Intermittent-Furrow Tree-Planting Machine Evaluation

Dan W. McKenzie, Raymond Merala, and Alan Alsobrook
Mechanical Engineer and Agricultural Engineer,
USDA Forest Service, Equipment Development Center,
San Dimas, Calif.; and Forester/Silviculturist,
Strong River Ranger District, 8ienville National Forest,
Raleigh, Miss.

A commercially available intermittent-furrow mechanized planter was evaluated, based on established performance criteria, to gain field experience data on mechanized planting. The planter tested met most of the criteria.

During the winter of 1981, an intermittent-furrow tree-planting machine was evaluated by the San Dimas Equipment Development Center (SDEDC). The evaluation was performed on the Bienville National Forest, Strong River Ranger District, Raleigh, Miss., using the Marden Spot Planter, Model 100 (fig. 1). The Model 100 is produced by the Marden Manufacturing Co., Inc., Auburndale, Fla.

The Model 100 is mounted on a two-wheeled carrier, which can be towed by a rubber-tired or crawler tractor, and weighs 5,400 pounds. The planter is capable of planting both bare-root and containerized stock. The planter's height above ground is adjusted by means of a turnbuckle. The planting mechanism can be powered by the hydraulic pump on the towing tractor or by a power takeoff pump driven by the tractor's engine.

The Model 100 operator sits in the planter facing to the rear and manually loads seedlings. The planting sequence is initiated by depressing a foot pedal switch, which actuates the solenoid hydraulic valve and causes the planting arm to move downward. When the planter moves forward, the hollow dibble forms a furrow into which a seedling is injected. The packing wheel then firmly plants the seedling. The arm returns to the reload position when the pedal switch is released. The total cycle time to load, lower the planting arm, eject and pack the seedling, and return the planting arm so it is ready again to be loaded is 31/z to 4 seconds. The prime mover for the planter was a John Deere (JD) 550crawler tractor, usually used by the District to pull afire plow.

Figure 1.—*Marden Spot Planter, Model 100.*

The Model 100 Spot Planter was used to reforest 136 acres in small, scattered parcels. Loblolly pine *(Pinus taeda)* was planted on 8- by 8-foot spacings at 681 seedlings per acre, with minimum acceptable stocking established at 300 well-distributed seedlings per acre. All loblolly seedlings were 1-0 bare-root stock. In addition, a 35-acre sheared and windrowed site with droughty, sandy soils was planted with longleaf pine (P. *palustris)* on a5- by 8-foot spacing, giving 1,089 seedlings per acre. Minimum acceptable stocking was established at 600 well-distributed seedlings per acre. Longleaf seedlings were also 1-0 bare-root stock.

The field evaluation was based on a performance criteria for an intermittent tree planter developed by SDEDC in cooperation with the Forest Service, Southeastern Area

State and Private Forestry, and approved by the Forest Regeneration Committee, which is chaired by a member of the Forest Service, Timber Management Staff, Washington Office.

The planter planted well while turning and is able to plant up and down slopes without creating furrows that would be washed out during an intense rainfall. The planter met the packing criterion.

The planter was pulled, without difficulty, by the JD 550 crawler tractor weighing 15,500 pounds. The maximum pull, with the dibble in the ground, was 4,500 pounds, with a mean pull of 3,000 pounds.

The average measured instantaneous production rate was 952 seedlings per hour with a standard deviation of 70. When this instantaneous rate is reduced by a field efficiency of 80 percent, the sustained planting rate becomes 762 seedlings per hour.

The planter cost was $9,995, which was well below the price of $19,535 given by the affordability equation developed by SDEDC. This affordability equation is based on parametric cost estimating. Two parametric values are used: (*1*) Cost of hand planting (the next best alternative) and (*2*) machine production or planting rate. The equation for a towed tree planter is:

$$X = -\$67{,}500 + [(1{,}203)\ (HPC)\ (MPR)]$$

Where X = Maximum affordable tree planter purchase price.

HPC = Hand planting cost in dollars per seedling.

MPR = Machine production rate in seedlings per hour.

For more information on the development of this affordability equation, obtain Project Record 8124 1203 entitled "Tree-Planting Machine-How Much Can You Afford to Pay for One?" from SDEDC.

Season-long records of planter production, operating time, breakdowns (failures), and repair time were kept to determine reliability (how often it breaks), availability (percentage of time operating), and maintainability (how long it takes to fix when it breaks). Reliability was 4,035 cycles per failure. Availability was 67 percent. Maintainability was 2.34 hours per failure.

No significant safety problems with the Model 100 were observed or reported during the season-long field tests on the District. The planter has a rollover-protected operator's station, which is judged to be both more comfortable and safer than those usually found in conventional continuous-furrow tree-planting machines. In the Model 100, the operator enters from the left side, over the planting arm, and can sit erect since there is no need to place the seedlings directly into the ground. The operator uses a horn to communicate with the tractor operator.

The results of the evaluation were reported in a July 1982 Project Record 8224 1201, "Evaluation of an Intermittent-Furrow Tree-Planting Machine," issued by SDEDC.