International Journal of Environment and Climate Change

Volume 13, Issue 11, Page 1765-1769, 2023; Article no.IJECC.107469
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Assessing the Potential Seed Vigor of Rice Varieties

V. Vakeswaran [a++*]

[a] *Seed Centre, Tamil Nadu Agricultural University, Coimbatore, India.*

Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i113332

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/107469

Original Research Article

Received: 08/08/2023
Accepted: 14/10/2023
Published: 28/10/2023

ABSTRACT

Rice (*Oryza sativa* L.) is a fundamental staple crop, feeding billions and sustaining livelihoods worldwide. Amid the global food security context, rice holds a pivotal role, demanding increased efficiency and productivity to meet the dietary demands of a growing global population. Emphasizing seed quality and vigor is crucial in achieving these goals. Tamil Nadu Agricultural University (TNAU) responds to the dynamic agro-climatic conditions by introducing rice varieties tailored to Tamil Nadu's unique agricultural landscape. This research paper examines the seed vigor of TNAU released rice varieties within the seed chain. The study was conducted in a completely randomised design, the study assessed seed vigor in terms of radicle emergence time, mean germination time, germination percentage, speed of emergence, shoot length, root length, days to first count, days to final count, vigour index – I, vigour Index – II, electrical conductivity, and field emergence. Seed vigor also impacts storage potential. This study results shows that the rice varieties were categorized into three groups based on seed vigor. Twelve exhibited high seed vigor potential including ADT 51, CO52, TRY 1, TRY3, TKM13, ADT39, ADT 54, BHAVANI, ASD16, ADT37, ADT43, and ADT 53. Six showed medium potential including CO 53, ASD 19, IW Ponni, TKM 9, ADT 42, and ADT 45. Eight had low seed vigor potential including CO 50, ADT 52, TPS5, VGD 1, ADT 38, ADT 46, CO 51, and MDU 6. These classifications aid informed seed management and cultivation decisions, highlighting the suitability of high-vigor varieties for direct seeding and improved agricultural productivity.

[++] *Associate Professor;*
**Corresponding author: E-mail: vakeswaran.v@tnau.ac.in;*

Keywords: Oryza sativa; seed vigor; global food security; cropping systems.

1. INTRODUCTION

Rice (*Oryza sativa* L.) stands as one of the world's most essential staple crops, nourishing billions of people and serving as the foundation of livelihoods for countless communities. In the context of global food security, rice plays an integral role, and its continuous cultivation and production are imperative to meet the dietary needs of an ever-expanding global population. This reality places immense pressure on the agricultural sector to enhance the efficiency and productivity of rice cultivation, with a particular focus on seed quality and vigor.

In response to dynamic agro-climatic setting characterized by varying rainfall patterns, soil types and cropping systems, TNAU has been consistently introducing and releasing new rice varieties carefully tailored to the unique requirements of Tamil Nadu's agricultural landscape. These new cultivars are expected to not only exhibit traits like disease resistance and high yield potential but also demonstrate superior seed vigor, a critical factor influencing germination, early seedling growthand overall crop performance.

Seed vigor, often described as the inherent potential of seeds to perform optimally under a range of environmental conditionsis a crucial determinant of crop establishment and subsequently yield [1,2]. In the context of rice cultivation, the vigor of seeds holds particular significance as it directly affects the stand establishment and early growth of the crop. Seeds with high vigor germinate quickly, produce vigorous seedlings and can better withstand biotic and abiotic stress resulting in improved crop performance [3-5].

This research paper aims to shed light on the potential seed vigor of the rice varieties released by TNAU within the context of the seed chain. Understanding the seed vigor of TNAU released rice varieties is crucial not only for ensuring successful crop establishment but also for optimizing resource use, minimizing risks, and enhancing the overall sustainability of rice cultivation in the region. By systematically evaluating the vigor of these rice seeds, this study aims to provide a comprehensive understanding of their potential in terms of germination, early seedling growthand subsequent field performance.The findings of this research will not only benefit farmers and seed producers but will also serve as a valuable resource for policymakers, guiding decisions related to crop variety selection and seed management practices, ultimately advancing the goal of resilient and sustainable rice production systems in this vital agricultural region.Also contributes to the ongoing dialogue surrounding the crucial role of seed quality in shaping the future of agriculture in Tamil Nadu and beyond.

2. MATERIALS AND METHODS

This study focused on the rice varieties that had been released by TNAU and were currently part of the seed chain. To conduct this research, pure seeds were obtained directly from the breeding stations responsible for these varietiesand all the chosen varieties were cultivated at the Agricultural Research Station, Bhavanisagar. This cultivation enabled us to obtain freshly harvested seeds, which served as the foundational material for this study.

2.1 Varieties Taken for the Study

According to the Breeder Seed Production Indent of TNAU for the 2019-2020 period, a total of 26 varieties were selected for the study as listed below: ADT 36, ADT 37, ADT 38, ADT 39, ADT 42, ADT 43, ADT 45, ADT 46, ADT 51, ADT 52, ADT 53, CO 43, CO (R) 50, CO 51, CO 52, CR 1009 SUB 1, ASD 16, ASD 19, TKM 9, TKM 13, TRY 1, TRY 3, TPS 5, MDU 6, and VGD 1.

The rice varieties ADT 49, CO 52 and VGD 1 were not initially included in the breeder seed production indent. However, due to their widespread popularity, these varieties were incorporated into this study. Conversely, IWPONNI, IR20, IR36, and IR50 were present in the production indent. Nevertheless, this study focused exclusively on the varieties released by TNAU, leading to the exclusion of these aforementioned varieties from the research.

2.2 Details of Laboratory Experiment to be Conducted

Treatments: All the above rice varieties

Location of the experiment: Agricultural Research Station, Bhavanisagar.

Methods: The study was conducted in completely randomised design (CRD). The freshly harvested rice varieties will be assessedfor their potential seed vigour and the observations to be recorded viz., radicle emergence time, mean germination time, germination percentage, speed of emergence, shoot length, root length, days to first count, days to final count, vigour index – I, vigour Index – II, electrical conductivity and field emergence.

The seed vigor of these rice varieties will play a significant role in determining their storage potential. The evaluation of the potential seed vigor for each rice variety will be conducted using the following methodology.

2.3 Methodology for Vigour Prediction in Rice

2.3.1 Radicle emergence time and mean germination time

The Mean germination time describes the average time for a seed to germinate or the delay (lag period) from the start of imbibition to radicle emergence (Elis and Roberts, 1980). The seeds (10 numbers) will be placed in a petri plate in the growth chamber (100 % RH and 25 ± 20°C) and the radical emergence time will be observed for individual seed and noted as radical emergence time of individual seed. This is an indicative index of the particular seeds vigour index. The mean of radical emergence time of all the 10 seeds will be calculated and expressed as mean germination time of the seed sample representing the lot.

2.3.2 Speed of germination

According to Maguire [6], the speeds of germination were calculated by flowing equation:

$$GS = \frac{\sum n}{\sum n(n \times DN)} \times 100$$

where, n is the number of seeds germinated on day Dn, Dn is the number of days from sowing, corresponding to n and the highest G.S. is the fastest speed.

2.3.3 Vigour index I

The vigour index is a measure of seedling performance, which relates together the germination percentage of a seed sample and the growth of the seedlings produced after a given time [7]. It is calculated by following equation:

$$Vi = \frac{\%Gr \times MSH}{100}$$

Where

VI =Vigour index
GR =Final germination percentage
MSH=Mean seedling length

2.3.4 Vigour index II

$$VI = \frac{Gr\ \%X\ MSDW}{100}$$

Where

VI=Vigour index
GR %=Final germination percentage
MSDW=Mean seedling dry weight (mg)

3. RESULTS AND DISCUSSION

In the study, the rice varieties were categorized into three distinct groups based on their seed vigor potential. Among the varieties examined, 12 exhibited high potential seed vigor. These exceptional varieties included ADT 51, CO52, TRY 1, TRY3, TKM13, ADT39, ADT 54, BHAVANI, ASD16, ADT37, ADT43, and ADT 53, showcasing robust germination and early seedling growth characteristics. Additionally, six rice varieties were classified as possessing medium potential seed vigor. This category featured CO 53, ASD 19, IW Ponni, TKM 9, ADT 42, and ADT 45, indicating good but not exceptional seed vigor attributes. Lastly, eight rice varieties were categorized as having low potential seed vigor, signifying challenges in germination and early seedling establishment. These varieties included CO 50, ADT 52, TPS5, VGD 1, ADT 38, ADT 46, CO 51, and MDU 6.

These classifications provide valuable insights into the varying seed vigor levels among the studied rice varieties aiding in informed seed management and crop cultivation decisions. High potential seed vigor varieties are ideally suited for direct seeding in rice cultivation. Their robust germination and early seedling growth characteristics make them highly adaptable to the demands of direct seeding practices, ensuring a successful and efficient crop establishment. This suitability underscores the importance of selecting high potential seed vigor varieties when opting for direct seeding methods, ultimately contributing to improved crop yields

Table 1. The potential seed vigour of TNAU released rice varieties under seed chain

S. No	Rice varieties	MGT	G (%)	Speed of emergence	Shoot length (cm)	Root length (cm)	Dry matter production (gm/10 seedling)	Days to first count	Days to final count	Vigour index - I	Vigour Index – II	Electrical conductivity (dsm^{-1})	Field emergence (%)
1	ADT 51	**32.6**	98	8.2	11.2	23.1	0.076	5	14	**3361**	**2.607**	0.032	**86**
2	TKM13	**32.4**	96	8.1	11.2	23.4	0.070	5	14	**3322**	**2.422**	0.033	**83**
3	TRY1	**32.5**	97	8.1	11.1	22.9	0.071	5	14	**3298**	**2.414**	0.030	**87**
4	TRY3	**32.8**	98	8.3	11.3	23.2	0.073	5	14	**3381**	**2.519**	0.034	**84**
5	CO52	**32.9**	96	8.2	10.9	23.4	0.073	5	14	**3293**	**2.504**	0.033	**85**
6	ADT39	**32.5**	96	8.4	11.3	23.2	0.072	5	14	**3312**	**2.484**	0.037	**87**
7	ADT54	**33.1**	98	8.2	11.1	23.7	0.071	5	14	**3410**	**2.471**	0.035	**84**
8	BHAVANI	**32.9**	96	8.3	11.2	23.7	0.073	5	14	**3350**	**2.548**	0.038	**86**
9	ASD16	**32.7**	96	8.4	11.3	23.5	0.072	5	14	**3341**	**2.506**	0.036	**88**
10	ADT37	**32.8**	98	8.2	11.2	23.6	0.071	5	14	**3410**	**2.471**	0.035	**86**
11	ADT43	**32.6**	96	8.1	11.3	23.2	0.073	5	14	**3312**	**2.519**	0.034	**85**
12	ADT53	**32.4**	96	8.1	11.1	23.5	0.074	5	14	**3322**	**2.560**	0.035	**84**
1	ASD19	**33.3**	95	7.9	10.8	22.8	0.064	5	14	**3192**	**2.150**	0.043	**82**
2	IW PONNI	**33.6**	94	7.9	10.7	22.7	0.068	5	14	**3140**	**2.271**	0.041	**83**
3	CO53	**33.1**	94	8.0	10.6	22.6	0.065	5	14	**3121**	**2.158**	0.041	**81**
4	TKM9	**33.4**	91	7.6	10.6	22.7	0.064	5	14	**3030**	**2.131**	0.045	**82**
5	ADT42	**33.7**	94	7.6	10.8	22.3	0.064	5	14	**3111**	**2.118**	0.043	**81**
6	ADT45	**33.2**	93	7.5	10.6	22.6	0.062	5	14	**3088**	**2.058**	0.046	**82**
1	CO 50	**33.8**	94	7.2	10.2	22.0	0.059	5	14	**3027**	**1.900**	0.051	**74**
2	TPS5	**33.5**	91	7.1	10.3	21.8	0.072	5	14	**2921**	**2.311**	0.045	**73**
3	VGD1	**32.9**	93	7.0	9.6	21.1	0.056	5	14	**2855**	**1.719**	0.036	**72**
4	CO51	**34.6**	92	7.0	10.1	21.7	0.071	5	14	**2926**	**2.258**	0.053	**74**
5	ADT38	**34.9**	92	7.1	10.1	22.4	0.069	5	14	**2990**	**2.243**	0.045	**74**
6	ADT 52	**33.9**	93	7.1	10.1	22.1	0.061	5	14	**2995**	**1.964**	0.049	**77**
7	MDU6	**34.6**	92	7.1	10.1	21.4	0.070	5	14	**2898**	**2.205**	0.054	**73**
8	ADT46	**34.8**	93	7.2	10.1	21.5	0.067	5	14	**2939**	**2.117**	0.049	**76**
Mean		33.3	95	7.8	10.7	22.7	0.68	5	14	3167	2.293	0.04	81
SEd		**0.23**	**0.41**	0.58	0.18	0.31	0.004	NS	NS	**5.2**	**1.08**	0.018	**2.21**
CD (0.05)		**0.489**	0.84	1.02	0.373	0.63	0.008			**10.3**	**2.17**	0.162	**4.43**

and overall agricultural productivity. These results were supported by Finch-Savage, W. E., &Bassel, G. W. [8].

However, our research revealed that the seed vigor levels among rice cultivars varied depending on varietal genetic character. This observation aligns with previous studies, which have also noted the variability in seed vigor assessment by Li Z., et al. [9], Copeland, L.O. and Mcdonald, M.B. [10], Marcos, F.J. [11], Ellis et al. [12].

4. CONCLUSION

In this study, rice varieties were categorized into three groups based on seed vigor potential. Twelve exhibited high potential, including ADT 51, CO52, TRY 1, TRY3, TKM13, ADT39, ADT 54, BHAVANI, ASD16, ADT37, ADT43, and ADT 53, with robust germination. Six had medium potential, like CO 53, ASD 19, IW Ponni, TKM 9, ADT 42, and ADT 45, while eight showed low potential, such as CO 50, ADT 52, TPS5, VGD 1, ADT 38, ADT 46, CO 51, and MDU 6. These classifications offer insights for informed seed management and cultivation decisions. High potential seed vigor varieties are well-suited for direct seeding, ensuring efficient crop establishment and improved agricultural productivity.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Perry DA. Report of the Vigour Test Committee, 1974-1977. Seed Science and Technology. 1978;6:159-181.
2. ISTA. International Rules for Seed Testing; International Seed Testing Association: Bassersdorf, Switzerland; 2013.
3. Sun Q, Wang JH, Sun BQ. Advances on seed vigor physiological and genetic mechanisms. J. Integr. Agric. 2007;6: 1060–1066.
4. Zhang H, Wang WQ, Liu SJ, Moller IM, Song SQ. Proteome analysis of poplar seed vigor. Plos One. 2015;10:e0132509
5. Wang XM, Tang QY, Mo WW. Seed filling determines seed vigour of superior and inferior spikelets during hybrid rice (*Oryza sativa* L.) seed production. Seed Sci. Technol. 2020;48:143–152.
6. Maguire JD. Speed of germination-aid in selection and evaluation for seedling emergence and vigor. Crop Sci. 1962;2: 176-177.
7. Abdul-Baki AA, Anderson JD. Vigor determination in soybean seed by multiple criteria 1. Crop Science. 1973;13(6):630-633.
8. Finch-Savage WE, Bassel GW. Seed vigour and crop establishment: extending performance beyond adaptation. Journal of Experimental Botany. 2016;67(3):567-591.
9. Li Z, Zhang T, Zhu M, Li C, Li B, Lu X, Wang J, Jia L, Qi H, Wang X, et al. High-Vigor Seeds Associated with Seed Hardness and Water Absorption Rate in Rice (*Oryza sativa* L.). Agriculture. 2022; 12(5):712.
10. Copeland LO, Mcdonald MB. Principles of Seed Science and Technology, 4th Ed.; Springer: New York, NY, USA; 2001.
11. Marcos FJ. Seed vigor testing: An overview of the past, present and future perspective. Sci. Agric. 2015;72:363–374.
12. Ellis RH, Roberts EH. Towards a rational basis for testing seed quality. In Seed Production (ed. P.D. Hebblethwaite), Butterworths, London. 1980;605-645.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/107469