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78. © Host species and habitat affect nodulation by specific *Frankia* genotypes in two species of *Alnus* in interior Alaska. Anderson, M. D., Ruess, R. W., Myrold, D. D., and Taylor, D. L. *Oecologia* 160:619-630. 2009.

Host species and habitat affect nodulation by specific *Frankia* genotypes in two species of *Alnus* in interior Alaska

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Abstract Alders (*Alnus* spp.) are important components of northern ecosystems due to their ability to fix nitrogen (N) in symbiosis with *Frankia* bacteria. Availability of optimal *Frankia* may be a contributing factor in limiting the performance and ecological effects of *Alnus*, but the factors underlying distribution of *Alnus*-infective *Frankia* are not well understood. This study examined the genetic structure (*nifD*-K spacer RFLP haplotypes) of *Frankia* assemblages symbiotic with two species of *Alnus* (*A. tenuifolia* and *A. viridis*) in four successional habitats in interior Alaska. We used one habitat in which both hosts occurred to observe differences between host species independent of habitat, and we used replicate sites for each habitat and host to assess the consistency of symbiont structure related to both factors. We also measured leaf N content and specific N-fixation rate (SNF) of nodules (^{15}N uptake) to determine whether either covaried with *Frankia* structure, and whether *Frankia* genotypes differed in SNF in situ. *Frankia* structure differed between sympatric hosts and among habitats, particularly for *A. tenuifolia*, and was largely consistent among replicate sites representing both factors. Leaf N differed between host species and among habitats for both

hosts. SNF did not differ among habitats or host species, and little evidence for differences in SNF among *Frankia* genotypes was found, due largely to high variation in SNF. Consistency of *Frankia* structure among replicate sites suggests a consistent relationship between both host species and habitat among these sites. Correlations with specific environmental variables and possible underlying mechanisms are discussed.

Keywords Actinorrhizal · Boreal · Distribution · Nitrogen fixation · Symbiosis

Introduction

In terrestrial ecosystems of the northern hemisphere, alders (*Alnus* spp., Betulaceae) are important early colonizing plants in both primary and secondary seral systems (e.g., Chapin et al. 1994; Van Cleve and Viereck 1981), due largely to their ability to form root nodule-based, nitrogen (N) fixing symbioses with actinomycete bacteria of the genus *Frankia*. This symbiosis allows alder to maintain high N content and growth rates in low nutrient and/or disturbed habitats, which can result in both strong competitive effects of alder growth and facilitative effects of alder-derived N on associated plant species throughout succession (e.g., Vogel and Gower 1998; Wurtz 1995; Chapin et al. 1994; Walker and Chapin 1986; Van Cleve and Viereck 1981). Controlled inoculation studies between *Alnus* species and *Frankia* strains indicate that specificity of associations is variable for both organisms, and that infection by different *Frankia* inocula can have large effects on host growth, N content, and N-fixation (Martin et al. 2003; Prat 1989; Hooker and Wheeler 1987; Sellstedt et al. 1986; Dillon and Baker 1982; Dawson and Sun 1981).

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