Data Analysis of Cold Rice Blast Based on Near Infrared Spectroscopy

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Feng Tan [1] Xiaodan Ma [1] Chun Wang [2※] Tingyi Shang [1]

1 College of Information Technology Heilongjiang Bayi Agricultural University DaQing China 163319

2 College of Engineering Heilongjiang Bayi Agricultural University DaQing China 163319

Abstract. In order to overcome the low diagnostic accuracy of traditional blast visual defects, set cold rice blast for example, four data groups has been acquainted through near infrared spectroscopy, the first group is healthy and diseased planting stock; the second group is three diseased levels of leaf blast; the third group is five diseased levels of grain blast; the forth group is four diseased levels of panicle blast, according to the analysis , we can know that different circumstances of plants had their own near-infrared spectral bands which made the preliminary basis for real-time detection of cold Rice blast.

Keywords: Cold Rice; Blast; Near Infrared Spectroscopy; Disease Detection

1 Introduction

The rice planting area in China accounts for 1/4 of the food crops area, While the production close to 1/2 of the national's total grain output, and over 1/2 of the commodity, So rice plays a very important role in China's grain production. Rice blast [1]is one of the most important diseases in rice production ,Widely distributed in the world rice area in the whole growth period of rice causing widespread damage. Blast is a major disease in the production of rice production in cold land, Year of the disease cuts 23% of the rice production in cold, severe up to 45%, or even never

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[1] Corresponding Author：Wang Chun（1963-）, PhD Supervisor Professor

produced. Among them, the rice leaf blast and the rice ear and neck blast caused the largest loss. The annual incidence rate of leaf blast is 40-50%,Up to 80% when it is very serious; Up to 50% of neck blast. Traditional method of classification detection of rice disease resistance is based on visual concept of the disease by plant protection experts, it has drawbacks of subjective factors, and time-consuming. Therefore, there is an urgent need for a new technology to solve the technical problems in cold blast resistance classification, In modern agricultural production, there's an increasingly high demand for the frequency, speediness and accuracy of work in the forecast on cold blast, classification and the evaluation of prevention work. This claims a new research of cold rice disease diagnosis technology.

In recent years, for the advantages of non-destructive, fast and accurate , multi-spectral，The technology [1-5] is more and more used in the field of plant diseases detection. Adams et al [6] used 550nm, 650 and 750nm spectral image to detect trace elements in vegetables; Bravo [7] detected the wheat yellow rust in the visible and near infrared bands ;Yang Z et al [8] ,with the help of the 16 band spectral analyzer studied the wheat canopy invasion which was Infringed by Schizaphis germanium .In 1994,Qi-Ying Lin [9] and other Scientists imposed a laser Raman spectrometer to take a Raman scattering experiment towards the clusters of rice dwarf virus in three samples which were purified ,The results showed that the intensity of different viruses is different. mechanism of action which the Small molecule cysteine stay in the silver surface, Hao Yaqiong 2002 [10] using surface-enhanced Raman scattering discussed and studied the adsorption method, the use of molecular spectroscopy lays the foundation that explores the mechanism and further improve the enzyme activity. (In)2002, Cheng Hongyan [11] found that C60 derivatives which its Raman spectra is significantly different from the original in Raman spectroscopy study ,Analysis of the emergence of organic functional groups makes the C60 changes the molecular structure.

In 2003 Yu duowei [12] utilized Raman spectra analysis whether the acid induce the part of the DNA purine, pyramiding fall off,And whether the reasons for the protonated pyramiding purine could be stronger than the relevant. In 2003, Exotic [13] and others used the Raman scattering method to study the quality of the SiC single crystal ,which can improve Lely.they found that the structure of the sample found is 6H-SiC,also pointed out that more defects exist in the sample, gave the

Raman spectra of SiC within 100-4000cm-1 for the first time, and detected the crystal structure successfully with the Raman spectroscopy. In 2010, Kang Yi Pu [14] and other people used the portable Raman spectrometer to measure the silver membrane Xoo seven races of the surface enhanced Raman spectroscopy (SERS),The results showed that the seven races of the SERS spectra in the peak position and relative intensity of the peak which has many differences, They Proved that this method can quickly and easily test the different Xoo races.Wu Di et al [15] technology achieve the early detection of Botrytis cindered eggplant leaves with the near infrared spectroscopy. Infected with the blast of cold rice, The changes of their Agencies within the physiological and external shape of each band is bound to cause the differences in spectral reflectance characteristics of change. Based on a combination of these changes，we can create a model for disease diagnosis. In this paper, We combine the advantages of the spectral analysis and image processing technology, adopt multi-spectral vision technology to explore identified classification test on disease resistance of rice varieties, The work provide technical support for automated identification .

II Materials and methods

2.1 Sample selection

Experimental samples were taken from experimental plots of rice in cold region in Heilongjiang Reclamation, during the experiment, four groups of experimental samples were selected, healthy and infected plants in different parts of plants; infected leaves of the three disease rating; infected grain level of the five diseases; infected stems of four disease rating.

2.2 Experimental apparatus

This experiment use WQF-600N FT-NIR spectrometer, the instrument is a measurement of material absorption of infrared radiation (or transmittance) of the analytical instruments. Since each substance has a characteristic absorption spectrum - there are only certain wavelengths to absob while other wavelengths is not absorbed, so the characteristics of the absorption spectra can be used to carry out qualitative analysis of substances. In addition, the total amount of material is proportional with the absorption, the absorption spectra can also make use of quantitative analysis of substances. Wave number range: 3300cm-1 ~ 10000cm-1; resolution: better than 4cm-1; wave number accuracy: better than the resolution set by the 1 / 2; transmission repeatability: 0.5% T; 100% T line of the letter noise ratio: 4300cm-1 ~ 4400cm-1, 32 scans (equivalent to 1 minute measurements), S / N better than 10000:1 (RMS value); splitter: CaF2; detector: DTGS (Pubs, InGaAs can beelection); source: air-cooled tungsten light source; Data Systems: General computer, connect inkjet printer or laser printer can output high-quality spectra; Software: Chinese Windows operating system under the common operating software systems, including spectrum acquisition offer, spectral transform, spectral processing, spectral analysis, construction the conventional mode of operation, and all other functions, which can provide both chemo metric software. Working with a lot of third party software in WINDOWS run together under the same time, users can also develop new operational procedures of spectral data in their needs .

Data Acquisition and Analysis

Ⅲ Healthy plants and infected plants in different parts of data collection

In order to study cold Blast spectral characteristics, In the Experiment, We first study the different parts between healthy plants and infected plants, stems, leaves and grains. The spectral characteristics is Obtained by near infrared spectroscopy instruments projection . The result is shown in Figure 1 and Figure 2 below.

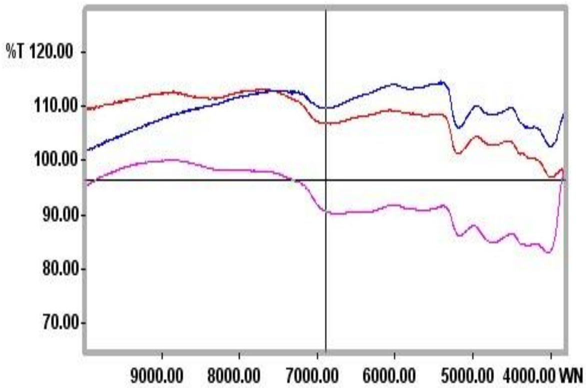

Figure 1spectrum contrast between healthy stem, leaf and grain

figure 1 shows what we select is rice plant stems, leaves and grains were compared with the spectrum, from which we can see that the transmittance of the spectrum of three parts are not in the same position; Figure 2 shows the spectrum of plant stems, leaves and seeds with a serious blast of damage. Figure 1 and Figure 2 shows the comparison which can be seen that stems transmission are relatively low, while the leaves and transmittance spectra of grain almost the same intensity, Wave number from the variation of transmittance on the stem and the transmittance spectrum of grain is in good agreement.

3.1 blast leaves of three levels of data collection Disease

According to different diseases of rice plant of infrared spectrum acquisition, the collected results are shown in Figure 3.Three lines from top to bottom in the figure correspond to the three diseases of rice plants in order to reduce the transmittance spectrum. It can be seen from the figure, leaves transmittance in the race’s serious incidence is the strongest, Bottom curve is the transmittance spectra(of) healthy plants, and its transmission strength is the weakest. And from the general trend, as the wave number decreases, the difference become smaller between transmission intensity, and local transmission in a large wave number is relatively large different In other words, in the near infrared band, as the wavelength increases gradually disease transmission in different degrees of intensity become not obvious.

when it is close to 4000nm，transmission rate of diseased leaves and no disease is very close.

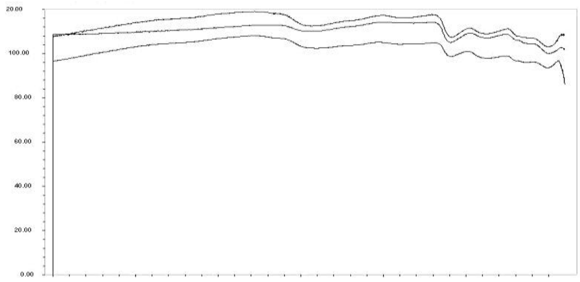

Figure 2 spectrum contrast between diseased stem, leaf and grain

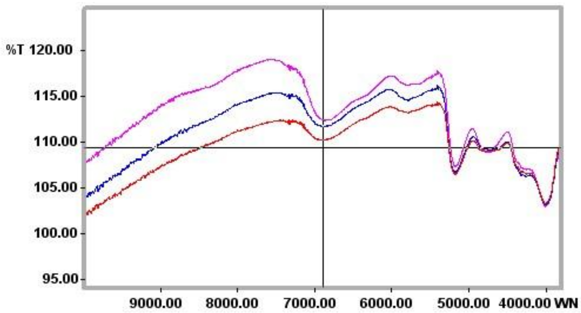

Figure 3 Degree Comparison of three leaf blast disease

3.2 Five diseased levels of infected seed of data collection

Figure 4 shows the near infrared transmittance spectroscopy of the five grains ,Contrast can be seen in Figure 3, The absorption peak in Grains is very high consist with rice leaves. The reason is that leaves organic components and grain shell organic components is very similar so the absorption peak location will be the same. Although part of the near-infrared light into the leaves or seeds inside, the grain ,is also the seed inside part of the internal components and the internal components inside leaves are not still change, so the absorption spectrum of the intensity at each wavelength is different. It can be seen from Figure 4, five different grains in case of blast injury of the transmission spectrum do not show very good consistency in parallel. according to analysis, it is because in the acquisition of spectrum, There are too many grains entering into the loading room, and with random arrangement grains, also the near infrared spectrometer is smaller than the grain size of the spot, so every time in the collection process, light pass through the outer surface of grain and incident angle of the interface is different, They lead to the light penetration depth in the grain interior change, so the curve characteristics in the Characterization of grain display inconsistency.

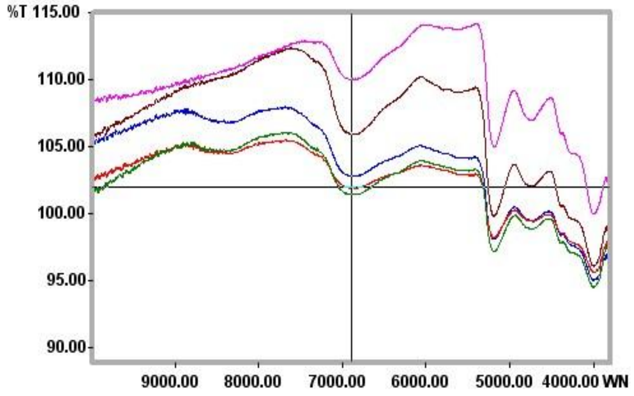

Figure 4 Blast Grain contrast between five infected level

From the analysis view, although the five kinds grains of spectral curves are irregular, due to different levels of disease, in some bands they have relatively strong discrimination, and also five curves do not cross too many points. If the differential sum rule act on the entire point ,it can eliminate part of the interference-free spectrum.

3..3 Four diseased levels of Infected stems of data collection

It can be seen from figure 5,like the leaves and seeds, the stem has a feature that the transmission of serious rice blast is higher than that of normal plants in the range of 4000WN ~ 10000WN.Besides,the regularity of the stem and seed is better than that of leaf, differences of stems in 40000WN ~ 70000WN are more obvious while differences in grains are more obvious in the 7000WN ~ 10000WN.In race's growing process, the changes of stem and seed are slight, only change with some reasons such as illness or under the influence of external transformation.Therefore,it is more reliable and more regularity among detection of the disease. The leaves and the light, moisture and other factors related larger, such as leaves in absence of sufficient water performed significantly, so the regularity is relatively poor. Although the parallel spectrum and regularity are not strong, the same conclusion still can be drawn from the analysis. Integrated to analyze ,It will be more effective to diagnose rice blast, and more easier to analyze quantitatively of the rice blast, if it is possible to analyze the rice blast combine with the strongest differences of stem, leaves and seeds.

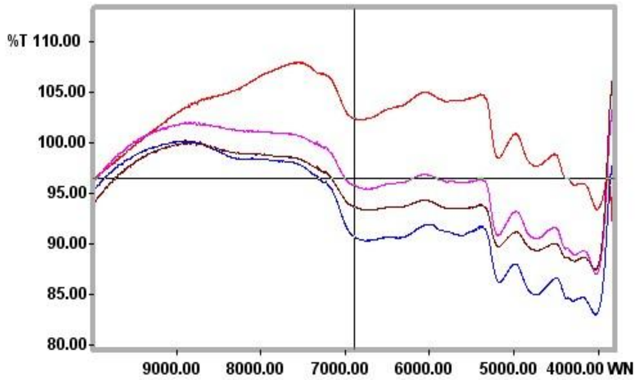

Figure 5 Panicle blast contrast between three Panicle level

The transmission of spectra can be collected to the appropriate map data. Table 1 shows the spectral data comparison of leaves between serious leaf disease and disease-free. It can be seen that larger wave number, the two large difference appears transmission intensity, and where is the small wave numbers becomes smaller. The difference reaches the maximum value in the 7899WN from the difference of transmission intensity view. When we subtract the two spectra ,we find that it has the largest difference of 6.106 in the 7565WN. It also indicates that the largestly different wavelength must concern the wave number 7565.

Ⅳ Error sources

The spectroscopy which is collected by near infrared spectrometer will have a slight error compared with the actual spectroscopy, mainly from the following:

1) The requirement which the moving mirror shifts from negative infinity to positive infinity leads to the ends of the interferogram data suddenly cutting off and then gets the incomplete data when the interference spectrum is acquired,due to the the actual moving distance of the moving mirror spectrometer.

2) when the interferogram is changed to the Spectrogram,the compensation of incomplete data (apodization) also make the peak distortion, resulting in error;
3) The transform used for a fast algorithm of discrete generalized fourier transform, will lead to the error between the data and continuous fourier transform.

Ⅴ Summary

this study conducted qualitative analysis of rice in cold land. there are four groups of experimental samples, namely,different parts in healthy plants and infected plants;three disease levels of infected leaves;five disease levels of infected grains;four disease levels of infected stems;The results showed that the plants have their own near-infrared spectral bands under different circumstances,the conclusion lays an early foundation for
real-time detection of rice blast cold disease using the near infrared spectroscopy technology.

Table 1the spectrum constract between healthy and diseased lamina

	Wave number	Transmittance	Wave number	Transmittance
Diseased leaves	9898	108.255	9403	111.691
	8898	114.439	8403	116.055
	7899	118.233	7404	118.661
Heathy leaves	9898	103.375	9403	106.256
	8898	108.708	8403	110.387
	7899	112.245	7404	113.045
	6900	110.271	6404	112.369

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