



Character Association and Path Analysis in Rice (*Oryza sativa* L.) Genotypes for cold tolerance

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Abstract:

Genotypic and phenotypic correlation among sixteen component characters was studied in 52 genotypes of Rice. Association analysis of parents revealed that Days to 50% flowering, plant height, seedling maturity after transplanting, number of productive tillers, Panicle exertion had high significant positive correlation with cold tolerance. Number of seeds/head, 100 seed weight, head diameter and per cent seed filling also had significant positive inter-correlation among themselves. Seedling growth (cm), panicle length, Days to 50% flowering, early seedling vigor and seed vigor influenced indirectly. Hence, this trait should be given priority in rice improvement programme for cold tolerance.

Introduction:

Rice (*Oryza sativa* L.) is the world's most staple food for about 2.5 billion people and which may escalate to 4.6 billion by the year 2050 ^[1]. Because of change in climate, the *rabi* season has low temperature vary from 8°C to 16°C starting from December to first fortnight of February ^[2]. The optimum day temperature before heading is 31° - 32°C and optimum night temperature is 21° - 22°C and the period for 15 days after heading varies from 8° to 16°C. Rice might suffer from low temperature at the seedling stage of the crop ^[3]. Even low temperature at the crop establishment and tiller development stage (vegetative phase) of the crop might affect the growth and development of the crop. Conventional high yielding varieties have little tolerance to low temperature. The major constraint is lack of suitable varieties for this ecosystem. Therefore, the technique of path coefficient analysis is utilized to have an idea of direct and indirect contribution of a trait towards the end product. The present investigation was undertaken to gather some useful information on genetic variability, character association and path coefficient analysis in a set of 52 rice genotypes.

Materials and Methods:

A field experiment was conducted during Rabi, 2010 at Directorate of Rice Research (DRR) farm, International Crops Research Institute for the Semi

Arid Tropics (ICRISAT) Campus Patancheru, Hyderabad, India. Situated at 17.53°N latitude, 78.27°E longitude and altitude of 545m above mean sea level with 52 genotypes of rice from different boro areas. Each entry was represented by single row of 4.5 m length with a spacing of 20 cm between rows and 15 cm between plants in a Randomized Block Design with three replications. Thirty days old seedlings were transplanted with a spacing of 20 cm and 15 cm between rows and plants, respectively. Five representative plants for each genotype in each replication were randomly selected to record 15 observations.

Results and Discussion:

The results from analysis of variance for 16 yield and quality traits of 52 genotypes are observed. All the characters studied exhibited highly significant differences in all the genotypes under study suggesting presence of sufficient variation among the genotypes for these traits ^[4]. Table 2 and 3 show the estimates of genotypic and phenotypic correlation. In general the genotypic correlation was found to be higher than the phenotypic correlation for all the traits under study ^[5]. The nature and magnitude of correlation among 16 traits in the present study revealed that Days to 50% flowering registered positive and significant correlations with coleoptile length, and seedling growth ^[6].

The panicle exertion exhibited positive and significant association with Tillers/ Plant, Productive Tillers. Days to maturity has positive and significant association with Plant height, Days to 50% flowering and Seed vigor ^[7]. Test Weight (g) has positive and significant association with Coleoptile Length (cm), Seedling growth (cm) and Seed vigor ^[8]. Tillers per Plant have positive and significant association with Productive Tillers and Radical length (cm). Days to 50% flowering has positive and significant association with Coleoptile Length (cm), Seedling growth (cm) and Seed vigor. Productive Tillers has positive and significant association with Radical length (cm). Coleoptile length revealed that seedling growth (cm) exerted

the highest direct positive effect on grain yield followed by panicle length, Days to 50% flowering, Early seedling vigor and seed vigor (Table 2), indicating the selection for these characters are likely to bring about an overall improvement in

single plant yield, directly^[9,10] Path coefficient analysis revealed that panicle exertion showed the highest negative direct effect on grain yield followed by radical length (cm), seedling maturity, number of tillers per plant and days to maturity^[11]

Table 1. Phenotypic and Genotypic correlation coefficients for yield and yield attributing characters in Rice

		Panicle exertion	Panicle length (cm)	Days to maturity	Spikelet sterility	Test Weight (g)	Early seedling vigor	Seedling maturity	Plant height	Tillers/Plant	Days to 50% flowering	Productive Tillers	Germination %	Coleoptile Length (cm)	Seedling growth (cm)	Radical length (cm)	Seed vigor.
Panicle exertion	P	1	0.02	-0.18*	0.07	-0.05	0.15	0.08	0.08	0.17*	-0.26**	0.18*	-0.1	-0.22**	-0.21**	-0.04	-0.22**
	G	1	0.12	-0.01	0.01	-0.02	0.2	0.02	0.03	0.21*	-0.30	0.21*	-0.2	-0.33**	-0.30**	-0.1	-0.32**
Panicle length cm	P		1	-0.19*	-0.11	-0.06	-0.17*	-2.26**	0.19*	0.1	0.08	0.35**	0.05	-0.19	-0.14	0.22**	-0.14
	G		1	-0.24*	-0.19	-0.10	-0.20*	-2.30**	0.19*	0.3	0.11	0.42**	0.20	-0.21	-0.20	0.33**	-0.22
Days of maturity	P			1	-0.11	-0.04	-0.26**	-0.02	0.24**	-0.35**	0.51**	-0.55**	-0.02	0.52**	0.49**	0.34**	0.48**
	G			1	-0.22	-0.10	-0.31**	-0.13	0.35**	-0.41**	0.61**	-0.65**	-0.12	0.65**	0.62**	0.44**	0.58**
Spikelet sterility	P				1	-0.05	0.01	-0.08	-0.01	0.01	-0.05	0.01	0.06	-0.06	-0.06	0.02	-0.06
	G				1	-0.10	0.10	-0.12	-0.11	0.11	-0.20	0.11	0.15	-0.21	-0.23	0.14	-0.26
Test Weight (g)	P					1	0.12	0.01	-0.04	-0.08	-0.07	-0.01	-0.06	0.33**	0.42**	0.32	0.40**
	G					1	0.21	0.14	-0.15	-0.21	-0.21	-0.21	-0.21	0.46**	0.51**	0.42	0.50**
Early seedling vigor	P						1	0.65**	-0.13	0.03	-0.33**	0.11	-0.15	-0.04	-0.08	0.07	-0.07
	G						1	0.74**	-0.22	0.12	-0.44**	0.21	-0.22	-0.12	-0.18	0.23	-0.14
Seedling maturity	P							1	-0.18*	-0.12	-0.20**	-0.05	-0.11	-0.08	-0.12	-0.01	-0.12
	G							1	-0.22*	-0.22	-0.31**	-0.14	-0.22	-0.14	-0.22	-0.13	-0.24
Plant height	P								1	0.11	0.13	-0.04	-0.07	0.12	0.11	-0.11	0.11
	G								1	0.21	0.28	-0.14	-0.24	0.22	0.21	-0.21	0.22
Tillers/Plant	P									1	-0.13	0.59**	-0.01	-0.20*	-0.19	0.15*	-0.16*
	G									1	-0.22	0.62**	-0.12	-0.32*	-0.21	0.21*	-0.21*
Days to 50% flowering	P										1	-0.38**	0.01	0.26**	0.26**	-0.13	0.26**
	G										1	-0.42**	0.11	0.32**	0.32**	-0.21	0.32**
Productive Tillers	P											1	-0.07	-0.43**	-0.41**	0.24**	-0.39**
	G											1	-0.14	-0.52**	-0.52**	0.32**	-0.42**
Germination %	P												1	-0.04	-0.12	0.05	0.01
	G												1	-0.12	-0.32	0.12	0.11
Coleoptile Length (cm)	P													1	0.94**	-0.24**	0.94**
	G													1	0.11**	-0.32**	0.16**
Seedling growth (cm)	P														1	-0.04	0.99**
	G														1	-0.14	1.3**
Radical length (cm)	P															1	0.04
	G															1	0.19
Seed vigor	P																1
	G																1

Table 2: Direct and indirect effects for seed yield and yield attributing characters in Rice at genotypic level

	Panicle exertion	Panicle length	Days to maturity	Spikelet sterility	Test Weight	Early seedling vigor	Seedling maturity	Plant height.	Tillers/ Plant	Days to 50% flowering	Productive Tillers	Germination %	Coleoptile Length (cm)	Seedling growth (cm)	Radical length (cm)	Seed vigor.
Panicle exertion	-0.0082	0.0002	-0.0015	-0.0006	0.0004	-0.0013	-0.0007	-0.0007	-0.0015	0.0022	-0.0015	0.0008	0.0019	0.0018	0.0003	0.0019
Panicle length cm	0.0057	0.1970	-0.0387	-0.0023	-0.012	-0.035	-0.051	0.038	0.021	0.017	0.069	0.010	-0.038	-0.027	0.043	0.028
Days to maturity	0.066	0.071	-0.03628	0.04	0.015	0.094	0.08	-0.08	0.12	-0.185	0.202	0.009	-0.188	-0.178	0.125	-0.177
Spikelet sterility	-0.001	0.0003	0.002	-0.0222	0.001	-0.0001	0.0018	0.0004	-0.0004	0.0012	-0.0002	-0.0013	0.0015	0.0014	-0.0005	0.0013
Test Weight (g)	0.0046	0.0056	0.004	0.005	-0.0912	-0.011	-0.001	0.004	0.007	0.006	0.0017	0.006	-0.0314	-0.038	-0.028	-0.036
Early seedling vigor	0.0032	-0.0036	-0.0053	0.0001	0.0026	0.0204	0.013	-0.0027	0.0007	-0.0069	0.0022	-0.0032	-0.0009	-0.0017	0.0002	-0.0015
Seedling maturity	-0.0008	0.0026	0.0002	0.0008	-0.0002	-0.0066	-0.0101	0.0018	0.0013	0.0021	0.0006	0.001	0.0009	0.0013	0.0002	0.0012
Plant height.	-0.0021	-0.0048	-0.0059	0.0005	0.0012	0.0033	0.0044	-0.0245	-0.0026	-0.0032	0.0001	0.0007	-0.0032	-0.0029	0.0029	-0.0028
Tillers/ Plant	-0.0238	-0.0145	0.047	-0.002	0.011	-0.0048	0.016	-0.014	-0.1336	0.0179	-0.0079	0.002	0.027	0.025	-0.021	0.022
Days to 50% flowering	-0.0117	0.0039	0.022	-0.002	-0.003	-0.015	-0.009	0.005	-0.006	0.0444	-0.017	0.0007	0.011	0.011	-0.005	0.011
Productive Tillers	0.009	0.019	-0.030	0.0005	-0.001	0.0036	-0.003	-0.0002	0.032	-0.020	-0.0546	-0.003	-0.023	-0.022	0.013	-0.021
Germination %	0.003	-0.001	0.0008	-0.001	-0.002	0.005	0.003	0.002	0.0005	-0.0005	0.002	-0.0321	0.001	0.0006	-0.001	-0.0005
Coleoptile Length (cm)	0.011	0.009	-0.026	0.003	-0.017	0.002	0.004	-0.006	0.010	-0.013	0.022	0.002	-0.0512	-0.048	0.012	-0.048
Seedling growth (cm)	-0.058	0.038	0.13	-0.016	0.112	-0.022	-0.033	0.031	-0.051	0.071	-0.011	-0.05	0.254	0.2678	0.011	0.265
Radical length (cm)	0.0001	-0.0006	0.0009	0.0001	-0.0008	0.0000	0.0001	0.0003	-0.0004	0.0004	-0.0007	0.0002	0.0007	0.0001	-0.0027	0.0001
Seed vigor.	0.006	0.003	0.012	-0.001	0.010	-0.0019	-0.0032	0.003	-0.004	0.007	-0.010	0.0004	0.024	0.025	-0.001	0.0262

Conclusion:

Correlation studies conclude Days to 50% flowering, plant height, seedling maturity after transplanting, number of productive tillers, seed vigor showed positive and significant association among themselves, indicating that simultaneous selection for these characters would result in improvement of cold tolerance of rice crop. Path analysis conclude that seedling growth (cm) , panicle length, Days to 50% flowering , Early seedling vigor and seed vigor were the most

important characters which could be used as selection criteria for effective improvement of cold tolerance. Therefore, due weightage should be given on these characters during selection for pedigree breeding work.

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