Estimation of photosynthetically active radiation using CROPGRO-Soybean model

Evandro Chaves de Oliveira[1], Débora R. Roberti[2], José Maria N. da Costa[3], Williams P. M. Ferreira[4], Flavio B. Justino[3], Rafael A. Rodrigues[3], Leonardo de O. Neves[5], Paulo H.L. Gonçalves[3], Leonardo José G. Aguiar[3], Osvaldo L. L. Moraes[2],

[1]Federal Institute of Espírito Santo, MG, Brazil
[2]Federal University of Santa Maria, RS, Brazil
[3]Federal University of Viçosa, MG, Brazil
[4]Embrapa Maize e Sorghum, MG, Brazil
[5]Federal Institute Catarinense, SC, Brazil
e-mail: evandro.oliveira@ifes.edu.br

1. Introduction

The photosynthetically active radiation (PAR) comprises the wavelengths between 400nme 700nm, visible radiation (TAIZ and ZEGER, 2006). Presents great importance in studies on plant growth, photosynthetic rate and stomatic conductance is the radiation that excites the molecules of chlorophyll plants, starting the flow of energy through the process of photosynthesis. With the present study aimed to evaluate the performance of the model CROPGRO-Soybean in the estimation of photosynthetically active radiation (PAR) during the cycle of soybean in Cruz Alta, Rio Grande do Sul.

2. Material and methods

We used the CROPGRO-Soybean model (Crop-Environment Resource Synthesis), that is inserted in the system DSSAT (Decision Support System for Agrotecnology Transfer), version 4.0.2.0 (HOOGENBOOM, 2004), which simulates the growth, development and productivity of soybeans (*Glycinemax*L. Merill). The simulations were performed to the conditions obtained in Experimental field of the Foundation Center of experimentation and research (FUNDACEP/ FECOTRIGO), located in the municipality of Cruz Alta, Average Plateau region of Rio Grande do Sul, whose geographical coordinates are: 28°36' South, and 53°40 ‘ West and alt. 409 meters. During the experiment, in addition to the input of meteorological variables of the model, was also monitored the photosynthetically active radiation (PAR) (Wm^{-2}), using

quantum sensor (model Kipp & Zonen-PAR LITE) measured 1 m above the surface, under crop.

3. Results and discussion

Can be seen in Figure 1, that the photosynthetically active radiation (PAR) during the cycle of the soybean was 1,150 MJ m^{-2}, averaging 8.8 MJ m^{-2} d^{-1} with extremes ranging between 0.5 and 14.5 MJ m^{-2} d^{-1}. The response of the model to photosynthetically active radiation (PAR) was 1,205 MJ m^{-2}, being the average of 9.2 MJ m^{-2} d^{-1} with extremes ranging between 0.5 and 15.0 MJ m^{-2} d^{-1}.

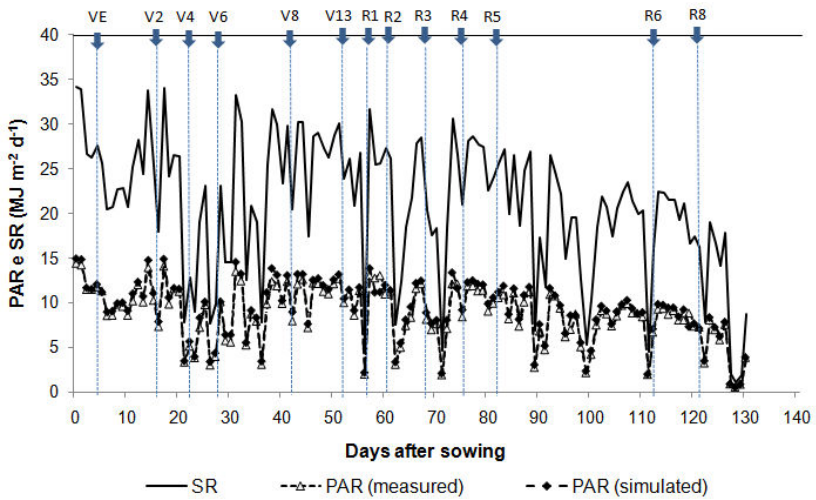

Figure 1. Solar radiation (SR) and photosynthetically active radiation (PAR) measured and simulated along the cycle of the soybean, during 2009/2010 growing seasons.

In Figure 2 shows the ratio between the PAR and the SR and estimation equation and its coefficient of determination (r^2). The field data pointed out that photosynthetically active radiation (PAR) was about 42% of global radiation (SR). As for the template, it appears that the PAR was approximately constant, i.e. 44% of SR throughout the cycle of the soybean.

In Figure 3 are the simulated and measured values of the par. Note that the PAR obtained from the CROPGRO-Soybean model overestimated their test the actual values of PAR measured by quantum

sensor. The difference between the simulated and observed values was low, suggesting the applicability of the model estimates of PAR.

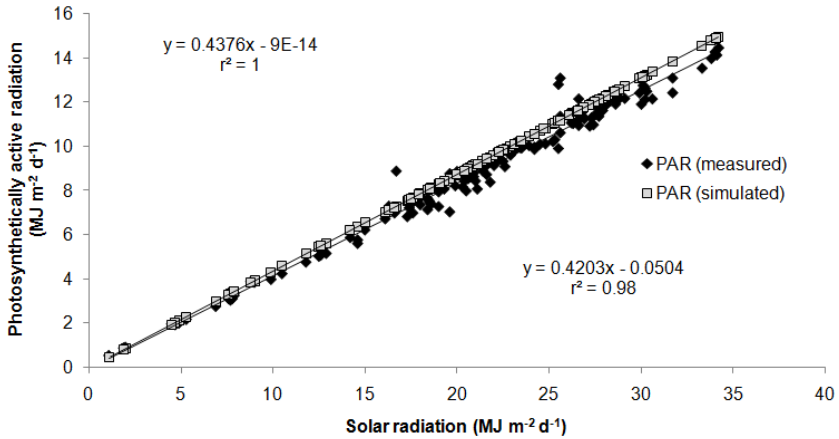

Figure 2. Relationship between daily values of photosynthetically active radiation (PAR) and solar radiation (SR).

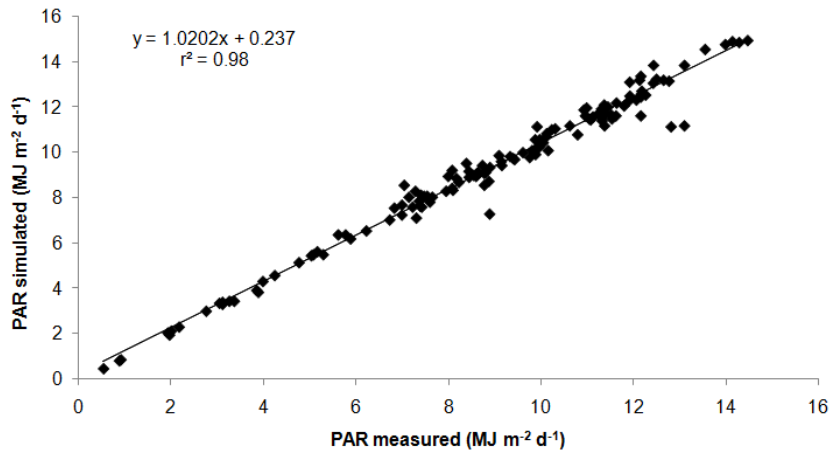

Figure 3. Validation of estimates of the PAR made by CROPGRO-Soybean model during the cycle of the soybean.

4. Conclusion

The CROPGRO-Soybean model presented satisfactory ability to prediction photosynthetically active radiation (PAR) to management, soil, climate conditions in Cruz Alta, RS.

5. References

HOOGENBOOM, G., JONES, J. W., WILKENS, P. W., PORTER, C. H., BATCHELOR, W. D., HUNT, L. A., BOOTE, K. J., SINGH, U., URYASEV, O., BOWEN, W. T., GIJSMAN, A. J., DU TOIT, A., WHITE, J. W. E TSUJI, G. Y. Decision Support System for Agrotechnology Transfer **Version 4.0 [CD-ROM].** Universityof Hawaii, Honolulu, HI, USA. 2004.

TAIZ, L.; ZEIGER, E. **Fisiologia Vegetal**. Trad: SANTAREM, E. R. 3a.ed., Porto Alegre: Artmed, 2006.