Electronic Journal of Plant Breeding, 10 (3): 1079 - 1085 (Sep 2019) DOI: 10.5958/0975-928X.2019.00138.8
ISSN 0975-928X

Research Article

Assessment of genetic variability in lowland rice varieties of Odisha

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(Received: 20 Mar 2019; Revised: 09 Jul 2019; Accepted: 14 Aug 2019)

Abstract
The present study is carried out to establish the nature of relation between twelve component characters including grain yield by taking 64 low land rice varieties (including 55 landraces of Odisha). The analysis of variance revealed significant differences among the genotypes for all the characters studied, there by indicating the presence of abundant variability among the genotypes. Nature of relation between grain yield per plant and yield components were studied by partitioning the correlation coefficients into direct and indirect effects by using simple correlation and path analysis. In the present investigation, the estimation of genotypic correlation were higher than that of phenotypic correlation, which indicated that environmental cause of correlation has affected the genetic cause. The results indicated that grain yield per plant was positively correlated with fertile grains per panicle, grain fertility %, 100-grain weight and harvest index signifying the importance of such traits for realization of high yield in rice. As simple correlation does not provide the true contribution of the characters towards the yield, these genotypic correlations were partitioned into direct and indirect effects through path coefficient analysis. From the study of path analysis it was revealed that prime emphasis should be given to harvest index followed by number of fertile grains per panicle, grain fertility percentage and 100-grain weight for realization of high and stable yields. The value of residual effect was low (0.22) indicating that major component traits contributing to yield has been included in this study.

Key words
Correlation, direct effects, genetic variability, low land rice and path analysis

Introduction

Rice is the staple food of more than 60% of people in the world. It ranks second to wheat among the most cultivated cereals in the world (Abodolereza and Racionzor, 2009). India accounts for nearly one-fourth (22%) of the rice produced in the world with the first place occupied by China. India has an area of 43.99 million hectares under rice cultivation with a total production of 109.70 million tonnes which average to 24.94 quintal per hectare' (Directorate of Economics and Statistics,2016-17). Rice is grown in different ecosystems such as rainfed upland, irrigated, rainfed lowland and flood prone area.

In Odisha, rice is grown over 39.63 lakh hectares of land out of which accounts for 60.55 % of the state rice growing area with production of 97.94 lakh MT (Odisha Economic Survey 2017-18). According to an estimate there are more than 50,000 varieties of rice in our country, but unfortunately most of these varieties are fast disappearing because of faulty agricultural practices.

Farmers are mostly lured by high yielding varieties which have confined themselves to few races of rice and have stopped cultivating local varieties. These local varieties are of immense value in agriculture as they are the store house of innumerable important genes as they have evolved in particular environment since millions of years. Unlike high yielding varieties, landraces harbor a great genetic potential for rice improvement. They are endowed with tremendous variability. This rich variability of complex quantitative traits still remains unexploited. Collection, characterization and evaluation of landraces are integral part of the pre-breeding process carried out by rice breeders. Therefore the need to characterize available landraces becomes important in modern crop improvement. Realizing the importance, fifty five local landraces of rice cultivated in rainfed lowland situation in different parts of Odisha were collected and investigated along with hybrids checks to assess the variability and to determine the association of yield and its contributing traits.

Materials and Methods

The experimental material consisted of 55 rice landraces (collected from different parts of Odisha state, 4 improved varieties and 5 released high yielding varieties suitable for lowland ecology (Table1). The experiment was conducted at Rice Research Station, Odisha University of Agriculture and Technology, Bhubaneswar during *kharif*, 2014 in RBD with two replications with spacing of 20 cm X 15cm. The recommended cultural practices were followed including need based plant protection measures to raise a normal crop. Observations were recorded in respect of all metric characters *viz.*, plant height (PH), effective tillers per plant (EBT), flag leaf area (FLA), panicle length (PL), fertile grains per panicle (FGP), grain fertility % (GF), 100-grain weight (GW), grain yield per plant (GYP), straw yield per plant (SYP), harvest index(HI) and grain L/B ratio (LB) on 5 competitive plants from each replication selected randomly from the middle row of each plot, where as character like days to 50% flowering (DF) was recorded on plot basis. The data recorded were subjected to statistical analysis of variance technique as proposed by Panse and Sukhatme (1961). The phenotypic and genotypic correlation coefficients were calculated using the method given by Johnson *et al*.(1955) and path coefficient analysis were worked as suggested by Dewey and Lu (1959).

Result and Discussion

The analysis of variance (Table2) revealed significant differences among the genotypes for all the characters studied, there by indicating the presence of abundant variability among the genotypes. Hence, the data was further subjected to correlation and path coefficient analysis to study the association between yield and its component characters and partitioning it into direct and indirect effects of yield related traits.

In plant breeding, correlation coefficient analysis measures the mutual relationship between various plant characters and determines the component characters on which selection can be based for genetic improvement in yield. Very often, selection for yield *per-se* is not reliable and therefore, indirect selection through component traits becomes important for the ultimate output, the grain yield. Hence, studies on character association not only help to understand physical linkage, but also provide information on nature and direction of selection.

In the present investigation correlation analysis was carried out both at phenotypic and genotypic levels and presented in (Table 3). In general, the estimation of genotypic correlation were higher than that of phenotypic correlation, which indicated that environmental cause of correlation has affected the genetic cause (Basavaraja *et al.* 2013, Rao *et al.* 2014 and Savitha and Usha Kumari 2015). Genotypic correlation may be either due to pleiotropic action of genes or due to linkage or more likely both. The main genetic cause of such correlation is pleiotropy, which refers to manifold effects of a gene (Falconer,1960).

In the present study, grain yield per plant exhibited positive correlation with fertile grains per panicle, grain fertility %, 100-grain weight and harvest index. This is in agreement with the result obtained by Goswami *et al*., 2000 with grain fertility % and grains per panicle; Nayak *et al.*, 2001 with spikelets per panicle and grains per panicle; Mishra and Verma 2002 with harvest index; Kole *et al*., 2008 with harvest index; Golam *et al.*, 2011 with fertile grains per panicle and Ashfaq *et al*., 2012 with seeds per panicle. This reveals that selection on the basis of these characters bears relevance to grain yield. Character like plant height and panicle length showed significant negative association with grain yield plant. Therefore, it is concluded that the superior performance of promising lines from the present set of material might have been resulted due to superior expression of component traits like fertile grains per panicle, grain fertility %, 100-grain weight and harvest index rather than plant height and panicle length.

As simple correlation does not provide the true contribution of the characters towards the yield, these genotypic correlations were partitioned into direct and indirect effects through path coefficient analysis. In the present investigation path analysis was carried out both at phenotypic and genotypic levels and presented in (Table 4).

In the present study, the high degree of correlation between yield and harvest index (0.799) and high direct effect of harvest index (1.086) on grain yield revealed true relationship between them and direct selection for harvest index will be rewarding for yield improvement. The correlation coefficient was observed to be positive and the direct effect was negative for the traits like fertile grains per panicle, grain fertility% and 100-grain weight indicating that the indirect effects seem to be the cause of correlation. These characters were found to influence yield through harvest index. Hence, prime emphasis should be given to harvest index followed by number of fertile grains per panicle, grain fertility percentage and 100-grain weight for realization of high and stable yields. These findings in relation to different component traits were in agreement with published report on path analysis by Reddy *et al.*, 2013,Vanisree *et al.* 2013 and Senapati and Kumar 2015, for direct effect of spikelets per panicle and test weight. The value of residual effect was low (0.22) indicating that major component traits contributing to yield has been included in this study.

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Electronic Journal of Plant Breeding, 10 (3): 1079 - 1085 (Sep 2019) DOI: 10.5958/0975-928X.2019.00138.8
ISSN 0975-928X

Table 1. List of 64 lowland rice genotypes used in the study

Sl No.	Name of the Genotype	Remarks	Place of collection
1	Mahipal	Landrace	Nawapara
2	Nadiarasi	Landrace	Koraput
3	Machakanta	Landrace	Koraput
4	Jubaraj	Landrace	Sonpur
5	Seulapana	Landrace	Keonjhar
6	Dhinkiasali	Landrace	Keonjhar
7	Kanthakamal	Landrace	Keonjhar
8	Ganjamgedi	Landrace	Cuttack
9	Dhulia	Landrace	Balasore
10	Julpaya	Landrace	Malkangiri
11	Nilarpati	Landrace	Malkangiri
12	Haladichudi	Landrace	Kalahandi
13	Ratanmali	Landrace	Kalahandi
14	Badashabhoga	Landrace	Kalahandi
15	Juiphoola	Landrace	Jharsuguda
16	Karpurakranti	Landrace	Jharsuguda
17	Ganjeijata	Landrace	Angul
18	Kalachampa	Landrace	Angul
19	Baudiachampa	Landrace	Angul
20	Ghumusara	Landrace	Angul
21	Bagudi	Landrace	Angul
22	Anu	Landrace	Angul
23	Baiganmanji	Landrace	Nayagarh
24	Mayurakantha	Landrace	Nayagarh
25	Kadaliachampa	Landrace	Nayagarh
26	Champeisiali	Landrace	Nayagarh
27	Landi	Landrace	Nayagarh
28	Bhutia	Landrace	Nayagarh
29	Parvatajeera	Landrace	Boud
30	Ranisaheba	Landrace	Boud
31	Kusuma	Landrace	Boud
32	Basabhoga	Landrace	Sambalpur
33	Jaladubi	Landrace	Sambalpur
34	Kendrajhalli	Landrace	Sambalpur
35	Laxmi	Landrace	Sambalpur
36	Sunakathi	Landrace	Sambalpur
37	Khandasagar	Landrace	Sambalpur
38	Budidhan	Landrace	Sambalpur
39	Bagadachinamala	Landrace	Sambalpur
40	Ratnachudi	Landrace	Sambalpur
41	Jalagudi	Landrace	Sambalpur
42	Desijhilli	Landrace	Sambalpur
43	Kadalipendi	Landrace	Sambalpur
44	Rasapanjari	Landrace	Puri
45	Champa	Landrace	Puri
46	Bankoi	Landrace	Puri
47	Biradiabankoi	Landrace	Puri
48	Habira	Landrace	Puri
49	Kakudimanji	Landrace	Puri
50	Jagabalia	Landrace	Puri
51	Dhoiabankoi	Landrace	Puri
52	Kalakadamba	Landrace	Puri
53	Damodarbhoga	Landrace	Puri
54	Gunjimanika	Landrace	Puri
55	Madhabi	Landrace	Puri
56	T 90	Improved variety	EB-1, OUAT
57	T 141	Improved variety	EB-1, OUAT
58	FR 13A	Improved variety	EB-1, OUAT
59	T 1242	Improved variety	EB-1, OUAT
60	Swarna	High yielding variety	EB-1, OUAT
61	Upahar	High yielding variety	EB-1, OUAT
62	Kanchan	High yielding variety	EB-1, OUAT
63	Mrunalini	High yielding variety	EB-1, OUAT
64	Jagabandhu	High yielding variety	EB-1, OUAT

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Table 2. Analysis of variance for yield and yield components in lowland rice germplasm

Sl.No.	Character	Treatment Mean Sum of square
1	Days to 50% flowering	21.605**
2	Plant height(cm)	745.071**
3	Flag leaf area(cm^2)	130.030**
4	Effective tillers/plant(No.)	3.971**
5	Panicle length(cm)	13.587**
6	Fertile grains/panicle(No.)	1625.599**
7	Grain fertility%	174.691**
8	100 -grain weight(g)	0.500**
9	Grain L/B ratio	0.403**
10	Straw yield/plant(g)	40.217**
11	Harvest index	0.008**
12	Grain yield/plant(g)	19.810**

** significant at 1 % level of probability

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Table 3. Phenotypic and genotypic correlation co-efficient among twelve characters of 64 lowland rice genotypes

Character		PH	FLA	EBT	PL	FGP	GF%	GW	LB	SYP	HI	GYP
DF	**P**	-0.428**	0.022	0.183	-0.182	-0.125	-0.055	0.056	0.042	0.070	0.089	0.176
	G	-0.491**	0.022	0.202	-0.200	-0.160	-0.082	0.054	0.028	-.096	0.107	0.212
PH	**P**		0.275*	-0.137	0.515**	0.028	0.004	-0.083	0.002	0.052	-0.333**	-0.331**
	G		0.312**	-0.186	0.588**	0.043	0.013	-0.099	0.007	0.033	-0.371**	-0.377**
FLA	**P**			-0.381**	0.320**	-0.096	-0.017	0.408**	-0.211	0.027	0.003	0.024
	G			-0.487**	0.342**	-0.107	-0.072	0.434**	-0.233	0.021	0.023	0.037
EBT	**P**				-0.099	-0.055	-0.156	-0.292*	0.059	-0.005	-0.078	-0.099
	G				-0.112	-0.030	-0.169	-0.354**	0.037	-0.018	-0.058	-0.085
PL	**P**					0.191	0.089	-0.207	0.121	0.136	-0.324**	-0.297*
	G					0.261*	0.124	-0.225	0.117	0.161	-0.355**	-0.321**
FGP	**P**						0.522**	-0.458**	-0.089	-0.022	0.316**	0.288*
	G						0.550**	-0.588**	-0.083	0.023	0.360**	0.361**
GF%	**P**							0.044	-0.127	-0.005	0.508**	0.467**
	G							0.042	-0.171	0.008	0.614**	0.557**
GW	**P**								-0.176	0.010	0.313**	0.325**
	G								-0.181	0.008	0.337**	0.343**
LB	**P**									-0.242**	0.032	-0.111
	G									-0.254*	0.036	-0.113
SYP	**P**										-0.388**	0.200
	G										-0.380**	0.213
HI	**P**											0.799**
	G											0.804**

** Significant at 1% level of probability P= Phenotypic correlation coefficient
* Significant at 5% level of probability G= Genotypic correlation coefficient
NB: Details of abbreviated form of the characters are given in materials and methods

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ISSN 0975-928X

Table 4. Direct and indirect effects of component traits on yield for 64 lowland rice genotypes

Character		DF	PH	FLA	EBT	PL	FGP	GF%	GW	LB	SYP	HI	Correlation with GYP
DF	**P**	**0.045**	-0.012	0.000	-0.008	0.008	0.002	0.004	-0.003	0.000	0.043	0.097	0.176
	G	**0.159**	-0.019	0.001	0.045	0.085	-0.149	-0.008	0.046	0.008	0.033	0.011	0.212
PH	**P**	-0.019	**0.028**	0.003	0.006	-0.022	-0.001	0.000	0.004	0.000	0.032	-0.362	-0.331**
	G	-0.078	**0.040**	0.021	-0.041	-0.250	0.040	0.001	-0.084	0.002	0.011	-0.040	-0.377**
FLA	**P**	0.001	0.008	**0.010**	0.017	-0.014	0.002	0.001	-0.022	0.002	0.017	0.003	0.024
	G	0.003	0.012	**0.067**	-0.107	-0.145	-0.099	-0.007	0.366	-0.063	0.007	0.002	0.037
EBT	**P**	0.008	-0.004	-0.004	**-0.043**	0.004	0.001	0.011	0.016	0.000	-0.003	-0.085	-0.099
	G	0.032	-0.007	-0.033	**0.220**	0.048	-0.028	-0.016	-0.299	0.010	-0.006	-0.006	-0.085
PL	**P**	-0.008	0.014	0.003	0.004	**-0.043**	-0.003	-0.006	0.011	-0.001	0.084	-0.352	-0.297*
	G	-0.032	0.023	0.023	-0.025	**-0.425**	0.242	0.012	-0.190	0.032	0.056	-0.038	-0.321**
FGP	**P**	-0.006	0.001	-0.001	0.002	-0.008	**-0.018**	-0.037	0.025	0.001	-0.014	0.343	0.288*
	G	-0.025	0.002	-0.007	-0.007	-0.111	**0.929**	0.052	-0.496	-0.022	0.008	0.039	0.361**
GF%	**P**	-0.002	0.000	0.000	0.007	-0.004	-0.009	**-0.071**	-0.002	0.001	-0.003	0.552	0.467**
	G	-0.013	0.001	-0.005	-0.037	-0.053	0.511	**0.095**	0.035	-0.046	0.003	0.066	0.557**
GW	**P**	0.003	-0.002	0.004	0.013	0.009	0.008	-0.003	**-0.054**	0.001	0.006	0.340	0.325**
	G	0.009	-0.004	0.029	-0.078	0.096	-0.546	0.004	**0.844**	-0.049	0.003	0.036	0.343**
LB	**P**	0.002	0.000	-0.002	-0.003	-0.005	0.002	0.009	0.009	**-0.008**	-.150	0.035	-0.111
	G	0 .004	0.000	-0.016	0.008	-0.050	-0.077	-0.016	-0.153	**0.270**	-0.088	0.004	-0.113
SYP	**P**	0.003	0.001	0.000	0.000	-0.006	0.000	0.000	-0.001	0.002	**0.620**	-0.422	0.200
	G	0.015	0.001	0.001	-0.004	-0.068	0.021	0.001	0.007	-0.069	**0.348**	-0.041	0.213
HI	**P**	0.004	-0.009	0.000	0.003	0.014	-0.006	-0.036	-0.017	0.000	-0.241	**1.086**	0.799**
	G	0.017	-0.015	0.002	-0.013	0.151	0.334	0.059	0.284	0.010	-0.132	**0.107**	0.804**

NB: i) Diagonal values (bold figures) represent direct effects
ii) Residual effect: Phenotype = 0.216 , Genotype = 0.231
iii)Details of abbreviated form of the characters are given in materials and methods