Missoula Technology and Development Center's 1995 Nursery and Reforestation Programs

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The USDA Forest Service's Missoula Technology and Development Center (MTDC) evaluates existing technology and develops new technology to ensure that nursery and reforestation managers have appropriate equipment, materials, and techniques for accomplishing their tasks. Work underway in 1995 is described and recent publications, journal articles, and drawings are listed. Tree Planters' Notes 46(2):36-45; 1995.

The Missoula Technology and Development Center (MTDC) has provided improved equipment, techniques, and materials for Forest Service nurseries and reforestation programs for more than 20 years. The Center has worked to improve efficiency and safety in these areas, and throughout the Forest Service. The Center evaluates existing technology and equipment and develops new technology and equipment. Projects are funded by the USDA Forest Service's Washington Office Timber Management Staff. The Center's program of work in nurseries and reforestation is selected by the National Forest Regeneration Committee, which is made up of representatives from various levels of the Forest Service. The following summaries describe the Center's current projects.

Nursery Projects

Nursery technical services (project leader-Ben Lowman). This continuing project allows MTDC to provide technical services to Forest Service nurseries and to respond to requests from state agencies and private individuals. New technology is continually monitored under this project. Center personnel disseminate this information by presenting papers at professional meetings and symposiums. The Center also answers inquiries from field personnel, visits various Forest Service nurseries, and provides drawings and publications on request.

The Center personnel attended the Western Nursery Conference in Moscow, Idaho, visited the Georgia Forestry Commission to view modifications to the acorn planter, and presented a summary of MTDC work at the Great Plains Reforestation Workshop in Nebraska during fiscal year 1994.

Your nursery project proposals are welcome. They should be submitted to Ben Lowman in writing or over the DG (B.Lowman:RO1A). Write a summary that clearly states the problem and proposes your desired action. The information is used to determine priorities, to link you with others with similar problems or with solutions to your problem, or to establish a project to solve the problem with appropriate equipment or techniques.

Pollen equipment (project leader-Debbie O'Rourke). Thirty years ago the Forest Service launched an expanded tree improvement program. A network of seed orchards with genetically superior trees was created in an effort to produce top-quality seed. These trees are now in the cone-bearing stage. Protecting the genetic quality of their seed is of prime importance.

Stands of timber surrounding Federal orchards produce "inferior" pollen that can threaten the decades of work done by tree breeders to upgrade seed quality. About 40% of the tree seed now produced by these orchards is the result of fertilization by outside, "inferior" pollen. Equipment and methods to control orchard pollination are essential to the seed improvement program.

The Center has been working with orchard personnel and Forest Service Research units to develop equipment for mass collection and mass application of pollen. A vacuum collection system developed by the Center gives orchard managers a means of collecting a large supply of pollen from the crowns of designated trees in a quick and efficient manner. This pollen is cleaned and stored for future application to target trees during their receptive period.

For application, the Center has developed a modified tractor-mounted air duster that can blow the collected pollen high into the crown of orchard trees. Dry pollen application was tried first, but "blow-by" was very high. Subsequent tests used pollen in water suspension. Monitoring of the effectiveness of this method will be completed by Don Copes, USDA Forest Service, Pacific Northwest Research Station, this year.

This equipment can help protect the quality of seed and increase orchard productivity by ensuring that an

adequate amount of genetically acceptable pollen is available. Systems for both West Coast Douglas-fir and North Carolina loblolly pine have been developed. A final report, complete with drawings and specifications, is being prepared (figures 1 and 2).

Native plant seed collector (project leader– Debbie O'Rourke). As part of the Forest Service's shift into ecosystem management, land managers are paying more attention to plant diversity. Management plans focus on all plants on a site, not just the commercial tree species. Shrubs and non-commercial trees will be part of the planning package. Because of the previous emphasis on commercial tree species, little work has been devoted to the techniques and equipment necessary for collecting various native plant seeds. This project will determine the needs in this area and find equipment or methods to meet these needs.

The Center is surveying Forest Service personnel to determine what equipment is needed to adequately collect plant seed from native shrubs and non-commercial species. MTDC will also conduct a market and literature search. Results will be reported to the Forest Regeneration Committee.

People in tree tops (project leader— Tony Jasumback). For many years equipment has been needed to gain access to the tops of trees for various cultural work such as pollination, cone collection, and insect and disease surveys. Tree climbing equipment is commonly used, but it is dangerous and provides only limited access to the entire crown.

Mechanical equipment such as lifts require frequent moving to reach all sections of a tree and are limited in the heights they can reach. The Center conducted a search of new commercial technology and determined

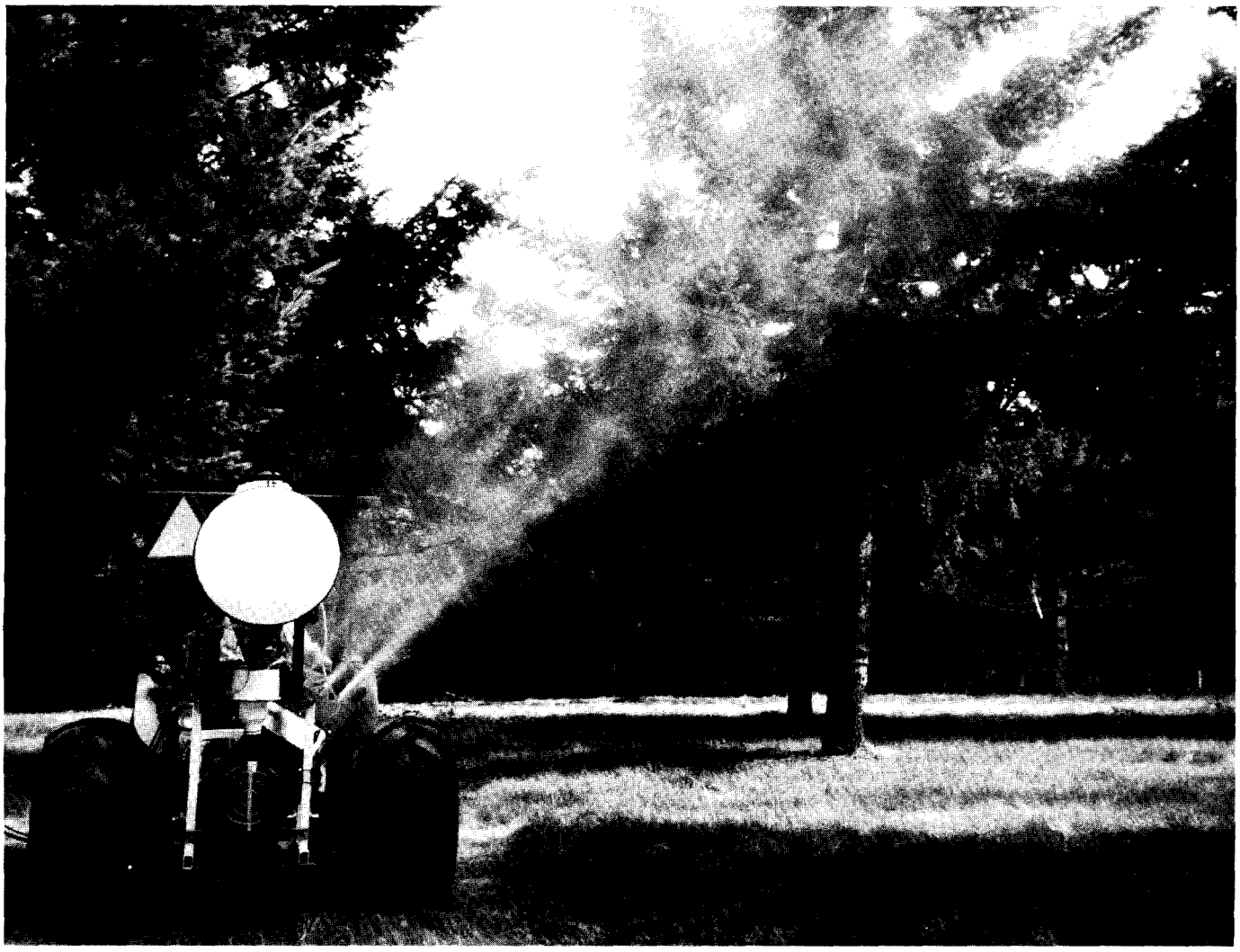

Figure 1—*Wet pollen applicator.*

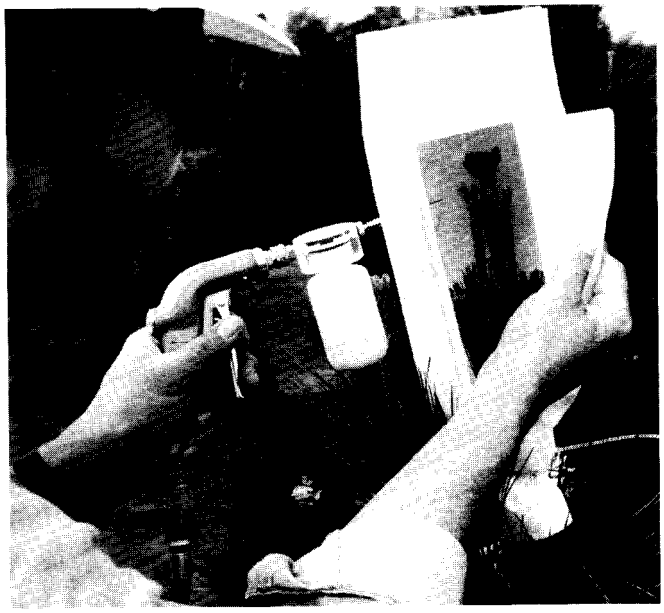

Figure 2—*A poly-mix applicator that applies a mixture of pollen from superior trees.*

that equipment already existed to meet Forest Service needs. The results were published in Tech Tip 9424-2314-MTDC, "Aerial Lifts for Working in Tree Tops," and the project is now closed.

Nursery soil fumigation (project leader— Dick Karsky). Growth of young trees is affected by the levels of pathogenic organisms present in the nursery environment. Certain cultural practices, such as crop rotation, have been used to reduce these levels in nursery seedling beds, but chemical application has been the preferred method. Dazomet (basamid) and methyl bromide were two fumigants used to sterilize beds in the past.

Methyl bromide has been found to be environmentally harmful and the U.S. Environmental Protection Agency will ban its use in 5 years. MTDC was asked to find an economically and environmentally acceptable way of sterilizing nursery bed soils. Both microwave and steam sterilization methods will be investigated. A cooperative agreement or contract will be arranged to determine the feasibility of microwave technology.

The Center has acquired a portable diesel-fired steam generator and will configure it for nursery operations. The Center is working with Bob James (a plant pathologist with the USDA Forest Service's Northern Region) and the Coeur d'Alene Nursery to develop a test plan for the steam sterilization machine. Preliminary testing will take place at the Coeur d'Alene Nursery and results will be reported.

Root pruner (project leader— Debbie O'Rourke). During seeding, grading, and packing operations at forest tree nurseries, seedlings are pruned in the packing shed to provide seedlings with a uniform root length. This is currently done by hand with paper cutters similar to those found in many offices. This system has a number of problems. Hand cutting is difficult. Workers tire quickly and are subject to injuries such as carpel tunnel syndrome and finger lacerations. The work is slow and typically requires additional personnel and equipment to keep up with production. Finally, contractors have difficulty meeting Forest Service root length specifications.

The Center was asked to develop a root pruner to automate the pruning process and increase packing shed safety and efficiency. The prototype accommodates up to an 8-inch-diameter seedling bundle, carrying it to the cutting area on a plastic conveyor chain. When these bundles enter the cutting area, the shear is activated and the seedlings are pruned to the correct length. The bundles are transported to the end of the unit and packed in boxes. The cutting area is completely enclosed with a Lexan guard, which provides a barrier between the operator and the cutting mechanism, yet still allows the necessary visibility. The system has been refined based on field tests. Fabrication drawings and a report will be prepared terminating the project (figure 3).

Machine vision (project leader— Dave Gasvoda). Forest Service tree nurseries tailor their seedlings to specific needs requested by nation forests and ranger districts. To do so, these nurseries must have an effective quality control system. Currently, lifted seedlings are delivered to packing sheds for grading and packing. Graders sort seedlings by hand, cull the unacceptable plants, and sort the others by stem diameter, top length, root area, and overall quality. They place the acceptable seedlings on a packing belt for final processing and packaging. Quality control checkers monitor this operation, picking samples and overseeing grader performance. This process is labor intensive and expensive. The Center was asked to automate the quality control and grading in an effort to reduce these costs.

Under contract to MTDC, Glenn Kranzler and Michael Rigney at Oklahoma State University delivered a machine vision quality control inspection station to the Forest Service's J. Herbert Stone Nursery (Central Point, Oregon) in February 1994. The system utilizes high-resolution line-scan camera technology and a personal computer. Ten tree seedling morphological features are measured at rates of up to 10

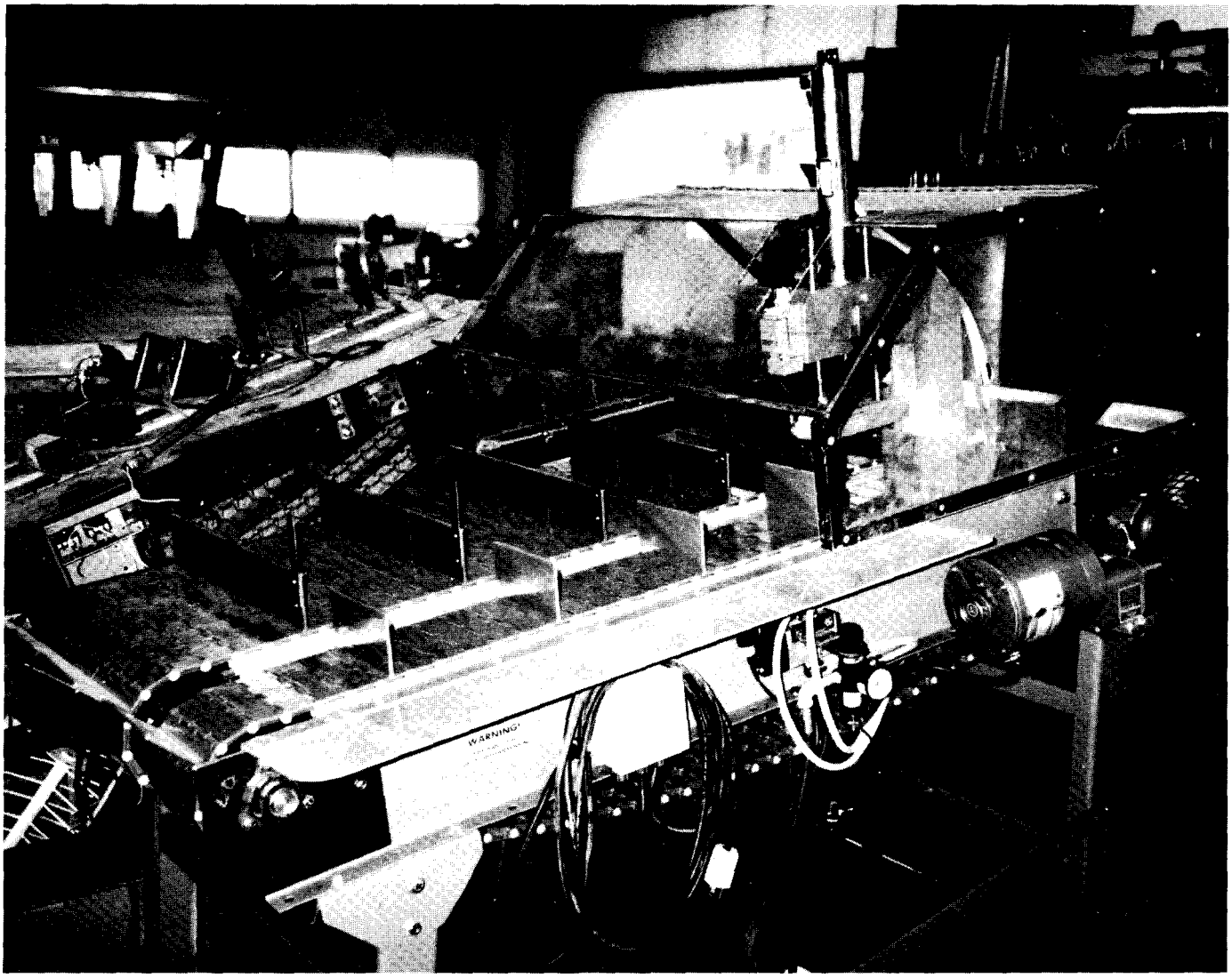

Figure 3—*The MTDC root pruner.*

seedlings per second. Initial performance tests demonstrated measurement precision equal to or greater than manual measurements.

The seedling inspection station can be expanded to automate grading in the production line. Several related aspects of defect detection and seedling handling still must be addressed to achieve a comprehensive automated system.

Investigation of color detection of defects such as chlorotic foliage and stripped root laterals showed promising results. A positioning and sorting mechanism for handling the seedlings after grading was found to be marginally suitable to support automated root pruning.

During fiscal year 1995, MTDC will continue to work with OSU to develop a fully functional automatic grading system. The problem of seedling sorting and handling after grading will be more completely examined. Progress will continue to reported under a new project-seedling grading machine (figure 4).

Smart toolbar (project leader— Dick Karsky). Nursery equipment operators have experienced problems in maintaining toolbar height at a consistent level above the seedbed during various cultural operations. This capability is essential for such tasks as root wrenching, root culturing, and top pruning.

With current technology, a system can be designed to automatically sense toolbar height and manipulate the tool to maintain that height. MTDC is working with Forest Service nursery personnel to perfect such a system. Essentially, this project tested various distance-sensing devices, determined the most applicable,

Figure 4—*Machine vision quality control inspection station for tree seedlings.*

and designed a system for automatic height control.

Both mechanical ground sensors and ultrasonic devices have undergone preliminary tests. The ultrasonic sensor seems most promising. However, for lateral control, the mechanical sensor is still necessary. A prototype smart toolbar was evaluated at the Coeur d'Alene nursery in 1995 and results will be reported.

Reforestation Projects

Reforestation technical services (project leader—Ben Lowman). Through this continuing project, Center personnel provide a variety of services to field units. Surveys are conducted to determine current reforestation field problems. Those problems are translated into projects in the reforestation program. The Reforestation Technical Services Project allows us to investigate promising new techniques and equipment that may, after evaluation, become part of the Forest Service inventory of equipment. In addition, the project provides a forum for answering inquiries from field personnel concerning equipment, material, and techniques applicable to reforestation activities. Papers presented at professional meetings, technical reports, and drawings are also funded through this project. Current work includes:

- Adaptation of a Pacific Northwest Region tree climbing guide into a Forest Service-wide guide. The guide was made available in the fall of 1995.
- Modification of the Salmon blade. The drawings were updated and sent to interested commercial manufacturers, including Weldco-Beales, for commercial production.
- Production of a video on natural regeneration and timber stand release with Doug Basford, USDA Forest Service, Northern Region. Loan copies are available from MTDC.

- Completion of work on the loblolly tree seed collection system and the power platform. Reports were published to close out these projects.
- Responded to numerous field inquiries for information on tree girdlers, feller bunchers, and excavators.

Center representatives meet with the Forest Service's National Forest Regeneration Committee each year to review the status of ongoing projects and new projects. Project proposals are welcome. They may be submitted to Ben Lowman at MTDC. Write a summary of the problem and the desired action. The information will be used to determine priorities, and to link you with others with similar problems or to those who may have solutions to your problem.

Animal repellents (project leader— Debbie O'Rourke). The survival and growth of seedlings planted on National Forest System lands has improved dramatically in the past 20 years, primarily because better quality seedlings are being produced in federal nurseries and because increased care is being used in planting and handling these seedlings. One major problem remains—animal predation of planted stock.

Although livestock, rodents, and other animals take their toll, deer and elk are the primary browsers. By nipping off buds and shoots, elk and deer restrict the growth of some seedlings and kill others. Fencing can reduce this damage, but it is expensive and impractical in most field situations. Chemical sprays, powders, and systemics have been tried for years with only limited success.

The Center has teamed with the USDA Animal and Plant Health Inspection Service (APHIS) under a cooperative agreement covering animal pest control research. In 1993 a steering committee including representatives from the Center, APHIS, and the USDA Forest Service's Pacific Southwest and Pacific Northwest Regions was formed to outline the project's objectives. The steering committee decided that APHIS and MTDC should enter into a contract covering three services: testing repellents and barriers on penned animals; publishing a comprehensive catalog of currently available animal repellents and barriers; and publishing a Tech Tip reporting the results of a field evaluation of repellents intended to keep animals away from certain areas. The tests have been completed and the catalog and Tech Tip were published. Another Tech Tip from MTDC on pocket gophers and gopher control based on a comprehensive report written by Ron Bonar is now available.

Seedling protection (project leader— Keith Windell). MTDC has been working with the USDA Forest Service's Southern Region timber management to evaluate commercially available devices that can to protect seedlings from animal damage and promote growth. Seedling protectors have been successfully used in Europe and in some areas of the United States for years. Along with protecting the young plant from animal browsing, these devices can create a microclimate around the seedling that will improve survival and promote its early growth (figure 5).

The Center conducted an extensive literature search to see what previous work had been done in this field. Results of that search were reported in "Tree Shelter Survey Results" (Proj. Rep. 9424-2822-MTDC). Tech Tip 9324-2315-MTDC, "Tree Shelters for Seedling Survival and Growth," summarized information published in the larger report and listed new shelter designs and information on manufacturers and distributors. A fact-finding trip to England allowed the center to monitor shelter development there and discuss current uses of the shelters. The findings were summarized in "Seedling Protection in England (Proj. Rep. 9324-2845-MTDC).

MTDC assisted at the National Tree Shelter Workshop held in June at Harrisburg, Pennsylvania. Center personnel discussed the durability of tree shelter materials. Jim McConnell, who retired from the Southern Region Timber Management Staff; Jim Barnett, project leader at the Southern Research Station; and Dave Haywood, research forester at the Southern Research Station, are helping to guide this project.

Mulch for seedlings (project leader— Keith Windell). Ground mulch is commonly used in the ornamental and landscape business to reduce vegeta-

Figure 5—*Deer and elk nip off buds and shoots from unprotected seedlings.*

tive competition and improve soil moisture around newly planted trees and shrubs. Forest Service researchers determined that ground mulch could significantly improve seedling survival and promote early growth.

As part of a nationwide cooperative research effort, MTDC collected data on various types of mulch material and current techniques and equipment used to place the material around newly planted trees. The Center has also helped collect the final data on a cooperative mulch test project with the Lolo National Forest.

Results will be published in an MTDC report intended to serve as a reference for field foresters. The report will include information on commercial mulches currently available, suggested installation techniques, a quick overview of the results of past mulch studies and of the cooperative mulch test, recommendations, and a comprehensive bibliography. Forest Service employees from the Southern Research Station, the Forest Products Laboratory, Pacific Northwest Region, and Northern Region are cooperating with the project (figure 6).

Stump applicator for feller-bunchers (project Leader— Dick Karsky). MTDC has designed and fabricated a tank and spray system that can be attached to feller-buncher tree harvesters for applying stump treatments during thinning operations. This system will be used to prevent annosum root rot in thinned conifer stands.

Heterobasidion annosum is the most important disease of thinned pine plantations in the Southern Region. Thinning opens a stand to colonization by *H. annosum* through the freshly cut stump surfaces. The fungus spreads to adjacent trees through root grafts. Treating stump surfaces with a solution of TIM-BOR™ or a solution of the competing fungus *Phlebia gigantia* can control this disease. However, stump application by hand is labor-intensive. The MTDC system allows the feller-buncher operator to treat the stump when it is cut.

The system consists of a 40-gallon tank, a diaphragm pump, a timer, and a full-cone nozzle. The nozzle is mounted behind the saw head where it can be seen by the operator and still be protected from debris. A 3-second spray burst fully covers a stump.

The prototype system was tested at the Savannah River Forest Station in September 1994. The unit proved to be a practical, easily attached stump applicator system. It can easily be adapted to different models of feller-buncher harvesters. Minor improvements incorporated into the prototype design will be tested at Savannah River in 1995. Results of the test will be reported.

Spot site pre-mixing (project leader— Dick Karsky). Most site preparation equipment developed for forest applications has been designed with a scalping action. Scalping moves much of the topsoil to the side of the planting spot or casts it even farther away. Foresters wanted better techniques that allowed the soil treated in spot site preparation to be left in the spot.

This requires a mixing action rather than a scalping movement. This technique is frequently used in agriculture and nursery work to cultivate and rotary-till. However, rocky soils in forestry applications have made mixing difficult. This project's goal is to provide equipment to Forest Service reforestation personnel that will enable them to prepare planting sites by mixing rather than scalping.

The Center contacted personnel from the Francis Marion National Forest in South Carolina (Southern Region) to define the problem and establish requirements for a mixing action site preparation machine. The Center will contact other regions and conduct a literature and equipment search to determine if existing products meet these needs.

Steep slope site preparation (project leader— Dick Karsky). Mechanical site preparation is generally restricted to slopes of less than 35%. With the emphasis on ecosystem management in the Forest Service, more residual material is being left after timber harvests. New methods are needed to adequately treat brush and logging debris and to prepare planting sites on slopes steeper than 35% with heavy slash.

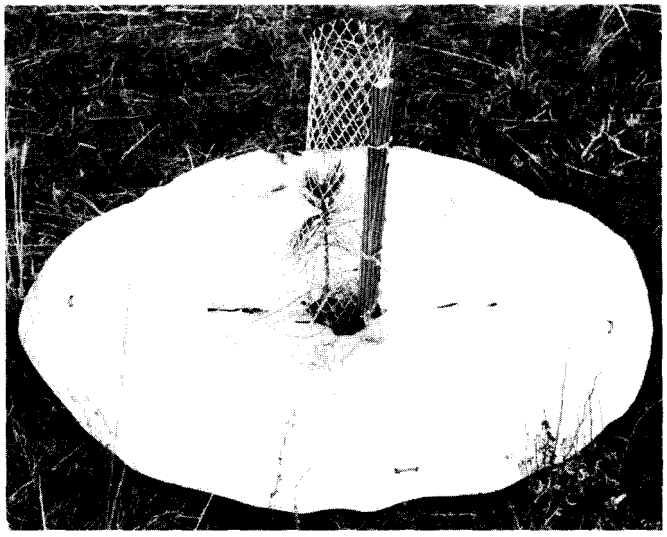

Figure 6—*Mulch mat.*

The Center conducted a market and literature search to seek equipment and techniques available for work on steep slopes. All applicable equipment— from large excavators to small four-wheel-drive ATV's— was considered. Results of the MTDC investigation revealed a variety of equipment that would meet Forest Service needs. The report, "Site Preparation Equipment for Steep Slopes" (Proj. Rep. 9224-2839-MTDC), was published and the project is closed.

Hawk scarifier (project leader— Keith Windell). This project will develop a safer digging head for a commercially available multiple-use chainsaw attachment. This attachment can be used for scarifying tree planting sites, clearing fire lines, and constructing trails. The Center is developing an alternative digging head that will do all these tasks and be safer to use than the currently available commercial design. An electrically powered test stand was constructed to simulate a gasoline chainsaw.

Several prototypes have been fabricated and tested. Additional field tests are planned for fiscal year 1996. Safety is the primary concern at this time (figure 7).

Small-area forestry equipment (project leaders— Bill Kilroy and Keith Windell). In this project, MTDC will determine the needs of field personnel for small-area forestry equipment. During fiscal year 1995, initial contacts have been made and site visits arranged. After determining what is needed in small-area operations, the Center will make an extensive market search to identify commercially available equipment that fills these needs. A catalog of this equipment and appropriate sources will be published, along with recommendations of further work to be presented to the Forest Service's Regeneration Steering Committee.

Figure 7—*Hawk scarifier.*

Cruiser's gear carrier (project leader— George Jackson). Forest Service timber cruisers are faced with the problem of carrying an increasing amount of equipment in the woods to do their job. In addition to the traditional gear, timber cruisers now may carry GPS satellite navigation receivers, laser tree measuring devices, electronic calculators, and recording devices. MTDC has designed a vest that efficiently carries this array of bulky equipment without restricting freedom of movement. It also distributes the load to minimize fatigue.

The cruiser's gear-carrying system consists of a vest constructed of 9-oz (per square yard) nylon mesh. The equipment pockets are constructed of 11-oz backcoated nylon duck. These pockets are sized to fit specific cruising gear and instruments such as Relaskop, clinometer, compass, flagging tape, and D tape. The vest has breathable padding in the shoulder and back area and a large zippered back pocket accessible from either the right or left side. The system is designed so that quart paint cans and other bulky items can be carried in a detachable leak-resistant backpack.

The cruiser's gear-carrying system has been designed to allow the user to comfortably carry a large amount of equipment. The vests are durable and provide a long service life. They will be available in four sizes (small, medium, large, and extra large).

The Center has completed the procurement package, and the drawings and specifications have been forwarded to the General Services Administration for procurement. The cruiser's gear carrying system should be available from the General Services Administration by November 1995. A Tech Tip will be published (figure 8).

Pruning equipment (project leader— Keith Windell). The Center is beginning a project to determine what pruning equipment currently available is best for timber stand improvement. MTDC has surveyed field personnel for current methods and equipment used. Results are available in an MTDC publication. Researchers were contacted to determine the best and most efficient pruning methods. The Center purchased equipment for a comprehensive field evaluation. Field testing is underway in the USDA Forest Service's Pacific Northwest Region.

Figure 8—Cruiser gear-carrying system.

Field coordinate locator (project leader— Tony Jasumback). The Forest Service is continuing to incorporate global positioning system (GPS) technology into resource management tasks. MTDC supports this effort and serves as a clearinghouse for information, training, and acquisition of appropriate technology. The Center, in conjunction with the University of Montana, schedules GPS training courses designed for land managers, tests new products under forest canopy conditions, and holds a communications security account. As a result, MTDC can offer Forest Service personnel autonomous operation, realtime availability. Units will be able to order the military's Precision Lightweight GPS Receiver for use in land management operations. In recent tests at the Lubrecht GPS test range, this receiver provided navigational information to a way point with an average horizontal error of only 8 meters. This is in autonomous operation without a differential station. MTDC will be the keying facility for these receivers. Publications and a video on GPS operation and technology as it applies to land management are available from MTDC.

Recent MTDC Publications

Gasvoda D. 1993. Automated seedling height measurement. Proj. Rep. 9324-2810-MTDC. Missoula, MT: USDA Forest Service, MTDC.

Gasvoda D. 1994. Machine vision— a computerized sorting and grading system for tree seedlings. Tech Tip 9424-2319-MTDC. Missoula, MT: USDA Forest Service, MTDC.

Hallman R. 1993. Net retrieval tree seed collection system. Tech Tip 9324-2325-MTDC. Missoula, MT: USDA Forest Service, MTDC.

Hallman R. 1993. Reforestation equipment catalog. Proj. Rep. 9324-2837-MTDC. Missoula, MT: USDA Forest Service, MTDC.

Hallman R, Jasumback A. 1993. GPS training project— Indonesia. Proj. Rep. 9324-2848-MTDC. Missoula, MT: USDA Forest Service, MTDC.

Herzberg D. 1992. Mobile tree seedling coolers. Proj. Rep. 9324-2811-MTDC. Missoula, MT: USDA Forest Service, MTDC.

Jasumback A. 1993. Evaluating the GPS receiver under a dense tree canopy. Proj. Rep. 9324-2319-MTDC. Missoula, MT: USDA Forest Service, MTDC.

Jasumback A. 1993. Trimble Ensign GPS Receiver. Tech Tip 9324-2321-MTDC. Missoula, MT: USDA Forest Service, MTDC.
Jasumback A. 1994. Aerial lifts for working in tree tops. Tech Tip 9424-2314-MTDC. Missoula, MT: USDA Forest Service, MTDC.
Jasumback A. 1994. GPS Use survey results. Proj. Rep. 9424-2824-MTDC. Missoula, MT: USDA Forest Service, MTDC.
Karsky D. 1993. Site preparation equipment for steep slopes. Proj. Rep. 9324-2804-MTDC. Missoula, MT: USDA Forest Service, MTDC.
Karsky D. 1993. Chunkwood roads. Proj. Rep. 9324-2327-MTDC. Missoula, MT: USDA Forest Service, MTDC.
Karsky D. 1994. Excavators for site preparation. Tech Tip 9424-2310-MTDC. Missoula, MT: USDA Forest Service, MTDC.
Karsky D. 1994. Smart toolbar progress report. Proj. Rep. 9424-2821-MTDC. Missoula, MT: USDA Forest Service, MTDC.
Lowman B, and others. 1992. Bareroot nursery equipment catalog. Proj. Rep. 92242839-MTDC. Missoula, MT: USDA Forest Service, MTDC.
Windell K. 1993. Tree shelters for seedling survival and growth. Tech Tip 9324-2315-MTDC. Missoula, MT: USDA Forest Service, MTDC.
Windell K. 1993. Mulches for increased seedling survival and growth. Proj. Rep. 9324-2820-MTDC. Missoula, MT: USDA Forest Service, MTDC.
Windell K. 1993. Mulch evaluation project. Tech Tip 9324-2343-MTDC. Missoula, MT: USDA Forest Service, MTDC.
Windell K. 1993. Seedling protection in England. Proj. Rep. 9324-2845-MTDC. Missoula, MT: USDA Forest Service, MTDC.
Windell K. 1994. MTDC pruning equipment survey results. Proj. Rep. 9424-2817-MTDC. Missoula, MT: USDA Forest Service, MTDC.
Windell K. 1994. Tree shelter survey results. Proj. Rep. 9424-2822-MTDC. Missoula, MT: USDA Forest Service, MTDC.
Windell K. 1994. Power platform. Proj. Rep. 9424-2830-MTDC. Missoula, MT: USDA Forest Service, MTDC.

Recent Drawings
Orchard Seed Harvester— MTDC 851
Pollen Collector Head— MTDC 856
Progeny Seeder— MTDC 858
110-V AC Field Storage Unit— MTDC 865
Isozyme Lab Gel Slicer— MTDC 866
Cyclone Pollen Collector— MTDC 876
Seedling Box Pickup— MTDC 880
Vial Pollinator— MTDC 893
Root Pruner— MTDC 901
Acorn Planter— MTDC 908
Woods Cutting Planter— MTDC 909

All readers of Tree Planters' Notes may order these publications and drawings in single copies. **If you need additional information, contact:**

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