Mechanisms Controlling Ripening in Rice(Frontiers in Rice Science -from Gene to Field-,The 100^<th> Anniversary of Tohoku University, International Symposium)

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Previous studies indicated that the improvement of ripening capacity is critical to yield improvement of rice cultivars. The objectives of the present study were to evaluate improvement of yield in leading rice cultivars that were bred and grown in the Tohoku region in the 20th century, and to identify the physiological factors regulating the ripening in rice cultivars.

Ten leading rice cultivars were grown at low and high nitrogen (Low N and High N, respectively) under three environments. Yields were higher at High N than at Low N in all the cultivars tested, and its yield increase was greater in the newly bred cultivars released after 1960s (new cultivars) than in the old ones released before 1960 (old cultivars). The cultivar difference in photosynthetic rate (CER) of the flag leaf was small one week after heading, but CER was larger in new cultivars than in old cultivars three weeks after heading. A dependence of CER on leaf N concentration was evident in plants grown at High N three weeks after heading. The number of spikelets increased at High N in all ten cultivars, while the percentage of ripened grains was largely decreased in the old cultivars than in the new cultivars. These results indicate that high-N-induced yield improvement of rice cultivars in the 20th century in the Tohoku region has been accompanied by a greater CER during the ripening stage that might lead to a greater grain filling percentage.

In a series of studies, the factors controlling the ripening were analyzed. The effects of shading and CO_2 enrichment treatments on the ripening of a cultivar Sasanishiki that was grown in pots under 24/19 °C (day/night temperature) were examined, with an emphasis on a comparison between superior and inferior grains within a panicle. The shading and CO_2 enrichment before heading did not affect the early growth of either superior and inferior grains. When the shading treatment was imposed after heading, however, the early growth was delayed only in inferior grains. In inferior grains, the rate of dry matter accumulation during a linearly increasing phase was reduced by shading, but enhanced by CO_2 enrichment after heading stage, whereas the rate of superior grains was hardly affected by those treatments. The sugar concentration in grains appeared to be associated with the grain growth rate in inferior grains, but the association was not observed in superior grains. These results suggest that the early growth of rice grains appears to be controlled by the factor(s) other than photosynthetic capacity, probably by plant hormones, while the dry matter accumulation is regulated by the assimilate availability (source strength).