Archives

Frontline

Forestry Research Applications

Forestry Canada, Ontario Region

Technical Note No. 14

MANAGING BLACK SPRUCE STANDS FOR PERPETUAL SEED SUPPLY

by G.T. Atkinson and V.F. Haavisto

CATEGORY: Silviculture

KEY WORDS: Site-specific seed, gene complexes, superior phenotype, natural regeneration

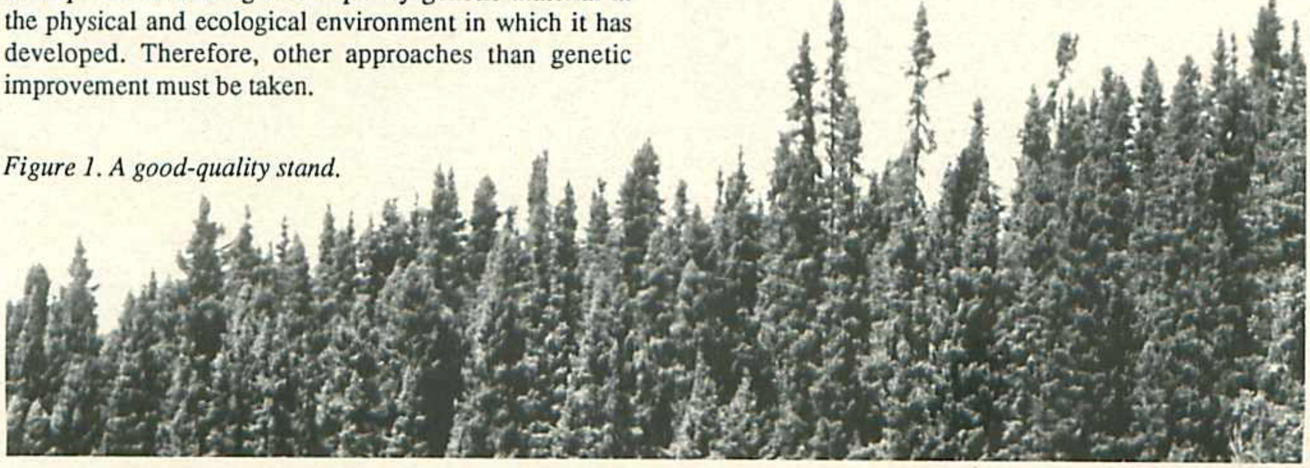
INTRODUCTION

To regenerate the vast areas of black spruce (*Picea mariana* [Mill.] B.S.P.) that are harvested annually, seed must be available. Although much of the area can be regenerated naturally, a considerable portion needs to be treated artificially, and for this, seed must be procured. Long-term testing to identify genetically superior seed sources is expensive and time-consuming. For the foreseeable future, seed production from seed orchards will be insufficient to meet our regeneration requirements for black spruce. We must preserve existing better-quality genetic material in the physical and ecological environment in which it has developed. Therefore, other approaches than genetic improvement must be taken.

For a precocious species such as black spruce, establishment and management of seed production areas (SPAs) in their natural setting is the most appropriate choice at the present time. According to Fowler (1986), "*in situ* conservation is undoubtedly the most effective method for preserving gene complexes". Current indications are that black spruce regeneration develops best on sites where it has become established naturally. To maximize the productivity of regenerated forest lands, the fastest-growing stands should be propagated. Consequently, cones should be collected (and seed stored and distributed) by site.

This technical note outlines a method by which phenotypically superior black spruce (Fig.1) gene pools

Figure 1. A good-quality stand.



can be maintained in perpetuity while retaining the genetic complex of the stands. The procedure described here was developed and tested in typical black spruce stands in the Wawa area of northern Ontario.

CHOOSING THE STAND

Choose a stand that is phenotypically superior. Such a stand is closed-canopied, uniform, relatively even-aged, and has vigorously growing merchantable trees that are less than 80 years old. The heights and diameters of the trees should be significantly larger than average for their age, as this suggests the potential for increased productivity under management. Chosen stands should represent typical site types in the area and should be permanently accessible.

Locate the stand so that the cut face will be perpendicular to the prevailing wind (i.e., it should generally run north-south in northern Ontario). The depth of the stand from east to west should be a minimum of 480 m. This will allow for eight 60-m-wide bands of timber to be harvested from the eastern edge of the uncut stand in good cone years, typically once every 4 years. The length of the cut from north to south will depend on the amount of seed required at each collection date. The potential per-hectare yield of seeds can be estimated as follows:

Yield (seeds/ha) = (Vol. of cones/tree)(No. of seeds/cone)(No. of trees/ha)

With averages of 1 L of cones per tree (Skeates and Haavisto 1987), 25 viable seeds per cone and 850 merchantable trees per hectare, approximately 6.4 million seeds per hectare can be obtained.

WHEN TO HARVEST CONES

Since the production of black spruce cones is periodic, it will be necessary to ascertain where the stand is in the cone production cycle. For the current crop, the amount of flower and cone production in relation to the average annual production can be determined by periodic visual inspections. Candidate trees will contain residual cones from the last 20 to 25 years of cone crops. These trees can be felled and used to make long-term cone crop predictions; all cones should be aged and counted.

Harvesting of the trees should only be done in the fall of good or bumper cone years to ensure an abundance of cones. Such cones yield the highest-quality seed (Skeates and Haavisto 1987).

OPERATIONAL LAYOUT AND HARVESTING

During harvesting, a 60-m-wide band of trees will be clearcut from the easternmost side of the standing timber during a good or bumper cone year. Conventional logging equipment can be used but some care must be exercised to minimize the loss of cones from the cone-bearing tops of the trees. A full-tree harvesting method should be used to remove the merchantable wood and the cone-bearing tops from the felling site to the roadside (Fig. 2). This will also ensure that minimal logging slash is left on the site to cover receptive seedbeds. At the landing, the most desirable cone-bearing tops will be collected and loaded for delivery to the cone-processing site. Black spruce cones can be removed manually, or the cones can be extracted with a mechanical processing unit such as that described by Horton (1984). Seed extraction is conducted in the conventional manner.

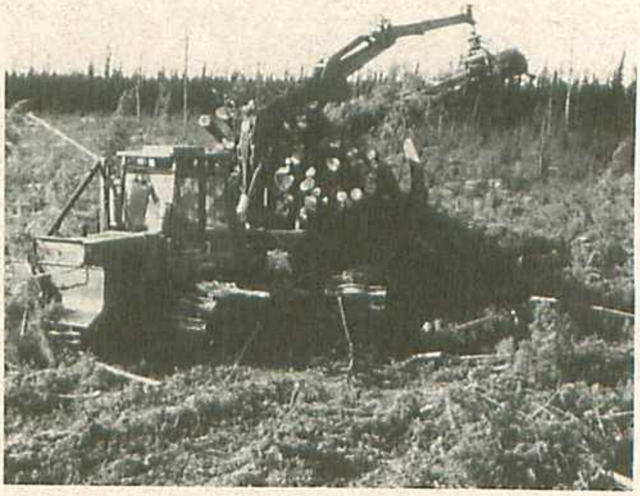


Figure 2. Cone-bearing tops being transported to the landing.

It is imperative that harvesting equipment be used carefully so that the seedbed is protected from excessive compaction or surface damage. Cone-bearing strips are harvested progressively westward, toward the prevailing wind (Fig. 3). If it is assumed that bumper cone years occur regularly, at 4-year intervals, the reserved stand (a minimum of 480 m deep) would be deep enough to allow for eight consecutive cuts. In this way, once the final cut has been harvested (approximately 30 to 40 years later), the regenerated initial cut will be in prime condition for cone production (Skeates and Haavisto 1987).

SITE PREPARATION

Once the harvesting has been completed in any one year, the seedbed may not be very receptive. Jeglum (1987) indicated that some feather mosses may dry excessively upon exposure and afford poor seedbed for seed germination and early survival. Competition from undesirable vegetation may proliferate and overcome germinants and young seedlings (Fig. 4). Seedbed preparation that is appropriate to the site is therefore essential to ensure that seed raining from the adjacent stand can alight on a receptive substrate.

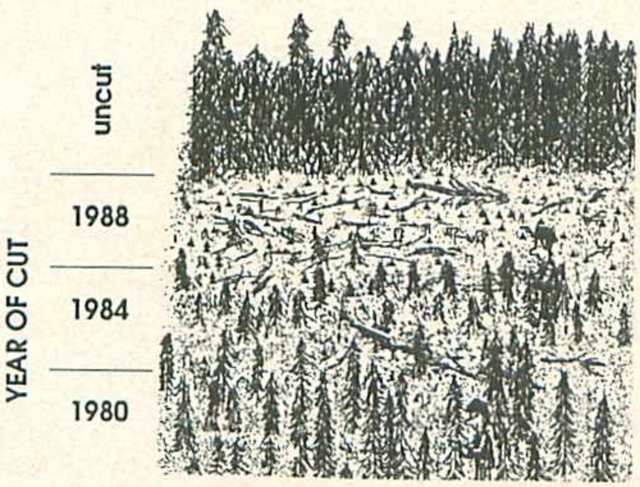


Figure 3. The operational layout of an ongoing harvesting operation.

HARVESTING SUBSEQUENT STRIPS

Successive cuts should be scheduled for harvesting during ensuing good cone years. Care must be exercised to ensure that the previous cutover and its regeneration are not damaged by men or equipment. The operating procedures for subsequent cuts should be the same as outlined for the first area cut.

PRESERVING GENE COMPLEXES

Strip cutting has been used effectively for regenerating black spruce sites naturally (Jeglum 1987). Seed that disperses across the cutover comes primarily from the edge of the stand. In order to preserve the gene complexes of the stand (the particular collection of genes and its expression on a given site) throughout the harvested area, a significant number of the phenotypically best trees in the stand should be felled, their cones collected and seed obtained. This seed should be used for the production of seedlings to be planted in the cutover area. Fairly wide spacing should be used, and seedlings should be planted in the most appropriate microsites. This assures some regeneration immediately after the harvest, even if natural regeneration was somewhat delayed.

Figure 4. Competition around the seedbed.

SUBSEQUENT ACTIVITIES

Once the regeneration has been established, competition control may be necessary. This can be accomplished chemically or manually. Once stand closure has occurred, judicious roguing can be considered to retain the best candidates, simultaneously decreasing intraspecific competition. Soil analysis should be carried out to determine if nutrients should be applied to the chosen stand. Besides normal silvicultural tending, routine management strategies for a seed orchard or seed production area can also be implemented (e.g., monitoring for diseases, insects, and floral production; inducing flowering).

CONCLUSIONS

The purpose of regeneration is to maintain the productivity of forested lands. Tree seed is needed for any regeneration program and certain advantages can be realized if the best seed is used. Without requiring long-term genetic testing, a first approximation at tree improvement can be realized by collecting seed from phenotypically superior stands. Such sources, however, are no longer abundant; thus, it is important that they be registered and preserved for seed production. A method has been devised for perpetuating phenotypically superior black spruce seed sources in their natural setting. The technique, which utilizes a progression of cuts in a candidate stand and accepts natural regeneration from seed in adjacent uncut parts of the stand, is biologically sound and imposes minimal constraints on timber harvesting. The technique has worked well for black spruce. A further advantage of this method is the preservation of an ecosystem that will give a perpetual supply of site-specific seed.

REFERENCES

Fowler, D.P. 1986. Strategies for the genetic improvement of important trees species in the Maritimes. Dep. Environ., Can. For. Serv., Fredericton, N.B. Inf. Rep. M–X–156. 30 p.

Haavisto, V.F. 1975. Peatland black spruce seed production and dispersal in northeastern Ontario, p. 250–264 *in* J.W. Fraser, *Ed.* Proc. Black Spruce Symposium. Dep. Environ., Can. For. Serv., Sault Ste. Marie, Ont., COJFRC Symp. Proc. O–P–4.

Horton, K.W. 1984. Mechanizing cone collection of black spruce in Ontario. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Joint Rep. No. 2. 16 p.

Jeglum J.K. 1987. Alternate strip clearcutting in upland black spruce. II. Factors affecting regeneration in first-cut strips. For. Chron. 63: 439–445.

Skeates, D.A. and Haavisto, V.F. 1987. Black spruce cone and seed production: yields from Ontario collections. Ont. Min. Nat. Resour., Maple, Ont. For. Res. Rep. No. 119. 28 p.

Graydy Atkinson (left) leads an FCOR study of techniques for the procurement and treatment of superior black spruce seed.

Fred Haavisto (right) is Liaison Officer in FCOR's Research Applications and Liaison Section. He maintains a specific interest in boreal forest management, including cone and seed production, harvesting methods and site preparation techniques.

Additional copies of this publication are available from:

Forestry Canada, Ontario Region
Great Lakes Forestry Centre
P.O. Box 490
Sault Ste. Marie, Ontario
P6A 5M7
(705)949-9461
(705)759-5700(FAX)

©Minister of Supply and Services Canada 1992
Catalogue No. Fo 29–29/14E
ISBN 0–662–20217–1
ISSN 1183–2762

Forestry Canada's mission is:
To promote the sustainable development and competitiveness of the Canadian forest sector for the well-being of the present and future generations.