# HARDWOOD PLANTATION ESTABLISHMENT USING CONTAINER GROWN STOCK[1]

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Successful hardwood plantations have been the exception rather than the rule in American forestry (5). The use of bare rooted, usually 1-0, nursery stock has been the general practice, but the success achieved with this method for conifers has not been repeated satisfactorily with hardwoods. Severe root injury during transplanting, weed competition, grazing animals, and unfavorable exposure are among the primary agents that resulted in substantial early mortality and tree deformity.

Modern tree farm management requires a successful technique or the establishment of hardwood species in stands or as inter-plantings (7). The use of container systems in conjunction with intensive early plantation care offers an opportunity to obtain successful regeneration of many hard wood species especially those with large seeds and taproot systems (2, 4).

A major production benefit occurs with container planting since plants can be started in controlled environments before the regular growing season. Also, seedling propagation, as well as the field planting, can be extended further into the growing season than is so with conventional nursery-bare rooted planting.

Planting a tree that has been seeded and grown in a special plantable container means higher production and planting costs. However, greater establishment success and more flexible planting plans, often in difficult site situations, may more than justify the increased initial investment.

## Characteristics and Advantages of Planting Container Grown Stock

A good container system for tree planting should be characterized by an optimum growing environment, which produces good stock in a short time. Such a system has a number of advantages over

1 J. Art. 4993. Mich. Agr. Exp. Sta. Research supported in part by the McIntire-Stennis Cooperative Forestry Research Program, the American Can Company, and Fred Prince, Jr., of Grosse Point, Mich.

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TABLE 1.—*Characteristics, advantages, and potential uses of a container-system for growing and planting forest trees*

| Characteristics | | Advantages | Applications |
|---|---|---|---|
| *Biological* | *Economic* | Control of growing environment | Reforestration and afforestation |
| Optimum water-holding capacity | Low cost | Reduces: | Landscape planting |
| Adequate aeration | Easily packaged and transported | Lag time between standard nursery production and operational needs | Highway beautification |
| High cation exchange capacity | Dimensionally stable | planting shock | Seed orchard development |
| Adequate nutrient supply | Uniform in size and composition | capital investment in permanent nurseries | Genetics research |
| Stable pH | Adaptable to mechanization | peak labor load requirements | Interplanting of valuable hardwoods in woodlands |
| Nonpathogenic or phytotoxic | Variety of sizes and configurations | Extends planting season | Erosion control |
| Easy germination and root growth | Aesthetically attractive | Increases planting success on adverse sites | Wildlife food plantings |
| Bio-degradable after planting | | | Home and garden market |
| Permit root movement to soil | | | |
| Resist frost heaving after planting | | | |

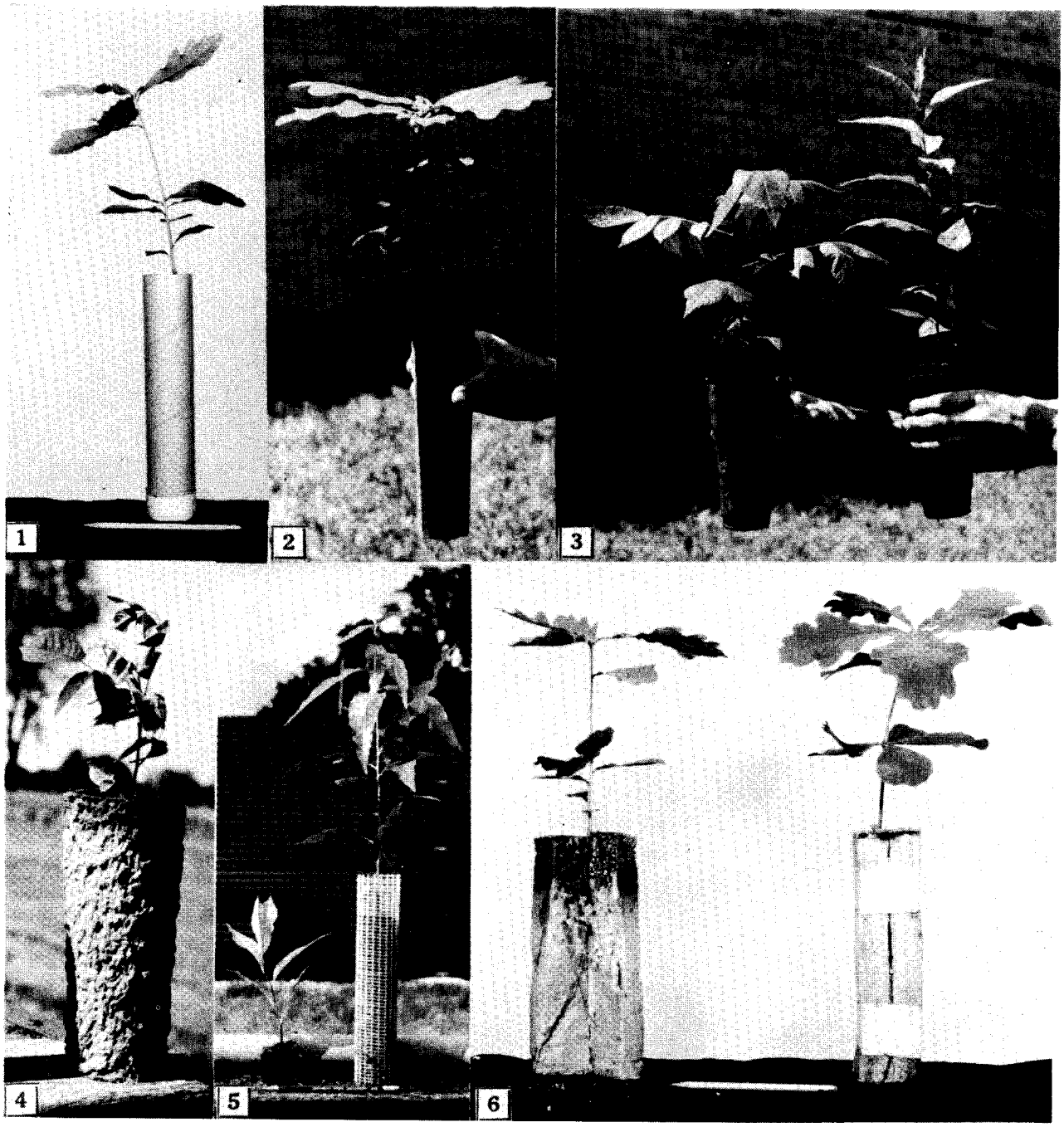


Figure 1.—Examples of forest trees seeded and grown in special planting containers: 1. Paper mailing tube (oak) ; 2. Weyerhaeuser impregnated pot with holes (oak) ; 3. Fertil pot (walnut and cherry) ; 4. papier-maché pot (walnut) ; 5. Jiffy-7 pellet and Conwed plastic mesh (cherry) ; 6. BR-8 Special-Hardwood block (oak) : *Left,* opened block to show well developed root system; *right,* as normally planted (3–4 weeks old) .

bare rooted stock and can be adapted to a variety of potential applications (table 1) .

## Methods and Procedures

Seed of three hardwood species, black walnut *(Juglans nigra),* black cherry *(Prunus serotina),* and red oak *(Quercus borealis),* collected from known seed sources was stratified prior to planting.

Planting containers used (fig. 1) included:

Paper tube with soil
Paper tube with Jiffy-7
Conwed plastic mesh with Jiffy-7
Fertil pot with soil
Weyerhaeuser resin-impregnated paper pot with soil (hole perforated) Jiffy-7 pellet
BR-8 Special-Hardwood block
Papier-mache pot with soil

Paper tubes are a 3-ply mailing cylinder with a Kraft paper wrapper, 10 inches long and 2 inches in diameter. Conwed, a plastic mesh material extruded in the form of a cylinder (6), was filled with six water-expanded Jiffy-7 pellets (3). The dimensions of this container were the same as the paper tubes. The Fertil tapered pot, manufactured in France, has a 4-inch top diameter and is composed of peat and paper fiber. Soil used was a peatloam greenhouse potting mix. The BR-8 material (1) is composed of acrylonitrile bonded wood pulp fibers made as a rectangular sandwich, each side 1 inch by 2 inches by 10 inches. Manufactured by American Can Company, the special block was designed with a 1-inch-diameter cavity to accommodate the seed.

Following stratification, germinated seeds were placed in the various containers and grown in a greenhouse environment for 3 weeks with watering as necessary. They were then moved to an outdoor, protected enclosure for 1 week prior to field planting for hardening. At time of planting, most seedlings had roots extending the full length of the container (fig. 2) .

Since large-seeded species were used and grown for a few weeks in the container prior to outplanting, supplemental nutrition was not required. However, if seedlings are held a longer period of time in such containers, a nutrient solution would be desirable. This is particularly true in the soil less wood pulp containers. A commercial, complete 30-10-10 soluble fertilizer with minor elements can be used for this purpose. This nutrient solution, made at the rate of 1 tablespoon per gallon is used as a regular liquid fertilizer with peat or soil potting mix. When used with the BR-8 material, it should be made half strength and no more than 2 ounces of solution applied per container in any week.

**Figure 2.—Tap root development of black walnut 3 weeks after seeding in papier-maché planting container. Illustrates normal root development in container at time of out-planting.**

Out-planting was done in both an open field provided with wind protection, and in a forest opening of a 35-year-old red pine *(Pinus resinosa)* plantation in May 199, in southern Michigan. Ten replications of each container and tree species were planted at each field location. Trees were planted

at a 3-by-3-foot spacing and kept free of competing vegetation with repeated, directed sprays of paraquat.

## Results

Seedling height and stem diameter measurements for each of the hardwood species planted in field and forest openings, after one growing season, are shown in tables 2-4.

In general, paper tube containers with soil gave the poorest plant growth for each tree species. We attribute this largely to poor soil aeration. The Fertil pot with soil produced plants with good shoot and root growth, showing the effect of large container volume. However, the poor strength and excess weight of such a container preclude it from use in any large scale reforestation program.


**Figure 3.—Black cherry one growing season after container planting on wind protected, open field site: a. Fertil pot with soil, b. Conwed plastic mesh with stack of 6 Jiffy-7 pellets. Nearest tree is 4.5 feet tall. Note control of weeds with paraquat.**

The Conwed with jiffy-7 pellets usually yielded the best seedling' growth (fig. 3). The organic potting media, along with the mesh nature of the container, resulted in an optimum condition of soil aeration. The mesh openings are large and permit easy root penetration, but the material is not biodegradable. What influence this might have on future root growth remains to be seen.

The Weyerhaeuser paper tube (with holes) containing soil produced better growth than the ordinary paper tube with soil. It appears that the main reason for this growth is the holes in the side of this container which again resulted in increased soil aeration and better soil drainage.

The paper tube with jiffy-7 as the potting media grew satisfactory seedlings. This container had increased soil aeration.

The individual jiffy-7 pellet is fine for small seeded species. However, it cannot accommodate large seeds nor is it able to supply the necessary room for root growth of tap-rooted species.

The BR-8 wood pulp material gave good shoot and excellent root growth. This soilless planting container compares favorably with the results achieved with the jiffy-7 pellet. Actually it is superior for accommodating large-seeded species as it allows a larger volume of root to be maintained. Different sizes and shapes of this BR-8 material can be molded to handle various sized seeds. The wood pulp material readily absorbs available plant water. Roots penetrate the vertically oriented wood fibers and develop easily into the surrounding soil once the containers are planted in the field.

The value of container planting was shown by an experiment that compared the field performance of black walnut trees planted as 1-0 bare rooted nursery stock versus direct seeding and 3-week-old container-grown trees (table 5). These results show that after 2 years there was no significant difference in height and diameter growth between the 3-year-old nursery-produced trees and the 2-year-old trees planted by the other methods. Foresters have seldom been satisfied with 1-0 barerooted hardwood seedlings for field planting. Using the container approach, we can achieve better hardwood establishment in a shorter time.

TABLE 2.—*First year growth in field and forest of various container-planted black walnut*

| Location | BR-8 block | Paper tube with soil | Paper tube with Jiffy-7 | Conwed with Jiffy-7 | Fertil pot with soil | Weyerhaeuser pot with holes |
|---|---|---|---|---|---|---|
| | *Height* | *Height* | *Height* | *Height* | *Height* | *Height* |
| | *Cm.* | *Cm.* | *Cm.* | *Cm.* | *Cm.* | *Cm.* |
| Field (protected) | 19.8 | 10.2 | 14.1 | 26.3 | 20.4 | 11.3 |
| Forest (opening) | 18.4 | 10.4 | 14.3 | 25.2 | 19.7 | — |
| | *Diameter* | *Diameter* | *Diameter* | *Diameter* | *Diameter* | *Diameter* |
| | *Cm.* | *Cm.* | *Cm.* | *Cm.* | *Cm.* | *Cm.* |
| Field (protected) | 0.7 | 0.5 | 0.6 | 0.9 | 0.9 | 0.6 |
| Forest (opening) | 0.4 | 0.4 | 0.4 | 0.6 | 0.5 | — |

TABLE 3.—*First year growth in field and forest of various container-planted black cherry*

| Location | Paper tube with soil | Paper tube with Jiffy-7 | Conwed with Jiffy-7 | Fertil pot with soil | Weyerhaeuser pot with holes | Jiffy-7 pellet |
|---|---|---|---|---|---|---|
| | *Height* | *Height* | *Height* | *Height* | *Height* | *Height* |
| | *Cm.* | *Cm.* | *Cm.* | *Cm.* | *Cm.* | *Cm.* |
| Field (protected) | 11.2 | 34.5 | 93.7 | 96.3 | 36.7 | 63.8 |
| Forest (opening) | 4.6 | 5.5 | 33.5 | 24.4 | — | 19.7 |
| | *Diameter* | *Diameter* | *Diameter* | *Diameter* | *Diameter* | *Diameter* |
| | *Cm.* | *Cm.* | *Cm.* | *Cm.* | *Cm.* | *Cm.* |
| Field (protected) | 0.3 | 0.5 | 1.0 | 1.2 | 0.5 | 0.9 |
| Forest (opening) | 0.1 | 0.2 | 0.4 | 0.3 | — | 0.3 |

TABLE 4.—*First year growth in field and forest of various container-planted red oak*

| Location | BR-8 block | Paper tube with soil | Paper tube with Jiffy-7 | Conwed with Jiffy-7 | Fertil pot with soil | Weyerhaeuser pot with holes |
|---|---|---|---|---|---|---|
| | *Height* | *Height* | *Height* | *Height* | *Height* | *Height* |
| | *Cm.* | *Cm.* | *Cm.* | *Cm.* | *Cm.* | *Cm.* |
| Field (protected) | 15.2 | 10.9 | 16.1 | 16.6 | 19.8 | 20.5 |
| Forest (opening) | 11.8 | 9.4 | 10.7 | 15.6 | 17.3 | — |
| | *Diameter* | *Diameter* | *Diameter* | *Diameter* | *Diameter* | *Diameter* |
| | *Cm.* | *Cm.* | *Cm.* | *Cm.* | *Cm.* | *Cm.* |
| Field (protected) | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Forest (opening) | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | — |

TABLE 5.—*Establishment technique and growth of black walnut after two growing seasons in open field*

| Growth | Age and planting technique | | | |
|---|---|---|---|---|
| | Seedling (1 year) | Direct seeded (—) | BR-8 Block (6 week) | Papier-mache pot/soil [1] (6 week) |
| | *Cm.* | *Cm.* | *Cm.* | *Cm.* |
| Height | 74 | 81 | 66 | 69 |
| Diameter | 0.46 | 0.55 | 0.46 | 0.53 |

[1] 3-in. by 10-in. diameter special container for hardwoods (Pullen Pot. Co., New Iberia, La.).


## Summary

Three species of hardwoods, black walnut, black cherry, and red oak, were grown in a variety of container systems for 3 weeks and then field planted. The sites were an open field with artificial wind protection and openings cut in a red pine plantation.

Best early growth and subsequent field response was obtained in a 10-inch long cylinder of plastic mesh containing a stack of expanded peat pellets. Poorest growth developed in paper mailing tubes filled with soil. Containers filled mostly with a peat potting soil showed superior results to containers filled with soil. Differences in aeration probably play a major role in the relative growth differences between types of containers.

A unique soilless container comprised of a specially treated wood pulp proved highly satisfactory for growing large seeded hardwoods. This container, which has a self-contained, organism-free growing medium, is light in weight and has high moisture capacity and lends itself to mechanization.

Field planting of container-grown seedlings a few weeks after germination is suggested as an improvement over the conventional use of 1-0 bare-rooted nursery stock. At least 1 year's time and considerable production cost may be saved by this approach.


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