



Bark-Scoring Tools to Repair Tree Grafts

Keith Windell, Project Leader

Grafted seed orchards of Douglas-fir are often subject to tree losses caused by delayed graft incompatibility. When the stock and scion (the grafted branch) are incompatible, the stock and scion wall off the foreign cells with a separation zone of dead, suberized (corky) tissue. The separation zone is termed “brownline.” This response occurs along the entire interface in the bark cells of both the stock and scion. This type of graft failure is the product of the defense mechanisms of each tree. The same process enables trees to wall off invading insects and disease organisms or to cover physical wounds with an impervious or protective covering.

If a graft becomes incompatible several years after grafting, seed production will be lost and genetic variability will be decreased. A number of years will be required to replace the incompatible grafts. Improving the long-term survival and performance of established grafts is difficult.

Bark scoring is one cultural technique that has potential to reduce graft losses and improve tree vigor. Numerous vertical cuts are made across the defective union (figure 1). The primary objective of bark scoring is to improve the flow of water and nutrients (translocation) across the graft union. Bark scoring Douglas-fir grafts temporarily overcomes the incompatibility by physically removing a portion of the barrier of dead tissue separating the living stock and scion cambial cells. New cambia differentiate across the cuts in the newly formed callus tissue. (Donald Copes, PNW-RN-487, 1989).

Small gasoline chain saws are sometimes used to make the small vertical cuts required in bark scoring. Some orchard managers feel that the chain saws are hard to guide with precision and tend to butcher the trees. Chain saws are also awkward to operate and tend to throw chain oil into the cut. A small battery-operated tool called the Woodzig (figure 2) was highly recommended by some managers. Unfortunately, it is no longer available.



Figure 1—This failed tree graft was scored with a chain saw.



Figure 2—The Woodzig was a handy bark-scoring tool. It is no longer available.

The Missoula Technology and Development Center (MTDC) was asked to identify or develop powered tools for safe, precise, and efficient bark scoring.



Project Approach—A bark-scoring tool needs to be relatively inexpensive. Many tools and attachments were considered and purchased. The tools were quickly tested at MTDC to see if they had any inherent safety risks, such as kickback. Special guards were fabricated and the tools were sent out for field evaluation.

Tools Considered

Cordless Circular Saw—One tool considered was a 3 $\frac{3}{8}$ -inch circular saw manufactured by Makita (figure 3). The saw (Model 5090D) is marketed for cutting wooden trim pieces. It is battery operated and uses a 9.6-volt battery that is used in other Makita cordless tools. The saw costs \$80 and is available at local hardware stores. The battery (\$39) and 1-hour battery charger (\$50) are sold separately. The saw is about 12 $\frac{1}{4}$ inches long and weighs about 4 pounds.

Cordless Right-Angle Drill—A 14.4-volt cordless $\frac{3}{8}$ -inch right-angle drill made by DeWalt was used to test different cutter tools. The drill has two speed ranges, one with a maximum speed of 800 rpm, and the other with a maximum speed of 1,250 rpm. The drill (Model DW966K) costs \$210. The price included a battery, a 1-hour battery charger, and a heavy-duty case. The tool is 12 $\frac{1}{2}$ inches long and weighs about 4 pounds with the battery. A 2-inch-diameter carving disc made by Percival, a 4-inch-diameter woodcarving blade made by Arbortech, and a 2-inch-diameter, three-wing slotting cutter made by Whiteside were purchased for testing (figure 4).

Small Cordless Chain Saws—A cordless Makita chain saw was among the tools considered (figure 5). The saw has a 4 $\frac{1}{2}$ -inch cutting capacity. This saw (Model UC120DWA) costs \$230. The price includes a 12-volt rechargeable battery (2.0 ampere hours), a 1-hour battery charger, bar guide, chain, blade cover, file, hex wrench, bottle of chain oil (for manual application), and carrying case. Chain speed is advertised at 520 feet per minute. The unit is 18 $\frac{1}{2}$ -inches long and weighs about 4.8 pounds. The factory tip guard had to be removed before this tool could be used for scoring.

As this project was winding down, another small cordless chain saw became commercially available. The saw is imported by Northern Tool & Equipment Co. from China and sells for \$95 (figure 6). It has not been field tested

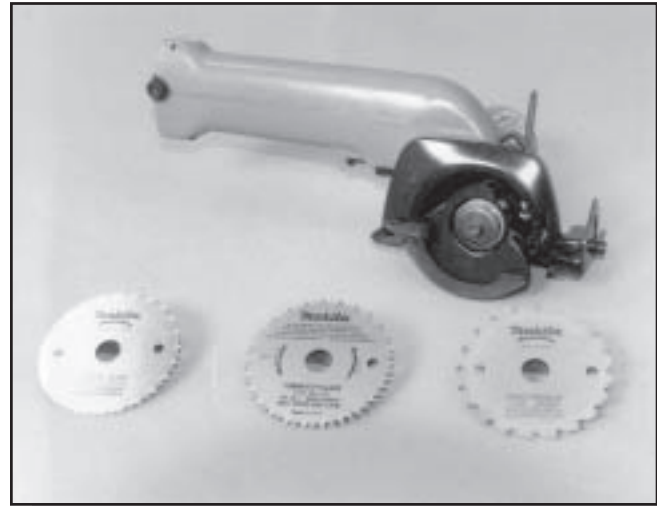


Figure 3—The Makita 3 $\frac{3}{8}$ -inch cordless circular saw.



Figure 4—The DeWalt cordless right-angle drill with (left to right): Percival 2-inch carving disc, Arbortech 4-inch-diameter industrial woodcarver blade, Whiteside 2-inch-diameter, three-wing slotting cutter, and Whiteside $\frac{1}{4}$ -inch-shank arbor with bearing.



Figure 5—The Makita cordless chain saw.

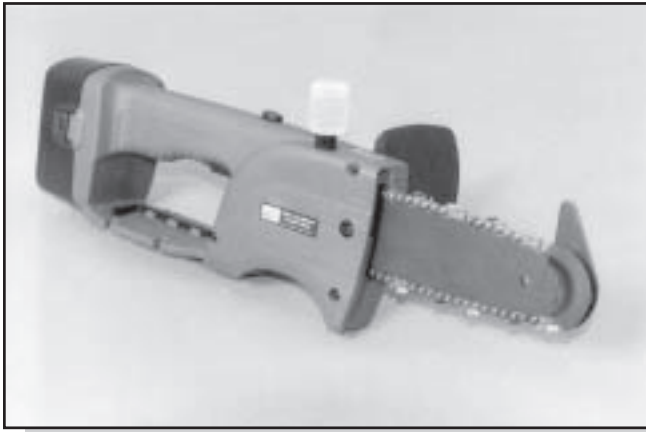


Figure 6—A cordless chain saw imported from China by the Northern Tool & Equipment Co.

so we can only compare its attributes to those of the Makita cordless chain saw. The Northern Tool & Equipment Co. chain saw uses the same size bar, and a similar saw chain and chain tensioning system as the Makita chain saw. The price includes an 18-volt rechargeable battery (1.7 ampere hours), a 3- to 5-hour battery charger, bar guide, chain, blade cover, and hex wrench. At this time extra batteries are not available through Northern Tool & Equipment Co. Chain speed is 465 feet per minute. The saw does offer a chain oiler system and rubber motor-housing gripping surface, features lacking on the Makita. The saw is about 19 inches long and weighs about 5.6 pounds.

Cordless Rotary Tool—A small rotary tool called the Wizard (sold by Black & Decker, figure 7) was tested for use on small stems (less than 1 inch in diameter). It has a pistol-grip handle and costs about \$50. A 3.6-volt rechargeable battery, a 3-hour battery charger (holds two VersaPak batteries), assorted attachments, and a carrying case are included. Extra batteries cost about



Figure 7—The Wizard cordless rotary tool with a high-speed rotary cutter and Lexan guard.

\$13 each. MTDC tried various rotary tool high-speed cutters and even adapted a 2-inch-diameter Arbortech woodworking saw blade for use on the Wizard. The tool weighs about 1.1 pounds.

MTDC Modifications

MTDC modified two tools: the Makita cordless chain saw, and the Black & Decker Wizard rotary tool.

Early in the project the Woodzig bar with wire chain was adapted for mounting on the Makita saw (figure 8). The original bar and chain was more versatile, allowing the saw to be used on larger trees, so this approach was dropped. Modification of the chain bar on the Makita cordless chain saw (figure 9) includes:

- Removing the factory tip guard.
- Grinding the rivets flush with the bar and staking them.
- Fabricating and installing the MTDC guard.



Figure 8—The Makita saw with the Woodzig bar and wire chain.



Figure 9—The MTDC modifications of the Makita cordless chain saw for bark scoring included removing the factory tip guard.

The materials cost about \$10 with 2 hours labor for all modifications.

Modification for the Wizard (figure 10) includes:

- Fabricating a circular Lexan guard.
- Purchasing a 2-inch-diameter Arbortech industrial saw blade.
- Fabricating an adapter to mount the Arbortech blade.
- Purchasing a 1/4-inch arbor so the adapter can be mounted on the rotary tool.
- Fabricating a holster for the Wizard (figure 11).

The materials cost about \$36 with about 2½ hours labor for all modifications.

Shop drawings for each of the modifications are available on request. For the Makita modifications ask for *Makita Bark Scoring Tool* (MTDC Drawing No. 986). For the Wizard modifications ask for *Wizard Bark Scoring Tool* (MTDC Drawing No. 987). Suggested Job Hazard Analyses will be included in each drawing set.

Field Evaluation

The field evaluation took place on the Rogue River National Forest. The basic premise was that people who did bark scoring operationally could best decide which was the optimal tool(s). Hal Miller and Ron Colton evaluated the bark-scoring tools at a Douglas-fir seed orchard on a broad diameter-range of trees. Factors such as bark thickness, swelling on tree bole in the grafted area, and tenderness of the bark on younger trees influenced their final recommendations. Most of the tools were weeded out quickly. Damage to trees or poor tool ergonomics was the usual reason. Occasionally a tool guard had to be revamped by MTDC's shop to allow for more efficient operation. Questions about the field evaluation can be answered by calling Hal Miller at 541-858-2329, or sending E-mail to: hnmiller@fs.fed.us.

Cordless Circular Saw—Some grafted Douglas-fir trees have a large swollen area at the graft union. The circular saw did not do a good job of creating a cut that was deep or uniform enough. Also, the standard saw blades were too narrow. Larger cordless circular saws are heavy and are hindered by lower tree limbs. This type of tool was dropped from further consideration.

Cordless Right-Angle Drill—The field evaluators said the Percival cutter design worked but was not their first choice. The Whiteside and Arbortech cutter



Figure 10—The Wizard cordless rotary tool with 2-inch-diameter Arbortech industrial blade and Lexan guard.



Figure 11—A holster for the Wizard bark scoring tool.

designs were not intended to operate at the right-angle drill's slow speeds and bounced around, damaging the tree. The right-angle drill was somewhat awkward to operate. The tool was dropped from further consideration.

Small Cordless Chain Saws—For scoring trees in the 1- to 8-inch-diameter class, the field evaluators preferred the cordless Makita chain saw fitted with MTDC's chain guard. This tool was very well balanced and had a comfortable handle. A Job Hazard Analysis was written stressing operational techniques that minimized the possibility of kickback. This was the only tool that was tested over an extended period of time. The saw cut about 180 trees (5- to 6-inch d.b.h.) with two fully charged batteries during a full 8-hour day. The operator reported no fatigue. All work was fast and efficient with very clean cuts. Clean cuts heal much faster than those made by a gasoline-powered chain saw that throws petroleum-based chain oil into the cut.

The cordless chain saw from China does not feel as well balanced as the Makita saw. It also comes with a different

chain (figure 12) that only has one raker behind the cutter tooth as opposed to the two rakers the Makita chain has behind the cutter tooth. The evaluators thought the Makita saw made a cleaner cut than the saw from China. Because of battery problems with the saw from China, no extended time-motion data were collected.



Figure 12—Cordless chain saw chains. The Makita chain on the left has two rakers for every cutter rather than one.

Cordless Rotary Tool—The Wizard produced a precision cut when scoring very-small-diameter stems (figure 13). This tool was very well balanced.



Figure 13—The Wizard made precision cuts on small branches.

Conclusions

The best all-around tool for tree scoring was the Makita cordless chain saw with MTDC bar modifications. For very-small-diameter stems (1 inch or smaller), the Black & Decker Wizard with rotary cutter or 2-inch-diameter Arbortech woodcarving blade is a good choice. In addition to locating useful commercially available tools, MTDC has developed modifications for these tools that should make them safer and more efficient for bark scoring. The guards were modified based on comments from the field evaluators. Engineering drawings of the modifications are available over the Forest Service's internal computer network at <http://fsweb.mtdc.wo.fs.fed.us/dwf/index.htm> or as hard-copy drawings upon request. As these tools continue to be used, additional modification requests may come in from the field. If they do, MTDC will tackle them with Nursery Tech Services funding. This project is now formally terminated.

Equipment Sources for Specialty Saws

❑ Makita Model UC120DWA 12-Volt Cordless Chain Saw (\$230).

- Any Makita authorized dealer.
- Harbor Freight Tools
3491 Mission Oaks Blvd.
Camarillo, CA 93011-6010
Phone: 800-423-2567
Fax: 800-905-5220
Web site: <http://www.harborfreight.com>

❑ 18-Volt Cordless Chain Saw from China (\$95)

- Northern Tool & Equipment Co.
P.O. Box 1499
Burnsville, MN 55337-0499
Phone: 800-533-5545
Fax: 952-894-0083
Web site: <http://www.northerntool.com>

The next five items are all available from the source following them.

❑ Arbortech 2-inch industrial blade from minigrinder woodworking kit (\$25)

❑ Arbortech Industrial Pro Kit with 4-inch, carbide-tooth industrial blade (\$100)

❑ Percival Carving Disc (\$62)

□ **Whiteside Three-Wing Slotting Cutter** (\$18)

□ **Whiteside 1/4-Inch-Shank Arbor With Bearing** (\$11)

- Woodcraft Supply Corp.
560 Airport Industrial Park
P.O. Box 1686
Parkersburg, WV 26102-1686
Phone: 800-225-1153
Fax: 304-428-8271

□ **High-Speed Steel Cutters for Rotary Tools**

- Any hardware store that sells Dremel tools.
- Woodcraft Supply Corp. (address above).
- Micro-Mark
340 Snyder Ave.
Berkeley Heights, NJ 07922-1538
Phone: 800-225-1066
Fax: 908-665-9383
Web site: <http://www.micromark.com>

About the Author

Keith Windell is a Project Leader for reforestation, fire and residues projects. He has a bachelor of science degree in mechanical engineering from Montana State University, as well as an extensive field background. He has worked for the California Department of Forestry, Bureau of Land Management, and the Forest Service.

Library Card

Windell, Keith. 2000. Bark-scoring tools to repair tree grafts. Tech Tip 0024-2372-MTDC. Missoula, MT: U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center. 6 p.

Describes tests of powered handtools used to score (cut) bark when repairing tree grafts in Douglas-fir seed orchards. When grafts are incompatible, a wall of corky (suberized) tissue forms between the host tree and the grafted branch. This wall prevents water and nutrients from flowing properly. Narrow cuts in the wall can allow water and nutrients to flow, enabling the grafted branch to survive. Small gasoline-powered chain saws have been used to make these cuts in the past, but they tend to butcher trees and throw chain oil into the cut, preventing it from healing properly. The Missoula Technology and Development Center tested a number of small, powered handtools. The best all-around tool for tree scoring was the Makita cordless chain saw (Model UC120DWA) with several custom modifications. The Black & Decker Wizard with a rotary cutter or 2-inch Arbortech woodcarving blade was a good tool for scoring small-diameter stems.

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