（学位第３号様式）

学 位 論 文 要 旨

氏　名	Keita Goto
題　目	Modeling the Dynamics in Water and Energy Resources of *Capsicum* in Response to Soil and Atmospheric Abiotic Stressors in a Tropical Climates （熱帯気候下の土壌・大気の複合的な環境ストレス要因に対するトウガラシの水・エネルギー資源の動態のモデル化）

Extreme water hazards such as floods and droughts occur frequently, in addition to annual fluctuations in microclimate factors (temperature, humidity, and solar radiation) that affect agricultural crops are expanding, especially in tropical Asia and Africa, where population growth is remarkable and the stable supply of food is disturbed. The mechanisms by which soil environment and climatic factors act on crop growth in a fluctuating manner can be elucidated from the perspective of plant physiology and applied to sensing technologies that enable the acquisition of biological data over wide areas and over time, making it possible to develop data-driven crop growth assessment. Therefore, to establish an information base for advanced growth assessment adapted to global climate changes, this study aimed to evaluate and to model the crop responses in a multiple stress environment.

First, photosynthesis measurements and chlorophyll fluorescence and water potential analysis were conducted in trials in slope fields, phytotrons, and actual tropical environments. The results quantitatively revealed that while reduced plant water availability due to extreme soil drought and waterlogging can be a limiting factor for individual growth, the irreversible impairment in leaf photosynthetic capacity and efficiency depends on excessive water loss and photoinhibition levels due to atmospheric and solar condition. In addition, stress evaluation indices were selected from environmental and growth parameters involved in this response mechanism, and physiological and morphological crop responses to soil and atmospheric stressors were applied to statistical models. In particular, we demonstrated that chlorophyll a/b ratio and maximum quantum efficiency of photosystem II, which are related to light-harvesting ability, are useful indicators for evaluating soil water stress and photoinhibition level, and developed a non-destructive mathematical model to predict biomass, transpiration and photosynthesis rate using these indicators as variables.

Next, given that meteorological models adaptable to tropical regions have not been fully investigated due to the complexity of the mechanism of action of factors such as heat and vapor pressure near the equator, we considered it necessary to evaluate and diagnose crop growth in real time from microclimate data surrounding agricultural land. Therefore, in this study, we attempted to analyze and accurately assess the effects of multiple stresses and growth stages, which have not been sufficiently investigated in the past, on the leaf water index, which shows a high correlation with vegetation data obtained from satellites, and demonstrated the effectiveness of continuous outdoor monitoring for horticultural crops. In particular, we monitored turgor pressure of *Capsicum* leaves under soil water and microclimate fluctuations in South Sumatra, Indonesia, a region severely affected by soil wet damage, and compared the responses of seedlings at different growth stages to determine the effects of fruit production on turgor regulation and photosynthetic product utilization under stressed environments.

In summary, this study provides original insights into advanced biomonitoring by modeling the nuanced relationship between plant water balance and assimilate resource utilization under multiple stress conditions, thereby contributing to the development of sustainable cropping systems in tropical climates and adverse environments.