（学位第３号様式）

学 位 論 文 要 旨

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題　目	Physiological analysis of anaerobic response mechanisms in Poaceae crops (イネ科作物の低酸素応答の生理学的解析)

Flooding is the second largest abiotic stress in crop production after drought. Flooding is categorized into submergence, partial submergence, or waterlogging, but field crops are not adapted to even in waterlogged environments, and growth and yield are negatively affected severely. To cope with stresses originating from hypoxia in soil and roots, it is important to understand the mechanisms that control the plant internal aeration capacity of crops under waterlogging, but the crop science has not made much progress in understanding the mechanisms involving actual measurements of oxygen. Therefore, this study aimed to elucidate the oxygen-based differences in aeration capacity between hypoxia-tolerant and hypoxia-sensitive species. First, we investigated interspecific differences of rice in root oxygen consumption and transport characteristics. The oxygen transportation rate of tested rice varieties for aerobic respiration varied from 49.1% to 108.6%. However, these values were significantly higher from those of maize and oats, raising the question of whether rice is suitable as a model plant for waterlogging tolerance breeding. Therefore, we conducted a study to clarify the hypoxic response of four millets, focusing on hypoxic response in leaves, shoot dry weight, and root characteristics. The results showed that Fv/Fm and SPAD values of common millet and finger millet decreased under hypoxic treatment, but this was not observed in Japanese barnyard millet and job`s tears, suggesting that these two species avoided the effects of hypoxic stress. There was a strong positive correlation between the ratio of shoot dry weight among treatments and the ratio of total root length among treatments, suggesting that root maintenance is important for maintaining dry matter production. Job`s tears and Japanese barnyard millet roots, which maintained well total root length under hypoxia, showed constitutive high aerenchyma/root sectional area ratio, root cortex/stele sectional area ratio, and main root length/lateral root length ratio, which were increased under hypoxia, suggesting that these contributed to maintenance of total root length. Although job`s tears avoided stress on leaf, shoot dry weight was significantly reduced by 18-31% under hypoxia, suggesting that the hypoxia tolerance of job`s tears is nearer to that of field crops than to that of rice or Japanese barn yard millet. Therefore, to determine where differences occur in plant internal aeration under waterlogging between sorghum, which is genetically closer to job`s tears and less tolerant to waterlogging, and job`s tears, we performed oxygen profiling from leaf to root tips using micro oxygen electrodes. The results showed that there was a tendency for a difference in oxygen partial pressure between the two species at the root-stem junction, and that the difference became significant at the root base, indicating that differences in oxygen transport begin to occur at these sites. Oxygen retainability and root cortex to stele ratio were higher in job`s tears than in sorghum. It is necessary to introduce these root characteristics into field crops to improve their aeration capacity to fill the oxygen partial pressure difference at the root tip and to develop varieties that can sustain root activity in low-oxygen soil.