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Stability analysis of quality traits in rice hybrids

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ABSTRACT

Fifty two hybrid combinations were evaluated for yield and yield contributing characters over four different agro-climatic zones in Andhra Pradesh, India during dry season 2010-11. Eighteen promising hybrids from all locations viz., Maruteru, Warangal, Jagtial and Ragolu which recorded significant higher yield than check were subjected to analysis for eleven quality characters. The analysis of variance of Eberhart and Russell model indicated the genotypes and environments were significant for all the quality characters except for milling per cent for genotypes indicating the diversity among the genotypes and environments studied. The GE interaction was significant only for head rice recovery, water uptake and kernel elongation ratio and non-significant for remaining characters. The high yielding hybrid APMS 9A x MTU II-143-26-2 was stable for head rice recovery and kernel elongation ratio while APMS 10A x MTU 1071 was stable for kernel elongation ratio, alkali spreading value and amylose content.

Key words: *rice hybrid, Eberhart and Russell model, GxE interaction, stability parameters*

With the enhanced income levels and changing food habits, breeding rice varieties with preferred grain quality features has become the second most important objective after yield. To meet the market and consumer requirements, milling and cooking quality characteristics are also to be improved. Quality characters are important in varietal development and subsequent adoption at the farm level. Grain quality attributes vary among varieties and production environments. So understanding gene expression in different environments is necessary for improving rice cooking quality traits. Dalvi *et al.* (2007), Panwar *et al.* (2008) and Waghmode and Mehta (2011) reported the existence of GE interaction for quality traits of rice. The present study was undertaken to investigate the influence of genotype x environment interaction on grain quality attributes in rice hybrids.

MATERIAL AND METHODS

The experimental material comprised of 52 rice hybrids combination along with three checks [(*viz*., MTUHR 2089 (hybrid check), MTU 1075 and MTU 1010 (varietal checks)] were evaluated at four different agro-climatic zones *viz.,* Regional Agricultural Research Station, Maruteru, Warangal, Jagtial and Agricultural Research Station Ragolu, Andhra Pradesh during dry season 2010-11. Twenty eight days old seedlings were planted at the rate of one seedling hill^{-1} with a spacing of 20 x15 cm in a randomized block design with two replications at all the locations. Eighteen promising hybrids from all locations which recorded significant higher yield than high yielding check MTU 1075 were subjected to analysis for eleven quality characters (physico- chemical) *viz.,* hulling per cent (H%), milling per cent (M%), head rice recovery (HRR%), L/B ratio, water uptake (WU), volume expansion ratio (VER), kernel elongation ratio (KER), gel consistency (GC), alkali spreading value (ASV), amylose content (AC) and protein content (PC). Physico-chemical characters were recorded by standard evaluation methods (DRR 2006). The biochemical quality parameters *viz.,* gel consistency, alkali spreading value, amylose content and protein content were estimated by using standard evaluation methods of Cagampang *et al.* (1973), Little *et al*. (1958), Juliano (1971) and Piper (1966), respectively. Quality analysis data of hybrids and checks from four locations were subjected to pooled stability analysis as per Eberhart and Russell (1966). The genotype with high mean, unit regression coefficient and non-significant deviation from regression was considered to be stable over environments. If b_i was equal to unity, a genotype was considered to have average stability (same performance in all the environments). If b_i was more than unity, it was suggested to have less than average stability (good performance in favourable environments) and if b_i was less than unity, it was reported to have more than average stability (good performance in poor environments).

RESULTS AND DISCUSSION

Analysis of variance of stability revealed that the genotypes and environments were significant for all the quality characters except for milling percentage indicating the diversity among the genotypes and environments studied (Table 1). The GE interaction was significant only for head rice recovery, water uptake and kernal elongation ratio and non significant for the remaining characters. Significant variation due to environment (linear) was observed for all the eleven quality characters revealing the linear contribution of environmental effects and additive environment variance on these characters. Similar results were reported by Dalvi *et al.* (2007) for L/B ratio, Panwar *et al.* (2008) for hulling per cent, milling per cent and head rice recovery per cent, and Waghmode and Mehta (2011) for milling per cent, head rice recovery per cent, L/B ratio, protein and amylose content. The mean sum of squares for pooled deviation was significant for all the characters indicating the non–linear response and unpredictable nature of the genotypes by significantly differing for stability. Significant non-linear responses were observed by Dalvi *et al.* (2007) for L/B ratio and protein content, Panwar *et al.* (2008) for hulling per cent, milling per cent and head rice recovery per cent and Waghmode and Mehta (2011) for milling per cent.

For hulling per cent none of the hybrids recorded regression value around unity. Only one hybrid APMS 9A x MTU II -187-6-1-1 exhibited high mean with b_i value close to unity (0.93) and non-significant s^2d_i for milling per cent exhibiting average stability. Head rice recovery is most important among milling indices, as the economic value of the rice is determined by percentage of unbroken rice kernel. Two hybrids *viz.,*

Table 1. Analysis of variance for stability performance of quality characters in rice.

Source	d.f.	H%	M%	HRR%	L/B	WU	VER	KER	GC	ASV	AC	PC
Genotypes	20	4.88*	5.87	37.30**	0.07**	7184.47 **	0.49**	0.04**	269.61 **	2.95**	3.18**	0.23 **
Environments	3	18.04**	22.75 **	949.92**	0.02*	659.61**	0.57*	0.06**	191.40 **	0.45**	11.35**	3.93 **
Env.+ (Geno. x Env.)	63	3.52	4.66	61.12**	0.01	203.64	0.18	0.01*	38.66	0.08	1.29*	0.28 **
Genotypes × environment	60	2.79	3.76	16.68*	0.01	180.85	0.16	0.01	31.02	0.06	0.79	0.10
Environment (linear)	1	54.13**	68.25 **	2849.75**	0.05**	1978.82**	1.72**	0.17**	574.19 **	1.36**	34.05**	11.79 **
Genotypes ×environment (linear)	20	3.05	1.86	32.33**	0.00	259.53*	0.18	0.01*	21.77	0.06	0.80	0.09
Pooled deviation	42	2.54**	4.48 **	8.44**	0.01**	134.76**	0.14**	0.01**	33.95 **	0.06**	0.74**	0.09 **
Pooled error	80	1.25	1.04	1.26	0.00	21.83	0.04	0.00	6.92	0.01	0.30	0.01

H%= Hulling per cent, M%= Milling per cent, HRR% =Head rice recovery%, L/B = Length/Breadth, WU= Water uptake, VER= Volume expansion ratio, KER= Kernel elongation ratio, GC= Gel consistency, ASV= Alkali spreading value, AC= Amylose content, PC= Protein content

Table 2. Stability parameters for quality characters as per Eberhart and Russell model in promising hybrids with checks in rice

Hybrids	Code	H%			M%			HRR%			L/B ratio			WU			VER		
			b_i	S^2d_i	$\overline{X}$	b_i	S^2d_i	$\overline{X}$	b_i	S^2d_i	$\overline{X}$	b_i	S^2d_i	$\overline{X}$	b_i	S^2d_i	$\overline{X}$	b_i	S^2d_i
APMS 6A xMTU II-110-9-1-1-1-1	A_1R_3	77.13	1.14	1.22	67.25	1.34	-0.45	56.75	0.60	1.18	2.95	2.93	0.00	106.88	-0.14	-14.12	3.90	0.30	-0.02
APMS 6A xMTU II -187-6-1-1	A_1R_5	77.88	1.35	-0.95	67.63	1.35	-0.28	51.88	1.48	2.91	3.17	3.47	0.01	130.00	0.67	7.11	4.47	0.24	-0.03
APMS 6A xMTU II-143-26-2	A_1R_7	78.13	1.96	-0.82	67.88	1.24	2.93	53.75	1.72	0.03	3.11	0.76	0.00	110.00	0.87	17.56	4.30	0.34	-0.01
APMS 6A xMTU II-283-7-1-1	A_1R_{12}	75.75	0.44	-0.33	66.88	0.39	2.69	53.38	1.38	0.43	3.06	0.87	0.02	101.88	-0.26	-10.22	4.25	3.64	0.48
APMS 9A xMTU 1071	A_2R_1	75.63	2.48	2.47	64.50	1.32	17.76	56.38	0.88	4.55	3.13	1.84	0.00	189.38	7.07	276.29	4.39	-0.50	-0.01
APMS 9A xMTU II-110-9-1-1-1-1	A_2R_3	76.50	3.69	0.45	66.88	2.46	6.86	58.13	0.68	4.74	3.08	2.67	0.00	110.00	0.36	47.09	4.09	0.50	0.13
APMS 9A xMTU II-110-11-1-1-1-6	A_2R_4	76.88	1.35	9.55	67.75	0.65	7.54	57.25	0.64	-1.19	3.03	-0.42	0.00	150.63	1.80	27.17	4.26	0.77	0.23
APMS 9A xMTU II -187-6-1-1	A_2R_5	77.25	1.89	1.32	68.00	0.93	-0.80	56.38	0.62	2.18	3.12	-0.32	0.00	108.75	-0.32	-17.35	4.01	1.97	0.11
APMS 9A xMTU II-143-26-2	A_2R_7	77.63	1.31	-0.59	67.75	1.19	-0.83	55.75	1.03	3.65	2.90	0.83	0.01	161.38	1.94	229.50	4.65	3.27	0.15
APMS 9A x MTU II-283-7-1-1	A_2R_{12}	77.13	-0.04	5.88	68.63	-1.15	19.57	55.13	1.05	7.86	3.17	-0.12	0.01	109.38	1.17	116.13	4.05	2.75	0.16
APMS 10A x MTU 1071	A_3R_1	78.75	1.87	-0.34	69.13	1.41	-0.52	54.63	0.77	5.71	3.04	1.43	0.00	173.75	0.68	22.15	4.69	-0.23	0.11
APMS 10A x MTU II -187-6-1-1	A_3R_5	78.63	0.66	-0.92	68.50	0.38	-1.13	53.13	1.16	7.68	3.08	1.74	0.00	163.13	1.68	41.55	4.55	0.47	-0.03
APMS 10A xMTU II-190-1-1-1-1-1	A_3R_6	77.63	0.50	0.06	68.25	0.37	0.26	49.00	1.23	44.52	2.76	0.18	0.00	130.00	-0.11	302.61	5.00	2.60	0.37
APMS 10A x MTU II-143-26-2	A_3R_7	77.88	-0.26	-0.70	67.50	0.07	-0.65	47.50	1.05	27.56	2.92	0.26	0.00	228.13	1.30	682.06	5.30	4.24	0.22
APMS 10A x MTU II-290-42-1	A_3R_{10}	77.25	-0.39	0.72	65.13	1.50	2.31	48.75	1.16	18.41	3.09	0.36	0.00	178.13	2.24	163.01	4.32	1.75	0.21
APMS 10A x MTU II-283-7-1-1	A_3R_{12}	78.25	-0.09	0.16	67.00	1.09	4.17	52.13	1.79	3.96	3.01	0.26	0.00	168.75	0.41	254.77	3.97	-0.34	0.05
IR 58025A xMTU II-110-9-1-1-1-1	A_4R_3	75.88	2.00	-0.53	66.38	2.20	1.58	51.13	1.43	-0.81	3.33	0.87	0.00	159.38	1.17	116.13	4.00	-0.41	0.02
IR 58025A xMTU II-190-1-1-1-1-1	A_4R_6	75.38	-0.40	9.68	66.88	0.75	3.52	49.50	1.60	3.47	3.24	-0.26	0.00	216.25	-1.22	67.75	4.31	-0.26	0.05
MTUHR 2089		74.63	1.33	-0.90	64.75	1.02	1.53	50.38	-0.18	2.18	3.11	-0.37	0.03	156.25	-0.14	11.63	4.50	0.00	-0.04
MTU 1075		76.75	-0.24	0.85	67.00	1.03	-1.11	53.88	0.41	2.57	3.14	2.03	0.00	151.88	0.05	17.89	4.34	-0.68	-0.02
MTU 1010		77.38	0.45	1.62	66.75	1.44	5.10	54.38	0.50	8.17	2.90	1.98	0.00	253.75	1.78	12.54	4.06	0.57	-0.03
General mean		77.06			67.16			53.29			3.06			155.13			4.35		

Table 2 contd.

Table 2 contd.

Hybrids	KER			GC			ASV			AC			PC		
	$\overline{X}$	b_i	S^2d_i	$\overline{X}$	b_i	S^2d_i	$\overline{X}$	b_i	S^2d_i	$\overline{X}$	b_i	S^2d_i	$\overline{X}$	b_i	S^2d_i
APMS 6A x MTU II-110-9-1-1-1-1	1.67	2.22	0.02	75.25	-0.35	62.33	2.20	0.19	0.00	24.75	-0.20	1.97	8.25	2.07	0.14
APMS 6A x MTU II -187-6-1-1	1.68	0.61	0.00	74.75	1.17	-4.60	2.38	0.08	0.00	23.47	0.76	0.72	8.54	0.83	-0.01
APMS 6A x MTU II-143-26-2	1.65	1.73	0.00	70.09	1.33	-2.78	2.33	0.45	0.04	24.08	1.80	0.04	8.48	1.10	0.12
APMS 6A x MTU II-283-7-1-1	1.86	0.64	0.00	82.49	-0.48	16.42	2.18	0.48	0.00	25.28	1.95	0.01	8.20	0.77	0.01
APMS 9A x MTU 1071	1.75	-0.72	0.01	65.00	0.58	0.81	2.87	2.63	0.44	25.69	-0.15	-0.21	8.07	0.59	0.15
APMS 9A x MTU II-110-9-1-1-1-1	1.71	-1.32	0.00	66.38	0.88	-2.27	2.16	0.94	0.01	23.67	0.92	0.37	8.27	0.91	0.17
APMS 9A x MTU II-110-11-1-1-1-6	1.75	0.04	0.00	82.13	1.21	5.87	2.20	1.17	0.01	23.91	1.01	-0.26	8.40	0.43	0.08
APMS 9A x MTU II -187-6-1-1	1.75	2.10	0.00	75.50	-0.30	88.59	2.08	0.48	0.00	23.37	1.40	0.03	7.91	0.67	0.03
APMS 9A x MTU II-143-26-2	1.81	1.00	0.01	66.97	1.54	-7.14	2.86	0.57	0.05	24.65	0.58	-0.09	8.03	0.90	0.00
APMS 9A x MTU II-283-7-1-1	1.82	1.69	0.00	69.38	1.89	14.84	2.16	0.71	0.00	25.10	1.85	0.54	8.09	1.16	0.03
APMS 10A x MTU 1071	1.90	1.02	0.00	73.63	1.34	-5.42	4.18	0.94	0.05	24.14	0.85	-0.12	8.57	1.54	0.15
APMS 10A x MTU II -187-6-1-1	1.82	1.76	0.01	72.63	-0.45	73.96	3.09	3.77	0.06	23.77	1.24	0.51	8.04	1.08	0.09
APMS 10A x MTU II-190-1-1-1-1-1	1.94	1.65	0.00	72.75	0.95	-5.37	2.54	0.31	0.28	24.15	1.90	2.76	8.11	1.17	0.07
APMS 10A x MTU II-143-26-2	1.87	-0.28	0.01	68.25	1.56	64.80	4.29	0.82	0.09	24.37	0.76	0.14	7.99	0.83	0.02
APMS 10A x MTU II-290-42-1	1.76	-0.54	0.00	44.25	1.50	-4.72	4.22	0.36	0.00	24.16	1.72	0.45	7.86	0.95	0.11
APMS 10A x MTU II-283-7-1-1	1.96	1.28	0.00	82.25	-0.11	29.80	3.62	0.11	0.03	24.17	0.68	-0.26	8.36	0.26	-0.01
IR 58025A x MTU II-110-9-1-1-1-1	1.64	4.57	0.00	79.00	2.28	14.00	2.28	0.67	0.02	23.26	1.54	0.59	7.98	1.54	0.07
IR 58025A x MTU II-190-1-1-1-1-1	1.92	1.47	0.01	76.25	1.39	143.96	4.19	0.67	0.02	23.97	-0.12	0.64	8.13	1.14	-0.01
MTUHR 2089	1.77	0.49	0.00	77.00	2.49	44.95	2.88	1.62	0.00	24.54	0.12	0.00	7.73	1.33	0.43
MTU 1075	1.76	0.45	0.00	70.70	0.76	26.20	2.88	1.62	0.00	23.88	0.71	1.10	8.21	0.73	0.03
MTU 1010	1.73	1.17	0.00	70.38	1.82	8.59	4.61	2.42	0.05	21.28	1.68	0.55	8.58	0.99	0.01
General mean	1.79			72.14			2.96			24.08			8.18		

$\overline{X}$ = mean, b_i = regression coefficient, S^2d_i = deviation from , H%= Hulling per cent, M%= Milling per cent, HRR% =Head rice recovery%, L/B = Length/Breadth, WU= Water uptake, VER= Volume expansion ratio, KER= Kernel elongation ratio, GC= Gel consistency, ASV= Alkali spreading value, AC= Amylose content, PC= Protein content

APMS 9A x MTU II-143-26-2 (b_i=1.03) and APMS 9A x MTU II-283-7-1-1 (b_i=1.05) were recorded to have mean higher than grand mean, b_i values around unity and non significant s^2d_i values for head rice recovery per cent (Table 2). Dalvi *et al.* (2007) and Waghmode and Mehta (2011) recorded stable hybrids for milling per cent and head rice recovery. Panwar *et al.* (2008) reported ideal genotypes with general adaptability for hulling per cent.

The hybrid IR 58025A x MTU II-110-9-1-1-1-1 (b_i=0.87) possessed average stability for L/B ratio with b_i value around unity and zero s^2d_i whereas two hybrids, APMS 9A x MTU II-143-26-2 (b_i=1) and APMS 10A x MTU 1071 (b_i=1.02) showed unit regression coefficient values (b_i=1) with above grand mean and non-significant deviation from linearity (s^2d_i=0) for kernel elongation ratio, reveals the stability of genotypes across environments. Similar findings of stable hybrids were reported by Dalvi *et al.* (2007) and Waghmode and Mehta (2011) for L:B ratio.

Gel consistency gives softness of rice and soft to medium gel consistency is preferred one by most of the rice consumers (Siddiq, 1992). For this trait average stability exhibited by APMS 10A x MTU II-190-1-1-1-1-1 hybrid with high mean, b_i value (b_i=0.95) around unity and non significant s^2d_i value while, APMS 10A x MTU 1071 hybrid recorded regression value around unity (0.94) with above general mean and non-significant deviation from regression for alkali spreading value and was found to be stable under four environments. Amylose content of rice determines the hardness or stickiness of cooked rice. Average stability for this trait was possessed by APMS 9A x MTU II-110-11-1-1-1-6 (b_i=1.01) and APMS 9A x MTU II-110-9-1-1-1-1 (b_i=0.92) hybrids with low mean than general mean and regression value around unity with predictable performance. One hybrid APMS 9A x MTU II-110-9-1-1-1-1 (b_i=0.91) and check MTU 1010 (b_i=0.99) registered regression values around unity with above grand mean and predictable performance for protein content and were found to be stable over locations. Waghmode and Mehta (2011) reported stable hybrids for amylose content and protein content whereas Dalvi *et al.* (2007) found hybrids with average stability for the trait protein content.

Environmental index (I_j) reveals the suitability of an environment. Based on the positive values of environmental index for grain yield. Maruteru (I_j=5.06) and Warangal (I_j=4.66) locations were found to be most suitable environments compared to Jagtial (I_j=2.56), while Ragolu (I_j= -12.28) location was poor in performance. Six hybrids each were adapted to favourable (better condition) and unfavourable (poor condition) environments for hulling per cent. For milling per cent, five hybrids each specifically adapted to better and poor environment conditions, whereas for head rice recovery per cent two and six hybrids where found to be ideal under favourable and unfavourable environments, respectively. For the trait L/B ratio four hybrids were suitable under favourable environments and five hybrids for unfavourable environments (Table 3). Panwar *et al.* (2008) and Waghmode and Mehta (2011) also reported genotypes to favourable and unfavourable environments for these traits.

Six hybrids were found to be adapted in better condition while three hybrids in poor conditions for water uptake. For volume expansion ratio, three hybrids were suitable to favourable and four hybrids for unfavourable environments. Whereas five hybrids were found to be ideal under favourable environment and two hybrids were suitable to unfavourable environment for kernel elongation ratio. With regards to gel consistency, it was observed that five hybrids were found to be highly responsive under favourable environment whereas four hybrids were found to be ideal for unfavourable environment. One hybrid was ideal in favourable environment for alkali spreading value and four hybrids were adapted in unfavourable environment for this trait. Two hybrids were suitable under better environment for amylose content, while three hybrids recorded ideal performance under unfavourable environment. For protein content, three hybrids were found to be specifically adapted to better environment while four hybrids were suitable to poor environments. Similar findings of genotypes to favourable and unfavourable environments for the traits *viz.,* amylose content and protein content were also reported by Panwar *et al.* (2008) and Waghmode and Mehta (2011).

The hybrid, APMS 9A x MTU II-143-26-2 with high yield was stable for head rice recovery and kernel elongation ratio while APMS 10A x MTU 1071 had stable performance for kernel elongation ratio, alkali spreading value and amylose content. From the present

Table 3. Stable hybrids for quality characters as per regression model of Eberhart and Russell in rice

Character	Stable performance	Favourable environment	Poor environment
Hulling per cent	—	A_1R_3, A_2R_7, A_1R_5, A_3R_1, A_2R_5 andA_1R_7	A_3R_5, A_3R_6, A_2R_{12}, A_3R_{12}, A_3R_7 A_3R_{10} and checks MTU 1010 and MTU 1010
Milling per cent	A_2R_5	A_2R_7, A_1R_7, A_1R_3, A_1R_5 and A_3R_1	A_2R_4, A_3R_5, A_3R_6, A_3R_7 and A_2R_{12}
Head Rice Recovery per cent	A_2R_7 and A_1R_{12}	A_1R_{12} andA_1R_7	A_2R_1, A_3R_1, A_2R_3, A_2R_4, A_1R_3, A_2R_5 and checks MTU 1075 and MTU 1010
L/B Ratio	A_4R_3	A_3R_5, A_2R_1, A_2R_3, A_1R_5 and check MTU 1075	A_1R_7, A_3R_{10}, A_2R_5, A_2R_{12} and A_4R_6 and check MTUHR 2089
Water uptake	—	A_4R_3, A_3R_7, A_3R_5, A_2R_7, A_3R_{10}, A_2R_1 and check MTU 1010	A_3R_1, A_3R_{12}, A_4R_6 and check MTUHR 2089
Volume expansion ratio	—-	A_3R_6, A_2R_7 and A_3R_7	A_3R_5, A_1R_5, A_3R_1, A_2R_1 and MTUHR 2089
Kernal elongation ratio	A_2R_7 and A_3R_1	A_3R_{12}, A_4R_6, A_3R_6, A_2R_{12} and A_3R_5	A_1R_{12} and A_3R_7
Gel consistency	A_3R_6	A_1R_5, A_2R_4, A_3R_1, A_4R_6, A_4R_3 and check MTUHR 2089	A_2R_5, A_1R_3, A_3R_5 and A_1R_{12}
Alkali spreading value	A_3R_1	A_3R_5 and check MTU1010	A_3R_7, A_4R_6, A_3R_{10} and A_3R_{12}
Amylose content	A_2R_4 and A_2R_3	A_3R_5, A_2R_5, A_4R_3 hybrids and check MTU 1010	A_2R_4, A_1R_5, A_4R_6 and check MTU 1075
Protein content	A_2R_3 and MTU 1010	A_1R_7 A_3R_1 and A_1R_3	A_1R_5, A_1R_{12}, A_2R_4 , A_3R_{12} and check MTU 1075

A_1R_3-APMS 6A xMTU II-110-9-1-1-1-1
A_1R_{12} -APMS 6AxMTU II-283-7-1-1
A_2R_4-APMS 9AxMTU II-110-11-1-1-1-6
A_2R_{12}-APMS 9AxMTU II-283-7-1-1
A_3R_6-APMS 10A xMTU II-190-1-1-1-1-1
A_3R_{12}-APMS 10AxMTU II-283-7-1-1
A_1R_5-APMS 6AxMTU II -187-6-1-1
A_2 R_1-APMS 9AxMTU 1071
A_2R_5 -APMS 9A xMTU II -187-6-1-1
A_3R_1-APMS 10AxMTU 1071
A_3R_7-APMS 10AxMTU II-143-26-2
A_4R_3-IR 58025AxMTU II-110-9-1-1-1-1
A_1R_7 -APMS 6AxMTU II-143-26-2
A_2 R_3-APMS 9AxMTU II-110-9-1-1-1-1
A_2R_7-APMS 9A xMTU II-143-26-2
A_3R_5-APMS 10A x MTU II -187-6-1-1
A_3R_{10} -APMS 10A x MTU II-290-42-1
A_4R_6-IR 58025AxMTU II-190-1-1-1-1-1

study it can be concluded that the hybrids *viz.,* APMS 9A x MTU II-143-26-2 and APMS 10A x MTU 1071 were stable for important cooking quality characters with high grain yield plant^{-1} which may be exploited for commercial cultivation in rice growing areas of Andhra Pradesh.

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