Cable-Scarification-A Site Preparation Alternative

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A cable-yarder scarification implement offers land managers an alternative to preparing planting sites on steep slopes when fire or chemicals cannot be used. The scarifier, powered by a lightweight yarder, works well in lighter slash (smaller than 9-inch dbh) where loads do not exceed 40 tons per acre and brush cover is less than 10 feet tall. Tree Planters' Notes 38(1):6-10; 1987

Preparing sites for planting on steep slopes often presents land managers with a difficult challenge, particularly if the slopes are covered with slash and brush.

What are the alternatives? Crawler tractors are restricted on steep slopes, and hand piling and hand scalping are slow and expensive. The method of choice more often than not has been prescribed burning. It can be an economical and practical way to rid a site of slash and prepare it for seedling planting.

However, air quality regulations and weather can restrict fire as a site preparation tool, and not all areas on steep slopes are suitable for burning. Chemical treatment may prove the best alternative in the long run.

In the meantime, mechanical methods can offer some of the best site preparation alternatives.

Figure 1—*Scarifier implement rides skyline cable downslope to begin digging planting spots.*

The Cable Scarifier

As part of its efforts to improve site preparation methods, the Missoula Equipment Development Center (MEDC) designed, built, and tested a cable scarification implement.

Cable scarification is not new, of course. It was introduced in the Pacific Northwest in the late 1960's. A high-lead cable yarder was used to drag two concrete-filled steel drums over an area to be planted. These drums weighed about 5,000 pounds. As they moved at line speeds of 500 to 1,000 feet per minute, they scattered the slash and created areas where seedlings could be planted without having to burn first.

MEDC's scarifying implement is much lighter, and with it, the yarder operator can dig out planting spots of various lengths as it moves up a slope.

The implement is approximately 10 feet wide by 4½ feet high and weighs 1,000 pounds (fig. 1). Scarifiers on either side of the implement's frame create planting spots about 24 inches wide. Teeth along the bottom of each scarifier penetrate surface litter and duff to help scoop out planting spots. The teeth are two-part replaceable backhoe teeth. Skids directly behind the scarifiers ensure that the teeth bite into the surface at the most efficient angle. These skids are adjustable to accommodate slopes of different steepness.

The implement travels up and down the yarder's skyline cable on two 10-inch sheaves mounted at the top of the frame. The mainline is attached to a swivel that in turn is hooked by cables to the implement.

We used a Clearwater cable yarder to test our scarifier implement. The Clearwater Yarder was designed by MEDC engineers a few years ago. It is a three-drum system mounted on a 5-ton Army truck (fig. 2). The yarder has a live skyline of 800 feet of ½-inch cable, with 7,500 pounds maximum line pull and a top line speed of 500 feet per minute. The mainline has 900 feet of $^3/_8$ - inch cable with 3,500 pounds maximum line pull and 1,000 feet per minute maximum line speed.

Test Procedures

To determine how well our scarifier worked, we tested it under a number of field conditions at sites in Idaho, Montana, and Oregon. Clearcut areas were selected in which the Clearwater Yarder could operate favorably, either first removing slash and then running the scarifier implement or operating the scarifier alone. We evaluated the slash loading on each test site. If it was too heavy, we yarded off enough material so that the scarifier could operate. A four-person crew yarded slash: two choker setters, one person on the deck, and the operator. A two-person crew operated the scarifier: an operator and a person at the mobile tailhold.

To begin the scarifying process, the skyline was tightened, lifting the implement off the ground. The mainline was then released, allowing the scarifier to travel down the skyline to the bottom of the slope. The scarifier was stopped by braking the mainline. Tension on the skyline was then released, lowering the scarifier to the ground. The mainline was then tightened. The scarifier bit into the soil, and as it was pulled back upslope it dug out a planting spot.

About every 10 feet, or when the scarifier hung up on a stump or other obstacle, tension on the skyline was tightened, lifting the implement over the obstacle or out of the scalp.

One trip up a slope was considered a pass and was repeated until adequate scarification was achieved, usually in two to four passes. Then the tailhold was moved and the procedure was repeated. All the passes from one tailhold position were considered a set.

For our tests, we used a D-5 crawler tractor with a 12-foot-high tower as a mobile tailhold.

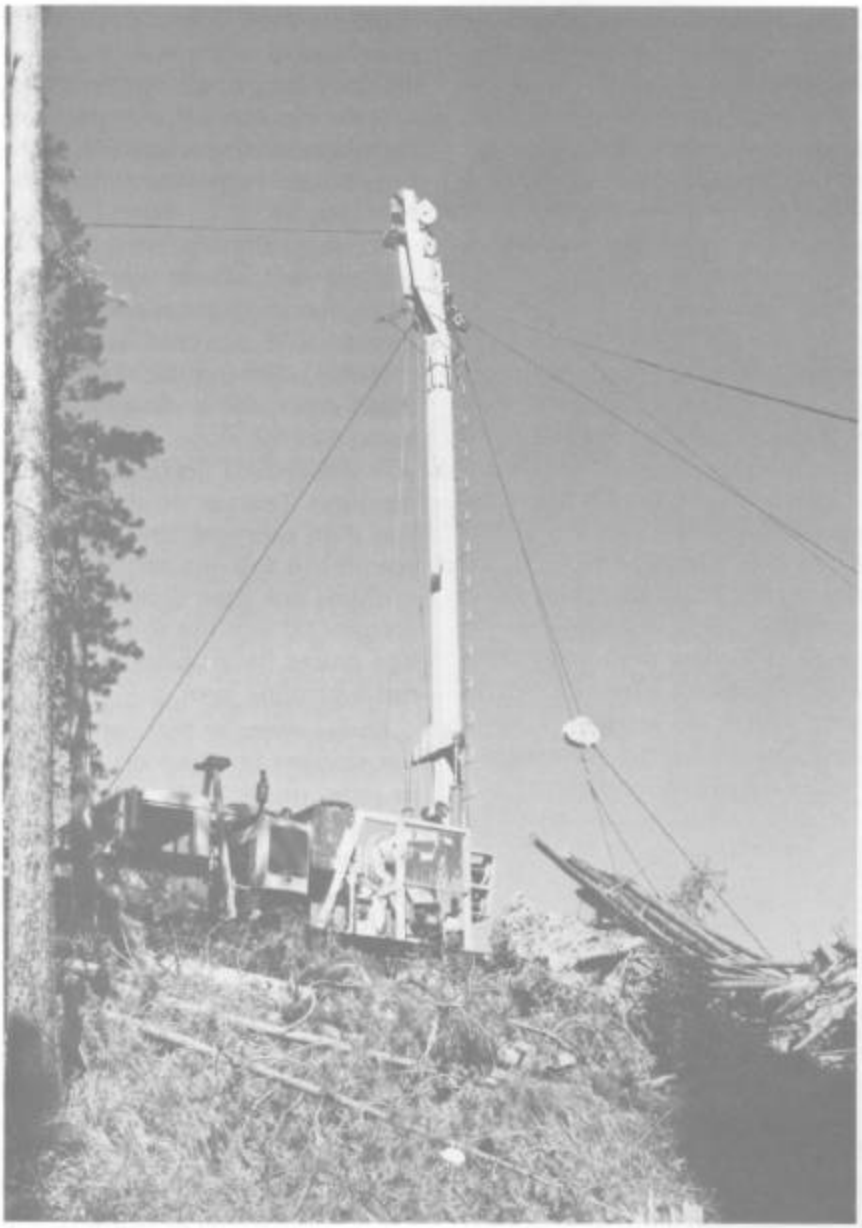

Figure 2—*Clearwater Yarder reduces slash loading before operating scarifier implement.*

Test Results

Initial shakedown testing was conducted on a clearcut on the Bitterroot National Forest in western Montana. The 20-acre test site contained heavy concentrations of lodgepole pine, ranging from 4 to 14 inches dbh. Slopes averaged 60 percent, with moderate grass and brush cover.

Before we could test the scarifier implement, much of this slash had to be removed. So 60 to 70 percent of the downed lodgepole was removed. Once yarding was completed, mostly fine slash and rotten logs remained in which to operate the scarifier.

Two to four passes of the scarifier per set provided adequate scarification. Some 500 to 600 planting sites were created per acre, with 3 to 4 acres prepared per operating day. Scalps were 2 to 4 inches deep, 18 to 20 inches wide, and 4 feet long (fig. 3). Needles and duff fell back over some of the scalps and would have to be cleared out before planting.

Another test site in western Montana, on the Flathead Indian Reservation, was in Douglas-fir/ninebark habitat type in the ninebark phase. Slopes were 45 to 50 percent. Vegetative cover consisted of a heavy cover of ninebark. After initial yarding of

heavy slash and cull logs, 33 percent of the test site was plantable. After one or two passes with the cable scarifier, 61 percent was plantable.

Before this treatment, the site would have been difficult to plant, and heavy ground cover and slash limited crew access. After treatment, hand-planting crews had relatively easy access, and the area was immediately planted to ponderosa pine at a spacing of 11 by 11 feet --- 360 trees per acre. Tree planters did some hand scalping to achieve the desired spacing. A check 3 months later showed 96 percent of the seedlings were alive and growing.

Yarding costs for this operation totaled about $170 per acre and scarification costs about $90 per acre (assuming $80 per worker-day personnel costs). However, in areas where fuel loadings are higher and terrain rougher, these costs would go up.

A ceanothus brush field on the Clearwater National Forest in Idaho served as another test site. This area had a steep slope – 60 to 90 percent – and was covered with brush that was 4 to 12 feet tall.

Our scarifying implement did not work well in the area. Even five of six passes were not enough to create adequate planting spots. The brush proved too thick and limber. The implement simply skidded over much of the

Figure 3—*Typical spot dug out by cable scarifier.*

vegetation, seldom reaching the ground. When it did, the yarder did not have the power to tear the brush out by the roots. A heavier scarifying implement and more powerful yarder would be needed.

To determine capabilities on West Coast fuel and brush types, the yarder and cable scarifying implement were tested on five different Bureau of Land Management sites in western Oregon. All had heavy concentrations of light slash with medium to heavy brush cover. Brush commonly was vine maple (*Acer circinatum* Pursh), willow (*Salix* sp.), and bigleaf maple (*A. macrophyllum* Pursh) from 4 to 7 feet tall. De-

pending on the site, it required two to eight passes per set to prepare a site for planting adequately in the estimation of the silviculturist working with the evaluation team.

We also found that material over 24 inches dbh had to be removed before the scarifier could be effective. In addition, the Clearwater Yarder's mainline cable proved too short; West Coast yarder span capability was needed. In addition, convex slopes prevented complete access to some areas needing treatment.

In ideal terrain, where slopes are concave, slash is light, and brush is small, the Clearwater

Yarder and the scarifier worked well. But BLM personnel estimated that in the Eugene District where the tests were conducted, these conditions exist on only about 5 percent of the land needing treatment. Normal conditions on the West Coast would require a bigger yarder and heavier scarification implement.

Discussion and Conclusions

Our evaluation enabled us to identify those conditions in which the scarification implement is likely to work well, resulting in higher production rates and lower costs per acre. We also recognized that there are sites unsuited to this system -- particularly West Coast sites where slash tends to be bigger and the slash loading heavier. The combination of Clearwater Yarder and scarifying implement works well on steep slopes and with slash loadings under 40 tons per acre of fuels smaller than 9 inches dbh and where brush cover is less than 10 feet.

Scarifying costs for site preparation on our test sites ranged from $100 to $200 per acre, with production rates of 2 to 4 acres per 8-hour day (yarding costs were $200 to $400 per acre at 1 to 2 acres per day).

After a thorough evaluation of the scarifying implement, we were able to reach some conclusions about its effectiveness as a site preparation tool:

* Treatment with this implement creates sufficient planting spots to achieve full stocking, and it can be considered a useful option in specific instances.
* The factors limiting cable scarification are terrain (adequate deflection), debris, vegetative cover, and, of course, costs.
* Site preparation with this implement is relatively slow and expensive compared to other current methods such as fire or chemicals.
* A larger yarder with a swing boom and heavier implement would improve production and be more effective in heavier slash and brush.
* Vegetative control is limited with this site preparation method.

Generally, the cable scarifier was effective in disturbing existing vegetation and scarifying soil for planting where conditions were ideal and brush was not large. In large, dense brush, the implement lacked the weight and the yarder lacked the power to be effective. No doubt, a larger yarder with a swing boom and a heavier implement would be more effective in heavier brush and more productive. In addition, the deflection and span capabilities of the Clearwater Yarder limited the areas that could receive site preparation in one set. The mobile tailhold was valuable. Estimates were that production was doubled using it versus using trees and stumps.

To sum up, this yarder-scarifier combination offers an effective alternative for site preparation on steep slopes under the specific conditions outlined and where normal treatment methods are not possible.

Construction drawings for the cable scarifier are available from MEDC; request drawing number MEDC-767. Building costs are estimated at $2,000 to $3,000.

For additional information, write or call the Missoula Equipment Development Center, Building 1, Fort Missoula, Missoula, MT 59801; (406) 329-3958 or FTS 585-3958.