WISCONSIN COVER CROP RESEARCH SUMMARY

FALL COVER CROPPING IN CORN SILAGE-CORN ROTATIONS WITH FALL MANURE IN WISCONSIN: EFFECTS ON YIELD AND RESIDUAL SOIL NITROGEN

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The objectives of this study are to determine the performance of cool-season grass cover crops in different regions of Wisconsin and to quantify effects on subsequent corn crop yield and management. With the prevalence of corn silage production in Wisconsin, which is harvested in late summer, there is a clear opportunity for cover crops to be planted. In addition, it is likely that manure will be applied after corn silage harvest allowing cover crops to provide both soil and nutrient conservation benefits. However, growers in Wisconsin climates may have concerns about trade-offs with management such as extra field work in the spring, competition for soil water and nutrients, and other associated costs that can only be addressed through coordinated research and extension efforts across the state. The potential for yield loss is a real concern of Wisconsin farmers and there are quantified examples of corn yield reductions following a rye cover crop (e.g. 13 bu/ac decrease reported by Stute et al., 2009). In this study, manure was applied at a target rate of 10,000 gallons/ac following corn silage harvest. First year availability of nitrogen (N) from manure was around 100 lb/ac at each site except Marshfield, where low percent solids in the liquid dairy manure resulted in a much lower nutrient contribution.

A recent extension publication titled “Cover crops, manure, and nitrogen management” provide the recommendation of reducing your manure nitrogen credit by 35 lb/ac when rye biomass is between 1000-2000 lb/ac. If biomass of any cover is less than 1000 lb/ac then no adjustments are needed. However, when cover crop biomass exceeds 2,000 lb/ac, then it appears all of the available N in the manure is taken up by the cover crop. Link to the extension publication can be found here: https://go.wisc.edu/dwx72w

RYE AS A COVER CROP OR SILAGE CROP FOLLOWING CORN SILAGE

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Winter rye (*Secale cereale*) is commonly used in the upper Midwest as a cover crop to prevent soil erosion, immobilize soil nitrate susceptible to leaching, and suppress weed growth. It can be planted in the fall after early harvested crops including maize (*Zea mays* L.) harvested for silage. Winter rye is also a high quality forage crop that can be harvested in the spring, thus diversifying forage. Cover cropping can reduce nitrate leaching, particularly when combined with fall manure application, with potential trade off in plant-available nitrogen (N) immobilization. This five-year study quantifies N uptake and N removal from rye-cover or rye-silage and evaluates how use of cover or silage crops alters optimal N fertilizer rate for the subsequent corn silage crop. The study was conducted in Arlington, WI. Whole plot treatments included winter rye as a forage (123 kg seed ha^{-1}), winter rye as a cover crop (123 kg seed ha^{-1}), and no rye. All plots received liquid dairy manure prior to rye planting in September of all four study years. Split plot treatments were N rates of 67, 112, and 179 kg N ha^{-1} applied as ammonium nitrate at sidedress. Soil nitrate concentrations at preplant and presidedress were lower with rye cover or rye

silage compared to the no rye control. However, optimum N rate did not differ between the control and rye cover. In 2012, corn silage yield following rye silage was significantly lower than other treatments, but in 2013 the corn silage yields were not as suppressed by the rye silage. These results indicate that a rye silage-corn silage system in Wisconsin could result in greater forage production while simultaneously protecting groundwater quality and reducing soil erosion.

NITROGEN BENEFITS WHEN INTERSEEDING RED CLOVER INTO CONTINUOUS CORN

Francis, Hannah R.; Ruark, Matthew D.; Zegler, Chelsea; Smith, Dan; West, Jaimie

Information pertaining to the benefits of intereseeding cover crops is lacking. Red clover is a leguminous cover crop that can grow in low radiation environments, is winter hardy for much of the northern USA, and is a low cost weed suppressant that has been shown to provide a nitrogen credit and improve corn yield. While it is clear that red clover is a cover crop that can provide immediate economic benefits in grain-based cropping systems, the potential N credit and the effect of interseeding red clover on subsequent corn yields has yet to be calculated. The objectives of this project were to determine the effect of interseeding red clover on (1) corn yields in the interseeded year and subsequent year, (2) response to N fertilizer in the interseeded year and the subsequent year and, (3) residual (post-harvest) and early season soil N content in a continuous corn, no-till management system. The plot design is a randomized, complete block-split with four replications, treated with or without red clover, at eight rates of N-fertilizer (0 to 315 kg-N ha^{-1} in 45 kg-N ha^{-1} intervals). Corn yields were evaluated when red clover is continually interseeded, or not interseeded following the first interseeding year. Results from 2018 and 2019 show that red clover grows well when interseeded with corn at the V4-V5 growth stage with no detriment to yield. In 2018, corn following the interseeded year out-yielded corn on plots with no history of interseeded red clover. Additional assessments of the fertilizer N equivalent of interseeded red clover will be presented. Overall, preliminary analysis indicates a positive effect of interseeding red clover.

Validation of nitrogen credit for corn from frost-seeding red clover cover crop into winter wheat

Francis, Hannah R.; Ruark, Matthew D.; Zegler, Chelsea; Smith, Dan; West, Jaimie

Including cover crops in cropping systems is a challenge in northern US Midwest temperate climates, where establishment is constrained by limited growing degree days following major cash crops like corn and soybeans. Frost-seeding red clover (*Trifolium pratense L.)* into winter wheat in a corn-soybean-winter wheat cropping system is a management technique to successfully incorporate more cover crops and ensure establishment. Red clover successfully establishes in low-radiation (underseeded) environments which allows for more biomass accumulation relative to other cover crops. Red clover is a legume, and can be used as a green manure for N credit. It is also a high quality forage crop, where above-ground biomass could be harvested for silage while below-ground biomass remains as a nitrogen credit. Red clover has been shown to have no adverse effect to wheat yield when frost-seeded, nor on the yield of the following corn crop. Initial frost-seeded trials in Wisconsin in 2010 show a 51 kg ha^{-1} N credit and a slight yield bump. This study seeks to validate observations of red clover in a corn-soybean-winter wheat system with the goals to (1) determine the effect of red clover (as green manure or silage crop) and tillage on corn yield, (2) determine the effect of red clover (as green manure or silage crop) on corn silage yield, and (3) calculate the N credit for red clover as a function of harvest/termination and

tillage used (chisel plow or no till). The experimental design is a randomized complete block split-split plot with four replicates. The treatments are no red clover cover crop, red clover harvested for forage in the fall, and red clover cover crop used as green manure. The split treatments are till (chisel plow) and no-till, with split-split plots as six (in 2018 and 2019) or eight (2016) nitrogen fertilizer rates (0-280 kg ha^{-1} in six 56 kg ha^{-1} increments or 0-313.6 kg ha^{-1} in eight 39.2 kg ha^{-1} increments). Results from a three-year trial in Arlington, WI show N credits in all treatments with red clover, and a yield loss with red clover treatments in till and no-till treatments in 2016 and 2018, but no yield change in 2019. Interest in planting legume cover crops in northern climates continues to increase, where a rigorous determination of N credits and yield changes in corn from frost-seeding red clover into winter wheat can assess farm profitability in an opportunity for sustainable intensification.

COVER CROP INTERSEEDING IN WISCONSIN USING A MODIFIED GRAIN DRILL

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The objective of this study was to evaluate interseeding cover crops into V5 corn using a modified grain drill and to access cover crop biomass and corn grain yield. The study was done in 2014, 2015, and 2016. All cover crops were successfully established in all years. In 2014 and 2015 within four weeks of seeding radish, red clover, and winter rye had germinated, had consistent growth during the growing season, and had good vigor up until two weeks of grain harvest. In 2015, the oat/pea did not have good vigor and had very poor biomass accumulation. In both years the corn never showed any visible symptoms of stress and the cover crops did not significantly reduce corn yields (<0.0001). Radish and oat/pea winterkilled and rye and red clover needed terminated in spring. Both years all cover crops were completely buried by the corn residue after harvest and resulted in variable biomass data. In 2016, all cover crop germinated, however only radish and red clover survived until grain harvest.