Rye Cover Crop Effects on Soil Properties in No-Till Corn Silage/Soybean Agroecosystems

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Introduction

A rye cover crop can provide multiple services including reduction in NO_3 leaching, erosion mitigation, and weed suppression, however, few studies have investigated how rye cover crops effect soil quality in corn-soybean cropping systems in the northern U.S Corn Belt. In this experiment, we investigated the effects of a rye winter cover crop on several soil quality indicators including: total soil organic matter, particulate organic matter, and nitrogen mineralization potential. The objectives of our study were to: 1) determine whether a rye winter cover crop improves soil quality, 2) determine if rye winter cover crop effects on soil quality vary significantly depending on which crop it follows in the corn-soybean rotation sequence, and 3) determine if the effects of a rye winter cover crop differ depending on soil depth.

Methods

➢ Experiment was conducted near Ames, IA from fall 2009 through 2011
➢ Four treatments were evaluated:
   A rye cover crop following both corn silage and soybean, rye following corn silage only, rye following soybean only, and no rye (control). These treatments were first established in fall 2001.
➢ The rye winter cover crop was planted after main crop harvest with a no-till grain drill and killed with glyphosate prior to main crop planting.
➢ Fifteen soil samples were taken in each plot during early June. Each sample was divided based on the depth from which it was taken in the soil profile. Samples in each plot were combined based on a 0-5 cm and a 5-10 cm soil depth range; yielding two bags of soil per plot.
➢ Samples were combined, sieved, and air-dried prior to analysis. Samples were burned at 460 C for weight loss on ignition analysis, which was used to determine total organic matter and particulate organic matter. Nitrogen mineralization potential was measured by re-hydrating air-dried soil samples and aerobically incubating for 28 days at 30 C.

Results

➢ All soil quality indicators were greater for the 'rye both' and 'rye following corn silage' treatments at the 0-5cm depth.
➢ Rye cover crops did not significantly increase particulate organic matter or nitrogen mineralization potential at the 5-10 cm soil depth, but total organic matter for the 'rye both' treatment was greater than the treatments without rye following silage.
➢ Differences between 'rye both' and 'rye following corn silage' compared to the other treatments may be due to the fact that rye has an earlier establishment window in fields that are harvested for silage, giving the rye more time to grow and add more biomass carbon to the soil. On average, a rye cover crop following corn silage produced 2.78 Mg ha-1 of shoot dry weight compared with 0.51 Mg ha-1 for rye following soybean.

Total Soil Organic Matter (Δ g. SOM/g. soil^{-1})

Avg. of both fields over 2 yrs	0-5cm	5-10cm
Treatment		
Rye both	0.0565a*	0.0502a
Rye follow. corn silage	0.0544a	0.0485ab
Rye follow. soybean	0.0495b	0.0473b
No rye	0.0493b	0.0476b
LSD 0.05	0.0021	0.0022

*Numbers within a column followed by same letter are not statistically different as indicated by the ANOVA or LSD test at the 0.05 probability level

Particulate Organic Matter (Δ g. POM/g. soil^{-1})

Avg. of both fields over 2 yrs	0-5cm	5-10cm
Treatment		
Rye both	0.0088a*	0.0040a
Rye follow. corn silage	0.0084a	0.0035a
Rye follow. soybean	0.0063b	0.0033a
No rye	0.0061b	0.0032a
LSD 0.05	0.0009	0.0006

*Numbers within a column followed by same letter are not statistically different as indicated by the ANOVA or LSD test at the 0.05 probability level

Nitrogen Mineralization Potential (Δ mg N /kg. soil^{-1})

Avg. of both fields over 2 yrs	0-5cm	5-10cm
Treatment		
Rye both	49.55a*	24.55a
Rye follow. corn silage	45.65a	21.52a
Rye follow. soybean	37.75b	22.90a
No rye	35.75b	18.51a
LSD 0.05	5.86	5.29

*Numbers within a column followed by same letter are not statistically different as indicated by the ANOVA or LSD test at the 0.05 probability level

Conclusions

Incorporation of a rye cover crop is a viable means for improving soil quality in corn silage /soybean cropping systems. The effects of a rye cover crop are most pronounced in the top 5 cm of soil and when following corn silage.