

## THE NURSERY PROGRAM AT MISSOULA TECHNOLOGY AND DEVELOPMENT CENTER

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**Abstract.** This paper highlights the various projects in the Nursery and Reforestation Program at the Missoula Technology and Development Center. Projects discussed are: The Root Pruner, Machine Vision, the Tree Seedling Counter, the Progeny Seeder, and Portable Field Storage. Other projects, including the Pollen Collector and the Bracke Scarifier Seeder will be discussed in less detail. Development efforts, field tests, and documentation will be described.

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### INTRODUCTION

The Missoula Technology and Development Center (MTDC) has provided improved equipment and techniques to Forest Service nurseries for more than 20 years. The goal is to continue to contribute to the efficiency, safety, and production of the Forest Service Nursery Program.

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### PROJECT STATUS REPORTS

#### Nursery Technical Services—TE02E12

MTDC's Nursery Technical Service project allows Center personnel to attend meetings and provide technical advise on request. The project allows us to provide technical services to Forest Service nurseries and respond to requests from State and Private personnel. Current work underway in this project includes a major update of the "Nursery Equipment Catalog," originally published in 1975. Work on this update is 70 percent complete and publication is planned for December of 1990. In addition, MTDC has drawings of various nursery equipment available on request. Additional drawings will be added as resources become available. A list of drawings and publications will be distributed in December, and the list is also periodically published in Tree Planters' Notes. Examples of projects that are responses to requests from the field include: **MTDC modified and built small root growth chambers for Forest Service Research laboratories. These are now being used by nurseries. MTDC designed and built electrical surge protection for 43 Forest Service weather stations used in the**

**Reforestation Improvement Program. MTDC made drawings of the gravity table modification designed and built at the California Division of Forestry, L.A. Moran Regeneration Center in Davis. New applicable technology is continually monitored under this project.**

#### Isozome Laboratory--OE02E33

A National Forest Genetics Electrophoresis Laboratory (NFGEL) was founded by the Forest Service in 1988 for starch gel testing of forest plant material. Since existing equipment was not designed for use on a production basis, problems with efficiency and accuracy were immediately evident. MTDC was asked to identify the problems and design an efficient system of equipment geared toward a production rather than a research environment.

MTDC engineers and NFGEL genetists met in November of 1989 and identified the problems and explored possible solutions. MTDC agreed to design and build buffer trays and gel molds, a gel slicer, and a grinding block, wick combs, and jig. Each piece of equipment would be part of an integrated system that would eliminate much of the hand work and provide consistant operating conditions.

Prototypes of the equipment were designed and built by MTDC. The prototypes were then sent for testing. All equipment provided good results, and it was agreed that the equipment offered a more efficient testing procedure.

**MTDC is currently searching for a plastics manufacturer to build the equipment required to fully equip NFGEL. Drawings are available upon request.**

#### Field Storage--6E62E11

A portable pick-up sized refrigeration unit was developed under contract by Polar Products of Torrence, California. The 12-volt system operates

from the 12-volt vehicle electrical system, a photo-voltaic array with a backup battery or 110-VAC through a battery charger.

The unit was field tested in Region 6 during spring planting. Reviews were mixed. Illinois Valley Ranger District, on the Siskiyou National Forest, reported in-bag temperatures were held below 35 F during a 6 to 10 hour day. Walla Walla Ranger District found the cooling capacity of the reefer to be adequate. The tree hauling capacity was insufficient since this District has fairly large planting sites. Suggested improvements were an easier method of inclining the PV array, simplifying the AC (battery charger) hookup, and reducing the overall weight.

A random survey of the field conducted by Dick Miller, WO Timber staff, suggested the demand for this unit varies. Regions 5 and 8 were the most enthusiastic. Many respondents were reluctant to use anything more mechanical than an insulated box and ice.

In FY91, MTDC is considering developing a 110-VAC storage unit. This unit would have a more simple electrical system and would require less maintenance.

#### Seedling Counter--5E52E28

To meet the demand for seedlings for national reforestation efforts, Forest Service nursery managers must have accurate cultural and inventory data. Much of this information is obtained by seedling counts. Such counts are labor-intensive and expensive.

An automated tree seedling counter was developed by MTDC with the aid of two contracts to Dr. Glenn Kranzler of Oklahoma State University.

0 The counter consists of light emitter and receiver circuitry housed in sealed aluminum enclosures and mounted on a skid. There is a magnetic pick up for determining distance traveled and to provide a reference for measuring stem diameter. A computer allows data storage and retrieval and interfaces with a personal computer. Along with a battery, all these components are mounted on a cart that attaches to a tractor with a three-point hitch. The heart of the machine is its unique opto-electronics that permit accurate seedling counts. A count is made each time a seedling interrupts the invisible light beam between the emitter and the receiver. Once a run is completed, the on-board computer can provide a diameter range of seedlings in the bed and distance traveled. It also produces a profile of seedling stem diameter versus quantity, from one-eighth millimeter to 30 millimeters in one-eighth millimeter increments. This data gives nursery managers an indication of how many seedlings won't meet their grading criteria.

A video, "The Seedling Counter" is available on request from MTDC.

#### Progeny Test Seeder--7E72E27

A seeder for exact placement of tree seeds for progeny testing has been developed. Two units were built and delivered to Bend Pine Nursery in Oregon and Wind River Nursery in Washington.

Seeds are individually placed into a "shutter box" apparatus in the seed laboratory using "air" tweezers. Each shutter box container holds 96 seeds. The shutter boxes are then taken to the field and sown with the seeder.

Two units were built and field tested. A publication and drawings will be prepared in FY 1991 and may be requested.

#### Pollen Collector--8E82E18

The Pollen Collection and Dispenser Project actually consists of two efforts, one to develop equipment to collect pollen for subsequent mass pollination uses and the other to develop equipment to apply pollen in controlled pollination work. The pollen collection equipment work is being done with Don Copes of the Pacific Northwest Forestry Sciences Laboratory in Corvallis, Oregon, on West Coast Douglas-fir. The pollen application equipment work is being done with Floyd Bridwater of the Southern Forestry Sciences Laboratory at Raleigh, North Carolina, on Loblolly Pine.

Several devices were evaluated for collecting pollen including: enclosing the lower two-thirds of the tree with canvas and shaking the tree; blowing through the tree and collecting on the opposite side; and vacuuming the tree and collecting electrostatically or with a cyclone separator. All of these methods work to some degree, but all have drawbacks. The cyclone separator was selected as the most promising and its development is continuing.

For application of pollen several air injector devices were evaluated for metering pollen into the airstream and several emitters for directing the pollen onto the individual cones were also evaluated. The equipment developed is light weight for application from an aerial bucket. We are in the process of making drawings of the applicator and looking at equipment for controlled pollen application.

#### Bracke Scarifier--9E92E18

The Seminole Ranger District on the Ocala National Forest asked MTDC to improve the Bracke seeder/scarifier machine to obtain better stocking for direct seeding of sand pine.

MTDC added an air planter to the unit as well as a Dickey John planter monitor. Drag chains were added to both units to cover seeds placed in the scarified spots. The seed drop location on the old planter unit was modified to improve it's performance with an optional plate

to restore it to the original configuration. The Bracke drive chain boxes were repaired, cleaned, and re-lubed.

The new air planter unit distributed the seeds out longer along the patch and delivered 25 seeds per patch. The Seminole Ranger District used the machine for 300 to 400 acres and had no problems with the machine. On inspecting the fields planted, the seeds were adequately covered, but the ground was still loose and had not packed around the seed. It appears that a packing mechanism would provide a more optimum seed bed.

MTDC considered a BC drag chain scarifier as an alternative to the Bracke Seeder Scarifier. The scarifier was assembled with the drawbar pulling three double-chain assemblies equally spaced. The scarifier was pulled with a D-4 crawler tractor. One test plot was broadcast seeded and then chain scarified and a second plot was first scarified and then broadcast seeded. Seedling germination will be monitored on these plots.

Although the three double-chain configuration was adequate, the double chain caused more soil disturbance or ridging than desired, so the scarifier was re-configured with five single chain assemblies. About 400 acres were seeded with the BC drag chain scarifier in the five single chain configuration. A cyclone broadcast seeder was mounted to the front of a skidder that pulled the scarifier. The seed is placed over the ground by the seeder and then covered by the drag chain scarifier. Other seeders may be used in this system to better control the quantity and placement of the seed before covering. Further modifications will be tested in FY 91.

#### Machine Vision--9E92E19

Tree seedlings are grown in Forest Service bare-root nurseries based on specifications tailored to specific Forest and District needs. After lifting, seedlings are delivered to packing sheds for grading and packing. Each Forest Service nursery has developed its own quality control standards for the seedlings they deliver to field units for outplanting.

The current quality control and grading process is unacceptably labor-intensive and expensive. The graders cull seedlings that do not meet field specifications, count seedlings that do meet specifications, and place them on a packing belt for final processing and packaging. The grader sorts the seedlings by stem diameter, top length, root area and overall quality. Quality control is maintained by checkers who sample graded seedlings and monitor grader's performance.

MTDC was asked to determine the feasibility of automating the quality control and grading process in an effort to reduce costs.

Work was done on contract to Oklahoma State University by Dr. Glenn Kranzler and Mike Rigby. They investigated using machine vision to perform the grading or quality control measurements needed in seedling grading operations. Machine vision and image processing were used to measure various morphological properties of seedlings. A grading scheme was integrated into the software to accept or cull each seedling, depending on morphological characteristics.

OSU's study proves that machine vision can measure morphological features more consistently than current methods. OSU has demonstrated the feasibility of using machine vision to measure, record, and grade individual seedlings. As a result, MTDC recommends that technology to automatic quality control in the grading process should be pursued. When automated quality control has been established, automating machine grading should be explored.

#### Packing Shed Root Pruner--9E92E20

Tree seedlings are pruned in the nursery packing shed to provide tree planters seedlings with a uniform root length. This process, currently done with a hand-operated paper cutter, requires additional personnel, is unsafe, and is often a bottleneck in the packing shed operation. MTDC is currently developing a root pruner prototype that will automate this process to increase packing shed efficiency. Safety will be improved.

MTDC first developed several preliminary concepts of root pruners. Conceptual drawings were reviewed by Forest Service Nursery managers and a prototype was developed. This design, a conveyor system with wire baskets that close around seedling roots and present them to the cutter, provided a safe and efficient method of root pruning. The prototype was equipped with three cutter heads for testing three types of cutters: (1) a high-speed circular saw, (2) reciprocating blades, and (3) a trigger air shear.

The prototype was tested by four Forest Service nurseries in the Northwest for comments and review. All nurseries were pleased with the concept and would like to see development continue. Modifications will be made and production testing should begin this winter.