Spectral Reflectance Patterns by Artificial Acid Rain in Pinus and Quercus species

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ABSTRACT

The objectives of this study are to reveal relationship between tree physiology and spectral reflectance on effects of artificial acid rain and to obtain basic data on optimal wave length for forest of LRC senser on KOMPSAT-2.

Three pH levels of artificial acid rain - control, pH4.5 and pH3.0 - were applied to Pinus and Quercus species. Three types of the acid rain were spraied at the amount of 500ml in every two days. Spectral reflectance data was collected once in a month by using GER 1500 (350~2500*nm*) or LI 1800(300~1100*nm*) Spectroradiometer. The data was measured three times in a pH level.

The results of this study are as follows; in April, the spectral reflectance of Pinus species was high in order at the level of pH3.0, control and pH4.5; in May, control, pH3.0 and pH4.5; in June, control, pH4.5 and pH3.0. That of Quercus species was high in the order of control, pH4.5 and pH3.0 in May; in June, control, pH3.0 and pH4.5, especially, within infrared wave length range, control, pH4.5 and ph3.0 .

INTRODUCTION

Air pollutants are made by burning fossil fuel and then dissolution of them into the precipitation causes acid rain. Although it can function as a resource of nutrients for soil and vegetation in an ecosystem(Evans,1984), it causes increment of soil acidity, leach of nutrients in soil and plant, and visible damages(Kim, 1986).

In recent decades, huge forest areas in developed countries such as Germany have been damaged by acid rain through air pollution. The damages of acid rain were already reported in Korea(Kim, 1986).

Because objects may have different reflectance throughout scanned wave length range, they can be classified using satellite image. Thus, vegetation can be classified effectively through the measurement of reflectance pattern and any changes on it can be monitored (Goetz et al., 1983).

The objectives of this study are to find out reflectance patterns in two tree species, to collect a basic data for effective monitoring of forest damages caused by acid rain, and to increase the availability of satellite image data from LRC sensor on KOMPSAT.

METHODS

Three seedlings, which are two or three years old, for a specise were selected in pines and oaks, and were planted into each pots. Three acidity levels of the artificial acid rain -

control, pH4.5 and pH3.0- were sprayed at the amount of 500ml once in every two days.

Spectral reflectance data for treated seedlings were collected once in a month by using GER 1500(350-2500nm) or LI 1800(300-1100nm) Spectroradiometer. The each data was measured three times in a collection.

Spectral reflectance data was transformed in graph and compared between measurements by acidity level, month by month.

RESULTS AND DISCUSSION

1. Monthly Spectral Reflectance Patterns by Acidity Level

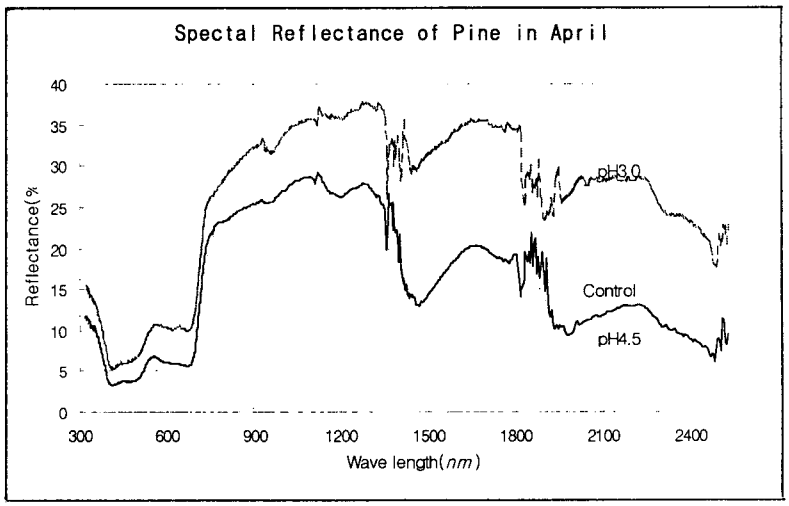

Fig. 1. Spectral Reflectance of Pine by Treating Artificial Acid Rain in April

Fig.1 represents spectral reflectance patterns of pines in April. Because it was still at the beginning of growing seasons and they did not grow vigorously, they had somewhat lower reflectance than a usual one. Throughout the whole wave length, reflectances by acidity level were high in the order of pH3.0, control and pH4.5. Especially, the reflectant difference among acidity levels in red band is shown obviously. It seems that the different reflectances result from the variance among the individual seedlings rather than from the difference by acidity level.

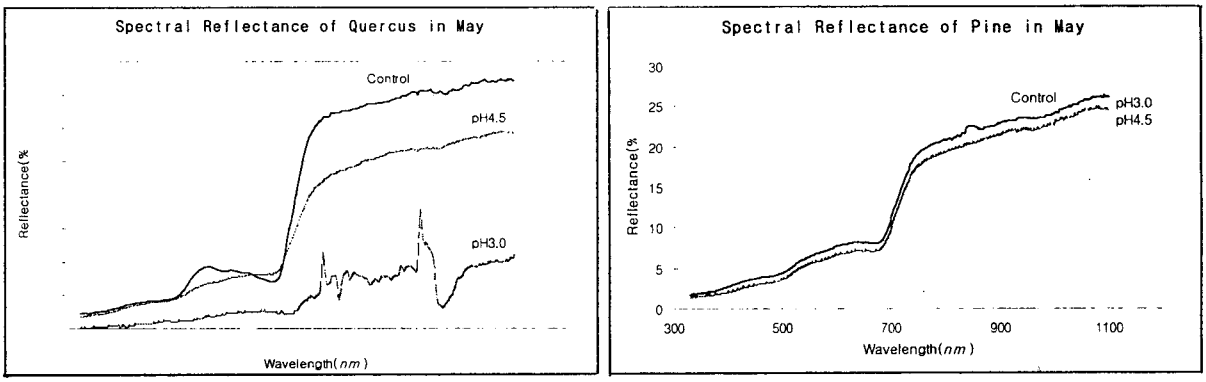

Fig 2. Spectral Reflectance of Pine and Quercus by Treating Artificial Acid Rain in May

Fig. 2 shows spectral reflectance patterns of pines and oaks in May. Reflectances of oaks are higher than those of pines and reflectant variance of oaks is larger than that of pines. These seem to result from the fact that new leaf development in oaks is not synchronouse. Control had begun to leaf earlier than another acidity levels. The higher acidity makes the seedlings leaf later. Kim(1992) reported that artificial acid rain did harm to seedling's growth and , especially, the higher acidity the heavier leaf damage.

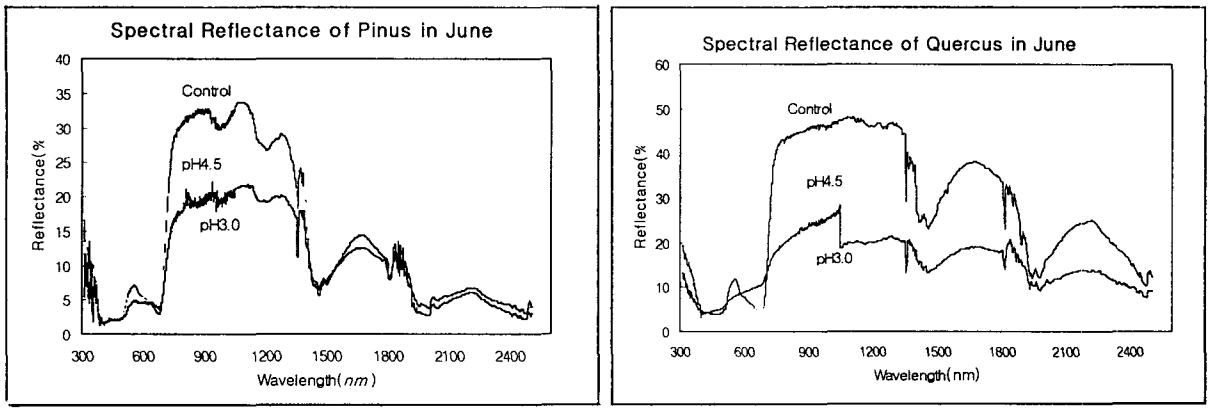

Fig 3. Spectral Reflectance of Pine and Quercus by Treating Artificial Acid Rain in June

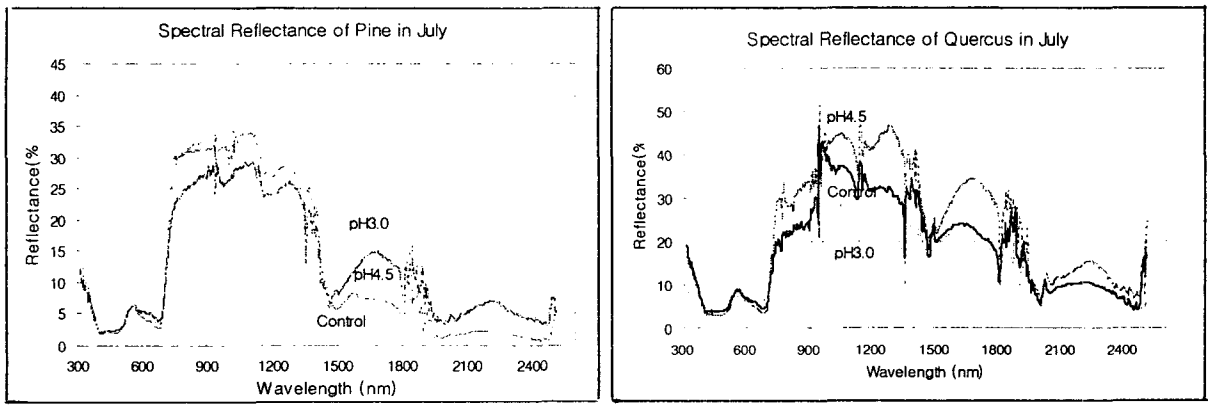

Fig 4. Spectral Reflectance of Pine and Quercus by Treating Artificial Acid Rain in July

A typical reflectance pattern in June, which is a growing period of plants, is shown in Fig. 3. While pines' reflectances within visible were almost same, those within near infrared reduced as pH level had reduced. In oaks, the variance of reflectance within near infrared is relatively large.

Variance of reflectance in July was extensively large because of unstable weather condition(Fig.4).

2. Reflectant Patterns for each bands in LRC Sensors

To explore the potential to utilize image data from KOMPSAT in forestry, it is neccessary to check which bands are effective to represent damages on forest by acid rain. Therefore, the reflectances measurents by Spectroradiometer for each LRC's bands were calculated to average. Reflectant patterns by acidity level were compared each other.

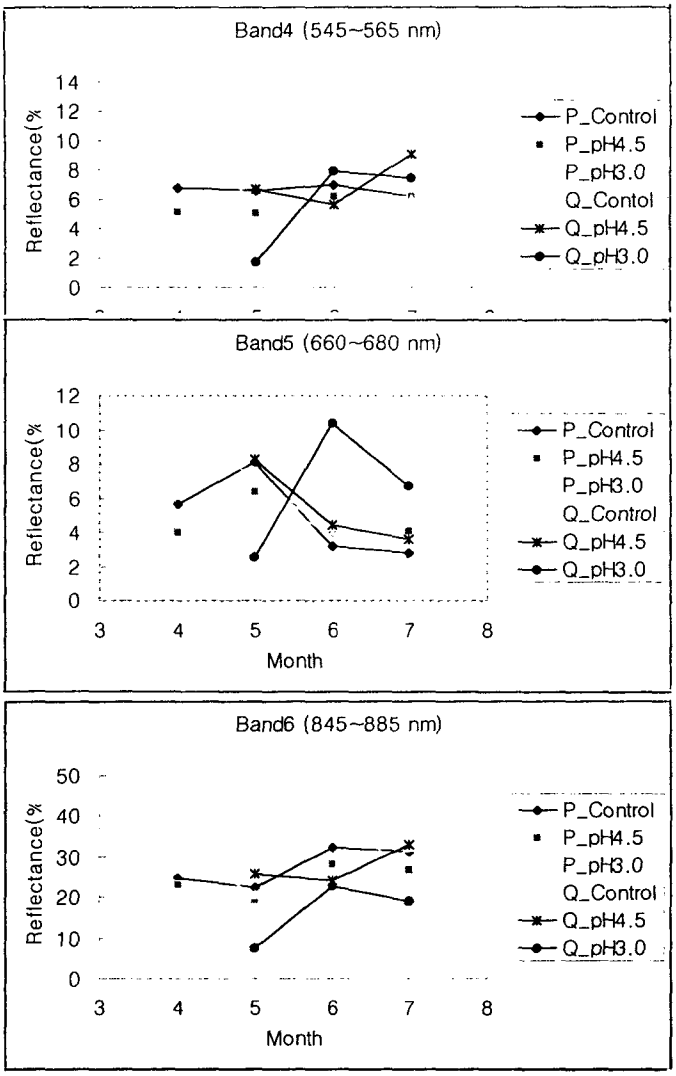

Fig. 5. Spectral Reflectance of LRC Wavelength by Treating Artificial Acid Rain

Fig.5 represents monthly spectral reflectance within three of LRC bands by acidity levels. As both of pines and oaks grow vigorouse, the variance among the reflectances reduces. Relatively well to another bands, reflectance in June represents effects by acid rain within both of band4 and band6. Further data collections are needed to perform in order to get enough data to define band characteristics of LRC sensors and spectral reflectance patterns by acidity level.

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