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Mechanism of Nitrogen Remobilization in Rice

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Approximately 80% of total nitrogen in the ear is remobilized through the phloem from senescing organs in rice (*Oryza sativa* L.). Major forms of nitrogen in the phloem sap are Gln and Asn and these amides should be synthesized in senescing organs following the degradation of N-containing macro-molecules, such as Rubisco in chloroplasts. Our previous localization-studies suggest that cytosolic glutamine synthetase (GS1) is important in the export of leaf nitrogen from senescing organs, while plastidic NADH-glutamate synthase (NADH-GOGAT) in developing organs is involved in the utilization of glutamine. Positive results that support the function of NADH-GOGAT were obtained with transgenic rice over-expressing this gene (1). To obtain conclusive evidence for the importance of GS1 in nitrogen recycling in rice, reverse genetic approaches have been conducted.

Rice plants possess three homologous but distinct genes for GS1: these are *OsGS1;1*, *OsGS1;2*, and *OsGS1;3*. *OsGS1;1* was expressed in all organs tested with higher expression in leaf blades. We characterized knockout mutants caused by insertion of endogenous retrotransposon *Tos17* into the exon-8 or the exon-10 of *OsGS1;1* (2). Homozygously inserted mutants showed severe retardation in growth rate and grain filling. The GS1 protein and its activity in the leaf blades were barely detectable. Re-introduction of *OsGS1;1* cDNA under the control of its own promoter into the mutants successfully complemented these phenotypes. The results indicate that GS1;1 is important for normal growth and grain filling in rice; GS1;2 and GS1;3 were not able to compensate for GS1;1 function.

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(1) Yamaya et al., *J Exp Bot* 53: 917-925 (2002)

(2) Tabuchi et al., *Plant J* 42: 641-651 (2005)