Carbon sequestration in perennial bioenergy, annual corn and uncultivated systems in southern Quebec

Claudia S. Zan, James W. Fyles, Patrick Girouard and Roger A. Samson

Abstract

The conversion of relatively undisturbed ecosystems such as forests and grasslands to intensively managed agroecosystems has had major impacts on global carbon (C) cycling largely as a result of land clearing, cultivation, and replacement of perennial vegetation by annual crops. Numerous studies have demonstrated the ability of fast-growing perennial plant species dedicated to bioenergy production to sequester substantial amounts of C. Thus, the conversion of conventionally managed agricultural land to perennial bioenergy crops can be expected to increase C stored in above- and belowground biomass and in soil organic matter because of their perennial nature and greater root biomass. In this study, C storage was compared among five ecosystems in southwestern Quebec including two perennial crops, switchgrass (*Panicum virgatum* L.), and willow (*Salix alba×glatfelteri* L.), and an annual corn (*Zea mays* L.) crop at two sites of differing soil fertility, a 20-year-old abandoned field, and a mature hardwood forest. After 4 years of production, corn had significantly higher levels of aboveground C than willow at the less fertile site, but no significant differences were detected at the more fertile site. Both perennial systems had significantly higher root C than the corn system but switchgrass had significantly higher root C levels below 30 cm compared with willow and corn. Soil organic C under willow at the more fertile site was higher than under the other managed or unmanaged systems, including willow at the less fertile site. The results of this study suggest that perennial energy crops grown on relatively fertile soils, have the potential to increase substantially soil C levels compared with conventional agricultural systems or unmanaged systems.

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