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Alteration of root growth caused by heavy forest machinery on Osankarica

Peter Železnik [1], Boštjan Mali [1], Robert Robek [1] and Hojka Kraigher [1]

[1] Slovenian Forestry Institute, Večna pot 2, SI-1000 Ljubljana
Contact: Peter Železnik E-Mail: peter.zeleznik@gozdis.si

ABSTRACT

Impact of heavy forest machinery on soil properties is well described. However, there is still a lack of surveys of root growth impacts, although available data suggest that development and turnover of fine roots significantly differ among undisturbed sites and sites, affected by forest operations including mechanized harvesting and skidding. Operational limitations are needed for sustainable forest management concerning long-term effects of soil compaction on soil physical properties and root growth caused by heavy forest machinery. Although some recommendations were given recently (e.g. from project EcoWood), both Slovenia and the rest Europe do not possess any standards or limitations with regard to mechanized harvesting and skidding. Additional relevant indicators are required from field measurements. Investigation of the machinery impacts on root growth using minirhizotrons was set up in autumn 2007 and autumn of 2008 after forest operations at a beech-dominated forest site at Osankarica (Pohorje mountain range, 1250 m/sl). First picture taking sessions begun in summer of 2008 and to date 5 assessments at monthly intervals in the vegetation season 2009 were analyzed. The differences in fine root turnover have not reached a statistical significance yet although tendencies have been detected.
KEYWORDS: mechanized forest operations, soil compaction, minirhizotrons, root growth and turnover

1. INTRODUCTION

As forestry machinery is becoming heavier and more powerful it also has more damaging effect on forest soils, mainly through soil compaction. Apart from immediate damage, made by machines on roots, compacted soil cut off neighbouring plant roots from water, nutrient and air supplies and thus cause physiological stress. Deep rutting strip off the top layers of soil from the ground and push it beside skid trail disabling recolonization of skid trail by plants and resulting in further heavy soil erosion.

Since development and turnover of fine roots significantly differs among affected and undisturbed sites (Robek et al. 2001), we initiated studies of machinery impacts on root growth using minirhizotrons. The latter provide a nondestructive, in situ method for viewing roots and are one of the best tools available for directly studying roots (Majdi 1996).

2. MATERIAL AND METHODS

Minirhizotrons were inserted at a 60° angle in autumn 2007 and autumn of 2008 after forest operations at a beech-dominated forest site at Osankarica (Pohorje mountain range, 1250 m/sl). First picture taking sessions begun in summer of 2008 and to date 5 assessments at monthly intervals in the vegetation season 2009 were analyzed. Minirhizotrons were installed at 2 m distances on two subplots in and beside wheel rut and in undisturbed soil profiles. First site comprised 3 x 3 minirhizotron tubes as shown in Figure 1. On second subplot 3 minirhizotron tubes were placed as control, 3 tubes beside wheel rut, 3 tubes in wheel rut where only harvester was driving and 3 tubes in wheel rut where also forwarder was driving. Pictures are being taken in tubes with a Bartz camera system in 2 directions and analyzed with RhizoTronMF® (Regent) Software Program. In spring 2009 we started with monthly picture taking sessions in all tubes.

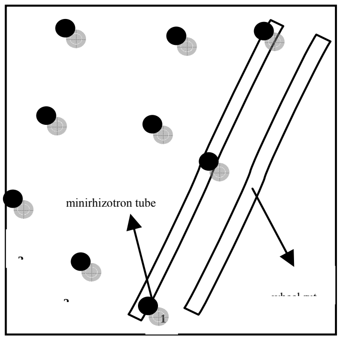
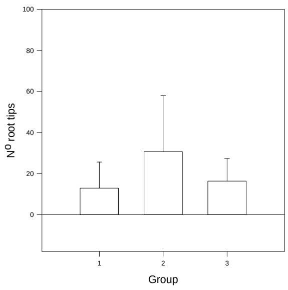


Figure 1: Schematic presentation of installation of minirhizotron tubes

3. RESULTS AND DISCUSSION

The results are organized according to tube position. Tubes of group 1 were installed in wheel rut, tubes of group 2 were installed beside wheel rut and tubes of group 3 were installed in intact soil and act as control.

Comparison between values of visible roots, present root tips, average root diameter and root length has shown the highest values of parameters in group 2 (beside wheel rut), followed by control group 3 and group 1. Values in group 2 also show the highest standard deviation (Figure 2). We hypothesize that trees may be compensating loss of roots in the area of wheel rut in soil beside skid trail. Values of parameter TL (number of root tips per length ratio), proposed by Robek, Kraigher et al. (2001), are not in accordance with our hypothesis. Usually lower TL is a sign of greater soil disturbance (Figure 3).



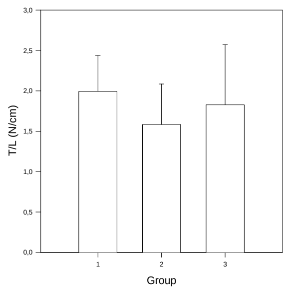


Figure 2. Average number of root tips with S.D.

Figure 3. Average TL with S.D.

We were not able to ascertain any statistical significant differences between the observed parameters, although tendencies were evident.

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