Managing Crop Residue With the Combine

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Managing flax residue with vertical tillage, tandem disc, or rake and burn did not produce significantly higher yield for three subsequent wheat, pea, and canola crops. Limited differences in soil attributes were observed, and they were diminished by the second and third years after tillage.

The objectives of this study were to compare the effects that vertical tillage, tandem disc, raking and burning, and no-till direct seeding into flax stubble would have on soil aggregation, air and water permeability, and yield of wheat, peas, and canola grown the following three years.

The field study was established in September of 2015 after harvesting operations had concluded on a flax stubble field south of Central Butte, Saskatchewan. The yield of the flax crop in 2015 averaged 30 bushels/acre (1,900 kg/ha) and was harvested with a John Deere CTS combine equipped with a straw chopper, in the first week of September 2015.

After harvest in the fall of 2015, treatments set up included a vertical tillage implement that was a combination of a vertical disc and rolling basket (VT), a tandem disc (CT), and a no-till (NT) treatment. In the spring of 2016 sub-plots of the no-till treatment were set up to evaluate flax residue that was raked and burned, and raked but not burned.

Vertical tillage left the ground smooth and virtually free of crop residue. Tandem discing also incorporated most of the crop residue, but the soil was lumpier.

In the spring of 2016, hard red spring wheat was sown using a hoe drill with paired row openers on 10 inch (25 centimetre) (cm) row spacing. In 2017, green peas were seeded into the plots, and Liberty Link® canola was seeded in 2018.

Few Impacts on Soil Properties

In 2016, the first year after flax, vertical tillage tended to decrease air permeability and the water infiltration rate compared to other treatments, which may be explained by an increase in the number of fine pores created by the pressure from the rolling baskets attached to the vertical tillage implement. There were no crop stubble burning effects on water infiltration or air permeability in 2016 or 2017.

Vertical tillage, tandem disc tillage, and raking and burning treatments did not significantly affect aggregate size in the soil surface 0-4 inches (0-10 cm) in the years following the treatment.

Slightly lower aggregate stability was observed with tandem disc treatments compared to vertical tillage treatment in both 2016 and 2017. This is attributed to a greater depth of incorporation of residue in the tandem disc treatment that would reduce organic matter available at the surface for binding soil particles together. Tillage in general also resulted in reduced aggregate stability compared to no- till in the first year. However, these effects had largely disappeared in subsequent years.

Tillage reduced density and strength at the soil surface, particularly the tandem disc treatment due to the greater working depth. The effect of tillage on reducing soil strength was still apparent in 2017, but effects had disappeared by 2018.

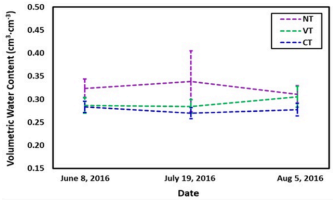

Table 1. Mean Volumetric Soil Water Content (from 0-20 cm depth in 2016)
Source: B.C. Si, J. Schoenau, T. King. 2019. Effects of Vertical Tillage on Soil Structure and Crop Yields in Southern Saskatchewan. Final report.

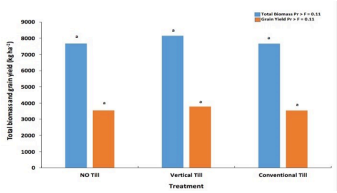

Table 2. Wheat Crop Total Biomass and Grain Yield in 2016
Source: Si et al, 2019

The raking and burning treatment in the spring of 2016 had relatively little influence on soil physical properties, but burned stubble ash covering the soil surface appeared to cause some slight reduction in air and water penetration.

No Differences in Yield

Wheat, pea, and canola yields over the three subsequent years were not significantly different (p=0.10) by any of the residue management strategies compared to no-till. Direct seeding into the flax residue was successful because the flax crop was harvested when conditions were dry, and the straw chopper on the combine evenly distributed the residue.

Due to costs incurred from tillage or raking and burning operations without significant yield increases, these operations were calculated to produce limited or net negative economic return. For example, the Saskatchewan Ministry of Agriculture 2016-2017 Farm Machinery Custom and Rental Rate Guide indicates the cost of vertical tillage at $31.88/acre ($78.85/hectare) and tandem disc at $40.20/acre ($99.30/hectare), costs that were not recovered with higher yields from these treatments.

From these results, managing crop residue by harvesting on warm, dry days conducive to good straw chopping and spreading would be the recommended method of dealing with difficult crop residues. Surface tillage or burning may be warranted under heavier crop residue conditions not observed in this study.

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RESEARCH PROJECT

Effects of vertical tillage on soil structure and crop yields in southern Saskatchewan

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