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Lodgepole pine takes up nitrogen fertilizer better in the summer and fall than in the spring

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Fertilization has the potential to greatly increase the productivity of lodgepole pine forests of Alberta and British Columbia. However, much of the fertilizer applied to forests is often not taken up by the trees. The objective of this experiment was to determine if there are large differences in the ability of lodgepole pine to take up N fertilizer when applied in spring, summer or fall.

Lodgepole pine (1 + 0 container stock from a Hinton, AB seed source) were grown for an entire growing season in 15 cm pots filled with a silt-loam soil from the Hinton area. The pots were watertight but had a false bottom which allowed for drainage. Seedlings were over-wintered outside in their pots and were brought into a controlled environment setup in early spring. The setup allowed us to change soil and air temperature, and photoperiod to mimic the typical growing season conditions in northern Alberta between May and September (see below). Seedlings were grown through these seasonal changes over a period of four month.

Conditions for ¹⁵ N fertilization of lodgepole pine	Spring	Summer	Fall
Photoperiod (hrs)	15	18	12
Relative humidity%	60	60	60
Air temp. (day/night) °C	12/8	20/17	14/10
Soil temp. (day/night) °C	4/3	19/15	11/10

Soil temperature was controlled by placing the watertight pots in a circulating water bath. Watering of the seedlings was controlled to prevent excess water from accumulating in the false bottom of the pot.

At the appropriate season (spring, summer or fall), a stable isotope ¹⁵N in the form of (¹⁵NH₄)₂SO₄ at 5.13 atom% was applied to the pots. During each season, seedlings were harvested 3, 7 or 30 days after fertilization and the amounts of ¹⁵N in the leaves, stems, and roots of the pine seedlings were determined.

Our results indicate that in the spring, only 4% of the added N was taken up by the pine seedlings, 30 days after fertilization, compared to 43% during the summer and 33% in the fall. Reasons for the poor uptake in



spring were related to both cool soil conditions and the fact that there were virtually no new root tips at this early time of the growing season. Only

during the summer and fall after new root tips had been developed and soils were warmer, was there significant uptake of the applied fertilizer.

Implications for management:

This study indicates that fertilizers applied in the spring will not be immediately taken up by the roots of the pine likely due to cold soil temperature and physiological limitations of the root system. Early spring application would leave the fertilizer susceptible to leaching, denitrification or uptake by other plants. However, if spring applied fertilizer is still available, it might be taken up later in the growing season (after soils warm up and root growth commences). Fall may be the better time to fertilize as the potential for N uptake by pine roots is still high, but the cooler soil and air temperatures may reduce loss due to volatilization of the N. Results will need to be verified under field conditions.

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Further Information:

Amponsah, I.G., Lieffers, V.J., Comeau, P. and Landhäusser, S.M. 2004. Nitrogen-15 uptake by *Pinus contorta* seedlings in relation to phenological stage and season. *Scand. J. For. Res.* 19: 329-338.

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