Soil Organic Carbon and Nitrogen Sequestration in Irrigated Cropping Systems of the Central Great Plains

Ardell D. Halvorson, Ronald F. Follett, Curtis A. Reule, and Stephen Del Grosso
USDA, Agricultural Research Service, Fort Collins, CO

Conversion of native grasslands to cultivated cropland has been long reported to result in the loss of soil organic matter (SOM) and soil organic carbon (SOC) with a conventional tillage (CT) production system under dryland conditions (Haas et al., 1957; Peterson et al., 1998). Farming methods utilizing intensive mechanical tillage for seedbed preparation and weed control contribute to increased levels of carbon dioxide (CO₂) released to the atmosphere from mineralization of SOM and loss of SOC through soil erosion (Janzen et al., 1999; Lal et al., 1999; Reicosky et al., 2002), causing a decline in soil quality and productivity.

Management strategies to sequester more SOC by using conservation farming technologies, such as reduced tillage (RT) and no-tillage (NT) systems, could help mitigate agriculture’s effect on atmospheric CO₂ levels and reduce its effect on global climate change (Lal et al., 1998; Peterson et al., 1998; Mosier et al., 2006). Soil organic C is important for improving water-holding capacity and nutrient availability of soil. Thus, we need to understand how management practices affect SOC. Reducing tillage intensity and maintaining maximum soil productivity for optimum grain yields in the central Great Plains can potentially increase SOC (Peterson et al., 1998). Halvorson et al. (2000) showed that after 27 yr of NT and intensive crop management, SOM levels under NT were 85% of native sod, whereas the CT, crop–fallow production system was 40% of native sod levels at a Nebraska site. Halvorson et al. (1999) showed SOC sequestration was enhanced by N fertilization in a NT, dryland cropping system in Colorado, which implies that having a high level of soil fertility was necessary to optimize residue production and SOC sequestration. Follett (2001) surmised that optimum fertility levels...