

Characterization of the relationship between quantity and quality of solar radiation in canopy under contrasting sky conditions

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Highlights: Spatial radiation distribution in tobacco canopy was measured and analyzed according to spectral composition under clear and overcast sky conditions.

Keywords: light quality and quantity, light environment, radiation, three-dimensional canopy

The light environment of a canopy is substantially affected by plant architecture and sky condition (Escobar-Gutierrez *et al.* 2009). The objective of this study was to reveal the relationship between quality and quantity of radiation in canopy under different sky conditions. Measurement was conducted in a tobacco (*Nicotiana tabacum*, cultivar 'K326') field (24°18'N, 102°29'E, Altitude: 1642 m) in Yunnan, China. Incoming spectral irradiation was measured at the three-dimensional grids around a plant located at the center of tobacco canopy (Fig.1) using FieldSpec3 field spectroradiometer (ASD Inc., USA) equipped with a Remote Cosine Receptor (model A124505, ASD Inc.), and the photosynthetic photon flux density above canopy was measured instantaneously using AccuPAR (model LP-80, Decagon Devices inc., USA) on July 22 (overcast) and July 30 (clear), respectively. The fraction of PAR (fPAR) and the spectral ratios between red (R), blue (B), green (G) and far-red (FR) measured at these sampling points were examined. The results (Tab.1) illustrated that R/FR had very high correlation with fPAR, while that for B/R was the lowest, and their relationship could be characterized as quadratic functions of log(fPAR). These relationships were more significant under overcast sky condition. This study indicated that certain relationships existed between light quantity and quality within plant canopy, and their relationships varied with spectral ratios and were affected by sky conditions.

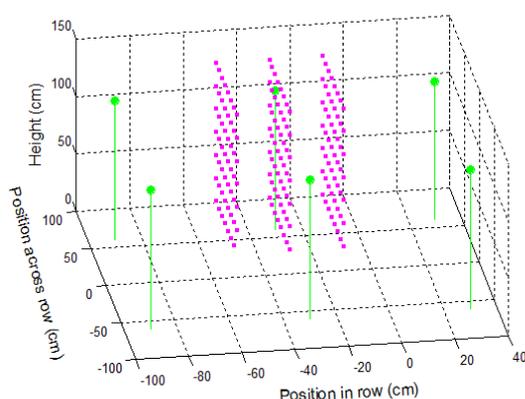


Fig.1 Measurement points (magenta) in the tobacco canopy (green)

Tab.1 Relationships between spectral ratios and fraction of PAR (fPAR) in light environment of tobacco canopy

Spectra l ratio	Sky condition	Function of log(fPAR)	R ²
R/FR	Overcast	0.062x ² +0.57x+1.36	0.99
	Clear	0.065x ² +0.69x+1.85	0.97
B/G	Overcast	-0.048x ² +0.0058x+0.94	0.92
	Clear	-0.028x ² -1.1E-5x+0.91	0.71
B/R	Overcast	-0.070x ² -0.11x+1.11	0.79
	Clear	-0.077x ² -0.35x+0.69	0.32

R, B, G and FR refer to red, blue, green, far-red, respectively.

ACKNOWLEDGEMENTS

This research was supported by China National Tobacco Corporation (110201102008).

LITERATURE CITED

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