Polyphosphate of *PPK*-expressing Transgenic Rice Promotes Phosphorus Removal of Slightly Polluted Water

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Abstract

With significant economic advantages, the plant floating bed has been widely utilized in the ecological remediation of eutrophic water because of the excessive phosphorus and nitrogen discharge in China. Previous research has demonstrated that polyphosphate kinase (ppk)-expressing transgenic rice (Oryza sativa L. ssp. japonica) (ETR) can effectively use phosphorus to support rice growth and boost rice yield. Here, ETR with single copy line (ETRS) and double copy line (ETRD) on floating beds are planted in slightly polluted water to investigate their capacity to remove aqueous phosphorus. Compared with wild type Nipponbare (WT), ETR greatly reduces the total phosphorus concentration in slightly polluted water though ETR has the same removal rates of chlorophyll-a, NO3--N, and total nitrogen in slightly polluted water compared with WT. ETRD can remove 72.37% of phosphorus in slightly polluted water. Polyphosphate (polyP) synthesis is a critical factor for the excessive phosphate uptake of ETR. The synthesis of polyP decreases the level of free intracellular phosphate (Pi) in ETR, simulating the phosphate starvation signaling. OsPHR2 expressions are elevated in the shoot and root of ETR in comparison to WT. Then, the expressions of corresponding phosphorus metabolism genes change, promoting phosphate uptake from slightly polluted water. The Pi accumulates in ETR for further growth. These findings highlight that ETR, especially ETRD, has significant potential for phosphorus removal and can be exploited as a novel material for phytoremediation in slightly polluted water.

Keywords

Rice Floating Bed, Transgenic Rice, Polyphosphate, Phosphorus, Phytoremediation