

Supporting information for

Internal phosphorus storage in two headwater agricultural streams in the Lake Erie Basin

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6 pages containing 4 supporting figures (Figure S1-S4) and 4 supporting tables (Table S1-S4).

Figure S1. Mud fraction (<0.063 mm particle size) for Sites G and S.

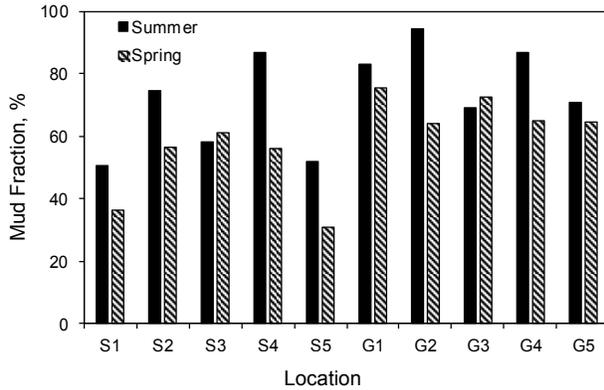


Figure S2. Relationships between (A) organic matter content (%) and total P concentration ($\mu\text{mol P/g}$), (B) total P concentration ($\mu\text{mol P/g}$) and total Fe concentration ($\mu\text{mol P/g}$), (C) total P concentration ($\mu\text{mol P/g}$) and BD-SRP concentration ($\mu\text{mol P/g}$). Site G and S samples are shown in white and black squares, respectively. Full list of Pearson's r correlation coefficients is shown in Table S3.

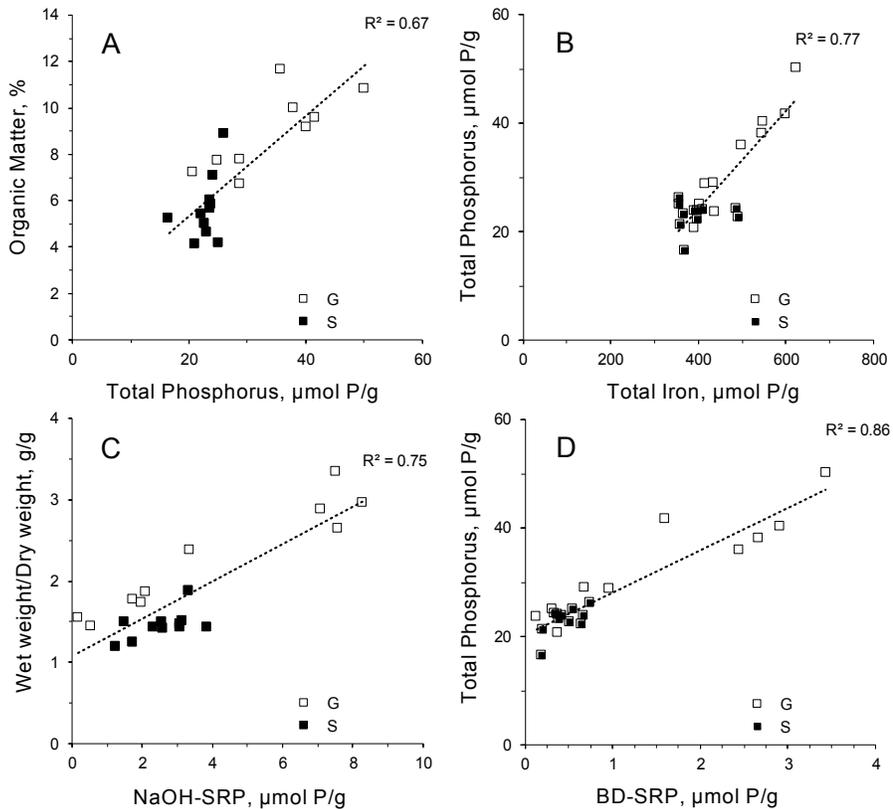


Figure S3. P binding fractions extracted from sediment cores at Sites G and S. (A) loosely bound P (H_2O -SRP), (B) redox-sensitive iron-bound P (BD-SRP), (C) redox-insensitive aluminum- and iron-bound P (NaOH-SRP), (D) P associated with organic matter (NaOH-DNRP), (E) P bound to colloidal redox-insensitive iron (Fe-P), (F) P bound to humic acid (HA-P), (G) P bound to calcium (HCl-P), and (H) residual strongly sorbed P (Res-P). Concentrations are per gram dry weight of sediment.

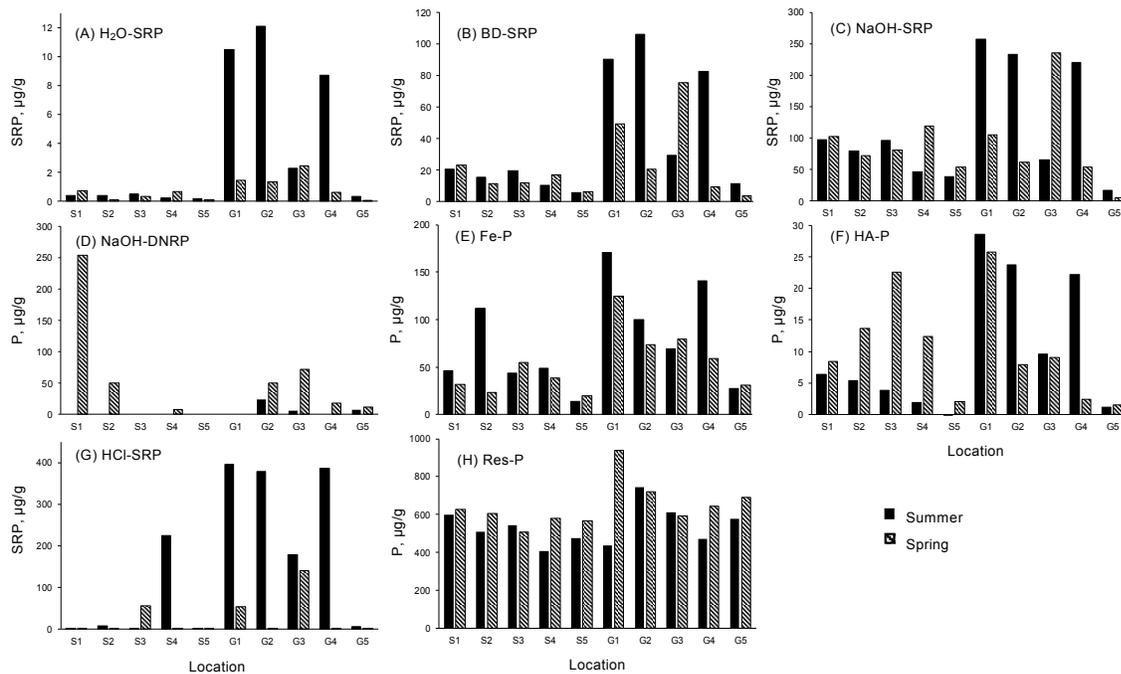


Figure S4. (A) Microbial reduction of Fe(II) and (B) phosphorus release (as soluble reactive phosphorus, SRP) over time in media containing acetate (dashed line) and no source of carbon (solid line) in cores from Sites S and G. Error bars depict standard deviation of the mean of triplicate absorbance readings.

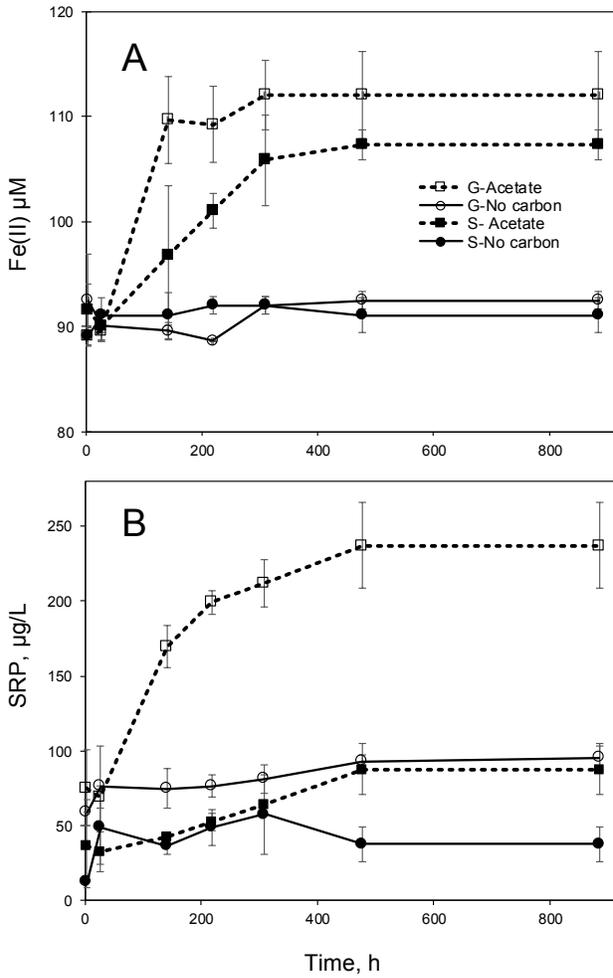


Table S1. Timeline of production cultural, tillage, and P fertility management and sampling for field G and S.

Date	Site G Operation	Date	Site S Operation
May 1, 2014	plant soybeans	Apr 7, 2014	fertilize (commercial P: 34 kg P/ha)
Sep 24, 2014	harvest soybeans	Apr 7, 2014	tillage
Sep 27, 2014	fertilize (commercial P: 25.7 kg P/ha)	May 8, 2014	plant soybeans
Sep 27, 2014	plant wheat	Oct 27, 2014	harvest soybeans
Jul 5, 2015	harvest wheat	Nov 10, 2014	fertilize (poultry litter: 39.2 kg P/ha))
Aug 31, 2015	fertilize (commercial P: 27.4 kg P/ha)	Nov 10, 2014	tillage
Sep 2, 2015	tillage	Apr 28, 2015	tillage
Sep 8, 2015	tillage	May 1, 2015	tillage
Sep 15, 2015	tillage	May 3, 2015	plant corn
Sep 17, 2015	tillage	May 3, 2015	fertilize (commercial P: 9.3 kg P/ha)
May 24, 2016	plant corn	Oct 5, 2015	harvest corn
May 24, 2016	fertilize (commercial P: 5.5 kg P/ha)	Oct 15, 2015	plant rye cover crop
Oct 15, 2016	harvest corn	Mar 21, 2016	fertilize (poultry litter: 31.3 kg P/ha)
Nov 1, 2016	tillage	May 27, 2016	plant soybeans
Apr 26, 2017	plant soybeans	Oct 16, 2016	harvest soybeans
Aug 29, 2017	<i>summer core collection</i>	Oct 23, 2016	fertilize (commercial P: 23.1 kg P/ha)
Oct 7, 2017	harvest soybeans	Oct 24, 2016	plant rye cover crop
Oct 10, 2017	tillage	May 14, 2017	plant soybeans
Oct 20, 2017	fertilize (commercial P: 16.9 kg P/ha)	Aug 29, 2017	<i>summer core collection</i>
May 8, 2018	plant soybeans	Oct 3, 2017	harvest soybeans
May 29, 2018	<i>spring core collection</i>	Oct 6, 2017	plant wheat
Oct 20, 2018	harvest soybeans	Oct 6, 2017	fertilizer (commercial P: 12.7 kg P/ha)
Oct 24, 2018	fertilize (commercial P: 33.1 kg P/ha)	May 29, 2018	<i>spring core collection</i>
		Jul 1, 2018	harvest wheat
		Jul 1, 2018	harvest wheat straw
		Aug 6, 2018	fertilize (dairy manure: 21.1 kg P/ha)
		Oct 15, 2018	plant wheat

Table S2. Physicochemical properties of sediment cores at Sites G and S.^a

Core/season	Organic Matter %	Total P μmol P/g	Total Fe μmol Fe/g	Fe:P molar ratio	Am-Fe μmol Fe/g	ww/dw g/g	mud F %
S1/Summer	5.99	23.8	397.2	16.7	195.3	1.51	50.7
S2/Summer	5.01	22.7	490.4	21.6	209.9	1.49	74.7
S3/Summer	5.42	22.2	398.3	17.9	174.5	1.47	58.2
S4/Summer	7.07	24.2	486.5	20.1	42.7	1.49	87.0
S5/Summer	5.25	16.5	369.4	22.4	12.4	1.19	51.9
G1/Summer	9.15	40.2	546.4	13.6	225.4	2.96	82.9
G2/Summer	10.83	50.2	622.6	12.4	255.0	3.35	94.6
G3/Summer	7.78	28.8	415.1	14.4	151.7	1.86	69.3
G4/Summer	9.97	38.1	544.6	14.3	228.8	2.88	86.9
G5/Summer	7.22	20.7	390.0	18.8	155.2	1.44	70.8
S1/Spring	8.88	26.1	355.9	13.6	69.9	1.88	36.3
S2/Spring	5.85	23.9	410.8	17.2	69.9	1.43	56.5
S3/Spring	4.61	23.2	367.1	15.8	28.4	1.41	61.2
S4/Spring	4.14	25.1	355.7	14.2	50.0	1.42	56.2
S5/Spring	4.11	21.1	359.3	17.0	54.0	1.24	30.8
G1/Spring	9.57	41.7	599.6	14.4	96.3	2.38	75.3
G2/Spring	6.70	28.8	435.4	15.1	107.9	1.72	64.0
G3/Spring	11.67	35.8	497.4	13.9	102.2	2.64	72.4
G4/Spring	7.73	25.0	402.6	16.1	75.7	1.77	64.8
G5/Spring	5.68	23.7	437.5	18.5	37.8	1.54	64.6

^a Total Fe, total iron; Fe:P molar ratio, total Fe:total P molar ratio; Am-Fe, amorphous iron; ww/dw, wet weight to dry weight ratio; mud F, mud fraction (particle size <0.063 mm).

Table S3. Pearson's r correlation coefficients between sediment characteristics for twenty cores sampled in summer and spring from Sites G and S.^a

	T P	T Fe	Am Fe	ww/dw	PW-SRP	H ₂ O-SRP	BD-SRP	NaOH-SRP	NaOH-DNRP	Fe-P	HA-P	HCl-SRP	Res-P	Fe:P ratio	Mud fraction
O M	0.81	0.71	0.49	0.90	0.53	0.77	0.79	0.46	0.19	0.61	0.26	0.68	0.23	0.58	0.59
T P		0.85	0.58	0.96	0.75	0.86	0.89	0.63	0.67	0.81	0.46	0.69	0.34	0.78	0.67
T Fe			0.53	0.82	0.46	0.68	0.72	0.40	0.01	0.79	0.31	0.74	0.19	0.33	0.84
Am Fe				0.60	0.47	0.65	0.70	0.47	0.06	0.67	0.02	0.42	0.13	0.41	0.46
ww/dw					0.72	0.91	0.91	0.62	0.09	0.79	0.43	0.73	0.20	0.71	0.68
PW-SRP						0.83	0.77	0.73	0.06	0.70	0.49	0.39	0.25	0.76	0.38
H₂O-SRP							0.93	0.70	0.04	0.82	0.51	0.71	0.07	0.70	0.64
BD-SRP								0.82	0.14	0.79	0.56	0.72	0.12	0.72	0.59
NaOH-SRP									0.38	0.58	0.67	0.48	0.09	0.60	0.29
NaOH-DNRP										0.04	0.28	0.08	0.02	0.13	0.23
FeOx-P											0.35	0.72	0.07	0.50	0.71
HA-P												0.35	0.04	0.42	0.23
HCl-SRP													0.23	0.34	0.79
Res-P														0.41	0.08
Fe:P ratio															0.18

^a Organic matter as loss on ignition (OM), total phosphorus (TP), total iron (T Fe), amorphous iron (Am Fe), wet weight to dry weight ratio (ww/dw), pore water SRP (PW-SRP), sediment P binding fractions (H₂O-SRP, BD-SRP, NaOH-SRP, NaOH-DNRP, Fe-P, HA-P, HCl-SRP, and Res-P), iron to phosphorus molar ratio (Fe:P), and mud fraction (particle size <0.063 mm). OM in % was arcsine-square root transformed and other variables were natural log-transformed prior to correlation analyses. Correlation coefficients in boldface are statistically significant ($p < 0.05$).

Table S4. Pore water SRP ($\mu\text{g/L}$) and P binding fractions ($\mu\text{g P/g dw}$) for sediment cores at Sites G and S.^a

Core/season	PW-SRP	H ₂ O-SRP	BD-SRP	NaOH-SRP	NaOH-DNRP	Fe-P	HA-P	HCl-SRP	Res-P
S1/Summer	93.06	0.40	20.53	97.49	0.00	46.31	6.35	2.45	599.51
S2/Summer	122.71	0.42	15.61	79.68	0.00	111.51	5.32	8.83	509.44
S3/Summer	60.11	0.49	19.72	96.05	0.00	43.96	3.73	3.25	544.64
S4/Summer	38.15	0.21	10.40	46.01	0.00	48.87	1.83	224.57	409.19
S5/Summer	35.95	0.17	5.88	39.16	0.00	13.67	0.00	1.35	473.82
G1/Summer	798.14	10.50	90.34	256.99	0.00	170.63	28.62	395.45	438.69
G2/Summer	952.99	12.12	106.44	233.41	23.94	99.92	23.72	378.59	743.35
G3/Summer	197.39	2.28	29.66	65.18	5.81	69.01	9.58	178.57	610.79
G4/Summer	341.27	8.74	82.53	219.94	0.00	140.69	22.18	386.40	472.21
G5/Summer	61.21	0.36	11.42	16.80	7.85	27.34	1.15	5.42	578.78
S1/Spring	126.00	0.74	23.07	103.20	254.39	31.71	8.34	1.74	626.18
S2/Spring	29.96	0.12	11.53	72.20	50.81	23.36	13.60	1.16	607.32
S3/Spring	127.56	0.37	11.88	80.71	0.00	54.71	22.65	55.36	505.99
S4/Spring	666.34	0.68	16.98	119.71	7.76	38.40	12.38	0.33	580.75
S5/Spring	95.54	0.10	6.25	54.36	0.00	19.87	1.99	0.69	566.80
G1/Spring	362.59	1.43	49.63	104.75	0.00	125.14	25.80	55.09	938.84
G2/Spring	731.89	1.37	20.93	61.69	51.02	73.09	7.93	0.95	719.48
G3/Spring	760.80	2.43	75.74	235.26	72.46	79.18	9.01	141.04	594.37
G4/Spring	261.86	0.61	9.58	53.68	18.80	59.38	2.39	1.31	646.06
G5/Spring	19.02	0.09	4.07	5.34	11.46	31.03	1.48	1.14	689.30

^a Pore water SRP (PW-SRP), sediment P binding fractions (H₂O-SRP, BD-SRP, NaOH-SRP, NaOH-DNRP, Fe-P, HA-P, HCl-SRP, and Res-P).