Modulating plant growth-metabolism coordination for sustainable agriculture

With the support by the National Key Research and Development Program of China and the National Natural Science Foundation of China, the research team led by Prof. Fu XiangDong (傅向东) at the State Key Laboratory of Plant Cell and Chromosome Engineering (PCCE), Institute of Genetics and Developmental Biology (IGDB), Chinese Academy of Sciences (CAS), has uncovered a novel function of the rice transcription factor GRF4 to help to improve nitrogen utilization efficiency (NUE) while maintaining their high yield of the Green Revolution varieties (GRVs), which has been published in *Nature* (2018, 560: 595—600) as a cover story.

The green revolution of the 1960s helped to boost agriculture through the creation of high-yield cereal crops. It has been known that gibberellins (GAs) promote plant growth through destruction of the DELLA proteins. In GRVs, the accumulation of high levels of the DELLA proteins causes the semidwarf phenotypes resistant to lodging, achieving an exponential growth of crop yield. But these semidwarf GRVs have a problem: they are poor at using nitrogen and so require high amounts of environmentally damaging fertilizer to reach their full potential. Development of new GRVs that remain high-yielding with reduced fertilizer supply is thus an urgent global sustainable agriculture goal.

Fu's team has recently revealed that boosting the activity of the transcription factor GRF4 improves the rice plants' nitrogen usage while maintaining their high yield of rice GRVs. Fu and his colleagues showed that *GRF4* is essential for N-mediated growth responses, and abundance of GRF4 is regulated by fertilizer supply. They showed that the balanced opposing activities and physical interactions of GRF4 and DELLA proteins confer homeostatic co-regulation of growth, C and N metabolism. GRF4 promotes and integrates N assimilation, C fixation and growth, whilst DELLA inhibits them. In consequence, the DELLA protein inhibits GRF4-OsGIF1 activation of target genes, which in turn confers yield-enhancing dwarfism, but also reduces NUE. However, GRV NUE and grain yield are increased by tipping the OsGRF4-DELLA balance towards increased OsGRF4 abundance. Thus, modulation of plant growth and metabolic co-regulation enables novel breeding strategies for GRVs for future sustainable food security and a new Green Revolution.

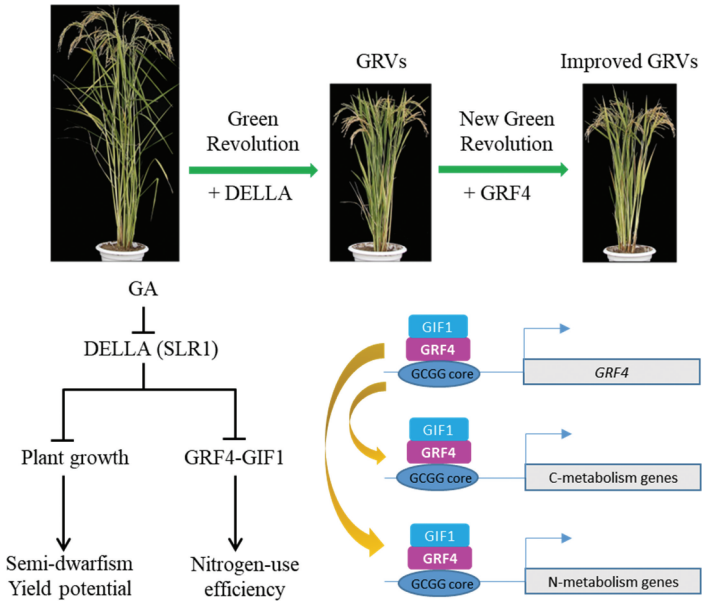

Figure New breeding strategies contribute to the drive for sustainable agriculture.