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Evaluation of rice growth model 'ORYZA2000' under nitrogen limited conditions in irrigated environment

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ABSTRACT: Rice (*Oryza sativa* L.) is grown in wide range of locations and climatic conditions under a different variety of hydrologic, cultural and seasonal regimes around the world. Simulation modeling is one of the most powerful tools for analyzing interactions in the soil, plant and atmosphere systems. ORYZA 2000 is a crop growth model for lowland rice (*Oryza sativa* L.) developed by the International Rice Research Institute and Wageningen University. This model has been evaluated extensively in a wide range of environments. Experiment was carried out for Evaluation of rice growth model ORYZA2000 under nitrogen limited conditions in irrigated environment. Experiment was laid out in randomized block design (RBD) with six nitrogen levels replicated four times. In this study, ORYZA2000 was calibrated and evaluated using data from field experiment of lowland rice. Crop growth parameters *i.e.* leaf area index, dry biomass were generated and calibrated at variable nitrogen conditions using ORYZA2000 rice model and was evaluated by RMSE, normalized RMSE and correlation coefficient. The experiment was carried out with BPT5204 rice cultivar growing under irrigated condition.

Key Words : ORYZA2000, Potential, Development stages, Nitrogen levels, Simulation

Table-1: Calibrated development rates for transplanted rice at 120 kg N/ha.

Crop	DVRJ $(°Cd)^{-1}$	DVRI $(°C\ d)^{-1}$	DVRP $(°C\ d)^{-1}$	DVRR $(°C\ d)^{-1}$
Transplanted rice	0.000334	0.000758	0.001682	0.001504

Table-2: Evaluation results of ORYZA2000 simulation of leaf area index for the validation in transplanted rice

Treatments	**N**	**X_{obs}**	**X_{sim}**	**R^2**	**RMSE absolute**	**RMSEn (%) normalized**
T_1 – 90 kg N/ha	8	3.09	4.36	0.97	0.44	14.67
T_2 – 120 kg N/ha	8	3.74	5.05	0.83	0.46	12.38
T_3 – 150 kg N/ha	8	3.85	5.47	0.87	0.75	19.65
T_4– 180 kg N/ha	8	4.21	6.62	0.79	0.85	20.23
T_5 – 210 kg N/ha	8	3.93	6.41	0.82	0.87	22.31
T_6 – 240 kg N/ha	8	3.77	6.14	0.79	0.83	22.22

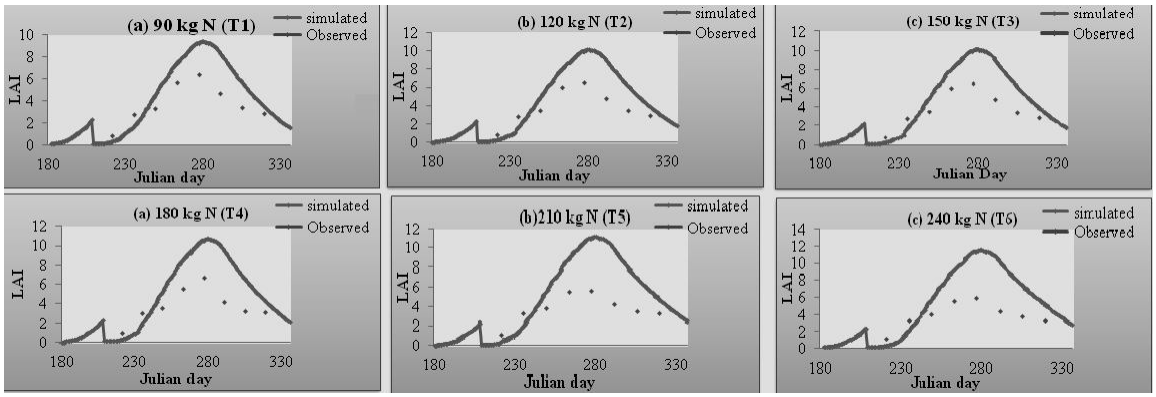

Fig.-1: Simulated and Observed leaf area index of transplanted rice at variable nitrogen.

Table-3: Evaluation results of ORYZA2000 simulation of dry biomass for the validation in transplanted rice.

Treatments	N	X_{obs}	X_{sim}	R^2	RMSE absolute	RMSEn (%) normalized
T_1 – 90 kg N.ha	8	5411	5019	0.97	138	2.56
T_2 – 120 kg N.ha	8	6008	5719	0.97	102	1.70
T_3 – 150 kg N.ha	8	6652	6206	0.97	159	2.39
T_4– 180 kg N.ha	8	7191	6587	0.96	213	2.96
T_5 – 210 kg N.ha	8	7602	6870	0.98	258	3.40
T_6 – 240 kg N.ha	8	8102	7095	0.97	356	4.39

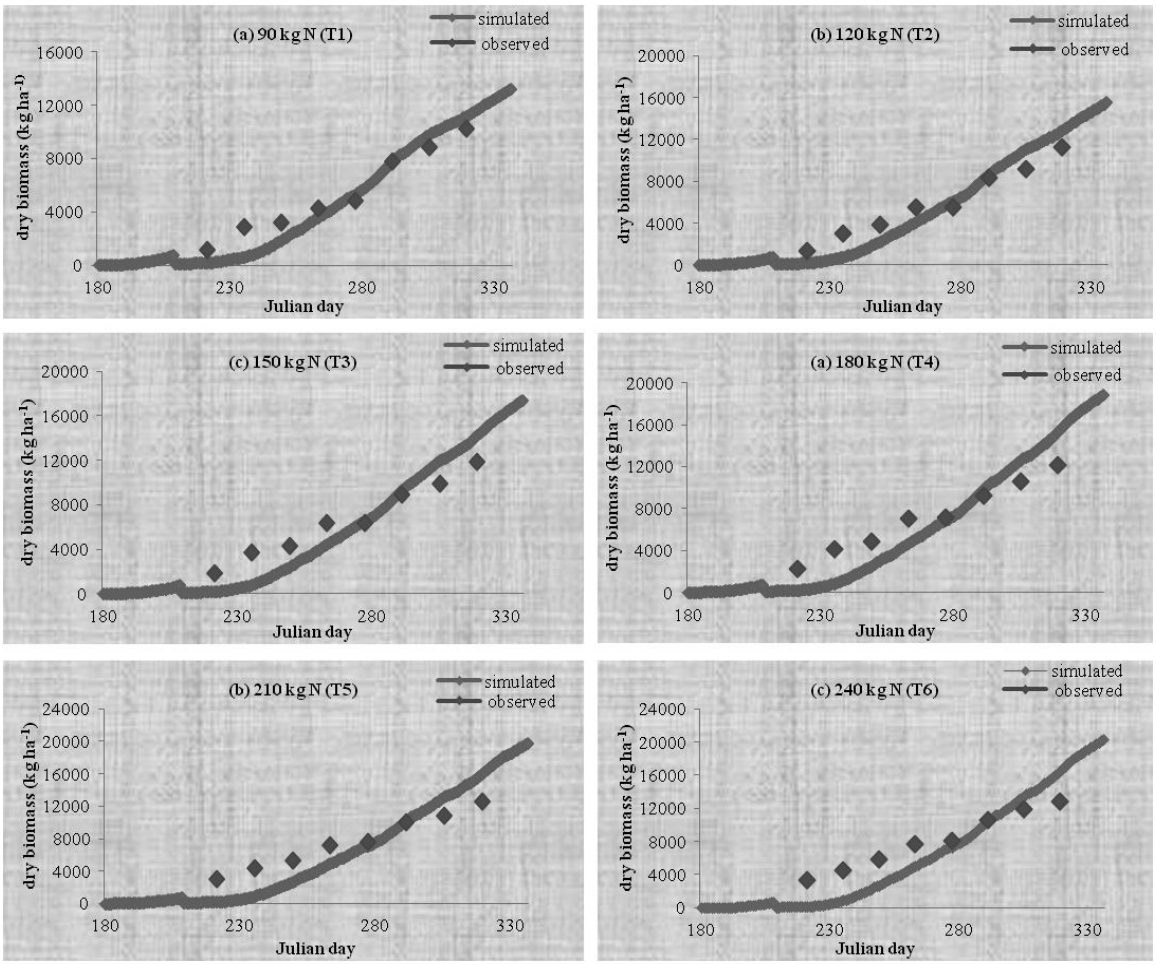

Fig.-2: Simulated and Observed dry biomass of transplanted rice (BPT5204) at variable nitrogen.

Table-4: Simulated and Observed Straw yield of transplanted rice.

Treatments	Simulated Straw Yield (kg/ha)	Observed Straw Yield (kg/ha)
T_1 – 90 kg N/ha	8731	6237
T_2 – 120 kg N/ha	10597	6544
T_3 – 150 kg N/ha	12174	6857
T_4– 180 kg N/ha	13338	7043
T_5 – 210 kg N/ha	14085	7303
T_6 – 240 kg N/ha	14580	7415

Table-5: Simulated and Observed Grain yield of transplanted rice.

Treatments	Simulated Yield (kg/ha)	Observed Yield (kg/ha)
T_1 – 90 kg N/ha	4862	4927
T_2 – 120 kg N/ha	5178	5169
T_3 – 150 kg N/ha	5589	5403
T_4– 180 kg N/ha	5738	5892
T_5 – 210 kg N/ha	5844	5642
T_6 – 240 kg N/ha	5984	5614

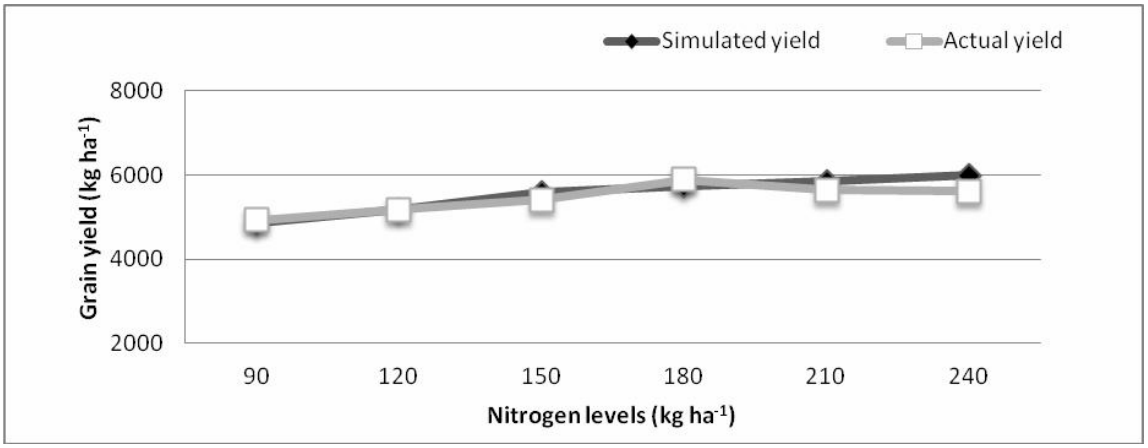

Fig.-3: Simulated and observed grain yield of transplanted rice at variable nitrogen levels.

Table-6: Evaluation results of ORYZA2000 simulation of straw and grain yield of transplanted rice parameters for validation.

Crop Variables	N	X_{obs} (SD)	X_{sim} (SD)	R^2	RMSE absolute	RMSEn (%) normalized	t value
Straw yield	6	6900(450)	12250 (2240)	0.98	2184	29.20	7.30
Grain yield	6	5441(350)	5532 (429)	0.79	37	1.00	1.14