

Table S1. Physicochemical properties and heavy metals of rice root zone soil under different treatments at different periods. Values are presented as Mean $\pm$ standard deviation. Different Letters indicate significant differences between samples at $p < 0.05$ using ANOVA test.

Treatment	Period	TN (g/kg)	NH ₄ ⁺ -N (mg/kg)	TP (g/kg)	Cu (mg/kg)	Zn (mg/kg)	Mn (mg/kg)	Pb (mg/kg)	Cd (mg/kg)
A	S1	1.85 $\pm$ 0.13a	19.07 $\pm$ 1.99de	0.98 $\pm$ 0.03a	149.67 $\pm$ 4.56a	274.25 $\pm$ 0.68ab	171.79 $\pm$ 3.09b	243.65 $\pm$ 7.49bc	1.05 $\pm$ 0.02ab
	S2	1.85 $\pm$ 0.00a	27.64 $\pm$ 0.22b	0.95 $\pm$ 0.06ab	146.84 $\pm$ 5.36ab	277.35 $\pm$ 3.78a	174.61 $\pm$ 5.52b	208.03 $\pm$ 10.79d	1.16 $\pm$ 0.04a
	S3	1.62 $\pm$ 0.02bcd	16.4 $\pm$ 0.94e	0.82 $\pm$ 0.06cd	135.64 $\pm$ 2.07cd	277.47 $\pm$ 3.87a	177.17 $\pm$ 9.17b	260.96 $\pm$ 2.52ab	1.17 $\pm$ 0.01a
	S4	1.60 $\pm$ 0.04bcd	8.64 $\pm$ 0.15f	0.82 $\pm$ 0.06cd	154.69 $\pm$ 2.53a	276.87 $\pm$ 3.29a	157.33 $\pm$ 7.75b	267.53 $\pm$ 1.71a	0.99 $\pm$ 0.06b
B	S1	1.71 $\pm$ 0.11ab	21.16 $\pm$ 0.74de	0.87 $\pm$ 0.06bc	140.82 $\pm$ 0.69bc	260.84 $\pm$ 1.54d	172.92 $\pm$ 5.01b	237.27 $\pm$ 2.87c	0.93 $\pm$ 0.01b
	S2	1.69 $\pm$ 0.06abc	26.37 $\pm$ 1.96bc	0.82 $\pm$ 0.09cd	131.81 $\pm$ 0.84d	271.65 $\pm$ 3.05abc	166.84 $\pm$ 3.27b	211.77 $\pm$ 14.01d	0.91 $\pm$ 0.02b
	S3	1.54 $\pm$ 0.03cd	10.16 $\pm$ 0.35f	0.69 $\pm$ 0.05e	115.03 $\pm$ 3.20e	263.51 $\pm$ 1.59cd	165.06 $\pm$ 6.28b	250.37 $\pm$ 5.00abc	0.92 $\pm$ 0.04b
	S4	1.53 $\pm$ 0.08cd	7.54 $\pm$ 0.97f	0.74 $\pm$ 0.03de	140.82 $\pm$ 3.99bc	264.35 $\pm$ 5.52bcd	153.84 $\pm$ 2.85b	269.10 $\pm$ 0.89a	0.89 $\pm$ 0.06b
CK	S1	1.27 $\pm$ 0.03e	22.24 $\pm$ 3.69cd	0.51 $\pm$ 0.05f	28.08 $\pm$ 1.09f	96.47 $\pm$ 1.14e	363.17 $\pm$ 11.07a	35.69 $\pm$ 1.92e	0.65 $\pm$ 0.08c
	S2	1.38 $\pm$ 0.03d	48.92 $\pm$ 2.49a	0.55 $\pm$ 0.04f	27.75 $\pm$ 0.54f	97.29 $\pm$ 1.10e	378.51 $\pm$ 15.87a	30.71 $\pm$ 1.53e	0.68 $\pm$ 0.01c
	S3	1.18 $\pm$ 0.04e	10.77 $\pm$ 0.27f	0.58 $\pm$ 0.06f	26.35 $\pm$ 1.03f	99.19 $\pm$ 2.64e	367.14 $\pm$ 5.72a	33.72 $\pm$ 1.30e	0.66 $\pm$ 0.04c
	S4	1.14 $\pm$ 0.01e	8.54 $\pm$ 0.59f	0.59 $\pm$ 0.05f	27.50 $\pm$ 0.32f	96.98 $\pm$ 5.64e	360.20 $\pm$ 13.57a	32.05 $\pm$ 2.02e	0.66 $\pm$ 0.12c