（学位第３号様式）

学 位 論 文 要 旨

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題　目	Study on nitrogen use efficiency of sugarcane (*Saccharum* spp.) under drought stress conditions (水ストレス条件下のサトウキビの窒素利用効率に関する研究)

Drought stress at early growth stage maybe a reason for the reductions of nitrogen use efficiency (NUE), resulting in low yield and sugar quality in sugarcane. For this reason, it was hypothesized that improvement of NUE could help sugarcane confront to drought stress or selecting varieties with higher NUE could be a strategy for sugarcane production under drought stress conditions. This study investigated the relationship between NUE and drought tolerant ability under different levels of nitrogen (N) application with various varieties in order to provide beneficial information for the current breeding program aiming at better drought tolerant ability at early growth stage in sugarcane.

The responses to water stress and N application, and the relationship between NUE and drought tolerant ability of sugarcane were investigated in Chapter 2. The results showed that the drought reduced the growth, biomass and NUE traits. Applying N supported better growth performance, but increasing N did not result in higher growth and NUE, especially under the drought stress condition. The strong positive correlation coefficients between NUE traits and drought tolerance index (DTI) may suggest that higher NUE traits could help the plant have a better ability to tolerate drought stress.

The growth, NUE, and drought tolerant ability of different sugarcane varieties were evaluated in Chapter 3 to get a better understanding about the relationship between NUE and drought tolerant ability in sugarcane. An experiment was conducted under a glasshouse condition with five sugarcane varieties under different water regimes. The results showed the drought reduced the photosynthetic rate, growth parameters and NUE traits. Varietal differences were found in all growth- and NUE-related traits and DTI. The positive correlations between the NUE traits and DTI also suggested that higher NUEs could support a better tolerant ability to drought stress.

In Chapter 4, the daily changes in soil moisture content and photosynthetic response were observed to point out the critical soil moisture value that will be helpful information for irrigation management in sugarcane. The results showed the photosynthesis changed in parallel with changing of soil moisture content. Photosynthesis could be a useful indicator to determine the time to start irrigation. Irrigation should start at a soil volume moisture content of 15% or a pF of 2.8 to avoid any reduction of photosynthesis.

From Chapter 2 and Chapter 3, it could be concluded that the NUE traits should be an added tool along with yield components for screening drought tolerant sugarcane varieties in the future breeding. In Chapter 5, screening of the commercial sugarcane varieties by NUE traits was conducted under a rain-fed condition. The results showed that the drought stress caused reductions in plant height and SPAD, but they were not statistically significant. Genetic variations in growth, yield components, and biomass traits were found among investigated varieties. The positive associations between NUE traits and total biomass production suggested that higher NUE traits could support better growth performance of sugarcane under rain-fed conditions. From this study, NiF3, NiF8, and Ni27 showed the best performance with the highest growth, yield components, and biomass parameters as well as NUE.

In conclusion, higher drought tolerant ability in sugarcane resulted from better use of N source and NUE traits could be key tools to screen drought tolerant sugarcane varieties to water stress at early growth stage. NiF3, NiF8 and Ni27 could be introduced as promising varieties in terms of NUE performance and drought tolerant ability and thus be used as reference varieties or crossing materials in the future breeding program.