Soil Erosion Risk and Mitigation through Crop Rotation on Organic and Conventional Cropping Systems

By ALISON G. NELSON. 2005.
Master of Science Thesis, University of Manitoba, Winnipeg, Manitoba

ABSTRACT

Organic cropping systems are often accused of increasing soil erosion risk through an increased use of tillage for weed control. However, little research has been conducted in Canada regarding soil erosion risk on organic farms. It is known that crop rotations can be used to ameliorate a variety of agronomic problems encountered in cropping systems, including soil erosion. Organic systems, which do not use synthetic pesticides and fertilizers, rely more heavily on crop rotations than conventional systems to solve agronomic problems such as weeds and insects. The objective of this study was to compare cropping practices (including crop rotations and tillage regime) on organic and conventional cropping systems, and examine the effect of crop rotation (annual-, biennial-, or perennial-containing rotations) and management (organic or conventional) on soil properties relating to wind and water erosion risk.

A mail-out survey was the source of data on soil conservation, crop rotation and tillage practices from 225 organic and conventional farmers in the study provinces of AB, SK, MB, ON, PEI, NB and NS. When compared to conventional farmers, organic farmers had more perennials and green manures in rotation, but fewer organic farmers had zero tillage practices on their farm. More organic farmers had other soil conservation practices (such as shelterbelts, contour tillage, ridge tillage and the use of composts) on their farm than conventional farmers.

Soil from three long-term rotation studies in the prairies (Lethbridge, AB; Scott, SK and Glenlea, MB) and 25 paired organic and conventional farms (in AB, SK, MB, ON, PEI and NS) was sampled. The effect of management and rotation on dry and wet aggregate stability, as well as percent organic carbon (C) was determined. At the long-term studies, the biennial-containing rotation resulted in the highest wet and dry aggregate stability. Management significantly affected organic C in both the long-term studies and the farm pairs, with the organically managed soils having lower C contents than the conventionally managed soils. Despite the lowered organic C levels in the organic systems, aggregate stability remained higher, or equivalent to the conventional systems. This result indicates that aggregate stability in the organic systems is independent of total organic C levels at the current time (however, there are limitations to lowered levels of organic C, and at some point lower C will begin to affect soil properties). The organic soils may be higher in certain C compounds (such as polysaccharides) that stabilize the soil aggregates, but do not alter the total organic C levels.

Few differences in the measured soil properties of the paired organic and conventional farms were found. However, when farms were compared based on having an annual- or perennial-containing rotation, the farms with perennials in rotation were found to have higher wet aggregate stability. Rotation (annual- versus perennial-containing rotations) had a larger effect on wet aggregate stability and percent organic C than management in the farm pairs.

Organic management does not inherently lead to a higher risk of soil erosion than conventional management. While organic systems generally have higher intensities of tillage than conventional systems, organic farms also tend to have more perennials in rotation, which has been shown in this study to lower the risk of soil erosion.