

Appendix A

Soil properties under different amounts of straw substitution in rice production (for the years 2016 to 2018)

Years	Treatment ¹⁾	Available N (mg kg ⁻¹)	Available P (mg kg ⁻¹)	Available K (mg kg ⁻¹)	pH	Organic C (g kg ⁻¹)
2016	CT	139.4±3.5 c	6.1±0.4 d	104.3±8.7 d	7.76±0.01 a	17.0±0.7 b
	NPK	150.5±2.8 b	8.5±2.0 c	109.0±9.8 d	7.73±0.03 a	17.3±0.1 ab
	LNPKS	158.0±8.1 b	15.3±0.7 b	130.7±1.5 c	7.70±0.06 a	17.5±0.2 ab
	MNPKS	169.8±3.2 a	17.4±0.4 a	156.0±4.0 b	7.64±0.03 a	17.7±0.4 ab
	HNPKS	172.1±9.1 a	17.7±0.7 a	186.7±11.5 a	7.73±0.13 a	17.9±0.4 a
2017	CT	137.7±1.1 c	5.9±0.8 c	104.0±1.0 e	7.56±0.03 a	17.9±0.3 b
	NPK	174.1±9.6 b	10.5±0.5 b	119.7±5.5 d	7.51±0.08 a	18.0±0.1 b
	LNPKS	180.3±4.2 ab	16.9±0.9 a	143.3±7.5 c	7.40±0.27 a	18.2±0.2 b
	MNPKS	183.3±2.6 ab	17.3±0.3 a	175.0±5.0 b	7.46±0.10 a	18.7±0.2 a
	HNPKS	187.7±4.8 a	17.5±0.5 a	203.3±2.9 a	7.45±0.15 a	18.9±0.2 a
2018	CT	135.6±4.6 d	4.7±0.2 d	103.0±4.4 c	7.51±0.03 b	18.2±0.6 c
	NPK	163.6±5.3 c	13.6±0.4 c	113.3±17.5 c	7.60±0.05 ab	18.9±0.3 b
	LNPKS	170.1±3.6 bc	16.2±0.9 b	136.0±4.0 b	7.87±0.06 a	19.2±0.2 b
	MNPKS	172.7±2.4 b	17.0±0.5 b	151.0±5.0 b	7.65±0.27 ab	19.9±0.2 a
	HNPKS	183.8±3.5 a	18.7±0.5 a	189.3±7.5 a	7.44±0.18 b	20.1±0.2 a

¹⁾ CT, no fertilization; NPK, mineral N, P, and K fertilization; LNPKS, 2.5 t ha⁻¹ rice straw substitution plus mineral N, P, K; MNPKS, 5 t ha⁻¹ rice straw substitution plus mineral N, P, K; HNPKS, 7.5 t ha⁻¹ rice straw substitution plus mineral NPK.

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Different letters (a, b, c, d) within the same column indicate significant differences ($P<0.05$) among different fertilization treatments. The values are mean \pm standard deviation (SD) ($n=3$).

Appendix B

Rice yield components, grain yield, and straw yield under different amounts of straw substitution in rice production (for the years 2016 to 2018)

Years	Treatment ¹⁾	Effective panicle (10^4 ha^{-1})	Number of spikelets per panicle	Seed setting rate (%)	1000-grain weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
2016	CT	105.6 \pm 13.8 c	114.0 \pm 18.7 b	83.1 \pm 1.2 ab	23.8 \pm 0.4 b	2846.3 \pm 94.3 c	2820.0 \pm 240.0 e
	NPK	145.2 \pm 4.3 b	159.7 \pm 8.8 a	75.9 \pm 1.1 c	24.5 \pm 0.4 ab	5087.3 \pm 13.3 b	4860.0 \pm 40.0 d
	LNPKS	153.2 \pm 12.9 ab	168.6 \pm 22.0 a	81.6 \pm 3.6 ab	24.8 \pm 0.4 a	6701.9 \pm 444.0 a	6180.0 \pm 120.0 b
	MNPKS	169.2 \pm 7.2 a	172.9 \pm 2.1 a	84.8 \pm 2.0 a	25.2 \pm 0.8 a	6904.1 \pm 891.5 a	6900.0 \pm 360.0 a
	HNPKS	150.0 \pm 10.8 ab	165.7 \pm 4.0 a	80.0 \pm 2.6 bc	24.7 \pm 0.4 ab	5469.6 \pm 44.7 b	5560.0 \pm 385.7 c
2017	CT	94.8 \pm 6.0 c	143.3 \pm 8.3 b	89.1 \pm 0.7 a	24.7 \pm 0.3 c	2932.7 \pm 68.6 c	4200.0 \pm 720.0 b
	NPK	147.6 \pm 3.2 b	211.9 \pm 0.8 a	84.3 \pm 1.8 d	25.5 \pm 0.3 b	6358.6 \pm 291.7 b	7380.0 \pm 60.0 a
	LNPKS	162.0 \pm 2.4 a	216.8 \pm 1.6 a	86.8 \pm 1.1 bc	25.8 \pm 0.2 ab	6557.3 \pm 296.6 b	7920.0 \pm 840.0 a
	MNPKS	169.2 \pm 7.2 a	222.0 \pm 6.2 a	87.5 \pm 0.6 ab	26.0 \pm 0.0 a	7961.5 \pm 460.8 a	8240.0 \pm 733.2 a
	HNPKS	149.6 \pm 5.4 b	214.5 \pm 7.6 a	85.1 \pm 0.2 cd	25.6 \pm 0.2 ab	6470.9 \pm 76.5 b	7666.3 \pm 169.5 a
2018	CT	144.4 \pm 8.7 d	118.5 \pm 7.8 b	87.5 \pm 0.7 c	21.3 \pm 0.1 d	3019.1 \pm 63.1 c	4960.0 \pm 249.8 c
	NPK	172.8 \pm 14.4 c	177.2 \pm 7.3 a	86.0 \pm 0.6 d	22.5 \pm 0.0 c	6785.4 \pm 599.6 b	7020.0 \pm 480.0 b
	LNPKS	190.4 \pm 1.8 ab	182.7 \pm 4.3 a	92.3 \pm 0.8 a	22.9 \pm 0.1 b	7324.8 \pm 322.8 ab	7346.7 \pm 204.3 b
	MNPKS	199.2 \pm 5.2 a	184.5 \pm 6.4 a	93.1 \pm 0.1 a	23.1 \pm 0.1 a	7664.6 \pm 282.4 a	8120.0 \pm 91.7 a
	HNPKS	180.8 \pm 10.2 bc	179.8 \pm 13.5 a	91.2 \pm 0.6 b	22.7 \pm 0.1 c	7242.8 \pm 548.9 ab	7120.0 \pm 674.4 b

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¹⁾ CT, no fertilization; NPK, mineral N, P, and K fertilization; LNPKS, 2.5 t ha⁻¹ rice straw substitution plus mineral N, P, K; MNPKS, 5 t ha⁻¹ rice straw substitution plus mineral N, P, K; HNPKS, 7.5 t ha⁻¹ rice straw substitution plus mineral NPK.

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Appendix C

Aboveground uptake and use efficiency of N and P under different amounts of straw substitution in rice production (for the years 2016 to 2018)

Years	Treatment ¹⁾	N uptake (kg ha ⁻¹)			Nitrogen use efficiency (%)	P uptake (kg ha ⁻¹)			Phosphorus use efficiency (%)
		Grain	Straw	Aboveground		Grain	Straw	Aboveground	
2016	CT	33.6 \pm 0.7 c	17.8 \pm 1.4 b	51.4 \pm 0.9 c	-	5.3 \pm 0.2 d	3.5 \pm 0.3 b	8.8 \pm 0.1 d	-
	NPK	75.2 \pm 4.1 b	39.6 \pm 1.3 a	114.8 \pm 5.4 b	35.2 \pm 2.7 b	10.5 \pm 0.6 c	4.7 \pm 0.6 a	15.1 \pm 1.2 c	19.5 \pm 3.6 b
	LNPKS	90.8 \pm 5.8 a	45.7 \pm 6.9 a	136.4 \pm 4.5 a	47.2 \pm 2.0 a	12.3 \pm 0.5 ab	5.2 \pm 0.5 a	17.5 \pm 1.0 ab	26.7 \pm 3.3 ab
	MNPKS	95.9 \pm 13.7 a	43.5 \pm 2.1 a	139.3 \pm 15.4 a	48.8 \pm 8.3 a	13.9 \pm 1.6 a	4.9 \pm 0.5 a	18.7 \pm 1.8 a	30.5 \pm 5.9 a
	HNPKS	75.2 \pm 1.1 b	43.7 \pm 6.3 a	118.9 \pm 6.5 b	37.5 \pm 4.1 b	11.8 \pm 1.0 bc	4.8 \pm 0.7 a	16.6 \pm 0.4 bc	24.0 \pm 1.3 ab
2017	CT	36.4 \pm 1.5 c	21.2 \pm 1.2 b	57.6 \pm 2.2 c	-	5.7 \pm 0.3 c	5.5 \pm 1.0 b	11.2 \pm 1.1 c	-
	NPK	99.2 \pm 3.1 b	55.4 \pm 4.3 a	154.6 \pm 1.3 b	53.9 \pm 1.8 b	13.5 \pm 1.5 b	8.0 \pm 0.6 a	21.6 \pm 1.3 b	31.8 \pm 2.7 b
	LNPKS	100.9 \pm 5.4 b	59.4 \pm 8.6 a	160.4 \pm 8.1 b	57.1 \pm 4.1 b	14.8 \pm 1.1 b	8.6 \pm 1.6 a	23.5 \pm 1.4 b	37.6 \pm 4.4 ab
	MNPKS	115.8 \pm 8.8 a	58.0 \pm 9.6 a	173.8 \pm 7.5 a	64.6 \pm 3.2 a	17.0 \pm 0.1 a	8.9 \pm 0.7 a	25.9 \pm 0.8 a	45.0 \pm 4.3 a
	HNPKS	99.9 \pm 1.7 b	56.9 \pm 3.7 a	156.8 \pm 5.1 b	55.1 \pm 4.1 b	14.3 \pm 1.1 b	8.4 \pm 0.5 a	22.8 \pm 0.8 b	35.5 \pm 4.8 b
2018	CT	42.0 \pm 1.8 b	41.6 \pm 1.6 b	83.6 \pm 3.2 b	-	5.8 \pm 0.4 b	6.2 \pm 0.6 c	12.0 \pm 0.9 d	-
	NPK	105.8 \pm 12.7 a	71.2 \pm 3.9 a	177.1 \pm 14.9 a	51.9 \pm 10.0 a	13.5 \pm 1.2 a	7.6 \pm 0.4 bc	21.1 \pm 1.2 c	27.8 \pm 5.3 b
	LNPKS	112.1 \pm 6.6 a	76.3 \pm 8.8 a	188.4 \pm 15.3 a	58.2 \pm 9.1 a	14.7 \pm 0.9 a	8.8 \pm 1.2 ab	23.6 \pm 0.7 ab	35.4 \pm 4.0 ab

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MNPKS	116.9±2.1 a	80.1±2.1 a	197.1±4.2 a	63.0±4.1 a	14.6±0.4 a	10.1±1.2 a	24.7±1.6 a	39.0±5.3 a
HNPKS	110.1±9.6 a	71.9±7.3 a	182.1±16.8 a	54.7±9.1 a	14.3±1.2 a	8.2±0.4 b	22.5±0.8 bc	32.2±5.0 ab

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