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Thursday Morning, December 12, 1985

The Thursday morning session convened at 8:00 a.m. with Everett Emino serving as moderator.

OVERWINTERING LINERS IN A WELL-WATER HEATED STORAGE STRUCTURE[1]

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Abstract. A quonset nursery overwintering structure was built using a floor which was heated with 55 to 55.5°F well water as the heat source. The structure was covered with milky-colored, air-inflated polyethylene.

Medium temperatures during two study periods dropped only to 29°F with a typical minimum difference of 2.1° over a normal unheated overwintering structure. Preliminary liner observations showed some benefit with *Euonymus alata* 'Compacta' and *Rhododendron* 'Hino Crimson', but none with *Ilex crenata* 'Hetzii' which was successfully overwintered in both structures.

REVIEW OF LITERATURE

Polyethylene covered structures have been used successfully to prevent desiccation of overwintered nursery stock and reduce temperature fluctuation (1) for many years. The absolute cold that roots experience is also a controlling factor to successfully overwinter plants. In an effort to maintain higher temperatures, the use of air-inflated double milky polyethylene has been shown to be beneficial (5). While killing temperatures for many plants do not occur until 23°F (2), it has been shown that young roots can be injured at 27°F (6). Since temperatures of the growing medium can easily drop below these injury levels even in storage structures, an overwinter-

[1] Supported by a grant from the New Jersey Association of Nurserymen.
[2] County Agricultural Agent.

ing house was designed to heat the medium using well-water to heat the floor of the structure (3). This offered some opportunity to protect plants having little root hardiness (4) and also opened the possiblity of overwintering liners.

METHODS AND MATERIALS

A 14 × 96 ft quonset overwintering structure was built at the South Jersey Research Center in Centerton, New Jersey, following New Jersey Plan 153 (Figure 1). A 6 in. bed of crushed stone was placed on the floor of the structure covering a ¾ in. polybutylene pipe network and header system (Figure 2). The pipes were spaced to give 3, four-run loops which terminated in a double-header return system designed to give equal flow throughout the entire network. Water which enters the system and passes through the closest loop must return by going across the house and back again. In a similar manner, water which travels across the house to the last loop will also return across the house. In either case, the length of travel, hence the friction path, is the same giving equal flow to all floor loops. Water was supplied from a 75 ft deep, 4 in. well and returned to a 1¼ in. well 70 ft deep, and monitored with a water meter. Temperatures in the well-water heated storage (WWS) structure, and a similarly constructed normal storage (NS) structure with a crowned, black polyethylene covered (non-heated) floor, were monitored with a Campbell Scientific 21X Micrologger.

Liners were produced in #18 cell trays (10.5 × 21 × 3.5 in.). Each cell measured 3 × 3 × 3.5 in. and they were monitored with thermocouples placed in the center of the cells. The medium was a peat:vermiculite:sand mix (70:25:5, v/v/v), into which cuttings of *Euonymus alata* 'Compacta', *Rhododendron* 'Hino Crimson', and *Ilex crenata* 'Hetzii' were placed. All cuttings were stuck on August 27, 1984, using a quick-dip liquid hormone and placed under an intermittent mist.

RESULTS

During engineering study periods the flow rate in the WWS was 9.3 gpm. The water coming into the WWS was 55 to 55.5°F. The heat loss of the water was 2.5 to 3.0°F and resulted in a heat input to the floor near 12,000 BTU/HR. This was the heat equivalent of about 2.5 gallons of fuel oil per day. The additional cost of the WWS was $2,377 which included a $1,784 well and return. The well could easily be used for up to three houses (25 gpm).

Temperature recordings during 1985 indicated that neither the WWS nor the NS were subjected to temperatures which

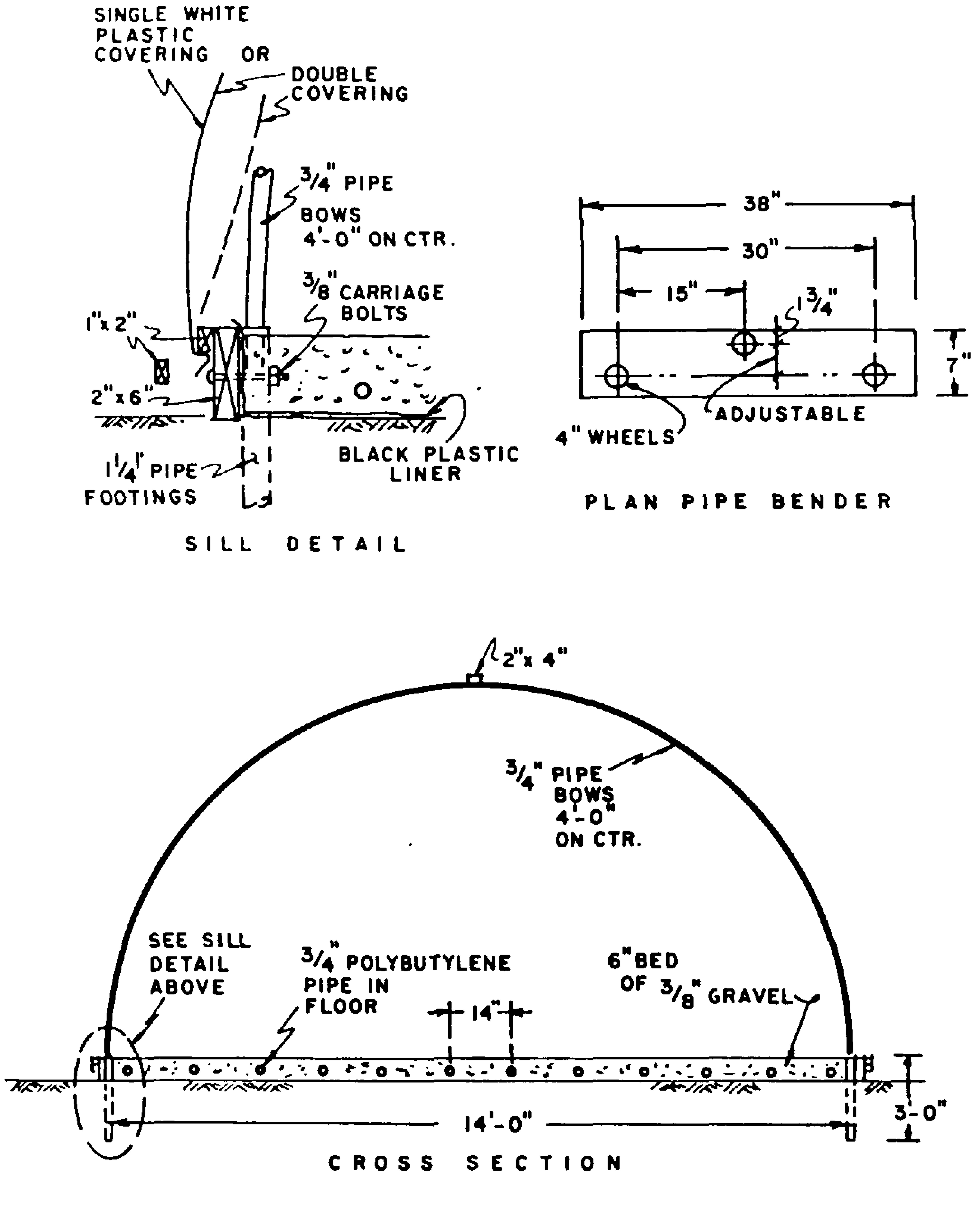

Figure 1. New Jersey Plan 153: Construction details of a floor heated nursery storage house.

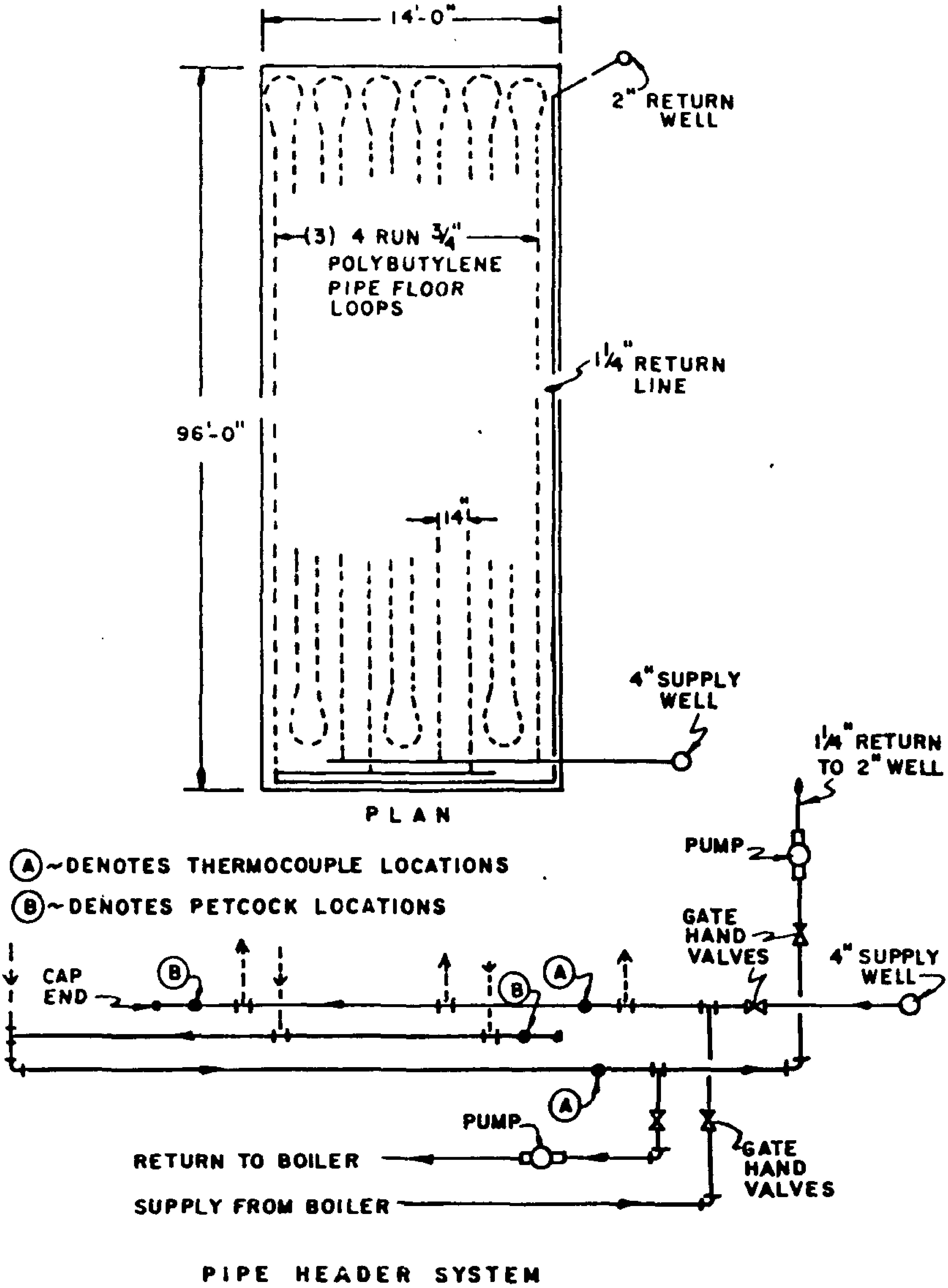

Figure 2. Engineering details for a heated floor incorporating a double-header return system.

caused the medium to drop below 32°F during the monitoring period (Figure 3), while the outdoor temperature dipped to 10.2°F. The medium temperatures in the WWS were never less than 2.1°F. above the NS medium temperature (Table 1), and the time spent at near freezing temperatures was much greater in the NS structure. During observations of two earlier episodes, the NS cells dropped below 32°F 9 hours earlier than the WWS cells. the lowest medium temperature recorded in earlier studies was 29°F when the outdoor temperature was −2°F.

Table 1. Cell temperature differential between a well-water heated storage structure and a similarly constructed normal structure[1].

Average cell difference (°F)	Minimum cell difference (°F)
2.95	2.3
2.67	2.1
4.15	4.1

[1] When temperatures dropped below 33°F.

The liner survival data during the experiment was intended as preliminary information. The liners were evaluated on

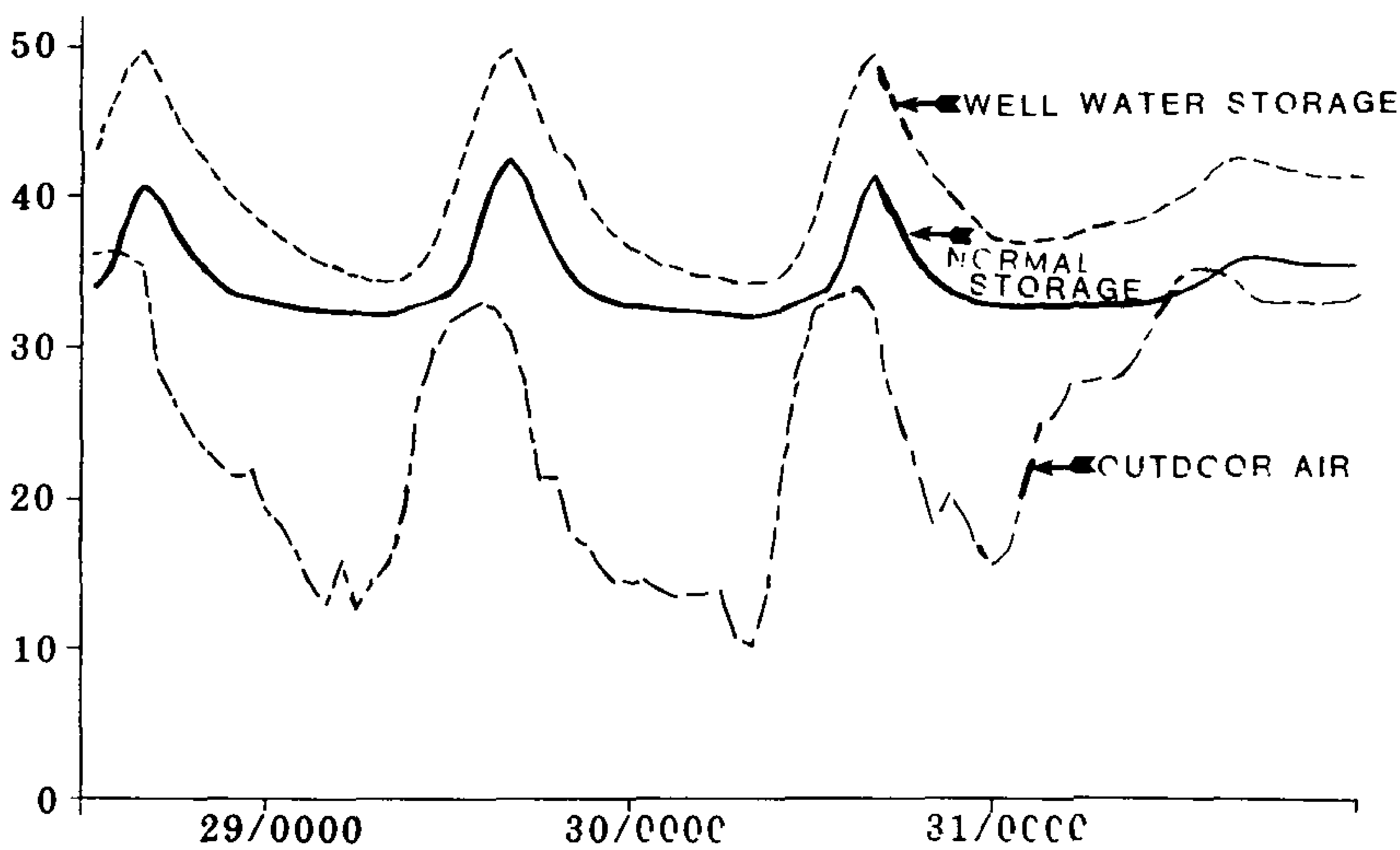

Figure 3. Medium temperatures under winter storage conditions in 3 × 3 × 3.5 in. cells.

May 8, 1985 and showed positive results for *Euonymus* and *Rhododendron* (Table 2), with the *Ilex* surviving well in both structures.

Table 2. Percent liner survival (preliminary)

Liner type	Percent survival	
	Well-water heated storage	Normal storage
Euonymus alata 'Compacta'	82.8 (30)[1]	73.7 (38)
Rhododendron 'Hino Crimson'	85.0 (40)	50.0 (30)
Ilex crenata 'Hetzii'	100.0 (40)	100.0 (40)

[1] Number of Replications

DISCUSSION

Traditional year-round greenhouse structures cost approximately $2.30 per sq ft while the WWS structure cost approximately $1.50 per sq ft (both calculations excluding labor). The 35% savings in the cost of the storage structure may be a feasible alternative to an additional year-round greenhouse if liners can be successfully overwintered.

Although medium temperatures during the study period were not extremely cold, outdoor temperatures dropped to −10°F earlier in the season. Since the medium temperature had dropped to 29°F when the outdoor temperature was −2°F, the liner medium temperature should have experienced colder temperatures. As indicated in Table 2, storage of liners was more successful in the WWS than the NS for the *Euonymus* and the *Rhododendron*, while no differences were detected for the *Ilex*.

The potential for the WWS house as an overwintering structure for rooted cuttings needs additional evaluation. Economically, the structure can be well justified if success in overwintering liners is near or equal to that in greenhouses now used. From early results it does appear that there is benefit from using a floor heated overwintering structure to store liners over a normally constructed storage structure. Furthere research is necessary to determine root hardiness of liners, and overwintering performance.

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PROPAGATION BY ROOT CUTTINGS

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Although propagation by root cuttings generally plays a minor role in the nursery industry, it presents a potential source of readily available material and perhaps should be considered more widely for those species which can be economically and practically propagated by this method. Plants propagated by root cuttings will be true-to-type, except for periclinal chimera plant types which do not reproduce true-to-type. A favorable aspect of root propagation, especially for the manager or foreman, is that it requires little skill to do and can be easily taught. Root cutting propagation will be illustrated by discussing some of our methods employed at Sheridan Nurseries and highlighted by examples of some species propagated.

A year prior to planting a field with root cuttings, it is seeded with a clover cover crop. A relatively sandy soil is preferred. The field is prepared for spring planting by fall plowing, adding required P and K according to a soil test, and cultivating. An application of Treflan (1 to 1½ lb/A) prior to planting helps in maintaining weed control.

Collection of roots presents a challenge. If they cannot be easily gathered from field-harvested plants, then they must be tediously dug from stock plants. Following collection, roots are stored in a barn in boxes containing a mix of composted bark and brick sand (3:2,v/v). Storage in the barn exposes the roots to temperatures which fluctuate from −2 to +6°C. in our area.

In February, after the majority of our grafting is completed, the root cuttings are made. Cuttings, approximately 12 cm in length, are made with a flush cut on the proximal end and an angled cut on the distal end to indicate the correct planting