丁永军,李民赞,安登奎,李树强.基于光谱特征参数的温室番茄叶片叶绿素含量预测[J].农业工程学报,2011,27(5):244-247

基于光谱特征参数的温室番茄叶片叶绿素含量预测

Prediction of chlorophyll content using spectral response characteristics of greenhouse tomato

投稿时间：8/28/2010 最后修改时间：11/2/2010

中文关键词: 温室 叶绿素 光谱分析 预测 光谱特征参数 番茄

英文关键词:greenhouse NIR spectroscopy forecasting feature parameters chlorophyll tomato

基金项目:国家自然科学基金（30871453）、（U0931001）和高等学校博士学科点专项科研基金（20100008110030）联合资助。

作者	单位
丁永军	1.“现代精细农业系统集成研究”教育部重点实验室，中国农业大学，北京 100083；2. 兰州城市学院信息工程学院，兰州 730070
李民赞	1.“现代精细农业系统集成研究”教育部重点实验室，中国农业大学，北京 100083；
安登奎	1.“现代精细农业系统集成研究”教育部重点实验室，中国农业大学，北京 100083；
李树强	1.“现代精细农业系统集成研究”教育部重点实验室，中国农业大学，北京 100083；

中文摘要:

为了快速、准确估测温室番茄叶片叶绿素含量，提升作物精细管理水平，利用光谱分析技术研究了温室番茄不同生长阶段叶绿素含量和响应光谱的相关性，在幼苗营养生长阶段叶片叶绿素含量呈增长趋势，到移植50天前后达到最大值，在此期间反射光谱的红边会向红外方向（长波）偏移，同时绿峰向蓝光（短波）方向偏移，绿峰幅值减小。从结果期开始叶绿素含量呈下降趋势，而红边、绿峰及绿峰幅值向相反方向变化。为了定量分析叶绿素含量和叶片反射光谱间的关系，从自定义的68个光谱特征参数中提取了7个能反映叶绿素含量变化的最优参量，并使用逐步回归、岭回归、主成分分量回归和偏最小二乘回归消除了最优参量的多重共线性，建立了叶绿素含量预测模型，其中岭回归模型精度最佳，均方根误差（RMSE）为0.406，决定系数(R2)为0.839。

英文摘要:

In order to estimate chlorophyll content of greenhouse tomato leaves fast and accurately and improve the precision management of tomato crop, this research studied the correlation of the chlorophyll content and spectral response at different growth stages of greenhouse tomato. Leaf spectral measurements from each treatment (4 N levels: 0%, 33.3%, 66.6%, 100%) were taken in the greenhouse using ASD FieldSpec HH. Chlorophyll content of tomato leaves were measured by alcoholic-acetone extraction in chemistry lab. It was found that Chlorophyll content of tomato leaf was increasing continuously to the maximum 50 days after the transplantation, while red edge moved to direction of NIR(long wave), green peak position moved to direction of blue light(short wave) and green peak amplitude decreased. The chlorophyll content would decrease after fruiting stage, while red edge, green peak position and its amplitude moved to the opposite direction. For quantitative analysis the relationship between chlorophyll content and spectral response, red edge parameters (Sred(area of red edge), Dred (amplitude of red edge) and Pred (position of red edge)) in the first derivative reflectance curve were obtained at bands of 680 nm to 760 nm. Similarly, blue edge, green peak and red valley parameters were defined to reflect spectral character. Vegetation indices have been used extensively to estimate the vegetation growth status. So the following wavelength were used for developing RVI,NDVI and ARVI index: l440 nm, l500 nm, l550 nm, l680 nm, l770 nm, Pblue (position of blue edge), Pyellow (position of yellow edge), Pred (position of red edge), Pgreenpeak (position of green peak), Predvalley (position of red valley). Seven optimal spectral characteristics parameters were chosen with the method of Karhunen-Loeve from the above-mentioned 68 self-defined feature parameters. At last, stepwise multiple regression (SMLR), principal component regression (PCR), ridge regression (RR) and partial least squares regression (PLSR) were used to develop the prediction models of the chlorophyll content of tomato leaf. The best model was obtained by RR. Root MSE was 0.406 and R-Square was 0.839.

查看全文 下载PDF阅读器

关闭