OUTPLANTING LONG TUBES WITH THE EXPANDABLE STINGER: A NEW TREATMENT FOR RIPARIAN RESTORATION

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Abstract

Long tubes are a new stock type developed specifically for restoration of challenging sites such as disturbed riparian areas. Constructed out of polyvinyl chloride plastic pipe, long tubes have a Vexar lining to promote good root growth and easier extraction. The expandable stinger is a new invention that was developed to outplant long tubes. The stinger is attached to an excavator, which hydraulically operates a metal beak that holds the long tubes in place while they are planted. The expandable stinger has been used to plant stream gravel bars and road cut and fill slopes, but has other potential applications.

Key Words

Nursery, seedling, propagation, cutting, container

Restoration of riparian areas is receiving increasing interest in recent years. But these sites present unique challenges. Besides a wide variety of soils and topography, riparian zones are unique in that their hydrologic condition does change rapidly. Streamside plants can be inundated by brief flood events and then the water table in the soil can drop rapidly. In addition, the erosive power of floods can dislodge newly established plants.

There are two different categories of plant materials used in riparian revegetation: 1) dormant, nonrooted hardwood cuttings used in bioengineering applications; and 2) live plants used for a variety of other purposes (Hoag and Landis 1999). Container or bareroot plants add diversity to the riparian revegetation area by ensuring the establishment of species that do not root readily from woody cuttings. However, standard nursery stock types have limitations. The root systems of even the largest bareroot or container seedlings are not deep enough to initially withstand the erosive forces of floods and then stay in contact with groundwater during the summer. Recently, nurseries have begun experimenting with larger stock types that will meet the challenges of riparian restoration. For example, the "Tall One" TreePotTM has a capacity of 173 in^3 (2,835 cm^3) and a root system that is 18 in. (46 cm) deep. What about a container that has a root system that is even deeper?

THE LONG TUBE STOCKTYPE

Long tubes consist of a 3 in. (7.6 cm) PVC pipe that is lined with Vexar® tubing (Figure 1). The pipe can be cut to any depth, depending on the project objectives, plant species selection and factors on the outplanting site. Typically, long tube containers are cut at 6 inch increments: 12, 18, and 24 in. (30, 46, and 61 cm). A 24 in. (61 cm) long tube is comparable in volume to a one-gallon (3,785 cm^3) container. Vexar tubing is cut to lengths longer than the PVC pipe to allow at least 3 in. (7.6 cm) or more netting to extend above the pipe. The extended netting can either be folded

down over the pipe or kept upright to protect plants from browsing. Vexar tubing is specially ordered from the manufacturer to be made of biodegradable plastic so that it will break down in the soil after outplanting. The tubes are filled with growing media consisting of 50% vermiculite and 50% *Sphagnum* peat moss. A similar stocktype using a 6 in. diameter by 30 in. long (15 x 76 cm) PVC pipe, without the Vexar tubing, was reported to successfully restore native desert plants to the Joshua Tree National Monument in Southern California (Miller and Holden 1992).

Figure 1. Long tube seedlings are constructed from sections of plastic pipe with a Vexar lining.

Advantages of the Long Tube

1. Greater root depth. From late spring to early fall, rainfall is low for much of the western United States and most soils dry out by mid summer. Riparian areas are no exception, as soils can dry to a depth of several feet by mid summer. After outplanting, long tube seedlings have the advantage of beginning root growth at much deeper soil depths during the first growing season. This allows roots greater access to either the water table or soils with higher moisture levels.
2. High root surface area. Long tubes have a high root surface area, which can be an advantage to early seedling establishment. Comparing the 24-in. (61 cm) long tube to other one-gallon (3,785 cm^3) containers, the long tube has twice the root surface area as the round one-gallon container and a third more than the "Tall One" Treepot™ container. This greater surface area creates more root-soil contact, resulting in potentially greater root egress into the native soil during initial establishment.
3. Easy to extract. The original reason for placing Vexar netting within the PVC pipe was to protect roots and stem from animal damage. A more important reason for using this material is because it holds the growing media together to allow easy and complete extraction without damage to the seedling. Seedlings would be hard to extract from the long tubes because of their weight and the high surface area. Without the Vexar, seedlings would have to be pulled from their container by the stem, which can result in physical injury. With long tube containers, this stress is eliminated because seedlings are extracted by pulling the Vexar netting. This makes it possible to extract long tube seedlings at any time. Most container seedlings can only be extracted late in the growing season after a firm root plug has developed. Unfortunately, this firm root plug often becomes root-bound and prevents good root egress after outplanting. The netting in the long tube gives the client a greater outplanting window and more flexibility in planning.
4. Eliminates root spiraling. The Vexar lining in the long tube also has another benefit. In round containers with smooth walls, roots grow in a spiral pattern. However, in long tubes, new roots follow the diamond-shaped pattern of the Vexar to the bottom of the container where they are air-pruned. This effectively prevents root spiraling and results in a better root system after outplanting.

Although long tube seedlings less than 24 inches can be planted by shovel or power auger on deep soils with few rocks, these soil types are rarely found in riparian areas in mountainous terrain. Recently, a planting device called the expandable stinger (US Patent 6,158,362 with additional patents pending) was invented to plant long tube seedlings or non-rooted cuttings of *Salix* and *Populus* in soils with high rock content. Attached to the arm of an excavator (Figure 2), the expandable

THE EXPANDABLE STINGER

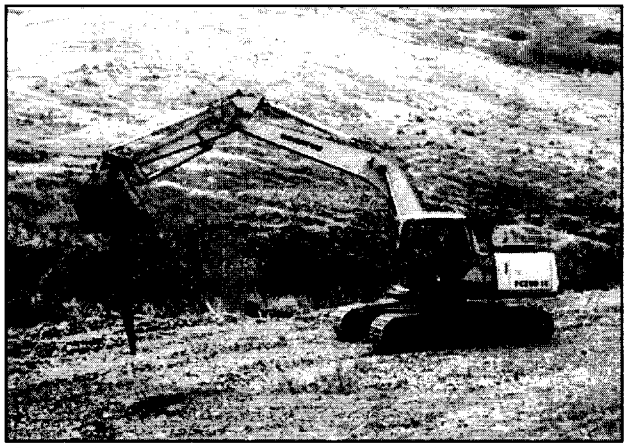

Figure 2. The expandable stinger operates from the arm of an excavator and can plant seedlings or unrooted cuttings in rocky soils or heavy brush.

stinger is hydraulically operated and can plant seedlings or cuttings in any soil type or slope gradient. The expandable stinger is composed of two parallel steel shafts, which are narrowed to a point at the end to form a "beak" (see figure 3A). The shafts are hinged in the middle so that they open and close in a scissor-like manner. Each half of the beak is formed to create a long hollow chamber in the middle when they are closed.

On the outplanting site, a long tube seedling or non-rooted cutting is inserted into the beak. The expandable stinger is then maneuvered to the planting spot, where the beak is inserted into the soil (Figure 3B). The beak is opened allowing the seedling to drop to the bottom of the created hole. While the beak is open, the stinger is lifted from the soil leaving the seedling in place (Figure 3C). On sandy or coarse textured soils, the sides of the hole will collapse on the plug, forming a good soil contact. Other soil types and soil conditions might require manually tamping the soil around the plug. Ideally, long tube containers are planted several inches below ground line.

The expandable stinger can plant seedlings and non-rooted cuttings at a rate of one to five per minute depending on planting density, soil type, site accessibility and degree of planning. Generally, planting rates decrease on rocky soils and steeper slopes and increase where planting densities are high and travel time from one planting area to another is minimal. Having a supply of seedlings or cuttings at the site and ready for planting increases

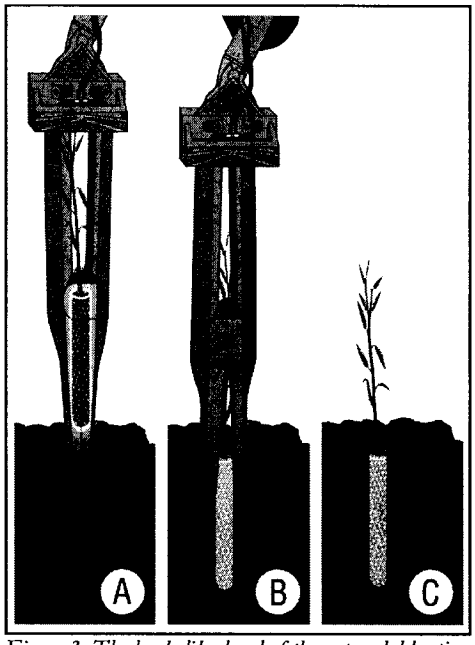

Figure 3. The beak-like head of the expandable stinger holds the seedling or cutting in place (A), while hydraulically opening a hole in the soil (B). When the beak is opened and the head removed, the seedling is successfully planted (C).

efficiency. However, this can be a challenge due to the large size and weight of these containers. Due to the inaccessibility of many sites to trucks, other methods of seedling transportation have been developed, such as using a trailer attached to an all-terrain vehicle.

Applications

The long tube stocktype and the expandable stinger expand the possibilities for riparian restoration. These areas include:

1. Gravel bars along streams. Gravel bars can stay barren for years because the high surface rock prevents seed germination and seedling establishment. While these sites look inhospitable, there is available moisture held within the gravel matrix, which can be accessed by roots of long tubes.
2. Steep slopes. Steep slopes along road cuts and fills revegetate slowly because seedling establishment is curtailed due to soil raveling. Planting a long tube seedling can shortcut the difficult early establishment phase of seedling development.
3. Invasive plants. On many streams, the riparian areas are overgrown with aggressive, undesirable vegetation, like the Himalayan

blackberry *(Rebus paruiflorus)*. This species can form a blanket of vegetation that is impenetrable to planting or the establishment of more desirable species. The expandable stinger can reach into these inhospitable sites and plant larger seedlings that can compete with the existing vegetation.

4. Road decommissioning. Another potential application would be to plant large seedlings in the middle of roads that are being taken out of service. This quick and effective visual screen discourages trespass and accelerates tree and shrub establishment.

Limitations

The expandable stinger is restricted to those sites accessible to an excavator. The main limitation is that, for safe operation, the steepness of slope must be less than 40 percent gradient. The size of the excavator also determines the planting radius: smaller excavators can reach 20 feet while the larger machines reach 50 feet.

A potential limitation to the long tube is the decomposition rate of the Vexar tubing. Although the tubing is composed of biodegradable plastic, it is unclear how fast this material breaks down in different soil types and moisture regimes.

FIELD TRIALS

The long tube stocktype and the expandable stinger have been in use for three years in eastern Washington and parts of Oregon. It was first used in the Aostin Creek Watershed, a 325 square mile watershed in the in the Blue Mountains of southeastern Washington to restore the loss of riparian vegetation resulting from winter floods. Over 50,000 long tubes and non-rooted cuttings of cottonwoods, willows and ponderosa pines were planted with the expandable stinger on newly created gravel bars, sites that were considered manually unplantable. At the end of the first year, survival was found to be greater than 80 percent (Johnson 2000). In spring of 2001, a Federal Highway Administration project in the coast range of southwestern Oregon was planted with ponderosa pine, big leaf maple, willows and ash. Steep, rocky cut and fill slopes were planted with long tubes using the stinger. Most of these sites were not accessible to planters due to the steep slope gradients. Initial establishment of all species was greater than 90 percent.

CONCLUSIONS

The long tube is a new stock type that has a root system that extends deep enough to assure establishment on these harsh sites. The expandable stinger is an effective and efficient method of planting long tubes. Although this outplanting system would be too expensive for typical planting projects, planting long tubes with the expandable stinger offers an innovative solution to many harsh sites such as disturbed riparian zones and road cuts and fills.

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REFERENCES

Hoag, J.C., Landis, T.D. 1999. Plant materials for riparian revegetation; USDA-National Resource Conservation Service, Aberdeen, ID. In: Forest and Conservation Nursery Associations. URL: http://www.fcnanet. org/proceedings.html. Athens, GA: University of Georgia, Forestry Extension.

Johnson, B.J. 2000. FY 2000 Riparian Planting Project Completed within the Asotin Creek Watershed, WA. Washington State Salmon Recovery Funding Board Report-Asotin Creek Riparian Tree Planting Project #99-1320D.

Miller, C., Holden, M. Propagating Desert Plants. In: Proceedings, Western Forest Nursery Association; 1992 September 14-18; Fallen Leaf Lake, Gen. Tech. Rep RM-221. Fort Collins, CO: US Dept of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 68-71.