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Interactive comment on "Can we manipulate root system architecture to control soil erosion?" *by* A. Ola et al.

A. Ola et al.

j.quinton@lancaster.ac.uk

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Dear anonymous reviewer,

Thank you for your time, valued suggestions and remarks on our manuscript. However, there are a few points we would like to comment on:

1. Abstract p 266, l 15: "at the soil surface dense root mats of roots may block soil pores thereby limiting infiltration, enhancing runoff and thus erosion". This suggests that a dense root mat in the topsoil will increase erosion rates while several studies showed that dense roots mats decrease the amount of soil erosion rates (e.g. De Baets, S., Poesen, J. (2010). Empirical models for predicting the erosion-reducing effects of plant roots during concentrated flow. Geomorphology 118: 425-432). So this statement is a

bit contradictory with the existing literature on roots effects on soil erosion in the topsoil.

It is important to consider that concentrated flow erosion is an incisive process which starts with the development of small rills at the soil surface which could develop into large gullies. Therefore it is important to have a dense root mat at the soil surface. Based on the plant species considered the amount of roots decreases with soil depth. Therefore the manipulation of roots at greater depth and their proliferation will indeed protect the subsurface soil when the topsoil is removed by soil erosion processes.

The effect of different rooting patterns remains largely unproved. Gyssels and Poesen (2003) do state: . . .depend on root type and their spatial distribution, as suggested by a study of Dissmeyer and Foster (1985). These authors show that erosion rates decline exponentially with an increase in surface soil occupied by fine roots, and that this effect is more pronounced in the case of fibrous lateral roots. âĂŽ and Gyssels et al. (2005) stateâĂŽ erosion by concentrated flow of species with a shallow but dense network (e.g., meadows) will be larger than the effects of deep rooted species (e.g., deciduous forest).‘ However, the evidence base appears to be rather weak – Just the paper of Dissmeyer and Foster. The referee also misses the point that we are refering to the hydrological effect of dense root systems in the topsoil, which has not been determined experimentally(saturated/unsaturated hydraulic conductivity, infiltration rate etc.) in many of these studies (including De Baets and Poesen, 2010, rather than erosion. It should be emphasized, that the root effect may vary depending on the response of the plant species to localized nutrient availability (i.e.compensatory growth versus overall increase in rooting depth, resulting in different root length densities present in the topsoil as well as in the subsoil).

2. p 268, l 6: “: : : vegetation modifies intrinsic soil properties: : :” which is definitely true, however these are ‘mainly’ the result from the root effects on the soil properties which is also highlighted in Figure 1. But these are already discussed in the next section.

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The above ground cover modifies the same intrinsic soil properties as the root system, but some mechanisms differ (reduced overland flow velocities, reductions of raindrop impact, interception of rainfall, waterloss from leaves etc.). Also, at this stage of the paper, we were not talking about the magnitude of the effect associated with either below- or above ground biomass.

3. I was wondering why only RLD is mentioned while the most frequent used root parameter within erosion studies (concentrated flow erosion) is root density.

Root density (RD) is the dry living root mass divided by the volume of the root permeated soil sample and may therefore (unlike RLD, which considers the length of the roots) (De Baets et al., 2006) not be the best indicator for the occupation of soil by roots (Bauhus and Messier, 1999; De Baets et al., 2006, De Baets et al., 2007). In addition, after testing 10 root variables (including RLD and RD) potentially influencing concentrated flow erosion rates, RLD was found to be indirectly linked to soil erosion rates, whereas RD is not sufficient to describe the effectiveness of a species in erosion control (Burylo et al., 2012), although RD may be used when biomass is assessed according to root diameter classes (Bolte and Villanueva 2006; De Baets et al., 2007). However, in the context of this manuscript RLD may still be more appropriate, as C invested in root length (assuming constant tissue density) contributes more towards root surface area (i.e. soil resource exploitation) than C invested in root diameter (Bauhus and Messier, 1999). Moreover, RD is not a root architectural trait (Bauhaus and Messier, 1999; Bolte and Vilanueva, 2006; De Baets et al, 2007).

Additional References: Bauhus, J. and Messier, C. (1999). Soil exploitation strategies of fine roots in different tree species of the southern boreal forest of eastern Canada. Can. J. For. Res. 29: 260–273.

Bolte, A. and Villanueva, I. (2006) Interspecific competition impacts on the morphology and distribution of fine roots in European beech (Fagus sylvatica L.) and Norway spruce (Picea abies (L.) Karst.). Eur J Forest Res, 125: 15–26.

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