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SHORT COMMUNICATION

SIMULATING PHENOLOGY AND YIELD OF RICE USING CERES- RICE MODEL IN NORTH WESTERN HIMALAYAS

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A rice crop model CERES-Rice was parameterized and validated in Himachal Pradesh using experimental results. Cultivar specific genotypic coefficients were derived for four varieties during calibration. Validation based on several independent sets of yield data, including different locations, years, nitrogen and irrigation water treatments showed good agreement (R^2=0.7785) between observed and simulated grain yield. The model predicted phenology of varieties reasonably well. The model, however, fails to simulate single grain weight. Significant association between simulated and observed grain yield were supported by the tests of significance for intercept and slope of the regression line (R^2=0.7289). Likewise harvest index was also simulated fairly well by the model. The model was used to design management practices of four varieties.

***Key words*: CERES-Rice, crop growth models, *Oryza sativa*, parameterization, validation.**

Rice is one of the most important staple food crops in India and its production has increased tremendously from 20.6 million tonnes (mt) in 1950-51 to 87.0 mt in 2003-04 due to increase in area under rice from 30.8 to 44.6 million hectares (m ha) and productivity from 668 to 1804 kg/ha. In future, expansion of area under rice is very unlikely due to tremendous increase in population and urbanization. Therefore, increasing demand has to come from increase in productivity per unit area. For achieving this, one of the prime requirements and non monetary inputs is transplanting cultivars at an appropriate time. In recent years dynamic crop simulation models have been found most useful to predict the phenology and yield by using minimum input data set (Hundal and Kaur 1999, Rao and Kushwaha 2005). Input data set for varieties cultivated in Himachal Pradesh are lacking. It was because of unavailability of these coefficients, an attempt has been made in this study to work out the coefficients of four varieties and simulate the CERES-Rice model for prediction of yield and use it as a decision support system.

A field experiment on rice crop was conducted during 2000 and 2001 *Kharif* seasons (July- October) in experimental farm of Department of Agronomy CSKHP Krishi Vishvavidyalaya, Palampur (32^0 6'N, 76^0 3'E 1290.8 m elevation) in north western Himalayas. Soils were Alifisols (Typic hapludalf). The soil texture was silty clay loam and acidic in reaction. The soil was rich in organic carbon, rated as high in total nitrogen, medium in available phosphorus and potassium in the upper 0-15 cm layer. These values decreased with increase in soil depth. Field experiment comprised of two dates of transplanting (23 June and 8 July and four varieties (RP-2421, HPR-1064, HPR-2027 and Naggar Dhan). These four varieties were transplanted after 26 days of sowing at 20 × 15 cm hill to hill spacing and with two seedlings per hill. The experiment was conducted in randomized complete block design with four replications. The simulation study was carried out using CERES-Rice (Godwin *et al*. 1992) model to predict the phenology, yield and yield attributes.

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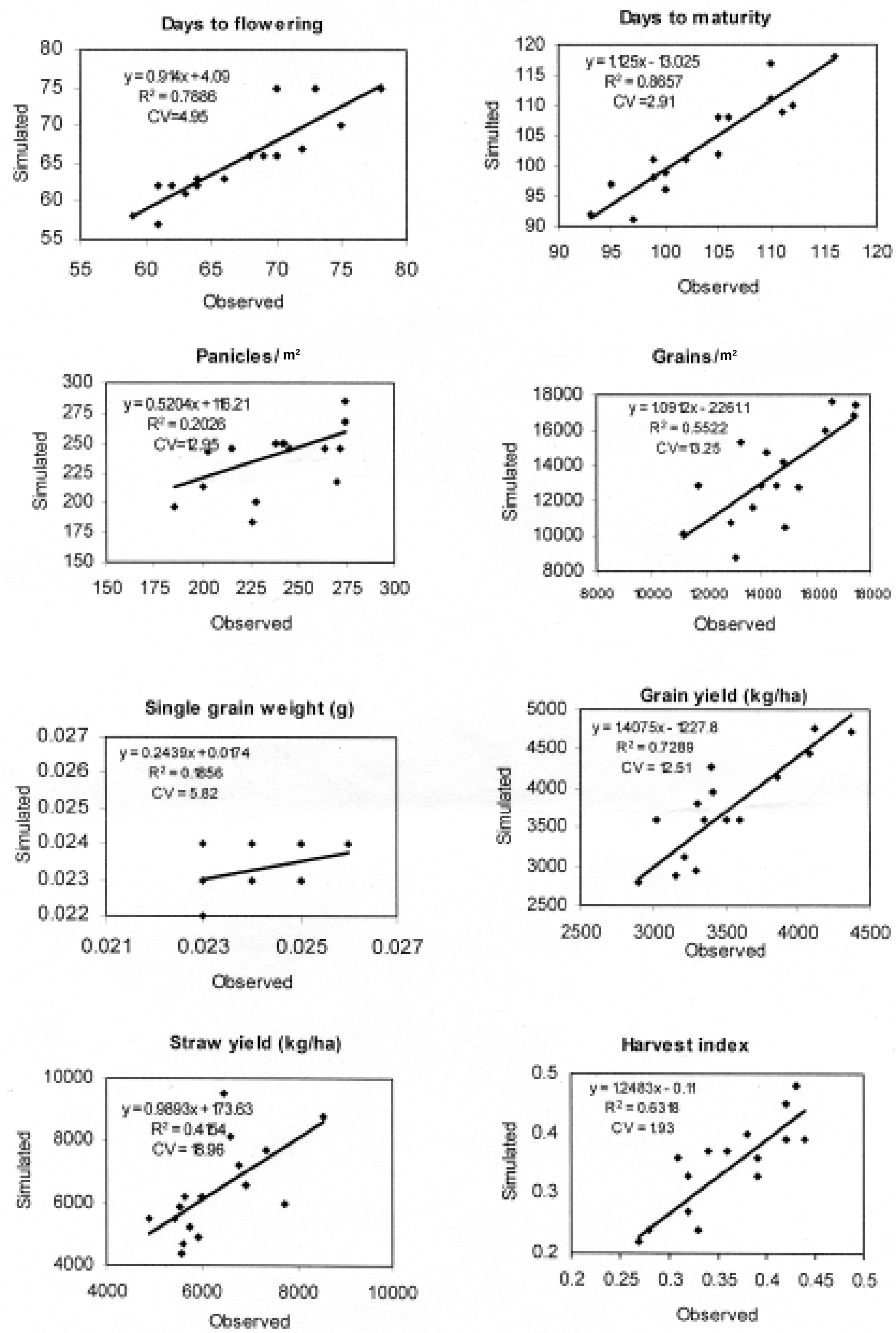

Fig. 1. Observed and simulated parameters of rice crop

Different statistical tools were used to evaluate the performance of the model in predicting various parameters. To test how well the model is predicting a point in time, such as date of flowering or date of maturity or yield etc. under different treatments, standard error of treatment means (S.Em) and coefficient of variation (CV) between the observed and simulated values were worked out using following formulae:

$$S.Em. = \sqrt{\frac{\sum_{i=1}^{n}(Sim.Yi - Obs.yi)^2}{n}}$$

CV= S.Em *100/x

Where n is the number of observations and x is the mean observed value, *Sim Yi* and *Obs Yi* are the simulated and observed values of *ith* observation. Smaller the values of S.Em and /or CV better is the model predictions. Regression equation was also fitted between observed and simulated data and goodness of fit between two types of data was worked out. Higher values of R^2 indicate the better simulation of the observed values.

The crop phenology was accurately simulated by the model for all the four varieties and difference between observed and simulated days over two years ranged from 0 to 7 days indicating that the model simulated the days to flowering (R^2=0.7886) and physiological maturity (R^2=0.8657) satisfactorily (Fig. 1). The small coefficient of variation for days to flowering (CV=4.95) and physiological maturity (CV=2.91), indicated a close association. Kumar and Sharma (2004) also reported an excellent estimation of days to flowering and physiological maturity for rice varieties by using CERES-Rice model. The number of grains simulated by the model matched closely with observed values from field experiment (Fig. 1). Significant association between observed and simulated values was supported by significant R^2=0.5522. CV was also low (13.25). Unlike number of grains, panicles/m^2 (R^2=0.1852) single grain weight (R^2=0.2026) were not correctly simulated by the model and the association between observed and simulated values was not significant. Jintrawat (1995) reported similar findings while using CERES-Rice model in Thailand.

The model performed well in predicting grain yield of all the four varieties and the association between simulated and observed values was significant (Fig. 1). Likewise goodness of fit (R^2=0.7289) was also significant. Rao *et al*. (2002) also reported similar results in Kerela while using CERES- Rice model. The model can be used as a decision support system for predicting /forecasting the yield under varying (aberrant /normal) weather conditions, for strategic and tactical decision making for crop management and improving the resource use efficiency.

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