

The study evaluated the potential viability of seeds from various types of rice (*Oryza sativa* L.)

ABSTRACT

Rice, a crucial staple crop for global food security, requires efficient production to meet the nutritional needs of an expanding population. Seed vigour is a crucial aspect of seed quality, and ANDUAT has introduced rice cultivars designed for the agricultural terrain of Acharya Narendr Deva University of Agriculture & Technology in India. This approach aims to improve seed vigour and quality in response to changing agro-climatic conditions. The study used a completely randomised design to assess seed vigour using various metrics such as electrical conductivity, field emergence, radicle emergence time, mean germination time, germination percentage, speed of emergence, shoot length, root length, days to first count, and days to final count. The study's findings revealed that rice types were categorized into three based on seed vigour. Eleven seeds showed varying levels of seed vigour potential, ranging from high to medium to low, NDR-359, IR-64, Damini, Sarjoo-52, Nagina-22, DRR-44, Barani Deep, Varalu, Lalat, NDR-2065 and NDR-2064. The study provides eleven categories for informed decision-making in seed management and cultivation, highlighting the suitability of high-vigor varieties for direct planting and improving agricultural yield.

Keywords: Rice, viability seed vigour and electrical conductivity

1. INTRODUCTION

Rice, also known as *Oryza sativa* L., is a crucial cereal crop for human sustenance, providing food for over half of the world's population [1, 2]. The current rice production is sufficient for life, but the growing population demands urgent enhancement of rice production. Rice seeds' vitality is crucial for high and consistent harvests. However, dishonest merchants blend seeds from similar years to cut costs, resulting in decreased germination. Extended storage of seeds also leads to degradation. The growing population demands an urgent need to enhance rice production, as existing yearly production is sufficient for survival[3]. To improve rice seed quality surveillance, it's crucial to develop mechanisms to detect seed viability from different years, while conventional methods like artificial seed germination are used to assess seed vigor.

H. Liu, et al., Staining and conductivity tests are techniques employed to assess seed vigour by finding correlations between the physical and chemical characteristics of seeds and their germination rates [4]. Seed vigour testing is hindered by intricate chemical processing and specialized skills and their widespread application is considered time-consuming and impractical. Seed vigour is a crucial factor in determining the performance of agricultural seeds, referring to their strength and ability to germinate and establish seedlings quickly and evenly in different climates[3,5,and 6]. (Finch-Savage and Bassel, Seeds with high vitality can significantly improve seed germination, emergence, crop performance, and yield even in less-ideal conditions[7]. Seed vigour is a complex trait influenced by genetic background and environmental conditions, making genetic analysis challenging [8, 9]. This research report examines some ANDUAT's rice varieties' seed vigor within the seed chain context, aiming to improve crop establishment, resource utilization, minimize hazards, and enhance regional rice production sustainability by examining their seed vigor. This study aims to evaluate the vitality of rice seeds, focusing on germination, early seedling growth, and performance in the field. It will benefit farmers, seed producers, and policymakers, guiding crop variety selection and seed management practices, and contributing to the development of resilient and sustainable rice production systems in Uttar Pradesh and beyond.

2. METHOD AND MATERIALS

2.1 Plant material and methodology

A study at ANDUAT, Kumarganj, Ayodhya, India, examined seedling vigour features of eleven rice genotypes with varying durations and grain types. The study followed a randomized design with replications, documenting every observation and including each replication in statistical analysis. The study will assess the potential seed vigour of recently harvested rice varieties using various observations such as radicle emergence time, germination time, germination percentage, speed of emergence, shoot length, root length, days to first count, days to final count, vigour index, electrical conductivity, and field emergence. The storage ability of these rice varieties will be significantly influenced by their seed vigour.

2.2 Varieties Taken for the Study

The study utilized eleven accessions of rice (*Oryza sativa* L.) as seed material like: NDR-359, IR-64, Damini, Sarjoo-52, Nagina-22, DRR-44, Barani Deep, Varalu, Lalat, NDR-2065 and NDR-2064.

2.3 Emergence time of radicles and germination time

The mean germination time is the average duration of a seed's germination, or the lag period from water absorption to radicle appearance. Ten seeds are placed in a growth chamber with 100% relative humidity and temperature range. Each seed's radical emergence time is recorded, indicating the specific vigour index. The mean germination time for the entire lot is the average time for roots to emerge from all 10 seeds.

2.4 Speed of germination

The test was conducted in the lab with three replications of one hundred seed each replication and each treatment by adopting between paper towel method described by ISTA procedure [10]. Number of germinated seed is counted daily and the index for the speed of germinated is calculated by the formula suggested by Maguire [11].

$$N_1/1 + N_2/2 + \dots + N_X/X = N$$

Where,

$N_1 \dots N_X$ are the number of seed germinated on day 1 to x day.

1...X are the number of days.

High value of N indicates high seed vigor. Seed is considered as germinated when the radicle has appeared hence, it should be counted daily and seed observed as germinated should be removed.

2.5 Seed vigor Index

The Seed vigor index was calculated as per method prescribed by Abdul-Baki and Anderson [17] and was expressed in whole number. For seed vigour index, standard germination percentage of seed was multiplied by total seedling length seedling dry weight separately.

- I. **Seed vigor index (SVI)** = Standard germination (%) x Total seedling length (cm).
- II. **Seed vigor index (SVII)** = Standard germination (%) x Total seedling dry weight (g).

2.6 Statistical analysis:

The data obtained from the various experiments were statistically analyzed in the appropriate programmed under Completely Randomized Design with three replications with angular transformation according to Panse and Sukhante [12].

3. RESULTS AND DISCUSSION

The study classified rice cultivars based on their seed vigour potential, with 11 out of the analyzed types exhibiting significant potential (Table 1,2). The study identified five rice varieties with high germination and early seedling growth characteristics: NDR-359, IR-64, Damini, Sarjoo-52, Nagina-22, DRR-44, Barani Deep, Varalu, Lalat, NDR-2065, and NDR-2064. Three rice varieties had moderate seed vigour potential, while five had low potential, indicating difficulties in germination and seedling growth (Fig. 1, 2). The study highlights the importance of identifying and cultivating high-quality rice varieties for successful seedling growth. The classifications of rice varieties reveal their seed vigour, aiding in informed decisions on seed management and crop cultivation. Highly vigorous seed variants with high potential are ideal for direct sowing in rice farming, as they can sprout and grow as seedlings, resulting in successful and efficient crop establishment. The essay emphasizes the importance of using high-potential seed vigour varieties for direct seeding techniques to significantly boost crop yields and overall agricultural output. The study suggests that embryo function as radicle emergence site influences quicker germination, with larger embryos being crucial for improving the vigor of indica rice cultivar seedlings, as noted by Pandey and Seshu, et al. [13]. Seedling vigour is a crucial factor in improving crop establishment in direct-seeded rice, which is quantitatively inherited [14]. The study evaluated 31 genotypes, identifying five as high vigour, five as low vigour, and 21 as medium vigour, based on seed vigour data from a study on the genotypes Bala, Vandana, AUS 276, Addaysel, N22, and IR 64. Sujay was found that various factors such as 100-seed weight, germination, shoot length, root length, seedling dry weight, and seed vigour index II yielded comparable results [15]. Cui et al., discovered a significant correlation between the five seedling vigour traits: germination rate, total dry weight, shoot dry weight, root dry weight, and maximum

root length [16]. The vigour test results indicate that certain types with lower vigour may become less viable sooner when stored under the same conditions.

Table 1: The potential of Germination %, Germination time, Speed of emergence, Shoot Length etc., rice parameter under seed vigour varieties

Varieties	G%	GT	SE	SL(cm)	RL(cm)	FE(%)
NDR-359	95.3	30.2	7.5	10.5	20.5	82.0
IR-64	97.0	31.7	6.8	11.4	22.7	83.0
Damini	93.3	32.3	8.2	10.4	21.3	80.0
Sarjoo-52	96.0	34.6	8.0	11.4	20.6	82.0
Nagina-22	93.0	33.1	7.4	11.2	21.2	82.3
DRR-44	91.7	31.7	6.6	11.4	22.7	84.0
Barani Deep	97.0	31.9	8.2	10.6	21.1	81.3
Varalu	96.7	31.7	7.7	10.6	20.4	84.7
Lalat	92.7	31.9	7.1	9.8	21.1	78.7
NDR-2065	89.0	31.0	8.0	10.0	19.8	84.3
NDR-2064	95.3	31.8	7.3	10.6	20.4	81.0
Mean	94.3	32.0	7.5	10.7	21.1	82.1
Minimum	89.0	30.2	6.6	9.8	19.8	78.7
Maximum	97.0	34.6	8.2	11.4	22.7	84.7
SE.m	0.95	0.45	0.21	0.22	0.37	1.86
SE.d	1.35	0.64	0.30	0.31	0.52	2.63
CD	2.763	1.321	0.621	0.643	1.073	5.372

*G%: Germination GT: Germination time SE: Speed emergence SL: Shoot Length RL: Root Length FE: Field emergence SE.m :Standard Error of Mean CD: Critical difference

Table 2: The potential of Dry Matter Production, Days to first count, Vigour index-1 VI2: etc., rice parameter under seed vigour varieties

Varieties	DMP(gm)	DFC	DFC	VII	VI2	EC(dsm/1)
NDR-359	0.064	6	16	3043	2.548	0.036
IR-64	0.069	6	16	2319	2.093	0.036
Damini	0.063	6	16	2823	2.133	0.035
Sarjoo-52	0.070	6	16	2307	2.289	0.037
Nagina-22	0.070	6	16	3103	2.316	0.037
DRR-44	0.063	6	16	2589	1.685	0.033
Barani Deep	0.072	6	16	2747	2.545	0.034
Varalu	0.070	6	16	2715	2.619	0.042
Lalat	0.065	6	16	2579	2.525	0.036
NDR-2065	0.069	6	16	3523	2.397	0.043
NDR-2064	0.064	6	16	3299	1.685	0.033
Mean	0.067	6	16	2822	2.258	0.037
Minimum	0.063	6	16	2307	1.685	0.033
Maximum	0.072	6	16	3523	2.619	0.043
SE.m	0.002	-	-	200.0	0.16	0.0010
SE.d	0.006	NS	NS	282.9	0.23	0.0014
CD	0.005	-	-	577.7	0.484	0.003

*DMP: Dry Matter Production DFC: Days to first count VII: Vigour index-1 VI2: Vigour index-2 EC: Electrical conductivity SE.m :Standard Error of Mean CD: Critical difference

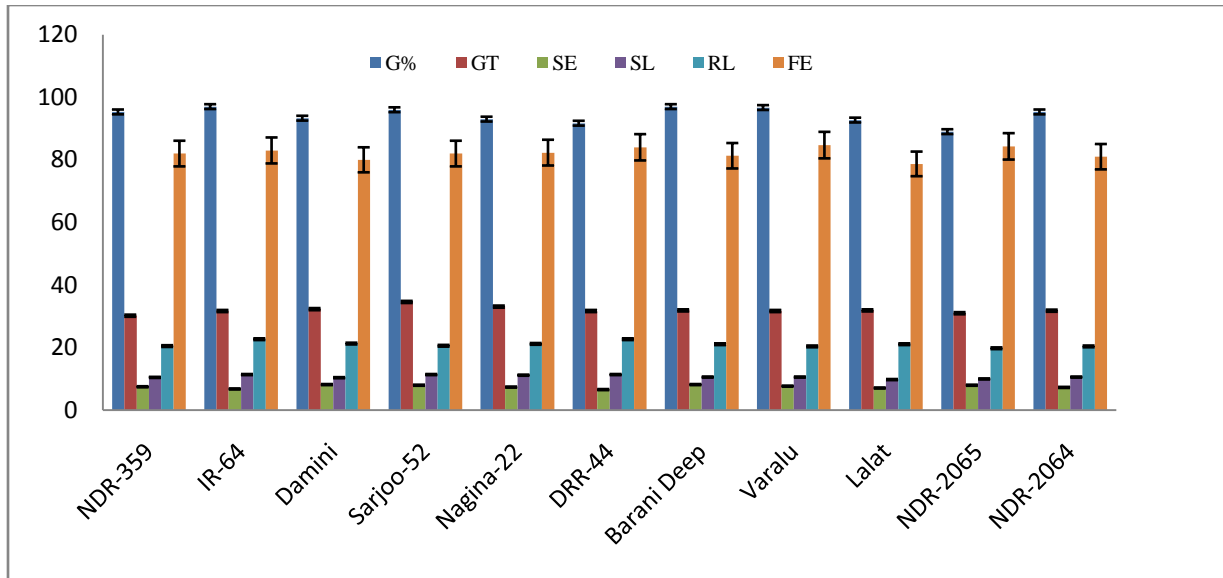


Fig. 1: The potential of Germination %, Germination time, Speed of emergence, Shoot Length etc., rice parameter under seed vigour varieties

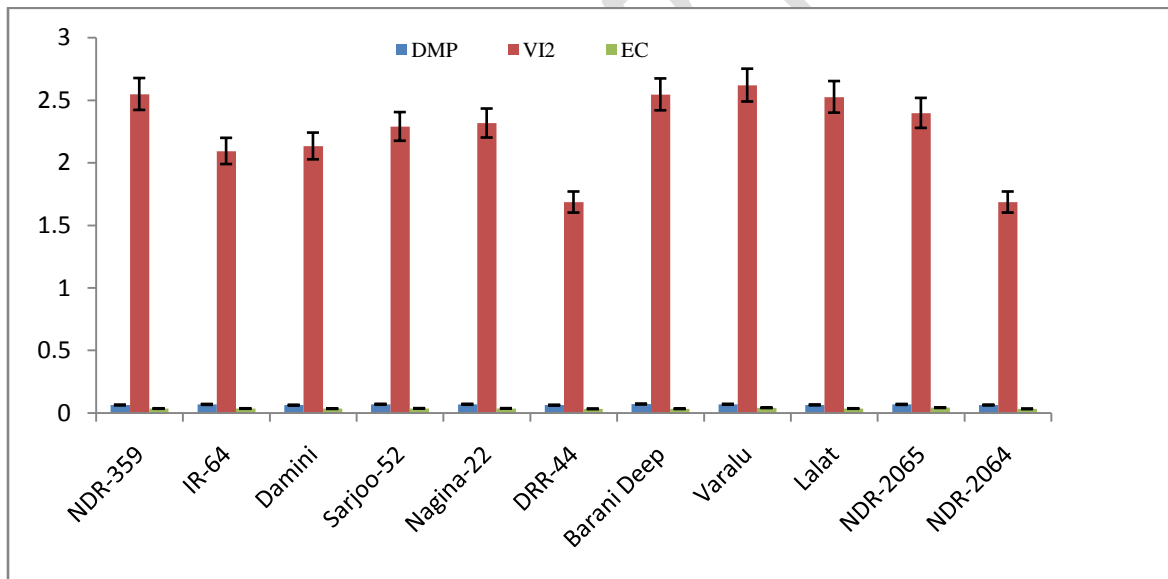


Fig. 2: The potential of Dry Matter Production, Vigour index-2 Electrical conductivity rice parameter under seed vigour varieties

4. CONCLUSION

The conclusion reveals that seeds from various types exhibit varying levels of vitality, resulting in varying performance in the field. They categorized rice varieties based on their potential for

seed vigor, revealing eleven varieties with promising germination and early seedling growth. Three varieties showed moderate potential, while the remaining five had low potential. The study highlights the importance of identifying and nurturing superior rice cultivars for effective seedling development, highlighting potential challenges in germination and seedling growth.

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