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SIMULATION OF THE WATER USE EFFICIENCY FOR THE CULTURE OF SOYBEAN USING THE CROPGRO MODEL

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SUMMARY
The present study aimed to simulate the water use efficiency by soybean culture, using CROPGRO model, and compare with Sulflux Network experimental results (Brazilian south network of Surface Flows and Climate Change) in Cruz Alta, RS, in the agricultural year 2009/10. The CROPGRO-soybean model overestimated the water use efficiency of soybeans for the conditions, period features and factors considered.

RESUMO
Simulação da eficiência do uso da água para a cultura da soja utilizando o modelo CROPGRO. O presente trabalho teve como objetivo simular, usando o modelo CROPGRO, a eficiência do uso da água pela cultura da soja e comparar com resultados experimentais da Rede Sulflux (Rede Sul Brasileira de Fluxos Superficiais e Mudanças Climáticas) em Cruz Alta, RS, no ano agrícola de 2009/10. O modelo CROPGRO-Soybean superestimou a eficiência do uso da água da cultura da soja, para as condições, características do período e fatores considerados.

INTRODUCTION

Using simulation models to predict soybean yield under water use efficiency could be very helpful in the management of deficit irrigation applications. In this context, CROPGRO-soybean model (Crop-Environment Resource Synthesis) simulates vegetative and reproductive development of soybean for certain location and climate, and is an excellent alternative to obtain information that helps in agricultural planning and management (Boote et al., 1998). Water use efficiency in CROPGRO-Soybean is not a parameter of the model. It can be calculated from the crop evapotranspiration and biomass production, which, in turn, are simulated by complex model subroutines (Ritchie, 1998; Boote et al., 1998). The aim of this study was to simulate the water use in CROPGRO-Soybean model against field data from experiments conducted with an eddy correlation technique on soybean crop in Cruz Alta, State of Rio Grande do Sul, and site of Sulflux Network**.**

MATERIALS 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

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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 Cruz Alta, Rio Grande do Sul, whose geographical coordinates are: 28°36' South and 53°40' West and alt. 409 meters. The soybean cultivars Fundacep 53RR were selected as the crop material. The planting date was December 14, 2009 and April 28, 2010 for the harvest. During the experiment, in addition to the input of soil, crop and meteorological variables of the model, it was also monitored the latent heat flow (LE), using the eddy correlation technique of Sulflux Network, and it was made using the following sensors at site: an three-directional 3D sonic anemometer (Campbell – CSAT3 3-D) and an open-path infrared CO_2/H_2O gas analyzing system (LiCor – LI7500). The procedure used to compute fluxes is discussed in Moncrieff et al. (1997). The water use efficiency for economic yield was defined as the ratio of grain yield per hectare and seasonal water consumption (ZHANG *et al*., 2004).

RESULTS AND DISCUSSION

Table 1 contains the results of grain yield, evapotranspiration, water consumption and water use efficiency for yield. The results contained in Table 1 indicate that the model satisfactorily estimated CROPGRO-Soybean grain yield of soybean FUNDACEP 53 RR, for the conditions of soil and climate of Cruz Alta - RS, which resulted in a difference of 10 kg ha^{-1} between the observed value (2848 kg ha^{-1}) and simulated (2838 kg ha^{-1}) by the model. The model simulated reasonably well the total evapotranspiration, with an overestimation of 13.1% compared to that observed in the field due to the effects of soil surface cover by crop residues in no-tillage system, especially early in the development cycle soybeans. Thus, we calculated the efficiency of water use in soybean, dividing grain yield by the amount of water consumed during their growing cycle, Table 1. It was found that the model is less efficient use of water to simulate approximately the same output from soybeans for the conditions typical of the period and the factors considered.

Table 1. Actual evapotranspiration, water consumption, yield and water use efficiency for yield (EUAr) of soybean plants.

Parameters	**Agronomic**	**CROPGRO**
Grain yield (kg ha^{-1})	2848	2838
Actual evapotranspiration (mm)	423.6	487.7
Water consumption (m^3 ha^{-1})	4236	4877
EUAr (yield) (kg m^{-3})	0.67	0.58

CONCLUSION

The CROPGRO-Soybean overestimated the water use efficiency of soybeans for the conditions, period features and factors considered.

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