AATCC Review

30 June 2025: Received
18 August 2025: Revised
26 August 2025: Accepted
25 September 2025: Available Online

https://aatcc.peerjournals.net/

Original Research Article

Open Access

KNM 7048 – a high yielding, early maturing long bold PJTAU rice (*Oryza sativa* L.) variety suitable for the states of Odisha, West Bengal, Chhattisgarh and Maharashtra

Sreedhar Siddi*[1], D. Anil[2], R. Abdul Fiyaz[3] and M. Sreenivas Prasad[3]

[1]*Rice Research Unit, Agricultural Research Institute, Professor Jayashankar Telangana Agricultural University (PJTAU), Rajendranagar, Hyderabad, Telangana -5000 030, India*
[2]*Agricultural Research Station, Kunaram, Professor Jayashankar Telangana Agricultural University (PJTAU), Dist. Peddapalli, Telangana -505 174, India*
[3]*Indian Council of Agricultural Research-Indian Institute of Rice Research, Rajendranagar, Hyderabad, Telangana-5000 030, India*

ABSTRACT

The present investigation aimed to address the key breeding challenges including achieving early maturity without yield penalty, incorporation of resistance to major diseases and enhancing milling and cooking quality in rice. The promising high yielding long bold rice variety KNM 7048 (IET 28332), released as Telangana Rice 6 during the year 2022, was developed at the Agricultural Research Station, Kunaram, Telangana. This genotype was derived through the pedigree breeding method from the cross KPS 3219/KNM 118. It is an early duration (115–120 days), semi-dwarf variety with moderate tillering and well-suited to irrigated ecosystems. The variety exhibits semi-compact panicle with well exerted branching attitude, long bold, awn less, and straw-coloured grains with low shattering. KNM 7048 demonstrated a mean yield of 5726 kg ha^{-1} across multi-location trials over three years with 18.49% yield advantage over the national check, and has a high yield potential of 7500–8000 kg ha^{-1} under optimal agronomical conditions. This variety displayed intermediate amylose content (23.11%) and high head rice recovery (69.8%) making it attractive to both consumers and millers. It also exhibited moderate resistance to leaf blast and sheath rot. Adapted to irrigated conditions during the kharif season with its superior grain yield, enhanced quality, and moderate disease resistance, this variety is recommended for cultivation in Odisha, West Bengal, Chhattisgarh, and Maharashtra where it represents a promising new option for improving rice production and grain quality in these regions, thereby potentially boosting productivity, farmer incomes, and national food security.

Keywords: *Amylose, blast, early, head rice recovery, KNM 7048, long bold, rice, sheath rot.*

INTRODUCTION

Rice (*Oryza sativa* L.) is a crucial cereal crop that feeds more than half of the global population, making its production essential for ensuring global food security [21]. Rice cultivation in India spans nearly 50 million hectares, yielding an estimated 145 million tons in the 2024–25 season [6]. With the projected global population surpassing nine billion by 2050, there is a pressing need to augment overall grain production by up to 50% to meet escalating food and calorie demands [19]. Meeting this demand will require a substantial increase in both rice production and productivity through the development and adoption of high-yielding rice varieties.

From a worldwide agricultural development perspective, rice grain quality like yield, has become a key priority for producers, millers and consumers, as it plays a crucial role in securing premium prices in the market. As a result, there is a growing need to shift the focus from solely maximizing yields to enhancing product quality [2], [14].

Corresponding Author: **Sreedhar Siddi*

DOI: https://doi.org/10.21276/AATCCReview.2025.13.04.542

This transition is essential not only to meet evolving market demands but also to strengthen the competitiveness and sustainability of agriculture.

Rising global temperatures and increasing climate variability are posing significant challenges to rice production, with extreme weather events such as heat or cold stress during flowering, and unseasonal rains at harvest leading to substantial yield losses. Between 1998 and 2019, India's rice output declined by an average of -3.93% annually due to climatic variability [7]. In this context, the development of climate-smart rice cultivars has become an urgent and practical strategy to sustain productivity and ensure food security. Flowering time is one of the most important agronomic traits of rice that determines the regional and seasonal adaptability and has a significant influence on the grain yield of rice varieties [8], [26]. The adoption of early-maturing rice varieties holds significant potential to enhance average yields while concurrently reducing vulnerability to climatic variability, production uncertainty, and downside yield risks. Additionally, their cultivation is associated with a potential decrease in greenhouse gas emissions, thereby supporting more sustainable agricultural practices. Collectively, these agronomic and environmental advantages suggest that early-maturing varieties may also lead to increased economic returns and higher net farm incomes for rice producers. While earlier research has indicated that long-duration rice varieties often facilitate greater biomass accumulation and are positively correlated with yield performance, prolonged growth periods can simultaneously intensify exposure to adverse weather events. This is particularly relevant in regions where the growing season is constrained by limited rainfall or water availability, increasing the risk of harvest losses under variable climatic conditions [13].

Biotic stresses caused by pests and diseases pose a significant risk to global rice yield production by 52%, of which approximately 30% of these damages are due to pathogen infection [9],[15]. Ongoing climate change is projected to significantly influence the distribution and severity of rice diseases [4] as well as host and pathogen interactions, and altering pathogen survival, reproductive strategies, and infection mechanism [25]. Rice blast disease represents one of the most critical threats to global rice production, causing annual yield losses estimated between 10% and 30% [16]. This disease also imposes a significant global burden, with annual yield losses estimated to exceed 157 million tons. The escalating unpredictability driven by climate change amplifies both the severity and frequency of disease outbreaks by promoting environmental conditions that favor pathogen development and spread. Traditional management strategies, including chemical applications and cultural practices, have demonstrated limited long-term efficacy as remarkable adaptability of pathogens, including their ability to overcome host resistance and respond to fluctuating environmental conditions. Therefore, the development and deployment of rice cultivars with durable and broad-spectrum resistance represent the most effective and economically sustainable strategy for the long-term control of rice blast disease [12], [5], [1]. Host-plant resistance is a key strategy for achieving high yields and ensuring sustainable rice production. In India, rice blast has emerged as the most prevalent disease following the large-scale adoption of semi-dwarf, high-yielding varieties during the Green Revolution [11]. More recently, its incidence has since increased across nearly all rice-growing regions, leading to significant yield losses. However, resistant cultivars remain largely unaffected, as the pathogen is unable to induce disease symptoms. Rice sheath rot, caused by *Sarocladium* species has recently emerged as a serious disease during the flowering and grain-filling stages, leading to considerable yield losses [18], [24]. Now prevalent in most rice-growing regions, it causes yield reductions ranging from 20% to 85%, establishing it as a globally emerging and destructive threat to rice production [3].

To mitigate yield losses in long-duration rice varieties caused by adverse weather, blast and sheath rot, breeding efforts have focused on developing early maturing, disease resistant genotypes with improved yield and grain quality [12]. Accordingly, a targeted program was initiated to develop high yielding, early duration rice varieties (120–125 days) combining resistance to blast and sheath rot with superior grain quality. This approach aims to enhance productivity and resilience by enabling rice crop to escape long term exposure to adverse weather and pathogen pressure.

MATERIALS AND METHODS

Rice breeding program was conducted at the Agricultural Research Station (ARS), Kunaram, to develop genotypes combining high yield, resistance to blast and sheath rot, early maturity, and acceptable grain quality. The experimental site is located at 18.6°N latitude, 79°E longitude, with an elevation of 231 meters above mean sea level (AMSL). The soil type is silty loam, with a pH of 7.43 and electrical conductivity (EC) of 0.26 dS m^{-1}. The breeding strategy focused on incorporating multiple farmer-preferred traits in to rice lines suitable for local agroecological conditions. To achieve this objective, the pedigree method of breeding was adopted, using two carefully selected parental lines; KPS 3219 and KNM 118. The female parent, KPS 3219, developed at ARS, Kampasagar, is characterized by its high yield potential, early maturity, medium slender grains, and tolerance to pests and diseases. The male parent, KNM 118, developed at ARS, Kunaram, is a long slender-grain variety with good market acceptability. It is also early maturing and exhibits resistance to leaf blast and moderate resistance to neck blast. Hybridization between the two parents was carried out during the *kharif* (rainy) season of 2014 at ARS, Kunaram. F_1 plants were raised and confirmed based on morphological characteristics. The resulting F_2 population, comprising approximately 5,000 plants, was evaluated during the kharif season of 2015. Selection in the F_3 and F_4 generations was conducted following the pedigree method, focusing on desirable traits such as semi-dwarf plant stature, long panicle length, high grain number per panicle, grain type (long slender or long bold) and high yield. This process of individual plant selection continued through the F_6 generation to ensure genetic uniformity and fixation of traits, including resistance to blast and sheath rot. A promising breeding line, KNM 7048, was identified from a bulk harvest of a selected F_6 family during the summer season of 2017–18. This line was subsequently evaluated in yield trials at ARS, Kunaram, over three consecutive years (2017–18 to 2019–20). Based on its superior performance, KNM 7048 was nominated for All India Coordinated Research Project on Rice (AICRP on Rice) under the Irrigated Early-Transplanted (E-TP) ecosystem. It was evaluated in the following multi-location trials: IVT-E-TP (2019), AVT-1-E-TP (2020), and AVT-2-E-TP (2021).

RESULTS AND DISCUSSION

The rice entry IET 28332 (KNM 7048) is an early-duration culture maturing in 115–120 days, was nominated and evaluated under All India Coordinated Research Project on Rice (AICRP on Rice) trials for the Irrigated Early-Transplanted (E-TP) ecosystem. It was tested across three consecutive kharif seasons in the Initial Varietal Trial (IVT-E-TP) during 2019, Advanced Varietal Trial 1 (AVT-1-E-TP) in 2020, and Advanced Variety Trial 2 (AVT-2-E-TP) in 2021. Across these trials, KNM 7048 consistently outperformed the standard checks, recording yield advantages of +18.49%, +20.23%, and +12.18% over the national, zonal, and local checks, respectively, based on overall means. The genotype demonstrated stable performance across diverse environments, with a mean grain yield of 5,726 kg ha^{-1} over three years and 83 test locations (Table 1). Based on its yield performance and adaptability, KNM 7048 was found suitable for irrigated wetland ecosystems in the states of Odisha, West Bengal, Chhattisgarh, and Maharashtra.

During the kharif season of 2021, multi-location agronomic field experiments were conducted at Coimbatore, Dhangain, Faizabad, Ghaghraghat, Jagdalpur, Karjat, Mandya, Maruteru, Ranchi, Rewa, Sabour, Vadgaon, and Varanasi to evaluate the response of rice genotypes to different nitrogen application levels under transplanted conditions. The treatments included 75% and 150% of the recommended nitrogen dose (RDN). The results indicated that grain yield varied significantly across most locations in response to nitrogen application levels.

In the Agronomy Nutrient Management trial, application of 100% RDN (150 kg N ha^{-1}) consistently produced higher grain yields compared to 50% RDN (75 kg N ha^{-1}) across all the experimental sites. The enhanced yields observed under 100% RDN (150 kg N ha^{-1}) nitrogen levels compared with 50% RDN (75 kg N ha^{-1}) can be attributed to greater nitrogen uptake by the crop, which positively influenced chlorophyll content, improved nutrient absorption, and enhanced assimilation and translocation of photoassimilates from source to sink. These physiological improvements likely contributed to increased photosynthetic activity, higher dry matter accumulation, improved tiller production, and superior yield-attributing traits, ultimately leading to increased grain and biological yields. The grain yields recorded at various locations under 100% RDN were as follows: Coimbatore (5.11 t ha^{-1}), Dhangain (5.22 t ha^{-1}), Faizabad (4.50 t ha^{-1}), Ghaghraghat (4.70 t ha^{-1}), Jagdalpur (1.66 t ha^{-1}), Karjat (4.24 t ha^{-1}), Mandya (4.48 t ha^{-1}), Maruteru (4.97 t ha^{-1}), Ranchi (3.85 t ha^{-1}), Rewa (5.60 t ha^{-1}), Sabour (5.17 t ha^{-1}), Vadgaon (5.49 t ha^{-1}), and Varanasi (4.83 t ha^{-1}). These findings clearly indicate that the rice culture IET 28332 (KNM 7048) requires 150 kg N ha^{-1} (100% RDN) to realize its potential yield, although the exact requirement may vary based on the soil fertility status of individual locations (Table 2). Similar trends have been reported by [22] where grain yield showed significant improvement with incremental nitrogen application from 100 to 300 kg N ha^{-1}. A significant interaction effect between crop establishment methods, varieties, and nitrogen levels was also observed. Moreover, studies under both the System of Rice Intensification (SRI) and Conventional Transplanting System (CTS) revealed that higher fertilizer doses improved growth, yield, and yield attributes, with the optimum dose identified as 100% Recommended Dose of Fertilizers (RDF) [20]. Among the different nitrogen levels, 125% RDN (recommended dose of nitrogen) recorded the highest grain, straw and biological yield and harvest index; however, it was at par with 100% RDN treatment during both the years of experimentation. Among the different nitrogen levels, 125% RDN (recommended dose of nitrogen) recorded the highest grain, straw and biological yield and harvest index; however, it was at par with 100% RDN treatment during both the years 2021 and 2022 of experimentation [17].

The proposed high-yielding rice genotype KNM 7048 is a long bold-grain, non-shattering, early maturing variety with a total growth duration of approximately 115–120 days. It exhibits a high yield potential, averaging 5,726 kg ha^{-1}, and demonstrates tolerance to blast and sheath rot, along with good grain quality and wide adaptability under varied agro-climatic conditions. In recognition of its superior performance, KNM 7048 was released in 2022 by the Central Varietal Release Committee (CVRC) under the name 'Telangana Vari 6' for cultivation in the states of Odisha, West Bengal, Chhattisgarh, and Maharashtra. It has been recommended as a suitable alternative to existing long bold-grain varieties, particularly for cultivation during the kharif season.

The rice variety KNM 7048 (IET 28332) is a semi-dwarf genotype exhibiting moderate tillering capacity and a semi-erect flag leaf with uniformly green plant parts. The panicle is semi-compact, well-exerted, and displays a semi-erect branching pattern. Grains are awnless, straw-colored, and classified as translucent long-bold type. The variety demonstrates low grain shattering, good head rice recovery, and acceptable cooking quality, making it particularly suitable for cultivation under irrigated conditions. The genotype produces approximately 260–285 ear-bearing tillers m^{-2} and attains a plant height of 103–108 cm, supported by a sturdy culm with an internodal thickness of 6–7 mm. Panicle length ranges from 26 to 27 cm, with each panicle bearing 150–170 grains. Panicles are fully exerted, awnless, and exhibit no signs of spikelet sterility. The kernels possess a 1000-grain weight of 25.6 g, are free from abdominal white, and exhibit morphological resemblance to Jagtiala Rice 1 (JGL 24423) (Table 3).

Grain quality analysis revealed that KNM 7048 possesses translucent long bold grains with a length to breadth (L/B) ratio of 2.91. It also demonstrated a head rice recovery of 69.8%, which is a critical trait from the perspective of milling efficiency and market value. This is consistent with earlier findings by [10], [23] who reported a positive correlation between head rice recovery and milling outturn. Furthermore, the variety has an intermediate amylose content of 21.82%, which is considered ideal from a consumer preference perspective, contributing to desirable cooking quality (Table 4). In terms of disease resistance, KNM 7048 exhibited moderate resistance to leaf blast and sheath rot in pathology screening trials conducted under NSN-2 (2019) and NSN-1 (2020 and 2021) conditions (Table 5).

Table 1: Summarized grain yield (kg/ha) data of coordinated varietal trials

Adoptability Zone: For the states proposed to release- Odisha, West Bengal, Chhattisgarh and Maharashtra

	Year of testing	No of trials / Locations	ProposedVariety IET 28343	National Check CO 51	Zonal Check	Local check
Mean grain yield(kg/ha)	1st year 2019	23	5790	5128	4549	5456
	2nd year 2020	25	5535	4680	4830	4967
	3rd year 2021	35	5821	4748	4855	4972
	Weighted Mean		**5726**	**4833**	**4763**	**5105**
% Increase over checks and qualifying varieties	1st year 2019			12.91	27.28	6.12
	2nd year 2020			18.27	14.60	11.44
	3rd year 2021			22.60	19.90	17.08
	Weighted Mean			**18.49**	**20.23**	**12.18**
Frequency in the topthree ranks (pooled for three years)			25/83	6/83	8/83	5/83

Note: The mean yield data given in table is pertaining to the states proposed.
Weighted mean: [(5790x23) + (5535x25) + (5821x35)] / [23+25+35] =5726

Table 2: Agronomic performance of the entry, IET 28332 in coordinated NMT of Early (TP) under transplanted conditions

N levels Kg/ha	Yield (t/ha) IET 28332	Check varieties Yield (t/ha)			For N level	
		Check -1 NC (CO-51)	Check -2 ZC (PR-124)	Check -3 LC	CD (at 5%)	CV (%)
Location: Coimbatore						
75 Kg/ha	3.84	4.84	3.94	-	0.10	1.84
150 Kg/ha	5.11	6.45	5.32	-		
Percent gain or loss under other doses						
F1: 75 Kg/ha	-33.07					
F2: 150 Kg/ha						
Location: Dhangain						
75 Kg/ha	3.68	2.36	2.60	2.66	0.30	8.51
150 Kg/ha	5.22	3.33	3.93	3.46		
Percent gain or loss under other doses						
F1: 75 Kg/ha	-31.84					
F2: 150 Kg/ha						
Location: Faizabad						
75 Kg/ha	4.07	2.93	3.09	2.15	0.20	5.83
150 Kg/ha	4.50	4.44	3.80	3.01		
Percent gain or loss under other doses						
F1: 75 Kg/ha	-10.56					
F2: 150 Kg/ha						
Location: Ghaghraghat						
75 Kg/ha	3.90	2.97	2.99	2.31	0.04	1.19
150 Kg/ha	4.70	4.37	3.84	3.0		
Percent gain or loss under other doses						
F1: 75 Kg/ha	-20.51					
F2: 150 Kg/ha						
Location: Jagdalpur						
75 Kg/ha	1.10	4.14	6.59	3.63	NS	18.38
150 Kg/ha	1.66	5.87	5.95	4.14		
Percent gain or loss under other doses						
F1: 75 Kg/ha	-50.90					
F2: 150 Kg/ha						
Location: Karjat						
75 Kg/ha	3.42	2.67	2.91	3.56	0.4	10.91
150 Kg/ha	4.24	3.57	4.0	4.67		
Percent gain or loss under other doses						
F1: 75 Kg/ha	-23.97					
F2: 150 Kg/ha						
Location: Mandya						
75 Kg/ha	4.14	3.91	3.57	-	NS	7.77
150 Kg/ha	4.48	4.23	3.89	-		
Percent gain or loss under other doses						
F1: 75 Kg/ha	-8.21					
F2: 150 Kg/ha						

Table 2 (cont.): Agronomic performance of the entry, IET 28332 in coordinated varietal trial NMT Early (TP) under transplanted conditions

N levels Kg/ha	Yield (t/ha) IET 28332	Check varieties Yield (t/ha)			For N level	
		Check -1 NC (CO-51)	Check -2 ZC (PR-124)	Check – 3 LC	CD (at 5%)	CV (%)
Location: Maruteru						
75 Kg/ha	4.08	3.55	5.13	-	0.72	14.46
150 Kg/ha	4.97	4.56	5.69	-		
Percent gain or loss under other doses						
F1: 75 Kg/ha	-28.81					
F2: 150 Kg/ha						
Location: Ranchi						
75 Kg/ha	3.47	3.91	4.67	3.15	0.19	4.53
150 Kg/ha	3.85	4.47	5.16	3.43		
Percent gain or loss under other doses						
F1: 75 Kg/ha	-10.95					
F2: 150 Kg/ha						
Location: Rewa						
75 Kg/ha	4.40	4.20	4.70	5.27	0.07	1.72
150 Kg/ha	5.60	5.47	5.13	6.23		
Percent gain or loss under other doses						
F1: 75 Kg/ha	-27.27					
F2: 150 Kg/ha						
Location:Sabour						
75 Kg/ha	4.84	4.19	4.85	4.24	0.15	3.39
150 Kg/ha	5.17	4.46	5.37	4.66		

Percent gain or loss under other doses						
F1: 75 Kg/ha	-6.81					
F2: 150 Kg/ha						
Location: Vadgaon						
75 Kg/ha	3.80	3.12	3.56	3.13	0.26	6.19
150 Kg/ha	5.49	4.71	5.14	4.52		
Percent gain or loss under other doses						
F1: 75 Kg/ha	-44.47					
F2: 150 Kg/ha						
Location: Varanasi						
75 Kg/ha	3.87	2.6	3.9	3.8	0.23	6.43
150 Kg/ha	4.83	3.6	5.2	4.94		
Percent gain or loss under other doses						
F1: 75 Kg/ha	-24.80					
F2: 150 Kg/ha						

Table 3: Distinguishing morphological characters of Rice variety, KNM 7048 (Telangana Rice 6)

Habit	:	Semi dwarf plant type with medium tillering green foliage.
Coleoptile colour		Colourless
Plant Height	:	103-108 cm
Leaf: Intensity of green colour	:	Medium
Basal leaf: Sheath colour	:	Green
Leaf: Anthocyanin pigment	:	Absent
Leaf Blade	:	Medium, green and non-pigmented
Flag leaf	:	Semi-erect and non-pigmented
Junction, Auricle, Ligule, Septum	:	Anthocyanin pigment absent
Internode thickness	:	6-7 mm
Ear bearing tillers/m^2	:	260-285
Awns	:	Awn less
Panicle	:	Semi compact and semi erect attitude of branching
Exertion	:	Well exerted
Panicle length	:	26-27 cm
Number of grains/Panicle		150-170
Lemma, Palea	:	Straw colour
Apiculus	:	Straw colour
Husk colour	:	Straw colour
Rice colour	:	Translucent, white colour
Abdominal white	:	Absent
L/B ratio	:	2.91
1000 grains weight (g)	:	25.6
Rice grade	:	Translucent long bold grain
Maturity (Days to 50% flowering)	:	85-90 days (*Kharif*)
Days to maturity (Seed to seed)	:	115-120 days (*Kharif*)

Table 4: Data on the quality characteristics

Designation	**Year**	**HR**	**MR**	**HRR (%)**	**KL (mm)**	**KB (mm)**	**L/B Ratio**	**ASV**	**AC (%)**	**GC (mm)**	**Grain Chalk**
Proposed variety IET 28332	2020	78.6	68.7	61.5	6.19	2.07	2.99	3	23.93	76	VOC
	2021	85.3	80.2	78.1	6.29	2.23	2.82	3	22.29	67	VOC
	Mean	82	74.5	69.8	6.24	2.15	2.91	3	**23.11**	**71.5**	VOC
National check	2020	77.8	68.3	63.1	5.32	1.93	2.75	4	25.6	50	VOC
	2021	78.6	71.4	70.8	5.65	2.01	2.81	4	25.22	45	VOC
	Mean	78.2	69.9	67	5.48	1.97	2.78	4	25.41	47.5	VOC
Zonal check	2020	79.5	68.3	56.8	6.17	2.03	3.03	4	23.81	67	VOC
	2021	81	74.1	73	5.55	1.99	2.78	4	23.29	64	A
	Mean	80.3	71.2	64.9	5.86	2.01	2.91	4	23.55	65.5	VOC

(Source: ICAR-Indian Institute of Rice Research, Progress report 2016 (Volume I: Varietal Improvement, P. No. 1.521)
(Source: Annual Report for the year, 2016-17, Quality control lab, Hyderabad)

HR (%): Hulling Recovery (%); MR (%): Milling Recovery (%); HRR (%): Head rice recovery (%); KL (mm): Kernel length (mm), KB (mm): Kernel breadth (mm); L/B ratio: Length and breadth ratio; ASV: Alkali spreading value; AC: Amylose content; GC: Gel consistency; VOC: Very occasionally present

Table 5: Summary of the reaction to major diseases of the entries

Diseases	**Year of Testing**	**No of locations**	**Proposed Entry IET 28343**	**Check varieties**							
				IR 64	**HR 12**	**RP bio226**	**TN 1**	**Vikramarya**	**NDR 359 (NC)**	**MTU 1010 (RC)**	**CO 51 (NC)**
				R (Blast)	**S (Blast)**	**R (BLB)**	**S (BB,RTD)**	**R (RTD)**			
Leaf blast	2019	17	4.9	5.4	7.9	5.9	6.8	5.9	4.6	-	3.9
	2020	20	5.2	5.6	8.0	6.7	7.3	6.7	5.5	4.9	5.2
	2021	28	5.0	4.6	7.6	5.9	6.2	6.2	4.8	5.2	4.2
	Mean	**65**	**5.0**	**5.2**	**7.8**	**6.2**	**6.8**	**6.3**	**5.0**	**5.0**	**4.4**
Sheath rot	2019	2	5.0	6.0	7.0	6.0	8.0	5.0	3.5	-	9.0
	2020	5	4.6	5.8	6.2	5.8	7.4	4.8	5.8	4.6	5.0
	2021	10	4.6	5.1	4.5	6.5	6.4	6.0	4.7	4.4	5.8
	Mean	**17**	**4.7**	**5.6**	**5.9**	**6.1**	**7.3**	**5.3**	**4.7**	**4.5**	**6.6**

Source: Screening Nurseries (NSN-2) for 2019, (NSN-1), 2020 and 2021

CONCLUSION

The development of IET 28332 (KNM 7048) successfully achieved multiple breeding goals i.e. high yield, early duration, disease resistance, and quality grain. Compared to standard varieties, KNM 7048 offered a significant yield advantage in irrigated kharif, while its resistance to blast and sheath rot helped protect farmers' returns. Its long bold grains and good cooking characteristics added market value. The release of this variety thus provided a valuable new option for rice producers in the states such as Odisha, West Bengal, Chhattisgarh, and Maharashtra. By cultivating KNM 7048, farmers can improve rice productivity and income under irrigated conditions, contributing to food security and rural livelihoods in the targeted states.

FUTURE SCOPE

In future, an integrated program that combines molecular tools with robust phenotyping, multi-environment testing, participatory evaluation, and value-chain analysis will maximize the long-term genetic potential and adoption of KNM 7048 derivatives. Prioritizing simultaneous gains for yield, stability, stress resistance, quality, and nutrition will ensure this germplasm contributes meaningfully to productivity and food-nutritional security in the face of climate change.

CONFLICT OF INTREST

The authors report no competing interests.

ACKOWLEDGEMENT

The authors sincerely acknowledge the Rice Breeding Section, Agricultural Research Station, Kunaram, Peddapally, Telangana, India (505174), for providing the facilities and support to carry out this work. The authors also extend their gratitude to the Associate Director of Research, Regional Agricultural Research Station, Jagtial, for valuable guidance and institutional support.

REFERENCES

1. Agbowuro GO, Afolabi M S, Olamiriki E F and Awoyemi SO (2020) Rice Blast Disease (*Magnaporthe oryzae*): A Menace to Rice Production and Humanity. *International J Pathogen Res* 4(3):32-39.

2. Barrett CB, Reardon T, Swinnen J and Zilberman D (2022) Agri-Food Value Chain Revolutions in Low- and Middle-Income Countries. *J Econ Lit* 60: 1316–1377.

3. Bigirimana VDP, Hua GK, Nyamangyoku OI and Hofte M. 2015. Rice sheath rot: an emerging ubiquitous destructive disease complex. *Front Plant Sci* 6 1066. doi: 10.3389/fpls.2015.01066.

4. Chaloner TM, Gurr SJ and Bebber DP (2021) Plant pathogen infection risk tracks global crop yields under climate change. *Nat Clim Change* 11 (8):710–715. doi: 10.1038/s41558-021-01104-8

5. Deng Y, Zhai K, Xie Z, Yang D, Zhu X, Liu J and Wang X (2017) Epigenetic regulation of antagonistic receptors confers rice blast resistance with yield balance. *Science* 355(6328): 962–965. https://doi.org/10.1126/ science. aai8898.

6. Foreign Agricultural Service/USDA, 2024-25.9-27.

7. Gupta DK, Pramanick S and Singh AK (2025) Long-Term Impact of Aerosols and Climate Variability on Rice Yields across Agroclimatic Zones in India. *Earth Sys and Envi* 9. https://doi.org/10.1007/s41748-025-00701-3.

8. Hori K, Matsubara K and Yano M (2016) Genetic control of flowering time in rice: Integration of Mendelian genetics and genomics. *Theor Appl Genet* 129(12): 2241-2252.

9. Jamaloddin M, Mahender A, Gokulan C G, BalachIranjeevi C, Maliha A, Patel H K (2021) Molecular approaches for disease resistance in rice, Rice Improvement, eds. J. Ali and S. H. Wani (Cham: Springer) 315-378. doi: 10.1007/ 978-3-030-66530-2_10.

10. Jinsong Bao (2019) Rice milling quality, Editor(s): Jinsong Bao, Rice (Fourth Edition), AACC International Press.339-369, ISBN 9780128115084, https://doi.org/10.1016/B978-0-12-811508-4.00010-1. (https://www.sciencedirect.com/science/article/pii/B9780128115084000101)

11. Khush GS (1978) Breeding methods and procedures employed at IRRI for developing rice germ plasm with multiple resistance to diseases and insects.

12. Khush GS, Mackill DJ, Sidhu GS (1989) Breeding rice for resistance to bacterial blight. In Bacterial Blight of Rice. 207-217.

13. Liang Z, Menjivar JR, Zhang L, Zhang J and Shen X (2024) Examining the effects of adopting early maturing crop varieties on agricultural productivity, climate change adaptation, and mitigation. *International J Low-Carbon Tech* 19.1256-1274. https://doi.org/10.1093/ijlct/ctad150.

14. Lin L, Gu T and Shi Y (2024) The Influence of New Quality Productive Forces on High-Quality Agricultural Development in China: Mechanisms and Empirical Testing. *Agriculture* 14. 1022.

15. Liu Z, Zhu Y, Shi H, Qiu J, Ding X and Kou Y (2021) Recent progress in rice broad-spectrum disease resistance. *Int J Mol Sci* 22. 11658. doi:10.3390/ ijms 222111658.

16. Mandal N, Adak S, Sahoo RN, Mukhopadhyay A and Rajashekara H (2023) "Spectral Characterization and Severity Assessment of Rice Blast Disease Using Univariate and Multivariate Models. *Frontiers Plant Sci* 14. 1067189.

17. Mohd Salim Mir, Waseem Raja, Raihana Habib Kanth, Eajaz Ahmad Dar, Zahoor Ahmad Shah, Mohammad Anwar Bhat, Aamir Hassan Mir, Fehim Jeelani Wani, Tauseef A. Bhat1, Javid Ahmad Bhat, Baby Summuna, Umer Fayaz, Suhail Fayaz, Bilal Ahmad Bhat, NadhirAl-Ansari, Mohamed A. Mattar and Ali Salem (2025) Optimizing irrigation and nitrogen levels to achieve sustainable rice productivity and profitability. *Scientific Rep* 15. 1-20. 10.1038/s41598-025-90464-8.

18. Peeters KJ, Audenaert K and Hofte M (2021) Survival of the fittest: how the rice microbial community forces *Sarocladium oryzae* into pathogenicity. *FEMS Microbiol Ecol* 97(2):fiaa253. doi: 10.1093/femsec/fiaa253. PMID: 33316039.

19. Prosekov AY and Ivanova SA (2018) Food security: the challenge of the present. *Geoforum* 91:73–77. doi:10.1016/j.geoforum.2018.02.030

20. Rafi, S.M., Thakur, A.K., Verma, O.P., Bhol, R., Panigrahi, K.K., Shatpathy, P (2024) Impact of fertilizer doses on growth and grain yield under different rice cultivation methods. *Annals Agri Res New Series* 45 (4): 336-343.

21. Rajput N, Muhammad UY, Muhammad Q, Saima PM, Shabana M, Abd El-Rahman M, Saltanat A, Sezai E, Rashid I and Shimin Z (2024) Understanding rice blast: investigating biotechnological methods to speed up the development of robust rice cultivars. *Genet Resources Crop Evol* 1-20.

22. Ramulu V, Reddy MD, Umadevi M and Sudharani Y (2020) Response of Rice Cultivars to Nitrogen Levels under Aerobic and Transplanted Conditions. *Indian J Agri Res* (54): 521-525.

23. Robin S, Mohanasundaram K, Manonmani S, Rajeswari S, Jeyaprakash P, Pushpam R, Thiagarajan K, Rabindran R, Suresh S, RavichandranV and Radhamani S (2019) TNAU Rice CO 51 (IET 21605) - A high yielding short duration fine grain rice variety for Tamil Nadu. *Electronic J Plant Breed* 10 (2): 324-333. DOI: 10.5958/0975-928X.2019.00042.5.

24. Sakthivel N (2001) Sheath Rot Disease of Rice: Current Status and Control Strategies. In: Major Fungal Diseases of Rice: Recent Advances. (Sreenivasaprasad, S. and Johnson, R., eds.). Dordrecht: Springer Netherlands, pp. 271–283. https://l ink.springer.com/book/10.1007/978-94-017-2157-8.

25. Velasquez AC, Castroverde CDM and He SY (2018) Plant–pathogen warfare under changing climate conditions. *Curr Biol* 28 (10): R619–R634. doi: 10.1016/j.cub.2018.03.054.

26. Zhou S, Zhu S, Cui S, Hou H, Wu H, Hao B, Cai L, Xu Z, Liu L, Jiang L, Wang H and Wan J (2021) Transcriptional and post-transcriptional regulation of heading date in rice. *New Phytol* 230:943-956.

