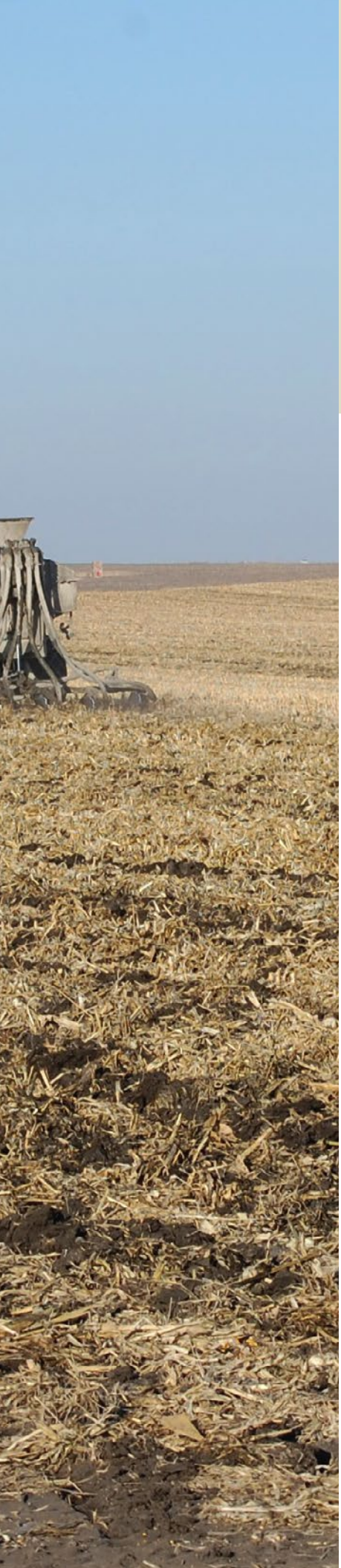

Effect of Annual and Perennial Cover Crops and Manure Application Timing on Yields

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This study aims to evaluate the impact of manure application timing and different ground cover strategies on drainage water quality and crop yields. Treatment comparisons evaluate the impact of fall vs spring injected liquid swine manure, spring urea ammonium-nitrate (UAN) sidedress, and three different treatments with either annual or perennial cover crops. This information can be used to develop appropriate manure and cover crop practices to minimize nutrient loss and enhance the use of swine manure as a nutrient resource.

Materials and Methods

Table 1 lists the treatments established on 36 one-acre plots in the fall of 2020 at the Northeast Research and Demonstration Farm drainage water quality research site. All fall manure was injected with 30-inch spacing after soils had cooled to below 50°F. Comparisons in no-till corn-soybean rotation plots included fall manure, fall manure with cereal rye cover crop, spring manure, and spring UAN sidedress applications prior to corn. The cereal rye cover crop was also included in the soybean phase of the rotation. Plots received 150 lb. N per ac. from injected liquid swine manure in the corn phase of the rotation. Spring UAN was applied at 150 lb. N per ac. as a sidedress approximately four weeks after planting in System 1. No manure or commercial N was applied before soybeans. The cereal rye cover crop was seeded with a no-till drill in the fall after manure injection at approximately 80 lb. per ac. Spring termination of the cover crop was done with glyphosate approximately ten days prior to corn planting and ±2 days of soybean planting.

Continuous corn plots were fall strip-tilled and received 200 lb. N per ac. from fall injected swine manure. Comparisons include a Kentucky bluegrass perennial groundcover (PGC) treatment, early interseed (~V5) multispecies cover crop in both 30-inch and twin 60-inch row spacings, and a no cover crop control. The twin rows were spaced eight inches apart with a 52-inch gap in between. The Kentucky bluegrass cover (Midnight variety) was drill seeded at 17 lb. per ac. on October 16, 2020. Table 2 shows the agronomic details for the multispecies cover crop mix.

Results and Discussion

Precipitation and Drainage. Table 3 gives the monthly precipitation for 2021 compared to the 1976-2020 average. Total precipitation was about four inches below the long-term average. Drought conditions prevailed in the April through July time period. August was considerably wetter than average. The greatest drainage flow occurred in November. There was minimal flow through August in most plots.

Continuous corn yields. Table 4 gives the yield results for continuous corn. There were no statistical differences in corn yield in any of the treatments with 30-inch row spacing. Cover crop growth was minimal in both the early interseed and perennial cover treatments with 30-inch row spacing, and the covers did not appear to affect corn yield. Cover crop growth was substantial in the twin-row 60-inch interseed plots. There was also a substantially lower yield in those plots, possibly caused by the interseeded cover

crop competing for moisture during drought conditions through mid-August. Additionally, manure was injected with 30-inch spacing. The twin 60-inch rows had fewer manure nutrients close to the row and roots needed to grow further to access all manure nutrients. This could also contribute to yield reduction. Rotated corn yields. Table 5 gives the treatment effects on corn yield in corn-soybean rotation for 2021. There was no significant yield difference between fall and spring applied manure. The cereal rye cover crop treatment had significantly lower yield (-18 bu. per ac.) than the no cover crop comparison. The spring UAN sidedress treatment had a significantly lower yield (-13 bu. per ac.) than the spring manure comparison. Lack of early-season moisture may have been a factor in the yield reductions.

Soybean yields. Table 6 shows the treatment effects on soybean yield in corn-soybean rotation for 2021. No nitrogen was applied before to soybeans. The cereal rye cover crop treatment had a significantly lower yield (-3.8 bu per ac) than the no cover crop comparison. System 1 also had a lower yield compared to Systems 2 and 6. System 1 was transitioned from conservation tillage to no-till in 2021, which may have played a role in the yield reduction.

Acknowledgements

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Table 1. Experimental treatments for Nashua manure management and water quality study beginning fall 2015.

System	Application timing and nitrogen source	Crop	Tillage	N application rate (lb./ac.)
1	Spring UAN sidedress	Corn Soybean	No-till No-till	150
2	Spring manure	Corn Soybean	No-till No-till	150
3a	Fall manure	Continuous corn	Strip-till	200
3b	Fall manure	Continuous corn + Early interseed cover	Strip-till	200
4a	Fall manure	Continuous corn +	No-till	200
4b	Fall manure	Perennial cover Continuous corn twin 60"+ Early interseed cover	No-till	200
5	Fall manure	Corn + rye cover Soybean + rye cover	No-till No-till	150
6	Fall manure	Corn Soybean	No-till No-till	150

* System 1 was transitioned from conservation tillage to no-till in 2021. Systems 3a, 3b, 4a, and 4b were transitioned from conservation tillage to strip-till in 2021. Phosphorus fertilizer is applied as needed according to soil testing to Systems 1, 2, 5, and 6. Potassium is applied as needed according to soil testing to all systems.

Table 2. Multispecies cover crop mix and approximate seeding rates drill interseeded on June 8.

Species	Seeding rate (lb./ac)	Species	Seeding rate (lb./ac.)
Sunn Hemp	3.1	Phacelia (Super Bee)	2.1
Cowpeas (CatJang black)	5.1	Brown Mustard (Kodiac)	1.2
Yellow blossom sweet clover	1.4	Rapeseed (Trophy)	1.0
Buckwheat (Mancan)	5.1	Hairy Vetch (MT)	3.4
Annual Ryegrass (Tam Tbo)	3.1	Total	25.5

Table 3. Precipitation (inches), 2021 growing season.

	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Total
2021	0.63	3.48	1.42	2.53	10.58	1.61	4.50	2.02	26.77
1976-2020 Avg	3.68	4.52	5.47	4.57	4.67	3.56	2.68	1.74	30.89

Table 4. Continuous corn yield, 2021 crop year.

System	3a	3b	4a	4b
Management	Fall manure	Fall manure + 30" Early interseed cover	Fall manure + Perennial cover	Fall manure + 60" Early interseed cover
Continuous corn yield, bu./ac.				
2021	228a	223a	217a	174b

Yields with the same letter within year are not significantly different at the P ≤ 0.05.

Table 5. Corn yield in corn-soybean rotations, 2021 crop year.

System	1	2	5	6
Management	Spring UAN sidedress	Spring manure	Fall manure + rye cover	Fall manure
Corn yield in corn-soybean rotation (bu./ac.)				
2021	226b	239a	223b	241a

Yields with the same letter within year are not significantly different at P ≤ 0.05.

Table 6. Soybean yield, 2021 crop year.

System	1	2	5	6
Management			rye cover	
Soybean in corn-soybean rotation (bu./ac.)				
2021	69.6b	74.9a	71.5b	75.3a

Yields with the same letter within year are not significantly different at P ≤ 0.05.