特 別 講 演 要 旨

VARIETAL DIFFERENCES OF PHOTOSYNTHESIS AND GRAIN YIELD IN RICE

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In the last 100 years, the grain yield per unit land area (GY) of rice in Japan increased to about double level. This fast increase of GY would be attributed to efficient control of pest or insect with agricultural chemicals, to the improved cultivation technology, and largely to the development of high yielding varieties. In this context, this work was carried out to know if photosynthetic rate could be the breeding objective for high yielding variety.

The grain yield of rice is determined by the rate of dry matter production and its partitioning to the grain. The rate of dry matter production would be proportional to the rate of canopy photosynthesis (CPS), which consists of the following three parameters; apparent photosynthetic rate per unit leaf area (APS) leaf area index, and light intercepting efficiency. The last two parameters, especially the last one has so far been appreciated as one of the most important high yielding characteristics. However, the first parameter, APS, has never been paid attention, although it is theoretically expected that it will contribute to the increase of GY.

In this paper, the simultaneous measurement of APS and transpiration was conducted on a flag leaf under the full sunlight in the field, with measuring system installed in a van-type car moving on the leve of the paddy field, and the relationship between APS and GY were investigated. Furthermore, the feasibility for APS to be the breeding criteria for high yielding varieties in rice was discussed. The results obtained were summarized as follows:

1. APS of a flag leaf at the heading stage showed no significant difference between the old (bred in 1882-1913), intermediate (bred in 1921-1940), and new (bred in 1949-1976) groups of the varieties. However, APS at the ripening stage, when the flag leaves were in senescing process, showed a large difference between three groups of the varieties, with the highest average value in the new group, and the lowest in the old group. Consequently, APS at the ripening stage showed an increasing trend with the year of release. This difference of APS at the ripening stage seemed to be

mainly due to the difference in mesophyll diffusion resistance rather than in stomatal diffusion resistance.

2. High positive correlation was observed between APSs of the fully expanded leaves at the maximum tillering stage, and those of the flag leaves at the heading stage for all the varieties examined. However, no correlation between APSs at the heading stage and those at the ripening stage was found. This implies that potential capability of APS is stable and specific to varieties, but after heading APS declines with different speed to varieties.

3. APSs at the heading stage were relatively stable through different years, but those at the ripening stage were variable, this is also showing that the potential capability of APS is the characteristic which is stable between years, although those at the ripening stage are variable for the different years. So we can say that SPSs in the senescing process respond to the climatic change differently with the varieties.

4. In regard to the correlation between APS and GY, a significant positive one was observed only in SPS at the ripening stage of nitrogen top-dressed plots, and there was no correlation for APS at any other stages.

From the results obtained here, it is concluded that the potential capability of APS of each leaf is specific to variety, with less relation to the grain yield, and APS in the senescding process was responsible to the varietal difference of the grain yield.