Performance of Climate Smart Rrice (*var*. CR DHAN 801): A Case study fromin Western Uundulating Zzone of Odisha

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ABSTRACT

This research paper presents a detailed case study conducted in Khairbhadi village of Kalahandi district as a part of the NICRA Project undertaken by Krishi Vigyan Kendra, Kalahandi (OUAT). The study evaluates the performance of the climate-smart rice variety CR DHAN 801 under drought conditions, which is crucial for ensuring food security in regions prone to water scarcity. To assess its effectiveness, the study employed a randomized block design, comparing CR DHAN 801 with two other rice varieties, namely MTU-1001 and Jamuna. The results obtained from the study indicated that CR DHAN 801 consistently outperformed the other two varieties across multiple parameters. This superiority is evident in growth parameters, yield attributes, economic viability, and resilience to water scarcity. CR DHAN 801 exhibited robust growth characteristics, optimal yield potential, and economic viability, making it a promising choice for cultivation in drought-prone regions. These findings underscore the significance of CR DHAN 801 as a resilient climate-smart variety highlighting its potential to contribute significantly to agricultural sustainability and resilience in areas facing water scarcity challenges.

Keywords: Climate-smart agriculture, CR DHAN 801, Drought resilience, rice variety, Kalahandi district.

INTRODUCTION

Rice cultivation holds immense importance in the agricultural landscape of Odisha, India. With a rich heritage and tradition deeply rooted in rice farming practices, Odisha stands as one of the foremost rice-producing states in the country. The cultivation of rice is not merely a means of sustenance but also a significant contributor to the state's economy, playing a pivotal role in the livelihoods of millions of farmers across the region. The diverse topography of Odisha, ranging from coastal plains to hilly terrains, provides an ideal environment for cultivating a wide array of rice varieties tailored to various climatic conditions and soil types prevalent in the state. Notably, rice cultivation in Odisha primarily relies on rainfed agriculture, with farmers heavily dependent on the seasonal monsoons for irrigation. This dependence on rainfall underscores the critical role played by nature's rhythms in shaping agricultural practices and livelihoods in Odisha, further highlighting the intricate relationship between rice cultivation, environmental factors, and the socio-economic fabric of the state.

Rice is crucial globally, particularly in India, which has the second-highest rice output after China. Worldwide, rice is cultivated on 158 million hectares, yielding 700 million tonnes (DRR, 2011). India's rice-growing area spans 43.86 million hectares, producing approximately 106.54 million tonnes annually, averaging 2424 kg per hectare. India accounts for 26 percent of global rice production (Malik - et al, 2023). In Odisha, rice farming covers 4.4 million hectares, with an average yield of 1,538 kg per hectare, constituting 89 percent of the cereal-growing area and contributing 92 percent to the total cereal production in the state (Das et al., 2022).Rice cultivation in Kalahandi District, Odisha, is vital, with approximately

0.184 million hectares with a total production of 0.884 million tonnes with a productivity of 48.04 MT per ha.

Cultivating climate-smart rice varieties like CR 801 is essential in areas prone to drought for several reasons. These specially bred varieties, designed to withstand droughts and use water efficiently, ensure better harvests even under tough conditions. By growing CR 801, farmers can maintain a steady food supply despite water shortages, bolstering food security. Additionally, these rice types help communities adapt to climate change by being resilient to extreme weather. Their lower water needs not only save resources but also ease pressure on irrigation systems. Furthermore, CR 801's higher yields cut down on farming expenses, boosting farmer's incomes and fostering prosperity. Overall, cultivating CR 801 promotes environmental sustainability by conserving resources and reducing emissions, benefiting both farmers and the environment in drought-prone regions(Mandal et al., 2019).

MATERIALS AND METHODS

EXPERIMENTAL SITE AND TOPOGRAPHY

During the 2023 kharif season, a trial was conducted at a farmer's field in Khairbhadi village, which is part of the NICRA Project facilitated by Krishi Vigyan Kendra Kalahandi (OUAT). Khairbhadi village is located within the Western undulating zone of Odisha, situated at coordinates 19.97^{o}N latitude and 83.26^{o}E longitude, with an elevation of 281 meters above sea level. The field's topography was uniformly medium-low land. The soil type in the experimental area was clay loam (silty clay) with medium fertility. Chemical analysis of the soil revealed medium levels of organic carbon (0.51%) and low in available nitrogen (192.7 kg/ha). At the same time, available phosphorus levels were moderate (38.52 kg/ha) and available potassium levels were also moderate (187.5 kg/ha). The soil had aneutral pH of 6.82 and an electrical conductivity (EC) of 0.13 (normal).

WEATHER CONDITIONS DURING THE CROPPING PERIOD:

Kalahandi experiences a sub-humid, tropical climate characterized by hot, arid summer and chilly winter. The monsoon typically commences in mid-June and extends until the first week of October. The region receives an average annual rainfall of 1378.2 mm, with the majority (80-90%) occurring between June and September, sourced from the southwest monsoon. While there are intermittent showers in winter and occasionally during summer, irrigation is often required for the *Khairf*crops due to the irregular distribution of rainfall. Although rainfall during the crop season was near normal, irrigation mitigated any adverse effects of fluctuating rainfall patterns. Maximum temperatures range from 35°C to 43°C during peak summer months, dropping below 20°C in December-January. This temperature fluctuation poses challenges for rice cultivation, particularly during flowering, as the crop is sensitive to temperature variations. Morning relative humidity remains consistently above 85% during the rainy season. Throughout the crop season, morning and afternoon relative humidity levels were within normal range, indicating minimal impact on crop production. Meteorological data for the experimentation period was sourced from the Meteorological observatory at the Regional Research and Technology Transfer Station (RRTTS), Bhawanipatna, which is presented below:

Table. 1: Meteorological data during crop season - *Kharif* 2023. *(Source: – RRTTS, Bhawanipatna)*

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Month	Temperature		Humidity		Rainfall (mm)	Rainy day(Nos.)	BSH(Hrs.)
	Min.	**Max.**	**Max.**	**Min.**			
June	26.2	38.4	60.6	48.3	98.2	8.0	2.9
July	24.9	31.9	82.4	78.2	364.6	18.0	1.4
August	24.3	31.7	80.1	78.4	336.0	11.0	1.8
September	24.1	31.1	87.3	83.0	287.4	12.0	2.3
October	20.3	32.2	72.1	67.9	53.6	2.0	6.6
November	18.0	30.8	78.0	64.3	1.8	0.0	4.9
Mean	**22.9**	**32.6**	**76.7**	**70.1**	**1141.6 (Total)**	**51**	**3.3**

Comment [Dk1]: Pls Put Accurate Data

EXPERIMENT DETAILS

1. **Experimental Setup:** The study utilized a Randomized Block Design (RBD), a common experimental design in agricultural research, to minimize variability and ensure robust statistical analysis. This design involves dividing the experimental area into blocks, with each block representing a homogeneous section of land, and randomly assigning treatments within each block to account for any variation in soil characteristics or microclimates.
2. **Treatment Groups:** Three different rice varieties were selected for comparison:
   - ❖ **CR Dhan 801:** This is the climate-smart rice variety under study, known for its resilience to adverse climatic conditions such as drought and flooding.
   - ❖ **MTU 1001:** A commonly cultivated rice variety, used as a benchmark for comparison against CR Dhan 801.
   - ❖ **Jamuna:** Another rice variety selected for comparison, chosen due to its local significance or as another standard for comparison.
3. **Replications:** Each treatment group (rice variety) was replicated thirteen times. Replication is essential to ensure the reliability and validity of experimental results by reducing the impact of random variability and allowing for more accurate statistical analysis.
4. **Maintaining Recommended Practices:**The experiment followed best practices for optimal rice growth maintaining the recommended package of practices of rice.
5. **Data Collection:** Throughout the growing season, data on various agronomic parameters such as plant height, tiller count, flowering duration, grain yield, and quality attributes may have been collected at specific intervals to assess the performance of each rice variety under study.

By adhering to these standardized treatment protocols within a Randomized Block Design, the research aimed to provide robust insights into the performance of CR Dhan 801 compared to other rice varieties under local agro-climatic conditions, specifically in Khairbhadi Village of Kalahandi District.

TEST VARIETY: CR DHAN 801 (Phalguni)

The cross between the breeding materials of IR81896-B-B-195 / 2* Swarna Sub1 / IR91659-54-35., resulted in the development of Climate-smart rice variety- CR Dhan 801 released by ICAR-NRRI, Cuttack, Odisha(Pradhan et al., 2019).It consistently outperformed its parent under drought and submergence conditions in AICRIP testing, leading to its release in several states including Odisha, West Bengal, Uttar Pradesh, Andhra Pradesh, and Telangana. CR Dhan 801 incorporates the Sub1 gene for submergence tolerance and qDTY1.1, qDTY2.1, and qDTY3.1 yield QTLs for drought stress, which were introduced via marker-assisted backcross breeding into the Swarna variety background. The genome recovery of the recipient parent exceeded 95%. With weak photosensitivity, CR Dhan 801 typically matures in about 140-145 days.It exhibits resistance against various diseases and pests including leaf blast, gall midge, leaf folder, and moderate resistance to sheath rot, tungro virus, brown spot, sheath blight, yellow stem borer, brown plant hopper, white-backed plant hopper, and grassy leaf hopper(CRRI, Cuttack, Odisha).It possesses short bold grain and other desirable grain quality parameters. Cultivation practices, pest and disease control as well as harvesting and processing of these varieties are similar to other commonly grown high-yielding varieties of rice.

~~EXPERIMENTAL FINDINGS~~RESULTS AND DISCUSSION:

The statistical analysis of the collected data has been conducted, and the findings are showcased in this chapter, accompanied by a thorough critical assessment. The presentation ~~endeavors~~endeavours to offer a vivid depiction of the data, ensuring clarity and coherence for a comprehensive understanding of the results.

Table: 2 – Experimental Findings.

Sl. No.	Particulars	CR DHAN- 801	MTU-1001	Jamuna	Standard Error SEm (±)	Critical Difference (CD) p=0.05
1	Plant Height (cm)	98	106	112	4.05	3.22
2	Maturity Duration	142	135	145	-	-
3	No. of effective tillers/hill	12	11	9	0.881	1.152
4	Panicle Length (cm)	27.1	24.3	23.2	1.16	1.55
5	Flag Leaf Length (cm)	41	34	39	2.08	2.77
6	Flag Leaf Area (cm^2)	47.56	44.37	42.63	-	-
7	Flowering Days	112	110	114	-	-
8	Lodging	Non-lodging	Non-lodging	Lodging	-	-
9	Grain type	Short & Bold	Short	Long &Slende	-	-

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10	No. of grains/panicles	158	146	148	3.52	4.69
11	Test Weight (g)	25.34	24.46	23.7	0.433	0.578
12	Kernel Length (mm)	5.31	5.15	4.86	0.131	0.174
13	Kernel Breadth (mm)	2.22	2.28	2.09	-	-
14	L:B Ratio	2.39	2.25	2.32	-	-
15	Average Grain Yield (q/ha)	43	38	36.5~~q~~	2.43	3.19
16	Return from Grain yield (Rs.)	93869	82954	79679	-	-
17	Return from Straw yield (Rs.)	13250	12500	11760	-	-
18	Gross Return (Rs.)	107119	95454	91439	-	-
19	Net Return (Rs.)	67009	55344	51329	-	-
20	B:C Ratio	1.67	1.37	1.28	-	-

N.B.: Cost of cultivation of Paddy= Rs. 40110/ha, the selling price of Paddy = Rs. 2183/quintal

Comment [Dk2]: please put Cost of Cultivation in Table

DISCUSSION

The research findings demonstrate the superior performance of the CR DHAN 801 variety compared to the MTU-1001 and Jamuna varieties across multiple parameters. Regarding yield, CR DHAN 801 consistently exhibited higher grain yields per hectare, indicating its potential for enhanced productivity under drought conditions.CR Dhan 801 yields significantly higher (43 q/ha) than MTU-1001 (38 q/ha) and Jamuna (36.5 q/ha). Additionally, CR DHAN 801 showcased ~~favorable~~favourable yield attributing characteristics such as a greater number of effective tillers per hill, longer panicle length, and higher number of grains per panicle, contributing to its overall superior yield potential.CR Dhan 801 exhibits superior tillering capacity with 12 effective tillers per hill, along with longer panicles (27.1 cm), potentially boosting grain yield. Its larger flag leaf (41 cm) and area (47.56 cm²) suggest better photosynthetic efficiency. From an economic perspective, CR DHAN 801 proved to be a more profitable option, generating higher returns from both grain and straw yield, leading to greater gross and net returns, with a more profitable benefit-cost ratio (B:C) of 1.67 compared to 1.37 for MTU-1001 and 1.28 for Jamuna. Furthermore, CR DHAN 801 demonstrated remarkable resilience to water scarcity, as evidenced by its ability to maintain growth and productivity even under drought conditions, highlighting its suitability for cultivation in drought-prone regions.

Comment [Dk3]: this study is based on climate resilience rice therefore please discuss about no. of irrigation and irrigation water application result in drought and submerge condition

CONCLUSION

In conclusion, this study proves CR DHAN 801's superiority over MTU-1001 and Jamuna in drought conditions in Khairbhadi village, Kalahandi, under the NICRA Project by Krishi Vigyan Kendra, Kalahandi. CR DHAN 801 displayed exceptional resilience to water scarcity, highlighting its adaptability to harsh environments. Its proper growth, including balanced patterns and robust tillering capacity, along with efficient photosynthesis, confirms its suitability for drought-prone regions. Additionally, CR DHAN 801 consistently surpassed the other varieties in yield and economic returns. Besides its tolerance to drought conditions, the variety also shows resilience to submergence as it contains the Sub1 gene for submergence tolerance(Thakuria et al., 2023).These findings outlineits significance in mitigating drought impacts and promoting agricultural sustainability, making it a promising choice for ensuring food security and farmer livelihoods in drought-affected regions.

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Comment [Dk4]: Please add at least 4 more references and use proper APA format for reference

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