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Growth of white spruce underplanted beneath spaced and unspaced aspen

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Establishing white spruce by planting it under established aspen stands has substantial potential as a method for regenerating boreal mixedwood stands. The presence of an aspen overstory serves to ameliorate frost problems and suppresses understory vegetation that may compete with white spruce, while harvest of the overstory aspen after establishment of the understory spruce can lead to subsequent development of a mixedwood stand.

In this study we examined the growth of white spruce during the first 10 years after being planted underneath trembling aspen following different thinning and fertilization regimes.

Understory in unthinned (top) and thinned (1000 sph, bottom) plots (Photos taken by Richard Kabzems [top] and Chiara Calabrese [bottom]).

Methods: The Sierra Road experiment was established in the fall of 1991 in a 39 year-old aspen stand located 85 km east of Fort Nelson, B.C. (58° 45'N, 121 ° 37' W). The experiment involved 4 levels of spacing: 1) untreated (6000 to 8000 stems·ha^{-1}); 2) 3000 stems·ha^{-1}; 3) 2000 stems·ha^{-1}; and 4) 1000 stems·ha^{-1}. Spacing treatments were completed during fall of 1991. While the original study examined four levels of fertilization we compare only two: 1) untreated; and, 2) a complete fertilizer mix comprising 200 kg·ha^{-1} N (ammonium nitrate), 100 kg·ha^{-1} P, 100 kg·ha^{-1} K, 25 kg·ha^{-1} Mg, 50 kg·ha^{-1} S, and 1.5 kg·ha^{-1} B. Fertilizer was applied in the selected plots by hand during June of 1994. In early July of 1996, white spruce (2+0 415B) were planted at a density of 1300 stems·ha^{-1}.

Results: Results indicate successful establishment and reasonable growth rates of white spruce planted under thinned and unthinned aspen stands**.** Thinning of the aspen stands to 1000 or 2000 stems ha^{-1} did increase diameter and height growth of the underplanted spruce, as well as increasing average diameter of the overstory aspen. Light levels under the aspen canopy were inversely related to aspen basal area. Fertilization did not have a significant effect on spruce size or growth rates.

Table 1. Effects of spacing on overstory aspen and underplanted white spruce characteristics in 2007. Values with different letters within a column were found to differ significantly ($p<0.05$) based on lsmean separation using the Tukey-Kramer test.

	Overstory Aspen				Underplanted White spruce (tenth year)	
Treatment	**Aspen density (# ha^{-1})**	**Aspen Basal Area (m^2 ha^{-1})**	**Top Height (m)**	**DBH (cm)**	**Height (cm)**	**Root collar diameter (mm)**
Control (unspaced)	2461c	37.69c	26.0	13.5c	99.0b	13.9b
3000 stems·ha^{-1}	2481c	39.71c	25.0	13.7bc	107.3b	15.4ab
2000 stems·ha^{-1}	1657b	30.49b	25.7	14.8b	141.4a	18.9a
1000 stems·ha^{-1}	1050a	22.06a	24.6	16.8a	135.0a	19.1a

The presence of aspen cover maintained air temperatures above freezing during summer frost events observed in 2007, but also delayed soil warming.

Implications: While height and diameter growth of underplanted white spruce were improved following thinning, the benefits are small and may lead to problems with increases in cover of understory vegetation as well as increasing costs. Results are consistent with other studies which indicate that basal area of the aspen overstory should be above 25 m^{2}ha^{-1} in stands selected for underplanting.

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Further Information:

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