



Experimental studies of mechanical behavior of root bundles

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Predicting the biomechanical reinforcement of complex root systems on steep hillslopes remains a challenge. Despite the wealth of experimental data regarding general aspects of root distributions and key soil factors and their utility in establishing general stress thresholds, there is a lack of fundamental information regarding the mechanical behavior of a bundle of roots. We present results from series of pullout experiments conducted in the laboratory and in the field for bundles of roots. Stress-strain behaviors are measured using a special pullout device capable of recording force and displacement of individual roots pulled as a bundle. Effects on macroscopic tensile strength are analyzed systematically by combining different parameter values and boundary conditions. We use a combination of cotton threads and roots sampled in the field with diameters in the range of 1 to 5 mm. The fibers/roots are horizontally oriented in a sand/soil-filled box. We test different spatial arrangements and root size distributions, soil types, moisture conditions, and confining pressures. Additionally, effects of root tortuosity and branching points are considered using cotton fibers. Results highlight the relative importance of root bundle composition in terms of root diameter, root stiffness and spatial clustering of roots, and help elucidate key parameters affecting the global behavior of root systems.