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Scalings of drag reduction by elastic or brittle reconfiguration in plants EMMANUEL DE LANGRE, SEBASTIEN MICHELIN, DIEGO LOPEZ, LadHyX - Ecole polytechnique — Slender flexible structures such as plants are elastically deformed by external flows. When the deformation is large , this results in a significant reduction of drag. We give a theoretical value of the exponent of the dependence on flow velocity in the drag law, based on scaling arguments. The theoretical value is shown to compare well with experimental data on a very large variety of plants, ranging from full trees to aquatic vegetation. It is also shown that elastic reconfiguration affects more the evolution of local bending stress or the uprooting moment than the total drag. Moreover, a nonlinearity in the local elastic behavior does not affect significantly the exponent of drag. The approach is then generalized to the case of brittle reconfiguration, or flow-induced pruning, a mechanism by which plant avoid permanent base damage under flow by losing parts of their architecture.

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