Geophysical Research Abstracts
Vol. 17, EGU2015-8991-1, 2015
EGU General Assembly 2015

Root growth, mycorrhization and physiological effects of plants growing on oil tailing sands

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Surface mining creates large, intense disturbances of soils and produces large volumes of by-products and waste materials. After mining processes these materials often provide the basis for land reclamation and ecosystem restoration. In the present study, tailing sands (TS) and processed mature fine tailings (pMFT) from Fort McMurray (Alberta, Canada) were used. They represent challenging material for ecosystem rebuilding because of very low nutrient contents of TS and oil residuals, high density of MFT material. In this context, little is known about the interactions of pure TS, respectively mixtures of TS and MFT and root growth, mycorrhization and plant physiological effects. Four herbaceous plant species (Elymus trachycaulus, Koeleria macrantha, Deschampsia cespitosa, Lotus corniculatus) were chosen to investigate root development, chlorophyll fluorescence and mycorrhization intensity with and without application of Glomus mosseae (arbuscular mycorrhizae) on mainly tailing sands.
Surprisingly both, plants growing on pure TS and plants growing on TS with additional AM-application showed mycorrhization of roots. In general, the mycorrhization intensity was lower for plants growing on pure tailings sands, but it is an interesting fact that there is a potential for mycorrhization available in tailing sands. The mycorrhizal intensity strongly increased with application of G. mosseae for K. macrantha and L. corniculatus and even more for E. trachycaulus.
For D. cespitosa similar high mycorrhiza infection frequency was found for both variants, with and without AM-application. By the application of G. mosseae, root growth of E. trachycaulus and K. macrantha was significantly positively influenced. Analysis of leaf chlorophyll fluorescence showed no significant differences for E. trachycaulus but significant positive influence of mycorrhizal application on the physiological status of L. corniculatus. However, this effect could not be detected when TS was mixed with MFT (1:1).