

How Does Soil Respond to Energy Crop Production?

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Corn stover and dedicated bioenergy crops are two potential cellulosic feedstock sources for producing biofuel. Excessive corn stover removal for biofuel may, however, increase risks of water and wind erosion, reduce soil C pools, and degrade soil quality in the long term. Dedicated bioenergy crops such as perennial warm-season grasses (switchgrass, miscanthus, and others) can be potentially low-input and alternative cellulosic feedstocks to corn stover removal. The dedicated bioenergy crops can provide biomass for biofuel production while maintaining soil and environmental quality and providing other ecosystem services. Current research on dedicated bioenergy crops is mostly focused on developing technologies for conversion of cellulosic feedstocks into ethanol and assessing biomass production potential. As a result, changes in soil properties and processes in response to growing bioenergy crops have not been widely discussed. The changes in soil properties including soil structural and hydraulic properties, organic C pools, fertility parameters, and water and wind erosion potential can directly affect the soil's capacity to function or provide ecosystem services. The few studies have found that perennial grasses may increase soil organic C pools, dry and wet soil aggregate stability, proportion of macropores, water infiltration, and soil water content compared with row crops. Impacts of perennial grasses on soil properties are, however, inconsistent, depending on management length, grass species, initial soil condition, land type, and climate. For example, dedicated energy crops may not increase soil C pools compared with row crops in the short term (<5 yr). Future research should include the following. One, further assessment of the impacts of monocultures and polycultures of perennial warm season grasses on biomass production, nutrient cycling, and soil properties to select the best species and mixtures for feedstock production and soil quality improvement. Two, marginal lands are being considered as potential candidates for cellulosic biomass production, but little or no information is available on the impacts of dedicated bioenergy crops on soil properties under marginal lands. Three, because, in most cases, establishment of energy crops requires fertilization, assessing how N, P, and K fertilization of energy crops for biomass production affects soil properties will be important to guide recommendations for optimum levels of fertilization that sustain biomass production and improve soil and environmental quality. In general, dedicated energy crops may have beneficial effects on soil and environment, but further research is needed to ascertain the extent of such benefits for different land types, climatic conditions, and management scenarios.