特 別 講 演 要 旨

Ecophysiological Characteristics of High Yielding Rice Cultivars

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Many researches on the yield formation process have been done especially from the standpoint of the analysis of yield components, photosynthesis and dry matter production of rice plants in Japan. From the results of these researches morphological, ecological and physiological characteristics contributing to high yield production were clarified. For example, these were on canopy structure, light intercepting character, leaf photosynthesis and so on. On the basis of these findings the desirable plant types for getting high yield were considered and furthemore, the ideal plant type was suggested theoretically. The concept of the ideal plant type has contributed to the breeding of the high yielding cultivars as well as the improvement of cultivation techniques for getting high yield.

However, few analytical researches have been done on what morphological, ecological and physiological characters are more or/and the most important for realizing high production in a certain improved high yielding cultivar or in a improved cultivation method. It has been said that rice plants with high leaf photosynthetic capacity will attain high yielding production. But it is very difficult to find the experimental results showing that the increase in yield was accomplished mainly owing to higher leaf photosynthetic rates when the yield formation processes in high yielding cultivars or in improved cultivation methods were analyzed.

Here, rather than attempting an exhaustive review of the literatures I would like to base my talk on our results of the last decade of the researches comparing rice yield, its components and the process of dry matter production between the recently improved high yielding cultivars and the Japanese standard cultivars, and clarifying that to what extent the

morophologilcal,ecological, and physiological characteristics related to yield formation were different among these cultivars and what characters contributed to increase in dry matter production in these improved cultivars.

The characteristics of high yielding rice cultilvars were as follows. Spiklet number per unit area was larger owing to larger panicles. Crop growth rate was higher not owing to larger leaf area index, but owing to higher net assimilation rate, especially from the maximam tillering stage to ripening stage, and light extinction coefficient was smaller owing to erect leaf arrangement. Gas exchange rate and CO_2 concentration in canopy were higher in larger plant height. Though leaf photosynthetic capacity was slightly improved but not distinctively, the extents of the decrease in the photosynthetic rate accompanied with leaf senescence and of the depression of the photosynthetic rate in the afternoon with sufficient light intensity were smaller. The exudation rate from the culm was higher and the resistance to water flow through plants was smaller, which was related to smaller top-root and leaf area -root weight ratios. Furthermore, the amount of cytokinin transported to shoots from roots through exudation was larger in the cultivar of which leaf photosynthetic rates were maintained longer at higher level during leaf senescence. Harvest index was higher not only owing to larger photosynthetic production during ripening, but also owing to larger amount of dry matter accumulated in stem before heading and transported to panicles after heading. On the basis these findings the characters in F_1 hybrid having high yielding capacity will be dicussed.

In conclusion we found that morphological,ecological and physiological characteristics mainly contributing to high yield were different among high yielding cultilvars though varietal improvement in rice has been much advanced. However, the cause or mechanism of these varietal differences has not yet been clarfied sufficiently. These mostly depends on the future research. More intimate cooperative researches are indispensable between crop physiologists and plant breeders, geneticists, biochemists and molecular biologists.