

RESEARCH ARTICLE

UTR-181: A Fine Grain, Long Duration, Blast Resistant Rice (*Oryza sativa* L.) Culture Suitable for Irrigated Ecology of Andhra Pradesh

P Srivalli¹, C Kiran Kumar Reddy¹, P Ramesh Babu¹, M Subba Rao¹, S Isha Parveen¹, K Sunil Kumar¹, M Sreenivasa Chari¹, E Aruna¹, V Chandrika¹, T Bhagavata Priya¹, V Madhuri¹, G Prabhakara Reddy¹, CH Srilakshmi¹, PV Satyanarayana¹, T Srinivas¹, M Girija Rani¹ and D Anuradha¹

Abstract

UTR-181 is a fine-grain rice culture more suitable for irrigated ecology, and being a long-duration culture is furthermore appropriate for Single Cropped Areas of the Andhra Pradesh state. It is derived from a cross of NLR-34449/MTU-1010 through the Pedigree method of breeding at Agricultural Research Station, Utukur, Kadapa. It recorded 10.1% yield improvement over the check BPT-5204 and exhibited 21.2% improvement over RGL 2537 in Station, Multilocation trials, minikit testing across the state of Andhra Pradesh. It has a non-lodging nature, high yielding, nitrogen responsive, with medium green foliage, low shattering and exhibits complete exertion of panicle. It is also tolerant to leaf blast, neck blast in comparison with the popular check BPT-5204. This variety has excellent cooking quality, intermediate amylose content and glycemic index (65.6). It also possesses essential grain characters like high head rice recovery (more than 65%) with translucent grains to get a premium market price.

Keywords: Rice, Variety, Yield

¹Agricultural Research Station, Utukur, ANGRAU, Andhra Pradesh, 515003, India.

***Author for correspondence:** p.srivalli@angrau.ac.in

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Introduction

Rice (*Oryza sativa* L.) is the staple food, and it can be adapted to diverse agro-climatic conditions throughout the world. In India, rice is cultivated in an area of about 44 million ha with a total production of 129 million tonnes and a productivity of 6214 kg/ha. In Andhra Pradesh, it is cultivated in 25 lakh hectares in the *kharif* and *rabi* seasons. The KC Canal belt is one of the most important rice growing zones of Andhra Pradesh, where rice crop has been cultivated for three seasons viz., early *kharif* (April-August), late *kharif* (August-January) and *rabi* (November-March), depending on the availability of irrigation water for rice cultivation. In the *kharif* season, short-duration (120-125 days), in late *kharif*, long-duration (150 days) and in *rabi*, medium-duration (130-135 days) varieties were generally cultivated in this area. BPT-5204 is predominantly cultivated in the Kadapa district of Andhra Pradesh.

Though BPT-5204 possess good yield potential and excellent grain & cooking quality, it is susceptible to major pests and diseases, due to which farmers often suffer heavy yield losses. Hence, there is a demand from the farming community

for stable rice varieties with sustained production even under adverse climatic conditions, with reduced cost of cultivation. Efforts were made at the Agricultural Research Station, Utukur, for the development of high-yielding, non-lodging, low-shattering rice varieties along with resistance to leaf blast, neck blast, plant hoppers, coupled with good grain quality. Many varieties possessing high yield potential with tolerance to blast and BPH were released for the replacement of Samba Mahsuri (BPT-5204). But, many of them were not accepted by farmers due to their poor cooking quality traits. UTR-181 possess excellent grain and cooking quality parameters similar to Samba Mahsuri.

Materials and methods

UTR-181 rice culture was developed at ARS, Utukur, Kadapa, ANGRAU, by following the pedigree method of breeding. This culture is a derivative of NLR-34449 × MTU-1010. This is a long-duration culture, and the growing season is July to August. It was tested for yield and its attributes at the station level yield trials from 2015-16 to 2017-18. The culture was tested in Multilocation testing in ANGRAU during the *khari*f season of 2018-19 and 2019-20 under slender grain trial. UTR-181 (IET 30082) was tested in AICRIP testing during *khari*f -2021 across 19 locations in the country. It was tested for pests and diseases in the AICRIP under NSN 2 nursery. It was tested in farmers' fields under minikit testing from 2020-21 to 2022-23 for three years in 42, 220, 255 locations throughout the state in comparison with the various checks, such as BPT 5204 and RGL 2537. The data on fifteen quality parameters in comparison with the check BPT 5204, as conducted at ARS, Nellore, during 2021-22. It was deposited as an indigenous rice

culture and got IC number (IC 650223) for further reference. The DNA fingerprinting data were generated by using different markers at RARS, Maruteru, and ANGRAU.

Results and discussion

The hybridization between NLR-34449 × MTU-1010 was attempted during 2009. Superior progeny was identified in F₆ generation and yield trials were conducted at station level for 3 consecutive years from 2015-16 to 2017-18 and it recorded an average grain yield of 8898 kg/ha as against the checks NLR-34449 (6034 kg/ha) and BPT-5204 (6560 kg/ha) which is 48.50% and 33.70% increase over the checks, respectively. It was tested in multilocation testing under the Slender Grain segment during *khari*f 2018 and late segment during *khari*f 2019 at the station level, and it recorded an average grain yield of 7198 kg/ha and 6415 kg/ha, which is a 7.37% and 13.10% increase over the check BPT-5204 (6704 kg/ha and 5670 kg/ha, respectively). Multilocation testing was also done in 8 centres against the check BPT-5204, wherein it recorded an average grain yield of 5908 kg/ha, which is a 16.2% increase over the check BPT-5204 (5084 kg/ha) variety used. In the year 2019, again it was tested in MLT in 9 centres against BPT-5204 and MTU-1190 checks, wherein it recorded 5711 kg/ha, which is 19.2% and 7.2% superior to the checks (4788 kg/ha & 5327 kg/ha, respectively) used. The overall mean of the culture was 7418 kg/ha (Table 1).

The performance of any culture was proven when it was tested on a large-scale area in the farmers' field. The culture was tested through DAATT centres and the Department of Agriculture throughout Andhra Pradesh

Table 1: Performance of UTR-181 in station yield trials and multi-location trials at ARS, Utukur

Name of the trial	Code testing	Year of	Grain yield (kg/ha)		CD (0.05)	CV (%)
			UTR-181	Per cent increase Check		
OYT (ARS, Utukur)	UTR-181	<i>Khari</i> f 2015	8750	5833 (NLR34449)	50.0	2489 16.6
PYT(ARS, Utukur)	UTR-181	<i>Khari</i> f 2016	9176	6234 (NLR34449)	47.2	1024 7.01
AYT (ARS, Utukur)	UTR-181	<i>Khari</i> f 2017	8769	6560 (BPT-5204)	33.7	700 5.35
MLT-Slender grain (ARS, Utukur)	Sg386	<i>Khari</i> f 2018	7198	6704 (BPT-5204)	7.37	530 4.73
MLT-Late (ARS, Utukur)	Sg412	<i>Khari</i> f 2019	6415	5670 (BPT-5204)	13.1	1116 7.40
MLT-SG (I year) (8 locations)	Sg386	<i>Khari</i> f 2018	5908	5084 (BPT-5204)	16.2	- -
MLT-SG (II year) (9 locations)	Sg412	<i>Khari</i> f 2019	5711	4788 (BPT-5204)	19.2	
				5327 (MTU 1190)	7.2	- -
Mean			7418	5839	27.0	

for three consecutive years from 2019-20, 2020-21 and 2021-2022 under minikit testing in 42, 220 and 255 farmers' fields, respectively. In minikit trials, the culture was tested against respective rice varieties grown in that particular area in different districts of Andhra Pradesh, wherein it recorded an average grain yield of 6209 kg/ha as against the check 5601 kg/ha, which is a 10.9% increase over the check (Table 2).

During *kharif* 2021, UTR-181 was nominated and tested as IET 30082 along with 63 entries under IVT-L trial in 19 centres all over India under AICRIP testing, along with two checks, BPT-5204 and ADT-49. It recorded an average grain yield of 4784 kg/ha with the highest yield of 12153 kg/ha at Kurumbapet centre. UTR-181 recorded an increased grain yield of 4.20% over BPT-5204 and 3.70 % over ADT-49 in different

centres of AICRIP (Table 3) (IIRR Annual Progress Report on crop improvement 2013, Vol. I, Page Nos. 1.215-1.226).

Disease and pest reaction

The culture was tested for various pests and diseases at the Agricultural research station, Utukur, from 2020-21 to 2022-2023, and it showed moderate resistance to leaf blast (3-4) (Table 4a). It also exhibited a lower percentage incidence and field tolerance to leaf folder (1) and stem borer (1), and BPH (1) in comparison with the popular check BPT-5204 (Table 4b). In AICRIP testing during 2021, it was tested in NSN II nursery, where it was found moderately resistant to neck blast and leaf blast (Table 5a) and exhibited moderate resistance to BPH at Pant Nagar and Gangavathi locations. It also recorded

Table 2: Three years of compiled data of UTR-181

Year of testing	No. of Minikits given	No. of Minikits data obtained	Minikit yield (kg/ha)	Check yield (kg/ha)	Per cent yield advantage
First year (<i>kharif</i> , 2020)	42	36	6735	6106	10.3
Second year (<i>kharif</i> , 2021)	220	213	5708	5177	10.2
Third year (<i>kharif</i> , 2022)	255	253	6185	5520	12.0
Total	517	455	6209	5601	10.9

Table 3: Performance of UTR-181 in Initial Varietal Trial- Medium slender under AICRIP testing during *kharif*, 2021

Year of testing	Name of the trial	Location	State	Grain yield (kg/ha)		
				UTR-181	BPT5204	ADT 49
2021-22	Initial Variety	Arundhutinagar	Tripura	5040	4550	4750
	Trial-Medium slender	Ranchi	Jharkhand	4255	4721	3657
		Sindewahi	Maharashtra 1	4510	2727	4510
		Karjat	Maharashtra 2	5442	4932	4252
		Sakoli	Maharashtra 1	2845	3507	3474
		Navagam	GUJARAT	2877	2606	3576
		Jeyapore	Odisha	2365	2145	1568
		Raipur	Chhattisgarh	2715	3312	4758
		Maruteru	Andhra Pradesh	4735	9410	6745
		Bapatla	Andhra Pradesh	5352	4831	4181
		Rajendranagar	Telangana	2555	3465	4844
		Kampasagar	Telangana	5582	5877	6025
		Aduthurai	Tamil Nadu	7118	5694	6007
		Coimbatore	Tamil Nadu	6736	4880	5256
		Mandya	Tamil Nadu	5244	5567	4656
		Mugad	Karnataka	4342	4165	5869
		Gangavathi	Karnataka	3936	5228	3936
	Sirsi	Karnataka	3100	2500	3367	
	Kurumbapet	Puduchery	12153	7143	6250	
Average performance of UTR-181 and check varieties over different locations				4784	4593	4615
% increase over BPT5204				4.2		
% increase over ADT49				3.7		

Table 4a: Reaction of UTR-181 to major diseases at ARS, Utukur from 2020-21 to 2022-23

Variety	Average leaf blast score (Range of scores)
UTR-181	3.6 (3 to 4)
Check (BPT-5204)	5.6 (4 to 7)

Table 4b: Reaction of UTR-181 to major insect pests at ARS, Utukur during 2020-21 to 2022-23

Variety	Dead hearts (%) (Score)	Leaf folder (%) (Score)	BPH per hill (%) (Score)
UTR-181	7.83 (1)	9.2 (1)	3.10 (1)
Check (BPT-5204)	14.9 (3)	18.1 (3)	23.4 (3)

Table 5a: Reaction of UTR-181 to major diseases

Variety	National Screening Nursery – II (AICRIP) (testing during 2021)			Variety	At ARS, Nellore Leaf Blast score
	Leaf Blast (19 locations)	Neck Blast (5 locations)	Sheath Blight (19 locations)		
UTR-181 (IET 30082)	6.3	4.8	5.1	UTR-181 (IET 30082)	5.0
Check (BPT-5204)	5.4	4.3	6.1	Check (BPT-5204)	8.0
Resistant check (Tetep)	3.2	1.5	6.0	Resistant check (Tetep)	2.0
Susceptible check (Pusa-44)	5.6	5.5	6.2	Susceptible check (Pusa-44)	6.0

Table 5b: Reaction of UTR-181 to major insect pests

Variety	National Screening Nursery – II (AICRIP) (testing during 2019)	
	Leaf Folder damage (4 locations)	Brown Plant Hopper damage score (2 locations)
UTR-181 (IET 30082)	11.1	5
cCheck (BPT-5204)	11.9	7
National check (WGL-14)	11.6	3
Susceptible check (TN-1)	12.5	7

Table 6: Interaction of grain yield between time of planting and nitrogen levels during *kharif* 2022

	N ₁ : 40 kg/ha	N ₂ : 80 kg/ha	N ₃ : 120 kg/ha	N ₄ : 160 kg/ha	Mean
July II F. N	4963	5327	5463	5497	5313
August I F. N	5486	5672	6234	6346	5935
August II F. N	5238	5579	6148	6016	5745
Mean	5229	5526	5948	5953	
		S.Em _x	179	224	
		CD (P=0.05)	NS	NS	

less incidence of leaf folder in the locations namely Kaul, Karjat and Navsari (Table 5b).

Agronomic evaluation

The culture UTR-181 was tested for four different nitrogen levels and different times of planting during *kharif* 2022, wherein it recorded 6148 kg/ha at 120 kg nitrogen application per hectare at August II F.N. It responds even up to 160 kg N with planting time of

August I F.N., but the optimum dosage is 80 kg/ha (Table 6).

Morphological features

The morphological features of the cultures are given in Table 7. The culture attains 50% flowering at 105-115 days after sowing, and it grows up to a height of 100-110 cm and bearing 18-23 tillers per plant. The panicle length is 25 cm, and the grains were medium slender

Table 7: Description of UTR-181

Trait/character	Description	Trait/character	Description
Plant height	100-110 cm	Lemma palea colour	Straw
Habit	Erect	Lemma palea pubescence	-
Days to 50% flowering	105-115 days	Seed coat colour (bran)	Straw
Lodging	Non lodging	Sterile lemma colour	Straw
Leaf blade colour	Green	Grain type	Medium slender
Basal leaf sheath colour	Green	Unpolished Kernel length (mm)	5.72
Leaf angle	Erect	Unpolished Kernal Breadth (mm)	1.78
Flag leaf angle	Erect	L/B ratio	3.21
Leaf length	45 cm (medium)	1000 grain weight (g)	14.5
Leaf width	1.2 cm (medium)	Gelatinization temperature	Intermediate
Leaf blade pubescence	Medium	Kernel elongation ratio	1.31
Ligule colour	White	Keeping quality	Good
Ligule shape	Split	Grain shattering	Low
Ligule length	3.6 mm	Flowering duration (days)	4-5 days
Auricle colour	White	Dormancy (weeks)	Two weeks
Collar colour	White	Total grains/panicle	400-450
Culm angle	Erect	Tillering ability	High tillering (18-23)
Flag leaf angle	Erect	Distinguishing morphological characters	High-yielding, non-lodging, fertiliser responsive, semi-dwarf with green foliage, grains are light straw glumed, medium slender grain, two-week seed dormancy, low shattering with high grain number per panicle
Culm internode colour	Green		
Panicle length	25 cm		
Panicle type	Compact		
Panicle exertion	Mostly exerted		
Awns	Absent		
Apiculus colour	Straw		
Stigma colour	White		

Table 8: Grain quality data of UTR-181

Trait/Character	UTR 181	Check (BPT 5204)
Grain type	MS	MS
Kernel length (mm)	5.72	5.13
Kernel breadth (mm)	1.78	1.81
L/B ratio	3.21	2.83
1000 grain weight (g)	14.5	14
Hulling per cent (%)	82.5	78.8
Milling per cent (%)	73.5	70.7
Head Rice recovery	65-70%	57.2
Volume expansion ratio	3.1	3.3
Gelatinization temperature	Intermediate	Intermediate
Water uptake (ml)	250 ml	330 ml
Kernel length after cooking (mm)	8	9.2
Keeping quality	Good	Good
Cooking quality	Very good	Excellent
Elongation ratio (mm)	1.31	1.74
Alkali spreading value	7.0	4.0
Amylose content (%)	24.0	23.4
Gel consistency (mm)	65	24

type with straw colour, and awns were absent. The culture is non-lodging, tall with erect plant type, dark green foliage, fertiliser responsive, low shattering, two weeks dormancy and higher grain yield. Each panicle was fully exerted from the boot leaf and comprises 400-450 grains per panicle.

Quality features

After grain yield, the second most important thing that needs to be considered is quality, which includes physical, milling, cooking and chemical quality parameters. The culture UTR-181 is a medium slender culture with the kernel length of 5.72 mm, breadth 1.78, whereas the kernel L/B ratio was 3.21. The head rice recovery of the culture is >65% and it is an acceptable recovery draw the millers' point of view. Absence of grain chalkiness and good kernel elongation ratio of 1.31 and volume expansion of 3.1 show a good sign for the cooking quality of rice. The grain size belongs to the medium slender group, and the amylose content (24%) and gel consistency (36 mm) were also under desirable limits (Table 8). In the organoleptic test conducted with 15 individuals, it was found that the keeping quality was

very satisfactory and on par with BPT-5204. Its straw is very palatable to cattle.

In view of the above, it was concluded that the culture UTR-181 possess good yielding ability at the station level and also at farmers' fields, good milling and cooking quality traits along with blast resistance, suitable for sowing from July to August. Further, even under delayed transplanting conditions (aged seedlings), it was found to be suitable for cultivation in the irrigated rice ecology of Andhra Pradesh state.

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