Journal of Experimental Agriculture International

Volume 46, Issue 6, Page 693-698, 2024; Article no.JEAI.117016
ISSN: 2457-0591
(Past name: American Journal of Experimental Agriculture, Past ISSN: 2231-0606)

The Study Evaluated the Potential Viability of Seeds from Various Types of Rice (*Oryza sativa* L.)

Girish Goyal [a++], Shwetank Shukla [b], Shubham Kumar Srivastava [c], Anand Kumar Diwakar [b], Sanjay Kumar Tripathi [d], Jitender Bhati [e] and Pradip Kumar Saini [f*]

[a] Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (Uttar Pradesh), India.
[b] Department of Soil Science and Agricultural Chemistry, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (Uttar Pradesh), India.
[c] Department of Agriculture, Bindeswari Mahavidyalaya, (affiliated to RMLAU, Ayodhya, Uttar Pradesh) Akbarpur-Ambedkar Nagar (Uttar Pradesh), India.
[d] College of Agriculture, (Campus) Lakhimpur Kheri, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (Uttar Pradesh), India.
[e] Department of Genetic and Plant Breeding, Gochar Mahavidyala (Maa Shakumbhari University, Saharanpur, Uttar Pradesh), Rampur Maniharan, Saharanpur (Uttar Pradesh), India.
[f] Department of Crop Physiology, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (Uttar Pradesh), India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/jeai/2024/v46i62525

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/117016

Original Research Article

Received: 08/03/2024
Accepted: 11/05/2024
Published: 21/05/2024

[++] Assistant Director Research/Assistant Professor, Directorate of Research;
**Corresponding author: E-mail: pradipnduat@gmail.com;*

Cite as: *Goyal, G., Shukla, S., Srivastava, S. K., Diwakar, A. K., Tripathi, S. K., Bhati, J., & Saini, P. K. (2024). The Study Evaluated the Potential Viability of Seeds from Various Types of Rice (Oryza sativa L.). Journal of Experimental Agriculture International, 46(6), 693–698. https://doi.org/10.9734/jeai/2024/v46i62525*

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 Narendra 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; 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. The 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. METHODS 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].

N1/1+N2/2+……...+NX/X=N

Where,

N1…NX 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 [12] 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 [13].

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 (Tables 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 (Figs. 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 [14]. Seedling vigour is a crucial factor in improving crop establishment in direct-seeded rice, which is quantitatively inherited [15]. 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 [16]. Cui, 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 [17]. 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 SEm: 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	VI1	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 VI1: Vigour index-1 VI2: Vigour index-2 EC: Electrical conductivity SEm :Standard Error of Mean CD: Critical difference*

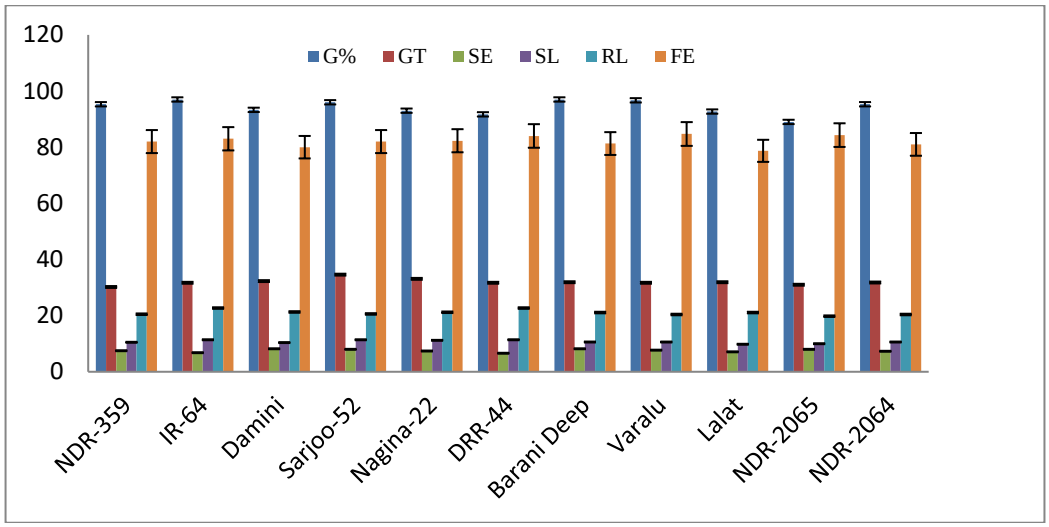

Fig. 1. The potential of Germination %, Germination time, Speed of emergence, Shoot Length etc., rice parameter under seed vigour varieties

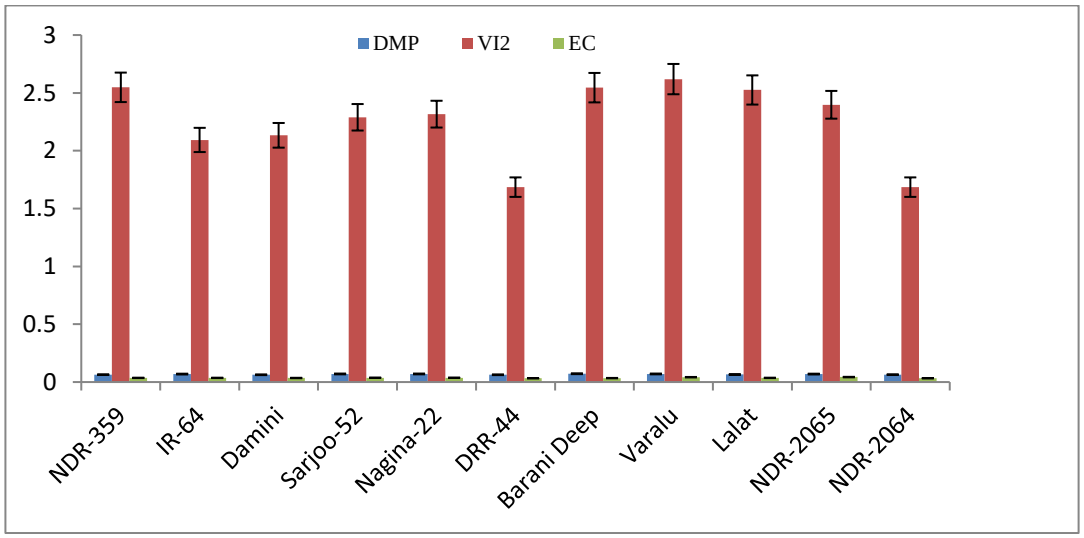

Fig. 2. The potential of Dry Matter Production, Vigour index-2 Electrical conductivity rice parameter under seed vigour varieties

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.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERANCES

1. Jiang, Nan, Jun Yan, Yi Liang, Yanlong Shi, Zhizhou He, YuntianWu, Qin Zeng, Xionglun Liu, Junhua Peng. Resistance genes and their interactions with bacterial blight/leaf streak pathogens (Xanthomonas oryzae) in rice (*Oryza sativa L.)*-an updated review. Rice2020;3(1):13.

2. Ghanghas, Neeraj, Mukilan MT, Shikha Sharma, Pramod K Prabhakar. Classification, composition, extraction, functional modification and application of rice (*Oryza sativa*) seed protein: A comprehensive review. Food Reviews International. 2022;38(4):354-383.
3. Min, Tai Gi, Woo Sik Kang. Simple, quick and nondestructive method for Brassicaceae seed viability measurement with single seed base using resazurin. Horticulture, Environment, and Biotechnology. 2011;52:240-245.
4. Liu, Huan, Yanfang Zhu, Xia Liu, Yu Jiang, Shiming Deng, Xunru Ai, Zhijun Deng. Effect of artificially accelerated aging on the vigor of Metasequoia glyptostroboides seeds. Journal of Forestry Research. 2020;31(3):769-779.
5. Mavi K, PowellAA, MatthewsS.Rate of radicle emergence and leakage of electrolytes provide quick predictions of percentage normal seedlings in standard germination tests of radish (*Raphanus sativus*). Seed Science and Technology. 2016;44(2):393-409.
6. Demir, Ibrahim, Burcu B. Kenanoglu, and Eren Özden. Seed vigour tests to estimate seedling emergence in cress (*Lepidium sativum L*.) seed lots. NotulaeBotanicae Horti Agrobotanici Cluj-Napoca. 2019;47(3):881-886.
7. Finch-Savage, William E, George W. Bassel. Seed vigour and crop establishment: Extending performance beyond adaptation. Journal of Experimental Botany. 2016;67(3):567-591.
8. Foolad Majid R, Prakash Subbiah, Liping Zhang. Common QTL affect the rate of tomato seed germination under different stress and nonstress conditions. International Journal of Plant Genomics; 2008.
9. Sun Qun, Sun Qun, Wang JianHua Wang JianHua, Sun BaoQi Sun BaoQi. Advances on seed vigor physiological and genetic mechanisms. 2007;1060-1066.
10. International Seed Testing Association (ISTA,). Seed germination Testing, International Rules for Seed Testing, Zurich, Switzerland; 1976.
11. Maguire JD. Speed of germination-aid selection and evaluation for seedling emergence and vigor. Crop Science. 1962;2:176-177.
12. Abdul-Baki, Aref A, James D. Anderson. Vigor determination in soybean seed by multiple criteria 1. Crop Science. 1973;13(6):630-633.
13. Panse, Vinayak Govind, Pandurang VasudeoSukhatme. Statistical methods for agricultural workers. Statistical Methods for Agricultural Workers. 1954;3.
14. Pandey MP, SeshuDV, AkbarM.Genetic variation and association of embryo size to rice seed and seedling vigour. 1992;310-320.
15. Zhang HB. BAC workshop manual. Southern crop improvement facility, Texas A and M University, College Station.1995;36-37.
16. Sujay V. Evaluation of early vigor related traits in upland rice (*Oryza sativa*). diss., UAS, Dharwad; 2007.
17. Cui K, PengS, XingY, XuC, YuS, ZhangQ1. Molecular dissection of seedling-vigor and associated physiological traits in rice. Theoretical and Applied Genetics. 2002;105:745-753.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/117016