 meeting
2. Management, staffing, running costs, maintenance and servicing problems
3. Cabinet reflective and glazing materials (WRO and GCRI).
4. New CE equipment and microprocessor control (GCRI).
5. Provision of high radiant-flux densities (School of Biology, Sussex University).
6. Cabinets for 14C research (GCRI).
7. Phytotoxicity and use of toxic materials in cabinets (GCRI).
8. Heat reclamation and energy management (NVRs).
9. Automatic irrigation (UCW).
10. Instrumentation and sensors.
11. Any other business
12. Date and location of next meeting.
13.00 Lunch
14.00-15.30 Tour of Institute facilities
15.30 Tea and discussion



Minutes of the 1984 AFRC C.E. Users Group Meeting held on 4th October 1984 at Glasshouse Crops Research Institute, Littlehampton, W. Sussex.

Those Present:

Dr. A.J. Abbott	Long Ashton Research Station, Bristol
Mr. J.R. Aldous	John Innes Institute, Norwich
Dr. D. Atkinson	East Mailing Research Station, Maidstone
Mr. D. Avery	East Mailing Research Station, Maidstone
Mr. K.R. Bambridge	University of Nottingham
Mr. J.R. Bolton	National Vegetable Research Station, Warwick
Mr. J.T. Burrell	A.F.R.C., London
Mr. J. Caseley	Weed Research Organisation, Oxford
+ colleague	Weed Research Organisation, Oxford
Mr. K. Chivers	University of Reading
Mr. R. Clare	
Mr. K.E. Cockshull	G.C.R.I.
Mr. R.P. Cox	G.C.R.I.
Mr. S.H. Crothers	Dept. of Agriculture, Northern Ireland
Mr. C. Davey	
Mr. D. Dickinson	University of Reading
Mr. D. Edwards	University College of North Wales
Mr. M.J. Elsworth	Long Ashton Research Station, Bristol
Mr. J.F. Farrar	University College of North Wales
Mr. D.J. Fitter	G.C.R.I.
Dr. T.J. Flowers	University of Sussex, Brighton
Dr. R. Fordham	Wye College, Ashford, Kent
Mr. G. Frankland	A.F.R.C., London
Mr. A.P. Gay	Welsh Plant Breeding Station, Aberystwyth
Mr. P. Gull	East Mailing Research Station, Maidstone
Mr. M. Hannah	G.C.R.I.
Mr. D.M. Harvey	John Innes Institute, Norwich
Mr. N. Helyer	G.C.R.I.
Mr. J.W. Hine	Grassland Research Institute, Hurley
Mr. C.R. Holbourn	G.C.R.I.
Mr. C.C. Hole	National Vegetable Research Station, Warwick
Mr. R.F. Hughes	Long Ashton Research Station, Bristol
Dr. L.D. Incoll	University of Leeds
Dr. H.G. Jones	East Mailing Research Station, Maidstone
Mr. S.C. King	Long Ashton Research Station, Bristol
Mr. M. Ledieu	G.C.R.I.
Dr. J. Moorby	A.F.R.C., London
Dr. A. Morgan	National Vegetable Research Station, Warwick
Mr. I. Pearman	Rothamsted Experimental Station, Harpenden
Mr. V. Priest	Letcombe Laboratory, Wantage
Dr. D. Vince-Prue	G.C.R.I.
Mr. R.E. Randall	G.C.R.I.
Mr. B. Roberts	East Mailing Research Station, Maidstone
Dr. D. Rudd-Jones	G.C.R.I.
Mr. L.R. Saker	Letcombe Laboratory, Wantage
Mr. F. Sandwell	M.A.F.F., Harpenden
Mr. R. Simmons	Weed Research Organisation, Oxford
Mr. P. Tatham	M.A.F.F., Harpenden
Mr. A.P. Tester	Welsh Plant Breeding Station, Aberystwyth
Dr. Brian Thomas	G.C.R.I.

Dr. G. Thorne	Rothamsted Experimental Station, Harpenden
Mr. Tibor Tischner	Hungary
Mr. C.H.S. Walker	Letcombe Laboratory, Wantage
Mr. G.S. Weaving	National Institute of Agricultural Engineering, Bedford
Mr. J. Weir	Electricity Council, Stoneleigh, Warwick
Mr. J.K. Welling	University of Sussex, Brighton
Dr. J. Whipps	G.C.R.I.
Mr. P. Wiggell	A.D.A.S., Cambridge
Mr. B.A. Williams	Grassland Research Institute, Hurley
Mr. B.J. Wilson	Wye College, Ashford, Kent
Dr. A.R. Yeo	University of Sussex, Brighton

Dr. D. Rudd-Jones, Director of G.C.R.I., welcomed all the participants. He reviewed briefly (a) the introduction of the 80 Saxcil Cabinets within the A.F.R.C., stemming from a visit by Lord Rothschild to the U.S.A., which showed the requirement for C.E. cabinets and (b) daylight cabinets, cabinet failures (E. & A.C.) and successes (Rothamsted).

1. MINUTES OF THE 1983 MEETING

These were corrected to read: C. Hole (N.V.R.S.) as reporting on costs of electronic ballasts, not D. Dickinson.

Matters Arising from the Minutes

(a) C.R. Holbourn (G.C.R.I.) described a promising high frequency system of control gear, for fluorescent tubes being marketed by Helvar Ltd. This could operate either normal (1½") or slimline (1"), 5 ft. tubes, and could incorporate electronic dimmers. The estimated cost of replacing a Saxcil cabinet with the Helvar system consisting of a single row of 42 slimline tubes, complete with dimmer would be £1,750. The saving in power costs from the slimlines and more efficient control gear would be £214 per year per cabinet. There would also accrue the advantages of more uniform lighting and flexible control obtainable through the dimming system. It is hoped that a Saxcil Cabinet will eventually be adapted to the above type of equipment for evaluation.

(b) A.P. Gay (W.P.B.) reported that the 8 ft. tube starters recommended at the previous User Group Meeting had proved satisfactory.

2. MANAGEMENT, STAFFING, RUNNING COSTS, MAINTENANCE & SERVICING

(a) Running Costs and Replacement of Cabinets

K. E. Cockshull (G.C.R.I.) stated that G.C.R.I. operated two types of cabinet (Saxcil and Weiss) and each type was operated under a separate Service Project. Staff inputs for maintenance, monitoring etc., and equipment and laboratory supplies purchases for cabinets were then allocated to the appropriate Service Project. In addition, a rental charge related to the original capital cost of the cabinet was added together with an estimate of the cost of provision of electricity and other services. Each experiment performed in the cabinets had a Research Objective and at the end of a yearly quarter the cabinet time used by each Research Objective was recorded. The total costs of each Service Project were then allocated to Research Objectives in proportion to their usage of the cabinets in that quarter. On this basis it was estimated that the Saxcil and Weiss cabinets cost £26 and £41 respectively per cabinet day in 1983/84.

For L.A.R.S., A.J. Abbott reported their cabinet costs as £68 per cabinet week, comprising £31 for electricity, £22 depreciation, £11 for maintenance and £4 for growing costs. Comparatively their large growing rooms cost £200 per week. To reduce costs in depreciation, L.A.R.S. operate 10 year old cabinets in 20 year old buildings.

Replying to a question on what the A.F.R.C. policy was with regard to writing off cabinets, J. Moorby (A.F.R.C. HQ) said that there wasn't one, beyond operating the cabinets until they were useless. The cost of replacing all the A.F.R.C. Saxcils would be about £2,000,000; the eight new Weiss rooms at J.I.I. had cost £400,000. There was thus no overall plan for funding Saxcil replacement. Saxcils could be modified with microcomputer control and monitoring to improve their efficiency and this could extend their operating life another 10 years, if the cabinet structure was still sound (as it was in the opinion of many users). However, depending on circumstances, it might be better to buy new Weiss or Fisons cabinets.

G.S. Weaving (N.I.A.E.) deprecated the present piecemeal approach to assessing cabinet running costs (he believed in other cases they could be 2 or 3 times more) and replacement with new cabinets. He thought results should be collated to produce data for the design of new cabinets.

(b) Maintenance

L.D. Incoll (University of Leeds) enquired about means of protecting cabinet surfaces.

D. Dickinson (P.E.L. Reading) said that the main corrosion hazard was water in the bottom of the cabinets and that they should be kept as dry as possible. He recommended the use of water tank paints (non-toxic and non-tainting) for cabinet interiors rather than bitumastic paints which could be toxic to plant life.

S.H. Crothers (D. of A. Belfast) had produced a fibreglass base for a cabinet.

J. Aldous (J.I.I.), said aluminium shelves had proved satisfactory in cabinets. Another participant advised galvanising, however, care must be taken not to use it on surfaces which came in contact with nutrient solutions which are used for growing plants, because zinc poisoning of plants is possible.

R.F. Hughes (L.A.R.S.) had found nylon coatings successful.

3. CABINET REFLECTIVE AND GLAZING MATERIALS

(a) Sides

The large growth rooms at W.R.O. suffered from deterioration (blotching) of the melinex on the walls according to R. Simmons. C.R. Holbourn confirmed that this could occur, as one of the G.C.R.I. cabinets subjected to high r.h. (•90%) had produced blotches, but it had not been established whether the humidity was the full reason for the effect.

J. Moorby said that care should be taken in selecting adhesive coatings as some of the glues contain di-butyl phthalate (not in melinex) which is phytotoxic and such effects had been observed on plants in Sweden.

(b) Floors

The question of black versus reflective flooring was one which R.P. Cox

Transcribed from duplicated copies by L.D. Incoll, 18/8/2008

(G.C.R.I.) had evaluated on Saxcils. When setting up an empty cabinet with a black, floor grille (equivalent to foliage floor) it was not possible to attain r.h.'s of 90% with high irradiance (particularly with incandescents present). This was due to the grille absorbing the radiation, and heating up, with subsequent conduction of heat to the air passing through the grille, resulting in a temperature rise and r.h. reduction. Temperature 'nudging' would not correct the condition. However, loading with plants enabled 90% r.h. to be attained. With silver floors the 90% r.h. could easily be attained with an empty cabinet.

Ceilings

Where the perspex ceilings on Saxcil cabinets required replacement, R.E. Randall (G.C.R.I.) was looking into the possibility of replacing them with SERAC panel, for ease of removal and cleaning.

D. Dickinson (P.E.L., Reading) quoted a price of £60 (delivered) for replacement double glazing on one Saxcil. It was agreed that the safety, spectral quality, and phytotoxicity etc., of new ceiling materials must be satisfactory before commitment to purchase.

4. NEW CONTROLLED ENVIRONMENT EQUIPMENT AND MICROPROCESSOR CONTROL

D.J. Fitter (G.C.R.I.), who was responsible for the installation of new microprocessor control and monitoring equipment, outlined the requirement for updating the Saxcil control system in the Plant Physiology cabinets. The completed first phase of the project would be demonstrated to the Group after the discussion.

The control side of the system was confirmed as operating satisfactorily by R.P. Cox (G.C.R.I.), but there were still some problems on the monitoring side, particularly with the PCRC humidity sensors.

In the discussion on microcomputer systems, G.S. Weaving (N.I.A.E.) emphasised the flexibility available with such systems, both for system enlargement and for data processing. This was agreed and illustrated by the ability of software to save repetition of some of the electromechanical hardware and also the ability to transfer easily large amounts of data to larger computers, for example the VAX, enabling more detailed analysis.

L.D. Incoll (Leeds) asked if the system software was easily transferable to microcomputers other than the BBC. D.J. Fitter (G.C.R.I.) replied that a certain amount of work would be required but the programme was in BASIC which should easily adapt to most other computers.

R.E. Randall (G.C.R.I.) said that Stonefield Ltd. (the manufacturers of the G.C.R.I. micro-processor) were interested in enquiries and had produced a leaflet describing use of their microprocessor, for environmental control.

In reply to a question on A.F.R.C. policy on choice of microcomputers, J. Moorby (A.F.R.C. HQ) dispelled any belief that there were restrictions on certain types of microcomputers for control and monitoring.

During the discussion on sensors related to the microprocessor system:
(a) G.S. Weaving (N.I.A.E.) recommended to the meeting, a report resulting from a meeting of the A.F.R.C. Transducer Working Party, Chaired by Professor R. Bell (ADAS Director General),
(b) it was divulged that money was available within the A.F.R.C. to develop new sensors.

5. HIGH RADIANT FLUX DENSITIES

T.J. Flowers (University of Sussex, enquired what would be the most suitable lamps for obtaining $1000 \text{ umol m}^{-2} \text{ s}^{-1}$ in cabinets. D.M. Harvey (J.I.I.) responded with a report on the metal halide lamps which they had now been running in cabinets for $3\frac{1}{2}$ years. Over that period there was a drop of about 45% in illumination. The lamps showed no spectral shift and there had been only one failure at 20,000 hours. A copy of the report on HID lamps distributed at the last User Group Meeting was again available from D.M. Harvey after the discussion.

Details of results from users of polyphosphor tubes were requested by J. Weir (Electricity Council). The lamps were to be recommended for their higher illumination and efficiency but were more expensive. Replying to the question from K.E. Cockshull (G.C.R.I.) regarding the best type of HID lamp for cabinet use, J. Weir recommended the high pressure Sodium lamp, which could be mixed with metal halide.

In order to obtain the maximum irradiance possible from fluorescent tubes, K.R. Bambridge (Sutton Bonington) enquired if there was a commercial reflector available for 5 ft w/w tubes. He was advised to try the Ford Motor Company or Helvar Ltd. J. Weir also mentioned that commercial tubes with reflective backing on the tube itself were available; he didn't advise DIY backing of the tube - it could be dangerous.

T. Tischner, a visitor from the Hungarian A.R.I, at Martonvasar, gave a description of his institute phytotron. There was a total of 50 'walk in' and 'reach in' growth chambers (manufactured by Conviron) in the phytotron. Most chambers produced 40 to 50 kilolux, 15 cms from the light canopy, the others being about 20-25 kilolux. The main fluorescent tubes were cool, white Sylvania, with incandescents as required. Metal halide lamps were also used in cabinets and the lamps provided up to 100 kilolux with the advantages of a greater proportion of far red radiation and 60% better illumination, than fluorescents. Winter wheat production was much better with metal halide than with fluorescents. He described briefly a special cabinet which was capable of giving up to 100 different environments in different portions of the cabinet at the same time. This was achieved by separating off the differently conditioned airflows (method not disclosed because patent pending) and by adjusting plant to light heights.

6. CABINET FOR ^{14}C RESEARCH

This cabinet, described by J. Whipps (G.C.R.I.) was developed by various people at W.R.O., Letcombe, over the past eight years. It was designed to provide a constant level of $^{14}\text{CO}_2$ in air rather than using the pulse method which had certain disadvantages, i.e. uneven labelling, difficulty in the carbon budgeting and possible radioactive damage with large pulses. The cabinet was constructed inside a laboratory which provided facilities for removal of waste heat and any radio-active contamination which might emanate from the cabinet.

The Cabinet provided the following:

- (a) recirculating airflow conditioned to the temperature and r.h. required.
- (b) Fluorescent and tungsten lighting.
- (c) Specific radioactivity was produced by the controlled pumping of $\text{Na}_2^{14}\text{CO}_2$ solution into a stirred bath of lactic acid. The pumping was controlled by a radio-active gas monitor/controller. An IRGA monitored the CO_2 level in the air (between 0.03 and 0.1%).

- (d) Glove ports provided protection for personnel handling plants in the cabinet and a transfer port enabled loading and unloading of plants.

The rhizosphere for the plants being grown was sampled by flushing the plant pots with air, the outgoing gas for analysis being absorbed in NaOH for subsequent analysis by scintillation counter.

7. PHYTOTOXICITY AND USE OF TOXIC MATERIALS

L.D. Incoll (Leeds) said a meeting devoted to materials toxic to plant growth would be held at Leeds University in January. Further details were obtainable from him.

R.P. Cox (G.C.R.I.) asked if anyone had suffered deleterious effects to plants from leakage of refrigerant gas into plant chambers, but no one seemed to have experienced such effects.

8. HEAT RECLAMATION AND ENERGY MANAGEMENT

J.I.I. anticipate 45% heat reclamation from their new scheme, which uses cabinet waste heat to warm a glasshouse and assist with domestic water heating. A consultant was employed to plan the scheme, for which details are available.

9. AUTOMATIC IRRIGATION

No new systems have been installed at any of the establishments represented by participants. A brief review of systems used at present revealed:

- (a) J.I.I. use wick strips in plant pots with the wick hanging into stainless steel troughs of nutrient in order to give capillary feed.
- (b) N.V.R.S. use pots stood in covered troughs with a constant nutrient level, gravity fed from an adjustable tank.
- (c) Rothamsted use the standard N.I.A.E. system in which pots are stood in a sand bed which has constant nutrient level, just below the surface, again giving capillary feed to the pots.

10. INSTRUMENTATION AND SENSORS

There is a project area at N.I.A.E. to investigate and develop new sensors e.g. IRGAs solid state CO₂ sensors, IR lamps, fibreglass optic interfaces between sensors and microcomputers or data loggers,

L.D. Incoll (Leeds) asked, in view of the expense of r.h. sensors like the Vaisälä, whether the cheap tumble drier type had been investigated. D.J. Fitter (G.C.R.I.) said he was currently assessing that type using a circuit set up by Wye College.

11. NEXT MEETING

The 1985 Meeting will be held at John Innes Institute, Norwich.

R.P. Cox
31st October 1984

**LIST OF PARTICIPANTS
ARC CE USERS GROUP MEETING 1984
AT THE GRASSHOUSE CROPS RESEARCH INSTITUTE**

Dr. A.J. Abbott, Long Ashton Research Station, Bristol
Mr. J.R. Aldous, John Innes Institute, Norwich
Dr. D. Atkinson, East Malling Research Station, Maidstone
Mr. D. Avery, East Malling Research Station, Maidstone
Mr. K.R. Bambridge, University of Nottingham
Mr. J.R. Bolton, National Vegetable Research Station
Mr. J.T. Burrell, AFRC, London
Mr. J. Caseley, Weed Research Organisation, Oxford
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Mr. K. Chivers, University of Reading
Mr. R. Clare
Dr. K.E. Cockshull, GCRI
Mr. R. Cox, GCRI
Mr. S.H. Crothers, Department of Agriculture, N. Ireland
Mr. C. Davey
Mr. D. Dickinson, University of Reading
Mr. D. Edwards, University College of North Wales
Mr. M.J. Elsworth, Long Ashton Research Station
Mr. J.F. Farrar, University College of North Wales
Dr. T.J. Flowers, University of Sussex
Dr. R. Fordham, Wye College
Mr. G. Frankland, AFRC
Mr. A.P. Gay, Welsh Plant Breeding Station
Mr. P. Gull, East Malling Research Station
Mr. M. Hannah, GCRI
Mr. D.M. Harvey, John Innes Institute, Norwich
Mr. N. Helyer, GCRI
Mr. J.W. Hine, Grassland Research Institute
Mr. C. Holbourn, GCRI
Mr. C.C. Hole, National Vegetable Research Station, Warwick
Mr. R.F. Hughes, Long Ashton Research Station
Dr. L.D. Incoll, University of Leeds
Dr. H.G. Jones, East Malling Research Station
Mr. S.C. King, Long Ashton Research Station
Mr. M. Ledieu, GCRI
Dr. J. Moorby, AFRC
Dr. A. Morgan, National Vegetable Research Station, Warwick
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Mr. G.E. Wilson, Meat Research Institute
Mr. B.J. Wilson, Wye College
Mr. A.R. Yeo, University of Sussex