



e ISSN-2230-9411



RESEARCH ARTICLE

DOI: 10.15740/HAS/IJFCI/7.1/57-60

## Variability, heritability and genetic advance studies in $F_2$ population of rice (*Oryza sativa* L.)

M. SALA AND P. SHANTHI

**ABSTRACT :** An investigation was carried out in  $F_2$  population of eight crosses with 160 single plants to estimate the variability, heritability, genetic advance and genetic advance as percentage. The results showed that PCV values in general was higher than GCV for various characters studied. The high PCV and GCV values was obtained for single plant yield followed by number of productive tillers per plant and low PCV and GCV was observed for plant height and panicle length. The small difference observed between GCV and PCV indicate the presence of high genetic variability for the traits which may facilitate selection. The traits thousand grain weight and number of fertile spikelet per panicle and single plant yield had high heritability along with high genetic advance as per cent of mean indicate that these characters attributable to additive gene effects which are fixable revealing that improvement in these characters would be possible through direct selection.

**KEY WORDS :** Rice, Genotypic co-efficient of variation, Phenotypic co-efficient of variation, Heritability, Genetic advance as a per cent of mean

**HOW TO CITE THIS ARTICLE :** Sala, M. and Shanthi, P. (2016). Variability, heritability and genetic advance studies in  $F_2$  population of rice (*Oryza sativa* L.). *Internat. J. Forestry & Crop Improv.*, 7 (1) : 57-60, DOI: 10.15740/HAS/IJFCI/7.1/57-60.

**ARTICLE CHRONICAL :** Received : 06.02.2016; Revised : 14.04.2016; Accepted : 15.05.2016

### INTRODUCTION

Rice is life and prince among cereals and this unique grain helps sustain two thirds of world's population. It is the backbone of India's economy providing direct employment to about 70 per cent working people in the country. 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. In developing countries, rice accounts for 715 kcal/capita/day, 27 per cent of

dietary energy supply, 20 per cent of dietary protein and 3 per cent of dietary fat. Countries like Southeast Asia are heavily reliant upon rice. India accounts for nearly one-fourth (22%) of the rice produced in the world and it ranks 2<sup>nd</sup> next to China. World rice production now is around 597.8 million tones grown over 151 million hectares with a productivity of 3.96 tones/ ha. India has an area of 50 million hectares under rice cultivation with the production of 104 million tones and average productivity is four tonnes/ha. To meet the food demand of the growing population and to achieve food security in the country, the present production levels need to be increased by 2 million tonnes every year, which is possible through other innovative breeding approaches Subbaiah *et al.* (2011).

#### MEMBERS OF RESEARCH FORUM

**Address of the Correspondence :** M. SALA, Tamil Nadu Rice Research Institute (TNAU) ADUTHURAI (T.N.) INDIA  
Email: [swtsala1@gmail.com](mailto:swtsala1@gmail.com)

**Address of the Coopted Authors :** P. SHANTHI, Tamil Nadu Rice Research Institute (TNAU) ADUTHURAI (T.N.) INDIA

Knowledge on genetic variability is the basic requirement in any crop improvement programme. Environmental effects influence the total observable variations of quantitative traits. Therefore, partitioning of overall variance due to genetic and non-genetic causes becomes necessary for effective breeding programme. The genotypic co-efficient of variation estimates the heritable variability, whereas phenotypic component measures the role of environment on the genotype. High PCV and low GCV for a character indicated high influence of environment in its expression. The phenomenon of transmission of characters from parents to offspring is usually measured in terms of heritability. Therefore the estimates of heritability and genetic advance would help to formulate a sound breeding programme. To keep all these in mind an attempt was also made to determine the scope of selection through heritability and genetic advance.

## EXPERIMENTAL METHODS

The experimental material consisted of 160 F<sub>2</sub> progenies derived from eight different crosses *viz.*, Padmini x CSR 36, Naveen x TRY(R) 2, TRY(R)2 x CSR36, Moti x TRY(R) 2, Moti x CSR 36, Naveen x AC660 (tulasi), Naveen x Nuakalageera, Padmini x TRY(R) 2 developed at the research farm of department of plant breeding and genetics, Tamil Nadu Rice Research Institute, Aduthurai during November 2014 to April 2015. The experiment was laid out in Randomized Block Design; adopting a spacing of 10 x 15 cm. Normal agronomic practices were followed throughout the crop growth period to obtain a good harvest. Observations were obtained on one hundred and sixty plants of F<sub>2</sub>

population of eight different crosses for plant height, total tillers, number of productive tillers/plant, panicle length, thousand grain weight, number of grains per panicle, number of fertile spikelet per panicle, number of sterile spikelet per panicle, single plant yield.

### Statistical analysis :

Statistics such as mean and phenotypic and genotypic co-efficient of variation (PCV and GCV) were computed based on the method suggested by Panse and Sukhatme, 1961. Heritability in the broad sense was computed with the formula suggested by Lush, 1940. The genetic advance was estimated adopting the method suggested by Johnson *et al.*, 1955. All the above characters were calculated using Microsoft Excel.

## EXPERIMENTAL RESULTS AND ANALYSIS

The potentiality of a cross is measured not only by mean performance but also on the extent of variability. Knowledge on nature and magnitude of genotypic and phenotypic variability present in any crop species plays an important role in formulating successful breeding programmes (Allard, 1960). Siva Subramanian and Mathavamenon (1973) also highlighted the importance of variability in early segregating generations and suggested that magnitude of genotypic co-efficient of variability and phenotypic co-efficient of variability should be given importance. Jennings *et al.* (1979) suggested that crosses which will realise early homozygosity are ideally suited for further breeding work. The mean, range, variability estimates *i.e.*, Genetic co-efficient of variation (%), phenotypic co-efficient of variation (%), heritability (%) (broad sense), genetic advance as per cent of mean

**Table 1 : Variability, heritability and genetic advance for quantitative traits in F<sub>2</sub> generation of rice**

Sr. No.	Character	Mean	Range	PCV (%)	GCV (%)	Heritability (h <sup>2</sup> ) (%)	GA as a per cent of mean
1.	Plant height (cm)	115.6	85-144	8.94	7.01	61.50	11.32
2.	Total tillers (Nos)	18.8	12-28	23.16	17.72	58.56	27.93
3.	No. of productive tillers/plant (Nos)	17.2	10-23	27.65	22.34	65.29	37.18
4.	Panicle length(cm)	25.5	20-30.5	8.97	7.44	68.72	12.69
5.	No.of grains/panicle(Nos)	146.0	104-198	14.12	11.46	65.93	19.176
6.	Thousand grain weight (g)	19.0	12-25.8	17.31	15.05	75.67	26.97
7.	Number of fertile spikelet per panicle (Nos)	114.0	70-180	16.83	13.52	64.57	22.38
8.	Number of sterile spikelet per panicle (Nos)	32.0	10-60	35.41	18.54	27.47	20.00
9.	Single plant yield	23.4	10.30-43.4	41.52	35.78	74.28	63.52

are presented in Table 1 and Fig 1. Considerable range of variation was observed in the study material for all the traits under study indicate enough scope for bringing improvement in the desirable direction.

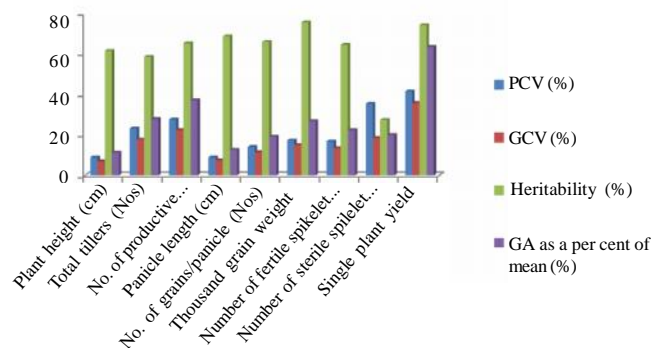


Fig. 1 : Variability, heritability and genetic advance for quantitative traits in F<sub>2</sub> generation of rice

All traits have higher phenotypic co-efficient of variation than genotypic co-efficient of variation which could be attributed to the role of environment. This was in conformity with the earlier findings Bhadru *et al.*, 2012. Genotypic co-efficient of variation measures the extent of genetic variability percent for a trait but does not assess the amount of genetic variation which is heritable. The lowest difference of PCV and GCV was observed for plant height (8.94/7.04) followed by panicle length (8.97/7.44) indicating lesser contribution of environmental variation towards the expression of these traits. Thus, selection based on phenotypic performance of these traits would be effective to bring about considerable improvement of these traits. The low trend of variability for plant height was also reported by Anilkumar (2008). Nandeswar *et al.* (2010) and Kalaimaghal (2011) also reported low GCV for panicle length in F<sub>2</sub> generation. This low variability depicts less difference in the genetic makeup of the parents involved in the cross (Venkatesan *et al.*, 2007). The high PCV and GCV was obtained for single plant yield (41.52/35.78) followed by number of productive tillers per plant (27.65/22.34). These results were accordance with Vanishree *et al.* (2013) estimates high GCV and PCV for plant height, number of filled grains per panicle and single plant yield. Purusothaman (2010) and Venkata Subbaiah *et al.* (2011) also reported the same result as per our current study, high GCV and PCV for number of productive tillers per plant in F<sub>1</sub> and F<sub>2</sub> generation.

High heritability was observed for all the characters

studied except total tillers (58.56%) and number of sterile spikelet per panicle (27.47%). Khan *et al.* (2009) reported that high heritability for panicle length, number of productive tillers per plant. Direct selection based on highly heritable characters can help to improve the yield. The heritability estimates along with genetic advance can help to improve and predict effect of selection in selection programme. The traits thousand grain weight (75.67/26.97) and number of fertile spikelet per panicle (64.57/22.38) and single plant yield (74.28/63.52) had high heritability along with high genetic advance as per cent of mean indicate that these characters attributable to additive gene effects which are fixable revealing that improvement in these characters would be possible through direct selection. Similar results were also found by Kalaimagal (2011) in F<sub>2</sub> and F<sub>3</sub> generation for thousand grain weight and single plant yield. Ghosh and Sharma (2012) also observed that high heritability and high genetic advance for thousand grain weight and single plant yield in F<sub>1</sub> generation. Moderate heritability along with high genetic advance as a per cent of mean seen in total tillers (58.56/27.93). Similar results were also reported by Raju *et al.* (2004) moderate heritability along with moderate genetic advance for number of productive tillers per plant in F<sub>2</sub> generation which indicates that the trait was highly controlled by additive gene effect which can be further improved through mass selection. Low heritability and moderate genetic advance as a per cent of mean was noticed in number of sterile spikelets per panicle (27.47/20.00). Similar work on the related topic was also done by Kiran *et al.* (2013) and Reddy *et al.* (2013).

The high PCV and GCV was obtained for single plant yield followed by number of productive tillers per plant and low PCV and GCV was observed for plant height and panicle length. The small difference observed between GCV and PCV indicate the presence of high genetic variability for the traits which may facilitate selection. The traits thousand grain weight and number of fertile spikelet per panicle and single plant yield had high heritability along with high genetic advance as per cent of mean indicate that these characters attributable to additive gene effects which are fixable revealing that improvement in these characters would be possible through direct selection. Similar work on the related topic was also done by Meena *et al.* (2013) on the genetic variability studies in F<sub>2</sub> generation of okra.

**Acknowledgement :**

DST-SERB is duly acknowledged for funding to carry out this work successfully.

**REFERENCES**

- Allard, R.W. (1960). *Principles of plant breeding*. John Wiley and Sons. Inc., U.S.A. pp. 485.
- Anilkumar, C.V. (2008). Genetic analysis of economic traits in segregating population of rice (*Oryza sativa* L.). M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, T.N. (INDIA).
- Bhadru, D., Tirumala, R. V., Chandra, M. Y. and Bharathi, D. (2012). Genetic variability and diversity studies in yield and its component traits in rice (*Oryza sativa* L.). *SABRAO J. Breed. & Genet.*, **44**(1): 129-137.
- Ghosh and Sharma, S.C. Deepak (2012). Genetic parameters of agro morpho physiological traits in rice (*Oryza sativa* L.). *Electron. J. Plant Breed.*, **3**(1): 711-714 .
- Jennings, P.R., Coffman, W.F. and Kauffman, H.E. (1979). Rice improvement. Int. Rice. Res. Inst Los Banos, Manila, Phillipines.
- Johnson, H.W. Robinson, H.F. and Costock, R.E. (1955). Estimates of genetic and environmental variability in soyabean. *Agron. J.*, **47**(7): 314-318.
- Kalaimaghal, R. (2011). Studies on genetic variability of grain iron and zinc content in F<sub>2</sub> F<sub>3</sub> generation of rice (*Oryza sativa* L.). M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, T.N. (INDIA).
- Khan, Abdus Salam, Imran, Muhammad and Ashfaq, Muhammad (2009). Estimation of genetic variability and correlation for grain components in rice. *American-Eurasian J. Agric. & Environ. Sci.*, **6**(5): 585-590.
- Kiran, K.K., Rao, M.R. Gururaja and Suresh, K. (2013). Variability and frequency distribution studies in F<sub>2</sub> population of two crosses of rice (*Oryza sativa* L.). *Asian J. Bio. Sci.*, **8**(2): 153-159.
- Lush, J.L. (1940). Intra - sire correlation and regression of offspring on dams as a method of estimating heritability of characters. *Proc. American Soc. Anim. Prod.*, **33**: 293-301.
- Meena, Mahesh, Gangappa, E., Mallikarjun, K., Basavaraja, T., Asif, M., Venkatesha, K.T., Basavaprabhu, N.M. and Vijaya Kumar, K.V. (2013). Genetic variability studies in F<sub>2</sub> generation of okra [*Abelmoschus esculentus* (L.) Moench]. *Internat. J. Plant Sci.*, **8**(1): 183-186.
- Nandeshwar, B.C., Pal, S., Senapati, B.K. and De, D.K. (2010). Genetic variability and character association among biometrical traits in F<sub>2</sub> generation of some rice crosses. *Electron. J. Plant Breed.*, **1**(4): 758-763.
- Panse, V.G. and Sukhatme, P.V. (1961). *Statistical methods for agricultural workers*. 2<sup>nd</sup> Ed., Indian Council. Agric. Res., New Delhi. pp. 22.
- Purusothaman, R. (2010). Genetic analysis for high iron and zinc content in rice (*Oryza sativa* L.) grains. M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, T.N. (INDIA).
- Raju, C.H.S., Rao, M.V.B. and Sudarshanam, A. (2004). Genetic analysis and character association in F<sub>2</sub> generation of rice. *Madras Agric. J.*, **91**(1-3): 66-69.
- Reddy, M. Rajendar, Raju, Ch. Surendar, Sravani, D. and Reddy, S. Narender (2013). Inbreeding depression and residual heterosis for kernel characters in F<sub>2</sub> generation of aromatic rice. *Internat. J. agric. Sci.*, **9**(2): 814-817.
- Siva Subramanian, S. and Madhavamenon, P. (1973). Combining ability in rice. *Madras Agric. J.*, **60**: 419-421.
- Subbaiah, P. V., Sekhar, M. R., Reddy, K. H. P. and Reddy, N.P.E. (2011). Variability and genetic parameters for grain yield and its components and kernel quality attributes in CMS based rice hybrids (*Oryza sativa* L.). *Internat. J. Appl. Biol. & Pharam. Technol.*, **2**(3): 603-609.
- Vanishree, S., Swapna, K., Ch., Damodar Raju, Ch., Sreendar Raju and Sreedhar, M. (2013). Genetic variability and selection criteria in rice. *J. Biological & Scient. Opinion*, **1**(4): 203-206.
- Venkata, Subbaiah, P., Sekhar, M. Reddi, Reddy, K.H.P. and Reddy, N.P. Eswara (2011). Variability and genetic parameters for grain yield and its components and kernel quality attributes in CMS based rice hybrids (*Oryza sativa* L.). *Internat. J. Appl. Boil. & Pharm. Technol.*, **2**(3): 603-609.
- Venkatesan, M., Anbuselvam, Y., Elangaimannan, R. and Krathikeyan, P. (2007). Combining ability for yield and physical characters in rice. *Oryza.*, **44**(4): 296-299.

7<sup>th</sup>  
Year  
★★★★★ of Excellence ★★★★★