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Nitrate stimulates root suckering in trembling aspen (*Populus tremuloides*)

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Abstract: In a greenhouse experiment, we tested whether the initiation, density, and growth of trembling aspen (*Populus tremuloides* Michx.) root suckers are related to postdisturbance soil nutrient availability. After decapitation of functional 2-year-old aspen root systems, nutrient solutions adjusted for various concentrations and forms of mineral N, different concentrations of Ca^{2+}, K^+, or PO_4^{3-}, and different pH were applied to the roots and their suckering response was assessed after 35 days. Root systems treated with NO_3^- at concentrations of 1.5 and 7.5 mmol/L produced nearly double the sucker density compared with an unfertilized control, while fertilizing with N in the form of NH_4^+ did not affect sucker numbers, regardless of concentrations. The best growth of suckers was achieved with a mixture of 15 mmol/L NO_3^- + NH_4^+whereas the lowest growth was observed with 15 mmol/L NH_4^+. Neither Ca^{2+}, K^+, and PO_4^{3-} nor the pH tested in this study impacted sucker density or growth. This has implications for understanding the impacts of disturbance on forest succession and the subsequent regeneration of aspen stands. The results suggest that the amount of nitrification, depending on the type and severity of disturbances, will influence the regeneration density of aspen.

Résumé : Dans une expérience en serre, nous avons vérifié si l'initiation, la densité et la croissance des drageons racinaires de peuplier faux-tremble (*Populus tremuloides* Michx.) étaient reliées à la disponibilité des nutriments après une perturbation. Après avoir décapité le système racinaire fonctionnel de peupliers âgés de deux ans, nous avons ajouté des solutions nutritives contenant différentes concentrations et formes de N minéral, différentes concentrations de Ca^{2+}, K^+ ou PO_4^{3-} et ajustées à différents pH. Nous avons évalué le drageonnement après 35 jours. Les systèmes racinaires traités avec NO_3^- à des concentrations de 1,5 et 7,5 mmol/L ont produit près du double de la densité de drageons comparativement au témoin non fertilisé alors que la fertilisation avec NH_4^+ n'a eu aucun effet sur le nombre de drageons peu importe la concentration. La croissance des drageons a été la plus forte avec 15 mmol/L de NO_3^- + NH_4^+ et la plus faible avec 15 mmol/L de NH_4^+. Les Ca^{2+}, K^+ et PO_4^{3-} et les différents pH testés dans cette étude n'ont eu aucun impact sur la densité ou la croissance des drageons. Cela a des conséquences sur la compréhension des impacts des perturbations sur la succession forestière et la régénération subséquent des peuplements de peuplier. Les résultats indiquent que la quantité de nitrification, dépendamment du type et de la sévérité des perturbations, influencera la densité de la régénération de peuplier.

[Traduit par la Rédaction]

Introduction

Trembling aspen (*Populus tremuloides* Michx.) is an early successional clonal tree species that re-establishes by root suckering after aboveground disturbances. After the removal or death of the aboveground portion of the clone, changes in the ratio of cytokinins to auxins and potentially in other plant hormones (see review by Frey et al. 2003) are thought to trigger the development of suckers on aspen root systems. A range of other possible factors influencing the initiation of root suckers in aspen have been studied, but the impacts of mineral nutrition on suckering, particularly the forms of N, have not received much attention (Frey et al. 2003). Nitrate is known to stimulate the biosynthesis of cytokinins (Werner et al. 2001; Schmülling 2002), which are known to be involved in sucker initiation in aspen (Frey et al. 2003). Following disturbance, nitrification, i.e., the conversion of NH_4^+ to NO_3^-, can increase substantially (Likens et al. 1969; Min et al. 1998; Carmosini et al. 2002; Lapointe et al. 2005), and a higher ratio of NO_3^- to NH_4^+ is believed to favor early successional species (Kronzucker et al. 1997, 2003; Reich et al. 2001) such as aspen.

Some of the densest and most vigorous aspen suckering occurs following fire (Bartos and Mueggler 1981; Brown and DeByle 1987; Fraser et al. 2003); in contrast, regeneration after logging is often inconsistent (Frey et al. 2003). Higher soil temperatures that accompany fire disturbances have been considered to be a factor in sucker initiation because of the effects of temperature on root metabolism and hormonal balance (Schier et al. 1985; Hungerford 1988). Consequently, there is expected to be a positive correlation between sucker initiation after disturbances and soil temperature (Frey et al. 2003). However, Fraser et al. (2003) found more suckering on burned sites than on clearcut harvested sites despite little differences in soil temperature. Also, several studies found a poor relationship between sucker initia-

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