

A.R.C. Unit of Flower Crop Physiology

Cabinet Users' Meeting on Humidity (2nd Feb. 1966)

1. Layout of cabinet.
2. Humidifying devices.
 - a) Trough (Acock - Sutton Bonington)
 - b) Defensor Atomiser (Wareing - Aberystwyth).
 - c) Link in inlet/outlet (Sagar - Bangor) using drip, steam or spray.
 - d) Drip on cooler bank.
3. Humidity detectors
 - a) Hair hygrometers (spot or local recording)
 - b) Wet and dry thermometers
 - (i) Assman psychrometer (Spot)
 - (ii) Thermocouples (Spot or recording)
 - (iii) Foster RH calculating recorder
 - (iv) Resistance thermometers or thermistors (spot or recording)
 - c) Dewpoint (spot only;
 - d) Polystyrene wafers - resistance (spot or recording}
 - e) Lithium chloride - resistance (spot or recording)
 - f) Gregory - capacitance (spot or recording;

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Mr. B. Acock (Sutton Bonington), Dr. P. Bishop (Imperial College),
Dr. G. Hackett (Letcombe Regis), Professor Heath & Dr. Hughes (Reading),
Dr. O. Jewiss (Grassland Research Inst., Hurley), Mr. L. Mouldsley (N.I.A.E.),
Mr. Needham (Entomology, Rothamsted) and Dr. J. S. Pate (Belfast)
were present.

I. The cooler bank, floor and subfloor assemblies of a Saxcil Cabinet were removed and the general layout discussed. Several alternative positions for the dry bulb detector were indicated. The thermal insulation of the cooler valve motor from the valve body was discussed.

II. Humidifying devices

i) Initial humidification The quickest and most effective way is to insert a hose in the lower fresh air port and allow a gentle stream of water to run in until water pours out of the overflow from the base trap. It is almost impossible to control the air exchange by the butterfly valves in the ports. Coverplates should be fitted with only small holes for ventilation. This makes the humidification problem much more manageable. Most cabinets leak so much that fresh air exchange is in fact unnecessary (demonstrated by CO₂ monitoring).

ii) General background humidification to overcome loss of moisture due to leakage, or when few plants are transpiring in the cabinet or to allow recovery after opening the doors.

a) Steam devices are to be avoided as far as possible because they can so easily interfere with the basic operation of the cabinet.

b) Atomisers can be situated either in the cabinet or in the duct above or below the fan. A Defensor atomiser is being used by Professor Wareing at Aberystwyth. A spinning disc atomiser might be used in the plant space or even the main fan might be mounted with a jet of water on to it. Owing to the transport of droplets of water, any atomising device is liable to interfere with the dewpoint control system, but can be useful where saturating humidity is required quickly.

c) A most effective wick system operating from a perspex trough 2½" x 2" x 4' 6" with an automatic water supply based on a carburettor float valve was demonstrated by Dr. Acock. The trough is hung high up by the outlet slit with wicks of Terry towel supported by ½" expanded aluminium leaning over into the duct. After opening the doors of a cabinet with no plants in it the relative humidity fell to approximately 50% and rose to about 90% (the controlled level) in about 10 minutes. A mass produced trough is being looked for (? a chromatography trough). The system requires an overhead, preferably low pressure, deionised water supply. Access to the float valve is through the standard port fixed on all cabinets. This system does not interfere much with the light climate. The air passing the trough will be cooled as it takes up moisture which may interfere with the dry bulb detector if it is left in its position in the exit duct. A similar system was also demonstrated by Dr. Hackett, using chopped strand mat from G. F. Taylor Ltd., Crowthorne, Berks.

d) The inflow and outflow ports can be linked and a wet wick, trickle of water over marbles, or atomiser put in the ascending part of the link.

The flow is upwards in the link so a dripping system should be effective. The amount of air recirculating through the link can be controlled by the butterfly valves. Dr. Sagar (Bangor) had reported using a humidifier in the link.

e) The simplest device is to insert a perforated tube on a central 'T' piece or a mist propagation nozzle through the cover plate on lower fresh air port and to allow water to dribble or spray on to the cooler bank. When water drips freely from the base overflow the flow can be restricted. When the doors are opened, the flow can be increased for 5-10 minutes. Since the principle of humidity control depends on the fins of the cooler being wet, this is the most direct approach to the problem.

iii) Problems

It is important that the air leaving the cooler bank and striking the wet bulb detector should be saturated. Mr. Acock and Mr. Mouldsley hope to investigate this further in the future.

The system also would not be properly effective if any droplets are carried in the air stream off the cooler bank. Anyone who has an opportunity to investigate this would obtain very useful information.

It is worthwhile checking that the heater coils have not shifted in transport by inspecting through one of the small side panels in the base (the one on the left when facing the control panel). If the heater is displaced towards the cooler bank at its free end it could press up against the dewpoint detector and give erroneous control.

III Humidity Detectors

i) General Policy

For any long term work involving several cabinets, it is essential to have a remote continuously recording system. Hairhygrographs are not suitable. The cost of a multipoint recorder and thermocouples (e.g. a 6" strip chart recorder such as Xactrol) is not much more than 3 or 4 thermohygrographs and is very much more reliable.

ii) Wet and dry systems

The biggest problem here is the design of a small ventilated and irrigated chamber for use with thermocouples or resistance thermometers. Those available commercially are about the size of a thermohygrograph and much too large. Something the size of a matchbox is needed, with a remote reservoir outside the cabinet. With such a small unit, the airflow within the cabinet might provide adequate ventilation. The N.I.A.E., Nottingham and Reading are pursuing this matter.

For a detector, thermocouples are by far the cheapest, are connected directly into a potentiometric recorder, but require a reference junction. A hot reference junction at 45°C is used at Reading (cost about £10 for 9 junctions). Using copper constant in the range -5° to +45° gives almost exactly 2 m.v. The low temperature is useful for monitoring the glycol chiller.

Resistance thermometers and thermistors are of numerous types. The ones mentioned below are those being tested by users.

Foster Instrument Company Limited, Letchworth, Herts.

Recorder for 6 dry bulb temps and 6 relative humidities

or 6 wet bulb temps..... £ 414

Aspirated boxes each 44

Elements per pair..... 14

(Note - the box is too big)

N.I.A.E have this equipment

Degussa Hard Glass Type P4 (supplied by Lush beach and Segner Bayley Ltd.)
559. Altrincham Road, Styal, Wilmslow, Cheshire.

Thermister probes Grant Instrument Limited, Toft, Cambridge

Mullard Limited, Terrington Place, London, W.C.2.

Nottingham have this type of equipment.

iii) Dry detectors

Humidity detectors made by the Phys-Chem. Research Corporation (English Agents D. & K. Laboratories Limited, 4 Tilney Street, Park Lane, London W.1.) were demonstrated (A. P. Hughes). These have a resistant charge from 1 K ohm at 100% to 20 K ohm at 50% RH and cost £9 each. A resistance bridge (Electrenis Switchgear - £105) is needed to produce a signal for recording. A Xactrel recorder (£160) is suitable. A series of detectors can be switched to the bridge and recorder in sequence. The advantage is that no reservoir of water is required and no ventilation is necessary. The unit can easily be placed just before the fan through the upper fresh air duct, or it can be placed in the plant space. The detector is a polystyrene wafer the size of a large postage stamp. An even smaller detector 1 cm x ½ cm is available operating from 100 K ohm to 10 K ohm over the same humidity range. No one had any information on the lithium chloride cell nor the Gregory humidity detector. Information on these would be useful. The "Hygrodynamics" detectors are like the PCRC ones.

IV Auxilliary Equipment

It is useful to have a small chamber with a mixing fan into which a tray of saturated salt solution can be placed, together with the humidity detector for the purpose of calibration. A dewpoint hygrometer may be useful for absolute calibrations.

Mr. Acock demonstrated a simple and highly effective plastic canopy on a frame, which can be clipped around the cabinet door frame with the operator standing inside the canopy.

Dr. Bishop reported that a square section plastic guttering with end sections was now available from Limpet Rainwater Goods, J. W. Roberts Ltd, 15 Buckingham Gate, Westminster, London, S.W.1. and was most useful for making subirrigation troughs. It is 4" wide at top, 2" deep, in sections 6 ft. and 12 ft. long (11/3 and 22/6) with end stops at 2/1 each.

Notes on Applied Science 4 "Measurement of Humidity" by M. J. Hickman, H.M.S.O., contains a lot of useful information.

V Further demonstration

It is hoped to arrange a second demonstration of the various pieces of equipment in April for those who were unable to attend this first meeting. Will anyone who has any items which would be of interest either for demonstration or to circulate in the notes please let me know?