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ONLINE ISSN : 1349-1008
PRINT ISSN : 1343-943X

Plant Production Science
Vol. 9 (2006) , No. 2 93-105

[PDF (190K)] [References]

Cited JST-Link Center

A Quantitative Knowledge-based Model for Designing Suitable Growth Dynamics in Rice

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(Received: April 4, 2005)

Abstract: Quantifying growth dynamics in rice (*Oryza sativa* L.) is important for precision design and diagnosis in cultural management. The primary objective of this study was to develop a general knowledge-based model to design the time-course growth dynamics including stem number, leaf area index (LAI) and aboveground dry matter accumulation with desired target yield under different conditions in rice. Driven by physiological development time (PDT)-based growing degree-days (GDD), the fundamental algorithms of rice growth indices, which vary with the variety, environmental factors and production levels, were formulated from the existing literature and research data. The stem number curve was established according to the dynamic pattern of the stem development and the principle of determining stem number from final panicle number. Under the principle of realizing the maximal photosynthetic production during forty days before and after heading, we obtained the optimum LAI at heading was calculated, and the LAI dynamic from the ratios of LAIs at different growth stages to optimum LAI at heading with linear interpolation method. The aboveground dry matter accumulation curve was described by a logistic curve. Case studies with the typical data sets and variety types at different eco-sites indicated a good performance of the model system, with the root mean square error (RMSE) of 2.5×10^4 ha^{-1}, 0.37 and 700 kg ha^{-1}, for the stem number, LAI and aboveground dry matter accumulation, respectively. This model overcomes the weakness of poor spatial and temporal adaptation of traditional rice management patterns and expert systems.

Keywords: Dry matter, Expert system, Knowledge-based model, LAI, Rice, Stem number

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To cite this article:

Dingchun Yan, Yan Zhu, Shaohua Wang and Weixing Cao: “A Quantitative Knowledge-based Model for Designing Suitable Growth Dynamics in Rice”. Plant Production Science, Vol. **9**, pp.93-105 (2006) .

doi:10.1626/pps.9.93

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