Oryza Vol. 46. No.3, 2009 (250-253)

Heterosis for quality traits in *indica/indica* hybrids of rice

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ABSTRACT

Eighteen indica/indica hybrids produced by crossing three male sterile lines with six restorers were analyzed for various quality traits and mid parent heterosis and heterobeltiosis. For head rice recovery, IR 68886A x IR 21567 registered significant positive relative heterosis and heterobeltiosis. For kernel length only one cross viz., IR 58025A x IR 21567 possessed positive significant mid parent heterosis. Most of the indica/indica hybrids exhibited significant negative heterosis for water uptake and volume expansion ratio. Significant negative relative heterosis was recorded for gel consistency in all the hybrids except for IR 62829A x IR 29723. The relative heterosis and heterobeltiosis for amylose content were found to be negative indicating that the indica/indica hybrids in the present study had their amylose content less than their mid parent and better parent values

Key words: *rice hybrids, heterosis, heterobeltiosis, quality traits*

With the realization of the possibility of producing hybrids on commercial scale, increasing attention has been given to heterosis breeding in rice. The major considerations in commercial exploitation of heterosis are (a) whether it is possible to obtain sufficient heterosis for characteristics of economic importance and (b) whether it is possible to fix such heterosis in pure breeding lines. Heterosis breeding has been successfully utilized to enhance the productivity of rice. Besides yield, quality considerations have been attracting the attention of breeders with increased quality consciousness of the consumers. Detailed information about heterosis for quality characters by using the parental lines has direct relevance in hybrid rice breeding.

Three male sterile lines and six restorers were sown under uniform conditions and crosses were attempted to obtain 18 *indica/indica* hybrids. The harvested produce was used for analyzing hulling percentage (HP), milling percentage (MP), head rice recovery (HRR), kernel length (KL), kernel breadth (KB), L/B ratio, kernel length after cooking (KLAC), elongation ratio (ER), water uptake (WU), volume expansion ratio (VER), alkali spreading value (ASV), gel consistency (GC) and amylose content (AC) and the estimates of mid parent heterosis and heterobeltiosis were worked out for various grain quality characters.

All the *indica/indica* hybrids except IR 58025A x IR 29723 recorded significant negative mid parent heterosis and heterobeltiosis ranging from –9.77 percent to –4.67 percent and from –11.25 percent to –5.57 percent respectively for hulling percentage (Table 1). For head rice recovery, only one cross viz., IR 68886A x IR 21567 registered significant positive relative heterosis (33.66%) and heterobeltiosis (28.18%). As positive heterosis for this trait is desirable, it would be possible to develop hybrids with higher head rice recovery by selecting at least one parent with higher head rice recovery and another with average head rice recovery. However, Gravois (1994) observed non-significant average heterosis for head rice recovery but heterosis was found to be significant for rough rice yield. For kernel length, only one cross viz., IR 58025A x IR 21567 possessed positive significant mid parent heterosis (5.17%). For this trait, positive heterosis is desirable in those cases where long kernels are

Table1. Estimates of relative heterosis and heterobeltiosis for quality traits in indica/indica hybrids of rice

Cross combination	Hulling (%)		Milling (%)		HRR (%)		K L (mm)		K B (mm)		L/B ratio	
	MP	Hb	MP	hb	MP	hb	MP	hb	MP	hb	MP	hb
IR 58025A x Ajaya R	-2.61	-7.45**	-1.73	-8.79**	-11.23**	-25.52**	3.28	-1.92	-0.84	-12.71**	1.62	-14.51**
IR 58025A x MTU 9992	1.16	-2.61	-0.21	-6.08*	13.01*	-10.63*	2.96	-0.08	-4.11	-10.97**	6.52*	-3.87
IR 58025A x KMR 3	-4.67*	-7.36**	-4.60	-8.28**	5.36	-8.18*	-0.35	-10.08**	1.73	-8.27**	-4.45	-21.40**
IR 58025A x IR 40750R	1.00	-2.32	1.36	-4.96*	-0.90	-14.25**	-3.24	-6.88**	-8.58**	-13.06**	5.32*	-3.44
IR 58025A x IR 29723	4.18	2.06	3.24	-1.53	-2.56	-14.29**	-0.54	-4.32*	-0.25	-8.00**	-1.37	-12.21**
IR 58025A x IR 21567	-1.82	-6.51**	-2.16	-8.92**	7.69	3.80	5.17**	2.48	1.42	-5.09*	2.91	-6.03**
IR 62829A x Ajaya R	-7.86**	-10.84**	-11.65**	-15.16**	-12.67**	-20.03**	-3.75	-5.24*	-16.37**	-24.78**	13.85**	3.62
IR 62829A x MTU 9992	-0.41	-2.36	-0.20	-2.77	-7.60	-31.90**	-1.54	-5.18**	1.00	-4.05	-2.72	-4.31
IR 62829A x KMR 3	-3.27	-4.25*	-3.80	-4.17	-30.75**	-33.84**	-0.52	-4.31*	5.09*	-3.13	-6.42*	-16.92**
IR 62829A x IR 40750R	-0.06	-1.57	-4.14	-6.97**	-17.51**	-21.81**	-3.07	-5.88**	8.38**	5.52*	-10.78**	-10.86**
IR 62829A x IR 29723	-2.26	-2.45	-4.54	-5.70*	-1.03	-4.44	-3.65	-6.40**	-5.48*	-10.82**	1.60	-1.55
IR 62829A x IR 21567	-5.96**	-8.82**	-8.19	-11.56**	5.43	-7.39	1.80	-2.36	4.43*	0.00	-2.77	-3.10
IR 68886A x Ajaya R	-3.79	-5.57**	-4.59	-7.28**	-1.21	-22.09**	-3.24	-6.90**	-11.03**	-18.00**	7.64*	-4.26
IR 68886A x MTU 9992	-1.84	-2.36	-2.50	-3.85	-35.05**	-45.36**	-1.25	-2.87	-4.28*	-6.68**	3.24	-0.98
IR 68886A x KMR 3	-2.84	-3.27	-3.78	-4.59	-5.45	-22.82**	3.96	-5.01**	-2.72	-8.05**	5.94*	-8.03**
IR 68886A x IR 40750R	-4.27*	-4.33*	-4.88*	-6.57**	7.29	-12.97**	-1.60	-4.02*	-2.51	-2.51	0.84	-1.63
IR 68886A x IR 29723	-0.63	-1.88	-4.03	-4.03	0.58	-17.18**	3.58	0.98	0.60	-2.58	2.86	-2.78
IR 68886A x IR 21567	-9.77**	-11.25**	-12.81**	-15.00**	33.66**	28.18**	-0.33	-1.56	0.98	-0.72	-1.43	-4.26

Contd.../-

Cross	KLAC (mm)		ER		WU (ml)		VER		ASV		GC (mm)		AC (%)	
combination	MP	Hb	MP	Hb	MP	hb	MP	hb	MP	hb	MP	hb	MP	hb
IR 58025A x Ajaya R	-14.01**	-16.36**	-17.05**	-19.18**	-7.84*	-9.61*	-1.80	-11.70	12.50**	12.50**	-47.09**	-48.29**	2.51	-19.31**
IR 58025A x MTU 9992	-8.05**	-11.81**	-10.95**	-11.96**	-9.47*	-17.30**	-2.02	-10.87	1.01	-16.66**	-49.19**	-62.50**	-2.91	-18.53**
IR 58025A x KMR 3	-15.23**	-19.09**	-15.50**	-20.40**	9.52*	-11.53**	0.51	-10.19	45.00**	-3.33	-57.33**	-71.42**	-0.53	-22.75**
IR 58025A x IR 40750R	-14.28**	-20.90**	-11.30**	-15.09**	18.60**	-1.92	-10.20	-18.09*	33.25**	-11.16*	-38.92**	-39.28**	-31.08**	-44.98**
IR 58025A x IR 29723	-10.57**	-15.45**	-10.59**	-12.25**	-17.75**	-20.00**	-10.47	-23.07**	0.00	-7.14	-63.09**	-63.09**	1.59	-18.04**
IR 58025A x IR 21567	-8.49**	-11.81**	-12.96**	-13.96**	-6.93	-9.61*	-3.52	-8.85	8.33	8.33	-60.55**	-63.02**	-8.05**	-26.73**
IR 62829A x Ajaya R	-5.31	-14.42**	-1.62	-10.00**	-1.05	-6.00	-14.66*	-19.65**	70.87**	13.91**	-12.75*	-26.13**	-5.79**	-17.24**
IR 62829A MTU 9992	-4.86	-12.87**	-3.07	-8.16*	4.54	2.22	-4.92	-9.38	-32.20**	-48.71**	-30.69**	-42.62**	3.01	-2.44 x
IR 62829A x KMR 3	-20.65**	-27.00**	-20.73**	-29.72**	1.29	-13.33	1.98	-4.63	0.00	0.00	-1.67	-27.86**	-1.05	-14.45**
IR 62829A x IR 40750R	-5.08	-9.67**	-1.91	-4.04	18.98**	4.44	-9.23	-13.23	75.00**	75.00**	-45.13**	-52.40**	-3.51*	-13.79**
IR 62829A x IR 29723	-10.98**	-17.34**	-7.28	-11.53**	-14.00**	-21.81**	-20.70**	-28.84**	55.55**	0.00	1.37	-12.50*	-5.29**	-14.36**
IR 62829A x IR 21567	-11.82**	-19.60**	-13.23**	-17.78**	-6.38	-10.20*	-2.44	-3.23	66.75**	11.16*	-28.02**	-41.14**	-5.00**	-15.32**
IR 68886A x Ajaya R	-14.02**	-18.80**	-11.52**	-13.24**	8.04	-6.00	9.60	-1.45	-50.00	-66.66**	-53.42**	-55.02**	-2.01	-7.75**
IR 68886A x MTU 9992	-17.43**	-23.07**	-16.48**	-21.03**	-7.50	-13.95**	1.15	-7.98	-32.20**	-48.71**	-47.95**	-62.96**	-11.26**	-13.08**
IR 68886A x KMR 3	-15.20**	-21.36**	-18.64**	-19.89**	-10.14	-16.21**	-0.04	-10.69	0.00	0.00	-40.65**	-61.37**	-19.92**	-25.91**
IR 68886A x IR 40750R	-13.33**	-22.22**	-11.89**	-19.22**	-12.67*	-16.21**	4.78	-4.41	0.00	0.00	-45.35**	-48.67**	-14.01**	-17.56**
IR 68886A x IR 29723	-6.97**	-14.52**	-10.37**	-15.84**	2.17	-14.54**	-22.20**	-33.15**	55.55**	0.00	-74.78**	-76.19**	2.74	-0.18
IR 68886A x IR 21567	-19.63**	-24.78**	-19.50**	-23.89**	-9.30*	-20.40**	-9.27	-14.28	-50.00**	-66.67**	-63.25**	-63.54**	0.09	-4.27**

* Significant at 5% level   MP: Mid parent heterosis (or) Relative heterosis
** Significant at 1% level   hb: Heterobeltiosi

preferred, whereas in those situations where short kernels are desirable, heterosis in negative direction is required. However, incase of kernel breadth, negative heterosis is desirable from the quality point of view as bolder grains are less preferred. Similar results were given by Sahai *et al.,* (1986), Sasmal (1988) and Reddy *et al.,* (1991). The relative heterosis and heterobeltiosis for L/B ratio ranged from –10.78 percent to 6.52 percent and from –21.40 percent to 3.62 percent, respectively. Singh and Singh (1993) observed that heterosis for L/ B ratio was not found to be accompanied by simultaneous heterosis for kernel length and kernel breadth.

In the present study, most of the hybrids exhibited significant negative heterosis for water uptake and volume expansion ratio. For gelatinization temperature as intermediate values are preferred from consumer point of view, positive or negative heterosis is not desirable if both the parents have either low or high gelatinization temperature. Significant negative relative heterosis was recorded for gel consistency in all the hybrids except for IR 62829A x IR 29723 which showed positive but non-significantly negative. However, the type of heterosis desirable depends upon the parents used in the cross. If both the parents have hard gel consistency, i.e., less gel length, then positive heterosis is desirable so that the resulting hybrid would have longer gel length indicating medium or soft gel consistency. The relative heterosis and heterobeltiosis for amylose content were found to be negative indicating that the *indica/indica* hybrids had their amylose content less than their mid parent and better parent values. Kuo *et al.,* (1995) also obtained negative heterobeltiosis for this trait. However, positive heterosis for this trait is not desirable, as it would result in high amylose types if both the parents have high amylose content. On the other hand, if both the parents have low amylose content, then positive heterosis is desirable as it may give hybrids with intermediate amylose content.

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