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除草剂胁迫下大麦叶片丙二醛含量的光谱快速检测方法

Rapid detection of malondialdehyde in herbicide-stressed barley leaves using spectroscopic techniques

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中文关键词：近红外光谱,偏最小二乘法,支持向量机,丙二醛,大麦

英文关键词:near infrared spectroscopy least squares approximations support vector machines MDA barley

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中文摘要:

丙二醛（MDA）是植物衰老和抗性生理研究中的一个重要指标，传统检测方法程序复杂，检测费时。该研究应用近红外光谱技术实现了除草剂胁迫下大麦叶片丙二醛（MDA）含量的简便、无损、快速检测。采集75个大麦叶片样本的近红外光谱数据，比较了Savitzky-Golay平滑（SG）、变量标准化（SNV）、多元散射校正（MSC）等7种预处理方法，建立了大麦叶片丙二醛含量预测的最优偏最小二乘法（PLS）模型，将PLS提取的特征向量（LV）作为最小二乘-支持向量机（LS-SVM）模型的输入变量，建立了LV-LS-SVM模型。选用回归系数（RC）方法提取原始光谱的特征波长，将其分别作为PLS、MLR和LS-SVM的输入变量建立相应模型。将相关系数（r）和预测集均方根误差（RMSEP）作为模型的主要评价指标。结果表明，LV-LS-SVM模型效果优于PLS模型，LV-LS-SVM模型在SNV及MSC预处理后预测效果相同，其预测的r和RMSEP分别为 0.9383和10.4598，获得了满意的预测效果。说明应用光谱技术检测大麦叶片中MDA含量是可行的，且预测精度较高，为大麦生长状况的大田监测及除草剂胁迫对大麦抗性等生理信息的快速检测提供了新的途径。

英文摘要:

Malondialdehyde (MDA) is an important indicator for research of plant senescence and resistance. Traditional detection method is complex and time-consuming. In this study, near infrared spectroscopy was used to detect the malondialdehyde (MDA) in herbicide-stressed barley leaves as a convenient, non-invasive and rapid method. A total of 75 barley leave samples were collected for near infrared spectral scanning. Seven spectral preprocessing methods were compared for a better prediction performance, including Savitzky-Golay (SG) smoothing, standard normal variate (SNV), multiplicative scatter correction (MSC) and so on. The optimal partial least squares (PLS) model was obtained for the detection of MDA in barley leaves. The latent variables (LVs) extracted by PLS were also applied as input variables to develop leas squares-support vector machine (LV-LS-SVM) model. PLS, MLR and LS-SVM models were developed using EWs selected by regression coefficient. The correlation coefficient (r) and root mean square error of prediction (RMSEP) were applied as the indices of model assessment. The results indicated that LV-LS-SVM mode was better than PLS model, and the LV-LS-SVM model by SNV and MSC preprocessing methods achieved the same prediction performance with higher correlation, which r and RMSEP were 0.9383 and 10.4598. An excellent prediction precision was achieved. The results demonstrated that near infrared spectroscopy was successfully applied for the rapid and high accurate detection of MDA in herbicide-stressed barley leaves, and this supplied a new approach for on field monitoring and resistance detection of biological information of barley.

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