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Temperature control over root growth and root biomass in taiga forest trees

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Root elongation of greenhouse-grown Alaskan taiga tree seedlings increased with increasing root temperature in all six species examined and was most temperature sensitive in warm-adapted aspen *(Populus tremuloides* Michx.). Root elongation was slower in fine than large roots and in black spruce *(Picea mariana (Mill,)* B.S.P.) was less temperature sensitive in fine than in large roots. Root elongation in the laboratory was slowest in black spruce, which has an inherently slow growth rate, and most rapid in poplar *(Populus balsamifera* L,) and aspen, which grow more rapidly. In contrast, field root elongation rates tended to be highest in black spruce from cold wet sites, suggesting that site factors other than soil temperature (e.g., moisture) predominated over genetic differences among species in determining field root elongation rates, The seasonal *pattern* of root elongation was closely correlated with soil temperature and reached maximum rates in July for all tree species (except aspen medium-sized roots). Most roots of each species were in the top 20 cm of soil. However, root growth penetrated to greater depth in warm compared with cold sites. Root biomass in a 130-year black spruce forest (1230 g/m ^{2}) comprised only 15% of total tree biomass. Root biomass of 25-year aspen and 60-year poplar sites (517 and 5385 g/m ^{2} respectively) comprised a greater proportion (57% in poplar) of total tree biomass than in spruce,

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L'élongation des racines de semis d'arbres de la taiga d'Alaska, croissant en serres, a suivi un accroissement de la temperature au niveau des racines dans les six espéees étudiées et s'est révélée particuliérement sensible chez le peuplier faux-tremble *(Populus tremuloides* Michx.) qui s'adapte a la chaleur. L'élongation était plus lento chez les petites racines que chez les plus grosses racines et dans Ie cas de I'épinette noire *(Picea mariana* (Mill.) B.S.P.), ('elongation des petites racines etait moins dépcndante de]a temperature chez les racines plus grosses. L'épinette noire, qui génétiquement a un lent niveau de croissance, a montré la plus lente elongation de racines au laboratoire, la plus rapide se manifestant chez le peuplier baumier *(Populus balsamifera* L.) et chez le peuplier faux-tremble, espèces a croissance plus rapide, Sur le terrain, au contraire, Ia vitesse de ('elongation des racines s'est révélée la plus élevée chez I'épinette noire de stations froides et humides, suggérant que des facteurs du milieu autres que la temperature du sol (e.g., humidite) avaient plus d'importance que les differences génétiques entre les espéces, Une étroite correlation s'est manifestée entre le modèle saisonnier de ('elongation de racines et la temperature du sol, atteignant pour touter les essences un niveau maximum en juillet (sauf pour les ravines moyennes du peuplier faux-tremble). La majorité des racines de chaque essence se retrouvaient dans les premiers 20 cm de sol, La croissance racinaire réussissait cependant a atteindre une plus grande profondeur dans les stations plus chaudes que plus froides. La biomasse racinaire dans une forêt d'épinettes noires de 130 ans (1230 g/cm^2) ne faisait que 15% de la biomasse totale des arbres, alors que la biomasse racinaire chez des peupliers faux-tremble de 25 ans et chez des peupliers baumiers de 60 ans (517 et 5385 g/cm^2 respectivement) constituait une proportion plus élevée (57% chez le peuplier baumier) de la biomasse totale des arbres.

[Traduit par le journal]

Introduction

Forest ecology has emphasized study of aboveground processes, The summer climate of interior Alaska provides near optimal aboveground conditions for tree growth: 20-h days and moderately warm air temperatures (July mean, 1941-1970 of 16°C). Because of low soil temperature (1— 10°C) and in some taiga **sites low** nutrient availability, it is likely that belowground processes such as root growth exert a major influence over tree growth and distribution.

In this study, we investigated the temperature control over root growth as a potential distinguishing feature of the major interior Alaskan tree species, We concentrated on black spruce, a slowly growing evergreen found in cold nutrient-poor sites and on aspen and poplar, rapidly growing deciduous trees encountered on more favorable sites (Van Cleve and Viereck 1981).

We hypothesized that temperature would play a major role in regulating root growth and expected to see the following patterns: (i) more rapid root growth at warmer temperatures, (ii) less temperature sensitivity in more cold-adapted species, and *(iii)* high root —shoot ratio in cold nutrient-deficient sites.

Site description and methods

The forests of interior Alaska are dominated by six tree species, each of which occurs in distinct site types: aspen

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