Advances in Agricultural Technology & Plant Sciences
ISSN: 2640-6586

Academic Strive
Researcher's perception is our reality

Research Article *Volume 8 Issue 1*

OUAT Kalinga Rice 8 (Suryashree): A New Heat Tolerant Cultivar for Odisha

Ranjith P*, Naik BS, Mohapatra S, Pal R, Seni A and Biswasi S

Regional Research and Technology Transfer Station, India

***Corresponding author:** P Ranjith, Regional Research and Technology Transfer Station, OUAT, Sambalpur - 768 025, Odisha, India, Email: pranjith.gpb@ouat.ac.in

Received Date: January 10, 2025; **Published Date:** January 16, 2025

Abstract

A heat tolerant rice cultivar OUAT Kalinga Rice 8 (Suryashree) was released in Odisha for cultivation in *Rabi* in irrigated medium land situations by the State Sub-Committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops, Government of Odisha, Bhubaneswar in its meeting held on 12.04.2023 and approved for notification by Government of India, Ministry of Agriculture and Framers Welfare on its meeting held on 02.05.2023 and notified on 25.09.2023 in the Gazette of India. It can tolerate heat stress above 38oC, matures in 125 days, yields 4276 kg seed per hectare under *rabi* condition (*Dalua situation*) and has resistance to gall midge. It has yield advantage of 18.98 per cent, 18.54 per cent and 12.12 per cent over national check 'Gontra bidhan-3', zonal check 'Mandakini' and local check 'Lalat', respectively.

Keywords: Heat-Tolerance; Rice; Suryashree; Variety Release

Introduction

Among the staple crops rice plays a vital role in feeding a significant portion of world's population. However, rice crop is susceptible to various biotic and abiotic stresses. Among them heat stress is important in *rabi* season (*Dalua* crop) which is a severe threat to the food security [1,2]. So this is the peak time for the researchers and scientists to develop heat tolerant rice varieties that can withstand high temperatures and maintain productivity in changing climatic conditions [3]. Rice being a C3 plant is particularly sensitive to heat stress, making it highly susceptible to rising global temperatures. Heat stress reduces photosynthetic efficiency, impairs grain development, and causes yield losses. As global temperatures continue to rise, heat waves during critical growth stages, such as flowering and grain filing, resulting in an increased number of chaffy grains, significantly affecting rice production [4].

In India rice is cultivated in an area of 4.45 million hectares, which can be classified into seven different ecosystems: irrigated *kharif* (27.4%), rainfed upland (19.1%), medium land (12.4%), shallow lowland (22.5%), semi-deep (7.9%), deep (3.4%), and irrigated *rabi* (7.4%) [1]. The immense diversity in growth conditions makes classification and characterization of the rice environments a challenging task. The total cultivated land of the state is 61.01 lakh ha out of which 30.94 lakh ha (47%) is high land, 18.43 lakh ha (28%) medium land and 16.45 lakh ha (25%) low land and about 46% of cultivated land in *kharif* season is irrigated. Total 78.6, irrigated Odisha's share in the country's rice production is 11%. Rice in Odisha is now grown on an area of 4.4 million hectares, which accounts for 91% of the area under cereals and contributes about 94% of total cereal production in the state [4]. With the objective of high yield, heat tolerance and resistance to gall midge for *rabi* season (*Dalua* crop), a breeding programme was initiated.

Materials and Methods

The present breeding programme was initiated in the All India Coordinated Research Project on Rice, RRTTS, Chiplima, Sambalpur, Odisha located at 20°-9'N latitude and 82°-39' and 85°-15'E longitude. The heat tolerant lines were received from INGER, IRRI, Philippines under CISA project. It was tested in different AICRP testing centres. Preliminary Yield Trial (PYT) was carried for three consecutive years, i.e., from 2014 to 2017 and it was tested under AICRP on Rice with culture name IR-12C-147 and IET No 27737 over 20 locations all over India during *kharif* 2018-2019 (IVT) and 2019-2020 (AVT1). It has performed well in many centres especially in Haryana; the yield potential was 8 t/ha. The state level Multi-location Trial (MLT) was conducted in different agro-climatic zones of Odisha, *viz.*, Chiplima, Kirei, Jeypore and Ranital for three consecutive years during 2018-19, 2019-20 and 2020-21.

The crop was inspected regularly at a 20 days interval to record the phonological events which was recorded during reproductive stage of the crop.

Growing Degree Days (GDD)

Compiling all the growing degree days by daily mean temperature above the base temperature express the degree day. 10^0 C is taken as the base temperature. This is determined by using the formula as per Nuttonson, 1955.

$$GDD\ \left({}^{0}C\right) = \frac{\left(T + T\,min\right)}{2} - Tbase \qquad (1)$$

Where
T max = Daily Maximum temperature (^{0} C)
T min = Daily Minimum temperature (^{0} C)
T base = Minimum base temperature (^{0} C)

Grain Yield Use Efficiency (GYHUE)

Grain yield use efficiency is indicated as amount of yield produced per unit of growing degree days. This computed using the formula:

$$GYHUE = \frac{Total\ Yield\left(kglha\right)}{\sum GDD} \qquad (2)$$

Dry Matter Use Efficiency (DMUE)

Dry matter use efficiency is indicated as amount of dry matter produced per unit of growing degree days. This is computed using the formula:

$$GYHUE = \frac{Total\ dry\ matter\left(g\ hill-1\right)}{\sum GDD} \qquad (3)$$

SPAD

A SPAD or Chlorophyll meter is used to measure the chlorophyll content of leaves. This device provides a quick and non-destructive method to assess the health and nutritional status of plants by quantifying the chlorophyll levels, which are indicative of the plant's photosynthetic capacity and overall vigor.

Results and Discussion

The pooled data (2018 to 2021) of the Station Preliminary Yield Trials Table 1 revealed the yield advantage of 'IR12C-147' (4273 kg/ha) by 76% over the national check 'Gontra bidhan 3' (4267 kg/ha), Zonal check Manadini and local check of Lalat (Tables 1-4). It performed well in Haryana Zone II, expressed 8.3q/ha and having percentage increase over weighed means >22.44% over National Check, >32.85 % over Zonal check and >39.34 % over Local check (Fgires 1 & 2).

Figure 1: Multilocational trail of heat tolerant genotypes.

Figure 2: Depicting grain variation for IR12C-147 and other varieties.

The reaction of IR12C147 to major diseases and insect pests was moderately resistant to gall midge [5]. The multi-location trials (MLTs) conducted in different agro-climatic zones of Odisha during 2018-19 corroborated the results of All India Coordinated Trials and Station PYTs tested over years (Table 1).

State	Year of testing	No. of locations tested	Name of the trial	OUAT Kalinga Rice-8 (Suryashree) IET 27737	NC (Gontra Bidhan-3)	ZC (Mandakini)	LC (Lalat)
Odisha, Haryana & Maharashtra	2018	24	IVT-MS	4845	4189	4191	4111
	2019	5	AVT-1-MS	5324	5032	5055	5165
Weighted Mean				5084.5	4610.5	4623	4638
% increase over 2019		2018			(+) 13.5	(+) 13.49	(+) 15.1
				(+) 5.48	(+) 5.05	(-) 2.98	
% increase over Weighted Mean					(+) 18.98	(+) 18.54	(+) 12.12

Table 1(a): State wise summary of mean grain yield (Kg/ha) in Co-ordinated (MS) trials during 2018-19. OUAT Kalinga Rice-8 (Suryashree).

Year	Name of the trials	No. of test entries (No. of location)	Yield (Kg/ha)			
			OUAT Kalinga Rice-8 (Suryashree) IET 27737	N.C. (Gontra Bidhan-3)	ZC (Mandakini)	LC (Lalat)
2018	IVT-MS	64 (24)	4733	5561	5056	5351
2019	AVT-1-MS	19 (30)	5109	4750	3482	4456
Weighted Mean			5425	5033	3873	4768
% increase over Weighted Mean				(+)7.22	(+)28.6	(+)12.11

Source: IIRR Annual Progress Report Vol. 1 – Varietal Improvement (2018 & 2019).
Table 1(b): Overall mean grain yield (Kg/ha) in Co-ordinated (MS) trials during 2018-19.

Zone (States)	Year of testing	No. of locations tested	Name of the trial	OUAT Kalinga Rice-8 (Suryashree) IET 27737	NC 1 (Gontra Bidhan-3)	ZC (Mandakini)	LC (Lalat)
Zone – III	2018	24	IVT-MS	4387	4937	5760	5995
Zone-II	2019(3)	5	AVT-1-MS	6002	6597	6096	6164
Weighted Mean				4980	4412	4078	5002
% increase over	2018				(-) 12.53	(-) 31.29	(-) 36.65
	2019				(-) 9.91	(-) 1.56	(-) 2.69
% increase over Weighted Mean					(+) 22.44	(+)32.85	(+) 39.34
Zone – V	2018	24	IVT-MS	4041	4737	4570	4637
	2019	5	AVT-1-MS	5109	4750	3482	4456
Weighted Mean				5447	4697	3564	4291
% increase over	2018				(-) 17.22	(-) 13.09	(-) 14.74
	2019				(+) 7.02	(+) 31.84	(+) 12.78
% increase over Weighted Mean					(-) 10.2	(+) 18.75	(-)1.96
Zone – VI	2018	24	IVT-MS	4104	5567	5057	6417
	2019	5	AVT-1-MS	5393	5310	4121	5638
Weighted Mean				5413	4958	4569	5227
% increase over	2018				(-) 35.64	(-) 23.22	(-) 56.35
	2019				(+)1.53	(+)23.58	(-)4.54
% increase over Weighted Mean					(-)34.11	(+)0.36	(+)60.89

Table 1(c): Zone wise summary of mean grain yield (Kg/ha) in coordinated trials (MS trials) during 2018-19.OUAT Kalinga Rice-8 (Suryashree).

S.No	Name of the variety	Jeypore			Ranital			Kirei		
		2018-19 (kg/ha)	2019-20 (kg/ha)	2020-21 (kg/ha)	2018-19 (kg/ha)	2019-20 (kg/ha)	2020-21 (kg/ha)	2018-19 (kg/ha)	2019-20 (kg/ha)	2020-21 (kg/ha)

1.01	IR-12C-147 Proposed variety	2740	2391.25	3956	4838	4721.67	4959	4527.33	4798	4634.33
2	Lalat (LC)	2876.25	2062.75	2816	1966	1656	2990	2418.33	1681.67	2939
3	MTU-1010 (LC)	-	2062.25	2337.33	2720	2341	2881.33	2676.67	2405.33	2820.33
Yield advantage over check variety MTU 1010		At par	(+) 16%	(+) 69%	(+) 78%	(+) 102%	(+) 72%	(+) 69%	(+) 99%	(+) 64%
Yield advantage over check variety Lalat		At par	(+) 12%	(+) 40%	(+) 146%	(+) 185%	(+) 65%	(+) 87%	(+) 185%	(+) 57%

MLT of OUAT Kalinga Rice 8 (Suryashree) performed well in all three locations having high yield advantage over check varieties.

Table 2: Yield data of Multi Location Trials in state for Three years (2018-19, 2019-20, 2020-21).

Treatment Sowing dates	Days to maturity	Plant height (cm)	Tillers m-2	Panicle length (cm)	Test weight (g)	Grains panicle-1	Sterile grains panicle-1	SPAD value at 80DAT
Dec-10	130	87.6	438	23.2	21.2	118	25	30.7
Dec-20	127	90.8	387	23.2	21.3	125	24	33.9
Dec-30	119	99.4	367	23.9	21.3	139	26	36.4
Jan-01	112	97.5	364	23.6	22.2	119	30	27.3
CD (P=0.05)	1	6.1	41	NS	NS	11.7	2	0.02
Varieties								
MTU-1156	124	96	387	24.3	21.5	131	25	32.2
IR12C-147	127	100	395	25.2	22.9	134	20	40.7
CD (P=0.05)	0.1	3.5	NS	0.7	NS	10.1	1.5	0.01

Table 3: Comparative performance of IR 12C-147 with other varieties at different date of sowing for growth, yield attributes and SPAD values during rabi 2018-19 at RRTTS, Chiplima (Data pooled over 2 years).

Treatment Sowing dates	Grain yield (t ha-1)			Straw yield (t ha-1)			GYHUE			DMHUE		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Dec-10	3.9	3.6	3.8	4.9	3.6	4.3	3	2.3	2.7	6.3	4.8	5.6
Dec-20	4.3	4.4	4.4	4.9	5.9	5.4	3	2.9	2.9	6.1	6.4	6.3
Dec-30	4.5	4.8	4.7	5.5	5.6	5.6	3.2	3.1	3.2	6.8	6.5	6.6
Jan-01	3.6	3	3.3	4.3	4	4.2	2.8	2.6	2.7	5.9	5.4	5.7
CD (P=0.05)	0.7	1.1	0.9	0.8	1.2	1	0.4	0.5	0.2	0.6	1.2	0.5
Varieties												

MTU-1156	4.2	3.7	4	5.2	4.6	4.9	3	2.6	2.8	6.4	5.6	6
IR12C-147	4.5	5.1	4.8	5.6	6	5.8	3	3.1	3.1	6.6	6.5	6.5
CD (P=0.05)	0.7	1.1	0.9	0.8	1.2	1	0.3	0.6	0.2	0.6	1.2	0.4

Table 4: Comparative yield , grain heat use efficiency (GYHUE) and dry matter heat use efficiency (DMHUE) of IR-C-147 with other varieties and dates of sowing during *rabi* at RRTTS, Chiplima.

OUAT Kalinga Rice 8(Suryashree) expressed high 4.8 Grain yield (t ha-1) when compared to check variety MTU1156 4.0 Grain yield (t ha-1) and high Grain yield Use efficiency recorded 3.1 when compared with check variety was 2.6 and high Dry matter use efficiency in case of OUAT Kalinga Rice 8 (Suryashree) 6.5 while check variety recorded 6.

OUAT Kalinga Rice 8(Suryashree) performed well in comparison to the check variety in term of Days to maturity, Plant height, Tillers (m2), Panicle length, Test weight and Grains panicle sterile grains per panicle and SPAD values.

The biochemical characteristics of Suryashree are detailed in Table 4. It outperformed the local check (Lalat) in 50 percent flowering and plant height, and the zonal check (Mandakini) in plant height. Suryashree is suitable for cultivation in lowland irrigated medium lands during the rabi season, with a duration of 125 days and a seeding to flowering range of 65-87 days. Based on the performance of IR12C147, it was released as Suryashree by the State Sub-Committee on Crop Standards, Notification, and Release of Varieties for Agricultural Crops, Government of Odisha, Bhubaneswar, in April 2022. Promoting Suryashree among farmers will significantly boost the production and productivity of heat-tolerant rice varieties in Odisha.

Conclusion

The development of heat tolerant rice varieties is of utmost important to secure the global food supplies in the face of climatic change. Through an integrated approach that combines genetic research, biotechnology, physiological studies and agronomic strategies, researchers aim to equip rice plants with the ability to thrive under rising temperatures, ensuring food security for the future generations. The ultimate goal of this any research work is to create a sustainable agricultural system that can with stand the challenge posed by an increasingly warming world. So in coming days farmers may be benefited with the new cultivar OUAT Kalinga Rice8 (Suryashree) going to have a great impact on the farmers community.

Acknowledgement

The authors are thankful to INGER, CISA and IIRR for release of the variety. All India Coordinated Research Project on Rice , IIRR and National Rice Research Institute (NRRI), Cuttack for the efforts made in DNA finger printing of 'IR12C-147' with checks.

References

1. Anonymous (2018) Annual Report 2018-19, All India Coordinated Research Project on Rice, Indian Institute of Rice Research, Hyderabad.

2. Anonymous (2019) Annual Report 2019-20, All India Coordinated Research Project on Rice, Indian Institute of Rice Research, Hyderabad.

3. FAOSTAT (2014).

4. Mishra A (2023) Rice cultivation with special reference to Odisha. International Journal of Research Publication and Reviews 4(12): 4450-4453.

5. ICAR-Indian Institute of Rice Research (2019) The reaction of IR12C147 to major diseases and insect pests was moderately resistant to gall midge. In Annual Progress Report Vol. 1 – Varietal Improvement (2018 & 2019). Hyderabad, India: ICAR-IIRR.