No-Till Grain Production in Wyoming: Status and Potential

Jay B. Norton
University of Wyoming Department of Renewable Resources

Introduction

1. Growth of corn-based ethanol production is expected to increase crop prices and intensify production of wheat and other non-biofuel crops as producers switch to corn and as wheat replacement costs for livestock feeding rise (Guellich, 2006; Ishidoh et al., 2008).

2. Incentives for carbon (C) sequestration may promote adoption of practices such as no-till grain production (Fischer et al., 2000), especially conservation tillage (Lynch et al., 2001).

3. Scarcity prices for feed and fertilizer will force producers to reduce inputs.

4. Cropping systems that reduce or eliminate tillage and fertilizer, and enable intensification, might become increasingly prevalent as producers respond to limited and carbon sequestration incentives.

5. Information is needed to help eastern Wyoming wheat producers adapt to these emerging production pressures.

Conventional Crop-Fallow

Economic Stability in an Unpredictable Environment

• Crop failure systems improve land & crop relatively profitable

• Excess water and nutrients stored during fallow ensure better crop for years

• High available water at planting increases yield potential.

A Leaky System

• 75 percent or more of annual precipitation is typically too less rainfall, evaporation, deep percolation, and water

• Nutrient supply is out of sync with crop demand. Nutrients accumulate during fallow, leach below winter temperatures, deplete soils and contribute to offsite pollution.

• Great plains soils have lost 30 to 60 percent of the SOM accumulated during millennia of grassland cover and intensive fallow systems (Aber et al., 1998).

• SOM preferably lost through evaporation by wind and water

• Tillage and fertilizer eliminate decomposition, leading to loss of organic carbon and nitrogen and soil organic matter.

Less water and nutrient availability in spring

• In a North Dakota continuously cropped wheat-soybean system, no-till had continuous lower anaerobic (AN) conditions that are critical under water stress; no-till resulted in lower N mineralization from SOM under tillage than no-till and greater N release renewal of SOM as yields decreased.

• In Kansas, continuous no-till wheat had lower available water at planting time (September) than reduced-till rotations that incorporate crop residues, especially in the fall profile.

• However, over 80 percent of precipitation was lost during fallow years, revealing water shortage limitation in productivity; growth under continuous crop tillage than cropping systems that include tillage and fallow.

But higher grain yields over the long term

North Dakota winter wheat yields more grain under no-till and range available water levels:

• Yields during years with 0.20-0.27 m March soil water content from leaf spot disease, especially in the no-till treatments under fallow for test.

• The authors emphasize importance of N fertilization in maintaining healthy plants under no-till conditions;

• No-till and minimum-till make much better use of moderate and high fertilizer N rates.

• Under these continuous wheat-soybean rotations, no-till spring-planted systems had higher yields in higher yield potential and fallow periods.

• Yield differences likely contribute to differences in spring soil nitrate content as no-till increases more nitrogen in the soil;

• Other studies show fertilization needs decrease with time as higher SOM contents stabilize under no-till.

Rebuilding Soil Organic Matter (SOM)

• Improved yields despite lower early season moisture and nutrients result from increased SOM contents with reduced tillage;

• Increased SOM results from less leaching, which also decomposes and conserves SOM;

• Over time, nutrition-supplying potential of soils increases under continuous crop no-till;

• Larger, more diverse microbial community in long-term no-till soils with more late-season moisture causes increased mineralization through the seasons, reducing fertilizer needs.

Rebuilding Soil Organic Matter

Organic matter fractions contributing to water storage capacity and infiltration:

• Organic matter functions as hydrophobic keratin, silts, and positive pores such increased nutrient availability in long-term research in Colorado;

• More SOM improves physical properties including water holding capacity and infiltration of crop roots.

• Increased water storage efficiency facilitates infiltration and reduction wetness;

• Lossing can increase without intensification;

• Crusts rely on late-season precipitation and nutrient availability from decomposing residues;

• Late-season N availability boosts protein.

Success includes new management approaches

• Average yields increase but annual yields drop significantly;

• Lower fertilizer requirements to match annual yield;

• High C:N ratio; incorporate fertilizer below to avoid nutrient depletion;

• Become used to our fertilizer relative to available water, which can decrease forage yields, plant water resources, and water usage;

• New approaches to determining soil nutrient supply may be necessary.

Table 1. Average wheat acres harvested and yield over seven Census of Agriculture years.

Table 2. Approach of C and N inputs in long-term agroecosystems.

Table 3. Approach of C and N inputs in long-term agroecosystems.

Conclusions

Wyoming’s low adoption rates of conservation tillage systems may represent opportunities for intensified production systems that increase yields, conserve natural resources, and facilitate storage of soil organic matter. The challenge for researchers, agricultural educators, and Wyoming producers is to develop and commit to new management strategies necessary for success of conservation cropping systems.

References


From Grant et al., 2002. Based on 34 years of data. From Sherrod et al., 2005. Based on 12 years of data.

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From Sherrod et al., 2005. Based on 12 years of data. Active SOM proportion found in long-term grass systems.

$^{*}$ correlating data for wheat, which is mostly non-irrigated and data for spring wheat, which is mostly non-irrigated and is growing under a continuous corn system.

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