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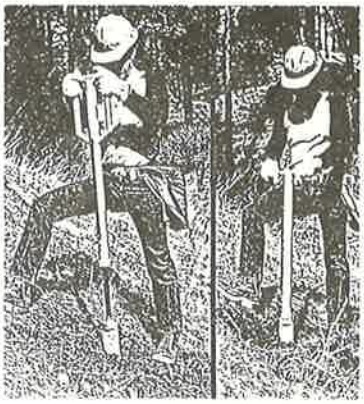
United States
Department of
Agriculture

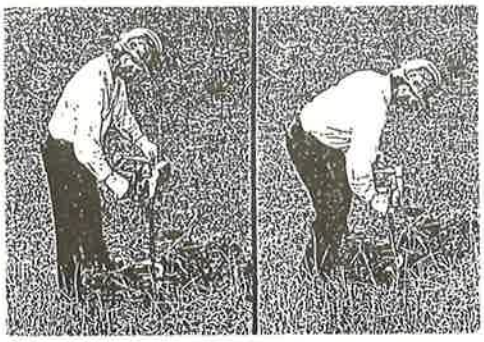
Forest Service

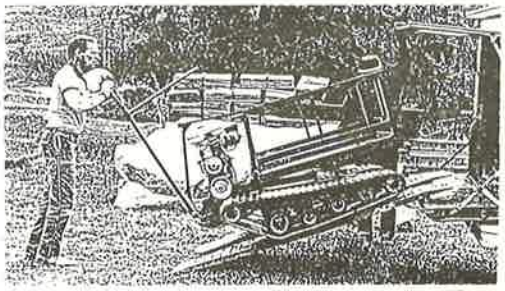
Technology and
Development Center

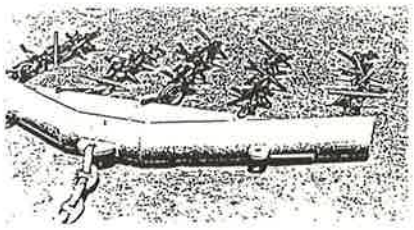
Missoula, MT

NEW RESOURCE TOOLS AND EQUIPMENT









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New Resource Tools and Equipment

Richard G. Hallman
Resource Planner

A variety of new tools designed to make reforestation tasks more efficient and economical have recently been developed or improved by Missoula Technology and Development Center (MTDC) engineers. The improvements are part of the continuing cooperative effort to help resource managers solve problems inherent in wildland reforestation.

The Salmon Blade

The Salmon Blade is an improved tractor-mounted blade designed for wildland site preparation. Many commonly used scarification techniques do not effectively eliminate competition from undesirable vegetation. Dozer blade scarification often disturbs too much of the ground cover so that soil moisture is lost and erosion is encouraged. Dozer-mounted brush blades create furrows that often fail to kill the grass because roots are not adequately exposed. The Salmon Blade is adapted from a dozer-mounted brush blade and is designed to turn over grass to expose the roots. Treatment with the Salmon Blade effectively kills unwanted vegetation. The Salmon Blade produces a series of furrows that catch and hold seed and water and provide an ideal microsite for regeneration. The blade rescatters slash or piles it.

The Salmon Blade.

The Salmon Blade was developed cooperatively by Douglas Basford, forester on the Salmon Ranger District, Salmon National Forest in Idaho; Robert Herman, heavy equipment mechanic on the Salmon National Forest; and Ben Lowman, project leader at MTDC. The blade was modified from a commercial brush blade and extensively tested during the 1986 and 1987 field season in pine grass and on a variety of slash and ground conditions. Approximately 400 acres on the Salmon National Forest were treated with the blade.

The Salmon Blade features plow-like attachments on each tooth, which turn the soil to create varying amounts of soil disturbance. After treatment, an adequate seedbed should exist for 5 to 10 years, so site preparation for natural regeneration can continue in both seed and nonseed years. Stocking levels of 1,000 to 6,000 seedlings per acre are reported on the Salmon National Forest. Production rates ranged from 1½ to 2 acres per hour in grass cover with little or no slash and 1 to 1½ acres in moderate slash. Cost per acre in areas needing only scarification ranged from $75 to $85 per acre. The recommended machine size for this blade is 95 to 130 horsepower.

Advantages:

- Blade design increases production with less disturbance to remaining trees.
- Blade can pile brush or scarify.
- Blade depth is easy to control because it is mounted on the front of the tractor.
- Different levels of scarification can be achieved by fluctuating the blade depth to produce various sized furrows.
- One trip with a tractor over an area can produce adequate soil disturbance for seedbeds.
- Adequate seedbeds should exist 5 to 10 years after treatment.
- Scarifying and rescattering the slash on the site produces microsites for young seedlings. This reduces slash piling and burning up to 90 percent on Douglas-fir sites.
- Scarifying up to the base of existing trees in a shelterwood cut allows seedlings to establish themselves near these trees. This should produce better uniformity and improved seedling survival.

As with most dozer attachments, the Salmon Blade is not recommended for slopes exceeding 35 percent.

Drawings for building the blade are available from MTDC. Fabrication cost for the attachments to the teeth of the brush blade range from $1,200 to $2,500. The brush blade with 30-inch teeth costs $6,000 to $7,000. The Salmon Blade is also available from two commercial sources:

Weldco-Beales
2328 Roosevelt Ave.
P.O. Box 8
Enemclaw, WA
(206) 825-3581

Balderson Inc.
600 Balderson Blvd.
P.O. Box 6
Wamego, KS 66547-0006
(913) 456-2224

Costs range from $7,200 to $9,500

Blade design increases production with less disturbance to remaining trees.

The Anchor Chain Scarifier

A rugged, inexpensive scarifier that features anchor chain has been adapted for site preparation in post-logging operations by MTDC engineers. The heavy anchor chain effectively treats light to moderate slash and prepares the ground for natural regeneration. The Anchor Chain Scarifier is adapted from the British Columbia drag scarifier developed in the late 1970's by the British Columbia Ministry of Forests. Engineers at MTDC modified the scarifier by adding heavier chain that rides close to the ground to achieve better disturbance of the soil and better break-up of slash material. Current scarifiers are designed for agricultural treatments and their teeth are not durable enough for forest environments.

The Anchor Chain Scarifier features a V-bar spreader and a single-point hitch with attachment points for drag chains. The spreader is made of 12- to 16-inch well casing with optional 3/8-inch wear plates. MTDC engineers varied the size of the chain links to adjust the degree of scarification. The larger chains treat areas with heavier slash. Chain links ranged from:

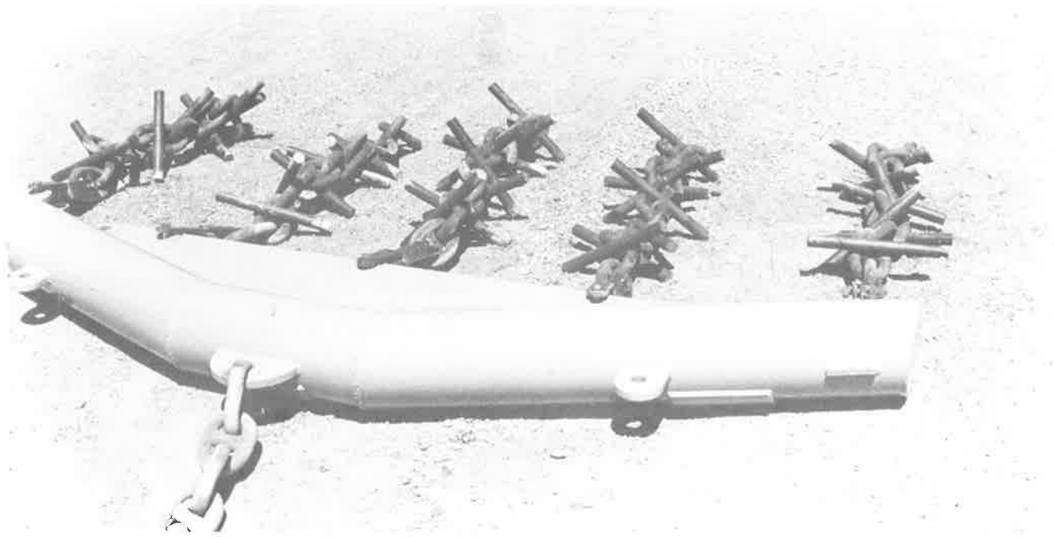
Chain Size	*Chain Weight Per Link*
2-inch stud-link chain	25 lb
2½-inch stud-link chain	50 lb
3-inch stud-link chain	86 lb

Steel cross-bars add an average of 18½ pounds per link. Time elapsed since logging, the amount of slash remaining, vegetative competition, soil moisture, duff depth, stump density and height, and degree of slope determine scarification treatment.

The Anchor Chain Scarifier was tested on partial cuts on the Northern Region Lolo National Forest. The tests used a crawler-tractor in the 100 hp class. Slopes ranged from 35 to 45 percent. The scarifier averaged 1 acre per hour. It operated best in an up-and-down hill pattern followed by a criss-cross side-hill configuration. The goal of 35 percent scarification treatment was easily met.

The Anchor Chain Scarifier costs $6,000 to $8,000 depending on materials and cost of labor. Maintenance costs are low. Most repairs can be made with a welding torch.

A video of the Lolo National Forest tests, design drawings, and a materials list are available from MTDC.



Anchor chain scarifier.

Portable Power Platform

The Iron Horse Wood Caddy tractor is an off-road vehicle that transports equipment and supplies and provides a lightweight power source for operating implements and hand-held tools. The machine is easily operated by cne person and costs about $5,500.

MTDC chose this machine as the most promising portable power source for performing forestry tasks. Forestry workers placed a high priority on a portable power source in a Servicewide survey conducted in 1986. They asked for an off-road vehicle that could safely climb a 60-percent slope and operate on a 35-percent grade. They wanted a machine that would operate at variable speeds at or near maximum grade engine rpm and one that could operate accessories by direct drive or electrical generation. They also wanted the vehicle to be operated by a non-riding driver. The Iron Horse appears to meet these needs. MTDC engineers will conduct field tests in 1988 to evaluate the machine for forestry field work.

The Iron Horse is simple to operate. The steering arm runs from a clutch that transfers all the power to one track to initiate turns. Its application for forestry work seems unlimited. The roller, winch, and trailer can accomplish most tasks associated with precommercial thinning, slash disposal, and release cutting. Delimbing and yarding operations are simple even in tight spots, which makes the machine especially useful for wood gathering, residue treatment, and post-and-pole operations. Because of the low ground pressure, the Iron Horse is well suited for operating on soft ground or in environmentally sensitive areas. Using the flat bed box and seedling frame, the Iron Horse can transport seedlings, tools, or heavy bulky materials in and out of the woods.

MTDC engineers have begun modifications to make the Iron Horse even more versatile. A steel mounting platform has been fitted to the load bunks, to accommodate a "Lil Chipper" brush chipper (manufactured by Limco, Inc.) and a spray applicator for applying herbicides (manufactured by Fenco). The modification costs approximately $400. A parts list and line drawings are available from MTDC. Modifications for direct drive units or electrical generation allow mechanical site preparation, planting, direct seeding, cone collection, slash disposal, or plantation maintenance. These modifications may also accommodate power scalpers, scarifiers, tillers, flail trenchers, nordic trail track setters, snow plows and snow blowers, planting augers, interseeders, hydroseeders, seed blowers, water pumps, and mulchers. A variety of hand tools may be powered by the machine as well. The modifications will be part of the 1988 field tests.

Iron Horse Wood Caddy.

Portable power platform performs most forestry tasks.

Hammer-Action Hand Planter

A hammer-action hand planter has been designed to plant seedlings in rocky soil. Although commercial hand planters perform well in ideal soil conditions, the operator continuously absorbs the shock while operating the auger in rocky soil. Hammer-action uses an inner staff with a tool head attached. The hammer head and handle/slider tube incase the staff. The operator simply raises the handle/slider tube the length of the staff and slams the hammer head down against the staff stop. The force generated drives the tool head into the ground to create a suitable planting hole.

MTDC began work on the hammer-action planter in FY 1987 in respose to a request for help from the Intermountain Station at Boise, Idaho. They were planting willows rooted in super tubes on a rocky site near Vale, Oregon. Shallow, narrow planting holes were required. The conditions at the site ranged from sand-sized particles to rocks 12 inches in diameter. The site had spaces filled with silt between rocks with vegetation ranging from heavy sod to Kentucky blue grass and clover.

MTDC engineers converted three commonly used commercial planting tools to the hammer-action design. A T-handle and a double-D handle were fitted to the head:

KBC Bar—Creates standard 12-inch or deeper holes for bare root stock. Blade is 4 inches wide x 12 inches long x 1-inch thick and tapers to a point.
DD-Handle: Length 48-5/8 inches
Weight 20 pounds, 10 ounces
T-Handle: Length 44-5/8 inches
Weight 17 pounds, 15 ounces

OST Bar—Creates 12-inch or deeper holes for bare root stock. Blade is 3 inches wide x 10-3/4 inches long. Blade thickness tapers to a thin wedge.
DD-Handle: Length 48-5/8 inches
Weight 20 pounds, 10 ounces
T-Handle: Length 44-5/8 inches
Weight 17 pounds, 15 ounces

Super Leech Pine Dibble—Designed for planting containerized stock in super tubes. Dibble length: 9 inches x 1-3/4 inch diameter. Tapers to 1¼ inches at the tip.
DD-Handle: Length 46-3/4 inches
Weight 21 pounds, 8 ounces
T-Handle: Length 42-3/4 inches
Weight 18 pounds, 10 ounces

The hammer-action tools were used to plant the Vale site in 1987. Results showed:

1. The hammer-action planters were more effective than conventional spades and planting bars.

2. The super-dibble tip and the OST bar tip were most effective at the Vale site. The OST bar was used to pry rocks.

3. The tools were generally considered too heavy and the handle length was thought to be too short.

MTDC engineers incorporated the recommendations into the hand planter. Each of the three hammer heads has been fitted to DD and T handle designs for the 1988 field season.

The hammer-action planter costs about $50. Drawings are available from MTDC.

Hammer-action hand planter.

Planting Auger

A cone-shaped, power-driven auger has proved effective in planting seedlings in rocky soils. Seedlings planted with the tapered auger have achieved a 90-percent survival rate after 5 years. The cone-shaped auger was the concept of Russ Ryker, an Intermountain Forest and Range Experiment Station research scientist. His auger was used to plant a rocky planting site on the Mountain Home Ranger District on the Boise National Forest in 1983. The auger was 14 inches long with an 8-inch diameter top that narrowed to a 4-inch bottom. Results were compared to those achieved with straight-sided augers. After five growing seasons, seedlings planted in the tapered holes had a greater survival rate. Mean seedling heights were similar in all treatments.

In 1986 MTDC was asked to refine the cone-shaped auger. MTDC built six prototypes with auger length varying from 30 to 34 inches and bit length from 14 to 21 inches:

2½-inch to 6-inch taper with double flighting

4 spiraled angle fins

1¼-inch to 6-inch taper with double flighting

1-inch to 4-inch taper with 1-inch wide flighting

1¼-inch to 6-inch taper with single flighting

4-inch to 6-inch taper with two-step/single flighting with 6 inches between steps

The six prototypes were evaluated on the Boise National Forest in 1987. Further refining resulted in a 30-inch long, cone-shaped auger with an 18-inch bit length. The MTDC auger featured a 3- to 6-inch taper with double flighting and three steps.

Auger Evaluation

	Cone Shape (20 operators) percent	*Straight bit (15 operators) percent*
Ease of Operation		
Hard to operate	20	54
Moderately easy to operate	75	46
Easy to operate	5	0
Amount of Glazing		
Severe	0	0
Moderate	25	20
None	75	80
Difficulty in Penetrating Soil Organic Material		
Severe	0	0
Moderate	50	67
Slight	50	23
Soil in Hole after Augering		
Excessive	0	7
Adequate	90	86
Inadequate	10	7

Auger Evaluation

Auger Hole Inches	*Tree Placement*	*Augering Time Seconds*[1]	*Planting Time Seconds*[1]	*5th Year Height*	*5th Year Survival*[1]
4	Center hole	45.6 a	195.1 b	57.3	86 ab
4	Side hole	45.2 a	154.9 a	57.7	82 a
6	Center hole	87.7 a	255.3 d	59.3	80 a
6	Side hole	96.0 bc	191.5 b	57.0	82 a
4 to 8	Center hole	81.8 b	232.2 c	62.2	90 b

[1] *Mean auger and planting time per 10 tree row and fifth year seedling mean heights and survival. Values followed by the same letter are not significantly different at the 95 percent level of confidence.*

The improved MTDC cone-shaped auger was compared to a commercial straight-bit auger during the 1987 field season. Both augers planted seedlings on a site characterized by heavy rock, light subsurface organic debris, and an average amount of soil moisture. The augers were evaluated for ease of operating, amount of glazing, difficulty in penetrating the soil, and the amount of soil left in the hole after augering.

The auger performed well but was heavier than commercial straight-bit augers. User comments led to a final auger that is 30 inches long, has a bit length of 12 inches and weighs 7½ pounds (comparable to commercial augers). The cone-shaped auger costs about $200. Design drawings are available. Commercial production of the cone-shaped auger is anticipated.

For information on all these improved resource tools, contact Dick Hallman, Resource Planner at the Missoula Technology and Development Center, Bldg. 1 Fort Missoula, Missoula, Montana 59801 (FTS 585-3946 or (406) 329-3946).

Cone-shaped, power-driven planting auger.