

Selected Nursery Projects at the Missoula Technology and Development Center

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Abstract: The USDA Forest Service Missoula Technology and Development Center (MTDC) offers technical expertise, technology transfer, and new equipment development to federal, state, and private forest nurseries. Current and recently completed projects at MTDC include a container block steam sterilizer, shielded herbicide sprayer, time-domain reflectometry (TDR) nursery soil moisture meter, modified brushes for the Woodward Flail-Vac Seed Stripper, greenhouse top mower, and several other projects in progress. MTDC has its reports and fabrication drawings available for viewing at <http://www.fs.fed.us/eng/t-d.php>

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Introduction

USDA Forest Service Missoula (MTDC) and San Dimas (SDTDC) Technology and Development Centers help solve problems identified by field employees of the USDA Forest Service. The reforestation and nurseries program is located at MTDC in Missoula, Montana. The principle 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 Management staff group at the Washington Office, and through State and Private Forestry.

We have about 15 reforestation and nurseries projects going on at any one time. Our website provides additional information about all the projects and fabrication drawings we've worked on for nearly 60 years.

Styrofoam™ Block Sterilizer

MTDC has developed a method and equipment to sterilize used Styrofoam™ containers before filling them with media and sowing seeds. Certain pathogens, like *Pythium* spp. and *Fusarium* spp., remain in the residual soil and in some roots that may remain after the seedlings have been extracted from the blocks.

Many nurseries dip their used blocks into hot vats of water (160 to 180 °F [71 to 82 °C]) and hold them there for at least 2 minutes. This method works, but is slow and labor intensive.

Project Leader Andy Trent evaluated steam heat, like that in a sauna, and found that it will effectively sterilize 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 steam room for a specific period of time and then removed.

Andy first tested individual blocks in an oven, then moved up to installing a sauna heater in an insulated storage van. Both of these tests validated the concept of using steam heat to sterilize Styrofoam™ containers, so we applied it at an operational level.

We procured a boiler and steam distribution system and built an operational production-sized system at USDA Forest Service Lucky Peak Nursery in Boise, Idaho. The room is a 24 by 47 by 10 ft (7.3 by 14.3 by 3 m) converted cooler that holds up to 4,000 blocks. A propane boiler (fig. 1) produces steam for the room at 160 °F (71 °C). Steam is injected into the room through a 1-in (2.6-cm) black pipe with 1/16-in (0.16-cm) holes every 6 in (15 cm). Estimated labor is about 4 hours for one person using a forklift to load and unload the room, a large reduction in time over dipping the blocks in hot water. After 6 hours at 160 °F (71 °C), tests showed that *Fusarium* spp. levels were reduced from 90% to 5%. Eighty percent of the blocks had no fungal growth after treatment. Cost to heat the room was about U.S. \$3.00 per hour, and total installation cost was



Figure 1—This propane boiler supplies 160 °F (71 °C) steam to a 24 by 47 by 10 ft (7.3 by 14.3 by 3 m) room used to sterilize used Styrofoam™ containers.

about U.S. \$24,000. Lucky Peak Nursery also found other uses for the steamroom, including sterilizing used seed trays and mulch fabric, and drying and opening cones.

A boiler suitable for producing steam can be sized to whatever room is available. For example, a sauna heater was adequate for the two-pallet test room, while a larger boiler was needed for the large room at Lucky Peak.

MTDC has documented the successful results in *Using a Steamroom to Sterilize Pallets of Styrofoam Seedling Container Blocks* (0524-2808-MTDC), by Andy Trent, Robert James, Clark Fleege, and Gary Hileman. The report is available in paper copy, or electronically from our website. In addition, Andy reported these findings at the 2006 Western Forest and Conservation Nursery Association meeting. See these proceedings for his report (Trent and others 2007).

Shielded Herbicide Sprayer

Weeds are a problem in hardwood nursery beds. Herbicides such as glyphosate kill the weeds, but also kill seedlings if the spray is misdirected. Several nurseries have fabricated shielded sprayers to prevent herbicides from being applied to the hardwood seedlings. MTDC reviewed this existing equipment, selected the best features, and incorporated those features into a new prototype model.

The MTDC sprayer is mounted on a three-point tractor 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.

Project leader Keith Windell developed a prototype spraying system, had it fabricated, and field tested it in May 2002 and again in 2004 after MTDC modified the sprayer following the initial tests. Field testing was done at the Virginia Department of Forestry's New Kent and Augusta nurseries. The Virginia nurseries retested the sprayer and found that it works well.

Shielded Herbicide Sprayer for Hardwood Nursery Seedling Beds (0624-2827-MTDC) documents the project and is only available in electronic form at <http://www.fs.fed.us/eng/t-d.php>. In the report, Keith documented some of the other designs he found, including an Egedal sprayer that also worked well. MTDC also has construction drawings available for the improved prototype and some of the other models we examined available upon request

Time-Domain Reflectometry (TDR) Nursery Soil Moisture Meter

Recognizing the need for fast, accurate soil moisture readings, MTDC was asked to evaluate portable electronic moisture measuring devices to see if such instruments were an alternative to the weigh-and-bake method many nurseries use. The idea was to use time-domain reflectometry (TDR) moisture measurement for portability and quick response.



Figure 2—MTDC's improved shielded herbicide sprayer was evaluated in Virginia.

Other goals were to provide data logging and transfer of field measurements into permanent electronic storage, and to use a personal digital assistant as a compact computing and data-logging platform.

Over the course of 2 years, Project Leader Ted Etter is now in the final testing phase of a system that seems promising. The major components are the Campbell Scientific TDR moisture probe (model CSI-616), an HP hx2190 Personal Digital Assistant for data conversion and logging, and a TDR Interface from SGT Engineering (fig. 3).

The TDR probe signals are converted into volumetric moisture content readings. Factors that influence correlation between the probe signal period and soil moisture include soil composition, soil conductivity, soil moisture, and soil bulk density. The system contains regression software for generating conversion formulas for specific soils and field conditions.

Ted plans to have four operational units out for field testing in 2006. Feedback so far indicates the TDR probes are accurate and user-friendly. He will document the results of the project in 2006 or 2007, depending on additional testing needs.

Modified Brushes for the Woodward Flail-Vac Seed Stripper

Lucky Peak Nursery manager, Clark Fleege, asked MTDC to develop and test a prototype mechanical forbs seed harvester at Lucky Peak Nursery. Too many seeds were lost

using their Woodward Flail-Vac Seed Stripper. Instead of developing a new machine, Project Leader Gary Kees developed four different brush configurations to try on the Woodward Flail-Vac. The replacement brushes cost about U.S. \$310 per set, plus the cost of core fabrication, and have stiffer brushes with convoluted or wavy wafers (fig. 4). In limited testing at Lucky Peak on wild geranium (*Geranium maculatum*) and Arizona fescue (*Festuca arizonica*), the new brushes collected significantly more seeds than the original brushes. Detailed documentation was published in *Native*



Figure 3—Components of the TDR nursery soil moisture meter.



Figure 4—Stiff bristles with convoluted wafers worked better than the factory brushes to collect small forbs seeds on this Woodward Flail-Vac Seed Stripper.

Plants Journal (Kees 2006). Fabrication plans for the core can be obtained from MTDC.

Greenhouse Top Mower _____

Project Leader Keith Windell is working on a portable pruner or mower to cut the tops of fast-growing greenhouse crops at Lucky Peak Nursery. The system will also collect the clippings with a vacuum or sweeping device. The Lanz top pruner shows some promise, but may be too large and cumbersome for the greenhouse at Lucky Peak. Keith is now looking at some simple and lightweight methods.

Collecting Dormant Hardwood Cuttings _____

Tara Luna, Kas Dumroese, and Tom Landis have written a how-to guide for volunteers and non-botanists that describes the selection, preparation, and care of dormant hardwood cuttings intended for restoration projects. Red-osier dogwood (*Cornus sericea*), willow (*Salix* spp.), and cottonwood

(*Populus* spp.) are the featured species. The report is available from MTDC in electronic and paper copy (Luna and others 2006).

Source of Pollination Bags _____

MTDC was asked to find suppliers of isolation bags because some of the old suppliers had gone out of business. We were able to locate 2 sources of quality bags: Orchard Wholesale Bags in British Columbia, whose bags cost US\$ 0.69 each; and PBS International Bags from the United Kingdom. Their bags cost U.S. \$3.55 each. A final report with contact information for these companies is on the MTDC website.

For More Information _____

A complete listing of the nurseries projects completed over many years is available electronically to Forest Service and BLM employees at MTDC intranet site, <http://fsweb.mtdc.wo.fs.fed.us/programs/ref/>. Drawings and reports that are available in electronic form are available to the public at <http://www.fs.fed.us/eng/t-d.php>.

Paper copies of MTDC reports and drawings are available from:

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