【Workshop 2】Crop Production under Heat Stress

Phenology Modelling in ORYZA2000: Issues and Prospects

P.A.J. van Oort and H. Meinke

Centre for Crop Systems Analysis, Department of Plant Sciences, Wageningen University

P.O. Box 430, 6700 AK Wageningen, The Netherlands

(Pepijn.vanoort@wur.nl / fax +31-(0)317-485572 / tel +31-(0)317-481357)

We review the current state of phenology modeling in the ORYZA2000 crop growth simulation model, possible improvements and consequences of poor mechanistic description of phenology. Zhang (2008) studied thermal time accumulation requirement to maturity for a single rice variety grown on a single location in a 20 years time series. The study concluded (1) thermal time accumulation requirement is not constant but increasing over time and (2) this outcome severely limits the accuracy of climate impact assessments done with models like ORYZA2000. The first conclusion may not be true. Ignoring specific processes affecting development would lead to the wrong conclusion that thermal time requirement is not constant. It calls for more accurate and mechanistic modeling of phenology. Currently the ORYZA model describes phenological development as a function of photoperiod sensitivity (a photoperiod sensitive phase within the juvenile phase) and thermal time accumulation; it includes delay in development due to transplanting shock and delay in development before flowering in case of drought stress. Along with the ORYZA model comes a program for calibrating development rates. This program is not consistent with the model – it calculates rates from thermal time, taking into account temperature shock but not photoperiod. Hence any calibrated development rates will be wrong in case of photoperiod sensitive varieties and in case of experimental set-ups in which the crop was stressed. In this paper we consider options for further improving phenology modeling in ORYZA. We discuss this from the point of data needs and modeling needs. In particular, we discuss: (1) are we using the right temperature; (2) including photoperiod sensitivity in calibration (3) stress and effect on development and (4) alternatives to the bilinear function for calculating thermal time accumulation. The work presented is part of an emerging research agenda on designing climate robust rice-based cropping systems.