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THE STINGER

A TOOL TO PLANT UNROOTED HARDWOOD CUTTINGS

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THE STINGER

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

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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, reduce 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 developed a tool called "The Stinger" (Hoag and Short, 1993). The technology is not new, but many basic design improvements have been made. to facilitate planting unrooted cuttings into rock rip-rap or on steep banks.

The Stinger is designed for planting willow and cottonwood cuttings and poles into rock rip-rap. In the past, unrooted woody vegetation was either planted prior to rock placement, or cuttings were planted 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 establishment success. The Stinger, however, builds on these methods and utilizes the power of a backhoe to plant larger diameter and longer unrooted cuttings or poles than was possible before. The Stinger can plant unrooted cuttings through rock rip-rap with minimal effort. This method also allows the placement of cuttings above the ice layer on reservoirs where cuttings are not as likely to be torn out by the force of the ice. Planting woody vegetation into rip-rap also improves the strength, stability 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 8 and 9 for actual design. The entire attachment weighs approximately 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 various backhoe attachments (figure 1). In one case, a hydraulic breaker attachment was used in conjunction 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 causing the whole apparatus to vibrate into the streambank. A

helper then pushes the willow pole into the hole after 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.

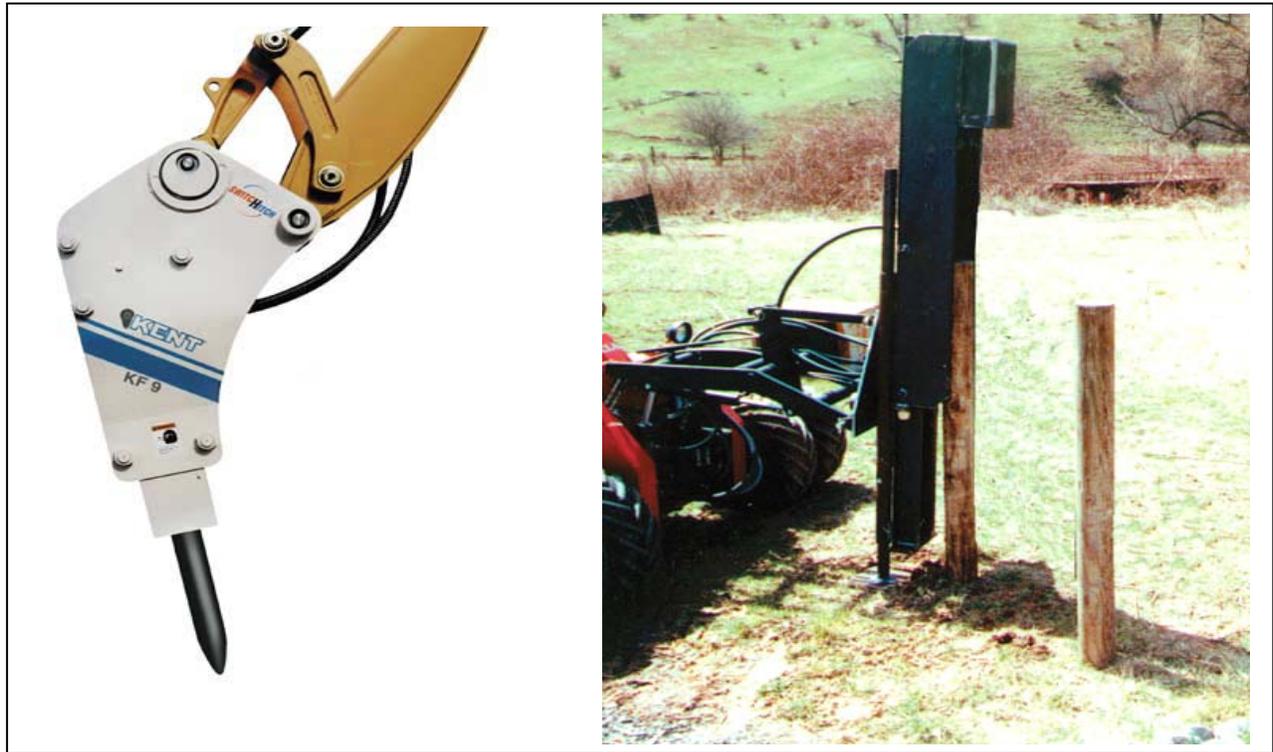


Figure 1. Examples of backhoe and bobcat attachments that can be used to install willow poles into the streambank through rock rip-rap. A Hydraulic Breaker (left) can vibrate the tip into cobble streambanks, and the Post Pounder (right) can pound posts (large cuttings or poles) into the soil.

Planting Methods

The stinger is first used to punch a hole through the rip-rap and into the soil. The willow or cottonwood cutting or pole is then 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 (figure 2). The backhoe operator then pushes the Stinger down, pushing the cutting into the hole. Only 1- 2 feet of the cutting or pole 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 or poles directly through rip-rap. Planting tests in Idaho and Nevada have demonstrated this size cutting has had excellent establishment success. Two guidelines are recommended:

- First, the cuttings should be planted deep enough to be in permanently moist soil
- Second, the top of cuttings should extend 1- 3 feet above the high water level



Figure 2. 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. When complete, the cutting or pole will stick out of the ground about 1 foot.

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, 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 such as coyote willow (*Salix exigua*), should be planted in the first row closest to the shore, 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 cottonwoods or willows have less flexible stems, but have deeper root systems and larger trunk diameters that can withstand more wave energy.

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 tree-type species have been planted as close as 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 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

The stinger has been used to pin large hay bales to the bank with large willow poles (figure 3). 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, brush mattresses, and vertical bundles to the streambed to improve their stability.



Figure 3. 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 an excellent tool for planting vegetation on streambanks and shorelines. It is particularly well suited for retrofitting established rock riprap. It can be adapted in a variety of ways to fit unusual situations such as cobble bed streams, alternative streambank erosion control techniques, and hard to plant areas. The design has been adjusted to fit a number of different brand name backhoes.

One of the positive benefits of the Stinger is the cost. It is relatively inexpensive and easy to build when compared to purchasing and modifying 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. 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. It is easy to build and 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.

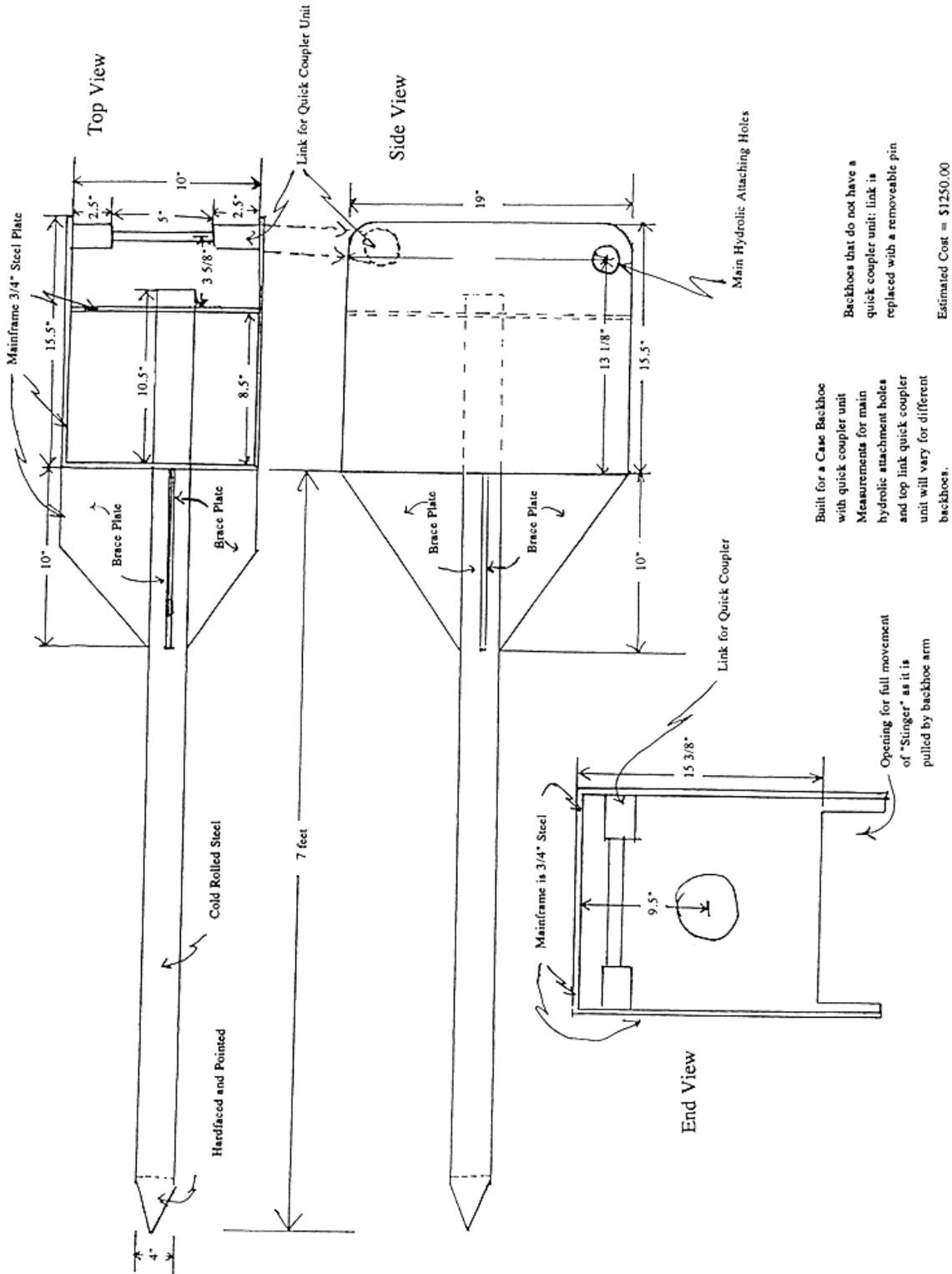
- 2) Mainframe is manufactured from 3/4-inch steel plate
- 3) Mainframe is designed to support the bar and to provide a point of attachment to the main hydraulic arm of the backhoe. This allows the bar to move back and forth so it can punch a hole into a vertical bank at almost any angle.
- 4) Dimensions 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 will 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 hydraulic 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 removable pin

Estimated Cost = \$1250.00

References

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.

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For additional information contact:

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