

# NURSERY PROJECTS AT THE MISSOULA TECHNOLOGY AND DEVELOPMENT CENTER

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## Abstract

The USDA Forest Service Missoula Technology and Development Center provides technical expertise, new equipment prototypes, and technology transfer services to Federal, State, and cooperator forest tree seedling nursery managers. Some recently completed or current projects at MTDC involve: a seedling temperature monitor, a shielded herbicide sprayer, hardwood cuttings preparation equipment, equipment to replace the copper coating on used styroblocks, equipment to sterilize styroblocks, an improved bench root pruner, a nursery soil sterilizer, study of animal damage to seedlings and repellents to prevent damage, snow-making equipment to protect overwintering seedlings, and a whitebark pine seed scarifier to improve germination.

## Key Words

Seedling temperature, Roundup, herbicide, soil pathogens, nursery equipment, whitebark pine, sterilizing equipment

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## INTRODUCTION

The Missoula Technology and Development Center (MTDC) is one of two technology and development centers that serve the USDA Forest Service by helping to solve problems identified by field employees. For over 50 years, MTDC has been evaluating existing technology and equipment, developing equipment prototypes, and conducting technology transfer through its reports, web sites, and videos.

The main focus of the nurseries program is to develop new equipment or technology to improve nursery operations and processes. The program is sponsored and funded by the Forest and Rangeland Staff group at the Washington Office, and by the State and Private Forestry, Reforestation, Nurseries, and Genetic Resources group.

Projects originate from ideas or concepts from field personnel. A national steering committee reviews the project proposals that typically come from employees at the Forest Service Federal nurseries, and from State and Private cooperators. The steering committee selects the highest priority projects for MTDC to work on.

Projects typically last from 2 to 3 years depending on the complexity of the project. Equipment-based

projects are field tested and fabrication drawings are made so the equipment can be duplicated by other nurseries. Results are usually formally documented and available from MTDC.

A complete listing of nursery projects completed over the years is available electronically to Forest Service and BLM employees at MTDC's intranet site, <http://fsweb.mtdc.wo.fs.fed.us/programs/ref>. The list is also included in the printed report, *Reforestation & Nurseries*, (0224-2805-MTDC), available on request by calling 406.329.3978.

This presentation will describe current nursery projects at MTDC that may be of interest to you.

## SEEDLING TEMPERATURE MONITOR

The objective of this project was to measure and record tree seedling storage and transportation temperatures to determine if and when the seedlings were exposed to harmful conditions. MTDC engineers found a commercially available product, the Thermochron *iButton*, manufactured by Dallas Semiconductor Corp., that met this need.

The Thermochron *iButton* (fig. 1) is a small device about the size of 2 stacked dimes. It records time and



Figure 1. The ThermoChron iButton, the size of 2 stacked dimes, measures time and temperatures of seedling bundles while they in storage or being transported.

temperature. It can be programmed to log at specific time intervals, for example 5 minutes or 1 hour, and to record the temperature at the end of that time period. The information is downloadable to a computer using a special adapter and cable, and the data can be easily graphed with time on the X-axis and temperature on the Y-axis. This display readily shows whether the seedlings were subjected to extreme temperatures and, if so, when.

The ThermoChron iButton has an internal battery that does not need recharging, and can last for up to 10 years or 1 million temperature measurements. The device is inexpensive, about \$10 per button. A starter kit that includes an iButton, computer cable, and adapter costs about \$25.

For more information, view the iButton web site at <http://www.ibutton.com>, or request a copy of *Monitoring the Temperature of Tree Seedlings with the ThermoChron iButton Data Logger* (0024-2311-MTDC). Andy Trent is the project leader.

### SHIELDED HERBICIDE SPRAYER

One of the challenges in hardwood nursery beds is killing the weeds that grow between the crop rows. Chemicals such as Roundup kill the weeds, but also kill the seedlings if the spray is misdirected. Several nurseries have made their own shielded sprayers to prevent herbicides from being applied to the hardwood seedlings. MTDC was asked to review this existing equipment, select the best features, and incorporate those features into a new prototype model.

Project leader Keith Windell worked with machinery developed by several Southern nurseries. He developed a prototype spraying system, had it fabricated, and field tested it in May 2002.

The MTDC prototype sprayer is mounted on a three-point hitch (fig. 2). It is a fully contained system with up to nine nozzles. The shields are adjustable, and the sprayer can be steered for perfect alignment as it is pulled down the rows. The spray pump is run off the tractor's power take off and is calibrated before spraying.

Field testing was done at the Virginia Department of Forestry's New Kent and Augusta nurseries. Two

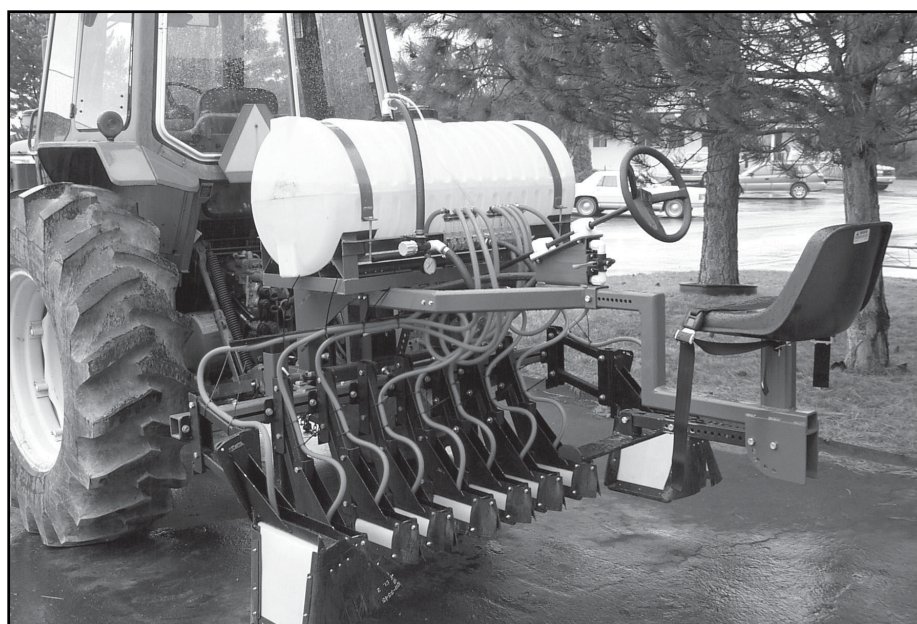


Figure 2. This new shielded herbicide sprayer applies Roundup between rows of hardwood seedling crops in nurseries.

deficiencies became evident. Steering was awkward because the steering wheel, support, and gear box blocked the view of the shields and the crop rows. This made it hard to see where to steer. The second problem was that, in soft soils, the shields tended to dig rather than float on the surface as intended. MTDC will make some modifications to the sprayer unit and retest it in 2003.

## **HARDWOOD CUTTINGS PREPARATION EQUIPMENT**

Several years ago MTDC developed a machine to plant hardwood cuttings into nursery beds. The new project is to develop equipment to prepare the cuttings before planting. The current practice at many nurseries is to cut long whips from stumps, then use table saws to cut the whips into 6- to 8-inch (15- to 20-cm) cuttings. This work is time consuming and raises safety concerns because of the close proximity of the operator's hands to the saw.

Project leader Gary Kees has completed a prototype saw that should make the job of preparing the cuttings easier and safer. The electric miter saw has a brake that stops the blade once the cut is made and a foot-operated clamp that holds a bundle of whips as they are cut. The saw will be tested at the Bessey Nursery in Halsey, Nebraska, early in 2003.

## **COPPER TREATMENT FOR STYROFOAM BLOCKS**

Copper-coated styroblocs are becoming the containers of choice for some nurseries as the benefits of these blocks become better understood. These benefits include ease of seedling extraction, reduced root spiraling, improved seedling development, and longer usable container life.

Copper-coated styroblocs can be purchased from styrobloc manufacturers, but the coating wears off after about two growing cycles. MTDC was asked to look at methods and equipment to recoat the blocks with the copper treatment, assuming it is feasible to do so. Project leader Wes Throop is just beginning the project.

## **STYROFOAM BLOCK STERILIZER**

MTDC is looking at methods and equipment to sterilize styroblocs before filling them with media and sowing seeds. Certain pathogens like *Pythium* and *Fusarium* remain in the residual soil and in some roots that may remain after the seedlings have been extracted.

Many nurseries dip their used blocks into vats of hot water (160 °F to 180 °F [71 °C to 82 °C]) and hold them there for at least 2 minutes. This method works, but is very slow and labor intensive. A typical nursery can dip only about 25 to 30 blocks at a time, but must sterilize thousands of blocks each year.

MTDC has been looking at alternative methods of sterilization. We first looked at infrared heat, but we could not provide enough heat to the inner cavities without melting the tops of the blocks.

Next, we looked at using microwave or radio frequency waves, using a large radio frequency oven made for drying. MTDC tested several styroblocs at various exposure durations and found that the oven was effective at reducing pathogen levels to acceptable levels, but the equipment costs were excessive.

We are now evaluating whether using dry heat, like that in a sauna, will effectively sterilize the blocks. The concept is that a large room could be constructed where pallet loads of blocks could be treated at one time. The blocks could be left in the oven for a specific period of time, perhaps 1 or 2 hours, and then removed. Preliminary testing indicates that the styroblocs must be wetted or sprayed down before heating. Further work is planned within the next year. Andy Trent is the project leader.

## **ROOT PRUNER**

In Western nurseries, roots are pruned before seedlings are stored. Pruning is typically done with a blade mounted like a large paper cutter. This method is slow, repetitive, and subjects workers to the risk of finger lacerations.

MTDC has developed a new root pruning system that incorporates a commercially available rotary cutting head (fig. 3) to prune the roots. The device uses large

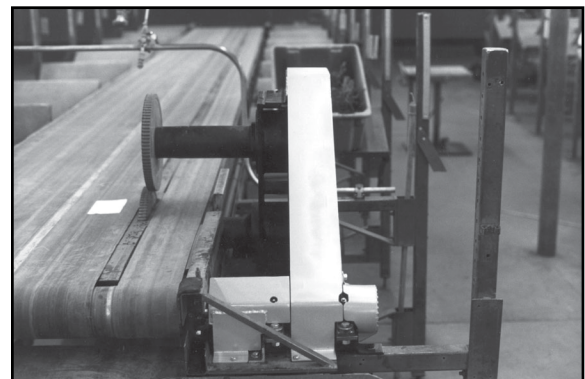


Figure 3. This root pruner cutting head trims roots to length in the packing operation better than the paper-cutter type of equipment currently being used.



12-inch (30.5 cm) counter rotating gears that are mounted flush with the sorting table to draw in and shear the roots. It stays sharp for a long time, and the gears can be reground and remounted when necessary. The cutting head has been tested and proven to effectively prune roots without ripping the roots, jamming, or bogging down.

Initial testing was done at the J Herbert Stone and Coeur d'Alene nurseries. Although the system cut the roots very well, overall production was slowed down because of the additional time it took for workers to align the seedlings on the conveyer. MTDC is working with the nurseries to use the pruner as a stand-alone unit at the end of the sorting table. This will allow the workers to concentrate on sorting without having to align the seedlings for pruning. Wes Throop is project leader.

### **NURSERY SOIL STERILIZATION**

Methyl bromide has been the preferred method at most nurseries for fumigating soil to combat soil pathogens. However, methyl bromide has been found to be environmentally harmful and its use will be banned or severely curtailed. MTDC was asked to look at alternatives to chemical fumigation for tree seedling nurseries.

Looking at an older technology still used in Europe, MTDC built a prototype steam treatment machine for treating nursery beds. If soil is heated to at least 160 °F (71 °C) for 20 minutes, tree seedling pathogens are killed, while desirable microorganisms survive. MTDC's steamer featured a 1-million BTU (293 kw) boiler that has been outfitted to inject steam into the soil at about 8 inches (20 cm) deep (fig. 4). Field



Figure 4. MTDC developed this prototype machine to inject steam into nursery beds, sterilizing the soil as an alternative to using pesticides. It proved to be too slow for production use.

testing of the steamer concluded that it effectively controlled the pathogens, but the prototype machine was too slow for field production use. Test results are documented in *Nursery Soil Steam Fumigation* (9724-2833-MTDC), available from MTDC.

As another alternative, we are evaluating infrared heat for sterilizing the soil. In theory, infrared or radiant burners should be much more efficient in heating the soil than steam. The idea is to lift soil from the soil bed onto a conveyor belt where infrared burners mounted 12 inches (30.5 cm) above the conveyor will heat the soil. Project leader Andy Trent is conducting preliminary tests to determine if this concept warrants full field testing.

### **ANIMAL DAMAGE/REPELLENTS**

MTDC has an ongoing cooperative agreement with Dr Dale Nolte, USDA Animal and Plant Health Inspection Service (APHIS), that offers technology transfer of important animal pest control research. Together, MTDC and APHIS have been: 1) testing commercial repellents and barriers on animals confined in pens. *Comparison of Commercial Deer Repellents* (0124-2331-MTDC) documents the results; 2) developing equipment and conducting studies to reduce pocket gopher populations in reforested areas; 3) developing a comprehensive manual on animal damage management practices that will be published in 2003; and 4) providing information to national forests on bear foraging behavior and management practices.

### **MAKING SNOW TO PROTECT OVERWINTERING SEEDLINGS**

Artificially made snow can help protect nursery seedlings from extremely cold temperatures in northern climates when there is little natural snowfall. MTDC was asked to develop a snow-making machine that is portable, needs little maintenance, and is inexpensive.

Itasca Greenhouses in Cohasset, Minnesota, reported using a commercial snow maker called the Back Yard Blizzard to make snow for seedling protection. It is a small unit costing around US\$ 2000 that works well but does not provide enough coverage for the needs of most nurseries.

As an alternative, MTDC developed a prototype snow gun that provides four times as much snow as the Back Yard Blizzard. All parts of the prototype snow maker are commercially available and cost a total of about US\$ 300. They are simple to assemble and operate. Project leader Andy Trent plans to test

this prototype in the winter of 2002-2003 with Itasca Greenhouses. This machine does require an industrial air compressor, but these compressors are readily available at rental stores.

### **WHITEBARK PINE SEED SCARIFIER**

Whitebark pine is being planted for restoration projects because its seeds are an important food source for grizzly bears. Scarifying the seed coat increases germination dramatically at the nursery, from about 1% to 2% natural germination, to more than 60% germination if there is a 1-mm cut in the seed coat. Currently, each seed is being cut manually with an Exacto knife, a tedious process that presents its own set of safety concerns.

MTDC has developed an instrument that may replace the Exacto knife operation. The instrument uses a rotary-head cutting tool to make a 1-mm cut through the seedcoat (fig. 5). Laser sensors adjust the cutting tool for the size of the seed. Germination tests using seeds cut by the tool were conducted at the Coeur d'Alene Nursery during the spring of 2002. Andy Trent is project leader.



*Figure 5. Several whitebark pine seeds that were cut using the whitebark pine seed scarifier.*

### **CONTACTS FOR MORE INFORMATION**

Many nursery drawings done by MTDC are available electronically at the Reforestation, Nursery, and Genetic Resources web site:

<http://www.rngr.fs.fed.us>

Most drawings and reports done by MTDC are available to Forest Service and BLM employees at the FSWeb intranet site:

<http://fsweb.mtdc.wo.fs.fed.us>

Paper copies of MTDC's reports and drawings are available from:

USDA Forest Service, MTDC

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