TECHNICAL NOTE

USDA - Natural Resources Conservation Service
Boise, Idaho

PLANT MATERIALS TN NO. 6 **OCTOBER 2008**
REVISED

THE STINGER

A TOOL TO PLANT UNROOTED HARDWOOD CUTTINGS

J. Chris Hoag, Wetland Plant Ecologist, PMC, Aberdeen, Idaho
Dan Ogle, Plant Materials Specialist, Boise, Idaho

THE STINGER

A Tool to Plant Unrooted Hardwood Cuttings of Willow and Cottonwood for Riparian, Streambank or Shoreline Erosion Protection

J. Chris Hoag, Wetland Plant Ecologist, PMC, Aberdeen, Idaho
Dan Ogle, Plant Materials Specialist, Boise, Idaho

Introduction

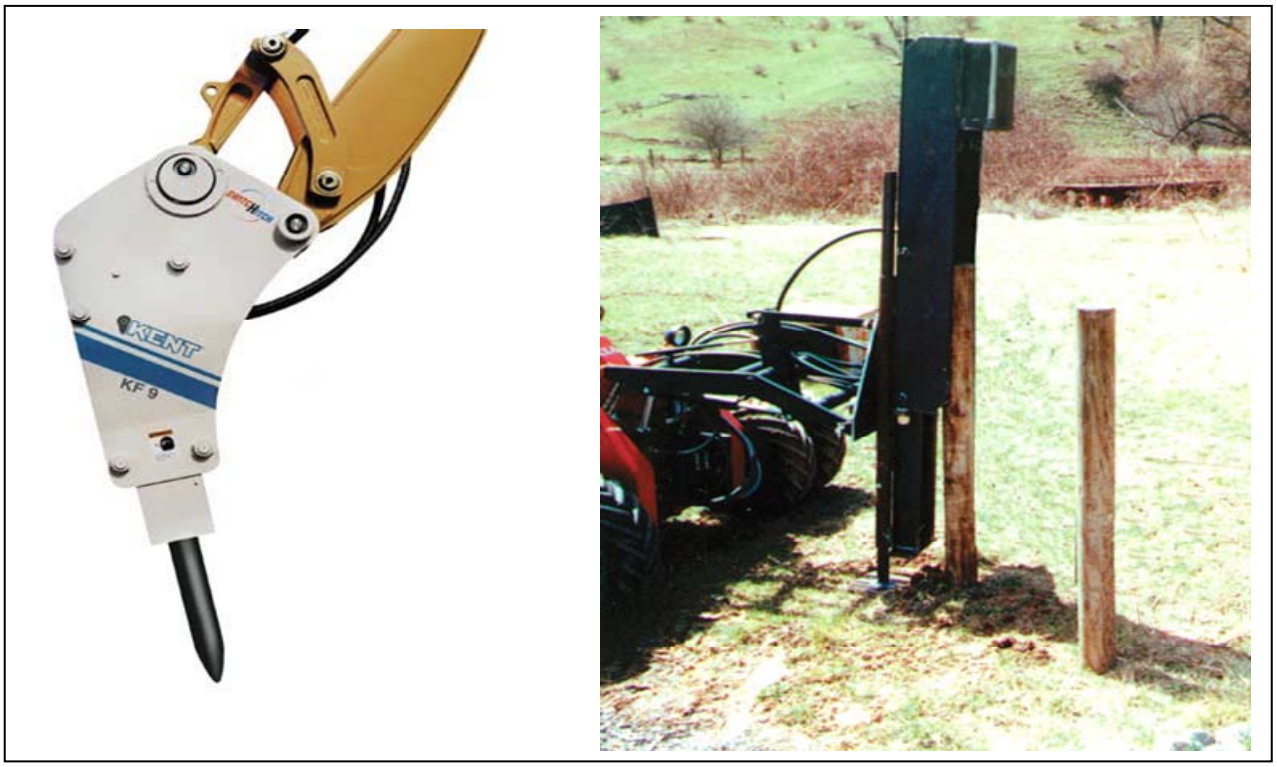
Rock rip-rap has been used throughout North America to control shoreline and channel erosion on lakes, reservoirs, rivers, and streams. In an effort to improve the aesthetics of rock rip-rap, cut down on the maintenance and replacement of damaged sections of rip-rap, improve water quality and enhance wildlife habitat, the USDA – Natural Resources Conservation Service, Plant Materials Center, Aberdeen, Idaho has developed a tool called "The Stinger" (Hoag and Short, 1993). The technology is not new, but many basic design improvements to this tool to facilitate planting unrooted cuttings into rock rip-rap or on steep banks have been made.

The Stinger is designed for planting willow and cottonwood cuttings into rock rip-rap. In the past, unrooted woody vegetation was planted into rock rip-rap, but planting methods concentrated on inserting the cuttings in the ground first and then dumping rock on top of the cuttings or planting through rip-rap with a steel bar or other hand planting tool. These methods can be effective when installed properly, but are not always efficient and because of improper planting techniques, have not always achieved great cutting establishment success. The Stinger, however, builds on these methods and utilizes the power of a backhoe to plant larger diameter and longer unrooted cuttings than was possible before. The Stinger can plant unrooted cuttings through rock rip-rap with minimal effort to better stabilize the rock. This method allows the placement of cuttings above the ice layer on reservoirs where they are not as likely to be torn out by the force of the ice. Planting woody vegetation into rip-rap also improves the strength and aesthetics of the rip-rap.

The Stinger is designed to fit on the end of a backhoe arm in place of the bucket. It is constructed by welding a long cold rolled round steel bar to a support frame. The support frame is attached to the backhoe arm, using the same pins that would be used to secure the bucket to the backhoe arm. The upper hydraulic ram on the backhoe arm moves the bar forward and backward so holes can be punched at almost any angle. See attached specification sheet and drawing on pages 6 and 7 for actual design. The entire attachment weighs approximately 900- 1000 pounds and can be transported either attached to the backhoe arm or in a pickup or truck bed. The Stinger was designed to be heavy enough to punch a hole through spaces between large rock rip-rap and into the moist to wet soil under the rock. Once The Stinger reaches the soil under the rock rip-rap, it is pushed into the soil deep enough to make a hole that allows the placement of the cutting into permanently moist soil.

Over the years, other modifications have been made using different attachments to a backhoe. In one case, a hydraulic breaker attachment was used with a longer rod to push large cuttings into large cobble embedded streambanks. The rod is placed on the streambank and the vibratory mechanism is turned on and the whole apparatus will vibrate into the streambank. A helper is there

with a willow pole and he pushes it into the hole when the backhoe operator pulls the rod out. In another case, the contractor used a post pounder attachment to a bobcat and reached over the streambank and pounded the cuttings in at the various zones. Each of these attachments works well for planting willow poles, but they are also very expensive. While the stinger is about $1000 to build, the other attachments are from $8000-$20,000.



Examples of backhoe and bobcat attachments that can be used to install willow poles into the streambank either through rock rip-rap or into bare bank situations. A Hydraulic Breaker (left) can vibrate the tip into cobble streambanks, and the Post Pounder (right) can pound posts (large cuttings) into the soil.

Planting Methods

The willow or cottonwood pole is inserted part way into the hole. A metal cap is placed over the top of the cutting and the tip of The Stinger is placed on the top of the cap. The backhoe operator then pushes The Stinger down, pushing the cutting into the hole. Only 1- 2 feet of the cutting should remain above the rock surface. The majority of the cutting (2/3 to 3/4 of the length) should be in the ground. To finish up, take a shovel and throw some dirt in around the top of the hole to make sure there is good soil to stem contact for the cutting

The Stinger can plant 3- 6 inch diameter by 4- 12 feet long unrooted willow and cottonwood cuttings directly through rip-rap. In field tests in southern Idaho and northern Nevada, this size cutting has had excellent establishment success when two key planting guidelines are followed:

First, the cuttings should be planted deep enough to be in permanently moist soil.
Second, the cutting tops should extend 1- 5 feet above the high water level.

Planting a willow pole into rock riprap. In photo 1, the stinger has already punched a hole into the rock. In photo 2, the cap is placed on the pole and the stinger is guided into the hole in the top of the cap. In photo 3, the stinger pushes the pole into the pre-punched hole. The cutting will have about 1 foot sticking out of the ground when done.

For irrigation reservoirs that have highly fluctuating water levels, the initial hole should be placed one vertical foot below the high waterline in the spring of the year for best results. Plant the cuttings when the water level has dropped two vertical feet or more below the high waterline. If plantings are planned on reservoirs that are operated differently, care should be taken to ensure the cuttings are in moist soil during the growing season, but not inundated longer than 1 month. Once established, cuttings can be inundated for longer periods of time.

If shoreline erosion control is the primary purpose of the planting, always plant in layers using different types of willow and/or cottonwood species. Shrub-type willows should be planted in the first row (on the water side) and tree-type willows or cottonwoods should be planted further up the bank. The shrub-type willows intercept the wave first and absorb most of its erosive energy. Shrub-type willows have more flexible stems that will bend and not break. Tree-type willows or cottonwoods have less flexible stems, but have deeper root systems and larger trunk diameters that can withstand more wave energy (Hoag 1993).

If the planting site has been rip-rapped, plant one row of shrub-type willows about 4- 6 feet apart and one row of tree-type willows or cottonwoods about 5- 8 feet up the bank on a 10- 12 feet spacing. The spacing depends on the type of maintenance that is planned for the planting site. Plant the cuttings at wider spacing if equipment will be used to pull rock rip-rap back up the bank as part of a regular maintenance schedule.

If the planting site has not been rip-rapped and has a vertical slope, which is common in riparian corridors, plant each layer with a narrower spacing and the cuttings closer together to provide better

protection for the exposed soil. Shrub-type willows have been planted as close as 1- 2 feet apart, while the tree-type willows have been planted as close as 5- 6 feet apart.

The primary limiting factor for establishing cuttings is moisture. The key to good establishment is placing the cuttings into permanently moist soil where competition from the roots of the surrounding vegetation is significantly decreased (Hoag et al. 1991).

When planting unrooted cuttings into rock rip-rap, vertical banks, or eroded streambanks, insert the cuttings at a 45° angle to the water surface. This will protect the cuttings from damage caused when the bank above the cutting sloughs off and crashes down onto the stem. This sloughing can cause a vertically planted cutting to break off or to be torn out of the ground. This technique also reduces the damage the cutting might sustain from heavy wave action, floating debris, or floating ice chunks.

A maintenance schedule is very important for the first 2 years following the planting. Dead cuttings should be replaced as soon as possible to prevent holes in the vegetative "armor" that could allow excessive wave energy through to impact the shoreline. The longer the period between planting and replacement, the higher the potential erosion hazard to the shoreline or streambank.

Other uses for the Stinger

We have also used the stinger to pin large hay bales to the bank with large willow poles. In one project, the state permitting agency required the use of hay bales as barbs rather than rock. The bales were installed using The Stinger to pound large willow poles through the bales to secure them to the bank during high water flows. Another use might be to pin gabions to the streambed to improve their stability so they do not tip over.

An example of an alternate use of The Stinger is pinning a hay bale to the bank so high stream flows will have a harder time removing them from the streambank

Summary

The Stinger is a relatively inexpensive tool for planting vegetation on streambanks and shorelines. It is particularly well suited for retrofitting established rockrip. It can be adapted in a variety of ways to fit unusual situations like cobble bed streams, alternative streambank erosion control techniques, and hard to plant areas. The design has been fitted to a number of different brand name backhoes with very little adjustment.

One of the main positive benefits of The Stinger is the cost. It is relatively cheap and easy to build when compared to purchasing and then modifying some of the backhoe attachments.

The operation of The Stinger takes a slightly different skill set from the operator than typical backhoe work. The combination of lifting The Stinger up at a slight angle and then pounding it down into the same hole without expanding the hole too much is difficult and time consuming. A lot of time and money can be saved by having a highly skilled backhoe operator running The Stinger.

The Stinger is another tool that is available to a riparian restorationist. It can help in unusual situations where standard planting techniques will not work well. It is easy to build and cheap enough to be affordable.

THE STINGER - DESIGN SPECIFICATIONS

SHAFT
1) Cold rolled round steel bar

2) 8 feet long including attachment area

3) Total length for punching holes is 7 feet

4) Business end of the bar is pointed and hard-faced with electric welding rod

5) The bar is 3.5 inches in diameter

MAINFRAME
1) The mainframe attaches "The Stinger" to a backhoe

NOTE: This particular design is for a backhoe that has a quick coupler hitch which allows for quick and easy removal of the bucket (usually found on CASE backhoes). Some modification to the design will be necessary for a backhoe that does not have a quick coupler attachment.

2) Mainframe is manufactured from 3/4-inch steel plate

3) Mainframe is designed to support the bar and to provide a point of attachment to the main hydraulic arm of the backhoe. This allows the bar to move back and forth so it can punch a hole into a vertical bank at almost any angle.

4) Dimensions of mainframe are 15.5 inches tall (parallel to bar) by 16.5 inches wide by 10 inches deep

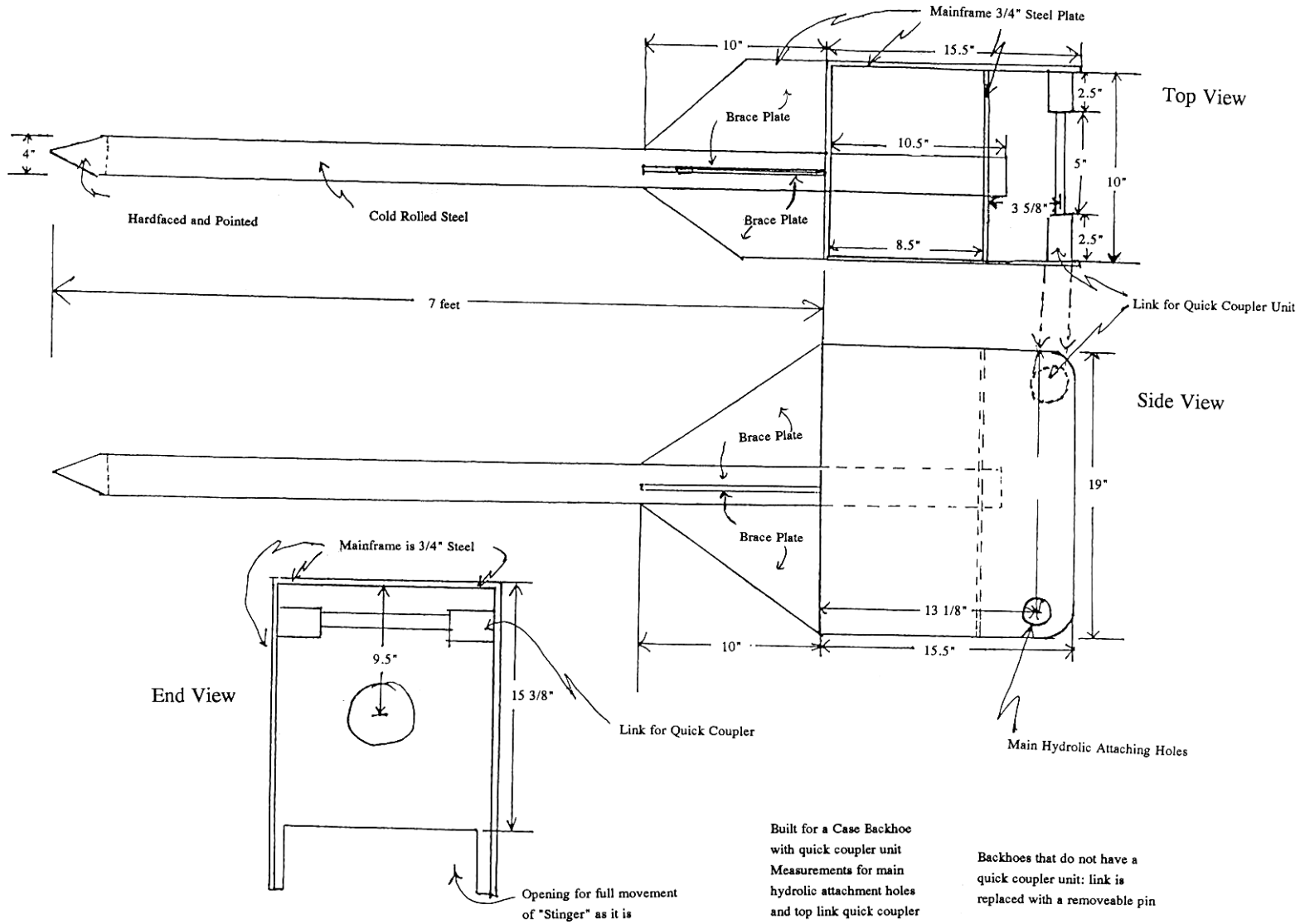
5) The heavy materials called for in this design are necessary because of the heavy torque and pressure that is exerted on the bar as it is pushed into the rock riprap and the soil underneath it. Lighter materials can be used if the planting site is coarse soil with no rock rip-rap.

CAP
1) The cap is made of 2 pieces of steel pipe welded together end to end with a separator plate between them. The diameter of the top piece should be slightly bigger than the diameter of The Stinger bar. The diameter of the bottom part of the cap is based on the size of the cuttings that will be planted. The steel pipe pieces should be about 10-12 inches long.

2) Handles are welded on to the sides of the pipe at the welding point. The handles are used by the worker to move the cap from one place to the next and to place the cap on top of the cutting.

NOTE: The potential designs of a custom-made Stinger are not limited to these specifications. A skilled machine shop or welder should be able to manufacture a similar tool that is specifically designed to fit on available equipment and heavy enough for conditions found at a typical planting site.

THE STINGER



Built for a Case Backhoe with quick coupler unit Measurements for main hydrolic attachment holes and top link quick coupler unit will vary for different backhoes.

Backhoes that do not have a quick coupler unit: link is replaced with a removeable pin

Estimated Cost = $1250.00

Useful References

Briggs, J.A. and B. Munda. 1992. Collection, evaluation, selection, and production of cottonwood poles for riparian area improvement. Final Report to the US Fish & Wildlife Service. USDA-SCS, Tucson Plant Materials Center, Tucson, AZ. 32 p.

Carlson, J.R. 1992. Selection, production and use of riparian plant materials for the western Unites States. In: Proceedings--Intermountain Forest Nursery Association. USDA Forest Service Gen. Tech. Rep. RM-211. Rocky Mountain Forest and Range Experiment Station, Ft. Collins, CO. pp 55-67.

Carlson, J.R., Conaway, G.L., Gibbs, J.L., and Hoag, J.C. 1991. Design criteria for revegetation in riparian zones or the intermountain area. In: Proceedings--Symposium on Ecology and Management of Riparian Shrub Communities. USDA Forest Service Gen. Tech. Rep. RM-65. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. pp 163-166.

Carlson, M.C. 1938. The formation of nodal adventitious roots in *Salix cordata*. American Journal of Botany 25: pp 721-725.

Carlson, M.C. 1950. Nodal adventitious roots in willow stems of different ages. American Journal of Botany 37: pp 555-561.

Chmelar, J. 1974. Propagation of willows by cuttings. New Zealand Journal of Forestry Science 4: pp 185-190.

Crouse, M.R. and R.R. Kindschy. 1984. A method for predicting riparian vegetation potential of semi-arid rangelands. In: Proceedings--1984 Pacific Northwest Range Management Short Course; range watersheds, riparian zones, and economics: interrelationships in management and use, Corvallis, OR. 83 p.

Densmore, R. and J.C. Zasada. 1978. Rooting potential of Alaskan willow cuttings. Canadian Journal of Forest Research 8: pp 477-479.

Dirr, M.A. and C.W. Heuser, Jr. 1987. The reference manual of woody plant propagation: from seed to tissue culture. Varsity Press, Inc., Athens, GA. 239 p.

Fenchel, G., W. Oaks, and E. Swenson. 1988. Selecting desirable woody vegetation for environmental mitigation and controlling wind erosion and undesirable plants in the Rio Grande and Pecos River valleys of New Mexico. Five year interim report (1983-87). Los Lunas, NM: USDA-SCS Los Lunas Plant Materials Center. 49 p.

Fischenich, C. 2000. Glossary of Stream Restoration Terms. USACE Waterways Experiment Station, ERDC TN-EMRRP-SR-01, Vicksburg, MS. 16 p.

Haissig, B.W. 1970. Preformed adventitious root initiation in brittle willows grown in controlled environment. Canadian Journal of Botany 48: pp 2309-2312.

Haissig, B.W. 1974. Origins of adventitious roots. New Zealand Journal of Forest Science 4(2): 299-310.

Hoag, J.C. 1991. Planting Techniques from the Aberdeen, ID, Plant Materials Center for vegetating shorelines and riparian areas. In: Proceedings--Symposium on Ecology and Management of Riparian Shrub Communities, USDA Forest Service Gen. Tech. Rep. RM-65. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. pp 163-166.

Hoag, J.C. 2003. Willow Clump Plantings. Technical Note 42, USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID. TN-42, Dec. 2003. 8p.

Hoag, J.C. 2007. How to plant willows and cottonwoods for riparian restoration. USDA Natural Resources Conservation Service, Idaho Plant Materials Technical Note No. 23, Boise, ID. 23 p.

Hoag, J.C. and H. Short. 1993. Use of willow and poplar cuttings for vegetating shorelines and riparian areas. Paper presented at USA Corps of Engineers & USDI Bureau of Reclamation Reservoir Shoreline Erosion Control and Revegetation Workshop, Riverton, WY. April, 1993. 12 p.

Hoag, J.C., B. Simonson, B. Cornforth, and L. St. John. 2001. Technical Note 39: Waterjet Stinger - A tool to plant dormant unrooted cuttings of willows, cottonwoods, dogwoods, and other species. USDA-NRCS, Boise, ID. ID- TN39, Feb. 2001. 13p.

Hoag, J.C., F.E. Berg, S. K. Wyman, and R.W. Sampson. 2001. Riparian Planting Zones in the Intermountain West. USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID. Riparian/Wetland Project Information Series No. 16, Mar. 2001. 24p.

Hoag, J.C., G.L. Young, and J.L. Gibbs. 1991. Planting techniques for vegetating riparian areas from the Aberdeen Plant Materials Center. Paper presented at The 45th Annual Meeting of the Society for Range Management, Spokane, WA. 6 p.

Hoag, JC. 2005. Simple Identification Key to Common Willows and Cottonwoods of the Intermountain West. USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID. Riparian/Wetland Information Series 19, May 2005. 16p.

Kauffman, J.B. and W.C. Krueger. 1984. Livestock impacts on riparian ecosystems and streamside management implications...a review. Journal of Range Management 37: pp 430-437.

Kay, C.E. and S. Chadde. 1992. Reduction of willow seed production by ungulate browsing in Yellowstone National Park. In: Proceedings--Symposium on Ecology and Management of Riparian Shrub Communities. USDA Forest Service Gen. Tech. Rep. RM-65. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. pp 92-99.

Natural Channel Designs, 2006. Santa Clara River Master Plan, St. George, UT. Tom Moody, Flagstaff, AZ. August 2006.

Ogle, D.G. 1990. Restoration of Severely Eroded Streambanks Using Willow Poles. Paper presented at SCS Training Course (EP&I), Boise, Idaho. 2 p.

Parsons, P.A. 1963. Vegetative control of streambank erosion. In: Proceedings of the Federal Interagency Sedimentation Conference. Misc. Publ. 970. USDA Agricultural Research Service (Science and Education Administration), Washington, D.C. pp 130-136.

Peterson, L.A. and H.M. Phipps. 1976. Water soaking pretreatment improves rooting and early survival of hardwood cuttings of some Populus clones. Tree Planter's Notes 27 (1): pp 12, 22.

Phipps H.M., E.A. Hansen and A.S. Fege. 1983. Pre-plant soaking of dormant *Populus* hardwood cuttings. St. Paul (MN): USDA Forest Service, North Central Forest Experiment Station. Research Paper NC-241. 9 p.

Platts, W.S. 1981. Impairment, protection, and rehabilitation of Pacific Salmonid habitats on sheep and cattle ranges. In: Proceedings--Propagation, enhancement and rehabilitation of anadromous Salmonid habitat in the Pacific Northwest. Humboldt State University, Arcadia, CA. pp 82-92.

Platts, W.S. and J.N. Rinne. 1985. Riparian and stream enhancement management and research in the Rocky Mountains. North American J. Fish Manage 5: pp 115-125.

Platts, W.S., C. Armour, G.D. Booth, and others. 1987. Methods for evaluating riparian habitats with applications to management. USDA Forest Service Gen. Tech. Rep. INT-221. Intermountain Research Station, Ogden, UT. 177 p.

Schaff S.D., S.R. Pezeshki, F.D. Shields. 2002. Effects of pre-planting soaking on growth and survival of black willow cuttings. Restoration Ecology 10(2):267-274.

Schultze, R.E. and G.I. Wilcox. 1985. Emergency measures for streambank stabilization: an evaluation. Paper presented at North American Riparian Conference, Tucson, AZ, April, 1985. 3 p.

Skovlin, J. M. 1984. Impacts of grazing on wetlands and riparian habitat: a review of our knowledge. In: Natural Research Council/Natural Academy of Sciences. Developing Strategies for rangeland management, Boulder, CO: Westview Press. pp 1001-1103.

Stange, C., D.G. Ogle, and L. St. John. 2002. Technical Note 43: Tree Planting Care and Management. Idaho NRCS State Office, Boise, ID. Apr. 2002. 30p.

Thomas, J.W., C. Maser, and J.E. Rodiek. 1979. Wildlife habitats in managed rangelands--the Great Basin of southeastern Oregon, riparian zones. USDA Forest Service Gen. Tech. Rep. PNW-80. Pacific Northwest Forest and Range Experiment Station, Portland, OR. 18 p.

USDA, NRCS 2006. Idaho Web Page (http://www.id.nrcs.usda.gov/programs/plant.html, 25 July, 2006). Idaho NRCS State Office, Boise, ID 83709 USA

Van Haveren, B.P. and W.L. Jackson. 1986. Concepts in stream riparian rehabilitation. In: Transactions of the 51st North American Wildlife and Natural Resources Conference. pp 280-289.

Wyman, S., D. Bailey, M. Borman, S. Cote, J. Eisner, W. Elmore, B. Leinard, S. Leonard, F. Reed, S. Swanson, L. Van Riper, T. Westfall, R. Wiley, and A. Winward. 2006. Riparian area management: Grazing management processes and strategies for riparian-wetland areas. Technical Reference 1737-20. BLM/ST/ST-06/002+1737. U.S.DI, BLM, National Science and Technology Center, Denver, CO. 105 p.

For additional information, contact:

J. Chris Hoag, Wetland Plant Ecologist
USDA Natural Resources Conservation Service
Plant Materials Center
Aberdeen, ID 83210-0296
Phone: (208) 397-4133
Email: Chris.Hoag@id.usda.gov

Dan Ogle, Plant Materials Specialist
USDA Natural Resources Conservation Service
9173 West Barnes Dr, Ste C
Boise, Idaho 83709
Phone: (208) 685-6987
Email: Dan Ogle@id.usda.gov