（学位第３号様式）

学　位　論　文　要　旨

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題　目	Study on the yield prediction in sugarcane using evapotranspiration and growth curve analysis (サトウキビの蒸発散特性と生長曲線解析法を用いた収量予測に関する研究)

The sugarcane industry in Okinawa has been experiencing unstable yields per unit area due to weather conditions such as typhoons and droughts, as well as the aging of the farming population, lack of farmers, and delays in fertilizer management. In the production field, growth surveys are conducted periodically from six months before the start of operation, and the yield is predicted based on the results of these surveys to determine the operation period of the sugar refinery. However, the current yield prediction methods used in sugar refineries are unstable and their accuracy needs to be improved. As a result of material production, crops release large amounts of water into the atmosphere through transpiration. Without precipitation or irrigation supply, this water loss has a significant impact on growth and yield. In this study, we aimed to clarify the relationship between water balance and growth and yield in sugarcane fields, and to improve the accuracy of yield prediction using the growth curve analysis method.

To clarify the evapotranspiration characteristics in sugarcane fields, evapotranspiration was measured by the heat balance Bowen ratio method in Miyako and Naha. In addition, the modified Penman method, solar radiation method and Penman-Monteith method proposed by FAO were used to calculate the reference evapotranspiration and crop coefficients. The results showed that the solar radiation method was more accurate in terms of estimation accuracy. In order to establish a method for estimating soil moisture content in sugarcane fields, we tried to adapt the tank model method. A modified tank model method incorporating the Penman-Monteith method and the solar radiation method, which takes into account the change in soil moisture content, was used to estimate the change in soil moisture content over time with high accuracy.

The relationship between evapotranspiration (ΣETe) and dry weight (DW) calculated by the improved tank model was investigated using new planting and ratooning at different growing seasons. The relationship between ΣETe and DW can be approximated by a logistic curve for new planting and a straight line for ratooning. A yield prediction model based on a logistic curve was developed using data from weather-sensitivity tests. The logistic curve was used to predict the trend of sub stem length and raw material stem weight in each crop type. In addition, the final yield could be predicted by multiple regression analysis using the sub stem length, stem diameter, and number of stems for each month, taking into account the appearance of inflection points in the logistic curve. The estimation accuracy of the multiple regression analysis was further improved by adding evapotranspiration as an explanatory variable.

As a result, the relationship between evapotranspiration and sugarcane growth and yield, and the possibility of yield prediction based on the logistic curve were clarified. Stable production of sugarcane in Okinawa is expected through the implementation of cultivation techniques such as appropriate irrigation until the inflection point of the logistic curve appears, early implementation of stubble management, amount and method of fertilizer application, and introduction of high-yielding varieties to ensure early growth.