# FOREST SERVICE
# EQUIPMENT DEVELOPMENT REFORESTATION PROGRAM

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ABSTRACT: This paper briefly covers current projects in the reforestation program at Missoula Equipment Development Center (MEDC) and San Dimas Equipment Development Center (SDEDC) which includes; the Cull Seedling Grinder, Nursery Equipment Investigation, Precision Seeder, Spot Site Preparation Equipment, Wildland Cone Harvesting Equipment, Intermittent Tree Planters, Low-Energy Cone Drying Kiln, and Seedbed Thinning Equipment.

## INTRODUCTION

MEDC is one of two Development Centers in the Forest Service. The following is a brief overview of current reforestation projects at MEDC and SDEDC.

## CULL SEEDLING GRINDER

Forest nurseries have the problem of disposing of cull seedlings. Most current disposal methods are expensive because of handling, and are wasteful because the seedlings' organic matter is not recycled. To remedy the situation, MEDC was asked to make available a grinding system that could efficiently reduce wet, muddy cull seedlings to segments less than 1-inch (2.54-cm) long. In 1980, a market search was conducted to determine what equipment is available.

In 1981, testing was begun by experimenting with a medium-size (35-horsepower) (26 kw) ginder. It soon became apparent that more horsepower was needed to properly prepare the seedlings for the nurserybed. In 1982, modifications were made to the grinding system to improve the grinding action. The testing of a larger (120-horsepower) (90 kw) grinder was begun at a second Forest Service nursery. Testing and additional modifications were made in 1982. All testing was completed in 1983.

In 1984, the results of the 3-year testing program will be written up for an article in Tree Planters' Notes, and also presented at selected nursery association meetings. It appears that when all modifications are incorporated into the seedling grinding system, nursery managers will have the techniques needed to use cull material to upgrade economically the organic content of their nursery soils. This will save both the cost of buying soil amendments and cull seedling disposal costs.

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## NURSERY EQUIPMENT INVESTIGATION

Under this project MEDC will investigate the reported need to improve equipment for three nursery operations:

(1) Seedling Lifter - Although several mechanical seedling lifters are commercially available, most nursery managers still prefer to lift manually. For various reasons, they do not trust their crop to the available machines. But, they do recognize that mechanical lifting must be improved and implemented.

(2) Root Pruner - Vertical and horizontal pruning of seedling roots in the nurserybed has been done to some degree by most nursery managers for many years. Recent experience suggests that the practice should be expanded, but more control and precision is sought. Nursery managers want improved root-pruning equipment that will give them the quality results they need.

(3) Transplanter - Field foresters are finding that transplanted seedlings can often survive on harsh sites where regular nursery stock cannot. Transplanting seedlings at the nursery can improve the root-shoot ratio, size, and vigor of a seedling. Northwest nursery managers have recently stated that old transplant equipment currently used is not suitable because of changing requirements and costs. New, improved nursery transplant equipment is needed.

## PRECISION SEEDER

As forest nursery personnel attempt to produce large and more vigorous and uniform seedlings, more precision and uniformity is required in every phase of their operation. Perhaps the step that requires the most precision is sowing the seed. Uniformly spaced seed in the nurserybed helps determine the quality of subsequent cultural practices. A recent survey of northwest forest nurseries revealed that the need for a precision seeder is high on the equipment improvement list.

In 1983, the MEDC was funded to investigate the requirements for a precision seeder and to determine how current seeders rank in regard to those requirements.

## SPOT SITE PREPARATION EQUIPMENT

In 1976, MEDC conducted a survey to identify Timber Management equipment needs. The lack of equipment for removing competing vegetation from selected spots on steep slopes ranked as one of the top five problems. Accomplishing spot site preparation on steep slopes has become a serious problem because aerial logging methods have made it more feasible to work on such slopes. Also, land managers are increasingly concerned about compaction caused by the heavy ground equipment used for site preparation. The goal is to make available the equipment Timber Management personnel need to do spot site preparation on steep slopes.

In 1980, a selected group of Forest Service Timber Management personnel met to define the problem and set development criteria. MEDC was assigned the task of improving or developing spot site preparation equipment in five categories: (1) cable yarder operated, (2) dozer mounted, (3) handtools, (4) thermal, and (5) chemical. A market and literature search was conducted to determine the availability of equipment that could be used in the five categories; typical problem areas were visited to verify development criteria. To begin the development effort, a contract was awarded for the construction of a lightweight, truck-mounted cable yarder.

In 1981, the yarder was delivered and two cable operated scarification implements were built and tested. Also, three dozer-mounted implements were designed and tested. In 1982 and 1983, two additional cable-operated implements were designed, built, and testing was begun. Site preparation hand tools were sent to six Regions for testing. Also, front- and rear-mounted scalpers for crawler tractors were built and tested.

In 1984 final work on cable-operated implements will be done. After testing and final modification, drawings and specifications for the construction of cable-operated implements will be completed.

## WILDLAND CONE HARVESTING EQUIPMENT

To meet expandinq reforestation programs, new equipment and techniques are needed. One of the greatest needs is to provide seed that is adapted to the sites to be reforested. To provide the greatest compatibility between seed stock and site conditions, harvesting cones in wildlands is often the only alternative. Rough terrain, thick underbrush, steep slopes, and the widely dispersed and hard-to-reach nature of the cone crop make wildland cone harvesting difficult. The goal is to develop safe, efficient methods of harvesting cones in wildlands and report these methods to field reforestation personnel.

MEDC personnel met with an ad hoc committee representing reforestation experts from various Forest Service units. The committee laid out the project goals and prepared a development schedule. The first major effort in the project was to mount a tree shaker on a crawler tractor. The unit was successfully tested on the Winema National Forest, Oregon, in 1981 and 1982. This unit is designed
to work in roadless areas. A shaker with a 30-foot (9-m) telescoping boom for truck-mounted, roadside shaking, was also fabricated and tested in 1982.

The testing indicated that a truck-mounted shaker with a long reach can produce, quickly and efficiently, many bushels of cones along the roadside. In 1983, a progress report was written to describe the work done to date. Drawings were prepared for the crawler-tractor-mounted shaker. A totally new slip-on truck-mounted shaker was designed, and will be fabricated and tested before the end of 1984.

## INTERMITTENT TREE PLANTERS

Successful tree planting on National Forests, through the use of commercially produced intermittent containerized and bare-root planting machines, is the objective of this project. More uniform, higher quality, and lower cost planting are possible advantages of intermittent treeplanting machines. Also, compared to continuous furrow tree-planting machines, intermittent ones generally cause less ground disturbance (resulting in lower soil erosion potential), can require lower energy inputs, require less site preparation (resulting in further energy conservation), and provide a more natural regeneration appearance.

In a market survey, three recently developed intermittent tree planters were found that showed promise enough to warrant field evaluation. They were the Harden Spot Planter model 100, the Timberland single-row, self-powered planter, and the Timberland two-row "HODAG." The model 100 was field evaluated in 1981 and in 1982, SDEDC distributed a Project Record on the evaluation. The tests were based on a "Performance Criteria for Intermittent Tree Planter," developed by San Dimas in cooperation with the Southeastern Area, State and Private Forestry, and approved by the Forest Regeneration Committee, which is chaired by the Assistant Director of Silviculture, Timber Management Staff, Washington Office. The Harden model 100 met most of the criteria.

Following improvements made by the manufacturer to overcome deficiencies, the model 100 was reevaluated in 1982. Also in 1982, both of the Timberland machines were field evaluated and reports on the evaluations were completed. In 1983, the Timberland two-row HODAG and a Marden model 200 tree planter were field evaluated. The model 200 is similar to the 100 but has a self-contained power system.

Based on preliminary information, the Forest Service to date has purchased two HODAG's and three model 100's. Also under this project, SDEDC continues to support the North Carolina State University intermittent tree-planter development program.

## IOW-ENERGY CONE-DRYING KILN

Several years ago, MEDC personnel conducted an investigation of nursery equipment needs for processing small seedlots. One of the problems was the lack of an energy-efficient, versatile, cone-drying kiln. Because most nurseries were built when energy was cheap and seedlot size was large, oil- or gas-fired drying kilns were built for large-scale drying. In recent years, the trend has been to smaller seedlots, and fuel costs have soared. The old kilns are expensive to operate and inefficient. The goal is to make available a low-energy kiln to dry cones for small seedlots.

MEDC worked with the National Tree Seed Laboratory at Macon, Georgia, to determine the exact costs involved in drying cones at more than 20 seed extractories throughout the country. The survey has been completed and data analyzed. The results show that no one kiln design can meet the requirements of all U.S. seed processors. Instead, what is needed are design criteria for building a kiln that will meet requirements based on both tree species and meteorological conditions at each particular site.

A report will be written to complete the project. The document will serve as a guide to those designing and fabricating cone-drying kilns. By using the information, the builder can incorporate state-of-the-art data to minimize construction costs and, in many instances, substantially reduce operating expenses.

## SEEDBED THINNING EQUIPMENT

Field personnel involved in reforestation work are asking for larger diameter tree seedlings with better developed root systems. This requires less dense growing conditions in the seedbed. Incorrect germination data or higher-than-expected survival, can cause seedling density to be too high. By thinning, density is controlled and uniform spacing is achieved. But most thinning is done by hand, which is expensive. The goal is to make available to nursery managers equipment that will enable them to thin seedbeds effectively and economically.

MEDC engineers consulted nursery managers to determine requirements for seedbed thinning equipment. A market search revealed several commercially available thinners that potentially could be modified to thin seedling beds. A commercially available beet thinner was purchased, and tested in 1980. Testing and additional modifications were made in 1981. The results showed that the tractor-mounted thinner can substantially reduce thinning costs. However, it cannot be used under all conditions or on all tree species.

While testing the mechanical thinner, nursery managers suggested that a hand-operated thinner be tested. A prototype was fabricated and testing began. Testing and modification of both systems continued into 1982. Because the hand-operated thinner performed so well, Forest Service nursery managers recommended that no further work be done on the mechanical thinner. Thus, MEDC attention focused on the hand thinner. A production study was conducted at a Forest Service nursery that showed the hand-operated thinner cut costs (as compared to hand thinning) by 8 to 1.

Ten improved hand-operated thinners were built at MEDC in 1983. They were sent to Forest Service nurseries for summer work. This implementation effort and the preparation of construction drawings and specifications will complete the project.