The Andhra Agric. J 65 (3): 555-560, 2018

Assessment of Genetic Variability Studies in Wet Direct Sown Rice

P Sri Lakshmi, N Chamundeswari, M Lal Ahamed and V Srinivasa Rao
Andhra Pradesh Rice Research Institute, Maruteru, West Godavari, A.P

ABSTRACT

Genetic variability for yield, quality, direct seeded, AG and SV traits were studied under wet direct sowing conditions in rice. The results of genetic parameters revealed high GCV and PCV coupled with high heritability and high genetic advance as percent of mean for number of panicles / plant, leaf area index, SSL on 10th day, SSL on 14th day, SRL on 10th day, SRL on 14th day, SVI-2, AG % after 2 weeks of submergence, plant survival % after 2 weeks, AG% after 3 weeks of submergence, plant survival % after 3 weeks suggesting an additive type of gene action. The remaining traits manifested low to moderate estimates for GCV and PCV, moderate to high heritability and low to high estimates for genetic advance as percent of mean indicating the preponderance of both additive and non-additive gene effects in controlling these traits.

Key words: *Anaerobic germination, Direct seeding, Early seedling vigour,Genetic parameters, Grain yield. Rice.*

Rice, India's most prominent crop is the staple food of the people of the eastern and southern parts of the country. Transplanting is the dominant method of rice establishment in the rice-wheat growing areas of the Indo-Gangetic Plains and in all Asia. However, economic factors and recent changes in rice production technology have improved the desirability of direct-seeding methods (Pandey and Velasco 2005). Accordingly, there has been a rapid shift to the direct-seeding method of rice establishment in Southeast Asia. The major forces driving the spread of direct-seeding methods are the availability of chemical methods of weed control, the increasing scarcity of water and its rising cost, and less availability of farm labour. Good land preparation and levelling and effective weed control are critical for the success of wet-seeded rice (Balasubramanian and Hill, 2002). Under direct seeded rice culture, varieties with high seedling vigour are required for better competitive ability against weeds (Mackill and Redona, 1997).Varieties that can germinate in flooded soils could be beneficial for direct seeded systems not only in low land areas but also for intensive irrigated systems where early flooding can suppress weeds. In rice besides yield, it is also important to look into the quality aspects for better consumer preference and also to get premium price in the market.

For the formulation of successful breeding programme, knowledge on the nature and magnitude of the genotypic and phenotypic variability present in any crop species plays a vital role. The efficiency of selection in plant breeding largely depends upon the amount of heritable variation present in the material. The effective use of genetic variation for crop improvement programme is possible only if it is considered in relation to heritability. Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection (Umesh *et al,* 2015). Hence the present study was conducted to estimate genetic parameters of variation for yield and yield components, quality traits, seedling vigour traits and anaerobic germination for 50 genotypes under wet direct sown situations of Andhra Pradesh.

MATERIALS AND METHODS

The present investigation was taken up during *kharif* 2016 in field at Andhra Pradesh Rice Research Institute (APRRI) and Regional Agricultural Research Station (RARS), Maruteru, West Godavari district of Andhra Pradesh. Observations were recorded for 50 genotypes on the following attributes viz; Plant height at maturity (cm), days to 50% flowering, No. of panicles/Plant, Panicle length (cm), No. of grains/ Panicle, Spikelet fertility (%), grain yield/plant(g), test weight (g), hulling (%), milling (%), Head Rice Recovery (%), kernel length (mm), kernel breadth (mm), kernel L/B Ratio, kernel elongation ratio, volume expansion ratio, culm diameter (mm), bending strength, leaf area index, harvest index, Germination % on 10th day, Germination % on 14th day (Rate of germination), Seedling Shoot Length on 10th day (cm), Seedling Shoot Length on 14th day (cm), Seedling Root Length on 10th day (cm), Seedling Root Length on 14th day (cm), Seedling Fresh Weight on 14th day (mg), Seedling Dry Weight (mg), Seedling Vigour Index -1, Seedling Vigour Index -2, Anaerobic Germination % after 2 weeks of submergence, plant survival % after 2 weeks, Anaerobic Germination % after 3 weeks of submergence, plant survival % after 3 weeks. The differences between 50 genotypes for different characters were tested for significance by using Analysis of Variance technique as proposed by Cochran and Cox (1950). The genetic parameters, namely, genotypic coefficient of variation

(GCV) and phenotypic coefficient of variation (PCV), heritability in broad sense (h^2) and genetic advance as per cent of mean were estimated by the formulae suggested by Burton and Devane (1953) and Johnson *et al.,* (1955).

RESULTS AND DISCUSSION

The analysis of variance (Table 1) indicated that the genotypes differed significantly for all the characters which further ascertain that there is considerable variation present in the fifty genotypes of rice.

Among the characters, higher estimates of PCV and GCV were observed for the traits (Table 2), no. of panicles/Plant (12.46 and 13.01), leaf area index (24.52 and 24.78), SSL on 10th day (cm), SSL on 14th day (cm), SRL on 10th day (cm) (27.97 and 30.28), SRL on 14th day (cm) (20.86 and 22.73), SVI -2 (20.33 and 21.90), AG % after 2 weeks of submergence (23.59 and 24.29), plant survival % after 2 weeks (29.94 and 30.67) AG % after 3 weeks of submergence (32.75 and 33.31), plant survival % after 3 weeks (41.68 and 42.98). This indicates the existence of wide genetic base among the genotypes taken for study and possibility of genetic improvement through selection for these traits. These results are also in conformity with the findings of Tomar *et al.* (2016), Onyia *et al.* (2017), Niranjan murthy *et al.* (1999), Lakshmi *et al*. (2016).The bending strength (10.42 and 19.87), harvest index (19.06 and 20.53), seedling fresh weight (mg) (18.19 and 23.50), seedling dry weight (mg) (17.55and 22.12), seedling vigour index -1 (19.43 and 23.92) exhibited a gap between PCV and GCV i.e. high PCV and moderate GCV showing high environmental influence. Similar results were also reported by Islam *et al.* (2016), Lakshmi *et al*. (2016).

Moderate values for the PCV and GCV were recorded for the traits Plant height at maturity (cm) (12.46 and 13.01), days to 50% flowering (10.06 and 10.22), No. of grains/panicle (11.32 and 12.09), grain yield/plant (g) (17.94 and 18.72), test weight (g) (17.52 and17.69) , kernel breadth (mm) (10.47 and 11.79), kernel L/B Ratio (12.94 and 13.60), culm diameter (mm) (11.68 and 13.76), germination % on 10th day (11.37 and 11.67). Hence, selection for these traits may be misleading if adopted in the rice improvement programme through these traits. Similar findings by Sameera *et al.* (2015), Pavan Shankar *et al.* (2016), Tomar *et al.* (2016), Kishore *et al.* (2015).

The estimates of PCV and GCV were low for the characters spikelet fertility (%) (3.87 and 4.64), panicle length (cm) (7.38 and 7.68), hulling (%) (7.68 and 2.01), milling (%) (2.25 and 3.00), head rice recovery (%) (5.35 and 5.88), kernel length (cm) (8.85 and 9.24), kernel elongation ratio(6.13 and 6.80) ,volume expansion ratio (2.94 and 4.44), germination % on 14th day (7.61 and 7.79). The direct selection for these traits may not be rewarding for genetic improvement and need for creation of variability either by hybridization or mutation followed by selection. These results were in consonance with the findings of Karande *et al.*(2015), Sameera *et al.* (2015), Nirmaladevi *et al.* (2015).

In the present investigation, the range of heritability was from (39.9%) hulling % to (98.1%) test weight (g). High estimates of broad sense heritability coupled with high genetic advance were obtained for the characters, Plant height at maturity (cm), days to 50% flowering, number of panicles/plant, number of grains/panicle, grain yield/plant (g), test weight (g), kernel L/B ratio, culm diameter (mm), bending strength (g/stem), leaf area index, harvest index, germination % on 10th day, SSL on 10th day (cm), SSL on 14th day (cm), SRL on 10th day (cm), SRL on 14th day (cm), SFW on 14th day (mg), SDW (mg), SV I -1, SV I -2, AG % after 2 weeks of submergence, Plant survival % after 2 weeks, AG % after 3 weeks of submergence and plant survival % after 3 weeks. The characters that show high heritability with high genetic advance are controlled by additive gene action (Panse and Sukatme, 1957) and can be improved through simple or progeny selection methods. Selection for the traits having high heritability coupled with high genetic advance is likely to accumulate more additive genes leading to further improvement of their performance. Similar results for high heritability estimates were also obtained by Sameera *et al.* (2015) and Pavan Shankar *et al.* (2016).

The traits panicle length (cm), HRR (%), kernel length (mm), kernel breadth (mm), kernel elongation ratio, germination on 14th day (%) exhibited high heritability and moderate genetic advance indicates the involvement of both additive and non additive gene action. Hence simple direct selection may be effective to improve these traits. These traits could also be improved by adapting recurrent selection method. These results were in consonance with the findings of Pavan Shankar *et al.* (2016), Parvathi *et al.* (2011), Nirmaladevi *et al.* (2015) and Lakshmi *et al*. (2016) except spikelet fertility (%) which is exihibiting high heritability and low genetic advance indicates involvement of both additive and non additive gene action for this trait and selection for such traits may not be rewarding. Similar results obtained by Mahendra *et al.* (2015) and Onyia *et al.* (2017).

The remaining traits such as hulling %, milling %, volume expansion ratio exhibited moderate heritability and low genetic advance indicating the operation of non-additive gene action. The heritability is being exhibited due to favorable influence of

Table 1: Analysis of variance for yield and yield components, quality traits, direct seeded traits, seedling vigour traits and anaerobic germination among 50 genotypes of rice (*Oryza sativa* L.)

S.No.	Source	Replication	Treatment	Error
	Degrees of freedom	1	49	49
		Mean Squares		
1	Plant height at maturity(cm)	40.4496	415.0369 **	18.0157
2	Days to 50% flowering	2.8900	181.241 **	2.8084
3	Number of panicles/ plant	1.0000	7.8294 **	1.1837
4	Panicle length (cm)	0.2809	6.9421 **	0.2803
5	Number of Grains/ panicle	169.0000	1165.0000 **	76.3878
6	Spikelet fertility (%)	2.2801	27.4519 **	4.9052
7	Grain yield/ plant(g)	0.9351	15.9948 **	0.6838
8	Test weight (g)	0.2601	24.7364 **	0.2413
9	Hulling (%)	2.2500	3.4337 **	1.4745
10	Milling (%)	5.2900	6.7602**	1.8818
11	Head rice recovery (%)	9.0000	26.4294**	2.4694
12	Kernel length (mm)	0.0104	0.4843**	0.0207
13	Kernel breadth (mm)	0.0009	0.1135**	0.0135
14	Kernel L/B ratio	0.0090	0.2337**	0.0117
15	Kernel elongation ratio	0.0015	0.0217**	0.0022
16	Volume expansion ratio	0.0225	0.0379**	0.0149
17	Culm diameter	0.0166	1.3097**	0.2127
18	Bending strength	83.3386	422.9965**	82.9399
19	Leaf area index	0.0121	0.9963**	0.0103
20	Harvest index	0.0002	0.0197**	0.0015
21	G % on 10th day	0.3600	194.653**	4.9518
22	G % on 14th day	0.2025	96.173**	2.1821
23	SSL on 10th day (cm)	0.0059	11.8570**	0.3722
24	SSL on 14th day (cm)	0.1475	13.9590**	0.9230
25	SRL on 10th day (cm)	0.1537	11.2150**	0.8911
26	SRL on 14th day (cm)	0.0778	9.6240**	0.8259
27	SFW on 14th day (mg)	66.2596	127.9030**	32.0678
28	SDW (mg)	2.5921	10.6630**	2.4200
29	SVI -1	1.9432	10.3170**	2.1153
30	SVI -2	0.1063	10.8340**	0.8042
31	AG % after 2 weeks of submergence	2.0051	344.6898**	10.0637
32	Plant survival % after 2 weeks	1.8117	248.8780**	5.9417
33	AG % after 3 weeks of submergence	1.5376	220.6570**	3.7596
34	Plant survival % after 3 weeks	7.8176	132.5070**	4.0646

**** Significant at 1 % level, G% -germination per cent, SSL –seedling shoot length, SSR- seedling root length, SFW – seedling fresh weight, SDW- seedling dry weight, SVI- 1 seedling vigour index-1, SVI –II seedling vigour index –II, AG % - anaerobic germination per cent.**

Table 2: Analysis of variance for yield and yield components, quality traits, direct seeded traits, seedling vigour traits and anaerobic germination among 50 genotypes of rice (Oryza sativa L.)

S.No	Character	Mean	Range		Coefficient of variation		Heritability (%) (broad sense)	Genetic advance as per cent of mean (5% level)
			Minimum	Maximum	GCV	PCV		
1	Plant height at maturity (cm)	113.09	89.9	158.4	12.46	13.01	91.7	24.57
2	Days to 50% flowering	93.87	67.0	109.5	10.06	10.22	96.9	20.41
3	Number of panicles/plant	8.44	5.5	13.0	21.60	25.15	73.7	38.20
4	Panicle length (cm)	24.74	21.0	31.1	7.38	7.68	92.2	14.59
5	Number of grains/panicle	206.10	147.0	250.0	11.32	12.09	87.7	21.84
6	Spikelet fertility (%)	86.73	77.7	96.0	3.87	4.64	69.7	6.66
7	Grain yield/ plant (g)	15.42	10.0	21.2	17.94	18.72	91.8	35.40
8	Test weight (g)	19.97	13.1	28.6	17.52	17.69	98.1	35.74
9	Hulling (%)	77.85	74.0	81.5	1.27	2.01	39.9	1.65
10	Milling (%)	69.35	64.0	75.0	2.25	3.00	56.4	3.49
11	Head rice recovery (%)	64.64	54.0	72.0	5.35	5.88	82.9	10.04
12	Kernel length (mm)	5.44	4.5	6.7	8.85	9.24	91.8	17.47
13	Kernel breadth (mm)	2.14	1.6	2.9	10.47	11.79	78.8	19.14
14	Kernel L/B Ratio	2.58	1.8	3.7	12.94	13.60	90.5	25.35
15	Kernel elongation ratio	1.61	1.3	1.8	6.13	6.80	81.4	11.39
16	Volume expansion ratio	3.66	3.3	4.0	2.94	4.44	43.7	4.00
17	Culm diameter (mm)	6.34	4.9	8.2	11.68	13.76	72.1	20.43
18	Bending strength (g/stem)	65.62	36.2	10.42	19.87	24.24	67.2	33.56
19	Leaf area index	2.86	1.6	4.5	24.52	24.78	98.0	50.00
20	Harvest index	0.50	0.3	0.7	19.06	20.53	86.2	36.45
21	G % on 10th day	85.64	65.0	98.0	11.37	11.67	95.0	22.84
22	G % on 14th day	90.04	70.5	100.0	7.61	7.79	95.6	15.33
23	SSL on 10th day (cm)	10.04	6.2	16.6	23.86	24.62	93.9	47.63
24	SSL on 14th day (cm)	12.28	7.7	18.3	20.79	22.21	87.6	40.08
25	SRL on 10th day (cm)	8.12	4.3	14.1	27.97	30.28	85.3	53.20
26	SRL on 14th day (cm)	10.05	5.3	15.0	20.86	22.73	84.2	39.43
27	SFW on 14th day (mg)	38.05	25.0	60.0	18.19	23.50	59.9	29.00
28	SDW (mg)	11.56	7.3	16.6	17.55	22.12	63.0	28.70
29	SVI-1	10.42	6.0	15.8	19.43	23.92	66.0	32.50
30	SVI-2	11.01	7.1	16.4	20.33	21.90	86.2	38.89
31	AG% after 2 weeks of submergence	54.84	21.5	82.5	23.59	24.29	94.3	47.19
32	Plant survival % after 2 weeks	36.81	16.4	61.7	29.94	30.67	95.3	60.23
33	AG% after 3 weeks of submergence	31.80	10.5	53.3	32.75	33.31	96.6	66.32
34	Plant survival % after 3 weeks	19.23	5.3	46.3	41.68	42.98	94.0	83.26

PCV = Phenotypic coefficient of variation, GCV = Genotypic coefficient of variation environment rather than genotype indicating the possibility of improvement of these traits through heterosis breeding rather than simple selection. Similar results were reported by Sameera *et al.* (2015).

CONCLUSION

The present study identified the presence of adequate genetic variability among 50 tested genotypes for all 34characters. The results also revealed the presence of high GCV and PCV coupled with high heritability and high genetic advance as percent of mean in several morphological traits indicated that these traits were controlled by additive type of gene action in the inheritance of these characters, these characters can be further improved by following simple selection procedure. This information about the genetic variability, heritability and genetic advance would be useful for proper identification and selection of appropriate rice genotypes for further breeding programs related to higher yield and genotypes tolerant for anaerobic germination in rice.

LITERATURE CITED

Balasubramanian V and Hill J E 2002 Direct seeding of rice in Asia: emerging issues and research needs of the 21st century. In: Pandey, S et al, editors. Direct seeding: research strategies and opportunities. Manila (Philippines): International Rice Research Institute, p 15-39.

Burton G W and Devane E W 1953 Estimating heritability in tall fescue (*Festuca arundiraceae*) from replicated clonal material. *Agronomy Journal*, 45: 478-481.

Cochran G W and Cox G M 1950 *Experimental Designs*. John Wiley and Sons, New York, 45-67.

Islam M Z, Khalequzzaman M, Bashar M K, Ivy N A, Haque M M and Mian M A K 2016 Variability assessment of aromatic and fine rice germplasm in bangladesh based on quantitative traits. *The Scientific World Journal*. Id 2796720.

Johnson H W, Robinson H F and Comstock R E 1955 Estimates of genetic and environmental variability in soybean. *Agronomy Journal,* 47 (7): 314-318.

Karande S S, Thaware B L, Bhave S G and Burondkar M M 2015 Estimate of genetic variability and heritability in some exotic germplasm lines in kharif rice (*Oryza sativa* L.). *International Journal of Applied Biology and Pharmaceutical Technology*, 6 (4): 128-130.

Kishore N S, Srinivas T, Nagabhushanam U, Pallavi M and Sameera S K 2015 Genetic variability, correlation and path analysis for yield and yield components in promising rice genotypes. *SAARC Journal of Agriculture,* 13 (1): 99-108.

Lakshmi P S, Chamundeswari N, Satyanarayana P V, Santhosh Kumar M, Shalini T, Girija Rani M and Ravi Kumar B N V S R 2016 Genetic parameters of variation for anaerobic germination and seedling vigour traits in rice (*oryza sativa* L.). *Progressive Research – An International Journal,* 11 (VII): 5069-5072.

Mackill D J and Redona E D 1997 Breeding strategies for rainfed low land rice in drought proven environments. *Proceedings of International Workshop,* Thailand. 105-110.

Mahendra B, Suresh B G and Aishwarya S R 2015 Genetic variability, correlation and path coefficient for grain yield and quantitative traits of elite rice genotypes at Uttar Pradesh. *Electronic Journal of Plant Breeding,* 6 (2): 586-59.

Niranjana Murthy Kulkarni R S and Uday Kumar M 1999 Genetic variability, heritability and genetic advance for morpho physiological traits in rice. *Oryza,*36 (2): 159-160.

Nirmaladevi G, Padmavathi G, Suneetha K and Babu, V R 2015 Genetic variability, heritability and correlation coefficients of grain quality characters in rice. *SABRAO Journal of Breeding and Genetics,* 47 (4): 424-433.

Onyia V N, Okechukwu E C, Atugwu A I and Akpan N M 2017 Genetic variability studies on twelve genotypes of rice (*Oryza sativa* L.) for growth and yield performance in south eastern nigeria. *Not Sci Biol*, 9(1):110-115.

Pandey S and Velasco L (2005) Trends in crop establishment methods in Asia and research issues. In: Rice is Life: Scientific Perspectives for the 21st Century, Proceeding of the Word Rice Research Conference, 4-7 November 2004, Tsukuba, Japan, pp. 178-181.

Panse V G and P V Sukhatme 1957 Statistical methods for agricultural workers, ICAR, New Delhi, 4th Edn.

Parvathi S P, Satyanarayana Rao V, Lal A M and Anil K P 2011 Variability, heritability and genetic advance for yield and grain quality characters in rice. *The Andhra Agricultural Journal*, 58 (1): 116-118.

Pavan Shankar H P, Krishna veni B, Dayal Prasad Babu J and Srinivasa Rao V 2016 Assessment of genetic variability and association studies in dry direct sown rice (*Oryza sativa* L.), *Journal of Rice Research.* 9 (2).

Sameera S K, Prasanna R A, Jayalakshmi P, Nirmala J and Srinivas T 2015 Genetic variability studies for yield and yield components in rice. *Electronic Journal of Plant Breeding*, 6 (1): 269-273.

Tomar S S, Suresh B G, Rout S and Patra S S 2016 Evaluation of medium early maturing rice (*Oryza sativa* L.) hybrids for grain yield and quality traits. *Environmental. Life Science*, 9 (7): 834-840.

Umesh U, Jaiswal H K, Sravan T, Showkat A Waza and Rahul B (2015) Estimation of genetic variability, heritability and genetic advance for yield and quality traits in some indigenous Basmati rice (*Oryza sativa* L.) genotypes. *International Journal of Farm Sciences,* 5(4): 32-40.

Received on 30.06.2017 and revised on 18.07.2018