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PROPAGATION OF *JUNIPERUS CHINENSIS* 'TORULOSA' USING BOTTOM HEAT

JERRY L. WETHERINGTON

Tampa Wholesale Nursery
Route 3, Box 436
Dover, Florida 33527

Abstract. The propagation of torulosa juniper, *Juniperus chinensis* 'Torulosa' (*J. chinensis* 'Kaizuka'), in the Florida climate has long presented a problem. Whether this be a climate problem, stock selection, or procedure, has not in the past been determined to any degree of consistency. However, general opinion seems to suggest that bottom heat would be the most conclusive single factor contributing to successful propagation of this plant. It was fully realized at the onset of this experiment at Tampa Wholesale Nursery that bottom heating was not a new process, neither were we pioneering any radically new or innovative techniques for providing the heat. The specific purpose was to design and implement a system that would provide a functional, economical means of producing liners for this operation, as well as to add to existing knowledge of techniques and procedures for propagation of this plant.

REVIEW OF LITERATURE

Determinations of the overall system design were done by evaluating information provided by Dr. R. W. Henley, Extension Specialist in the Ornamental Horticulture Department of the University of Florida, evaluating written descriptions of other existing systems, and from personally evaluating existing operating systems. Initial concerns were that the system design and function be developed in direct coordination with physical facilities into which it was to be built. In addition, this system must be designed to be monitored effectively as it related to all aspects of the physical environment in which it was to exist.

MATERIALS AND METHODS

The area selected for installation of this experiment was inside a fiberglass propagation structure, fan cooled and gas heated. The size of the structure to be heated was 6 × 30 ft. (one standard nursery greenhouse bench). Provisions were made during all phases of design and construction to provide for additional benches to be added to the system if so desired.

For maximum heat economy the heating grid was installed in a medium directly on the greenhouse floor. A wood frame, 6-in. deep, enclosed the area to be heated and was lined with 4 mil poly. This area was then filled with ground aggregate rock to a depth of 4 in. The aggregate was watered and tamped to a firm smooth surface. After reviewing the various tube materials available for hot water distribution, black polyethylene was chosen. Later analysis of all factors considered will show that this was probably not the most advantageous material as the metal clamps needed to hold it in place were expensive and difficult to install. However, for the purpose of this experimental stage it served well; ¾ in. size was installed directly on the top of the aggregate by clamping the tube to wood stringers placed 24 in. apart. Heated water was introduced into opposing corners of the grid and woven through the bed in alternating coils to insure even heat distribution. The coils were spaced 6 in. apart then covered with 1 in. of aggregate. Figure 1 shows the grid system as installed.

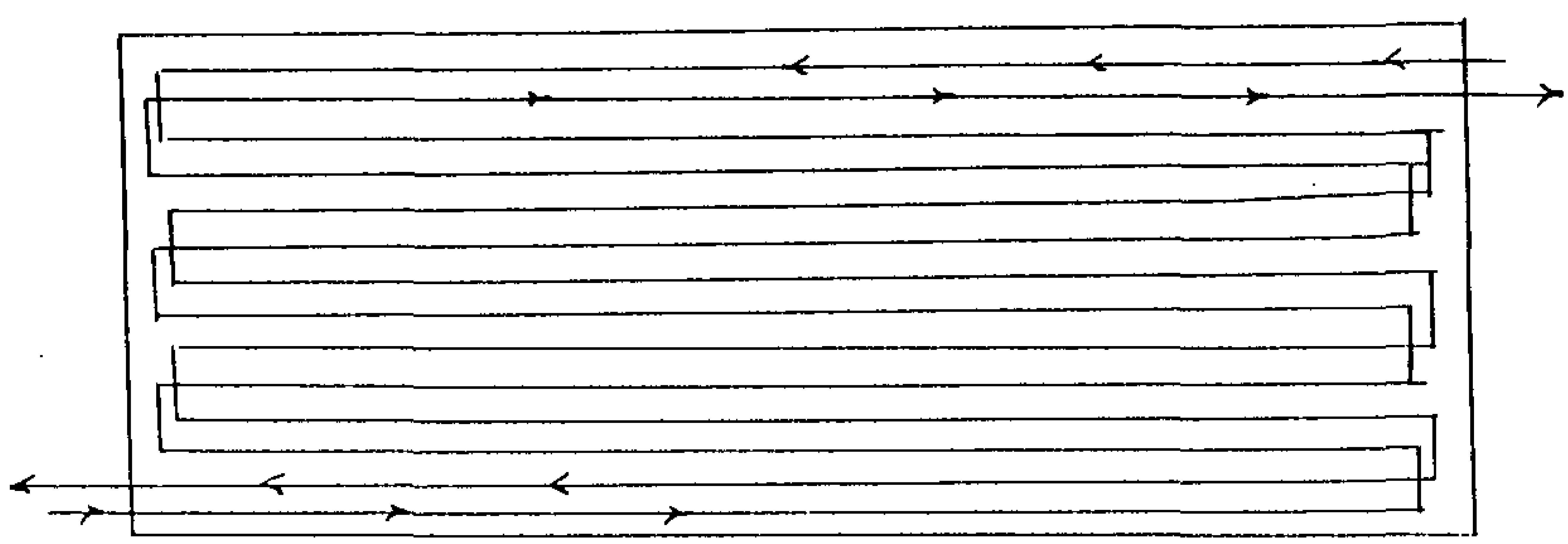

Figure 1. Heating Grid

The water-heating unit used was a 75-gal. standard home, 2-element electric water heater. Modification was made to insure proper pressure release at 15 psi. Electric clocks were connected to each element to monitor total heating time.

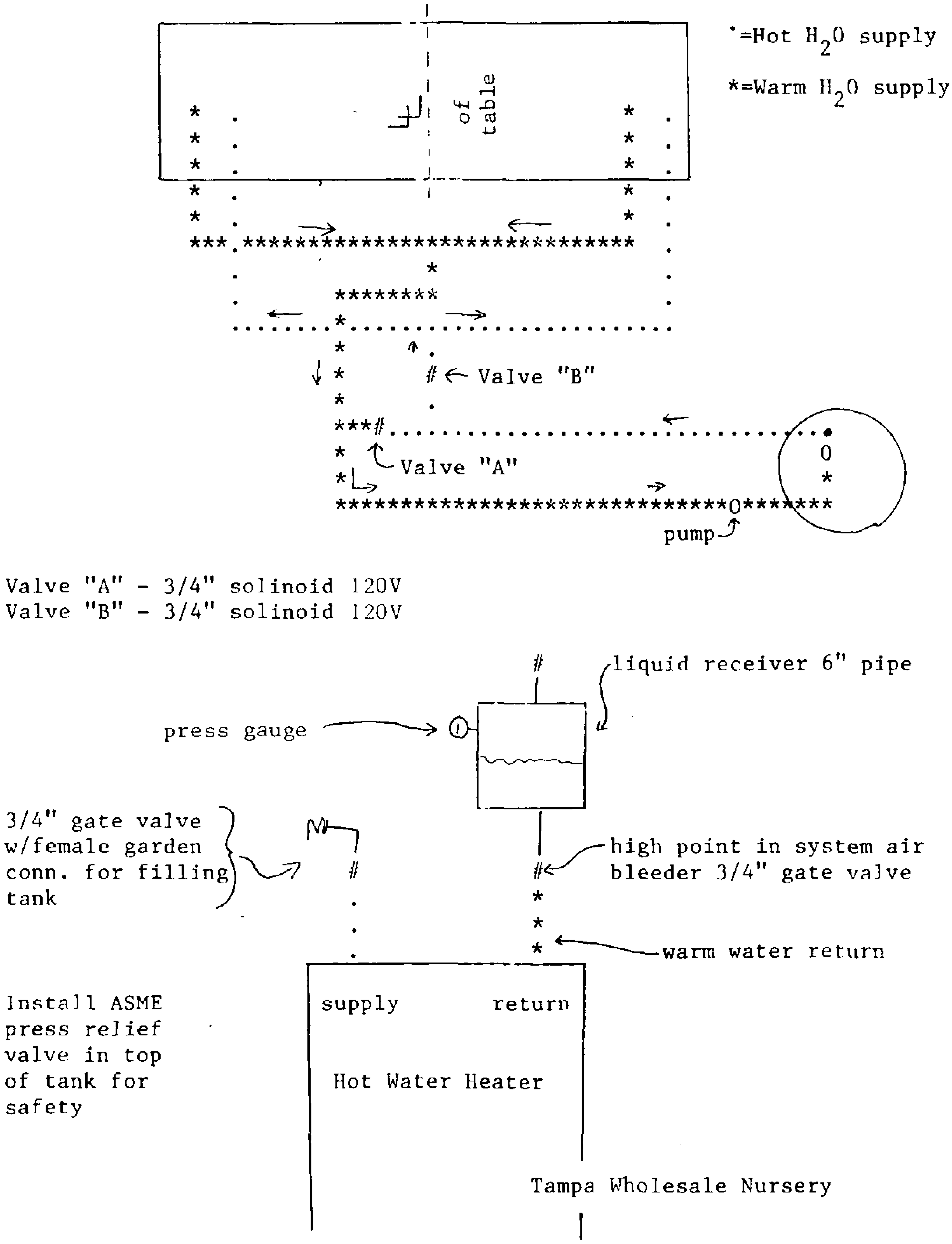

Figure 2. Circulation System

Figure 2 shows the circulation system. The water-circulation pump is located on the return line immediately prior to entering the heating unit. The pump runs continuously as water circulation to the grid is controlled by a two-story switching relay. The switching mechanism reacts to the thermocouple placed directly in the bench material. Bench temperature was calibrated to maintain 70° to 76°F at mid-tray level in the propagation flats.

Since this was a closed circulation system, it was necessary to locate an air collection-release tank atop the heating tank at the highest point in the system. Gate valves above and below the collection tank allow for air release without opening the circulation system.

Two-thousand torulosa juniper cuttings were stuck on January 21, 1983. Cutting wood was selected from nursery stock material in 15-gal. containers. Cuttings were made from tips of lateral branches. Experimental and control groups were both dipped in a solution of captain and Benlate (benomyl), then treated by dipping the lower 1½ in. of stems in Hormodin 2 powder. The control group was situated immediately alongside the heated bench. All factors of light, ambient air temperature, and air circulation were maintained compatible on both groups. As the experiment progressed, it was noted that approximately 50% more moisture was required on the heated bench to maintain appropriate wetness.

Temperature in the heated bench was maintained at 74° to 78°F. The control bench temperature changed as the ambient air temperature in the greenhouse changed. Figure 3 shows recorded temperatures.

RESULTS AND DISCUSSION

First sign of callusing was noted on the heated bench on the 13th day. First root initiation was noted on the 22nd day. No callusing or root initiation was noted in the control group on these dates. Rooted cuttings were removed from the heated bench on the 45th day and random trays counted for sampling; 92% of the cuttings in the experimental group were counted as rooted sufficiently for removal and potting as liners. None of the cuttings in the control group was sufficiently rooted for potting at the time (Figure 4).

Additional energy cost for operating this system during this period was computed to be appoximately 1.4 cents per plant. Based on the return temperature of the water, a relatively small additional amount of energy would be required to extend the capacity of this system to at least 300% the present capacity.

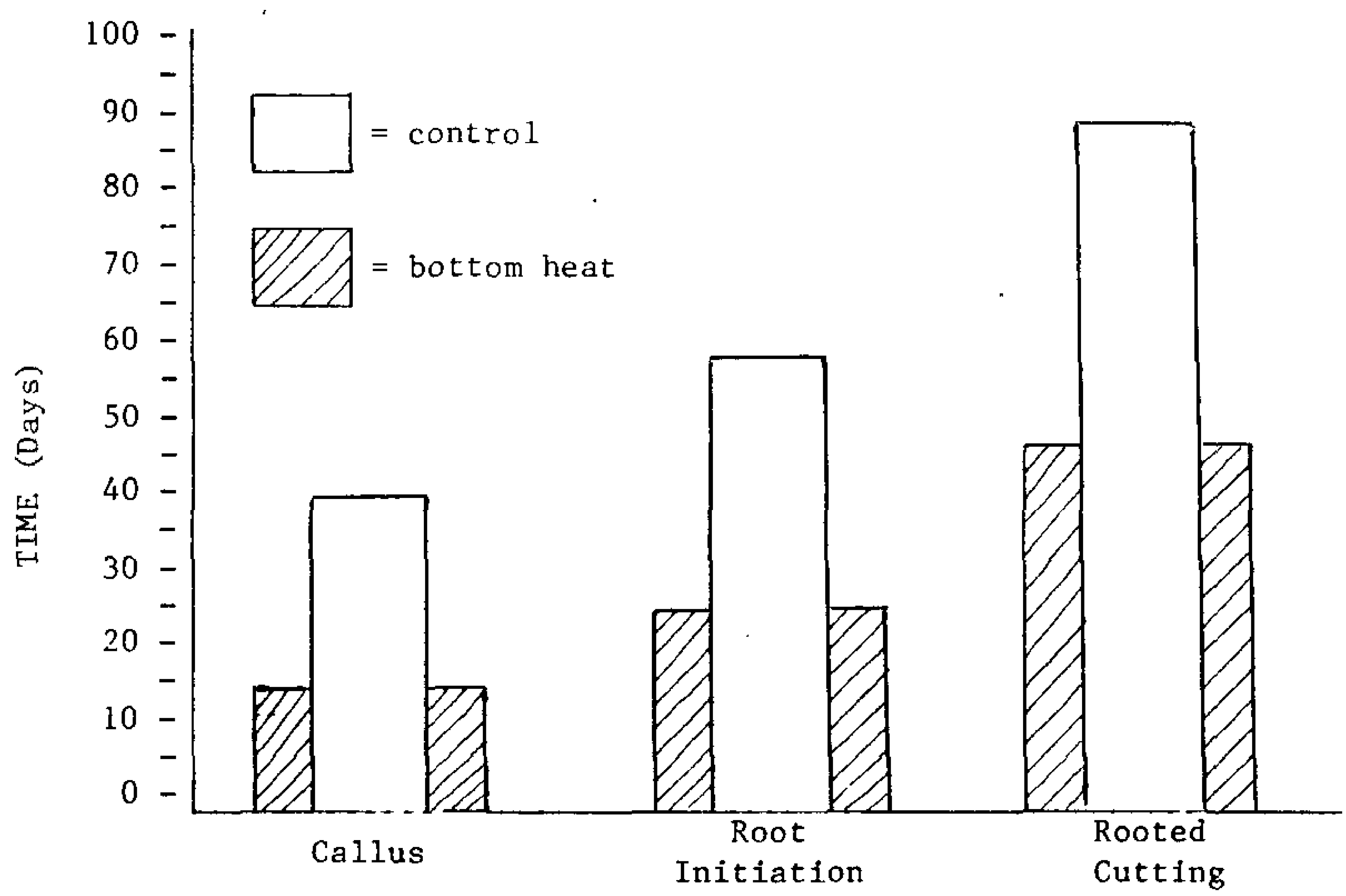

Figure 3. Time of callus, root initiation, and rooted cutting of torulosa juniper.

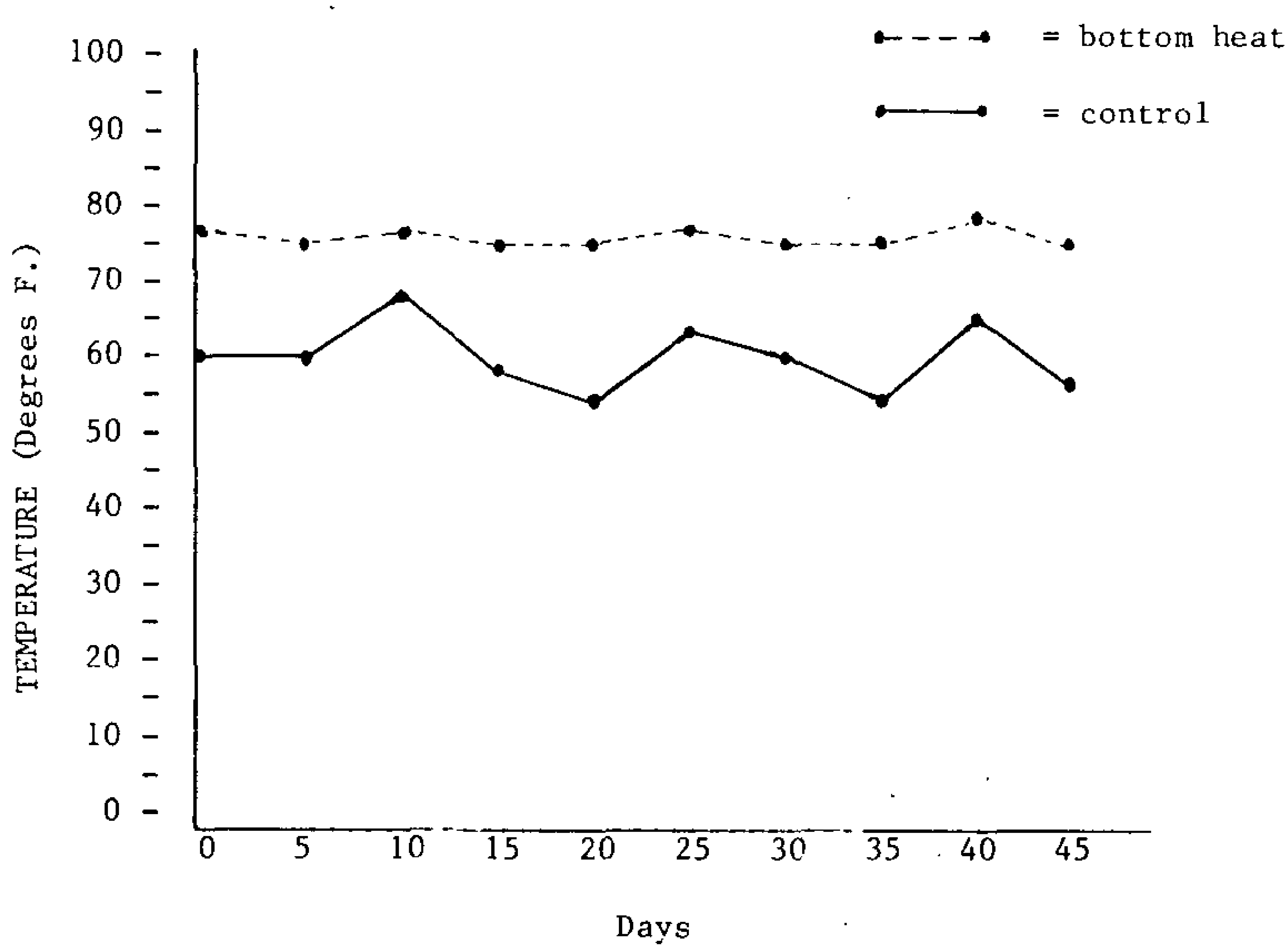

Figure 4. Soil temperatures recorded at 8:00 a.m.

We can conclude most definitely that bottom heat provided faster rooting and a higher percent of take. Considering the relatively short period required and the low cost per plant produced, bottom heat is an economical approach. The rooted cuttings produced under bottom heat conditions showed better health and growth with very little die-back, leading to a better quality plant.

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BIOTHERM BOTTOM HEATING IN PROPAGATION

TED SPRINGER

Biotherm Engineering
611 Mountain View Avenue
Petaluma, California 94952

Bottom heating is not a new idea. Fifty years ago steam-heated greenhouses were heated from the ground up. Today we are returning to that method as it becomes more and more critical to use energy in the most efficient way possible. Now, however, we are interested in the number of cubic feet actually heated as well as in minimizing the level of heat used. We are interested in the transfer of low-grade heat. The Biotherm system does this by using hot water as the heat carrier. We do not need or want high temperatures in our growing benches. One mum grower quite accidentally discovered the advantages of bottom heat when he left his Modine unit on the floor following a tornado. He began to notice increased plant growth, which dramatically illustrated what we have known all along: soil temperature is what counts! For many plants a 70°F thermostat setting will give a good crop. But this is head high! It is not the same with bottom heat. Check the soil temperature where the best plant is growing to determine what a 70°F degree thermostat setting really means. Different containers and media affect the gradient between air and root-zone temperatures but, in general, the difference is around 10°F.

What we want, then, is to reduce energy requirements by minimizing the heat level and space heated. What is extremely