

Influence of Tillage and Crop Residue Management on Crop Yield, Greenhouse Gas Emissions and Soil Quality

S.S. Malhi^{1*}, R. Lemke², R. Farrell³ and D. Leach¹

¹Agriculture and Agri-Food Canada, Research Farm,

²Agriculture and Agri-Food Canada, SPARC, Swift Current, Saskatchewan,

³Department of Soil Science, University of Saskatchewan

*P.O. Box 1240, Melfort, Saskatchewan, Canada, S0E 1A0,

ph 306-306-752-2776 (Ext. 230), fax: 306-752-4911,

malhis@agr.gc.ca

The objective of this study was to determine the influence of tillage and crop residue management on crop yield, soil aggregation and nitrous oxide (N₂O) emissions on a Gray Luvisol soil near Star City, Saskatchewan, Canada. The field experiment was established in 1998 on a 4-year rotation (barley-pea-wheat-canola) under two tillage systems (no tillage, NT and conventional tillage, CT), two levels of straw (straw retained, S and straw removed, NS) and four rates of N fertilizer (0, 40, 80 and 120 kg N ha⁻¹, except no N to pea phase of the rotation). Tillage and straw treatments usually had no effect on crop seed, straw, chaff and root yield in 1998, 1999 and 2000. However, in 2001 (after 4 years) NT had 389, 436 and 218 kg ha⁻¹ more seed, straw and chaff yield of canola than CT, and S increased seed and straw yield by 258 and 281 kg ha⁻¹ compared to NS, respectively. The combination of NT and S gave the highest canola yield. The N₂O emissions were higher in N-fertilized treatments than the zero-N treatments, and were substantially higher in CT plots than in NT plots where N was applied. The proportion of aggregates in the fraction with the smallest sieve opening (<0.42 mm) was significantly greater in CT compared to NT, while there was a higher proportion of large aggregates (>12.7 mm) under NT than under CT. Addition of straw tended to increase the proportion of large aggregates and decrease the proportion of fine aggregates. The NT plus S gave the lowest proportion of fine aggregates (<0.42 mm) and greatest proportion of large aggregates (>38 mm). This suggests less potential for soil erosion when tillage is eliminated and crop residues are returned to the soil. In summary, the findings suggest that returning crop residue under NT would improve soil quality and productivity and may also be better for the environment.