CONTAINERIZED PLANTING SYSTEMS FOR SOUTHERN CONDITIONS

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ABSTRACT

Over a three-year period, approximately twenty containers were evaluated. Several container systems have the potential to extend the planting season, increase seedling growth, and adapt to automation.

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Container planting offers southern nurserymen an exciting alternative to traditional methods of seeding and planting southern pine. Foresters in the Pacific Northwest and Canada now grow a large percentage of their seedlings in containers rather than in nurseries. Because of the short growing season in these areas, foresters have difficulty obtaining economical and reliable nursery stock. Container planting extends their planting season and improves seedling quality.

At the Southern Forest Experiment Station in Pineville, Louisiana, we have been testing various containers to determine which ones are practical for the South, with its relatively long growing season and its high summer temperatures. Early studies indicate that some containers may successfully upgrade production, although no single system will accomodate the entire Southern pine region, with its vast range of geographical and environmental conditions. This paper describes container systems being tested for Southern application and proposes criteria for assessing their effectiveness.

CONTAINERS 2/

Containers fall into three general categories: tubes, blocks, and plugs. Tubes, which have an exterior wall, require filling with a growing medium, and the seedlings remain in the tubes for outplanting. Blocks, though similar in shape and size to tubes, have no outer wall and require no filling, since the block itself is both the container and the growing medium. The seeds are sown

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2/ Mention of container products is for information only and does not constitute endorsement by the USDA Forest Service.

in the block, and the entire package is later transplanted, the block becoming part of the soil. Plugs are grown in molds, which like tubes, require filling. Unlike tube and block seedlings, plug seedlings must be removed from their containers before outplanting, and rooted seedlings, along with the growing media, are planted.

The primary advantage of tubes is wall rigidity, providing both ease in handling as well as the impermeability necessary to prevent desiccation from dry soil. We have evaluated several tube materials, including plastic nondegradable tubes, kraft paper tubes, Japanese paperpots, and biodegradable plastic tubes.

Tubes made from non-degradable plastic constrain the roots, thereby lowering survival on dry sites and causing poor growth. Most paper tubes are also unacceptable, for they are characteristically attacked by microorganisms. In kraft paper tubes, for example, our seedlings frequently became chlorotic, and the paper deteriorated before the seedlings were large enough to outplant.

Japanese paperpots offer encouragement. The container is a flat package opening like a honeycomb, and each cell is filled with a soil medium. The glue used to bind the tubes is soluble, dissolving when the tubes are watered. The roots can penetrate the paper without difficulty, and the paper has been treated with a fungicide, a nitrogen source, and with plastic fibers. Paperpots were developed in Japan for transplanting sugar beet seedlings and have been adapted to forestry in Scandinavia. Various sizes are available--we have found 1 x 6 inches to be convenient.

Union Carbide Corporation has developed a biodegradable plastic tube, which can be broken down by soil microorganisms. The firm has provided us with blow-molded, hexshaped tubes from caprolactone polyester for our evaluations. The plastic can also be used to construct a variety of suitable containers such as bullets and mesh-like tubes. The rate of degradation can be controlled by varying the amount of filler added to the plastic. Our tests show that tubes can be made to deteriorate in as little as two months or to remain intact for more than a year. The degradability factor overcomes the root constraint problems characteristic of styrene plastic tubes.

Blocks are usually rigid and require no filling; they also allow rapid root egress upon outplanting. We have evaluated such products as Famco's Gro-blocks, Agritec Polyloam, Keyes Peat Sticks, and RCA Peat Sausage.

Gro-blocks, previously manufactured by American Can Company under the name BR-8, consist of acrylonitrile-bonded softwood pulp, molded into a truncated, wedge-shaped strip of twelve blocks, each 3/4 x

3/4 x 3-1/2 inches. Nutrients are incorporated into the blocks. At age two years, Gro-block seedlings were almost twice the size of nursery-grown plants.

Agritec Polyloam, a polyurethane foam block, provides great convenience in handling. The blocks can be molded or cut into a single unit, called a "bun," which can be cut into any size for ease in handling many seedlings at once during the early stages of cultivation. The bun can later be separated into individual blocks for outplanting. We used a bun consisting of 180 blocks, each 3/4 x 3/4 x 4 inches. Polyloam has cation and anion exchange capacity, and nutrients are incorporated into the blocks. According to the manufacturer, Polyloam retains water; however, we have observed low water retention when the foam blocks have been planted in dry soil.

The Keyes Fiber Company's Peat Stick, measuring 1 x 1 x 6 inches, is a molded product consisting of peat and vermiculite with nutrients incorporated. Growth and survival rates, even during midsummer plantings, have been excellent. The Peat Stick is not yet available commercially; it is currently being redesigned to make it smaller, the present form being too bulky and expensive to handle conveniently.

The Peat Sausage, manufactured by the Research Council of Alberta, consists of blocks packaged in a sausage-like polyethylene casing that must be removed before planting. The casing is filled by extruding moist peat through a die. Sausages are normally twenty-five feet long before they are cut into individual blocks. The primary disadvantage of the Peat Sausage is its great weight, resulting in high delivery costs. Since the manufacturing process is not complex, the containers could possibly be produced locally to reduce freight costs.

Plugs have been used successfully in the Pacific Northwest and Canada. They provide an ideal biological setting for seedlings, since no root constraint occurs after planting. Roots rapidly establish themselves in the surrounding soil, and the seedlings are usually large and healthy. We evaluated such containers as BC/CFS styroblocks, Spencer-Lemaire fold-up trays, Swedish multipots, and test tubes. These containers are similarly designed, although the Spencer-Lemaire fold-up tray can be opened to remove seedlings easily.

Application of plugs to Southern conditions is limited. The seedlings must remain in the cavities of the container long enough for the roots to bind the growth media together, a process normally requiring five or six months. This growth period represents an improvement for the Northern areas, where two to three years are required to produce conventional nursery stock. In the South bare-root seedlings can be grown in nine months, and seedlings have been grown in tubes and blocks in as little as eight to twelve weeks. Another disadvantage of plugs is their fragility, which necessitates transplanting them by hand. Since southern conditions are amenable to automated planting, plugs are practical here only for situations requiring hand-planting and for progeny tests and other research applications where particularly large seedlings are desirable.

Tubes that degrade rapidly and blocks seem to be the most effective existing containers for adaptation to the South. So far, Japanese paperpots and Gro-blocks have been the most successful products tested. They are available in sufficient quantities for adequate experimentation, and they function well in this region. However, new container production systems need to be developed specifically for Southern markets, although we have not yet determined the ideal combination of container, growing environment, disease controlling agents, and fertilizers.

All of our containers were tested in glass and plastic greenhouses. Midsummer cooling was a major problem, and the high temperatures were detrimental to germination and early seedling establishment. Although a germination facility with controlled heating, cooling, and lighting would be the best possible environment, the cost is prohibitive. Shadehouses seem to be an acceptable compromise, since they provide shelter while allowing light, air, and rain to reach the seedlings.

Potting mixtures for tubes and plugs should consist of at least 50 percent peat; equal amounts of peat and vermiculite are effective. The condition of the water sources should be carefully monitored, and a pH of 5.0 to 5.5 should be maintained. Many deep wells produce water with a pH greater than 7.0, and the poor water quality causes chlorosis, poor seedling development, and disease.

Disease is a major problem in the large-scale production of containerized seedlings. The high temperatures and relative humidity of the southern climate favor development of fungi causing root rot and damping-off; therefore, a broad-spectrum fungicide must be used. The seed itself may carry pathogenic fungi. In such cases seedcoat sterilization or a fungicide coating is necessary. Disease can also be controlled by inoculating the seedlings with certain strains of mycorrhizae, presently being developed.

Although we have not yet perfected an ideal nutrient regime, results to date show that containerized seedlings respond well to a wide range of nutrient balances, particularly during spring and summer plantings, when our seedlings grew rapidly and vigorously. Nutrients should ultimately help containerized seedlings to outgrow bareroot seedlings.

OUTLOOK

Before container planting will be widely adopted in the South, nurserymen must be convinced of its superiority over conventional methods. We believe that container planting already has the potential to extend the planting season significantly; furthermore, container planting should ultimately improve the survival and growth rate of seedlings. Finally, indications are that container planting will soon be adaptable to automation.

Our tests indicate that containerized planting can extend the present planting season from four months to nine or ten months of the year. Although we have used container planting successfully during all twelve months, special care was needed to guard against freezing during the coldest months; nursery-grown seedlings needed no extra care. Some wet sites are not accessible for planting bare-root seedlings in winter, and container planting might be effective here.

Because containerized seedlings are more expensive than bare-root nursery stock, they must exhibit superior growth and survival. When adequate fertilization and disease control techniques have been developed, containerized plants should outgrow bare-root seedlings.

Finally, container planting must be adaptable to automation. Jerry Edwards (Region 8, US Forest Service), has led the field in developing automated planting equipment in the South. Edwards is currently working on a prototype planting machine suitable for container planting. This innovation will reduce the labor necessary for planting, allowing for a permanent labor force in place of the present highly seasonal one. If automated container planting becomes possible, the potential for application in the South is enormous, since seedlings could be grown year-round and planted by stable, skilled labor.

No nurseryman should attempt any large-scale container planting operations until he has gained knowledge and experience in the method. Few nurserymen specializing in growing southern pine seedlings have extensive experience growing plants in enclosed environments such as greenhouses and shadehouses, where temperature and disease control are problems. To avoid discouragement, nurserymen should attempt only small-scale projects to gain experience in the techniques and problems of container planting before investing significant time and capital. Nurserymen should attempt to develop container planting skills in existing personnel, since no experienced labor force presently exists in the South.

The government is currently sponsoring programs to provide incentives to small landowners to plant trees. Container planting will offer economic advantages to nurserymen supplying seedlings to these landowners, since the technique will make it possible to grow superior seedlings throughout the year.