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Agricultural Field Observation Using Hyperspectral Sensor in Syonai

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This study investigates the adequate selection of hyperspectral (HS) components for estimating the adequate amount of fertilizer to be applied for paddy field to keep the rice protein within a certain level, thus for ensuring the quality of the rice. The SPAD value has been generally used to estimate these values and showed its usability. However, it is difficult to obtain SPAD values over a widespread area. This study evaluates the performance of an airborne HS image. Moreover, we investigate the possibility of applying a multispectral (MS) image for the same target.

We have established multiple observation systems, such as a crane mounted HS sensor system, a balloon mounted digital camera system, and a radio-control-helicopter mounted HS sensor system. For the purpose of applying widespread satellite or airborne sensor images, we have simulated models from high spatial and temporal resolution images obtained from these observation systems. Our past studies showed the efficiency of the vegetation index (VI) "NDGI", which is generated from green and red bands, to estimate the amount of rice protein using crane mounted HS sensor images. This NDGI is also effective to estimate the degree of damage from a salt breeze on rice, and is applicable to the MS image of SPOT. Estimating methods, such as neural networks (NN), are also examined. The genetic algorism indicated the adequate selection of bands from crane mounted HS sensor images to estimate protein content of rice. A single-layer perceptron is usable to estimate the damage degree of soybean and a multi-layer perceptron estimates sucrose, glucose, and amino acid of soybean.

In this paper, we applied a single-layer perceptron, which has input nodes corresponding to band number and a single output node, and VI, which are generated from 2 bands like NDVI, to both HS and MS images. The results using HS images have high correlation with both SPAD values and protein content. The correlation coefficients by NN are 0.99 and 0.98 for SPAD and protein respectively and by VI 0.74 and 0.78. Next, we examined the possibility of MS images using simulated MS images from HS images. The correlation coefficients by NN are 0.73 and 0.40 for SPAD and protein respectively and by VI 0.41 and 0.30. Last, we investigated an ASTER satellite image. The correlation coefficients by NN are 0.51 for protein and by VI 0.49.