Soilless Container System Developed For Growing Conifer Seedlings

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Introduction

The reasons for developing an economical and biologically sound procedure for field planting container-grown conifers within a few months of seed germination have been presented elsewhere by others, including the authors (1,2,4,5,6). Some advantages and potential uses of container planting are summarized below:

Advantages

Better control of early growing environment

Improved early root

development

Extended planting season

Increased planting success on, adverse sites

Reduction in: 1) Lag time between standard nursery production and operational needs; 2) planting shock; 3) capital investment in permanent nurseries; 4) peak labor load requirements.

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Potential uses

Reforestation
Erosion
control
Seed orchard
development Genetics
research
Wildlife food plantings

All of us would prefer reforestation with the better root development of natural reproduction along with proper stand density if obtainable. Since natural reproduction is not. always adequate or available, we suggest a container system as an alternative. Small container systems for conifers using split plastic tubes, peat pots, and bullets, now in common use, can be substituted for direct field seeding. They provide a favorable microsite and a protected environment for the critical period of germination. The new seedling with its developing root system is subsequently field planted and (we hope) survives and develops.

A soilless container system recently developed appears to have promise.

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Previous Work

Much of the effort to develop a small conifer planting container has centered around a cylindrical soil filled tube. Most existing containers have some undesirable features including relatively small rooting volumes, rigid and nonbiodegradable walls, a tendency to frost heave, and the need for filling with potting mix-a time consuming and costly process.

One of the most commonly used containers is the split plastic tube sometimes called the "Ontario Tubeling". Although widely planted, this tube is being used less now because of some of the objectionable features mentioned above.

One container system that appears to have real possibilities is a block of acrylonitrile bonded softwood pulp prepared in a variety of configurations. A product of the American Can Company, this is commercially available to the horticultural trade in cakes or cubes and known as BR-8[2] blocks (3). We have tested a number of configurations of this experimental material made specifically for forestry purposes. The orientation of wood fibers in manufacturing has been arranged so that normal vertical root development is *along* rather than *across* an interface.

Some additional improvements have been made in the BR-8 conifer blocks since previously reported on (5). These include a wider space between blocks (which inhibits cross rooting between individual containers), a somewhat lower bulk density, buffering of the pH at 6.5, increased cation exchange capacity to

[2]Currently manufactured under trade name Gro-Blok by Famco, Inc., Medina; Ohio.

75meq/100g, and a balanced nutrition including minor elements so that fertilizer is ordinarily- not needed for the first month. The latest modification is a truncated wedge shape molded in a strip of 12' individual blocks attached to a backing strip of the same material. AA preformed seeding slit is built into the top of each block. At planting time, individual blocks are readily separated by breaking along a perforation line in the block.

Physical characteristics of the soilless blocks are summarized and compared with those of the split plastic tube in Table 1.

Table 1.—*Physical characteristics of soilless pulpwood conifer containers as compared with split plastic tubes*

Container	Volume (*cc*)	Bulk Density (*g/cc*)	H_2O At Field Cap. (*g*)	Total Avail. H_2O (*g*)
Split plastic[1]	10.0	0.63	5.6	5.3
Pulp-block, small	18.2	0.09	15.1	8.4
Pulp-block, new wedge-shape	30.2	0.10	30.0	17.4

[1]Tube filled with ½ sand, ¼ Perlite, ¼ peat.

Cultural Procedures

Procedures for growing conifer seedlings in soilless containers have been outlined (5). Our procedure consists of placing 10-15 strips containing 12 individual blocks in trays with a copper screen bottom. The purpose of the screen is to inhibit root development below the container before outplanting. Blocks are seeded either by hand or semimechanically and watered by subirrigation. Moisture in the blocks is controlled gravimetrically between 400 and 600 per cent moisture content by weight. Moisture is determined by weighing entire block-tray assemblies on a top loading balance. Mineral free water is used, and nutrients[3] are added to the irrigation water according to species requirements. Since the growing medium is soil-free, few pathological problems are encountered. If damping-off becomes a problem, it can be controlled with Captan.

The time required to grow planting size conifers in soilless wood pulp blocks will vary. While jack pine is ready for outplanting in 8 weeks, white spruce requires 12-16 weeks. We raise seedlings in greenhouses at Michigan State with a 12-hour photoperiod at 80°F. and night temperatures of 72°F. Prior to field planting, seedlings raised under greenhouse conditions require a hardening off period of from 7-10 days.

[3]RX-30, available in Canada or Acme 30-10-10 by Acme Quality Paints, Detroit, Mich.

Field Planting

Over the past two growing seasons, jack pine *(Pinus banksiana)* and white spruce *(Picea glauca)* seedlings were raised in two sizes of the soilless pulp blocks, and in split plastic tubes for comparison purposes. Jack pine was planted on all of the following three sites, while white spruce was used on only the latter two: (a) A coarse sand soil in a clear-cut jack pineoak forest type in northern Michigan (Grayling series), (b) a loamy sand clean tilled soil in the podzol soil region (Rubicon series), and (c) a loamy sand, clean tilled soil (Spinks series) in the gray brown podzolic soil region of southern Michigan.

Planting was done with several dibbles (fig. 1, A and B). A spring loaded planting tool was also used and shows promise for production operations with this type of container (fig. 1, C and D). For each species-container combination, 100 seedlings were, planted in four replications at each of the three study sites-approximately 1200 seedlings per site.

Results

Two-year field results in terms of seedling height, diameter, and survival are shown in Tables 2 and 3.

Jack pine performance in all three containers was very satisfactory. Survival was somewhat poorer in the large pulpwood blocks at the two northern sites, attributed primarily to lack of root-soil contact from the large blocks at the time of planting. Thus the roots were never able to ramify into the soil from the block.

Some of the surviving trees were partially frost heaved. This was more noticeable on the plastic tubes. Height and diameter growth are not significantly different between containers within a particular site. Seedlings on the loamy sand, northern Michigan site had more than double the growth on either of the other sites (fig. 2). This is a reflection of the favorable effects of a heavy snow cover and the protection of a nearby windbreak.

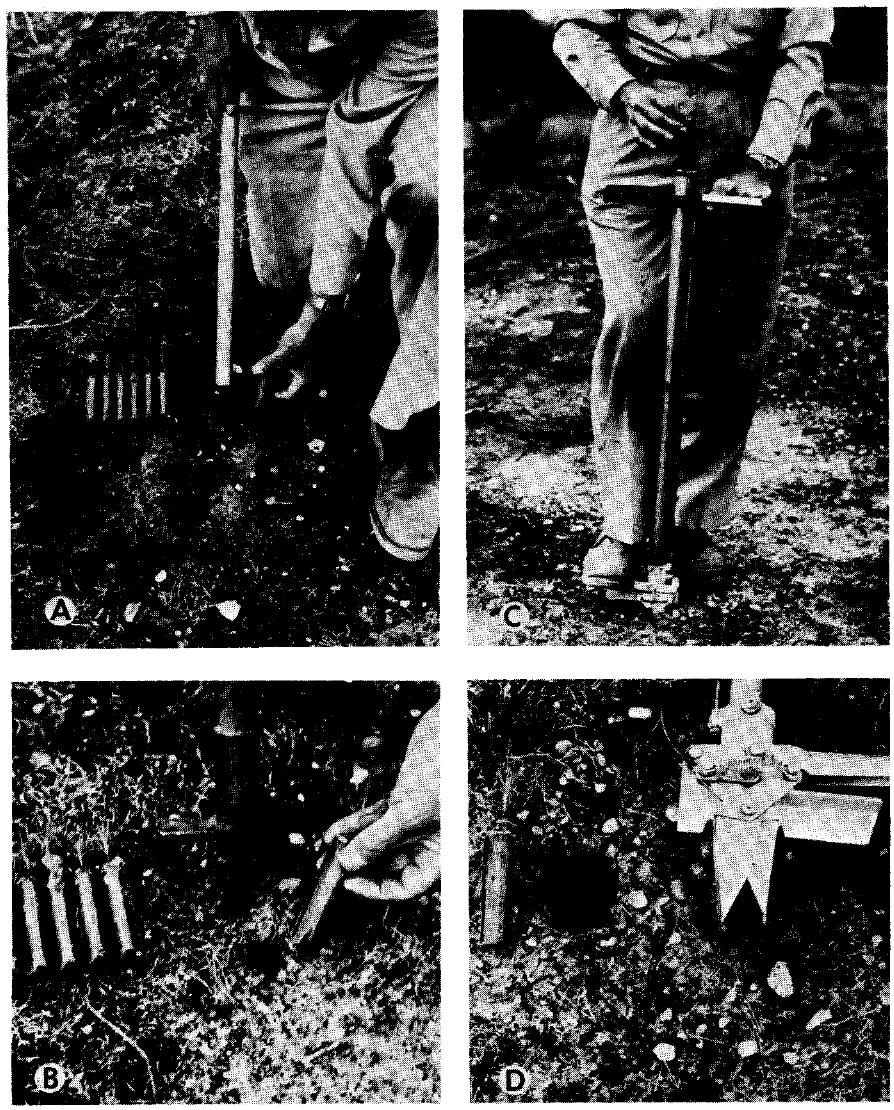

Figure 1.-Planting tools for pulpwood blocks (A) 3/4 electrical conduit cut to suitable length and provided with hand grip, (B) square-shaped dibble mounted on wooden handle with foot step, (C) spring-loaded tool to make wedged-, shaped hole (tubeling is fed through top), (D) detail of tool head, hole, and 8 week-old tubeling in wood pulp block.

White spruce did not perform in the containers as well as jack pine. The less than satisfactory survival in all containers, especially the pulpwood blocks, was probably again due to failure to get root-soil contact at planting time. The need to provide for a longer preplanting growth period for white spruce is thus indicated. As with jack pine, the growth of surviving spruce trees on the protected northern Michigan site far exceeded that on the less protected southern Michigan site.

Conclusions

Our experience with this soilless container system indicates that seedlings can be produced in it with shoot dimension comparable to seedlings raised in split plastic tubes or by direct seeding (fig. 3). Root development throughout the soilless block, with direct rootsoil contact at time of planting and subsequent lateral root elongation into the soil following field planting, is in marked contrast with the nearly vertical root growth from the plastic tube. This better root development from the soilless block has resulted in less tendency to frost heave.

TABLE 2.—*Growth and survival of container[1] grown jack pine on three contrasting sites after second field season*

Site	Survival			Ht. Growth (cm)			Diameter (mm)		
	s.p.	p.-s	p.-l	s.p.	p.-s	p.-l	s.p.	p.-s	p.-l
Coarse sand (jack pine cut-over)	99	87	82	15.0	13.3	16.2	2.1	1.8	2.1
Loamy sand-tilled (N. Mich.)	92	88	76	47.7	44.2	45.8	5.5	5.7	6.7
Loamy sand-tilled (S. Mich.)	96	91	90	22.3	19.3	20.6	4.2	3.7	3.6

[1] s.p.=split plastic; p.–s=soilless pulp block, small; p.–l=soilless pulp block, large.

TABLE 3.—*Growth and survival of container*[1] *grown white spruce on two contrasting sites after second field season*

Site	Survival			Ht Growth (cm)			Diameter (mm)		
	s.p.	p.–s	p.–l	s.p.	p.–s	p.–l	s.p.	p.–s	p.–l
Loamy sand-tilled (N. Mich.)	77	49	44	10.1	12.8	13.0	3.2	2.5	2.1
Loamy sand-tilled (S. Mich.)	87	73	68	4.5	5.7	4.7	1.4	1.5	1.2

[1] s.p.=split plastic; p.–s=soilless pulp block, small; p.–l=soilless pulp block, large.

As far as block size is concerned, there seems to be no advantage in using pulpwood blocks which greatly exceed the dimension of the plastic tube. In the original phases of the investigation, we used a square shaped block 5/8 by 5/8 by 3 inches-very comparable to the plastic tube. Subsequently, we went to blocks that were almost four times this physical dimension and presently we are using a wedge shaped block which appears to be a good compromise. It is 1/2 inch longer than the plastic tube, and the root growing volume and available water holding capacity are three times as great as the split plastic tube. While a comparable number of soilless tubelings requires more bench production space, less frequent waterings are needed than with the plastic tubeling.

Container regeneration systems in general are a feasible alternative to natural regeneration. Numerous systems have been proposed.

There does not seem to be any top growth advantage of the soilless system over the split plastic tube for the first 2 years in the field. However, we feel that the ability of the soilless system to retain bottom root development within the block at the time of planting, while at the same time promoting a proliferation of lateral roots, represents a distinct advantage. At the moment of planting, the roots are in direct soil contact and can readily ramify into the soil.

The principal advantages of the soilless system-the container functioning as the growing medium and the resultant near natural root development-make this regeneration approach most promising.

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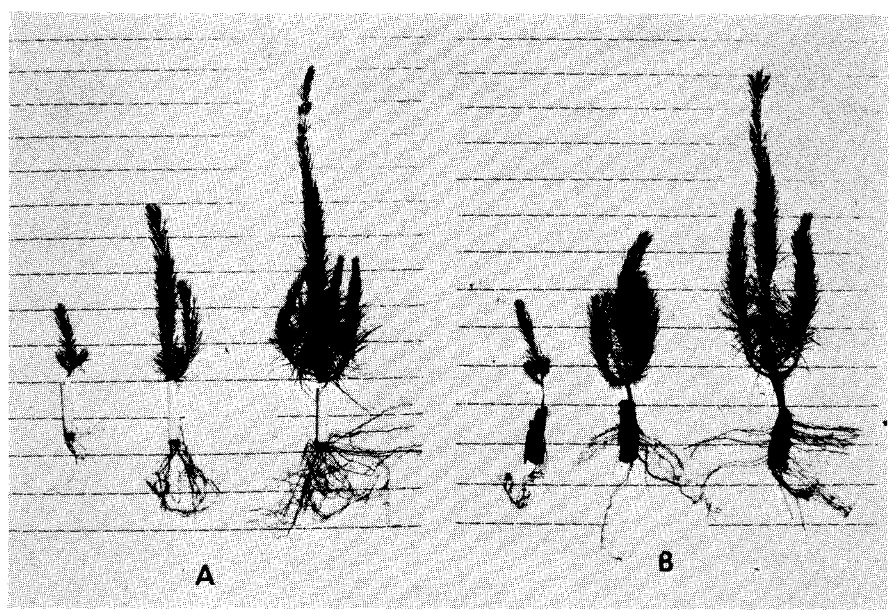
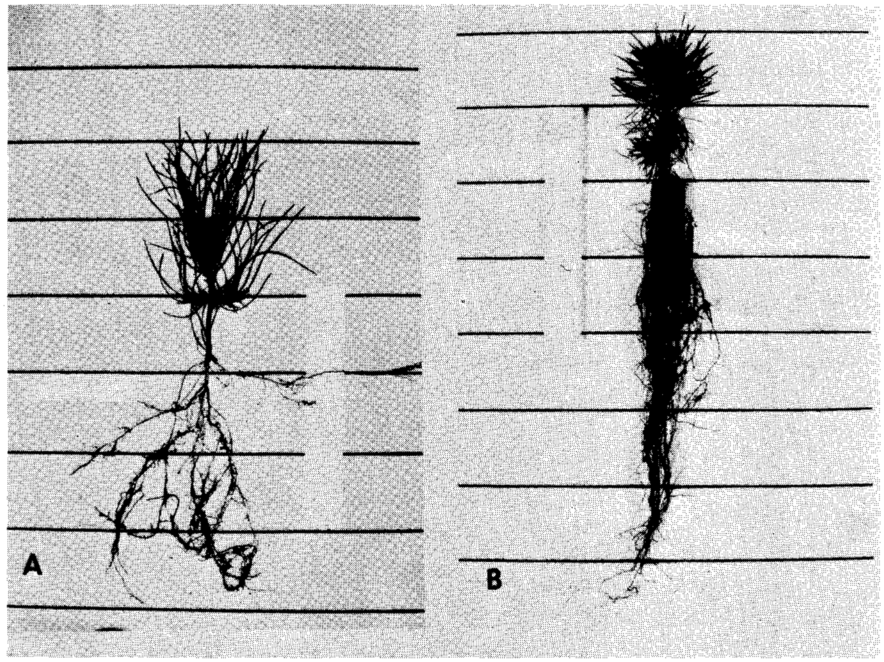


Figure 2.—Container grown jack pine after second growing season in field. For both (A) split plastic tubes and (B) small pulpwood blocks, from *left* to *right*: Coarse sand-jack pine cutover; loamy sand-southern Michigan exposed site; loamy sand-northern Michigan with protection from wind. *Note*: Shoot growth is similar for both containers. Lateral root development is superior in pulpwood blocks.



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