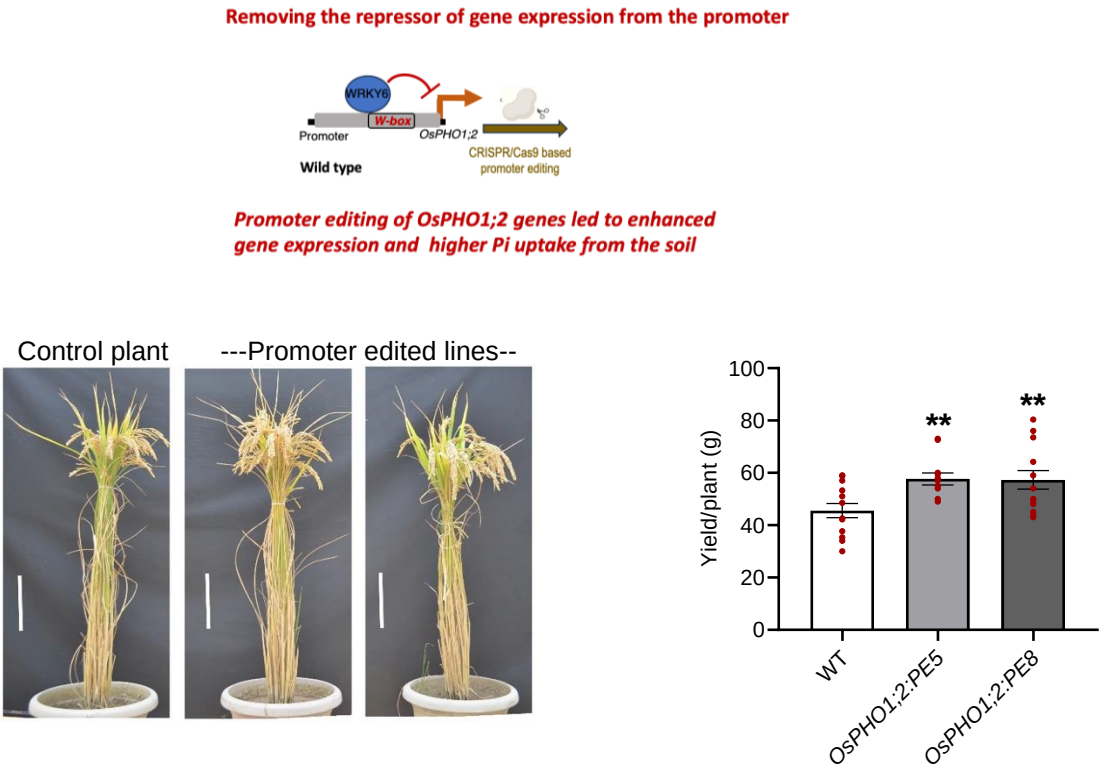
Gene promoter-edited Rice lines with improved grain yield in low phosphate soil

India imports almost 4.5 million tonnes of Diammonium phosphate (DAP), a phosphate fertilizer for agriculture. Rice occupies approximately 36% of India's cultivable land and is therefore the largest consumer of phosphate (Pi) fertilizers. However, only about 20% of the applied phosphate fertilizer is utilized by the crop, while the rest becomes fixed in the soil. As a result, there is a need to improve rice for better phosphorus use efficiency. Dr. Jitender Giri's lab at BRIC-NIPGR in New Delhi has generated rice lines that demonstrate improved Pi uptake and grain yield, even in soils fertilized with lower phosphate levels. His team has employed innovative gene-editing tool CRISPR/Cas9, which provide unmatched precision for targeted genetic modifications aimed at enhancing plant functions. Rice absorbs phosphate through its roots and transfers it to the above-ground shoots with the aid of a Pi transporter named OsPHO1;2. Regulatory elements located upstream of the gene govern the expression of OsPHO1;2. They identified a short sequence within the promoter of OsPHO1;2 that acts as a binding site for a negative regulator, known as a repressor, which modulates the expression of the OsPHO1;2 gene. This group employed an innovative approach by using CRISPR/Cas9 to eliminate the repressor binding site from the OsPHO1;2 gene's promoter. The resulting plants displayed increased expression of OsPHO1;2, leading to enhanced Pi uptake from the soil and ultimately 26% improved grain yield under low phosphate condition over the control plants. Rice lines with enhanced phosphate use efficiency will decrease the need for phosphate fertilizers in rice, lowering cultivation input costs, preventing fertilizer loss into water bodies, subsequently minimizing pollution.



The image represents the gene editing methodology, increased panicle number and yield in promoter-edited rice lines.

Reference: Maurya, K., Mani, B., Singh, B., Sirohi, U., Jaskolowski, A., Sharma, S., Tatiparthi, H.V., Mangrauthia, S.K., Pandey, R., Poirier, Y. and Giri, J. (2025), Editing *cis*-elements of *OsPHO1;2* improved phosphate transport and yield in rice. Plant Biotechnol. J. https://doi.org/10.1111/pbi.70165