

## The Progeny Seeder

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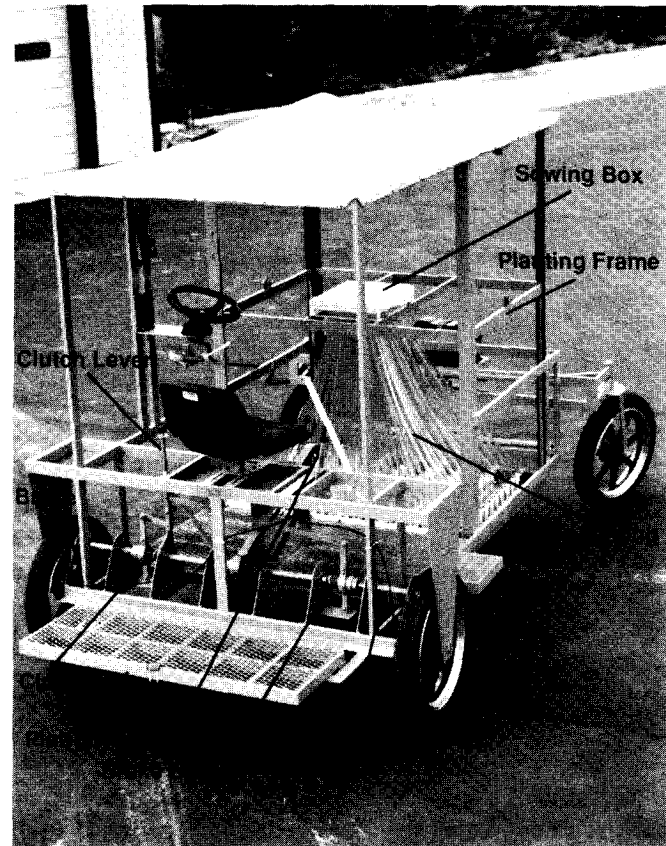
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*A seeder to sow progeny test tree seeds in nurseries was developed by the USDA Forest Service's Missoula Technology and Development Center. The four-wheel, pedal-driven vehicle punches 96 dibble holes into the soil. A shutter-type tray then sows seeds simultaneously into each dibble hole. The seed trays are filled before field sowing. Because covering the seeds was not incorporated into the design, seeds must be covered with dirt or grit using a spreader or by hand. The seeder was developed as an alternative to the current labor-intensive plywood board sowing method. Tree Planters' Notes 42(3) :9-12; 1991.*

As part of the Forest Service tree improvement program, Forest Service nurseries sow special high-value tree seed in test plots. The sowing specifications for these higher value seeds differ from normal sowing specifications. The progeny test seeder was developed to mechanize the sowing operation. Mechanizing sowing should reduce labor costs, reduce personnel injuries, and increase the rate of sowing.

The Missoula Technology and Development Center (MTDC) designed the progeny seeder (figure 1) for exact placement sowing of progeny test seeds in bareroot nursery beds. The sowing pattern was determined by Pacific Northwest Region personnel. The pattern can be modified to meet specific requirements. The seeder sows 96 seeds simultaneously in a pattern of 8 rows and 12 seeds in each row with rows spaced on 6-inch centers. The 12 seeds in each row are spaced in 3-inch centers. The development and growth characteristics of progeny test seedlings are closely monitored for tree improvement. Exact placement sowing is necessary to allow each seedling to display its individual genetic variations.

Progeny seeds have traditionally been sown by hand using a perforated 4- by 8-foot plywood board. A plywood sheet with holes drilled through it was placed atop the nursery bed. The progeny seeds were then dropped into the holes. The holes were filled with dirt to cover the seeds. The plywood board was then lifted and moved forward to the next planting location on the nursery bed. This method was tedious and labor intensive. A 5- or 6-member



**Figure 1**—Rear view of entire progeny seeder; note the operational features and the sowing box.

sowing team is required to bend and stoop over the nursery bed for long hours.

The progeny seeder was developed as an alternative to this traditional method. It reduces the amount of bending and stooping required of the sowers and reduces the labor requirements by increasing sowing efficiency.

### Description

The progeny seeder is a four-wheel, pedal-powered vehicle. It is 145 inches long, 90 inches tall, and 78 inches wide, and weighs about 1,200 pounds. The wheels are on 70-inch centers. The machine was designed for nursery beds that are 4 feet wide and have 18- to 24-inch paths.

The drive train consists of a chain drive input, a differential, two clutches, and a final chain drive to each of the rear wheels. A disk brake is attached to each rear wheel sprocket. The cable-operated brakes function as service brakes and parking brakes. A lever located to the right of the seat is used to operate the brakes.

Because of the seeder's extremely low gearing, it has a hitch and tow bar so that it can be towed between the field and the storage buildings. The pin connected tow bar is disconnected from the hitch and attached to the frame when the seeder is not being towed.

An operator must steer the seeder while the seeder is being towed. The final drives have been clutch-coupled to the differential. For the operator's safety during towing, the clutches must be disengaged before and during towing to keep the pedals from rotating. Maximum speed is 8 mph. A lever located to the left of the seat engages and disengages the clutches.

The steering system is adapted from a power boat steering system. A boat steering wheel, a single helm, and an 8-foot steering cable are used. The end of the steering cable is attached to the slider assembly located on the front of the seeder. Rotating the steering wheel controls the left-right movement of the slider assembly along two parallel stainless steel rods. A bar link connects each front wheel to the slider assembly. Thus, the left-right movement of the sliders along the two rods controls the steering of the front wheels.

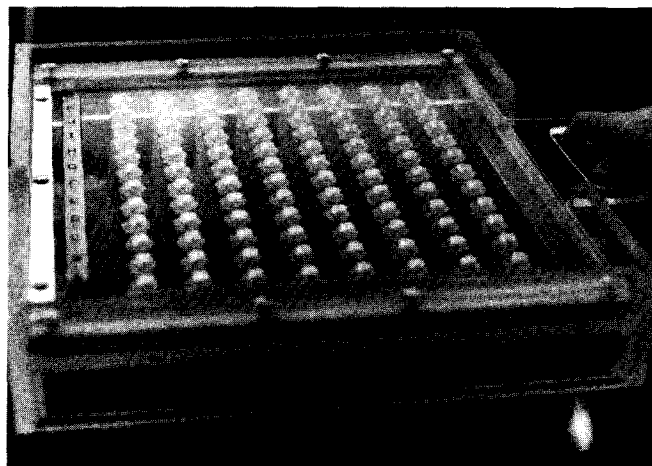
A platform on the back of the seeder allows the sowers to cross the seed bed. The platform folds up to allow the sowers to cover the sown seeds with dirt as soon as possible after the seeds are sown.

The frame of the vehicle envelops a planting frame. The planter is raised and lowered within the frame of the seeder using the battery powered winch. Eight rows of planters are attached to the bottom of the planting frame. A sowing box is attached to the top of the planting frame. Clear vinyl tubing connects the planters to the sowing box.

The eight rows of planters are placed on 6-inch centers. Each row consists of a bar with 12 drop tubes and a bar with 12 carriage bolts. The drop tubes and carriage bolts are aligned and spaced on 3-inch centers along the row. The drop tubes control the placement of the seeds. The heads of the carriage bolts make the dibbles in the nursery bed. A lever located on the rear of the planting frame rotates the carriage bolts into and out of their functioning position.

The sowing box has eight rows of 12 holes drilled through its bottom surface. A clear vinyl tube con-

nects each hole with its corresponding drop tube on the planters (figure 2). The sowing box will hold one seed tray.

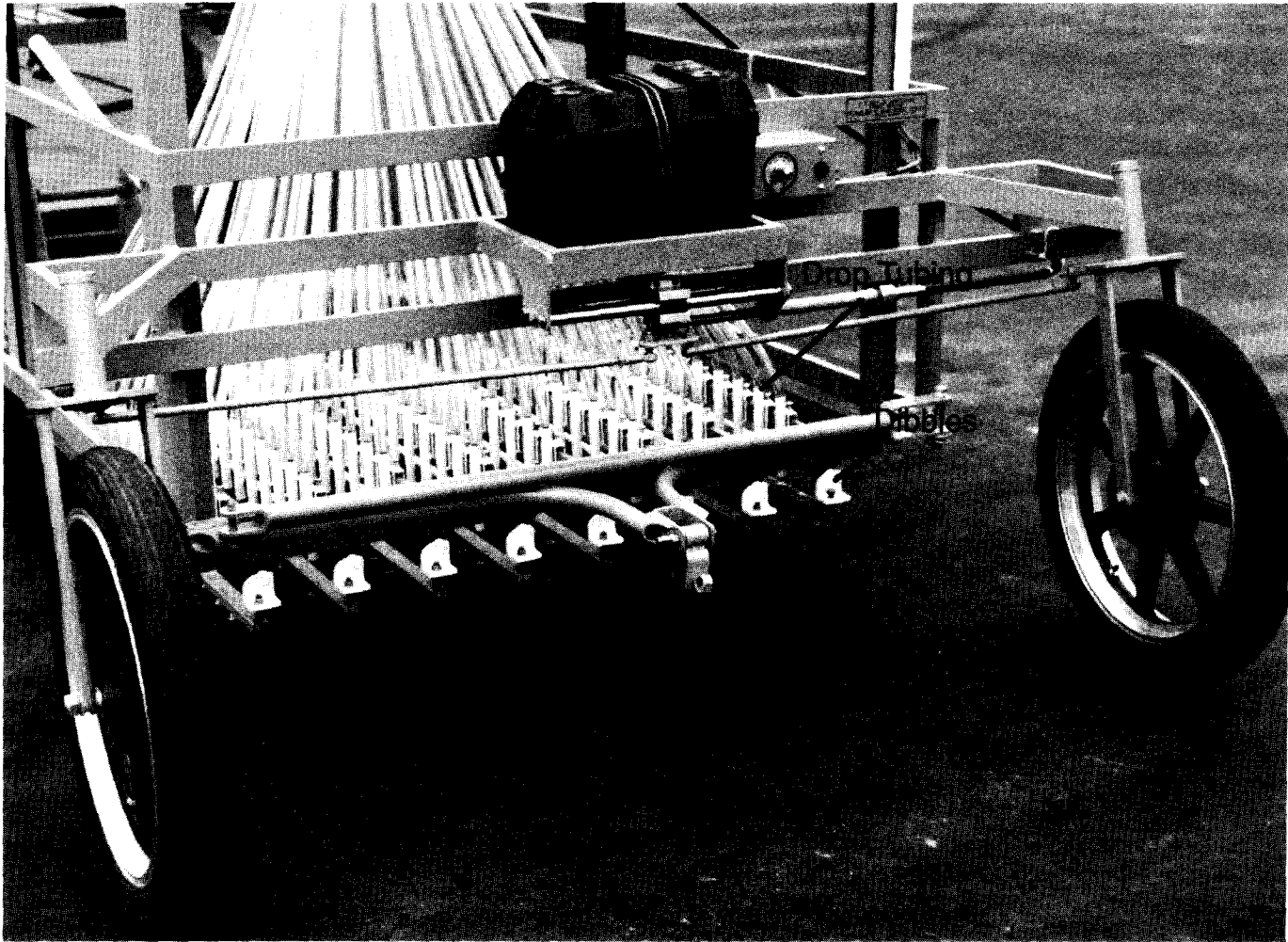


**Figure 2**—Close-up of the seed box and seed tray; operator is about to release the seeds into the box.

The shutter-type seed tray is a sandwich of three clear plastic plates. The top plate is a solid cover. The middle plate is the shutter for the bottom plate. The pattern of the holes drilled through the middle and bottom plates matches the pattern of the holes drilled through the bottom surface of the sowing box. The holes in the shutter plate and bottom plate are aligned and misaligned by sliding the shutter plate. When the seed tray is in the sowing box, the seeds are released by sliding the shutter to align the holes in the two plates and the sowing box (figure 3).

### Operating Procedures

Sowing with the seeder is an indoor-outdoor process. The seed trays are filled inside the seed building. A vacuum pump with vacuum tweezers is provided to place the seeds in the seed trays. Several different sizes of tips are provided to accommodate various sizes of seeds. A seed tray is placed on the table with the bottom plate on the top. With the shutter plate positioned to align the holes of the shutter plate and bottom plates, the progeny seed are placed in the holes. The seeds are captured between the cover and bottom plates by sliding the shutter to misalign the holes of the shutter and bottom plates. After all the seed trays are filled, they are transported to the field for sowing. Wooden tote boxes have been designed for transporting the seed trays.



**Figure 3**—Close-up of the tubing and the dibbles.

After towing the seeder to the field, the operator provides the pedal power to position the progeny seeder along the nursery bed. The carriage bolts are placed in the functioning, or straight down, position. The electric winch is used to lower the planting frame until the bolt heads make dibbles in the nursery bed. After raising the planting frame slightly, the carriage bolts are rotated 90° to a nonfunctioning position. The planting frame is lowered to position the bottoms of the drop tubes just above the nursery bed. The seeder is now ready for sowing. A pre-filled tray is placed inside the sowing box. Sliding the shutter plate aligns the holes of the shutter plate, bottom plate, and sowing box to release the seeds (figure 3). The vinyl tubing guides the falling seeds into the dibbles. The winch is used to raise the planting frame slightly. The operator pedals the seeder forward to the next planting spot. An assistant operator covers the sown seeds with dirt or grit.

The progeny seeder was designed to be operated by a 3 or 4-person crew. One field person will operate the seeder; a second will cover the seeds and assist the operator. A third person, located in the seed building, will pre-fill the trays. A fourth person will transport trays to and from the field and provide assistance in the field or in the seed building as required.

#### Testing

Missoula Technology Design Center has fabricated two progeny seeders. The first one was fabricated in the fall of 1988 and was field tested at the USDA Forest Service's Wind River Nursery in Carson, Washington. It had a shutter box mounted atop the planting frame. The shutter box was filled with seeds in the field just prior to sowing. The same 4-person crew used the seeder for over a month and offered some suggestions for improvements. MTDC modi-

fied the first seeder and incorporated those modifications into the design of the second progeny seeder, which was fabricated in the spring of 1991. Three major modifications resulted from the Wind River field test.

1. The shutter box atop the planting frame was replaced with a sowing box to make the field sowing more efficient. An assistant operator covers the seeds when the progeny seeder is moved forward to the next sowing site along the nursery bed. It is faster to place a pre-filled seed tray into the sowing box than to fill the shutter box. Faster sowing allows the assistant operator to cover the seeds sooner. This minimizes the chance of seeds being displaced by the wind.
2. The planter rows on the original seeder were rigidly attached to the planting frame. A slightly uneven nursery bed would cause some dibble holes to be deeper than others or some dibble holes to be missing. Each planter row was modified with springs. The independent suspension of each row results in more uniformly sized dibles.
3. As a safety measure, clutch couplings were added to the final drive of each of the rear wheels. This allows the progeny seeder to be towed without the pedals rotating. The ergonomics of the new seeder have been improved. The position of the pedals in relation to the seat are more compatible. The steering wheel was relocated from the back of the planting frame to the side of the vehicle.

The modified seeder was retested at Wind River Nursery during the 1991 spring sowing season. The redesigned seeder was also field tested this spring at the W. W. Ashe Nursery in Brooklyn, Mississippi, and at Bend Pine Nursery in Bend, Oregon. The results of these tests will be published after their evaluation.

From the preliminary testing of the original seeder, the sowing rate using the improved seeder should be slightly faster than the sowing rate using the plywood board. The number of workers necessary for sowing progeny seed has been reduced and since the amount of stooping is reduced, the stress on those workers has been reduced as well.

Information and drawings (ask for plan #858) are available upon request from:

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