## MINNESOTA–Cover Cropping Advances Manure Nitrogen Management for Corn

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Farmers who apply fall liquid manure might consider a cover crop as a nitrogen (N) management tool. Recent on-farm research compared manure management with and without a cover crop.

Fall injecting manure into a winter rye cover crop.

Winter rye in the spring, having recovered from manure injection.

Liquid swine and dairy manure are frequently fall-applied, prior to spring corn planting. However, corn does not take up substantial N until mid-June or later. Most N in swine manure and about one-half in dairy manure is the inorganic ammonium form, which can rapidly convert to nitrate by microbial nitrification when soil is >50°F, in fall or spring. The remainder of manure N is in organic form which is more slowly converted to ammonium form and later to nitrate. Nitrate does not bind to soil particles and can move in soil water out of the root zone to drainage tile or groundwater. The challenge is how to conserve N until the following corn crop can use it.

Winter rye, when planted as a fall cover crop, can take up nitrate in fall and spring. It is the most reliable cover crop in Minnesota for establishment after corn silage or soybean harvest and is winter hardy. Rye can prevent soil erosion on sloping soils, especially after low-residue crops like silage corn or soybean. The challenge is to plant the cover crop as soon as possible before or just after harvest to ensure good establishment, and yet to slow nitrification by delaying manure application until fall soil temperatures decline.

In the 2016 and 2017 growing seasons, 19 on-farm trials across central and southern Minnesota were carried out to determine whether a winter rye cover crop, planted immediately after corn silage or soybean harvest and later injected with liquid dairy or swine manure, would take up a significant amount of soil nitrate, and, after termination, release it rapidly enough to meet the subsequent corn crop needs.

Drilled winter rye and non-cover crop control treatments, replicated three times per site, were established immediately following corn silage or soybean harvest in 2015 and 2016 using field-scale equipment. Later in the fall, liquid dairy or swine manure was injected into the winter rye and non-cover crop control treatments. Rye was terminated by herbicide in the spring before it reached 8-10" in most trials, and was usually tilled in. At termination, rye height, biomass, and N content were measured, along with soil nitrate-N in the 0-24" layer. Corn was planted at 9 sites in 2016 and 10 in 2017 after rye termination. Some trials received supplemental N fertilizer at a rate determined by the farmer. Corn was harvested as silage or grain, depending on the trial, and measured for yield and N uptake.

Results are summarized here. The full report is available at z.umn.edu/3k2o.

- Rye was successfully established by drilling after corn silage or soybean harvest at all sites, although fall growth was limited at later-planted sites.
- Survival of rye after manure injection was dependent on how aggressive the injectors were. Injectors or disk covers that disturbed or covered most of the soil surface caused the greatest reduction in rye density, although rye did recover sufficiently at most sites. Least disturbance occurred with smaller knives, with or without narrowly spaced disk closures.
- Rye biomass at spring termination was related to how early the rye had been established the preceding fall. The earlier the establishment, the greater the biomass.
- Spring soil nitrate-N was greater in control plots than rye plots, indicating rye had been effective in taking up nitrate-N remaining from the previous crop and manure.
- There was no significant difference in corn grain or silage yield following a winter rye cover crop compared to no cover crop.
- The cover crop was terminated at and usually before reaching 12" and 1 ton/ac of biomass dry matter. In most cases the cover crop was terminated by herbicide and later tilled in. Future research is required to determine the effect of different methods and timings for cover crop termination on performance of the subsequent corn crop.