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## 冬小麦冠层对入射光合有效辐射吸收比例的估算方法评价

### Assessment of approaches for estimating fraction of photosynthetically active radiation absorbed by winter wheat canopy

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#### 中文摘要:

目前研究估算作物冠层对入射光合有效辐射的吸收比例(fAPAR)时多采用冠层光能截获效率(fIPAR)、冠层叶面积指数(LAI)和Beer-Lambert法则、冠层光谱植被指数等信息。该文以冬小麦为例,利用田间观测数据序列(包括冠层LAI、冠层fIPAR和冠层光谱特性等方面)对各种fAPAR估算方法进行了较为全面的总结、分析、评价,以明确各法的优势和不足,为今后相关研究提供参考。结果表明,冬小麦营养生长期中fAPAR与fIPAR值较为接近,而冬小麦生殖生长期中二者差异显著;整个研究时段内,利用fIPAR估算的fAPAR结果较好;根据叶面积指数和Beer-Lambert法则估算的fAPAR在抽穗至腊熟期间结果偏小,原因在于该法不能体现穗部对光合有效辐射的有效吸收;直接借用文献记载的fAPAR~NDVI(归一化差值植被指数)函数关系估算的fAPAR在冬小麦营养生长期及生殖生长期末期均明显偏大。此外,通过将fAPAR与NDVI、比值植被指数(RVI)、土壤调整植被指数(SAVI)、修改型土壤调整植被指数(MSAVI)等常用植被指数进行相关性分析,发现fAPAR与NDVI的相关关系最强,基于田间数据证实了采用NDVI估算fAPAR的合理性。

#### 英文摘要:

The approaches for estimating the fraction of photosynthetically active radiation absorbed by crop canopy (fAPAR) include the one using the fraction of intercepted photosynthetically active radiation (fIPAR), the one by the leaf area index (LAI) and the Beer-Lambert law and the ones with the different linear or non-linear relationships between the fAPAR and the normalized difference vegetation index NDVI. In this paper, all the above fAPAR estimation methods were tested using the field data of the LAI, fIPAR and the spectral characteristics of winter wheat, with the aims to illustrate the advantages and disadvantages of them and offer references for further study. The results showed that the fAPAR was close to the fIPAR during the vegetative growth period with the green leaves dominated canopy, while a remarkable difference was found between them in the reproductive stage with the increasing leaf senescence. The approach using the fIPAR to estimate the fAPAR gave a good estimation. The approach by the Beer-Lambert law and the LAI underestimated the fAPAR from the heading to dough stages, which may be due to the absorption of photosynthetically active radiation by the green wheat stems and spikes not being included. The empirical fAPAR-NDVI relationships vastly overestimated the fAPAR during the vegetative growth period and the end of reproductive period. The correlation analysis of the fAPAR to the NDVI, the ratio vegetation index (RVI), the soil adjusted vegetation index (SAVI) and the modified soil adjusted vegetation index (MSAVI) of the wheat canopy was performed. It demonstrated that the correlation between the NDVI and the fAPAR was the best, which makes it more useful in the fAPAR estimation

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