

Table S1. Characterization details of two NPs

NPs	Size nm	Zeta potential mV	Mobility $\mu\text{mcm/Vs}$	Conductivity mS/cm
CuO	40	6.773	0.526	0.0121
ZnO	30	6.643	0.517	0.0104

Table S2. The physical and chemical properties of soil

Test indicators	Cu	Zn	P	Na	K	Ca	Mg	Al	Fe	pH
	mg/kg	mg/kg	mg/kg	g/kg	g/kg	g/kg	g/kg	g/kg	g/kg	
Results	44.5	80.5	533.3	12.5	22.8	22.1	12.3	67.1	35.3	7.9

Table S3. The primes used in this study

Gene Name	LOC No.	Forwad Primer Sequence (5'→3')	Reverse Primer Sequence (5'→3')
<i>TDC1</i>	<i>Os08g0140300</i>	GCGAGGGTGAAACCTTCCA	GCGAGCCGGTGGAGTCC
<i>T5H</i>	<i>Os12g0268000</i>	CCTCGTCCTGGACATCTTCGTC	ATGGCGAACCTCTTGATGAACAC
<i>SNAT1</i>	<i>Os05g0481000</i>	GGGCTGCGGCAACTTGGTCC	AGAAAGCTCGGTCTAAAATCTGGGGTAT
<i>SNAT2</i>	<i>Os08g0102000</i>	CATATGCAGATGCAGGCGGCG	CTCGAGGGAGGAGGTGTTTTG
<i>ASMT1</i>	<i>Os09g0344500</i>	CGCCAAGGCTCCCAGTAACAAC	TGATCGTGCGCACTACTGACTCCGGC
<i>COMT</i>	<i>Os08g0157500</i>	ACATATGGGTTCTACAGCCGC	GGGTACCCTACTTTGTGAACTCGA
<i>UBQ5</i>	<i>Os06g0650100</i>	CCGACTACAACATCCAGAAGGAG	AACAGGAGCCTACGCCTAAGC
<i>Cu/ZnSOD1</i>	<i>Os03g0351500</i>	ATCCTGATGATCTTGAAAGGG	AAAACACATAGTTCATTGGGCG
<i>Cu/ZnSOD2</i>	<i>Os07g0665200</i>	CTTAGCAAGACCACTGGAAATG	TGTTGAAAGTTGAGACGTCTA
<i>Cu/ZnSOD3</i>	<i>Os08g0561700</i>	CACCCTTTTTGTCATCTTCGAG	TTACTGTGAGACGAACGATCAA
<i>PRX11</i>	<i>Os01g0294700</i>	TACCGCGACCTCCTCAACTA	GAAGCCCGGCATGAACCT
<i>PRX65</i>	<i>Os05g0134400</i>	CTCCCGACTCCACCTTCA	GGAGCAGTGGCCGACG
<i>PRX89</i>	<i>Os06g0681600</i>	TTCACGACTGCTTCGTCAG	TCTCGACCACGCTCTTGATG
<i>CATA</i>	<i>Os02g0115700</i>	TCCAGTGTGATGAGTCGTTGG	TCTTCACATGCTTGCTTCACG
<i>CATB</i>	<i>Os06g0727200</i>	TCCTACTGGTCGCAGTGTGATG	TTTCAGGTTGAGACGTGAAGCC

Table S4. The total content of 17 amino acids in fresh rice leaves

Amino Acid	Mock	+ Mel	CuO NPs (1 g/kg)		ZnO NPs (1 g/kg)	
			Mock	+ Mel	Mock	+ Mel
Asp	3.43 ±0.14 a	3.37 ±0.21 a	2.49 ±0.10 d	2.90 ±0.17 c	2.88 ±0.17 c	3.39 ±0.15 b
Thr	1.82 ±0.11 a	1.84 ±0.18 a	0.93 ±0.10 d	1.26 ±0.11 c	1.12 ±0.09 c	1.43 ±0.08 b
Ser	1.42 ±0.20 a	1.44 ±0.10 a	0.73 ±0.10 d	0.91 ±0.06 c	0.86 ±0.08 bc	1.17 ±0.18 b
Glu	4.48 ±0.15 a	4.46 ±0.17 a	2.86 ±0.19 d	3.36 ±0.11 b	3.05 ±0.06 c	3.53 ±0.10 b
Gly	3.03 ±0.07 a	2.98 ±0.09 a	1.87 ±0.04 d	2.27 ±0.11 b	2.00 ±0.04 c	2.39 ±0.13 b
Ala	1.64 ±0.07 a	1.69 ±0.07 a	0.75 ±0.10 c	1.12 ±0.08 b	0.73 ±0.10 c	1.21 ±0.09 b
Cys	0.19 ±0.01 a	0.19 ±0.02 a	0.08 ±0.01 d	0.13 ±0.02 c	0.12 ±0.01 c	0.16 ±0.01 b
Val	1.33 ±0.06 a	1.34 ±0.14 a	0.68 ±0.04 c	0.93 ±0.12 b	0.71 ±0.07 c	1.00 ±0.06 b
Met	0.33 ±0.01 a	0.33 ±0.02 a	0.18 ±0.01 d	0.24 ±0.02 c	0.25 ±0.06 c	0.28 ±0.01 b
Ile	1.20 ±0.03 a	1.23 ±0.05 a	0.67 ±0.03 d	0.96 ±0.03 b	0.83 ±0.02 c	1.01 ±0.03 b
Leu	2.60 ±0.07 a	2.65 ±0.07 a	1.40 ±0.08 c	1.92 ±0.08 b	1.36 ±0.16 c	1.89 ±0.16 b
Tyr	1.02 ±0.04 a	1.01 ±0.05 a	0.49 ±0.04 c	0.70 ±0.05 b	0.55 ±0.10 c	0.73 ±0.11 b
Phe	1.32 ±0.08 a	1.45 ±0.11 a	0.77 ±0.10 c	1.06 ±0.05 b	0.82 ±0.04 c	1.04 ±0.05 b
Lys	1.72 ±0.14 a	1.78 ±0.05 a	0.88 ±0.09 c	1.38 ±0.05 b	0.83 ±0.15 c	1.26 ±0.14 b
His	0.73 ±0.12 a	0.79 ±0.08 a	0.34 ±0.05 c	0.54 ±0.03 b	0.36 ±0.10 c	0.57 ±0.06 b
Arg	2.39 ±0.19 a	2.39 ±0.18 a	1.36 ±0.17 c	1.81 ±0.06 b	1.43 ±0.09 c	1.73 ±0.11 b
Pro	1.21 ±0.04 a	1.24 ±0.14 a	0.69 ±0.05 c	1.01 ±0.06 b	0.73 ±0.12 c	0.97 ±0.05 b
Sum	29.85 ±0.87 a	30.18 ±0.58 a	17.17 ±0.89 c	22.50 ±0.82 b	18.63 ±0.47 c	23.74 ±0.55 b