

Table S1. Residue properties of winter crops before rice season in 2019

Rotation	Components	Residue DM ¹ (kg m ⁻²)	Residue N (g m ⁻²)	Residue C (g m ⁻²)	C/N ratio	N (%)	C (%)
RP ²	Rice straw	2.09	27.7	708.8		1.3	33.9
	Roots, straw	0.09	1.8	25.2		2.0	28.1
	Total	2.18a ⁵	29.4a	734.0a	27.9		
RW ³	Roots	0.10	0.6	17.2		0.7	17.4
	Straw	0.39	2.4	135.8		0.6	34.6
	Total	0.49b	3.1c	153.0b	50.1		
RC ⁴	Roots	0.04	0.9	10.8		2.1	26.5
	Straw	0.50	15.1	163.1		3.0	32.8
	Total	0.54b	16.0b	173.9b	10.9		

¹DM: dry matter;²RP: rice-potato with rice straw mulch;³RW: rice-wheat;⁴RC: rice-green manure (Chinese milk vetch).⁵Different lower letters in the same column indicate statistical significance at $P = 0.05$.

The same as below

Table S2. Rice biomass and grain yield in the last four years under rotations

Rotation	Biomass (g m ⁻²)				yield (t ha ⁻¹)			
	2016	2017	2018	2019	2016	2017	2018	2019
RF ¹	1539.5c	1811.9b	1543.5b	1411.3a	8.5b	9.8c	7.7c	7.7a
RP	1772.8a	1895.1a	1884.3a	1636.5a	10.0a	10.7a	8.8a	8.6a
RW	1675.6b	1698.4a	1821.2a	1322.4a	9.6a	9.9ab	8.3b	7.8a
RC	1756.6a	1832.6a	1867.9a	1651.5a	9.3ab	10.2b	8.5ab	8.5a

¹RF: Rice-fallow.

The same as below

Table S3. Percentage share of total soil C and N content in investigated layers in ratio total stock in 0-50 cm (%)

Soil depth (cm)	Rotation	SOC _D ¹	TN _D ²	AN _D ³
0–10	RF	25.9±2.6a	26.0±0.6a	25.4±1.6a
	RP	23.2±4.0a	22.2±1.6b	25.2±3.8a
	RW	23.5±2.2a	24.5±1.9ab	25.7±2.0a
	RC	22.3±2.4a	22.5±2.8ab	25.5±2.7a
10–20	RF	26.8±1.8a	28.1±2.6a	24.0±3.1b
	RP	23.8±1.2b	28.1±0.7a	28.1±1.9ab
	RW	26.1±1.3ab	28.6±1.3a	30.9±2.5a
	RC	24.4±0.6ab	25.9±1.1a	28.0±1.0ab
20–30	RF	30.6±3.9a	25.8±2.5a	26.3±1.3a
	RP	27.3±2.3ab	28.3±3.2a	24.7±4.0a

30–40	RW	23.9±3.0b	27.4±3.1a	24.5±4.1a
	RC	25.5±2.2ab	27.3±2.0a	26.0±2.3a
	RF	9.0±0.6c	9.1±1.0c	14.4±1.2a
	RP	20.6±3.7a	13.6±1.0b	15.7±1.8a
40–50	RW	14.1±1.3b	10.9±1.8c	14.1±1.8a
	RC	17.3±1.0ab	17.1±0.7a	13.5±1.0a
	RF	7.6±0.4c	11.0±1.4a	9.9±1.5a
	RP	5.1±0.2d	7.8±0.3b	6.3±0.8bc
	RW	12.4±1.6a	8.6±1.4b	4.8±0.5d
	RC	10.5±1.1b	7.2±0.2b	7.0±0.6b

¹SOC_D: Soil organic carbon density;

²TN_D: Total nitrogen density;

³AN_D: Available nitrogen density;

⁴Different lowercase letters represent the statistical significance at $P = 0.05$ among rotations within the same soil layer.

The same as below

Table S4. The stratification ratios of SOC, TN, and AN densities

	Rotation	SOC _D	TN _D	AN _D
SR _{10–20 cm}	RF	0.97±0.11a	0.93±0.09a	1.08±0.23a
	RP	0.98±0.22a	0.79±0.06a	0.90±0.18a
	RW	0.90±0.06a	0.86±0.11a	0.83±0.05a
	RC	0.91±0.09a	0.87±0.15a	0.92±0.13a
SR _{20–30 cm}	RF	0.86±0.20a	1.01±0.11a	0.97±0.11a
	RP	0.85±0.15a	0.79±0.13a	1.05±0.27a
	RW	1.00±0.23a	0.90±0.09a	1.08±0.25a
	RC	0.88±0.17a	0.84±0.17a	0.99±0.19a
SR _{30–40 cm}	RF	2.89±0.31a	2.87±0.27a	1.77±0.06a
	RP	1.18±0.43b	1.63±0.07b	1.63±0.40a
	RW	1.68±0.21b	2.30±0.57a	1.84±0.26a
	RC	1.29±0.15b	1.32±0.15b	1.90±0.26a
SR _{40–50 cm}	RF	3.38±0.20b	2.38±0.24a	2.59±0.24c
	RP	4.55±0.92a	2.83±0.18a	4.00±0.21b
	RW	1.92±0.31c	2.92±0.72a	5.39±0.84a
	RC	2.14±0.40c	3.14±0.45a	3.66±0.07b