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EXTENT OF HETEROSIS OVER ENVIRONMENTS IN RICE HYBRIDS USING CMS SYSTEM

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ABSTRACT

An experiment was conducted to assess the magnitude of heterosis for grain yield and its attributes by evaluating 60 hybrids at three different locations. The analysis of variance for combining ability over locations revealed presence of significant differences among the locations, genotypes, parents, parents vs. crosses and crosses for all the characters studied. Significant negative standard heterosis was recorded by eleven hybrids over the best check MTU-1010 for days to 50% flowering. The hybrid combinations, IR-58025A x RNR-15038 and IR-58025A x RNR-2781 were found to be most promising for number of productive tillers per plant. As many as 41 crosses showed significant superiority for number of filled grains per panicle and twenty hybrids exhibited positive heterosis for spikelet fertility (%) over the hybrid check KRH-2. The hybrids, IR-58025A x RNR-15038, IR-79156A x NWGR-3132, IR-58025A x RNR-2781 and IR-79156A x RNR-2781 expressed highly significant positive heterosis for grain yield per plant over standard checks and these hybrids also proved its performance in productive tillers per plant, panicle length and number of filled grains per panicle. The potentiality of those hybrids could be further evaluated in multi-locational trials for commercial cultivation.

INTRODUCTION

Rice is the most important food crop of Asia and primary source of food for more than half of the world's population. Plateauing trend in the yield of high yielding varieties and declining natural resources like land and water make the task of rice production quite challenging (Viraktamath *et al.*, 2010). This emphasizes the development of realistic strategies to boost the rice production rapidly through maximum utilization of innovative technologies. Hybrid rice is the best practically feasible option available to increase the production and have yield advantage of 20% over the commercial high yielding varieties (Virmani and Kumar, 2004). India is the second largest country after China, which has implemented hybrid rice technology on a commercial scale. Significant heterosis have been reported in rice by Padmavathi *et al*. (2013), Pratap *et al*. (2013), Thakare *et al*. (2013) and Samrath and Sharma (2016) in their studies. In order to sustain rice cultivation and to increase the productivity in the country we need to use this technology successfully and exploit the heterosis through development and use of genetically divergent parental lines (Viraktamath *et al.*, 2006) from time to time. Keeping in view of the above the present research work carried out with the objective to develop high yielding rice hybrids by crossing wild abortive cytoplasmic male sterile lines with elite restorers and to identify the promising high yielding rice hybrids for commercial cultivation.

MATERIALS AND METHODS

The present experiment was carried out with 60 hybrids developed by crossing five CMS lines with twelve restorers in line x tester design during *rabi* 2013-14. During *kharif*, 2014 the 60 hybrids along with their parents and two checks (KRH-2 and MTU-1010) were evaluated at three different locations *viz*., Rajendranagar, Kampasagar and Jagtial. Twenty eight days old seedlings were transplanted in randomized block design with three replications. Each entry was planted in a row of 4 m length with a spacing of 20 cm between rows and 15 cm between plants. Observations were recorded for days to 50% flowering, plant height (cm), number of productive tillers per plant, panicle length (cm), number of filled grains per panicle, spikelet fertility (%), 1000 grain weight (g) and grain yield per plant (g).The data for the trait, days to 50 % flowering was recorded on plot basis. For other traits data was recorded on five plants selected at random from each entry in each replication. Mean of pooled data from three locations was subjected to statistical analysis as per Kempthorne (1957) and standard heterosis over the checks were computed as per the formula given by Liang *et al*. (1971) and expressed in percentage.

RESULTS AND DISCUSSION

The pooled analysis of variance for combining ability over locations revealed presence of significant differences among the locations, genotypes, parents, parents vs. crosses and crosses for all the characters studied (Table 1). Interaction effects of lines x testers x locations were recorded significant differences for the traits plant height, number of productive tillers per plant, number of filled grains per panicle and grain yield per plant. This indicates the existence of wide variability in the material under study and there is a scope for identifying promising parents and hybrid combinations.

Estimates of standard heterosis pooled over three locations exhibited significant negative heterosis in eleven hybrids

Table 1: Analysis of variance for yield and its component traits in rice

Source of variation	DF	Days to 50% flowering	Plant height (cm)	No. of productive tillers / plant	Panicle length (cm)	No. of filled grains / panicle	Spikelet fertility (%)	1000 grain weight (g)	Grain yield / plant (g)
Locations	2	46.98**	12663.24**	255.48**	514.56**	24924.70**	771.73**	1.38*	6578.31**
Replications x Locations	4	18.87*	5.64	11.93**	4.74*	153.50	9.19	0.76	12.45*
Genotypes	76	267.79**	741.57**	19.55**	24.44**	12088.86**	81.55**	84.88**	453.16**
Parents	16	428.58**	1022.91**	18.74**	23.85**	15470.87**	75.19**	113.16**	292.43**
Parent vs Crosses	1	2258.21**	208.66**	26.27**	279.54**	83045.21**	63.24**	389.17**	2548.35**
Crosses	59	190.45**	674.31**	19.66**	20.28**	9969.05**	83.58**	72.05**	461.23**
Lines	4	233.16**	479.18**	42.21**	29.59**	16757.89**	20.95**	34.09**	414.56**
Testers	11	349.92**	562.29**	6.37**	23.88**	12617.44**	101.53**	149.30**	238.03**
Line x Tester	44	46.21**	406.05**	12.41**	15.10**	5199.44**	58.45**	25.16**	213.46**
Parents x Locations	32	12.03*	106.73**	4.03**	8.14**	784.09**	21.57**	0.20	36.49**
(Parent vs Cross) x Locations	2	10.98	224.96**	15.62**	1.57	1068.40**	22.24*	0.02	171.10**
Crosses x Locations	118	7.51	256.14**	5.26**	5.96**	795.53**	6.61	0.47*	66.12**
Line x Locations	8	3.64	571.71*	6.92	19.17**	909.18	11.32	0.14	72.45
Tester x Locations	22	11.78*	311.60	6.309	3.33	1180.93*	7.33	0.583	70.85
Line x Tester x Locations	88	6.80	213.59**	4.85**	5.42**	688.84**	6.002	0.483 *	64.36**
Error	456	7.78	16.00	1.71	1.56	93.09	5.65	0.35	5.10

* Significant at 5 % level, ** significant at 1 % level

Table 2: Standard heterosis of hybrids for yield and yield component characters over locations in rice

Crosses	Days to 50% flowering		Plant height (cm)		No. of productive tillers / plant		Panicle length (cm)	
	KRH-2	MTU-1010	KRH-2	MTU-1010	KRH-2	MTU-1010	KRH-2	MTU-1010
IR-58025A x RNR-15351	4.34**	6.96**	-8.28	2.67	9.61	28.20*	8.82	15.41**
IR-58025A x WGL-3962	4.57**	7.19**	-13.54*	-3.21	5.08	22.90	10.22	16.90**
IR-58025A x IR-83142-B-57-B	-7.24**	-4.91**	-7.13	3.95	-1.29	15.44	5.37	11.75*
IR-58025A x RNR-15398	4.34**	6.96**	4.93	17.46*	6.99	25.13*	12.63*	19.45**
IR-58025A x D-4098	-3.90**	-1.49	-11.63	-1.08	-25.66*	-13.06	12.38*	19.18**
IR-58025A x NWGR-3132	4.45**	7.07**	-4.04	7.42	-2.49	14.04	8.22	14.77*
IR-58025A x RNR-15028	3.12*	5.71**	-1.79	9.94	25.47*	46.74**	14.05**	20.96**
IR-58025A x RNR-15038	7.80**	10.50**	-3.19	8.36	31.10**	53.33**	19.03**	26.24**
IR-58025A x RNR-2458	5.79**	8.44**	-6.84	4.28	2.56	19.95	13.83*	20.72**
IR 58025A x RNR-2456	3.01*	5.59**	-4.84	6.52	9.42	27.97*	4.35	10.67
IR-58025A x RNR-17462	5.01**	7.64**	-2.02	9.68	3.56	21.12	14.87**	21.83**
IR-58025A x RNR-2781	3.90**	6.50**	-1.78	9.94	28.38**	50.15**	18.39**	25.55**
IR-79156 A x RNR-15351	-1.45	1.02	-12.02	-1.52	-11.97	2.95	9.70	16.34**
IR-79156 A x WGL-3962	0.23	2.74	-1.78	9.94	-13.40	1.29	9.72	16.36**
IR-79156A x IR-83142-B-57-B	-0.78	1.71	-15.06*	-4.92	-23.88*	-10.98	-1.05	4.95
IR-79156 A x RNR-15398	1.22	3.76**	3.39	15.73*	-5.60	10.41	2.75	8.97
IR-79156 A x D-4098	-5.90**	-3.54*	-11.97	-1.47	9.71	28.31*	3.33	9.59
IR-79156 A x NWGR-3132	0.00	2.51	-19.37**	-9.74	26.31*	47.73**	14.80**	21.75**
IR-79156 A x RNR-15028	-3.12*	-0.69	-11.53	-0.97	-16.80	-2.69	4.04	10.34
IR-79156 A x RNR-15038	3.12*	5.70**	-15.83*	-5.78	13.62	32.89**	14.99**	21.96**
IR-79156 A x RNR-2458	4.90**	7.53**	-24.94**	-15.98*	-31.49**	-19.87	1.00	7.12
IR-79156 A x RNR-2456	1.45	3.99**	-12.09	-1.60	17.93	37.93**	10.16	16.84**
IR-79156 A x RNR-17462	5.46**	8.10**	4.85	17.37*	4.08	21.73	8.71	15.30**
IR-79156 A x RNR-2781	1.67	4.22**	3.22	15.54*	23.11*	43.98**	18.34**	25.51**
IR-80555 A x RNR-15351	-5.12**	-2.74	-17.14**	-7.25	10.74	29.52*	0.51	6.59
IR-80555 A x WGL-3962	-5.79**	-3.43*	1.55	13.68	-3.17	13.25	9.46	16.09**
IR-80555A x IR-83142-B-57-B	-7.79**	-5.48**	-15.35*	-5.25	-3.66	12.68	7.86	14.39*
IR-80555 A x RNR-15398	2.90*	5.48**	-11.15	-0.54	3.79	21.39	4.63	10.97
IR-80555 A x D-4098	-8.57**	-6.28**	-12.89*	-2.49	-10.45	4.73	-0.16	5.88
IR-80555 A x NWGR-3132	-1.56	0.91	-19.13**	-9.47	-7.02	8.74	-2.65	3.25
IR-80555 A x RNR-15028	-8.46**	-6.17**	-12.57	-2.13	6.89	25.02*	9.72	16.36**

ranging from -7.31 (APMS-6A x IR-83142-B-57-B) to -3.43 per cent (IR-80555A x WGL-3962) over the check MTU-1010 (Table 2). Negative heterosis for days to 50% flowering plant height is desirable for breeding short statured plant type and it was observed in16 hybrids when compared with KRH-2. Out of 60 crosses evaluated, only five crosses *viz*., IR-58025A x RNR-15038 (31.10), IR-58025A x RNR-2781 (28.38), IR-79156A x NWGR-3132 (26.31), IR-58025A x RNR-15028 (25.47) and IR-79156A x RNR-2781 (23.11) exhibited significant positive standard heterosis over KRH-2 for number of productive tillers

Table 2: Cont..........

Crosses	Days to 50% flowering		Plant height (cm)		No. of productive tillers / plant		Panicle length (cm)	
	KRH-2	MTU-1010	KRH-2	MTU-1010	KRH-2	MTU-1010	KRH-2	MTU-1010
IR-80555 A x RNR-15038	3.34*	5.93**	-12.08	-1.59	14.56	33.99**	5.28	11.65*
IR-80555 A x RNR-2458	3.56*	6.16**	-16.36*	-6.38	6.47	24.53*	12.93*	19.77**
IR-80555 A x RNR-2456	-0.89	1.60	-15.78*	-5.72	0.61	17.68	-3.45	2.39
IR-80555 A x RNR-17462	-0.89	1.60	-5.74	5.52	-5.21	10.86	-7.56	-1.97
IR-80555 A x RNR-2781	1.89	4.45**	6.02	18.68*	4.60	22.33	16.82**	23.89**
IR-68897 A x RNR-15351	-3.11*	-0.68	-9.67	1.12	-10.23	5.00	6.64	13.09*
IR-68897 A x WGL-3962	1.56	4.11**	-3.15	8.41	3.82	21.42	17.85**	24.98**
IR-68897A x IR-83142-B-57-B	-7.57**	-5.26**	-9.40	1.41	-10.13	5.11	13.75*	20.64**
IR-68897 A x RNR-15398	1.01	3.54*	3.03	15.33*	-1.46	15.25	13.56*	20.43**
IR-68897 A x D-4098	-8.35**	-6.05**	-15.31*	-5.20	-4.01	12.26	9.78	16.42**
IR-68897 A x NWGR-3132	-3.45*	-1.03	-7.94	3.05	-4.56	11.62	1.78	7.94
IR-68897 A x RNR-15028	-7.68**	-5.37**	-11.25	-0.65	-8.64	6.85	-1.90	4.04
IR-68897 A x RNR-15038	0.00	2.51	-4.93	6.42	2.39	19.76	12.60*	19.42**
IR-68897 A x RNR-2458	-1.00	1.48	-4.00	7.46	-5.44	10.60	4.93	11.29*
IR-68897 A x RNR-2456	-4.78**	-2.40	-1.59	10.16	2.82	20.25	11.29*	18.02**
IR-68897 A x RNR-17462	3.57*	6.16**	11.50	24.81**	1.49	18.70	18.62**	25.81**
IR-68897 A x RNR-2781	0.11	2.62	0.80	12.84	15.92	35.58**	14.63**	21.58**
APMS-6A x RNR-15351	2.34	4.91**	-14.38*	-4.16	-14.92	-0.49	14.19**	21.10**
APMS-6A x WGL-3962	3.68**	6.28**	-1.05	10.76	4.63	22.37	10.46	17.15**
APMS-6A x IR-83142-B-57-B	-9.58**	-7.31**	-7.93	3.06	-11.49	3.52	0.87	6.98
APMS-6A x RNR-15398	2.45	5.0**	9.03	22.05**	-19.71	-6.09	9.37	16.00**
APMS-6A x D-4098	-8.13**	-5.83**	-13.92*	-3.65	-24.43*	-11.62	7.17	13.67*
APMS-6A x NWGR-3132	4.68**	7.30**	3.58	15.94*	-22.49*	-9.35	1.27	7.40
APMS-6A x RNR-15028	-2.67	-0.23	-12.22	-1.74	-3.92	12.38	5.83	12.24*
APMS-6A x RNR-15038	4.57**	7.19**	-0.71	11.14	15.11	34.63**	21.11**	28.44**
APMS-6A x RNR-2458	4.01**	6.62**	-18.73**	-9.02	-13.98	0.61	-6.31	-0.63
APMS-6A x RNR-2456	1.11	3.65*	-9.05	1.81	-14.79	-0.34	0.97	7.09
APMS-6A x RNR-17462	1.56	4.11**	-7.11	3.98	-26.31*	-13.82	6.32	12.76*
APMS-6A x RNR-2781	5.68**	8.33**	-13.28*	-2.93	7.93	26.23*	9.52	16.15**

Table 2: Cont..........

Crosses	No. of filled grains / panicle		Spikelet fertility (%)		1000 grain weight (g)		Grain yield / plant (g)	
	KRH-2	MTU-1010	KRH-2	MTU-1010	KRH-2	MTU-1010	KRH-2	MTU-1010
IR-58025A x RNR-15351	3.37	7.96	-1.60	-4.80**	-20.92**	-25.71**	-15.54	-0.22
IR-58025A x WGL-3962	15.82	20.97*	3.57*	0.20	-4.33**	-10.12**	-3.89	13.53
IR-58025A x IR-83142-B-57-B	1.37	5.87	-1.67	-4.87**	6.69**	0.23	-17.78	-2.88
IR-58025A x RNR-15398	52.10**	58.86**	0.34	-2.92	-23.84**	-28.45**	5.28	24.36
IR-58025A x D-4098	-7.78	-3.69	1.29	-2.01	-3.28*	-9.14**	-19.26	-4.62
IR-58025A x NWGR-3132	31.20**	37.03**	0.20	-3.06	-8.67**	-14.20**	-15.64	-0.34
IR-58025A x RNR-15028	49.89**	56.55**	3.98*	0.60	-16.68**	-21.73**	28.83*	52.19**
IR-58025A x RNR-15038	72.29**	79.94**	3.78*	0.40	-22.45**	-27.15**	47.89**	74.70**
IR-58025A x RNR-2458	20.35*	25.69 *	0.55	-2.72	-19.49**	-24.36**	-10.69	5.51
IR 58025 A x RNR-2456	24.09*	29.61**	1.94	-1.38	-26.79**	-31.22**	0.55	18.78
IR-58025A x RNR-17462	28.97**	34.70**	1.23	-2.07	-12.37**	-17.68**	3.30	22.03
IR-58025A x RNR-2781	55.11**	61.99**	-0.46	-3.70*	-11.12**	-16.51**	38.94**	64.13**
IR-79156 A x RNR-15351	38.53**	44.69**	0.57	-2.71	-33.89**	-37.89**	-34.05**	-22.09
IR-79156 A x WGL-3962	19.97*	25.30*	5.36**	1.93	-6.45**	-12.11**	-14.04	1.55
IR-79156 A x IR-83142-B-57-B	-12.34	-8.45	-1.96	-5.15**	4.50**	-1.83	-47.03**	-37.43**
IR-79156 A x RNR-15398	20.84*	26.20**	-3.46*	-6.60**	-20.55**	-25.36**	-34.15**	-22.21
IR-79156 A x D-4098	29.94**	35.71**	-0.62	-3.85*	-7.54**	-13.14**	-13.30	2.42
IR-79156 A x NWGR-3132	53.47**	60.29**	2.63	-0.71	-6.14**	-11.83**	39.95**	65.32**
IR-79156 A x RNR-15028	47.04**	53.57**	6.84**	3.36*	-13.61**	-18.84**	-9.33	7.11
IR-79156 A x RNR-15038	65.43**	72.78**	5.68**	2.24	-10.64**	-16.06**	27.83*	51.00**
IR-79156 A x RNR-2458	7.47	12.24	-2.41	-5.59**	-9.42**	-14.91**	-29.01*	-16.14
IR-79156 A x RNR-2456	47.34**	53.89**	-2.96	-6.12**	-19.17**	-24.06**	8.47	28.14*
IR-79156 A x RNR-17462	44.17**	50.58**	-2.16	-5.35**	-8.65**	-14.19**	-7.28	9.53
IR-79156 A x RNR-2781	54.91**	61.79**	1.78	-1.53	-6.55**	-12.21**	37.73**	62.70**
IR-80555 A x RNR-15351	32.95**	38.86**	-3.21	-6.36**	-14.27**	-19.47**	-12.98	2.80
IR-80555 A x WGL-3962	29.89**	35.65**	3.07	-0.28	-4.39**	-10.18**	-7.94	8.75
IR-80555 A x IR-83142-B-57-B	-8.07	-3.99	0.77	-2.51	14.39**	7.46**	-6.63	10.30
IR-80555 A x RNR-15398	1.24	5.73	-2.23	-5.41**	-18.48**	-23.42**	-39.58**	-28.63*
IR-80555 A x D-4098	-21.78*	-18.30	0.05	-3.21	15.13**	8.16**	-31.13**	-18.65
IR-80555 A x NWGR-3132	34.32**	40.29**	2.48	-0.86	-1.74	-7.69**	-4.60	12.70

Table 2: Cont..........

Crosses	No. of filled grains / panicle		Spikelet fertility (%)		1000 grain weight (g)		Grain yield / plant (g)	
	KRH-2	MTU-1010	KRH-2	MTU-1010	KRH-2	MTU-1010	KRH-2	MTU-1010
IR-80555 A x RNR-15028	43.31**	49.68**	7.86**	4.35*	-3.82**	-9.64**	19.23	40.85**
IR-80555 A x RNR-15038	41.00**	47.26**	5.97**	2.52	-17.80**	-22.78**	3.12	21.82
IR-80555 A x RNR-2458	55.14**	62.03**	-3.13	-6.28**	-44.84**	-48.18**	-26.34*	-12.98
IR-80555 A x RNR-2456	10.16	15.05	-0.05	-3.31	-18.70**	-23.63**	-23.91*	-10.12
IR-80555 A x RNR-17462	3.45	8.05	0.66	-2.61	-4.94**	-10.69**	-18.63	-3.87
IR-80555 A x RNR-2781	61.57**	68.75**	9.06**	5.51**	15.20**	8.23**	21.52	43.55**
IR-68897 A x RNR-15351	38.74**	44.90**	2.35	-0.98	-12.65**	-17.94**	-8.50	8.09
IR-68897 A x WGL-3962	44.88**	51.31**	3.12	-0.23	-7.01**	-12.64**	13.41	33.98*
IR-68897 A x IR-83142-B-57-B	15.43	20.56*	6.24**	2.78	6.23**	-0.20	-18.46	-3.68
IR-68897 A x RNR-15398	26.56**	32.18**	7.12**	3.64*	-7.23**	-12.85**	-16.74	-1.65
IR-68897 A x D-4098	-16.33	-12.62	5.47**	2.04	5.36 **	-1.02	-42.86**	-32.50*
IR-68897 A x NWGR-3132	26.96**	32.60**	4.22*	0.83	-10.35**	-15.78**	-8.28	8.35
IR-68897 A x RNR-15028	-10.60	-6.63	0.02	-3.23	-7.36**	-12.97**	-24.65*	-10.99
IR-68897 A x RNR-15038	40.51**	46.75**	7.91**	4.40*	-6.32**	-11.99**	-10.43	5.81
IR-68897 A x RNR-2458	-18.30	-14.67	-5.61**	-8.68**	-14.16**	-19.36**	-41.55**	-30.95*
IR-68897 A x RNR-2456	32.17**	38.04**	3.75*	0.37	-12.44**	-17.75**	-5.61	11.51
IR-68897 A x RNR-17462	28.05**	33.74**	-1.70	-4.90**	-12.31**	-17.62**	-4.01	13.40
IR-68897 A x RNR-2781	50.97**	57.68**	8.48**	4.95**	0.96	-5.16**	23.17*	45.51**
APMS-6A x RNR-15351	45.20**	51.65**	0.71	-2.57	-29.00**	-33.30**	-23.44*	-9.56
APMS-6A x WGL-3962	16.59	21.77*	-0.50	-3.74*	-4.60**	-10.38**	-10.28	5.99
APMS-6A x IR-83142-B-57-B	9.48	14.34	0.41	-2.86	9.02**	2.41	-19.17	-4.51
APMS-6A x RNR-15398	15.32	20.44*	0.30	-2.97	-27.28**	-31.69**	-12.37	3.52
APMS-6A x D-4098	-7.69	-3.59	-0.98	-4.21*	9.41**	2.78*	-12.96	2.83
APMS-6A x NWGR-3132	45.27**	51.72**	-3.11	-6.26**	-17.29**	-22.30**	-19.88	-5.35
APMS-6A x RNR-15028	52.74**	59.53**	5.16**	1.74	-20.08**	-24.92**	14.56	35.33*
APMS-6A x RNR-15038	74.77**	82.53**	6.83**	3.35*	-23.55**	-28.18**	32.43**	56.45**
APMS-6A x RNR-2458	46.39**	52.89**	5.54**	2.11	-20.55**	-25.36**	-12.56	3.29
APMS-6A x RNR-2456	33.38**	39.30**	3.25	-0.11	-32.79**	-36.86**	-10.77	5.41
APMS-6A x RNR-17462	37.93**	44.06**	-2.61	-5.77**	-21.05**	-25.84**	-20.91	-6.56
APMS-6A x RNR-2781	53.09**	59.88**	6.30**	2.85	-3.91**	-9.73**	31.39**	55.22**

* Significant at 5 % level, ** significant at 1 % level

per plant. Sharma *et al.* (2013) reported both positive and negative heterosis in their studies as in the case of present study suggesting methods of exploiting both additive and non-additive gene effects.

The hybrids, APMS 6A x RNR-15038 (28.44), IR-58025A x RNR-15038 (26.24), IR-68897A x RNR-17462 (25.81), IR-58025A x RNR-2781 (25.55) and IR-79156A x RNR-2781 (25.51) were excelled their performance in desirable direction for panicle length. The significant positive standard heterosis was recorded in 41 hybrids with a range from 19.97 (IR-79156A x WGL-3962) to 74.77 (APMS-6A x RNR-15038) when compared with check KRH-2 for number of filled grains per panicle. Highly superior heterotic combinations identified for this trait were APMS-6A x RNR-15038, IR-58025A x RNR-15038 and IR-79156A x RNR-15038. Gouri Shankar *et al.* (2010) and Tiwari *et al.* (2011) also reported positive heterosis for this character. Significant positive standard heterosis was recorded by 20 hybrids over the hybrid check, KRH-2 for spikelet fertility (%) and it is an important character which directly influences the grain yield.

The highly significant heterosis over KRH-2 and MTU-1010 was observed in the hybrids, IR-58025A x RNR-15038 (47.89 and 74.79%), IR-79156A x NWGR-3132 (39.95 and 65.32%), IR-58025A x RNR-2781 (38.94 and 64.13%) and IR-79156A x RNR-2781(37.73 and 62.70%) for grain yield. A wide range of heterosis for grain yield also observed by Padmavathi *et al.* (2013) and Pratap *et al.* (2013).

The hybrids, IR-58025A x RNR-15038, IR-79156A x NWGR-3132, IR-58025A x RNR-2781 and IR-79156A x RNR-2781 were found to be promising for grain yield per plant. Also these hybrids were found to be superior in productive tillers per plant, panicle length and number of filled grains per panicle. Hence, the potentiality of those hybrid combinations should be further tested in multi-locational trials for commercial cultivation.

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