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Research Article

ADT 53- Short duration high yielding fine grain rice variety for *Kuruvai /Kodai* seasons of Tamil Nadu

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Abstract
The rice variety ADT 53 (AD07073) is a short duration culture (110-115 days) which was released during 2019 by TNAU for *Kuruvai/ Kodai/ Navarai* season of Tamil Nadu. This variety was evolved through pedigree breeding from the cross ADT 43 / JGL 384. It has non-lodging compact plant type with well exerted compact panicle. The variety recorded an average grain yield of 6334 kg/ha in 242 trials which are 9.4 per cent higher than ADT 43 (5788 kg/ha in 112days) and 14.0 per cent over CO 51 (5562 kg/ha in 112 days). The culture had shown a resistance reaction to leaf folder and moderately resistant to brown spot, blast diseases and rot under field condition. The variety ADT 53 possesses a medium slender grain with a 1000 grain weight of 14.8 grams. It has 65 per cent milling outturn and good cooking quality parameters like a soft gel consistency, moderate amylose and gelatinization temperature.

Keywords
Paddy, Rice ADT 53, Early maturity, Medium slender grain

INTRODUCTION

In Tamil Nadu, the short duration rice growing season contributes to 38.2 per cent of the total rice area of 19.2 lakh hectares and produced around 32 lakh metric tonnes of paddy in *Kuruvai/ Kodai / Navarai / Sornavari* seasons (https://www.tnagrisnet.tn.gov.in/). The existing short duration varieties though have ruled different zones of paddy areas in Tamil Nadu under conditions due to their specific advantages. Still the variety ADT 43 released in the year 1998 is predominant (BSP indent, 2016-2018) and remains popular among rice farmers due to its grain quality and millers as well as consumers preference. Hence the choice among short duration varieties is very much limited for *Kuruvai/Kodai/Navarai*season as other varieties do not match local environments by giving equal yield in all locations. Under the present context, it becomes a long felt need by the farmers to have a new short duration variety suitable for *Kuruvai / Kodai / Navarai* seasons for augmenting productivity in not only delta but also other areas under paddy cultivation withnon-lodging as well as high yielding toward the preference of farmers, millers and consumers (Juliano *et al*., 1990). Research efforts have been undertaken in Tamil Nadu Rice Research Institute, Aduthurai to identify a suitable short duration high yielding with non-lodging good grain cooking quality variety for *Kuruvai / Kodai* season which resulted in the identification of one a variety namely Rice ADT 53.

MATERIALS AND METHODS

The variety Rice ADT 53 is derivative of the cross between ADT 43/JGL 384. The culture has been developed through pedigree selection by combining yield as well as grain quality. It was tested in the culture name AD 07073. The crossing programme was initiated during *Kuruvai (Kharif)* 2003 at Tamil Nadu Rice Research Institute, Aduthurai. The segregating progenies were selected and advanced during 2003-2006 and the homozygous culture AD 07073 was evaluated in Station trials with the check ADT 43 and CO51 since 2007. It was tested in Multi-location trials in different research Stations of TNAU in 12 locations between 2011 and 2012. Based on its superior performance over check varieties, this culture was assessed in Adaptive Research Trials during 2013 and 2014 in 132 locations spreading over *Kuruvai/ Kodai/ Navarai* growing districts in Tamil Nadu. Field Screening was carried out for its reaction to pests and diseases. Quality parameters were also assessed for this culture in comparison with the standard varieties. On a farm, the trial was conducted in 69 locations during 2015-2018. Based on the superiority over the station, MLT, ART, OFT it was proposed for release as Rice ADT 53. In 2018, the State Variety Release Committee approved and released it as Rice ADT 53.

RESULTS AND DISCUSSION

In varietal trials conducted over four years (2007-2010) at TRRI, Aduthurai, the culture has recorded a mean grain yield of 5949 kg/ha(**Table 1**) in the station trials and manifested a yield advantage of 22 per cent over the best check variety ADT 43 with good grain quality. Multi-Location Trials conducted at six locations during 2011-12, the culture has given a mean grain yield of 6019 kg/ha in 111 days out yielding the check variety ADT 43 with 17.25 per cent yield advantage. In 2012, the culture has recorded a mean grain yield of 5502 kg/ha in 112 days out of six locations tested under *Kuruvai* season which is 5.2 per cent yield increase than ADT 43. On overall performance analysis in 12 locations of two years MLT, the weighted mean showed 5761 kg/ha in 112 days and is 11.2 per cent yield advantage over the check variety ADT 43 (5179 kg/ha) (**Table 2**).

Table 1. Performance of ADT 53(AD 07073) in on-station trials TRRI, Aduthurai

S. No	Trials	Grain Yield (kg/ha)		Days to Maturity	
		AD 07073	ADT 43	AD 07073	ADT 43
1	Initial Yield Trial 2007	6500	5412	112	110
2	Preliminary Yield Trial 2008	6333	5097	110	110
3	Advanced Yield Trial 2009	5088	4777	112	110
4	Advanced Yield Trial 2010	5874	4294	112	111
	Mean (4)	**5949**	**4895**	**111**	**110**
	% increase over the checks		**+ 22**		

Table 2. Mean performance of ADT 53(AD 07073) in Multi-Location MLT –QR-Early (2011&2012)

S. No.	Location	Grain Yield (kg/ha)		Days to Maturity	
		AD 07073	ADT43	AD 07073	ADT43
1.	2011 (6)	6019	5133	111	109
2.	2012 (6)	5502	5225	112	114
	Mean (12)	**5760**	**5179**	**112**	**112**
	% increase over the checks		**+11.2**		

Table 3. Performance of AD 07073 (IET 23955) in National Trials (IVT E) - *Kharif*2013

Sl.No.	Location	AD 07 073	Tulasi(RC)
1	Pantnagar	1678	2352
2	Ludhiana	4940	4367
3	Kaul	4250	3850
4	Cuttack	3065	3685
5	Jeypore	4848	1939
6	Patna	4476	2381
7	Chinsurah	4698	4412
8	Varanasi	4900	5250
9	Waraseoni	2523	1325
10	Rewa	4479	1391
11	Karjat	5797	5636
12	Sakoli	3200	2153
13	Vadagaon	4485	4722
14	Vyra	4295	2655
15	Dabhoi	3824	2745
16	Mareteru	2195	1205
17	Warangal	3235	4391
18	Coimbatore	7694	6622
19	Ambasamudram	7125	5688
20	Aduthurai	4444	1471
21	Moncompu	2841	1592
22	Pattambi	4690	3968
23	Mandya	6086	5672
24	Bramavar	2164	2925
25	Gangavati	9259	4784
26	Kurumbapet	6500	4500
	Mean	**4527**	**3526**
	Per cent increase over	**-**	**26.7**

The results of the Adaptive Research Trials obtained from 152 locations distributed across 20 districts conducted in two years namely 2013 and 2014 by both the Department of Agriculture and Krishi Vigyan Kendras were compiled. The culture AD 07073 outperformed the check by recording an average grain yield of 6337 kg/ha in 117 days which is 9.6 and 6.3 per cent yield increase than ADT 43 (5784 kg/ha in 116 days) and CO 51 (5964kg/ha in 116 days) (Table 3).Under the AICRP evaluation trial, the culture was tested in Initial Varietal Trial- Early-Transplanted as IET 23955 during 2013. It has recorded an average of 4594 kg/ha in 26 locations and has given the highest yield of 9259 kg/ha at Gangavati location (Table 4). Its performance is much higher than the check variety Tulasi in the locations at Tamil Nadu and Karnataka viz., Coimbatore, Ambasamudram, Aduthurai, Mandya and Pondicherry (Kurumbapet) clearly indicating the culture's adaptability to Tamil Nadu conditions.

Table 4. Overall mean performance of ADT 53(AD07073) in Adaptive Research Trials (2013 and 2014)

S. No	Trial Type	Locations	Yield (kg/ha)			% inc. over checks	
			AD 07073	ADT 43	CO 51	ADT 43	CO 51
2013							
1.	JDA-ART-2013	47	5905	5786	5627	2.0	4.9
2.	KVK-ART-2013	12	5991	5075	5396	18.1	11.0
	Mean	59	5923	5639	5579	5.03	6.2
2014							
3.	JDA-ART-2014	75	6374	6177	6283	3.2	1.4
4.	KVK-ART-2014	18	6538	5563	6016	17.5	8.7
	Mean	93	6407	6051	6229	5.9	2.9
Over all Mean (Weighted mean)		**152**	**6337**	**5784**	**5964**	**5.4**	**4.4**

In the large demonstrations conducted at five locations, the culture AD07073 has been found to have 13.8 per cent and 16.2 per cent higher yield than ADT 43 and CO51 respectively (Table 5). During 2016-18, a total of 69 On-Farm Trials were conducted for this culture along with the check variety ADT 43. Farmers opined that the culture AD 07073 is less fertilizer consuming variety, non-lodging, fine grain type with good marketability. Besides, AD 07073 had also recorded 17.4 per cent yield increase over ADT 43 (Table 6). Thus, it has been proved that AD 07073 could be a choice variety for the farmers in short duration segment.

Table 5. Performance of ADT 53(AD 07073) in Large Scale Demonstrations (2015 -2017)

S. No	Location	Area (ac)	Yield (kg/ha)			Days to Maturity		
			AD 07073	ADT 43	CO 51	AD 07073	ADT 43	CO 51
1.	TRRI, Aduthurai 2015	0.5	6890	6370	6050	110	111	112
2.	TRRI, Aduthurai 2016	1ac	6620	6328	6120	111	110	108
3.	ARS ,Pattukottai 2016	1ac	7200	6220	5800	108	112	109
4.	SWMRI, Thanjavur 2016	0.5	6950	5525	5825	112	111	112
5.	TRRI, Aduthurai 2017	1ac	6850	6100	6110	111	110	110
	Mean (5)		**6902**	**6109**	**5981**	**110**	**111**	**110**
	% increase over checks			**+13.0**	**+15.4**			

Table 6. Performance of AD 07073 in On-Farm Trials through TRRI, Aduthurai During 2016 - 2018

S. No	No of Locations	Grain Yield(kg/ha)		
		AD 07073	ADT 43	CO 51
1	**69**	**6678**	**5690**	**5918**
		% yield increase over the checks	**+17.4**	**+12.8**

The culture AD 07073 on overall analysis recorded mean productivity of 6334 kg/ha with the maturity duration of 112 days under 242 trials. This average yield is found to be 9.4 per cent higher than ADT 43 (5788 kg/ha in 112days) and 14.0 per cent over CO 51 (5562 kg/ha in 112 days) (Table 7). At Alanganallur in Madurai district, this culture recorded the highest grain yield of 9875 kg/ha depicting the highest yield potential of this variety.

Table 7. Overall mean yield performance of ADT 53(AD 07073) in different trials

S.No	Name of the Trials	Locations	Grain Yield (Kg/ha)			Days to Maturity		
			AD 07 073	ADT 43	CO 51	AD 07 073	ADT 43	CO 51
1.	On-Station Trial (2007 - 2010)	4	5949	4895	-	111	110	-
2.	Multi-Location Trials (2011&12)	12	5760	5179	-	112	112	
3.	Adaptive Research Trials (2013 &14)	122	6188	6022	6023	117	116	116
4.	KVKs (2013 &14)	30	6319	5368	5768	109	110	109
5.	Large Scale Demonstrations (2015-16 & 2016-17)	5	6902	6109	5981	110	111	110
6.	OFT (2015 -18)	69	6678	5690	5918	-	-	-
7.	National Trial (Kharif,2013)*- IET 23955	*26	4594	3625 (Tulasi)	-		-	-
	No. of Trials	**242**						
	Overall Weighted Mean Yield in Kg/ha		**6334**	**5788**	**5562**	**112**	**112**	**112**
	Per cent increase over the checks			**+9.4**	**+14.0**			

Not included in the mean

The culture has compact plant type, moderately compact dense panicles and matures in 110-115 days. In addition, the culture had also shown resistance to pests like stem borer, leaf folder and diseases like blast and sheath blight. The culture AD 07073 possess medium slender grain, white rice and has 65 per cent milling out turn with 58.5 per cent of Head Rice Recovery which is in accordance with Shivani *et al.* (2007) and Oko *et al,* (2012) who reported a significant positive association of head rice recovery with milling outturn. It has good cooking quality parameters like soft gel consistency and moderate gelatinization temperature (**Table 8a-8d**).

Table 8a. Physical quality characteristics

Variety	Milling Yield (%)	Head Rice Recovery (%)	Kernel Length (mm)	Kernel Breadth (mm)	L/B Ratio	*Grain Type
2014						
AD 07073	62.0	58.8	5.9	2.0	2.95	MS
ADT 43	64.5	54.8	6.0	1.9	3.15	MS
CO 51	70.0	61.4	6.3	2.3	2.73	MS
2015						
AD 07073	65.0	58.5	6.0	2.0	3.0	MS
ADT 43	62.5	56.2	5.9	2.0	3.0	MS
CO 51	62.5	56.2	6.4	2.2	2.9	MS

*MS - Medium slender,
(Source: Crop Scientists' Meet on Rice Report, 2014 & 2015)

Table 8b. Cooking Quality Characteristics (Mean of 2013 & 2014)

Parameters	AD 07 073	ADT 43	CO 51
Kernel length after cooking (mm)	9.6	9.1	8.7
Kernel breadth after cooking (mm)	2.9	2.9	2.9
Linear elongation ratio	1.6	1.5	1.4
Breadth wise expansion ratio	1.4	1.3	1.3
Volume expansion (ml)	4.3	4.1	3.7

(Source Crop Scientists' Meet on Rice Report, 2014 & 2015)

Table 8c. Biochemical and Nutritional Characteristics

Parameters	AD 07 073	ADT 43	CO 51
Gel consistency	Soft (87mm)	Soft (64mm)	Soft (89mm)
Gelatinization Temperature	Intermediate	Intermediate	Intermediate
Amylose Content	Intermediate (24.3)	Intermediate (25.4)	Intermediate (22.1)
Zinc (ppm)	26.06	28.61	-
Iron (ppm)	14.70	14.30	-

(Source Crop Scientists' Meet on Rice Report, 2014 & 2015)

Table 8d. Fodder Quality Analysis- Paddy Straw

Entries	Crude Protein (%)	Crude Fibre (%)	Crude Fat (%)	Ash Content (%)
AD 07073	5.22	31	1.42	17
ADT 43	5.50	28	1.26	16

The key morphological characters to distinguish other varieties during seed production are Erect angular boot leaf during flowering, Semi erects during maturity stage, white coloured and Split shaped Ligule, slightly curved grain tip, Droopy panicle of medium length The description as per the DUS characters are presented in **Table 9**. Rice ADT53 was differentiated from other popularly grown variety *viz.,* CO51, ADT43 and JGL384 using the molecular marker technology. A total of 10 SSR markers *viz.,* RM 302, RM 335, RM 5961, RM 431, RM 463, RM3412, RM 8262,RM 3476, RM 336, RM 412 were taken for the study. Among them two primers *viz.,* RM 336 and RM 412 revealed polymorphism among varieties. (**Fig. 1**)

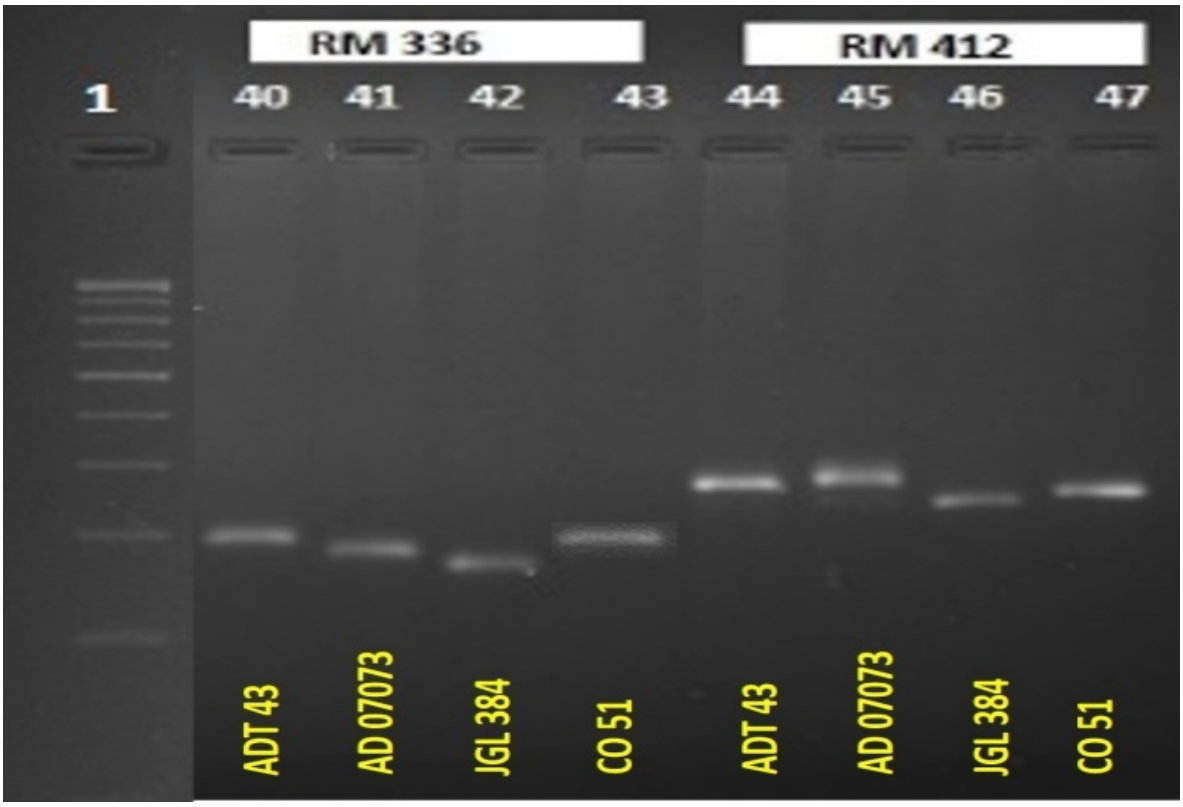

Fig. 1. DNA fingerprinting of Rice ADT 53(AD07073)

Table 9. Descriptor of rice ADT 53(AD07073)

A	Plant height	:	94.0 cm (85 – 105cm)
B	Distinguishing morphological characters (as in Crop Production Guide)	:	
	Early plant vigour	:	Good
	Coleoptile	:	Green
	Basal leaf sheath colour	:	Green
	Leaf-blade colour	:	Green
	Leaf pubescence	:	Medium, Leaf margin- strong
	Auricle	:	Present, light green
	Anthocyanin pigment	:	Absent
	Collar	:	Present, light green colour
	Ligule	:	Present, white colour, **Split shape**
	Septum	:	Cream
	Flag leaf angle	:	Erect angular boot leaf during flowering, Semi erect during the maturity stage
	Days to 50% flowering	:	83(80-85)days
	Panicle exsertion	:	Well exerted
	Stigma color	:	White
	Apiculus color	:	Straw
	Panicle length	:	22.5cm (21-25cm)
	Filled grains/panicle	:	~180-220 nos.
	Average single plant yield	:	35 - 40 g
	Panicle type	:	Compact
	Awns	:	Absent
	Grain tip	:	Slightly curved
	Hull colour	:	Straw and Gold
	Seed coat (kernel) colour	:	Light brown
	Threshability	:	Easy
	Aroma	:	Absent
	Grain / Paddy		
	L x B x T (mm)	:	7.7x 2.3 x1.12
	1000 grain weight (g)	:	14.8 g (14.5-15.1)
	Brown rice		
	L x B x T (mm)	:	5.8 x 1.9 x 1.02
	L/B ratio	:	3.1
	Rice grade	:	Medium slender
	Milled Rice colour	:	White
	Abdominal white	:	Occasionally present
	Translucency	:	Translucent
C	Maturity (range in no. of days) seeding/ transplanting to flowering, seed to seed)	:	Seed to seed: 110-115 days
D	Maturity group (early, medium and late wherever such classification exists)	:	Early

Due to superiority over the checks, ADT 43 and CO 51 with higher yield potential, improved pest and disease resistance and good cooking qualities, this culture AD 07073 was proposed as a new variety Rice ADT 53 for cultivation during *Kuruvai/ Navarai/ Kodai* seasons in Tamil Nadu. The culture AD 07073 was released as Rice ADT 53 by the 49th SVRC during 2019. It is recommended for *Kuruvai /Kodai / Navarai* seasons of Tamil Nadu. The national identity of this variety is IC 629212.

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Fig.2. Field View of Rice ADT 53

Fig.3. Single plant and panicle bunch of Rice ADT 53

Fig.4. Grain, Raw, Parboiled and Cooked rice