SESSION 3: MANAGING THE PROPAGATION ENVIRONMENT

Monitoring Variation in the Propagation Environment

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INTRODUCTION

Environments in greenhouses never stay constant, varying between day and night, and often having different zones within a greenhouse to such a degree that the microenvironment of propagating trays and pots may not stay within acceptable limits. Greenhouse environments and designs are detailed in texts such as Garzoli (1988) but little information is available on microclimate changes within a greenhouse. Five greenhouses at Burnley were monitored over several weeks using electronic data recording equipment and infrared thermal imaging techniques. Spatial and temporal variation of temperatures were monitored in the macroenvironment of the greenhouse and the microenvironment of the propagating pots.

Significant variation of temperatures occurred in a glasshouse heated with an overhead radiant gas heater located along the gable ridge. A gas burner produced hot gases which passed along the length of the tube causing it to heat up and radiate heat to the plants below. The hot gases pass out of the greenhouse and are exhausted to the atmosphere. The macroenvironment of the greenhouse is controlled by a thermostat which switches on the heater when the air temperature falls below the set point of 18C. During the monitored period over a cold night, the air temperature in the greenhouse (monitored under the bench) remained relatively uniform at 18C, whilst the outside air temperature dropped to 9C. Whilst the macroenvironment in the greenhouse, as seen by the thermostat, was stable and within acceptable limits, there was considerable variation in the soil surface temperatures of the propagating pots and trays, ranging from 31C at the hot end of the greenhouse, to 20C at the cooler end. Thermal imaging equipment recorded the spatial variation along the length of the greenhouse and results indicated a dramatic variation in the microenvironment of the plants.

Large vertical variations in temperature were also recorded in 150-mm pots of marigold seedlings. The base of the pot remained at 17C, whilst the soil surface at the top of the pot rose to 20C. Foliage temperatures were considerably higher with the very uppermost leaves absorbing most radiant heat which raised their temperatures above 25C.

Comparison of the microenvironment in two propagating trays showed quite different temperature profiles for a polystyrene tray to that of a black plastic tray. Two trays placed alongside each other recorded variations of 4C in the soil temperature. The temperature in the polystyrene tray (maximum 31C) was consistently higher than the black plastic tray (maximum 27C). The radiant energy absorbed at the soil surface of the polystyrene tray, was unable to leave the soil by conduction, because the side walls of each cell are heavily insulated. In the black plastic tray with thin walls for each cell, the same absorption of radiant energy occurs, but more heat is lost to the surroundings via conduction through the walls and so the soil does not heat up as much. This difference is also noticed when radiant heat from direct sunlight causes the polystyrene cells to heat up more than plastic trays, and also during a clear cold night when the radiant heat loss of the soil is lower in a polystyrene tray than in a thin-walled plastic tray.

Another heating system for propagating plants uses heated beds or mats, providing heat from below via conduction. Heat passes upwards from the base to the top of the pot. The air is not heated. A 150-mm pot on a heated mat (set at 25C) was monitored and the thermal environment varied dramatically on two successive nights. On a mild cloudy night where little radiant heat loss occurred, conditions inside the pot remained nearly constant at 20 to 22C. On the following cloudless night, significant radiant heat loss occurred from the top of the pots resulting in pot temperatures falling to 12C whilst the mat temperature rose to 35C in an attempt to provide more heat. This under-pot heating system did not maintain a good pot microclimate under the colder conditions

CONCLUSION

Thermal imaging techniques and electronic monitoring equipment have been successfully used to monitor variations in greenhouse macro- and microenvironments under different thermal conditions.

LITERATURE CITED

Garzoli, K. 1988. Greenhouses: Handbook for nurserymen, horticulturists and gardeners. AGPS Press, Canberra, Australia.

Design and Construction of a Controlled Environment for Propagation of Ornamental Plants

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A controlled environment is one where all climatic variables are controlled and set by the grower.

DESIGN CONSTRAINTS

We were using in-bed electrical cables which were proving inefficient and expensive to run. Determined to reduce the heating costs by at least 40% for our 60 m^2 of heated propagation beds which were costing us approximately $800 per winter month to run, the first decision was which irrigation system to use? Fog, mist, or high pressure mist? The second was to determine which method of heating and therefore what fuel type to use. We were working with an existing tall tunnel, 18.5 m × 6.2 m × 3.4 m (l×w×h) which was used to house stock plants.

IRRIGATION SYSTEM

In the early nineties the buzz word in the propagation world was fogging. It seemed