

WINTER RYE COVER CROP AND FORAGE COMPARISON FOLLOWING CORN SILAGE IN WISCONSIN

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Corn silage provides an economically important source of feed for dairy and beef cattle, with nearly one-million acres harvested in Wisconsin annually. Corn silage may present environmental challenges, however, as very little crop residue remains in the field and manure is often applied after harvest. This creates conditions possibly vulnerable to soil erosion and nutrient loss from runoff over the fall-to-spring fallow period.

In the U.S. Upper Midwest, fall-planted winter cereal grains can be used as a cover crop to prevent soil erosion and surface water runoff as well as immobilize soil nitrate (NO₃) susceptible to leaching. Winter cereal rye (*Secale cereale*) has been the most popular choice due to easy fall establishment, winter hardiness, rapid spring growth and relatively low seed cost. Planted in the fall as an over-wintering cover crop, the rye can be terminated early the following spring, or can be left to grow and harvested as an early season (late May), high quality forage crop, thus diversifying a farm's forage options.

Farmers, crop production professionals and conservation planners have offered observations and questions relative to using rye as a cover crop, or as a forage crop after corn silage. These include: If rye scavenges soil NO₃⁻, does it provide a nitrogen credit to a following corn crop? And, what are the economics of using rye as a forage crop in an otherwise continuous corn silage rotation? In fall of 2011, a trial was established at the UW-Madison Arlington Agricultural Research Station (South Central Wisconsin) to gain experience with these issues, and was continued through 2016.

OBJECTIVES

- Evaluate winter rye as a cover crop following harvest of corn silage, and managed either as a spring-terminated cover crop or as an early season forage crop preceding the next corn silage crop;
- Determine differences in corn silage yield response to varying nitrogen (N) rates following fall manure application with rye as a cover crop, forage crop and no rye;

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- Measure the extent to which rye cover and forage crops affect the yield of a following corn silage crop?
- Quantify total forage production and estimate the economic impact (+/-) from including rye as cover or forage in a continuous corn silage rotation?

STUDY DESIGN AND METHODS

- Plano silt loam soil (Typic Argiudolls); very deep and well-drained
- Continuous corn silage, no-till planting
- Fall-applied liquid dairy manure at 9,700-12,000 gal/ac
 - ~64-106 lb N/ac available in the first year

RCB split plot arrangement; three replicates

Whole plot factor was fall-seeded cover crop:

- Winter rye as cover crop (90 lb/ac PLS) terminated with a standard burndown rate of glyphosate in early spring
- Winter rye as forage (90 lb/ac PLS) harvested at boot stage
- No cover crop (No CC)

Split-plot factor was N fertilization rate:

- 60, 100, 160 lb/ac of N applied at sidedress as ammonium nitrate. The 100 lb N rate approximates the UWEX recommended rate (UWEX A2809, MRTN rate) considering manure N credits.

Economic return from adding rye as a cover or forage crop is determined via partial budget analysis considering:

Net value to adding rye (\$/ac) = Value of all forages produced (corn silage and rye forage) (\$/ac) – Relevant costs associated with rye cover or forage (\$/ac). Forage value estimated via *Milk/Ton Dry Matter (TDM) Forage*, an index of milk production potential based on energy content using forage analysis parameters crude protein, neutral detergent fiber (NDF), in vitro NDF digestibility, starch, and non-fiber carbohydrate and an estimate of dry matter intake (Shaver, et al. 2001) * Ave mailbox milk price (\$/cwt). Corn silage yields at 100 lb N rate.

FIVE-YEAR TRIAL RESULTS

Corn silage yield was subjected to an ANOVA using the MIXED model procedure in SAS (9.4) and statistical significance was determined at $\alpha \leq 0.10$.

- Neither rye as cover crop or forage affected optimal N rate in any study year. There was no effect of N rate treatment in 2012, 2014, 2015 or 2016, with slight increase in yields (all cover crop treatments) at 100 pounds N per-acre in 2013, compared to the low N rate of 60 pounds N per-acre.
- Fall-seeded winter rye as a cover crop (terminated early spring) did not reduce corn silage yields compared to the no cover crop treatment, and was nearly cost-neutral over the five years.

- Rye harvested as forage decreased subsequent corn silage yield in three of the five study years. However, total forage yields, when adding rye forage, were equal to or greater than corn silage produced with no rye in each of the five study years. Reasons for corn silage yield reductions following rye forage are not determined, but could not be overcome with the higher rate of (sidedressed) N.
- Economic return favored the rye forage to corn silage treatment three of five years, with a negative return in only one year, when considering potential milk production using the Milk per Ton of Dry Matter forage quality index.
- Late-planted rye with minimal biomass accumulation resulted in good spring growth. However, planting rye 10-15 days earlier in the fall would likely produce closer to a suitable yield goal of 2 ton DM/ac.