International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(5): 621-624

Received: 19-07-2019
Accepted: 21-08-2019

Swathi GR
Department of Agrometeorology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Uttam Diwan
SRF, Department of Agrometeorology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

HV Puranik
Scientist, Department of Agrometeorology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

GK Das
Head of the Department, Department of Agrometeorology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Abhinav Patel
M.Sc. Agriculture Department of Agrometeorology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Correspondence
Swathi GR
Department of Agrometeorology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Assessment of production potential of karma Mahsuri, mtu-1010 and Mahamaya varieties of rice at different districts of Chhattisgarh

Swathi GR, Uttam Diwan, HV Puranik, GK Das and Abhinav Patel

Abstract
The studies were conducted in Department of Agrometeorology on Karma Mahsuri, Mahamaya and MTU-1010 varieties of rice with 3 dates of sowing (1st June, 15th June and 30th June). For these studies, used long term (1987-2017) daily weather data for 3 districts (Raipur, Bastar and Sarguja). The result revealed that anthesis and maturity periods varied considerably in all varieties under different sowing dates. Duration from sowing to maturity was more in 1st date of sowing (D1) as compared to delayed sowing (D2 & D3). This shorting of duration was due to thermal stress at later sowing dates.

Keywords: Karma Mahsuri, MTU1010, Mahamaya, Chhattisgarh, rice crop and production potential

1. Introduction
Rice is one of the most important cereal crops of the world. It forms the backbone for the National food grain supply and contributes to 46% to total cereal production and 43% to total food grain production. India has the largest area under rice crop (about 45 Million ha) and ranks second in production, next to China. Chhattisgarh, popularly known as "Rice Bowl of Central India" and occupies an area around 3.79 million hectare with a production of 6.9Mt. Rice crop is grown mostly under rain-fed condition. Even in the 32-36% of irrigated area, the productivity of rice in the state is 2050 kg /ha (Anon. 2017) [1].
Climate plays an important role in rice production. Rice is vulnerable to change in weather and its cultivation continues to be a risky enterprise under unfavorable environments. It is important to determine how growth and yield response of rice crop are influenced by elevated temperature as it would have crucial implications on future food security of this highly populated region of the world.
Crop simulation models can be used as a tool for agricultural risk analysis. The CERES - RICE model is used to analyze the production potential of rice cultivars and to determine the optimum planting date for rice. CERES RICE Model was able to predict phenological developments accurately (Kumar *et al.* 2007) [4]. The CERES- RICE Model can be used for decision making for crop management and improving the resource use efficiency (Singh *et al*. 2015).

2. Materials and methods
Input data required to run the crop simulation model (CERES-RICE) of DSSAT V 4.5 includes crop data, daily weather data, soil data and crop specific genetic co efficients.
Model were evaluated for three different districts i.e. Raipur (latitude 21^0 4′N, longitude $81^0$39′E), Bastar (latitude 19°05'N, longitude 82°04'E) and Sarguja (latitude 23°01'N, longitude 83°03'E) with three dates of sowing (D1 01 June, D2 15 June and D3 30 June) and three varieties (Karma Mahsuri, MTU1010 and Mahamaya) during Kharif season 2017.

2.1 Weather data
The daily weather data of the Year 2017 for 3 districts were collected from Dept of Agrometeorology, College of Agriculture, Raipur (C.G.).

2.2 Soil data
Physical and chemical parameters of soil are required. Soil water drainage, field capacity, wilting point, layer wise information on initial soil moisture, organic carbon, pH and soil

Texture information for three districts were collected from Department of Agrometeorology, College of Agriculture, Raipur (C.G.).

2.3 Genetic co efficient

The genetic co-efficients of different varieties were derived from calibration of model are presented in Table 1.

Table 1: Genetic coefficients used for Karma Mahsuri, Mahamaya and MTU 1010 Varieties in CERES-Rice model

	Varieties	P1	P_2R	P_5	P_2O	G1	G2	G3	G4
District Raipur	Karma Mahsuri	500.0	435.0	340.0	11.8	41.0	0.019	1.00	1.00
	MTU1010	400.0	360.0	160.0	11.5	42.0	0.023	1.00	1.00
	Mahamaya	460.0	390.0	190.0	11.5	40.0	0.026	1.00	1.00
Bastar	Karma Mahsuri	390.0	310.0	260.0	11.5	40.0	0.019	1.00	1.00
	MTU1010	400.0	320.0	160.0	11.5	41.0	0.023	1.00	1.00
	Mahamaya	340.0	360.0	140.0	11.5	40.0	0.026	1.00	1.00
Sarguja	Karma Mahsuri	360.0	280.0	260.0	11.8	40.0	0.019	1.00	1.00
	MTU1010	340.0	250.0	170.0	11.5	40.0	0.023	1.00	1.00
	Mahamaya	350.0	340.0	140.0	11.5	40.0	0.026	1.00	1.00

3. Result and Discussion

The production potential of different rice varieties viz., Karma Mahsuri, MTU-1010, Mahamaya has been worked out using DSSAT (Decision Support System for Agro-technology transfer) model for three districts i.e. Raipur, Bastar and Sarguja which represent the agro-climatic zones of Chhattisgarh under different dates of sowing i.e., 01/06/2017 (D1), 15/06/2017 (D2) and 30/06/2017 (D3) using the weather data of the year 2017-18. The duration of anthesis, maturity and grain yield have been obtained from the simulation model (Table 2, 3, 4).

3.1 Production potential of Karma Mahsuri under three dates of sowing at different districts of Chhattisgarh

Table 2 showed that Karma Mahsuri variety of rice crop sown on D1 (1st June) took 100 days for anthesis period as compared to D2 (15th June) 94 days and 87 days in D3 (30th June) at Raipur district. It observed from the table that first date of sowing and growing environment generally took more number of days for anthesis than late sown crop and duration consistently reduced with subsequent delay in sowing. The decrease in duration from D1 to D3 for anthesis was 13 days. Similarly, maturity took more number of days 126 days in D1 (1st June) followed by 120 days in D2 (15th June) and 113 days in D3 (30th June), respectively. The reduction in number of days from D1 to D3 for maturity was also 13 days. At Raipur, highest grain yield of 5425 Kg/ha was recorded in D1 (1st June) and lowest 4156 Kg/ha was recorded in D3 (30th June).

At Bastar District, for anthesis highest number of days i.e. 94 days was recorded on 1st date of sowing (1 June) and lowest days (86 days) was recorded in third date of sowing (30 June). 8 days reduction from D1 to D3 was observed for anthesis. Maturity took 118 days under D1 (1 June) followed by 117 days in D2 (15 June) and 115 days in D3 (30 June), respectively. Maximum grain yield (5443 Kg/ha) was recorded in D1 and lowest (5106 Kg/ha) in D3 (30 June).

Table 2: Production Potential of Variety Karma Mahsuri under three dates of sowing at three districts of Chhattisgarh

Station	D1	D2	D3
	Days of Anthesis		
Raipur	100	94	87
Bastar	94	91	86
Sarguja	90	85	79
Days of Maturity			
Raipur	126	120	113
Bastar	118	117	115
Sarguja	114	111	110
Grain Yield (Kg/ha)			
Raipur	5424	5031(-7.4%)	4156(-23.3%)
Bastar	5443	5362(-1.4%)	5106(-6.1%)
Sarguja	5378	5297(-1.8%)	5144(-4.3%)

For anthesis, Karma Mahsuri variety took 90 days in D1 (1 June) followed by 83 days in D2 (15 June) and 79 days in D3 (30 June) at Sarguja District. D1 (1 June) took maximum number of days (114 days) for maturity as compare to D2 (111 days) and D3 (110 days). The reduction of duration for maturity stage from D1 to D3 was 4 days. In Sarguja district, maximum grain yield 5378 Kg/ha was recorded in D1 (1 June) as compared to delayed sowing. Grain yield decreased slowly up to 15 June (5297 Kg/ha) and after that it decrease sharply when sowing was done on 30 June (5144 Kg/ha).

3.2 Production potential of MTU-1010 under three dates of sowing at different districts of Chhattisgarh

At Raipur district, highest number of days i.e. 94 days were recorded on 1st date of sowing (1 June) and lowest days (84 days) was recorded in third date of sowing (30 June) for anthesis. 10 days reduction from D1 to D3 was observed for anthesis. Maturity took 111 days under D1 (1 June) followed by 106 days in D2 (15 June) and 101 days in D3 (30 June), respectively. Maximum grain yield (4821 Kg/ha) was recorded in D1 and lowest (4427 Kg/ha) in D3 (30 June).

Table 3 showed that MTU1010 variety of rice crop sown on D1 (1st June) took 97 days for anthesis period as compared to D2 (15th June) 92 days and 87 days in D3 (30th June) at Bastar district. The decrease in duration from D1 to D3 for anthesis was 10 days. Similarly, maturity took more number of days 115 days in D1 (1st June) followed by 111 days in D2 (15th June) and 110 days in D3 (30th June), respectively. The reduction in number of days from D1 to D3 for maturity was also 5 days. At Bastar, highest grain yield of 4949 Kg/ha was

recorded in D1 (1st June) and lowest 4580 Kg/ha was recorded in D3 (30th June).

MTU1010 variety took 90 days in D1 (1 June) followed by 85 days in D2 (15 June) and 81 days in D3 (30 June) for anthesis at Sarguja District. Maximum number of days was observed in D1 (1 June) (109 days) for maturity as compared to D2 (105 days) and D3 (104 days). The reduction of duration for maturity stage from D1 to D3 was 5 days. Highest grain yield 4851 Kg/ha was recorded in D1 (1 June) as compared to delayed sowing. Grain yield decreased slowly up to 15 June (4495 Kg/ha) and after that it decreased rapidly when sowing was done on 30 June (4472 Kg/ha) as shown in Table 3.

Table 3: Production Potential of MTU-1010 under three dates of sowing at different districts of Chhattisgarh

Station	D1	D2	D3
	Days of Anthesis		
Raipur	94	89	84
Bastar	97	92	87
Sarguja	90	85	81
Days of Maturity			
Raipur	111	106	101
Bastar	115	111	110
Sarguja	109	105	104
Grain Yield (Kg/ha)			
Raipur	4821	4568(-5.2%)	4427(-8.1%)
Bastar	4949	4908(-0.8%)	4580(-7.4%)
Sarguja	4851	4495(-7.3%)	4472(-7.8%)

3.3 Production potential of Mahamaya under three dates of sowing at different districts of Chhattisgarh

For anthesis, Mahamaya variety took 96 days in D1 (1 June) followed by 90 days in D2 (15 June) and 85 days in D3 (30 June) at Raipur District. D1 (1 June) took maximum number of days (112 days) for maturity as compare to D2 (107 days) and D3 (104 days). The reduction of duration for maturity stage from D1 to D3 was 8 days. In Raipur district, Maximum grain yield 5218 Kg/ha was recorded in D1 (1 June) as compared to delayed sowing. Grain yield decreased slowly up to 15 June (4873 Kg/ha) and after that it decrease rapidly when sowing was done on 30 June (5854 Kg/ha).

At Bastar District, for anthesis highest number of days i.e. 99 days was recorded on 1st date of sowing (1 June) and lowest days (88 days) was recorded in third date of sowing (30 June). 11 days reduction from D1 to D3 was observed for anthesis. Maturity took 116 days under D1 (1 June) followed by 112 days in D2 (15 June) and 110 days in D3 (30 June), respectively. Maximum grain yield (5002 Kg/ha) was recorded in D1 and lowest (4542 Kg/ha) in D3 (30 June).

Mahamaya variety of rice crop sown on D1 (1st June) took 103 days for anthesis period as compared to D2 (15th June) (96 days) and 92 days in D3 (30th June) at Sarguja district. The decrease in duration from D1 to D3 for anthesis was 11 days. Similarly, maturity took more number of days 121 days in D1 (1st June) followed by 118 days in D2 (15th June) and 116 days in D3 (30th June), respectively. The reduction in number of days from D1 to D3 for maturity was 5 days. At Sarguja, highest grain yield of 5436 Kg/ha was recorded in D1 (1st June) and lowest 5154 Kg/ha was recorded in D3 (30th June) which is shown in Table 4.

Table 4: Production Potential of Mahamaya under different dates of sowing at different districts of Chhattisgarh

Station	D1	D2	D3
	Days to Anthesis		
Raipur	96	90	85
Bastar	99	93	88
Sarguja	103	96	92
Days to Maturity			
Raipur	112	107	104
Bastar	116	112	110
Sarguja	121	118	116
Grain Yield (Kg/ha)			
Raipur	5218	4873(-6.6%)	4854(-6.9%
Bastar	5002	4977(-0.4%)	4542(-9.1%)
Sarguja	5436	5333(-1.8%)	5154(-5.1%)

Model estimated the days taken to anthesis and physiological maturity among all the dates of sowing and variety. Number of days to attain anthesis and physiological maturity were found to be decreased as the sowing dates were delayed in all the three varieties (Karma Mahsuri, MTU1010 and Mahamaya).The analysis found that 3rd date of sowing (30 June) is most vulnerable to possible increase of temperature followed by 2nd (15 June) and 1st date of sowing (1 June). As yield reduction is lowest in 1st date of sowing (1st June) with all the cultivars (Karma Mahsuri, MTU1010 and Mahamaya) in 3 agro-climatic zones of Chhattisgarh, it will be appropriate to go for early season (1 June) sowing of rice to minimize climate induced yield loss considering the future scenarios.

Similarly, Dongarwar *et al.* (2005) [2] reported that early sowing on 15 and 30 June resulted significantly higher grain yield 31.29 and 32.61 q/ha, respectively than late sowing on 15 August (28.40 q/ha).

Verma *et al.* (2004) studied the response of hybrid rice 'PA 6201' to date of planting and found that early planting on 20 June produced significantly higher grain yield than late planting on 5 July and 20 August. Similarly, the sowings on 30th June resulted in the highest yield while the sowings on 15th June gave the least yield has also been reported by Vange *et al.* (2009) [6].

4. Conclusion

The present study investigates that the temperature rise has differential effects on rice yield in different agro climatic zones are also varied with the different sowing dates. The results shows that highest grain yield was found in first date of sowing 1 June as compared to 15 June (D2) and 30 June (D3) in all the districts at Chhattisgarh. Karma Mahsuri and MTU1010 are suitable for early sowing. MTU1010 can be transplanted in 1st week of June for getting good yield. While,

Mahamaya can be sown 1st to 2nd week of June in all the districts of Chhattisgarh.

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