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Research Article

Rice TPS 5, non-lodging short bold grain variety

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Abstract
The culture, TP 08010 with higher yield, cooking quality characteristics was developed from Agricultural Research Station, Thirupathisaram of Tamil Nadu Agricultural University for cultivation during Kar/late *Pishanam* season. TP 08010 is a derivative of the cross between ASD16 and ADT37 with the duration of 118 days. This culture with erect medium tall stature, moderate productive tillering, long droopy panicles with complete fertility and long erect boot leaf possesses all the characters of the rice variety ASD 16. This culture recorded a mean grain yield of 6300 Kg/ha over 5 years of station trials with 14.7 per cent yield improvement over ASD16 besides exhibiting good record under different field trials inclusive of MLT's and ART's. The culture, TP 08010, is moderately resistant to stem borer, leaf folder, gall midge BPH and WBPH under field conditions. It produces short bold white rice with intermediate amylose, soft gel consistency and moderate gelatinization temperature. It produces good quality cooked rice.

Key words
Rice, Thirupathisaram 5, Bold Grain, Short duration

Introduction

Global demand for food is rising because of population growth, increasing affluence and changing dietary habits. The UN/FAO forecasts that global food production will need to increase by over 40% by 2030 and 70% by 2050 (FAO, 2009). India's rice production has improved with the use of better rice varieties, more precise nutrient management practices, and improved irrigation infrastructure (CRRI Vision, 2030). In Tamil Nadu, around 153 rice varieties have been released and among them 86 are short duration varieties. In *Kar* season short duration rice varieties like ASD 16, ADT 43 and ADT 45 are grown by the farmers in Tamil Nadu. The gross cropped area in Tamil Nadu is around 58.43 lakh hectares of which gross irrigated area is 33.09 lakh hectares which is 57 per cent and the remaining 43 per cent of area are under rainfed cultivation (Thiyagarajan and Kalaiyarasi, 2013).

Increasing the productivity of the crop with the in-built tolerance to biotic and abiotic stresses remains always a challenging task for plant breeders. Plant breeders devote constant efforts for development of better varieties in crops to face and adopt the present crop situations. It is necessary to enhance the yield strata and narrow the yield gap for further increase in rice productivity. In Tamil Nadu, bold rice segment is being subjugated by ASD 16 in the short duration group which was released in 1980's that shows lesser buffering capacity to the present climate change and cropping situations. This necessitates identifying suitable replacement for ASD 16 that circumvent the stagnancy in productivity besides holding the key traits of the old variety. Under this context, efforts were made at Agricultural Research Station, Thirupathisaram of Tamil Nadu Agricultural University, to evolve high yielding, non-lodging rice variety having non-shattering bold grain type with resistance to major pests and diseases.

Materials and methods

Rice TPS 5, a non-lodging short bold grain variety, was evolved at Agricultural Research Station, Thirupathisaram. It is the cross between two popular and versatile varieties, ASD 16 and ADT 37. Desirable plants bearing high yield and non-lodging traits were selected in F_2 and advanced further to F_3. In F_3 to F_4, the progeny rows were evaluated for their sustained performance, homozygosity and the culture TP 08010 was identified as the best. The culture, TP 08010 was confirmed for its superiority after it was evaluated under various yield trials *viz.*, Multi location trial (MLT), Adaptive research trial (ART) , AICRP trials *viz*., Initial varietal trial (IVT), Advanced varietal trial (AVT) (Figure 1) and On Farm Trials (OFT's) besides, the reaction of the culture against major pests and diseases was also studied. The milling and cooking qualities of this culture was also assessed based on standard evaluation system and consumer acceptability. Thus, the culture TP 08010 was finally selected and released as Rice TPS 5 during 2014.

Results and discussion

Performance of Rice TPS 5 (TP 08010 culture) over different trials : Rice TPS 5 (TP 08010 culture) recorded a mean grain yield of 6377 Kg/ha over 4 years of station trials conducted during 2007 to 2011 with 14.7 per cent yield improvement

over ASD16 (Table 2). In Multi Location Trials (MLT) conducted at 10 locations during 2009-10, it ranked second with the mean grain yield of 6315 Kg/ha, which was 15 per cent higher than ASD16 (5495 Kg/ha) and ADT 43 (5497 Kg/ha) and 4 per cent increased over ADT 45 (6071 Kg/ha) (Table 3).

Based on its performance in MLT, TP 08010 was promoted to evaluate in Adaptive Research Trials (ART) during 2010-11 in 12 districts (33 locations), of which the culture out yielded the check ASD 16 (4.74 per cent higher yield) in 7 districts. During 2011-12, the culture tested in 10 districts and it out yielded the check ASD 16 (5847vkg/ha) in 6 districts. It recorded a mean grain yield of 5937 Kg/ha in 44 locations which was on an average 11.4 per cent higher than ASD16 (Tables 4 & 5). In AICRIP, the rice culture TP 08010 ranked fifth among forty three entries tested under AICRIP trials during Kharif 2011 (Table 6).

On Farm Trials (OFT's) were conducted with TP 08010 during 2010-11 in 7 locations. It recorded a mean grain yield of 5945 Kg/ha which was 17.3 per cent higher than ASD 16. During late *Pisanum* season, OFT was conducted in three farmers holdings and TP 08010 have shown superiority over local check (ASD 16). Further, during *Kumbapoo* 2011 in 52 farmers holdings performance of this culture was assessed through the OFT's. Farmers were very much impressed on the performance and harvested on an average of six tonnes per ha.

Grain quality: The rice culture, TP 08010 has short bold grain type with good milling percentage (67.5%) and head rice recovery (58%). It has intermediate amylose and gelatinization temperature and soft gel consistency which are the desirable traits for good cooking quality (Table 8).

Reaction to pests and diseases: The culture, TP 08010 was evaluated at Coimbatore, Madurai and Aduthurai against major pests and diseases of rice. It was found to be resistant to BPH (Score-1), WBPH (Score-1) and moderately resistant to yellow stem borer (Score -3). It was also found to be moderately resistant the Blast (Score-5), Sheath rot (Score-5) sheath blast (Score-5) (Table 7).

Morphological features of Rice TPS 5 (TP 08010)

Characters	Specification of TPS 5 (TP 08010)
Early plant vigour	Good
Coleoptile colour	Green
Basal leaf sheath colour	Green
Leaf sheath colour	Green
Leaf blade colour	Green
Leaf pubescence	Intermediate
Leaf length	45.0-48.0 cm
Leaf width	2.00 cm
Days to 50% flowering	85-90 days
Panicle exertion	Well-exerted panicle
Stigma colour	White
Apiculus colour	Light Green
Number of effective tillers	15-20
Plant height (cm)	100 -110 cm
Panicle length (cm)	24-30 cm
No. of Grains/panicle	250 - 300
Panicle type	Long, compact, droopy
Awning	absent
Days to maturity (days)	118 days
Seed coat (Kernel) colour	White
Junction of auricle	light green
1000 grain weight (g)	22.7 g
Hull (husk) colour	Straw
Thresh ability	Good
Aroma	Absent
Grain yield per plant (g)	65-85 g
Grain	short bold
LxB	6.0 x 2.6 mm
L / B ratio	2.3mm
Rice grade	Short bold
Milled rice colour	White
Abdominal white	Occasionally present

Based on the improved performance over the check variety ASD 16 and versatile features of this new rice culture TP 08010, it was released by Tamil Nadu Agricultural University as a new variety TPS 5 for general cultivation in Tamil Nadu during *Kar* and late *Pishanam* season except Ramanathapuram, Sivagangai and Nilgris Districts.

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Table 1. Performance of TP 08010 in different trials

Trial	Total locations	TP 08010	ASD 16	ADT 43	TPS 3
Agricultural Research Station, Thirupathisaram (2007-2010)	4	6377	5559	-	-
Multi-location trials MLT II (2009-10)	10	6315	5495	5497	-
OFT	69	6598	5269	-	5153
ART	77	6038	5554	5839	-
Avg. performance	183	6301	5419	5592	5153
% Increase over			13.21	10.14	18.21

Table 2. Yield Performance of TP 08010 in Station Trials, at Agricultural Research Station, Thirupathisaram (2007 to 2010)

S.NO	Name of the Trial	Grain Yield (Kg/ha)		
		TP 08010	Check	
			ASD16	ADT 45
1	IYT (2007 Kharif)	5980	5120	5228
2	PYT (2008 Kharif)	6750	5995	5800
3	AYT (2009 Kharif)	6970	6111	6161
4	AYT (2010 Kharif)	5809	5010	5333
	Mean	6377	5559	5630
	% increase over		14.7	13.2

Table 3. Performance of TP 08010 in MLT 2009-10

Station	Grain Yield (Kg/ha of TP 08010 and Check)			
	TP 08010	ASD16	ADT43	ADT45
Aduthurai	5973	5195	4565	5510
Ambasamudram	7953	5719	6496	8023
Coimbatore	6899	NT	5499	6881
Madurai	4833	5139	4806	4889
Thanjavur	5600	6800	7800	7800
Trichy	8000	NT	6042	5000
Pondicherry	5404	5066	4876	4971
Tirur	5336	5052	4319	4752
Thirupathisaram	6838	NT	5075	6811
Mean	6315	5495	5497	6071
Per cent Increase	-	15	15	4

Table 4. Abstract of the performance of TP 08010 in Adaptive Research Trial: Rice 03/10-11

S.No	District	TP 08010	ASD 16	ADT 43	% Increase over
1	Thiruvallur (4)	5858	4823	4994	17.6 (ASD 16) 14.8(ADT 43)
2	Cuddalore(5)	7176	5560	5738	22.5 (ASD16) 20.2 (ADT 43)
3	Kanyakumari (2)	7700	7450	7000	3.24(ASD 16) 9.09 (ADT 43)
4	Madurai (2)	4441	4859	4930	
5	Trichy (3)	6627	6373	8000	3.82 (ASD16)
6	Perambalur (2)	4925	4775	4245	3.04 (ASD16) 11.09 (ADT 43)
7	Theni (2)	7515	6710	7250	10.71 (ASD 16) 3.52 (ADT 43)
8	Thiruvarur (2)	6458	6142	6990	4.88(ASD16)
9	Karur (5)	5227	5115	5470	2.2 (ASD16)
10	Tirunelveli (3)	7140	7060	7200	1.12 (ASD16)
11	Nagapattinum (3)	4110	3933		4.30 (ASD16)
12	Pudukottai (1)	5980	-	5660	
	Mean over districts (33)	6138	5847	6070	4.74(ASD16) 1.11(ADT43)

Table 5. Abstract of performance of TP 08010 in Adaptive Research Trial: Rice 03/11-12

Sl.No.	District	TP 08010	ASD 16	ADT 43	% Increase over
1	Kanyakumari (5)	7183	6618	5519	7.8 (ASD16) 23.16 (ADT 43)
2	Trichy (3)	5545	-	5685	-
3	Thiruvarur (4)	4755	4033	4308	15.2 (ASD16) 9.4 (ADT43)
4	Karur (5)	5630	5485	5462	2.6 (ASD16) 3.0 (ADT 43)
5	Tirunelveli (5)	5465	5196	6486	5.2 (ASD16)
6	Pudukottai (2)	4525	5041	4441	1.9 (ADT 43)
7	Coimbatore (5)	6078	6155	5855	3.8 (ADT 43)
8	Dharamapuri (5)	6672	6273	6792	5.8 (ASD16)
9	Cuddalore (5)	4880	4947	5042	-
10	Namakkal (5)	8630	8854	6492	24.7 (ADT 43)
	MEAN (44)	5937	5260	5608	11.4 (ASD16) 5.5 (ADT 43)

Table 6. Grain yield (Kg/ha) of entries in Initial Variety Trial - Early- DS(Normal rain), Kharif 2011-AICRIP trial (Anonymous, 2012)

Designation	IET No	Locations									
		CRRI Orissa	Pusa Bihar	Ranchi Jharkhand	Hazaribagh Jharkhand	Masodha UP	Raipur Chattisgarh	Jagdalpur Chattisgarh	Derol Gujarat	Mugad Karnataka	Mean
TP 08010	22808	1769	7667[2]	951	1458	3500[6]	4188[5]	3627	2619[9]	5521	3794[5]
Local check	*	2609	4167	1427	1979	2555	2313	2331	2047	6283	3035
Regional check	**	2906	4000	1834[4]	2049	3110	2375	2962	2606	4985	3124
National check	Sahbhagidhan	2049	6833[3]	1766[6]	2639[4]	2835	3125	5527[2]	2858[4]	5298	3896[3]

Rank in the location given in superscript

*Local check: Sahabhagi dhan, saro, BVD109, Sadabahar, Narndra 97, Inirabarani Dhan1, JDP377, AAUDR1, MGD101

**Regional check : Govind - NW; NDR92- E; Tulasi- E&W)

Table 7. Reaction of TP 08010 culture to major insect pest of rice under field condition

Station	Culture/Check Varieties	Pests						Diseases	
		Gall Midge		Stem Borer		BPH	Leaf folder		
		% Silver Shoot	Grade	% dead Heart	% White ear	No./Hill	% Leaf damage	Blast	Sheath Rot
Madurai	TP 08010	0.6	1.0	1.97		2.83			
Aduthurai		-	-	4.76	3.75	5.0	2.14		
Thirupathisaram	TP 08010	-	-	0.6	1.0	Nil	1.97		
	ASD 16	-	-	2.3	1.2	Nil	3.1		
Coimbatore	TP 08010	-	-	-	-	-	-	5	5
	ASD 16	-	-	-	-	-	-	8	9
	ADT 43	-	-	-	-	-	-	8	9
	ADT 45	-	-	-	-	-	-	6	7
Madurai	TP 08010	-	-	-	-	-	-	-	5
	ASD 16	-	-	-	-	-	-	-	7
	ADT 43	-	-	-	-	-	-	-	5
	ADT 45	-	-	-	-	-	-	-	7

Table 8. Grain quality of TP 08010

a. Milling, Grain and Cooking quality traits

	Trait	TP 08010	ADT(R)45	ASD 16
Milling quality traits	Hulling %	80.0	72.5	74.5
	Milling %	67.5	60.0	59
	Head Rice Recovery %	58.0	51.0	50.2
Physical grain quality traits	Kernal Length (mm)	6.0	6.0	5.4
	Kernal Breadth (mm)	2.6	2.0	2.4
	LB ratio	2.3	3.0	2.2
	Grain type	SB	MS	SB
	KLAC (mm)	8.9	8.9	9.5
	KBAC (mm)	3.2	2.9	3.7
Cooking quality traits	LER	1.46	1.48	1.75
	BER	1.18	1.45	1.54
	VE(ml)	4.0	4.0	4.0
	GT	Intermediate to high	Intermediate to high	Intermediate to high
	GC	Soft	Soft	Soft
	Alkali Spreading Value	5	4	5

b) Biochemical properties of TP 08010

Traits	TP 08010	ADT (R) 45	ASD16
Amylose content (%)	24.00	24.16	23.12

(Mean of tests conducted at AC&RI, Killikulam)

c) Organo-leptic evaluation of cooked rice

Details	TP 08010	ADT (R) 45	ASD16
Colour and appearance	7	7	7
Flavour	8	7	7
Texture	7	7	7
Taste	8	7	7
Overall acceptability	8	7	7

(Maximum score = 10); Test Conducted at AC&RI, Killikulam

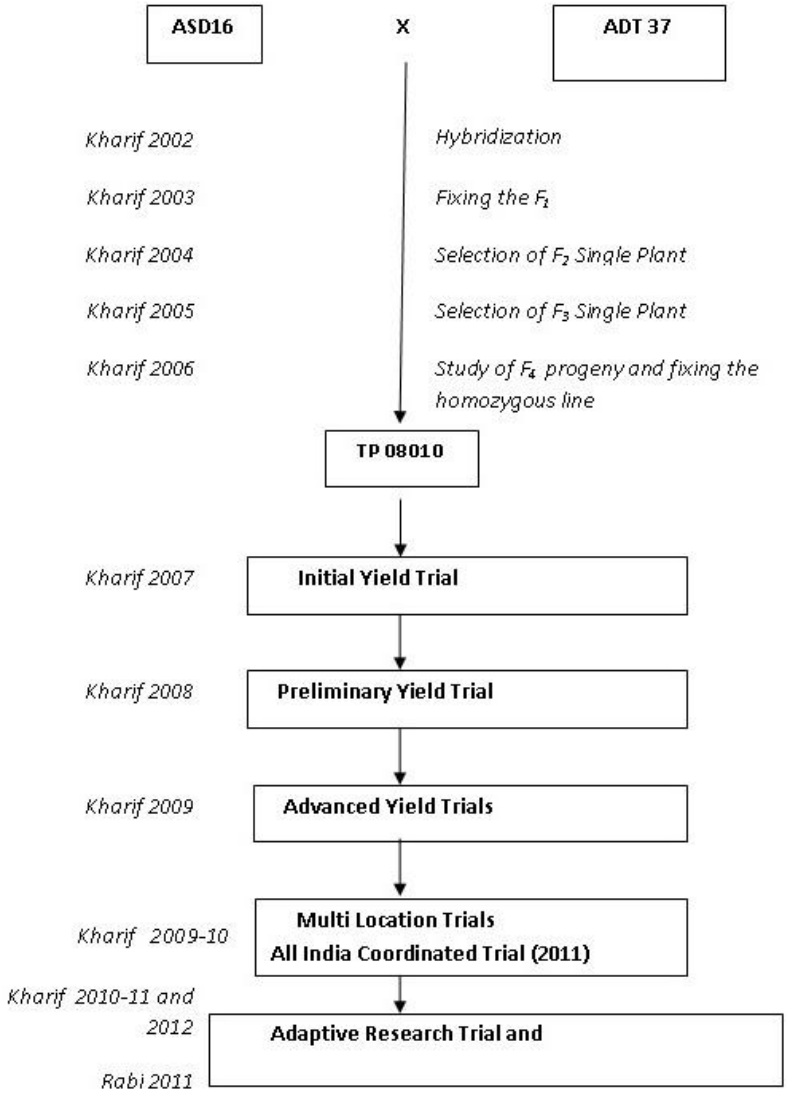

Figure 1. Pedigree Chart of TP 08010