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ASSESSING PRODUCTION POTENTIAL ON WHEAT CROP (VAR; KANCHAN) USING DSSAT MODEL FOR CHHATTISGARH REGIONS

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ABSTRACT
Wheat production in the Chhattisgarh is influenced by heat stress due to late sowing. For optimization of yield, sowing at the appropriate time to fit the cultivar maturity length. The DSSAT model was used to determine to assess the production potential for other different districts *i.e.* Raipur, Bilaspur, Jagdalpur and Ambikapur under three dates of sowing (D1 = 25/11/2013, D2 = 05/12/2013, D3 = 15/12/2013). Evaluation with simulated data of three dates of sowing at four districts of Chhattisgarh. It was found that Ambikapur shows higher grain yield (5128-5042kg/ha) followed by Jagdalpur (4559-4258kg/ha), Bilaspur (4314-4198kg/ha) and Raipur has shows lowest grain yield (4358-4046kg/ha) under all three dates of sowing and D2 (5246kg/ha) more suitable period for Ambikapur due to the low temperature and favorable weather condition. In other stations D1 shows higher grain yield followed by D2 and D3. Therefore, D2 was observed the optimum production potential yield for kanchan variety for four districts of Chhattisgarh state under normal condition. Further model evaluation might also be needed for other cultivars which are released for this region.

INTRODUCTION

Wheat crop has wide adaptability; It can be grown not only in the tropical and sub-tropical zones, but also in the temperate zone and the cold tracts of the far north, beyond even the 60 degree north altitude. India is second largest producer of wheat in the world after China with about 12% share in total world wheat production. Wheat is grown in almost all the states in Northern and Central India. The production level of wheat in India had a quantum jump from 6.46 million tonnes from an area of 9.75 million ha in 1950-51 to more than 95.84 million tonnes from an area of about 30.47 million hectares during 2013-14. Uttar Pradesh ranks first in area and total production, while Punjab ranks first in productivity due to favorable environmental conditions and better management techniques. In Chhattisgarh for wheat crops growing area is 102.8ha and where production 130.0 million tonnes and productivity 1304 kg/ha during the year 2013-2014. The sowing of wheat is often delayed due to delay in harvesting of medium and late during rice varieties in Chhattisgarh. The productivity of wheat in Chhattisgarh is low as compared to national average. Weather variables are an important factor, which determines the productivity levels particularly of *Rabi* crops. Late sown wheat crop faces high temperature during grain filling and ripening phases which is one of the major causes of stunted growth and low productivity of wheat in this area. Grain yield, being a complex character, is highly influenced by environment; therefore, direct selection for yield would not give better results (Singh *et al.,* 2014). Environmental factor also plays a important role to crop plant growth of the pathogens and disease development (Deepthi *et al.,* 2014)

Crop growth simulation models are quantitative tool based on scientific knowledge gained through experimentation and technological innovations in the fields of biological, physical, and chemical science relating to agricultural production system (Bannayan *et al.,* 2007; Soler *et al.*, 2007; Andarzian *et al.,* 2008). Therefore, these models can increase understanding and management of the agricultural system in a holistic way. The crop simulation models have been used to assessing production potential yield of any crop and the estimated yields altered agronomic management practices to adjust in the changed environment need to be identified (karl *et al.,* 2002). The model can be identify gaps between potential and on-station farm yield and yield contributing characters (Pal *et al.,* 2012). Aggarwal (2000) studied climatically potential grain yield of wheat and yield gaps in India. The aim of this paper was to assess the production potential of wheat crop under different dates of sowing at four districts *i.e.* Raipur, Bilaspur, Jagdalpur and Ambikapur of Chhattisgarh state.

MATERIALS AND METHODS

Study area

Chhattisgarh state, situated in Eastern India is located between 17°41" N and 24°45" N latitudes and 79°30" E and 84°15" E longitudes. It is surrounded in the west by Madhya Pradesh and Maharashtra, in the north by Madhya Pradesh in the east

by Orissa and Jharkhand (the new state separated from Bihar) and in the south by Andhra Pradesh. Chhattisgarh spreading over a geographical area of 137.90 lakh hectares.The only four districts were taken for the study whish represent the 3 agroclimatic zones of Chhattisgarh and the geographical location are as shown in the following (Table 1)

The DSSAT 4.6 Simulation model

For this study the DSSAT 4.6 (Decision Support System for Agro-Technology Transfer) model was used. It is an integrated computer system developed by IBSNAT (International Benchmark Sites Network for Agro Technology). It simulates plants growth, plant development and yield on a day by day basis (Jones *et al.,* 2003; Tsuji, 2003). Wheat simulation models proved to be an important tool for knowledge acquisition, determination of quantitative relationships, hypothesis testing, dynamic prediction and decision support (Wu *et al.,* 2013). It has being used as a research and teaching tool while used to assess the potential yields of wheat crop during the year of 2013-14. Attempts were made to work out under normal condition on wheat yields with different three dates of sowing (D1- 25/11/2013, D2-05/12/2013 and D3- 15/12/2013) for four districts.

Input data

Weather information

Daily weather data of the study area used in study were collected from the Department of Agricultural Meteorology, Indira Gandhi Krishi Vishwavidyalaya Raipur (Chhatisgarh) in the year of 2013-14.Preparation of weather file for Simulation model require weather data to be stored in specific format of *DSSAT 4.6* and where given the file extension of *WTH*. Data. In *DASST 4.6* uses used weather parameters in a sequence of Julian day solar radiation, maximum and minimum temperature and rainfall.

Soil data

Soil data from experimental field collect including Soil texture, soil classification, soil depth (cm) colour, field capacity, runoff curve number, pH buffer determination method and determination of nitrogen, phosphorus and potassium were collected from the Department of Soil Science & Agricultural Chemistry, IGKV, Raipur.

Genetic coefficient

Already calibrated and validated genetic coefficients of wheat variety which grown in Chhattisgarh where collected from Department of Agrometeorology, Indira Gandhi Krishi Vishwavidyalaya Raipur (Chhatisgarh) where following as:

RESULTS AND DISCUSSION

To assess production potential of wheat crop (var. Kanchan) was worked out using CERES- model for four different station of Chhattisgarh namely the Raipur, Bilaspur, Jagdalpur and Ambikapur under different dates *i.e.* 25/11/2013 (D1), 05/12/2013 (D2) and 15/12/2013 (D3) using the weather data of Rabi season 2013-14. Table: 1 showed that the duration for anthesis period was higher on D2 as compare to D1 and D3 on Raipur districts. But other station shows decreasing order from D1 to D3, but the duration of anthesis was higher on Ambikapur districts followed by Jagdalpur, Bilaspur and Raipur districts.

Similarly total number of days for maturity was also high at Ambikapur which varying from 148 (D1) to 134 (D3) to followed by Jagdalpur 133 (D1) to 127 (D3), Bilaspur 132 (D1) to 126 (D3) and Raipur 130 (D1) to 124 (D3) respectively (Fig: 1). All districts shows similarly decreasing trend of total number of maturity in different dates of sowing due to temperature variation at different station.

Therefore, duration of maturity was less 2 to 3 days in D1, 2 to 16 days in D2 and 2 to 14 days in D3. Raipur station temperature was slightly higher than the other 3 stations. Model

Table 1: Different four stations of Chhattisgarh and there geographical location

S. NO.	Station	Latitude	Longitude
1	Raipur	21°14' N	81°39′E
2	Bilashpur	22°05′N	82°08′E
3	Ambikapur	23°07′N	83°12′E
4	Jagdalpur	19°07′N	82°00′E

Table 2: Genetic coefficient used for Kanchan Variety in CERES-Wheat model

Parameters	Genetic coefficients
P1V	16.0
P1D	53.0
P5	710.0
G1	21.0
G2	27.0
G3	1.3
PHINT	60.0

Table 3: Production Potential of wheat crop (Var; Kanchan) under three dates of sowing for four districts of Chhattisgarh at normal condition

Station	Dates of sowing		
Days of anthesis	D1	D2	D3
Raipur	95	96	93
Bilaspur	97	97	95
Jagdalpur	99	98	95
Ambikapur	113	110	105
Days of maturity			
Raipur	130	128	124
Bilaspur	132	130	126
Jagdalpur	133	130	127
Ambikapur	148	144	138
Harvest index(ratio)			
Raipur	0.33	0.36	0.37
Bilaspur	0.32	0.34	0.36
Jagdalpur	0.35	0.36	0.39
Ambikapur	0.3	0.32	0.32
Vegetative weight(kg/ha)			
Raipur	8963	7786	6978
Bilaspur	9223	8172	7441
Jagdalpur	8617	7435	6693
Ambikapur	12054	11378	10717
Grain weight (kg/ha)			
Raipur	4358	4300	4046
Bilaspur	4314	4224	4198
Jagdalpur	4559	4258	4258
Ambikapur	5128	5246	5042

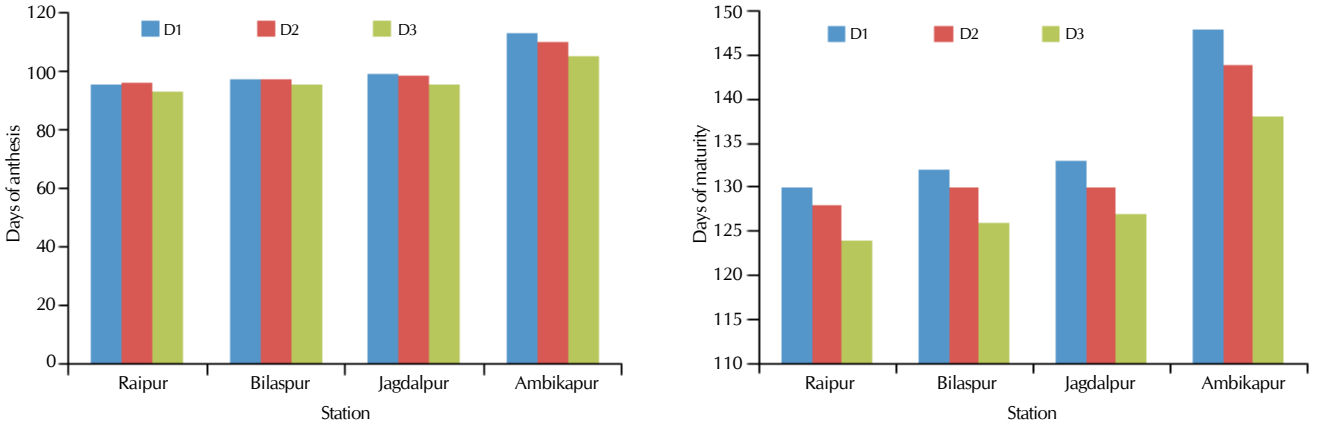

Figure 1: No of days of anthesis and maturity stages of wheat crop (Var; Kanchan) under three dates of sowing in four districts of Chhattisgarh at normal condition

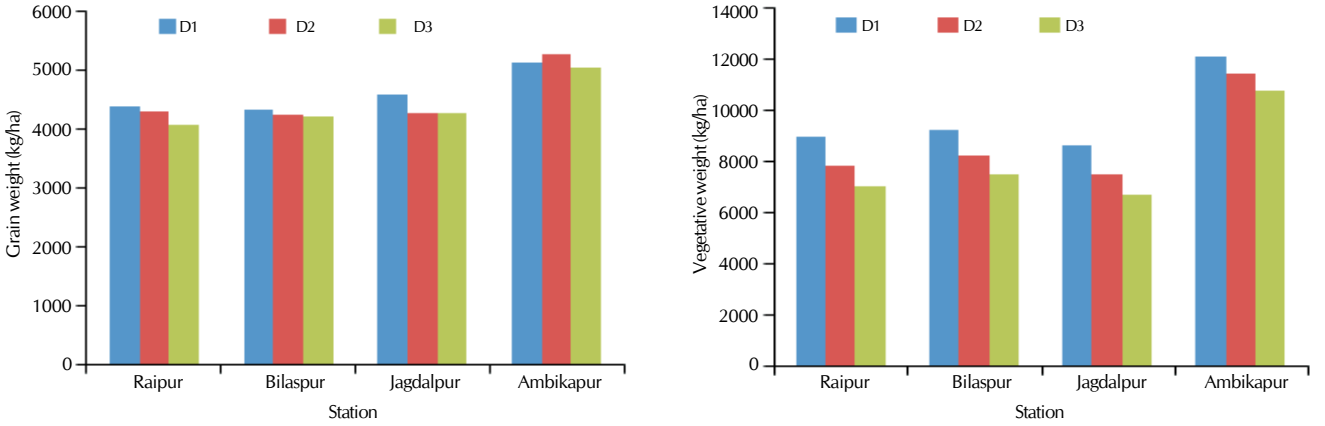

Figure 2: Grain weight and vegetative weight of wheat crop under different dates of sowing in four districts of Chhattisgarh at normal condition

underestimated the days to antheis and physiological maturity among all dates of sowing and variety. Reduction in days to attain anthesis and maturity of wheat crop with delay in sowing has also been reported by (Kour *et al.*, 2010; Pal *et al.*, 2015)

Ambikapur got higher vegetative weight as compare to other stations. It shows that Ambikapur climatic condition favourable for wheat production and D1 looks like higher vegetation production in all four station. In grain yield production, Ambikapur shows higher grain yield under all three dates of sowing as compare to other station and D2 (5246kg/ha) more suitable period for Ambikapur due to the period of winter and favourable weather condition . In other stations D1 shows higher grain yield followed by D2 and D3 at Jagdalpur, Raipur and Bilaspur respectively (Fig. 2). In respect of harvest index from Jagdalpur shows the highest (0.35) followed by Raipur, Bilaspur and Ambikapur, respectively. All stations at D3 shows highest harvest index followed by D2 and D1 except Ambikapur.

The degree of advancement was lower in the relatively colder regions. Attainable wheat yield in various regions under temperature change scenarios clearly indicated a greater reduction in yield with the magnitude of the temperature rise and the reduction in wheat yield had association with the

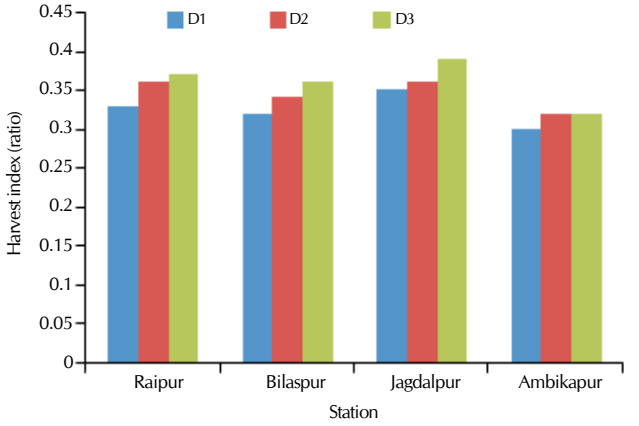

Figure 3: Harvest Index of wheat crop (Var; Kanchan) under three dates of sowing in four districts of Chhattisgarh at normal condition

latitudes (Rai *et al.*, 2004). From the response of simulation modeling, it was found that the accuracy of simulated value decreases with delayed sowings for all four districts. Similar result was also reported by (Pal *et al.*, 2008).

We found that late sowing dates (beyond 25 November) the length of sowing time to anthesis and phesiological maturity,

vegetative weight, grain weight and harvest index were reduced compared to the normal date of sowing (25 November). At all four districts, in growing season increase the monthly mean temperature at different stages. Due to high temperature resulted in accelerating crop development and shortening crop growth cycle and reduced the biomass production (Heng *et al.,* 2007).

REFERENCES

Aggarwal, P. K., Talukdar, K. K. and Mall, R. K. 2000. Potential yields of the rice-wheat system in the Indo-Gangetic Plains of India. Rice-Wheat Consortium Paper Series 10. *Rice-Wheat Consortium for the Indo-Gangetic Plains,* New Delhi, India, p. 11.

Andarzian, B., Bakhshandeh, A. M., Bannayan, M., Eman, Y., Fathia, G. and Alami Saeed, K. 2008. Wheat Pot: a simple model for spring wheat yield potential using monthly weather data. *Biosystems Engineering*. **99:** 487-495.

Bannayan, M., Kobayashi, K., Marashi, H. and Hoogenboom, G. 2007. Gene-based modeling for rice: an opportunity to enhance the simulation of rice growth and development? *J. Theoretical Biology*. **249:** 593-605.

Choudhury, S., Sastri, A. S. R. A. S., Singh, R., Patel, S. R. and Naidu, D. 2008. Assessment of production potential of rice with and without moisture stress in clayey soil using CERES- Rice model. *J. Agrometeorology*. **10(2):** 165-169.

Deepthi, P., Shukla, C. S., Verma, K. P. and Reddy., E. S. S. 2014. YIELD LOSS Assessment and influence of temperature and relative humidity on charcoal rot development in sesame (*Sesamum Indicum L.). The Bioscan*. **9(1):** 193-195.

Heng, L. K., Asseng, S., Mejahed, K. and Rusan, M. 2007. Optimizing wheat productivity in two rainfed environments of the west Asia-North Africa region using simulation model. *Eur. J. Agron*. **26:** 121-129.

Kalra, N., Aggarwal P. K., Abrol Y. P., Pathak H., Choudhary A., Chander S., Sehgal M., Sujith Kumar, Soni U. A., Sntosh, Rai H.K., Kumari K., Sindhu J., Sharma A., Catterjee A., Puri S. and Hussain, M. Z. and Khan, S. A. 2002. Impact of climate change on soil and crop productivity. *Science Culture*. **68(9-12):** 233-243.

Kour, M., Singh, K. N., Singh, M., Thakur, N. P. and Kachroo, D. 2010. Phenophase prediction model for wheat (*Triticum aestivum* L.) growth using agrometeorological indices sown under different environments in temperate region of Kashmir. *J. Agrometeorology*. **12(1):** 33-36.

Pal, R. K., Rawat, K. S., Singh J. and Murty, N. S. 2015. Evaluation of CSM-CERES-wheat in simulating wheat yield and its attributes with different sowing environments in *Tarai* region of Uttarakhand. *J. Applied and Natural Science*. **7(1):** 404-409.

Pal, R.K., Murty, N. S. and Rao, M. M. N. 2012. Response of wheat to temperature as simulated with CERES-wheat model. Journal of Agrometeorology. **14(2):** 163-166.

Pal, R. K., Tripathi, P. and Mishra, A. K. 2008. Simulation modeling of growth parameters of wheat genotype using CERES-wheat model, *J. Agrometeorology* **(Special Issue-Part- I):** 125-126.

Rai, H. K., Sharma, A. Soni, U. A., Khan, S. A., Kumari, K., Chander, S. and Kalra, N. 2004. Simulating the impact of climate change on growth and yield of wheat. *J. Agrometeorology*. **6(1):** 1-8.

Singh, A. K., Singh, S. K., Garg, H. S., Kumar, R. and Choudhary, R. 2014. assessment of relationships and variability of morphophysiological characters in bread wheat (*Triticum aestivum*) under drought stress and irrigated conditions. The Bioscan. **9(2):** 473-484.

Soler, C. M. T., Sentelhas, P. C. and Hoogenboom, G. 2007. Application of the CSM-CERES-Maize model for sowing date evaluation and yield forecasting for maize grown off-season in a subtropical environment. *European J.* **18**: 165-177.

Wu, C., Anlauf, R. and Ma, Y. 2013. Application of DSSAT model to simulate wheat growth in Eastern China. *J. Agriculture Science*. **5(5):** 198-208.