# Belowground controls on soil carbon accumulation in perennial bioenergy cropping systems

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The perennial grasses switchgrass (*Panicum virgatum* L.) and big bluestem (*Andropogon gerardii* Vitman) are promising candidates for sustainable bioenergy production. However, land conversion for bioenergy production leads to substantial soil carbon (C) losses, and these must be repaid if these bioenergy crops are to help curb rising atmospheric $CO_2$ concentrations. We evaluated differences in soil C accumulation and the processes that affect it, under a variety of switchgrass and big bluestem cultivars. Our experiments are located at the Fermilab National Environmental Research Park, Batavia, Illinois, and at the Agricultural Research and Development Center (ARDC), Ithaca, Nebraska. We found considerable within and between-species variability in soil C accumulation. Specific root length (SRL) differed significantly among the swithgrass cultivars with a five fold difference between cultivars with the highest and lowest average SRL. These differences were consistent across a range of growing and drought stress conditions. SRL was a good predictor of soil C input by switchgrass cultivars in the early years of the experiments, however soil C accumulation in the later years appeared to be mediated by processes other than the quantity of root C input. Our data revealed variation in rhizosphere metabolic profiles of switchgrass and big bluestem cultivars as well as in bulk soil microbial communites. Together, our data indicate that we might expect differences among species and cultivars in the chemical composition of root exudate input and microbial residue formation, which may explain variation among cultivars and species in soil C accumulation.