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烤烟成熟鲜烟叶生化组分高光谱估算方法筛选

Selecting optimal hyperspectral method for estimation of biochemical concentration of FCV tobacco leaf at the maturity stage

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作者	单位
李佛琳	南京农业大学江苏省信息农业高技术重点实验室，南京 210095;国家农业信息化工程技术研究中心，北京 100089
赵春江	国家农业信息化工程技术研究中心，北京 100089
刘良云	国家农业信息化工程技术研究中心，北京 100089
王纪华	国家农业信息化工程技术研究中心，北京 100089
曹卫星	南京农业大学江苏省信息农业高技术重点实验室，南京 210095

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中文摘要：

为实现实时无损快速预测鲜烟叶的品质生化组分、筛选估算生化组分最佳的方法，使用ASD Fieldspec FR2500对烤烟成熟鲜烟叶进行了反射率、透射率光谱测定和常规生化组分分析。对可见近红外波段(350～1650 nm)单波段光谱和选用已有100种光谱指数共两类光谱参量进行了与生化组分之间线性函数、幂函数、指数函数共3种形式相关分析和基于决定系数的筛选。结果表明，对于叶绿素a、叶绿素b、类胡萝卜素、钾估算方法分别是Gitelson and Merzlyak2(GM_2) (R^2=0.81)、光化学指数2(PRI_2) (R^2=0.80)、Gitelson and Merzlyak2(GM_2) (R^2=0.83)、1420 nm吸收峰开始位置(λs_{1420}) (R^2=0.67)的线性拟合最优。对于总糖、比叶重、氮、烟碱最优方法分别是在532 nm反射率一阶微分线性拟合(R^2=0.54)、在1423 nm透射率线性拟合(R^2=0.45)、在666 nm反射率倒数对数一阶微分的幂函数拟合(R^2=0.44)，在1135 nm反射率倒数对数二阶微分的线性拟合(R^2=0.20)。通过筛选的光谱方法可以评估烟叶的品质状况。

英文摘要：

The goal of this work is to develop non-destructive techniques that can conveniently, rapidly and accurately assess FCV tobacco leaf biochemistry status at the maturity stage at leaf levels by selecting optimal hyperspectral method for estimation of biochemistry concentration and biophysical parameter. The data of reflectance and absorption spectra of fresh tobacco leaf were measured with ASD Fieldspec FR2500 at the maturity stage, and the parameters of biophysical and biochemistry of the leaf were collected by normal method. The correlation between spectral parameters consisting of single band reflectance, logarithm of reciprocal of reflectance, transmittance and absorption and 100 existing spectral indices selected in the visible and near-infrared spectrum(350～1650 nm), with biochemistry concentration was analyzed by using linear, power and exponential fitting. Optimal method was selected based on the strongest strength of determination coefficient. The result indicated that optimal optical methods for chlorophyll a, chlorophyll b, carotenoids and potassium concentration of leaf were respectively Gitelson and Merzlyak 2 (GM_2) (R^2=0.81), Photochemical Reflectance Index 2(PRI_2) (R^2=0.80), Gitelson and Merzlyak 2 (GM_2) (R^2=0.83), the starting position of reflectance gallery at 1420 nm(λs_{1420}) (R^2=0.67) using linear fitting. Water-solubility total sugar, specific leaf weight(SLW), total nitrogen, nicotine were respectively first derivative of reflectance at 532 nm using linear fitting(R^2=0.54), transmittance at 1423 nm using linear fitting(R^2=0.45), first derivative of logarithm of reciprocal of reflectance ($\delta\log(1/R)$) at 666 nm using power fitting(R^2=0.44), second derivative of logarithm of reciprocal of reflectance ($\delta\delta\log(1/R)$) at 1135 nm using power fitting(R^2=0.20). It is feasible to predict matter concentration of tobacco leaf by optimal optical method for spectral parameters.

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主办单位：中国农业工程学会 单位地址：北京朝阳区麦子店街41号

服务热线：010－65929451 传真：010－65929451 邮编：100026 Email：tcsae@tcsae.org

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