Madras Agric. J., 83(3): 185-188 March 1996
https://doi.org/10.29321/MAJ.10.A01001

GENETIC VARIABILITY AND CHARACTER ASSOCIATION STUDIES IN SEMI-DRY RICE

T.PRADYUMNA RAO, P.GOMATHINAYAGAM and G.SOUNDRAPANDIAN.

Department of Agricultural Botany
Agricultural College and Research Institute
Tamil Nadu Agricultural University
Madurai 625 104

ABSTRACT

Forty drought tolerant rice genotypes were used to study genetic variability, character association and path analysis between yield and its contributing traits under semi-dry cultivation in two environments. Irrespective of the environment, high phenotypic and genotypic coefficients of variation coupled with high heritability and high genetic advance in spikelet sterility and leaf area index indicated the predominance of additive gene effects in controlling them. Difference in GCV estimates over the environments was found to be a good tool to find out favourable environment to exploit genotypic variation and to exercise selection for improvement of traits. Productive tiller number, harvest index and drymatter production had positive and significant correlation with yield in both environments. Harvest index and drymatter production showed positive and direct effect on yield, and a negative indirect effect on each other with yield.

KEY WORDS : Genetic Variability, Semi-dry rice

Semi-dry rice culture is a predominant form of cultivation prevailing in many areas. Development of high yielding genotypes under such conditions requires a thorough knowledge of existing genetic variation and extent of association of yield contributing characters. The observed variability is a combined estimate of genetic and environmental causes, and the genetic variability alone is heritable. Moreover the estimates of genetic variability across the environments within the conditions can, however, result with a favourable environment to exploit complete genetic variability to exercise selection for the development of yield contributing traits. An estimate of heritability alone does not give an idea about the expected gain in the next generation but it has to be considered in conjunction with genetic advance. Correlation and path analysis will establish the extent of association between yield and yield components and bring out relative importance of their direct and indirect effects and thus give a clear understanding of their association with yield. With an intent to develop genotypes to the particular condition, the present study was undertaken to get information on the above genetic constants and character association.

MATERIALS AND METHODS

Forty drought tolerant rice genotypes with diverse geographical origin were grown in a randomised block design with three replications at [illegible] and Research Institute, Madurai (E1) and Agricultural Research Station, Paramakudi (E2) under semi-dry conditions. Eighty plants of each genotype were raised under direct seeded condition in four rows per replication with a row-to-row and plant-to-plant spacing of 20 and 10 cm respectively. The crop was grown under dry cultivation for 60 days and then converted as low land paddy. Five hills were taken from each plot to record observations such as plant height, productive tiller number, spikelet sterility, root length on 30 days after sowing (DAS), leaf area index (LAI) harvest index (HI),drymatter production (DMP) and single plant yield at harv est. Standard statistical procedures were followed for calculating genetic constants, phenotypic and genotypic coefficient of variation (Burton 1952), heritability (Handon *et al.*, 1956) and genetic advance (Johnson *et al.*, 1955). The genotypic and phenotypic correlation coefficients were calculated as outlined by Gandhi *et al.*, (1964) and path analysis following the method of Deway and Lu (1959).

RESULTS AND DISCUSSION

Phenotypic (PCV) and genotypic (GCV coefficients of variation (Table 1) were observed tc be high for spikelet sterility and LA (Ravindranath *et al.*, 1973), indicating the scope fo improving them through direct selection. Althougl the influence of environment of each trait could b determined by the difference in PCV and GCV, th

Table 1. Estimates of the genetic variability for E1 (Upper values) and E2 (lower values)

	Mean	±SE	PCV	GCV	PCV-GCV	GCV-GCV (E1-E2)	h^2	GA	GA%
PHT	87.6 76.9	±2.3 ±1.8	17.0 22.2	16.7 22.1	0.3 0.1	-5.4	96.6 98.4	29.5 34.7	33.7 45.1
PTN	5.8 6.4	±0.3 ±0.4	24.7 28.0	24.1 26.9	0.6 1.1	-2.8	95.3 92.5	2.9 3.4	48.5 53.3
SSt	11.9 9.3	±0.3 ±0.4	42.5 44.5	42.4 44.2	0.1 0.3	-1.8	99.5 98.9	10.4 8.6	87.3 90.6
RL	12.9 4.9	±0.3 ±0.4	24.1 22.8	23.9 21.0	0.2 1.8	2.9	98.4 84.7	6.3 1.9	48.8 39.8
LAI	3.3 2.6	±0.1 ±0.1	35.3 38.3	34.9 38.3	0.4 0.0	-3.4	97.7 99.9	2.4 2.1	71.1 78.8
HI	0.36 0.36	±0.1 ±0.1	17.7 23.2	17.1 22.5	0.6 0.7	-5.4	93.2 94.1	0.12 0.16	34.0 45.0
DMP	23.4 23.5	±0.7 ±0.5	18.0 27.6	17.6 27.5	0.4 0.1	-9.9	95.5 99.0	8.3 13.2	35.4 56.4
SPY	8.4 8.3	±0.4 ±0.3	23.2 26.3	22.6 26.0	0.6 0.3	-3.4	95.0 97.2	3.9 4.4	45.4 52.8

PHT : Plant height; LAI : Leaf area index; PTN : Productive tiller number; HI : Harvest index; SSt : Spikelet sterility; DMP : Drymatter production; RL : Root length on 30th day; SPY : Single plant yield

difference between the GCV estimates across the environments might indicate more precisely the influence on genetic variability (Johnson *et al.*, 1955). Irrespective of the environment, differences between PCV and GCV were low for plant height and spikelet sterility. These results indicate the stability of these traits over the environments. The direction of shift in GCV estimates of E2 from E1,

Table 2. Phenotypic (upper values) and genotypic (lower values) correlation co-efficient for different characters at E1 (upper diagonal) and E2 (lower diagonal)

	PHT	PTN	SSt	RL	LAI	HI	DMP	SPY
PHT		0.105 0.100	-0.167 -0.169	-0.067 -0.070	0.125 0.133	-0.006 -0.019	0.002 -0.000	0.001 -0.002
PTN	0.316* 0.329		0.172 0.179	-0.215 -0.224	0.074 0.076	0.448** 0.466	0.263 0.276	0.539** 0.571
SSt	-0.258 -0.264	-0.041 -0.043		-0.046 -0.046	-0.116 -0.120	0.028 0.029	0.356* 0.366	0.274 0.283
RL	0.218 0.237	0.058 0.082	-0.350* -0.391		-0.108 -0.111	-0.055 -0.052	0.080 0.082	0.032 0.034
LAI	0.352* 0.356	0.265 0.276	-0.106 -0.106	0.082 0.087		-0.198 -0.208	0.292 0.298	0.082 0.085
HI	-0.080 -0.079	0.223 0.240	-0.113 -0.121	0.174 0.193	-0.032 -0.034		-0.109 -0.120	0.613** 0.625
DMP	0.432** 0.436	0.223 0.236	-0.044 -0.044	-0.051 -0.044	0.304 0.306	0.384* -0.389		0.693** 0.690
SPY	0.409** 0.412	0.454** 0.481	-0.112 -0.116	0.128 0.156	0.307 0.312	0.435** 0.421	0.639** 0.650	

PHT : Plant height; LAI : Leaf area index; PTN : Productive tiller number; HI : Harvest index; SSt : Spikelet sterility;
DMP : Drymatter production; RL : Root length on 30th day; SPY : Single plant yield

was negative for all characters except for root length on 30 DAYS (Table 1), indicated that there was considerable increase in genotypic variation of these traits at E2 as compared to E1. Greater expression of genotypic variation might be considered as favourable environment to exercise the selection for the improvement of these traits under the semi-dry condition. Different expression of genotypic variation was reported between environments (Saini *et al.*,(1974). High heritability was observed for all characters studied (Table 1). Similar observations were reported for plant height, leaf area index and single plant yield (Ravindranath *et al.*, 1983), spikelet sterility (Singh *et al.*, 1984), harvest index (Sukanya Subramanian 1985) and drymatter production (Ayyamperumal *et al.*, 1985). Since all the traits exhibited high heritability, either mass selection or hybridisation followed by bulk selection can be adopted in improvement of these traits. High heritability coupled with high genetic advance observed in spikelet sterility (Singh, *et al.*, 1984) and leaf area index (Ravindranath *et al.*, 1983) indicated the predominance of additive gene effect in controlling them.

Genotypic and phenotypic correlation coefficients between yield and the related components for both the locations are presented in Table 2. Magnitude of the same was similar at both locations. In general, the genotypic correlations were higher than the corresponding phenotypic correlations (Chauhan and Tandon, 1984). The low phenotypic correlation could consult due to the modifying effect of environment on the association of characters at the ginic level.

In both the environments, productive tiller number, HI and DMP had positive and highly significant correlation with yield (Table 2). This indicated the strength of association between these traits and grain yield, which was unaltered by environmental effect. Significant and positive correlation of yield with productive tiller number (Amrithadevarathinum, 1990; Rajarathinam and Guruswamy Raja, 1992), harvest index and drymatter production (Takeda *et al.*, 1984) was reported in rice.

Significant and positive correlation of plant height with yield at E2 and productive tiller number with HI and spikelet sterility with drymatter production at E1 was observed. These results indicated that the association between different traits differed with environment, and hence the correlation response of different traits to selection

Table 3. Path co-efficient analysis showing the direct (bold) and indirect effects of yield components on grain yield at E1 (upper values) and E2 (lower values) environments. Residual effect E1 = 0.1161 and E2=0.1819

	PHT	PTN	SSt	RL	LAI	HI	DMP	GCC
PHT	**0.005**	0.004	0.005	-0.001	-0.001	-0.013	-0.000	-0.002
	0.050	0.019	-0.014	0.012	0.010	-0.060	0.395	0.412**
PTN	0.001	**0.039**	-0.005	-0.003	-0.000	0.326	0.214	0.571**
	0.016	**0.059**	-0.002	-0.004	0.008	0.183	0.214	0.481**
SSt	-0.001	0.007	**-0.026**	-0.001	0.001	0.021	0.283	0.283
	-0.013	-0.003	**0.055**	-0.020	-0.003	-0.092	-0.040	-0.116
RL	-0.000	-0.009	0.001	**0.015**	0.001	-0.037	0.063	0.034
	0.012	0.005	-0.021	**0.052**	0.002	0.147	-0.040	0.156
LAI	0.001	0.003	0.003	-0.002	**-0.005**	-0.146	0.230	0.085
	0.018	0.016	-0.006	0.005	**0.027**	-0.026	0.278	0.312
HI	-0.000	0.018	-0.001	-0.001	0.001	**0.701**	-0.093	0.625**
	-0.004	0.014	-0.006	0.010	-0.001	**0.760**	-0.352	0.421**
DMP	-0.000	0.011	-0.010	0.001	-0.002	-0.085	**0.774**	0.690**
	0.022	0.014	-0.002	-0.003	0.008	-0.296	**0.906**	0.650**

GCC : Genotypic correlation co-efficient ** Significant at 1% level

PHT : Plant height; LAI : Leaf area index; PTN : Productive tiller number; HI : Harvest index; SSt : Spikelet sterility; DMP : D matter roduction; RL : Root length on 30th day; SPY : Single plant yield might vary with environment. Such alterations in the nature of character association was reported by Roy and Murthy (1969) and Chauhan and Tandon (1984). The association of HI with DMP was negative (Sukanya Subramanian and Rathinam, 1984a) in both environments and significant at E2. Newell and Eberhart (1961) opined that when two characters showed negative association between them it would be difficult to exercise simultaneous selection for them in development of a variety. This indicates that the simultaneous selection for harvest index and drymatter production might be difficult under semi-dry condition in the development of an improved variety.

Path analysis has revealed that the DMP and HI exhibited high direct effect, when compared with the genotypic correlation co- efficient in both environments, but reduction in genotypic correlation co-efficient of these traits with yield was due to indirect negative effect between them. This result is in agreement with Sukanya subramanian and Rathinam 1984b). Productive tiller number, which showed high positive correlation with grain yield, had low effect on yield and was compensated by HI and DMP at both environments. This shows that while selecting for productive tiller number, a balance should be struck with DMP and HI. Thus the path analysis supported the results obtained from correlation studies.

REFERENCES

AMRITHADEVARATHINAM, A. (1990). Genetic variability, inter- relationship and path analysis of yield and yield characters in early maturing indica and Japonica rice genotypes. **Madras Agric.J., 9-12**: 363-368.

AYYAMPERUMAL, A., MANIVASAKAM, P., BALASUBRAMANIAN, R. and RANGASWAMY, P. (1985). Genetics of harvest index and drymatter production in rice under sodic soils. In: **Proc. of National Symp. on Genetics and Plant Physiology. Drymatter production in crop plants.** Tamil Nadu Agricultural University.

BURTON, G.W. (1952). Quantitative inheritance in grasses. In: **Proc. of 6th International grassland congress., 1**: 277-283.

CHAUHAN, V.S. and TANDON, J.P. (1984). Genetic variability and character association in hill rices. **Oryza 21**: 138-142.

DEWEY, D.R.and LU, K.H. (1959). A correlation and path co-efficient analysis of components of creasted wheat grass seed production. **Agron.J.,51**:515-518.

GANDHI, S.M., SANGHI, A.K., NATHWAT, K.S. and BHATNAGAR, M.P.(1964). Genotypic variability and correlation co-efficients in indian what. **Indian J.Genet., 24**: 1-8.

HANSON, C.H., ROBINSON, H.F. and COMSTOCK, R.E. (1956). Biometrical studies of yield in segregating populations of Korean *Lespedeza*. **Agron.J.,48**: 268-272.

JOHNSON, H.W., ROBINSON, H.F. and COMSTOCK, R.E. (1955). Estimation of genetic and environmental variability in soybean. **Agron.J.,47**: 314-318.

MISHRA, K.N., NANDA, J.S. and CHAUDARY, R.C.(1973). Correlation, path co-efficient and selection indices in dwarf rice. **Indian J.Agric.Sci., 43**: 306-311.

NEWELL, L.C. and EBERHART, S.A. (1961). Clone and progeny evaluation in the improvement of swit ch grass *Panicum irrigatus* L. **cROP.sCI.,1**: 117-121.

RAJARATHINAM, S. and GURUSWAMY RAJA, V.D. (1992). Correlation and path analysis in some rice varaities under alkaline stress. **Madras Agric.J., 79**: 374-378.

RAVINDRANATH, B., PERAIAH, A., SREE RAM REDDY, N., SUBRAMANIAN, D., RAMAYYA, B. and MURTHY, K.R.K. (1983). Inter-relationship between yield and yield components in rice. **Andhra.Agric.J.,20**:287-290.

ROY, N.N. and MURTHY, B.R. (1969). Character association under different environments in breed wheat. **Indian J. Genet., 29**: 233- 240.

SAINI, S.S., SIDHU, G.S., ISH KUMAR and GOOMBER, T.S. (1974). Phenotypic stability for yield of some rice varieties. **Indian J.Agric.Sci.,44**: 644-647.

SINGH, R.P., RAO, M.J.B .K. and RAO, S.K. (1984). Genetic evaluation of upland rice germplasm. **Oryza 21**: 132-137.

SUKANYA SUBRAMANIAN. (1985). Genetic analysis of rice yield and its components. In:**Proc.National Symp. for Genetics and Plant Physiology. Drymatter production in crop plants.** Tamil Nadu Agricultural University.

SUKANYA SUBRAMANIAN and ATHINAM, M. (1984a). Association of grain yield and yield attributes in the hybrids of crosses between tall and semi dwarf varieties of rice. **Madras Agric.J.,71**: 536-538.

SUKANYA SUBRAMANIAM and RATHINAM, M. (1984b). Path analysis in rice. **Madras Agric.J.,71**:541-542.

TAKEDA, T., OKA, M. and AGATA, W.(1984). Characteristics of drymatter and grain production of rice cultivars in the warmer part of Japan. II Composition of grain production between old and new types of rice cultivars. **Plant Breed Abst., 54**: 6666.

(Received: March 1994 Revised: June 1995)