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Assessment of genetic variability and character association for yield and related traits in upland rice (*Oryza sativa* L.)

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ABSTRACT

The present investigation was conducted at Zonal Research Station, (Birsa Agricultural University), Chianki, Palamau during Kharif. Thirty drought tolerant upland rice genotypes including two checks viz. Vandana and Anjali were laid out in the Randomized Block Design with three replications in rainfed upland situation. Data were recorded and analysed for ten yield attributing. A wide spectrum of variability was observed for all the characters under study. High genotypic coefficient of variation was exhibited for grain yield (19.84) followed by unfilled grain (18.36 and sterility % (15.94). High heritability estimates coupled with high genetic advance were observed for plant height and filled grains per panicle. The genotypic correlation coefficients were found to be higher than the corresponding phonotypic correlation coefficients. This indicated that there is strong inherent association between yield and its component traits. Plant height has negative correlation with yield indicating that taller rice plant have low yield. Grains per panicle, number of filled grains per panicle and test weight have positive and significant genotypic and phenotypic correlation with yield. Panicle length, numbers of grains per panicle, filled grain per panicle; test weight and harvest index contributed maximum direct or indirect effect on yield, indicating these traits should be given emphasis while selecting high yielding upland rice for western plateau of Jharkhand.

Key words: *Upland rice, PCV, GCV, heritability, genetic advance and character association.*

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important cereal crop of India. It is staple food of majority of the people of the country as well for state of Jharkhand. Rice cultivation ranks first in area as well in production with an area of 44.0 mha in which around 6.0 mha covered under upland rice that accounts 13 percent of total area of rice in India. In Jharkhand, the area under rice cultivation is 18.0 lakh ha out of which upland rice covered an area around 2.0. Lakh hectare. It is mostly grown under rainfed upland situation fully depends upon monsoon. Upland rice ecology is much harsh environment for rice cultivation in which intermittent drought is the major constraint[1] and cause a yield penalty from 12 to 46 per cent[2]. Rainfed upland rice is an important component of cropping system in Jharkhand plateau. Rainfed upland rice cultivation in plateau is suffering from the problem of poor productivity mainly due to erratic rainfall, poor soil fertility as well as lack of improved varieties. Poor yield potential of traditional rice cultivars necessitates the development of the high yielding cultivars for rainfed upland condition. Most of the characters of interest to breeders are complex and they are result of the interaction of a number of components[3]. The information on certain genetic parameters of variability for different characters of economic significance is important for plant breeders before releasing any variety.

Estimation of heritability and genetic advance will play an important role in exploiting future research projections of rice improvement. The information on extent of variability, heritability and genetic advance has been reported[4,5] for panicle characters and for plant height[6]. Selection for yield per se may not be much rewarding unless other yield attributing traits are taken into consideration. Correlation coefficient is a statistical measure which is used to find out the degree and diversion of relationship between two or more variable. Correlation coefficient analysis measures the nature and relationship between various plant characters and determines the component characters of economically important. Hence, the present investigation was undertaken with a view to establish relationship between yield and yield attributing traits and to estimate the direct and indirect effects of yield component traits on grain yield in upland rice genotypes.

MATERIALS AND METHODS

The present investigation was conducted at Zonal Research Station, (*Birsa Agricultural University*), Chianki, Palamau during *Kharif* 2012. Thirty drought tolerant upland rice genotypes including two checks *viz.* Vandana and Anjali were laid out in the Randomized Block Design with three replications in rainfed upland situation. Each entry was sown in fifteen rows plot of 5 meter length with 20 cm inter row spacing. The standard packages of practices were followed in each experiment. Data were recorded five randomly selected plants in each treatments and analyzed for ten yield attributing characters *viz.*, Days to 50% flowering, days to maturity, Plant height (cm), Panicle length (cm), Number of filled grains per panicle, Number of unfilled grains per panicle, sterility %, 1000-seed weight (g), grain yield (q/ha)and harvest index. The analysis of estimates of variability was done according to the previously described method[7]. The phenotypic and genotypic coefficient of variability, heritability in broad sense, genetic advance at 5 per cent selection intensity were computed as suggested[8]. The phenotypic correlation coefficients among all the traits under study were calculated[9] and the path analysis was carried out as per method[10].

RESULTS AND DISCUSSION

Analysis of variance for grain yield and 9 other yield contributing characters revealed that all the genotypes differed significantly; which clearly indicated the presence of enormous variability among the genotypes for all the characters studied (Table-1).The wide spectrum of variability was observed for all the characters which may offer scope for selection for evolving promising genotypes. The plant height ranged from 68.06-117.20. The range of filled grain was (63.04-109.53). The genotype exhibited significant variation for unfilled grain (10.86-15.06) whereas the character sterility percentage range from 8.11-20.83. test weight ranged from 20.67-28.83 while the harvest index ranged from 24.47-44.1. Grain yield (q/ha) had appreciable range of variation (16.37-28.06). A wide range of variation for most of the characters studied were also reported[11,12]. The panicle length varied from a ranged of 18.73 to 23.20 which clearly showed that there is lesser genotypic and phenotypic coefficient of variation. The GCV was high in unfilled grain 21.03 followed by sterility 19.24and grain yield (q/ha) 18.74. Whereas low to moderate estimates of GCV were exhibited by remaining characters (Table 1). A narrow margin of estimates between GCV and PCV were observed in the characters like plant height, panicle length, flag leaf length , flag leaf width, panicles per plant, spikelets per panicle, filled grain, harvest index , days to 50% flowering and test weight which clearly suggested that these characters may be less influenced by the environmental factors. The findings where in close were in agreement with those of earlier workers[12,13].

Table 2 revealed that the heritability estimates ranged from 70 to 99%. The unfilled grain showed lowest (70%) and plant height (99%) highest heritability estimates. The grain yield, unfilled grain/ panicle, sterility and plant height showed high GCV along with high heritability indicating effectiveness

of selection based on their traits. Although filled grain, harvest index, days to 50% flowering and test weight had exhibited high heritability but low GCV as reported[14]. The character plant height, filled grain, harvest index and days to 50% flowering showed high heritability with high genetic advance. Johnson et al. (1955) had shown that high heritability accompanied by high genetic advances is essential for selection programme.

The genotypic and phonotypic correlation coefficients were studied for different traits along with grain yield for understanding the correlation among themselves. The estimates of genotypic and phonotypic correlation coefficients between grain yield and its components are presented in Table 3. The genotypic correlation coefficients were found to be higher than the corresponding phonotypic correlation coefficients. This indicated that there is strong inherent association between yield and its component traits. The plant height, panicles length, filled grain,, harvest index and test weight had very high positive significant association with grain yield. Similar type of results were also described[15,16,17]. The important characters for rainfed upland situation are i.e. days to 50% flowering, unfilled grain, sterility and maturity showed negative association with grain yield. This finding is in close agreement with the earlier findings[17,18,19.]

Further the path coefficient analysis results indicated that high positive direct effects on grain yield were observed for biological yield and harvest index (Table 4). Similar findings were also reported[20,21]. The direct contribution of plant height, filled grain was positive but low in magnitude. Based on the results of present study on correlation and path analysis the characters namely biological yield , harvest index, filled grain and test weight had influenced the grain yield per plant either directly or indirectly for higher grain yield potential in upland situation. These characters should be included in the breeding programme for improving the grain yield of upland rice.

Table 1: Analysis of variance for ten characters in 30 upland rice genotypes

S. No.	Characters	Mean squares		
		Replication	Treatment	Error
1	Days to 50% flowering	0.549	33.240*	15.111
2	Days to maturity	0.123	19.495**	5.123
3	Plant height (cm)	8.897	640.521**	163.670
4	Panicle length (cm)	1.871	5.902*	2.747
5	No. of filled grains/panicle	18.870	400.412**	130.292
6	No. of unfilled grains/panicle	1.888	4.102*	1.729
7	Sterility %	1.929	9.011**	3.734
8	1000-seed weight (g)	0.129	9.978**	2.783
9	Seed yield (q/ha)	2.358	26.378**	5.641
10	Harvest index	0.689	45.320*	17.125

Table 2: Range, mean, genotypic and phenotypic coefficients of variation (GCV, PCV, %), heritability (h^2%) and genetic advance (GA) % of mean, for grain yield and associated character in upland rice

Character	Year	Range	Mean	GCV	PCV	h^2%	G.A.% of mean
Days to 50 % flowering	2012	57.00-70.33	62.90	9.07	9.15	95	18.56
	2013	57.61-72.67	64.80	9.83	9.93	96	20.05
Days to maturity	2012	93.00-101.67	97.71	12.17	12.24	96	24.91
	2013	87.00-100.66	93.94	12.24	12.48	95	24.70
Plant height (cm)	2012	68.06-117.20	99.47	9.66	10.13	**99**	18.98
	2013	58.80-87.46	74.44	9.29	9.78	**96**	18.17
Panicle length (cm)	2012	18.73-23.20	21.16	5.19	5.94	75	9.35
	2013	16.07-23.09	21.91	5.21	5.88	84	9.52
Filled grain / panicle	2012	63.04-109.53	91.61	6.98	7.59	92	13.21
	2013	55.26-114-.86	90.18	11.20	11.62	85	22.23
Unfiilled grain/panicle	2012	10.86-15.06	12.67	21.03	25.01	**70**	36.40
	2013	9.80-16.07	12.81	22.65	11.62	**72**	41.02
Sterility %	2012	8.11-20.83	70.33	19.24	23.06	71	33.09
	2013	5.48-26.98	65.85	25.40	28.52	78	46.61
100-seed weight (g)	2012	20.67-28.33	23.39	7.36	7.54	94	14.82
	2013	21.20-26.93	23.75	7.77	7.94	95	15.68
Seed yield (q/ha)	2012	16.37-27.06	22.51	17.15	17.91	91	33.81
	2013	16.32-29.78	21.45	18.74	19.71	90	36.67
Harvest index %	2012	24.47-44.18	34.33	11.82	12.20	94	23.59
	2013	21.62-41.16	30.18	16.24	16.74	94	32.47

Table 3: Genotypic and Phenotypic correlations for 10 characters studied

Character		Days to 50% flower	Plant height	Panicle length	Filled grain	Unfilled grain	Sterility%	Days to maturity	Harvest index	Test weight	Grain yield/ Plant
Days to 50% flowering	**G**	1.000	-0.247	0.035	-0.282*	0.128	0.193	0.960**	-0.198	-0.400**	**-0.316***
	P	1.000	-0.242	0.046	-0.255	0.116	0.168	0.956**	-0.193	-0.389**	**-0.300***
Plant height	**G**		1.000	0.369*	0.229	-0.306*	-0.340*	-0.282	0.235	0.368*	**0.391****
	P		1.000	0.327*	0.205	-0.252	-0.278	-0.276	0.226	0.355*	**0.372****
Panicle length	**G**			1.000	-0.005	-0.166	-0.139	-0.044	0.216	0.132	**0.222**
	P			1.000	-0.026	-0.112	-0.094	-0.033	0.191	0.114	**0.193**
Filled grain	**G**				1.000	-0.106	-0.374**	-0.292*	**0.349***	**0.434****	**0.624****
	P				1.000	-0.141	-0.390**	-0.261	**0.295***	**0.392****	**0.552****
Unfilled grain	**G**					1.000	**0.961****	0.195	-0.445**	-0.192	**-0.370****
	P					1.000	**0.962****	0.169	-0.380**	-0.165	**-0.299***
Sterility%	**G**						1.000	0.255	-0.498**	-0.273	**-0.522****
	P						1.000	0.216	-0.412**	-0.233	**-0.422****
Days to maturity	**G**							1.000	-0.257	-0.450**	**-0.366***
	P							1.000	-0.254	-0.435**	**-0.350***
Biologi Cal yield	**G**								-0.007	0.241	**0.720****
	P								-0.051	0.216	**0.727****
Harvest index	**G**								1.000	0.523**	**0.687****
	P								1.000	0.497**	**0.645****
Test weight	**G**									1.000	**0.538****
	P									1.000	**0.505****

*,**: Significant at 5% & 1% respectively

Table 4: Path Coefficient analysis showing direct (diagonal) and indirect effects of yield component characters at genotypic and phenotypic level

Character		Days to 50% flowering	Plant height	Panicle length	Filled grain	Unfilled grain	Sterility	Days to maturity	Harvest index	Test weight	Grain yield/ Plant
Days to 50% flowering	**G**	**-0.015**	-0.003	-0.0002	-0.011	-0.002	0.004	0.007	-0.136	0.001	**-0.316**
	P	**-0.010**	-0.003	-0.0002	0.045	0.001	-0.018	0.004	-0.132	-0.001	**-0.300**
Plant height	**G**	0.004	**0.011**	-0.002	0.009	0.004	-0.008	-0.002	0.161	-0.001	**0.391**
	P	0.002	**0.011**	-0.001	-0.036	-0.001	0.029	-0.001	0.154	0.001	**0.373**
Panicle length	**G**	-0.001	0.004	**-0.005**	-0.0002	0.002	-0.003	-0.0003	0.148	-0.0001	**0.222**
	P	-0.001	0.003	**-0.004**	0.005	-0.001	0.010	-0.0001	0.131	0.0003	**0.193**
Filled grain	**G**	0.004	0.002	0.000	**0.041**	0.001	-0.008	-0.002	0.239	-0.0003	**0.624**
	P	0.003	0.002	0.0001	**-0.176**	-0.001	0.041	-0.001	0.202	0.001	**0.552**
Unfilled grain	**G**	-0.002	-0.003	0.001	-0.004	**-0.012**	0.021	0.002	-0.306	0.0001	**-0.370**
	P	-0.001	-0.003	0.001	0.025	**0.004**	-0.100	0.001	-0.260	-0.0004	**-0.299**
Sterility	**G**	-0.003	-0.004	0.001	-0.015	-0.011	**0.022**	0.002	-0.342	0.0002	**-0.522**
	P	-0.002	-0.003	0.0004	0.069	0.004	**-0.104**	0.001	-0.282	-0.0005	**-0.422**
Days to maturity	**G**	-0.014	-0.003	0.0002	-0.012	-0.002	0.006	**0.008**	-0.176	0.0003	**-0.366**
	P	-0.010	-0.003	0.0001	0.046	0.001	-0.023	**0.005**	-0.174	-0.001	**-0.351**
Harvest index	**G**	0.003	0.003	-0.001	0.014	0.005	-0.011	-0.002	**0.686**	-0.0004	**0.688**
	P	0.002	0.002	-0.009	-0.052	-0.002	0.043	-0.001	**0.684**	0.001	**0.645**
Test weight	**G**	0.006	0.004	-0.001	0.018	0.002	-0.006	-0.003	0.359	**-0.001**	**0.538**
	P	0.004	0.004	-0.001	-0.069	-0.001	0.024	-0.002	0.340	**0.002**	**0.505**

G (R SQUARE = 0.9985 RESIDUAL EFFECT = 0.0381)
P (R SQUARE = 0.9952 RESIDUAL EFFECT = 0.0694)

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