This article was listed in Forest Nursery Notes, Winter 2008

76. In-slab bench heating improves propagation hygiene and cuts maintenance costs. Carmen, P. International Plant Propagators' Society, combined proceedings 2006, 56:96-99. 2007.
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In-Slab Bench Heating Improves Propagation Hygiene and Cuts Maintenance Costs©

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INTRODUCTION

The Australian National Botanic Gardens (ANBG) is dedicated to growing, studying, and promoting Australian plants. It currently holds around 6,500 species of Australian plants, many of which are new to horticulture.

In June 2004, a new production nursery was opened. Major features of this modern facility include: twin-skin polytunnels, a computerized Building Management System (BMS), and "in slab" bench top heating.

The twin-skin polytunnels provide maximum light throughout the year and insulation for additional warmth in the cooler months to optimize growing conditions. The BMS computer controls and monitors the irrigation and ventilation within the polytunnels and growing areas.

"In-slab" heating bench tops are used to provide bottom heat to maximise root growth throughout the propagation and young plant development phases. These bench tops have been constructed to replace "in-sand" benches and heated cold frames in the old nursery. In this case, electric heating cables have been installed in concrete slabs 3 m long, 900 mm wide, and 75 mm thick and placed on prefabricated steel benches. The use of electric cables to heat buildings has been around for a long time, but using them in this way in a nursery may well be a first.

From a production point of view, the combination of these three features has significantly improved the growth of the plants.

From a propagation point of view, the use of in-slab bench top heating has solved most of the hygiene problems associated with the in-sand bench heating in the old nursery.

BACKGROUND

The ANBG nursery grows between 10,000 and 15,000 plants each year, and all these plants are used in new gardens or as replacements. The ANBG nursery differs from most commercial nurseries in that:

- Many of the plants are "new" to horticulture, and striking them may require a range of different treatments and/or methods.
- The number of plants required is often between 1 and 20 as opposed to 100s, if not 1000s, in commercial nurseries.
- Most of the plants grown in the nursery are propagated by cuttings or grafts from mother plants where the provenance is known and documented and the propagation history recorded.

COMMENTS ON HYGIENE

Staff at the ANBG nursery has a philosophy of getting the basics right to begin with, and this starts with nursery hygiene. Good hygiene practised throughout the propagation cycle results in higher strike rates for cuttings with more healthy roots and concomitantly stronger plants.

The majority of hygiene practices at the ANBG nursery have not changed with the move to the new nursery. These are:

- Pots are washed and steam sterilized, and all propagation and potting mixes are pasteurised.
- All pots and materials are transported on trolleys, and there is no contact with the ground in any part of the process.
- All hoses are stored off the ground.
- There is regular maintenance in propagation tunnels, i.e., removal of dead leaves and cuttings.
- All growing mixes are formulated to encourage healthy plants with a good balance between air-filled porosity and water-holding capacity.
- Cuttings are placed in 100-mm square punnets with uniform spacing to allow adequate air movement.

However, despite these practices there were major problems with the maintenance of the in-sand heating benches. To get an idea of the significance of the in-slab bench tops it is necessary to discuss the propagation conditions in the old nursery and compare them with those in the new production nursery.

COMPARISONS

Old Nursery.

Propagation Structure.

- Glasshouse.
- Light control—partially removable 70% shade cloth.
- Southern end non-ventilated set up for fog propagation—cuttings and grafts.

Hot Beds.

- 3 x 10 m^2 bench tops.
- Heat supplied by electric heating cables in 100 mm of washed river sand.
- Weight unknown.

Temperature Control.

A single thermostat was placed in the corner of each bed and was set for 23 oC.

- Tests using data loggers revealed that the system was unable to supply the required temperature especially at night in winter.
- Removal of 50 mm of the sand improved the heat transfer, but the system still could not consistently deliver the required temperature.

Irrigation/Humidity.

For propagating cuttings and grafts:

- "Dann" foggers were used to maintain humidity and were controlled by a "Jefferies" mist controller with light sensor.
- Using fog as the source of humidity means that the sand in the hotbeds dried out quickly, resulting in uneven heat distribution and the media in the cutting punnets drying from below. To counter this all benches were watered daily.

Hygiene/Pests and Diseases.
The control and elimination of pests and diseases in the propagation phase was a time-consuming factor in the old nursery. Some comments:

- Uneven distribution of the fog caused wet spots and dry spots, and these areas could not be used.
- Moss and liverwort quickly became established in the wet spots, and the spores began to germinate in any punnets where cuttings were slow to root. Moss and liverwort are also a haven and food source for slugs and fungus gnats.
- Fungal diseases like botrytis were difficult to control.
- Cleaning up media spills on the sand was difficult.
- A sheet of Marix weed mat was placed on the benches, but it also became infested with moss and liverwort.
- Ants also invaded the sand beds, making nests and then farming/ spreading insects like scale and mealy bugs.

Safety.
With electric wires in sand there is always a risk that they may be damaged.

New Nursery.

Propagation Structures.
Twin-skin polytunnels are used to provide optimum growing conditions with maximum light. There are seven tunnels, each contains five benches with concrete in-slab bench tops.

Environmental Controls.

- Humidity is supplied with Dann foggers controlled by a combination of the BMS and balance arms.
- Light is moderated by the use 70% shade cloth and whitewashing in summer.
- The BMS also controls the temperature via evaporative coolers and opening roof vents.

Benches.
The benches used throughout the nursery are made from prefabricated galvanised steel. They range in height from 900 mm–950 mm.

In-Slab Concrete Bench Tops.
In this case each bench top:

- Is 3 m long x 900 mm wide x 75 mm thick.
- Can supply heat in a range from 0–30 °C.
- Weighs 640 kg.
- Has been treated with cream-coloured epoxy paint.

Testing and Performance.
Testing with data loggers in punnets of cutting mix on these benches indicated that the heat transfer over a 24-h period is consistent with little drop of temperature during the night.

Bench-Top Hygiene.
Each bench:

- Is sloped towards the drainage line on the floor, and all surface water runs away freely.
- Has improved drainage, and with the elimination of sand there is no moss or liverwort and nowhere for slugs to hide.
- Is easily cleaned, and any spills can be easily swept up. When a bench has been cleared of punnets, it is sprayed with sodium hypochlorite and lightly scrubbed and then washed down. It is then ready for re-use.
- Can be isolated to minimise the risk of contamination.

Additional Maintenance.
Because there is still a risk that the cuttings may dry out, all the benches are still watered daily, and some of this water is trapped under each punnet.

Safety.
Having the electric heating cables fully enclosed in concrete means that there is no risk of their being punctured.

CONCLUSIONS

- In-slab bench tops are easy to keep clean and are virtually maintenance-free.
- No fungicides or pesticides have been used in the propagation tunnels in the new nursery.
- Bench space is able to be used more efficiently.
- Staff has more time to concentrate on other facets of the production process.
- Benches tops can be used for experimental purposes to establish optimum temperature for root development.