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Fungal Denitrification Activity in Vertical Flow Constructed Wetlands as Impacted by Plant Species Richness, Carbon, Nitrogen and pH Amendments

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R : 9 F 2017 / A : 2 N 2017 / P : 7 N 2017
S S +B Ha .52 .0T2 T.07 Tw6 TT.52 8.52 821.52 8.52 8.52 8.52 8.52 8.52 TJ(.52wT .5(- .5( ).52 8.5( )825 8.5(, 8.52TJ(.52
U , J 318000, C

[2] S L S , T U ,
J 318000, C

[3] C L S , U ,
Ha 310058, C

. 2011). I ( ) C (. 2011; C . 2014). H w C .

P w H, C, N C (F w . 2009). A , H - C N (. 2011). I - w C, N H C ; w w .

T (PFDR) 30 w w (FS) w (, -), w C, N H . E w w (1) PFDR; (2) C, N H FS ; (3) w - .

Materials and Methods

T FS w T U (121 21 E, 28 34 N) P . T FS w 1.2 ( ) 0.45 ( ) 0.45 (w). T - w 0.24 [3] w w 50 (: 1 2), 30 (: 4 6), 30 (- : 50 85). w w - H (L . 2015).

P FS w w L . (2015). B , C (*Iris pseudacorus, Canna glauca, Scirpus validus* *Cyperus alternifolius*) w FS w- : (UNP); w (MONO); - (MI). E FS (= 5, 5 w) w w (. 2011). T MONO w

, 20 FS , w MI 5 FS . 20 20 - . FS w w (0.2 [3] [1]) (10) (L . 2015). T w M A 2013.

A A 2013, - FS w w 30 , L . (2015) w 30 w - FSM . S - FSM w w w (2) . A w 4 C PFDR.

C , w w (H . 2012). T , . . w 2.8 [1] w (w) - (w), 2.0 [1] w H . (2012). T PFDR w N_2O w N_2O w .

Tw w . C w N_2O w - C (GL), (SS), (SC), (ME), (ET), (GL) (SA), w w (10 N [1] w, C S 1998). T C w 5 C [1] w. S , N (AA), (AC), (SNI) (SNA) w N_2O , T N w 10 N [1] w, N w w GL (5 C [1] w, S D L 2010). A , (UNA) - w . T H w w H = 2.8, 5.6 8.4 1.0 L [1] HC NaOH , w HC NaOH (UNA) w . A w , w w 500 µL 100 L [1] 10 (H . 2012). A w .

A w -w ANO A w (10% /). S - w 10 . S w 20 C 8 , w , w (H . 2012) - (50 L, D G P , D , N C). N_2O w (GC-14B, K , J) w ^{63}N (ECD) 80/100 P Q (3) - (95% 5%) (w 40 L $^{-1}$). C w 65 300 C, . F , N_2O w $^{-1}$ w ($^{-1}$) (L . 2015).

S w PFDR w w -w ANO A w . H (HSD) T $p=0.05$. T w SPSS w (11.5).

Results and Discussion

U , C - FS w UNA F . 1 ($p<0.05$), T 1 . A C , SC GL PFDR UNP , GL SS PFDR MONO . C , SC PFDR MI (F . 1). U C , w - PFDR w ($p>0.05$, F . 1; T 1). A ,

Table 1 Tw -w ANO A

F	T III	.	F	S .
C (A)	48.31	7	16.85	<0.01
S (B)	0.04	2	0.05	0.96
A B	2.37	14	0.41	0.97
N (A)	116.81	4	33.32	<0.01
S (B)	4.55	2	2.60	0.08
A B	10.21	8	1.46	0.18
H (A)	0.38	3	1.37	=0.05
S (B)	0.15	2	0.84	0.78
A B	0.36	6	1.66	<0.05

PFDR w w -w ANO A ($p>0.05$, T 1).

I w C , - C , w (F w . 2009). S C , . I , C , PDFR FS w UNA, w C - . E , (H . 2014). B . (2006) 40% C . C w UNA, N PFDR FS F . 2 ($p<0.05$), T 1 . A N , SNI PFDR (F . 2) . P w

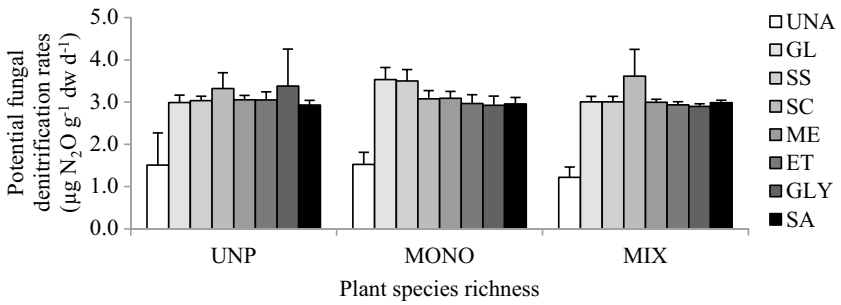

Fig. 1 M SD *ME* , *ET* , *GLY* , *SA* , *UNP* , *GL* , *SS* , *SC* , *UNA* , *MONO* , *MIX* - - . S $p=0.05$

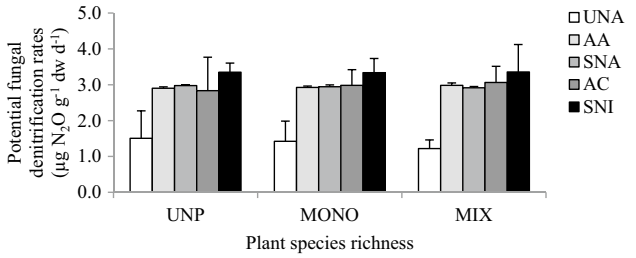

Fig. 2 M ⁄ SD ⁄ ⁄ ⁄ ⁄ ⁄ - ⁄ ⁄ ⁄ ⁄ ⁄ . *AA* ⁄ ⁄ ⁄ , *SNA* ⁄ , *AC* ⁄ ⁄ , *SNI* , ⁄ ⁄ ⁄ ⁄

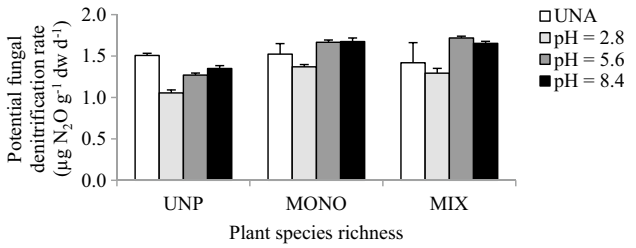

Fig. 3 M ⁄ SD ⁄ ⁄ ⁄ ⁄ ⁄ ⁄ ⁄ ⁄ H ⁄ , ⁄ ⁄ ⁄ ⁄

⁄ PFDR ⁄ N- ⁄ ⁄ ($p > 0.05$, T⁄ 1).

McL⁄ ⁄ M⁄ (2006) ⁄ ⁄ ⁄ ⁄ ⁄ N (, , ⁄ ⁄ ⁄) ⁄ ⁄ ⁄N (NH_4^+, NO_3^- ⁄ NO_2^-) ⁄ ⁄, ⁄ ⁄ NO_2^- N_2O ⁄ ⁄ ⁄ w N ⁄ - . I , N ⁄ ⁄ ⁄ PFDR ⁄ ⁄ ⁄ w ⁄ , ⁄ w ⁄ ⁄ N ⁄ ⁄ ⁄ ⁄ - ⁄ ⁄ (McL⁄ ⁄ M⁄ 2006). A N ⁄ , SNI ⁄ ⁄ PFDR FS . S ⁄. (1991) *Fusarium oxysporum* ⁄ *Gibberella fujikuroi* w ⁄ ⁄ NO_3^- ⁄ NO_2^- N_2O ⁄ ⁄ ⁄ , w ⁄ NO_2^- N_2O. T ⁄ w⁄ ⁄ ⁄ ⁄ w⁄ SNI, ⁄ w - ⁄ ⁄ w⁄ ⁄ ⁄ ⁄ NO_3^- NO_2^- (S ⁄ D L⁄ 2010). I ⁄ , UNA ⁄ ⁄ ⁄ H ⁄ 6.00 6.89. C ⁄ w H- ⁄ ⁄ - , H⁄ (H = 2.8, 5.6 ⁄ 8.4) ⁄⁄ ⁄ PFDR UNP ⁄ ($p = 0.05$, F . 3). T w⁄ ⁄ ⁄ H+ w H+ PFDR ⁄ w ⁄ , ⁄ ⁄. (2010) w ⁄ ⁄ ⁄ ⁄ w ⁄ H . C ⁄ w H 2.8 ⁄ , 5.6 ⁄ 8.4 H ⁄ - ⁄⁄ ⁄ ⁄ PFDR UNP, MONO ⁄ MI ⁄ , ⁄⁄ ⁄ ⁄ ⁄ w ⁄ ⁄⁄ ⁄⁄ ⁄ - ⁄⁄ ⁄⁄ w H ⁄ ⁄ ⁄ ($p < 0.05$, T⁄ 1). T ⁄ ⁄ ⁄ w ⁄ ⁄⁄ ⁄ PFDR ⁄ H ⁄ ($p > 0.05$, T⁄ 1). ⁄ ⁄ ⁄ - ⁄ ⁄ ⁄ w . B⁄ ⁄. (2010) ⁄ ⁄. (2010) ⁄ ⁄ - ⁄ ⁄ 24- ⁄ ⁄ 10- H-⁄ - ⁄ w ⁄ H w⁄ ⁄ ⁄ . I , H w⁄ ⁄⁄ ⁄⁄ ⁄⁄ , ⁄ ⁄ H w⁄ ⁄ H ⁄ - . O ⁄ , ⁄⁄ ⁄⁄ w H ⁄ - ⁄ ⁄ ⁄ ⁄ ⁄⁄ ⁄ ⁄ PFDR ($p < 0.05$, F . 3; T⁄ 1). T w⁄ ⁄ ⁄ H ⁄ ⁄ , ⁄ ⁄ ⁄ ⁄ ⁄⁄ ⁄ ⁄ H (⁄ ⁄. 2012) ⁄ ⁄ ⁄ ⁄ H (M⁄ ⁄ ⁄ R 1983).

P ⁄ ⁄ ⁄⁄ ⁄ w⁄ ⁄ - ⁄ ⁄ ⁄ ⁄⁄ - ⁄ ⁄ ⁄ ⁄ - ⁄ ⁄ w C ⁄ , N ⁄ - ⁄ H . A C⁄ , GL⁄ SS ⁄ ⁄ PFDR , w⁄ ⁄ ⁄ ⁄ . A N ⁄ , SNI ⁄ ⁄ ⁄ PFDR, ⁄ ⁄ ⁄ ⁄ ⁄ . H w , H ⁄ ⁄ ⁄ PFDR ⁄⁄ ⁄ ⁄ ⁄ ⁄ ⁄ . P ⁄ ⁄ ⁄ ⁄⁄ ⁄ ⁄ PFDR . T ⁄ - ⁄ PFDR ⁄ ⁄ ⁄ w C ⁄ N ⁄ ⁄ ⁄ H . R ⁄ ⁄ ⁄ ⁄ ⁄ N ⁄ FS , C, N, ⁄ H ⁄⁄ ⁄ w ⁄ ⁄ .

Acknowledgements T w w⁄ N⁄ ⁄ S⁄ ⁄ F ⁄ ⁄ P ⁄ (L 17D010001) ⁄ N⁄ ⁄ N⁄ ⁄ S⁄ ⁄ F ⁄ C ⁄(51279121).

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