APSIM Rice: A growth and development model for rice

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Abstract

This paper reports on progress in the development of a crop growth and development model for rice. The model has been developed from a pre-existing wheat module within the APSIM (Agricultural Production Systems sIMulator) framework, parameterized and calibrated using published and unpublished data for rice. The next step is to expand the validation to include a broader range of growing conditions and to incorporate new rice specific functionality into the model.

Key Words

Rice, model, APSIM

Introduction

A growing number of ACIAR (Australian Centre for International Agricultural Research) research projects in South East Asia and China are adopting systems modeling approaches to explore the biophysical, social and economic implications of change in farming practice. A key 'tool' in these projects is the farming systems model APSIM (Agricultural Production Systems sIMulator, McCown *et al* 1996) which provides for the simulation of crop, forage and soil related processes and their associated interactions, and the influence of climate and management factors on these processes. Typically, rice is one of the more important annual food crops in the target systems. While the principal focus of these projects is not necessarily rice related, many of the production related interventions under consideration are likely to influence, or be influenced by the rice crop (eg via soil nutrition & water). This provided the impetus for the development of a rice crop module for use within the APSIM framework. This paper reports on progress in the development of APSIM Rice and presents results from preliminary testing of the model against an Australian dataset.

Method

APSIM Rice is being developed in two stages. The first stage aims to address the short-term demands of existing project activities. These call for the development of a functioning APSIM Rice module in a short period of time, but with adequate performance under the range of growing conditions likely to prevail in the project locations. While it may be feasible to modify one of the many existing rice models to be compatible with APSIM, a more efficient approach is to take an existing module for a 'like' crop within the current APSIM crop library and re-parameterise it to represent the crop of interest. The suitability of this approach is based on the substantial physiological similarity between the template and new crop, and is amply demonstrated by the current suite of APSIM legume modules developed from a common legume template. With this in mind, it was decided to use APSIM Wheat as a template for the rice model (http://www.apsim-help.tag.csiro.au/APSIM_docs/modules/Wheat_science.pdf). The method involved re-parameterising the template using published and unpublished data for rice. Values for those parameters which couldn't be found in the literature were set through calibration against 'quality' datasets. Datasets from a range of irrigation treatments (upland and lowland, irrigated and rainfed) conducted in central and southeast Queensland were used for this purpose.

It is also recognized that there are long-term strategic advantages in having a more robust and widely applicable rice modeling capability within APSIM. The second stage of rice model development will aim to build on and improve the first version and will clearly involve a more substantial investment in terms of model development and testing. The intention in this second stage is to construct APSIM Rice from a

library of sub-routines that are most appropriate for simulating rice growth and development, as opposed to just using wheat sub-routines (as in Stage 1). This provides more flexibility in model construction and allows for incorporation of the most appropriate simulation methodologies. It also enables the inclusion of new rice specific sub-routines eg the impact of transplanting on growth and development. This paper reports on progress on stage one of model development.

Results

Figure 1 shows example calibration plots for APSIM Rice (Stage 1) of grain yield and total above ground biomass under a range of flooded and unflooded irrigated treatments (Borrell *et al* 1997).

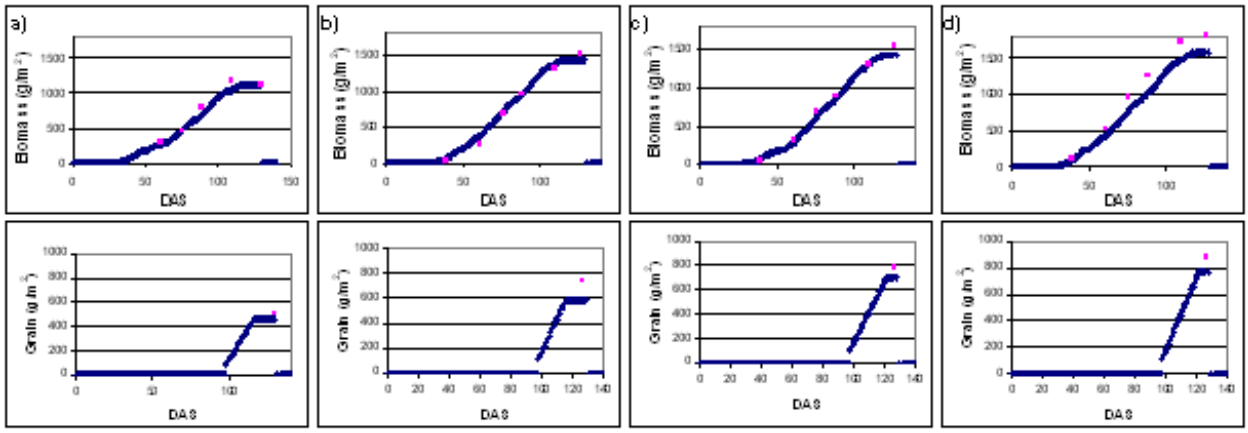

Figure 1. Calibration plots of APSIM Rice output (continuous line) versus observed results (points) from Borrell *et al* (1997). Treatments include (from left to right) intermittent flood (a), saturated profile (b), partial flood (c) and full flood (d). Plots are of time series of grain biomass (bottom), and total above-ground biomass (top).

Conclusions

The first stage of development of APSIM Rice is well underway with promising model performance under the limited range of conditions tested to date (Figure 1). However, there are a number of improvements that will need to be addressed in Stage 2:

- Include a capability to simulate the impacts of transplanting on crop growth and development
- Improved simulation under rainfed/upland (ie water stressed) conditions
- More 'realistic' simulation of leaf area growth and phenology

Furthermore, independent validation is required under a broader range of growing conditions. This will be ongoing and based on datasets currently being collected as part of existing project activities and from other published/unpublished international sources.

References

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