Electronic Supplementary Information for

Fragmentation of nanoplastics driven by plant-microbe rhizosphere interaction during abiotic stress combination

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Contains supplementary tables 1-3 and supplementary figures 1-9.

Table S1. Physicochemical characteristics of the test soil used in this study

pH	EC ($ds \cdot m^{-1}$)	CEC ($cmol \cdot kg^{-1}$)	O.M. (%)	TOC (%)	T-N (%)	P ($mg \cdot kg^{-1}$)	K ($mg \cdot kg^{-1}$)	Ca ($mg \cdot kg^{-1}$)	Mg ($mg \cdot kg^{-1}$)	Fe ($mg \cdot kg^{-1}$)
6.4±0.6	1.99	14.98	2.15	1.25	0.120	49±10	53±10	50±10	44±10	6550 ±157

Table S2. Chemical names, abbreviation, molecular form and weight of styrene oligomers used in this study

	Abbreviation	Molecular formula	Molecular mass
Styrene monomer	Styrene	C_8H_8	104.15
1,3-diphenyl propane	SD-1	$C_{15}H_{16}$	196.29
2,4-diphenyl-1-butene	SD-2	$C_{16}H_{16}$	208.30
Trans-1,2-diphenyl cyclobutane	SD-4	$C_{16}H_{16}$	208.30
2,4,6-triphenyl-1-hexane	ST-1	$C_{24}H_{24}$	312.45
1a-phenyl-4e-(1'phenylethyl)tetralin	ST-3	$C_{24}H_{24}$	312.45

Table S3. List of carbon sources in the EcoPlate™

No	C-source	Group
1	Water	-
2	Pyruvic acid methyl ester	Carbohydrates
3	Tween 40	Polymers
4	Tween 80	Polymers
5	α-cyclodextrin	Polymers
6	Glycogen	Polymers
7	D-cellobiose	Carbohydrates
8	α-D-lactose	Carbohydrates
9	β-methyl-D-glucoside	Carbohydrates
10	D-xylose	Carbohydrates
11	i-erythritol	Carbohydrates
12	D-mannitol	Carbohydrates
13	N-acetyl-D-glucosamine	Carbohydrates
14	D-glucosaminic acid	Carboxylic & acetic acids
15	Glucose-1-phosphate	Carbohydrates
16	D,L-α-glycerol phosphate	Carbohydrates
17	D-galactonic acid-γ-lactone	Carboxylic & acetic acids
18	D-galacturonic acid	Carboxylic & acetic acids
19	2-Hydroxy benzoic acid	Carboxylic & acetic acids
20	4-Hydroxy benzoic acid	Carboxylic & acetic acids
21	γ-hydroxybutyric acid	Carboxylic & acetic acids
22	Itaconic acid	Carboxylic & acetic acids
23	α-ketobutyric acid	Carboxylic & acetic acids
24	D-malic acid	Carboxylic & acetic acids
25	L-arginine	Amino acids
26	L-asparagine	Amino acids
27	L-phenylalanine	Amino acids
28	L-serine	Amino acids
29	L-threonine	Amino acids
30	Glycyl-L-glutamic acid	Amino acids
31	Phenylethylamine	Amino acids
32	Putrescine	Amino acids

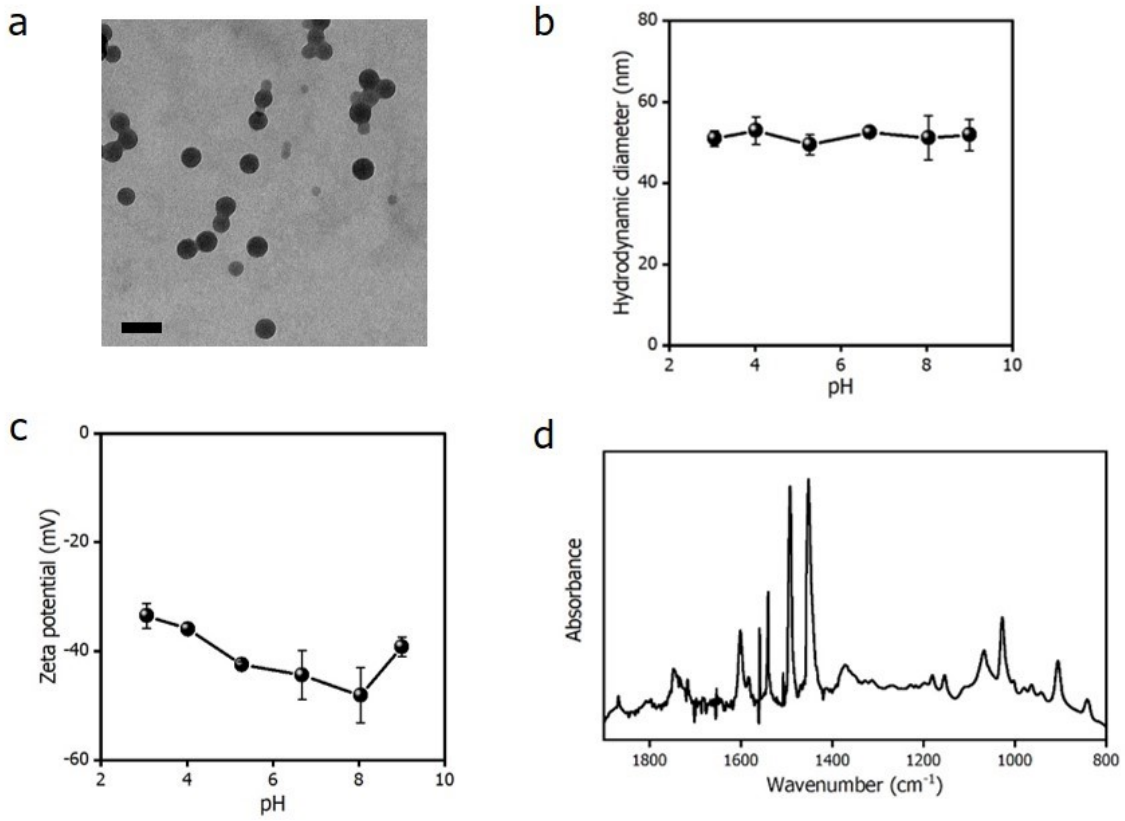

Fig. S1 PS NP characterization. (a) Representative TEM image (scale bar, 100 nm). (b) Hydrodynamic diameter and (c) zeta potential as a function of pH. (d) FTIR spectrum.

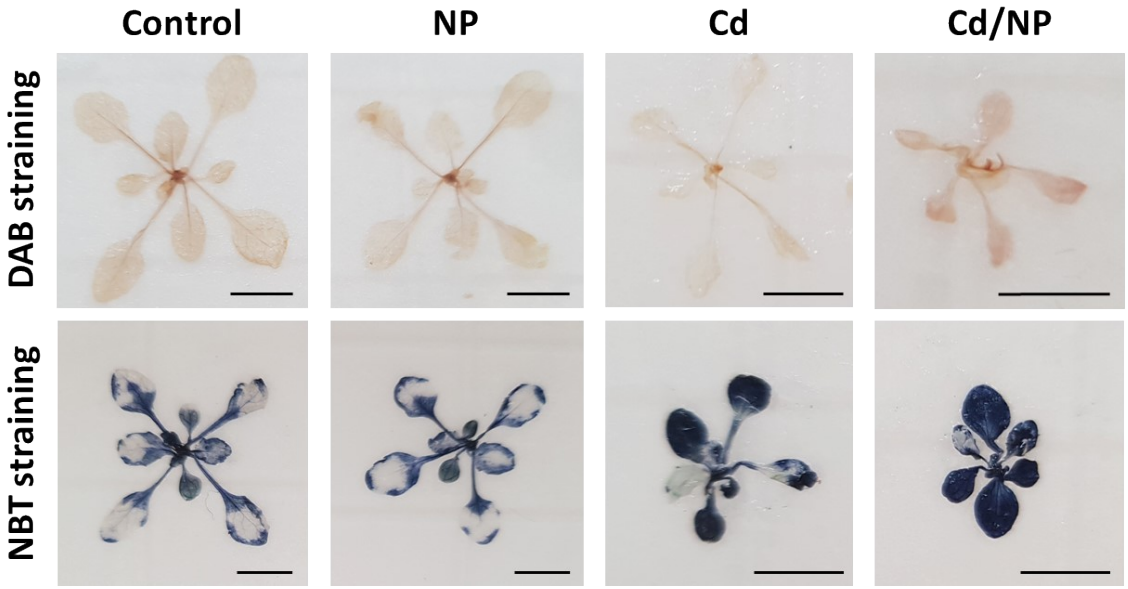

Fig. S2 Histochemical staining assay detecting H_2O_2 and $O_2^{\bullet-}$ with DAB and NBT in in whole (except roots) 21-day-old *A. thaliana* grown in half-strength MS media with NP, Cd or Cd/NP. Scale bars, 5 mm.

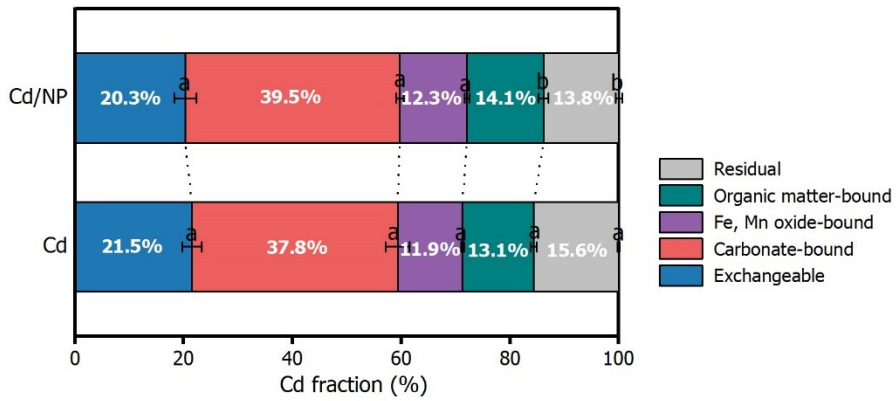

Fig. S3 Cd speciation as determined by sequential extraction. Significant differences are indicated by different letters ($P < 0.05$).

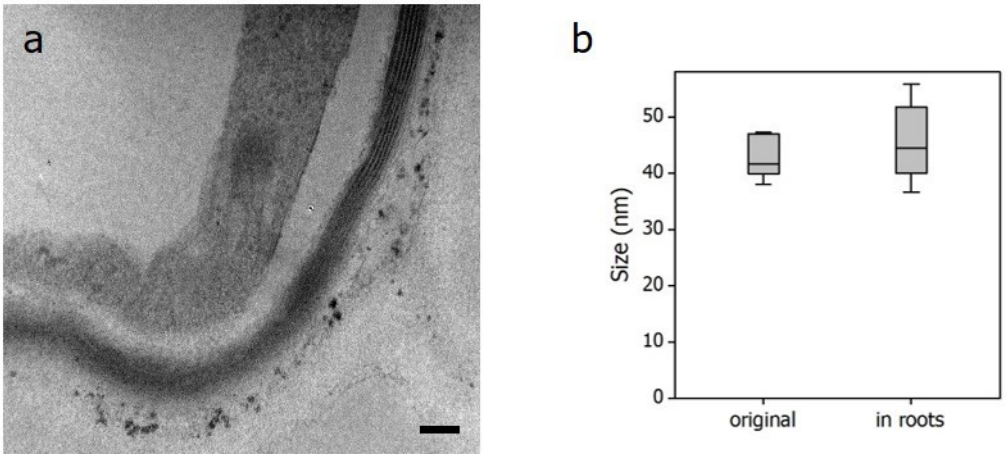

Fig. S4 (a) Representative TEM image (scale bar, 200 nm) of transverse sections of 21-day-old roots subjected to NP alone. (b) NP particle size in exposure stock suspension and roots subjected to NP alone. Averages and standard deviations are shown (n = 100).

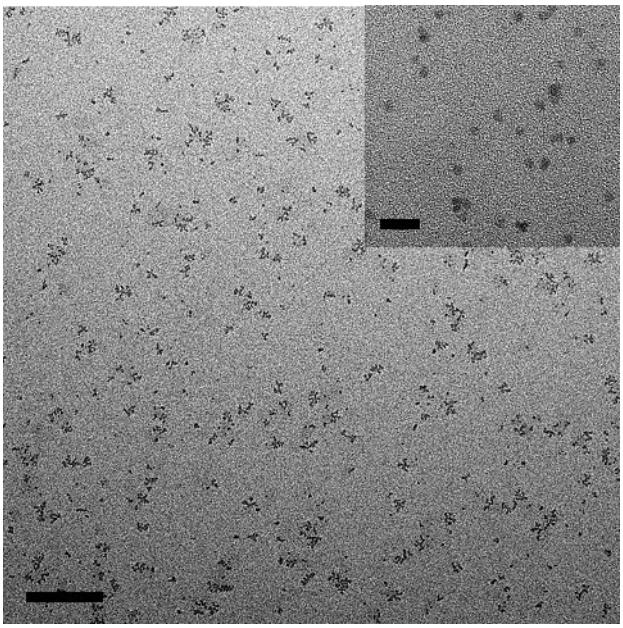

Fig. S5 Representative cryo-TEM image (scale bar, 100 nm) (inset: higher magnification, scale bar, 10 nm) of residual NPs in hydroponic media after 21-day-old plants were removed from the media.

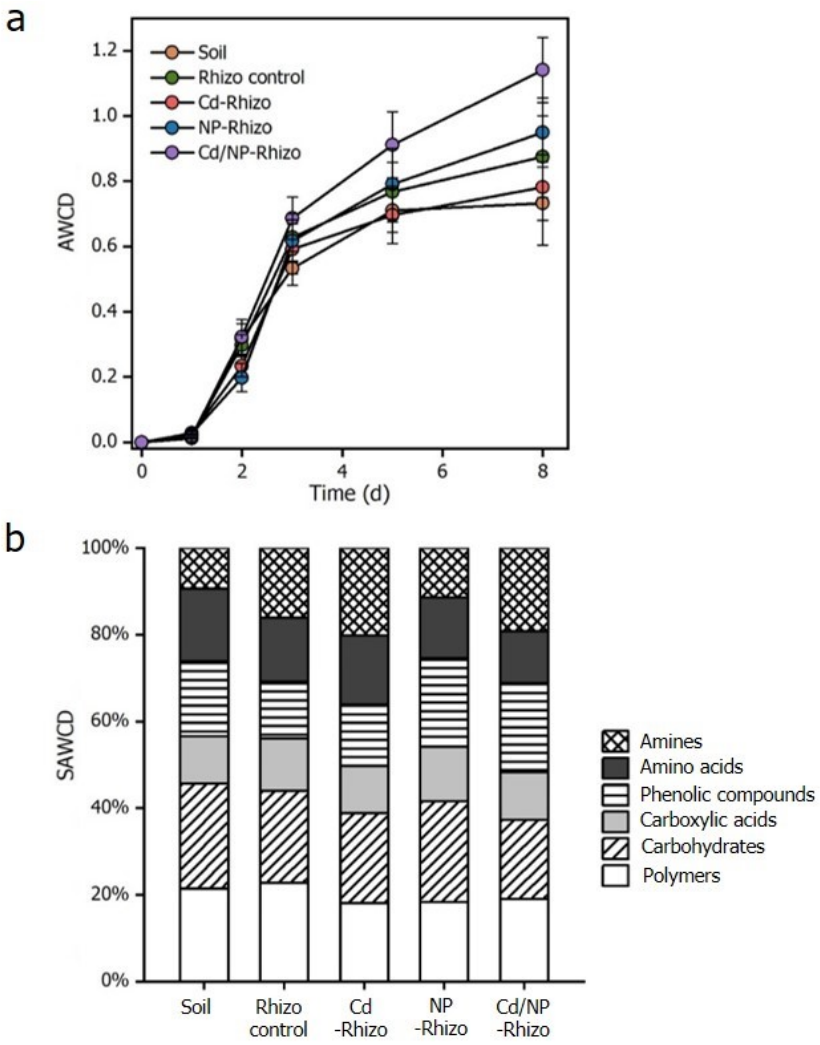

Fig. S6 Physiological profiling of rhizosphere bacterial communities by Biolog EcoPlate. (a) AWCD (means ± SD) for different treatments. (b) Relative ratio of utilized substrate (SAWCD) at 8 d.

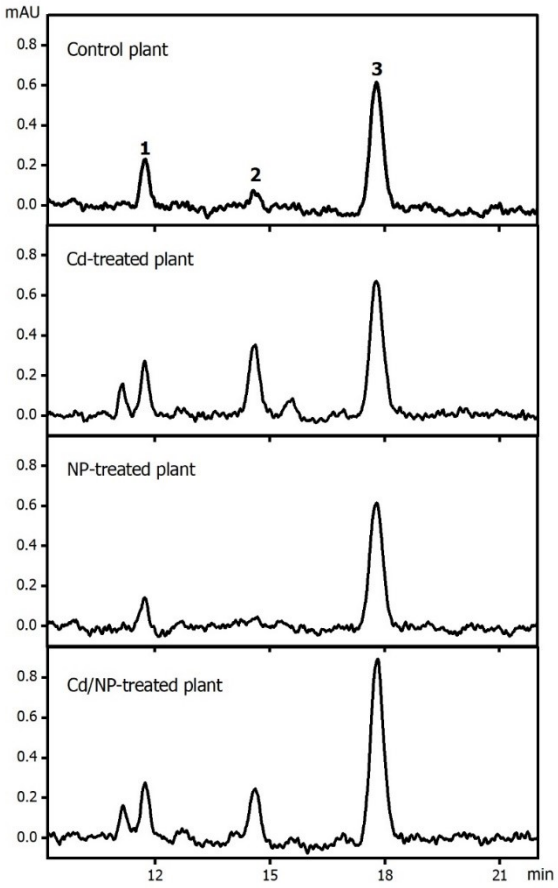

Fig. S7 HPLC chromatograms of root exudates from control and treated plants. The peaks are assigned to different organic acids: 1, malic acid; 2, succinic acid; 3, fumaric acid.

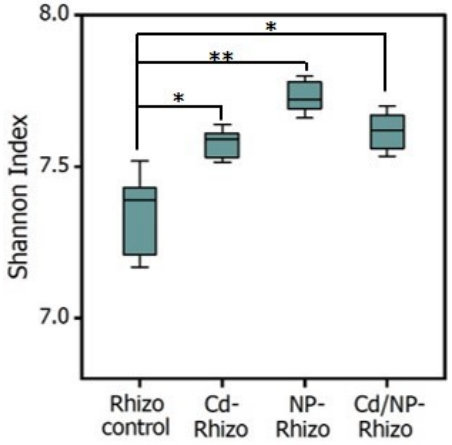

Fig. S8 Alpha diversity indices for control and treated rhizosphere samples. Averages and standard deviations are shown (n = 3). *$P < 0.05$, **$P < 0.005$.

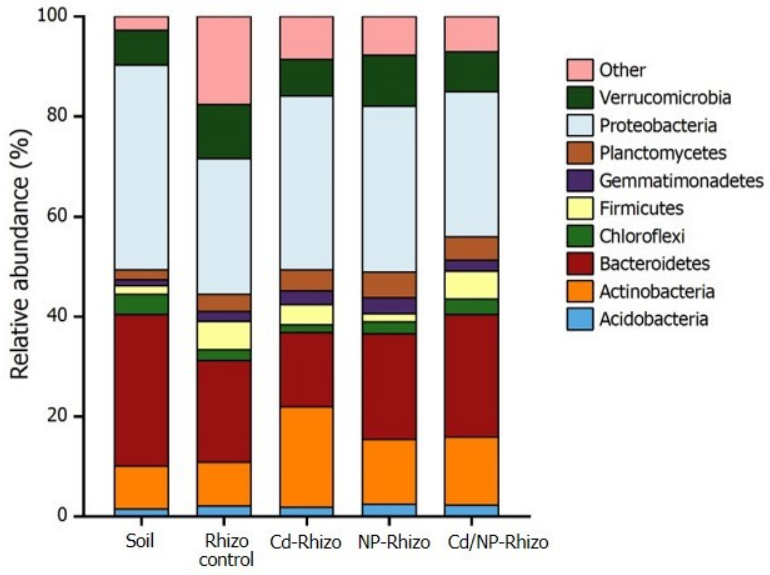

Fig. S9 Average relative abundance of the top 9 most abundant bacterial phyla in each root microbiome.