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GENETIC ANALYSIS THREE LINE RICE HYBRIDS YIELD AND YIELD ATTRIBUTING CHARACTERS UNDER AEROBIC CONDITION

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ABSTRACT

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. The estimates of heritability, coefficients of variability and genetic advance computed for 19 characters including drought and yield contributing traits.

The traits *viz*., 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 had high heritability accompanied with high genetic advance indicating lesser environmental influence and were under the control of additive gene effect.

KEYWORDS: Aerobic Rice, Additive Gene Action, Genetic Advance, Heritability

INTRODUCTION

Rice (*Oryza sativa* L.), a member of poaceae family, is one of the world's most important food crops, feeding more than half of the world's population. It is the most diversified crop due to its adaptation to wide range of geographical and climatic regimes. According to estimates from the United States Department of Agriculture, the average world rice productivity was 3.59 tonnes per hectare with a production of 452 million tones from 155.3 million hectares. The world population, particularly in the rice consuming countries is increasing at a faster rate. By the year 2025, about 756 million tonnes of paddy, which is 70 per cent, more than the current production, will be needed to meet the growing demand (Tuong and Bowman, 2002). 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 programme depends to a greater extent on the knowledge of the genetic architecture of the population and selection of appropriate breeding method for the improvement of traits of interest. It is essential to estimate the various types of gene action for the selection of appropriate breeding procedure to improve the quantitative and qualitative characters (Banumathy *et al.*, 2003).

Keeping in view the genetic studies in aerobic rice were undertaken 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

The study was conducted in the Research farm of the Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Madurai, Tamil Nadu, India during 2009-2011. Six Lines and 15 Testers were subjected to crossing by 'Line x Tester' mating design (Kempthorne, 1957). Ninety hybrids along with six lines, 15 testers and one check were raised in a Randomized Block Design (RBD) with three replications under non-puddled and non flooded aerobic soil, during Rabi, 2010. The hybrids along with their parents were maintained under irrigated condition upto 55 days. From the 56th day onwards the treatment plot was maintained under aerobic condition. For every irrigation thereafter, soil sampling was carried out before and after 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 under normal flooded condition till maturity. Five plants were selected at random and tagged. Data were recorded at panicle initiation (75-80 days), flowering and maturity stages for physiological and quantitative traits. Observations of B lines were recorded for the corresponding A lines.

Observations were recorded for the drought tolerant, yield and its component traits *viz*., Days to 50 per cent flowering (DF), Plant height (PH), Number of Productive tillers per plant (PT), Number of panicles per plant (PP), Panicle length (PL), 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 as per the Standard Evaluation System (1996). The analysis of variance of RBD and their significance for all the characters were worked out as suggested by Panse and Sukhatme (1964). Phenotypic and genotypic co-efficient of variability (PCV and GCV) were worked out as described by Burton (1952). Heritability (h^2) in the broad sense was calculated according to Lush Jay (1940). Genetic advance was derived according to the method of Johnson *et al.* (1955 a).

RESULTS AND DISCUSSIONS

Analysis of variance showed significant differences among the parents and hybrids for all the traits studied. The line x tester interaction was significant for all the characters studied. Further, ANOVA for combining ability revealed that the specific combining ability effects were higher than the *gca* effects (Table I and II). Data in the Table III depicted that genetic variability existed in most of the 19 characters and was estimated on the basis of phenotypic and genotypic co-efficient of variations. Highest phenotypic co-efficient of variation was observed in SPAD Chlorophyll meter reading (35.58) followed by Dry shoot weight (32.50) and Biomass yield (30.80). Similar findings were reported by Muhammad Rashid *et al*. (2007). Minimum level of phenotypic co-efficient of variation was recorded in Days to 50 per cent flowering (6.71). Almost similar pattern was observed in genotypic co-efficient of variation. The PCV value was found to be higher in all the 19 characters studied than the GCV. The differences between PCV and GCV for the 19 characters were very less indicating less environmental influence on those characters. 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 to12.10, 23.33 to 30.81, 18.62 to 23.21 and 18.03 to 32.50 respectively.

Low, moderate and high estimates of broad sense heritability and genetic advance was observed in 19 traits (Table III) and (Figure 1).

High heritability accompanied with high genetic advance was recorded in 12 traits *viz*., 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 had indicating lesser environmental influence and the heritability is due to additive gene effects and selection may be effective. This was in conformity with the earlier findings of Utharasu. (2007). Moderate heritability along with low genetic advance was observed in days to 50 per cent flowering, panicle length and 100 grain weight. Similar results were reported by Sabesan *et al*. (2009). Low heritability and high genetic advance was recorded by dry shoot 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 reports of Sheeba *et al*. (2010) for days to 50 per cent flowering, plant height and 100 grain weight; Malarvizhi *et al*. (2010) for plant height, spikelet fertility, single plant yield, dry shoot weight and relative water content.

CONCLUSIONS

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 programme.

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APPENDICES

Table 1: Analysis of Variance for Combining Ability for Different Biometrical traits in Parents and Hybrids

Source of Variation	df	Mean Squares									
		Days to 50 Percent 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**	0.01**	145.82**
Line x 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

** Significant at 1% level

Table 2: Analysis of Variance for Combining Ability for Different Physiological Traits in Parents and Hybrids

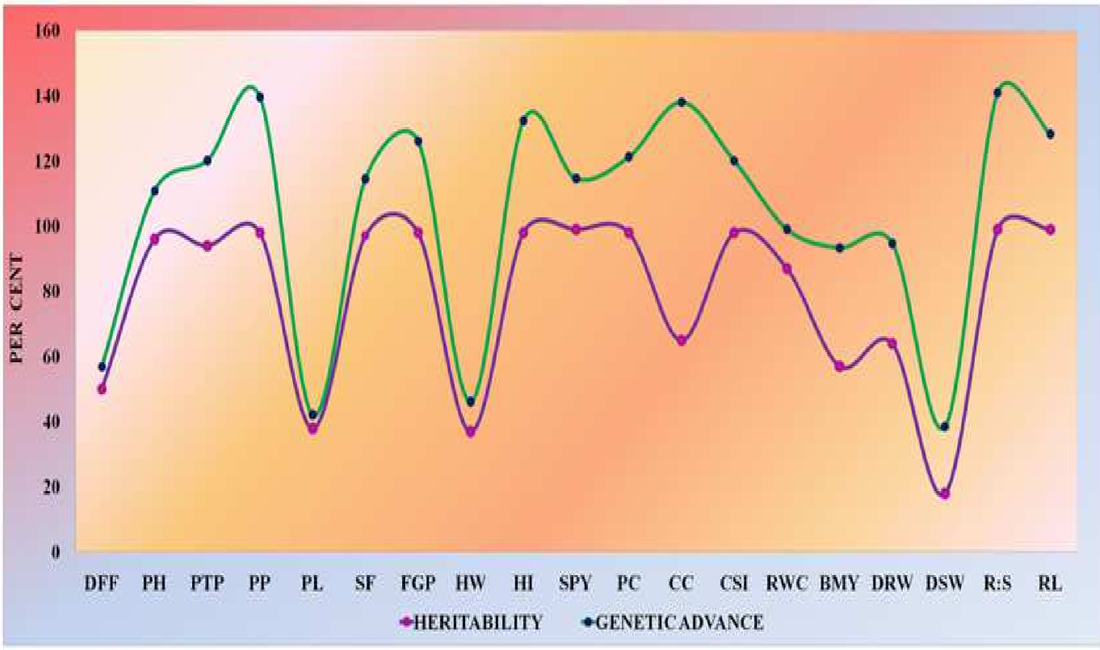
Source of Variation	df	Mean Squares								
		Proline Content	SPAD Chlorophyll Meter Reading	Chlorophyll Stability Index	Relative Water Content	Biomass Yield	Dry Root Weight	Dry Shoot Weight	Root : Shoot Ratio	Root Length
Replication	1	0.59	1.23	1.15	0.01	15.15	0.01	2.89	0.001	0.001
Hybrids	89	95.78**	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 x 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

** Significant at 1% level

Table 3: Variability Parameters for Different Traits

Characters	PCV (%)	GCV (%)	Heritability (%)	Genetic Advance as Percent of Mean
Days to 50 per cent 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	22.10
Relative water content	6.75	6.30	87.00	12.13
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

Figure 1: Heritabilty and Genetic Advance for Single Planty Yield and Its Components



DFF - Days to 50 per cent flowering
PH - Plant height
PTP – Productive tillers per plant
PP – Panicles per plant
PL – Panicle length
SF – Spikelet fertility
FGP – Filled grains per panicle
HW – Hundred grain weight
HI – Harvest index
SPY – Single plant yield
PC – Proline content
CC – SPAD chlorophyll meter reading
CSI – Chlorophyll stability index
RWC – Relative water content
BMY – Biomass yield
DRW – Dry root weight
DSW – Dry shoot weight
R : S - Root : Shoot
RL - Root length