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Effects of vegetation root on hydro-mechanical properties of debris flow source

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In recent years, shallow landslides and debris flow usually have occurred successively in areas with good vegetation coverage, causing casualties and economic losses. After the occurrence of shallow landslides, the failure mass accumulated in the channel, providing the material source for debris flow. And the quantity of the failure mass determines the scale of debris flow. Therefore, it is an important basis for debris flow disaster management in vegetated mountainous areas to deeply understand the influence of vegetation on the hydro-mechanical properties of debris flow sources. This study takes the shallow landslides that occurred in Mengdong village, China in 2018 as the objects, analysis the changes in soil hydro-mechanical properties influenced by tree roots through field investigation and laboratory tests, and discusses the failure mechanism of the shallow landslides. The field investigation results indicate that the vertical root distribution can be expressed as an exponentially decayed polynomial model, that is, with the increase of depth, the distribution of tree roots increased first and then decreased. Furthermore, the maximum root area density is 0.266 mm^2/cm^2 at 20-40cm depth, and 80% of the roots are distributed in the soil above the slip surface. Laboratory test results show that the root-soil density above the slip surface was lower which was 1.04 g cm^{-3}, and the maximum porosity of the root-soil is 61.23%. In addition, the saturated permeability of the root-soil above the slip surface is 10-17 times that of the soil below. The shear strength of the root-soil above the slip surface is lower than that below it under saturated conditions. The difference in root distribution and the resulting changes in the hydro-mechanical properties of soil may increase the risk of slope failure and the probability of debris flow after heavy rainfall. This research could be used as a reference for debris flow source analysis and hazard management.

Keywords: Root-soil system; Landslide-induced debris flow; Geohazard chain; Hydro-mechanical properties