Establishment of White Spruce Growth Trial in an Aspen Understory

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Abstract—*A conifer release trial was established in a 45-year-old aspen overstory stand in Northeast British Columbia, Canada. Thinning occurred from 0 to 100% in increments of approximately 10% to yield a total of ten units. Treatment consisted of physically cutting aspen stems at the root collar or girdling at breast height (d.b.h.) for trees <10 cm d.b.h., and >10 cm d.b.h., respectively. The thinning treatment was conducted following standard brushing and weeding contracts common to the British Columbia Ministry of Forests. At this time no significant difference in diameter growth can be found between treatments. All girdled trees were flushed the following year after treatment. The result of flushing may have limited the response of the coniferous understory. Continued monitoring of the site may provide valuable information to the operational applicability of thinning aspen stands of this age to release understory spruce.*

Introduction

Many studies have looked at the relationship between total thinning of overstory species and growth (diameter) response of the understory spruce (Lees 1966, 1970; Steneker 1967; Yang 1989, 1991; Yang and Bella 1994). Thinning the stand encourages two important environmental changes: (1) it increases the amount of solar radiation transmitted through the forest canopy; and (2) it alters the quality and quantity of litter accumulating on the forest floor. Man and Lieffers (1999) reported that overstory aspen canopies influence light levels, and air and soil temperatures, and may possibly influence soil nutrient availability and soil moisture.

Aspen overstories can serve as a nurse crop, reducing frost, insect damage, and competition from understory vegetation (Man and Lieffers 1999). At a time when diversity (Anonymous 1995) is a major component of our forest practices, maintaining an aspen component may enhance or maintain structural and species diversity in our boreal forests.

For the most part, mixed-wood stands of the boreal forest are initiated following large-scale disturbance by fire (Anonymous 1995). Following such a disturbance, it is not uncommon for forests to be composites of overstory aspen and understory spruce (Rowe 1972). Many of these stands (deciduous and deciduous/coniferous forests) in the Peace Region of British Columbia and Alberta contain a substantial component of regenerating spruce at varying stages of development. Spruce may be in the understory only (<5 meters); it may be in a juvenile or pole stage or vertically stratified in the main canopy. It is not uncommon to find these attributes in 20- to 30-hectare size stands. The location of seed source, forest floor environment, and type of stand initiating disturbance will affect the timing and success of understory regeneration (Kelty 1996).

In the Peace Region, the abundance of mixed woods where understory spruce is present is unknown. However, a great amount of interest has surfaced

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regarding the facilitation and protection of this understory for future harvest as a commercial crop (Brace 1991). This interest has been advanced by the development of oriented stand board and improvements in pulping technology, which has increased the harvest of Boreal mixed wood and deciduous forests (Lieffers and Beck 1994).

By maintaining a partial overstory of aspen in these stands we may see improved growth of both species and increased overall stand yield. In this study, we were interested in observing the relationship of thinning one species (overstory) on the diameter growth of another species (understory).

Conventional theory suggests that over identical time periods, given equivalent growing conditions, with all else held equal, growth rates will be equal. In a natural experimental setting, it is difficult to hold all variables to equal influence. We have attempted to alter one variable (percent overstory) while holding all else static in this study, assuming all other variables that influence growth do so to the same degree throughout the study area.

We expected to establish a relationship between the degree of thinning and growth response; that is, at what thinning percentage maximum growth of spruce could be attained. Logan (1969), Eis (1970), Lieffers and Stadt (1994), and Coates et al. (1994) all reported increased spruce height growth with improving light environment (increased thinning). Lieffers and Stadt (1994) found that 40% of full sunlight was sufficient to attain growth rates nearly equal to that attained at full sunlight. Coates et al. (1994) predicted that optimal height growth for understory spruce could be attained at 50% of full sunlight, while Logan (1969) reported maximum height growth for white spruce at 45% of full sunlight. Eis (1970), Lieffers and Stadt (1994), and Coates et al. (1994) reported their findings after observing light transmittance and growth over one growing season, while Logan (1969) reported results after nine growing seasons.

This paper is being presented as an establishment report for the purpose of these proceedings. The following information describes initial stand structure, treatment, and current findings.

Methods

The experimental site is located in an even-aged aspen stand 100 kilometers (60 miles) northwest of Fort St. John (56°51'30" N, 121°25' W) in Northeast British Columbia, Canada. The site index for spruce (base age @ 50 years) is 18 meters. Soils are classified as orthic gray luvisols characterized by silty clay loam of glacial lacustrine origin (Agriculture Canada 1986). Forest floor vegetation is dominated by *Cornus canadensis* L., *Lathyrus orchroleucuc* Hook., *Rosa acicularus* Lindl., *Viburnum edule* (Michx) Raf., and *Vaccinium vitis idaea* L. (Douglas et al. 1989, 1991). The site is situated in the Boreal White and Black Spruce moist and warm biogeoclimatic zone (Meidinger and Pojar 1991); series has been classified as mesic (01 site series).

In 1955, a forest fire swept through large portions of what is now known as the Fort St. John Forest District. The disturbance created by this fire began the stand initiation process that has resulted in the current stand structure. Reconnaissance of the site was conducted in the summer of 1998. Aspen and spruce stocking composition was determined. Aspen density prior to treatment averaged 3,920 stems per hectare (sph) and spruce understory averaged 1,050 sph.

Aspen crown canopy height was determined to be 18 meters. No other disturbances have taken place in the stand.

Ten research plots were located on the ground in 1998. Each plot is comprised of a 70- x 70-meter (0.49-ha) treatment plot with a 40- x 40-meter (0.16-ha) measurement plot located in the center. Each thinning plot was randomly selected.

Thinning treatments took place following baseline measurement completion. Each plot was located to reduce edge effect and to minimize stocking variability among plots. Plot perimeters were tight chained, flagged, and painted. Gross treatment area was GPSed in the winter of 1998.

Thinning was conducted under a British Columbia Ministry of Forests Brushing and Weeding Standards Agreement (Anonymous 1998). The standards set out in this agreement require the operation to be conducted using the follow conventions. Aspen stems <10 centimeters in diameter at breast height (d.b.h. = 1.3 meters) were physically thinned (cut at root collar). Aspen stems >10 centimeters at breast height were girdled at breast height. Percent treatments ranged from 0 to 100% removal of the baseline stand in increments of approximately 10% for a total of 10 installations (table 1).

In the fall of 1998, baseline measurements of bark on tree diameter at breast height were taken for six trees on each of the 10 thinning plots. This was repeated in year 2 (1999) where all trees except one was measured. Means and standard deviations were calculated for all thinning treatments in each year (table 1).

Discussion and Results

To date no clear results can be attained from our data set. Figure 1 shows the average change in diameter for all thinning treatments between year 1 (1998) and year 2 (1999). The data set is very small—six measured trees per plot. During the late summer and fall of 2000, we will conduct destructive sampling at the site. This will allow us to acquire a larger data set for 1998, 1999, and 2000 (50 trees each of aspen and spruce per plot). At this time we cannot draw any substantive conclusions, and to do so with such a small data set could be misleading.

Helms and Standiford (1985) found the factors responsible for increased growth to be prerelease diameter growth rate, diameter, and prerelease height.

Table 1—Initial group diameters (year 1) and first-year diameters (year 2) with standard deviation, diameter change, and stems measured in each group.

Group	Thin	Year 1 mean d.b.h.	Year 1 standard deviation	Year 2 mean d.b.h.	Year 2 standard deviation	Diameter change	n
	%	- - - - - -	- - - - - -	mm	- - - - - -		
1	0	34.7	8.6	38.9	9.7	4.1	6
7	15	33.7	8	35.8	8.5	2.1	6
9	30	24.4	6.3	27.2	5.4	2.8	6
8	40	28.3	5.7	29.8	6.5	1.4	6
2	50	30.7	13.5	32.6	13.5	1.8	6
3	60	31.6	7.7	36.7	7.8	5.1	6
5	70	34.8	15.6	39.3	14.9	4.5	6
6	80	24	8	28.5	9.2	4.4	5
10	90	25.3	10.2	33.1	12.9	7.8	6
4	100	24.2	7.8	28.9	6.8	4.6	6
Grand mean all groups		29.2	9.1	33.1	9.5	3.9	

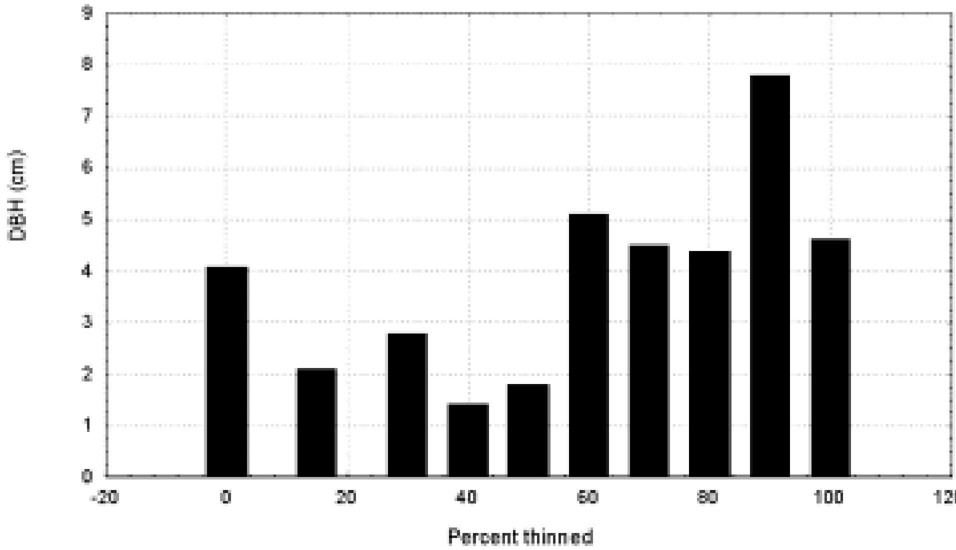

Figure 1—Plot of diameter change versus percent thinning.

In this study the pretreatment light environment may have been sufficient to facilitate near maximum diameter growth, pre and post thinning.

Light environment may be a concern. Girdled aspen trees produced leaves in the summer of 1999. Therefore, the percent thinning (girdling included) does not accurately represent the light environment. This may have resulted in less of a light environment change than anticipated. It is possible that because of the flush in 1999 there was insufficient change in light environment to obtain a significant diameter growth response. Waring and Schlesinger (1985) suggested the allocation priority is first to leaf and root development, and later to stem development. Therefore, stem growth response may not be noticeable until the second or third growing season following treatment.

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