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基于高光谱图像的稻瘟病抗氧化酶值早期预测

Early prediction of antioxidant enzyme value of rice blast based on hyper-spectral image

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中文关键词：图像处理,作物病虫害,模型,抗氧化酶,早期预测

英文关键词:image processing plant diseases models antioxidant enzyme incubation period early detection

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中文摘要:

水稻稻瘟病是危害水稻种植的真菌病害，早期预测病害源头是防治稻瘟病的有效手段。在病害症状显证之前实现早期预测，能从源头上更好地遏制病害，阻止分生孢的大量繁殖，达到稻瘟病早期防治的目的。该文通过连续分时段测定水稻稻瘟病潜育期稻苗的高光谱图像和相对应的稻苗抗氧化物酶SOD（superoxide dismutase，SOD）值，利用高光谱图像处理技术结合化学计量学方法，建立稻瘟病潜育期内稻苗冠层高光谱图像与抗氧化酶SOD酶活之间的关联预测模型。结果表明，基于全光谱信息建SOD酶值预测模型，模型具有较好的预测效果，校正集相关系数RC=0.9921，校正集均方根误差RMSEC= 5.135 U/g；预测集相关系数RP=0.9274，预测集均方根误差RESEP=34 U/g。出于建立更为广泛应用的稳定的多光谱成像检测系统的需要，基于选定的6个特征波长526、550、672、697、738和747 nm建立了简化的SOD酶值预测模型，该模RC=0.6945，RMSEC=17.92 U/g；RP=0.5488，RESEP=22.0085 U/g。研究表明，在水稻稻瘟病潜育期内，通过高光谱图像反演相应的SOD酶活性信息，推断水稻稻瘟病病害迫程度信息是可行的。

英文摘要:

Abstract: The rice blast is a fungal disease which can damage the rice cultivation and reduce the yields at least by 40% to 50% in the worst period. The early detection of rice b is an effective mean to control the disease spread. The present paper is concerned with the study of the early prediction of antioxidant enzyme value SOD of rice blast based on hy spectral images within the incubation period. The aim of study is to realize the rice blast early detection through monitoring the antioxidant enzyme SOD activity variation. The hy spectral system operated in the visible and short-wave near infrared range was applied for non-invasive determination of antioxidant enzyme value SOD. The hyper-spectral image rice canopy were obtained in six separated time periods (0, 12, 24, 36, 48, 60 hours) after vaccination, and the antioxidant enzyme value SOD of canopy in different inoculation time measured using chemical method synchronously. For each hyper-spectral image, the rice seedlings were extracted using threshold segmentation method and average spectrum of seedling were calculated. The each average spectrum was considered as a sample, therefore, there are 150 hyper-spectral images which would product 150 samples. The all of sam were divided into two sets: calibration sets which included 100 samples and prediction sets which included 50 samples. The hyper-spectral images were used to construct predicti model of antioxidant enzymes SOD activity with chemometrics methods. The different spectrum pre-processing methods were applied, including the first derivative, the second derivative, Savitzky-Golay smoothing and Direct Orthogonal Signal Correction (DOSC). After pre-processing, the Partial Least Square (PLS) method based on full spectrum was u train the calibration sets and predict the predictive sets. The results showed that the DOSC-PLS could produce the best prediction. The DOSC-PLS model yields a reasonable accu with RC= 0.9682, RMSEC = 6.225 U/g for calibration and with RP=0.8665, RESEP = 12.82 U/g for prediction respectively; Instead of using a wide range of spectra, the number of wavebands was reduced for more stable, comprehensive and faster model in the subsequent multispectral imaging system. From this point of view, important wavelengths were selected to simplify the model. On the basis of analysis of PLS, the loading method was used to select feature wavelengths base on the first five principal components which cove 92% information of original spectrum. Six wavelengths (526, 550, 672, 697, 738 and 747 nm) were selected as the feature wavelengths for SOD prediction with PLS regression. With identified reduced number wavelengths, the RC=0.6945, RMSEC=17.92 U/g for calibration and RP =0.5488, RESEP = 22.0085 U/g for prediction were achieved. In spite of the predic ability based on feature wavelengths was depressed, but the feasibility of simplified model has been confirmed. The subsequent study will take a closer look at the improvement o prediction ability based on a few feature wavelengths. All in all, the results shown that it is feasible to predict SOD enzyme activity variation for evaluating stress degree of rice bl based on hyper-spectral images within the incubation period.

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