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RESEARCH

GENETIC VARIABILITY AND CORRELATION STUDIES FOR SEEDLING VIGOUR TRAITS IN RICE (*ORYZA SATIVA* L.) GENOTYPES

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Abstract: Seedling vigour is important agronomical traits and contributer to subsequent tillering quality and yield of rice. Crop stand is dependent on the seedling vigour. For higher grain yield, good crop stand is equally important along with high yield potential. Therefore the present study was carried out to explore the genetic variability and correlation among 11 seedling vigour related traits in 33 rice genotypes including 3 checks *viz*. Narendra 359, Karma mahsuri and IGKVR 1244, at S.G. College of Agriculture and Research Station, Jagdalpur (C.G.). High heritability was found for all the 11 seedling vigour traits. Highest seedling vigour-I at 14th day was recorded for Narendra 359 followed by R2699-31-1, R2326-108-1-61-1 and R2737-25-1. High heritability coupled with high GAM was recorded for root/shoot ratio at 7th day, shoot length at 14th day, shoot length at 7th day and root/shoot ratio at 14th day. The findings from the character association analysis revealed that seedling vigour index-I at 14th day showed high positive significant association with characters like germination percentage, shoot length at 14th day, root length at 14th day and seedling height at 14th day. Further, these promising genotypes can be used in future breeding programme.

Keywords: Rice, Seedling vigour, Genetic Variability, Heritability, Correlation analysis

INTRODUCTION

Rice is the most important cereal of the world providing 21% of global human per capita energy and 15% of per capita protein. Rice (genus *Oryza*) has only two domesticated species *Oryza sativa* L. and *Oryza glaberrima* L., out of its twenty-two species. Hence, *Oryza sativa* L. is the major food crop for people in Asia and nearly 90% of the world's rice is produced and consumed in this region (Warusawithana *et al*., 2017).

In world total rice grown in area 165.68 million hectares with the production of 514.57 million tonnes and productivity of 4640 kg per hectare during 2022-23 (Anonymous, 2024). In the world, 85% of the total rice area is in Asia. Asia is the world's leading producer of rice, accounting for around 90% of global output. People in Asian countries consume more than 75% of the world's rice, making rice vital to Asia's food security. Because of the predicted growth in the population, rice demand is expected to rise even more (Tripathi *et al*., 2011).

India is the second largest producer and consumer of rice in the world. Rice breeding in India has made significant impact in the socioeconomic spheres by simultaneously ensuring food security as well as commerce. In India total rice grown in area 47.83 million hectares with the production of rice during 2022-23 is estimated at record 135.75 million tonnes and productivity of 2838 kg per hectares.

Chhattisgarh is known as “rice bowl of India” and about 82% population of the state is dependent on agriculture for their livelihood. In Chhattisgarh total rice grown area is 3.77 million hectares with the production of 9.81 million tonnes and productivity of 2602 kg per hectare during 2022-23.

Rice seedling vigour is a complex quantitative feature that has been encoded in nature. Seedling vigour is an agronomical traits and sign of potential seed germination. It improves the speed, uniformity of the seedlings with stand establishment and grain

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yield. It determines the quick, uniform emergence and growth of seedlings under a wide range of field circumstances (Anumalla *et al*., 2015).

For higher seed yield, good crop stand is equally important along with high yield potential. Crop stand is dependent on the seedling vigour. Some characters like root length, shoot length and seedling height has been identified as standard indicator of seedling vigour. The current study was initiated with the main aim of identifying rice genotypes with superior early seedling vigour related traits which belongs to *Oryza sativa* L. *ssp. indica* (Akshaya *et al*., 2020).

Seedling vigour is an important characteristic of seed quality, reflecting potential seed germination, seedling growth, seed longevity and tolerance to adversity. Seedling with strong vigour may significantly improve the speed and uniformity of seed germination and lead to perfect field emergence, good crop performance, and even high yield under different conditions (Sun *et al*., 2007).

MATERIALS AND METHODS

Thirty-three genotypes of rice were evaluated for seedling vigour traits in randomized block design with two replications at Research cum Instructional Farm of S.G. College of Agriculture and Research Station, Kumhrawand located in Jagdalpur, Bastar (C.G.). All laboratory observations were recorded in each replication was considered for statistical analysis. The details of genotypes used for the present study was furnished in table 1.

Estimation of seedling vigour traits

In order to assess and quantify the genetic variability among the genotypes for the characters under study, the following parameters were estimated as given below. Germination percentage (%), root length (cm) at 7^{th} day, shoot length (cm) at 7^{th} day, seedling height (cm) at 7^{th} day, root/shoot ratio at 7^{th} day, seedling vigour index-I at 7^{th} day, root length (cm) at 14^{th} day, shoot length (cm) at 14^{th} day, seedling height (cm) at 14^{th} day, root/shoot ratio at 14^{th} day, seedling vigour index-I at 14^{th} day.

RESULTS AND DISCUSSION

In ANOVA all the characters were found to be significant at 1% level. The presence of highly significant values of mean sum of square for all the 11 characters indicated that high variability was present among the genotypes for the characters.

Analysis of Genetic variability parameters

Table 3 presents the results of the genetic variability parameters, including mean, genotypic coefficient of variability (GCV), phenotypic coefficient of variability (PCV), broad sense heritability (h^2), and genetic advance as a percentage of mean (GAM), for seedling vigour characteristics. The magnitude of PCV values for all traits was greater than the corresponding GCV values, suggesting that these characters may be influenced by the environment.

Genotypic Coefficient of Variability (GCV) and Phenotypic Coefficient of Variability (PCV)

Phenotypic coefficient of variation values was found to be slightly higher than genotypic coefficient of variation values showing the influence of environment on character expression. Moderate GCV and PCV values were observed for characters like shoot length at 7^{th} day, root/shoot ratio at 7^{th} day, shoot length at 14^{th} day and root/shoot ratio at 14^{th} day. High heritability was found for all the 11 seedling vigour traits. High heritability coupled with high GAM was recorded for root/shoot ratio at 7^{th} day, shoot length at 14^{th} day, shoot length at 7^{th} day and root/shoot ratio at 14^{th} day. Similar results were obtained by Mounika Reddy *et al*., (2022), (germination percentage, seedling height, seedling vigour index-I, root length and shoot length), Bezawada *et al*., (2020) (germination percentage, seedling height, shoots length and root length).

Correlation Analysis

The findings from the character correlation analysis revealed that seedling vigour index-I at 14^{th} day showed high positive significant association with characters like germination percentage, shoot length at 14^{th} day, root length at 14^{th} day and seedling height at 14^{th} day. Further, these promising genotypes can be used in future breeding programme. Similar results were obtained by Sai Teja *et al*., (2024) (shoot length at 7^{th} day, root length at 7^{th} and 14^{th} day).

CONCLUSION

Out of 33 genotypes showed that genotypes Narendra359 followed by R2699-31-1, R2326-108-1-61-1 and R2737-25-1 are having good seedling vigour index. Moderate GCV and PCV values were reported for characters like shoot length at 7^{th} day, root/shoot ratio at 7^{th} day, shoot length at 14^{th} day and root/shoot ratio at 14^{th} day. High heritability was found for all the 11 seedling vigour traits. Highest heritability combined with high GAM was recorded for root/shoot ratio at 7^{th} day, shoot length at 14^{th} day, shoot length at 7^{th} day and root/shoot ratio at 14^{th} day. The findings of this study can be used for future breeding programs to develop varieties that are not only high-yielding but also have strong seedling vigour, which is important for successful crop establishment and better overall crop performance.

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Table 1.1: Genetic variability parameters of 11 studied characters.

Traits	Mean	Minimum	Maximum	Heritability (%)	GA% mean	GCV (%)	PCV (%)
GP	94.39	89.15	99.00	76.29	3.79	2.11	2.41
SL-7	2.34	1.82	3.25	98.28	24.75	12.12	12.22
RL-7	9.16	6.66	10.93	91.78	16.89	8.56	8.93
R/SR-7	4.05	3.01	5.67	95.87	25.68	12.73	13.00
SH-7	11.33	9.00	13.32	66.80	13.61	8.09	9.89
SVI-I-7	10.70	8.69	12.46	68.75	14.47	8.47	10.21
SL-14	7.16	5.32	9.27	94.65	25.07	12.51	12.86
RL-14	17.41	14.44	21.84	91.50	14.07	7.14	7.47
R/SR-14	2.53	1.91	3.15	86.98	24.01	12.50	13.40
SH-14	24.57	20.17	29.58	95.14	14.41	7.17	7.35
SVI-I-14	23.20	18.76	28.84	96.03	16.12	7.99	8.15

Key words: **GP %** = germination percentage; **SL-7** = shoot length at 7th day ; **RL-7** = root length at 7th day; **R/SR-7** = root /shoot ratio at 7th day ; **SH-7** = seedling height at 7th day; **SVI-I -7** = seedling vigour index-I at 7th day; **SL-14** = shoot length at 14th day ; **RL-14** = root length at 14th day; **R/SR-14** = root /shoot ratio at 14th day ; **SH-14** = seedling height at 14th day; **SVI-I -14** = seedling vigour index-I at 14th day.

Table 1.2: Phenotypic correlation coefficients of yield and yield attributing characters

Traits	GP	SL-7	RL-7	R/SR-7	SH-7	SVI-I-7	SL-14	SL-14	R/SR-14	SH-14	SVI-I-14
GP	1.000	0.128	-0.071	-0.166	0.021	0.234	0.165	0.154	-0.083	0.194	0.438**
SL-7			0.275*	-0.717**	0.525**	0.541**	-0.095	-0.219	-0.038	-0.205	-0.150
RL-7				0.444**	0.823**	0.782**	-0.268*	-0.198	0.149	-0.278*	-0.276*
R/SR-7					0.087	0.044	0.003	0.085	0.051	0.063	0.006
SH-7						0.975**	-0.202	-0.234	0.076	-0.270*	-0.243*
SVI-I-7							-0.156	-0.196	0.049	-0.220	-0.136
SL-14								0.315*	-0.824**	0.734**	0.710**
SL-14									0.254*	0.875**	0.841**
R/SR-14										-0.238	-0.237
SH-14											0.963**
SVI-I-14											1.000

***, ** significant at 5% and 1% level, respectively**

Key words: **GP %** = germination percentage; **SL-7** = shoot length at 7th day ; **RL-7** = root length at 7th day; **R/SR-7** = root /shoot ratio at 7th day ; **SH-7** = seedling height at 7th day; **SVI-I -7** = seedling vigour index-I at 7th day; **SL-14** = shoot length at 14th day ; **RL-14** = root length at 14th day; **R/SR-14** = root /shoot ratio at 14th day ; **SH-14** = seedling height at 14th day; **SVI-I -14** = seedling vigour index-I at 14th day.

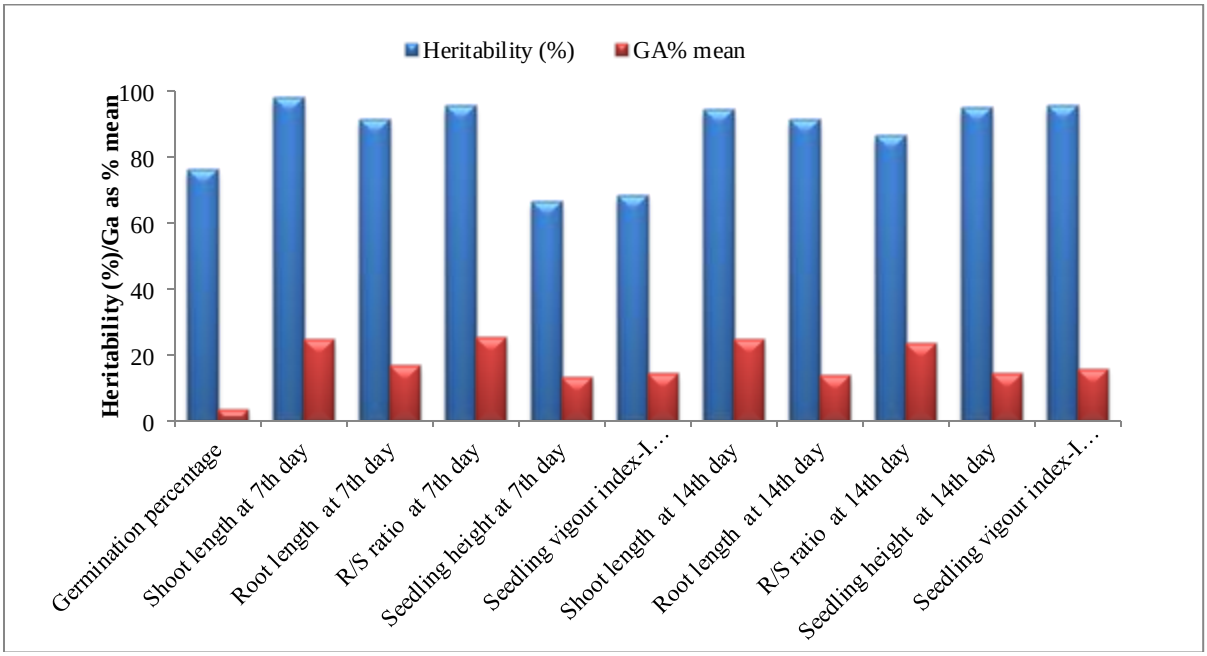

Fig. 1.1: Bar diagram showing heritability coupled with genetic advance as percent of mean for yield and yield attributing traits

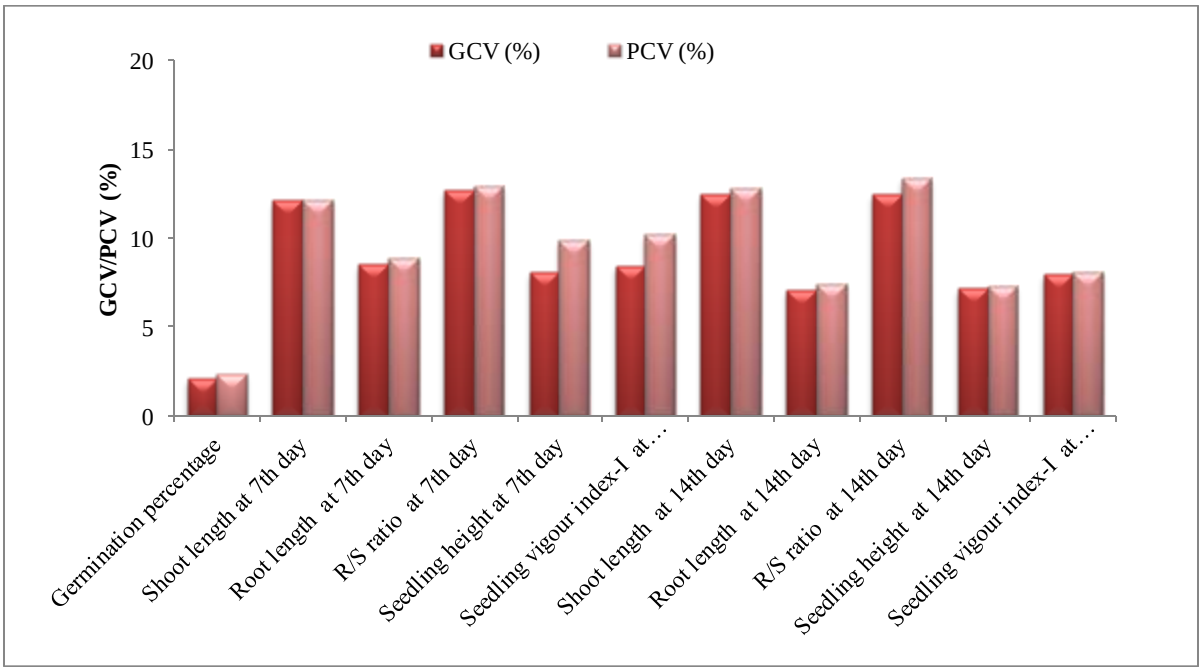

Fig. 1.2: Bar diagram showing phenotypic and genotypic coefficient of variation for yield and yield attributing characters.

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