

Appendices

Table S1. Primers used in this study.

Table S2. Statistical table of genome alignment results.

Figure S1. Standard curve for absolute quantification of *CsGORK* (a), *CsAKT1* (b) and *CsHAK5;3* (c) in cucumber.

Figure S2. Confocal imaging of DiI-PNC. Confocal imaging shows the distribution of PNC in leaves of the plants with foliar PNC application (a). Confocal imaging shows the distribution of PNC in roots of the plants with root PNC application (b).

Figure S3. The phenotypic parameters in salt stressed (75 mM NaCl, Day 7) cucumber plants with foliar delivery or root application of PNC. Total area of leaf (a), total length of root (b), total surface area of root (c), root volume (d). Mean \pm SE (n = 3). Different lowercase letters indicate significant differences among different treatments at the $P < 0.05$ level. Ctrl, control cucumber plants under 75 mM NaCl (7 days); PNC/Leaf, cucumber plants with leaf PNC application under 75 mM NaCl (7 days); PNC/Root, cucumber plants with leaf PNC application under 75 mM NaCl (7 days).

Figure S4. Fv/Fm and transpiration rate (Tr) in salt stressed (75 mM NaCl, Day 7) cucumber plants with foliar delivery or root application of PNC. a, after salt stress (75 mM NaCl, 7 days), leaf Fv/Fm in control cucumber plants, cucumber plants with foliar PNC delivery and cucumber plants with root PNC application. b, after salt stress (75 mM NaCl, 7 days), leaf Tr in control cucumber plants, cucumber plants with foliar PNC delivery and cucumber plants with root PNC application. Mean \pm SE (n = 3). Different lowercase letters indicate significant differences among different treatments at the $P < 0.05$ level. Ctrl, control cucumber plants under 75 mM NaCl (7 days); PNC/Leaf, cucumber plants with leaf PNC application under 75 mM NaCl (7 days); PNC/Root, cucumber plants with leaf PNC application under 75 mM NaCl (7 days).

days); PNC/Root, cucumber plants with leaf PNC application under 75 mM NaCl (7 days).

Figure S5. Leaf and root cerium content in salt stressed (75 mM NaCl, Day 7) cucumber plants with foliar sprayed or root applied PNC. Total cerium content (a), leaf cerium content and root cerium content (b). Mean \pm SE (n = 3). Different letters indicate significant differences among different treatments at the $P < 0.05$ level. Ctrl, control cucumber plants under 75 mM NaCl (7 days); PNC/Leaf, cucumber plants with leaf PNC application under 75 mM NaCl (7 days); PNC/Root, cucumber plants with leaf PNC application under 75 mM NaCl (7 days).

Figure S6. The ROS level, MDA content and REC (relative electric conductivity) in salt stressed (75 mM NaCl, Day 7) cucumber plants with foliar delivery or root application of PNC. Contents of H_2O_2 (a) and $O_2^{\bullet-}$ (b), MDA content (c) and REC (d) in cucumber leaves and roots of plant with foliar sprayed or root applied PNC. DAB staining (e, indicating H_2O_2 level) and NBT staining (f, indicating $O_2^{\bullet-}$ level) of leaves and roots of cucumber plants with foliar sprayed or root applied PNC. Different lowercase letters indicate significant differences among different treatments at the $P < 0.05$ level. Ctrl, control cucumber plants under 75 mM NaCl (7 days); PNC/Leaf, cucumber plants with leaf PNC application under 75 mM NaCl (7 days); PNC/Root, cucumber plants with leaf PNC application under 75 mM NaCl (7 days).

Figure S7. RNA electrophoresis detection of cucumber plants with foliar delivery or root application of PNC. Electrophoretic detection of RNA for RNA seq (a), Electrophoretic detection of RNA for qPCR (b).

Figure S8. Transcriptome quality analysis of cucumber leaves and roots with leaf and root PNC application. PCA analysis of transcriptomic data from cucumber leaves (a) and roots (b). qPCR analysis (c) and correlation analysis (d) of cucumber leaves and roots. FA-L(R): leaves (root) of cucumber with leaf PNC application, RA-L(R): leaves

(root) of cucumber with root PNC application. Ctrl, control cucumber plants under 75 mM NaCl (7 days); PNC/Leaf, cucumber plants with leaf PNC application under 75 mM NaCl (7 days); PNC/Root, cucumber plants with leaf PNC application under 75 mM NaCl (7 days).

Figure S9. Heat map of gene expression for transcriptome quality verification.

Figure S10. GO enrichment analysis of cucumber leaves and roots with leaf and root PNC application (75 mM NaCl, Day 7). GO enrichment analysis of differential expressed genes in leaves of cucumber plants with foliar sprayed (c) or root applied (d) PNC. GO enrichment analysis of differential expressed genes in roots of cucumber plants with foliar sprayed (e) or root applied (f) PNC. Ctrl, control cucumber plants under 75 mM NaCl (7 days); PNC/Leaf, cucumber plants with leaf PNC application under 75 mM NaCl (7 days); PNC/Root, cucumber plants with leaf PNC application under 75 mM NaCl (7 days).

Figure S11. Phylogenetic analysis of GORK, AKT1 and HAK5 in Arabidopsis Thaliana and cucumber . The number represents the branch length of the evolutionary tree.

Figure S12. The gene expression level of *CsGORK*, *CsAKT1* and *CsHAK5;3* in cucumber under normal condition with leaf and root PNC application.

Figure S13. Structural analysis of *CsAKT1*. Prediction of transmembrane structure of *CsAKT1* (a). Multiple alignment of AKT1 amino acid sequences from Arabidopsis and cucumber (b). Prediction of conserved domain of *CsAKT1* (c).

Figure S14. Analysis of the effect of knock out of *CsAKT1* on its protein translation.

Figure S15. The phenotypic parameters of salt stressed (75 mM NaCl, Day 7)

***CsAKT1* knockout cucumber plants with foliar delivery or root application of PNC.** Total area of leaf (a), total length of root (b), total surface area of root (c) and root volume (d) of root knockout of *CsAKT1* cucumber seedlings with leaf application and root application of PNC under salt stress. Mean \pm SE (n = 3). Different lowercase letters indicate significant differences among different treatments at the $P < 0.05$ level. Ctrl, control cucumber plants under 75 mM NaCl (7 days); PNC/Leaf, cucumber plants with leaf PNC application under 75 mM NaCl (7 days); PNC/Root, cucumber plants with leaf PNC application under 75 mM NaCl (7 days).