研究论文

利用高光谱参数预测水稻叶片叶绿素和籽粒蛋白质含量

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摘要　　通过温室水培试验，测定2个品种、4个供氮水平的水稻剑叶在抽穗期后不同生育期的高光谱反射率，及对应叶片的叶绿素、全氮以及籽粒蛋白等生化组分的含量。结合水稻光谱曲线特征以及氮素营养胁迫特点，利用统计相关分析法，研究了9个植被指数和8个微分参数与叶片叶绿素、全氮含量的相关性，结果表明这些相关性均达到正显著水平。尤其是利用绿峰550 nm附近的反射率构建的植被指数GNDVI与叶绿素含量、R850/R550与全氮含量之间的相关性最好，相关系数分别为r=0.876 1，r=0.888 1(n=16)。微分参数中，以红谷面积SRo与叶绿素含量、差值归一化指数EGFN与全氮含量之间相关性最好，相关系数分别为r=0.854 4，r=0.858 4 (n=16)。利用基于"秀水110"构建的相关模型，可以较为准确地预测"丙9914"叶片叶绿素、全氮含量。其中利用GNDVI和SRo参与构建的相关模型可以较为准确地预测"丙9914"在收获期籽粒蛋白含量，预测值与实测值之间具有较好的相关性，拟合度分别为0.991 4和0.994 2 (n=4)。说明用高光谱参数预测水稻叶片叶绿素含量及籽粒蛋白质含量是可行的。

关键词　　水稻　高光谱参数　叶绿素　蛋白质　相关分析

分类号　S511

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Hyperspectral Variables in Predicting Leaf Chlorophyll Content and Grain Protein Content in Rice

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Abstract　A green house experiment was conducted to investigate the relationships between the flag leaf hyperspectral reflectance and the leaf chlorophyll content as well as the grain protein content in solution-cultured rice. Two rice cultivars （"Xiushui 110" and "Bing 9914"） were grown under four nitrogen levels during period of July 2003 to October 2003. The flag leaf hyperspectral reflectance were measured under laboratory conditions with an ASD FieldSpec Pro FRTM at four different developmental stages after heading. The contents of chlorophyll and total nitrogen in the leaves, and the grain protein content were determined. The relationships between nine existing vegetation index and eight first derivatives and the chlorophyll content as well as the total nitrogen content in leaves were analyzed using statistical models. As a result, the hyperspectral variables were significantly correlated with the chlorophyll content and the total nitrogen content. GNDVI was correlated significantly with the leaf chlorophyll content and R800/R553 with the leaf total nitrogen content, r=0.8761 and r=0.8881 (n=16), respectively. The correlations between SRo and the chlorophyll content and that between EGFN and the total nitrogen content were the highest, r=0.8544 and r=0.8584 (n=16), respectively, as the first derivatives were correlated with the leaf chlorophyll and total nitrogen content. The mathematical model based on "Xiushui 110" could successfully be used in the prediction of the leaf chlorophyll and total nitrogen content in "Bing 9914" leaves. Based on the established model, GNDVI and SRo could be used to predict the grain protein content in "Bing 9914" at the harvesting stage, R^2=0.9914 and R^2=0.9942 (n=4), respectively. The results suggested that the hyperspectral variables could be used to estimate the leaf chlorophyll content, the leaf total nitrogen content and the grain protein content in the solution-cultured rice.

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