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SHORT COMMUNICATION

Plant Facilitation on a Mine Tailings Dump

John Markham,[1,2] Ian Young,[1] and Sylvie Renault[1]

Abstract

Facilitation is a potentially useful tool in restoration efforts. We investigated the causes of facilitation in planted *Picea mariana* seedlings in an unvegetated mine tailings dump. Clusters of plants doubled the survival rate in the first growing season compared to single plants. In the first year mycorrhizal inoculation had no effect on survival, but by the second growing season only mycorrhizal inoculated plants survived, most of these being in plant clusters. This suggests that facilitation in this environment is partly the result of interactions with mycorrhizae.

Key words: facilitation, mine tailings, mycorrhizae, *Picea mariana*.

Introduction

Facilitation can be an important component in restoration efforts due to the inhospitable nature of many areas needing restoration (Bradshaw 1983; Hastings et al. 2007). However, the causes of facilitation effects are not often investigated and there is a need to separate the different factors that can lead to facilitation (Brooker et al. 2008). We investigated the possibility that facilitation could increase plant survival in a mine tailings site. The Gunnar gold mine was active from 1936 to 1943. The tailings generated cover 11 ha of previously forested land. The tailings are nonacid generating, have low organic carbon content (0.24%), and lack many of the macro- and micronutrients necessary for normal plant growth (unpublished data). Our previous work on this site has shown that succession from the edge of the tailings pond occurs at a rate of about 1 m a year (Markham et al. 2008). However, the central part of the site has remained unvegetated.

We compared the survival of tree seedlings planted in small clusters as opposed to isolated individuals. We used *Picea mariana*, a species that is part of the natural succession occurring on the site, but is only found once shrubs have formed a dense cover (Markham et al. 2008). To separate the above and belowground facilitation effects, additional treatments were used: the planting of *P. mariana* neighbors with their shoots cut off to provide a belowground effect, and artificial shoots to provide a shoot only effect. As one of the possible mechanisms of facilitation is the establishment of mycorrhizal networks (van der Heijden & Horton 2009) we crossed these treatments with a mycorrhizal fungi inoculation treatment.

Methods

On 15 June 2009 1-year-old *Picea mariana* seedlings from the Pinelands Forest Nursery (Manitoba) were planted into a nonvegetated region of the Gunnar Mine tailings. At this time *P. mariana* in the area were starting to break bud. The seedlings were 20 to 25 cm tall with a 7.5 cm long by 2.5 cm diameter soil plug. The seedlings were planted in 10 rows of 8 plots with a 2 × 2−m spacing (Fig. 1). There were four neighbor treatments crossed with two mycorrhizal treatments in each row. The neighbor treatments were single plants, clusters of plants, single plants with root clusters, and single plants with artificial shoot clusters. The clusters of plants consisted of nine other *P. mariana* plants surrounding a treatment plant, all spaced evenly around the treatment plant. The artificial shoots were plastic shoots used as artificial conifer decoration, that is, twisted metal wires with 3 mm wide by 2-cm long strips of green polyethylene wrapped around their base. This material was cut into 30-cm strips and placed 5 cm into the tailings. The root cluster treatment consisted of a central plant surrounded by nine root plugs of *P. mariana* with their shoots removed a day prior to planting. For each neighbor treatment, half of the replicates received a mycorrhizal fungi inoculation. The mycorrhizal culture was *Laccaria bicolor* (University of Alberta Microfungus and Herbarium Culture #6061), a common fungal partner of *P. mariana.* Inoculation was accomplished by inserting potato dextrose agar sections cut from an active fungal culture into the center of the root plug several days prior to planting. Noninoculated seedlings had a sterile section of potato dextrose agar (PDA) inserted into their root plug. In each replicate, the clusters and plugs had the same inoculation treatment as the treatment plant they

[1] Department of Biological Sciences, University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada
[2] Address correspondence to J. Markham, email markhamj@cc.umanitoba.ca

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