Supplementary Information

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Supplementary Table 1: ANOVA-Table of the phenotyping and root morphological traits under Cd exposure

**Chlorophyll content measured on the 21st day after germination (Chl 21_{DAG}), Shoot length (SL), Leaf area (LA), Plant height (PH), Relative water content (RWC), Fresh weight (FW), Dry weight (DW), Number of root tips (NRT), Root network area (NAR), Surface area of roots (SAR), Root length (RL), and Number of root tips (NRT)*

Variables	Chl_21DAG	SL (cm)	LA (cm^2)	PH (cm)	RWC	FW (mg)	DW (mg)	NRT	NAR (mm^2)	SAR (mm^2)	RL (cm)
Phenotypic and Root Morphological Traits											
SKD-1											
Control	31.87±0.87	35.6±1.35	10.44±0.11	96.46±8.49	74.59±3.26	430.93±59.78	40.47±7.6	20+5.89	68+30.68	1095.88+187.49	60.86+7.83
Cd (50mg/kg)	33.18±1.74	36±0.82	7.53±0.73	91.3±12.52	46.77±2.39	357.73±16.27	30.67±5.92	21+9.27	71.8+7.39	715.5+69.22	55.3+12.09
CdNP100	38.16±1.1	26.4±0.71	7.22±0.83	63.44±0.74	42.22±7.28	257.7±26.62	35.86±9.13	25.42+0.06	19.66+11.55	761.56+1.32	37.04+0.13
CdNP250	37.6±0.37	26.27±0.21	8.73±0.86	64.73±1.56	57.43±26.22	269.88±52.05	38.96±8.53	29.5+0.05	24.47+10.33	648+1.58	38.29+1.47
CdNP500	35.53±1.88	26.3±1.13	7.49±1.39	64.98±2.01	45.94±3.92	246.5±5.67	22.9±2.08	24.89+0.03	55.03+0.47	957.85+1.13	38.68+1.09
NP100	43.95±2.33	35.3±1.47	8.36±0.84	105.95±3.75	43.85±8.42	199.5±14.74	71.93±4.9	26.97+1.25	53.37+0.69	774.87+2.09	70.65+4.09
NP250	41.4±1.39	29±2.02	6.55±0.27	103.7±4.75	45.42±4.7	191.25±14.7	39±4.62	33.25+0.95	63.13+0.98	674.5+2.98	74.7+3.5
NP500	43.4±0.63	34.9±2.14	8.05±2.59	106.6±3.9	73.81±10.05	180±12.86	40.28±5.52	27.19+1.16	75.6+0.16	993.27+8.61	71.7+4.59
P*T	***	***	ns	***	*	***	***	ns	**	***	***
Borlaug-16											
Control	30.53±2.	36.4±0.9	10.18±1.	84.78±5.1	154.77±7.9	443.33±22.	45.51±4.8	21+11.9	59.28+8.1	1662.37+447.	48.38+4.2

	9	4	23	6	1	1	7		9	65	2
Cd (50mg/kg)	30.6±0.29	33.53±1.91	9.01±0.38	74.36±3	118.22±13.14	335.53±16.88	40.71±1.74	14.67+7.59	49.67+14.55	754.95+124.06	40.82+2.67
CdNP100	36.3±0.56	25.23±3.79	6.13±1.88	65.19±4.02	71.92±50.53	209.44±62.35	30.77±10.55	27.69+0.05	23.85+13.73	787.65+1.58	39.96+0.65
CdNP250	30.77±0.59	23.55±0.82	6.07±0.69	54.43±0.77	144.05±32.88	386.63±8.6	63.5±0.73	24.92+0.05	50.43+0.47	596.59+1.58	30.93+0.05
CdNP500	33.4±0.86	25.9±1.44	8.3±1.1	91.84±2.19	96.35±9.32	283.33±14.4	43.78±2.11	34.59+0.04	62.17+0.34	964.26+2.25	65.94+0.74
NP100	41.95±0.7	35.4±2.17	8.37±0.47	117.15±3.3	76.02±12.62	234±12.05	50.63±5.48	28.6+3.02	29.27+0.26	812.99+0.8	81.75+5.35
NP250	48.95±2.15	29.1±2.46	5.92±1.65	117.6±5.85	55.68±8.73	212.25±12.9	42±6.45	26.63+0.21	52.7+0.08	619.4+0.99	88.5+6.9
NP500	53.35±2.95	32.6±2.34	8.52±1.9	133.85±4.51	50.81±0.42	262.5±11.95	46.5±4.62	37.43+0.39	70.8+0.16	1005.5+0.36	101.25+6.62
P*T	***	***	*	***	**	***	**	*	***	***	***
P*Cv	ns	ns	ns	ns	***	*	ns	ns	ns	ns	*
ns=non-significant, *=p<0.05, **=p<0.01, ***=p<0.001, P*T= Probability between treatments, P*Cv= Probability between cultivars											

Supplementary Table 2: FTIR analysis of green synthesized MnO_2 NP

Peak Values (cm^{-1})	Strength	Functional Groups	Interpretations
1734.4	Strong	C=O stretching	Aldehyde
1363.56	Medium	O-H bending	Phenol
1216.36	Strong	C-O stretching	Vinyl Ether
518.4	Strong	C-Br	Halo Compound

Supplementary Table 3: Rietveld Refinement Parameters and Goodness of Fit for MnO_2 Nanoparticles (MnO_2NPs)

Parameters	**Values**
Crystallite size (Rietveld Refinement)	41 nm
RwpR_{wp}Rwp	109
RpR_{p}Rp	130
Goodness of fit	2.36
Chi^2	2.36
Bragg R-factor	11.71
RF-factor	6.902

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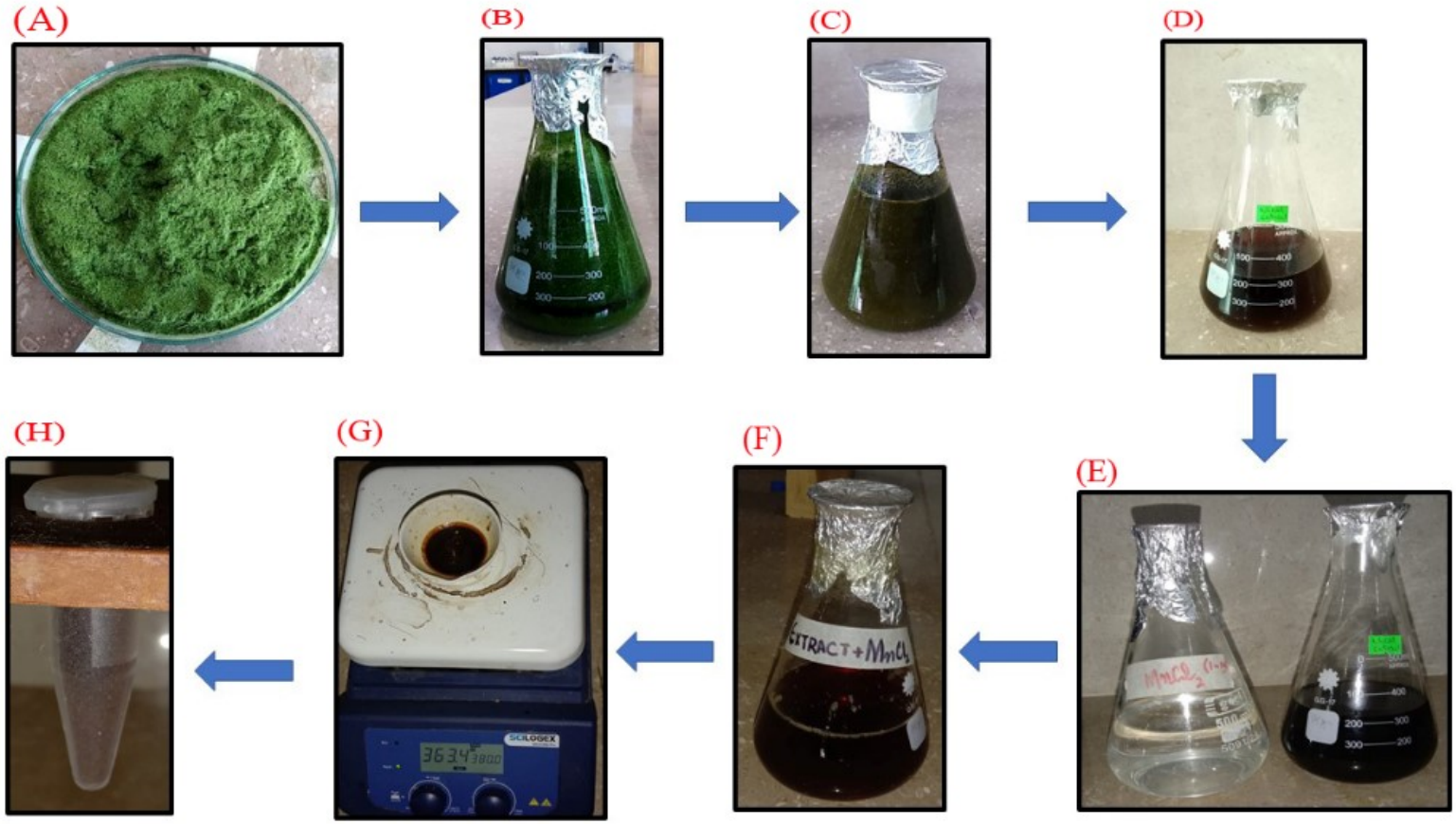
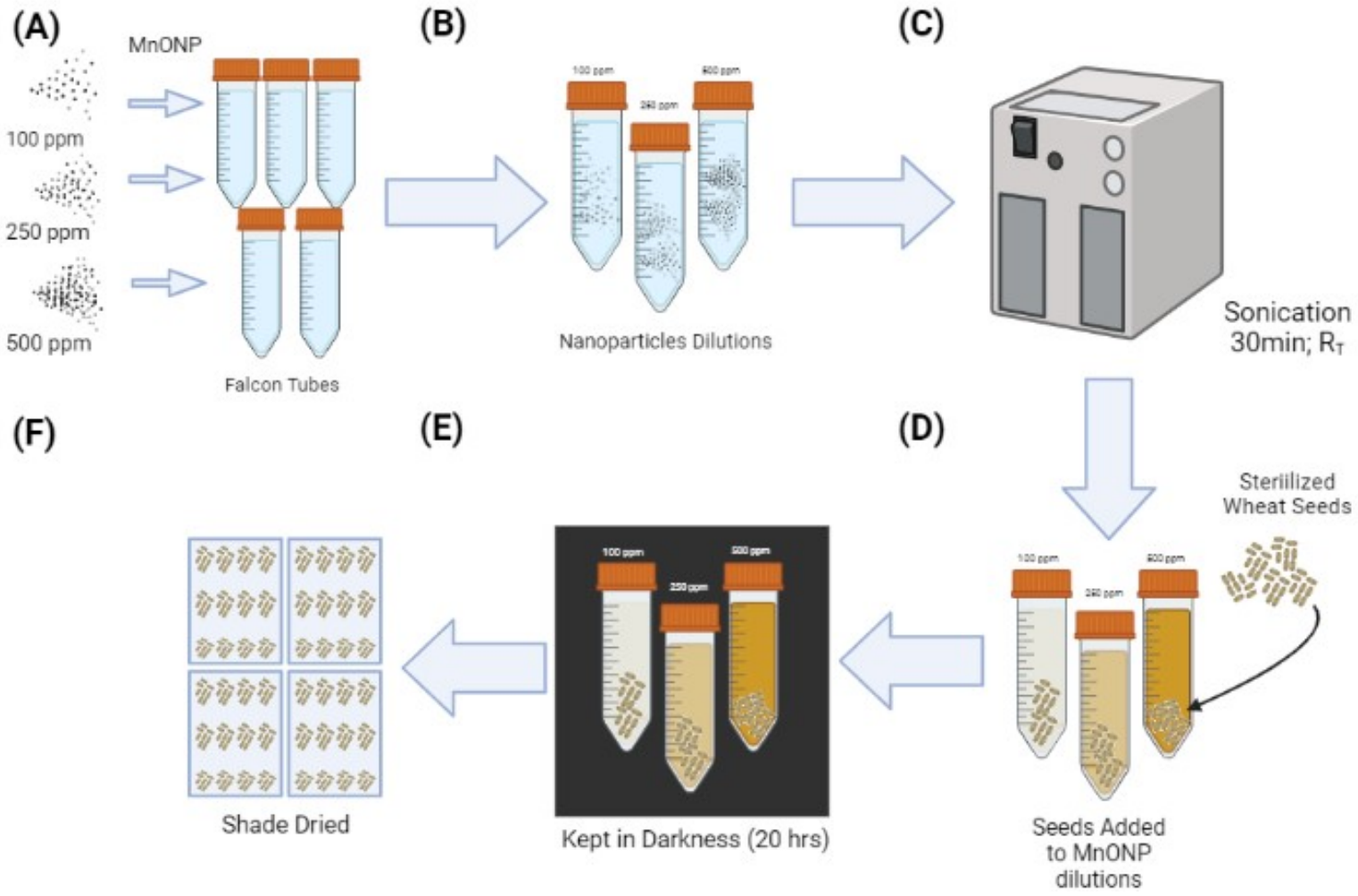


Supplementary Figure 1: Schematic sketch of green synthesis of MnO2 NP

(A) Grinded Wheat powder (B) Wheat powder in dH_2O (C) Complete mixture of Wheat powder and dH_2O (D) Cell free Wheat extract after filtration (E) Wheat extract (Right) and 1mM $MnCl_2$ solution (Left) (F) 1:1 Mixture of $MnCl_2$ and Wheat extract (G) Paste formation in China dish (H) Pure MnO_2 NP in China dish after furnace.



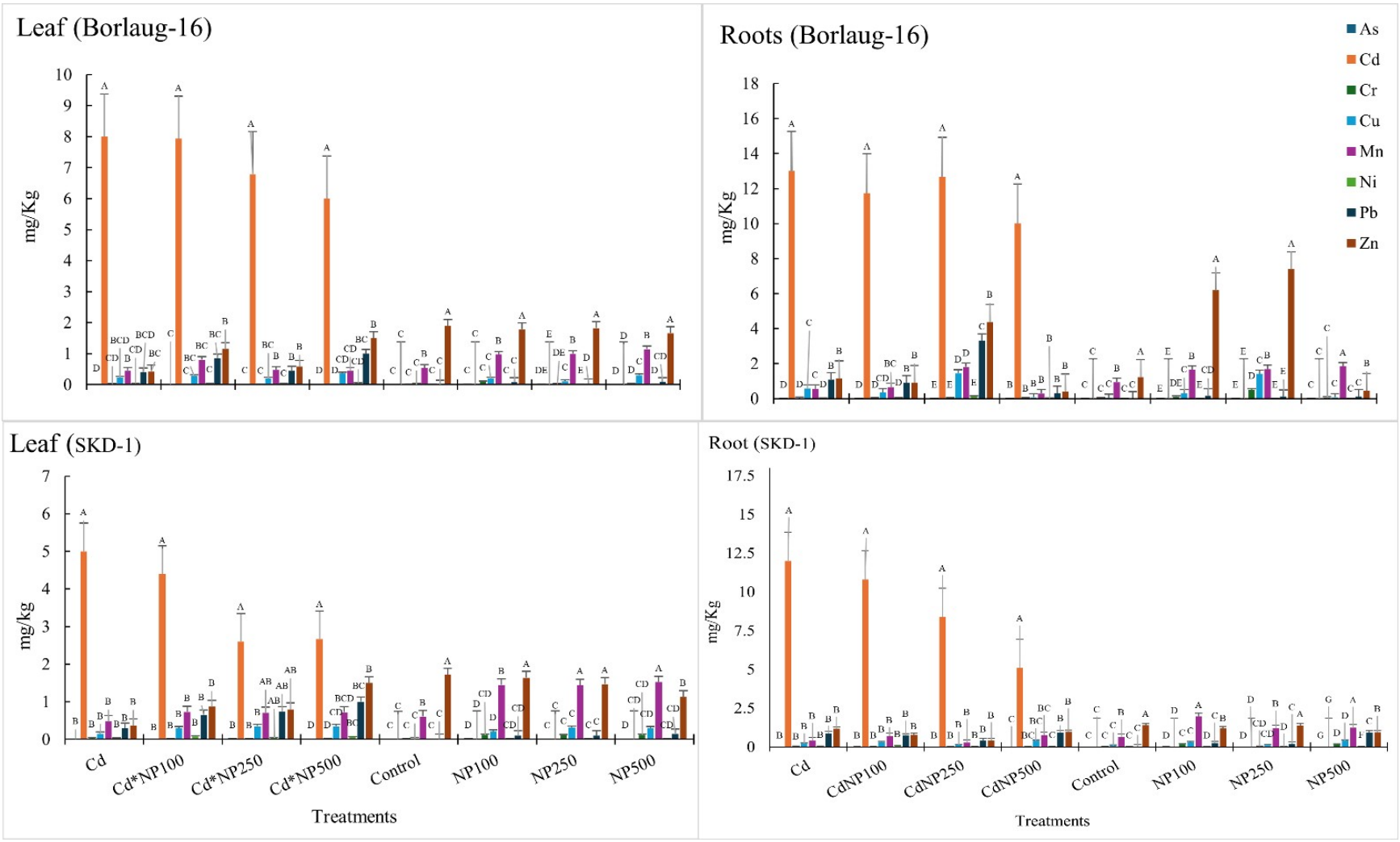
Supplementary Figure 2: Mechanism of Nanopriming Wheat Seeds with MnO_2 NP

(A) *Different dilutions of MnO_2 NP and 50mL falcon tubes are taken* ***(B)*** *Various suspensions of MnO_2 NP are made in dH_2O* ***(C)*** *Sonication is performed at room temperature for 30min* ***(D)*** *Surface sterilized Wheat seeds are added to MnO_2 NP dilutions and* ***(E)*** *kept in darkness for 20hrs* ***(F)*** *Nanoprimed seeds are shade dried.*

*

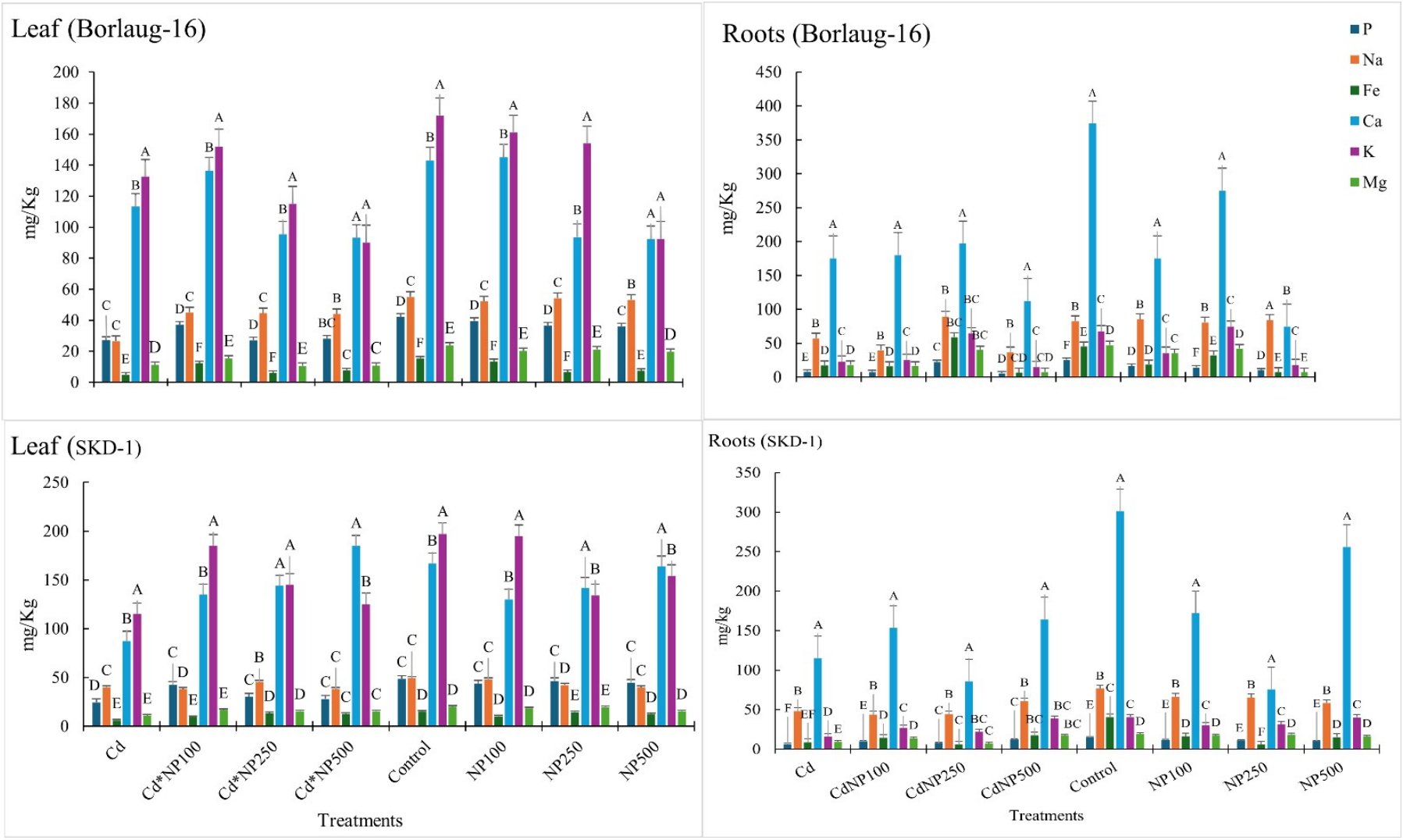
Supplementary Figure 3: Q-Q Scatter Plot, Histograms, and coefficient of correlation between Ionome of both cultivars

The lower triangle represents Q-Q Scatter plot of Phenotypic traits, the upper triangle represents coefficient of correlation values, and the middle line dissecting the two triangles represents histograms of both cultivars.



Supplementary Figure 4: Uptake of Trace elements in leaf and root tissues of Borlaug-16 and SKD-1 cultivars.

As: arsenic, Cd: cadmium, Cr: chromium, Cu: copper, Mn: manganese, Ni: nickel, Pb: lead, Zn: zinc.



Supplementary Figure 5: Uptake of Mineral nutrients in leaf and root tissues of Borlaug-16 and SKD-1 cultivars.

P: phosphorous, Na: sodium, K: potassium, Mg: magnesium, Ca: calcium, Fe: iron.

```
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   => Phase:       1
   =>    Bragg R-factor:   11.71
   =>    RF-factor     :   6.902
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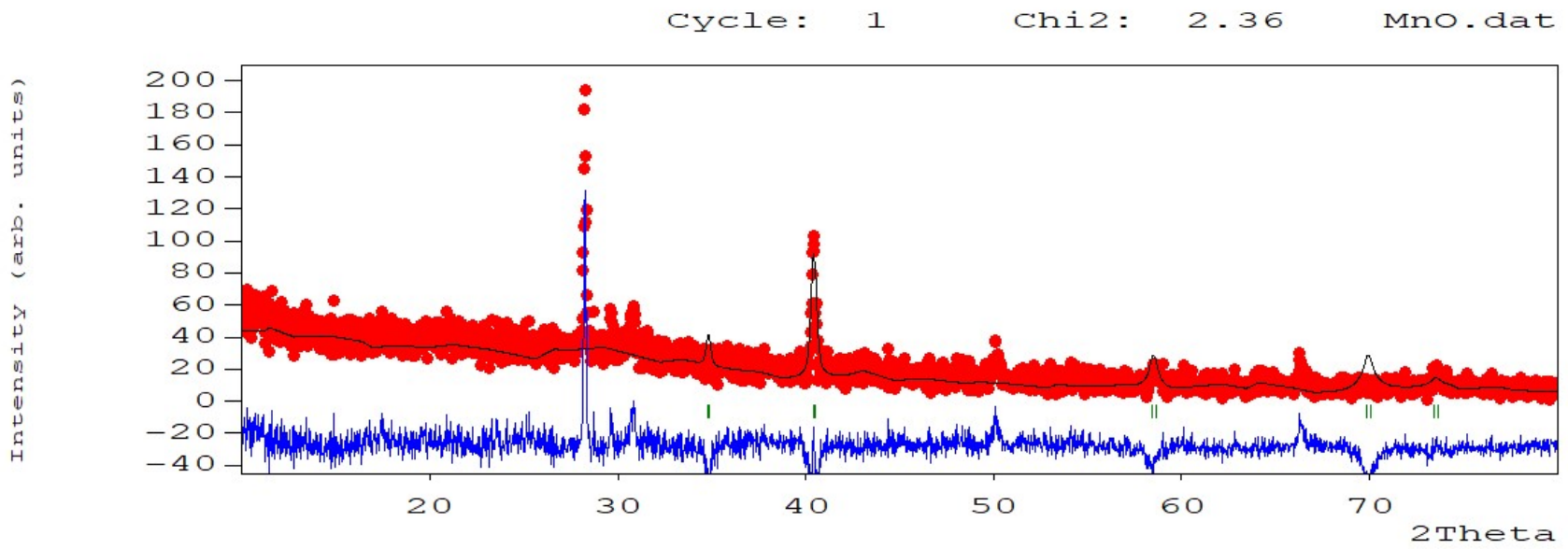

Supplementary Figure 6: X-ray powder diffraction patterns of MnO_2NPs, both experimental and simulated, were refined using Rietveld analysis.