



## Assessment of Genetic Variability for Early Vigour Traits under Dry Direct Sowing and under Anaerobic Condition in Rice

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### ABSTARCT

Forty eight genotypes of Rice (*Oryza sativa* L.) were grown under dry direct sowing during *Kharif* 2016 and observations were recorded on early vigour traits and yield components. During the same season screening was done for anaerobic germination and data were recorded on early vigour traits after 7, 14 & 21 days of submergence. Results indicated significant differences among the characters studied. All the variability parameters studied *viz.*, PCV, GCV, heritability and genetic advance as percent of mean were high for number of ear bearing tillers, grain yield, root length at 7 DAS in field, root length at 14 DAS in field, germination percentage after 7 days of submergence, germination percentage after 14 days of submergence, shoot length after 21 days of submergence, root length after 21 days of submergence, dry matter after 21 days of submergence, vigour index under 21 days of submergence, number of leaves 21 days of submergence, germination percentage under 21 days of submergence and total soluble sugars indicating the role of additive gene action in the inheritance of these traits.

**Key words:** *GCV, genetic advance, heritability, PCV, rice.*

Rice is the major staple food crop in Asia, Latin America, parts of Africa and the Middle East. Major share of rice cultivation is during *kharif* season. A small share of rice is grown in *rabi*/summer season with assured irrigation. Indian rice largely depends upon monsoon rains and only 59% rice has assured irrigation. Looming water crisis, water-intensive nature of rice cultivation and escalating labour costs drive the search for alternative management methods to increase water productivity in rice cultivation. Direct seeding of rice is being adopted in irrigated low land ecosystem also because it reduces labour costs in addition to other benefits. Wide adoption of direct seeded rice practice has been hindered by poorly levelled fields, heavy rainfall and poor drainage which cause accumulation of water in the fields shortly after sowing leading to poor crop establishment. This is due to the inability of most rice varieties to germinate and reach the water surface under complete submergence. Hence, tolerance of anaerobic condition during germination is an essential trait for direct seeded rice cultivation both in rainfed as well as in irrigated ecosystems. Hence the present investigation was taken up to identify genotypes with anaerobic germination ability combining high

grain yield & dwarf plant stature for cultivation under direct sowing.

### MATERIAL AND METHODS

The material for the investigation comprised of 48 rice genotypes. These genotypes of rice were grown in *Kharif* season during 2016 in a randomized block design with two replications at Agricultural College Farm, Bapatla. Each entry was planted in three rows of 3m length with a spacing of 20x15 cm. Observations were taken on five randomly selected plants for yield & yield component and early vigour traits in field *viz.*, plant height (cm), number of ear bearing tillers, panicle length (cm), grain yield (g), test weight (g), shoot length (cm) on 7<sup>th</sup> and 14<sup>th</sup> day after sowing, root length (cm) on 7<sup>th</sup> and 14<sup>th</sup> day after sowing, dry weight (mg) on 7<sup>th</sup> and 14<sup>th</sup> day after sowing, germination percentage, vigour index. The genotypes sown in the field were screened for anaerobic germination as per Reddy *et al.* (2015) during *Kharif* 2016 in randomized complete block design with two replications at APRRI & RARS, Maruteru. Data were recorded on five randomly selected plants for shoot length (cm) after 7 and 14 days of submergence, root length (cm) after 7 and

14 days of submergence, number of leaves under 7 and 14 days of submergence, dry matter (mg) after 7 and 14 days of submergence, anaerobic germination percentage under 7 and 14 days of submergence, vigour index under 7 and 14 days of submergence. The genotypes which recorded >75% germination under submergence for 14 days were screened for anaerobic germination under submergence for 21 days. Data was recorded on early vigour traits under anaerobic conditions. Estimation of total soluble sugars was carried out according to the procedure described by the Anthrone method (Hedge and Hofreiter, 1962). Free amino acid concentration was estimated by using ninhydrin method described by Moore and Stein (1948). The analysis of variance, genetic variability and genetic advance were estimated as per the methods given by Panse and Sukhatme (1967), Burton and Devane (1953), Lush (1940) and Johnson *et al.* (1955).

## RESULTS AND DISCUSSIONS

The results of analysis of variance for 34 characters studied in rice genotypes indicated that there was significant differences among all the genotypes studied. The mean, range, GCV, PCV, heritability and genetic advance as percent of mean values obtained for yield components, early vigour traits in field and early vigour traits under 7, 14 and 21 days of submergence were presented in Table 1, 2 & 3. Wide range of variation was observed for plant height (80.5-155.95 cm), grain yield (17- 47 g) among the thirteen characters studied under field conditions. Highest phenotypic and genotypic coefficients of variation was observed for root length at 14 days after sowing (28.45 and 26.95 respectively) while germination percentage manifested the least values (8.43 and 7.68 respectively). The estimates of heritability ranged from 62.42 % (dry matter at 7 days after sowing) to 94.66 % (test weight). The maximum value for genetic advance as percent of mean was observed for root length at 14 days after sowing (52.6) followed by root length at 7 days after sowing (41.76), grain yield (41.51) and number of ear bearing tillers (38.85).

Study of genetic parameters for early vigour traits revealed that shoot length after 7 days of submergence showed high PCV and GCV (54.65 and 53.59) followed by vigour index under 7 days of submergence (49.99 and 48.74), anaerobic germination percentage under 14 days of submergence (48.27 and 47.14) and number of leaves under 14 days of submergence (47.68 and

47.03). High heritability and genetic advance as percent of mean was manifested by vigour index under 14 days of submergence (97.59 and 54.19) and least was exhibited by number of leaves under 7 days of submergence (81.25 and 0.53) respectively.

High PCV & GCV was observed for vigor index under 21 days of submergence (74.81 and 74.49) followed by anaerobic germination percentage under 21 days of submergence (72.4 and 71.65) respectively. Estimates of heritability was high for anaerobic germination percentage under 21 days of submergence (99.38) and low for root length after 21 days of submergence (84.47). The estimates of genetic advance as percent of mean varied from 48.13 (root length after 21 days of submergence to 214.57 (vigour index under 21 days of submergence) .

The study of genetic parameters showed high heritability estimates ranging from 80-90% for most of the characters reflecting ample scope for their improvement through appropriate breeding procedures. The estimates of phenotypic coefficient of variation for all the characters were high than the estimates of genotypic coefficient of variation. This close correspondence between the estimates of phenotypic coefficient of variation and genotypic coefficient of variation was also reflected by their high heritability values and indicated meager influence of environment on the expression of these traits.

Among the yield components high heritability coupled with high genetic advance as percent of mean was recorded for plant height, number of ear bearing tillers, grain yield and test weight. Under field conditions shoot length at 7 and 14 days after sowing, root length at 7 and 14 days after sowing, dry matter at 7 & 14 days after sowing and vigour index manifested high heritability coupled with high genetic advance as percent of mean. These results are in accordance with the findings reported by Lakshmi *et al.* (2016), Subbarao *et al.* (1996) and Okelola *et al.* (2007). Anaerobic germination percentage after 7 and 14 days of submergence and total soluble sugars exhibited high heritability and high genetic advance as percent of mean. Under 21 days of submergence all the vigour traits studied *viz.*, shoot length, root length, dry matter, number of leaves, anaerobic germination percentage, anaerobic response index and vigour index also recorded high heritability and genetic advance as percent of mean indicating the operation of additive gene action in the inheritance of the trait. Hence good response to



**Table 2 Mean, variability, heritability and genetic advance as percent of mean for vigour traits at 7 and 14 days of submergence in rice**

S. No	Character	Mean	Range		Coefficient of variation		Heritability (%) (broad sense)	Genetic advance as per cent of mean (5 % level)
			Minimum	Maximum	PCV%	GCV%		
1	Shoot length after 7days of submergence (cm)	7.53	0.00	19.10	54.65	53.59	96.14	8.54
2	Root length after 7 days of submergence (cm)	2.79	0.00	8.04	45.46	44.24	94.74	2.48
3	Dry matter after 7 days of submergence (mg)	13.31	0.00	23.00	32.75	29.87	83.14	7.47
4	No.of leaves under 7 days of submergence	1.07	0.00	2.00	29.47	26.57	81.25	0.53
5	Anaerobic germination percentage under 7 days of submergence	78.50	0.00	100.00	25.35	24.37	92.43	37.88
6	Vigour index under 7 days of submergence	1.41	0.00	3.18	49.99	48.74	95.06	1.38
7	Shoot length after 14days of submergence (cm)	14.83	0.00	28.10	40.80	39.88	95.52	11.91
8	Root length after 14days of submergence (cm)	3.78	0.00	8.25	43.13	40.77	89.36	3.00
9	Dry matter after 14 days of submergence (mg)	19.16	0.00	36.00	42.22	40.62	92.59	15.43
10	Vigour index under 14 days of submergence	0.87	0.00	2.80	67.37	66.41	97.59	1.18
11	No.of leaves under 14 days of submergence	1.30	0.00	2.00	47.68	47.03	97.30	1.24
12	Anaerobic germination percentage under 14 days of submergence	57.07	0.00	100.00	48.27	47.17	95.48	54.19
13	Free amino acids (mg g <sup>-1</sup> )	1.82	0.50	4.12	57.19	57.30	100.00	2.14
14	Total soluble sugars (mg g <sup>-1</sup> )	21.75	9.44	41.66	51.95	51.88	100.00	23.22

PCV= Phenotypic coefficient of variation      GCV =Genotypic coefficient of variation

**Table 3 Mean, variability, heritability and gentic advance as percent of mean for vigour traits at 7 and 14 days of submergence in rice**

S. No	Character	Mean	Range		Coefficient of variation		Heritability (%) (broad sense)	Genetic advance as per cent of mean (5 % level)
			Minimum	Maximum	PCV%	GCV%		
1	Shoot length after 21 days of submergence (cm)	17.63	8.00	28.00	35.56	33.65	89.58	65.61
2	Root length after 21 days of submergence (cm)	3.30	1.95	4.40	27.66	25.42	84.47	48.13
3	Dry matter after 21 days of submergence (mg)	14.69	6.00	27.00	45.49	44.70	96.56	90.48
4	No.of leaves under 21 days of submergence	1.21	1.00	2.00	34.02	33.04	98.01	66.11
5	Anaerobic germination percentage under 21 days of submergence	44.47	6.60	100.00	72.40	71.65	99.38	146.17
6	Vigour index under 21 days of submergence	0.87	0.03	2.61	74.81	74.49	94.34	214.57
7	Anaerobic response index	5.03	-3.80	15.40	64.16	63.43	97.91	129.31

PCV= Phenotypic coefficient of variation

GCV =Genotypic coefficient of variation

selection can be attained for improvement of these trait. Similar results were reported by Akram *et al.* (1993) for shoot length, Jaikui *et al.* (1996) for root length and Ramadevi (1998) for vigour index under field conditions.

High heritability estimates and moderate to low genetic advance as percent of mean was recorded for panicle length, shoot length after 7 and 14 days of submergence, root length after 7 and 14 days of submergence, dry matter after 7 and 14 days of submergence, vigour index under 7 and 14 days of submergence, number of leaves under 7 and 14 days of submergence, germination percentage in field and free amino acids suggesting the involvement of both additive and non-additive gene action and provides limited scope for improvement of these traits through selection. Previous findings by Satya and Jebraj (2013) and Hosseini *et al.* (2012) also confirmed the present result for root length after 7 and 14 days of submergence. These findings are in accordance with Rajendra *et al.* (2015) for vigour index under 7 and 14 days of submergence.

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