

Supporting information

Figure S1. XPS and dissolution assay of PNC. A, XPS analysis of the synthesized PNC. B, the measured dissolved cerium content from the dialysis eluent collected from the mixture of PNC and leaf extracts (0 h and 48 h incubation).

Figure S2. Screening of optimal PNC concentration to improve rapeseed salt tolerance. A, phenotypic performance of 0, 0.005, 0.01, 0.05, 0.1 mM PNC treated rapeseed seedlings after 12 days of salt stress (200 mM NaCl). B, the time course of chlorophyll content level (CCI, chlorophyll content index) in PNC and buffer treated rapeseed under salt stress (day 1 to day 12). C, fresh weight of whole rapeseed seedlings treated with different concentrations of PNC after 12 days of salt stress. Mean \pm SE (n = 8-16). *, $P < 0.05$.

Figure S3. Effects of PNC and CeCl₃ on rapeseed seedlings growth under normal conditions. A-F, Seedling phenotype (A), fresh weight (B), chlorophyll content index (C), chlorophyll content (D), leaf length and width of the second true leaf (E), and leaf area of the second true leaf (F) of rapeseed plants treated with buffer, PNC, and CeCl₃ under normal condition.

Figure S4. PNC increased the chlorophyll content of rapeseed leaves under salt stress. Total chlorophyll content of the second true leaf of rapeseed plants treated with PNC and buffer after 12 days' salt stress (200 mM NaCl). Mean \pm SE (n = 8). *, $P < 0.05$.

Figure S5. Effect of CeCl₃ on rapeseed seedling under salt stress. A-D, fresh weight (A), chlorophyll a and b content (B), total chlorophyll content (C), and leaf length and width of the second true leaf (D) of rapeseed plants treated with buffer or CeCl₃ after 12 days of salt stress (200 mM NaCl). Mean \pm SE (n = 6-8).

Figure S6. Effect of PNC on stomatal conductance and quantum yield of PS II of rapeseed leaves under salt stress. No difference in stomatal conductance (A) and quantum yield of PS II (B) were observed between rapeseed plants treated with buffer and PNC after 12 days of salt stress (200 mM NaCl). Mean \pm SE (n = 4).

Figure S7. Effect of CeCl₃ on leaf electrolyte leakage index in rapeseeds under salt stress. No difference in electrolyte leakage index was observed between rapeseed plants treated with buffer and CeCl₃ after 12 days of salt stress (200 mM NaCl). Mean ± SE (n = 6).

Figure S8. Effect of CeCl₃ on leaf cell viability of rapeseeds under salt stress. A, Evans blue staining of leaves from plants treated with CeCl₃ and buffer after 12 days of salt stress (200 mM NaCl). The blue spots represent dead cells. B, the absorbance of extracted Evans blue. Mean ± SE (n = 4).

Figure S9. Effect of CeCl₃ on leaf cell membrane permeability of rapeseeds under salt stress. A, confocal imaging of fluorescence signal of propidium iodide (PI) from rapeseed leaf treated with CeCl₃ and buffer after 12 days of salt stress (200 mM NaCl). Green fluorescent dots represent the stained nucleus. B, the calculated number of dead cells per confocal image. Scale bar, 30 μm. Mean ± SE (n = 9).

Figure S10. Effect of PNC on CAT activities in rapeseeds under salt stress. No difference in CAT activities was observed between rapeseed plants treated with PNC and buffer under salt stress (200 mM NaCl). Mean ± SE (n = 6).

Figure S11. Effect of CeCl₃ on leaf lipoxygenase activities in rapeseeds under salt stress. No difference in lipoxygenase activities was observed between rapeseed plants treated with buffer and CeCl₃ after 12 days of salt stress (200 mM NaCl). Mean ± SE (n = 6).

Table S1. Primers for quantitative real-time PCR (qRT-PCR) analysis.