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Natural Resources Research Update

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Title: Long-term tillage and cropping sequence influence on dryland soil carbon, nitrogen, physical properties, and crop yields.

Contributing scientists: U.M. Sainju, J.D. Jabro, T. Caesar-TonThat, A.W. Lenssen, R.G. Evans, and W.B. Stevens

Location: USDA-ARS, Northern Plains Agricultural Research Laboratory, Sidney, Montana.

Novel management practices are needed to improve dryland soil C and N sequestration, N mineralization, soil physical properties, and crop yields in the northern Great Plains. We evaluated the 21-yr effect of tillage and cropping sequence on dryland soil aggregation, C and N storage, N mineralization and availability, physical properties, and crop grain and biomass (stems + leaves) yields in eastern Montana, USA. Treatments were no-tilled continuous spring wheat, spring-tilled continuous spring wheat, fall- and spring-tilled continuous spring wheat, fall- and spring-tilled spring wheat-barley (1984-1999) followed by spring wheat-pea (2000-2004), and the conventional spring-tilled spring wheat-fallow. Soil bulk density, gravimetric water content, and saturated hydraulic conductivity were minimally influenced by tillage intensity after 21 years of treatment imposition (Jabro et al., 2009). Reduced tillage with annual cropping improved soil aggregation, C and N sequestration, and microbial activities in 4.75-0.25 mm aggregate size class compared with the conventional system, such as spring-tilled spring wheat-fallow (Sainju et al., 2009a). Because of greater proportion of aggregates and intermediate levels of organic C and N concentration, C and N can be sequestered mostly in small macroaggregates (2.00-0.25 mm size class) by using these management practices (Sainju et al., 2009a). Inclusion of pea in the crop rotation increased N mineralization and availability in <2.00 mm size class (Sainju et al., 2009a, 2009c). Long-term no-tillage or spring tillage with continuous cropping increased soil surface residue C and N, C and N storage, and potential N mineralization, and reduced N loss compared with the conventional system at the surface 20 cm layer (Sainju et al., 2007, 2009c). Alternate-year summer fallowing increased spring wheat grain and biomass yields compared with annual cropping but reduced annualized yields and soil organic matter (Sainju et al., 2009b). For sustaining dryland crop yields and soil organic matter, no-tillage with annual cropping system can be adopted in the northern Great Plains (Sainju et al., 2007, 2009b, 2009c).

1. Jabro, J.D., U.M. Sainju, W.B. Stevens, A.W. Lessen, and R.G. Evans. 2009. Long-term tillage influences on soil physical properties under dryland conditions in northeastern Montana. Archives in Agronomy and Soil Science. 55(6):633-640.

2. Sainju, U.M., T. Caesar-TonThat, and J.D. Jarbro. 2009a. Carbon and nitrogen fractions in dryland soil aggregates affected by long-term tillage and cropping sequence. Soil Science Society of America Journal 73:1488-1495.

3. Sainju**, U.M.,** T. Caesar-TonThat, A.W. Lenssen, and R.G. Evans 2009b**.** Dryland crop yields and soil organic matter as influenced by long-term tillage and cropping sequence. Agronomy Journal 101:243-251.

4. Sainju, U.M**.,** T. Caesar-Tonthat, A.W. Lenssen, R.G. Evans**,** and R. Kohlberg. 2009c. Tillage and cropping sequence impacts on nitrogen cycling in dryland farming in eastern Montana, USA. Soil and Tillage Research. 103:332-341.

5. Sainju, U.M.**,** T. Caesar-Tonthat, A.W. Lenssen, R.G. Evans, and R. Kohlberg. 2007. Long-term tillage and cropping sequence effects on dryland residue and soil carbon fractions. Soil Science Society of America Journal 71: 1730-1739

For more information contact Dr. Robert Evans (Robert.evans@ars.usda.gov)