Limitation in triosephosphate utilization determines trade-off between grain protein content and yield in rice.

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**Abstract:**

Despite self-sufficiency in food, every second Indian child appears to be Protein energy malnourished. Indian population acquires more than 70% of the dietary requirement of proteins from cereals. While the dietary energy intake is adequate, the low grain protein content (GPC), low levels of indispensable amino acids in cereals, poor bioavailability and digestibility, plant-based dietary systems are strong determinants of malnutrition, especially in developing countries. Our clinical studies using deuterium isotope labelled plants clearly demonstrated that rice protein is better digested by humans than pulses. However, by screening rice germplasm and cultivars we noticed that a high GPC is often associated with reduced yields. Therefore, understanding this trade-off has strategic relevance in crop improvement aiming towards mitigating protein malnutrition while sustaining food security. We hypothesized that such trade-off could arise mainly because of a single shared source of reductants from chloroplast electron transport mechanism, for carbon as well as nitrogen assimilations. To verify this, we screened a subset of 150 rice accessions from the 3K rice genome panel from IRRI for yield and GPC and identified specific contrasts. Assessing the response of these contrasts to high light and reduced source capacity which alter reductant availability, strongly indicated that Triose-Phosphate Utilization (TPU) limitation is the major reason for this trade-off. We suggest that, combined with TPU limitation, better uptake and remobilization of nitrogen would be an appropriate strategy for enhancing GPC in rice without compromising for grain yield. This would be the best approach for sustaining food and nutrient security.