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Genetic Variability, Heritability and Genetic Advance for Zinc Concentration and Yield related Traits of Genotypes of Rice (*Oryza sativa* L.) grown under Aerobic condition

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ABSTRACT

Aerobic cultivation system of rice is important to meet the growing food demand as irrigated cultivation system faces limitation due to scarcity of water resources. Considering it, present investigation was carried out to identify potential genotypes which can suite aerobic condition. Ten genotypes were evaluated in a randomised blocked design with five replications. All genotypes exhibited significant variation for all the traits. The phenotypic coefficient of variation was slightly greater than genotypic coefficient of variation indicating a negligible influence of environment over these traits.

All the characters recorded high heritability ranging from 61.89 to 96.19 percent. Heritability in conjugation with high genetic advance per mean for all the traits were recorded indicating that these traits could be use in future hybridization programme.

Key words: *Aerobic rice, Genotypic Coefficient of Variation, Heritability, Genetic Advance as percent of Mean.*

INTRODUCTION

Rice is one of the significant cereal commodities which fulfils nutrition requirement of billions of world's populations. Total rice production is increased to 490.9 million metric tons worldwide[1] and among that 90 percent is produce and consume in developing countries. As the world's population is increases, the demand for production of rice is also rises to meet the growing demand.

In recent years, the increases in rice yield have resulted from intensive research in irrigated rice varieties but as fresh water resources are declining, growing of rice under aerobic condition is gaining popularity. But research finding on performance of rice under aerobic condition is very limited. Development of variety under such condition require a thorough knowledge of genetic variation of yield contributing characters[2].

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The observed variability is a combined contribution of genetic and environmental factors whereas genetic variability is heritable. Knowledge of genetic variation is the basis of selection of genotypes for development of new varieties and heritability is one of the key estimates for the selection. Heritability estimates along with genetic advance is more helpful in predicting expected genetic gain in the succeeding generation.

In this instance, Akinwale *et al*.,[3] reported high to medium sense of heritability for days to heading, days to maturity, plant height, number of panicles and grain yield while Abebe *et al*.,[4] reported high to medium heritability with high genotypic coefficient of variation (GCV) and genetic advance as percent of mean (GAM) for various agronomic traits in 36 rice genotypes suggesting a high component of heritable portion of variation. Fentie *et al*.,[5] evaluated 12 upland rice genotypes and reported existence of adequate genetic variability, heritability and genetic advance among the tested materials.

As estimation of performance of genotypes for yield attributing characters and genetic variability is important before launching a breeding programme and limited reports are available regarding performance of genotypes in aerobic condition. Therefore, the present study was carried out to asses the mean performance and extent of genetic variability, heritability and genetic advance among ten rice genotypes for yield and related traits in aerobic condition.

MATERIAL AND METHODS

Experimental conditions

The present investigation was carried out in *Kharif* 2017 at the experimental sites of the Department of Plant Biotechnology, UAS, GKVK, Bengaluru.

The experiment was laid out in Randomized Complete Block Design (RCBD) with five replications. To meet the nutrient demand of the crop, fertilizers were applied according to the standard package and practises. As the experiment was done in aerobic condition, irrigation was done at four days interval for all plots. All other necessary measures were taken to control weed, pest and disease infestation.

The ten rice genotypes used in this experiment included three aerobic rice genotypes (ARB-6, AM-72, AM-65) and other upland (Azucena) and irrigated rice varieties (Chittimutyalu, Burma Black, Azucena, Moroberakan, Black rice, Ratnachudi). Morphological and yield related observations were recorded on days to 50 % flowering, days to maturity, plant height (cm), number of tillers per plant, number of productive tillers per plant, panicle length (cm), days of maturity at appropriate stages of crop and grain yield per plant(g). Biomass of plant (g) after harvest.

Statistical analysis

Mean values of five replication was used from different plant traits of all the genotypes. The results were analyzed by analysis of variance (ANOVA). When ANOVA values were significant, means were compared using Duncan Multiple Range test at 5% level probability level using SPSS version 15.0.

The phenotypic and genotypic variance and coefficient of variation were estimated according to the methods suggested by Burton and Devane, 1953[6]. Heritability (h2) in broad sense and genetic advance (GA) were computed using the formula adopted by Hanson *et al*.,.[7]

RESULTS AND DISCUSSION

Varietal performance for yield related traits

Analysis of variance showed a wide range of variation among the rice genotypes for twelve quantitative characters (Table 1). The analysis of data revealed highly significant variance due to treatment, suggesting inherent genetic difference among the genotypes. Significant genetic variation in various component characters exhibited by the genotypes indicated the efficiency of selection of these characters (Table 2). Similar findings were also reported by Shahrier *et al*.,[8] for all the traits in 34 rice genotypes and Abebe *et al*.,[4]

for 13 yield related characters in 36 rice genotypes. Further mean performance of all the characters are presented in Table 2.

Among the traits, days to attain 50% flowering varies from 76 (Black rice) to 140 (Jeergasamba) with an average of 113.13 days while plant height varies from 76 to 140 with an average of 104.36cm. The number of tillers varies from 8.8 (AM-65) to 24.6 (Chittimutyalu) with an average of 15.02 and the number of productive tillers varies from 8.8 (AM-65) to 24.6 (Chittimutyalu) with an average of 15.02. Grain length varies from 1.4 (Chittimutyalu) to 2.9 (Azucena) with an average of 2.14 mm and grain breadth varies from 0.68 (Chittimutyalu) to 1.8 (Azucena) with an average of 0.95 mm. Grain Length and Breadth Ratio (LBR) varies from 1.61 to 3.45 with an average of 2.39 while biomass yield per plant varies from 18.82 (AM-65) to 61.45 (Moroberekan) with an average of 36.36 g. Grain yield varies from 12.86 (Chittimutyalu) to 41.79 (Azucena) with an average of 22.2 g per plant. As a wider variation was observed among the genotypes for all the characters hence these traits can be effectively used for selection of better performing genotype in aerobic condition. Kumar *et al*.,[9] observed considerable differences for agro morphological traits in both early and medium maturing rice genotypes, indicating a wider variability and room for improvement through selection.

Phenotypic and genotypic variability

The Phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were categorised as low (0-10%), moderate (10-20%) and high (>20%) as indicated by Sivasubramanian *et al*.,[10]. According to this classification, a high GCV and PCV was recorded for all the traits which indicated the possibility of improvement of these traits.

Further in the current study, a small difference was recorded between GCV and PCV. Environmental influence of any traits is indicated by the magnitude of difference between genotypic and phenotypic coefficient of variation, large difference reflect a large environmental effect whereas small differences reveal a high genetic influence. A narrow magnitude of the difference of PCV and GCV for all the studied characters was recorded means the environmental effect on these traits are less. The result is in agree with Idris and Mohamed, 2013[11] who reported small differences between genotypic and phenotypic coefficients of variations for plant height and panicle length., Khatun *et al*.,[12] also reported narrow magnitude of PCV and GCV for days to attain 50% flowering, days to maturity, grain length, stomatal conductance in rice. Thus, selection based on the phenotypic performance of these characters would be effective to bring about considerable genetic improvement.

Heritability and genetic advance

Heritability is classified as low (below 30%), medium (30-60%) and high (above 60%) as suggested by Johnson *et al*.,[13]. Considering this delineation, high heritability was observed for all the characters which suggest that these traits were less influenced by the environment in their expression. Hence, rice breeders can make a superior genotypic selection based on the phenotypic performance of these characters[14].

Heritability in conjugation with genetic advance give a more reliable selection value[14]. In the present study, high GAM was observed for all the traits in both the condition. Shrivastava *et al*.,[15] noticed similar result for culm length, number of unfilled grain per panicle, biomass yield and grain yield. Babu *et al*.,[16] reported similar observation for grain iron content. This result is also supported by Mulugeta and Firew.,[17] for biomass yield and number of unfilled grains per panicle.

In the present study, high heritability in conjugation with high GCV and GAM was recorded for all the traits indicating that these traits were under genetic influence and controlled by additive gene actions. Hence, simple selection could be effective to improve these traits.

Table 1: Analysis of variance for yield and its associated traits in selected rice accessions in aerobic condition

		Mean Sum of Squares											
Source of variation	**df**	**DTF**	**PHT**	**NTL**	**NPT**	**PL**	**DTM**	**GL**	**GB**	**LBR**	**BY/P**	**GY/P**	**HI**
Genotype	9	1082.01**	1508.91**	168.31**	189.19**	61.84**	1005.24**	0.45**	0.01**	0.26**	554.31**	68.15*	.12**
Replication	2	3.22	55.60	16.10	37.80	25.22	44.03	.02	.007	.013	3.05	3.29	.13
Error	18	3.51	20.757	11.76	9.312	5.13	25.70	0.0098	0.004	0.033	28.29	28.02	.02
CV		1.55	5.202	18.69	17.25	11.574	3.358	4.657	7.102	7.701	15.53	34.75	30.36

**Significant at <.01 level * Significant at <.05 level ns=Non-significant

DTF = Days to Flowering PHT = Plant Height (cm) NPT = Number of Productive tillers PL=Panicle Length NTL=Number of Tillers DTM=Days to Maturity GL=Grain Length GB=Grain Breath LBR=Grain Length Breath Ratio BY/P=Biomass per Plant GY/P=Grain Yield per Plant HI= Harvest Index

Table 2: Mean values of traits observed in selected genotypes under aerobic condition

Genotypes	**DTF**	**PH**	**TL**	**NPT**	**PL**	**DTM**	**GL**	**GB**	**LBR**	**BY/P**	**GY/P**	**HI**
ARB-6	111.000	94.733	19.133	18.133	21.733	134.667	2.580	0.842	3.549	36.650	24.880	0.675
AM-65	108.000	122.400	8.733	10.533	25.200	145.333	2.227	0.927	2.415	18.821	17.093	0.717
AM-72	111.667	97.200	19.067	18.800	22.833	142.000	2.160	0.957	2.262	32.430	12.860	0.478
Moroberekan	122.333	140.767	10.667	8.767	26.300	153.000	2.433	1.240	1.978	42.163	23.197	0.559
Black rice	76.000	103.800	16.400	15.733	20.767	100.000	2.397	0.943	2.544	28.633	19.730	0.698
Chittimutyalu	108.333	68.633	25.733	24.633	19.633	139.000	1.547	0.820	1.618	32.073	22.237	0.691
Jeergasamba	139.667	101.400	15.133	14.333	21.333	162.333	1.487	0.680	2.674	32.310	16.963	0.530
Burma Black	125.333	105.200	14.200	13.600	20.633	171.333	2.327	1.074	2.180	40.233	18.927	0.487
Ratnachudi	105.333	99.000	14.800	14.667	25.300	179.667	1.960	0.811	2.443	61.853	28.970	0.590
Azucena	127.667	118.133	13.133	12.867	29.300	151.000	2.883	1.767	2.459	46.269	41.793	0.755

DTF = Days to Flowering PHT = Plant Height (cm) NPT = Number of Productive tillers PL=Panicle Length NTL=Number of Tillers DTM=Days to Maturity GL=Grain Length GB=Grain Breath LBR=Grain Length Breath Ratio BY/P=Biomass per Plant GY/P=Grain Yield per Plant HI= Harvest Index

Table 3: Estimates of genetic parameters for different quantitative traits among selected rice accessions under aerobic condition

Traits	**Min**	**Max**	**Mean± SE**	**Vg**	**Vp**	**GCV (%)**	**PCV (%)**	**H^2 BROAD SENSE (%)**	**GA**	**GAM (%)**
DTF	76	140	113.13±2.7	537.66	601.42	20.49	21.67	89.39	45.16	39.92
PHT	68.6	140.8	104.36±3.2	735.54	823.30	25.98	27.49	89.34	52.81	50.59
NTL	9	25	15.5±.68	35.12	39.86	38.23	40.73	88.11	11.46	73.93
NPT	8.88	24.6	15.02±.63	32.04	36.65	37.67	40.29	87.42	10.90	72.56
DTM	100	180	147.93±3.8	1074.38	1186.94	22.15	23.28	90.52	64.24	43.42
GL	1.4	2.9	2.24±.06	0.41	0.429	28.70	29.26	96.19	1.29	57.99
GB	.68	1.8	.95±.02	0.076	0.102	28.81	33.31	74.81	0.49	51.34
LBR	1.61	3.45	2.39±.09	0.228	0.35	19.99	24.81	64.97	0.79	33.20
BY/P	18.82	61.45	36.36±1.87	112.62	188.05	29.18	37.70	59.89	16.91	46.52
GY/P	12.86	41.79	22.2±1.36	71.748	106.86	38.15	46.56	67.14	14.29	64.40

Vg=Genetic variance Vp=Phenotypic variance PCV = Phenotypic Coefficient of variation GCV= Genotypic Coefficient of variation H2 % = Heritability percentage in broad sense GA=Genetic Advance GAM= Genetic Advance as per Mean DTF = Days to 50% Flowering PHT = Plant Height (cm) NPT= Number of Productive tillers NTL=Number of Tillers DTM=Days to Maturity GL=Grain Length GB=Grain Breath LBR=Grain Length Breath Ratio BY/P=Biomass per Plant GY/P=Grain Yield per Plant

CONCLUSION

The present study showed significant amount of variation among the genotypes for all the yield related traits. Since crop improvement is depends on magnitude of genetic variation so in the current study high heritability in conjugation with high genetic advance indicating that these characters could be used to select notable improvement in cultivation under aerobic condition.

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