



Research Article

Rice MDU 6: A high yielding long slender grain variety

N. Ananthi*, R.P.Gnanamalar, S.Jebaraj, S.M.Ibrahim, C.Vanniarajan and C.R.Anandakumar

Agricultural College and Research Institute, Tamil Nadu Agricultural University,
Madurai – 625104.

Email: ananthi.n@tnau.ac.in

(Received: 9 Apr 2017; Revised: 20 Sep 2017; Accepted: 29 Nov 2017)

Abstract

A short duration, high yielding, long slender grain rice culture, ACM 01010 was developed from Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai and was released as Rice MDU 6 during 2015. ACM 01010 is a derivative of MDU 5 / ACM 96136. It has semi dwarf stature (95-105 cm), high tillering capacity, white long slender grain with superior grain quality. It matures in 110 - 115 days and it is suitable for short duration rice growing areas. This culture recorded a mean grain yield of 6118 kg/ha (9.7 per cent and 10.2 per cent increased yield over the checks, ADT 43 and ADT (R) 45 respectively) in different yield trials including MLTs and ARTs. In ART, this culture registered more than 7000 kg/ha in 29 locations out of 160 locations tested. The culture, ACM 01010, is moderately resistant to leaf folder, stem borer, GLH and WBPH under field conditions. It possesses intermediate amylose content, gelatinization temperature and soft gel consistency. It produces white long slender rice with desirable cooking quality. As raw rice, it is highly suitable for making pongal and variety rice besides it is also suitable for aval (flaked rice) and pori (parched paddy) making.

Key words

Rice MDU 6, long slender grain, short duration, raw rice, parched paddy

Introduction

Rice is one of the most important cereal crop of the world meeting the dietary requirements of the people living in the tropics and sub tropics. Traditionally rice plant breeders concentrated on breeding for high yield. In recent decades human demand for high quality rice is continuously on increase, which entailed in incorporation of preferred grain quality features as the most important objective next to enhancement in yield.

A paradigm shift in the rice breeding strategies from quantity centered approach to quality oriented effort was inevitable, since India has not only become self sufficient in food grain production but also is the second largest exporter of quality rice in the world (Sreedhar *et al.*, 2005). Improvement in grain quality that does not lower yield is the need of hour at present context in order to benefit all rice growers and consumers. Like grain yield, quality is not easily amenable to selection due to its complex nature. Lack of clear cut perception regarding the component traits of good quality rice is one of the important reasons for the tardy progress in breeding for quality rice varieties. With the increase in yield, there is also a need to look into the quality aspects to have a better consumer acceptance, which determines the profit margin of rice growers which in turn dictates the export quality and foreign exchange in India (Babu *et al.*, 2012).

In Tamil Nadu, out of 21 lakh hectares, 5 lakh hectare area is covered with short duration rice varieties in all the seasons. Since, water has become a scarce commodity, short duration rice varieties maturing in 100-115 days are predominately cultivated in majority of the rice growing areas. During *Kuruvai* (June-July) season short duration rice varieties viz., ADT 43, ADT (R) 45, ASD 16 and MDU 5 are cultivated by the farmers of Periyar Vaigai River Project Area (PVRP). ADT 43 (1998) is one of the popular rice variety being cultivated for its grain type and high market value. ADT (R) 45 and ASD 16 have also found region specific position in rice cultivation. MDU 5 rice variety (released during 1996) is the one which is grown as contingent crop if water is delayed from PVRP. The farmers of Tamil Nadu prefer mostly an early duration rice variety to escape from water shortage and in addition they prefer slender/ fine grain varieties for cultivation because of its superior grain quality and high export value. Hence, need for an early duration rice variety with high commercial value is very much needed for the present day short duration rice scenario. With this background, the breeding work was initiated at Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai to evolve high yielding, short duration fine grain rice variety with desirable grain quality with resistance to major pests and diseases.

Materials and methods

A high yielding rice culture ACM 01010 was evolved at Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai and released as Rice MDU 6 during 2015. It is a derivative of MDU5 /ACM 96136. Single plants with desirable grain qualities and high yield was selected in F₂ and was forwarded as single plants to progeny rows. The progenies were assessed for their performance in comparison with the checks ADT 43 and ADT (R) 45 under station trials during *Kharif*, 2005-08, Multi Location Trials during 2008-10, Adaptive Research Trials during 2011-12 and AICRIP and On Farm Trials during 2013 (196 trials) (Figure1).

Pest and disease performance was tested under artificial and field conditions at Aduthurai, Coimbatore and Madurai during 2009-10 and 2013 (Annual Rice Meet Report 2009-10 and 2013). Physical, cooking and biochemical properties of the culture was tested for its grain qualities and its end user acceptability along with the checks ADT 43 and ADT 45 as per IRRI, SES at Department of Rice, TNAU, Coimbatore (Annual Rice Meet Report, 2009) and at Home Science College & Research Institute (HSC & RI), Madurai. Thus, the culture ACM 01010 was finally selected and released as Rice MDU 6 during 2015. The morphological characters of the rice variety MDU 6 is recorded using DUS descriptors and given in Annexure I.

Results and discussion

Rice MDU 6 has recorded a overall mean grain yield of 6118 kg/ha at 196 locations which was 9.7 and 10.2 per cent increased grain yield over ADT 43 (5496 kg/ha) and ADT (R) 45 (5550 kg/ha) respectively (Table 1).

The culture ACM 01010 recorded a mean grain yield of 6794 kg/ha over three years of station trials with 20.08 per cent improved yield over ADT 43 and 28.85 per cent over ADT (R) 45. (Table 2). In Multi Location Trials (MLT) 2008-09 and 2009-10 the mean grain yield was 5236 kg/ha and 6120 kg/ha respectively which was 9.5 per cent (4782 kg/ha) and 11.7 per cent (5480 kg/ha) higher than the check variety ADT 43. (Table3A, 3B).

Based on its performance in MLT, ACM 01010 was promoted to evaluate in Adaptive Research Trials (ART) during 2011-12 and 2012-13 in 25 districts (160 locations) across Tamil Nadu. In the first year of Adaptive Research Trial (ART) during, 2011-12 in 15 districts (77 locations) of which the culture, out

yielded the check varieties, ADT 43 (7.8 per cent higher yield) (5652 kg/ha) and ADT (R) 45 (5.5 per cent higher yield) (5791 kg/ha) in ten districts (Table 4). During 2011-12, the culture tested in 18 districts (83 locations) and it out yielded the check varieties ADT 43 (11.6 per cent higher yield) (5378 kg/ha) and ADT (R) 45(9.0 per cent higher yield) (5506 kg/ha) in 16 districts. (Table 5). Among the 160 locations of ART conducted, the culture recorded the mean grain yield of 6093 kg/ha which was 9.21 and 6.82 per cent increased yield than ADT 43 (5579 kg/ha) and ADT (R) 45 (5704 kg /ha) respectively. (Table 6). In AICRIP trials conducted during *kharif* 2013 across 25 locations in the country in Initial Varietal Trial - Early, the culture was evaluated as IET 23994 and it has recorded 4212kg/ha which is 16.5 per cent increased yield over the regional check,Tulasi(Table 7).

In OFT (2013), the culture ACM01010 recorded a mean grain yield of 7200 kg/ha which was 15.4 per cent higher yield than ADT 45 (Table 8). The culture was found to perform better (7186 kg/ha) with 47 per cent yield advantage over ADT (R) 45 (4766 kg/ha) in Large Scale Demonstration trials.

The culture ACM 01010 is moderately resistant to leaf folder ,stemborer, GLH and WBPH (Table 9).

The grain size and shape are the first criteria for rice quality that breeders consider in developing new varieties for release and commercial production (Adair *et al.*, 1966). Preferences for grain size and shape vary from one group of consumers to another. In general, medium to long grains are preferred in the Indian subcontinent while the country is also replete with hundreds of short grain aromatic types and long grain basmati types the latter commanding highest premium in both domestic and international markets. There is a strong demand for long-grain rice in the international market (Shobarani *et al.*, 2006)

Rice grain quality traits encompass the totality of all characteristics and features of rice or the rice products that meets the consumer demands and preference. Different rice genotypes have diverse physicochemical and physical properties, which influences the grain quality properties (Chemutai *et al.*, 2016)

Cooking quality of rice is mainly determined by water uptake, volume expansion and kernel elongation. These traits are primarily influenced by the alkali value and amylose content of the kernels (Adilakshmi and Upendra.2014).

The rice culture, ACM 01010 has white long slender rice with intermediate amylase (21.8%) soft gel consistency (82 ml) and moderate gelatinization temperature. As a raw rice it is suitable for making soft, tasty pongal and variety rices besides it is also suitable for aval and pori making. (Table 10).

Considering the higher yield, short duration, long slender white rice, good cooking quality besides suitable for aval (flaked rice) and pori (parched paddy) making when compared to the checks ADT 43 and ADT (R) 45, the culture ACM 01010 was released as a new variety, **Rice MDU 6** by SVRC for general cultivation during Kar/ Kuruvai/ Sornavari/ Navarai seasons wherever short duration rice varieties are cultivated throughout Tamil Nadu. The morphological characters of the rice variety MDU 6 is given in Annexure I.

References

Adair C.R., Brachell H.M., Jodon N.E., Johnston T.H., Thysell J.R., Green V.E., Webb B.D. and Atkins J.G., 1966. Rice Breeding and testing methods in the U.S. In U.S. Department of Agric. Rice in the U.S.: Varieties and Production. *USDA Agri. Rs. Serv. Handbook*, 289, pp. 19-64.

Adilakshmi.D and A.Upendra .2014. Combining ability analysis for quality and nutritional traits in rice.

International Journal of Farm Sciences. 4(2): 15-23.

Chemutai LR, Musyoki M.A, W.F.Kioko , N.S.Mwenda and K.G.Muriira. (2016) Physicochemical Characterization of Selected Rice (*Oryza Sativa* L.) Genotypes Based on Gel Consistency and Alkali Digestion. *Biochem Anal Biochem* 5: (3) 285.

Babu. V.R., K. Shreya, Kuldeep Singh Dangi, G. Usharani and P. Nagesh . 2012. Genetic variability studies for qualitative and quantitative traits in popular rice (*Oryza sativa* L). hybrids of India. *Int. J.of Sci. Res. and Publications* 2: (6) 1-5.

Rukmini, K.D., Parimala, K., Venkanna, V., Lingaiah, N., Hari, Y. and Chandra, B.S.,

Estimation of Variability for Grain Yield and Quality Traits in Rice (*Oryza sativa* L.), *Int. J. Pure App. Biosci.* **4(2)**: 250-255 (2016).

Sreedhar, S., Vanisree, S., Kulakarni, N and Ganesh, M., 2005. Gene effects for certain physical quality traits and grain yield in rice. *Madras Agricultural Journal*, 2005, 92(4-6):183-187.

ANNEXURE I Morphological characters of Rice MDU 6 (ACM 01010)

Description of variety / hybrid :

a.	Plant height	:	95 - 105 cm
b.	Distinguishing morphological characters	:	DUS descriptors
	• Early plant vigour	:	Good
	• Coleoptile	:	Green
	• Basal leaf sheath colour	:	Green
	• Leaf sheath	:	Green
	• Leaf blade colour	:	Green
	• Leaf pubescence	:	Intermediate
	• Boot leaf	:	Erect
	• Leaf length	:	39 - 40 cm
	• Leaf width	:	1.1 to 1.2 cm
	• Days to 50% flowering	:	80 to 85 days
	• Panicle exertion	:	Well exerted panicle
	• Stigma colour	:	White
	• Apiculus colour	:	Light green
	• Number of productive tillers	:	15 - 18
	• Panicle length	:	24 - 28 cm
	• No. of grains / panicle	:	230 - 280
	• Panicle type	:	Intermediate, droopy
	• Awning	:	Absent
	• Days to maturity	:	110 – 115 days
	• Seed coat colour (Kernel)	:	White
	• Junction of auricle	:	Pale green
	• 1000 grain weight (g)	:	17.3
	• Hull (husk) colour	:	Straw
	• Threshability	:	Good
	• Aroma	:	Absent
	• Grain yield per plant (g)	:	25 - 35
	• Grain	:	Long slender
	• L x B	:	6.8 x 2.2 mm
	• L/B ratio	:	3.09
	• Rice grade	:	Long slender
	• Milled rice colour	:	White
	• Abdominal white	:	Occasionally present

Table 1. Overall mean yield performance of ACM 01010 in different trials

Name of the trials	No. of trials	Average grain yield (kg/ha)		
		ACM 01010	ADT 43	ADT (R) 45
Station trials	4	6794	5658	5273
Multi location trials (2008- 09)	9	5236	4782	4908
Multi location trials (2009-10)	8	6120	5480	6118
AICRIP-IVT- Early 2013*	16	4212	-	3487 (Tulasi)
Adaptive Research trial (2011-12 and 2012-13)	160	6093	5579	5704
OFT 2013	15	7200	-	6239
Overall weighted mean yield in kg/ha	196	6118	5496	5550
Per cent increase over checks			9.7	10.23

* The results are not included for calculating overall mean

Table 2. Yield performance of ACM 01010 in station trials, Dept. of PBG, AC&RI, Madurai

Sl. No.	Name of the trial	Duration(days)	Grain yield kg/ha			SEd	CD 5%	CV%
			ACM 01010	ADT 43	ADT (R) 45			
1)	IET, 2008-09	115	6361	-	4361	127	269.43	4.63
2)	PYT, 2009-10	111	7000	5639	5250	153.58	443.67	4.55
3)	CYT, 2010-11	109	6890	5630	5704	140.33	291.11	7.94
4)	AYT, 2011-12	109	6926	5704	5778	206.78	426.78	4.72
	Mean	111	6794	5658	5273			
	% Increase			20.08	28.85			

Table 3A. Performance of ACM 01010 in MLT I during 2008-09

S. No.	Location	Duration (days)	Grain Yield (kg/ha)		
			ACM01010	ADT 43	ADT (R) 45
1	Aduthurai	111	5280	4848	3960
2	Ambasamudram	108	3422	3840	4852
3	Coimbatore	111	5733	5671	6474
4	Madurai	104	5889	4389	5060
5	Thanjavur	105	6675	6000	4425
6	Pondicherry	114	5326	5048	4770



7	Tirur	120	3541	3442	3395
8	Tirupathisaram	108	5807	5260	5286
9	Karaikal	107	5454	4537	5954
Mean		110	5236	4782	4908
Per cent increase over check				9.5	6.7

Table 3 B. Performance of ACM 01010 in MLT I during 2009-10

S. No.	Location	Duration (days)	Grain Yield (Kg/ha)		
			ACM01010	ADT 43	ADT (R) 45
1	Aduthurai	112	4931	4565	5510
2	Ambasamudram	108	7703	6496	8023
3	Coimbatore	117	7437	5499	6881
4	Madurai	109	6750	4806	4889
5	Thanjavur	113	5600	7800	7800
6	Pondicherry	117	5114	4876	4971
7	Tirur	110	5302	4319	4752
8	Tirupathisaram	111	4832	4765	5010
Mean		111	6120	5480	6118
Per cent increase over check				11.7	-

Table 4. District-wise performance in ART Rice 3 / (2011-12)

Districts	Grain yield (kg/ha)			% increase over checks	
	ACM01010	ADT 43	ADT (R) 45	ADT 43	ADT (R) 45
Salem (5)	6528	5602	5950	16.5	9.7
Kanyakumari (4)	5976	5564	5647	7.4	5.8
Coimbatore (5)	6736	5856	5715	15.3	17.9
Namakkal (5)	6538	6492	6801	1	-
Pudukkottai (6)	5646	5307	5569	6.4	1.4
Thiruvavur (5)	4442	3978	3913	11.7	13.6
Thiruvannamalai(5)	5688	5527	5769	2.9	-
Karur (5)	5628	5462	5580	3.04	0.9
Cuddalore (7)	5155	5274	5154	-	-
Trichy (6)	6118	5625	6040	8.8	1.3
Dharmapuri (3)	7183	6467	6500	11	5.8
Theni (5)	8000	8492	8221	-	-
Vellore (5)	5621	4376	4782	28.5	17.5
Erode (6)	7396	6817	6844	8.5	8.1
Dindigul (5)	5972	4299	5011	38.9	19.2
Overall mean (77)	6109	5652	5791	7.8	5.5

Table 5. District-wise performance in ART Rice 3 / (2012-13)

Districts	Grain yield (kg/ha)			% increase over checks	
	ACM01010	ADT 43	ADT (R) 45	ADT 43	ADT (R) 45
Salem (5)	6630	6090	6294	8.9	8.9
Kanyakumari (3)	6450	5882	5097	10	26.6
Coimbatore (5)	5429	5168	5261	5	3.2
Namakkal (5)	7125	6478	6547	10	8.82
Pudukkottai (5)	6020	5240	5280	14.9	14
Thiruvavur (2)	6005	5910	5813	1.6	3.3
Thiruvannamalai(5)	5858	4740	5075	23.6	15.5
Madurai (5)	6464	6082	6413	6.3	0.8
Cuddalore (5)	5448	4869	5006	-	-
Trichy (5)	6285	5394	5710	16.5	10.1
Dharmapuri (4)	5106	5099	5168	0.13	-
Vellore (5)	5688	4412	5130	28.9	10.9
Erode (5)	5925	5667	5572	4.5	6.3
Dindigul (5)	6048	4617	5069	31	19.3
Thanjavur (5)	6194	5666	5758	9.3	7.6
Kancheepuram (5)	6481	5886	5968	10.1	8.6
Ariyalur (4)	6094	5156	5119	18.2	19
Nagapattinam (5)	5299	4718	4789	12.3	10.6
Overall mean (83)	6002	5378	5506	11.6	9.0

Table 6. Pooled Mean in Adaptive Research Trials (2011-12 and 2012-13)

SI. No.	Year	Grain Yield (kg/ha)		
		ACM01010	ADT 43	ADT (R) 45
1.	2011-12 (77)	6109	5652	5791
2.	2012-13 (83)	6002	5378	5506
	Overall mean (160)	6093	5579	5704
	% inc. over checks		9.21	6.82



Table 7. Performance of ACM01010 (IET 23944) in AICRIP: IVT E - *kharif* 2013

Sl. No.	Location	Grain Yield (kg/ha)*	
		ACM 01010	Tulasi (RC)
1.	Ludhiana	2630	4367
2.	Kaul	3000	3850
3.	Cuttack	3200	3685
4.	Jeypore	4394	1939
5.	Patna	4619	2381
6.	Chinsurah	4085	4412
7.	Varanasi	6450	5250
8.	Waraseoni	2175	1325
9.	Rewa	4063	1931
10.	Kanjat	4182	5636
11.	Sakoli	3469	2153
12.	Vadagaon	4722	4722
13.	Vyra	2167	2655
14.	Dabhoi	2549	2745
15.	Warangal	4147	1205
16.	Coimbatore	6982	2798
18.	Ambasamudram	5813	6622
19.	Aduthurai	4412	5688
20.	Moncombu	2783	1592
21.	Pattambi	5375	3968
22.	Mandya	5914	5672
23.	Brahmavar	2111	2925
24.	Gangavati	6481	4784
25.	Kurumbapet	5375	4500
	Mean	4212	3616
Per cent increase over control			16.5

*Not included for calculating overall weighted mean in Table 1.



Table 8. Performance of ACM 01010 in OFT Madurai and Tirunelveli Districts - *kharif* 2013

SI. No.	Farmers Name and Location (5 cents each)	Duration (days)	Mean Grain Yield Kg/ha	
			ACM01010	ADT (R) 45
1.	OFT, Mr. Kennedy, Meetupatti	112	6775	4520
2.	OFT, Mr. Panchacharam, Velichanatham	111	6400	4852
3.	OFT, Mr. Thirumalai Soundirarajan, MDU (W)	115	6225	5110
4.	OFT, Mr. Jeyakumar, Cheranmahadevi	114	9000	9445
5.	OFT, Mr. Krishnan chettiar, Palayamkottai	125	7200	7000
6.	OFT, Mr. Suppukutty, Kadayanallur	110	11560	10320
7.	OFT, Mr. Pradheep, Mukoodal	118	10180	9470
8.	OFT, Mr. Kadalthurai, Sankarankovil	115	8000	7200
9.	OFT Mr., Kamtchi, Manur	125	7400	6840
10.	OFT, Mr. Nalayiramoorthy, Ambasamudram	113	5000	6000
11.	OFT, Mr. Palanivel, Alanganallur, MDU	112	5950	4750
12.	OFT, Mr. Ravi, Pudhupatti, Alanganallur	113	6225	4625
13.	OFT, Mr. Ramanan, Vadipatti	113	6050	4200
14.	OFT, Mr. Pandiyan, Chatirapatti	111	6115	4575
15.	OFT, Mr. Chandran, Thirumalpuram	112	5925	4675
Mean		114.6	7200	6239
Per cent over control				15.4

Table 9. Reaction of ACM 01010 to major insect pests and diseases under field condition

Station	Culture/ check varieties	Pests							Diseases				
		Stem borer		Leaf folder % LD	BP H	GLH	WBPH	Bla st	RTD	Brow n spot	Shea th rot	Sheat h blight	BLB
		Dead heart (%)	White ears (%)										
Aduthurai	ACM 01010	4.00	20.42	2.77	7	-	-	-	5	9	7	9	
	ADT 43	6.38	13.57	18.74	7	-	-	-	5	9	9	9	
	ADT (R) 45	6.94	10.00	5.33	7	-	-	-	7	7	5	9	
Coimbatore	ACM 01010	-	-	-	7	3	5	5	5	-	7	7	-
	ADT 43	-	-	-	9	3	7	7	7	-	5	7	-
	ADT (R) 45	-	-	-	9	7	5	5	7	-	7	7	-
Madurai	ACM 01010	4.41	8.12	9.90	9	-	-	7	-	3	7	5	5
	ADT 43	7.46	6.98	6.61	9	-	-	7	-	5	7	5	9
	ADT (R) 45	3.68	9.27	14.69	7	-	-	7	-	7	9	3	7

(Annual Rice Meet 2009 - 2010)

Table 10. Grain quality characters of ACM 01010

a. Milling, physical and cooking quality characters

Quality characters		ACM 01010	ADT 43	ADT 45
Milling quality traits*	Milling yield (%)	73.80	65.0	74.0
	Head rice yield (%)	62.15	58.50	61.08
Physical grain quality traits*	Kernel length (mm)	6.8	5.5	6.0
	Kernel breadth (mm)	2.2	1.7	1.9
	L/B ratio	3.09	3.20	3.156
	Grain Type	LS	MS	MS
Cooking quality characters**	Kernel length after cooking (mm)	10.0	8.8	8.2
	Kernel breadth after cooking (mm)	2.8	2.2	2.7
	Linear elongation ratio (LER)	1.64	1.60	1.41
	Breadthwise expansion ratio (BER)	1.47	1.29	1.50
	Volume expansion (ml)	5.0	5.5	4.0

(*Source : IICPT, Thanjavur & TNAU, Coimbatore; ** Source : HSC & RI, Madurai)

a. Biochemical characteristics of ACM 01010

Parameters	ACM 01010	ADT 43	ADT (R) 45
Gel consistency	Soft	Soft	Soft
Gelatinization temperature	High to intermediate	High to intermediate	High to intermediate
Amylose content	21.8	24.0	22.4

(Source : TNAU, Coimbatore)

c. Organoleptic evaluation of cooked rice

Details	ACM 01010	ADT 43	ADT (R) 45
Colour and appearance	8	7	7
Flavour	7	7	6
Texture	8	7	7
Taste	8	8	7
Overall acceptability	8	7	7

(Maximum score = 10) (Results from HSC & R I Madurai - 2013)

d. Organoleptic evaluation of Flaked rice

Details	ACM 01010	ADT (R) 45	Co (R) 51
Colour and appearance	8	8	7
Flavour	8	8	5
Texture	8	8	6
Taste	8	7	5
Overall acceptability	8	7	6

(Maximum score = 10) (Results from HSC & R I Madurai - 2013, 2014)

Figure 1. Pedigree chart of ACM 01010

