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# Unravelling floods selection mechanisms for vegetation from laboratory experiments and implications for river restoration efficiency

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The establishment and evolution of vegetation in organized patterns on river bar alluvial sediment are active morphodynamic processes governed by flow hydrology. Although this is well documented in literature, how do time scales between the arrival of flow disturbances and vegetation growth interact to determine the survival of certain vegetation characteristics is still unclear. We started to explore such dynamics within the research project RIVERINE (RIver – VEgetation interactions and Reproduction of Island Nuclei formation and Evolution), funded by the Hydralab III European Framework Programme. Laboratory experiments are important tools which allow comprehensive observations of the feedbacks between flow, channel morphology and vegetation, which are otherwise difficult to observe at the real scale.

In this work we present the results of novel flume experiments that we carried out at the Total Environment Simulator (TES) of the University of Hull, United Kingdom. Starting from an initial levelled slope of 1%, the channel was seeded with Avena Sativa at a uniform density. A number of days after seeding, the flume was flooded daily for 4 days with a flood disturbance which lasted 15 minutes. Different flood magnitudes as well as times between seeding and the first disturbance and flume geometries (i.e., parallel and convergent walls) were investigated. After each disturbance the eroded material (sediment, seeds and plants) was collected at the channel bottom and corresponding statistics for main root length, number of roots and stem height were calculated. At the same time, random samples of non–eroded plants were sampled from the flume and the same statistics were computed for a control run. After every flood disturbance, the channel bed surface was measured with a laser scanner and photographed.

Since flooding frequencies were comparable with the plant root germination and growth time scales, vegetation and flood disturbances were in direct competition. Results show that while non-eroded plants continue to grow in successive runs, flow erosion acts preferentially on plants that have a weaker root system. In particular, a direct linkage between flow magnitude and the first statistical moment of the distribution of the eroded plants seems not to depend on successive runs as long as the distributions of the eroded and the non-eroded plants overlap. Channel geometry influences specific stream power, which in turn would affect the limit where colonization by vegetation in a converging channel is successful. Although the collected data at present have an explorative value only, our findings can be useful for river restoration practice. We show that the timescale of flood disturbance and that of root growth interact in determining whether a particular vegetation species can be successful in the colonization of a given river system. Moreover, the analysis of the influence of channel shape can be useful to identify the best location for plant establishment.