Effects of burn/low-till on erosion and soil quality

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1. Introduction

Burn/low-till (BLT) for growing winter wheat following winter wheat has been practiced since the mid-1980’s by some grain producers in the annual cropping areas of the Northwestern Winter Wheat Region of the US. Residue burning eliminates the numerous seedbed tillage operations that are normally required to reduce residues and control weeds and diseases in continuous winter wheat production. The detrimental effects of burn and till systems on soil erosion are well documented. However, there is little or no data on the effects of burning with no-till or low-till annual cropping on either erosion or soil quality. A 3-year field study comparing winter season erosion resulting from burn/low-till (BLT) seeded winter wheat following winter wheat and conventionally managed (CM) winter wheat following various crops was completed in 1997. Results indicate soil loss from the BLT fields was not significantly different from that of the CM fields with various crops preceding winter wheat. For the BLT fields, soil loss was as closely related to soil disturbance (number of tillage operations) as to the amount of surface residue. When residue and crop cover did not differ with the number of tillage operations, an increased number of tillage operations after burning loosened the soil and resulted in greater soil loss. No adverse effects on soil loss or soil quality from using the BLT with one or two-pass seeding of winter wheat following winter wheat were found in this study. The results have implications for harvesting wheat stubble as a source of biomass, or as an alternative technique for initiating conversion from a conventional tillage to a no-till seeding system, without high initial investment in new seeding equipment.

There is documentation that burning grass and forest residue reduces disease and insect infestations (Daubenmire, 1968; Iwanami, 1973). However, the effect of burning cereal residues on disease and weed pests appears to be variable (Hardison, 1976). Since high temperatures are not uniform over the soil surface during a burn, there is incomplete destruction of weed seeds and organisms (Rasmussen et al., 1986). With tillage systems, repeated burning followed by tillage decreases soil organic matter, microbial activity, and produces undesirable changes in soil physical properties (Unger et al., 1973; Dormaar et al., 1979; Biederbeck et al., 1980; Rasmussen et al., 1980). The effects of residue burning followed by one or two-pass fertilize-seed management on erosion and soil quality had not been studied prior to this project.

Soil quality has been defined as ‘the capacity of a soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health’ (Doran and Parkin, 1994). Soil quality encompasses not only crop productivity and environmental protection, but also food safety, and animal and human health. Soil functions as a major producer of food, an environmental filter to clean air and water,