Laboratory Spectral Modeling of Chlorophyll Content and Nitrogen Level Relationships for Rice Plants

*San Lin Phyo[1], Yukihiro Takahashi[1]

1. Hokkaido University

According to Food and Agriculture Organization (FAO) reports, rice is a major food crop around the world as more than half of the population worldwide consume rice. Besides, rice production in Asia is 90% of global rice production. Based on previous studies, rice production needs to increase approximately 40% by the end of 2030 as the global population will reach 9 billion by 2050. Therefore, timely monitoring of rice growth is crucial for global food security and agricultural sustainability. Chlorophyll content is one of key biochemical parameters reflecting crop growth status for rice plants. Moreover, nitrogen fertilizer level is also the most important plant macronutrient and plays a significant role in photosynthesis process. Therefore, chlorophyll content and nitrogen level monitoring for rice plants are essential for rice crop yield prediction. Chlorophyll content of rice plant is changing at each growing stage and can vary depending on nitrogen fertilizer application. Although several research regarding chlorophyll content based on spectral indices have been published, there are still limitations regarding band selection to improve chlorophyll content monitoring. Therefore, this study focuses on new ways to select the best appropriate bands for chlorophyll content monitoring. The purpose of this study is to derive and evaluate spectral indices for modeling the chlorophyll-nitrogen relationship in rice leaves using laboratory acquired reflectance spectra. In this study, rice plants under four different nitrogen fertilizer conditions were used to monitor chlorophyll content. The Soil and Plant Analysis Development (SPAD) value which is a relative chlorophyll content index in ecological agricultural surveys and vegetation remote sensing applications and spectral data was acquired at each growth stage using chlorophyll meter and handheld spectrometer. After that Normalized Difference Spectral Indices (NDSI) were extracted. Among those spectral indices, the best band combinations were selected by applying machine learning regression methods. In future, the selected bands can tend to utilize satellite sensors. In this seminar, the methods that were used for this study will be presented and the analysis results will be discussed.

Keywords: Chlorophyll content, Nitrogen level, Normalized Difference Spectral Index (NDSI), Hyperspectral Spectrometer, Machine learning regression

