International Journal of Agricultural Sciences
Volume 13 | Issue 1 | January, 2017 | 49-52 ■ e ISSN-0976-5670
DOI:10.15740/HAS/IJAS/13.1/49-52
Visit us : *www.researchjournal.co.in*

RESEARCH PAPER

Studies on variability, heritability and genetic advance analysis in rice (*Oryza sativa* L.) under submergence

M. VENKATESAN*, C. A. SOWMIYA AND B. ANBARASI
Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, ANNAMALAINAGAR (T.N.) INDIA (Email : sowmiyatnau@gmail.com)

Abstract : The present experiment was conducted with 26 rice genotypes under submergence and normal conditions. Based on eleven characters namely, days to first flowering, plant height, number of tillers per plant, number of panicles per plant, panicle length, 1000 grain weight, photosynthetic rate, stomatal conductance, intercellular CO_2 conc., transpiration rate and grain yield per plant, studies on variability, heritability and genetic advance were made both in submergence and normal conditions. The characters of major contributors in normal condition were number of panicles per plant, number of tillers per plant, intercellular CO_2 Conc. and stomatal conductance. In case of submergence condition the major contributors were number of panicles per plant and 1000 grain weight. High heritability along with high genetic advance as per cent of mean was observed for number of panicles per plant, photosynthetic rate and grain yield per plant in normal and submergence conditions which indicate that these traits are governed by additive gene action. Added, low heritability along with high genetic advance as per cent of mean was observed for intercellular CO_2 Conc. in both normal and submergence conditions. Since genetic per cent of mean was high for both cases, the expected progress under selection could be obtained in the next generation itself and selection of such characters cases might be effective.

Key Words : Variability, Heritability, Genetic advance analysis, Rice, Submergence

View Point Article : Venkatesan, M., Sowmiya, C.A. and Anbarasi, B. (2017). Studies on variability, heritability and genetic advance analysis in rice (*Oryza sativa* L.) under submergence. *Internat. J. agric. Sci.*, **13** (1) : 49-52, **DOI:10.15740/HAS/IJAS/13.1/49-52.**

Article History : Received : 24.08.2016**; Revised :** 07.11.2016**; Accepted :** 10.12.2016

INTRODUCTION

Rice (*Oryza sativa* L. 2n : 2X : 24) is the most important cereal crop cultivated widely in many parts of the world. Genus *Oryza* belongs to the tribe Oryzeae in the family Poaceae. Out of the 24 species of rice, 22 species are wild and only 2 species are cultivated *i.e.*, *O.sativa* and *O.glaberima.*

As a cereal grain, it is the most widely consumed staple food for a large part of the world's human population, especially in Asia. More than 90 per cent of the rice is produced and consumed in Asian countries. It ranks third in the production of agricultural commodity. Rice, with 1,20,000 varieties, has the richest gene bank in the plant kingdom and feeds more than one half of the world's population.

In 2015, the world rice production was 478.8 m tons. In India about 44.6 million ha area is under rice cultivation and produced 90 million tonnes. Submergence stress is the third most importance one among the 421 biotic and

*** Author for correspondence:**

abiotic stresses (Widawsky and O'Toole, 1995). Hence, the present study on variability, heritability and genetic advance helps in identifying new genes or alleles for higher levels of tolerance (Sarkar *et al.,* 2006).

MATERIAL AND METHODS

The present experiment was carried out to study about the submergence tolerance of 26 genotypes as well as the check variety Swarna Sub 1 during Samba 2011. The experiment was carried out in pot culture yard of Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu. The Experimental material for the study of variability, heritability and genetic advance of the selected genotypes comprised of 26 genotypes *viz.*, AURL 4101, AURL 4102, AURL 4103, AURL 4104, AURL 4105, AURL 4106, AURL 4107, AURL 4108, AURL 4109, AURL 4110, AURL 4111, AURL 4112, AURL 4113, AURL 4114, AURL 4115, AURL 4116, AURL 4117, AURL 4118, AURL 4122, AURL 4125, AURL 4127, AURL 4138, AURL 4135, AURL 4138, AURL 4139 were collected from International Rice Research Institute (IRRI), Philippines.

The seeds of each genotypes of rice were directly sown in pots during Samba 2011 (Aug-Dec) and thinning was employed on tenth day such that only three healthy sturdy seedlings were left per plot. In tillering stage, the plants were submerged in an outdoor cement concrete tank to a depth of 1.5 m and subsequently the same rice genotypes in pots are kept without submergence as control.

The experimental design followed was RBD with three replications. On single plant basis of the three randomly selected plants of each genotype per replication, eleven traits were recorded (Statistical Analysis Panse and Sukhatme, 1978). The traits taken under study were days to flowering, plant height, number of tillers per plant, number of panicles per plant, panicle length, 1000 grain weight, photosynthetic rate, stomatal conductance, intercellular CO_2 conc., transpiration rate and grain yield per plant. The mean values were used for statistical analysis.

RESULTS AND DISCUSSION

The variability estimates such as genotypic co-efficient of variation (GCV), phenotypic co-efficient of variation (PCV), heritability and genetic advance as per cent of mean were estimated for both normal and submergence conditions for all the eleven characters and presented in the Tables 1 and 2 (Allard, 1960).

Scales of PCV and GCV: low <10, moderate 10-20 and high >20; heritability: low <30, moderate 30-60 and high >60; genetic advance as per cent of mean: low <10, moderate 10-20 and high >20. Based on the scales, PCV, GCV, heritability and genetic advance were classified for the eleven characters of both normal and submergence conditions.

The GCV of normal condition ranged from 2.61 per cent to 70.31 per cent. High GCV were observed in intercellular CO_2 conc. (70.31%), stomatal conductance (50.73%) followed by transpiration rate (22.09%), grain yield per plant (20.76%) and number of panicles per plant (20.24%) (Burton and Devane, 1953). Moderate GCV were observed in number of tillers per plant (16.25%), photosynthetic rate (15.38%) and panicle length (12.82%). Low GCV were recorded in 1000 grain weight (8.27%), followed by days to first flowering (8.07%) and

Table 1 : Magnitude of variability and estimates of heritability and genetic advance for various characters in 26 rice genotypes in normal condition

Sr. No.	Characters	GCV (%)	PCV (%)	h^2	GA as per cent of mean
1.	Days to first flowering (days)	8.07	8.17	77.60	16.43
2.	Plant height (cm)	2.61	3.38	49.72	4.16
3.	Number of tillers per plant	16.25	18.18	50.61	22.71
4.	Number of panicles per plant	20.24	20.55	61.07	26.80
5.	Panicle length (cm)	12.82	18.00	50.73	18.81
6.	1000 grain weight (g)	8.27	11.35	53.03	12.40
7.	Photosynthetic rate	15.38	15.57	67.60	31.30
8.	Stomatal conductance	50.73	76.33	50.54	76.19
9.	Intercellular CO_2 conc.	70.31	125.15	40.93	96.30
10.	Transpiration rate	22.09	33.81	40.06	62.73
11.	Grain yield per plant (g)	20.76	29.14	65.20	33.40

plant height (2.61%).

The GCV of submergence condition ranged from 1.45 per cent to 50.97 per cent. High GCV were recorded in intercellular CO_2 conc. (50.97%), stomatal conductance (47.50%), transpiration rate (26.70%), followed by number of panicles per plant (20.79%) and grain yield per plant (20.74%). Moderate GCV were observed in panicle length (14.78%), number of tillers per plant (14.63%), photosynthetic rate (14.62%) and 1000 grain weight (12.91%). Low GCV was recorded in days to first flowering (1.99%) and plant height (1.45%).

The PCV of normal condition varied from 125.15 per cent to 3.38 per cent. High PCVs were recorded in intercellular CO_2 conc. (125.15%), stomatal conductance (76.33%), transpiration rate (33.81%), grain yield per plant (29.14%) and number of panicles per plant (20.55%). Moderate PCV were observed in number of tillers per plant (18.18%), panicle length (18.00%), photosynthetic rate (15.57%) and 1000 grain weight (11.35%). Low PCV were recorded in days to first flowering (8.17%) followed by plant height (3.38%).

The PCV in submergence conditions were found to vary from 87.32 per cent to 2.04 per cent. High PCV were recorded in stomatal conductance (87.32%), intercellular CO_2 conc. (74.50%), transpiration rate (42.94%), number of panicles per plant (27.35%) and grain yield (26.43%). Moderate PCV were found in number of tillers per plant (19.26%), panicle length (18.57%), photosynthetic rate (16.94%) and 1000 grain weight (13.68%) (Anbanandan *et al.*, 2009 and Rajamani *et al.*, 2004). Low PCV was recorded in days to first flowering (3.10%) and plant height (2.04%).

In normal condition, heritability varied from 77.60 per cent to 40.06 per cent. High heritability was observed in days to first flowering (77.6%), photosynthetic rate (67.60%), grain yield per plant (65.20%) and number of panicles per plant (61.07%). Moderate heritability was observed in 1000 grain weight (53.03%), panicle length (50.73%), number of tillers per plant (50.61%), stomatal conductance (50.54%),plant height (49.72%), intercellular CO_2 con., (40.93%) and transpiration rate (40.06%).

In submergence condition, heritability ranged from 89.05 per cent to 30.85 per cent. The highest heritability was found in 1000 grain weight (89.05%), followed by photosynthetic rate (70.47%), panicle length (63.36%), number of panicles per plant (61.78%), number of tillers per plant (61.76%) and grain yield per plant (61.62%). Moderate heritability was found in intercellular CO_2 conc.,(52.44%), plant height (50.53%), days to first flowering (41.33%), transpiration rate (38.67%) and stomatal conductance (30.85%).

Genetic advance as per cent of mean in normal condition ranged from 96.30 per cent to 4.16 per cent. Highest genetic advance was observed in intercellular CO_2 conc.,(96.30%), followed by stomatal conductance (76.19%), transpiration rate (62.73%), grain yield per plant (33.40%), photosynthetic rate (31.30%), number of panicles per plant (26.80%) and number of tillers per plant (22.71%). Low genetic advance was seen in panicle length (18.81%), days to first flowering (16.43%), 1000 grain weight (12.40%) and plant height (4.16%).

In submergence condition, the genetic advance was observed from 86.63 per cent to 2.13 per cent. Highest genetic gain or genetic advance was observed in intercellular CO_2 conc.,(86.63%) followed by stomatal

Table 2 : Magnitude of variability and estimates of heritability and genetic advance for various characters in 26 rice genotypes in submergence condition

Sr. No.	Characters	GCV (%)	PCV (%)	h^2	GA as per cent of mean
1.	Days to first flowering (days)	1.99	3.10	41.33	2.64
2.	Plant height (cm)	1.45	2.04	50.53	2.13
3.	Number of tillers per plant	14.63	19.26	61.76	22.92
4.	Number of panicles per plant	20.79	27.35	61.78	32.56
5.	Panicle length (cm)	14.78	18.57	63.36	24.24
6.	1000 grain weight (g)	12.91	13.68	89.05	25.10
7.	Photosynthetic rate	14.62	16.94	70.47	25.99
8.	Stomatal conductance	47.50	87.32	30.85	55.50
9.	Intercellular CO_2 conc.	50.97	74.50	52.44	86.63
10.	Transpiration rate	26.70	42.94	38.67	34.20
11.	Grain yield per plant (g)	20.74	26.43	61.62	33.55

conductance (55.50%), transpiration rate (34.20%), grain yield per plant (33.55%), number of panicles per plant (32.56%), photosynthetic rate (25.99%), 1000 grain weight (25.10%), panicle length (24.24%) and number of tillers per plant (22.92%). Low genetic advance was observed in days to first flowering (2.64%) followed by the lowest genetic gain plant height (2.13%).

In normal condition, high heritability accompanied with high genetic advance characters were number of panicles per plant (61.07% and 26.80%), photosynthetic rate (67.6% and 31.30%) and grain yield per plant (65.20% and 33.40%). While in submergence condition, characters which have high heritability and genetic advance were number of tillers per plant (61.76% and 22.92%), number of panicles per plant (61.78% and 32.56%), panicle length (63.36% and 24.24%), 1000 grain weight (89.05% and 25.10%), photosynthetic rate (70.47% and 25.99%) and grain yield per plant (61.62% and 33.55%).

In normal condition, low heritability accompanied with high genetic advance characters were transpiration rate (40.06% and 62.73%), intercellular CO_2 Conc. (40.93% and 96.30%) and number of tillers per plant (50.61% and 22.71%). But in case of submergence condition, character which have low heritability and high genetic advance was only intercellular CO_2 Conc. (52.44% and 86.63%).

Thus, high heritability and high genetic advance indicate that most likely the heritability was due to additive gene effects and selection might be effective. Also low heritability and high genetic advance revealed that the characters were governed by additive gene effects in which low heritability exhibited due to high environmental effects. Selection might be effective in such cases. Tetwar *et al*. (2014); Shinde *et al*. (2015); Sahoo *et al*. (2015) and Sahare *et al*. (2015).

Since high heritability and high genetic advance was seen in both conditions of characters like number of panicles per plant, photosynthetic rate and grain yield per plant, selection of these characters might be effective. And also since low heritability and high genetic advance was observed in both conditions of character intercellular CO_2 Conc., selection of the same character might be effective.

REFERENCES

Allard, R.W. (1960). *Principles of plant breeding*. John Wiley and Sons, Inc. NEW YORK, U.S.A.

Anbanandan, V., Saravanan, K. and Sabesan, T. (2009). Variability, heritability and genetic advance in rice (*Oryza sativa* L.). *Internat. J. Plant Sci.,* **4** (1) : 61-63.

Burton, G. W. and Devane, E. M. (1953). Estimating heritability in tall Fescue (*Festuca arundinaceae*) from replicated clonal material. *Agron. J.,* **45** : 478-481.

Panse, V.G. and Sukhatme, P.V. (1978). *Statistical methods for agricultural workers*. 3rd Ed., Indian Council of Agricultural Research, NEW DELHI, INDIA.

Rajamani, S., Rani, D. and Subramaniyam, D. (2004). Genetic variability and character association in rice. *Andhra Agric. J.*, **51** (1& 4): 36-38.

Sahare, Divya and Mahapatra, Avinash (2015). Effect of organic manures and liquid organic manures on growth, yield and economics of aerobic rice cultivation. *Internat. J. agric. Sci.*, **11** (1): 183-188.

Sahoo, S.C., Behera, M. and Banerjee, P.K. (2015). Assessment of hybrid rice (*Oryza sativa*) under farmers' condition in the east and south eastern coastal plain zone of Odisha. *Internat. J. agric. Sci.,* **11** (1): 204-206.

Sarkar, R.K., Reddy, J.N., Sharma, S.G. and Ismail, Abdelbagi M. (2006). Physiological basis of submergence tolerance in rice and implications for crop improvement. *Curr. Sci.,* **91**(7): 899 - 906.

Shinde, S.R., Kumar, Kamlesh and Pawar, R.M. (2015). Genetic studies in upland rice (*Oryza sativa* L.). *Internat. J. Plant Sci.,* **10** (1): 33-37.

Tetwar, Sangeeta, Gupta, Ruplata, Koshta, Nidhi and Verulkar, S.B. (2014). Genetic analysis of drought tolerance rice genotypes under diverse ecosystem (*Oryza sativa* L.). *Internat. J. Plant Sci.,* **9** (1): 79-86.

Widawsky, D.A. and O'Toole, J.C. (1995). Prioritizing the rice biotechnology research agenda for eastern India. The Rock Feller Foundation, NEW YORK, INDIA.