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Simulated Impacts of Crop Residue Removal and Tillage on Soil Organic Matter Maintenance

1. Brent J. Dalzell [a],
2. Jane M. F. Johnson[b],
3. Joel Tallaksen[c],
4. Deborah L. Allan[d] and
5. Nancy W. Barbour[e]

1. ***a*** *Department of Soil, Water, and Climate University of Minnesota–Twin Cities Borlaug Hall 1991 Upper Buford Circle St. Paul, MN 55108*
   b *USDA-Agricultural Research Service North Central Soil Conservation Research Lab. 803 Iowa Ave. Morris, MN 56267*
   c *University of Minnesota West Central Research and Outreach Center 46352 State Highway 329 Morris, MN 56267*
   d *Department of Soil, Water, and Climate University of Minnesota–Twin Cities Borlaug Hall 1991 Upper Buford Circle St. Paul, MN 55108*
   e *USDA-Agricultural Research Service North Central Soil Conservation Research Lab. 803 Iowa Ave. Morris, MN 56267*

Abstract

Cellulosic biofuel production may generate new markets and revenue for farmers. However, residue removal may cause environmental problems such as soil erosion and soil organic matter (SOM) loss. The objective of this study was to determine the amounts of residue necessary for SOM maintenance under different tillage and residue removal scenarios for corn–soybean [*Zea mays* L.–*Glycine max* (L.) Merr.] and continuous corn rotations for a site in west-central Minnesota. We employed a process-based model (CQESTR) to evaluate management practices and quantify SOM changes over time. Results showed that conventional tillage resulted in SOM loss regardless of the amount of residue returned. Under no-till, residue amount was important in determining SOM accumulation or depletion. For the upper 30 cm of soil, average annual rates of 3.65 and 2.25 Mg crop residue ha^{-1} yr^{-1} were sufficient to maintain SOM for corn–soybean and continuous corn rotations, respectively. Soil OM in soil layers below 30 cm was predicted to decrease in all scenarios as a result of low root inputs. When considered over the upper 60 cm (maximum soil depth sampled), only continuous corn with no-till was sufficient to maintain SOM. Results from this work are important because they show that, for these management scenarios, no-till management is necessary for SOM maintenance and that determining whether SOM is accumulating or declining depends on the soil depth considered. At current yields observed in this study area, only continuous corn with no-till may generate enough residue to maintain or increase SOM.