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COLLECTING BLACK SPRUCE CONES

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INTRODUCTION

Each year, an estimated 33,700 ha of black spruce (*Picea mariana* [Mill.] B.S.P.) cutover do not regenerate naturally. To artificially regenerate this area, 1,145 hl of cones would be required to provide sufficient seed for containerized seedlings. Almost 35,000 hl of cones would be necessary if the area was seeded at a rate of 250,000 viable seeds per hectare (Haavisto 1980). Traditionally, cone collection contracts have been issued to individuals who handpick during the autumn from cone-bearing slash in cutovers. During recent years, in some areas, cone-bearing tops have been gathered and delivered to central locations for mechanical processing. Less frequently, cones have also been collected from standing trees in plantations, naturally regenerated areas, seed production areas, and seed orchards.

Black spruce cones are small, averaging 290 per litre (Skeates and Haavisto 1987). Generally, the current year's cone crop, which averages 1 litre, is located in the top metre of a tree's crown. Due to the semiserotinous nature of the species, older cones that remain on the tree can contain a considerable store of seed as well.

Currently, much of the harvesting of black spruce is done by full-tree logging and cone-bearing slash is accumulated at roadside, thereby providing for easier cone collecting. Significant improvements have been made in black spruce cone procurement methods since the late 1960s. This technical note outlines some of these developments.

COLLECTING FROM LOGGING SLASH

Handpicking

Handpicking of cones is generally done from logging slash. During early studies, Haig (1969) found that on average it took 15.4 person-hours to handpick 1 hl of black spruce cones in a good cone year. Because of considerably more handling of tops during a poor cone year, it took 18.7 person-hours per hl.

The difficulty in twisting the small cones off the branch and the time spent in handling each individual cone triggered the development of several hand-assist tools. These were based on the hand rakes that are used to harvest blueberries. Figure 1 shows examples of two rakes designed to facilitate cone picking. For both, the raking action is from the underside of the cone-bearing tree top and the tool is pulled toward the body. Quite often, cones need to be cleaned because pieces of twigs remain attached. Despite this, these tools improved

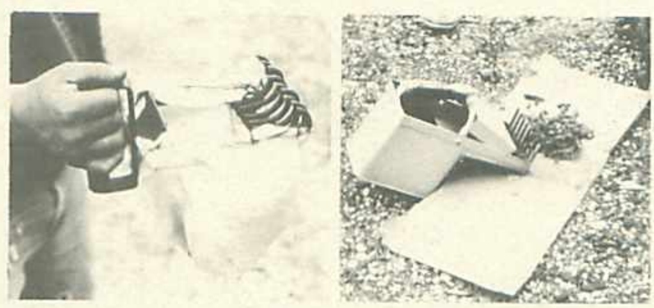

Figure 1. Examples of hand rakes designed to assist with picking black spruce cones: (a) rake with curved teeth and a 0.5-L canvas collector bag, and (b) rake with straight teeth and a collector container incorporated into the body.

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the rate of cone collection by a factor of about three, and reduced collection time to approximately 5.0 hours/hl. Even when using tools like these, cone collecting by hand remains tedious and time consuming.

It was thought that a hammer-mill type peat/soil shredder might offer a simple, inexpensive motorized method for cone removal. All cones, regardless of age, were effectively separated when cone-bearing branches were hand-fed into the hopper (Fig. 2). The cones were subsequently hand sorted from the mass of debris created by the shredder. Studies conducted during 1977 (Haavisto 1979a) showed that an average of 86% of the cones were clean; the remainder had some twigs attached (Fig. 3) that were subsequently removed by hand. No damage to the cones was observed. With a ready supply of cone-bearing tops, as at a landing, one person with a peat/soil shredder could process about 0.5 hl of cones per hour (Haavisto 1979b).

Figure 2. Hammer-mill type peat/soil shredder used to separate black spruce cones from branches.

Mechanical Picking

Mechanical cone processing was studied by the Canadian Forest Service–Sault Ste. Marie during the late 1960s (Haig 1969). An agricultural threshing machine, modified to accept cone-bearing logging slash, was used. Revolving toothed cylinders stripped twigs, foliage, and cones from branches. The cones were separated from the resulting debris by a series of vibrating screens positioned in an air blast. Average production rates of 3.1 and 2.4 hl of cones per machine hour during a good and poor cone year, respectively, were encouraging.

Figure 3. Example of black spruce cones removed from branches using a peat shredder.

In 1978, a cooperative effort by the Ontario Ministry of Natural Resources (OMNR) and the Canadian Forestry Service–Sault Ste. Marie was launched to take the early developments initiated at the OMNR Hearst District office and produce a cone harvesting system that uses a modified agricultural combine. During field testing of the system 22,000 cone-bearing black spruce tops were processed. This yielded 227 hl of cones. More than one-half of the processing costs were found to be in cutting and gathering tops in the cutovers. Stripping cone-bearing branches from the main stem accounted for another one-third of the costs. The potential for cost saving by reducing the time required for cutting/gathering and top-stripping was apparent (Smith and Woodcock 1981). A plan to purchase cone-bearing black spruce tops (minimum 75 cones/top) and strip them at a central location was initiated. Dominy (1987) reported that two systems utilizing prototype top-stripping machines to provide feedstock to the combines were tried at OMNR regional work centres at Kapuskasing in northeastern Ontario and at Dryden in northwestern Ontario in the mid-1980s. Due to safety considerations, the top-stripping machines were modified, but after this their productivity became insufficient. Consequently, a portable brush chipper was used at Kapuskasing to process the tops. The processed material was then fed into a modified agricultural combine. In Kapuskasing, an average of 3.4 hl of cones per hour for a two-person crew (chipping of tops, processing, and bagging of cones) was reported using purchased tops (Horton 1984). Figure 4 shows the relative costs for the different phases of the mechanized process, dependent on the price paid for black spruce cones. Operational cone processing at regional OMNR centres for over 10 years attests to the success of the mechanized cone collection program.

COLLECTING FROM STANDING TREES

The complete black spruce cone complement can only be collected if the tree top is accessible and visibility is good for working. Picking from standing trees, unless they are very short, is therefore limited to those in which the crowns can safely be reached using a ladder. The picking rate is dependent on the size of each tree's cone crop. Climbing semi-mature and mature black spruce trees is not recommended for safety reasons, because the small-diameter top may break under the weight of a person. Furthermore, due to the relatively small volume of cones on an individual tree, climbing with the use of a gin-pole should only be considered for specialized collections (Yeatman and Nieman 1978).

Cone collecting from a standing crop is obviously slower than picking from tops at landings or scattered in a cutover. Tree selection, ladder positioning, and ascending and descending while being careful to prevent damage to the trees, is time consuming. This is normally done only for high value crops, such as in seed orchards or seed production areas. Average collection rates for experienced pickers using ladders has been found to vary from 13.0 to 21.5 person-hours per hl. Cones from trees up to 2.5 m high can readily be picked from the ground by carefully bending the tree top. Usually such trees have relatively small cone crops.

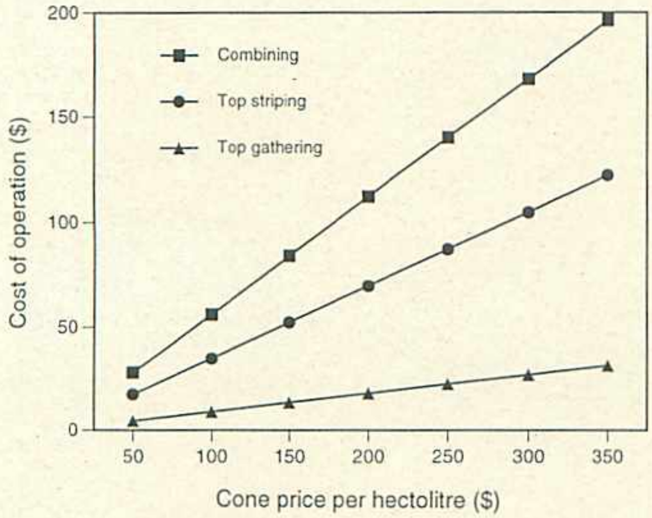

Figure 4. Cost of gathering, top stripping, and combining cone-bearing black spruce tops relative to price of cones.

In plantations or seed orchards, where the ground is relatively even, trees up to 5 m in height can be picked using conventional stepladders or lightweight orchard (tripod) ladders. These can be positioned directly over the tree or beside it (Fig. 5). Tripod ladders up to 5 m tall can be easily handled and are very stable. Straight ladders can also be used. These are leaned directly against the tree, with the ladder nestled into the branches for anchoring. The angle of repose must be quite steep to minimize the weight of the picker on the tree and to reduce the likelihood of breaking branches.

Where tree heights range from 5 to 10 m, extension ladders are required. Safety considerations dictate that these be "tied back". To do this, stabilizing ropes attached high up the ladder are fastened to ground-level anchor points, such as neighboring trees, thereby forming a stable tripodal stance.

Although more suited to sampling than operational use, a longhandled cone rake was developed that can reach up to a height of 7 m. When pushed upward in the crown the rake dislodges the cones, which then drop into the attached collector bag. As with hand rakes, subsequent cone cleaning is necessary. Because the crown architecture of the tree can be detrimentally altered by removing some twigs, only those cones that can be easily seen from the ground should be collected by this method.

Figure 5. Cone picking using tripod ladders.

For seed orchards and plantations various types of equipment (e.g., man-lifts) have been developed or modified to allow a person to work safely in tree tops. This equipment is generally suitable for high-value crops only.

MANAGEMENT CONSIDERATIONS

Black spruce cone collecting should only be done in specified (approved) areas to ensure that seed source location is known. Plantations, seed production areas, and seed orchards with trees less than 10 m high can readily be handpicked using ladders. However, as this process is labor intensive, the annual requirements for seeds might not be met. By mechanizing the process, adequate numbers of cones could be processed. It has been estimated that black spruce cone needs in Ontario can be supplied by four strategically located, mechanized processing facilities (Smith and Woodcock 1981). To ensure cost-effective procurement of mechanically harvested cones, the following considerations should be noted:

1) Collecting should be done within 2 years of a good or bumper cone crop year, and before any seeds have been released.

2) Timber harvesting operations in very cold weather (<-20°C) can result in a major loss of cones. Felling alone can dislodge more than 50% of the cones.

3) Mechanized equipment can effectively harvest cone crops up to 5 years old; however, seed cost will be somewhat higher and seed quality may be lower than when picking only from the current year's crop.

4) The purchase of tops based on advertised standards and prices must be done from strictly controlled areas in order to allow tracking of seed source location.

5) Cone-bearing tops must be dry to ensure that molding or heating does not occur in storage.

6) Using readily available refrigerated vans, cone-bearing tops can be adequately stored and inexpensively transported in large quantities (10,000 tops per load) over considerable distances to central processing sites.

7) Cone bearing branches must be stripped from the stem before processing. Production rates reported are: hand stripping ± 90 tops/person-hour; machine stripping, 150–200 tops/hour per two-person crew; and chipping of tops, ± 400 tops/person-hour).

8) Delivering tops to a central location is the most appropriate collection method, since the operation can be done at a time when labor is readily available. About 1,200 tops/hour can be processed by a three-person crew.

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