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SCOPE FOR EXPLOITATION OF HETEROSIS USING TRADITIONAL LAND RACES AND CULTIVARS IN RICE (*ORYZA SATIVA* L.)

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Abstract

Rice (*Oryza sativa* L.) is a plant belonging to the family of grasses, Gramineae (Poaceae). Rice traditional landraces and improved cultivars are useful pool of important traits and need to be analyzed for hybrid breeding. Furthermore, released cultivars have good desirable agronomic characters, which can be used directly in the hybrid breeding program. It is important to know the degree and direction of hybrid vigor for its commercial exploitation of improved rice varieties. The experimental material used were four traditional land races and six improved high yielding varieties of Tamil Nadu raised in Randomized Block Design during *Kharif* 2013. Three types of heterosis were studied in six crosses between rice cultivars (improved and landraces). These crosses showed highly variations in the expression of all the types of heterosis for yield and yield components. Grain yield manifested highly higher mean performance and significant standard heterosis in three crosses. Relative heterosis ranged from 6.59 (TPS 4 × Kathanellu) to 36.10 per cent (ADT 39 × Kavuni), heterobeltiosis from 1.26 (ASD 16 × Navara) to 40.31 per cent (ADT 39 × Kavuni) and standard heterosis from 15.36 (ASD 16 × Navara) to 53.31 per cent (IR 72 × Veeradangan). With appropriate choice of traditional land races and improved cultivars used in parental lines, it is possible to develop F_1 rice hybrid possessing distinct yield superiority over the best-inbred lines.

Key words : Rice, heterosis, F_1 hybrids, relative heterosis, heterobeltiosis, standard heterosis.

Introduction

Rice (*Oryza sativa* L. 2n = 2x = 24) is one of the most important cereal crop in India. Rice is the life and the prince among cereals as this unique grain helps to sustain two thirds of the world's population. Knowledge of genetic diversity in crop species is fundamental to its improvement. Land races provide a vast genetic variability for the present day rice improvement programme (Zhenshan *et al*., 1996). Landraces comprise of the unique source for gene of high adaptability but are poor yielders. More than one hundred thousand landraces and improved cultivar collections available in the rice germplasm worldwide largely contribute to the rich genetic diversity of rice. Through domesticated, un-adopted landraces are phenotypically less desirable such that plant breeders have recognized for improvement of various useful traits *viz.,* grain quality (Ghose *et al*., 1960), medicinal properties (Das and Oudhia *et al*., 2000; Shastri *et al*., 2004). The specially rice genotypes are more often native landraces than improved high yielding cultivars (Shenoy *et al*., 2001). Genetic diversity provides a scientific basis for efficient utilization of germplasm resources in crop improvement. Therefore, a proper assessment of their genetic worth in crop improvement programs aimed at utilizing these in rice breeding is advocated. Heterosis is a phenomenon in which F_1 hybrids derived from diverse parents show superiority over their parents. Genetic differences between parents are the primary cause of heterosis. Breeders have extensively investigated the genetic diversities between parents and their relationship with heterosis for predicting heterosis. The objective of the present study was to determine the genetic diversity among landraces and improved cultivars of rice use in heterosis rice breeding for improvement of yield components. The hybrid rice programs depends upon the magnitude of heterosis which also helps in the identification of potential cross combinations to be used in the conventional breeding programs to create wide array of variability in segregating generations. A good hybrid should manifest high heterosis for commercial exploitation.

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Materials and Methods

The experimental material consisted of four medicinal landraces *viz*., Veeradangan Kavuni, Kathanellu and Navara which were collected from Tamil Nadu and

Navara is a medicinal landrace of Kerala these landraces are having superior nutritional grain qualities and low yielder and six improved semi-dwarf high yielding varieties *viz.,* IR 72, ADT 39, ADT 45, ASD 16 and TPS 4 of medium grain quality along with standard check ADT 43 raised in Randomized Block Design replicated thrice by adopting a spacing of 30 × 10 cm at Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Madurai (Tamil Nadu), India; during *Kharif* 2013. Seedlings at 26 days after sowing were transplanted into the main field. Each entry was planted in five rows each having ten plants with a inter row spacing of 20 cm and intra row spacing of 10 cm. All the recommended package of practices were followed. Observations were recorded on ten randomly selected plants in parents and three plants in F_1s for each replication. The means were computed for yield and characters such as days to 50 per cent flowering (days), plant height (cm), number of productive tillers per plant, panicle length (cm), number of filled grains per panicle, hundred grain weight (g) and single plant yield (g). The relative heterosis (di), heterobeltiosis (dii) and standard heterosis (diii) were estimated by Fonseca and Patterson (1968). For computing standard heterosis, the best performing parent for each character was used as a standard check. In the present study ADT 43 was adjudged as standard check. Significance of above three types of heterosis was tested by 't' value and it was computed.

Results and Discussion

Analysis of variance for biometrical characters revealed significant differences among the genotypes for characters studied indicating the existence of significant amount of variability for the characters (table 1). The mean values indicated considerable variation for all biometrical characters (Table 2 and Fig. 1). Gilbert (1958) viewed that *per se* of parents is an indication of performance of their progenies in advanced generations.

Among the parents, Kavuni (112.40 days) was the late flowering and TPS 4 (66.00 days) was the early flowering genotype. The parental genotypes, TPS 4 (66.00 days), Navara (68.20 days), Veeradangan (75.40 days), ADT 43 (75.80 days) and ASD 16 (76.40 days) showed significantly lower values than the grand mean value. Among the hybrids, ADT 39 × Kavuni (109.68 days) was the late flowering and ADT 43 × Navara (69.72 days) was the early flowering. The hybrids, ADT 43 × Navara (69.72 days), ASD 16 × Navara (70.72 days) and IR 72 × Veeradangan (78.04 days) showed significantly lower values than the grand mean value. With regard to plant height among the parents, Kavuni was found to be the tallest (138.13 cm) and the TPS 4 (74.96 cm) was the shortest. The parents, TPS 4 (74.96 cm), ADT 43 (85.18 cm), IR 72 (85.65 cm), Kathanellu (87.97 cm), ADT 45 (92.28 cm) and ASD 16 (94.80 cm) showed significantly lower values than the grand mean value. Maximum plant height among the F_1 hybrids was recorded by ADT 39 × Kavuni (122.95 cm) and minimum by TPS 4 × Kathanellu (85.82 cm). The two hybrids, TPS 4 × Kathanellu (85.82 cm) and ASD 16 × Navara (94.81 cm) registered significantly lower values than the grand mean value. The undesirable characters of these landraces were tall growing, late flowering and lodging type. Among the ten parents studied, Kavuni recorded the lowest number of productive tillers per plant (10.20) while Veeradangan (15.20) showed the highest number of productive tillers per plant. The female parent ADT 39 (14.60) registered significantly higher values for this trait. In F_1 hybrids, it ranged from 12.20 (ADT 43 × Navara) to 16.20 (IR 72 × Veeradangan). The hybrids *viz*., IR 72 × Veeradangan (16.20), ASD 16 × Navara (15.04), ADT 45 × Kavuni (14.36), TPS 4 × Kathanellu (14.24) and ADT 39 × Kavuni (14.12) were found to be significant.

Among the male parents Kavuni (26.35 cm) had the longest panicle length and Navara (22.53 cm) had the shortest panicle length. None of the female parents showed significant values for panicle length. Among the F_1 hybrids ADT 43 × Navara (22.54 cm) had the lowest panicle length while ADT 45 × Kavuni (27.60 cm) was with highest panicle length. Among the ten parents the highest mean value for number of filled grains per panicle was observed in ADT 43 (128.40) and Veeradangan (97.01) recorded minimum number of filled grains per panicle. ADT 43 (128.40) and ADT 45 (124.70) exhibited significantly superior values for this trait. Among the hybrids, ADT 45 × Kavuni (130.67), ADT 39 × Kavuni (127.00) recorded significant values. Among the F_1 hybrids, highest number of filled grains per panicle were recorded by ADT 45 × Kavuni (130.67) and the lowest by TPS 4 × Kathanellu (109.65).

For the hundred grain weight, among the parents ASD 16 registered the highest hundred grain weight (2.64 g) while, ADT 39 was found to be the low (1.84 g). ASD 16 (2.64 g) and Veeradangan (2.55 g) registered significantly higher values for this trait. Among the hybrids, the maximum hundred grain weight was recorded by IR 72 × Veeradangan (2.69 g) and the minimum value by ADT 39 × Kavuni (2.13 g). Among the F_1 hybrids, IR 72 × Veeradangan (2.69 g) and ASD 16 × Navara (2.49 g) showed significance over their grand mean value (2.29

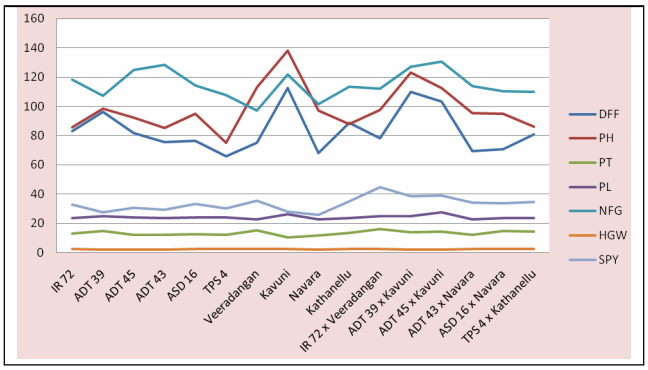

Fig. 1 : Mean performance of parents and F_1 hybrids for biometrical traits in rice.

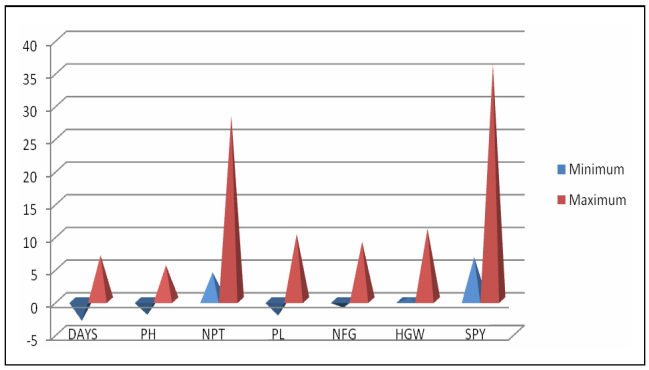

Fig. 2 : Range of relative heterosis for biometrical traits.

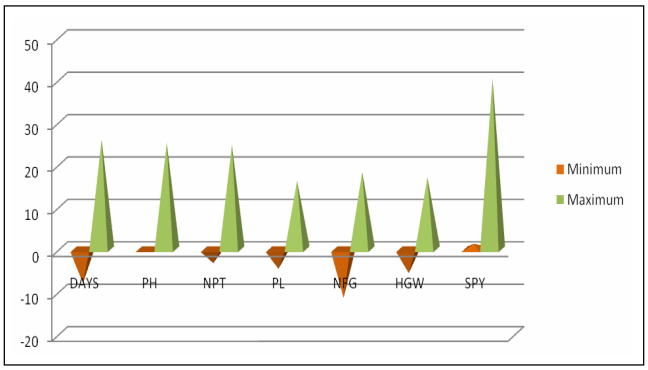

Fig. 3 : Range of heterobeltiosis for biometrical traits.

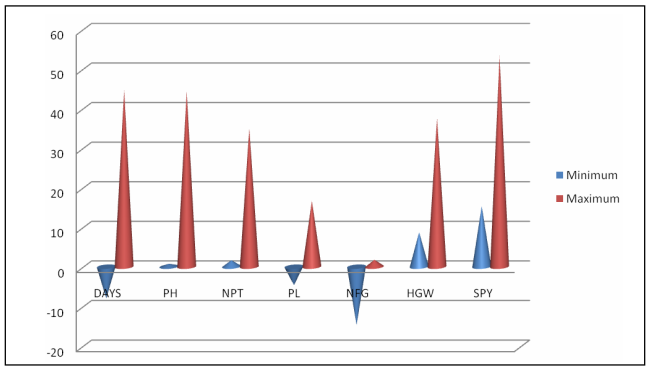

Fig. 4 : Range of standard heterosis for biometrical traits.

g). Among the parents, Veeradangan was found to be high yielder (35.46 g) and Navara was the low yielder (25.80 g). Among the parents, none of the female parents showed significant values for single plant yield. Among the F_1 hybrids maximum single plant yield was recorded in IR 72 × Veeradangan (44.80 g) and minimum in ASD 16 × Navara (33.71 g). Among the F_1 hybrids, IR 72 × Veeradangan (44.80 g), ADT 45 × Kavuni (39.09 g) and ADT 39 × Kavuni (38.54 g) and showed significance over the grand mean value (33.33 g). Overall mean performance when compared among hybrids for important yield characters and single plant yield three hybrids *viz.,* IR 72 × Veeradangan, ADT 39 × Kavuni and ADT 45 × Kavuni were found to be best hybrids for future recombination breeding.

Heterosis is a universal phenomenon and exploitation of heterosis is a quick and convenient way of combining desirable characters and hence, assumes greater significance in the development of hybrids. The heterosis per cent observed for different traits over relative heterosis, mid parent, better parent and standard check (ADT 43) given in table 3 (figs. 2, 3 and 4). Positively significant relative heterosis was recorded in ADT 39 × Kavuni (6.90%) followed by ADT 45 × Kavuni (6.07%). Negatively significant heterosis were observed for hybrid ADT 43 × Navara (-3.16%) followed by ASD 16 × Navara (-2.58%). Three hybrids were found to possess significant negative heterobeltiosis, where as two hybrids possessed significant positive heterobeltiosis. The hybrid, ADT 45 × Kavuni (25.91%) recorded higher magnitude of positive heterobeltiosis. Among the six hybrids, two hybrids registered higher magnitude of significant positive heterobeltiosis. Among them, negatively significant heterosis was observed for ADT 43 × Navara (-8.02%) followed by ASD 16 × Navara (-7.43%). Out of six hybrids, two hybrids recorded negative significant standard heterosis for days to 50 per cent flowering, three hybrids recorded significant positive standard heterosis. Three hybrids, ADT 39 × Kavuni (44.69%), ADT 45 × Kavuni (35.88) and TPS 4 × Kathanellu (6.96) had significant positive standard heterosis. The hybrids, ADT 43 × Navara (-8.02%) followed by ASD 16 × Navara (-6.70%) recorded significant negative standard heterosis. The early maturing varieties are desirable in rice all condition.

In case of plant height relative heterosis for plant height ranged from -2.23 (ADT 45 × Kavuni) to 5.34 per cent (TPS 4 × Kathanellu). Dwarf varieties are highly favourable as they confer resistance to lodging. Hence, negative heterosis for plant height is preferred in rice. Three hybrids recorded significant positive heterosis and none of the hybrid recorded significant negative heterosis for plant height. The highest significant positive relative

Table 1: Analysis of variance of parents and F_1 hybrids for biometrical traits in rice.

Source	df	Mean squares						
		Days to 50 per cent flowering	Plant height per plant	Number of productive tillers	Panicle length	Number of filled grains per panicle	Hundred grain weight	Single plant yield
Replication	2	2.82	37.92	0.15	0.04	16.31	0.001	2.02
Genotypes	15	639.78**	764.02**	7.79**	5.44**	280.69**	0.17**	71.32**
Error	30	3.40	9.59	0.15	0.56	9.89	0.004	3.11

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

Table 2 : Mean performance of parents and F_1 hybrids for biometrical traits in rice.

Source	Days to 50 per cent flowering	Plant height (cm)	Number of productive tillers per plant	Panicle length (cm)	Number of filled grains per panicle	Hundred grain weight (g)	Single plant yield (g)
Female parents							
IR 72	83.20	85.65*	13.00	23.39	118.10	2.31	32.99
ADT 39	96.00	98.32	14.60*	24.67	107.34	1.84	27.47
ADT 45	81.80	92.28*	12.20	23.76	124.70*	1.99	30.70
ADT 43	75.80*	85.18*	12.00	23.65	128.40*	1.96	29.22
ASD 16	76.40*	94.80*	12.40	23.88	114.32	2.64*	33.29
TPS 4	66.00*	74.96*	12.20	23.94	107.64	2.33	30.16
Male parents							
Veeradangan	75.40*	112.79	15.20*	22.75	97.01	2.55*	35.46*
Kavuni	112.40	138.13	10.20	26.35*	121.98*	2.33	27.94
Navara	68.20*	97.01	11.40	22.53	101.52	2.23	25.80
Kathanellu	88.80	87.97*	13.60	23.48	113.24	2.34	35.15
F_1 hybrids							
IR 72 x Veeradangan	78.04*	97.63	16.20*	24.90	112.22	2.69*	44.80*
ADT 39 x Kavuni	109.68	122.95	14.12*	24.75	127.00*	2.13	38.54*
ADT 45 x Kavuni	103.00	112.62	14.36*	27.60*	130.67*	2.18	39.09*
ADT 43 x Navara	69.72*	95.16	12.20	22.54	113.65	2.29	34.09
ASD 16 x Navara	70.72*	94.81*	15.04*	23.61	110.21	2.49*	33.71
TPS 4 x Kathanellu	81.08	85.82*	14.24*	23.58	109.65	2.35	34.81
Grand mean	83.52	98.51	13.31	24.09	114.89	2.29	33.33
SE	1.06	1.79	0.23	0.43	1.82	0.04	1.02
CD (5 %)	3.08	5.16	0.66	1.25	5.24	0.10	2.94

heterosis was recorded in TPS 4 × Kathanellu (5.34%) followed by ADT 39 × Kavuni (4.56%) and no hybrid recorded significantly negative heterosis for plant height. The heterobeltiosis for plant height ranged from 0.01 (ADT 43 × Navara) to 25.04 per cent (ADT 39 × Kavuni). Out of six hybrids, five hybrids recorded significant positive heterobeltiosis. The hybrids, ADT 39 × Kavuni (25.04%) and ADT 45 × Kavuni (22.04%) recorded significant positive heterobeltiosis. The standard heterosis ranged from 0.75 (TPS 4 × Kathanellu) to 44.34 per cent (ADT 39 × Kavuni). Among the hybrids, five hybrids recorded significant positive standard heterosis. The hybrids, ADT 39 × Kavuni (44.34%) and ADT 45 × Kavuni (32.22%) recorded significant positive standard heterosis.

All the six hybrids recorded significant positive relative heterosis for number of productive tillers per plant. The relative heterosis ranged from 4.27 (ADT 43 × Navara) to 28.21 per cent (ADT 45 × Kavuni). The hybrid, ADT 45 × Kavuni (28.21%) recorded the higher magnitude of positive relative heterosis followed by 26.38 per cent (ASD 16 × Navara). The heterobeltiosis for number of productive tillers per plant ranged from -3.28 (ADT 39 × Kavuni) to 24.61 per cent (IR 72 × Veeradangan). Among the hybrids four hybrids recorded significantly positive

heterobeltiosis. The maximum positive heterobeltiosis was recorded by IR 72 × Veeradangan (24.61%) followed by ASD 16 × Navara (21.29%). Among the six hybrids, five hybrids recorded significant positive standard heterosis for number of productive tillers per plant. The standard heterosis ranged from 1.66 (ADT 43 × Navara) to 35.00 per cent (IR 72 × Veeradangan). The highest significant positive standard heterosis was observed in IR 72 × Veeradangan (35.00%) followed by ASD 16 × Navara (25.33%) and 19.66 per cent (ADT 45 × Kavuni).

The relative heterosis for panicle length ranged from -2.36 (ADT 43 × Navara) to 10.14 per cent (ADT 45 × Kavuni). Out of six hybrids, two hybrids recorded significant positive relative heterosis. Highly significant relative heterosis was observed by ADT 45 × Kavuni (10.14%) and IR 72 × Veeradangan (7.91%). Two hybrid registered significant negative relative heterosis. The highly significant negative relative heterosis were observed in ADT 43 × Navara (-2.36%) followed by ADT 39 × Kavuni (-2.20%). The heterobeltiosis for panicle length ranged from -4.67 (ADT 43 × Navara) to 16.13 per cent (ADT 45 × Kavuni). Among hybrids, three hybrids recorded significant positive heterobeltiosis and one hybrid recorded significantly negative heterobeltiosis for the panicle length. The highest significant positive heterobeltiosis was observed in ADT 45 × Kavuni (16.13%) followed by IR 72 × Veeradangan (6.43%). Out of six hybrids one hybrid recorded significant positive and one hybrid recorded significant negative standard heterosis for panicle length. The standard heterosis ranged from -4.67 (ADT 43 × Navara) to 16.68 per cent (ADT 45 × Kavuni). The hybrid, ADT 45 × Kavuni (16.68%) recorded the highest magnitude of significant positive standard heterosis. The hybrid ADT 43 × Navara (-4.67%) recorded the higher magnitude of significant negative standard heterosis for the panicle length.

The relative heterosis for number of filled grains per panicle ranged from -1.14 (ADT 43 × Navara) to 8.94 per cent (ADT 39 × Kavuni). Among the hybrids, three hybrids recorded significant positive relative heterosis for number of filled grains per panicle. The hybrids were ADT 39 × Kavuni (8.94 %) followed by ADT 45 × Kavuni (5.94%) and IR 72 × Veeradangan (4.33%). The heterosis over better parent for number of filled grains per panicle ranged from -11.49 (ADT 43 × Navara) to 18.28 per cent (ADT 39 × Kavuni). Among the hybrids, two hybrids recorded significant positive heterobeltiosis. The highest significant positive heterobeltiosis was recorded in ADT 39 × Kavuni (18.28%) followed by ADT 45 × Kavuni (4.79%). Out of six hybrids, four hybrids recorded significant negative standard heterosis for number of filled grains per panicle. The standard heterosis ranged from -14.79 (ASD 16 × Navara) to 1.76 (ADT 45 × Kavuni). Among the hybrids, only two hybrids recorded significantly positive heterosis.

The relative heterosis for hundred grain weight ranged from 0.42 (TPS 4 × Kathanellu) to 10.95 per cent (IR 72 × Veeradangan). The hybrid IR 72 × Veeradangan (10.95%) followed by ADT 43 × Navara (9.32%) recorded higher magnitude of significant positive relative heterosis for hundred grain weight. The heterobeltiosis for hundred grain weight ranged from -5.66 (ASD 16 × Navara) to 16.96 per cent (ADT 43 × Navara). Among the hybrids, four hybrids recorded significant positive heterobeltiosis for the hundred grain weight. The highest significant positive heterobeltiosis was observed in ADT 43 × Navara (16.96%) followed by IR 72 × Veeradangan (16.76%) and ADT 39 × Kavuni (15.57%). All the six hybrids recorded significant positive standard heterosis for hundred grain weight. The standard heterosis for hundred grain weight ranged from 8.74 (ADT 39 × Kavuni) to 37.59 per cent (IR 72 × Veeradangan). The hybrid, IR 72 × Veeradangan (37.59%) followed by ASD 16 × Navara (27.03%) and TPS 4 × Kathanellu (19.89%) recorded higher magnitude of significant positive standard heterosis for hundred grain weight.

All six hybrids, recorded significant positive relative heterosis for single plant yield. The relative heterosis ranged from 6.59 (TPS 4 × Kathanellu) to 36.10 per cent (ADT 39 × Kavuni). Highly significant relative heterosis was observed by ADT 39 × Kavuni (36.10%), ADT 45 × Kavuni (33.30%) and IR 72 × Veeradangan (30.90%). The heterobeltiosis for single plant yield ranged from 1.26 (ASD 16 × Navara) to 40.31 per cent (ADT 39 × Kavuni). Five hybrids recorded significant positive heterobeltiosis for single plant yield. The highest positive heterobeltiosis was recorded in ADT 39 × Kavuni (40.31%) followed by IR 72 × Veeradangan (35.79%) and ADT 45 × Kavuni (27.30%). All the hybrids recorded significant positive standard heterosis for single plant yield. The standard heterosis ranged from 15.36 (ASD 16 × Navara) to 53.31 per cent (IR 72 × Veeradangan). Highly significant positive heterosis observed in IR 72 × Veeradangan (53.31%) followed by ADT 45 × Kavuni (33.76%) and ADT 39 × Kavuni (31.89%). All the six hybrids exhibited significant positive relative heterosis for single plant yield.

Relative heterosis is of limited importance because it is only the deviation of F_1 from mid parental value. The hybrid IR 72 × Veeradangan exhibited positive significant desirable relative heterosis for the characters *viz.,* number

Table 3 : Heterosis (per cent) for different biometrical traits.

Characters		IR 72 × Veeradangan	ADT 39 × Kavuni	ADT 45 × Kavuni	ADT 43 × Navara	ASD 16 × Navara	TPS 4 × Kathanellu
Days to 50 per cent flowering	di	-1.58	6.90**	6.07**	-3.16*	-2.58*	4.75**
	dii	-6.20**	14.25	25.91**	-8.02**	-7.43**	22.84**
	diii	2.95	44.69**	35.88**	-8.02**	-6.70**	6.96**
Plant height	di	-1.59	4.56**	-2.23	4.46**	-0.99	5.34**
	dii	13.99**	25.04**	22.04**	11.71**	0.01	14.48**
	diii	14.62**	44.34**	32.22**	11.71**	11.31**	0.75
Number of productive tillers	di	14.89**	12.06**	28.21**	4.27**	26.38**	10.38**
	dii	24.61**	-3.28	17.70**	1.66	21.29**	16.72**
	diii	35.00**	17.66**	19.66**	1.66	25.33**	18.66**
Panicle length	di	7.91**	-2.20*	10.14**	-2.36*	1.25	-0.53
	dii	6.43*	0.31*	16.13**	-4.67*	-1.13	-1.47
	diii	5.27	4.65	16.68**	-4.67*	-0.17	-0.27
Number of filled grains per panicle	di	4.33**	8.94**	5.94**	-1.14	1.02	-0.71
	dii	-4.97*	18.28**	4.79*	-11.49**	-4.29*	1.86
	diii	-12.59**	-1.09	1.76	-11.49**	-14.79**	-14.60**
Hundred grain weight	di	10.95**	1.93	0.92	9.32**	1.76	0.42
	dii	16.76**	15.57**	9.54**	16.96**	-5.66*	0.85
	diii	37.59**	8.74**	11.23**	16.96**	27.03**	19.89**
Single plant yield	di	30.90**	36.10**	33.30**	23.91**	12.59**	6.59**
	dii	35.79**	40.31**	27.30**	16.65**	1.26	15.41**
	diii	53.31**	31.89**	33.76**	16.65**	15.36**	19.11**

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

of productive tillers per plant, panicle length, number of filled grains per panicle, hundred grain weight and single plant yield. ADT 39 × Kavuni exhibited desirable positive and significant desirable relative heterosis for number of productive tillers per plant, number of filled grains per panicle and single plant yield. The hybrid ADT 45 × Kavuni showed desirable significant positive relative heterosis for number of productive tillers per plant, panicle length, number of filled grains per panicle and single plant yield. This was in accordance with the finding of Tirkey *et al.* (2006) and Tiwari *et al.* (2011).

Heterobeltiosis is a measure of hybrid vigour over the better parent. All the six hybrids exhibited significant positive heterobeltiosis for single plant yield except ASD16 × Navara. The hybrid IR 72 × Veeradangan exhibited positive significant desirable heterobeltiosis for the characters *viz.,* number of productive tillers per plant, panicle length, hundred grain weight and single plant yield and negatively significant desirable heterosis for days to 50 per cent flowering. ADT 39 × Kavuni exhibited desirable heterobeltiosis in positive and significant desirable heterobeltiosis for panicle length, number of filled grains per panicle, hundred grain weight and single plant yield. The hybrid ADT 45 × Kavuni showed desirable significant positive heterobeltiosis for number of productive tillers per plant, panicle length, number of filled grains per panicle and single plant yield. These result were in accordance with Parihar and Pathak (2008).

Standard heterosis is the one which is very important from plant breeder's point of view. Hence, for the evaluation of hybrids, standard heterosis is to be emphasized. All the six hybrids exhibited significant positive standard heterosis for single plant yield. The hybrid IR 72 × Veeradangan exhibited positive significant desirable standard heterosis for the characters *viz.,* number of productive tillers per plant, hundred grain

weight and single plant yield. ADT 39 × Kavuni exhibited positive and significant desirable standard heterosis for number of productive tillers per plant, hundred grain weight and single plant yield. The hybrid ADT45 × Kavuni showed significant positive standard heterosis for number of productive tillers per plant, panicle length, hundred grain weight and single plant yield while, ASD 16 × Navara exhibited negatively significant standard heterosis for days to 50 per cent flowering and positively significant heterosis for number of productive tillers per plant, hundred grain weight and single plant yield. The hybrid ADT 43 × Navara showed positive and significant desirable standard heterosis for hundred grain weight, single plant yield and negatively significant desirable heterosis for days to 50 per cent flowering. The hybrid TPS 4 × Kathanellu showed significant positive standard heterosis for number of productive tillers per plant, hundred grain weight and single plant yield. Similar findings were reported by Balan (2005) and Chimmili (2012). All the three heterosis *viz.,* relative heterosis, heterobeltiosis and standard heterosis discussed above were found to be best in three hybrids *viz.,* IR 72 × Veeradangan, ADT 45 × Kavuni and ADT 39 × Kavuni. Hence, it can be concluded that *per se* performance coupled with heterosis would be more reliable in identification and isolation of superior hybrids, thus weightage should be given to both *per se* performance as well as heterosis. Hence, these heterosis could be exploited through selection of superior and trait specific genotypes in the segregating generations for evolution of high yielding varieties. However, desirable transgressive segregants might be selected in succeeding generations to develop potential varieties from their progenies.

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