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Using a ^{15}N stable isotope-enriched rye cover crop to determine N-fate and partitioning in dairy cropping systems

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Cover crop use addresses many of the main concerns for soil health management in dairy systems. One of the main reasons for increasing cover crop use in the Upper Midwest (USA), commonly cereal rye (*Secale cereale*), is nitrogen (N) management ahead of a cash crop (corn or soybeans) following fall-applied manure. With manure, a key concern is limiting N pollution while retaining enough plant-available N with the next cash crop. While growing rye decreases pre-plant soil nitrate levels, after the cover crop is terminated, farmers commonly ask about the fate of the accumulated cover crop nitrogen—do they ever get that nitrogen back? We hypothesized that while rye takes up a lot of N before corn planting, most cover crop N is not plant-available during decomposition and instead remains in the soil. To test this hypothesis, we used ^{15}N-enriched cereal rye to determine the partitioning of above-ground cereal rye cover crop N in soil N fractions (POM, particulate organic matter, and MAOM) as influenced by cover cropping, manure, and their interaction throughout the growing season in a corn silage system. A randomized complete block (silage grown with or without a rye cover crop and with or without fall-applied manure) design field study was conducted in Arlington, WI (USA). Microplots of ^{15}N enriched cereal rye were established within whole plot treatments. Soil samples within the microplots and whole plots were collected throughout the silage growing season. First year results show rye does reduce pre-plant nitrate (up to 90% reduction in soil NO_3-N compared to no cover crop), suggesting a water quality benefit. While there was some rapid mineralization of up to 10% of cereal rye N into the soil nitrate pool during the silage growing season, most of the recovered cereal rye N was in the MAOM fraction (20% of the cereal rye N). This suggests nitrogen from decomposing cereal rye, while not readily plant-available, contributes to the organic N pool, an important N reserve in agricultural soils, ultimately reducing downstream N pollution while facilitating nutrient cycling in dairy systems.