The Pharma Innovation Journal 2018; 7(10): 516-518

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2018; 7(10): 516-518

www.thepharmajournal.com
Received: 17-08-2018
Accepted: 18-09-2018

Surya Prakash Singh
Department of Agriculture Meteorology, N.D. University of Agriculture & Technology, Kumarganj, Faizabad, Uttar Pradesh India

SR Mishra
Department of Agriculture Meteorology, N.D. University of Agriculture & Technology, Kumarganj, Faizabad, Uttar Pradesh India

Anil Kumar Jena
Assistant Professor, Agriculture, Faculty of Agricultural Sciences, Arunachal University of Studies, Namsai, Arunachal Pradesh, India

Rimi Deuri
Assistant Professor, Agriculture, Faculty of Agricultural Sciences, Arunachal University of Studies, Namsai, Arunachal Pradesh, India

Pranamika Sharma
Assistant Professor, Agriculture, Faculty of Agricultural Sciences, Arunachal University of Studies, Namsai, Arunachal Pradesh, India

Correspondence
Surya Prakash Singh
Department of Agriculture Meteorology, N.D. University of Agriculture & Technology, Kumarganj, Faizabad, Uttar Pradesh India

Evaluation of DSSAT model of rice genotypes under different weather conditions

Surya Prakash Singh, SR Mishra, Anil Kumar Jena, Rimi Deuri and Pranamika Sharma

Abstract
A field experiment was conducted during *Kharif* 2013 to generate the ground truth data of rice crop at Agro meteorological Research Farm of N.D.U.A&T, of Kumarganj, Faizabad (U.P.) as to assess the evaluation of DSSAT model for genotypes under different weather conditions. Higher change (10.8%) from base yield was recorded with decrease of minimum temperature by 3 ^{0}C over normal while, higher 13.6% change from base yield was recorded with decrease of maximum temperature by 3 ^{0}C over normal. The yield attributing characters closely simulated to observed values under timely (5 July) transplanting of rice crop, suggested that the simulated yield were well within the accepted limits, therefore the model can be used for predicting rice yield and phenological events.

Keywords: DSSAT model**,** simulated yield, phenological event, predicting rice yield

Introduction
Rice (*Oryza sativa* L., 2n=24) is a member of Poaceae (gramineae) family, widely grown in tropical and sub-tropical regions. Rice is a primary source of the food for 57% of world's population. Rice is an essential food for more than two billion people. Total food grains production of India during 2011-12 it was 252.56 million tons in which, the rice production was 103.41 million tons [1]. Two thirds of the world's population is living in Asia where rice is the prime source of daily food. This makes the production of rice an important social, political and economic factor. India's target for rice production is 120-130 million tons by 2025 [2]. This calls for an annual increase of 2.0 million tones coming primarily with enhancements in resource use efficiency and productivity.

The model encompasses process-based computer models that predict growth, development and yield as a function of local weather and soil conditions, crop management scenarios and genetic information. DSSAT also includes a basic set of tools to prepare the input data, as well as application programs for seasonal, crop rotation and spatial analysis. The crop models not only predict crop yield, but also resource dynamics, such as for water, nitrogen and carbon, and environmental impact, such as nitrogen leaching.

Databases describe weather, soil, experiment conditions and measurements, and genotype information for applying the models to different situations. Software helps users prepare these databases and compare simulated results with observations to give them confidence in the models or to determine if modifications are needed to improve accuracy [3].

These applications have been conducted by agricultural researchers from different disciplines, frequently working in teams to integrate cropping under such climate variability. Researchers from all continents have used these models in studying potential impacts of climate change on agricultural production [4]. The models have also been widely used in studying the potential use of climate forecasts for improving management of different cropping systems [4].

Materials and Methods
To generate ground truth data for validation of the present investigation an experiment was carried out during *kharif*-2013 at Instructional farm of N.D. University & Technology, Kumarganj, Faizabad (U.P.). The Faizabad district falls in semi-arid zone, receiving a mean annual rainfall of about 1100 mm out of which about 82.5 percent of the total rainfall occur during southwest monsoon (from June to September), with 7 percent of total rain in winter season.

Transplanting of healthy seedling was done at 4-5 leaf stage when they are about 15-20 cm height and 25 days old. These uprooted seedlings were transplanted on 5 July, 15 July and 25 July 2013 at the spacing of 20 × 10 cm by using 3 seedlings per hill. Seedlings were transplanted at 2-3 cm depth in water.

Yield attributes collected are panicles/m^2, filled grains/panicle and thousand-grain weight. The crop was harvested at grain moisture content of 18 ~ 20%. In each plot, a m2 area where plant sampling was not done earlier, was selected for grain and straw yield determination. The grain yield was converted to 0% moisture content.

The model was used to simulate grain yield of the varieties using historical daily weather data (maximum and minimum temperature) of the location. The model is said to be sensitive to an input parameters (VIZ., weather variable) if a major or large change occurs in output when the input parameter changes in small amount.

Results and Discussion

Model calibration was done with experiment data of kharif (2010 and 2012) for improving tuning in the model (Table-2). Validation of the model was done with ground truth data of experiment rice were made with the adjusted coefficients. Error percent ranged between 2.56 (D_1V_3) and 10.64 (D_1V_1); 5.04 (D_3V_3) and 10.51 (D_1V_1) and 4.47 (D_1V_3) and 9.97 (D_3V_2) during 2010, 2012 and 2013 respectively. During 2013 lowest error percent was recorded in cv. Swarna sub-1 under timely transplanting, i.e. 5 July and error % increased with delay in transplanting.

The DSSAT model simulate better for grain yield of cv. Swarna sub-1 followed by Sarjoo-52 and NDR-359 under timely transplanting. Model overall overestimated the grain yield in all the years.

Evaluation of the model

The performance of the model was evaluated through genetic coefficient of DSSAT model for rice cultivars (Table-1).

Table 1: Derived genetic coefficient of DSSAT model for rice cultivars

Parameters	Varieties		
	Sarjoo-52	NDR-359	Swarna Sub-1
P1	650.0	1150.0	750.0
P2O	200.0	120.0	150.0
P2R	520.0	150.0	400.0
P5	12.0	11.0	11.3
G1	59.0	60.0	59.0
G2	.0250	.0180	.0220
G3	1.00	1.00	1.00
G4	1.00	1.00	1.00

Table 2: Calibration and validation of DSSAT model for grain yield (kg/ha) under different dates of transplanting

Date of transplanting	Varieties								
	Sarju-52			NDR-359			Swarna Sub-1		
	Obs.	Sim.	Error %	Obs.	Sim.	Err. %	Obs.	Sim.	Err. %
Year 2010									
D_1	5651	6252	10.64	3840	4165	8.46	4301	4411	2.56
D_2	5443	5967	9.63	3630	3945	8.68	4071	4300	5.63
D_3	5254	5656	7.65	3420	3741	9.39	3690	3790	2.71
Year 2012									
D_1	5691	6289	10.51	4020	4345	8.08	4173	4461	6.90
D_2	5483	6004	9.50	3810	4125	8.27	3861	4061	5.18
D_3	5294	5693	7.54	3600	3921	8.92	3590	3771	5.04
Year 2013									
D_1	3983	4166	4.59	3640	3965	8.93	4030	4210	4.47
D_2	3510	3821	8.86	3430	3745	9.18	3720	3984	7.10
D_3	3290	3452	4.92	3220	3541	9.97	3440	3611	4.97
Mean			6.13			9.4			5.51
SD			1.1			0.5			0.4
CV %			20.1			5.8			5.4

Where, D_1-5 July, D_2-15 July 202 and D_3-25 July

Sensitivity analysis of rice cultivars for minimum temperature:

It is evident from the Table-3 that the simulated grain yield decreased with increase of minimum temperature by 1 ^{0}C over normal while decrease by 1 ^{0}C over increased the yield, higher % change from base yield (10.88%) was recorded with decrease of minimum temperature by 3 ^{0}C over normal.

Table 3: Sensitivity analysis of DSSAT 4.5 model for rice to minimum temperature

Min. Temperature (^{0}C) over normal temp.	Simulated grain yield (kg ha^{-1})	% change from base (4147 kgha^{-1}) yield
1	3910	-5.71
2	3766	-9.19
3	4325	-13.8
-1	4462	4.29
-2	4598	7.60
-3	4325	10.88

Sensitivity analysis of rice cultivars for maximum temperature:

It is evident from the Table-4 that the simulated grain yield decreased with increase of maximum temperature by 1 ^{0}C while decrease by 1 ^{0}C over normal increased the yield. Consequently, higher % change from base yield (13.36%) was recorded with decrease of maximum temperature by 3 ^{0}C over normal.

Table 4: Sensitivity analysis of DSSAT 4.5 model for rice to maximum temperature

Max. Temperature (^{0}C) over normal temp.	Simulated grain yield (kgha^{-1})	% change from base (4147 kgha^{-1}) yield
1	3989	-3.81
2	3865	-6.80
3	3658	-11.79
-1	4258	2.68
-2	4410	6.34
-3	4701	13.36

Conclusions

It can be concluded from the above findings that the evaluation of DSSAT model of rice was found good enough research tools to predict the phenological occurrence, grain yield and harvest index of the rice crop in advance and this can be used to facilitate the farmers to make broad decision on the crop management operations.

References

1. Anonymous. Socio-economic review (2011-12), Directorate of Economics and Statistics, Govt. of India, New Delhi, 2012, 18.
2. Rai, Mangala. Rice Research. ICAR News-A science and Technology News letter, July-September, 2006, 20.
3. Uehara G. Technology transfer in the tropics. Outlook Agricultural. 1989; 18:38-42.
4. Rosenzweig C, Allen LH, Jr, Jones JW, Tsuji GY, Hildebrand P. Climate Change and Agriculture: Analysis of Potential International impacts (ASA Special Publication No. 59). Amer. Soc. Agron., Madison, 1995, 382.
5. Jones JW. Decision support system for agro-technology transfer; DSSAT v3.In: Tsuji, G.Y., Hoogenboom, G., Thornton, P.K. (Eds.), Understanding Options for Agricultural Production. Kluwer Academic Publishers, Dordrecht, the Netherlands, 1998, 157-177.