

Genetic Analysis on Three Line Rice Hybrids under Aerobic Condition

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Abstract The present study was conducted with a view to study the genetic properties of the population based on which breeding methods are to be formulated to improve of the crop. Drought and yield attributing characters were studied for estimates of heritability, coefficients of variability and genetic advance. Out of 19 characters seven drought tolerant traits and five yield contributing traits showed high heritability accompanied with high genetic advance indicating lesser environmental influence and were under the control of additive gene effect.

Keywords Drought, Variability, Biometrical, Physiological, Aerobic.

Introduction

Rice (*Oryza sativa* L.) is the world's most important cereal crop and is the staple food for more than half of the world's population [1]. China has pioneered the advantages of heterosis in promoting the successful use of hybrid rice which has resulted instead increase in annual grain production from 0.33 billion tonnes to 0.5 billion tonnes. Per capita annual grain consumption in China is up to 0.4 tonnes. This progress has reversed the fundamental problem of chronic food shortages and realized the basic coordination of grain supply and demand [2]. However, with an increasing world population and gradually deteriorating environment, food security has become a major challenge around the world, especially in Asia and Africa [3—5]. Great cooperation and dedication is needed to break through the yield barrier by increasing the rice yield per unit area [6].

Rice is the single largest user of water, requiring two to three times more water input (rain, irrigation) per unit of grain produced than the major cereal crops, such as wheat and maize. Various field techniques to save irrigation water have been explored. Aerobic rice is one such option to decrease water requirements in rice production. Hybrid rice technology had also shown increased yield, farmer profitability and better adaptability to stress environments such as water scarce and aerobic conditions.

The success of plant breeding program depends to a greater extent on the knowledge of the genetic

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Table 1. Analysis of variance for combining ability for different biometrical traits in parents and hybrids. **Significant at 1% level.

Source of variation	df	Days to 50 per cent flowering	Plant height	Productive tillers per plant	Panicles per plant	Panicle length	Spikelet fertility	Filled grains per panicle	Hundred grain weight	Harvest index	Single plant yield
Replication	1	3.563	0.0393	0.054	0.0001	0.068	4.059	1.605	0.002	0.001	2.01
Hybrids	89	45.840**	60.724**	6.757**	11.692**	2.126**	40.081**	1257.936**	0.336**	0.01**	84.60**
Lines	5	116.875**	112.597**	8.287**	55.170**	4.156**	19.016**	1919.817**	3.216**	0.02**	11.18**
Testers	14	30.490**	51.784**	5.032**	7.494**	1.089**	63.989**	877.262**	0.102**	0.91**	145.82**
Line×Tester interaction	70	43.836**	58.808**	6.992**	9.426**	2.189**	36.804**	1286.794**	0.177**	0.01**	77.40**
Error	89	23.984	2.425	0.115	0.081	1.572	2.370	9.411	0.052	0.010	5.140

architecture i.e. types of gene action of the population for selection of an appropriate breeding method for the improvement of quantitative and qualitative traits of interest [7].

These factors formed the base to carry out the present experiment on aerobic rice with the objective to estimate the genetic component of variance for drought tolerance, yield and yield components involving aerobic cultivars and to compute the heritability and genetic advance for 19 characters.

Materials and Methods

Production of hybrids using three line breeding systems

The study was conducted at Agricultural College and Research Institute, Madurai, Tamil Nadu, India during 2009-2011. Six Lines and 15 Testers were crossed by 'line × Tester' mating design [8]. The 111 genotypes including the hybrids along with their parents and one check were raised in a randomized block design (RBD) with three replications under non-puddled and non-flooded aerobic condition.

Evaluation of rice hybrids under aerobic condition

The hybrids along with the ir parents were maintained under irrigated condition up to 55 days. From 56th day onwards the treatment plot was maintained under aerobic condition. Soil sampling was carried out

before and after every irrigation to assess the soil moisture content. Irrigation was given only when hair-line crack was noticed in the treatment plot and the control plot was maintained normally under flooded condition till maturity. Five plants selected at random were tagged. Data was recorded at panicle initiation (75-80 days), flowering and maturity stages for physiological and quantitative traits on B lines and their corresponding A lines.

Data analysis

The standard evaluation system was used to record observations on drought tolerant, yield and its component traits viz., Days to 50% flowering (DF), plant height (PH) number of productive tillers per plant (PT), number of panicles per plant (PP), panicle length (PL),

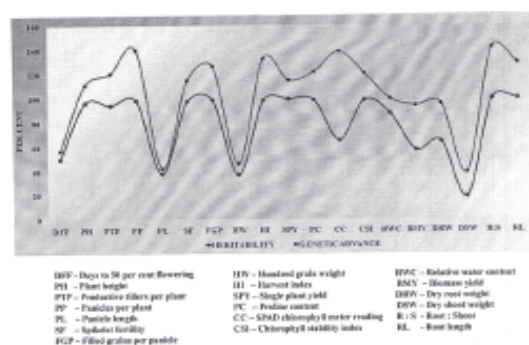
**Fig. 1.** Heritability and genetic advance for single plant yield and its components.

Table 2. Analysis of variance for combining ability for different physiological traits in parents and hybrids. **Significant at 1% level.

Source of variation	d f	Mean squares								
		Proline content	SPAD Chlorophyll meter reading	Chlorophyll stability index	Relative water content	Biomass yield	Dry Root weight	Dry shoot weight	Root : shoot ratio	Root length
Replication	1	0.59	1.23	1.15	0.01	15.15	0.01	2.89	0.001	0.001
Hybrids	89	95.78**	31.41**	339.80**	144.13**	51.48**	1.68**	9.06**	0.007**	0.002**
Lines	5	22.34**	54.21**	877.14**	496.14**	26.66**	15.88**	28.09**	0.04**	0.005**
Testers	14	191.09**	38.85**	285.14**	71.35**	71.35**	0.78**	7.21**	0.005**	0.002**
Line × tester interaction	70	81.97**	28.29**	312.35**	133.54**	49.28**	0.85**	8.07**	0.004**	0.002**
Error	89	0.620	0.527	0.634	0.530	5.400	0.260	5.840	0.003	0.001

filled grains per panicle (FG), spikelet fertility (SF), hundred grain weight (HGW), proline content (PC), SPAD chlorophyll meter reading (SCMR), chlorophyll stability index (CSI), relative water content (RWC), biomass yield (BMY), dry shoot weight (DSW), dry root weight (DRW), root/shoot ratio (RS), root length (RL), harvest index (HI), single plant yield (YLD) under water stress and fully irrigated (control) conditions. Analysis of variance of RBD and their significance for all the characters were worked out as suggested by standard method. Phenotypic and geno-

typic coefficients of variability (PCV and GCV) were worked out. Broad sense Heritability (h^2) was calculated and the genetic advance was derived [9].

Results and Discussion

Analysis of variance and line × tester interaction showed significant differences among the parents and hybrids for all the traits studied. The combining ability analysis showed that the specific combining ability effects were higher than the GCA effects (Tables 1

Table 3. Variability parameters for different traits.

Characters	PCV (%)	GCV (%)	Heritability (%)	Genetic advance (%)
Days to 50% flowering	6.71	4.73	50.00	6.88
Plant height	7.52	7.36	96.00	14.83
Productive tillers per plant	13.49	13.09	94.00	26.16
Panicles per plant	20.61	20.39	98.00	41.57
Panicle length	5.37	3.33	38.00	4.25
Spikelet fertility	8.74	8.62	97.00	17.49
Filled grains per panicle	13.91	13.78	98.00	28.13
100-grain weight	12.10	7.34	37.00	9.18
Harvest index	16.96	16.81	98.00	34.33
Single plant yield	7.65	7.62	99.00	15.61
Proline content	11.55	11.43	98.00	23.31
SPAD chlorophyll meter reading	35.58	35.51	65.00	73.02
Chlorophyll stability index	10.96	10.85	98.00	72.10
Relative water content	6.75	6.30	87.00	22.13
Biomass yield	30.81	23.33	57.00	36.39
Dry root weight	23.21	18.62	64.00	30.77
Dry shoot weight	32.50	18.03	18.03	20.60
Root : Shoot ratio	20.64	20.50	99.00	41.93
Root length	14.35	14.29	99.00	29.32

and 2). The findings reported by [10] coincided with the present observations that high phenotypic coefficient of variation on SPAD chlorophyll meter reading (35.58) followed by dry shoot weight (32.50) and biomass yield (30.80) and low phenotypic coefficient of variation in days to 50% flowering (6.71). Genotypic coefficient of variation showed similar observation as PCV. The PCV value was found to be higher in all the 19 characters studied than the GCV and their difference indicated less environmental influence on those 19 characters. In this experiment environment played its role in modifying the value of genotypic coefficient in phenotypic coefficient particularly in case of 100 grain weight, biomass yield, dry root weight and dry shoot weight where the coefficient changed from 7.34 to 12.10, 23.33 to 30.81, 18.62 to 23.21 and 18.03 to 32.50 respectively (Table 3)

Low, moderate and high estimates of broad sense heritability and genetic advance were observed in 19 traits (Table 3) and (Fig. 1).

Selection may be effective for the traits productive tillers per plant, panicles per plant, filled grains per panicle, harvest index, proline content, SPAD chlorophyll meter reading, chlorophyll stability index, biomass yield, dry root weight, dry shoot weight, root : shoot ratio and root length due to high heritability with high genetic advance and lesser environmental influence. This was in conformity with the earlier findings [11]. Sebesan et al. [12] reported similar results for days to 50% flowering, panicle length and 100 grain weight. High heritability and moderate genetic advance was observed in plant height spikelet fertility, single plant yield, relative water content. This is in accordance with the earlier reports for days to 50% flowering [13], plant height and 100 grain weight; for plant height [14] spikelet fertility, single plant yield, dry shoot weight and relative water content.

Conclusion

Genetic variability studies provide basic information regarding the genetic properties of the population based on which breeding methods are formulated for

further improvement of the crop. Considering the fact that Heritability gives the information on the magnitude of inheritance of quantitative traits, while genetic advance will be helpful in formulating suitable selection procedures based on the above results the traits reflecting high heritability with high genetic advance can be given importance while selection and the genotypes that are showing these results can utilized in the further crop improvement program.

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