Article

Influence of Soil and Manure Management Practices on Surface Runoff Phosphorus and Nitrogen Loss in a Corn Silage Production System: A Paired Watershed Approach

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Table S1. Summary of abbreviations used.

Abbreviation	Definition
NH4+-N	Ammonium nitrogen
BMPs	Best management practices
B1P	Bray 1 extractable phosphorus
DRP	Dissolved reactive phosphorus
FMT	Fall applied manure with chisel tillage
RSMT	Fall rye cover crop with spring manure and chisel tillage
FMST	Fall manure with spring chisel tillage
BFMT	Fall applied manure with chisel tillage with grass-legume buffer strip
NO3-N	Nitrate nitrogen
N	Nitrogen
P	Phosphorus
K	Potassium
SS	Suspended sediment
TP	Total phosphorus
TN	Total nitrogen

Table S2. Event-based means and regression slopes for calibration and treatment periods, predicted treatment periods means, and hypothesis test results for runoff volume, suspended sediment, and nutrient concentrations and loads for snowmelt events only

Measure	Treatment †	Calibration Period mean	Treatment period mean	Predicted Treatment Mean	Change‡	Mean P-value† ‡	Calibration slope	Treatment slope	Slope P-value
Runoff			mm		%				
surface runoff	FMT	8.17	4.44						
	BFMT	12.8	8.55	5.51	54	NS	1.38	1.36	NS
	RSMT	7.56	11.4	3.83	196	NS	0.91	1.59	NS
	FMST	8.13	8.94	4.55	96	NS	0.79	0.99	NS
Runoff Concentrations			mg L⁻¹						
Suspended sediment	FMT	175	130						
	BFMT	344	205	22.0	-16	NS	0.43	0.33	NS
	RSMT	161	67.6	177	-58	*	0.87	0.38	NS
	FMST	493	28.3	191	-90	**	0.45	0.12	NS
Total P	FMT	0.25	0.29						
	BFMT	0.31	0.50	0.41	8	NS	1.23	0.64	NS
	RSMT	0.28	0.16	0.50	-72	*	1.24	0.52	#
	FMST	0.16	1.20	0.13	579	**	0.13	0.89	NS
Dissolved reactive P	FMT	0.06	0.10						
	BFMT	0.06	0.19	0.08	109	**	0.59	0.70	NS
	RSMT	0.06	0.04	0.09	-66	+	0.78	0.09	**
	FMST	0.07	0.99	0.09	647	**	0.56	4.34	NS
Total N	FMT	24.12	7.36						
	BFMT	18.0	7.52	7.17	1	**	0.76	0.87	NS
	RSMT	24.7	2.66	12.5	-82	**	0.64	0.12	**
	FMST	13.5	5.91	7.57	-33	**	0.00	0.27	+
Nitrate-N	FMT	19.8	4.43						
	BFMT	13.8	4.03	3.70	1	**	0.83	0.89	NS
	RSMT	21.1	0.89	5.05	-85	**	0.62	0.09	*

					Change	P			P
	FMST	8.77	0.57	4.48	-85	**	0.08	0.08	NS
Ammonium-N	FMT	2.38	1.33						
	BFMT	2.11	1.52	1.20	32	+	0.71	0.88	NS
	RSMT	1.74	0.67	0.97	-27	**	0.80	-0.02	+
	FMST	1.32	2.91	0.76	232	**	0.42	1.62	*
Runoff Loads			kg ha^{-1}						
Suspended Sediment	FMT	21.3	6.62						
	BFMT	98.7	11.5	58.3	-80	**	0.99	0.19	NS
	RSMT	20.3	7.44	11.4	-34	+	0.81	0.70	NS
	FMST	15.1	2.03	6.04	-66	**	0.31	0.10	NS
Total P	FMT	0.03	0.01						
	BFMT	0.05	0.03	0.026	27	NS	1.29	0.61	NS
	RSMT	0.03	0.02	0.008	90	NS	1.02	0.87	NS
	FMST	0.01	0.06	0.008	605	**	0.29	0.79	NS
Dissolved reactive P	FMT	0.006	0.005						
	BFMT	0.007	0.013	0.006	128	NS	1.05	0.86	NS
	RSMT	0.005	0.004	0.004	-2	NS	0.83	0.33	NS
	FMST	0.006	0.046	0.005	784	**	0.81	1.80	NS
Total N	FMT	1.93	0.38						
	BFMT	2.20	0.46	0.39	19	**	0.88	0.41	NS
	RSMT	1.77	0.28	0.34	-18	**	0.85	0.31	NS
	FMST	0.99	0.34	0.27	27	**	0.35	0.06	NS
Nitrate-N	FMT	1.56	0.25						
	BFMT	1.62	0.22	0.28	-23	**	0.80	0.39	NS
	RSMT	1.49	0.11	0.24	-55	**	0.85	0.19	NS
	FMST	0.73	0.05	0.18	-71	**	0.34	0.03	NS
Ammonium-N	FMT	0.20	0.06						
	BFMT	0.30	0.11	0.08	30	**	1.36	0.86	NS
	RSMT	0.15	0.07	0.04	55	+	0.88	0.44	NS
	FMST	0.11	0.16	0.03	411	NS	0.38	0.64	NS

† FMT = Fall applied manure with chisel tillage; BFMT = Fall applied manure/chisel tillage with grass buffer; RSMT = Fall rye (cover crop) with spring applied manure and chisel tillage; FMST = Fall applied manure with spring tillage

‡ Change is the percent difference between predicted means and treatment period arithmatic means

†‡ *P*-values for testing calibration vs. treatment period: **$P \leq 0.01$; *$P \leq 0.05$; +$P \leq 0.10$; #$P \leq 0.25$, NS ≥ 0.25

Table S3. Event-based means and regression slopes for calibration and treatment periods, predicted treatment periods means, and hypothesis test results for runoff volume, suspended sediment, and nutrient concentrations and loads for rain events only

Measurement	Treatment †	Calibration Period mean	Treatment Period Mean	Predicted Treatment Mean	Change‡	Mean *P*-value† ‡	Calibration slope	Treatment slope	Slope *P*-value
Surface Runoff			mm		%				
Runoff	FMT	3.15	5.45						
	BFMT	2.84	4.82	7.05	-32	NS	0.85	0.89	NS
	RSMT	2.65	7.12	3.86	85	#	0.93	1.39	+
	FMST	3.41	5.73	5.59	2	NS	1.06	0.82	#
Runoff Concentrations			mg L⁻¹						
Suspended Sediment	FMT	4844	1475						
	BFMT	3095	580	1368	-52	**	0.70	0.28	+
	RSMT	4320	619	1203	-42	**	0.85	0.36	+
	FMST	1488	506	602	-11	**	0.26	0.25	NS
Total P	FMT	5.25	2.23						
	BFMT	4.41	1.32	2.66	-45	**	0.86	0.27	*
	RSMT	5.13	1.43	2.13	-34	**	0.80	0.39	#
	FMST	2.25	1.17	1.09	2	**	0.47	0.21	+
Dissolved reactive P	FMT	0.04	0.10						
	BFMT	0.04	0.16	0.08	70	**	0.63	0.25	NS
	RSMT	0.04	0.12	0.08	0.3	*	0.57	0.59	NS
	FMST	0.06	0.24	0.09	70	*	0.91	0.46	NS
Total N	FMT	23.6	12.2						
	BFMT	17.6	6.55	12.2	-41	**	0.73	0.58	NS
	RSMT	22.2	8.82	15.1	-37	**	0.61	0.16	*
	FMST	11.6	8.21	9.28	-17	*	0.30	0.19	NS
Nitrate-N	FMT	6.14	4.35						
	BFMT	3.75	2.06	3.80	-40	#	0.53	0.74	NS
	RSMT	5.23	3.40	4.95	-19	NS	0.64	0.06	+
	FMST	4.38	3.66	4.64	-34	NS	0.21	0.15	NS
Ammonium-N	FMT	0.52	0.31						
	BFMT	0.40	0.16	0.33	-68	**	0.90	-0.002	*
	RSMT	0.37	0.21	0.23	-11	+	0.57	0.03	+
	FMST	0.29	0.44	0.23	69	NS	0.73	0.06	*
Runoff Loads			kg ha⁻¹						
Suspended Sediment	FMT	191	179						
	BFMT	110	65.6	122	-46	NS	0.37	0.39	NS
	RSMT	148	96.3	84.2	14	NS	0.71	0.95	#
	FMST	66.5	62.4	65.0	-4	NS	0.34	0.33	NS
Total P	FMT	0.20	0.23						
	BFMT	0.15	0.12	0.19	-34	NS	0.73	0.49	*
	RSMT	0.16	0.18	0.15	18	NS	0.86	1.01	NS
	FMST	0.09	0.12	0.11	13	NS	0.44	0.42	NS
Dissolved reactive P	FMT	0.001	0.007						
	BFMT	0.001	0.004	0.008	-42	+	0.68	0.26	**
	RSMT	0.001	0.005	0.004	7	*	0.96	0.27	**
	FMST	0.002	0.021	0.007	190	NS	1.43	2.66	+
Total N	FMT	0.82	1.02						
	BFMT	0.57	0.49	0.96	-49	NS	0.62	0.51	NS
	RSMT	0.66	0.84	0.57	47	NS	0.71	1.03	#
	FMST	0.40	0.52	0.53	-2	NS	0.34	0.34	NS
Nitrate-N	FMT	0.13	0.19						
	BFMT	0.10	0.10	0.22	-56	NS	0.50	0.51	NS
	RSMT	0.10	0.24	0.11	121	NS	0.67	1.07	#
	FMST	0.13	0.12	0.17	-30	NS	0.15	0.17	NS

Ammonium-N	FMT	0.02	0.04						
	BFMT	0.02	0.01	0.05	-84	NS	0.96	0.05	*
	RSMT	0.01	0.01	0.02	-28	NS	0.71	0.10	*
	FMST	0.01	0.03	0.02	16	#	0.44	0.62	*

† FMT = Fall applied manure with chisel tillage; BFMT = Fall applied manure/chisel tillage with grass buffer; RSMT = Fall rye (cover crop) with spring applied manure and chisel tillage; FMST = Fall applied manure with spring tillage

‡ Change is the percent difference between predicted means and treatment period arithmatic means

†‡ *P*-values for testing calibration vs. treatment period: **$P \le 0.01$; *$P \le 0.05$; +$P \le 0.10$; #$P \le 0.25$, NS ≥ 0.25