



TOOLS planting FOR

Steven Kloetzel |

ABSTRACT

Planting propagules for restoration projects requires specialized tools. Several hand and power tools are discussed, as well as appropriate applications and installation rates. Equipment costs and sources are detailed.

KEY WORDS

Planting methods, seedling installation, cutting installation, hoedad, planting hoe, dibble, expandable stinger, planting bar, augers, power hammer, Hy-Gro Tiller

An In-the-Field Perspective

Through 13 y of designing, bidding, installing, supervising, and monitoring dozens of native plant restoration projects, I have been blessed with the opportunity to try out a variety of techniques for properly and quickly installing large numbers of seedlings and other small plant propagules. Restorationists are not often presented with the optimum soil conditions for which common planting tools were designed. Additionally, plant propagules used for native plant restoration sites are typically deeper and narrower than plant materials used for landscaping and gardening. Specialty tools and innovative methods are called for. Use of the appropriate tools and methods can mean the difference between a live or dead plant, and an on-budget or over-budget project.

As one would expect, the cost per planted seedling or the expected survival rate will depend upon many factors specific to the project. In this article, I discuss appropriate uses for given tools, detail some anticipated installation rates, give some pros and cons for each method, and list tool costs and suppliers. This is by no means a complete discussion of all the tools and methods available to the practitioner, and I encourage anyone with additional techniques or more information on tools discussed here to contribute an article to *Native Plants Journal*.

HAND TOOLS

Hand-planting methods provide the restoration practitioner with optimum flexibility in plant placement, distribution, and micro-site utilization. A well-trained and experienced hand-planter can surpass the planting quality, and generally match the speed, of many automated methods when installing small seedlings (grown in 49- to 710-ml [3- to 45-in³] containers). If you like to mix up the species distribution and make use of those important pockets of moisture, shade, organic matter, and deeper soils, then hand-planting may be just what you're looking for. Hoedads, dibbles, planting bars, specially designed planting shovels, pick mattocks, and round-point shovels are popular planting tools.

Hoedads

Hoedads, also known as planting hoes, were developed specifically for planting bareroot conifer seedlings for reforestation and have since been adapted for container applications. Hoedads come in a variety of sizes and shapes, and are one of the most versatile tools available. Different blade sizes and shapes can properly install 49- to 710-ml (3- to 45-in³) container seedlings, as well as bareroot plants with roots up to 36 cm (14 in) in length. Brackets, holding the hickory handle to the desired blade, are typically brass for extra weight and penetration, or tin alloy ("Tinselite") for lighter applications. Brackets can be found in 2 blade angle configurations: 100° angle for applications on gently sloped or flat areas and 90° angle for steep ground planting. Cost is roughly US\$ 45, fully

A WORD OF CAUTION: PREPARE YOUR BODY AND PROTECT YOUR WORKER'S BODIES!

MOVING FROM MONTHS ON THE COMPUTER OR couch to 8 or 10 h per day of swinging, bending, and lifting is bound to hurt many a planter. All of the tools discussed in this article will prime you for carpal tunnel syndrome and back problems if you are not physically prepared. Ready yourself and your planters with appropriate strengthening and stretching exercises before the project. Many planters practice yoga or Tai Chi. Require daily stretching before, during, and after work. Additionally, sturdy boots, safety glasses, and hard hats should be required for, and supplied to, planters. Experienced crew leaders will agree that the time and resources spent on worker protection will be offset by potential downtime and worker's compensation claims.

assembled; but note that hoedads are usually ordered as separate pieces and you get to do the assembly. Keep some spare blades, handles, and nuts and bolts with matching socket or box wrenches handy, as you'll likely need them. A flat metal file or electric grinding wheel will be needed to keep blades sharp.

Hoedads require a significant amount of training and should be swung with caution by novices. A novice planter, with good instruction and supervision, can usually get the hang of the "throw and release" method required in a couple of days. Beginning planters installing 164-ml (10-in³) container seedlings may only install 10 to 20 plants/h, while experienced planters may install from 30 to 100 plants/h, with an average of 50. Installation of smaller seedlings (grown in 49- to 84-ml [3- to 5-in³] containers) will likely double these figures. Rates will vary widely depending upon plant



Photo by Steven Kloetzel, courtesy of Bitterroot Restoration Inc



Figure 1. Restoration planters wielding hoedads, Silverbow Creek, Montana.

distribution, species composition, soils (or lack thereof), amount of competing vegetation to be removed, whether the plants are pre-pulled from containers, and so on. “J-rooting” (folding up the roots in the hole), “slip-planting” (setting the roots in a non-vertical position), and setting the plant at an improper depth are all problems to watch for. The USDA Forest Service has full-time inspectors on their planting sites to minimize improper planting. An engaged and watchful crew leader can perform the same function.

This tool is particularly useful in the rocky and compacted conditions commonly encountered in upland and riparian restoration sites (Figure 1). It is swung much like a pick, and therefore can break up rocks and compaction. The planter keeps swinging until the blade is sunk to the proper depth. With each swing the planter lifts up on the butt of the handle a bit to decompact the near side of the hole. An experienced planter can usually tell in the first swing or two if a good planting spot has been selected. A properly prepared hole is essentially a decompacted slit in the soil; a slit is helpful if minimal surface disturbance is required. Soil amendments, fertilizer packets, and other treatments are easy to incorporate with a hoedad. If plant competition is a problem, or a planting basin is required, a scalping blade on the back of the planting blade may be used to scrape away soil, litter, rocks, and competing

vegetation. Some compaction in the planting hole can occur on the backside of the blade with this tool, but compaction is typically less than with other methods. Hoedads can be used for planting through erosion control blankets, with the scalping blade used to chop a slit in the blanket if necessary. Be sure this doesn't compromise your blanket strength or erosion control goals, however. For minimal impact to erosion control blankets, consider using dibble sticks, described below.

Given their choice of tools, crews I have supervised would often choose their hoedads over all other tools, even when digging holes for 4- or 8-l (1- or 2-gal) pots. On wetland planting projects, I have seen planters put in more than 2400 plants per person per 10 h day with small-bladed hoedads. These time-tested tools are the choice of most USDA Forest Service reforestation crews in the northwestern US. Many old planters will tell you that it's hard to beat a hoedad for versatility. And you've heard the old line about not touching a cowboy's horse? Well, the same applies to crusty old tree planters and their 'dads.

Dibble Sticks

Dibble sticks, like hoedads, are sized to the container type. Dibbles are useful tools for small, container seedlings being planted into soft soils, such as the sand or muck one hopes to encounter on a wetland restoration project. Manufactured tools are available for US\$ 46 to 66, in sizes to match the dimensions of root plugs from various containers, including Ray Leach “Cone-tainer”™ Super Cells (164 ml [10 in³]) and Fir/Pine Cells (49 or 60 ml [3 or 4 in³]), and several cavity dimensions of Styrofoam® block containers. Most designs have an unpadded foot pedal (or two) for forcing the point into the soil. This is a low-maintenance tool with no assembly required.

I've also used my fair share of broomsticks, rebar, and other “shade-tree welder” designs for a lot less money. These improvised devices usually don't work as well as the manufactured ones, and it doesn't take long to pay off a good tool when your planters can move along at a more rapid pace. Plans for making your own dibble were provided by McCreary and Tecklin (2000).

Planters can use dibbles with very little training, just a watchful supervisor's eye to make sure plants are being installed deep and straight enough, without roots getting too compressed. This gets tougher to achieve with the 130- and 164-ml (8- and 10-in³) sizes; these sizes are better installed with hoedads or shovels on all but the loosest of soils. With plants having root plugs of 49 or 60 ml (3 or 4 in³), a novice planter might achieve only 20 to 30 plants/h, while an experienced planter can dibble 150 to 250/h in mucky or sandy soils.

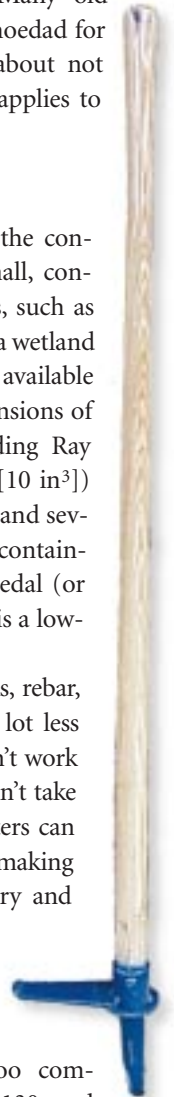




Figure 2. Dibble planting 50-ml (3-in³) wetland plugs, Monticello Creek, Utah.

Dibbles are great for planting wetland plugs though erosion control blankets with minimal damage to blankets (Figure 2). When sharp, they can also be used for planting small plugs directly into low-density coir logs. They cannot easily be used where specifications call for fertilizer packets or other such amendments. Compaction or “slicking” of the sides of the planting hole becomes a problem in clayey soils, so one should seek other tools for planting in clay. Dibbles do not work well in compacted, dense, or rocky soils. They are best used on level ground and are an excellent choice if you are planting directly into a water-covered site. (There’s not much joy in swinging a hoedad into water, unless you just want to cool off!)

Planting Bars

Many planters consider this an “old school” tool, and it is not commonly used for restoration projects in the western US, but I’m told that planting bars are widely used in the southeastern US for planting bareroot or container reforestation seedlings. Bars are typically welded out of 2 pieces of hardened steel, and include 1 or 2 pedals to help force the blade into the soil. Bars with a limited range of blade sizes are available for US\$ 25 to 35. These tools are simple to maintain, with blade sharpening being the main effort required.

As with planting shovels, minimal up-front training is needed, but significant efficiency and technique may be gained by wielding this tool for many long days. Production rates are comparable to planting shovel rates, however, bars are heavier than planting shovels (on average, 4.3 kg [9.5 lb] versus 2.5 kg [5.5 lb]) so beginning and occasional planters will find this tool more tiring. A tired planter generally means poorer planting quality.

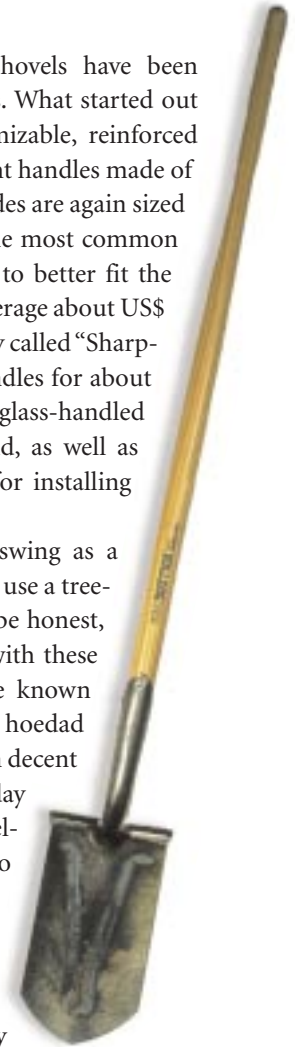
These tools are best suited to non-rocky, looser soils which are commonly encountered on reforestation sites in the southeastern US. Compaction of the sides of the planting hole will be a problem in clayey soils. A planting bar is a heavy tool to sling around all day, but I’m sure there are plenty of planters out there who will swear by their bars.

Tree-Planting Shovels

A wide variety of straight-handled shovels have been designed specifically for use with seedlings. What started out as a tile spade has evolved into a customizable, reinforced shovel with bolt-on footpads. “D” or straight handles made of fiberglass, wood, or metal are available. Blades are again sized to the seedling, with 2+0 bareroot stock the most common size. Planters often cut down their blades to better fit the container size being planted. These tools average about US\$ 65, but extra-beefy all-metal models, usually called “Sharpshooters,” are available with cushioned handles for about US\$ 135. If you’re using wooden or fiberglass-handled models, keep some spare handles on hand, as well as replacement footpads. Keep tools handy for installing parts and sharpening your blade.

Although not as difficult to learn to swing as a hoedad, significant technique is required to use a tree-planting shovel quickly and efficiently. To be honest, I’ve never become intimately acquainted with these “spoons,” but Canadian tree planters I’ve known insist that their rates are comparable to hoedad rates. I believe that may be true on sites with decent soil and with smaller seedlings, but someday I’d like to pit a hoedad crew with a shovel-planter crew on a rock-pile restoration site to see which performs better.

Soil amendments, fertilizers, and other such in-soil treatments are easily installed with planting shovels. Compaction of the sides of the hole can be a problem with any shovel planting method, particularly in clayey soils. This is probably not the best choice if you have compacted or rocky soils; these sites are better suited to hoedads. Sites requiring removal of competing vegetation will also need to have an advance crew prepare the site with “scalps” sized to the specifications for the project. As indicated above, tree-planting shovels are the tools of choice for some Canadian reforestation crews, as well as some pine planters in the southeastern US.





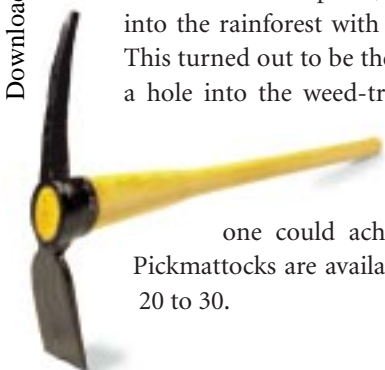
Round-point Shovels

For the many restoration sites being planted by volunteer groups and other occasional planters, the best tool may be the most readily available tool. Round-point or garden shovels are relatively cheap and plentiful; however, if you are going to be using it hard all day long, it pays to get a high-quality shovel, preferably one with a fiberglass handle. Costs should range from US\$ 20 to 40.

Round-point shovels are slow and inefficient for planting small container seedlings, but they don't take a lot of experience to operate. All of the tools discussed above strive to lift as little soil as possible in order to speed production. Soil displacement is maximized with this tool, however, which means your planters will tire more quickly. These types of shovels are still the best tool, aside from augers, for planting landscape-type 4- to 8-l (1- to 2-gal) container plants in good soil. Rates for 4-l (1-gal) pots should range from 5 to 10 plants/h, while plants grown in 8-l (2-gal) pots should go in at 3 to 8 plants/h. As always, rates are dependent upon your soils, personnel, access, and specifications.

Pickmattocks

While volunteering on a restoration project at Limahuli National Tropical Botanical Garden (URL: <http://ntbg.org/limahuli.html>) on the island of Kaua'i, Hawai'i, I encountered a new use for an old trail-building tool. I asked what tools we would be using to plant the approximately 0.9-l (1-qt) container tree seedlings they had grown for their ambitious 365-ha (900-ac) project. I was wishing I had brought my trusty hoedad on the airplane, however, I soon found myself hiking into the rainforest with a pack of plants and a pickmattock. This turned out to be the perfect tool for scalping and getting a hole into the weed-tree infested volcanic cobble we were planting into (Figure 3). Planting was decidedly slow, perhaps 10 plants/person/h, but likely the best one could achieve under the difficult conditions. Pickmattocks are available at many hardware stores for US\$ 20 to 30.



POWER TOOLS

Jumping to power tools is an expensive step but is often called for with larger plant propagule sizes. While not easily utilized by volunteer and occasional crews, power augers, dibbles, and hammers can plant large seedlings and long cuttings under most conditions to a greater depth and with more efficiency than can hand workers. Safety and training becomes a much larger issue with any power tool, so allocate time and resources for these important actions.



Photo courtesy of Limahuli National Tropical Botanical Garden

Figure 3. Planting with a pickmattock at Limahuli National Tropical Botanical Garden on Kaua'i, Hawai'i.

If you are going to do a significant amount of mechanized planting, I recommend that you make the acquaintance of an experienced heavy-equipment contractor in your region. These folks have all kinds of ideas for performing tasks mechanically that we "ologists" can't even imagine. For instance, long-reach excavators can be outfitted with an amazing arsenal of grapples, augers, tree-spades, and dibbles that may make achievable a task you thought was impossible. If the right tool doesn't exist or is unavailable, many contractors are good at fabricating a tool for the task.

Power Augers

Many types of power augers are available, all with different applications. Chainsaw-head, 1-person, 2-person, remotely powered, and heavy equipment-mounted augers are all used on restoration sites (for example, see Jeffrey and Horiuchi [2003]). When container size is larger than 336 ml (20 in³), power augers will boost production in most soils. This is especially true for some of the tall and narrow larger containers being used for restoration projects, such as PVC tube pots and 656-ml (40-in³) Deepots™ and 2.8- to 30.3-l (1- to 8-gal) Treepots™, distributed by Stuewe & Sons Inc.

Cost varies widely depending upon the type of auger desired. You can expect to spend at least US\$ 600 for a 1-person auger with bits. Remotely powered augers, used for drilling holes deeper than 1 m (3 ft), will set you back US\$ 1200 to 2000 with bits. Hand-operated augers are occasionally available for rent but don't expect a well-maintained rental tool. The 1- and 2-person augers are high-maintenance tools, with a significant amount of downtime possible, so on your larger projects it's a good idea to have a spare one at the ready as well as extra parts and bits. Before purchasing, I'd recommend that you rent or hire augers mounted on heavy equipment until you are sure you have the correct piece of equipment and plenty of work to keep it busy. A tractor-mounted auger with operator runs about US\$ 60/h, while an auger-equipped excavator can hire for US\$ 125/h plus mobilization.

Augers are best used in finer soils and on reasonably level ground. As soils get coarser, operators will be thrown around more and bits and gearboxes may get broken. Consider skid-steer, tractor, or excavator-mounted augers for rocky sites. A watchful eye is required to be sure holes don't get drilled too deep, or extra time will be needed for backfilling. Digging deeper than the container depth, however, will reduce subsoil compaction and likely increase growth rates. Settling of the seedling in the planting hole can be a problem, and consequently some contracts require adding fill or resetting plants as soils settle. Augers certainly make planting of large stock easier, and facilitate incorporation of amendments into the soil. Due to the size of the hole created, watering in your seedlings is always a good idea with augers.

Chainsaw-head augers use a heavy-duty chainsaw motor mounted to a gearbox, with the bit attached at a right-angle to the powerhead. These are high-rpm augers well suited to planting large quantities of container seedlings of 262-ml (16-in³) to 1-l (1-qt) in an assembly line manner. Rates I've encountered range from 30 to 70 plants/person/h.

Direct-drive, 1- or 2-person augers are commonly used for planting large containers. With the 2-person units, planters have an easier time of drilling through coarser soils. Planting rates vary widely by container size and soils. Remotely pow-

ered Little Beaver™ augers have the power unit mounted on a small carriage, which is attached to the bit and gearbox via an extendable drive shaft (Figure 4). These devices are great for planting cuttings deeply in fine-textured soils, but also can be used to plant 4- to 32-l (1- to 8-gal) plants. It is hard to move from point A to point B quickly with this type of auger, however, unless you are on very level ground.

From my experience, unless you have excellent soils and planting-bed preparation, or are trying to plant something deeper than 31 cm (12 in), most experienced crews prefer some combination of hand tools over hand-held power augers because of the noise, exhaust, physical abuse, and breakdowns they are subjected to with these tools. On a large project I worked on in southern California, we had a 40-person crew planting with augers for several weeks at an unacceptably slow rate. The project manager, a former landscaper, was comfortable with augers but inexperienced with hand-planting methods. We brought in some new crew leaders experienced in other methods, converted most of that crew to using hoedads, and production rates jumped back up to the rate at which we had bid the project. Some of the planters and supervisors felt that planting quality also improved.

Conversely, on a riparian rehabilitation project I was involved with, we started out using hoedads as planned to



Photo by Sam Adams. Courtesy of Bitterroot Restoration Inc

Figure 4. Installing 2 to 3.6 m (6 to 12 ft) cottonwood pole cuttings with a remotely powered Little Beaver™ auger, Yuba City, California.

install seedlings grown in Ray Leach Super Cells (164-ml [10-in³]). We soon discovered that the site had such highly compacted silts and clays that we could only make very slow progress at great effort. Yet there was not a rock to be found in the glacial lake sediments. We found a Little Beaver™ with a 10-cm x 1-m (4-in x 3.3-ft) bit to rent for US\$ 60/d and completed that project with far less effort, happier planters, less compaction in the holes, and better planting quality. It pays to experiment with different methods, and to listen to planters with experience using different tools.

Power Hammers

Many riparian and wetland restoration projects require the installation of long willow (*Salix* spp. [Salicaceae]) or cottonwood (*Populus* spp. [Salicaceae]) cuttings. While the “jury appears to still be out” as to whether planting nonrooted, dormant cuttings provides acceptable long-term survival, planting cuttings to the proper depth will help maximize survival. After years of struggling to set long cuttings at the proper depth (planted two-thirds to three-fourths in the soil) using metal rods, hammers, and customized postpounders, I encountered small, electric power hammers. These tools are designed for installing 3-m (10-ft) electric grounding rods and for small-scale concrete demolition. Outfitted with a pointed rod for a bit, they pilot holes efficiently through virtually any type of soil condition. I’ve even installed cuttings through 30-cm (12-in) riprap, as the hammer action will break through rock amazingly well.

Power hammers are available from a number of manufacturers and in a range of weights. Gas and electric models are available. I used a Hilti™ TE 705 for several years, which cost about US\$ 1000 plus bits. I currently run a Bosch 11314EVS that weighs 5.2 kg (11.4 lb) and delivers 1300 to 2600 blows per minute. It’s pretty hard to swing a mallet or postpounder that fast! This unit costs about US\$ 600 plus US\$ 75 per bit. Occasionally I’ve found these tools at rental shops. For electric models you’ll also need to purchase or rent a generator and plenty of high-amperage power cords. Make sure your generator is powerful enough to run your tool at maximum energy pull. It’s also a good idea to have an all-terrain vehicle or some other means to move the generator around your project area, as a large generator can weigh 44 kg (100 lb). As I have learned the hard way, these tools require some routine maintenance, so make sure you read and follow the owner’s manual.

Many of these tools come with a rotary option for drilling in rock and concrete. Get a tool that does not have this option, or make sure you can turn off the rotation. Rotation slows down the operation and will bind up the bit if you are planting through erosion control blankets. When selecting bits, purchase, or have made, a bit that is plenty long for the task at hand. You can usually order 1.9-cm by 64- to 76-cm (0.75-in by 25- to 30-in) round or hexagonal metal bits from the man-

ufacturer. I’ve also had bits made out of 1.9- to 2.5-cm (0.75- to 1-in) diameter hexagonal steel rod, or round “stress rod,” with good success. Bits should be sharpened with a 4-sided point for breaking rock.

Very little training is required to use these tools, but operators should become familiar with the safe use and maintenance of the hammer and generator. When installing 46- to 91-cm (18- to 36-in) cuttings, one can expect a rate of 35 to 60 cuttings/person/h. I typically line out a 3- or 4-person crew in an assembly line, with 1 person on the hammer and another person laying out and installing cuttings. The other 2 people seat the cuttings into the hole with a “deadblow” shot-filled mallet, seal the soil around the cutting with the mallet, water the cutting, and prune the top to a 45° angle. Be cautious working with electric tools around water, and make sure workers are wearing waders. I did have an operator fall over backward into a river with his Hilti™ hammer landing on his chest, still running and spraying water everywhere. The crew was relieved to discover that, while the operator and his hammer were completely soaked, the operator was not “zapped.”

For many jobs power hammers will be unnecessary due to optimum soil conditions, but until you get started, it is hard to know. On big jobs it’s best to arrive prepared for several options.

Waterjet Stinger

Chris Hoag and colleagues at the USDA NRCS Aberdeen Plant Materials Center in Aberdeen, Idaho, have refined another technique for planting cuttings: a high-pressure water pump plumbed to a hollow stinger. They call this the “waterjet stinger.” I have never used this method but am told it works very well in a range of soil types. Design specifications and costs for the waterjet stinger were presented in Hoag and others (2001) and can also be viewed on the *Native Plants Journal* website (URL: <http://www.nativeplantnetwork.org>).

Expandable Stingers

Planting long cuttings and larger seedlings in riparian restorations poses some unique challenges for the practitioner. Often, cuttings and smaller seedlings have difficulty surviving in these sites due to cobbly soils or where the riverine system has become incised and the depth to water table subsequently greater. Another challenge is the recent effort to revegetate some of the thousands of miles of riprapped riverbanks found throughout the world. Thanks to a clever tool designer from Washington State named Dan Culley, we now have the expandable stinger, also known as a power dibble (Figure 5). Although yet of limited availability and a patented technology, Culley’s tool mounts on an excavator arm, and can plant a 61- to 244-cm (2- to 8-ft) cutting through virtually any kind of bank treatment. This dibble is also designed to handle 7.6-cm by 36- to 91-cm (3-in by 14- to 36-in) seedlings that are typically grown in a piece of PVC pipe with a rigid mesh (“Vexar”) liner.

The mesh liner helps hold the seedling together and ease pulling from the container. The inventor has even designed a “50-shot” stinger for 7.6-cm by 36-cm to 61-cm (3-in by 14- to 24-in) containers, which has a magazine mounted to the tool in order to speed planting. The magazine is a series of concentric rings, which allows the operator to choose from a variety of species loaded into the unit (Figure 5).

According to Gary Decker of Northwest Revegetation and Ecological Restoration Inc, the company which has formed around this equipment, the single-shot model will plant 50 to 80 seedlings/h at a cost of US\$ 8.50 to 10 per seedling, including the plant. The 50-shot model can plant up to 2X these progress rates, depending upon substrate. Add to this the mobilization costs necessary to get their patented equipment on your project, and you may well have a cost-effective method for revegetating an area you thought impossible.

This suite of tools has been used on several revegetation projects here on the Flathead Indian Reservation, as well as on US Army Corps of Engineers projects around the northwestern US. The Confederated Salish and Kootenai Tribes of the Flathead Indian Reservation will likely use an expandable stinger as a part of their toolbox on upcoming river restoration projects.

The Hy-Gro Tiller™

Another interesting piece of equipment that facilitates seedling planting and survival is the Hy-Gro Tiller™, developed by Ray Graham of Chehalis Valley Reforestation Inc. This beefy tool mounts on an excavator arm and performs spot cultivation in preparation for subsequent hand planting. It will clear, scalp, and cultivate a planting bed up to 91 cm (36 in) deep by 107 cm (42 in) wide in almost any material. Used by the timber companies to improve reforestation survival and growth rates on difficult sites, it has also been used on a range of restoration projects. John Hendrikson of Wild Thyme Farm (Oakville, Washington; 360.273.8892) contracted the tiller to prepare individual planting sites on a 2-ha (5-ac) riparian mitigation site. He was quick to say “the Hy-Gro Tiller is the most cost-effective and successful long-term method for planting,” and after 3 y is still able to replace seedlings easily in the soil loosened by the equipment. Costs are about US\$ 0.50 per seedling bed plus mobilization, with reported rates of 2 to 6 beds/min. I’m sure these costs can be recovered in the time saved during the hand-planting phase, especially in heavy sods and compacted soils. This machine will even incorporate fertilizer into the bed as it cultivates, through a hopper mounted on the excavator. Access to the planting site is of course a serious consideration when using any excavator-mounted planting tool.

Backhoes, Excavators, and Tree Spades

This article concentrates on methods for planting seedlings, generally defined as plants smaller than 20 l (5 gal) in size. For planting the really big stuff, such as balled and



Figure 5. The expandable stinger working on a riparian project and loading the “50-shot” head, Central Point, Oregon.

burlapped plants, or for large plant salvaging, you’ll want big toys. Given an artful operator, backhoes and excavators can be used to plant a range of sizes, and even used for plant salvage provided the salvage materials won’t be held for very long. For more careful planting and salvage operations, tree spades are excellent tools that can be mounted on a variety of equipment and can capture seedlings with a root ball diameter as small as 61 cm (24 in). One exciting recent development in heavy equipment technology is tracked skid-steers, which can exert

less ground pressure than a person walking. Mount a tree spade on one of these units and you have a truly exceptional restoration tool perfect for those sites requiring instant gratification. But that is a topic for another article.

OTHER HELPFUL ACCESSORIES FOR THE PLANTER

Tree Planter Bags

Specialized canvas or vinyl bags are crucial for efficient hand planting, allowing planters to haul hundreds of seedlings, tools, soil amendments, and personal items. These are a must for your bigger planting jobs. Bags provide for efficient maneuvering of planters and materials over the planting site. Bags will allow planters to carry up to 400 small (49-ml [3-in³]) seedlings or up to 150 larger (177-ml [10-in³]) seedlings. One, two, and three-bag models are available, but most planters prefer the 2-bag size. These are comfortable enough for planters to wear all day, with waist padding, and padded shoulder and sternum straps. Use canvas bags for handling bareroot seedlings, and vinyl for all other types. An average cost is US\$ 35 per bag.

Other Necessities

Sturdy boots, gloves, and lots of drinking water are strongly recommended for your planters. Safety glasses are a good idea, as rocks will fly and dust will blow. Many projects require hardhats, too. Hardhats and ear protection should always be worn around heavy equipment. Use of some fertilizers or soil amendments will require that planters wear dust masks. Protect your planters so they can have a safe and healthy workday.

RESOURCES

Following are several companies that specialize in planting tools and accessories. Also listed are contractors or manufacturers with speciality power tools discussed above.

ASV Positrack. Grand Rapids, Minnesota; 800.346.5954; URL: <http://www.positrack.com>; tracked skid-steers and attachments.

Ben Meadows Company. Atlanta, Georgia; 800.241.6401; URL: <http://www.benmeadows.com>; hand tools, tree planter bags.

Bosch Inc. Worldwide; 877-267-2499; <http://boschtools.com>



Chehalis Valley Reforestation. Oakville, Washington; 360.273.9714; Hy-Gro Tiller™ attachment contractor and sales.

Forestry Suppliers. Jackson, Mississippi; 800.647.5368, URL: <http://www.forestrysuppliers.com>; hand tools, 1 and 2-person augers, tree planter bags.

Grainger Inc. Nationwide; 208.377.2801; URL: <http://www.grainger.com>; tools of every kind including power hammers.

Hilti Inc. Worldwide; 800.879.8000; URL: <http://www.us.hilti.com>

Little Beaver Inc. Livingston, Texas; 800.227.7515; earth drills and augers.

Northwest Revegetation and Ecological Restoration Inc. Hamilton, Montana; 406.363.2828; URL: <http://www.nwrer.com>; expandable stinger and ripper planter, plants, planting, and leasing of equipment.

Stuewe & Sons Inc. Corvallis, Oregon; 800.553.5331; URL: <http://www.Stuewe.com>; variety of containers for growing native plants.

TerraTech/International Reforestation Suppliers. Eugene, Oregon; 800.321.1037; URL: <http://www.terratech.net>; hand tools, various augers including chainsaw head augers, tree planter bags.

REFERENCES

Hoag, JC, Simonson B, Cornforth B, St John L. 2001. Waterjet stinger: a tool for planting dormant nonrooted cuttings. *Native Plants Journal* 2:84–89.

Jeffrey J, Horiuchi B. 2003. Tree planting at Hakalau National Wildlife Refuge—the right tool for the right stock type. *Native Plants Journal* 4:30–31.

McCreary DD, Tecklin J. 2000. Homemade dibble facilitates planting willow and cottonwood cuttings. *Native Plants Journal* 1:59–60.

ACKNOWLEDGMENT

Individual tools shown on p 34, 35, 37, 38, and 42 used with permission from Ben Meadows Company, Janesville, Wisconsin.

AUTHOR INFORMATION

Steven Kloetzel

Habitat Restoration Botanist

Confederated Salish and Kootenai Tribes

Natural Resources and Tribal Preservation Departments

PO Box 278

Pablo, MT 59855

stevekloetzel@cskt.org