erations are hygiene, air porosity, availability, handling, and price. One approach is the use of a single type of standardised tray that fits most situations. A more specialised approach would be the matching of particular crop requirements to a specific tray type. The use of plugs or cells is becoming more common however reports of propagator experience are not all reporting success. Plugs certainly have a place but not for every crop. It was emphasised by several that the use of plugs needs a management system that meets the requirements of their use. It is not entirely straightforward to simply switch from cutting production in conventional trays to direct sticking in cell trays. Each tray type has particular features and usually takes some experimenting to test if the tray and the propagation system as a whole are meeting the crop's requirements. This often leads to flexibility within the propagation system, which allows a range of tray types to be used. This emphasises the important principle of the tray matching the management of the propagation environment. This is similar to the earlier discussion in this forum regarding the matching of the mix to the management system. The propagation environment, the tray, and the mix are all connected and each component should not be separated out. Changing one will have an affect on all.

PROPAGATION ENVIRONMENTS FORUM

PANEL MEMBERS: Don Currey, Jeff Elliot, Lee Gilbert, Richard Whisker, and Jan Velvin

The panel members each gave a brief presentation based on their own experience of the propagation environments used by or known to them. A general discussion followed which covered the following:

BENCH CONSTRUCTION AND DESIGN

A problem with some bench designs is their thermal properties. This is the bench's ability to hold and distribute heat. A bench construction which appears effective in tackling this problem is a solid concrete bench containing hot water piping. This method creates a very effective thermal mass and also encourages improved hygiene allowing easy cleaning of the bench surface. Another bench material that has good thermal properties is ferrous sand. Constant, even heat and good hygiene are significant components of any propagation bench environment. A problem with concrete benches is their high weight, especially if the bench is raised off the ground. Some thought is needed as to the framing required to achieve this. Benches containing peat, sand, or pumice in varying mixes have advantages of enabling good contact between the tray or pot and the bench surface for water and heat uptake but often have various hygiene problems. Benches raised above the ground provide easier working conditions, however if your environment is aiming for as much cool air above the tray surface as possible then raised benches may not help due to heat rising. With this in mind it was suggested that instead of monitoring the environment air temperature it was more important to monitor the plant level or bench

temperature. If your bench is at ground level then consider what the ground is like and the efficiency and positioning of heating cables as bench heating may be lost into the ground itself. Electric cables or hot water piping can provide bench heating. A source of hot water that is under utilised and often overlooked is solar heating. The initial installation costs can be high but longer term this energy source is very cost effective.

MISTING AND FOGGING CONTROL

Light meters could be an effective method to regulate misting and fogging. This method provides water when it is actually needed. When sunlight is strong misting or fogging will be frequent to counter evapotranspiration and alternatively on cloudy days watering would be less frequent. The light meter does provide a precise method to control air humidity and mix moisture in your environment. As with any tool, the light meter will only be effective if it is used together with sound environment management and observation. Observation skills are very important in managing water requirements. Technology can assist in the creation and management of a propagation environment but it should be monitored regularly and supplemented with human intervention. One approach to the control of misting or fogging and to the whole environment, is the interception of light or heat before it reaches the plant. This can be done by the use of shade or thermal screens. This could in turn reduce water requirements. It should be remembered that where water is used to cool the air temperature, maintain humidity, and water the plants, concentrating on one of these may cause a problem in another area. An example shared was the use of fog, which effectively maintained humidity and cooled the air, but did not water the plants adequately.

MIST LINE BLOCKAGES

A common problem is the blocking of mist lines with moss and algae when white plastic pipe is used due to sufficient light entering the inside of the pipe. A possible solution was to paint the pipes black to keep out the light but this resulted in the pipes becoming over heated with drastic results. Another, more successful solution is to paint pipes with aluminium paint. This reduces the light but does not overheat the pipe. Other solutions to overcome this problem include treating the water with ozone or dilute chlorine; or flushing the pipes for several minutes each day.

GREENHOUSE DESIGN

The propagation environment is made up of a number of components including light, temperature, humidity and air movement. All are related to each other and altering one will change another. This principle has been emphasised throughout this forum. Greenhouse design is the physical putting together of all these components to achieve an optimum environment for propagation. The use of shade screens can control light and temperature where thermal screens have a stronger influence on temperature. The use of tents or tunnels within the greenhouse can be used to control humidity and temperature. Wet walls can be used to control air temperature and humidity. They are most effective in drier climate areas. A basic principle of cutting propagation is the aim for cooler temperatures around the leaf and warmer temperatures around the root; the "hot bottoms and cool tops" idea. The design of the greenhouse has particularsignificance on the air temperature component of this principle.