EFFECTS OF PROPAGATION CONTAINER SIZE ON DEVELOPMENT OF HIGH QUALITY SEEDLINGS

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Abstract. Seeds of *Pinus thunbergiana*, Japanese black pine, *Sapindus drummondii*, western soapberry, and *Pistacia chinensis*, Chinese pistache were germinated and grown in bottomless containers on wire benches. Containers 3, 6, 9, 12 and 15 inches deep and 1½, 2 and 2½ inches square were constructed from paraffin-coated milk carton stock. Top growth of Japanese black pine was greatest in the 2½-inch square and 9 inch deep container. Top growth of Chinese pistache and western soapberry was about the same in all container sizes and depths. Root growth was greatest in the 2½ square inch containers either 9 or 12 inches deep for all three species. Root development in 1½ and 2-inch containers was erratic for all species. There appears to be an optimum depth for air pruning of the taproot. Root development appears proportional to the diameter of the container.

REVIEW OF LITERATURE

The production of high quality tree liners in the greenhouse, using bottomless containers on wire benches appears to have a great potential in container nursery production. Johnson (3) found that container planting in the plug form may be a viable and economically attractive reforestation method. He found that seedling size is a reflection of diameter and volume of the container. He also concluded that the large size of the seedlings, which were grown in paper pots, was impressive. Hite (2) also reported that field survival of greenhouse grown stock is greatly influenced by the soil volume in the container: the larger the container, the higher the survival. There appears to be a 20% overall gain in survival through the use of container grown stock.

Potter (4) stated, "This revolutionary idea in propagation economized the cost of production, cuts to less than half the time formerly needed to produce a suitable liner and ensures production of liners that are disease-free, with strong root systems that cut the mortality rate to near zero as the plants go into forests or nursery rows or containers." He also reported that no root curling or restriction occurs. The root system is more fibrous, and therefore, summer and fall planting may be possible. The active growing root system sustains the plant; whereas, the bare-root seedling does not have the roots to balance out the top growth of the young plant. In addition, Aycock (1) also reported that the planting season could be extended into June and July by using container-grown seedlings.

Most tube methods developed to date are for reforestation projects. This system of seedling production has been very beneficial to

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[1]Journal Article No. 3005 of the Agricultural Experiment Station, Oklahoma State University, Stillwater.

the forestry industry and should also prove beneficial in production of shade and ornamental trees. Tubes used for reforestation projects to date have been quite small, generally one and one-half inches in diameter or less. For the production of shade and ornamental trees, economics would allow for larger containers if: 1) survival following transplanting increased, or 2) growth of tops and roots increased, thus decreasing production time, or 3) if root quality increased, aiding survival and/or performance in the landscape.

MATERIALS AND METHODS

To determine an optimum propagation container size for production of tree liners, the following experiment was conducted: containers 3, 6, 9, 12 and 15 inches deep and 1½, 2 and 2½ inches square were constructed without bottoms from paraffin-coated milk carton stock. Containers were placed on a wire bench to provide air pruning of roots growing out of the bottoms of containers. Growing medium was a 1:1 by volume mix of perlite and shredded Canadian sphagnum peat. The experiment was conducted in a clear glass greenhouse.

The experiment began March 15, 1974, with seeding of test species: Japanese black pine, Chinese pistache and western soapberry. Each species was replicated 12 times in each container size-depth combination. Seven weeks after planting, all containers were fertilized with Osmocote 18-6-12 at the rate of 1000 lb. N/A/yr. Additional Osmocote at the rate of 2000 lb. N/A/yr was applied July 19, 1974. On August 31, 1974, 5 months from the seeding date, six replications were selected at random and top and root weights determined.

RESULTS AND DISCUSSION

Root development was best in 2½-inch square containers, 15 inches deep for western soapberry (Fig. 1) and either 9 or 12 inches deep for Japanese black pine and Chinese pistache (Figs. 2 and 3). Root development of all species in 1½ or 2-inch square containers of all depths was erratic. This suggests an optimum depth container, at least for the species tested. Of perhaps more interest in the appearance of the root systems, roots from all plants in the 2½-inch square containers 6 or 9 inches deep were very fibrous with many lateral roots developing from the taproot which had been air pruned at the base of the container. In the 12 and 15 inch deep containers, the taproot development had been suppressed less and fewer fibrous roots were present. Containers 3 inches deep were apparently too shallow for good root development of any of the species tested. Air pruning of the taproot greatly stimulated development of lateral roots which often grew to the corners and downward and were again air pruned at the bottom (Fig. 4). Fibrous roots reach every part of the growing medium, thus increasing access to moisture and nutrients. There was no observed kinking or curling of the roots in any depth

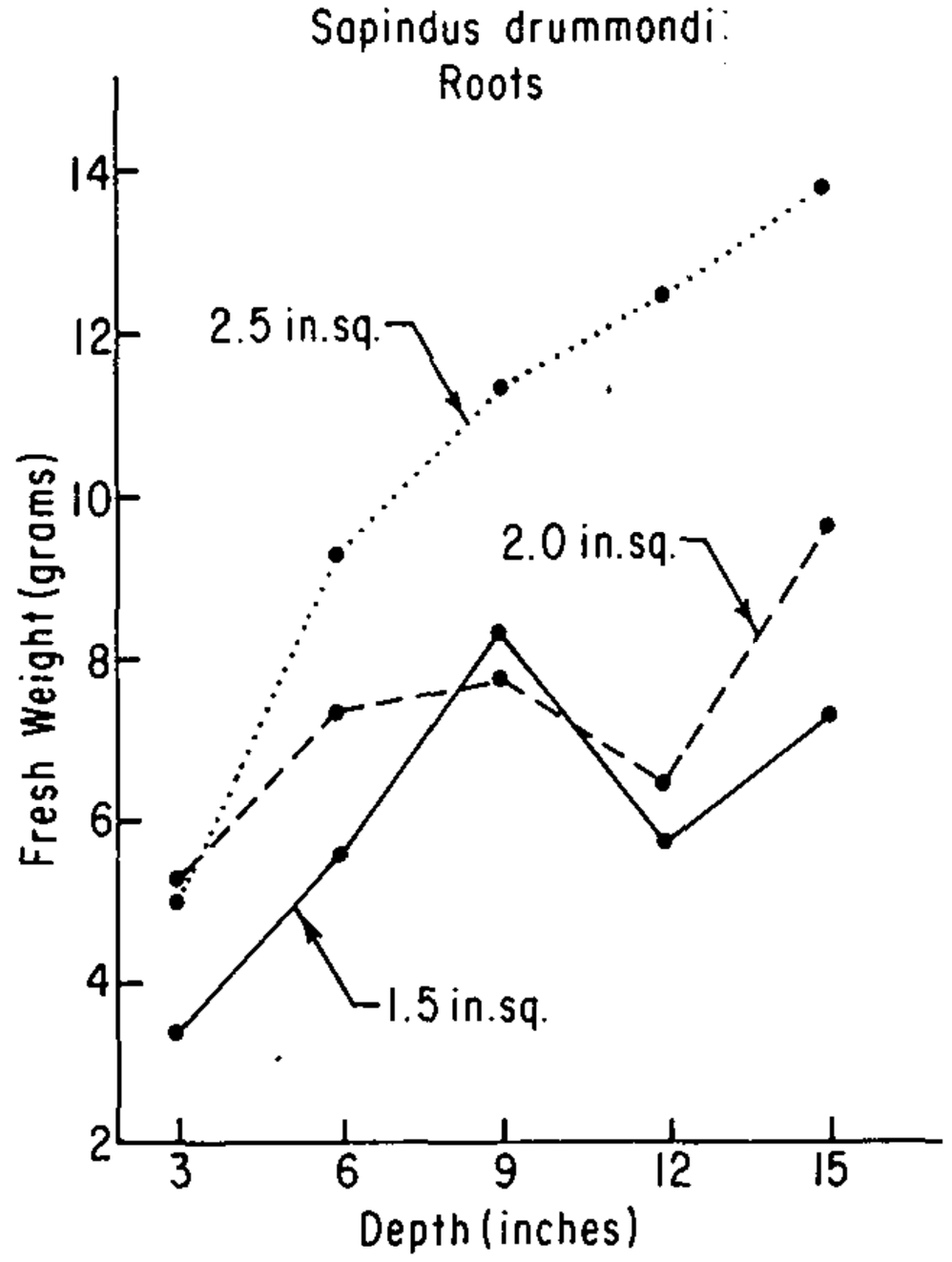

Figure 1. Effects of container size and depth on root development of western soapberry seedlings.

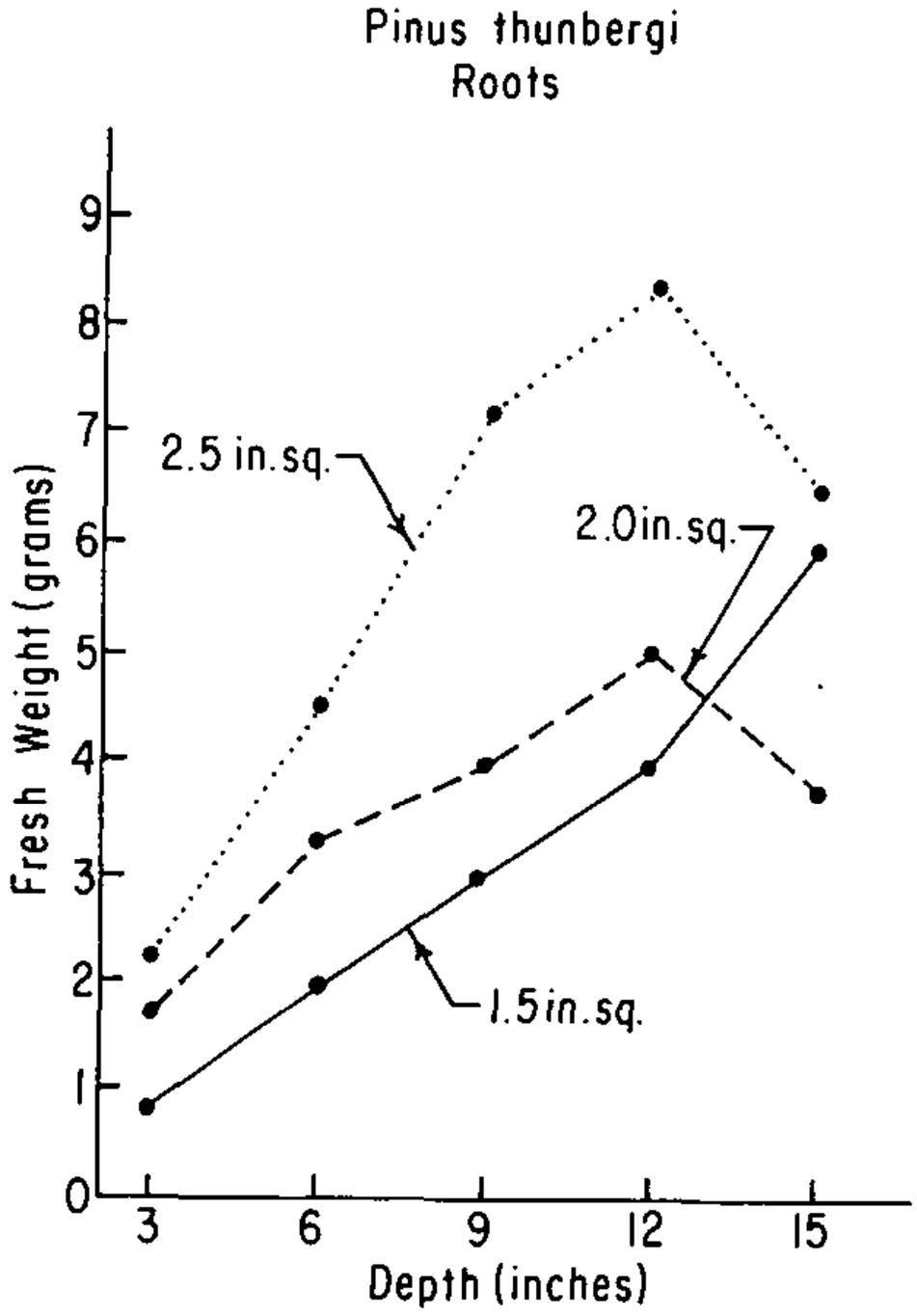

Figure 2. Effects of container size and depth on root development of Japanese black pine seedlings.

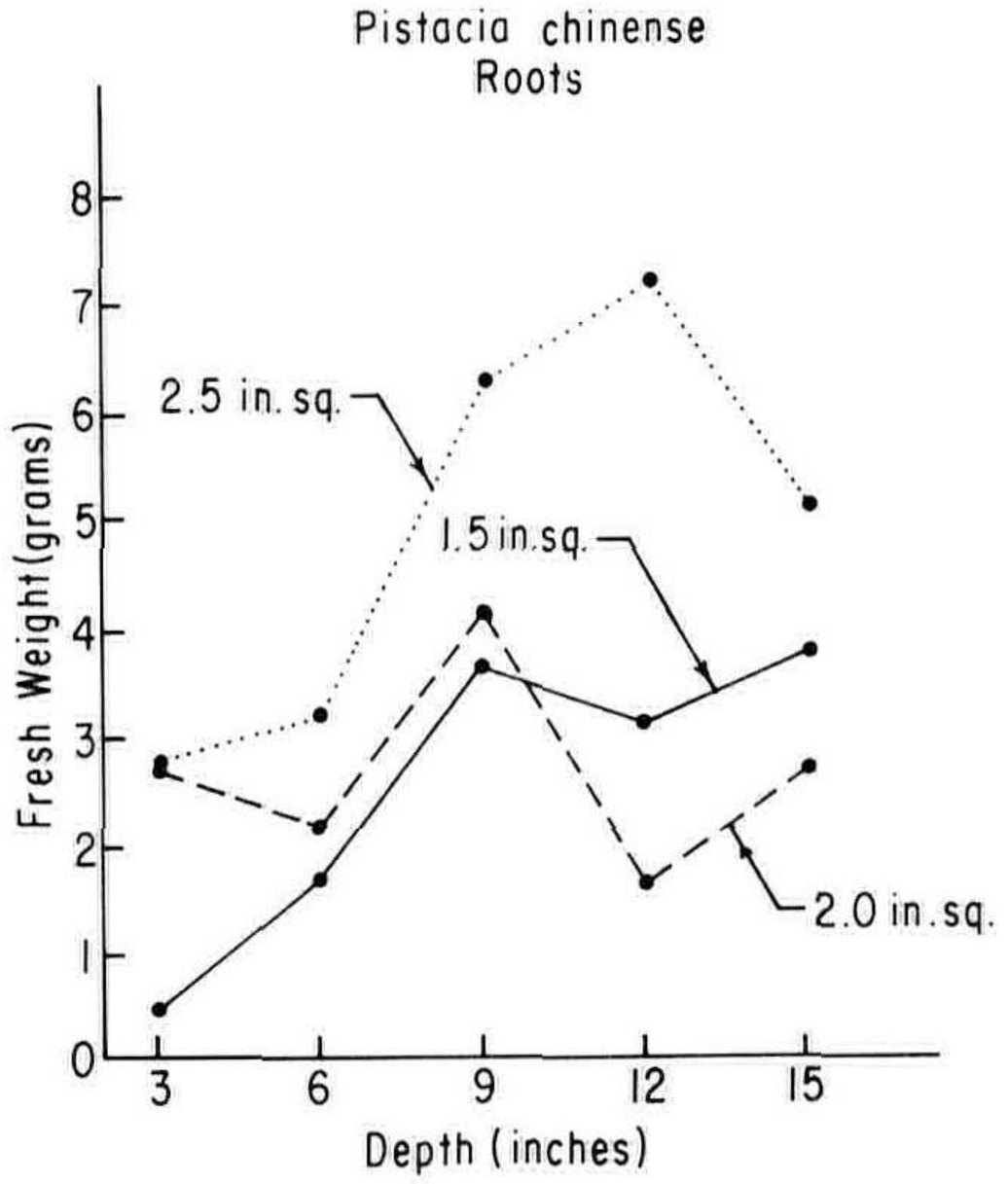

Figure 3. Effects of container size and depth on root development of Chinese pistache seedlings.

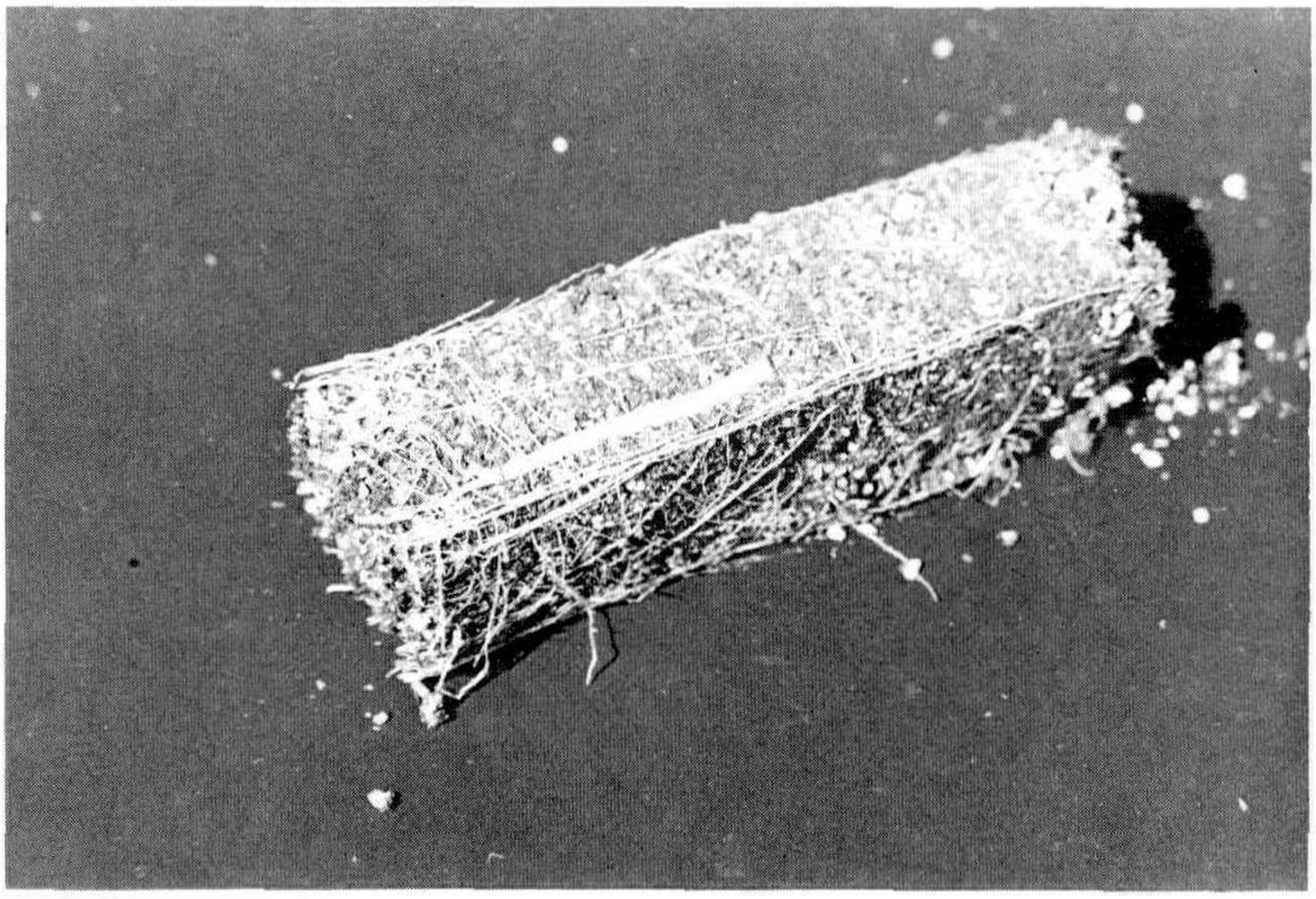

Figure 4. Effect of air pruning and square containers on root development of tree seedlings.

or size container. This may prove very beneficial when growing the seedlings on in a larger container. Reduction of taproot dominance should cause a reduction in wrapping and curling which is a particular problem associated with present container production of trees. In addition, with the undisturbed fibrous root system in the container, summer and fall planting may be possible with little or no transplant shock and rapid establishment.

Top growth of pistache and soapberry was about the same in all container sizes and depths. However, top growth and lateral branching of Japanese black pine was superior in the 2½-inch square container 9 inches deep (Fig. 5). On visual observation, the most healthy and vigorous plants of each species was in the 2½-inch square container 9 inches deep.

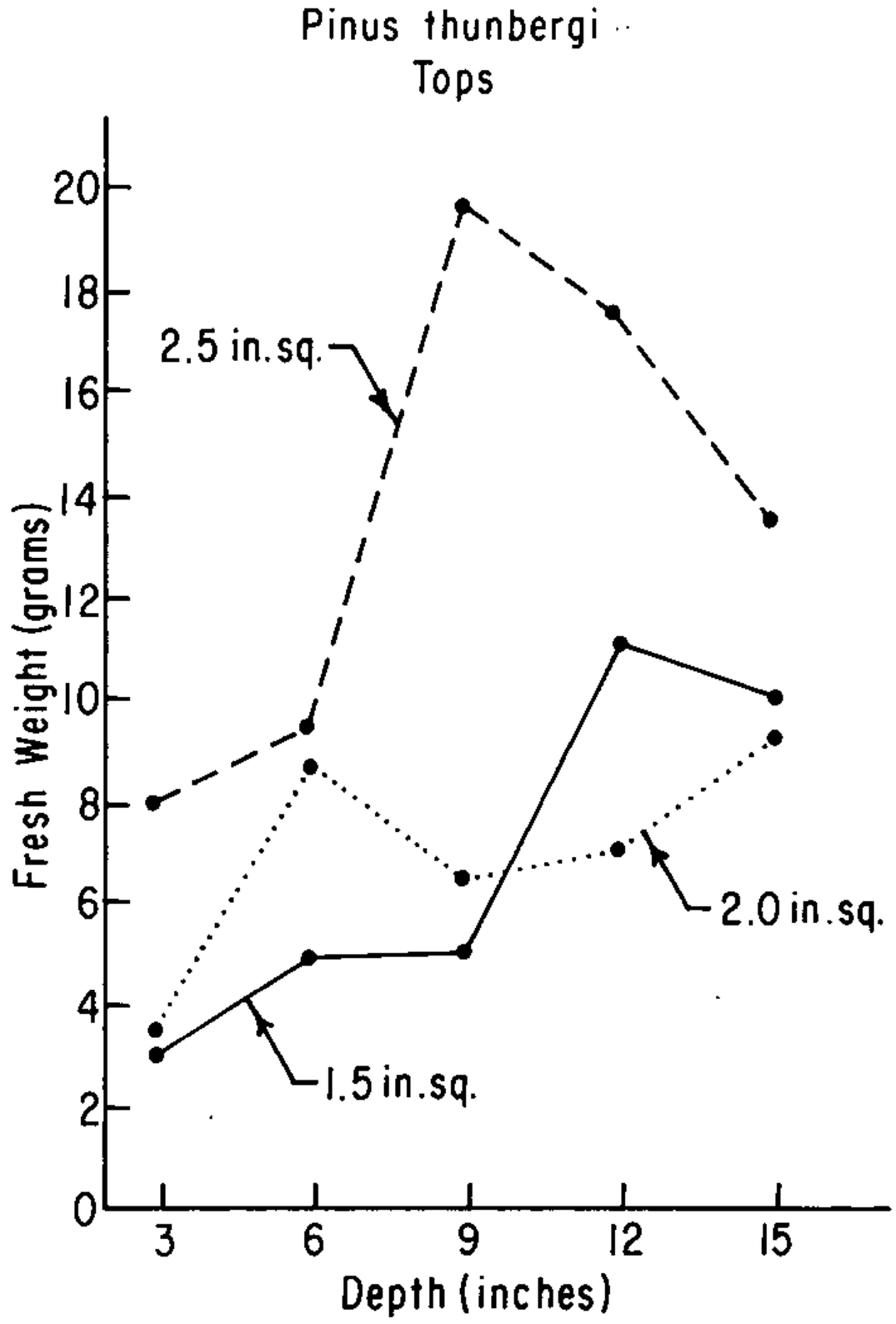

Figure 5. Effect of container size and depth on top development of Japanese black pine seedlings.

The container production and air pruning of roots of tree seedlings results in a very fibrous root system without taproot distortions. Container size particularly affects root development of the seedlings. There appears to be an optimum depth at which the taproot should be air pruned. Development of roots and top is proportional to the diameter of the container. In addition, this technique has considerable merit in preventing "girdling roots" which very subtly cause the early demise of many shade and ornamental trees.

LITERATURE CITED

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PETE VERMEULEN: Would you comment more on the use of the square container versus a round container?

RANDY DAVIS: If you use a round container the root will go to the edge and circle, with the square container however, it goes to the edge, goes to the corner and then goes straight down. Some of the newer round containers have a ridge built into them which also stops the root from going around. So if you use a round container it ought to have a ridge down it to stop the root from circling.