Propagating Woody Ornamentals With Bottom Heat

Bob Black
Bennett's Creek Wholesale Nursery, 3613 Bridge Road, Suffolk, Virginia 23435

INTRODUCTION

Bennett's Creek Nursery is located in the southeastern corner of Virginia. During the cooler months our climate requires supplemental heat to maintain 21C (70F) root zone temperatures. This paper will describe our recently installed heating system. Crops produced, propagation technique, and overall benefits of the system are discussed.

THE HEATING SYSTEM

In 1994, we added 743 m^2 (8000 ft^2) of hot-water tube mats, which were placed on the floors of nine free-standing greenhouses. The dimensions of each greenhouse were 5.2 m × 19.5 m (17 ft × 64 ft). The mats are coupled to a one million BTU cast iron boiler. The fuel for the boiler is natural gas. In order to protect our investment, the majority of the system is located in an adjacent shed. All piping was insulated and placed below ground. The following equipment is housed in the boiler shed:

- Electronic ignition, double burner boiler
- Main circulator pump
- Air separator
- Expansion tank
- Pressure relief valve
- Pressure reduction valve
- Low water emergency cut-off
- Primary aquastat
- Secondary aquastat
- Two isolation valves

Each greenhouse contains the following:

- Two 2.2 m × 19.2 m (7 ft × 63 ft) grow mats (with 0.6-cm (0.25-in.) diameter rubber tubes spaced 10.2 cm (4 in.) on center
- Supply headers
- Return headers
- Mechanical flow control valve
- Circulator pump
- Thermostat and remote soil temperature sensor (root zone)
- 61-cm (24-in.) vent fan
- Thermostat (air temperature control)
- Two isolation valve

MAIN LOOP CONNECTION BETWEEN THE BOILER AND GREENHOUSES

The components in the boiler shed are linked to the greenhouses via a 6.4-cm (2.5-in.) diameter piping system. The copper pipe inside the boiler shed is connected to hot water plastic pipe (CPVC) outside the boiler shed. The supply and return piping exit the boiler through the floor. All CPVC pipe is insulated with a rubber material

and placed 46 cm (18 in.) below ground. The supply and return pipes run the length of the greenhouse range along one end. Just beyond the farthest house from the boiler shed, the supply and return pipes are connected to form a loop system. This design supplies evenly heated water to all greenhouses regardless of distance from boiler. Each greenhouse is coupled to the main loop with 4 cm (1.5 in.) diameter supply and return piping.

HOW THE SYSTEM REALLY WORKS

As previously mentioned, the boiler has two burners. Each burner is equipped with an aquastat (water temperature sensitive thermostat). The primary aquastat, which controls the primary burner, is set at 54C (130F). The primary burner will burn until this temperature is reached in the boiler. The secondary aquastat is set at 52C (125F) and is located on the supply pipe boiler shed. If the primary burner can't maintain at least 52C (125F) at the boiler, then the secondary burner is activated to obtain this temperature. This design greatly increases the efficiency of the system. Only during the coldest winter nights is the secondary burner needed.

In each greenhouse a thermostat connected to a soil probe monitors the root zone temperature. If the soil temperature drops below the desired level, the thermostat signals the main circulator pump and the small circulator pump in the greenhouse simultaneously and they are energized. The main circulator pump is located on the supply line exiting the boiler. The small circulator pump is located on the return line inside the greenhouse. Hot water circulates in the main loop via the main circulator and is drawn into the greenhouse via the small circulator. The mechanical flow control valve is located on the supply leg entering the greenhouse. It is just inside the greenhouse. This valve automatically opens as the small circulator comes on. Hot water is then allowed to flow through the tube mats via supply and return headers connected to the tubing. Once the desired root zone temperature is reached, the small circulator pump shuts off. In turn the mechanical flow control valve automatically shuts off and the greenhouse is again isolated from the main loop. If the root zone temperatures are satisfied in all greenhouses then the main circulator pump shuts off. The boiler will continue to maintain 54C (130F) regardless of flow.

The pressure in the system is reduced to 12 psi before entering at the boiler. Very little additional water enters once the system is initially filled. The water is also chemically treated to prevent corrosion of any system components. The level of treatment must be monitored periodically to make sure that it is still at the correct level. If found to be low, an additional chemical treatment is added. Chemical is pumped into the system at the boiler via a boiler drain on the return line.

NURSERY CROPS PROPAGATED

The system was installed primarily for conifer cutting propagation during the winter. However many other crops are currently produced using this system. Selected cultivars of hollies, camellias, barberries, and gardenias root particularly well at the onset of cooler weather. Each greenhouse usually roots a fall crop of one of the aforementioned genera, which are then moved to a minimum-heat holding house in early winter. Then a crop of conifers (mostly junipers) are rooted in the same house.

CUTTING PROPAGATION

Cuttings are collected from young container-grown plants in the nursery. The lower foliage is stripped and the cutting is quick dipped in a liquid rooting compound. Most cuttings are about 10 cm (4 in.) long. On most plants, tops are removed to promote early bushy growth.

After preparation the cuttings are direct stuck in 7.6-cm (3- in.) pots in trays containing 36 individual cells. The media is a very porous mix of composted pine bark, perlite, and sphagnum peat moss (16 : 8 : 1, by volume). Fertilizer incorporated into the propagation media includes: 2.4 kg m^{-3} (4 lb yd^{-3}) of Osmocote 18-6-12, 3.0 kg m^{-3} (5 lb yd^{-3}) of dolomite, and 0.9 kg m^{-3}(1.5 lb yd^{-3}) of micronutrients. The trays of cuttings are placed on the tube mats on the graveled floor of the greenhouses.

Intermittent mist is applied sparingly. During cool season propagation in covered greenhouses very little mist is needed in comparison to warm season propagation. More emphasis is placed upon hand syringing than frequent misting. Conifers seem to respond well to this technique. Syringing also helps correct dry spots associated with bottom heat systems.

CONCLUSION

We like the results from the two seasons we've used our boiler system. Overall crop quality is up and we've gained a 5% increase in overall rooting percentage. We also like the flexibility in regard to production timing. No matter what the weather conditions we're able to maintain warm root zone temperatures.

If there is anything we would change in the system design, it would be the flow control valves. An electronically operated valve coupled with the thermostat in each house would probably be worth the extra expense. This would better isolate the greenhouse if that greenhouse wasn't calling for heat. Overall we are very pleased with the system performance.