(学位第３号様式)

学 位 論 文 要 旨

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題　目	Strategies of Transient Submergence Tolerance Cope with Translocation of Photosynthetic Products in Rice Plant (イネの光合成産物転流における短期間冠水耐性の戦略)

Submergence is an environmental challenge for crop cultivation which causes physiological perturbation and yield loss. Tolerant genotypes are characterized by the ability to maintain physiological processes to minimize the negative effects of flooding stress. Photosynthesis decrease during complete submergence, regardless of whether or not a plant tolerates submergence. The metabolic regulation of non-structural carbohydrates (NSCs; polysaccharide and soluble sugars), which control its level and distribution, are important for plants in response to submergence. For instance, the translocation of photosynthates upon complete submergence are believed to influence on plants' tolerance to submergence, which can be evaluated using ^{13}C discrimination approach. This study was aimed to evaluate: (1) the photosynthetic ability in *Sub1A* and non-*Sub1A* rice genotypes during submergence through analysis of chlorophyll fluorescence (Fv/Fm ratio) to monitor a PSII activity; (2) the relation of NSC levels with plant elongation; and (3) the relation of photosynthate distribution with plant elongation. The first factor was the environmental condition consisting of control and submergence. The second factor was rice genotypes consisting of *Sub1A* and non-*Sub1A* rice genotypes. In the first and second experiments Inpari30 (*Sub1A*) and IR72442 (non-*Sub1A*) rice genotypes were used. Measurement of plant height, SPAD, chlorophyll fluorescence and photosynthetic rate indicates that shoot length increased more significantly in IR72442 than in Inpari30 in response to submergence. The noticeable decline was observed in the photosynthetic rate of both genotypes during submergence with severe decrease in chlorophyll content and chlorophyll fluorescence in IR72442 compared to that in Inpari30. In Inpari30, PSII in chloroplasts was presumably maintained during submergence and then after flooding, leading to quick adaptation to an aerobic environment as shown by a recovery of dry weight compared with that in IR72442.

Investigation of the distribution of NSC (starch and soluble sugar) contents in plant organs suggested that elongation of a non-*Sub1A* genotype during submergence was achieved by starch and sugar consumption distributed to the newly developed organs. In contrast, a *Sub1A* genotype such as Inpari30 which did not exhibit shoot elongation and showed slower NSCs distribution during submergence, ~~t~~hus confirming the better growth performance on post submergence due to efficient distribution of retained NSC to the new developed organ.

The changes in photosynthate accumulation and distribution during submergence indicates that even though photosynthetic activity was inhibited during submergence, the assimilate can be translocated to the newly developed leaves of submerged IR72442 (*non Sub1A*), to address the needs for elongation. In contrast, the submergence-tolerant IR67520 (*Sub1A*) exhibited less shoot elongation and slower translocation of ^{13}C labelled substances during submergence, thus the traits presumably brought the better growth performance of this genotype on post-submergence through a quick recovery of metabolic activity.