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Correlation and path co-efficient analysis for genetic response of seed yield traits at varying spacing in rice cultivars

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ABSTRACT

Genotypic and phenotypic correlation and path-coefficient analysis were worked out for grain yield, seed yield and yield contributing components in rice cultivars sown at varying spacing under normal condition. Among the different characters, number of productive tillers per plant was significantly correlated with grain yield per plot in positive direction at both spacing. 1000 grain weight and grain yield per plot showed significant positive association with seed yield. Therefore, importance of 1000 grain weight should be given in getting seed recovery in rice genotypes. Path analysis further revealed that at space planting grain yield per plot showed maximum direct effect both at genotypic (0.993) and phenotypic level (1.640), its association with seed yield was also significantly positive. So, emphasis should be given on 1000 grain weight under closer spacing but both for 1000-grain weight and grain yield per plot under space planting to get higher seed recovery.

Key words: *Grain yield, Seed yield, Correlation, Path-coefficient analysis*

Knowledge of correlation coefficient among yield component characters is valuable in selection of the genotypes. But path analysis of yield component traits brings out the relative importance of their direct and indirect influence and helps in understanding their association with seed yield. Seed recovery in rice cultivars is very important which accounts the whole production programme. Ratio of filled and unfilled grains is also decisive factors which affect seed recovery after the formation of healthy grains. Therefore, the present study was undertaken to analyse the correlation and path components of productivity in rice crop.

Field experiment was conducted in randomized block designed (RBD) with three replications at the farm of Directorate of Seed Research, Kushmaur, Mau, U.P. during wet season of 2010. The soil of the experimental field was clayey in texture. Its organic carbon content was about 0.30%, N (255 kg N per ha), available phosphorus (9.5 kg P_2O_5 per ha) and available K (270.50kg K_2O per ha). The electrical conductivity of the soil was 1.70 Ds/m and the pH was 8.5. Fertilizers @ 100 kg of N, 60 kg of P_2O_5 and 40 kg of K_2O were applied. In trial I, the transplanting of seedlings was done at a distance of 15 cm apart keeping row to row distance 20 cm. But in trial II, the plant to plant distance was maintained 20 cm keeping row to row distance same as in experiment I. Each genotype was sown 16 rows in the bed length of 12m. All agronomical practices were followed to raise good crop. Five competitive plants were randomly selected from each replication of both the trials. Boarder rows were removed before harvesting and yield was taken only for 14 rows. Observations on 50% flowering, days to maturity, plant height (cm), ear bearing tillers (EBT per plant), single panicle length (cm), number of filled grains per plant, number of unfilled grains per plant, grain weight of filled grains (gm), 1000 grain weight (gm) and grain yield in net plot area(kg) were recorded. Seed was graded in the laboratory model Seed Processing Unit of DSR. For sieving of paddy grains, sieves of 1.8 mm size were used. Seed yield or seed recovery was calculated in percent by applying under mentioned formula:-

$$\text{Seed recovery} = \frac{\text{Grain yield - under size grains + Other impurities x 100}}{\text{Grain yield}}$$

The statistical analysis was carried out on the mean data of the characters studied. The analysis of correlation coefficient was done following the standard statistical procedures followed by Dewey and Lu, 1959.

From the *per se* performance (Table 1), MTU 7029 was found the highest yielding genotype both at 15 cm and 20 cm interplant distance followed by Pratikshya, BPT 5204, Naveen and Sarjoo 52. Grain yield of Sarjoo 52 and Naveen was at par with each other. But seed recovery was found better in case of Sarjoo 52 than Naveen. This may be due to difference in grain size because Sarjoo 52 possesses bold and medium size grain while Naveen possesses lmedium, slender and low 1000 grain weight grains. Maximum seed recovery was observed in MTU 7029 (75.71% and 76.58% in case of Trial I and Trial II) followed by Pratikshya (75.16% and 75.74% in case of Trial I and Trial II). Percent gain in grain yield at space planting was found 1.86% higher and for seed yield was 1.14% higher in case of MTU 7029. This shows that by increasing interplant distance, both grain yield and seed recovery increases in case of MTU 7029 but in case of other varieties this increase is nominal. This may be due to genetic potential of the variety.

The plant height had negative association with seed yield (-0.032) indicating less importance of this trait in selection process (Table 2). This finding is also in agreement with previous workers (Babu *et al*., 2006). Its direct effect was high and positive (10.168) whereas, the indirect effect of this trait on 1000-grain weight (0.495) and grain yield per plant (1.274) was moderate to high (Table 3). This observation was also supported by earlier worker (Babu *et al*. 2006).

The direct and indirect effects of yield components on the seed yield are presented in Table 3 and 4. The genotypic correlation values showed that the productive tillers per plant had significant positive relationship with grain yield per plot at both the spacing. Its direct effect on seed yield was high (0.935) in case of closer spacing. These findings are in close agreement

Table 1. Character mean of Trial I (Varieties sown at a distance of 20 x 15 cm) and Trial II (Varieties sown at a distance of 20 x 20 cm) ; Date of Transplanting : 22/07/2010

Character	Trial	Sarju 52	Naveen	BPT 5204	MTU 7029	Pratikshya	S.E.±	C.D.	C.V.
Days to heading	I	68.3	66.3	85.3	80.6	83.0	0.45	1.47	1.02
	II	69.0	67.3	86.3	81.3	83.6	0.43	1.41	0.97
Days to maturity	I	115.3	114.6	135.3	138.3	137.6	0.34	1.11	0.46
	II	116.3	115.3	136.3	138.6	139.3	0.35	1.14	0.47
Plant height (cm)	I	118.8	149.3	96.4	115.4	110.1	0.98	3.20	1.44
	II	115.0	147.3	93.0	113.6	108.6	0.38	1.24	0.57
No. of panicles /plant	I	7.4	7.9	13.0	10.6	8.8	0.40	1.30	7.25
	II	8.4	8.6	14.3	11.6	9.3	0.22	0.73	3.70
Length of spike (cm)	I	22.3	27.0	20.9	23.7	23.3	0.14	0.46	1.05
	II	22.2	26.8	20.8	23.1	23.4	0.09	0.30	0.69
No. of filled grains / plant	I	1040.4	1067.0	1883.3	1506.3	1197.0	43.09	140.53	5.57
	II	1050.0	1068.6	1885.3	1512.0	1208.0	36.63	119.45	4.71
No. of unfilled grains / plant	I	125.3	203.0	325.0	408.3	385.3	12.77	41.67	7.64
	II	125.0	199.6	319.0	410.3	376.3	12.17	39.70	7.37
Grain weight of filled grains (gm)	I	23.23	19.61	27.69	24.18	23.84	1.37	4.49	10.06
	II	22.97	19.24	26.91	24.25	24.40	1.39	4.53	10.23
1000 grain weight (gm)	I	21.31	18.69	16.84	17.45	20.13	0.29	0.96	2.71
	II	21.65	18.81	16.98	17.53	20.26	0.23	0.75	2.09
Grain yield / plot (kg)	I	16.06	16.08	17.28	19.80	19.28	0.37	1.22	3.53
	II	16.07	16.09	17.40	20.17	19.34	0.15	0.48	1.42
Seed yield (%)	I	74.12	69.93	66.21	75.71	75.16	0.23	0.76	0.56
	II	74.54	70.30	66.77	76.58	75.74	0.27	0.89	0.64
Percent gain in grain yield / plot over Trial I		0.06 %	0.06 %	0.69 %	1.86 %	0.31 %			
Percent gain in seed yield over Trial I		0.56 %	0.52 %	0.84 %	1.14 %	0.77 %			

Table 2. Correlation coefficient between seed yield and yield contributing characters in rice; Date of transplanting: 22/07/2010

Character	Trial No.	Correlation coefficient	Days to maturity	Plant height	No. of panicles/ plant	Length of spike	No. of filled grains/ plant	No. of unfilled grains/ plant	Grain weight of filled grains	1000 grain weight	Grain yield/ plot	Seed yield
Days to 50% flowering	I	G	0.961**	-0.847	0.821**	-0.652	0.788**	0.863**	0.925**	-0.527	0.812**	0.032
	II	P	0.957**	-0.842	0.768**	-0.646	0.773**	0.845**	0.711**	-0.505	0.766**	0.030
		G	0.962**	-0.819	0.779**	-0.629	0.804**	0.854**	0.902**	-0.542	0.720**	-0.004
		P	0.957**	-0.815	0.762**	-0.626	0.781**	0.831**	0.737**	-0.526	0.717**	0.006
Days to maturity		G		-0.728	0.711**	-0.515	0.683**	0.960**	0.778**	-0.516	0.946**	0.232
		P		-0.725	0.685**	-0.513	0.667**	0.945**	0.571**	-0.496	0.905**	0.230
		G		-0.702	0.650**	-0.494	0.676**	0.954**	0.900**	-0.500	0.886**	0.225
		P		-0.701	0.639**	-0.492	0.663**	0.933**	0.623**	-0.488	0.878**	0.222
Plant height		G			-0.709	0.954**	-0.718	-0.498	-0.082	0.241	-0.513	-0.032
		P			-0.684	0.941**	-0.706	-0.485	-0.830	0.223	-0.493	-0.037
		G			-0.702	0.957**	-0.721	-0.447	-0.732	0.210	-0.392	0.041
		P			-0.695	0.953**	-0.712	-0.441	-0.818	0.206	-0.390	0.040
No. of panicles/ plant		G				-0.614	0.023	0.621	0.972**	-0.884	0.452*	-0.475
		P				-0.581	0.950	0.570	0.658**	-0.783	0.436*	-0.440
		G				-0.637	0.908	0.554	0.895**	-0.840	0.291*	-0.523
		P				-0.627	0.980	0.540	0.649**	-0.804	0.283*	-0.502
Length of spike		G					-0.648	-0.247	-0.072	0.130	-0.298	-0.012
		P					-0.613	-0.238	-0.761	0.114	-0.285	-0.009
		G					-0.652	-0.216	-0.958	0.109	-0.187	0.088
		P					-0.632	-0.209	-0.759	0.096	-0.190	0.087
No. of filled grains / plant		G						0.569	0.957**	-0.846	0.429**	-0.467
		P						0.563	0.719**	-0.811	0.400*	-0.455
		G						0.572	0.926**	-0.820	0.319*	-0.497
		P						0.569	0.649**	-0.815	0.306*	-0.486
No. of unfilled grains / plant		G							0.532	-0.561	0.980	0.260
		P							0.367	-0.562	0.918	0.250
		G							0.651	-0.587	0.940	0.274
		P							0.422	-0.584	0.919	0.264
Grain weight of filled grains		G								-0.506	0.472*	-0.211
		P								-0.316	0.355*	-0.143
		G								-0.423	0.509**	-0.104
		P								-0.245	0.411*	-0.038
1000 grain weight		G									-0.370	0.538**
		P									-0.350	0.520**
		G									-0.299	0.526**
		P									-0.284	0.521**
Grain yield /plot		G										0.518**
		P										0.487*
		G										0.598**
		P										0.590**

*, ** Significant at 5% and 1% level, respectively

with those of earlier workers who found a positive association between productive tillers and grain yield (Li *et al*., 1991; Wilfred Manuel and Rangaswamy, 1993 and Swain and Reddy, 2006). Panicle length showed negatively significant association with grain yield per plot (-0.012). The direct effect of this trait on seed yield is negative (-10.77). Hence, the importance of this trait while selecting a genotype of high seed yield is not much required.

Under closer spacing (20x15cm) transplanting among the different yield components, 1000 grain weight showed the maximum direct effect (2.048) which showed significant positive association with grain yield per plot and seed recovery. Days to 50% flowering and maturity had shown negative indirect effect on 1000 grain weight. The effect of genetic residual factor on the plot yield was higher (0.9863) than the phenotypic residual factor (0.0244). The result showed that emphasis should be given to 1000 grain weight while selection under closer planting condition to improve the grain yield and seed yield in rice genotypes.

Under space planting, significant positive association of days to maturity with grain yield per plot (0.886) and positive association with seed yield are due

Table 3. Path- coefficient analysis under 20x15 cm sowing (Trial I) 2010-11

Character		Days to 50% flowering	Days to maturity	Plant height	Ear bearing tillers	Panicle length	No. of filled grains plant^{-1}	No. of unfilled grains plant^{-1}	Grain weight of filled grains	1000 grain weight	Grain yield plot^{-1}	Correlation due to seed recovery
Days to 50% flowering	(G)	1.273	-10.806	-8.622	0.767	7.027	0.818	12.854	-0.179	-1.081	-2.019	0.032
	(P)	-3.684	4.612	1.143	-0.734	-0.404	0.093	-0.769	0.064	-0.010	-0.280	0.030
Days to maturity	(G)	1.224	-11.245	-7.408	0.665	5.548	0.709	14.299	-0.150	-1.057	-2.352	0.232
	(P)	-3.526	4.819	0.983	-0.655	-0.321	0.080	-0.860	0.051	-0.010	-0.331	0.230
Plant height	(G)	-1.080	8.192	10.168	-0.663	-10.274	-0.746	-7.415	0.016	0.495	1.274	-0.032
	(P)	3.104	-3.495	-1.356	0.654	0.589	-0.085	0.441	-0.075	0.004	0.180	-0.037
Ear bearing tillers	(G)	1.045	-8.002	-7.216	0.935	6.612	0.023	9.252	-0.188	-1.812	-1.125	-0.475
	(P)	-2.830	3.302	0.928	-0.956	-0.363	0.114	-0.519	0.059	-0.016	-0.159	-0.440
Panicle length	(G)	-0.831	5.793	9.701	-0.574	-10.770	-0.673	-3.680	0.014	0.267	0.740	-0.012
	(P)	2.380	-2.474	-1.277	0.556	0.625	-0.074	0.217	-0.068	0.002	0.104	-0.009
No. of filled grains plant^{-1}	(G)	1.004	-7.690	-7.310	0.0215	6.984	1.037	8.472	-0.185	-1.734	-1.067	-0.467
	(P)	-2.848	3.216	0.958	-0.908	-0.383	0.120	-0.512	0.065	-0.016	-0.146	-0.455
No. of unfilled grains plant^{-1}	(G)	1.100	-10.803	-5.066	0.581	2.663	0.590	14.884	-0.103	-1.149	-2.437	0.260
	P)	-3.115	4.558	0.658	-0.545	-0.149	0.068	-0.909	0.033	-0.011	-0.336	0.250
Grain weight of filled grains	(G)	1.178	-8.757	-0.839	0.909	0.779	0.994	7.930	-0.193	-1.037	-1.173	-0.211
	P)	-2.622	2.752	1.126	-0.629	-0.476	0.087	-0.334	0.090	-0.006	-0.130	-0.143
1000 grain weight	(G)	0.672	5.806	2.458	-0.827	-1.406	-0.878	-8.353	0.098	2.048	0.919	0.538**
	(P)	1.862	-2.392	-0.302	0.748	0.071	-0.098	0.511	-0.028	0.020	0.128	0.520**
Grain yield plot^{-1}	(G)	1.039	-10.648	-5.216	0.423	3.210	0.445	14.598	-0.091	-0.758	-2.484	0.518**
	(P)	-2.823	4.365	0.669	-0.417	-0.178	0.048	-0.835	0.032	-0.007	-0.366	0.487*

Genotypic Residual = 0.9863 Phenotypic Residual = 0.0244 G = Genotypic
*and ** Significant at P = 0.05 and 0.0, respectively P = Phenotypic

to its direct effect at genotypic level (0.780). Highly significant association of 1000 grain weight (0.526) and grain yield per plot (0.598) with seed yield is due to their direct effect (0.457 and 0.993) indicating that their importance in selection under space planting. 1000 grain weight is indirectly affected by days to 50% flowering both at genotypic (0.815) and phenotypic level (0.793).

The direct effect of unfilled grains per plant is higher (14.884) in closer spacing. But it shows negative correlation with grain yield per plot (-2.437). It means production of unfilled grains is the genetic trait in rice genotypes. In space planting (20x20cm), the direct effect of unfilled grains is in negative direction (-0.013). It depicts that the production of unfilled grains decreases in space planting as a result grain yield per plot is increased. Grain yield per plot is significantly correlated with seed yield, so seed yield is increased.

The present investigation gives an idea about the association of characters for the improvement of grain yield and seed yield at closer and space planting. Among the traits studied, days to 50% flowering, days to maturity, number of panicles per plant, number of filled grains per plant and grain weight of filled grains per plant showed very high association with grain yield per plot at both the spacing. This observation was in close agreement with previous workers (Babu *et al*. 2006; Sathya *et al*. 1999). Days to maturity, 1000 grain weight and grain yield per plot showed significant positive association with seed yield. Therefore, importance of 1000 grain weight should be given in getting seed recovery in rice genotypes.

Though grain yield per plot showed maximum

Table 4. Path- coefficient analysis under 20x20 cm sowing (Trial II) 2010-11

Character		Days to 50% flowering	Days to maturity	Plant height	Ear bearing tillers	Panicle length	No. of filled grains plant^{-1}	No. of unfilled grains plant^{-1}	Grain weight of filled grains	1000 grain weight	Grain yield plot^{-1}	Correlation due to seed recovery
Days to 50% flowering	(G)	**-1.504**	0.750	0.322	-0.0003	-0.019	-0.015	-0.011	0.006	-0.248	0.715	**-0.004**
	(P)	**-1.505**	-0.100	1.670	0.0873	-0.683	-0.218	-0.321	-0.072	-0.039	1.176	**-0.006**
Days to maturity	(G)	-1.447	**0.780**	0.276	-0.0002	-0.015	-0.012	-0.012	0.006	-0.229	0.880	**0.225**
	(P)	-1.440	**-0.104**	1.435	0.0732	-0.538	-0.185	-0.360	-0.061	-0.036	1.440	**0.222**
Plant height	(G)	1.232	-0.548	**-0.393**	0.0003	0.030	0.013	0.006	-0.005	0.096	-0.390	**0.041**
	P)	1.227	0.073	**-2.048**	-0.0797	1.041	0.199	0.170	0.080	0.015	-0.640	**0.040**
Ear bearing tillers	(G)	-1.173	0.507	0.276	**-0.0004**	-0.020	-0.017	-0.007	0.006	-0.384	0.289	**-0.523**
	(P)	-1.147	-0.066	1.424	**0.1145**	-0.684	-0.274	-0.208	-0.063	-0.060	0.464	**-0.502**
Panicle length	(G)	0.947	-0.385	-0.376	0.0002	**0.031**	0.012	0.002	-0.007	0.050	-0.186	**0.088**
	P)	0.942	0.051	-1.953	-0.0718	**1.091**	0.176	0.081	0.074	0.006	-0.312	**0.087**
No. of filled grains plant^{-1}	(G)	-1.210	0.528	0.283	-0.0003	-0.020	**-0.018**	-0.007	0.006	-0.375	0.317	**-0.497**
	(P)	-1.176	-0.069	1.460	0.1123	-0.690	**-0.279**	-0.219	-0.063	-0.061	0.502	**-0.486**
No. of unfilled grains plant^{-1}	(G)	-1.285	0.744	0.176	-0.0002	-0.006	-0.010	**-0.013**	0.004	-0.269	0.934	**0.274**
	P)	-1.252	-0.097	0.903	0.0619	-0.229	-0.159	**-0.386**	-0.041	-0.044	1.507	**0.264**
Grain weight of filled grains	(G)	-1.358	0.702	0.287	-0.0003	-0.030	-0.017	-0.008	**0.007**	-0.193	0.506	**-0.104**
	P)	-1.109	-0.065	1.677	0.0744	-0.828	-0.181	-0.162	**-0.098**	-0.018	0.674	**-0.038**
1000 grain weight	(G)	0.815	-0.390	-0.082	0.0003	0.003	0.015	0.007	-0.003	**0.457**	-0.297	**0.526****
	P)	0.793	0.051	-0.423	-0.0922	0.105	0.228	0.225	0.024	**0.075**	-0.465	**0.521****
Grain yield plot^{-1}	(G)	-1.083	0.691	0.154	-0.0001	-0.005	-0.006	-0.012	0.003	-0.137	**0.993**	**0.598****
	P)	-1.079	-0.091	0.799	0.0324	-0.207	-0.085	-0.354	-0.040	-0.021	**1.640**	**0.590****

Genotypic Residual = 0.0986 Phenotypic Residual = 0.1071 G = Genotypic
*and ** Significant at P = 0.05 and 0.0, respectively P = Phenotypic

direct effect both at genotypic (0.993) and phenotypic level (1.640), its association with seed yield was significantly positive. The genotypic residual factor (0.0986) was very less than phenotypic residual factor (1.071). From the present study it can be concluded that emphasis should be given on 1000 grain weight under closer spacing but both for 1000 grain weight and grain yield per plot under space planting to get higher seed recovery.

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