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District Level Crop Weather Calendars and Advisories for Kharif Rice in Odisha, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The crop weather calendar is a visual depiction of key facts about crop growth phases, typical crop water requirements, and alerts that should be sent out in response to weather that is conducive to the spread of pests and diseases. Farmers and other stakeholders may successfully plan crops, schedule irrigation, and take plant protection measures by using these calendars, which are practical and helpful tools for farmers. The crop weather calendars are prepared in different

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languages for better understanding to farmers and explain the usage importance and plan farm operation and activities by taking decisions as per the prevalent crop weather conditions in fields. It plays a vital role for important crops and various varieties through research & development-based process at village/ panchayat level. It also helpful for improving the quality of medium range weather forecast based on Agro-Advisory Services (AAS). The AAS provides strategies based on weather for crop and livestock management to increase production and food security. The AAS has been useful to advise farmers regarding farm operations to manage the inclement weather for effective crop production in the changing environment. The Research was carried out on the studies of crop weather calendar on Rice crop in different districts of Odisha by All India co-ordinated research project on Agrometeorology, Bhubaneswar centre with the support of Agro Meteorological Field Unit (AMFU). It has been prepared with an objective to study climate normal of past 30 years from (1993-2023). Climatic data of Rice crop in Kharif season has been taken 25th SMW to 42nd SMW for medium duration (125 days) and 26th to 49th SMW for long duration (150 days) Rice crop in both English and Odia (local) languages for the coastal districts i.e (Khordha, Puri, Kendrapada and Jagatsinghpur) of Odisha. From the crop weather calendar the medium duration of rice crop, it was found that for sowing to seeding the mean temperature is 29^{0}C, before the transplanting and the water requirement of 670-690 mm is found congenial for better yield of the crop. The growth of the crops severely affected where the temperature falls below 20^{0}C, for high yielding of Rice crop during the kharif season the favourable weather conditions are T_{max}: 30^{0}C, T_{min}: 26^{0}C, Rainfall: 78 mm to 110 mm during the 29th to 30th week with RH 87%. For the pest likes stem borer and leaf folder the congenial weather conditions are Temperature :20 to 30^{0}C, RH:87%, Wind speed (Km/h) <5 and Rainfall: 00-30 mm. Similarly for Blast and BLB diseases, the favourable conditions during the 28th-31st week to 48th week, when the temperature range 20-30^{0}C, RH=> 90 %, Wind speed < 5 (Km/h) RH:30-50%. It has been found that the severity of pest and diseases increases with decreases in temperature and High RH and very low rainfall.

Keywords: Crop weather calendar; rice; long duration; medium duration; AMFU & agro advisory services (AAS).

1. INTRODUCTION

Weather is one of the most important factors affecting the agricultural production. The increase in climatic variability and associated extreme weather episodes such as erratic rainfall distribution, abrupt change in day and night temperatures during crop season and sudden outbreaks in pest disease population, especially in developing countries, are throwing challenges to sustaining production levels of different crops. One strategy that farmers can adopt to sustain or increase crop yields in the face of a highly variable climate is to manipulate the crop environment through improved management strategies for adaptation (Kaur et al., 2013, Karunakar, 2015).

Agriculture is one of the most important sectors in Odisha. Proper planning for this sector requires relevant and reliable information in timely manner. Information on crop, its stages and the week-by-week weather during the crop season is essential for proper management of agriculture. Thus, farm operations planned in conjunction with weather information are very likely to curtail the costs of inputs and various field operations (Prabhjyot-Kau, 2013, (Prabhjyot-Kau, 2013, Sing, 2011).

Rice is grown under varying eco-systems on a range of soils under varying climatic and hydrological conditions ranging from waterlogged and poorly drained to well drained situations in Odisha. Rice is also grown in different ecologies from irrigated to upland, rain-fed lowland, deep water and very deep or tidal wetland ecologies. Upland rice is grown in around 6.0 million ha of well-drained soil where the moisture stress and blast are the major constraints and productivity is around 1t/ha. Mostly early maturing varieties of 80 to 110 days duration are grown, depending upon the rainfall pattern and soil topography. Rice is also grown in Coastal wetlands, where tidal water fluctuates as per Moon cycle and period of day. Soil salinity is a problem in areas near the creeks in wet season and in dry season rice (Samui et al., 2007, Dhekale et al., 2018).

Crop weather calendar (CWC) is a comprehensive guide for farmers. It is a tool that provides information on average weather of every week, planting, sowing and harvesting periods of locally adapted crops in a specific

Agro-ecological zone. Further, stage-wise pest disease infestation information can also be added. It also provides information on the sowing rates of seed and planting material and the main agricultural practices. This tool supports farmers and agriculture extensionists in taking appropriate decisions on crops and their sowing period, respecting the agro- ecological dimension. It also provides a solid base for emergency/ contingency planning of the rehabilitation of farming systems after disasters. The concept of using crop-weather calendar is not new (Chowdhury et al., 2022, Samui et al., 2005, Chowdhuri et al., 2024). For instance, FAO calendars provide information on the crop sowing and harvesting dates, seed rate, operation timings of mechanical equipment in the period etc. This calendar describes the month wise weather and operations to be taken up during the period.

It is a pictorial representation of summarized information on crop growth stages, normal water requirements of crop growth, warnings to be issued based on prevailing weather conditions and meteorological conditions favourable for development of pest and diseases. These calendars are useful and handy tools for farmers and other stakeholders for taking appropriate decision on crop planning, irrigation scheduling and plant protection measures for successful crop production.

All India co-ordinated research project on Agrometeorology, Bhubaneswar centre with the support of Agro Meteorological Field Unit (AMFU), Bhubaneswar has prepared such Crop Weather Calendar (CWC) for medium (125 days) and long duration (150 days) paddy varieties in both English and Odia (local) languages for the coastal districts (Khordha, Puri, Kendrapada and Jagatsinghpur) of Odisha. The methodologies adopted for preparation of such calendars as under.

2. MATERIALS AND METHODS

2.1 Collection of Data

The daily Weather data i.e maximum, minimum temperature, Relative Humidity (Max and Min), Rainfall, Rainy Days Sunshine hours, wind speed and evaporation data for the last 30 years (1993-2023) were collected from the Department of Agricultural Meteorology, OUAT and India Meteorological Department (IMD), Bhubaneswar. Weekly climatic normal for SMW (25^{th} to 42^{th}) for medium duration and (26^{th}-49^{th}) for long duration Kharif Rice data collected from Department of Economics & Statistics, Govt. of Odisha. These normal meteorological data sets were arranged in weekly format for cropping season from the month of sowing to harvesting of the Kharif rice crop for the study area. The data for phenology of rice have been obtained from field experiments conducted under the ACRIPAM centre, OUAT, Bhubaneswar. CWC for rice was formulated by combining the weekly climatic averages and phenological calendar for the crop along with optimum weather criteria needed at different phenological stages of the kharif Rice. For knowing the high yielding values for optimum climate normal data from last 10 years (2013-2023) was used to find out the stage wise phenophase normal for high yield. The data for high productivity year of the crop, collected from the Department of Economics & Statistics, Govt. of Odisha. The range of different meteorological parameters for the high productivity of rice crop was worked out from the actual meteorological data of high productivity year. Weather conditions that favour pest incidence and the nature of weather alerts were gathered. The objective of this study was preparation of crop weather calendar and rice cultivation advisory for the farmers during the kharif season. The goal of this study to find out the relation between weather and diseases & pest interaction in rice crop during the kharif season. The research is based on pest and diseases interaction along with weather condition, the data is collected from Department of Entomology and pathology, OUAT and weather data averaged over the last 10 years.

2.2 Study Area

Four coastal districts of Odisha i.e., Khordha, Jagatsinghpur, Kendrapara and puri were choosen for developing the crop weather calendars. These districts are located in the east and south eastern coastal plain agroclimatic zone of Odisha.

2.3 Preparation of Crop weather Calendar

2.3.1 Structure of crop weather calendar

The structure of crop weather calendar designed by AICRPAM consist of the three parts in the main body as depicted in figure. The crop weather calendar is prepared by using three parts A, B & C.

List 1. Districts wise Crop weather calendars

District	Latitude	Longitude	Agro climatic conditions
Khordha	19^0 55' to 20^0 25'E	84^0 55' to 86^0 5' E	The district comes under hot and humid climate having lateritic, alluvial, red and mixed red & black soil groups. It is surrounded by Cuttack district at its north, puri at its East and Ganjam and Nayagarh at its south. Major crops grown are rice, groundnut and pulses (Greengram, Blackgram etc.). The Length of growing period (LGP) is around 175 days with cropping intensity (CI) of 163%.
Jagatsinghpur	19^0 58' to 20^0 23'N	86^0 03 to 86^0 45'E	The district comes under hot and humid climate having mostly alluvial and saline soils. It is bounded by cuttack district as its west, Kendrapara as its North, Puri at its south and Bay of Bengal at its East. Major crops grown are rice, groundnut and pulses (Greengram, blackgram etc.). the LGP (Length of growing season) ranges between 182 -203 days with cropping intensity (CI) of 203%.
Kendrapara	20^0 20' to 20^0 37'N	86^0 14' to 87^0 01'E	The district comes under hot and humid climate having mostly alluvial, saline and black soils. It is surrounded by Jagatsinghpur district at its south, Bhadrak at its North, Jajpur at its north - west, Cuttack at is west and Bay of Bengal at its East. Major crops grown are Rice, Groundnut, Jute and Pluses (Greengram, Blackgram etc.) The LGP ranges between 168-210 days with cropping intensity (CI) of 180%.
Puri	19^0 28' to 19^0 58' N	85^0 41 to 85^0 56'E	The district comes under hot and humid climate having mostly alluvial and saline soils. It is bounded by Jagatsinghpur district at its north, Ganjam at its south and Bay of Bengal at its east. Major crops grown are Rice, groundnut, pulses (Greengram, Blackgram etc.) and plantation crops like coconut and banana. The LGP ranges between 175-266 days with cropping intensity (CI) of 205%.

Table 1. Crop weather calendar template (Part: A, Part: B & Part: C)

Part-A	**Months**
Standard Meteorological week (SMW)	
Name of meteorological parameters	Climatic Normal
Part- B	**Name & pictures of phenological stages of crops**
Stage wise climate normal for high yield of crops	
Part-C	**Climatic normal for diseases**
Name of Diseases, insect pests of crop	Climatic normals required for major diseases of the crop along with susceptible crop phenological stages.

The CWC consists of three parts:

a) **Part A:** Upper most part represents the actual climatic normals on weekly basis. using the historical meteorological data for maximum temperature (ºC), minimum temperature (ºC), maximum relative humidity (%), minimum relative humidity (%), sunshine hours (hours/day) and wind speed (km/hr). Total weekly rainfall (mm), number of rainy days and evaporation (mm) were computed as per availability of data.

b) **Part B**: This part contains the information on crop phenological events of the crop are represented in a weekly time frame

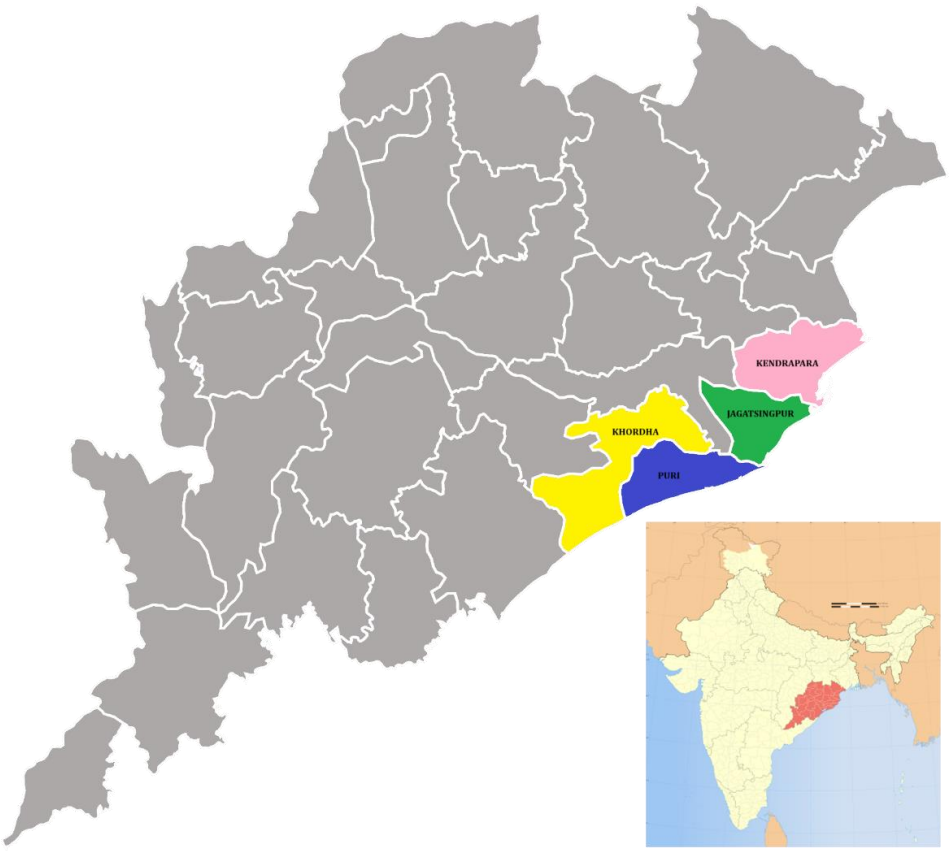


Fig. 1. Location map of the Study Area

and favourable climate parameter to realize potential or high yield of crop.

c) **Part C:** This lower part of the calendar contains the information regarding the favourable weather conditions for development of the insects-pest and diseases incidence.

Methodology followed for making CWC:

In this crop weather calendars (CWC) contains six parts.

1. The uppermost portion (1st part) of the crop weather calendar consists of weather warnings like extreme rainfall, wet spell duration, cloudy weather, drought and high wind.
2. The 2nd part of the CWC contains district level long term average (LTA) meteorological data (maximum temperature, minimum temperature, rainfall & BSH) of respective standard meteorological weeks (SMW). Weekly averages were worked out using 30 years observed data of OUAT meteorological observatory.
3. The 3rd part of the CWC indicates the phenological stage-wise congenial weather conditions for realizing maximum yield of the crop. District level crop yield data was obtained from the Department of Economics & Statistics, Govt. of Odisha for identifying the high productivity crop years. The range of meteorological parameters (Maximum temperature, minimum temperature, rainfall &GDD) for each phenological stage corresponding with the SMW was worked out from the actual meteorological data especially for the high productivity crop years.
4. The 4th part of the CWC gives information on the water requirement for rice crop at different stages. The stage-wise crop water requirement was derived by multiplying PET with crop coefficient for rice (FAO method). further the water required for special operations was added at each stage to obtain the total water requirement for the corresponding stage.
5. The 5th part of the CWC gives information on climatic average required for major pest or diseases of the crop as well as susceptible crop phenological stages. If the

climatic conditions are conducive and the pathogen is present, there are chances of occurances of the pest and diseases. The chance of infestation is shown w.r.t. SMW and growth stages. The photographs of the major pest and diseases infections are also placed for better understanding.

6. The final 6th part of the CWC depicts different growth stages of rice crop such as sowing, seedling, transplanting, tillering, panicle development, flowering, physiological maturity and harvest with respect to SMWS and months. The phenological stages for rice crop were computed using the crop data generated from long term experiments if "All India coordinated research project on Agrometeorology", Bhubaneswar centre.

3. RESULTS AND DISCUSSION

3.1 Crop Weather Calendar of Medium & Long Duration Rice Crop

The CWC for kharif rice of different districts of Odisha (Khordha, Jagatsingpur, Puri & Kendrapada), the entire growth period of the rice in these districts were divided into five phenological stages (SMW) starting from sowing and seedling (25- 28 SMW), Transplanting (29-31 SMW), Tillering to panicle development (32 to 34 SMW), Flowering (35-38 SMW) and Grain filling to maturity (39 to 42 SMW) for medium duration rice. For long duration of Rice, it was from 4th week June to December 1st week (26 SMW- 49 SMW) for sowing & seedling (26- 29 SMW), Transplanting (30-32 SMW), tillering to panicle development (33-39 SMW), flowering (40-43 SMW), flowering (40 to 43 SMW) & Grain filling to maturity (44 to 49 SMW). Similarly for long duration kharif rice duration from 26th SMW to 49th SMW.

Data pertaining to climate normal for different weather parameters (averaged over 30 years) have been presented in the Table 2. The climatic normal for kharif rice has been taken for both medium duration (25 to 42 SMW) and long duration (26 to 49 SMW) from sowing to maturity. The different weather warnings issued for both medium and long duration kharif rice like rainfall, wet spell duration, cloudy weather, drought and High wind. The rainfall warming during the 25 to 38 SMW (>200 mm/day) and from 39 to 42 SMW (>100 mm/day). The wet spell duration (>125mm for 3 days) from during the 25 to 38 SMW. During the crop growth high wind warnings (> 62mm/hr) from 35 to 42 SMW.

In Khordha district for rice crop the highest normal rainfall was found 89 mm during the 29th SMW followed by 84.4 mm and 84.2 mm during the 31st and 34th SMW. The highest normal maximum temperature (34^{0}C) found during 25th week and temperature minimum (23.3^{0}C) was found during 42nd SMW. The BSH (bright sunshine hour) recorded highest in 42nd week (6.4). The crop sown during 25th & 26th SMW is a long and warm season kharif rice crop so it can be successfully grown as a kharif crop during the monsoon season.

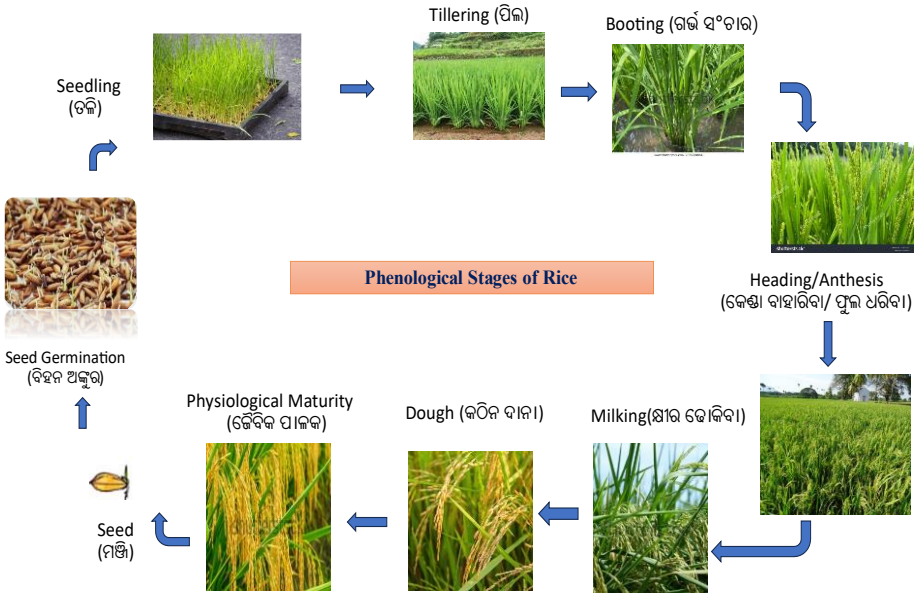


Fig. 2. Phenological stage of Rice crop

Table 2. Crop Weather Calendar of Rice (125 days-medium duration) of Khordha District

SMW		25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Weather warnings	Rainfall	>200mm/day										>200mm/day							
	Wet spell Duration	>125mm for 3 days										>125mm for 5 days			>50mm for 3 days				
	Cloudy Weather														Cloudy				
	Drought	10 days										15 days			20 days				
	High Wind											>62 km/hr			>62 km/hr				
Weekly Normal Weather	Rainfall (mm)	56.4	59.7	65.4	63.7	89.0	63.6	84.4	79.2	70.4	77.8	76.1	64.2	62.1	84.2	52.6	59.6	52.5	37.0
	Tmax (^{0}C)	34.0	33.4	32.8	32.8	32.2	32.2	32.0	32.0	32.2	32.3	32.0	32.0	32.4	32.3	32.7	32.6	32.4	32.1
	Tmin (^{0}C)	25.9	25.8	25.7	25.7	25.6	25.5	25.4	25.5	25.5	25.5	25.4	25.2	25.2	25.1	25.0	24.6	24.1	23.3
	BSH	4.3	4.1	3.5	4.1	4.5	4.1	3.8	4.2	3.9	4.7	4.9	4.2	5.0	5.2	5.6	5.7	6.3	6.4
Climatic Normal for High Yield	RH (%)	81-86				83-87			89-92			80-90			84-92			74-84	
	Tmax(^{0}C)	31-34				32-33			29-33			29-33			31-32			31-33	
	Tmin(^{0}C)	25-26				25-26			25-26			25-26			24-25			21-24	
	GDD	670-690							370-390			390-410			510-520				
Water Requirement		250-300				500-550						250-300			50-100				
Congenial weather conditions for pest &diseases of rice																			
STEM BORRER								**Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0**											
LEAF FOLDER								**Temp (0C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0-30**											
BPH, WBPH &GLH																			**Temp (0C): >30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0-30**
CASE WORM							**Temp (0C):20-30, RH (%): >70, Wind Speed (Km/h): >5, RF (mm):30-50**												
BLAST								**Temp (0C):20-30, RH (%): >90, Wind Speed (Km/h): <5, RF (mm):30-50**											
BLB								**Temp (0C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):>50**											
SHEATH BLIGHT								**Temp (0C):20-30, RH (%): >70, Cloudy weather**											
SHEATH ROT								**Temp (0C):20-30, RH (%), Wind Speed (Km/h): <5, RF (mm):30-50**											
BROWN SPOT							**Temp (0C):20-30, RH (%): >90, Wind Speed (Km/h): >5, RF (mm):30-50**												
FOOT ROT								**Temp (0C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0-30**											

Growth Stage

Sowing & Seedling

Transplanting

Tillering to PD

Flowering

Grain filling to maturity

SMW	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Month	June			July			August				September				October			

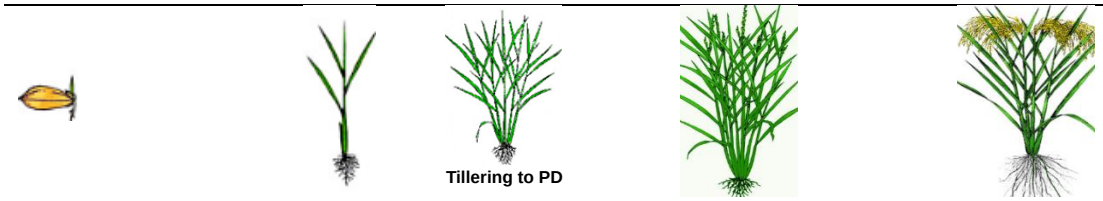
Table 3. Crop Weather Calendar of Rice (150 Days-Long Duration) of Khordha District

SMW		25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Weather warnings	Rainfall	>200mm/day										>200mm/day							
	Wet spell Duration	>125mm for 3 days										>125mm for 5 days			>50mm for 3 days				
	Cloudy Weather														Cloudy				
	Drought	10 days										15 days			20 days				
	High Wind											>62 km/hr			>62 km/hr				
Weekly Normal Weather	Rainfall (mm)	59.7	65.4	63.7	89.0	63.6	84.4	79.2	70.4	77.8	76.1	64.2	62.1	84.2	52.6	59.6	52.5	37.0	32.3
	Tmax (^{0}C)	33.4	33.4	32.8	32.8	32.2	32.2	32.0	32.0	32.2	32.3	32.0	32.0	32.4	32.7	32.6	32.4	32.1	32.0
	Tmin (^{0}C)	25.8	25.8	25.7	25.7	25.6	25.5	25.4	25.5	25.5	25.5	25.4	25.2	25.2	25.0	24.6	24.1	23.3	22.0
	BSH	4.1	3.5	4.1	4.5	4.1	3.8	4.2	3.9	4.7	4.9	4.2	5.0	5.2	5.6	5.7	6.3	6.4	6.8
Climatic Normal for High Yield	RH (%)	82-86				86-92			89-90			80-90				84-92			74-84
	Tmax(^{0}C)	31-34				29-33			29-33			29-33				31-32			31-33
	Tmin(^{0}C)	25-26				25-26			25-26			25-26				24-25			21-24
	GDD	660-680							370-390			910-930				470-490			
Water Requirement		250-300				600-650						350-400				100-200			

SMW	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Month	June			July			August				September				October			November

Congenial weather conditions for pest &diseases of rice	
STEM BORRER	Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0
LEAF FOLDER	Temp (0C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0-30
BPH, WBPH &GLH	Temp (0C): >30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0-30
CASE WORM	Temp (0C):20-30, RH (%): >70, Wind Speed (Km/h): >5, RF (mm):30-50
BLAST	Temp (0C):20-30, RH (%): >90, Wind Speed (Km/h): <5, RF (mm):30-50
BLB	Temp (0C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):>50
SHEATH BLIGHT	Temp (0C):20-30, RH (%): >70, Cloudy weather
SHEATH ROT	Temp (0C):20-30, RH (%), Wind Speed (Km/h): <5, RF (mm):30-50
BROWN SPOT	Temp (0C):20-30, RH (%): >90, Wind Speed (Km/h): >5, RF (mm):30-50
FOOT ROT	Temp (0C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0-30

Growth Stage



Sowing & Seedling | Transplanting | Flowering | Grain filling to maturity

Table 4. Crop Weather Calendar of Rice (125 Days-Medium Duration) of Jagatsingpur District

SMW		25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Weather warnings	**Rainfall (mm)**	**>200 mm/day**										**>200 mm/day**				**>100mm/day**			
	Wet spell duration	**>125 mm for 3 days**										**>125 mm for 5days**				**>50 mm for 3 days**			
	Cloudy weather															**Cloudy**			
	Drought	**10 days**										**15 days**				**20 days**			
	High wind											**>62 km/hr**				**>62km/hr**			
Weekly normal weather	**Rainfall (mm)**	67.2	58.8	64.3	58.0	105.7	70.9	83.8	72.1	61.7	63.5	68.4	73.6	69.8	84.6	47.3	56.9	43.7	36.1
	Tmax (^{0}C)	31.0	30.8	30.5	30.4	30.2	29.8	29.9	30.0	29.7	29.9	29.8	29.7	29.7	29.7	29.8	30.0	29.3	29.5
	Tmin(^{0}C)	27.9	27.8	27.6	27.5	27.5	27.2	27.1	27.3	27.2	27.0	27.1	27.0	26.9	27.0	26.6	26.7	26.0	25.2
	RHI	82	83	87	85	87	87	87	86	87	87	87	87	87	88	87	86	85	85
	RHII	854	85	86	86	86	87	87	88	88	87	87	88	87	87	85	83	82	80
Climate Normal for high yield	**RH(%)**	78-87				83-87			83-86			80-88				79-84		71-80	
	Tmax (^{0}C)	31-32				31-32			30-32			30-33				32-33		32-33	
	Tmin (^{0}C)	27-28				26-27			26-27			25-28				26-27		25-26	
	GDD	670-690							370-390			390-410				510-520			
Water requirement		250-300				670-690						250-300				50-100			
Congenial weather conditions for pest & Diseases of Rice																			
STEM BORRER								**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):0**											
Leaf Folder								**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):0-30**											
BPH, WBPH & GLH																**TEMP: >30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):0-30**			
CASE WORM						**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):30-50**														
BLAST				**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):30-50**															
BLB								**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):>50**											
SHEATH BLIGHT								**TEMP: 28-32^{0}C, RH (%): >90, CLOUDY WEATHER**											
SHEATH ROT								**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):30-50**											
BROWN SPOT				**TEMP: 20-30^{0}C, RH (%): >90, WIND SPEED(Km/h): <5, RF(MM):30-50**															
FOOT ROT								**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):0-30**											
GROWTH STAGES																			
		 **Sowing &Seedling**				 **Transplanting**			 **Tillering to PI**			 **Flowering**				 **Grain filling & maturity**			
SMW		25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
MONTH		**JUNE**		**JULY**				**AUGUST**					**SEPTEMBER**				**OCTOBER**		

Similarly for long duration the weather warmings are same, the highest rainfall received during the 29th week (89mm) followed by (84.4 mm) in the 30th week. The Tmax (33.4^{0}C) and Tmin (15.4^{0}C) for long duration of Rice. The highest BSH recorded 7.3 hr/day in the 47th SMW. In Jagatsingpur district the mean rainfall 105mm, Maximum/minimum temperature 30.8 to 18.9^{0}C and RH -88-70%. Similarly, in Kendrapada and puri district the rainfall on 29th SMW 105.7 mm/day & 106.6 mm/day, the maximum and minimum temperature 30.8^{0}C & 18.9^{0}C and the relative humidity 88 to 70%.

3.2 Phenophase Wise Weather for Kharif Rice

Sowing to seedling period: In medium duration rice crop this period extends from 25th to 28th week and the range of maximum and minimum temperature 31^{0}C-34^{0}C & 25^{0}C-26^{0}C, RH: 81-86% and the water requirement of crop 250-300 mm. Similarly for long duration Rice this period extends from 26th to 29th SMW, the range of Tmax (30-34^{0}C) & Tmin (25-28^{0}C), RH: 78-87% and the water requirement same as medium duration. These are the favourable climatic normal for potential productivity of Rice.

Transplanting: For transplanting growth stage, the period from 29th to 31th SMW and the range of the relative humidity 83 to 87%, the maximum and minimum temp 32-33^{0}C & 25-26^{0}C.

Tillering to Panicle development (PD): From tillering to panicle development of the crop, the RH 82-90%, temperature maximum & minimum 29-33^{0}C ,25-26^{0}C respectively and BSS (Bright Sunshine Hours) was found 5.6-5.2 hr/day. Rainfall during tilling to PD 85mm was found congenial for the expansion of the leaves and chlorophyll content and hence for the better yield for the plant.

Flowering: anthesis is the most important stage for the rice crop, during the flowering period the Maximum & minimum temperature 29-33^{0}C & 25-26^{0}C and the RH is 80-90%. The water requirement during the anthesis period 250-300 mm.

Grain filling to maturity: This period extends from 39 to 42 SMW (for medium duration) & 44 to 49 SMW (for long duration). The range of actual weekly maximum/minimum temperature are for gain filling (70-77) & (30-32), the RH 70-77% and for maturity (63-66) & (30-31), the RH 63-66%. The water requirement during this period is 100-200 mm.

GDD (Growing Degree Day): For high yielding of Rice crop the medium duration GDD requirement was from 25th to 31th SMW i.e 670-690^{0}C, from 32 to 34 (370-390), 35th to 38th (390-410), 39th to 42th (510-520). For long duration (150 days) of rice crop the GDD requirement was from 26th to 32nd week i.e 660-680, from 33th to 37th week i.e (370-390), from 38th to 43th week i.e (910-930) and from 44th to 49th week i.e (470-490).

Congenial weather conditions for pest and diseases of Rice: The bottom part of the crop weather calendar which contain the climatic normal required for major pest and diseases of Kharif Rice as well as susceptible crop phenological stages of the crop. The major pest and diseases of the study area i.e stem borer, leaf folder, BPH, WBPH & GLH and Case worm were observed during the transplanting to flowering stage due to Temperature more than 30^{0}C, wind speed (km/h): <5, rainfall:(0-50) mm and the RH =>70% are the favourable weather conditions for the pest of the Rice crop. In different diseases like Blast, BLB, Sheath Blight, Sheath Rot, Brown spot and foot root are observing from the 27th SMW to 43th SMW (sowing to flowering stage). The favourable weather conditions for diseases like Temperature: 20-30^{0}C, RH= > 90%, wind speed <5 km/hr and Rainfall >50 mm. these are observed from sowing- seedling to transplanting, transplanting to tillering/ panicle development, PD to flowering due to insufficient rainfall and aberrant weather conditions.

3.3 Crop Advisories for Paddy Cultivation

3.3.1 Paddy

Varietal selection:

- Upland rice varieties (Matures in 100-120 days) like Khandagiri, Sahabhagi Dhan, DRR-42, DRR-44, DRR-46, Mandakini, Naveen, GB-1, Bina-11, MTU-1010, Satyabhama, Swarna Shreya etc. can be cultivated.
- Medium land rice varieties (Matures in 120-140 days) like MTU 1156, MTU 1153, CR Dhan 310, RGL 2538, Lalat, Improved Lalat, Manaswini, MTU-1001, Sampada, Gitanjali, Nua acharmati etc can be cultivated.

- Low land rice varieties (Matures >140 days) like Pratikshya, Swarna, Swarna Sub-1, RGL-2537, MTU-1075, Mrinalini, Hashanta, Rani Dhan, CR 1009, CR 1009 Sub-1, DRR 50, Pooja, MTU-1064, CR-1018, Sarala, Durga, Pradhan Dhan, Nua Kalajeera, Nua chinikamini, CR Sungadhi Dhan-907 etc can be cultivated.

3.4 Seed Treatment

Seed treatment is necessary before sowing of Paddy. It will control Seed borne diseases to some extent. Before sowing, seed treatment can be done with Carbendazim 50 % WP @ 2- gram/ kg of seeds or Carboxin 37.5 % + Thiram 37.5% D.S WP or thiram 75 % WS @ 3 gm/kg of seeds.

Seed sowing:

- Sow the paddy seeds in line preferably with seed drill or three tyne cultivator-cum-seed drill or behind the country plough at 15 x 15 cm or 20 x10 cm spacing. Seed should be placed at a depth of 4-6 cm.
- Use 24-30 kg of paddy seeds/acre for broadcasting and 12- 16 kg seeds/ acre for sowing by seed drill depending on the test weight of the seed.

3.5 Dry Nursery Field Preparation

For one-acre area of paddy transplanting 400 m2 (10 Decimal) size of land is required for nursery raising. Selected nursery field should be ploughed 3- 4 times. Apply 1 tonne of FYM and mixed it properly during last ploughing. Divide nursery area into smaller plots of 1.5-metre-long, 10 cm height and convenient length. Irrigation channels of size 30 cm in breadth should be made along the beds for irrigation/drainage.

3.6 Wet Nursery Field Preparation

Irrigation should be done in nursery field and puddle it 2-3 times followed by planking. Apply 200 kg of FYM, 4 kg of DAP ,2.5 kg of MOP and 1 kg of Zinc sulphate during last puddling. Sprouted Seeds should be sown @ 40-50 gram/ m2 area of seed bed by line sowing with 5 cm gap between each line or direct broadcasting and put dried compost over seeds. Apply light irrigations to the nursery area particularly in the evening so that the field remains wet and do not keep standing water.

3.7 Basal Fertilizer Management in Direct Seeded Rice

Incorporate well decomposed Farm Yard Manure or cow-dung @ 8 quintals /acre during the final land preparation in direct seeded rice. Apply full dose of Phosphorus and Potash @ 12kg each /acre (preferably 75 kg SSP or 27 kg DAP + 20 kg MOP) as band placement behind the plough or by fertiliser cum seed drill in upland rice as basal dose.

Weed management:

- Spray Bispyribac sodium 10% SC @ 120ml/acre in 8 tanks of 16 litre capacity sprayer at 8- 10 days after sowing or when the weeds are at 2-3 leaf stage in moist soil as an alternative to manual weeding or Metsulfuron Methyl 10%+ Chlorimuron Ethyl 10 % WP @ 8 gram / acre at 15-20 DAS (When the weeds are at 3-4 leaf stage) by mixing in 200-litre of water or apply tank mix of Fenoxaprop-p-ethyl + Ethoxysulfuron @ 260 + 50 g/acre at 15-20 DAS as an alternate to manual weeding.
- Use pre-emergence herbicide Pretilachlor @ 800 ml/acre or Oxadiargyl 80%W. P @ 30gm/acre or Pyrazosulfuron Ethyl 10% W.P @ 80gm/acre at 1-3 DAT. Spray the herbicide by mixing it in 200 litres of water per acre or Mix the herbicide with 20 kg of sand and broadcast it uniformly. Always use flat-fan or flood-jet nozzle and clean water for herbicide spraying.

3.8 Fertilizer Management in Nursery

Apply 200 kg of FYM, 4 kg of DAP, 2.5 kg of MOP during last puddling in 10-decimil nursery area. Apply light irrigations to the nursery area so that the field remains wet and do not keep standing water. Apply 4 kg of Urea at 15 DAS to the nursery area.

Nursery pest management: Apply Chlorantraniliprole 0.4 % G @ 400-gram or Cartap Hydrochloride 4% GR @ 800-gram or Fipronil 0.3% GR @ 1-kg in the 10 decimal nursery area 7-days before transplanting to manage gall midge, stem borer, caseworm, leaf folder and root knot nematode up to 3 weeks after transplanting.

Table 5. Crop weather calendar of Rice (125 days-medium duration) of Kendrapara District

SMW		25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Weather warnings	**Rainfall (mm)**	**>200 mm/day**										**>200 mm/day**				**>100mm/day**			
	Wet spell duration	**>125 mm for 3 days**										**>125 mm for 5days**				**>50 mm for 3 days**			
	Cloudy weather															**Cloudy**			
	Drought	**10 days**										**15 days**				**20 days**			
	High wind											**>62 km/hr**				**>62km/hr**			
Weekly normal weather	**Rainfall (mm)**	64.8	52.3	61.7	63.3	106.6	67.6	83.1	69.0	57.4		62.7	70.4	69.3	65.8	78.5	48.0	56.7	44.4	30.9
	Tmax (^{0}C)	30.5	30.4	30.2	29.9	29.8	29.8	29.7	29.8	29.6		29.6	29.5	29.6	29.6	29.6	29.9	29.9	29.8	29.4
	Tmin(^{0}C)	28.3	28.3	28.1	28.0	28.0	27.2	27.7	27.3	27.7		27.7	27.8	27.7	27.8	27.8	27.6	27.7	27.4	26.8
	RHI	81	83	87	85	87	87	86	86	87		87	87	87	86	88	87	86	85	85
	RHII	84	84	85	85	86	87	85	85	86		85	85	85	84	84	82	80	78	76
Climate Normal for high yield	**RH(%)**	75-82			78-87			79-81				79-84				75-82			63-71	
	Tmax (^{0}C)	32-33			31-33			31-33				30-33				32-33			32-33	
	Tmin (^{0}C)	26-27			25-26			26-27				25-27				26-27			25-26	
	GDD	670-690						370-390				390-410				510-520				
Water requirement		250-300			500-550							250-300				50-100				
Congenial weather conditions for pest & Diseases of Rice																				
STEM BORRER								**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):0**												
Leaf Folder								**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):0-30**												
BPH, WBPH & GLH																**TEMP: >30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):0-30**				
CASE WORM						**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):30-50**															
BLAST				**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):30-50**																
BLB								**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):>50**												
SHEATH BLIGHT								**TEMP: 28-32^{0}C, RH (%): >90, CLOUDY WEATHER**												
SHEATH ROT								**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):30-50**												
BROWN SPOT				**TEMP: 20-30^{0}C, RH (%): >90, WIND SPEED(Km/h): <5, RF(MM):30-50**																
FOOT ROT								**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):0-30**												
GROWTH STAGES																				
		 **Sowing &Seedling**			 **Transplanting**			 **Tillering to PI**				 **Flowering**				 **Grain filling & maturity**				
SMW		**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	
MONTH		**JUNE**		**JULY**				**AUGUST**					**SEPTEMBER**				**OCTOBER**			

Table 6. Crop weather calendar of Rice (125 days-medium duration) of Puri District

SMW		25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Weather warnings	**Rainfall (mm)**	**>200 mm/day**										**>200 mm/day**				**>100mm/day**			
	Wet spell duration	**>125 mm for 3 days**										**>125 mm for 5days**				**>50 mm for 3 days**			
	Cloudy weather															**Cloudy**			
	Drought	**10 days**										**15 days**				**20 days**			
	High wind											**>62 km/hr**				**>62km/hr**			
Weekly normal weather	**Rainfall (mm)**	64.8	52.3	61.7	63.3	106.6	67.6	83.1	69.0	57.4		62.7	70.4	69.3	65.8	78.5	48.0	56.7	44.4	30.9
	Tmax (^{0}C)	30.5	30.4	30.2	29.9	29.8	29.8	29.7	29.8	29.6		29.6	29.5	29.6	29.6	29.6	29.9	29.9	29.8	29.4
	Tmin(^{0}C)	28.3	28.3	28.1	28.0	28.0	27.2	27.7	27.3	27.7		27.7	27.8	27.7	27.8	27.8	27.6	27.7	27.4	26.8
	RHI	81	83	87	85	87	87	86	86	87		87	87	87	86	88	87	86	85	85
	RHII	84	84	85	85	86	87	85	85	86		85	85	85	84	84	82	80	78	76
Climate Normal for high yield	**RH(%)**	75-82			78-87			79-81				79-84				75-82			63-71	
	Tmax (^{0}C)	32-33			31-33			31-33				30-33				32-33			32-33	
	Tmin (^{0}C)	26-27			25-26			26-27				25-27				26-27			25-26	
	GDD	670-690						370-390				390-410				510-520				
Water requirement		250-300			500-550							250-300				50-100				
Congenial weather conditions for pest & Diseases of Rice																				
STEM BORRER		**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):0**																		
Leaf Folder		**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):0-30**																		
BPH, WBPH & GLH		**TEMP: >30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):0-30**																		
CASE WORM		**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):30-50**																		
BLAST		**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):30-50**																		
BLB		**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):>50**																		
SHEATH BLIGHT		**TEMP: 28-32^{0}C, RH (%): >90, CLOUDY WEATHER**																		
SHEATH ROT		**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):30-50**																		
BROWN SPOT		**TEMP: 20-30^{0}C, RH (%): >90, WIND SPEED(Km/h): <5, RF(MM):30-50**																		
FOOT ROT		**TEMP: 20-30^{0}C, RH (%): >70, WIND SPEED(Km/h): <5, RF(MM):0-30**																		
GROWTH STAGES																				
		 **Sowing &Seedling**			 **Transplanting**			 **Tillering to PI**				 **Flowering**				 **Grain filling & maturity**				
SMW		**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	
MONTH		**JUNE**		**JULY**				**AUGUST**					**SEPTEMBER**				**OCTOBER**			

Table 7. Crop weather calendar of Rice (150 days -long duration) of Kendrapada District

SMW		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Weather warnings	**Rainfall (mm)**	**>200mm/day**											**>200 mm/day**						**>100 mm/day**						
	Wet spell duration	**>125 mm for 3 days**											**>125 mm for 5 days**						**>50 mm for 3 days**						
	Cloudy weather																		**cloudy**						
	Drought	**10 days**											**15 days**						**20 days**						
	High wind												**>62km/hr**						**>62km/hr**						
Weekly normal weather	**Rainfall (mm)**	**58.8**	**64.8**	**58.0**	**105.7**	**70.9**	**83.8**	**72.1**	**61.7**	**63.5**	**68.4**	**73.6**	**69.8**	**84.6**	**47.3**	**56.9**	**43.7**	**36.1**	**40.8**	**11.8**	**12.6**	**11.4**	**1.3**	**0.1**	**19.3**
	Tmax (^{0}C)	**30.8**	**30.5**	**30.4**	**30.2**	**29.8**	**29.9**	**30.0**	**29.7**	**29.9**	**29.8**	**29.7**	**29.7**	**29.7**	**29.8**	**30.0**	**29.3**	**29.5**	**29.0**	**28.5**	**28.1**	**27.5**	**27.2**	**26.7**	**26.0**
	Tmin(^{0}C)	**27.8**	**27.6**	**27.5**	**27.5**	**27.2**	**27.1**	**27.3**	**27.2**	**27.0**	**27.1**	**27.0**	**26.9**	**27.0**	**26.6**	**26.7**	**26.0**	**25.2**	**24.1**	**23.4**	**22.4**	**21.6**	**20.7**	**19.8**	**18.9**
	RHI	**83**	**87**	**85**	**87**	**87**	**86**	**87**	**87**	**87**	**87**	**87**	**87**	**88**	**87**	**86**	**85**	**85**	**83**	**82**	**81**	**81**	**79**	**79**	**80**
	RHII	**85**	**86**	**86**	**86**	**87**	**87**	**88**	**88**	**87**	**87**	**88**	**87**	**87**	**85**	**83**	**82**	**80**	**77**	**78**	**76**	**75**	**73**	**72**	**70**
Climate normal for high yield	**RH (%)**	78-87	83-87						80-88				71-80						70-85			72-80			
	Tmax(^{0}C)	30-32	29-31										31-33						29-31			29-30			
	Tmin(^{0}C)	26-28	26-27										23-26						20-24			18-19			
	GDD	660-680							370-390				910-930						470-490						
Water Requirement		250-300	600-650										350-400						100-200						

Congenial weather conditions for pest & diseases of Rice	
STEM BORRER	Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0
LEAF FOLDER	Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0-30
BPH, WBPH & GLH	Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0-30
CASE WORM	Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):30-50
BLAST	Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):30-50
BLB	Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):30-50
SHEATH BLIGHT	Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):>50
SHEATH ROT	Temp (^{0}C):20-30, RH (%): >90, CLOUDY WEATHER
BROWN SPOT	Temp (^{0}C):20-30, RH (%): >90, Wind Speed (Km/h): <5, RF (mm):30-50
FOOT ROT	Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0-30

GROWTH STAGE

Sowing and seedling

Transplanting

Tillering and panicle development

Flowering

Grain filling to maturity

SMW	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Month		**July**					**August**					**September**			**October**			**November**						

Table 8. Crop weather calendar of rice (150 days long duration) of Kendrapada District

SMW		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Weather warnings	Rainfall (mm)	>200mm/day												>200 mm/day						>100 mm/day					
	Wet spell duration	>125 mm for 3 days												>125 mm for 5 days						>50 mm for 3 days					
	Cloudy weather																			cloudy					
	Drought	10 days												15 days						20 days					
	High wind													>62km/hr						>62km/hr					
Weekly normal weather	Rainfall (mm)	58.8	64.8	58.0	105.7	70.9	83.8	72.1	61.7	63.5	68.4	73.6	69.8	84.6	47.3	56.9	43.7	36.1	40.8	11.8	12.6	11.4	1.3	0.1	19.3
	Tmax (^{0}C)	30.8	30.5	30.4	30.2	29.8	29.9	30.0	29.7	29.9	29.8	29.7	29.7	29.7	29.8	30.0	29.3	29.5	29.0	28.5	28.1	27.5	27.2	26.7	26.0
	Tmin(^{0}C)	27.8	27.6	27.5	27.5	27.2	27.1	27.3	27.2	27.0	27.1	27.0	26.9	27.0	26.6	26.7	26.0	25.2	24.1	23.4	22.4	21.6	20.7	19.8	18.9
	RHI	83	87	85	87	87	86	87	87	87	87	87	87	88	87	86	85	85	83	82	81	81	79	79	80
	RHII	85	86	86	86	87	87	88	88	87	87	88	87	87	85	83	82	80	77	78	76	75	73	72	70
Climate normal for high yield	RH (%)	78-87			83-87				80-88					71-80						70-85			72-80		
	Tmax(^{0}C)	30-32			29-31									31-33						29-31			29-30		
	Tmin(^{0}C)	26-28			26-27									23-26						20-24			18-19		
	GDD	660-680							370-390					910-930						470-490					
Water Requirement		250-300			600-650									350-400						100-200					
Congenial weather conditions for pest & diseases of Rice																									
STEM BORRER		Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0																							
LEAF FOLDER		Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0-30																							
BPH, WBPH & GLH		Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0-30																							
CASE WORM		Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):30-50																							
BLAST		Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):30-50																							
BLB		Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):30-50																							
SHEATH BLIGHT		Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):>50																							
SHEATH ROT		Temp (^{0}C):20-30, RH (%): >90, CLOUDY WEATHER																							
BROWN SPOT		Temp (^{0}C):20-30, RH (%): >90, Wind Speed (Km/h): <5, RF (mm):30-50																							
FOOT ROT		Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0-30																							

GROWTH STAGE

Sowing and seedling

Transplanting

Tillering and panicle development

Flowering

Grain filling to maturity

SMW	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Month	July				August						September				October				November					

Table 9. Crop weather calendar of Rice (150 days -long duration) of Jagatsinghpur District

SMW		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Weather warnings	Rainfall (mm)	>200mm/day												>200 mm/day						>100 mm/day					
	Wet spell duration	>125 mm for 3 days												>125 mm for 5 days						>50 mm for 3 days					
	Cloudy weather																			cloudy					
	Drought	10 days												15 days						20 days					
	High wind													>62km/hr						>62km/hr					
Weekly normal weather	Rainfall (mm)	58.8	64.8	58.0	105.7	70.9	83.8	72.1	61.7	63.5	68.4	73.6	69.8	84.6	47.3	56.9	43.7	36.1	40.8	11.8	12.6	11.4	1.3	0.1	19.3
	Tmax (^{0}C)	30.8	30.5	30.4	30.2	29.8	29.9	30.0	29.7	29.9	29.8	29.7	29.7	29.7	29.8	30.0	29.3	29.5	29.0	28.5	28.1	27.5	27.2	26.7	26.0
	Tmin(^{0}C)	27.8	27.6	27.5	27.5	27.2	27.1	27.3	27.2	27.0	27.1	27.0	26.9	27.0	26.6	26.7	26.0	25.2	24.1	23.4	22.4	21.6	20.7	19.8	18.9
	RHI	83	87	85	87	87	86	87	87	87	87	87	87	88	87	86	85	85	83	82	81	81	79	79	80
	RHII	85	86	86	86	87	87	88	88	87	87	88	87	87	85	83	82	80	77	78	76	75	73	72	70
Climate normal for high yield	RH (%)	78-87			83-87				80-88					71-80						70-85			72-80		
	Tmax(^{0}C)	30-32			29-31				29-33					31-33						29-31			29-30		
	Tmin(^{0}C)	26-28			26-27				25-28					23-26						20-24			18-19		
	GDD	660-680							370-390					910-930						470-490					
Water Requirement		250-300			600-650									350-400						100-200					
Congenial weather conditions for pest & diseases of Rice																									
STEM BORRER		Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0																							
LEAF FOLDER		Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0-30																							
BPH, WBPH & GLH		Temp (^{0}C):20-30, RH (%): >70, Wind Speed (Km/h): <5, RF (mm):0-30																							
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GROWTH STAGE

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3.9 Beushaning

In paddy field where herbicide has not been applied, “Beushaning” may be done after accumulation of enough water (at least 7-10 cm standing water) at 25-30 days after sowing. After “Beushaning” apply 35 kg of urea/acre as top dressing. If fertilizer has not been applied during sowing, apply 35 kg of DAP, 15 kg of MOP and 15 kg of Urea per acre after “Beushaning”. Do not go for “Beushaning” if the crop is more than 45 days old.

3.10 Seedling Treatment

If granular pesticide has not been applied, then dip the root of paddy seedlings with solution of 1 ml chlorpyriphos/ liter of water for 8 to 10 hours before transplanting.

Basal fertilizer management in transplanted rice: Apply 35 kg DAP, 27 kg Potash and 8 kg Urea per acre during last puddling. For sandy soil apply 35 kg DAP, 15 kg Potash and 8 kg Urea per acre during last puddling. Transplanting of 20-25 days old seedlings should be done at a spacing of 20x15 cm, plant 2-3 seedlings per hill for high yielding varieties.

3.11 Pest Management

Stem borer: To manage stem borer in paddy at early stage of crop, apply Cartap Hydrochloride 4 % G @ 8-kg/acre or Chlorantraniliprole 0.4% GR @ 4-kg/acre or Imidacloprid 0.3% GR @ 6-kg/acre by mixing it with sand at 1:1 ratio.

Leaf folder and case worm: Due to cloudy weather, there is a chance of leaf folder and case worm infestation. To manage this pest in paddy spray Fipronil 5% SC @ 400-ml/acre or Profenophos 50% EC @ 400-ml/acre or Chlorantraniliprole 18.5% SC @ 60-ml /acre.

BPH and WBPH-: The high humid weather condition is favourable for Brown Plant Hopper (BPH) and White Backed Plant Hopper (WBPH) infestation in paddy. To manage BPH and WBPH in paddy avoid excess use of nitrogenous fertilizer. Do not keeping standing water in the field for longer period. Alter the micro-climate of the rice field by alternate wetting and drying technique. Make alleys at 6 feet spacing for sunlight entry and proper aeration below the crop zone. If >10-15 hoppers/hill noticed, spray Pymetrozine 50% WG @ 120 g/acre or Dinotefuran 20 % SG @ 80 g/acre or Flonicamid 50 % WG @ 60- gram/acre or Triflumezopyrim 10% SC @ 100 ml / acre at the base of the plant.

3.12 Disease Management

Bacterial leaf blight: To control Bacterial leaf blight in paddy, dip the roots of seedlings in Streptomycin solution by mixing 1 g in 10 litre of water for 20 minutes before transplanting.
To manage this disease chemically, spray Copper Hydroxide 53.8% DF @ 600-gram/acre or 200-gram Plantomycin along with Copper Oxy Chloride 50% WP @ 600-gram/acre.

Blast: To Manage Blast diseases first drain out excess water from the paddy field. Spray Hexaconazole @ 400-ml/acre or Azoxystrobin+ Difenoconazole @ 200-ml/acre or Tebuconazole + Trifloxystrobin @ 80-gram/acre.

Sheath blight: For controlling this disease, spray Tebuconazole 50%+ Trifloxystrobin 25 % WG @ 80-gram/acre or Propiconazole 25% EC @ 200ml/acre.

Sheath rot: To control sheath rot disease spray Carbendazim 50% WP @ 400- gram/acre or Propiconazole 25% EC @ 200-ml/acre or Iprodine 25% + Carbendazim 25% WP @ 500-gram/acre by mixing in 200-litre of water.

Foot rot: To control foot rot disease in paddy spray Metalaxyl 8% +Mancozeb 64% WP @ 400- gram/acre or Carbendazim 12% +Mancozeb 63% WP @ 400-gram/acre.

4. CONCLUSION

The crop weather calendars were developed in the present study for medium and long duration rice crop at different phenological stages by combining the information on weekly normal meteorological data, with ranges of meteorological parameters for high production of the crop. In Odisha, the highest production of Rice crop achieved with the range maximum/ minimum temperature, relative humidity, Bright sunshine hours and rainfall from 31 to 34^{0}C/ 26-28^{0}C and 89 mm-105 mm rainfall respectively during the sowing and seeding to maturity. This calendar and crop advisory are most useful for issuing the Agro Advisory services for the Rice crop. These calendars are useful for crop planning, irrigation, Scheduling and plant protection measures, which are of vital importance for effective crop planning and for maximizing and stabilizing food production in the country.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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