別紙様式３

学位論文の要旨

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学位論文 題　　目	Nondestructive estimation method of water status of living crops using near infrared spectroscopy （ 近赤外分光法を用いた作物中水分の非破壊推定法に関する研究 ）

【論文の要旨】（和文の場合1, 200字程度、英文の場合８００語程度）

For proper irrigation planning, a nondestructive method of measuring the water content of plants and soils is needed. Chapter 1 is the general introduction. First, I review previous studies about nondestructive methods of measuring water content. Then, I realize that near-infrared (NIR) reflectance technology is designed to provide rapid, nondestructive, and accurate measurements of water inside materials. However, previous studies were conducted with NIR spectroscopy devices that were very large and/or expensive, which prevents application of the technique in operational conditions. It is unknown whether the inexpensive handheld NIR spectroscopy device can be used to estimate water content because the range of wavelength is very narrow compare to expensive NIR spectroscopy devices. The aim of this study, therefore, is to investigate the feasibility of rapid and nondestructive measurement using NIR to examine spectral absorption properties and features as indicators of water status in soils and plants.

Chapter 2 details the first attempt using an inexpensive handheld NIR spectroscopy device for nondestructive measuring of the water content of plants and soils. A total of 40 reflectance spectra (1550–1950 nm) from different plant and soil samples were measured in the laboratory. The result of drying experiments confirmed that the absorption of NIR light by the samples' water was highest around 1940 nm and lowest at around 1650 nm. The results of log-linear model and linear regression analysis showed significant effects to spectrum parameters based on the respective water percentages of leaves and soil. However, in the case of the $NDI_{1650:1940}$, the ANCOVA analysis showed a significant difference of regression among plant species. Compared to $NDI_{1650:1940}$, in the case of the $1/R_{1940}$, the ANCOVA analysis showed a non-significant difference of regression among plant species. It is suggested that the simple index using a single wavelength (1940 nm) can be used as a universal index to estimate the water content of leaves. These results reveal that an inexpensive handheld NIR sensor can be applied to measure the water status of living plants in the field by using single wavelength (1940 nm).

The objective of Chapter 3 is to evaluate the ability of a handheld near-infrared (NIR) sensor and water absorption index to estimate the water content in intact eggplant leaves using a pot experiment. The NIR spectroscopy using a single wavelength (1940 nm) has already been used to estimate the water content of detached samples in a laboratory (Chapter 2). However, it is not known whether this method can be used to estimate the water content of intact leaves of living plants. Therefore, I attempted to compare this method with the destructive method by simulating drought stress and analyzing the relationship between leaf water content and soil matric potential.

The water content of intact eggplant leaves was predicted with a calibration model using NIR reflectance. Both the measured and predicted water content of leaves decreased with decreasing soil matric potential. These results show that both destructive and NIR measurements can be used to estimate the water stress condition. Based on these findings, a handheld NIR sensor is useful for estimating the water content of intact leaves of living plants. Chapter 4 contains the general discussions and conclusions. I discuss the results of this study and conclude that an inexpensive handheld NIR spectroscopy device can be used to estimate water content of plant instead of expensive NIR spectroscopy devices.

(注１)　論文博士の場合は、「専攻、入学年度」の欄には審査を受ける専攻のみを記入し、入学年度の記入は不要とする。
(注２)　フォントは和文の場合、10.5ポイントの明朝系、英文の場合12ポイントのtimes系とする。
(注３)　学位論文題目が外国語の場合は日本語を併記すること。
(注４)　和文又は英文とする。