# A Labor-Saving Container Handling System

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*A tree seedling container handling system designed to handle the Tinus Rootrainer is described. The authors report a significant labor savings and the elimination of expensive and bulky trays to hold the Rootrainers.*

Large container tree seedling (CTS) nurseries must have container handling systems that will efficiently process large numbers of containers both to minimize production costs and to get an entire crop germinated over a relatively short period. Many CTS nurseries have developed sophisticated equipment to meet these requirements. Some nursery managers report filling and seeding as many as 500,000 cavities per day. However, small CTS nurseries, such as ours (Kansas State and Extension Forestry) with an annual production of 300,000 plants, have different requirements.

It is not as important for small nurseries to fill and seed 500,000 or even 100,000 cavities per day. But it is important to minimize the total labor used in producing and shipping a crop. With that in mind, we have designed and constructed a system which has greatly reduced our labor requirements.

Our system is designed around the Tinus Rootrainer (by Spencer-LeMaire, Ind., Edmonton, Alberta). This is because Dr. Richard W. Tinus, USDA Forest Service, found that large seedlings survive Great Plains climatic conditions better than small seedlings and large containers produce larger trees than small containers *(1)*. The 22-cubic-inch volume of theTinus Rootrainer is a reasonable volume compromise between a container for the largest possible trees and the higher costs of handling large containers and trees. Another reason for using the Tinus Rootrainer is that the seedlings can easily be removed from the container. Since our average order is about 60 seedlings and the customer expects every seedling to be "plantable," we remove each seedling from the container, grade it, and place the select seedlings back in the container.

Since the Tinus Rootrainer is a "book" of four cavities, it is necessary to have a tray to support individual "books" in a larger unit. We experimented with several homemade trays. We tried constructing trays with wood, ¼-inch cold round iron rods, and concrete reinforced wire. All of them seemed to be too expensive, and required too much labor and too much storage space. Finally, we designed a system that allows us to move large units by forklift rather than smaller units by hand. The basic unit is a bunker made of 1¼-inch angle iron with outside dimensions of 44 by 120 inches (fig. 1). It holds four rows of books for a total of 1,120 cavities. From filling with medium to preparation for shipping, the containers are moved as a unit on the bunkers.

When outdoors, the bunkers are moved by a forklift. In the more constricted greenhouse, however, a special bunker carrier is used. Pictured in figure 2, the bunker carrier is constructed of 2-inch pipe with four swivel wheels and two shafts with ratchets and

**Figure 1**—*Tinus Rootrainer containers are supported on an angle-iron bunker.*

**Figure 2**—*A bunker carrier is used to move bunkers from the headhouse to the greenhouse.*

cable for lifting the bunker. The lifting hooks are welded to 2½-inch pipe, which slides over the 2-inch pipe legs. The bunker carrier can lift and move any bunker from a row without disturbing any others.

The growing medium mixer is a 1-cubic-yard Davis feed mixer powered by a 3-horsepower motor. Six cubic feet of Canadian sphagnum peat moss and an equal amount of perlite are placed in the mixer. After the lid is closed (we installed a safety switch so that the mixer cannot operate with the lid open), a timer is set to 2 minutes and the switch is turned on. The timer and a solenoid control the amount of water that is injected as the mixer operates. This arrangement produces a very uniform growing medium. It is thoroughly mixed and every batch has the same moisture content. The mixer unloads through a controlled gate into a vertical 12-foot bucket elevator. The elevator moves the medium with a ½-horsepower motor to an 8- by 4- by 8-foot medium hopper. In the bottom of the hopper is a chain and slat system, which draws the medium through a chute into the containers on the bunker (fig. 3).

Before being filled with medium, the bunker is set on a wheeled shaker table. As the shaker table (fig. 4) is pulled under the hopper chute, the cavities are filled with soil and the soil is settled to a uniform density. Like most of our equipment, the shaker table was constructed by the senior author. The support frame sits on four springs. The shaking action is provided by a ½-horsepower motor with the drive shaft offset ½ inch on an eccentric attached to the support frame. From the shaker table, the bunker is moved by hand to a cradle, which supports the bunker while the cavities are being seeded.

**Figure 3**—*A chain and slat system draws the medium from a hopper into the containers.*

**Figure 4**—*A shaker table shakes the containers as they are being filled so that the medium is settled to a uniform density.*

A self-propelled vacuum drum seeder (fig. 5) straddles the bunker as it moves the full length of the bunker in 2 ½ minutes. The seeder can operate in either direction. The vacuum drum and the wheels are powered by a ¼-horsepower motor and a system of drive chains. The vacuum is provided by a home shop vacuum cleaner. The drum is 48 inches long and has three rows of holes so that three seeds are dropped with each revolution of the drum. The spacing of holes within each row is adjusted to match the cavities as they are arranged on the bunker. The holes were drilled with a no. 52 wire gauge bit.

**Figure 5**—*Seeding is done by a self-propelled vacuum drum seeder.*

Each hole in the drum might pick up from 1 to 6 seeds. To get an acceptable degree of accuracy,

we directed a small column of air at each row of holes after they passed over the seed hopper. The air brush removes the extra seed. The gearing arrangement is designed so that each cavity receives three seeds.

Unlike some nurseries, we have found no benefit in covering the seed. A 10:00 a.m., 12:00 noon, and 3:00 p.m. light irrigation is adequate to keep the seed moist. We have not experienced any problem with root orientation on our four primary species: Austrian pine, Scotch pine, ponderosa pine, and eastern redcedar. After being seeded, the bunker is moved to the greenhouse by bunker carrier.

The seedlings are graded just before being shipped. The grading trailer (fig. 6) is a four-wheel flatbed trailer with a conveyor belt running lengthwise down the

**Figure 6**—*A trailer with a conveyor belt is used to grade the seedlings.*

center of the trailer. The grading trailer is located so that there are bunkers with ungraded seedlings on both sides. Three graders work on each side of the trailer. Each grader places an armful of Rootrainers on the flatbed and then opens each book and removes the culls and fills the blanks with good seedlings. The graded books, as well as the culls, are placed on the conveyor belt. At the discharge end of the conveyor belt, the culls are allowed to drop into a bin. The graded books are lifted off the conveyor belt and taped into a unit of eight books or 32 seedlings, which is our sales unit. The tape machine operator controls the movement of the conveyor belt.

Eight books of graded seedlings are placed on the taping machine (fig. 7). With a hand lever, the books are slightly compressed. Two rolls of reinforced filament tape, which are mounted on a frame, are pivoted around the unit of books so that two rows of tape secure the unit. A short reversal of the tape frame causes a cutting edge to swivel out and cut the two tapes. As shown in figure 8, the taped unit is secure and easily handled.

In conclusion, we have found that this container handling system has significantly reduced our labor requirements. An additional benefit is that we no longer need expensive and awkward trays to hold the Rootrainers.

Two future innovations are planned to increase the efficiency of the system. Currently, as the bunker is drawn under the hopper chute, a person using a floor

**Figure 7**—*A taping machine secures the Tinus Rootrainers in units of 32 seedlings.*

**Figure 8**—*A taped unit of 32 seedlings is secure and easily handled.*

broom levels the medium, ensuring that all cavities are filled. Final brushing leaves the cavity with a slight depression to receive the seeds. We plan to add a powered brush to do this task mechanically.

Secondly, we plan to place the hopper, brush, and seeder on line, and gear their operation so that we will have a continuous flow of bunkers entering the greenhouse.

**Literature Cited**

1. Tinus, Richard W. Large Trees for the Rockies and Plains. In: North American Containerized Forest Tree Seedling Symposium. Great Plains Agricultural Council Publication No. 68: 112-118. 1974.