The OsNAC23-Tre6P-SnRK1a feed-forward loop regulates sugar homeostasis and grain yield in rice

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Molecular Plant ,
10.1016/j.molp.2022.01.016

Abstract

Tre6P (trehalose-6-phosphate) mediates sensing of carbon availability to maintain sugar homeostasis in plants, which underpins crop yield and resilience. However, how Tre6P responds to fluctuations in sugar levels and regulates the utilization of sugars for growth remains to be addressed. Here, we report that the sugar-inducible rice NAC transcription factor OsNAC23 directly represses the transcription of the Tre6P phosphatase gene TPP1 to simultaneously elevate Tre6P and repress trehalose levels, thus facilitating carbon partitioning from source to sink organs. Meanwhile, OsNAC23 and Tre6P suppress the transcription and enzyme activity of SnRK1a, a low-carbon sensor and antagonist of OsNAC23, to prevent the SnRK1a-mediated phosphorylation and degradation of OsNAC23. Thus, OsNAC23, Tre6P, and SnRK1a form a feed-forward loop to sense sugar and maintain sugar homeostasis by transporting sugars to sink organs. Importantly, plants over-expressing OsNAC23 exhibited an elevated photosynthetic rate, sugar transport, and sink organ size, which consistently increased rice yields by 13%–17% in three elite-variety backgrounds and two locations, suggesting that manipulation of OsNAC23 expression has great potential for rice improvement. Collectively, these findings enhance our understanding of Tre6P-mediated sugar signaling and homeostasis, and provide a new strategy for genetic improvement of rice and possibly also other crops.

上一篇： bZIP71 delays flowering by suppressing Ehd1 expression in rice
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