Plant Archives Vol. 19 No. 2, 2019 pp.4502-4504 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

HETEROSIS FOR GRAIN YIELD AND ITS COMPONENT TRAITS IN RICE (*ORYZA SATIVA* L.)

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Abstract

Six genotypes of rice namely, ADT 36, ADT 45, BPT 5204, ASD 16, ADT 37 and ADT 39 were mated in half diallel fashion. The resulting fifteen hybrids along with their parents were evaluated for grain yield and its component characters namely, days to 50 percent flowering, plant height, number of productive tillers per plant, panicle length, number of grains per panicle, 100 grain weight, kernel length, kernel breadth and kernel L/B ratio by adopting standard biometric genetic methods. The analysis of variance indicated that the parents and hybrids differed among themselves for all the ten characters studied. Among fifteen hybrids studied, five hybrids namely, BPT5204 × ASD16, ADT45 × BPT5204, ASD16 × ADT37, ADT45 × ASD16 and ADT45 × ADT37 exhibited maximum significant grain yield per plant and also recorded more than 30g of grain yield per plant. The hybrid BPT5204 × ASD16 (24.65 percent) recorded the maximum standard heterosis followed by ADT45 × BPT5204, ASD16 × ADT 37, ADT45 × ASD16 and ADT45 × ADT37 for the trait grain yield per plant.

Key words : grain yield, component traits, *Oryza sativa* L., genotypes

Introduction

Hybrids play an important role in enhanced yield production by heterosis breeding. Developing rice hybrids for both aerobic and drought prone situation is extremely essential to maintain the yields of rice for the present and the near future to keep the rice production sustainable for the growing population with the available depleting water resources. Hybrid rice is practically feasible and readily adoptable genetic option to increase rice production and has been amply demonstrated in China and India. Exploitation of heterosis is vital and considered to be one of the greatest achievements where the F_1 hybrids can be exploited commercially or can be used for selecting promising recombinants in the subsequent generations to release the best variety when it attained homozygosity.

Materials and Methods

Studies on heterosis of grain yield and its component traits in rice were investigated in the plant breeding farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, during 2015-2016. The randomly selected six rice genotypes namely, ADT36, ADT45, BPT5204, ASD16, ADT37 and ADT39 were raised in a crossing block and seedlings were transplanted in the main field adopting 30 cm between the lines and 20 cm within the lines and in between the two genotypes 50 cm spacing was maintained. Crosses were effected in all possible combinations with parental crosses in a half diallel mating design of Model I, Method II (Griffing, 1956) by adopting hand emasculation and artificial pollination. A total of 15 cross combinations were obtained. The matured set seeds were collected. The seeds were cleaned, dried and stored carefully for raising the F_1 generation.

All the 15 hybrids (direct crosses) along with their parents were raised in Randomized Block Design (RBD) with three replications during *Kuruvai* (June-September) season. Each genotype was accommodated in a single row of 1.5m length And single seedling was planted per hill. The spacing adopted was 30cm between rows and 20cm between plants. The recommended agronomic practices were followed. During the flowering period, five competitive plants in each of F_1 hybrid and parent were selected at random and tagged. The data for the traits namely, Days to 50 percent flowering, Number of productive tillers per plant, Plant height (cm), Panicle

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Table 1: Analysis of variance of RBD for parents and hybrids.

Source of vairation	Degrees of freedeom (df)	Days to 50 percent flowering	No. of productive tillers per plant	Plant height	Panicle length	No. of grains per panicle	100 grain weight	Grain yield per plant	Kernel length	Kernel breadth	Kernel L/B ratio
Replication	2	4.09	1.75	2.08	1.94	5.19	0.0002	1.09	0.001	0.003	0.01
Genotype	20	65.54**	50.83**	493.81**	48.21**	892.34**	0.27**	53.65**	0.27**	0.17**	0.29**
Error	40	0.65	0.09	2.22	0.31	3.99	0.003	0.38	0.002	0.002	0.002
SE (d)	-	0.66	0.25	1.22	0.45	1.63	0.04	0.50	0.03	0.03	0.43
CD (5%)	-	1.32	0.50	2.44	0.91	3.28	0.09	1.01	7.54	0.06	8.56
CD (1%)	-	1.76	0.67	3.26	1.21	4.37	0.12	1.34	0.10	8.39	0.11

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

length (cm), Number of grains per panicle, 100 grain weight (g), Grain yield per plant (g), Kernel length (mm), Kernel breadth (mm) and Kernel L/B Ratio were recorded.

Results and Discussion

Hybridization aims to combine the favorable genes present in different parents into a single genotype. The hybrids thus obtained may be utilized in two ways i) Utilizing the F_1 hybrids commercially with a view to exploit heterosis and ii) Selecting superior segregants from the hybrids in the subsequent generations and releasing best performing recombinants after attaining homozygosity. The utilization of hybrids will depend upon its genetic constitution which is measured based on the parameters like *per se* performance of hybrids and standard heterosis. Many researchers stressed that the *per se* performance is a useful index to evaluate and to select the hybrids. Among fifteen hybrids studied, five hybrids namely, BPT5204 × ASD16, ADT45 × BPT5204, ASD16 × ADT37, ADT45 × ASD16 and ADT45 × ADT37 exhibited maximum significant grain yield per plant and also recorded more than 30g of grain yield per plant.

The phenomenon of hybrid vigour has been extensively met in rice for enhancing the grain yield. A good selected hybrid should manifest high amount of heterosis for commercial exploitation. Among the three types of heterosis, the need for computing standard heterosis for exploitation of hybrid vigour has been stressed by Swaminathan *et al.,* (1972), Kadambavanasundaram, (1983) and Siddiq, (1987). Hence, in the present study, the hybrids were evaluated based on standard heterosis over the standard variety BPT5204 and promising hybrids were selected based on standard heterosis.

The hybrid BPT5204 × ASD16 (24.65 percent) recorded the maximum standard heterosis followed by ADT45 × BPT5204, ASD16 × ADT37, ADT 45 × ASD16 and ADT45 × ADT37 for the trait grain yield per plant. The above hybrids which recorded the maximum standard heterosis for grain yield per plant also registered significant favorable high standard heterosis for the traits *viz*., days to 50 percent flowering, except in the hybrid ADT45 × ADT37, number of productive tillers per plant, plant height, number of grains per panicle, 100 grain weight except in the hybrid ADT45 × BPT5204, kernel breadth except in the hybrid ADT45 × ASD16 and kernel L/B ratio. The hybrid ADT45 × BPT5204 which recorded

Table 2: Performance of best five crosses selected for grain yield per plant based on standard heterosis (diii), for other traits in percent.

Traits \ CROSSES	BPT5204 ×ASD16 (24.65**)	ADT45 × BPT5204 (19.97**)	ASD16 ×ADT37 (18.65**)	ADT45 ×ASD16 (17.45**)	ADT45 ×ADT37 (14.33**)
Days to 50 per cent flowering	-13.77**	-13.24**	-8.61**	-11.24**	-5.81**
Number of productive tillers per plant	30.75**	47.66**	14.75**	36.20**	34.89**
Plant height	-32.83**	-34.31**	-33.72**	-30.85**	-26.70**
Panicle length	7.15**	14.65**	-17.23**	-2.46	-9.26**
Number of grains per panicle	26.62**	28.74**	38.76**	34.21**	29.65**
100 grain weight	15.52**	1.76	22.57**	13.76**	23.46**
Kernel length	5.55**	1.93**	5.01**	5.25**	6.94**
Kernel breadth	-13.28**	-10.65**	-23.37**	-4.29**	-28.22**
Kernel L/B ratio	21.66**	14.10**	37.06**	10.61**	48.98**

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

Table 3: Relationship between *Per se*, performance and Standard heterosis.

Crosses / Traits	High Mean performance	High Standard heterosis	Percent Standard heterosis
Days to 50 percent flowering	ASDI6 × ADT39	ASD16 × ADT39	-14.09
	BPT5204 × ASD16	BPY5204 × ASD16	-13.77
	ADT45 × BPT5204	ADT45 × BPT5204	-13.24
	ADT45 × ASD16	ADT45 × ASD16	-11.24
	ADT37 × ADT39	ADT37×ADT39	-09.90
Number of productive tillers per plant	ADT45 × BPT5204	ADT45 × BPT5204	47.66
	ADT45 × ASD16	ADT45 × ASD16	36.20
	ADT45 × ADT37	ADT45 × ADT37	34.89
	BPT5204 × ASD16	BPT5204 × ASD16	30.75
	ADT45 × ADT39	APT45 × APT39	15.72
Plant height	ADT45 × BPT5204	ADT45 × BPT5204	-34.31
	ASD16 × ADT37	ASD16 × ADT37	-33.72
	BPT5204 × ASD16	BPT5204 × ASD16	-32.83
	ADT45 × ASD16	ADT45 × ASD16	-30.85
	ADT36 × ADT37	ADT36 × ADT37	-27.89
Panicle length	ADT45 × BPT5204	ADT45 × BPT5204	14.65
	BPT5204 × ASD16	BPT5204 × ASD16	7.15
	ADT45 × ASD16	ADT45 × ASD16	-2.46
	BPT5204 × ADT39	BPT5204 × ADT39	-5.28
	BPT5204 × ADT37	BPT5204 × ADT37	-8.79
Number of grains per panicle	ASD16 × ADT37	ASD16 × ADT37	38.76
	ADT45 × ASD16	ADT45 × ASD16	34.21
	ADT37 × ADT39	ADT37 × ADT39	30.87
	ADT45 × ADT37	ADT45 × ADT37	29.65
	ADT4 5 × BPT5204	ADT45 × BPT5204	28.74
100 grain weight	ADT37 × ADT39	ADT37 × ADT39	25.75
	ADT45 × ADT37	ADT45 × ADT37	23.46
	ASD16 × ADT37	ASD16 × ADT37	22.57
	ADT45 × ADT39	ADT45 × ADT39	16.05
	BPT5204 × ASD16	BPT5204 × ASD16	15.52
Grain yield per plant	BPT5204 × ASD16	BPT5204 × ASD16	24.65
	ADT45 × BPT5204	ADT45 × BPT5204	19.97
	ASD16 × ADT37	ASD16 × ADT37	18.65
	ADT45 × ASD16	ADT45 × ASD16	17.45
	ADT45 × ADT37	ADT45 × ADT37	14.33
Kernel length	ADT45 × ADT39	ADT45 × ADT39	10.68
	ADT36 × ADT45	ADT36 × ADT45	10.37
	ADT36 × BPT5204	ADT36 × BPT5204	9.95
	BPT5204 × ADT39	BPT5204 × ADT39	9.47
	ADT45 × ADT37	ADT45 × ADT37	6.94
Kernel breadth	ADT45 × ADT37	ADT45 × ADT37	-28.22
	BPT5204 × ADT37	BPT5204 × ADT37	-26.83
	ADT36 × ADT37	ADT36 × ADT37	-23.93
	ASD16 × ADT37	ASD16 × ADT37	-23.37
	ADT36 ×ASD16	ADT36 × ASD16	-14.80
Kernel L/B ratio	ADT45 × ADT37	ADT45 × ADT37	48.98
	ASD16 × ADT37	ASD16 × ADT37	37.06
	ADT36 × ADT37	ADT36 × ADT37	35.76
	BPT5204 × ADT37	BPT5204 × ADT37	35.03
	BPT5204 × ADT39	BPT5204 × ADT39	26.60

high standard heterosis for grain yield alone exhibited high standard heterosis for the trait panicle length.

None of the hybrids have recorded standard heterosis for all the characters studied. However the hybrids which recorded maximum standard heterosis for grain yield also expressed significant standard heterosis for many of the traits studied. Heterotic vigour achieved in F_1 generation of the above cross combinations should be given due consideration in self pollinated crops like rice as heterotic crosses may give transgressive segregants in the later generation. The above hybrid cross combination can be utilized for commercial cultivation, provided with cytoplasmic genetic male sterility system.

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