Table 2. Material Costs for Aluminum 3-Deck Racking System.

Item Description	Cost/Item	Quantity 40′ Trailer	Cost 40′ Trailer
Boards	24.50	96	$2,352.00
Racks	108.00	12	1,296.00
Z-Clamps	13.00	12	156.00
Load Locks	45.00	2	90.00
		Total Cost	$3,894.00

Note: The aluminum boards are made to your specifications regarding length. When measuring inside width of trailer, deduct 3½″ for the racking systems; this will give the proper board length.

Tuesday Afternoon, December 9, 1980

The afternoon session was convened at 1:30 p.m. with John P. Sparmann serving as moderator.

Editor's Note: Francis Gouin moderated a group of presentations on techniques to reduce energy use. The following papers by Francis Gouin, D.C. Milbocker, William Devine, James Kyle, and Adrian Knuttel were part of that session.

VEGETATIVE PROPAGATION UNDER THERMO-BLANKETS[1]

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Polyethylene film covered propagating chambers have been demonstrated to be effective for rooting cuttings of many species of woody ornamentals (1). These chambers can easily be constructed within existing greenhouses, and when filled to capacity with cuttings, will maintain near 100% humidity with minimum care.

Nurserymen have long recognized the advantages of direct sticking cuttings into individual containers. In addition to saving time, cuttings rooted by direct sticking grow faster and losses from transplanting are eliminated. Plants from direct stuck rooted cuttings develop faster because their roots are never disturbed. However, direct sticking requires 5 to 50 times more space than conventional high-density-sticking methods. The amount of additional space depends on the size of containers being used.

Nurserymen in southern regions have made extensive use of direct sticking because of their longer growing seasons and milder winters, while growers in colder regions must rely on

[1] Scientific Article No. A-2915, Contribution No. 5972 of the Maryland Agricultural Experiment Station, Department of Horticulture.

heated greenhouse to propagate. As these propagating structures become more expensive to construct, maintain, and heat, the possibilities for adapting direct sticking practices in colder regions become remote. Direct sticking in colder regions can only be accomplished with efficient, low-cost propagating systems.

Recent studies have shown that certain species of woody ornamentals can be rooted by direct sticking during summer and winter months outdoors under thermo-blankets in Maryland (4). Because thermo-blankets maintain a high humidity and reduce the intensity of light, they have all of the properties of polyethylene film covered chambers (1). Their insulating values have also been well documented (2, 3). Furthermore, thermo-blankets can be used on any well drained area, expanding the propagating facilities throughout the nursery especially during the summer months when bottom heat is not necessary.

PROPAGATING PROCEDURES

Studies on rooting semi-hardwood and hardwood cuttings by direct sticking under thermo-blankets have been in progress since mid-1976. In these studies, cuttings have been rooted in 2¼″ (5.6 cm) peat pots in wooden flats, 4″ (1 liter square plastic pots, 6″ (3.4 liter) plastic nursery cans, and in 3″ (0.8 liter) and 6″ (3.4 liter) black plastic planter bags. All studies have been conducted using a relatively sterile potting medium of equal parts peat moss, milled pine bark and sharp sand, expanded shale or horticultural grade perlite. Sufficient dolomitic limestone is added to adjust the pH to near 6.5 and Fritted Trace Elements (F.T.E. 503) is added according to manufacturers recommendations (Robert B. Peter Co., Inc., 2833 Pennsylvania Street, Allentown, PA 18104). To supply nutrients for developing roots, Osmocote 18-6-12 (Sierra Chemical Co., 1001 Yosemite Drive, Milpitas, CA 95035) was either incorporated into the potting mix at one half recommended rate or applied as a top dressing at recommended rates either immediately after the cuttings were stuck or after the cuttings rooted.

Summer propagation. Summer propagation studies were nearly always initiated in July using a variety of ornamentals: *Jasminum nudiflorum* Lindl., *Forsythia* X *intermedia* Zab., *Viburnum rhytidophyllum* Hemsl., *Ajuga reptans* L., *Hedera helix* L., *Pachysandra terminalis* Siebold & Zucc, *Vinca minor* L and numerous cultivars of *Rubus*. All terminal semi-hardwood and softwood vine cuttings were pruned to a uniform length of 6″ (15 cm). *Ajuga* was propagated from divisions without roots, and *Pachysandra* cuttings were pruned to a uniform length of 4″ (10 cm). The cuttings were stuck as shallow as possible generally 1″

(2.5 cm) deep, and thoroughly irrigated to saturate the soil and the ground beneath. Quarter inch (0.64 cm) microfoam (E. I. duPont deNemours & Co., Inc., Wilminton, Delaware 19898) was laid directly on top of the cuttings with all edges resting on the ground. White copolymer (4 mil) was then laid over the microfoam and sealed to the ground on one side with gravel and on the remaining 3 sides with pieces of pipe and boards (Figure 1).

The cuttings beneath the thermo-blanket were checked weekly and watered when necessary. Depending on species, rooting generally occured from 1 to 6 weeks. *Ajuga* rooted within 1 week while *V. rhytidophyllum* required 6 weeks to root. Rooting was determined by pulling gently on each cutting. If all but a few cuttings appeared rooted, the cuttings were allowed to remain under the thermo-blanket for an additional week after which time the thermo-blanket was either removed or the plants were moved into a growing area.

Winter propagation. Winter propagation studies were initiated in November using cuttings of *Juniperus horizontalis* Moench 'Wiltonii', *Ilex crenata Thumb.*, *Prunus laurecerasus* L., and *Pyracantha rogersiana* (A.B. Jackson) Bean (Syn.:) *P. crenulata* var. *rogersiana* (A.B. Jackson). Terminal hardwood cuttings were cut to a uniform length of 6″ and the base treated with 0.8% I.B.A. (Hormodin #3, Merck Chemical Division, Merck and Co., Inc. Rahway, N.J. 07065) prior to sticking. To eliminate the need for watering and to protect from loss of water, all winter propagation studies were conducted using sealed thermo-blankets. The sealed chambers were prepared by laying 4 mil, 10 ft. (3 meters) wide, white copolymer on the ground and covering the middle 3¼′ (1 meter) propagating area with a thin layer of pea gravel. Rubberized heating pads (Famco Electric Co., Progrow Supply Corp., Butler, WI 53007) were laid on top of the gravel. The containers filled with medium were placed directly on top of the heating pads and the cuttings were stuck. The cuttings were thoroughly watered and additional water was added to partially submerge most of the gravel. Quarter inch microfoam was then laid directly on top of the cuttings with all of the edges coming in direct contact with the gravel. The edges of the white copolymer sealing the bottom were then rolled together over the microfoam and sealed using pressure sensitive tape (Figure 2).

Temperature of the media were maintained at 80°F (22°C) until most of the cuttings had rooted. Time of rooting was estimated by observing similar cuttings rooting under intermittent mist in a greenhouse. When most of the cuttings in the greenhouse had rooted, media temperatures under the thermo-blankets were reduced to 45° F (7°C). The cuttings under the thermo-blanket were left undisturbed until mid-March when they were uncovered.

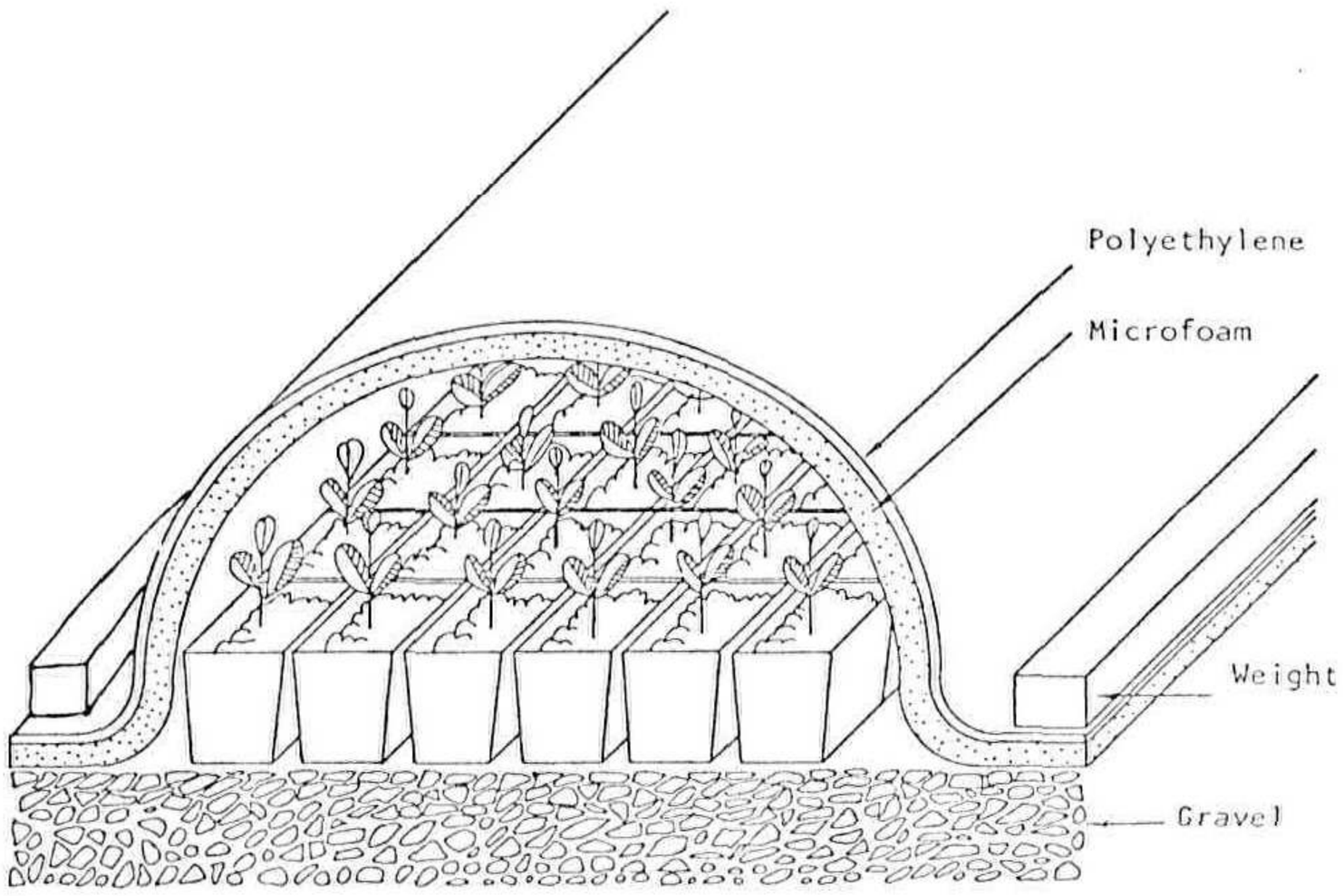

Figure 1. Summer propagation thermo-blanket using white polyethylene cover over ¼″ microfoam laying on top of the cuttings stuck in 4″ plastic pots. To insure adequate drainage, gravel is placed on top of existing soil. The blanket should be checked weekly for adequate moisture.

RESULTS AND CONCLUSION

To this date all studies have demonstrated that all species tested can be rooted outdoors under microfoam thermo-blankets. Bottom heat is essential for winter propagation but not for summer propagation (4). By using white copolymer over the microfoam, cuttings can be rooted outdoors in full sun. Positioning the thermo-blanket under partial shade has not been beneficial.

Although the winter moisture sealed thermo-blanket system was effective in retaining adequate moisture for rooting and growth for 4½ months, it made periodic inspection of cuttings almost impossible. Should something happen under the thermo-blanket during and/or after rooting, it would not become evident until after the plants were uncovered. Because this potential problem exists, it is highly unlikely that this sealed chamber technique would be acceptable for most propagators. Good propagators like to watch their rooting cuttings periodically.

For winter propagation it is recommended that a bottom copolymer liner be placed under the heating pads or cables with a thin layer of gravel between the two. The bottom coplymer will prevent the downward movement of water and keep the water near the heating pads or cables to be evaporated into the atmosphere of the chamber and to condense on the under surface of the microfoam. When using a copolymer bottom liner the same covering technique, used for summer propagation can be utilized in winter. Preliminary studies have shown that cuttings need only be watered every 2 to 3 weeks even when rooting media tem-

peratures are maintained at 80°F. After the cuttings have rooted and temperatures are lowered to 45°F, the loss of water from under the thermo-blanket is negligible.

Studies are now in progress to measure growth differences between plants propagated during winter months under the thermo-blanket in 1 liter and 3.4 liter containers and plants propagated in a greenhouse. After rooting, the greenhouse-propagated cuttings will be transplanted into liter containers and later shifted into 3.4 liter containers for growing on. Although growth differences have been observed in earlier studies, they have never been evaluated. To facilitate covering and uncovering, portable, inexpensive low quonset type structures, scarcely tall enough to accommodate containers and cuttings, are also being evaluated.

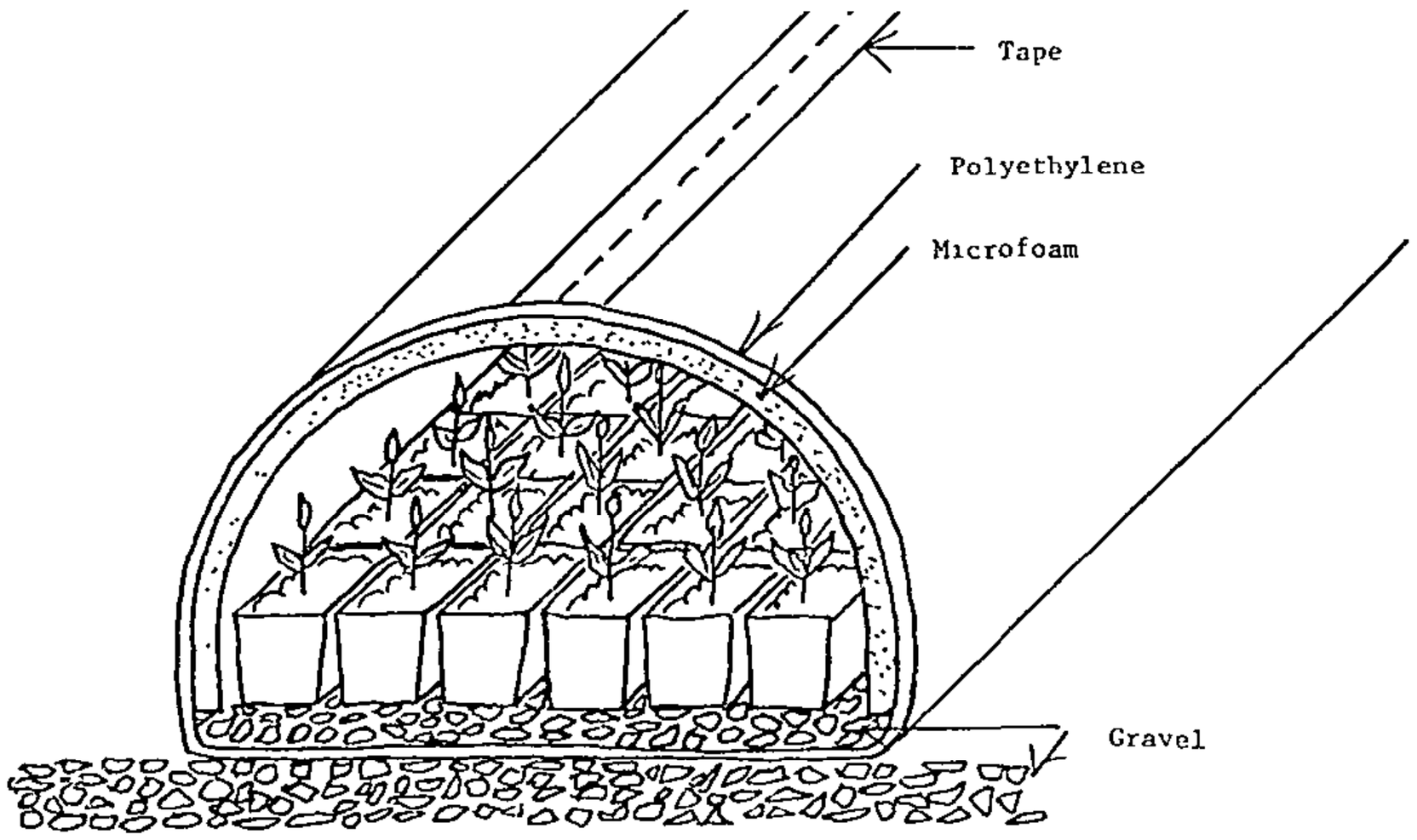

Figure 2. Moisture seal thermo-blanket using a single sheet of white polyethylene extending under the 4″ plastic pots and gravel and over the ¼″ microfoam and sealed on the ends and across the top with pressure sensitive tape. One thorough irrigation in the fall after sticking cuttings will maintain adequate moisture all winter long.

LITERATURE CITED

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