TITLE: SPECIES SPECIFIC RESPONSES TO TARGETED FERTILIZER APPLICATION ON RECONSTRUCTED SOILS IN A RECLAIMED UPLAND AREA

Abstract

Reforestation of reclaimed soil materials is a critical step in the successful recovery of forest ecosystems and their associated functions in post-mined upland areas. Reconstructed landforms often require a soil cover that supports the demands of a diverse and dynamic forest for the long-term future. Salvaged soils commonly used in upland soil reconstruction include lowland organic coversoils in the form of peat overlying blended and homogenized upland subsoil materials. The high soil organic content in peat can benefit tree growth by providing short-term nutrient cycling of nitrogen (N) and sulfur (S) and storing enough water for vegetation during dry years, while the underlying subsoil materials provide long-term nutrient availability through weathering and structural support for deep-rooted plants. Findings from a 5-year study suggested that planted tree seedling growth (i.e. trembling aspen, jack pine, white spruce) may have been limited by low phosphorus (P) and potassium (K) availability in the peat and the underlying coarse-textured subsoil materials, while N was readily available in the peat coversoil. Fertilization is a common method used to treat nutrient limitations on reclamation sites, supplying a wide range of nutrients to fulfill the varying requirements that are unique to each tree species; however, operational fertilizer applications of NPK on organic soils often induce strong positive responses from unwanted colonizing vegetation, which reduces the nutritional benefits intended for the seedlings and could render the fertilizer application ineffective.

In an effort to meet the nutritional demands of planted seedlings while reducing the response of competing vegetation, a follow-up study was developed to test the use of a fertilizer application that targets specific nutrient deficiencies in the soil and in each tree species. Liquid fertilizer was applied to six-year-old seedlings using five treatments in the field: Control (no fertilizer), NPK, PK, P, and K. Tree height, root collar diameter, foliar nutrient concentration, and vegetation cover were measured over two growing seasons. Aspen responded the strongest to fertilization, particularly in the P treatment, while pine and spruce marginally responded to the NPK treatment; however, growth responses depended on the type of underlying subsoil material. The competing vegetation increased in NPK and did not respond to the P, K and the Control treatments; despite the lower competition, tree seedlings did not respond as strongly as expected to the P and K treatments. Additional analyses of the soil conditions (e.g. pH, cation sorption, water availability, temperature) suggest that other factors were more limiting to the trees during the study, which reduced their response to the fertilizer additions. This study demonstrates that targeted fertilization in planted tree stands at a later age can be an option that allows for increased efficacy and cost savings; however, the outcome will be dependent on an understanding of other potentially limiting factors.

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Shauna has studied and worked at the University of Alberta since 2012, and throughout that time, she has completed an undergraduate degree in Environmental Earth Sciences and worked as a field technician on a variety of projects that focused on watershed monitoring and reclamation research. Today, Shauna is nearing the end of a Masters program at the U of A that specializes in land reclamation in the Alberta Oil Sands Region, specifically researching afforestation success on reconstructed soil capping prescriptions in reclaimed upland areas.

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