WISCONSIN-Rye as Cover Crop in Corn Silage Systems to Improve Soil Health & Yields

Francisco Arriaga, Mike Bertram, University of Wisconsin-Madison

Corn silage and alfalfa are used as feed sources because of their high feed values for milking cows. However, corn silage production can negatively impact soil properties and long-term productivity. Lack of crop residue leaves soil more susceptible to erosion, increases nutrient losses, reduces potential for nutrient recycling, and over time can reduce soil organic matter stocks, impacting soil quality and productivity. Using reduced tillage and cover crops in silage production can help enhance soil health.

Cover crops can help recycle soil nutrients, increase amount of soil organic carbon, and reduce erosion by providing residues on the soil surface. Additionally, cover crops provide an option for additional forage production by spring harvesting cover crop biomass. With this option, the cover crop would be planted in the fall after corn silage harvest and still protect soil from erosion and help recycle nutrients during winter and early spring months. Cover crop root systems have the added benefit of providing organic matter to soil.

Tillage plays an important role in crop production systems since residues are incorporated in the soil. The soil mixing process occuring in most tillage operations also affects nutrient stratification, organic matter accumulation due to oxidation (losses), and soil hydraulic properties given the physical destruction of soil aggregates. It is important to understand the impact of tillage in corn silage production systems and if cover crops help reduce negative effects tillage can have on soil.

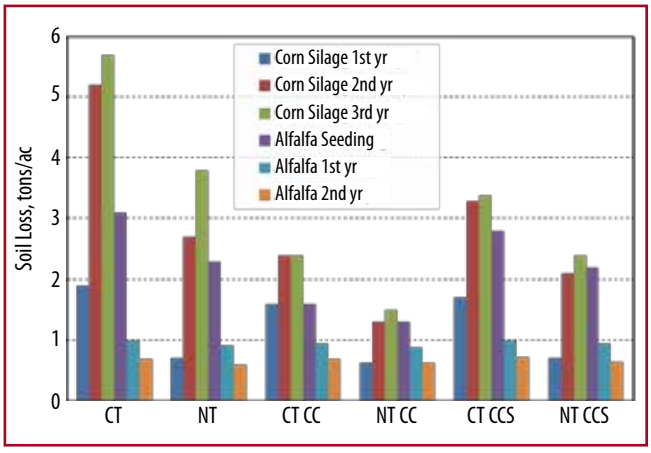
A study is being conducted to examine these issues near the University of Wisconsin's Arlington Agricultural Research Station. The objectives are to: 1) determine impact of integrating a cover crop into corn silage production systems on soil quality, plant nutrient availability, and productivity, 2) establish potential of harvesting cover crop biomass to supplement feed supplies, and 3) compare tillage practices on yield and soil properties of corn silage production including cover crops.

Six corn silage production systems, including the use of cover crops and 2 types of tillage, are being compared. Corn silage systems are established in plots measuring 45´ (18 rows) by 500´ (0.52 acres) with 3 replications for a total of 36 plots. Corn silage is grown in a 6-year rotation with alfalfa (C-C-C-A-A-A), with both phases of the rotation present each year. Dairy manure is injected each fall to all corn treatments.

Preliminary results from 2014 show no significant differences in yield among the 6 management systems (P=0.631). In general, no-tillage treatments had slightly greater yields (~2.5%) than conventional tillage when averaged over cover crop management systems. Unfortunately, the rye cover crop was established late in the fall (10/28/2013) and did not produce much biomass. The main differences in corn silage yield in 2014 were related to tillage.

Initial 2015 growing season results point towards no difference between CC and no cover crop (NC) with NT. Corn silage yields were lower when the cover crop was harvested as ryelage (CCH), but when considering total yield (corn silage plus ryelage), differences were little. For CT corn silage, CC did much better than NC. Total forage production was a little better with CCH. Overall, NT was similar to CT, and CC outperformed NC. The CC and CCH systems were similar for total production and both performed better than NC. Soil loss was estimated using the RUSLE2 model for the 6 management treatments (Figure 1). No-tillage reduced soil loss compared to conventional tillage, regardless of cover crop use or not. Including rye as a cover crop reduced soil loss values for conventional and no-tillage systems. Compared to alfalfa, corn silage has a greater risk for soil erosion, but alfalfa has a considerable erosion risk during the establishment year. Thus, alfalfa systems can benefit from cover crops by integrating them during establishment to reduce erosion potential. In-field measurements with a rainfall simulator will be conducted to corroborate these results.

Figure 1. CT – conventional tillage; NT – no-tillage; CC – cereal rye used as a cover crop; CCS – cereal rye used as a cover crop, harvested as silage in the spring.



As this study progresses, we expect to continue to monitor yields, soil fertility, and physical properties to compare tillage impact and rye cover crop. Preliminary data show that using no-tillage and rye as a cover crop and harvesting in the spring presents an option without affecting silage yields. Forage analyses are also in progress to determine any differences in quality. Crop productivity is expected to increase long-term given the soil health and reduced erosion benefits of the cover crop and less tillage.