ALTERNATIVE COLLECTION METHODS FOR RED SPRUCE (*PICEA RUBENS*) CONES

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Abstract—Commercially available pole pruners, hydraulic lifts, firearms, and certified tree climbing personnel are the most common means of collecting single source seeds from individual trees. These methods are highly productive at suitable locations, but have serious shortcomings for collecting red spruce (*Picea rubens* Sarg.) cones at high elevations in both the southern highlands and Northeastern States. Rough, inaccessible terrain precludes hydraulic lifts and makes collections by tree climbers' time consuming, while commercial pole pruners are difficult to handle once extended beyond 6–7 m. We present a novel pole pruner that is capable of reaching heights of up to 12 m, expanding the range and ease of use over commonly available pruners. Alternative collection methods are also presented, including cutting cone bearing limbs with specialized chainsaw chains and shaking cones loose from trees with ropes from heights of up to 25 m. Strategies for setting lines and removing and securing cones with ropes are offered.

INTRODUCTION

For restoration or general purpose plantation stock, most conifer seed are produced in open pollinated seed orchards or collected from the ground in forest stands. These seeds are orchard mixes from different parent trees with a variety of traits. In order to identify specific heritable traits, such as growth rates, phenology, crown structure, etc., it is helpful to distinguish between different families or offspring sharing a common mother tree. Commercially available pole pruners, hydraulic lifts, firearms, and certified tree climbing personnel are the most common means of collecting single source (half-sib) seeds from individual trees. Red spruce (*Picea rubens* Sarg.) are usually found in mid to high elevation stands across its range, and many remote populations are accessible only by foot. Rough terrain precludes hydraulic lifts and makes collections by climbers time consuming, while commercial pole pruners are difficult to handle once extended to lengths of 6–7 m. Red spruce cone are usually viable by late August to early September. The resinous cones (fig. 1) mature rapidly in mid to late September and begin to release seed. This short collection window coincides with fall foliage and recreation by the public in scenic mountain areas, which may be incompatible with shooting cones out of trees with firearms, especially in State and National parks.

OUR APPROACH

Red spruce requires substantial light exposure to stimulate cone production. Red spruce seedlings and advanced regeneration are shade tolerant and may survive for decades in the understory (Harlow and others 1978), but shaded trees grow very slowly and generally do not produce cones. Stunted trees on mountain tops or trees in sunny locations with extensive live crowns that touch the ground may have easy-to-reach cones by the age of 30 to 40 years (Harlow and others 1978). Conversely, in closed canopy forests under heavy competition for light, cones may be present at the very top of co-dominant trees and not visible to individuals on the ground. On quality sites, trees may reach 45 m in height with cones located near the top of the tree (fig. 2). Depending on accessibility of cones, single source seed are collected by: 1) hand if close to the ground, 2) ground collection if there is no possibility of cones

Figure 1—Resinous red spruce (*Picea rubens*) cone photographed at Mount Mitchell State Park, North Carolina, in September 2016. (Photo by Chris Maier)

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originating from other trees, 3) pole pruner, 4) setting lines and sawing branches, or 5) setting lines and shaking branches. Whenever cones are not accessible by hand, pole pruners are the most expedient option.

Long-Reach Pruner

Commercially available pole pruners are usually telescoping, reaching 2–5 m, or sectional where ~2-m locking poles may be connected in series as high as the user deems prudent. Once extended to >6 m, the poles become heavy and very flexible, limiting their utility. To extend the range of the pole pruners, we constructed a 12-m long-reach pruner by putting a pruning head atop a telescoping tree height pole (fig. 3). The unit is best deployed with at least two people as it gets unwieldy when fully extended. The pole is raised through the canopy, passing by and through lower branches which give the pole some support. In dense canopies, a spotter that can see the cone branch directs the individual manipulating the pole to the desired branch. It is imperative that the pole be raised up and down vertically; any attempt to lower the pole horizontally will lead to loss of control and damage to the equipment. Telescoping poles ranging from 14 m to 31 m are now commercially available [e.g., Geodata Systems Management Inc., Berea, OH (http://www.geodatasys.com/)]; shorter, heavy duty poles (<14 m) may be custom outfitted with a pruner head and saw. Given that red spruce have stiff, strong lateral branches, it is common to have cut branches hang or get lodged in lower branches, so planning for this situation is necessary.

Sawing Cone Bearing Branches

Beyond the range of long-reach pole pruners (12–14 m), we developed a technique to collect cones as high as 25 m using ropes and specially constructed chainsaw chains. On branches at least 3 cm in diameter, a throwline is set using a slingshot and shot bag (fig 4). The thin throwline is replaced with a strong 5-mm cord attached to a specialty saw chain (PockeTech HighLimb2-48 inch). The chain resembles a common saw chain, but it has bladed chisels on both sides of the chain and in both directions (fig. 5). This is a vast improvement over chains that only have chisels on one side of the chain. Early attempts to cut high branches were complicated by partially cut branches flopping over and releasing the saw, or having cut branches getting caught in other branches on the way down. To alleviate this problem, a tension line was set directly on the cone bearing branch (fig. 4). The sawing rope is gently pulled back and forth to cut the branch, and the tension line holds the branch straight. The tension line may also be used to retrieve branches over cliffs or ravines. The saw needs to be sharpened by hand daily to ensure quality cuts.

Figure 2—Tall red spruce (*Picea rubens*) on Hunter Mountain, New York. Cones are clustered near the top of the tree (see inset). (Photo by John Butnor)

Figure 3—Long-reach pole pruner constructed by attaching a pole pruner cutting head to a ~12-m telescoping tree height pole. (Photo by Tom Christensen)

Figure 4— Steps to retrieve cone bearing branches with rope-operated saw chains: 1) set throwline over the target branch with a shot-bag and sling shot; 2) replace throwline with strong 5-mm cord tied to saw chain; 3) if possible, set a tension line on the cone bearing branch; 4) gently pull saw back and forth, making cuts in both directions with a sharp chain; and 5) use tension line to support branch as it is cut and retrieve severed branch. (Photos by Chris Maier, John Butnor, and G. Scott Bryan)

Figure 5— Specialty saw chain (PockeTech HighLimb2-48 inch) that has bladed chisels on both sides of the chain and in both directions. (Photo by John Butnor)

Shaking Cone Bearing Branches

When a single branch cannot be tethered, the throwline may be sent over the top of the tree and replaced by a stronger 5-mm cord to facilitate shaking or whipping branches with rope to dislodge cones. Red spruce cones are firmly attached to the branches, but it is possible to shake or strip them loose with some effort. To catch the cones and insure they came from the subject tree, lightweight spun polyester row-cover fabric was placed on the ground (~3 x 20 m). Shaking cones from trees is a demanding, high energy endeavor. Many dislodged cones are ejected into the forest and not onto the fabric, but this method still leads to some cones being recovered. In the 2016 field season, the number of cones recovered via shaking ranged from 1 to 120 per tree. Whipping branches with the rope can help dislodge firmly attached cones. To magnify the force, tie the rope to a 1–2 m long "whip stick"—with some practice, the generated force is considerable.

CONCLUSIONS

Depending on accessibility of cones, single source seed were collected by: 1) hand if close to the ground, 2) ground collection if there is no possibility of cones originating from other trees, 3) pole pruner, 4) setting lines and sawing branches, or 5) setting lines and shaking branches. In the 2016 field season in North Carolina, Tennessee, and Virginia, we collected cones from 115 trees that yielded approximately 200,000 half-sib seeds from rugged mountainous terrain. These strategies were developed by trial and error in the field, and we hope this publication will help others with similar collection needs. We also tested radio-controlled chain saws, rope launchers powered by blank ammunition, and pruner heads on ropes (without poles); we do not recommend them in any way.

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