Evaluating liquid anaerobic digestate injection vs. surface application for NH₃-N conservation and corn yield response
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Background
- Growing dairy herd sizes, advancement in technologies, and economic incentives have contributed to the installation of anaerobic manure digesters
- Anaerobic digestion increases the pH and NH₃ concentration of the digested manure, increasing the potential for NH₃ volatilization
- Prior studies found that injection of the liquid digested manure reduced NH₃ loss compared to surface application without incorporation

Hypothesis
Liquid digestate injection will reduce ammonia (NH₃) gaseous loss as well as increase corn nitrogen availability and yield compared to surface broadcast without incorporation

Materials & Methods

Study sites: Three commercial dairy farms in PA with anaerobic digesters
- Farms apply liquid digested manure prior no-till corn-silage and winter rye or triticale grown for silage, sometimes also in March (2-3 times/annually)
- Farms vary in food waste anaerobic digester inputs, separate solid-liquid from anaerobic digested manure

Methane and CO₂ emissions from anaerobic digesters; Digestate injection reduced NH₃ volatilization

Results and Discussion

Digestate injection reduced NH₃ volatilization

PSNT and CSNT indicates there was more than sufficient N

Table 1. Digestate application rate and contents for each farm vs. raw manure

Table 2. Partial budget economic analysis for each farm

Injection increased net returns compared to surface broadcast on all farms.

Implications
- Digestate injection can conserve N, potentially increase yield and returns on investment as N fertilizer prices are increasing
- Soil & crop N tests indicated N availability and potential for loss is high, farms could reduce or eliminate side-dress N, possibly starter N

Study sites:
- Three commercial dairy farms in PA with anaerobic digesters

Study design:
- Side-by-side field scale treatment strips (6.09 to 9.14 m) ranged in length from 187 to 387 meters, same application rate, replicated 5-6 times.

Sampling:
- Ammonia volatilization in the first 24 hours after the liquid is injected or broadcast
- Pre-side dress nitrate soil test (PSNT)
- Corn stalk nitrate levels at corn harvest (10 corn stalks/treatment plot)
- Corn silage yield

Statistical analysis: Data were analyzed using the MIXED Model in JMP Pro 16 (SAS Institute Inc.) with manure application method as fixed effects, and blocks as a random effect. Yield data were pooled after testing for homogeneity of variances with treatments as fixed effect, and loc and locxblock as random.

Materials & Methods

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Table 2. Partial budget economic analysis for each farm

Across farms, corn yield was greater with injection than surface broadcast at p<0.01

Fig 2. Ammonia volatilization after digestate was broadcast or injected for farms A and B respectively.
*indicates values that differ at p<0.05

Fig 4. Pre-sidedress soil nitrate-N test results after digestate application.
*indicates values that differ at p<0.05

Fig 5. Late Season Cornstalk Nitrate Test (CSNT) results after digestate application.
*indicates values that differ at p<0.05

Fig 6. Corn silage dry matter yield and average corn silage dry matter yield across the farms. Standard error bar denoted pm each bar.

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