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GENETIC VARIABILITY FOR MORPHO-PHYSIOLOGICAL COMPONENTS OF YIELDING ABILITY IN RAINFED RICE (*ORYZA SATIVA* L.)

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Genetic variability parameters such as phenotypic and genotypic coefficients of variation (PCV & GCV), heritability and genetic advance (GA) for various morphological and physiological characters were estimated in 40 genotypes of rainfed rice (*Oryza sativa* L.). High estimates of PCV and GCV were observed for net assimilation rate, harvest index, absolute growth rate and crop growth rate, where as, moderate to high estimates of PCV and GCV were recorded for plant height, leaf area index, total dry matter, specific leaf weight and grain yield per plant, indicating wide variability in the material for these traits. However, there was little variability in the material for days to 50% flowering, total tillers, effective tillers, photosynthetic rate, spikelets per panicle, 1000-grain weight and panicle length. High heritability and high genetic advance indicate scope for improvement through simple selection for harvest index, 1000-grain weight, grain yield per plant and net assimilation rate.

Key words: Rainfed rice, variability, heritability, yield

The ideotype concept, as described by Donald (1968), tells about the importance of morphological and physiological characters in optimum combination to get the maximum productivity. The rainfed rice ecosystem has some production constraints such as rainfall pattern and limited radiation. The rice genotypes with better yielding ability under such situations should be physiologically efficient with optimum combination of morphological and physiological attributes of yield. Therefore, an integrated approach with major emphasis on physiological traits to breed varieties with increased yield potential has become absolutely essential. But the research work on the genetic variation for different physiological traits of rice are quite few. Keeping this in view, the present study was initiated to assess the extent of genetic variability,

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heritability and genetic advance for different morphological and physiological characters in rainfed rice.

MATERIAL AND METHODS

Forty genotypes of rainfed rice germplasm were evaluated in randomized complete block design with two replications at the Agricultural Research Station (Paddy), Sirsi (Karnataka), situated at an altitude of 619 m above mean sea level. Seeds were sown in nursery, and later 30 days old seedlings were transplanted in the main field. Each variety was grown in four rows of 2 m length with a spacing of 20 × 15 cms. Two plants were randomly selected from the central two rows in each plot for recording data on physiological characters whereas, five plants per plot were selected for recording yield data. The observations on days to 50% flowering were recorded on plot basis.

Analysis of variances was performed following standard procedures (Panse and Sukhtme, 1967). The phenotypic and genotypic coefficients of variability were computed according to the method suggested by Burton (1952) and heritability (broadsense) and genetic advance (GA) as per Robinson *et al.*, (1949).

RESULTS AND DISCUSSION

Significant differences were observed among genotypes for all characters except specific leaf weight at flowering and effective tillers per plant. High magnitude of variation in the experimental material was also reflected by wide range of values for almost all the characters (Table 1).

Estimates of coefficients of variability, heritability and genetic advance are also presented in table 1. The phenotypic coefficient of variation (PCV) in general was higher than genotypic coefficient of variation (GCV) for all the characters under study indicating the influence of environment on the manifestation of the characters. However, the difference between PCV and GCV was less for some characters, *viz., days to 50% flowering,* photosynthetic rate, *1000-grain weight* and harvest index, *indicating low environmental influence and predominance of genetic factors controlling these traits.* The quantum of genetic variation as indicated by GCV was highest for net assimilation rate (52.7%) followed by harvest index (44.2%), absolute growth rate (41.9%) and crop growth rate (41.05%). This indicated wide variation among the genotypes for the photosynthetic efficiency and partitioning of the dry matter produced. Considerable variability for harvest index was reported earlier also (Sheshshayee, 1987). Low values of GCV were obtained for other characters, *viz.,* days to

Table 1. Range, mean, variability, heritability and genetic advance values for different morpho-physiological traits in rainfed rice genotypes

Characters	Range	Mean	Phenotypic co-efficient of variation (PCV)	Genotypic co-efficient of variation (GCV)	Heritability	Expected genetic advance in % of mean
Days to 50% flowering	98.00-134.0	111.58	8.82	8.40	90.7	16.49
Total number of tillers	8.10-13.1	10.58	16.70	10.36	38.5	13.23
Plant height (cm)	36.50-123.0	83.79	24.40	21.19	75.4	37.90
LAI at 50% flowering	1.97-5.38	3.24	32.65	17.97	30.3	20.37
LAI at maturity	0.59-2.33	1.13	40.99	27.63	45.4	38.93
TDM at 50% flowering (g)	11.73-28.88	18.44	26.29	21.03	64.0	34.65
TDM at maturity (g)	16.27-36.61	23.20	20.46	16.29	63.4	26.72
SLW at 5-% flowering (mg cm^2)	3.51-7.53	4.73	24.01	11.37	22.4	10.99
SLW at maturity (mg cm^2)	6.74-32.01	14.24	49.49	33.72	46.4	47.33
AGR (g $plant^{-1}$ day^{-1})	0.06-0.49	0.15	68.69	41.90	37.2	53.33
CGR (gm^{-2} day^{-1})	1.93-11.60	4.79	51.95	41.05	62.4	66.80
NAR (gm^{-2} LA dy^{-1})	0.70-8.23	2.72	60.73	52.72	75.4	94.11
Photosynthetic rate (μ mol. CO_2 m^{-2} sec^{-1})	14.20-25.0	19.72	14.68	13.36	82.8	25.05
Effective tillers	6.60-11.7	8.69	19.14	9.03	22.2	8.74
Panicle length (cm)	12.90-20.0	15.76	13.94	7.43	28.4	8.18
Spikelets per panicle	43.90-122.1	65.36	27.95	16.93	36.7	21.12
Spikelet sterility (%)	15.66-43.60	23.83	28.50	25.21	78.2	45.95
1000-grain weight (g)	16.80-31.4	24.82	16.33	16.01	96.1	32.35
Harvest index (%)	6.99-54.2	27.27	46.87	44.92	91.9	88.70

50% flowering (8.4%), total tillers (10.3%) and effective tillers (9.03%) per plant, photosynthetic rate (13.3%), spikelets per panicle (16.9%), 1000-grain weight (16.9%) and panicle length (7.4%) indicating less scope for improvement of these traits through selection. Low variability for these traits were also reported in earlier studies (Talwar *et al.*, 1974; Sundaram *et al.*, 1988; Ganeshan and Subramanian, 1990). As against this, presence of moderate to high genetic variability for the remaining characters such as plant height, leaf area index, total dry matter, specific leaf weight and grain yield per plant would be helpful to exploit such variation by direct selection or by involving carefully chosen parents, from the material studied, in hybridization programme to generate more variability for further exploitation.

Heritability estimate was highest in case of 1000-grain weight (96.1%) followed by harvest index (91.9%) and days to 50% flowering (90.7%). Photosynthetic rate and grain yield per plant showed over 80% heritability. Earlier reports also indicated high heritability for 1000-grain weight (Kihupi and Doto, 1989 and Li *et al.*, 1991), days to 50% flowering and harvest index (Li *et al.*, 1991). High heritability along with high genetic advance was observed for harvest index, grain yield per plant and net assimilation rate. It is quite evident from these results that these traits are mainly governed by additive gene action. In case of days to 50% flowering, total tiller number, plant height, leaf area index at maturity, total dry matter at flowering and maturity, specific leaf weight at maturity, absolute growth rate, crop growth rate, photosynthetic rate, spikelet sterility and 1000-grain weight, moderate to high heritability coupled with moderate to low genetic advance was observed. This indicates that expression of these traits is governed by both additive and non-additive gene-action. The characters with low heritability and low genetic advance (effective tillers, leaf area index and specific leaf weight at flowering, panicle length and total spikelets per panicle) are presumed to be governed by non-additive gene action or the presence of high genotype-environment interaction. Similar results were also obtained in earlier studies (Maurya, 1976 and Paramasivan, 1980).

Considering all the points related to genetic variability discussed above, it may be concluded that traits like net assimilation rate, harvest index and grain yield can be improved more effectively by selecting superior phenotypes. Based on similar arguments, reasonably good progress can also be achieved in respect of plant height, total dry matter and crop growth rate.

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