Supplementary Materials

Table S1 Characteristics of the wetland sediment used in this experiment and/or treatments (Mean ± SE, *n* = 4).

Type	MC (%)	*p* (g/cm^3)	*ϕ* (%)	*pp* (g/cm^3)	LOI (%)	pH	NH^+_4-N (mg/g)	NO_3^--N (mg/g)	TN (mg/ g)	PO_4^{3}-P (mg/g)	TP (mg/g)
WS	49.03 ± 2.58	0.79 ± 0.04	68.95 ± 2.93	2.40 ± 0.05	17.22 ± 2.34	8.23 ± 1.16	0.148 ± 0.009	0.038 ± 0.002	0.844 ± 0.006	0.215 ± 0.003	0.581 ± 0.004
DS	5.22 ± 1.17	0.88 ± 0.98	23.47 ± 1.49	1.14 ± 0.03	12.43 ± 2.25	7.79 ± 1.78	0.135± 0.005	0.031± 0.003	0.831 ± 0.009	0.208 ± 0.005	0.562 ± 0.007

Abbreviations: WS, wet-sediment; DS, dry sediment; MC, moisture content; *p*, bulk density; *ϕ*, porosity; *pp*, particle density; LOI, loss on ignition; pH, hydrogen ions concentration; TN, total nitrogen; TP, total phosphate; PO_4^{3-}, phosphate; NO_3^--N, nitrate nitrogen; and NH^+_4-N, ammonium nitrogen.

Table S2 Findings from PCA of composite treatments (wet & dried-rewetted sediment treatments, mean ± SE, n = 64), with eigenvalues, percent variability, cumulative percent, eigenvectors (un-rotated) within PC1 and PC 2, Kaiser–Meyer–Olkin (KMO) and Levene's test for overall environmental indicators/data set.

	Treatments				
Parameters	**PC 1**	**PC 2**	**Environmental indicators**	**KMO**	**Levene's Test**
Eigenvalue	12..223	1.248	Overall	0.7439	0.000
Proportion	0.873	0.089			
Percent variability	87.30	8.90			
Cumulative percent	87.30	96.20			
Eigenvectors					
ROL	0.276	0.135			
Fe-PF	0.282	-0.078			
RSA	0.236	0.322			
RA	0.273	0.167			
ORP	0.229	0.530			
RP	0.276	0.208			
TN-RS	0.278	0.202			
TP-RS	0.280	0.150			
TN-RW	0.264	-0.325			
TP-RW	0.261	-0.307			
DOC	0.251	-0.374			
pH	-0.266	0.274			
DO	0.280	-0.165			
EC	-0.282	0.121			

Abbreviations: ROL, radial oxygen loss; Fe-PF, iron plaque formation; RSA, root surface area; RA activity; ORP, oxidation reduction potential; RP, root porosity; TN-RS, total nitrogen removal from sediments; TP-RS, total phosphate removal from sediments; TN-RW, total nitrogen reduction from pore water; TP-RW, total phosphate reduction from interstitial water; DOC-RW, dissolved organic carbon reduction from interstitial water, DO, dissolved oxygen; and EC, electric conductivity.

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Table S3 Root functional traits of four cultivated plants in the wet and dried-rewetted sediment treatments (Mean ± SE, n = 4, according to one-way ANOVA at P < 0.05).

Sediment type	Treatment	Species	ROL (mmol O_2/ kg root d.w. D)	RA (mg/g d.w. h)	RP (%)	Fe-PF (mg/g)	RSA (cm^2/plant)
WS	WSIS	IS	131.31 ± 4.25A	82.82 ± 2.81A	36.11 ± 2.29A	14.18 ± 1.85 A	21285.12 ± 2128.51A
	WSSF	SF	118.50 ± 4.89B	67.50 ± 4.43B	26.52 ± 2.13B	11.91 ± 1.60AB	5575.70 ± 889.67B
	WSCT	CT	84.65 ± 5.64C	62.33 ± 2.24B	18.89 ± 1.92C	9.96 ± 1.08BC	4375.31 ± 531.44BC
	WSCE	CE	67.87 ± 5.04D	49.99 ± 3.56C	12.32 ± 1.85C	8.02 ± 1.18C	2885.22 ± 486.78C
DS	DSIS	IS	122.09 ± 5.60A*	75.68 ± 5.32A*	31.14 ± 2.41A*	11.18 ± 1.33A*	18594.23 ± 1141.95A*
	DSSF	SF	106.63 ± 4.59B*	64.55 ± 3.49B*	24.71 ± 2.22B*	10.25 ± 1.29A*	4150.17 ± 522.64B*
	DSCT	CT	73.29 ± 5.72C*	60.54 ± 1.49B*	15.33 ± 1.98C*	7.49 ± 0.92B*	3670.47 ± 781.06B*
	DSCE	CE	54.70 ± 5.05D*	43.18 ± 2.68C*	11.66 ± 1.69D*	6.44 ± 0.84B*	2799.93 ± 612.99B*

Abbreviations: WS, wet sediment; DS, dried-rewetted sediment; ROL, radial oxygen loss; RA, root activity; RP, root porosity; Fe-PF, Fe plaque formation; RSA, root surface area; WSIS, wet sediment planted with Indian shot; WSSF, wet sediment planted with Sweet flag; WSCT, wet sediment planted with Chinese taro; WSCE, wet sediment planted with Chinese evergreen; DSIS, dried-rewetted sediment planted with Indian shot; DSSF, dried-rewetted sediment planted with Sweet flag; DSCT, dried-rewetted sediment planted with Chinese taro; DSCE, dried-rewetted sediment planted with Chinese evergreen; IS, Indian shoot; SF, Sweet flag; CT, Chinese taro, and CE, Chinese evergreen.

Table S4 Macronutrients and DOC removal percentages by four cultivated plant species from the pore water and sediments of wet and dried-rewetted sediments (Mean ± SE, *n* = 4, according to one-way ANOVA at *P* < 0.05).

Sediment type	Treatment type	Species	TN-RS (%)	TP-RS (%)	TN-RW (%)	TP-RW (%)	DOC-RW (%)
WS	WSIS	IS	87.01 ± 5.77a	78.21 ± 4.62a	82.45 ± 4.77a*	77.07 ± 5.71a*	80.89 ± 4.91a*
	WSSF	SF	79.22 ± 3.52b	71.72 ± 3.33b	75.31 ± 3.71b*	67.11 ± 4.92b*	78.33 ± 3.23a*
	WSCT	CT	70.42 ± 4.58c	66.91 ± 2.62c	70.85 ± 3.92c*	62.90 ± 3.64c*	75.18 ± 4.35a*
	WSCE	CE	65.34 ± 3.41d	59.21 ± 2.01d	63.18 ± 4.12d*	59.62 ± 3.12c*	63.27 ± 3.63b*
DS	DSIS	IS	84.39 ± 4.01A	76.06 ± 3.33A	68.15 ± 3.13A*	63.22 ± 3.85A*	69.32 ± 2.39A*
	DSSF	SF	74.98 ± 3.11B	69.37 ± 2.35B	63.03 ± 3.32B*	58.94 ± 2.86B*	63.42 ± 3.95B*
	DSCT	CT	67.29 ± 2.56C	61.95 ± 3.39C	56.80 ± 2.81C*	44.66 ± 2.46C*	60.76 ± 3.42B*
	DSCE	CE	63.19 ± 2.84D	56.24 ± 3.31D	53.93 ± 5.14C*	35.81 ± 2.68C*	55.83 ± 2.31C*

Abbreviations: TN-RS, total nitrogen reduction from sediment; TP-RS, total phosphate reduction from sediment; TN-RW, total nitrogen reduction from interstitial water; TP-RW, total phosphate removal from pore water; and DOC-RW, dissolved organic carbon removal from pore water.

Table S5 DO, pH, EC, and ORP in interstitial water of experimental plant species grown in wet and dried-rewetted sediments (Mean ± SE, *n* = 4, according to one-way ANOVA at *P* < 0.05).

Sediment type	Treatment type	Species	DO (mg/ L)	pH	EC (µS/cm)	ORP (mV)
WS	WSIS	IS	5.56 ± 0.92A	7.45 ± 0.52C	1231.04 ± 73.38D	-25.19 ± -3.69C
	WSSF	SF	5.02 ± 0.85A	7.68 ± 0.77B	1447.16 ± 71.43C	-36.27 ± -4.26B
	WSCT	CT	4.69 ± 0.78B	7.81 ± 0.82A	1736.87 ± 71.37B	-52.31 ± -6.25A
	WSCE	CE	4.17 ± 0.62B	7.87 ± 0.99A	2034.06 ± 65.25A	-54.65 ± -5.26A
DS	DSIS	IS	4.93 ± 0.83A*	7.73 ± 0.33C*	1563.69 ± 76.30C*	-42.36 ± -3.37D*
	DSSF	SF	4.47 ± 0.65A*	7.95 ± 0.42B*	1866.50 ± 138.36B*	-58.76 ± -3.78C*
	DSCT	CT	3.73 ± 0.60B*	8.25 ± 0.51A*	2069.77 ± 57.69B*	-66.99 ± -4.17B*
	DSCE	CE	3.45 ± 0.49B*	8.33 ± 0.66A*	2333.52 ± 65.17A*	-77.40 ± -5.47A*

Abbreviations: DO, dissolved oxygen; EC, electric conductivity; and ORP, oxidation reduction potential.

Table S6 Changes in sediment characteristics of wet and dried-rewetted sediments (mean ± SE, n = 4, according to one-way ANOVA at P < 0.05).

Wet sediment treatments							Dried-rewetted sediment treatments						
Treatments	Species	Depth (cm)	MC (%)	p (g/cm^3)	ϕ (%)	pp (g/cm^3)	Treatments	Species	Depth (cm)	MC (%)	p (g/cm^3)	ϕ (%)	pp (g/cm^3)
WSIS	IS	0–2	65.50	0.66	88.05	5.12	DSIS	IS	0–2	58.59	0.65	81.29	3.47
		2–4	63.89	0.60	92.99	4.92			2–4	64.75	0.68	78.36	3.22
		4–6	67.92	0.58	84.75	5.77			4–6	54.92	0.62	75.33	2.99
		6–8	64.71	0.61	86.29	4.83			6–8	55.83	0.64	74.52	4.75
WSSF	SF	0–2	62.66	0.66	76.46	2.87	DSSF	SF	0–2	56.73	0.67	74.23	2.25
		2–4	58.96	0.67	70.22	2.61			2–4	50.66	0.7	68.96	2.17
		4–6	65.96	0.69	84.39	3.22			4–6	59.85	0.65	70.8	2.08
		6–8	60.51	0.63	76.27	2.52			6–8	58.99	0.64	66.39	2.55
WSCT	CT	0–2	64.21	0.69	68.02	2.16	DSCT	CT	0–2	56.39	0.73	63.47	2.27
		2–4	55.99	0.67	67.25	2.18			2–4	52.36	0.77	65.26	1.99
		4–6	54.73	0.73	65.33	2.11			4–6	59.89	0.65	60.28	1.75
		6–8	61.15	0.65	71.25	2.17			6–8	55.25	0.75	66.23	1.86
WSCE	CE	0–2	57.19	0.70	64.38	1.97	DSCE	CE	0–2	54.41	0.79	61.03	1.83
		2–4	51.63	0.75	60.25	2.09			2–4	50.89	0.72	59.63	1.75
		4–6	53.26	0.69	69.31	1.92			4–6	53.25	0.75	66.75	1.62
		6–8	66.35	0.64	62.25	1.88			6–8	58.96	0.69	56.99	1.89
WSC	Control	0–2	58.76	0.72	58.11	1.84	DSC	Control	0–2	48.52	0.86	43.96	1.39
		2–4	52.96	0.76	54.58	1.80			2–4	45.26	0.92	55.26	1.23
		4–6	54.25	0.68	53.25	1.62			4–6	42.15	0.90	40.25	1.06
		6–8	52.39	0.71	50.45	1.67			6–8	40.25	0.84	39.69	1.09

Abbreviations: MC, moisture content; p, bulk density; ϕ, porosity; and pp, particle density.

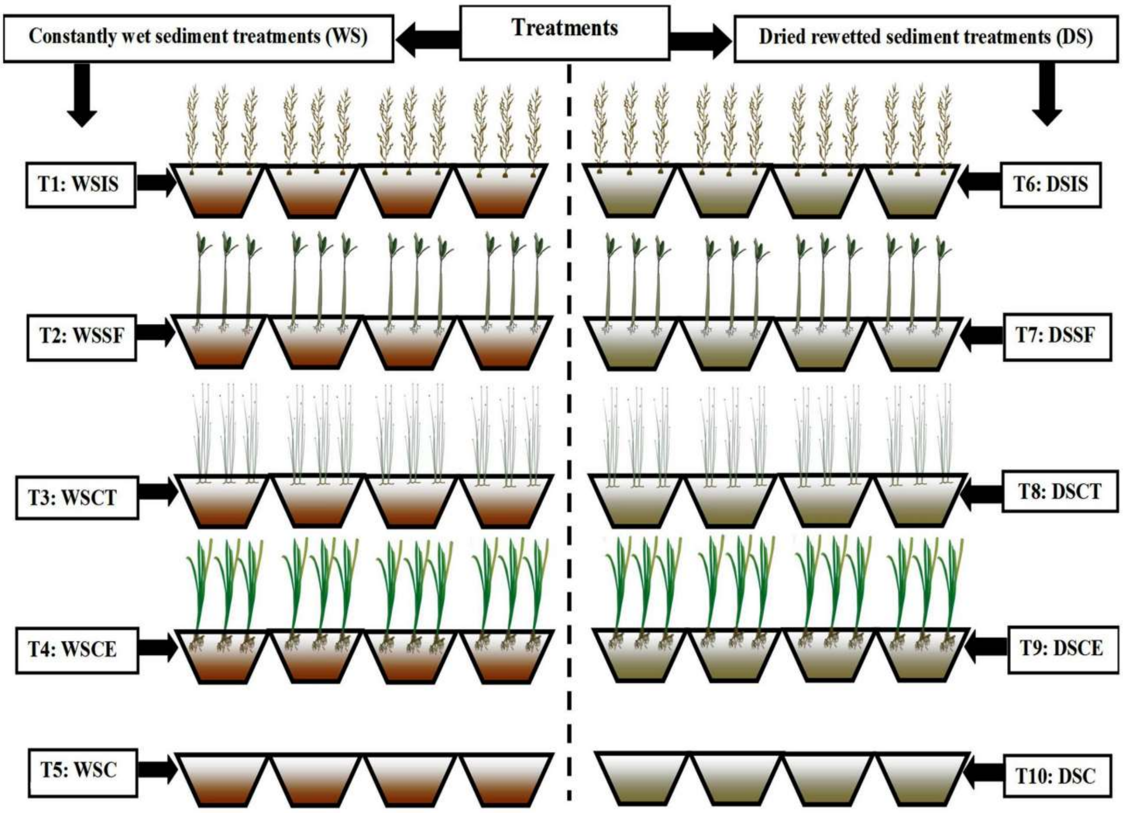

Fig. S1 Treatments design

1. Materials and methods

S1.1. Treatments detail

T1. Constantly wet sediment planted with Indian shot (WSIS)

T2. Constantly wet sediment planted with Sweet flag (WSSF)

T3. Constantly wet sediment planted with Chinese taro (WSCT)

T4. Constantly wet sediment planted with Chinese evergreen (WSCE)

T5. Constantly wet sediment without plantation as control (WSC)

T6. Dry-rewetted sediment planted with Indian shot (DSIS)

T7. Dry-rewetted sediment planted with Sweet flag (DSSF)

T8. Dry-rewetted sediment planted with Chinese taro (DSCT)

T9. Dry-rewetted sediment planted with Chinese evergreen (DSCE)

T10. Dry-rewetted sediment without plantation as control (DSC)

S1.2. Sediment collection and analysis

A total of 120–130 kg sediment was collected from the littoral zone of study site within 0.5–1.0 m depth of water, from the surface (top 15–20 cm) by using sediment core sampler. Collected sediment was immediately stored in 30 kg plastic container bins and then in ice-boxes for transportation. Subsequently, stones, plant roots, and woody materials were removed from wet sediments using small size spade, while the dried-rewetted sediments sieved after drying the sediment using 10 mm sieve for removal of waste materials. Half of the mesocosms (60–70 kg) were dried at room temperature (27 ± 3 °C) for 30 days to achieve a minimal level of moisture content around 5%–7%. These dried-rewetted sediments were designed to stimulate the effect of water level fluctuations or sediment drying followed by rewetting (Lu et al., 2018). Remaining 60–70 kg sediment was placed in wet sediment treatments (3 kg per container), and conserved wetted by addition of 1000–1200 mL distilled water weekly to maintain moisture content and/or water depth < 1–2 cm. During pre- and post-desiccation of sediment, representative sediment samples from each treatment were analyzed as described in sub-sections 2.4 and S2.8 to investigate desiccation effects on physicochemical properties of the sediments (Table S1). After desiccation (dried-rewetted) of the sediments, seedlings were planted in both wet and dried-rewetted sediment treatments, and kept water depth in all containers around 10–12 cm throughout the experimental period. After experiments, plants were removed and sediment samples were also collected from each treatment to analyze final changes in the sediment's physicochemical properties.

S1.3. Water collection and analysis

Collected water was always filtered before use in treatments by using a 25# plankton net to avoid external blooms. After every 18–20 days during the sampling period, average concentrations of total nitrogen (TN), total phosphate (TP), ammonium nitrogen (NH_4^+-N), nitrate nitrogen (NO_3^--N), phosphate (PO_4^{3-}-P), dissolved organic carbon (DOC) and dissolved oxygen (DO) of the lake water were 1.158 ± 0.052, 0.524 ± 0.005, 0.365 ± 0.014, 0.190 ± 0.006, 0.055 ± 0.004, 6.841 ± 0.179 and 5.341 ± 0.382 mg/L, correspondingly. The average pH, electricity conductivity (EC) and temperature of the lake water after every 18–20 days during the sampling period were 8.3 ± 0.1, 454 ± 5.64 µS/cm and 21.0 ± 1.70 °C, respectively. After every 15–20 days during the experiment period, interstitial water samples were collected and analyzed to record changes and/or removal of macronutrients and DOC in each treatment. Interstitial water was collected for analysis before the addition of new water in treatments to avoid influences on interstitial water quality. Addition of new water in the treatments was relied on minimum water availability in treatments around 2–3 cm to congregate release overlying nutrients near to rhizospheric zone and interstitial water for maximum uptake by plant roots (Cheng et al., 2009).

S1.4. Radical oxygen loss

All solutions were prepared under the N_2 gas chamber to minimize atmospheric oxygen ingress into solutions. Previously sluiced plant samples were inserted into 100 mL tubes and the plant roots were completely concealed under 80 mL deoxygenated nutrient solution. Afterwards, 10 mL deoxygenated

Ti^{3+}-citrate solution (TCS) was added in each glass tube by using a 10 mL syringe. After addition of the TCS into glass tubes, 2–3 cm of paraffin oil was added into the glass tubes to prevent the entrance of atmospheric oxygen. For each wet and dried-rewetted sediment treatments, 25 glass tubes were prepared including 5 tubes per species (making a total of 20), and 5 tubes without plants used as controls. Each glass tube had one healthy plant and these glass tubes with plants and without plants were incubated for six hours at 25°C under 1500 K lx light intensity in a covered box full with N_2 gas. Subsequent to six hours, all glass tubes were gently shaken and the sample inside each glass tube was extracted by using a plastic syringe attached with rubber tube. Absorbance of the oxidized TCS was measured by UV-visible spectrophotometer (UV-752, Shanghai Yuefeng, China) at the wavelength of 527 nm.

S1.5. Root porosity

Previously washed root samples (around 10 cm) were blotted on the tissue papers to remove attached water or moisture content. Then cut into small segments (0.5–0.6 g), and these segments were used for determination of the root porosity. Particular segments were immersed into distilled water and recorded their weight (Wa). Subsequently, these root segments were placed into tap water and vacuumed (dried) for 5–7 minutes, and this procedure was repeated approximately 4 to 5 times. Lastly, root segments were immersed again into distilled water and recorded their weight (Wb).

S1.6. Fe-plaque formation

Fresh roots of the experimental plants were washed and cleaned with deionized water to remove adherent materials, and immersed into extraction solution at 25 °C for 3 h. Extraction solution was prepared by the addition of 5 mL (1.0 M) sodium bicarbonate ($NaHCO_3$), 40 mL (0.3 M) tri-sodium citrate ($Na_3C_6H_5O_7$), and 3 g of sodium dithionite ($Na_2S_2O_4$). Anoxic condition of extraction solution was maintained by adding the dithionite after every one hour. Subsequent to 3 hours, root samples were washed with 15 mL distilled water and merged to the DCB extract. Further, added deionized water in this extract to make up 100 mL extract solution for analysis. This extract was digested in a combined solution of H_2SO_4 and H_2O_2 (80/20, volume/volume) at 360 °C. Amount of Fe in the digest was analysed by ICP-AES (Leeman Labs, Profile DV) (Mei et al., 2014).

S1.7. Root activity

Root samples of each plant species were washed with deionized water, cut into small segments around 1–2 cm and mixed randomly. After removal of the adherent water from roots by using tissue papers, 1–2 g of the root sample was weighed into a 100 mL conical flask with 50 mL (20 ppm) α-naphthylamine (α-N) solution. All these flasks were incubated at 25 °C for 2 h with continuous shaking. 2 mL α-N solution was drawn during pre and post incubation and added into a 20 mL graduated test tube. Subsequently, 1 mL of sulphanilic acid ($C_6H_7NO_3S$) (1%) and 1 mL of sodium nitrite ($NaNO_2$) (100 ppm) were added, and this solution was prepared up to 20 mL with distilled water. Subsequently following 50–60 minutes, the absorbance of oxidized α-naphthylamine was determined by a UV-visible spectrophotometer (UV-752, Shanghai Yuefeng, China) at a wavelength of 510 nm.

S1.8. Sediment characteristic analysis

The ring filled with sediment and dried at 105 °C until to attain a steady mass. The sediment p is the ratio of wet mass by sediment to ring volume. Sediment MC is the ratio of water lost by sediment to wet mass of sediment. Sediment ϕ is the ratio of lost water by sediment volume to ring volume. The pp of sediment was calculated using the equation: $pp = (-p/\phi - 1)$; where pp is the particle density (g/cm^3) of the sediment, p is the bulk density of the sediments (g/cm^3), and ϕ is the porosity of the sediment (%). Loss on ignition (LOI) was calculated on the basis of weight lost in furnace after heating the dry sediment at 550 °C for 6 h.

S.1.9. Correlations among nutrient removal, root functional traits and biogeochemical factors

According to PCA the first two principle components, including first principle component analysis (PCA-1) and second principle component analysis (PCA-2) were comprised with eigenvalues > 1. The PCA-1 and PCA-2 cumulatively rendered 96.2% variation in the data set. The PCA-1 and PCA-2 cumulatively rendered 96.2% variation in the data set. The PCA-1 had higher positive loadings for Fe plaque formation (Fe-PF) followed by DO, total phosphate removal percentages from sediment (TP-RS), total nitrogen removal percentages from sediment (TN-RS), ROL, root porosity (RP), root activity (RA), total nitrogen removal percentages from pore water (TN-RW), total phosphate removal percentages from pore water (TP-RW), DOC, root surface area (RSA) and ORP, while negatively correlated with EC and pH (Fig. 6 and Table S2). The PCA-2 was positively correlated with ORP followed by RSA, pH, RP, TN-RS, RA, TP-RS, ROL and EC, but negatively correlated with DOC followed by TN-RW, TP-RW, DO and Fe-PF, respectively.

The PCA-1 represented Fe-PF, RSA, RP, RA, ROL, DO, ORP, DOC, TN-RS, TP-RS, TN-RW and TN-RW along the horizontal distribution. Whereas, the horizontal distribution along PCA-2 showed pH and EC of the experimental treatments. Eigenvectors for macronutrients removal percentages from interstitial water and sediment, root functional traits, and biogeochemical variables of interstitial water were integrated in PCA-1 and PCA-2 (diverse color arrows). The mean factor loadings for each treatment (different colour symbols) displayed the most important controlling environmental factors for each treatment. It was recorded that the ORP (brown arrow), RSA (purple arrow), RP, TN-RS, RA, TP-RS and ROL (all represented in one black arrow), Fe-PF and DO (both represented in one blue arrow), TP-RW, TN-RW and DOC (all represented in one green arrow) fell closely on PCA or treatments, and they were positively correlated with each other in the treatments and PCA. Whereas, EC (dark green arrow) and pH (red arrow) were negatively correlated with ROL, RSA, RP, RA, Fe-PF, TN-RS, TP-RS, TN-RW and TP-RW on the same PCA-1. These positive correlations among

PCA variables showed that the RSA, RP, RA, ROL, Fe-PF, DO, ORP, and removal of TN-RS, TP-RS, TN-RW, TP-RW and DOC increased along with plants growth in treatments. Whereas, negative relationships among PCA variables displayed that the pH and EC decreased along with plants growth in the treatments.

Glossary

AM: Arbuscular mycorrhizal

CE: Chinese evergreen

CT: Chinese taro

DSIS: Dry-rewetted sediment planted with Indian shot

DSSF: Dry-rewetted sediment planted with Sweet flag

DSCT: Dry-rewetted sediment planted with Chinese taro

DSCE: Dry-rewetted sediment planted with Chinese evergreen

DSC: Dry-rewetted sediment without plantation as control

DSTs: Dry sediment treatments

DOC: Dissolved organic carbon

DO: Dissolved oxygen

D.W: Dry weight

EC: Electric conductivity

Fe-PF: Iron-plaque formation

FRPs: Fibrous-root plants

F.W: Fresh weight

IS: Indian shot

LOI: Loss on ignition

MC: Moisture content

ORP: Oxidation-reduction potential

pp: Sediment particle size density

p: Sediment bulk density

RA: Root activity

RB: Root biomass

RD: Root diameter

RGR: Relative growth rate

RL: Root length

ROL: Radial oxygen loss

RP: Root porosity

RSA: Root surface area

R/S: Root/shoot

SB: Shoot biomass

SL: Shoot length

TB: Total biomass

TP-RS: Total phosphate removal percentages from sediment

TN-RS: Total nitrogen removal percentages from sediment

TP-RW: Total phosphate removal percentages from pore water

TN-RW: Total nitrogen removal percentages from pore water

TRPs: Thick-root plants

WSIS: Constantly wet sediment planted with Indian shot

WSSF: Constantly wet sediment planted with Sweet flag

WSCT: Constantly wet sediment planted with Chinese taro

WSCE: Constantly wet sediment planted with Chinese evergreen

WSC: Constantly wet sediment without plantation as control

WSTs: Wet sediment treatments