利用叶片反射光谱预测大豆合交98-1667干物重模型

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摘 要:通过对不同波长光谱反射率的分析,确立大豆地上部干物重的敏感波段,计算出相应的植被指数,并建立植被指数与大豆地上部干物质量预测模型。结果表明:在可见光波段范围内,合交98-1667选取510 nm和680 nm 2个波段的光谱反射率与地上部干物重的相关性呈极显著;在近红外区域,选取800 nm、900 nm和1005 nm 3个波段,其中800 nm和900 nm的光谱反射率与合交98-1667地上部干物重的相关性均呈极显著,波长为1005 nm时呈显著相关。4种植被指数经过比较RVI相关性最好。通过RVI植被指数建立模型,$Y = 4.0216 \times RVI^2(900,680) - 99.106 \times RVI(900,680) + 625.36$,能较为准确预测大豆地上部干物重。

关键词:植被指数;光谱反射率;干物重;估测模型

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Predicting Model of Dry Matter Accumulation of Dwarf Soybean Hybrid 98-1667 by Leaf Reflectance Spectra

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Abstract: The sensitive wavebands were determined by analyzing relationship with spectra reflectance in different wavebands and the dry matter accumulation in above-ground part of soybean, and the prediction model was established. The results showed that there were highly significant correlations between spectra reflectance of 510 and 680 nm which selected from among visible light and the dry matter accumulation in the above-ground part of hybrid 98-1667, spectra reflectance of 800 and 900 nm in the range of near infrared light were highly significant correlated, and spectra reflectance of 1 005 nm was significantly correlated with the above-ground weight. After compared with those four vegetation indices, the RVI has the best relativity. The corresponding prediction model established by vegetation indices of RVI was $Y = 4.0216 \times RVI^2(900,680) - 99.106 \times RVI(900,680) + 625.36$, and it could be accurate to predict the dry matter accumulation in above-ground part of soybean .

Key words: Vegetation index; Spectrum reflectance; Dry matter accumulation; Estimation model

大豆植株地上部干物质的积累是大豆净光合作用的重要标志,干物质积累又是最终经济产量形成的物质基础。长期以来,常规的大豆干物质积累量主要是大田取样后进行室内测定,其结果相对准确,但费时费力、难以大面积开展,并具有一定的破坏性。由于光谱测量具有简便、快捷、非破坏性等特点,近年来植物光谱仪在植物生理、生态等方面的研究中得到广泛利用[1-5]。众多专家学者从统计学角度分析植物叶片或植株物质积累量与叶片反射光谱特征的定量关系,以植物光谱仪为手段,速测其干重[6-9]。该研究利用植物光谱仪通过筛选大豆叶片反射光谱的敏感波段,建立植被指数和地上干物重的预测模型。

1 材料与方法

1.1 供试材料

供试大豆品种合交98-1667。

1.2 试验设计

试验于2008年在黑龙江省农科院佳木斯分院试验地进行,前茬作物大豆,土质草甸土。试验小区0.2 hm^2。在样区设3个N肥试验水平,N0(不施

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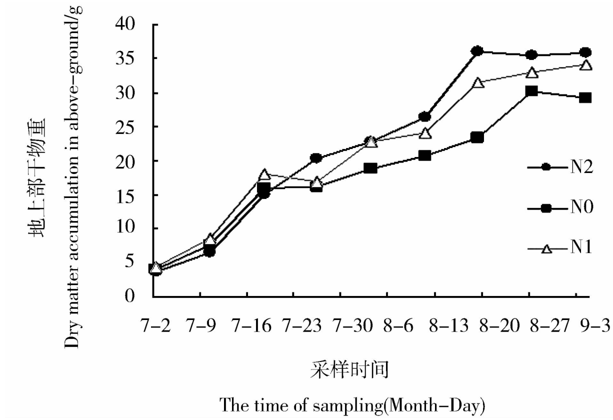

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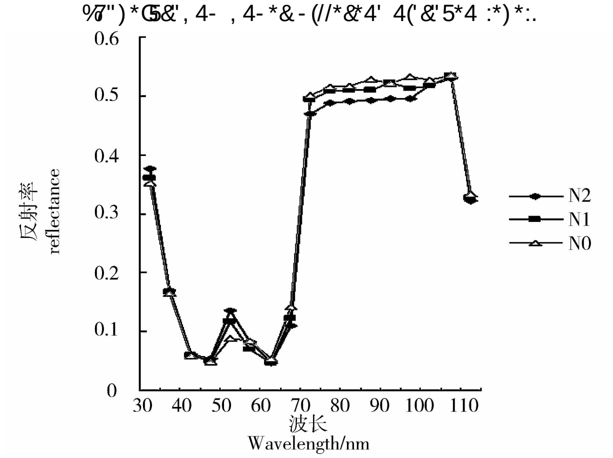

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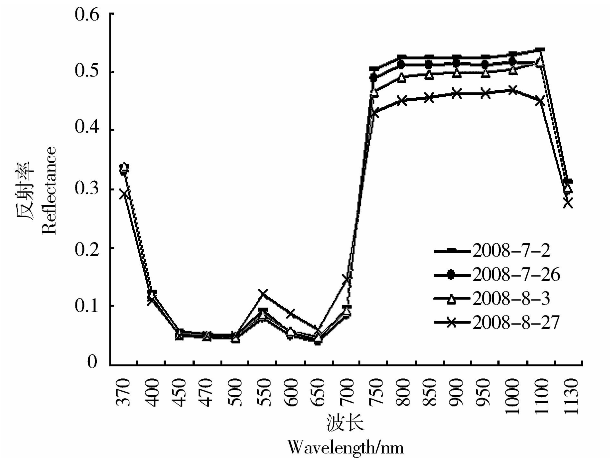

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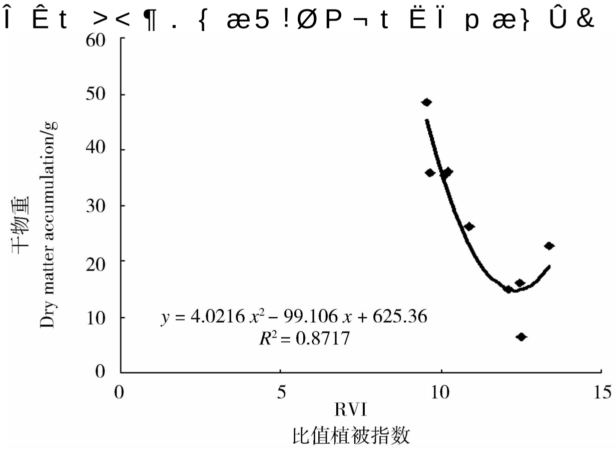

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2.5 模型的回归验证

将样区 2 在 9 个时期测得光谱反射率,代入回归方程:$y = 4.0216x^2 - 99.106x + 625.36$ 得出干物重的估测值,与样区 2 干物重的实测值进行显著性测验,结果差异不显著。

3 结论与讨论

各时期合交 98-1667 各波段总体反射比率变化趋势基本一致。其间差异在于反射比率的大小略有不同,可见大豆不同生长期,反射率光谱波形趋势基本一致,主要区别在反射率大小略有不同。

不同农作物中,光谱反射率在不同波段表现趋势大体相同,但具体选择的敏感波段有所不同[10-12]。宋开山等研究表明,冠层光谱反射率在 350 ~ 680 nm、760 ~ 1050 nm 波谱区与大豆 LAI 、地上鲜生物量相关性较大[13]。该研究对单波段光谱反射率及其衍生的植被指数与大豆地上部干物重相关性进行了比较,植被指数较单波段反射率与干物重的相关性更高些,在可见光波段范围内,合交 98-1667 选取 510 nm($r = 0.812$)和 680 nm($r = 0.817$) 2 个波段的光谱反射率与地上部干物重的相关性呈极显著;在近红外区域,选取 800 nm($r = -0.818$)、900 nm($r = -0.804$)和 1 005 nm($r = -0.781$)3 个波段,其中 800 nm 和 900 nm 的光谱反射率与地上部干物重的相关性均呈极显著,1 005 nm 光谱反射率对大地上干物重呈显著。其中 900 nm 和 680 nm 组合的比值植被指数预测地上部干物重的效果最好,与大豆干物重之间存在较为理想的多项式函数关系,准确性较高,将 RVI 代入回归方程得到如下模型:

$$\text{Weight} = 4.0216 \times \text{RVI}^2(900,680) - 99.106 \times \text{RVI}(900,680) + 625.36$$

该模型能较好的描述大豆合交 98-1667 光谱反射率与干物重的关系,且简单易行,结果较为准确地速测干物重,也为早期估测产量提供依据。但是,该试验数据量较少,且容易受试验地区土壤条件、气候条件和不同耕作栽培方式的影响,今后需做不同生态区、不同品种和不同年份的试验对研究结果做进一步的研究和证实。

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