Research on PAR and FPAR of Crop Canopies Based on RGM

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Abstract:

Photosynthetically Active Radiation (PAR) designates the spectral range of solar radiation from 400 to 700 nanometers that photosynthetic organisms are able to use in the process of photosynthesis. The Fraction of Absorbed Photosynthetically Active Radiation (FPAR) is the fraction of the incoming solar radiation in the Photosynthetically Active Radiation spectral region that is absorbed by a photosynthetic organism.

PAR and FPAR are two important variables in agricultural field. Commonly, PAR and FPAR in crop canopies are measured directly by some devices, such as SUNSCAN. The experimental results show that many factors, such as LAI(leaf area index), LAD(leaf ange distribution) and the heterogeneity of vegetation will affect the distribution of PAR and FPAR[1]. In order to understanding the exchange process of material and energy, Radiosity-Graphics combined Model (RGM)[2] is used to simulate the distribution of PAR and FPAR in canopy and some effect factors, such as the structure of canopy and sun zenith angle, can be analyze carefully.

As one of the computer simulation models, the radiosity method can take all the radiative transfer (RT) processes, such as reflection, transmission and multiple scattering into account. Mostly, it uses virtual laboratory technology and can describes the fine structures of canopy. All shadow and shading are considered in the model. Therefore, it can be taken advantage to simulate PAR and FPAR in the canopy with more precision.

Firstly, some corn scenes based on measured real structures are made[3] and PAR and FPAR of them are simulated and then compared with the measured data. They are fitting well, which can prove our model correctly. Secondly, two homogeneous discrete canopies scenes with erectophile and planophile leaf angle distribution respectively are made. Some

conclusions can be drawn according to the simulating data. (1) PAR will decrease with the height of canopy nearly exponentially. (2) Incident PAR among canopy in some height will increase with sun zenith angle. But different sun zenith angle will affect the vertical distribution of PAR much seriously for erectophile canopy than planophile one. (3) In the same way, FPAR for both scenes will increase with sun zenith angle, but FPAR of erectophile canopy increases with incident zenith angle more quickly than FPAR of planophile one. That is to say, the erectophile canopy have more sensitivity to sun zenith angle than the planophile canopy.

In conclusion, we can simulate the vertical distribution of PAR and FPAR for crop canopies accurately based on RGM, which is a good tool to analyze the structures of crop and the yield and to advise the sowing method in agriculture. It is also useful to validate and improve the remote sensing applications and products.

Keywords: Radiosity-Graphics combined Model (RGM), PAR, FPAR, corn

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