

What's New With Nurseries and Reforestation Projects at the Missoula Technology and Development Center

Brian Vachowski

Brian Vachowski is Program Leader for Nurseries, Reforestation, and Range at the Missoula Technology and Development Center (MTDC), 5785 Highway 10 West, Missoula, MT 59808; telephone: 406.329.3935; e-mail: bvachowski@fs.fed.us

In: Riley, L. E.; Dumroese, R. K.; Landis, T. D., tech. coords. 2006. National Proceedings: Forest and Conservation Nursery Associations—2005. Proc. RMRS-P-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 160 p. Available at: <http://www.rngr.net/nurseries/publications/proceedings>

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 nursery soil moisture meter, remote data collection systems, low cost weather stations, electronic soil penetrometers, reforestation toolbox Web site, shielded herbicide sprayer, synthetic fabrics to wrap seedlings, Styroblock™ sterilizer, whitebark pine seed scarifier, improved forbs seed harvester brushes, economic fencing to exclude wildlife from sensitive areas, and a cuttings preparation saw.

Keywords: nursery equipment, whitebark pine, sterilizing equipment, soil compaction, herbicide, electric fencing

Introduction

Missoula (MTDC) and San Dimas (SDTDC) Technology and Development Centers help solve problems identified by field employees of the USDA Forest Service. For 60 years, MTDC and SDTDC have been evaluating existing technology and equipment, developing equipment prototypes, and conducting technology transfer through their reports, Web sites, videos, and DVDs.

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 USDA Forest Service Forest Management staff group at the Washington Office and through State and Private Forestry.

Our focus is on applied technology and technology transfer. We do not conduct research, but sometimes we apply research findings to help solve on-the-ground problems.

Projects typically last from 2 to 4 years depending on their complexity. Equipment-based projects are field tested and fabrication drawings are made so the equipment can be duplicated by other nurseries. We document our projects through printed reports or journal articles that are available from MTDC. You can find our drawings and reports on our Web site: <http://www.fs.fed.us/eng/t-d.php>

Following are some current nursery projects that may be of interest to you.

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 oven-drying method many nurseries use. Project Leader Ted Etter found that the Campbell Scientific TDR (time domain reflectometry) probe, model CSI-616, looked the most promising.

A formula converts electronic TDR signals to volumetric soil moisture content. However, Ted thinks that the “one size fits all” formula is not accurate enough for nursery work. He is looking into the feasibility of developing more accurate formulas customized to reflect soil characteristics at individual nurseries. We have lab tested the probes to determine the effects of soil variables on the TDR readings. Ted is currently validating the formulas he has developed with field tests at several nurseries

in the Northwest. Until he completes these evaluations, the jury is still out as to whether these instruments will be accurate enough or user-friendly enough to replace the current soil bake-and-weigh method.

Remote Data Collection Systems

Project Leader Gary Kees is evaluating remote sensors that can be monitored via satellite that will tell silviculturists when distant sites are ready for planting (figure 1). We have purchased three AXTracker satellite systems and the necessary ground probes. The AXTracker is a satellite transmitter originally developed to track vehicles, remote facility alarms, broken pipelines, and so on. MTDC set out remote sensors to determine when sites are ready for planting. Sensors were placed at ground level and just below ground level at a remote planting site on the Boise National Forest. We were able to tell when the snow had melted by

observing the sensor temperatures on a Web site. Project Leader Gary Kees estimates a cost of about U.S. \$1,000 to monitor a site, including the cost of the AXTracker and sensors (Kees and Trent 2005).

Low-Cost Weather Stations

Measuring weather at project locations is of interest to researchers, incident managers, and to anyone who needs to keep track of site-specific weather conditions. MTDC is evaluating low-cost weather instruments that have data logger capabilities. We purchased three different systems for U.S. \$800 to U.S. \$1300 and evaluated them. Project Leader Gary Kees believes that these less expensive systems are good alternatives in specific applications to the more sophisticated RAWS weather stations that cost closer to U.S. \$15,000. It may also be possible to tie these weather stations into the AXTracker satellite system in order to monitor the readings remotely. A report should be completed in 2005 documenting the findings.



Figure 1—AXTracker satellite transmitters can be used to monitor remote conditions such as temperature, facility intrusions, or track vehicles if coupled with GPS.

Soil Compaction Tester

MTDC evaluated three electronic soil penetrometers (Rimik CP-40, Field Scout SC90, Eijkelkamp Penetrologer) on the Shasta-Trinity and Boise National Forests. This new generation of electronic penetrometers shows promise for many forestry soil applications as measured by soil strength. The penetrometers gave inconsistent results for tree contract inspections and are not recommended for that purpose. The electronic penetrometers give consistent results for measuring soil compaction in other situations, are easy to use, and collect data that can be stored for later downloading and use. The cost for the penetrometers we tested ranged from U.S. \$1,500 to U.S. \$5,200. We also tested a mechanical Compacto-Gage to see how it compared with the electronic instruments. Project Leader Gary Kees plans to document his findings and the availability of this new generation of soil penetrometers in 2005.

Shielded Herbicide Sprayer

Weeds are difficult to control in hardwood nursery beds. Chemicals such as Roundup™ kill the weeds, but also kill

the 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.

Project leader Keith Windell developed a prototype spraying system, had it fabricated, and field tested it in May 2002. The MTDC prototype sprayer is mounted on a 3-point tractor hitch. 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 New Kent and Augusta Nurseries. Some deficiencies became evident. MTDC modified the sprayer to correct the problems by redesigning the steering, adding height gauge wheels, and adding a more precise hood width adjustment (figure 2). The Virginia nurseries retested the sprayer and found that it works well. MTDC has construction drawings, available upon request, for the improved prototype, and plans to document the findings in 2005.



Figure 2—An improved shielded herbicide sprayer, developed by MTDC, was evaluated in Virginia.

Seedling Wrap

Jelly-rolling bareroot seedlings in wet burlap is a traditional way to protect and carry seedlings in planting bags just prior to planting. Over the past several years, many National Forests have used a synthetic fabric, Kimtex[®], as an alternative to burlap. Kimtex[®] is no longer available in the sizes needed for tree wrapping, so we were asked to find another fabric that would work.

The Bitterroot and Idaho Panhandle National Forests evaluated several synthetic fabrics in 2004. DuPont Sontara[™] absorbent fabric worked the best, and MTDC located a supplier, American Supply Corporation, that agreed to custom cut the fabric into 22-in (56-cm) wide rolls, 200-yd (183-m) long, for tree wrapping applications (Vachowski 2005).

Container Sterilizer

MTDC has looked at methods and equipment to sterilize used Styroblock[™] containers before filling them with medium 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 Styroblock[™] containers.

Currently, many nurseries dip their used containers into hot vats of water (160 to 180 °F [71 to 82 °C]) and hold them there for 1 to 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 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 and then removed. We procured a boiler and steam distribution system and built an operational production-sized system at USDA Forest Service Lucky Peak Nursery. The room is a 24-ft by 47-ft by 10-ft high (7.3-m by 14.3-m by 3-m high) converted cooler that holds up to 4,000 Styroblock[™] containers. A propane boiler (figure 3) produces steam for the room at 160 °F (71 °C). After 6 hours at 160 °F, tests showed that *Fusarium* spp. levels were reduced from 90 to 5 percent. 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 about U.S. \$24,000 (Trent and others 2005).

Whitebark Pine Seed Scarifier

Whitebark pine is being outplanted 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 percent natural germination to more than 60 percent 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 a machine that may replace the Exacto knife operation. Our first attempt produced a sophisticated instrument that uses a laser-guided rotary-head cutting tool to make a 1-mm cut through the seed coat. The



Figure 3— This propane boiler supplies 160 °F (71 °C) steam to a 24-ft by 47-ft by 10-ft high (7.3-m by 14.3-m by 3-m high) room used to sterilize used Styroblock[™] containers at USDA Forest Service Lucky Peak Nursery, Idaho.

prototype worked in limited testing, but was not adaptable enough to the large variability found in later seedlots.

We developed a less complex prototype, which consists of sandpaper-lined cans that rotate in an orbiting pattern. Karen Burr at the USDA Forest Service Coeur d'Alene Nursery evaluated the machine to see if it improved germination. She found that after 180 minutes of sanding, germination is similar to the results gained by individually nicking seeds by hand. Germination doubled over doing no treatment except stratification. Fabrication drawings are available from MTDC. Andy Trent is project leader.

Reforestation Toolbox

Field reforestation skills and knowledge are being lost as people retire. MTDC was asked to pull some of this knowledge together on a Web-based series of training modules for reforestation. The result is a work in progress, called the Reforestation Toolbox.

So far, Project Leader Andy Trent has developed content for four sections: planting tools, planting techniques, handling, and contract inspections. Cone collection, site preparation, field handling, and hardwoods sections are not completed. Forest Service reforestation specialists Glenda Scott and Duane Nelson are providing content for the site. Before publicizing the Web site, Andy is planning to have it peer reviewed.

Animal Management Economic Fencing

The project assigned to Project Leader Gary Kees was to look for low-cost methods for excluding wildlife from plantations, riparian areas, and aspen stands.

The systems were to be removable and reusable after 3–5 years and must stand up to wildlife and heavy snow.

The project is complete. Gary installed two types of electric fence (polyrope and high-tensile, figure 4) and one type of nonelectric polymesh fence around willow patch and aspen regeneration areas and monitored them over two winters. The polymesh fence held up well in a moose enclosure. Of the electric fences, the high-tensile electric fence held up very well in severe climatic conditions on the Continental Divide in Montana. The polyrope electric fence sagged initially, but stabilized over time and worked well once it was retightened. The fences effectively excluded moose and elk, but were not evaluated in areas of high deer concentrations. We also installed a high-tech monitoring system for the electric fences—one that transmitted signals to a satellite—so the results could be monitored on a Web site. Initially the monitoring system was not dependable, but performance

improved to the point that it is now working as the test continues (Kees 2004).

Mechanical Forbs Seed Harvester

Clark Fleege, manager of the USDA Forest Service Lucky Peak Nursery, asked MTDC to develop and test a prototype mechanical forbs seed harvester at Lucky Peak Nursery. Too many seeds were lost using their Woodland Flail Vac. Instead of developing a new machine, Project Leader Gary Kees has developed four different brush configurations to try on the Woodland Flail Vac. The replacement brushes cost about U.S. \$500 per set, and have stiffer brushes with convoluted wafers (figure 5). In limited testing at Lucky Peak on wild geranium (*Geranium maculatum*) and Arizona



Figure 4—MTDC evaluated nonelectric polymesh fence, polyrope electric fence, and high-tensile electric fence to exclude moose and elk from restoration areas.



Figure 5—Stiff bristles with convoluted wafers worked better than factory brushes to collect small forbs seeds on this Woodland Flail Vac brush harvester.

fescue (*Festuca arizonica*), the new brushes collected significantly more seeds than the original brushes.

Hardwood Cuttings Preparation Equipment

MTDC was asked to develop equipment to prepare hardwood cuttings for 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-in (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 developed a prototype saw that made 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 was tested at the Bessey Nursery in Halsey, NE, early in 2003, and drawings and a report are available from the MTDC.

For More Information

A complete listing of the nurseries projects completed over many years is available electronically to Forest Service and BLM employees at the MTDC intranet site,

<http://fsweb.mtdc.wa.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:

USDA Forest Service, MTDC
Attn: Publications
5785 Highway 10 West
Missoula, MT 59808
Phone: (406) 329-3978
Fax: (406) 329-3719

References

- Kees G. 2004. Fencing out wildlife: plastic mesh fences and electric fences monitored by satellite telemetry. Missoula (MT): USDA Forest Service, Missoula Technology and Development Center. 0424 2838. 18 p.
- Kees G, Trent A. 2005. AXTracker: an inexpensive satellite transmitter for sensing changes at remote locations. Missoula (MT): USDA Forest Service, Missoula Technology and Development Center. 0524 2802. 14 p.
- Trent A, James R, Fleege C, Hileman G. 2005. Using a steamroom to sterilize pallets of styrofoam seedling container blocks. Missoula (MT): USDA Forest Service, Missoula Technology and Development Center. 0524 2808.
- Vachowski B. 2005. Reusable toweling for wrapping tree seedlings. Missoula (MT): USDA Forest Service, Missoula Technology and Development Center. 0524 2323. 6 p.