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Resistance to uprooting of *Alfalfa* and *Avena Sativa* and related importance for flume experiments

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Vegetation influences sediment dynamics by stabilizing the alluvial sediment with its root system. Thus, vegetation engineers the riparian ecosystem by contributing to the formation and stabilization of river bars and islands. The resistance to uprooting of young plants in non-cohesive sediment depends on the competition between flow induced drag and root growth timescales. The investigation of flow-sediment-plant interactions in situ is difficult since variables cannot be controlled and material hardly be collected. In order to investigate ecomorphological processes, laboratory experiments are essential and have gained importance in the last decade.
To achieve a better understanding of the dependence of resistance to uprooting on the root system (length and structure) we conducted vertical uprooting experiments with *Alfalfa* and *Avena Sativa* which are both species that have been used in flume experiments on vegetation-flow interactions (e.g. Tal and Paola, 2010; Perona et al., in press). Seeds were seeded on quartz sand and vertically uprooted with constant velocity whereat the weight force required to uproot a seedling was measured. After uprooting, roots were scanned and analyzed and the correlation of root parameters with the uprooting work was studied.
Total root length was found to be the best explanatory variable, in particular the uprooting work increases following a power law with increasing root length. The impact of other root parameters (main root length, root number, tortuosity) on the uprooting work was as well analyzed. Still, not all influencing root parameters could be captured, like the angle between roots or root hair distribution. Environmental conditions like grain size and saturation were also found to have an effect on the uprooting resistance of roots. So, lower saturated sediment results in a higher uprooting work.
This work is a first step to better understand the energy regime for vegetation uprooting and its dependence on various biological and hydraulic variables. Future experiments using the same sediment and vegetation species will apply this knowledge to further investigate flow-vegetation-sediment interactions.

References:

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